FISH AND FISH HABITAT ASSESSMENT OF MAXAN CREEK WATERSHED, BRITISH COLUMBIA

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1.0 INTRODUCTION

AGRA Earth & Environmental Limited (AEE) was retained in 1995 by Yin Waghunlee Habitat Enhancement Corporation (now Dz'ilh K'Az Kwa Development Corporation) to conduct a Level 1 Fish Habitat Assessment within the Maxan Creek Watershed as part of a watershed assessment funded by Forest Renewal British Columbia (FRBC). The Fish Habitat Assessment was done for the mainstem Maxan, Foxy, and Crow Creeks and the upper Bulkley River and their tributaries (see Figure 1). The assessment included a review of relevant fish and habitat information, identification of affected fish habitat, a helicopter overflight, and rating of areas for further assessment and enhancement work. AEE rated lower Maxan Creek as the highest priority for further assessment work, followed by Bulkley River and Foxy Creek (AEE 1996). High priority was assigned to Maxan Creek because the creek has key spawning and rearing habitat for anadromous and resident salmonids and much of the watershed area has been developed for forestry and agriculture.

AEE was retained in the summer of 1996 to conduct the Level 2 Fish Habitat Assessment of the Maxan Creek Watershed. The aim of habitat evaluation is to identify habitat conditions in surveyed reaches that may limit fish production and to suggest restoration projects (Johnston and Slaney 1996: "Watershed Restoration Technical Circular No. 8"), which includes:

- identifying target fish species,
- determining if habitat requirements of various life stages of target fishes are met,
- where limitations are evident, noting locations, extent, and severity of the habitat conditions that indicate limitations,
- identifying the physical or biological process that causes the observed limitation (what is to be fixed in restoration projects), and
- summarizing habitat impairment and fish values for each reach.

Three creeks within the Maxan Creek Watershed were selected for assessment based on the results of the Level 1 Assessment (AEE 1996) by the Ministry of Environment, Lands and Parks (MELP) Watershed Restoration Program (WRP) Fisheries Specialist: Maxan Creek (lower), Foxy Creek, and the upper Bulkley River. The Level 2 assessment field work was initiated in October, 1996, and a helicopter and ground survey of visible degraded habitats of the upper Bulkley River and parts of Foxy and Maxan creeks was done. Stream habitat restoration and enhancement designs were made for 13 sites on the Bulkley River, 2 sites on Foxy Creek, and 1 site on Maxan Creek and are presented in a preliminary Restoration and Enhancement Design Report (AEE 1997a). A detailed habitat survey and the fish habitat assessment could not be completed at that time because of the heavy snow cover.

The Level 2 assessment field survey was completed in summer, 1997. The fish and fish habitat assessment was completed at that time and is presented in this report. Site-specific restoration prescription designs for those sites examined in 1997 are presented in a second Restoration and Enhancement Design Report (AEE 1997b).

