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DURAND CREEK WATERSHED

Level 1
Interior Watershed
Assessment Procedure

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Forest Renewal British Columbia (FRBC)

March 31, 1998

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March 31, 1998

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Re: Durand Creek Interior Watershed Assessment Procedure

Dear Ken:

Integrated Woods Services Ltd. is pleased to submit the above document. This is one of your four copies. Copies of the report will also be delivered to those persons listed below.

Yours,

Integrated Woods Services Ltd.

Per Héloise Dixon-Warren, B.Sc., R.P.F.

REGISTERED PROFESSIONAL FORESTER
PROVINCE OF BRITISH COLUMBIA
STEPHEN GARY HENDERSON
NO. 3196

Per Stephen Henderson, B.Sc., R.P.F.

cc: Don Brown, Senior Planning Forester. Ainsworth Lumber Company Ltd.
Ron Ignace, Chief. Skeetchestn Indian Band

EXECUTIVE SUMMARY

The objective of undertaking a Level 1 Interior Watershed Assessment Procedure (IWAP) for the Durand Creek Watershed is (1) to assist forestry managers in understanding the type and extent of current water-related conditions that exist within the watershed and (2) to recognise the possible hydrologic implications of proposed forestry-related development in the watershed. Ainsworth Lumber Company Ltd., Savona Division, initiated this IWAP with financial assistance provided through Forest Renewal British Columbia (FRBC). *Integrated* Woods Services Ltd. was employed by Ainsworth Lumber Company Ltd. to complete this project.

The Watershed Assessment was conducted in accordance with the procedures in the Forest Practices Code of British Columbia, Interior Watershed Assessment Procedure Guidebook (IWAP), Level 1 Analysis, September 1995. Where deemed necessary, conservative assumptions were utilised, to determine the required hazard indices.

The Durand Creek Watershed encompasses approximately 179.9 km^2 (17,988 ha.) and is located south of Kamloops Lake and approximately 40 km. west of Kamloops, British Columbia. The watershed was analysed upstream of the Point of Interest (P.O.I.) where the creek enters Kamloops Lake and included all tributaries and lakes up to the creek headwaters. For the analysis, the watershed was divided into the five (5) sub-basins based upon stream ordering. The sub-basins were labelled as follows: Durand Lake Sub-basin, Upper Durand Sub-basin, Tunkwa Lake Sub-basin, Skookumchuk Sub-basin and Residual Sub-basin.

The results of the IWAP indicate that the Durand Creek Watershed is a moderate hazard watershed. Although the Equivalent Clearcut Area (ECA) does not exceed the threshold level for the watershed overall, proposed forest development (harvesting, road construction) will increase the ECA above the threshold level in the Skookumchuk, Durand Lake and Upper Durand Sub-basins. Additionally, there are concerns with respect to the road network and the condition of the riparian buffers.

The following recommendations were developed from an interpretation of the results:

- A Fish and Fish Habitat Assessments (FHAP) should be completed for all sub-basins to fulfil the requirements of an Integrated Watershed Restoration Plan (IWRP) and assess the condition of the riparian buffers.
- Complete a Level 2 Assessment, Channel Conditions and Prescription Assessment (CCPA) to allow for a more detailed assessment of the watershed's condition. A CCPA is especially important for the Durand Lake, Skookumchuk and Upper Durand Sub-basins and it should be undertaken prior to the full implementation of the Forest Development Plans listed in Appendix VIII.
- A Sediment Source Survey and an Access Management Map should be completed for all sub-basins due to the concerns related to surface erosion.
- Minimise harvesting and road construction on and around erodible soils.
- Consider the application of partial cut silviculture systems and implementing a zero net increase in roads in the Durand Lake, Skookumchuk and Upper Durand Sub-basins.

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1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

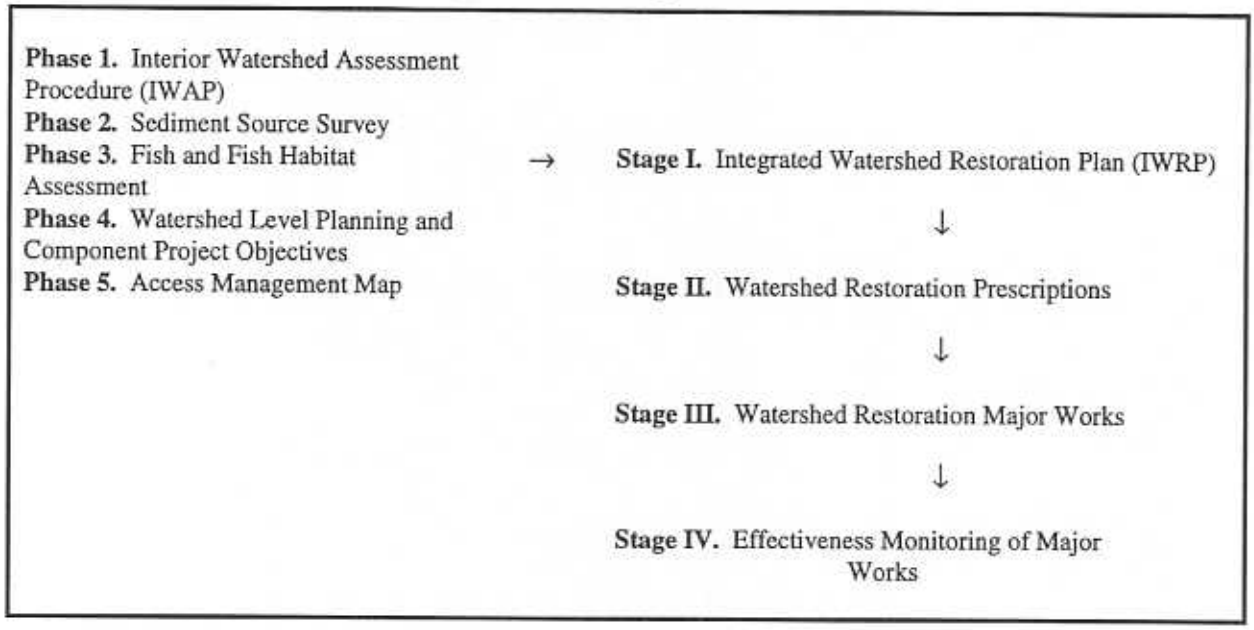
In October of 1997, *Integrated* Woods Services Ltd. was employed under contract by Ainsworth Lumber Company Ltd., Savona Division to complete an Interior Watershed Assessment Procedure (IWAP), Level 1 Analysis for the Durand Creek Watershed. Funding was provided through Forest Renewal British Columbia (FRBC) and by Ainsworth Lumber Company Ltd., Savona Division.

There are three levels to an Interior Watershed Assessment Procedure (IWAP). The Level 1 is a reconnaissance level analysis which is intended to identify watersheds that may have or will be impacted by past or proposed forest development. The Level 2 is guided by the results of the Level 1 and involves a stream channel assessment. The Level 3 is a comprehensive and detailed field analysis of the watershed. This latter assessment is undertaken if the results of both the Level 1 and Level 2 assessments state that it is warranted.

The IWAP, Level 1 Analysis for the Durand Creek Watershed is the first phase in a multi-phase project. If accepted for FRBC funding, other phases such as a Sediment Source Survey (SSS), a Fish and Fish Habitat Assessment Procedure (FHAP), an Access Management Map and a Watershed Level Planning and Project Component Objectives will be completed as the first stage of the Watershed Restoration Program (WRP). Each of these projects should be completed prior to initiating any watershed restoration prescriptions and/or major works.

The Interior Watershed Restoration Program (IWRP) is the first of four stages of the Watershed Restoration Program (refer to Figure 1). The objective of the IWRP is to (1) define the overall scope within the watershed, (2) specify watershed-level planning objectives and project component objectives and (3) guide a plan for the initiation of the next stages of watershed restoration.

Figure 1: Watershed Restoration Program (WRP) Stages



1.2 OBJECTIVES

The primary objectives for undertaking an IWAP are to:

- Assist forest managers in understanding the type and extent of current water-related problems existing within the watershed and to recognise possible hydrological implications of proposed forestry-related development in the watershed.
- Assess the condition of the watershed using pre-determined hazard indices and develop recommendations which, if undertaken, will restore and/or rehabilitate past environmental damage and mitigate or prevent further damage.

1.3 TERMS OF REFERENCE

The following terms of reference guided this IWAP:

1. This IWAP was completed in accordance with the British Columbia Ministry of Forests and Ministry of Environment, Lands and Parks, the Forest Practices Code of British Columbia Interior Watershed Assessment Procedure Guidebook (IWAP), Level 1 Analysis, September, 1995 and the Kamloops Land and Resource Management Plan, March 31, 1996.
2. The IWAP was to be completed within the time frames and budgets approved by FRBC in conjunction with Ainsworth Lumber Company Ltd., Savona Division.

1.4 KAMLOOPS LAND AND RESOURCE MANAGEMENT PLAN (LRMP)

The Kamloops LRMP, dated March 31, 1996, is a higher level, sub-regional plan which establishes direction for land use and specifies broad resource management objectives and strategies. The LRMP is a higher level plan than the IWAP; thus, future decisions regarding the activities in the Durand Creek Watershed through the LRMP may supersede those of the IWAP. There are two parks, namely Tunkwa Park and Mount Savona Park, within the watershed which were recommended through the LRMP process and established on April 30, 1996 (Ministry of Environment, Lands and Parks, 1996). Respectively, the parks are 5,091 ha. and 322 ha. in size and were created so as to protect the area's natural, recreational and tourism values (Ministry of Environment, Lands and Parks, 1997).

2.0 WATERSHED CHARACTERISTICS

2.1 GENERAL FEATURES

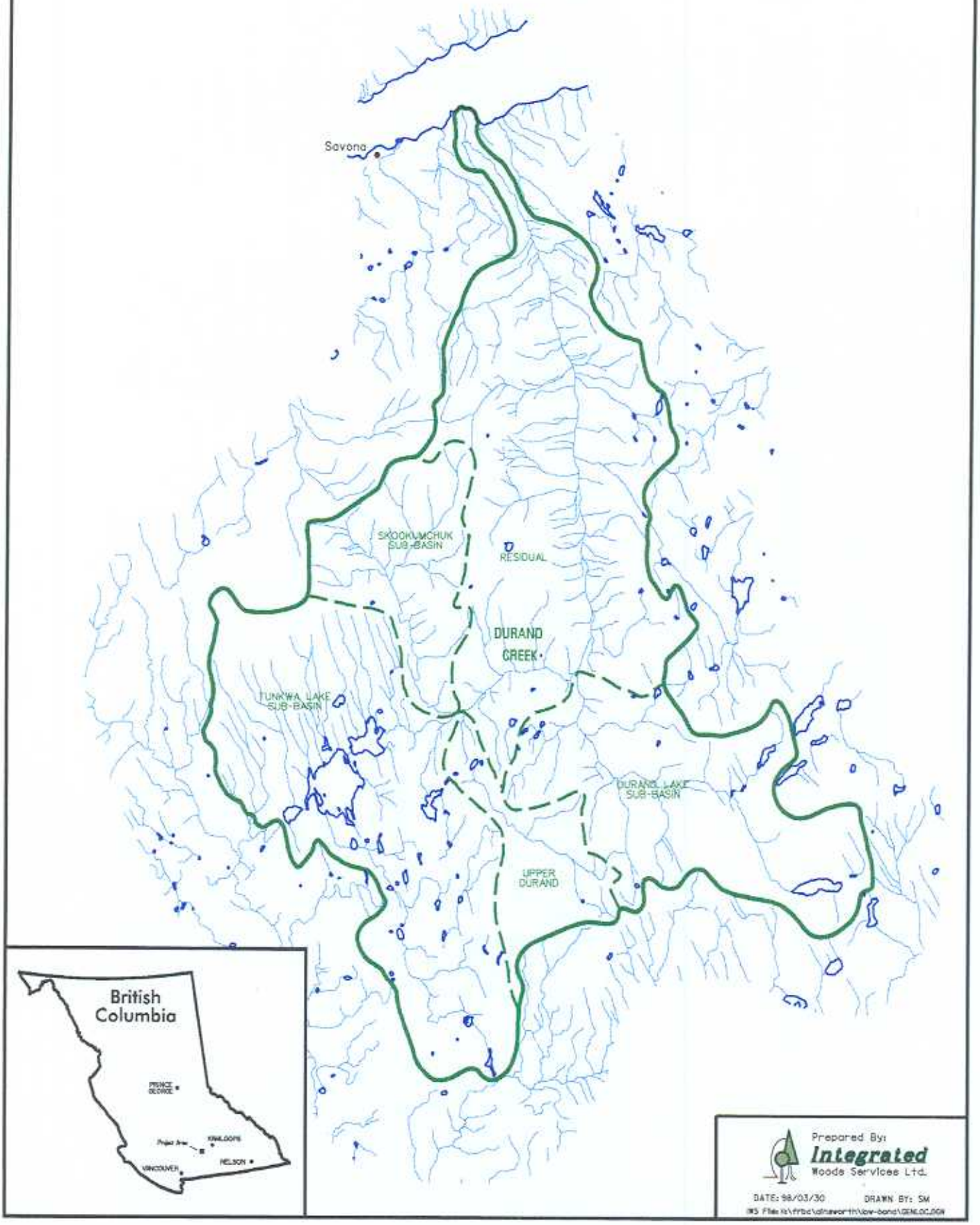
The Durand Creek Watershed is located south of Kamloops Lake and approximately 40 km. west of the City of Kamloops on the Trans-Canada Highway (Highway 1). It is within the Kamloops Forest District. The townsite of Savona, located on the southern shore of Kamloops Lake, is partially within the watershed. Access into the watershed from the north is via a well-used public, gravel road (Ballou Road/4200 Road) which also provides access to Tunkwa Park and the town of Logan Lake situated to the south. Figure 2 displays the general location of the watershed.

The Durand Creek Watershed has an area of approximately 17,988 ha. and is located within Hydrologic Zone #31, Thompson-Okanagan Plateau (Ministry of Forests Forests and Ministry of Environment, Lands and Parks, 1995) and the Thompson River Watershed (Code 120) (Ministry of Environment, Lands and Parks, 1997). The elevation within the watershed ranges from a minimum of approximately 330 metres at Kamloops Lake to a maximum of 1660 metres to the south of Dominic Lake. Three named mountains exist either directly adjacent to or within the watershed. The mountains and their respective approximate elevations are Mt. Savona (1520 metres), Mt. Anne (1400 metres) and Mt. Durand (1340 metres).

FIGURE 2:

GENERAL LOCATION MAP

Durand Creek Watershed



The watershed is primarily comprised of creeks fed by lakes (natural and artificial), spring snow-melt and overland water flow. The headwaters of Durand Creek are at Dominic Lake located in the south-eastern portion of the watershed with the mouth of the creek on Kamloops Lake just north of the sawmill operated by Ainsworth Lumber Company Ltd., Savona Division. Durand Creek has three major tributaries. Tunkwa Creek primarily drains the western portion of the watershed including both Tunkwa and Leighton Lakes, Ferguson Creek flows from Durand Lake and an un-name creek, second order tributary, referred to as Skookumchuk Creek (Anderson, 1997) by the locals flows into Tunkwa Creek. The water flow of many of the creeks and lakes is controlled by water license structures as several of the local ranchers depend upon the water for stock water and crop irrigation (Anderson per. comm., 1997; Haywood-Farmer pers. comm., 1997).

2.2 BIOGEOCLIMATIC ZONE INFORMATION

The Durand Creek Watershed encompasses an area which includes four biogeoclimatic (BGC) zones, namely the Bunchgrass (BG) Zone, the Ponderosa Pine (PP) Zone, the Interior Douglas-fir (IDF) Zone, and the MS (Montane Spruce) Zone (Ministry of Forests, 1989; refer to Appendix I). Climate is the most important factor influencing the development of terrestrial ecosystems (Lloyd et al., 1990) and this is represented in the zones present in the watershed in that all the zones have a precipitation range of very dry (x) to dry (d) and a temperature regime of hot (h) to warm (w) to cool (k) (Refer to Table 1).

Table 1: Biogeoclimatic Zones of the Durand Creek Watershed by Area and Percent

BGC Zone	Subzones present	Area (ha.)	Percent (%)	
BG = Bunchgrass	xh, xw	260	1.4	
PP = Ponderosa Pine	xh	502	2.8	
IDF = Interior Douglas-fir	dk, xh	14,463	80.4	
MS = Montane Spruce	xk	2,763	15.4	
		17,988	**100**	**TOTAL**

The BG is the hottest, driest zone in the province and is characterised by warm to hot, dry summers and moderately cold winters with little snowfall (Lloyd et al., 1990). This combination of temperature and precipitation results in the development of a grassland vegetation. This BGC

zone encompasses the lower elevational areas in the northern-most portion of the watershed adjacent to Kamloops Lake.

