

# **Salmon Watershed Planning Profiles for the Middle Fraser Habitat Management Area**

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Fraser River Action Plan  
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Canada 

**SALMON WATERSHED PLANNING PROFILES**  
**FOR THE**  
**MIDDLE FRASER HABITAT MANAGEMENT AREA**

Prepared for:

**DEPARTMENT OF FISHERIES AND OCEANS**  
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## TABLE OF CONTENTS

	<b>Page</b>
List of Watershed Planning Profiles.....	iii
List of Tables.....	iii
List of Figures.....	iii
1.0 Introduction.....	iv
1.1 The Department of Fisheries and Oceans Vision Statement.....	iv
2.0 Overview of Salmon Resources.....	vii
2.1 Sockeye.....	vii
2.2 Chinook.....	viii
2.3 Coho.....	viii
2.4 Pink.....	viii
2.5 Chum.....	ix
3.0 Methodology.....	ix
3.1 General Watershed Information and Hydrology.....	x
3.2 Salmon Escapement.....	x
3.3 Development Activity.....	x
3.4 Biophysical Conditions.....	xi
3.5 Sensitive Watershed and Habitat Features.....	xii
3.6 Special Considerations.....	xii
3.7 Summary of Habitat Concerns.....	xii
3.8 Recent Watershed Planning/Project Initiatives.....	xii
3.9 Specific Objectives and Strategies.....	xii
4.0 Results and Discussion.....	xiii
4.1 Summary of Habitat Concerns.....	xiii
4.2 Concerns Summary of Land Use Development.....	xiv
4.3 Management Objectives and Strategies.....	xvi
5.0 Acknowledgments.....	xviii
6.0 References.....	xviii

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## LIST OF WATERSHED PLANNING PROFILES

	<b>Page</b>
Fraser River mainstem.....	1
Coquihalla River.....	9
Kawkawa Creek.....	16
American Creek.....	23
Emory Creek.....	30
Gordon Creek.....	37
Yale Creek.....	44
Spuzzum Creek.....	51
Anderson River.....	58
Nahatlatch River.....	65
Kwoiek River.....	72
Stein River.....	79
Texas Creek.....	86
Churn Creek.....	93
Williams Lake River.....	100
Narcosli Creek.....	107
Baker Creek.....	114
Watershed planning profile references.....	121

## LIST OF TABLES

	<b>Page</b>
TABLE 1. Type of resource development activity and associated characteristics.....	xi
TABLE 2. Summary of habitat concerns by watershed for the Middle Fraser HMA.....	xiv

## LIST OF FIGURES

	<b>Page</b>
FIGURE 1. Location of the Middle Fraser Habitat Management Area.....	v
FIGURE 2. Watershed boundaries and salmon distribution .....	Map Sleeve 1
FIGURE 3. Percentage logging in salmon bearing watersheds.....	Map Sleeve 2
FIGURE 4. Water use and flow of salmon bearing watersheds .....	Map Sleeve 3

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## 1.0 INTRODUCTION

The Middle Fraser Habitat Management Area (HMA) consists of the Fraser River mainstem and 15 small to medium sized tributaries draining into the Fraser River between Hope and Quesnel (Fig 1). Watershed boundaries and salmon distribution are delineated in Fig 2 located in Map Sleeve 2.

The watershed profiles summarize physiographic information, streamflow characteristics, salmon escapement information, development activity, biophysical conditions, sensitive watershed and habitat features, special considerations and recent planning initiatives for each watershed. This information has been compiled from published and unpublished documents as well as the personal experience and professional judgment of Department of Fisheries and Oceans (DFO) staff. Based on the assessment of this information, management objectives and strategies have been developed to protect the salmon resource.

It is intended that the management objectives and strategies specified in this document be implemented within the HMA. The document is a valuable tool for DFO strategic planning and habitat management initiatives. In addition, it will benefit provincial Ministries of Environment, Lands and Parks (MELP), and Forests (MOF) by providing guidance for resource development activities as well as provide direction to municipalities, resource development companies, other stakeholders, and First Nations with interests in the HMA.

The information within this document is also maintained in an ACCESS database that includes input, searching and reprinting features. The information can be updated, and the objectives and strategies re-evaluated, as circumstances dictate. Related information for the Middle Fraser HMA can be found in an accompanying document titled the Strategic Fisheries Overview for the Middle Fraser HMA.