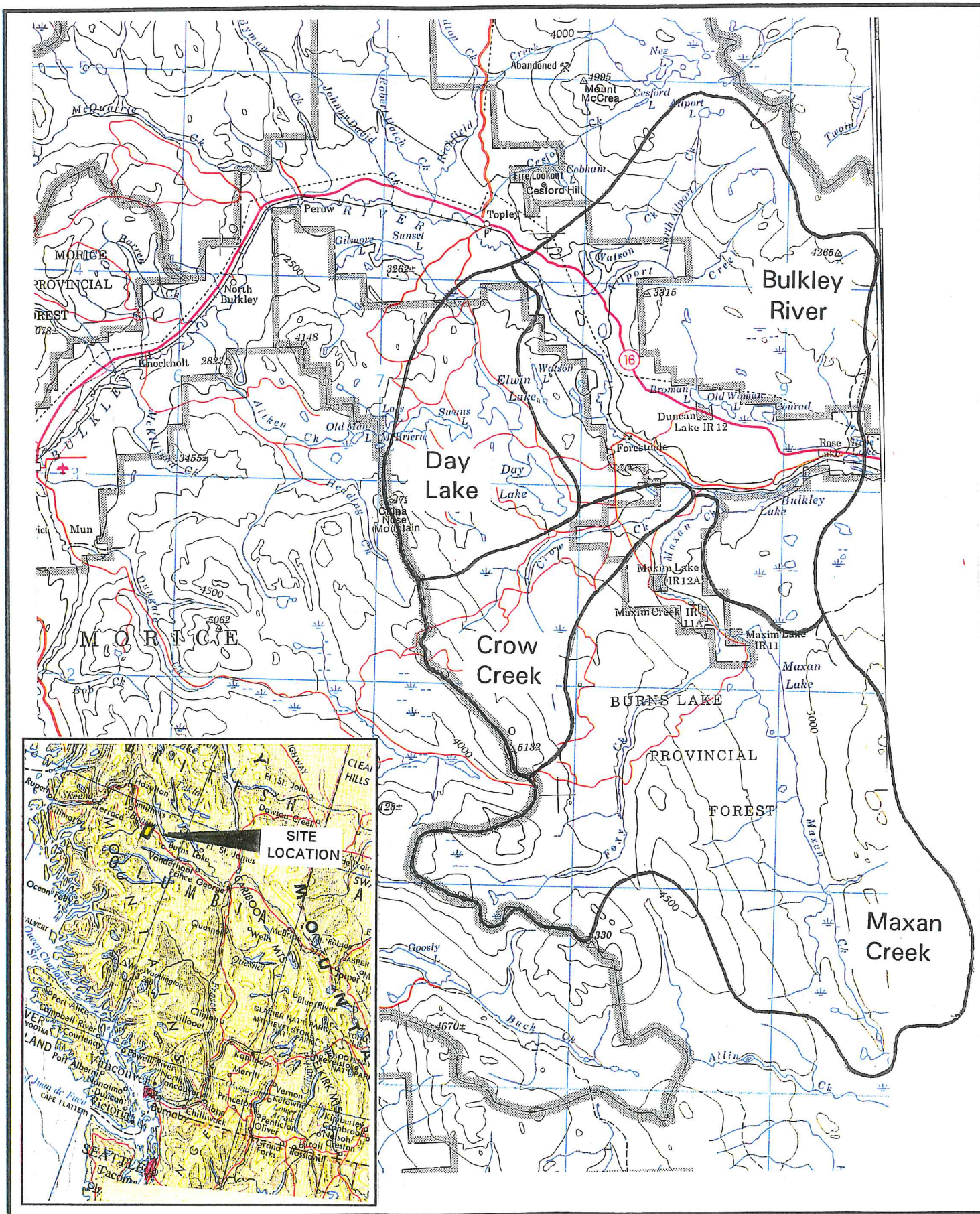

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Figure 1 Study Location: Watershed and Sub-Basin Boundaries for the Maxan Watershed - Lakes Forest District

1.1 STUDY OBJECTIVES

The primary objective of the Level 2 Fish and Fish Habitat Detailed Assessment for the Maxan Watershed, based on the "Schedule A" Scope of Work, was to develop prescriptions intended to rehabilitate or remedy impacts for two categories of sites:

Category 1: isolated impacts on a specific site, where those impacts are not cumulative in nature.

Category 2: sub-units and/or reaches within those sub-units that have been identified in the Level 1 Overview Assessment as heavily impacted and as having significant resource values.

The prescriptions include:

- a geographic location of each site,
- photographs of impact,
- a description of work to be completed (restorative, rehabilitative, or mitigative prescription),
- budget estimates, and
- time line estimates.

Prescriptions to rehabilitate or remedy the impact were developed for all Category 1 sites (isolated impact). For the areas that fell within the Category 2 sites, a detailed fish and fish habitat assessment was conducted. The specific objectives included:

- completion of the Habitat Survey Data Form 4 from "Watershed Restoration Technical Circular No. 8";
- a fish assessment to determine fish presence, distribution, and relative abundance for representative sites within the impacted reach;
- estimation of age structure by analyzing fork length from a representative number of captured fish;
- documentation of the location of redds, spawning, and holding adults;
- recommendations for short and long term objectives to rehabilitate the sub-unit;
- prescriptions to rehabilitate the sub-unit; and
- an explanation of how the prescriptions will lead to the overall objectives of watershed restoration.