The PP is the driest and, in summer, the warmest forested zone (Lloyd et al., 1990) and comprises a narrow band transecting the watershed from west to east to the south of the BG. The forests of this zone are generally open and parkland like.

The predominant zone existing within the watershed is that of the IDF. This zone is typical of low to mid-elevation landscapes and has a continental climate characterised by warm, dry summers and cool winters with a low to moderate snowfall (Lloyd et al., 1990).

The watershed's upper most areas (proximal to Mt. Savona and the Dominic Lake area) are generally mid-elevations sites and are ecologically classed as being within the MS Zone. This zone has a cool continental climate with cold winters and moderate snowfall and moderately, short summers (Lloyd et al., 1990). Refer to Table 1 for a list of the BGC zones by area and percent for the watershed.

2.2 QUATERNARY HISTORY

The surficial deposits and general topography of the Durand Creek Watershed are primarily the result of the last major glaciation called the Fraser Glaciation. This glaciation occurred approximately 10,000 to 26,000 years before present (years bp) during the Quaternary Period (Ryder 1976). During the maximum extent of the Fraser Glaciation, the ice in the area was as thick as 2400 metres (m). Ice flowed in an east-south-easterly direction away from the Coastal Mountains where the ice mass had accumulated.

Deglaciation began approximately 13,000 years bp primarily by downwasting and stagnation of glacial ice. Just over 9,000 years bp, melting of all valley ice was complete and the present creek and river drainage patterns established.

Kamloops Lake originated as a glacial lake which occupied depressions along the front or sides of the wasting ice lobes as the ice sheet melted and retreated northward, north-eastward and north-westward across the Thompson Plateau (Holland, 1976). Lacustrine (lake) deposits are found in the lower reaches of Durand Creek associated with Glacial Lake Thompson-Deadman

(Fulton 1969). During the glacial retreat period, differential melting caused a dam to form in the Thompson Valley at the confluence with the Deadman River (Fulton 1969). Lacustrine silts and sands were deposited as a result of the lake. The white silt banks common to the Thompson River Valley are remnants of these silt beds. The silt deposit elevations indicate the old lake levels (up to 1240 m), in the lower reaches of the Durand Creek Watershed (Ryder 1976).

3.0 SUMMARY OF RESOURCE USE AND ACTIVITIES

3.1 FIRST NATIONS AND TRADITIONAL USE

The Durand Creek Watershed is within the traditional territory of the Skeetchestn Native Band of the Secwepemc (Shuswap) Nation. As per the Kamloops LRMP (dated March 31, 1996), the watershed contains areas having either high potential high density, high potential medium density, high potential low density, medium potential low density or low potential low density of containing archaeological sites. Many of the First Nations bands with interests in the area covered by the LRMP are in the process of compiling archaeological data. The status of the Durand Creek Watershed in relation to Cultural Heritage Management may therefore change.

The area of the Durand Creek Watershed has traditionally been used by the Skeetchestn people for berry picking and plant gathering, hunting and fishing (Matthew pers. comm., 1997). Berries picked and plants gathered include strawberries (*Fragaria* sp.), low bush blueberries (*Vaccinium* sp.), kinnikinnick (*Arctostaphylos uva-ursi*), tiger lily bulbs (*Lilium columbianum*), "hooshum" berries (soopolallie/*Sheperdia canadensis*) and indian potato (western springbeauty/*Claytonia lanceolata*) (Anderson pers. comm., 1998). Fishing occurs on both Tunkwa and Leighton Lakes and Tunkwa and Durand Creeks. The area is not utilised for hunting as much today as it was in the past due to a decline in the game population (Anderson pers. comm., 1998).

3.2 FISH AND WILDLIFE RESOURCES

The Durand Creek Watershed, particularly with respect to Tunkwa and Leighton Lakes, is reknown for the fisheries resource. Fisheries in these lakes are highly productive due to the lake chemistry (basic pH) and significant shallow areas, both of which promote fish food production (Ministry of Environment, Lands and Parks, 1997). Rainbow trout were introduced to Tunkwa and Leighton Lakes in 1939 (Ministry of Environment, Lands and Parks, 1997) and the lakes are re-stocked every spring by the Ministry of Environment, Lands and Parks (Anderson pers. comm., 1997; Chan pers. comm., 1997). Additionally, approximately 1,000,000 eggs are

removed from Tunkwa Lake every spring to stock other local interior lakes (Chan pers. comm., 1997). Water quantity as it relates to supporting fish is a recognised issue for these lakes as the water level does fluctuate with the water needs within the watershed. Even in times of high water flow (snow-melt, precipitation) the lakes are considered shallow (Anderson pers. comm., 1997) and are subject to both winter and summer kill if a certain water level is not maintained (Chan pers. comm., 1997). Hence, although there exists a legal right for persons to use the water within the watershed, there is an effort to have water users conserve their use of water or find other water sources so that impact on the lakes is kept to a minimum (Chan pers. comm., 1997).

Although not documented, it is likely that fish travel downstream of the local lakes into Durand Creek, Tunkwa Creek and/or the other creeks within the watershed (Chan, 1997).

The watershed is comprised of grasslands, parkland forests. The wildlife species inhabiting the watershed by habitat type are given in Table 2.

Table 2: Wildlife Species within the Durand Creek Watershed by Habitat Type (FORECON Consulting Services, 1995)

Wildlife Species within the Durand Creek Watershed by Habitat Type		
Grassland	**Parkland Forests**	**Wetlands and Riparian Areas**
golden eagle	mule deer	moose
red-tailed hawk	blue grouse	beaver
sharp-tailed grouse	black bear	ruffed grouse
mountain bluebird	cougar	snakes
western rattlesnake	coyote	amphibians
gopher snake	variety of birds	waterfowl
pika	-	-

3.3 WATER LICENSES

Tunkwa and Leighton Lakes are both artificial lakes originally created as reservoirs for storing water for stock watering and for irrigation at lower elevations. There are two diversions located outside of the watershed boundary which contribute water to the watershed by directing water into Tunkwa Lake (Haywood-Farmer pers. comm., 1997). These diversions are on Guichon

Creek and Chartrand Creek and are licensed for irrigation, storage and conservation (Anderson pers. comm., 1998). With respect to area, they increase the landbase contributing to Durand Creek by 11,665 ha. (3,516 ha. and 8,149 ha. for Chartrand and Guichon Creek respectively). Although the total licensed diversion from these two diversions is 1911.5 acre/feet (1529.5 acre/feet for Guichon Creek and 382 acre/feet for Chartrand Creek), it is likely that the actual water volume entering the watershed from these two diversions is double what is licensed (Anderson pers. comm., 1998). Durand Creek Water Users Committee monitors the flow of water through the watershed, especially the contribution of water from these two (2) diversions (Anderson pers. comm., 1997). In addition, dams exist on Dominic Lake, Durand Lake, Tunkwa Lake, Leighton Lake and Ware Lake (Anderson pers. comm., 1997).

As of November 26, 1997, there were 39 water licenses registered with the Ministry of Environment, Lands and Parks. Refer to Table 3 for a list of types of water licenses existing within the watershed and the attached Durand Creek IWAP Overview Map (Appendix IX) for the location of the water intakes associated with these licenses.

Table 3: List of Water License Types with applicable Purpose Use Codes for the Durand Creek Watershed

Type of License	PUC (Purpose Use Code)	Number of Licenses	
Irrigation	IRR	10	
Domestic	DOM	3	
Domestic/Irrigation	DOM/IRR	6	
Storage	STONP	13	
Irrigation/	IRR/STONP	6	
Conserv. - stored water Conserv. - use of water	CONST CONUS	1	
		39	**TOTAL**

Refer to Appendix II for a list of all the water licenses and their holders within the Durand Creek Watershed. The information on water licenses was obtained from the "Water Rights Maps" of the Ministry of Environment, Lands and Parks. As the Ministry is no longer updating these maps

(Aird pers. comm., 1997-98), it is recognised that there may be inaccuracies with respect to the information pertaining to license and/or water intake status and location.

3.4 RECREATION

The area within the Durand Creek Watershed is well used for recreation due to the topography (open parkland forests and grasslands) and general location (Eastwood pers. comm., 1997). The market for recreation opportunities comes primarily from the Kamloops, Merritt, and Logan Lake populations areas (within 1/2 to 1 hour's drive) and the Lower Mainland (3-4 hours drive) (FORECON, 1995). Access into the area is well developed with roads (secondary and forest service roads/F.S.R.) providing access throughout much of the area. Several recreation features exist within the Durand Creek Watershed including upland fishing lakes, prominent mountains and hilltops, unique and diverse landscape settings and watercourses (FORECON, 1995).

The main upland fishing lakes within the watershed are Tunkwa, Leighton, Ware (Beaverhouse) Lake and Dominic Lake. Both Tunkwa and Leighton Lakes are within Tunkwa Provincial Park and are significant with respect to their fishery values and the local landscape. These two (2) lakes are extensively used by campers and fishers. Additionally, there is a private resort on Tunkwa Lake. Ware Lake offers bird watching in the spring, is used for retriever field trials, and duck hunting in the autumn (FORECON, 1995). Dominic Lake and area is recreationally important in that there is a private resort on the lake and it is used for fishing, camping, snowmobiling, and staging for trail activities (FORECON, 1995).

Two mountains are located within the watershed which are considered recreationally significant. Mt. Savona rises to an estimated 1520 metres with a summit which provides an excellent viewpoint, a staging area for hiking and other trail activities, and a hang gliding launch site (FORECON, 1995; Eastwood, 1997). It is located within the Mount Savona Park. Mt. Anne rises to approximately 1400 metres and is considered a potential destination for activities such as fishing, back-country camping or picnicking, hiking, viewing and/or nature study (FORECON, 1995).

An example of a unique and diverse landscape setting within the Durand Creek Watershed is the drumlinised landscape proximal to Tunkwa and Leighton Lakes. This landscape is characterised by rolling hills of grassland and forest, wetland and bog complexes, and numerous small

waterbodies (FORECON, 1995). This topography is ideal for non-motorised recreation (horseback riding, mountain bike riding, hiking and orienteering), bird watching, nature study, hunting, and winter recreation (snowmobiling, cross country skiing, and tobogganing).

3.5 FORESTRY DEVELOPMENT - PAST AND FUTURE

Within the Durand Creek Watershed, forest harvesting and associated development (e.g. roads, etc.) began in the 1940 to 1950's (Brown pers. comm., 1998). Prior to the early 1980's, timber harvesting primarily involved the selective removal of Douglas-fir (*Pseudotsuga menziesii*). The first clearcut and harvest of leading lodgepole pine (*Pinus contorta*) and spruce (*Picea* sp.) forests occurred in the upper portion of the watershed in the late 1970's and early 1980's (Hopkins pers. comm., 1998; Brown pers. comm., 1998).

Timber harvesting on crown land within the watershed is currently undertaken by Ainsworth Lumber Company. under Forest License (F.L.) A18690 and Pulpwood Agreement (P.A.) 16 and the tenure holders of Woodlots 387 and 1601. Ainsworth Lumber Company of 100 Mile House, purchased the mill in Savona adjacent of Durand Creek on Kamloops Lake in 1987 (Hopkins pers. comm., 1999). Prior to that date, the mill was owned by Evans Products who had purchased it from Savona Timber Company in 1972. Upon purchase, Ainsworth Lumber Company dismantled the lathe and sawmill and constructed a plywood layout facility on the premises.

The regeneration strategy used by Ainsworth Lumber Company on clearcut stands throughout the watershed is artificial (i.e. planting). In the past, stand regeneration was dependant upon naturals in conjunction with drag scarification. This latter method proved to be unsatisfactory due to the presence of a high number of non-serrotinous cones and heavy cattle grazing (Hopkins pers. comm., 1998).

3.6 MINING

As per the Kamloops LRMP (dated March 31, 1996), the Durand Creek Watershed is located within an area of moderate potential with respect for metallic mineral deposits (e.g. gold, silver, copper, molybdenum, lead) and high potential for industrial minerals (e.g. dimension stone, gypsum, limestone, silica). Exploration for minerals and subsequent mine development are considered allowable land uses throughout with the exception of the designated Protected Areas (Tunkwa Park, Mount Savona Park).

There are numerous active mineral claims/tenures within the watershed of which several are along creeks and are designated placer areas (an area where placer claims can be staked). Unless there is a technical report associated with a claim, there is no way of determining what mineral resources the owner of the claim is extracting (Park pers. comm., 1998).

Refer to the attached IWAP Map for the general location of the mining claims within the watershed area. This information was extracted from the "Mining Maps" produced by the Mineral Titles Branch, Energy and Mines Division of the British Columbia Ministry of Employment and Investment (refer to Appendix I).

3.7 RANCHING

The Durand Creek Watershed has high ranching and range values associated with it due to the grassland communities existing throughout much of the watershed. The area has been used for cattle grazing by local ranchers since the mid-1800's (Ministry of Environment, Lands and Parks, 1997). Cattle have always congregated proximal to Tunkwa and Leighton Lakes due to the presence of water in conjunction with the high forage values. Although these lakes are now included in Tunkwa Park, the continuance of cattle grazing within the park will be allowed and managed. An extensive fencing program is proposed for the Park and throughout the Guichon Range Unit to create a pasture system (Ministry of Environment, Lands and Parks, 1997) so that the values associated with the park are protected.

The majority of the watershed is within one of two range units, either the Guichon Creek Unit or the Durand Creek Unit. The remainder of the watershed is not designated as a range unit and is comprised of a combination of Crown and private lands. Several ranchers graze their cattle within the watershed under a grazing license (refer to Table 4) or a grazing lease. The grazing licenses are all within either of the range units whereas the leases cover the Crown land located outside of a unit. There are a total of five (5) grazing licences within the watershed which allow for a maximum of 1920 head of cattle to graze during a given period of time. There is one grazing lease which operates on the watershed's Crown land outside of the range units. This grazing lease is held by Indian Garden's Ranch Ltd. and is generally used from October 15 to May 15. As with all grazing leases, it is monitored by Crown Lands (Dedels pers. comm., 1998).

Table 4: The Grazing License Tenure Holders and applicable information for the Durand Creek Watershed

RANGE UNIT:			GUICHON CREEK UNIT			
Tenure Holder	**Tenure Type**	**License #**	**Grazing Period**	**Maximum # of Cattle***	**A.U.M.****	
A.M. and R.J. Anderson and M.P. Edwards	Grazing License	RAN070571	May 15 - October 15	60	233	
Gardens Creek Ranch	Grazing License	RAN070640	June 1 - October 15	553	2279	
Indian Gardens Ranch Ltd.	Grazing License	RAN070563	May 15 - October 15	942	3883	
				1555	**6395**	SUBTOTAL(S)
RANGE UNIT:			**DURAND CREEK UNIT**			
Tenure Holder	**Tenure Type**	**License #**	**Grazing Period**	**Maximum # of Cattle**	**A.U.M.**	
Fred Bowers	Grazing License	RAN071330	May 15 - October 15	165	783	
Kamlands Holdings Ltd.	Grazing License	RAN071329	May 15 - October 15	200	950	
				365	**1733**	SUBTOTAL(S)
				1920	**8128**	**TOTAL(S)**

* Each head of cattle refers to either a cow calf pair or one bull.
** AUM = animal unit month; the amount of forage required for one month by an average animal of the genus boas, aged six months or older

3.8 TRAPLINES

There is one trapline (0318T002) within the Durand Creek Watershed. The animals trapped on this trap line likely include coyote, muskrat, mink, beaver, squirrel, weasel and marten (Kier pers. comm., 1998). Information on the fur production is not available (Kier pers. comm., 1998).

3.9 OTHER

A 100 to 200 head (Anderson pers. comm., 1997) herd of feral (wild) horses range in the watershed proximal to Tunkwa Park (Ministry of Environment, Parks and Lands, 1997). The horse population has increased over the last several years and for some recreation users, their presence in the area is considered an attraction (Ministry of Environment, Parks and Lands, 1997) These horses compete with the cattle for forage as they use bunchgrasses heavily and are in the area throughout the year.