### 1.1 The Department of Fisheries and Oceans Vision Statement

DFO's sets a long-term policy objective, namely the achievement of an overall "net gain" of the productive capacity of Canada's fish habitats (DFO 1986). Specifically, the intent of the policy is to "increase the natural productive capacity of habitats for the nation's fisheries resources, to benefit present and future generations of Canadians". It sets out three specific goals: fish habitat conservation, restoration, and development. The Guiding Principle of the fish habitat conservation goal is to achieve no net loss of productive capacity in relation to development activities. No net loss applies to habitat which:

- currently produces fish harvested in a subsistence, commercial or recreational fishery; or
- although not directly supporting fish, provides nutrients and/or supplies food to adjacent; or
- downstream habitat; or contributes to water quality for fish; or
- has been identified by DFO as a candidate for enhancement activities.

# FRASER RIVER HABITAT MANAGEMENT AREAS

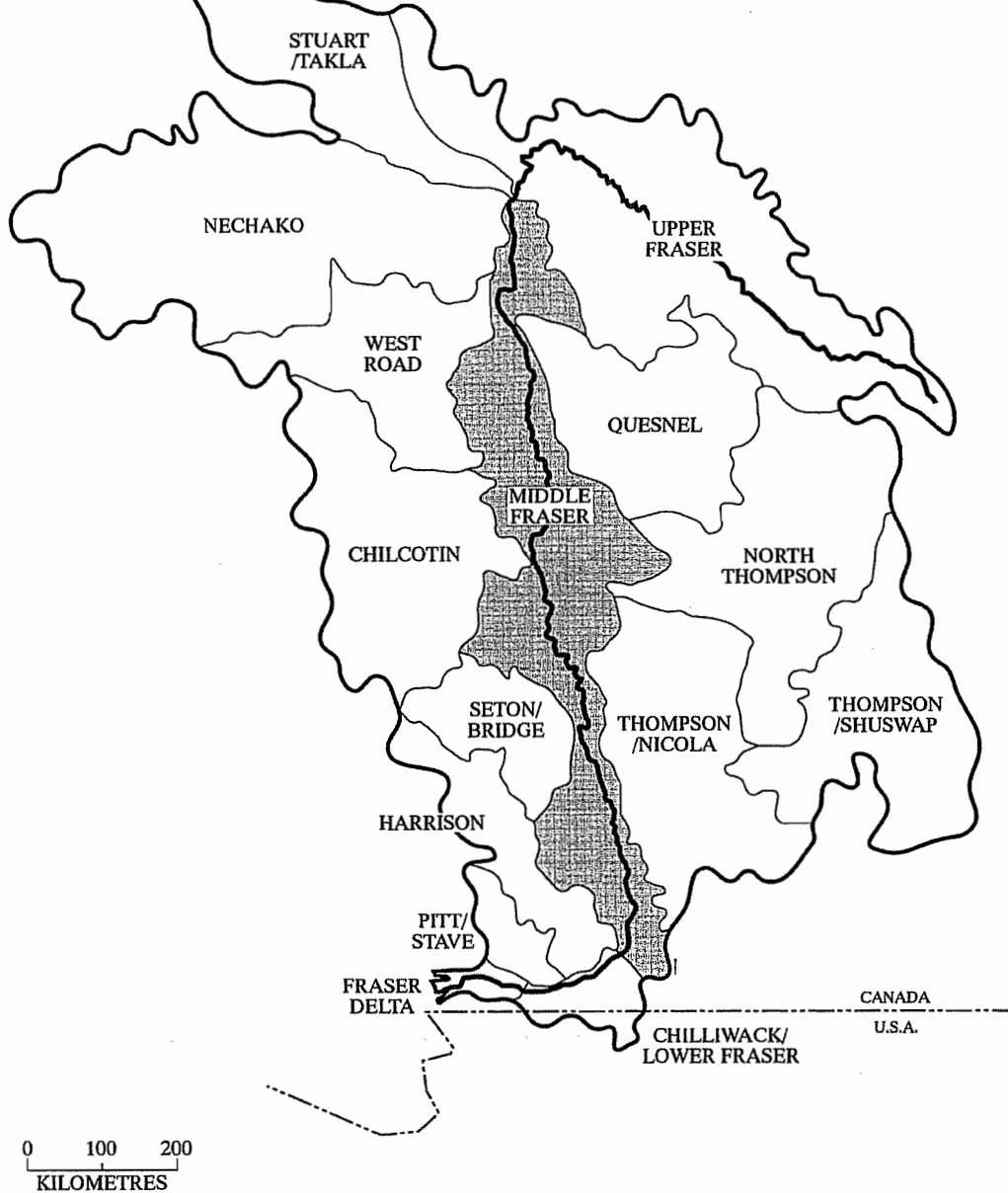


FIGURE 1. Location of the Middle Fraser Habitat Management Area.