1.2 STUDY AREA DESCRIPTION

The Maxan Creek Watershed encompasses 83 000 ha and contains 722 km of streams. Approximately 18% of the streams have been affected directly by forestry or are within 100 m of a road (AEE 1996). General reach characteristics are provided in AEE (1996) and Bustard (1984).

Lower Maxan Creek, between Bulkley Lake and Maxan Lake, is a low gradient, unconfined to occasionally confined meandering fifth order stream. It has been affected by agricultural development and forestry, which has removed riparian vegetation. Several impacts to fish habitat were identified in the Level 1 assessment including bank erosion, inadequate riparian vegetation, and road crossings (AEE 1996). For upper Maxan Creek upstream of Maxan Lake, impacts identified were beaver dams, lack of large woody debris (LWD), and some erosion. Foxy Creek is a third order tributary to Maxan Creek that has been affected by forestry. Reach 1 of Foxy Creek is unconfined, low gradient, and reach 2 is entrenched within a canyon, which has a series of falls and chutes between 10 and 12 km upstream from the confluence (Bustard 1984). Bank erosion, inadequate riparian vegetation, road crossings, and possible woody debris barriers were identified as impacts to fish habitat (AEE 1996).

The portion of the Bulkley River within the study area meanders through agricultural land and is bordered by the Canadian National Railroad (CNR) mainline. Riparian vegetation has been altered in most areas and has been completely removed in some areas. Overhead cover from vegetation, typically willow, is minimal. Erosion along outside meander bends has occurred, and the reach is colonized by beaver.

The watershed provides habitat for several anadromous and resident fish species including chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon *(O. nerka*), coho salmon (*O. kisutch*), Dolly Varden (*Salvelinus malma*), and rainbow trout (*O. mykiss*). For the study area, these species are considered target species, i.e., species in known areas of habitat degradation and therefore at risk or have had their abundances decline. Maxan Creek provides spawning and rearing habitat for salmonids including coho, sockeye, and chinook salmon (Bustard 1984). Juvenile chinook salmon have been found in Foxy Creek (Bustard 1984). The lower 3 km of Foxy Creek was described as the main fish-producing section of Foxy Creek (Bustard 1989). Rainbow trout were the most numerous in the lower 3 km gravel fan section of the creek and are present to the canyon section 10 to 12 km upstream (Bustard 1984).

2.0 METHODS

AEE conducted the fish and fish habitat assessment survey within the Maxan Creek Watershed on August 7 to 13, 1997. Reach breaks assigned to streams within the study area during the Level 1 assessment were used for the fish habitat assessment.

2.1 FISH HABITAT ASSESSMENT

Habitat conditions within the reaches identified with Category 2 sites were determined by walking the stream and surveying a random sample of habitat units to characterize the average conditions within a reach. Habitat units distinguished, following the methods of the "Watershed Restoration Technical Circular No. 8", were:

- pools (P): slow water areas with finer sediments including scour and dammed pools,
- glides (G): non-turbulent fast-flowing water,
- riffles (R): turbulent fast-flowing water,
- cascades (C): high gradient riffles, and
- other (O): wetlands including beaver ponds, or sub-surface flow, or where a channel is not observed.

These habitats units were separated into:

- primary: units in the main channel that occupy >50% of wetted width;
- secondary: units in minor channels isolated from the main channel by vegetated island;
- tertiary: significant, identifiable habitat units within the main channel that meet the minimum size criteria but are <50% of wetted width (see "Watershed Restoration Technical Circular No. 8" for minimum size criteria).