4.0 METHODS

4.1 OVERVIEW AND OBJECTIVES

As previously stated, the IWAP is one of the phases in the completion of the IWRP (refer to Figure 1.). It is an overview assessment that evaluates, within a watershed, the hydrological impacts from forestry-related activities. It is primarily an office based procedure which evaluates the level of equivalent clearcut area, roads, erodible soils, stream crossings, and landslides. The assessment of hydrological impacts focuses on the potential for change in the following: peak flow, mass wasting, surface erosion and the channel riparian buffer.

4.2 METHODOLOGY

With some exceptions, this IWAP was undertaken as per the procedures outlined in the Forest Practices Code of British Columbia, Interior Watershed Assessment Procedure Guidebook (IWAP), Level 1 Analysis, (Ministry of Forests and Ministry of Environment, Lands and Parks, 1995). Only those procedures which were not completed in accordance with the guidebook are described in full.

4.2.1 GENERAL DATA COLLECTION

To complete the IWAP, several sources of information was acquired either through manual compilation or digitally (refer to Table 5). Digital data was derived through queries using the Geographical Information System (GIS) ARCINFO, Version 7.0.4 . Digital resources included Forest Development Plan (FDP) forest cover (FC1 files) and Terrain Resource Inventory Maps (TRIM) files. Overall, the manually derived data must be obtained before the procedures involving the use of ARCINFO can commence.

Once all the manually derived information as given in Table 5 was compiled, the features were transferred using Microstation 95 and a base map created. Upon completion of the base map, this map was used by ARCINFO to produced a three dimensional model of the watershed (a digital terrain model/DTM). The DTM was created in order to find the H_{60}[1] line and the slopes equal to or greater than 60%.

[1] The H_{60} line is the elevation in the watershed above which 60% of the watershed lies. The elevation of the snowline.

Table 5: List of the features required to complete the Durand Creek IWAP, their datum source and whether they were digitally or manually derived.

MANUALLY DERIVED		DIGITALLY DERIVED	
FEATURE(S)	SOURCE	FEATURE(S)	SOURCE
Watershed and sub-basin boundaries	Maps - TRIM data (streams and contours)	H_{60} line determination	TRIM data, ARCINFO
Stream ordering	Maps - TRIM data	Areas of potential slope instability	ARCINFO
Road network additions/changes	Maps - FDP's Aerial photographs[2]	Road network	FDP's and ARCINFO
Location of landslides	Aerial photographs	Location and number of stream crossings	ARCINFO, TRIM and FDP's
Identification of erodible soils	Maps - Soil and Surficial Geology	Cutblocks and regeneration status	FC1 and FIP files and FDP's
Cutblocks - additions	Aerial photographs and FDP's	Area of Private and Federal lands, Parks and PA's	FDP's

4.2.2 SUB-BASIN IDENTIFICATION

The watershed was divided into five sub-basins based first upon stream ordering and second upon elevation. Refer to Table 6 for a description of each sub-basin and the overall watershed. Through stream ordering, Durand Creek was found to be a fifth order stream and three (Tunkwa Lake, Skookumchuk, Durand Lake) of the five sub-basins were determined due to the fourth order status of the creeks. The Upper Durand Creek Sub-basin was designated based upon the presence of higher elevational sites relative to those in the Tunkwa Lake Sub-basin located to the west. The remaining portion of the watershed has been placed in the Residual Sub-basin which incorporates all portions of the watershed downstream of the confluence where Durand Creek becomes a fifth order stream.

[2] Aerial photographs used for the completion of this IWAP are listed in Appendix III.

Table 6: Description of the sub-basins, residual area and the overall watershed.

SUB-BASIN OR AREA	HYDROLOGIC DESCRIPTION	AREA (HA./KM^2)	% AREA OF WATERSHED	
Durand Lake	Durand Creek above confluence with Tunkwa Creek; includes Dominic and Durand Lakes and Ferguson Creek	3508/35.083	19.5	
Durand Residual	the part of the Durand Creek Watershed not included within the sub-basins	6,184/61.844	34.4	
Skookumchuk	Skookumchuk Creek above confluence with Tunkwa Creek	1748/17.485	9.7	
Tunkwa Lake	Tunkwa Creek above confluence with Skookumchuk Creek; includes Tunkwa, Leighton and Ware Lakes and all associated tributaries;	5,368/53.681	29.8	
Upper Durand	higher elevational sites	1,180/11.801	6.6	
Durand Creek Watershed	**Project Area** - P.O.I. is the mouth of Durand Creek where it flows into Kamloops Lake	**17,988/179.9**	**100**	**TOTALS**

4.2.3 ERODIBLE SOILS

The erodibility of the soils within the watershed was determined using soil and surficial geology maps (refer to Appendix I) in conjunction with Table 6-1 of the IWAP Guidebook (Ministry of Forests and Ministry of Environment, Lands and Parks, 1995).

As the soil maps were originally produced for agricultural purposes and not forest development (i.e.. harvesting and road construction), the erosion classes provided with the soil maps were not used. Rather, each soil association was assigned an erodibility rating in consultation with the Regional Pedologist, Graeme Hope. The ratings were low (L), moderate (M) or high (H) and are based upon the description of soil parent material (Hope pers. comm., 1997). To associate the maps with Table 6-1 of the IWAP Guidebook (Ministry of Forests and Ministry of Environment, Lands and Parks, 1995), the map slope classes (A/a to H/h) were referred to. The assumption was made that for each soil polygon, the predominant slope, and the one that would be considered, was the first slope class (i.e. letter) following landform classification and the colon. The slope percent associated with each class was determined and referenced to Table 6-1. Using the slope percent and erodibility rating for each soil association, the overall soil erodibility (least erodible, erodible, very erodible) for each polygon was determined. Only those polygons which had a High rating were noted. It was also assumed that the erodibility rating applied to 100% of

the polygon. For those polygons which referenced more than one soil association, percent erodibility was determined if the erodibility classes for the two soil associations were different.

Referring to the surficial geology maps (Appendix I), all areas within the watershed delineated as erodible were noted and considered 100% highly erodible. This included those polygons representing lacustrine and fluvial deposits, landslide deposits and fan deposits. All polygons ascertained to have high erodibility from the soil maps and surficial geology maps were digitised onto an overview map for the watershed. Where erodible soils noted from the surficial geology maps over-lapped erodible areas from the soil maps, the assumption was made that this former information superseded this latter information.

4.2.4 UNSTABLE TERRAIN

The assumption was made that all slopes $\geq$ 60% is potentially unstable. This terrain was identified through GIS analysis and mapped.

The Durand Creek Watershed is within an area which is being inventoried for unstable terrain through an T.S.I.L.D. Terrain Stability Inventory Level D (T.S.I.L.D.) Assessment. The results of this assessment were not available at the time of the completion of this IWAP. It is suggested that the results of this assessment be reviewed and if the terrain identified as unstable substantially differs from what was identified in this IWAP, the IWAP should be amended to incorporate these results.

4.2.5 IDENTIFICATION OF FISH STREAMS

As no fish stream inventory reports were identified, all streams within the watershed were presumed to be a fish streams (that is, fish bearing) as per Section 1(1) of the Forest Road Regulation of the Forest Practices Code of British Columbia Act. This is supported by the fact that there are several lakes which are proximal to the creek's headwaters which are stocked annually by Ministry of Environment, Lands and Parks.

4.2.6 AERIAL PHOTOGRAPH COMPARISON

Aerial photographs taken in 1948 and 1995 (refer to Appendix III) were compared so as to note any visual differences to the Durand Creek stream channel, natural riparian buffer, etc.

4.2.7 GEOGRAPHICAL INFORMATION SYSTEM QUERIES

To complete an IWAP, Level 1 Analysis, several numerical scores (impact indicators) in four impact categories are required. There are a total of 13 scores which must be determined of which three are related to the impact category of Peak flow, five are related to the impact category of Surface erosion, two are related to Riparian buffer and three are related to Mass wasting. Refer to Table 7 in Section 5.0 for a list of the Impact Categories and their applicable Indicators.

Queries were performed by the ARCINFO on the base map to determine the 13 impact indicator scores. Scores are calculated and entered into a "Watershed Report Card" (Table 7) which is used to identify watershed constraints and guide the development of management recommendations.

4.2.7.1 EQUIVALENT CLEARCUT AREA (ECA) - CURRENT AND PROJECTED

Four Equivalent Clearcut Area's[3] (ECA's) were calculated. The Current Weighted and Unweighted ECA[4] was calculated by considering the status of the forest as of January 1, 1998 whereas the Projected Weighted and Unweighted ECA was calculated by incorporating all past and proposed forestry developments up until December 31, 2002.

The Weighted ECA is necessary to derive the Peak Flow impact category. Disturbances, such as road building, harvesting, burn sites, hydro lines and land slides directly affect the peak flow in a watershed. Without trees and vegetation to intercept snow or rainfall, potentially larger quantities of precipitation contribute to the peak flow of the watershed. Not all areas of the watershed contribute run-off equally to the peak flow. Clearcutting above the H_{60} line has a greater potential impact on the watershed's peak flow than below the line as snow usually remains in the harvested openings until the time that peak flow occurs. The potential for increased run-off at this time could increase the peak flow volume significantly. Therefore, cutblocks above the H_{60} are weighted more significantly during the analysis. To calculate the Weighted ECA, the H_{60} line was determined and regeneration information from past harvesting

[3] The ECA is the area that has been clearcut, with a reduction factor to account for the hydrological recovery due to forest regeneration.

[4] Weighted ECA = [(ECA above H_{60} * 1.5) + ECA below H_{60})]/Area {as per the IWAP Guidebook}
Unweighted ECA = (ECA above H_{60} + ECA below H_{60})/Area {used by Kamloops Forest District when reviewing Forest Development Plans}

was acquired from all of the organisations harvesting in the area. This included information from all major licensees and the Ministry of Forests.

The Current ECA's were calculated using 1997 NAD83 (North American Datum 83) Forest Cover map files provided in a ARC/INFO format. Analysis was performed using the internal FC1 databases contained within the forest cover. As the FC1 data was valid to mid-1997, no attempt was undertaken to adjust the database to reflect the time interval between the updated FC1 files and the development information provided by the licensees (refer to Appendix VIII).

The Projected ECA's were calculated using Forest Inventory Planning Data Exchange Files (FIPDEFs) to obtain the harvesting type, area and projected tree height for each disturbed polygon on the associated FC1 file. To obtain proposed development information, the Draft Forest Development Plan of each licensee (refer to Appendix VIII) operating within the watershed area was consulted. Tree heights were projected for the subsequent 5 years (January 1st 1998 to December 31, 2002) for the relevant forest cover polygons using the FIPDEF data. In the situation where the FIPDEF data was not current in that the file version number pre-dated the harvesting of blocks, the VDYP programme could not be utilised as accurate tree heights were not available. For these blocks, the assumption was made that the average height of the regenerating trees was less than (<) 3 metres resulting in a percent hydrologic recovery of 0%.

The FIPDEFs for this watershed have not been updated since November/December, 1996 so tree heights were projected to January 1, 1998 using the Ministry of Forests Variable Density Yield Prediction program (VDYP, version 6.3). Refer to Appendix IV for a list of the FIPDEFs used, their associated version number and date of last update.

A harvested block will have an adjusted ECA value depending on type of harvesting and tree regeneration. If a block has been selectively cut or is clearcut which has successfully regenerated then only a portion of it is "equivalent" to a clearcut. For these scenarios, the rate of hydrologic recovery [5] was considered based upon Table 8-1 in the IWAP Guidebook (Ministry of Forests and Ministry of Environment, Lands and Parks, 1995).

[5] Hydrologic recovery refers to the changes in snow accumulation and melt brought about by forest harvesting in that they are reduced as new forests grow.

4.2.8 ANALYSIS

The scores for each of the impact categories were divided into one of three Hazard Categories of (Hazard index in parentheses): Low (<0.5), Moderate (0.5-0.7) and High (>0.7). The raw scores of the impact indicators are converted into hazard indices using either a conversion table (refer to Table 1 of the IWAP Guidebook (Ministry of Forests and Ministry of Environment, Lands and Parks, 1995) or a spreadsheet. For this assessment the computerised spreadsheet titled IWAP103.xls was used. This spreadsheet uses Excel for Windows, Version 4.0 and does all necessary calculations.

4.2.9 ASSUMPTIONS

Assumptions were made during the GIS query and analysis portion of the IWAP that should be noted. They include the following:

1. For the Projected Weighted and Unweighted ECA Calculations, all existing and proposed cutblock information was included up to December 31, 2002.
2. Private land was excluded from the sub-basin area and ECA calculation when it totalled less than 15% of the sub-basin area (as per the IWAP Guidebook (Ministry of Forests and Ministry of Environment, Lands and Parks, 1995).
3. Cultivated land was excluded from the sub-basin area and ECA calculation when it totalled less than 15% of the sub-basin area (as per the IWAP Guidebook (Ministry of Forests and Ministry of Environment, Lands and Parks, 1995).
4. The information contained in the Soils of Ashcroft Area map and the Surficial Geology map for Kamloops Lake was the best source available for determining soil erodibility.
5. Licensee cutblocks were assumed to be most accurately mapped by the licensee and conflicting sources were ignored.
6. The IWAP does not account for any forested buffers which may exist adjacent to streams as this information is rarely included on forest cover maps. Hence, harvesting is presumed to occur directly up to the stream edge.
7. All roads are given the same weighting in the GIS Analysis in that they are not differentiated by type, condition, age, etc.
8. The Ministry of Forest's Variable Density Yield Prediction program (VDYP, version 6.3) projects tree heights to include the growing season of reference year (Bartram pers. comm., 1998). This means that if tree height is projected to any date in 2002, the reference year is 2002 and the growing year of 2002 will be included in the calculation.

9. For the projected ECA calculations, a zero increase in height (i.e. no tree growth) was presumed for any cutblocks (both NSR and SR[6]) identified off the Forest Development Plan which were not included on the Forest Cover (FC1 files). This was necessary due to inadequate data on tree growth for these blocks.
10. All streams were considered fish-bearing as per the Forest Practices Code of British Columbia Act.

4.2.10 FIELD ASSESSMENTS

Integrated Woods Services Ltd. completed one full day field assessment of the watershed area. The purpose of this field assessments was to (1) take note of the general topography of the watershed, (2) inspect as many of the major stream crossings as possible and take measurements, (3) assess the general road conditions and (4) take photographs.

The results, photographs (plates) and field cards are located in Appendix V. The localities within the watershed which were field assessed (i.e. notes were taken) are noted on the map as a "Δ" for Field Assessment.

5.0 RESULTS

5.1 OVERVIEW AND OBJECTIVES

The results for the impact categories and hazard indices are displayed in Table 7. The Data Entry Sheet - IWAP Version 1.03 (based upon the computerised spreadsheet titled IWAP103.xls) for each sub-basin are located in Appendix VI. The results in Table 7 were extracted from these Data Entry Sheets.

5.2 H_{60} RESULTS

Through analysis, the H_{60} for the Durand Creek Watershed was found to be 1179 metres. Refer to Appendix VII for a hypsometric (area-elevation) curve for the total watershed. As can be noted, the curve is percent of total watershed area against elevation (metres).

[6] NSR = Not Sufficiently Restocked
SR = Sufficiently Restocked

Table 7: "Watershed Report Card" - Impact Indicator Scores* and Hazard Index Ratings for each sub-basin within the Durand Creek Watershed as of January 1, 1998.