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The second goal, fish habitat restoration, deals with the rehabilitation of the productive capacity of fish habitats in selected areas where economic or social benefits can be achieved through the fisheries resource. The third goal, fish habitat development, deals with the improvement and creation of fish habitats in selected areas where, again, fisheries resources production can be increased for the social or economic benefit of Canadians. These latter goals, restoration and development, will complement conservation efforts and contribute to a net gain of habitat.

In addition, DFO has identified seven measurable and achievable goals for sustainable fisheries development (O. Langer 1994 in Webb et al. 1994). These goals are:

1. **Avoid irreversible human induced alterations to fish habitats.** Alterations to fish habitat that reduce its capacity to produce fish populations which cannot be reversed within a human generation are to be avoided.
2. **Maintain the genetic diversity of fish stocks.** No fish stock, regardless of its size, will be arbitrarily eliminated and, where possible, efforts to conserve and rebuild small and remnant stocks are to be made.
3. **Maintain the physical and biological diversity of fish habitats.** Physical and biological diversity of habitat provides fish with an opportunity to adopt alternative life history strategies, thereby providing protection from natural habitat variation.
4. **Provide a net gain in productive capacity through proper habitat management.** Ecological limits control productive capacity of a stream system. Natural and self-sustaining production systems are preferred over semi-natural, artificial or non-self-sustaining systems.
5. **Maximize the value of commercial, sport, and aboriginal fisheries.** All market and extra-market values are to be considered, and measured in a way that permits comparison of competing users of the fisheries resources.
6. **Maximize the non-consumptive values of the fisheries resources.** Intangible and cultural values associated with fishery resources are to be given due consideration in decision making.
7. **Distribute fishery net benefits in a fair and equitable manner.** Local communities are to be involved in the decision-making process pertaining to habitat conservation, enhancement, and restoration, and particularly who is to benefit and who is to pay.

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## 2.0 OVERVIEW OF SALMON RESOURCES

Salmon species produced in the Middle Fraser HMA include sockeye (*Oncorhynchus nerka*), pink (*Oncorhynchus gorbuscha*), chinook (*Oncorhynchus tshawytscha*), coho (*Oncorhynchus kisutch*), chum salmon (*Oncorhynchus keta*) and steelhead/rainbow trout (*Oncorhynchus mykiss*) (Fig 2). The Fraser River between Hope and Quesnel is a critical migration corridor for upper Fraser River salmon stocks and also provides important rearing habitat, primarily for chinook and coho salmon. Pink salmon spawn in the mainstem Fraser River at Churn Creek and the Seton River.

Pink are the most abundant salmon species with an average annual escapement of 43,445 fish between 1981-1992 and a maximum historical escapement of 187,741 adults. Sockeye are the second most abundant species with an average escapement of 6,050 fish between 1981-1992 and a historical maximum of 19,381. Chum salmon are produced primarily in the southern portion of the Middle Fraser HMA with an average escapement of 1,571 fish and a historical maximum of 4503 fish. Coho salmon are the fourth most abundant species in the study area with an average escapement of 802 fish and a historical maximum of 17,881 adults. Chinook escapement averaged 502 fish between 1981-1992 with a historical maximum of 1400 fish.

Escapement information has been obtained primarily from DFO's stock management data summaries (DFO 1994) and the Fish Habitat Inventory and Information Program (FHIIP) for the Chilliwack, Lillooet, Williams Lake and Quesnel subdistricts. Escapement trends are determined by assessing whether the 1981-1992 average escapement differs from the 1969-1980 average escapements by greater than 20%. Therefore, an increasing escapement trend is identified when the 1981-1992 average escapement exceeds the 1969-1980 average escapement by greater than 20%. A difference of less than 20% is considered to be a static escapement trend.

### 2.1 Sockeye

The Nahatlatch River produces the largest proportion (90.3%) of sockeye within the Middle Fraser HMA (DFO 1994). In the Nahatlatch system, average sockeye escapement between 1981-1992 equaled 5,465 fish with a historical maximum of 16,606 sockeye. The second largest producer of sockeye is the Kawkawa Lake watershed which produces 7.6 % (457 fish) of the average sockeye escapement with a historical maximum of 2172 fish. Smaller sockeye stocks are produced in the Coquihalla River, Emory Creek, Yale Creek, American Creek and Spuzzum Creek.

Escapement trend data is limited to the Nahatlatch River and Sucker Creek, a tributary to Kawkawa Lake. In the Nahatlatch River, sockeye escapement is increasing when average escapement values between 1969-1980 are compared to 1981-1992. Average historical escapements indicate that sockeye escapement is increasing in Sucker Creek.

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## **2.2 Chinook**

Chinook salmon are the most geographically widespread species in the Fraser River system and are the least abundant species produced in the Middle Fraser HMA (Birtwell et al 1988, DFO 1994). The average escapement of chinook to the study area totaled 502 adults between 1981-1992. The majority of chinook are produced in the northern portion of the Middle Fraser HMA and the largest chinook run returns to Baker Creek. Average escapement to Baker Creek was 244 fish or 48.6% of the total chinook escapement to the Middle Fraser HMA between 1981-1992. The maximum historical chinook escapement for Baker Creek between 1981-1992 was 400 adults. Narcosli Creek produced 27.7% (139 fish) of the average escapement between 1981-1992 with the Nahatlatch River, Churn Creek and Stein River producing less than 70 fish annually (DFO 1994). Escapement trends are unknown for most chinook stocks due to the lack of average escapement values between 1969-1980.

### **2.1.3 Coho**

The largest coho run is produced in the Nahatlatch River and represents 66% of the coho produced in the Middle Fraser HMA (DFO 1994). Between 1981 and 1992, the average coho escapement to the Nahatlatch River equaled 527 adults with a historical maximum run of 15,000 coho. Between 1981-1992, an average of 182 (23%) coho adults returned to the Kawkawa Lake system with a total historical maximum run of 2,391 fish. The Coquihalla River and the Stein River produce less than 50 fish annually and very small numbers of coho (less than 10 spawners) return to American Creek, Gordon River and the Anderson River.

The reliability of escapement data is highly variable, depending on the species, enumeration method used and variations in stream conditions. Coho salmon are inherently difficult to enumerate and coho escapement estimates are probably the most unreliable of all estimates for salmon species (DFO 1996).

In the Nahatlatch River, coho exhibit an increasing escapement trend as the average escapement between 1981-1992 (527 fish) shows more than a 20% increase over the average escapement between 1969 to 1980 (410 fish) (DFO 1994). Escapement data for the Kawkawa Lake system indicates that coho stocks in Sucker Creek appear to be decreasing when the average historical escapement (1969-1980) is compared to the average recent escapement (1981-1992) (DFO 1994).

## **2.4 Pink**

Pink are the most abundant salmon species in the Middle Fraser HMA and return in the odd cycle year. The majority of pink salmon are produced in the Coquihalla River where the average escapement between 1981-1992 equaled 30,972 or 71.3% of the total pink run within the study area. The maximum historical pink escapement was 118,921 for the Coquihalla River system. Smaller pink stocks are produced annually in the Nahatlatch River (5,516 fish), Spuzzum Creek

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(1,936) and the Kawkawa Lake system (1,318). Small numbers of pink salmon ranging from 10 to 850 fish are produced in the remaining systems within the study area. Pink spawners have also been observed in the mainstem Fraser River at Churn Creek and at the Seton River (Rosenberger pers. comm. 1996).

Pink salmon exhibit an increasing escapement trend in the majority of watersheds within the study area when average escapement values between 1969-1980 are compared to 1981-1992 escapements (DFO 1994). All historical maximum escapements for pink salmon have occurred between 1981-1992. Although historical pink escapement information is currently unavailable for Baker Creek, pink salmon escapement has been observed to be increasing in the last few years (Rosenberger pers. comm. 1996).

## **2.5 Chum**

The distribution of chum salmon is limited to the southern portion of the Middle Fraser HMA with the majority of chum produced in the Kawkawa Lake system and the Coquihalla River. The Kawkawa Lake watershed produced an average escapement of 994 or 63.3% of the total chum escapement to the study area between 1981-1992 with a maximum historical escapement of 2,750 adults. The average escapement between 1981-1992 in the Coquihalla River equals 413 or 26.3% of the total chum production in the study area. Average escapements of less than 100 fish are reported for American Creek, Emory Creek, Yale Creek, Spuzzum Creek, Anderson River and Texas Creek (DFO 1994).

Average chum escapement to the Coquihalla River and Kawkawa Lake are increasing when the average historical escapement between 1969-1980 is compared to the average escapement between 1981-1992 (DFO 1994). There is no escapement trend information available for the remaining river systems within the study area.