IMPACT CATEGORY	IMPACT INDICATOR	SUB-BASIN				
		DURAND LAKE	RESIDUAL	SKOOKUM-CHUK	TUNKWA LAKE	UPPER DURAND
PEAK FLOW	Total Peak Flow Index	0.47 (L)	0.15 (L)	0.37 (L)	0.19 (L)	0.16 (L)
	Road Density above H_{60} (km/km^2)	1.00 (H)	0.25 (L)	1.00 (H)	1.00 (H)	1.00 (H)
	Total Road Density (km/km^2)	0.46 (L)	0.45 (L)	0.57 (M)	0.53 (M)	0.54 (M)
PEAK FLOW HAZARD INDEX RATING		**0.65 (M)**	**0.28 (L)**	**0.65 (M)**	**0.57 (M)**	**0.57 (M)**
SURFACE EROSION	Roads on erodible soils (km/km^2)	0.00 (L)	0.38 (L)	0.02 (L)	0.06 (L)	0.01 (L)
	Roads within 100m of a stream (km/km^2)	0.72 (H)	1.00 (H)	1.00 (H)	1.00 (H)	0.87 (H)
	Roads on erodible soils < 100m from a stream (#/km^2)	0.00 (L)	0.57 (L)	0.06 (L)	0.09 (L)	0.01 (L)
	Active stream crossings (#/km^2)	0.67 (M)	1.00 (H)	1.00 (H)	1.00 (H)	0.78 (H)
	Total Road density (km/km^2)	0.46 (L)	0.45 (L)	0.59 (M)	0.54 (M)	0.56 (M)
SURFACE EROSION HAZARD INDEX RATING		**0.69 (M)**	**1.00 (H)**	**1.00 (H)**	**1.00 (H)**	**0.82 (H)**
RIPARIAN BUFFER	Portion of a stream logged (km/km)	0.83 (H)	0.92 (H)	0.66 (M)	0.70 (H)	1.00 (H)
	Portion of a fish-bearing stream logged (km/km)	0.50 (M)	0.55 (M)	0.39 (L)	0.42 (L)	0.61 (M)
RIPARIAN BUFFER HAZARD INDEX RATING		**0.83 (H)**	**0.92 (H)**	**0.66 (M)**	**0.70 (H)**	**1.00 (H)**
MASS WASTING	Landslide density (#/km^2)	0.00 (L)	0.00 (L)	0.00 (L)	0.00 (L)	0.00 (L)
	Roads on unstable slopes (km/km^2)	0.03 (L)	0.10 (L)	0.17 (L)	0.01 (L)	0.00 (L)
	Streams >60% and banks logged (km/km^2)	0.00 (L)	0.00 (L)	0.00 (L)	0.00 (L)	0.00 (L)
MASS WASTING HAZARD INDEX RATING		**0.01 (L)**	**0.05 (L)**	**0.09 (L)**	**0.00 (L)**	**0.00 (L)**

* Impact indicator scores range from 0.0 to 1.0 where: < 0.5 = Low (L)
0.5 to 0.7 = Medium (M)
> 0.7 = High (H)

5.3 HISTORICAL AERIAL PHOTOGRAPHS

A comparison of 1948 and 1995 aerial photographs (listed in Appendix III) for Durand Creek revealed that only minor changes have occurred to the natural, vegetated riparian buffer adjacent to the creek in the Residual Sub-basin.

5.4 ECA (EQUIVALENT CLEARCUT AREA) RESULTS - CURRENT AND PROJECTED

ECA is equal to the Total Peak Flow Index Indicator as a percent. As per Table 1 of the IWAP Guidebook (Ministry of Forests and Ministry of Environment, Lands and Parks, 1995), the Low, Moderate, and High thresholds for ECA are <30% for Low (L), 30% to <42% for Moderate (M) and ≥ 42% for High (H). As can be noted in Table 8 which displays the Current and Projected Weighted and Unweighted ECA's for the sub-basins and the overall watershed, all ECA's as of January 1, 1998 are Low whereas for the year 2002, the Weighted ECA for the sub-basins Skookumchuk, Durand Lake and Upper Durand are projected to be Moderate.

Table 8: Current and Projected ECA Scores for the sub-basins and the overall Durand Creek Watershed.

SUB-BASIN	CURRENT ECA (%) January 1, 1998		PROJECTED ECA (%) - includes the growing year of 2002 (FOLLOWING PROPOSED 5 YEARS OF DEVELOPMENT)	
	Weighted	Unweighted	Weighted	Unweighted
DURAND LAKE	28 (L)	19 (L)	39 (M)	26 (L)
DURAND RESIDUAL	9 (L)	8 (L)	10 (L)	8 (L)
SKOOKUMCHUK	22 (L)	15 (L)	32 (M)	22 (L)
TUNKWA LAKE	11 (L)	8 (L)	14 (L)	10 (L)
UPPER DURAND	10 (L)	7 (L)	33 (M)	22 (L)
OVERALL WATERSHED	15 (L)	11 (L)	21 (L)	15 (L)

6.0 DISCUSSION

6.1 OVERALL WATERSHED

By referring to the Data Entry Sheet for the overall Durand Creek Watershed (Excel spreadsheet WHOLE98.XLS in Appendix VI), it can be noted that the only Hazard Index currently with a High rating is Surface Erosion. The result (1.00) is attributed to the two impact categories "Roads within 100m. of a Stream" and "Active Stream Crossing". The concern with respect to Surface Erosion is sediment from road development and stream crossings entering creeks. It is possible that this rating

is an over-estimate as the Field Assessment suggested a lower risk due to the watershed's overall low relief/gentle topography, the condition of the roads, the low percent of erodible soils, and the area's low rainfall.

Both Peak Flow and Riparian Buffer have a Moderate rating. The rating for Peak Flow (0.57) is a result of the High hazard (1.00) for the impact indicator "Road Density above H_{60}". This moderate rating suggests that channels could be potentially unstable throughout the watershed. It is possible that the hazard score is an over-statement of what is on the ground as the Field Assessment suggested the channels were of a lower risk due to the overall relief/gentle topography of the watershed and the condition of the roads.

The Mass Wasting Hazard Index Rating (Landslides) has a Low hazard rating.

The overall ECA for the Durand Creek Watershed is expected to remain Low for the next five (5) years. The Current Weighted ECA is 15% and the Projected Weighted ECA is 21%.

If harvesting continues in the Guichon and/or Chartrand Creek watershed upstream of the diversions contributing water to Tunkwa Lake, it is possible that the hydrologic regime of the Tunkwa Lake sub-basin could change.

6.2 SUB-BASIN DISCUSSION

6.2.1 PEAK FLOW HAZARD IMPACT CATEGORY

With the exception of the Residual Sub-basin which has a Low (0.28) hazard rating, all sub-basins have a Moderate Hazard Index Rating for Peak Flow. These Moderate rating are due to impact indicator "Road Density above H_{60}". This rating suggests that the channel could be potentially unstable. It is possible that the score is an over-statement of what is on-site.

6.2.2 SURFACE EROSION HAZARD IMPACT CATEGORY

The Surface Erosion Hazard Impact rating for all sub-basins is High with exception of Durand Lake Sub-basin which has a Moderate rating. These predominant High ratings are due to the impact indicators "Roads within 100m of a stream" and "Active Stream Crossings". The concern with respect to Surface Erosion is sediment from road development and stream crossings entering streams. It is possible that these scores are higher than what is actually on-site as the Field

Assessment suggested lower risk due to the watershed's overall low relief/gentle topography, the condition of the roads, the low percent of erodible soil, and the area's low precipitation.

6.2.3 Riparian Buffer Hazard Impact Category

The Riparian Buffer Hazard Index is high for all the sub-basins with the exception of Skookumchuk. This latter sub-basin has a Moderate rating (0.66) for this category. The High ratings are attributed to the impact indicator "Portion of a Stream Logged". It is possible that these ratings are an over-estimate of what is on-site due to the following reasons:

- As the IWAP does not account for any forested buffers which may exist adjacent to streams, the assumption applies that harvesting occurs up to the stream. This is particularly relevant for recent harvesting activities as riparian buffers are now required for many streams as per the Forest Practices Code of British Columbia Act, (Bill 40-1994).
- The IWAP does not consider vegetation recovery in the riparian areas. For all existing blocks, it can be inferred that the riparian vegetation will recover from harvesting at the same rate as what is stated for hydrologic recovery. This can only be inferred if it is known that further disturbances have not occurred or are not on-going (e.g. due to cattle).

6.2.4 Mass Wasting Hazard Impact Category

All sub-basins within the watershed have a Low hazard rating for the Mass Wasting Impact Category. However, communication with personnel at Ainsworth Lumber Company Ltd., Savona Division suggested instabilities exist in the main channel in the Durand Lake Sub-basin adjacent to Cutting Permit 998 (Baron pers. comm., 1998).

6.2.5 Equivalent Clearcut Area - ECA

The Current Weighted, Current Unweighted and Projected Unweighted ECA's for all sub-basins are Low (<30%) whereas the Projected Weighted ECA for the Skookumchuk, Durand Lake and Upper Durand are Moderate (>30%).

7.0 CONCLUSION

This Interior Watershed Assessment Procedure (IWAP) was completed by *Integrated* Woods Services Ltd. under contract to Ainsworth Lumber Company Ltd., Savona Division. Funding was provided through Forest Renewal of British Columbia (FRBC) and Ainsworth Lumber Company Ltd., Savona Division.

The IWAP is the first level of an analysis which is intended to identify watersheds which may have or will be impacted by past and/or proposed forest development. Additionally, the IWAP guides Level 2 and Level 3 assessments if the results indicate that these other assessments are necessary. The results obtained from these assessments should be considered in all future forest development planning.

The results of this IWAP suggest that concerns related to hydrologic impacts are present in each of the sub-basins. These impacts are related to road development and harvesting directly proximal to streams. It is suspected that these impacts are over-estimated as the field assessments undertaken by *Integrated* Woods Services Ltd. suggested a lower risk due to the overall relief/gentle topography of the watershed, the condition of the roads, the low percent of erodible soils and the area's low rainfall. With respect to Equivalent Clearcut Area (ECA), the results show that it is expected to increase over the next five years in every sub-basin due to planned forestry development (blocks and roads). In three of the sub-basins, the Weighted ECA is projected to increase to a level greater than the threshold of 30%.

8.0 RECOMMENDATIONS

It is recommended that the results of this IWAP be utilised in future forestry developments at the Forest Development Plan stage. Recommendations and conclusions may change if the Draft Forest Development Plans utilised for the completion of this report are modified.

If the hydrologic regime of the Tunkwa Lake sub-basin changes due to harvesting within the Guichon and/or Chartrand Creek watersheds upstream of the diversions, the operation of the dams and diversions should be modified accordingly.

It is recommended that an IWAP be completed on the sub-basin of Chartrand Creek which contributes water into Tunkwa Lake.

8.1 PEAK FLOW HAZARD IMPACT CATEGORY

Due to the Moderate Hazard rating for Peak Flow for all sub-basins with the exception of the Residual Sub-basin it is recommended that a Level 2 Assessment/Channel Conditions Prescription and Assessment (CCPA) be completed prior to the full implementation of the Forest Development Plans (refer to Appendix VIII). No actions are recommended for the Residual Sub-basin.

8.2 Surface Erosion Hazard Impact Category

To confirm the results for the Surface Erosion High Hazard Impact rating, it is recommended that a Sediment Source Survey and an Access Management Map be undertaken for all sub-basins. Additionally, harvesting and road construction should be minimise on and adjacent to areas of erodible soils.

8.3 Riparian buffer Hazard Impact Category

Due to the High and Moderate ratings for all sub-basins for this category, it is suggested that a FHAP (Fish and Fish Habitat Assessment Procedure) be completed.

8.4 Mass Wasting Hazard Impact Category

No actions are necessary for any of the sub-basins for this category due to the Low rating.

8.5 Equivalent Clearcut Area - ECA

A Channel Condition and Prescription Assessment (CCPA) should be undertaken for the Skookumchuk, Durand Lake and Upper Durand Sub-basins prior to the full implementation of the 1998-2002 Forest Development Plan. This is especially important for the Durand Lake Sub-basin so that the instabilities identified adjacent to Cutting Permit 998 are addressed. Other alternatives to reducing the increase in ECA is to apply partial cut silviculture systems and have a zero net increase in roads through deactivating and/or rehabilitating existing roads prior to new road development.

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Chan, Brian. 1997. Senior Fisheries Biologist, Southern Interior Regional Headquarters, Ministry of Environment, Lands and Parks, Kamloops, British Columbia

Dedels, Mike. 1997. Range Technician, Kamloops Forest District, Ministry of Forests, British Columbia

Eastwood, Jennifer. 1997. Recreation Officer, Kamloops Forest District, Ministry of Forests, British Columbia

Haywood-Farmer, Bob. 1997. Land owner and water licensee, Savona, British Columbia.

Hope, Graeme. 1998. Research Pedologist, Kamloops Forest Region, Ministry of Forests, Kamloops, British Columbia.

Hopkins, Mark. 1998. Manager of Forest Practices, Ainsworth Lumber Company, Savona Division, British Columbia

Kier, Kurt. 1998. Wildlife Technician, Southern Interior Regional Headquarters, Ministry of Environment, Lands and Parks, Kamloops, British Columbia

Park, Elaine. 1997-98. Senior Tenures Officer, Gold Commissioners, Ministry of Employment and Investment, Kamloops, British Columbia.

APPENDICES

APPENDIX I

Maps consulted to complete the Durand Creek Watershed IWAP

Biogeoclimatic Unit Map, 1989. 92I/NE, 1:100,000, Ministry of Forests, Kamloops Forest Region, Kamloops, British Columbia

Geological Survey of Canada, Department of Energy, Mines and Resources, 1960-62, Map 1394A (92I/NE), Surficial Geology, KAMLOOPS LAKE, West of Sixth Meridian, British Columbia, Scale 1:126,720

Mineral Titles Branch, Energy and Mines Division of the British Columbia Ministry of Employment and Investment. 1997. Kamloops Lake, 092I10E, 1:31,680

Mineral Titles Branch, Energy and Mines Division of the British Columbia Ministry of Employment and Investment. 1997. 092I/10W, 1:31,680

Soils of the Ashcroft Area, British Columbia, 1972-1973, 1976; Kamloops Lake, 92I/NE, 1:100,000 (Soil Survey Report No. 26), Agriculture Canada

APPENDIX II

Water Licenses and their holders within the Durand Creek Watershed

Report Requested By : MAIRD
Date Report Requested : 1997/12/05 15:50
Report Sorted By : Source Hierarchy
Selection Criteria

START	: 907649 - Durand Creek left of Kamloops Lake
END	: - Upstream most point of source hierarchy
TRIBUTARIES	: Y

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority YYYY/MM/DD	PUC	Quantity/Units
----- SOURCE: Durand Creek left of Kamloops Lake -----						
----- 3755B B -----						
F045452	0241537	35 AC OF L A OF L 367 KDYD PLAN 12706 EXC PLAN 14728	WATSON MUIR DURAND CREEK WUC BOX 92 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1873/07/10	IRR	105.00 AF
----- 3755 C -----						
F006347	0241546	31 AC OF E 1/2 OF SE 1/4 OF SEC 2 & W 1/2 OF SW 1/4 OF SEC 1 TP 21 R 21 W6M	ANDERSON ANTHONY M & EDWARDS MICHAEL DURAND CREEK WUC BOX 168 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	P1908/08/15	IRR	93.00 AF

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority YYYY/MM/DD	PUC	Quantity/Units
F006352	0241541	54.1 AC OF S 1/2 OF NE 1/4 OF SEC 35 & S 1/2 OF NW 1/4 OF SEC 36 TP 20 R 21 W6M	INDIAN GARDENS RANCH LTD DURAND CREEK WUC BOX 68 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1894/01/18	DOM IRR	500.00 GD 163.00 AF
----- 3755 D -----						
F006352	0241541	54.1 AC OF S 1/2 OF NE 1/4 OF SEC 35 & S 1/2 OF NW 1/4 OF SEC 36 TP 20 R 21 W6M	INDIAN GARDENS RANCH LTD DURAND CREEK WUC BOX 68 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1894/01/18	DOM IRR	500.00 GD 163.00 AF
----- 3755 F -----						
F006341	0241544	77 AC OF SW 1/4 OF SEC 36 TP 20 R 21 W6M W OF DURAND CR	INDIAN GARDENS RANCH LTD DURAND CREEK WUC BOX 68 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1908/08/07	DOM IRR	500.00 GD 231.00 AF

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority YYYY/MM/DD	PUC	Quantity/Units
F006344	0241545	36.8 AC OF SE 1/4 OF SEC 35 TP 20 R 21 W6M	INDIAN GARDENS RANCH LTD DURAND CREEK WUC BOX 68 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1908/08/07	DOM IRR	500.00 GD 111.00 AF
F006353	0241542	35 AC OF SE PORTION OF L 783 KDYD	INDIAN GARDENS RANCH LTD DURAND CREEK WUC BOX 68 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1868/03/23	DOM IRR	500.00 GD 247.00 AF
----- 1754 BB -----						
F006341	0241544	77 AC OF SW 1/4 OF SEC 36 TP 20 R 21 W6M W OF DURAND CR	INDIAN GARDENS RANCH LTD DURAND CREEK WUC BOX 68 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1906/08/07	DOM IRR	500.00 GD 231.00 AF