## **3.0 METHODOLOGY**

The Middle Fraser HMA Salmon Watershed Planning Profiles consist of background information on watershed characteristics followed by assessment categories. These categories represent watershed features that can be altered by human activities and result in negative impacts to the fisheries resource. The watershed based characteristics include physiographic and biogeoclimatic information, streamflow characteristics and salmon escapement estimates. The assessment categories include resource development activity, biophysical conditions, sensitive watershed features and special considerations. A more detailed description of category and the assessment methodology used is described below.

From the background information and assessment of watershed features, specific management objectives and strategies consistent with sustainable land, water and other resource use have been developed for each watershed within the Middle Fraser HMA.

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### **3.1 General watershed information and hydrology**

The primary source of general watershed and hydrologic information for this report is Rood and Hamilton (1995a, 1995b). All flow data relate to the stream mouth and mean 7 day low flows for winter (November 1 to April 30) and summer (May 1 to October 31) are presented if available.

### **3.2 Salmon Escapement**

Salmon escapement information is presented by species with an assessment of the population trend. Escapement information includes the historic maximum escapement and year, the 1981 to 1992 average and maximum escapement and the 1969 to 1980 average escapement. The escapement trend is determined by comparing the 1981 to 1992 average escapement to the 1969 to 1980 average and is expressed as either static, increasing, decreasing or unknown. A difference of at least 20% is required to identify an increasing or decreasing trend.

The building potential for the stock is presented as low, medium or high. The measure of rebuilding potential has been determined by DFO (1994) and is based on changes in escapement over time. A "low" rating indicates that the historic maximum is greater than the recent (1981-1992) maximum by 50% and suggests there is significant potential to increase production.

### **3.3 Development Activity**

Development types are further broken down into characteristics associated with the particular development (Table 1). For example, characteristics related to forestry development include percent total and recent logging, equivalent clearcut area (ECA) status and riparian condition. Percent logging is defined as the total area of the watershed that has been logged including those blocks with some hydrologic recovery. This information has been compiled to assist DFO staff in "flagging" watershed that have a level of forest harvesting (e.g. >20%) that warrants particular attention. In some cases, watersheds may have a low overall percent logging but a high percentage of logging when examined at the sub-basin level. Site specific impacts can warrant the development of fisheries objectives and strategies to address forestry impacts on fisheries values. Equivalent clearcut area is a forest management term used to describe the total area within a watershed which functions in a similar fashion hydrologically to a clearcut opening, accounting for a recovery factor based on the stage(s) of forest regeneration (MacDonald et al 1997).

For each resource development category, a "level of concern" rating and comments are provided. The level of concern rating expresses the "sensitivity" of watershed features that can be altered by resource development activities and subsequently have a negative impact on fish and fish habitat. The level of concern is rated either "low" or "high". A low level of concern indicates that, based on the available information, and assuming that standard management practices are applied, minimal impact to salmon populations or their habitat would be expected to occur. Standard management practice assumes that an acceptable level of protection for stream habitat and water

TABLE 1. Type of resource development activity and associated characteristics.

Type of Development	Associated Characteristics
Forestry	% total logging, % recent logging, ECA status, riparian condition
Agriculture	Extent, riparian condition, water withdrawal, water quality
Urbanization	Population level, extent, riparian condition, water withdrawal, water quality
Recreation	Extent, riparian condition, water quality
Placer mining	Extent, water quality, riparian condition
Other mining	Extent, water quality
Industrial development	Extent, water quality, riparian condition
Linear development	Extent, riparian condition
Hydro development	Extent, riparian condition
Other development	Extent, riparian condition
Cumulative development	Consideration of the impact of all development activities.

quality will be provided. This includes standard practices such as the Forest Practices Code, the Land Development Guidelines, placer mining regulations and guidelines, and Guidelines for Mineral Exploration and Reclamation. It is also assumed that routine auditing of development activities will be performed to ensure compliance with the prescribed standards. A high level of concern would indicate that the particular watershed has a high probability for significant impacts on fish or fish habitat from present or proposed development activities or biophysical features.

*It should be noted that the level of concern assigned was based on the best available information. Reclassification may be necessary as new information becomes available, or as changes in either the physical habitat, rate of development, or status of the salmon populations occur.*

### 3.4 Biophysical Conditions

Biophysical conditions within the watershed were assessed and rated as having a “high” or “low” level of concern. The level of concern ratings were determined as described in the Development Activity section above. The following biophysical features are included in the watershed summary profiles for the Middle Fraser HMA.

- Soils
- Terrain
- Hydrology
- Channel stability

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### **3.5 Sensitive Watershed and Habitat Features**

This category is used to identify the presence of sensitive watershed features or specific habitat features that would require site specific management strategies and includes the following;

- Sensitive physical features; i.e. beaver dams, obstructions
- Sensitive biological features; i.e. critical spawning or rearing habitat, near extinction of stocks
- Significant environmental variables; biophysical conditions resulting from impoundment, nutrient enrichment. i.e. geological considerations, high water temperatures, water quality problems
- Unique features; i.e. highly productive groundwater seepage

### **3.6 Special Considerations**

The occurrence of, or the potential for, special considerations which may have present or future impacts on development activities including:

- Stock Management Initiatives
- Commercial Fishery
- Recreational Fishery
- Native Fishery
- Restoration Activity
- Restoration Opportunity
- Enhancement Activity
- Enhancement Opportunity

### **3.7 Summary of Habitat Concerns**

The summary of habitat concerns is the total number of “high” ratings for the Development Activity and Biophysical Conditions categories and the total number of Sensitive Watershed Features and Special Considerations.

### **3.8 Recent Watershed Planning/Project Initiatives**

The undertaking of recent watershed planning/project initiatives by government agencies and/or other stakeholders.

### **3.9 Specific Objectives and Strategies**

Objectives and associated strategies are developed to address fisheries related concerns that have been previously identified in the resource development, biophysical conditions, sensitive features

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and special considerations sections. Seven primary objective categories appear within the ACCESS program;

- Identify and protect salmon habitat
- Restore and enhance habitat
- Maintain and enhance water quantity for instream uses
- Maintain/enhance watershed and stream channel integrity and stability
- Maintain/enhance fish and habitat diversity
- Rebuild and enhance salmon stocks
- Other

After selection of the appropriate objective category, the strategy is developed to address the fisheries related concern. There are often several strategies developed to address a single management objective.

#### **4.0 RESULTS AND DISCUSSION**

There are a total of 15 salmon bearing watersheds in addition to the Fraser River mainstem within the Middle Fraser Habitat Management Area. A summary of land use development and habitat concerns within these watersheds are discussed in the following sections.

##### **4.1 Summary of Habitat Concerns**

The level of concern for a particular development activity and each biophysical condition is rated as being either “high” or “low” for each watershed. A high level of concern is given a value of 1 whereas a low level of concern has a value of 0. Similarly, the presence of sensitive watershed features and special considerations are assigned a value of 1. A total value for these four categories is expressed as a **total number of habitat concerns** by watershed within the Middle Fraser HMA (Table 2). This information indicates the extent of development activity, biophysical conditions, sensitive watershed features and special considerations associated with each watershed. However, there is a large variability in the extent and type of habitat related concerns within the study area. Furthermore, the presence of special considerations such as restoration works or enhancement opportunities increase the total number of habitat concerns. *Therefore, the total number of ranking points does not identify the priority of one watershed over another as each watershed, regardless of it's ranking contains habitat issues that require site specific attention.*

The Williams Lake River has the highest total number of habitat concerns (22), due to existing impacts of agriculture, urbanization, industrial development and linear development. There is also a high level of concern for the loss of natural hydrologic characteristics and channel instability. Williams Lake is anoxic during the summer and currently has a dam at the outlet of the lake, restricting year round access for anadromous salmonids.

TABLE 2. Summary of habitat concerns by watershed for the Middle Fraser HMA.

<b>Watershed</b>	<b>Development Activity</b>	<b>Biophysical Concerns</b>	<b>Sensitive Habitat Features</b>	<b>Special Considerations</b>	<b>Total</b>
Fraser River Mainstem	8	1	3	6	<b>18</b>
Coquihalla R.	7	2	2	3	<b>14</b>
Kawkawa C.	3	0	2	1	<b>6</b>
American C.	0	0	0	0	<b>0</b>
Emory C.	0	0	1	1	<b>2</b>
Gordon C.	3	0	1	0	<b>4</b>
Yale C.	0	0	1	0	<b>1</b>
Spuzzum C.	0	0	1	1	<b>2</b>
Anderson R.	4	1	2	1	<b>8</b>
Nahatlatch R.	3	2	2	4	<b>11</b>
Kwoiek R.	3	0	3	5	<b>11</b>
Stein R.	0	0	2	3	<b>5</b>
Texas C.	2	0	0	3	<b>5</b>
Churn C.	1	3	3	1	<b>8</b>
William Lake R.	17	2	2	1	<b>22</b>
Narcosli C.	5	1	3	0	<b>9</b>
Baker C.	5	1	3	4	<b>13</b>

The Fraser River mainstem has a total of 18 points where linear development, agriculture, urbanization and placer mining are the major resource development activities. The terrain in the lower river is sensitive to natural slope failures and there are large eroding streambanks in the upper river. The lower river lacks resting and holding pools for migrating adults and at some flow levels, migration is impeded through the Fraser Canyon.