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority YYYY/MM/DD	PUC	Quantity/Units
F006344	0241545	36.8 AC OF SE 1/4 OF SEC 35 TP 20 R 21 W6M	INDIAN GARDENS RANCH LTD DURAND CREEK WUC BOX 68 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1908/08/07	DOM IRR	500.00 GD 111.00 AF
F006352	0241541	54.1 AC OF S 1/2 OF NE 1/4 OF SEC 35 & S 1/2 OF NW 1/4 OF SEC 36 TP 20 R 21 W6M	INDIAN GARDENS RANCH LTD DURAND CREEK WUC BOX 68 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1894/01/18	DOM IRR	500.00 GD 163.00 AF
F006353	0241542	35 AC OF SE PORTION OF L 783 KDYD	INDIAN GARDENS RANCH LTD DURAND CREEK WUC BOX 68 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1868/03/23	DOM IRR	500.00 GD 247.00 AF
----- 3754 M -----						
C021846	0200928	STOR FOR F 7435 DURAND CR	KAMLANDS HOLDINGS LTD 1712 150 YORK ST TORONTO ONT M5H3S5	1953/09/05	STONP	100.00 AF

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority YYYY/MM/DD	PUC	Quantity/Units
C025346	0205505	SEE LICENCE	KAMLANDS HOLDINGS LTD 1712 150 YORK ST TORONTO ONT M5H3S5	1954/09/21	IRR STONP	75.00 AF 75.00 AF
C063597	3000209	SEE FILE	KAMLANDS HOLDINGS LTD 1712 150 YORK ST TORONTO ONT M5H3S5	1982/12/07	IRR STONP	200.00 AF 200.00 AF
F007435	0008430	SEE LICENCE	KAMLANDS HOLDINGS LTD 1712 150 YORK ST TORONTO ONT M5H3S5 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1919/01/23	IRR	282.00 AF
F013804	0241543	16.5 AC OF SE 1/4 OF SEC 33 & FRAC SW 1/4 OF SEC 34 TP 20 R 20 W6M EXC CPR R/W & TRANS CAN HWY PLAN H 599	KAMLANDS HOLDINGS LTD 1712 150 YORK ST TORONTO ONT M5H3S5 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1902/05/20	IRR	49.50 AF
----- 3756 % -----						
Z103399	3001567	SW 1/4 SEC 7 TP 20 R 20 W6M KDYD	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1989/12/05	IRR STONP	35.00 AF 70.00 AF

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority YYYY/MM/DD	PUC	Quantity/Units
----- 3756 A -----						
C059142	0367179	81 AC OF W 1/2 OF SEC 6 & SW 1/4 OF SEC 7 TP 20 R 20 W6M	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1980/08/29	IRR	202.50 AF
C061166	0241538	52.9 AC OF NW 1/4 OF SEC 6 TP 20 R 20 W6M	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1889/09/13	IRR	133.00 AF
F006320	0241548	21.7 AC OF SW 1/4 OF SEC 7 TP 20 R 20 W6M	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1908/12/15	DOM IRR	500.00 GD 55.00 AF
----- 3756 B -----						
C059142	0367179	81 AC OF W 1/2 OF SEC 6 & SW 1/4 OF SEC 7 TP 20 R 20 W6M	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1980/08/29	IRR	202.50 AF
C061166	0241538	52.9 AC OF NW 1/4 OF SEC 6 TP 20 R 20 W6M	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1889/09/13	IRR	133.00 AF
C061167	0241539	70.5 AC OF SW 1/4 OF SEC 6 TP 20 R 20 W6M	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1893/12/12	IRR	177.00 AF

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority YYYY/MM/DD	PUC	Quantity/Units
F006320	0241548	21.7 AC OF SW 1/4 OF SEC 7 TP 20 R 20 W6M	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1908/12/15	DOM IRR	500.00 GD 55.00 AF
		----- 3756 E -----				
C059140	0265081	28.5 AC OF W 1/2 OF SEC 31 TP 19 R 20 W6M	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1912/03/19	IRR	71.50 AF
C059142	0367179	81 AC OF W 1/2 OF SEC 6 & SW 1/4 OF SEC 7 TP 20 R 20 W6M	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1980/08/29	IRR	202.50 AF
C059610	0367180	50 AC OF W 1/2 OF SEC 31 & E 1/2 OF NW 1/4 OF SEC 30 TP 19 R 20 W6M	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1980/08/29	IRR	125.00 AF
C061167	0241539	70.5 AC OF SW 1/4 OF SEC 6 TP 20 R 20 W6M	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1893/12/12	IRR	177.00 AF
		----- SOURCE: Tunkwa Creek left of Durand Creek -----				
		----- 3757 F -----				
C036152	0273189	SE 1/4 OF SEC 25 TP 19 R 21 W6M	ANDERSON BERTHE & ANTHONY M & RAYMOND BOX 168 SAVONA BC V0K2J0	1967/03/21	DOM	1,000.00 GD

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority YYYY/MM/DD	PUC	Quantity/Units
		----- 3757 G -----				
C036150	0273004	16.5 AC OF S 1/2 OF SEC 25 TP 19 R 21 W6M	ANDERSON BERTHE & ANTHONY M & RAYMOND BOX 168 SAVONA BC V0K2J0	1967/01/24	IRR	49.50 AF
		----- SOURCE: Skookumchuck Creek left of Tunkwa Creek -----				
		----- 3757 L -----				
C065078	0355880	50 AC OF S 1/2 OF SEC 25 TP 19 R 21 W6M KDYD	ANDERSON BERTHE & ANTHONY M & RAYMOND BOX 168 SAVONA BC V0K2J0	1980/01/11	IRR STONP	150.00 AF 150.00 AF
		----- SOURCE: Tunkwa Creek left of Durand Creek -----				
		----- 3761 E -----				
C036151	0273004	STOR FOR C 36150 & 36152 TUNKWA CR	ANDERSON BERTHE & ANTHONY M & RAYMOND BOX 168 SAVONA BC V0K2J0	1967/01/24	STONP	50.20 AF
F006354	0241549	STOR FOR F 6353 DURAND CR	INDIAN GARDENS RANCH LTD DURAND CREEK WUC BOX 68 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1894/01/18	STONP	100.00 AF

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority YYYY/MM/DD	PUC	Quantity/Units
		----- 3761 D -----				
F006354	0241549	STOR FOR F 6353 DURAND CR	INDIAN GARDENS RANCH LTD DURAND CREEK WUC BOX 68 SAVONA BC V0K2J0 ------ DURAND CREEK WUC C/O HAYWOOD-FARMER DAVID BOX 68 SAVONA BC V0K2J0	1894/01/18	STONP	100.00 AF
		----- SOURCE: ZZ Lake (7850) left of Tunkwa Lake -----				
		----- 3761 J -----				
Z102909	3001151	E1/2 OF SE1/4 OF SEC 2 & W1/2 OF SW1/4 OF SEC 1 LS 3 6 7 & 10 TWP 21 R 21 W6M KDYD	ANDERSON ANTHONY & SUSAN PO BOX 168 SAVONA BC V0K2J0	1987/12/31	IRR STONP	250.00 AF 250.00 AF
Z102911	3001408	E1/2 OF SE1/4 SEC 2 W1/2 OF SW1/4 SEC 1 LS 3 6 7 & 10 TWP 21 R 21 KDYD	ANDERSON ANTHONY & SUSAN PO BOX 168 SAVONA BC V0K2J0	1988/12/15	IRR STONP	255.00 AF 255.00 AF
		----- SOURCE: Ware Lake on Tunkwa Creek -----				
		----- 92.I.056 A -----				
C039932	0305249	STOR FOR C 39931 CHARTRAND CR	WILDLIFE BRANCH 1259 DALHOUSIE DR KAMLOOPS BC V2C5Z5 ------ ENVIRONMENT LANDS & PARKS MINISTRY OF PARLIAMENT BUILDINGS VICTORIA BC V8V1X4	1971/05/10	STONP	100.00 AF

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority YYYY/MM/DD	PUC	Quantity/Units
----- SOURCE: ZZ Lake (7811) on Tunkwa Creek -----						
	----- 92.I.056 B -----					
Z103108	3001015	CONSERVATION PROJECT WITHIN SEC 22 & 27 TP 18 R 21 W6M	DUCKS UNLIMITED (CANADA) 954A LAVAL CRES KAMLOOPS BC V2C5P5 ------ FISHERIES BRANCH 1259 DALHOUSIE DR KAMLOOPS BC V2C5Z5 ------ ENVIRONMENT LANDS & PARKS MINISTRY OF PARLIAMENT BUILDINGS VICTORIA BC V8V1X4	1987/02/25	CONST CONUS	90.00 AF 1.00 CS
----- SOURCE: Durand Creek left of Kamloops Lake -----						
	----- 92I/10E(b) T -----					
Z103399	3001567	SW 1/4 SEC 7 TP 20 R 20 W6M KDYD	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1989/12/05	IRR STONP	35.00 AF 70.00 AF
----- SOURCE: Ferguson Creek right of Durand Creek -----						
	----- 92I/10E(b) N -----					
C059611	0367180	STOR POR C 59610 DURAND CR	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1980/08/29	STONP	65.00 AF

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority YYYY/MM/DD	PUC	Quantity/Units
F059272	0241947	STOR FOR C 59610 DURAND CR	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1908/10/27	STONP	60.00 AF
		----- SOURCE: Durand Creek left of Kamloops Lake -----				
		----- 92.I.057 B -----				
C059611	0367180	STOR FOR C 59610 DURAND CR	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1980/08/29	STONP	65.00 AF
		----- 92.I.057 A -----				
C059143	0367179	STOR FOR C 59142 DURAND CR	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1980/08/29	STONP	202.50 AF
C059144	0370175	STOR FOR C 61166 DURAND CR	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1980/08/29	STONP	43.00 AF
C059145	0370176	STOR FOR C 61167 DURAND CR	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1980/08/29	STONP	27.00 AF

Licence Number	File Number	Appurtenancy	Licensee/Applicant	Priority YYYY/MM/DD	PUC	Quantity/Units
F006273	0241540	STOR FOR C 61167 DURAND CR	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1893/12/12	STONP	150.00 AF
F006321	0241548	STOR FOR F 6320 DURAND CR	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1908/12/15	STONP	55.00 AF
F006361	0011383	STOR FOR F 61166 DURAND CR	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1919/06/11	STONP	90.00 AF
F059141	0265081	STOR FOR C 59140 DURAND CR	INDIAN GARDENS RANCH LTD C/O D HAYWOOD-FARMER BOX 68 SAVONA BC V0K2J0	1912/03/19	STONP	71.50 AF
----- SOURCE: Pyle Brook right of Dominic Lake -----						
----- 92.1.057 C -----						
C045899	0323642	BLK C OF L 5833 KDYD	PYLE GORDON 5004 E VERNON RD VERNON BC V1B3S4	1974/08/06	DOM	500.00 GD
----- SOURCE: McKay Creek right of Dominic Lake -----						
----- 92.1.057 D -----						
C032530	0265905	L 5832 KDYD	DOMINIC LAKE FISHING RESORT BOX 1219 LOGAN LAKE BC V0K1W0	1965/10/26	DOM	2,500.00 GD

---------- Total of 38 Licences Reported ----------

APPENDIX III

Aerial Photographs for 1948 and 1995 which provide coverage for the Durand Creek Watershed

1948	1995
BC612 #65	BCC95021 #52-55, 145-151
BC701 #28-31	BCC95020 #144-148
BC701 #33-40	BCC95041 #147-155, 45-55
	BCC95100 #205-218
	BCC95114 #180-195, 93-110, 0-18
	BCC95104 #125-129, 130-135, 140-142

APPENDIX IV

List of FIPDEFs and their associated version numbers

FIPDEF by Mapsheet	Last Update	Version Number
92I.056	1996-Nov-12	005
92I.057	1996-Nov-20	006
92I.066	1996-Nov-14	006
92I.067	1996-Nov-14	006
92I.076	1996-Nov-28	007
92I.077	1996-Dec-18	008

APPENDIX V

Field Assessments
Photographs, Field Cards

Plate 1: (Site 1) Mouth of Durand Creek and Kamloops Lake; looking north from bridge (December 9, 1997)

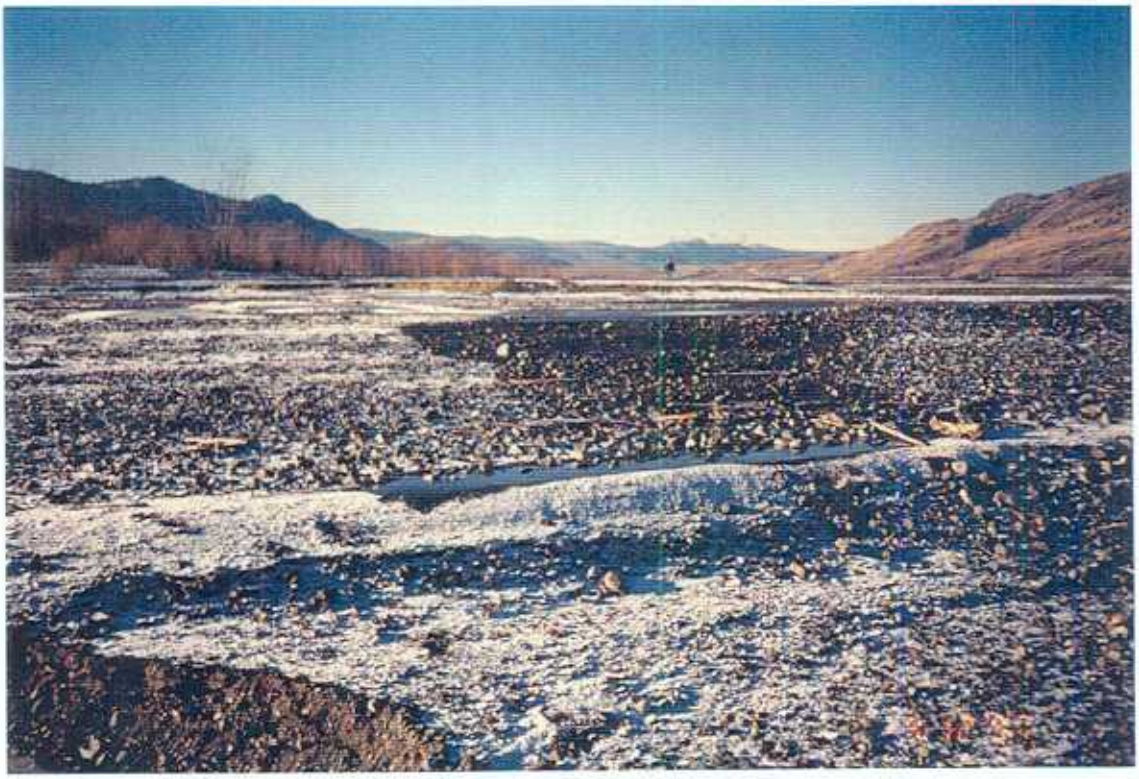


Plate 2: (Site 1) Alluvial fan deposit on Kamloops Lake at mouth of Durand Creek; looking west (December 9, 1997)

Plate 3: (Site 2) Approximately 30 metres upstream of bridge crossing Durand Creek looking north towards Kamloops Lake (December 9, 1997)

Plate 4: (Site 2) Approximately 30 metres upstream of bridge crossing Durand Creek looking upstream with Ainsworth Lumber Company, Savona Division in the background; debris in creek (December 9, 1997)

Plate 5: Ranchlands adjacent to Durand Creek approximately 6 1/2 km. along Tunkwa Lake Road (December 9, 1997)

Plate 6: (Site 3) Tunkwa Lake in Tunkwa Park (December 9, 1997)

Plate 7: (Site 4) Spillways/diversion ditch on Leighton Lake at Tunkwa Creek (December 9, 1997)

Plate 8: (Site 4) Dam on Leighton Lake to control water flow into Tunkwa Creek (December 9, 1997)

Plate 9: (Site 4) Culvert on Leighton Lake downstream of dam to control water flow into Tunkwa Creek (December 9, 1997)

Plate 10: (Site 5) Perched culvert on Tunkwa Creek along Tunkwa Lake Road; erosion occurred downstream of culvert in 1997 (December 9, 1997)

Plate 11: (Site 6) Tunkwa Creek at the confluence of Tunkwa Creek and Skookumchuk Creek (December 9, 1997)

Plate 12: (Site 7) Durand Creek upstream of culvert (December 9, 1997)

Plate 13: Cattle on Durand Creek proximal to the Tunkwa Creek confluence; cattle have access down to creek edge (December 9, 1997)

Plate 14: (Site 8) Durand Creek downstream of the confluence of Durand Creek and Tunkwa Creek (December 9, 1997)