The Coquihalla River, Nahatlatch River, Kwoiek River and Baker Creek have a total number of habitat concerns that ranges between a value of 11-14. The remaining systems have a total rating of less than 10. In some systems, including the tributaries flowing into the Fraser Canyon, a low total habitat rating results from the lack of information rather than the absence of resource development, biophysical conditions, or sensitive watershed features.

#### **4.2 Summary of Land Use Development in the Middle Fraser HMA**

Linear development has had the greatest impact on fisheries resources in the Fraser River mainstem and the Coquihalla River watershed. Within the Coquihalla River, linear development includes a major 4 lane highway (Highway 5), 2 industrial roads, Trans Mountain Pipeline, West Coast Energy gas pipeline and the B.C. Telephone fibre optic lightguide. Several major diversions, bank stabilization works and channel encroachments have occurred as a result of

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Highway 5 construction between Othello and Boston Bar Creek. Highway and pipeline construction and maintenance practices have resulted in the permanent loss of fish habitat and degraded the quality of spawning and rearing habitat. Linear development in combination with natural slides and sidecast failures from the old railway exacerbates the impacts of flood flows and results in a constant loss of riparian function, high rates of bedload movement and loss of fish habitat. Increased bedload movement from the upper river to the lower river has increased flooding and erosion problems adjacent to Hope.

In the Fraser River corridor, linear development includes the Trans Canada Highway, B.C. Railway, Canadian National Railway and hydroelectric power transmission lines. Site specific impacts in the upper river include side channel alienation, loss of riparian habitat and channelization in small tributaries. Through the Fraser Canyon, the primary impact of linear development results from railway maintenance practices where rock and debris are sidecasted into the Fraser River. Sidecasted materials are known to infill critical holding areas or create additional hydraulic barriers that increase the mortality of migrating salmon.

Urban development has impacted stream and riparian habitat in the Fraser River mainstem at Quesnel, Baker Creek, Williams Lake River, Knife Creek, Kawkawa Creek and the Coquihalla River. Major impacts from urban development include channelization, loss of stream complexity, encroachment, bank stabilization practices using rip rap, loss of riparian vegetation, alteration of the streambed for flood control works and culvert placement that create migration barriers.

The two watersheds with the greatest forest harvesting activity are the Anderson River and Gordon Creek where 23% of the total watershed area has been logged (Fig 3). The remaining drainages have less than 12% of the total watershed area logged. Although the percentage logged on a watershed level appears low throughout the study area, the rate of harvesting in the Middle Fraser HMA salmon streams has increased in recent years with the majority of cutblocks harvested in the last 10 years. Furthermore, in many watersheds, forest harvesting has been concentrated in a small number of sub-basins, creating drainage specific problems associated with hydrology, terrain stability or channel stability. Site specific problems associated with forest harvesting have been identified in the Nahatlatch River, Churn Creek, Anderson River, Gordon Creek and the Coquihalla River. Known impacts of forestry development on fisheries values include road and slope failures, degraded riparian habitat, channel bank erosion, road encroachments, increased suspended sediment loads and channel instability. A more detailed analysis of the equivalent clearcut area by sub-basin by applying the Watershed Assessment Procedure would provide more specific evaluation of the hydrologic effects of forest harvesting on fisheries values. Priority watersheds include the Nahatlatch River, Anderson River, Coquihalla River, Churn Creek and Narcosli Creek.

The most extensive agricultural development within the Middle Fraser HMA has occurred in Baker Creek, Narcosli Creek, Williams Lake River, Knife Creek and Churn Creek. The majority of agriculture is forage based, supporting cattle and dairy operations with some better sites

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supporting field crops and cereal grain production. Agriculture has the potential to alter the natural hydrologic regime by extracting surface and ground water for stock watering, domestic use and irrigation and thereby increase minimum flow problems. Major surface water extraction for irrigation occurs in Williams Lake River, Knife Creek, Narcosli and Baker Creek (Fig 4). Water demands on Williams Lake River and Knife Creek amount to most of the natural late summer flows and both these systems are fully recorded. Low flow problems are being partially addressed in Williams Lake River and Knife Creek where water storage structures for irrigation are used to meet water demands in low flow periods. Extensive agricultural development can increase peak flows as a result of the conversion of forested land to pasture land. The impacts of water withdrawal for agricultural purposes can also reduce the dilution factor in the mainstem Fraser River thereby increasing the impacts of wastewater effluents on salmonids. Other impacts of agriculture on fisheries values within the study area from overwintering of cattle and the operation of feedlots adjacent to streams and fording the streams result in the degradation of water quality and riparian vegetation.