Recorded by Heloise Dixon-Warren (1)
Stephen Dunsmore
Karen Cavell

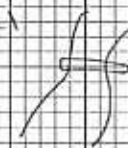
Dec. 9, 1997

Site #1

- confluence of Durand Creek and Kamloops Lake
- alluvial fan/deposit
2 photos - Durand Creek appears to meander during periods of ↑ H2O flow
- 3% gradient b/w confluence to road/bridge

D = 10 cm ← largest stone moved (intermediate axes)

- creek is cutting into deposit very gradually, almost entire stand w/ high levels of % c.f. (80%)
- lake level is relatively low
- pieces of L.W.D. spanning channel



≈ 1 metre ↓ cutting into fluvial/alluvial deposit

- Savona Airstrip will be South of confluence of creek & lake
- edge of creek - grasses, prickly rose, cottonwood,
- alluvial fan width = 102 m. (est.) to high shore
30-40 - N of bridge →
with bankfull width (Wbf) : 12 m.
D = 18 cm.
- alt of L.W.D. (L.W.D. deposit)

METRIC FIELD

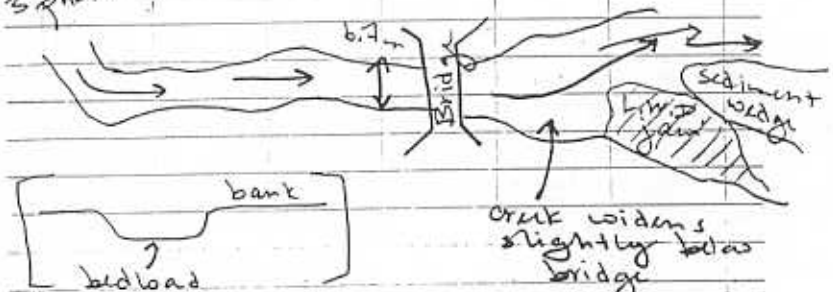
09/12/1997 (2)

d (depth @ bank full) = 70 cm.
- large c.f. deposits/ sediment wedge located to N of L.W.D. jam
- some aggradation in sediment wedge
saw cut end — materials deposited fra logging & the mill (dimensional lumber) [ASSUMPTION]

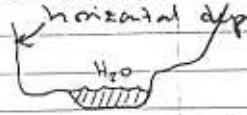
Site 2

Above bridge Wb = 6.7 m

3 photos



- increased cobbles above bridge
- slope = ≈ 2%
- no L.W.D.



photos: ① @ bridge looking ↑ stream
② = 30 m. fr. bridge looking ↑ stream
③ " " " " looking ↑ stream

TUNKWA LAKE PROVINCIAL PARK (3)
09/12/1997

photos (x2) (#11,12) Sth. route of ranch: Tunkwa Lake
- farming & to creek (≈ 1½ km.)
- cattle along/adjacent to creek

Site #3 Tunkwa Lake
B.C. Parks (wms/is ~ PAS)
- heavy use; lots of firepits
Pl (95%) Fd (5%), juniper, grasses
photo (x2) prickly rose

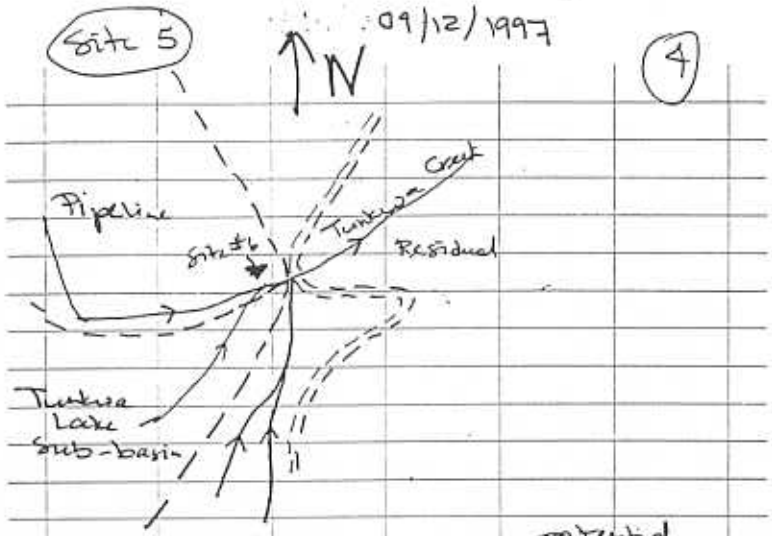
TUNKWA LAKE SUB-BASIN

Site 4 Brigman Lake
- spillway (x2)
- access blocked w/ cable barricades/bank jams
- "dam" @ spillway for Brigman Lake
photos (x2) - wooden cribwork
- loop of logs/ barricades @ NE side of Tunkwa Creek
- spillway = 1½ - 2 m. wide

150 mile

METRIC FIELD

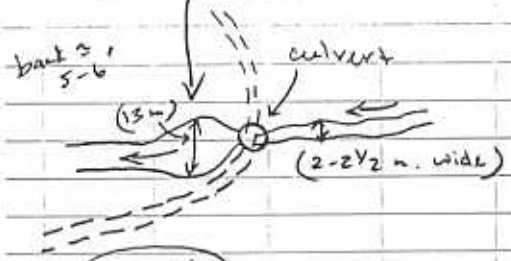
Site 5 09/12/1997 (4)



Culvert - perched culvert (1500 mm) — potential barrier to fish passage

(photo)

- creek bed "blown out" a dam stream side of culvert



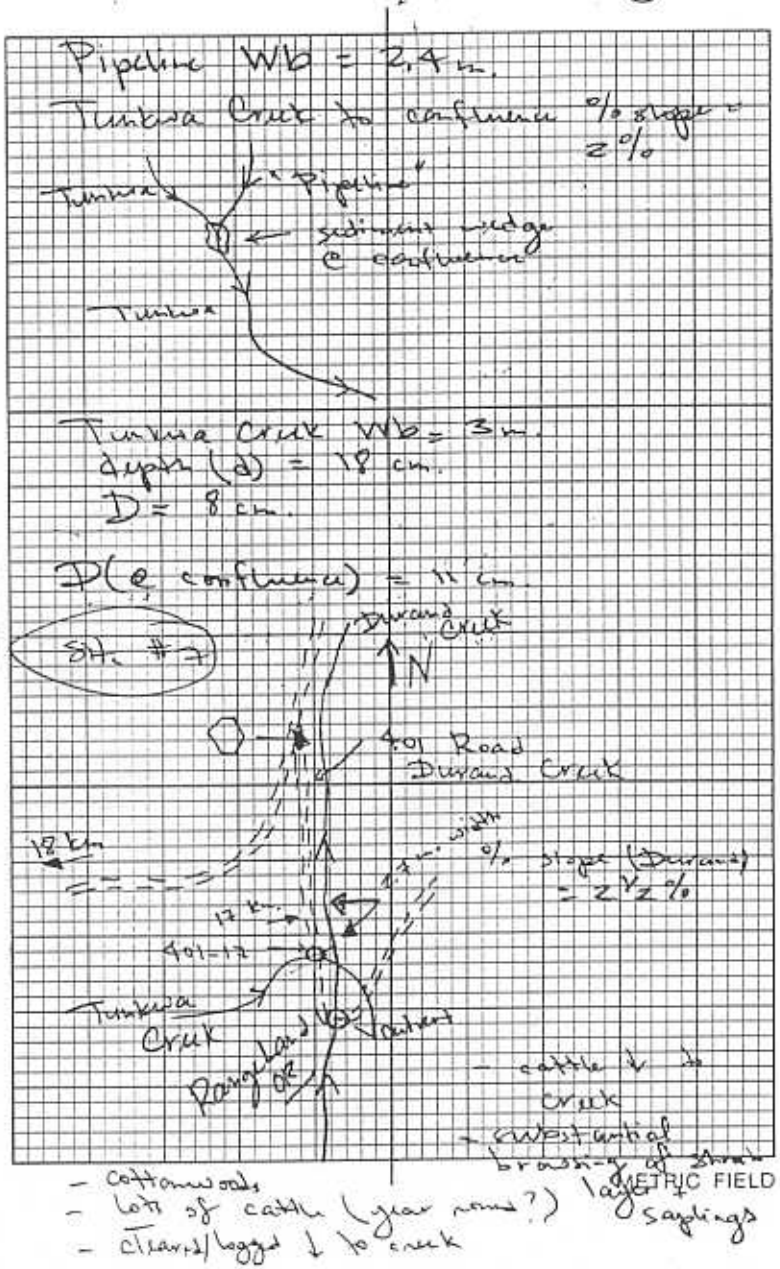
Site #6

confluence of Tunkwa Creek & "Pipeline" Creek

% slope → "Pipeline" to confluence 2%

"Pipeline" from Tunkwa Creek flowing

09/12/1997 (5)



09/12/1997 (6)

% slope Durand Crk (above culvert)
= 3%
- substantial impact of cattle (presumed)

Wb = 2.1 m.
- ranching v. grassland

Sx, Fd

- cobble, sands in bank

Site #8
= 15½ km. to E
- presence of unstable slopes (slide?), to S. of where range land "closes up" "fingers" — check photos

APPENDIX VI

1998 and 2002 Data Entry Sheet - IWAP Version 1.03 for each Sub-basin of the Durand Creek Watershed and the Overall Durand Creek Watershed

1998

Data Entry Sheet - IWAP Version 1.03 - November 1995

Enter watershed data in column 1.
Read scores and hazard indices in columns 5 and 6 on next page.

	(1)	(2)	(3)	(4)
Watershed Name?	REEK / DURAND LAKE			
Map units are In: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	35.083	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1179	m.		
ECA above H60?	6.468	sq.km.	*	
ECA below H60?	0.292	sq.km.	*	
Road length above H60?	43.423	km.	*	
Road length below H60?	5.065	km.	*	
Surface Erosion				
Length of road on erodable soils?	0	km.	*	
Length of road within 100 m. of stream?	10.804	km.	*	
Length of road on erodable soils within 100 m. of stream?	0	km.	*	
Number of active stream crossings?	20		*	
Riparian Buffer				
Total stream length?	46.21	km.	*	
Length of stream logged?	11.535	km.	*	
Total length of fish bearing streams?	46.21	km.	*	
Length of fish bearing streams logged?	11.535	km.	*	
Landslides				
Number of landslides?	0		*	
Length of road on unstable slopes?	0.264	km.	*	
Length of stream with logged banks and on slopes > 60%	0	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?				
Is there mining close to streams?				
Is there ATV use close to streams?				
Hydrologic zone?				
Percent area of crown land?	98.843			
Percent area of private land?	1.157			
Percent area with unstable slopes?	1.18			
Percent area with erodable soils?	0			
Dominant bedrock geology?				
Is there a fisheries (DFO or MoE) thermal concern?				

Notes:
(2) Enter data in units shown in this column.
(3) An asterisk in this column indicates essential data for calculations.
(4) "err" message in this column indicates an inconsistency in the data.

All cells except B6..B44 are protected.

Calculation Sheet

DURAND CREEK / DURAND LAKE
Map units were identified as: km. and sq.km.

		Indicator		Score	(6) Hazard Index
Peak Flow					
	Index above H60	0.28			
	Index below H60	0.01			
1	Total Peak Flow Index	0.28		0.47	
2	Road density above H60	1.24	km/sq.km.	1.00	
3	Total road density (See note below)	1.38	km/sq.km.	0.46	**0.65**
Surface Erosion					
4	Roads on erodable soils	0.00	km/sq.km.	0.00	
5	Roads within 100 m of a stream	0.31	km/sq.km.	0.72	
6	Roads that are both of the above	0.00	km/sq.km.	0.00	
7	Active stream crossings	0.57	no./sq.km.	0.67	
8	Total road density (See note below)	1.38	km/sq.km.	0.46	**0.69**
Riparian Buffer					
9	Portion of stream logged?	0.25	km/km.	0.83	
10	Portion of fish bearing streams logged?	0.25	km/km.	0.50	**0.83**
Landslides					
11	Landslide density	0.00	no./sq.km.	0.00	
12	Roads on unstable slopes	0.01	km/sq.km.	0.03	
13	Streams >60% and banks logged	0.00	km/sq.km.	0.00	**0.01**

Notes:
The calculations of scores for #3 and #8 above are slightly different.
This spreadsheet is based on the IWAP Guidebook dated September 1995.
However, the spreadsheet is subject to change. Please contact a Forest Service regional hydrologist to ensure that you are using the latest version.

Data Entry Sheet - IWAP Version 1.03 - November 1995

Enter watershed data in column 1.
Read scores and hazard indices in columns 5 and 6 on next page.

	(1)	(2)	(3)	(4)
Watershed Name?	/ DURAND RESIDUAL			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	61.844	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1179	m.		
ECA above H60?	1.23	sq.km.	*	
ECA below H60?	3.575	sq.km.	*	
Road length above H60?	15.515	km.	*	
Road length below H60?	67.311	km.	*	
Surface Erosion				
Length of road on erodable soils?	11.647	km.	*	
Length of road within 100 m. of stream?	38.991	km.	*	
Length of road on erodable soils within 100 m. of stream?	7.351	km.	*	
Number of active stream crossings?	107		*	
Riparian Buffer				
Total stream length?	122.364	km.	*	
Length of stream logged?	33.784	km.	*	
Total length of fish bearing streams?	122.364	km.	*	
Length of fish bearing streams logged?	33.784	km.	*	
Landslides				
Number of landslides?	0		*	
Length of road on unstable slopes?	1.92	km.	*	
Length of stream with logged banks and on slopes > 60%	0.017	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?				
Is there mining close to streams?				
Is there ATV use close to streams?				
Hydrologic zone?				
Percent area of crown land?	84.85			
Percent area of private land?	15.15			
Percent area with unstable slopes?	8.004			
Percent area with erodable soils?	5.774			
Dominant bedrock geology?				
Is there a fisheries (DFO or MoE) thermal concern?				

Notes:
(2) Enter data in units shown in this column.
(3) An asterisk in this column indicates essential data for calculations.
(4) "err" message in this column indicates an inconsistency in the data.

All cells except B6..B44 are protected.

Calculation Sheet

DURAND CREEK / DURAND RESIDUAL
Map units were identified as: km. and sq.km.

		Indicator		(5) Score	(6) Hazard Index
Peak Flow					
	Index above H60	0.03			
	Index below H60	0.06			
1	Total Peak Flow Index	0.09		0.15	
2	Road density above H60	0.25	km/sq.km.	0.25	
3	Total road density (See note below)	1.34	km/sq.km.	0.45	0.28
Surface Erosion					
4	Roads on erodable soils	0.19	km/sq.km.	0.38	
5	Roads within 100 m of a stream	0.63	km/sq.km.	1.00	
6	Roads that are both of the above	0.12	km/sq.km.	0.57	
7	Active stream crossings	1.73	no./sq.km.	1.00	
8	Total road density (See note below)	1.34	km/sq.km.	0.45	1.00
Riparian Buffer					
9	Portion of stream logged?	0.28	km/km.	0.92	
10	Portion of fish bearing streams logged?	0.28	km/km.	0.55	0.92
Landslides					
11	Landslide density	0.00	no./sq.km.	0.00	
12	Roads on unstable slopes	0.03	km/sq.km.	0.10	
13	Streams >60% and banks logged	0.00	km/sq.km.	0.00	0.05

Notes:
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Data Entry Sheet - IWAP Version 1.03 - November 1995

Enter watershed data in column 1.
Read scores and hazard indices in columns 5 and 6 on next page.

	(1)	(2)	(3)	(4)
Watershed Name?	EEK / SKOOKUMCHUK			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	17.485	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1179	m.		
ECA above H60?	2.455	sq.km.	*	
ECA below H60?	0.203	sq.km.	*	
Road length above H60?	27.124	km.	*	
Road length below H60?	2.727	km.	*	
Surface Erosion				
Length of road on erodable soils?	0.194	km.	*	
Length of road within 100 m. of stream?	13.422	km.	*	
Length of road on erodable soils within 100 m. of stream?	0.194	km.	*	
Number of active stream crossings?	27		*	
Riparian Buffer				
Total stream length?	36.135	km.	*	
Length of stream logged?	7.104	km.	*	
Total length of fish bearing streams?	36.135	km.	*	
Length of fish bearing streams logged?	7.104	km.	*	
Landslides				
Number of landslides?	0		*	
Length of road on unstable slopes?	0.901	km.	*	
Length of stream with logged banks and on slopes > 60%	0	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?				
Is there mining close to streams?				
Is there ATV use close to streams?				
Hydrologic zone?				
Percent area of crown land?	100			
Percent area of private land?	0			
Percent area with unstable slopes?	1.001			
Percent area with erodable soils?	1.73			
Dominant bedrock geology?				
Is there a fisheries (DFO or MoE) thermal concern?				

Notes:
(2) Enter data in units shown in this column.
(3) An asterisk in this column indicates essential data for calculations.
(4) "err" message in this column indicates an inconsistency in the data.

All cells except B6..B44 are protected.

Calculation Sheet

DURAND CREEK / SKOOKUMCHUK
Map units were identified as: km. and sq.km.

		Indicator		(5) Score	(6) Hazard Index
Peak Flow					
	Index above H60	0.21			
	Index below H60	0.01			
1	Total Peak Flow Index	0.22		0.37	
2	Road density above H60	1.55	km/sq.km.	1.00	
3	Total road density (See note below)	1.71	km/sq.km.	0.57	**0.65**
Surface Erosion					
4	Roads on erodable soils	0.01	km/sq.km.	0.02	
5	Roads within 100 m of a stream	0.77	km/sq.km.	1.00	
6	Roads that are both of the above	0.01	km/sq.km.	0.06	
7	Active stream crossings	1.54	no./sq.km.	1.00	
8	Total road density (See note below)	1.71	km/sq.km.	0.59	**1.00**
Riparian Buffer					
9	Portion of stream logged?	0.20	km/km.	0.66	
10	Portion of fish bearing streams logged?	0.20	km/km.	0.39	**0.66**
Landslides					
11	Landslide density	0.00	no./sq.km.	0.00	
12	Roads on unstable slopes	0.05	km/sq.km.	0.17	
13	Streams >60% and banks logged	0.00	km/sq.km.	0.00	**0.09**

Notes:
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Data Entry Sheet - IWAP Version 1.03 - November 1995

Enter watershed data in column 1.
Read scores and hazard indices in columns 5 and 6 on next page.

	(1)	(2)	(3)	(4)
Watershed Name?	REEK / TUNKWA LAKE			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	53.681	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1179	m.		
ECA above H60?	3.661	sq.km.	*	
ECA below H60?	0.679	sq.km.	*	
Road length above H60?	56.016	km.	*	
Road length below H60?	29.531	km.	*	
Surface Erosion				
Length of road on erodable soils?	1.715	km.	*	
Length of road within 100 m. of stream?	33.524	km.	*	
Length of road on erodable soils within 100 m. of stream?	0.949	km.	*	
Number of active stream crossings?	66		*	
Riparian Buffer				
Total stream length?	95.397	km.	*	
Length of stream logged?	19.944	km.	*	
Total length of fish bearing streams?	95.397	km.	*	
Length of fish bearing streams logged?	19.944	km.	*	
Landslides				
Number of landslides?	0		*	
Length of road on unstable slopes?	0.159	km.	*	
Length of stream with logged banks and on slopes > 60%	0	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?				
Is there mining close to streams?				
Is there ATV use close to streams?				
Hydrologic zone?				
Percent area of crown land?	99.817			
Percent area of private land?	0.183			
Percent area with unstable slopes?	0.047			
Percent area with erodable soils?	0.848			
Dominant bedrock geology?				
Is there a fisheries (DFO or MoE) thermal concern?				

Notes:
(2) Enter data in units shown in this column.
(3) An asterisk in this column indicates essential data for calculations.
(4) "err" message in this column indicates an inconsistency in the data.

All cells except B6..B44 are protected.

Calculation Sheet

DURAND CREEK / TUNKWA LAKE
Map units were identified as: km. and sq.km.

		Indicator	Score	(6) Hazard Index
Peak Flow				
	Index above H60	0.10		
	Index below H60	0.01		
1	Total Peak Flow Index	0.11	0.19	
2	Road density above H60	1.04 km/sq.km.	1.00	
3	Total road density (See note below)	1.59 km/sq.km.	0.53	**0.57**
Surface Erosion				
4	Roads on erodable soils	0.03 km/sq.km.	0.06	
5	Roads within 100 m of a stream	0.62 km/sq.km.	1.00	
6	Roads that are both of the above	0.02 km/sq.km.	0.09	
7	Active stream crossings	1.23 no./sq.km.	1.00	
8	Total road density (See note below)	1.59 km/sq.km.	0.54	**1.00**
Riparian Buffer				
9	Portion of stream logged?	0.21 km/km.	0.70	
10	Portion of fish bearing streams logged?	0.21 km/km.	0.42	**0.70**
Landslides				
11	Landslide density	0.00 no./sq.km.	0.00	
12	Roads on unstable slopes	0.00 km/sq.km.	0.01	
13	Streams >60% and banks logged	0.00 km/sq.km.	0.00	**0.00**

Notes:
The calculations of scores for #3 and #8 above are slightly different.
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Data Entry Sheet - IWAP Version 1.03 - November 1995

Enter watershed data in column 1.
Read scores and hazard indices in columns 5 and 6 on next page.

	(1)	(2)	(3)	(4)
Watershed Name?	EEK / UPPER DURAND			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	11.801	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1179	m.		
ECA above H60?	0.773	sq.km.	*	
ECA below H60?	0.007	sq.km.	*	
Road length above H60?	15.323	km.	*	
Road length below H60?	3.897	km.	*	
Surface Erosion				
Length of road on erodable soils?	0.032	km.	*	
Length of road within 100 m. of stream?	4.547	km.	*	
Length of road on erodable soils within 100 m. of stream?	0.032	km.	*	
Number of active stream crossings?	8		*	
Riparian Buffer				
Total stream length?	13.421	km.	*	
Length of stream logged?	4.087	km.	*	
Total length of fish bearing streams?	13.421	km.	*	
Length of fish bearing streams logged?	4.087	km.	*	
Landslides				
Number of landslides?	0		*	
Length of road on unstable slopes?	0	km.	*	
Length of stream with logged banks and on slopes > 60%	0	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?				
Is there mining close to streams?				
Is there ATV use close to streams?				
Hydrologic zone?				
Percent area of crown land?	100			
Percent area of private land?	0			
Percent area with unstable slopes?	1.254			
Percent area with erodable soils?	0.186			
Dominant bedrock geology?				
Is there a fisheries (DFO or MoE) thermal concern?				

Notes:
(2) Enter data in units shown in this column.
(3) An asterisk in this column indicates essential data for calculations.
(4) "err" message in this column indicates an inconsistency in the data.

All cells except B6..B44 are protected.

Calculation Sheet

DURAND CREEK / UPPER DURAND
Map units were identified as: km. and sq.km.

	Indicator	Score	Hazard Index
Peak Flow			
Index above H60	0.10		
Index below H60	0.00		
1 Total Peak Flow Index	0.10	0.16	
2 Road density above H60	1.30 km/sq.km.	1.00	
3 Total road density (See note below)	1.63 km/sq.km.	0.54	**0.57**
Surface Erosion			
4 Roads on erodable soils	0.00 km/sq.km.	0.01	
5 Roads within 100 m of a stream	0.39 km/sq.km.	0.87	
6 Roads that are both of the above	0.00 km/sq.km.	0.01	
7 Active stream crossings	0.68 no./sq.km.	0.78	
8 Total road density (See note below)	1.63 km/sq.km.	0.56	**0.82**
Riparian Buffer			
9 Portion of stream logged?	0.30 km/km.	1.00	
10 Portion of fish bearing streams logged?	0.30 km/km.	0.61	**1.00**
Landslides			
11 Landslide density	0.00 no./sq.km.	0.00	
12 Roads on unstable slopes	0.00 km/sq.km.	0.00	
13 Streams >60% and banks logged	0.00 km/sq.km.	0.00	**0.00**

Notes:
The calculations of scores for #3 and #8 above are slightly different.
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Data Entry Sheet - IWAP Version 1.03 - November 1995

Enter watershed data in column 1.
Read scores and hazard indices in columns 5 and 6 on next page.

	(1)	(2)	(3)	(4)
Watershed Name?	CREEK WATERSHED			
Map units are In: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	179.934	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1179	m.		
ECA above H60?	14.587	sq.km.	*	
ECA below H60?	4.756	sq.km.	*	
Road length above H60?	157.401	km.	*	
Road length below H60?	108.531	km.	*	
Surface Erosion				
Length of road on erodable soils?	13.588	km.	*	
Length of road within 100 m. of stream?	101.288	km.	*	
Length of road on erodable soils within 100 m. of stream?	8.526	km.	*	
Number of active stream crossings?	228		*	
Riparian Buffer				
Total stream length?	313.527	km.	*	
Length of stream logged?	76.454	km.	*	
Total length of fish bearing streams?	313.527	km.	*	
Length of fish bearing streams logged?	76.454	km.	*	
Landslides				
Number of landslides?	0		*	
Length of road on unstable slopes?	3.244	km.	*	
Length of stream with logged banks and on slopes > 60%	0.017	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?				
Is there mining close to streams?				
Is there ATV use close to streams?				
Hydrologic zone?				
Percent area of crown land?	5.49			
Percent area of private land?	94.51			
Percent area with unstable slopes?				
Percent area with erodable soils?				
Dominant bedrock geology?				
Is there a fisheries (DFO or MoE) thermal concern?				

Notes:
(2) Enter data in units shown in this column.
(3) An asterisk in this column indicates essential data for calculations.
(4) "err" message in this column indicates an inconsistency in the data.

All cells except B6..B44 are protected.

Calculation Sheet

DURAND CREEK WATERSHED
Map units were identified as: km. and sq.km.

		Indicator		(5) Score	(6) Hazard Index
Peak Flow					
	Index above H60	0.12			
	Index below H60	0.03			
1	Total Peak Flow Index	0.15		0.25	
2	Road density above H60	0.87	km/sq.km.	0.87	
3	Total road density (See note below)	1.48	km/sq.km.	0.49	**0.54**
Surface Erosion					
4	Roads on erodable soils	0.08	km/sq.km.	0.15	
5	Roads within 100 m of a stream	0.56	km/sq.km.	1.00	
6	Roads that are both of the above	0.05	km/sq.km.	0.24	
7	Active stream crossings	1.27	no./sq.km.	1.00	
8	Total road density (See note below)	1.48	km/sq.km.	0.49	**1.00**
Riparian Buffer					
9	Portion of stream logged?	0.24	km/km.	0.81	
10	Portion of fish bearing streams logged?	0.24	km/km.	0.49	**0.81**
Landslides					
11	Landslide density	0.00	no./sq.km.	0.00	
12	Roads on unstable slopes	0.02	km/sq.km.	0.06	
13	Streams >60% and banks logged	0.00	km/sq.km.	0.00	**0.03**

Notes:
The calculations of scores for #3 and #8 above are slightly different.
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2002

Data Entry Sheet - IWAP Version 1.03 - November 1995

Enter watershed data in column 1.
Read scores and hazard indices in columns 5 and 6 on next page.

	(1)	(2)	(3)	(4)
Watershed Name?	REEK / DURAND LAKE			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	35.083	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1179	m.		
ECA above H60?	8.99	sq.km.	*	
ECA below H60?	0.303	sq.km.	*	
Road length above H60?	51.59	km.	*	
Road length below H60?	7.622	km.	*	
Surface Erosion				
Length of road on erodable soils?	0	km.	*	
Length of road within 100 m. of stream?	15.071	km.	*	
Length of road on erodable soils within 100 m. of stream?	0	km.	*	
Number of active stream crossings?	31		*	
Riparian Buffer				
Total stream length?	46.21	km.	*	
Length of stream logged?	14.54	km.	*	
Total length of fish bearing streams?	45.918	km.	*	
Length of fish bearing streams logged?	14.54	km.	*	
Landslides				
Number of landslides?	0		*	
Length of road on unstable slopes?	0.546	km.	*	
Length of stream with logged banks and on slopes > 60%	0	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?				
Is there mining close to streams?				
Is there ATV use close to streams?				
Hydrologic zone?				
Percent area of crown land?	98.843			
Percent area of private land?	1.157			
Percent area with unstable slopes?	1.18			
Percent area with erodable soils?	0			
Dominant bedrock geology?				
Is there a fisheries (DFO or MoE) thermal concern?				

Notes:
(2) Enter data in units shown in this column.
(3) An asterisk in this column indicates essential data for calculations.
(4) "err" message in this column indicates an inconsistency in the data.

All cells except B6..B44 are protected.

Calculation Sheet

DURAND CREEK / DURAND LAKE
Map units were identified as: km. and sq.km.

		Indicator		Score	(6) Hazard Index
Peak Flow					
	Index above H60	0.38			
	Index below H60	0.01			
1	Total Peak Flow Index	0.39		0.66	
2	Road density above H60	1.47	km/sq.km.	1.00	
3	Total road density (See note below)	1.69	km/sq.km.	0.56	**0.74**
Surface Erosion					
4	Roads on erodable soils	0.00	km/sq.km.	0.00	
5	Roads within 100 m of a stream	0.43	km/sq.km.	0.96	
6	Roads that are both of the above	0.00	km/sq.km.	0.00	
7	Active stream crossings	0.88	no./sq.km.	0.98	
8	Total road density (See note below)	1.69	km/sq.km.	0.59	**0.97**
Riparian Buffer					
9	Portion of stream logged?	0.31	km/km.	1.00	
10	Portion of fish bearing streams logged?	0.32	km/km.	0.63	**1.00**
Landslides					
11	Landslide density	0.00	no./sq.km.	0.00	
12	Roads on unstable slopes	0.02	km/sq.km.	0.05	
13	Streams >60% and banks logged	0.00	km/sq.km.	0.00	**0.03**

Notes:
The calculations of scores for #3 and #8 above are slightly different.
This spreadsheet is based on the IWAP Guidebook dated September 1995.
However, the spreadsheet is subject to change. Please contact a Forest Service regional hydrologist to ensure that you are using the latest version.

Data Entry Sheet - IWAP Version 1.03 - November 1995

Enter watershed data in column 1.
Read scores and hazard indices in columns 5 and 6 on next page.

	(1)	(2)	(3)	(4)
Watershed Name?	/ DURAND RESIDUAL			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	61.844	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1179	m.		
ECA above H60?	1.646	sq.km.	*	
ECA below H60?	3.509	sq.km.	*	
Road length above H60?	20.24	km.	*	
Road length below H60?	69.683	km.	*	
Surface Erosion				
Length of road on erodable soils?	12.579	km.	*	
Length of road within 100 m. of stream?	41.047	km.	*	
Length of road on erodable soils within 100 m. of stream?	7.849	km.	*	
Number of active stream crossings?	111		*	
Riparian Buffer				
Total stream length?	122.364	km.	*	
Length of stream logged?	34.452	km.	*	
Total length of fish bearing streams?	122.364	km.	*	
Length of fish bearing streams logged?	34.452	km.	*	
Landslides				
Number of landslides?	0		*	
Length of road on unstable slopes?	1.935	km.	*	
Length of stream with logged banks and on slopes > 60%	0.107	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?				
Is there mining close to streams?				
Is there ATV use close to streams?				
Hydrologic zone?				
Percent area of crown land?	84.85			
Percent area of private land?	15.15			
Percent area with unstable slopes?	8.004			
Percent area with erodable soils?	5.774			
Dominant bedrock geology?				
Is there a fisheries (DFO or MoE) thermal concern?				

Notes:
(2) Enter data in units shown in this column.
(3) An asterisk in this column indicates essential data for calculations.
(4) "err" message in this column indicates an inconsistency in the data.

All cells except B6..B44 are protected.

Calculation Sheet

DURAND CREEK / DURAND RESIDUAL
Map units were identified as: km. and sq.km.

	Indicator		Score	(6) Hazard Index
Peak Flow				
Index above H60	0.04			
Index below H60	0.06			
1 Total Peak Flow Index	0.10		0.16	
2 Road density above H60	0.33	km/sq.km.	0.33	
3 Total road density (See note below)	1.45	km/sq.km.	0.48	**0.32**
Surface Erosion				
4 Roads on erodable soils	0.20	km/sq.km.	0.41	
5 Roads within 100 m of a stream	0.66	km/sq.km.	1.00	
6 Roads that are both of the above	0.13	km/sq.km.	0.60	
7 Active stream crossings	1.79	no./sq.km.	1.00	
8 Total road density (See note below)	1.45	km/sq.km.	0.48	**1.00**
Riparian Buffer				
9 Portion of stream logged?	0.28	km/km.	0.94	
10 Portion of fish bearing streams logged?	0.28	km/km.	0.56	**0.94**
Landslides				
11 Landslide density	0.00	no./sq.km.	0.00	
12 Roads on unstable slopes	0.03	km/sq.km.	0.10	
13 Streams >60% and banks logged	0.00	km/sq.km.	0.01	**0.06**

Notes:
The calculations of scores for #3 and #8 above are slightly different.
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Data Entry Sheet - IWAP Version 1.03 - November 1995

Enter watershed data in column 1.
Read scores and hazard indices in columns 5 and 6 on next page.