Relative to other resource development activities, there are smaller impacts from hard rock mining and placer mining on fisheries values in the Middle Fraser HMA. These impacts have occurred in the Fraser River mainstem, Churn Creek and the Coquihalla River.

### **4.3 Management Objectives and Strategies**

To minimize further impacts to salmon and salmon habitat from resource development activities, management objectives and strategies have been developed for each watershed and are summarized at the end of each watershed summary. A summary of the management objectives and strategies are provided for the Williams Lake River, the Fraser River mainstem, Coquihalla River, Nahatlatch River, Kwoiek River and Baker Creek.

Specific management objectives and strategies for the Williams Lake River include the protection and restoration of stream habitat in cooperation with the agricultural, urban and ranching communities. Impacts to riparian habitat can be addressed by developing a detailed Riparian Management Plan for the watershed that provides site specific prescription where necessary. The Urban Land Development Guidelines should be applied as a minimum to residential and industrial development. Problems with water withdrawal from agricultural development can be minimized through the development of a Water Management Plan that includes a determination of actual demand, the identification of base flows necessary to sustain fisheries values and investigation of water storage opportunities. Other strategies include restoring access to Williams Lake by anadromous species and re-introducing coho as part of the community based Streamkeepers Program.

Management priorities for linear development in the Fraser River corridor are to facilitate passage of migrating salmonids and to minimize the impacts of encroachment, channelization, flooding and maintenance activities on migration, spawning and rearing habitat. Management recommendations in the Fraser Canyon include improving railway maintenance procedures,

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identifying potential sites for hydraulic barriers to migrating salmonids, minimizing high water temperatures and maintaining cold water refuge areas. It is important to manage land use activities in the tributaries to the Fraser in order to sustain riparian and instream habitat, stream temperatures and natural hydrologic characteristics. Non salmon producing tributaries to the Fraser provide important habitat characteristics essential for salmonid production in the Fraser River watershed. Small, low gradient tributaries provide critical rearing habitat during the spring and summer when sediment loads are high in the mainstem Fraser. In addition, steep, flashy, glacial fed tributaries draining into the Fraser Canyon provide limited spawning and rearing habitat but instead provide critical cold water holding pools at their confluence with the Fraser mainstem. Another strategy is to document rearing areas in the Fraser River mainstem and accessible tributaries. The protection of salmon habitat can be assisted by the application of the Forest Practices Code Riparian Management Guidelines, the Land Development Guidelines as well as developing a foreshore classification and recommendations for urban communities.

In the Coquihalla River watershed, future impacts to fish habitat and the permanent loss of riparian function can be minimized by coordinating maintenance practices associated with highways and oil/gas pipelines companies and managing the cumulative effects of resource development. At the present time, an assessment of the hydrological impacts of forestry development on the Coquihalla mainstem is recommended. It has also been recommended that further linear development in the Coquihalla River corridor be restricted to minimize further loss of floodplain habitat and bedrock controlled adult holding pools. In the lower river, further encroachment and channelization can be prevented by developing a flood hazard management plan. Within the District of Hope, the Land Development Guidelines should be applied as a minimum for urban development.

The primary resource development activity in the Nahatlatch River watershed is forestry development. Management strategies to minimize future impacts to fisheries values from logging include the implementation of the Nahatlatch Riparian Management Plan developed by DFO and MELP. Further evaluation by the Watershed Assessment Procedure and restoration prescriptions as outlined by Rood and Hamilton (1995a) is also a management priority.

Forestry is currently the primary resource development activity in the Kwoiek River watershed. However, an application for an independent hydroelectric power facility is pending in the lower river downstream of Kwoiek Lake. Management recommendations include the implementation of a catch and release bull trout fishery and restoration of trout habitat in the middle and upper watershed. Prior to further logging, the hydrologic state of the watershed needs assessment by applying the Watershed Assessment Procedure.

Water withdrawal for agriculture, urbanization and forestry have affected fisheries values in Baker Creek. The hydrologic characteristics of the Baker Creek watershed include low summer and winter flows as well as high peak flows. A watershed assessment is currently being conducted. Management recommendations include a salmonid habitat inventory and the assessment of restoration and enhancement opportunities in both the upper and lower river.

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Watershed summaries provide details of management objectives and strategies for the remaining systems within the Middle Fraser HMA.

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