	(1)	(2)	(3)	(4)
Watershed Name?	EEK / SKOOKUMCHUK			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	17.485	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1	m.		
ECA above H60?	3.644	sq.km.	*	
ECA below H60?	0.178	sq.km.	*	
Road length above H60?	36.208	km.	*	
Road length below H60?	2.726	km.	*	
Surface Erosion				
Length of road on erodable soils?	0.194	km.	*	
Length of road within 100 m. of stream?	17.582	km.	*	
Length of road on erodable soils within 100 m. of stream?	0.194	km.	*	
Number of active stream crossings?	36		*	
Riparian Buffer				
Total stream length?	36.135	km.	*	
Length of stream logged?	8.782	km.	*	
Total length of fish bearing streams?	36.135	km.	*	
Length of fish bearing streams logged?	8.782	km.	*	
Landslides				
Number of landslides?	0		*	
Length of road on unstable slopes?	0.901	km.	*	
Length of stream with logged banks and on slopes > 60%	0	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?				
Is there mining close to streams?				
Is there ATV use close to streams?				
Hydrologic zone?				
Percent area of crown land?	100			
Percent area of private land?	0			
Percent area with unstable slopes?	1.001			
Percent area with erodable soils?	1.73			
Dominant bedrock geology?				
Is there a fisheries (DFO or MoE) thermal concern?				

Notes:
(2) Enter data in units shown in this column.
(3) An asterisk in this column indicates essential data for calculations.
(4) "err" message in this column indicates an inconsistency in the data.

All cells except B6..B44 are protected.

Calculation Sheet

DURAND CREEK / SKOOKUMCHUK
Map units were identified as: km. and sq.km.

		Indicator		(5) Score	(6) Hazard Index
Peak Flow					
	Index above H60	0.31			
	Index below H60	0.01			
1	Total Peak Flow Index	0.32		0.54	
2	Road density above H60	2.07	km/sq.km.	1.00	
3	Total road density (See note below)	2.23	km/sq.km.	0.74	**0.76**
Surface Erosion					
4	Roads on erodable soils	0.01	km/sq.km.	0.02	
5	Roads within 100 m of a stream	1.01	km/sq.km.	1.00	
6	Roads that are both of the above	0.01	km/sq.km.	0.06	
7	Active stream crossings	2.06	no./sq.km.	1.00	
8	Total road density (See note below)	2.23	km/sq.km.	0.83	**1.00**
Riparian Buffer					
9	Portion of stream logged?	0.24	km/km.	0.81	
10	Portion of fish bearing streams logged?	0.24	km/km.	0.49	**0.81**
Landslides					
11	Landslide density	0.00	no./sq.km.	0.00	
12	Roads on unstable slopes	0.05	km/sq.km.	0.17	
13	Streams >60% and banks logged	0.00	km/sq.km.	0.00	**0.09**

Notes:
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Data Entry Sheet - IWAP Version 1.03 - November 1995

Enter watershed data in column 1.
Read scores and hazard indices in columns 5 and 6 on next page.

	(1)	(2)	(3)	(4)
Watershed Name?	REEK / TUNKWA LAKE			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	53.681	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1179	m.		
ECA above H60?	4.52	sq.km.	*	
ECA below H60?	0.84	sq.km.	*	
Road length above H60?	57.455	km.	*	
Road length below H60?	29.638	km.	*	
Surface Erosion				
Length of road on erodable soils?	1.715	km.	*	
Length of road within 100 m. of stream?	33.524	km.	*	
Length of road on erodable soils within 100 m. of stream?	0.949	km.	*	
Number of active stream crossings?	66		*	
Riparian Buffer				
Total stream length?	95.397	km.	*	
Length of stream logged?	20.299	km.	*	
Total length of fish bearing streams?	95.397	km.	*	
Length of fish bearing streams logged?	20.299	km.	*	
Landslides				
Number of landslides?	0		*	
Length of road on unstable slopes?	0.159	km.	*	
Length of stream with logged banks and on slopes > 60%	0	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?				
Is there mining close to streams?				
Is there ATV use close to streams?				
Hydrologic zone?				
Percent area of crown land?	99.817			
Percent area of private land?	0.183			
Percent area with unstable slopes?	0.047			
Percent area with erodable soils?	0.848			
Dominant bedrock geology?				
Is there a fisheries (DFO or MoE) thermal concern?				

Notes:
(2) Enter data in units shown in this column.
(3) An asterisk in this column indicates essential data for calculations.
(4) "err" message in this column indicates an inconsistency in the data.

All cells except B6..B44 are protected.

Calculation Sheet

DURAND CREEK / TUNKWA LAKE
Map units were identified as: km. and sq.km.

		Indicator	Score	Hazard Index
Peak Flow				
	Index above H60	0.13		
	Index below H60	0.02		
1	Total Peak Flow Index	0.14	0.24	
2	Road density above H60	1.07 km/sq.km.	1.00	
3	Total road density (See note below)	1.62 km/sq.km.	0.54	**0.59**
Surface Erosion				
4	Roads on erodable soils	0.03 km/sq.km.	0.06	
5	Roads within 100 m of a stream	0.62 km/sq.km.	1.00	
6	Roads that are both of the above	0.02 km/sq.km.	0.09	
7	Active stream crossings	1.23 no./sq.km.	1.00	
8	Total road density (See note below)	1.62 km/sq.km.	0.56	**1.00**
Riparian Buffer				
9	Portion of stream logged?	0.21 km/km.	0.71	
10	Portion of fish bearing streams logged?	0.21 km/km.	0.43	**0.71**
Landslides				
11	Landslide density	0.00 no./sq.km.	0.00	
12	Roads on unstable slopes	0.00 km/sq.km.	0.01	
13	Streams >60% and banks logged	0.00 km/sq.km.	0.00	**0.00**

Notes:
The calculations of scores for #3 and #8 above are slightly different.
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Data Entry Sheet - IWAP Version 1.03 - November 1995

Enter watershed data in column 1.
Read scores and hazard indices in columns 5 and 6 on next page.

	(1)	(2)	(3)	(4)
Watershed Name?	EEK / UPPER DURAND			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	11.801	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1179	m.		
ECA above H60?	2.573	sq.km.	*	
ECA below H60?	0.018	sq.km.	*	
Road length above H60?	15.529	km.	*	
Road length below H60?	3.917	km.	*	
Surface Erosion				
Length of road on erodable soils?	0.032	km.	*	
Length of road within 100 m. of stream?	4.547	km.	*	
Length of road on erodable soils within 100 m. of stream?	0.032	km.	*	
Number of active stream crossings?	8		*	
Riparian Buffer				
Total stream length?	13.421	km.	*	
Length of stream logged?	6.635	km.	*	
Total length of fish bearing streams?	13.421	km.	*	
Length of fish bearing streams logged?	6.635	km.	*	
Landslides				
Number of landslides?	0		*	
Length of road on unstable slopes?	0	km.	*	
Length of stream with logged banks and on slopes > 60%	0	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?				
Is there mining close to streams?				
Is there ATV use close to streams?				
Hydrologic zone?				
Percent area of crown land?	100			
Percent area of private land?	0			
Percent area with unstable slopes?	1.254			
Percent area with erodable soils?	0.186			
Dominant bedrock geology?				
Is there a fisheries (DFO or MoE) thermal concern?				

Notes:
(2) Enter data in units shown in this column.
(3) An asterisk in this column indicates essential data for calculations.
(4) "err" message in this column indicates an inconsistency in the data.

All cells except B6..B44 are protected.

Calculation Sheet

DURAND CREEK / UPPER DURAND
Map units were identified as: km. and sq.km.

		Indicator		(5) Score	(6) Hazard Index
Peak Flow					
	Index above H60	0.33			
	Index below H60	0.00			
1	Total Peak Flow Index	0.33		0.55	
2	Road density above H60	1.32	km/sq.km.	1.00	
3	Total road density (See note below)	1.65	km/sq.km.	0.55	**0.70**
Surface Erosion					
4	Roads on erodable soils	0.00	km/sq.km.	0.01	
5	Roads within 100 m of a stream	0.39	km/sq.km.	0.87	
6	Roads that are both of the above	0.00	km/sq.km.	0.01	
7	Active stream crossings	0.68	no./sq.km.	0.78	
8	Total road density (See note below)	1.65	km/sq.km.	0.57	**0.82**
Riparian Buffer					
9	Portion of stream logged?	0.49	km/km.	1.00	
10	Portion of fish bearing streams logged?	0.49	km/km.	0.99	**1.00**
Landslides					
11	Landslide density	0.00	no./sq.km.	0.00	
12	Roads on unstable slopes	0.00	km/sq.km.	0.00	
13	Streams >60% and banks logged	0.00	km/sq.km.	0.00	**0.00**

Notes:
The calculations of scores for #3 and #8 above are slightly different.
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However, the spreadsheet is subject to change. Please contact a Forest Service regional hydrologist to ensure that you are using the latest version.

Data Entry Sheet - IWAP Version 1.03 - November 1995

Enter watershed data in column 1.
Read scores and hazard indices in columns 5 and 6 on next page.

	(1)	(2)	(3)	(4)
Watershed Name?	CREEK WATERSHED			
Map units are In: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	179.934	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1179	m.		
ECA above H60?	21.373	sq.km.	*	
ECA below H60?	4.848	sq.km.	*	
Road length above H60?	181.022	km.	*	
Road length below H60?	113.586	km.	*	
Surface Erosion				
Length of road on erodable soils?	14.52	km.	*	
Length of road within 100 m. of stream?	111.771	km.	*	
Length of road on erodable soils within 100 m. of stream?	9.024	km.	*	
Number of active stream crossings?	252		*	
Riparian Buffer				
Total stream length?	313.527	km.	*	
Length of stream logged?	84.708	km.	*	
Total length of fish bearing streams?	313.235	km.	*	
Length of fish bearing streams logged?	84.708	km.	*	
Landslides				
Number of landslides?	0		*	
Length of road on unstable slopes?	3.541	km.	*	
Length of stream with logged banks and on slopes > 60%	0.107	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?				
Is there mining close to streams?				
Is there ATV use close to streams?				
Hydrologic zone?				
Percent area of crown land?	5.49			
Percent area of private land?	94.51			
Percent area with unstable slopes?				
Percent area with erodable soils?				
Dominant bedrock geology?				
Is there a fisheries (DFO or MoE) thermal concern?				

Notes:
(2) Enter data in units shown in this column.
(3) An asterisk in this column indicates essential data for calculations.
(4) "err" message in this column indicates an inconsistency in the data.

All cells except B6..B44 are protected.

Calculation Sheet

DURAND CREEK WATERSHED
Map units were identified as: km. and sq.km.

	Indicator		Score	Hazard Index
Peak Flow				
Index above H60	0.18			
Index below H60	0.03			
1 Total Peak Flow Index	0.21		0.34	
2 Road density above H60	1.01	km/sq.km.	1.00	
3 Total road density (See note below)	1.64	km/sq.km.	0.55	**0.63**
Surface Erosion				
4 Roads on erodable soils	0.08	km/sq.km.	0.16	
5 Roads within 100 m of a stream	0.62	km/sq.km.	1.00	
6 Roads that are both of the above	0.05	km/sq.km.	0.25	
7 Active stream crossings	1.40	no./sq.km.	1.00	
8 Total road density (See note below)	1.64	km/sq.km.	0.56	**1.00**
Riparian Buffer				
9 Portion of stream logged?	0.27	km/km.	0.90	
10 Portion of fish bearing streams logged?	0.27	km/km.	0.54	**0.90**
Landslides				
11 Landslide density	0.00	no./sq.km.	0.00	
12 Roads on unstable slopes	0.02	km/sq.km.	0.07	
13 Streams >60% and banks logged	0.00	km/sq.km.	0.00	**0.03**

Notes:
The calculations of scores for #3 and #8 above are slightly different.
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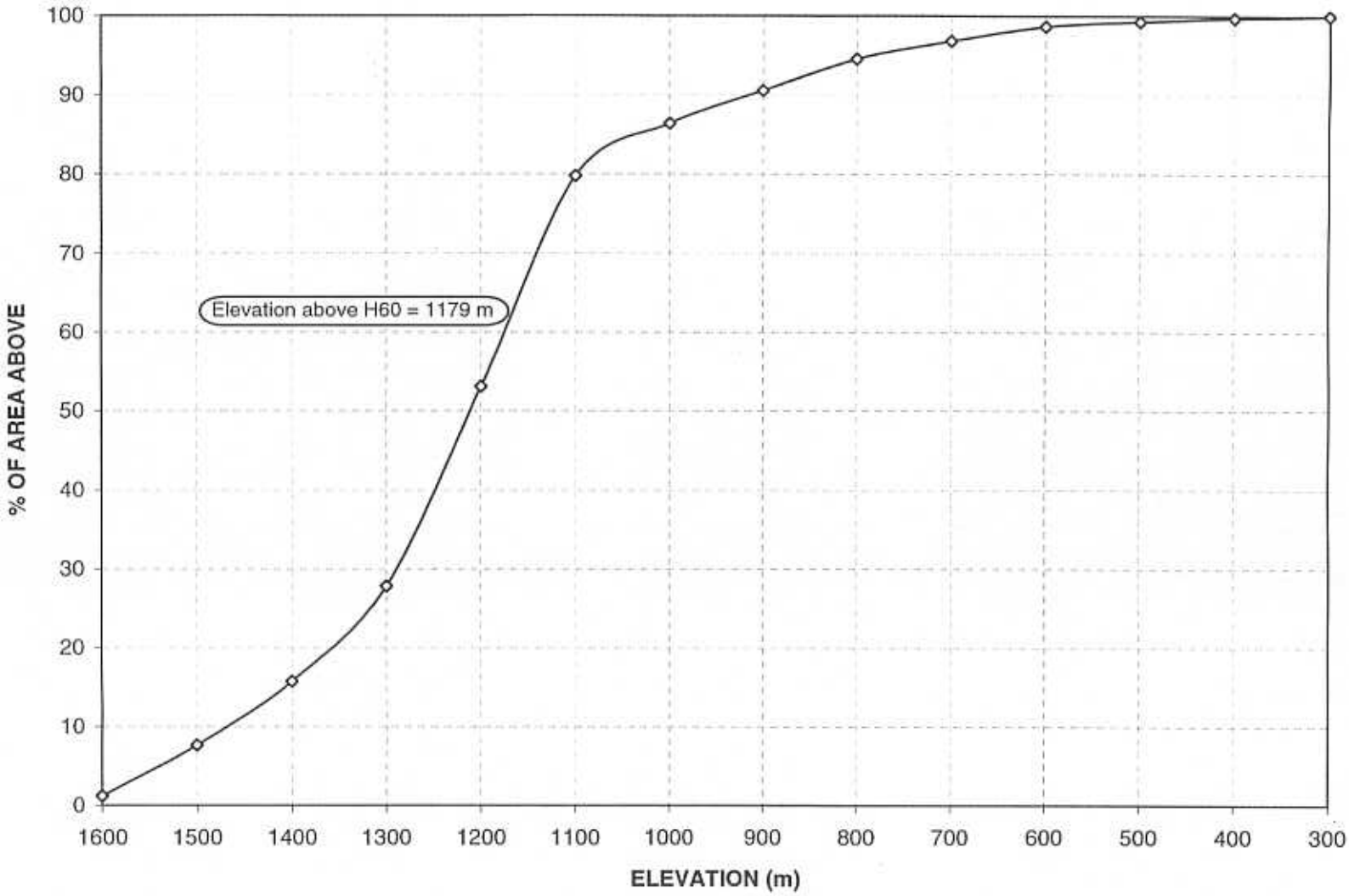
APPENDIX VII

Hypsometric Curve for the Durand Creek Watershed

DURAND WATERSHED H60 LINE



APPENDIX VIII

List of Forest Development Plans consulted for the Durand Creek IWAP

Ainsworth Lumber Company Ltd., Savona Division, 1:50,000, 1998-2003

Kamloops Forest District Small Business Forest Enterprise Program, Ministry of Forests, 1:50,000, 1998-2002

Weyerhauser Canada Ltd., Kamloops, 1:30,000, 1998-2003

APPENDIX IX

Durand Creek IWAP Overview Map