All habitat units encountered within each reach sampled were recorded. The length of most habitat units was measured, and a subsample of units was sampled to characterize habitat conditions. Systematic random sampling from a random start point was used to select the habitat units to be sampled. Typically, the second to fifth unit of each habitat unit was sampled within a reach until a minimum of five of each habitat type was sampled. All habitat characteristics were measured and recorded on the Habitat Survey Data Form ("Watershed Restoration Technical Circular No. 8"). The survey start point was taken as the stream mouth for Foxy Creek and the confluence with Bulkley Lake for Maxan Creek. Distance from the survey start to the location of the downstream boundary of the habitat unit was measured with a calibrated hip chain. Length of habitat units was measured with calibrated hip chain or tape measure, and width was measured with a tape measure. Discharge was calculated for Maxan and Foxy Creeks using the "floating chip" method in glide areas with no obstructions.

Habitat features recorded included (see Glossary for definitions):

- bankfull channel width (W_b)
- length and wetted width of habitat units,
- water depth,
- bankfull depth (bank height and mean water depth),
- pool types and depths,
- % and type of cover and overstream canopy closure,
- large woody debris (LWD),
- barriers and disturbance indicators,
- riparian vegetation type and structural stage of dominant vegetation,
- spawning gravel amount and type,
- substrate characteristics, and
- off-channel habitat.

Comments were recorded for bank condition including any evidence of erosion. Some minor additions to the standard methods for Fish Habitat Assessment were made. Channel gradient was determined with an Abney Level for the channel measured over the longest possible distance to obtain a more representative value of gradient ("Reconnaissance Fish and Fish Habitat Inventory") instead of for each habitat unit. A total cover estimate of the in-channel covers available for fish was visually estimated as the percent of the channel area covered. Cobbles were considered as part of boulder cover, because cobbles provide cover, especially for fry. Deep pool cover was considered to be any depth that could provide cover where any life-stage of fish could rest, hide, or feed and was not limited to pools greater than 1 m deep. Adult holding pools were defined as pools meeting the minimum size criteria with a residual pool depth equal to or greater than 1 m.

Habitat unit data were summarized by reach for each habitat unit. The mean length and standard deviation for each habitat unit was calculated as the average for all habitat unit lengths measured. Reach averages and reach totals were calculated as the weighted average of the sampled habitat units for:

- % pool, riffle, and glide area;
- holding pools; and
- functional LWD tally.

Summary values for habitat parameters were determined following the methods of "Watershed Restoration Technical Circular No. 8":

- Pool frequency was calculated as channel widths per pool: (reach survey length/average bankfull width)/number of pools;
- Mean number of functional LWD pieces per channel width was calculated as the functional LWD tally for the reach/(reach survey length/average bankfull width);

- Substrate quantity was calculated as the % occurrence of habitat units rated as having abundant amounts of spawning gravels;
- Woody cover in pools was calculated as the average % of wetted pool surface area comprised of wood cover;
- Total overhead cover in pools (all cover elements excluding woody debris) was calculated as the average % of wetted pool surface area comprised of overhead (boulders, cutbanks, instream vegetation, and overstream vegetation) cover;
- Cover in riffles and in glides was calculated as the average % of wetted surface area for each habitat type comprised of all cover types (small and large woody debris, boulders, cutbanks, instream vegetation, and overstream vegetation); and,
- Abundance of off-channel habitat was calculated as the number of identified off-channel habitats/length surveyed (km).

Generic descriptors of habitat quality (Johnston and Slaney 1996) were used to help identify damaged or poor habitat conditions. Regional standards for diagnostics of salmonid habitat condition were not available for the Burns Lake area (Ministry of Environment, Lands and Parks (MELP), Smithers, pers. comm.).

Sites of habitat disturbance and potentially limiting factors to fish production were identified during the ground survey of Maxan and Foxy Creeks. All degrees of bank erosion were noted during the habitat survey, including areas with minimal, natural erosion along outside meander bends and areas with root masses maintaining some bank stability. Areas where banks were unstable and had no root system from riparian vegetation that could provide some stability were identified for site-specific restoration prescriptions. Other types of habitat degradations noted included accumulation of sediment and debris, potential barriers to fish movement, and inadequately vegetated riparian areas. Most types of habitat degradations were observed where riparian vegetation has been altered or removed, roads were present, and cattle activity occurred.

For each site identified with habitat degradation that would benefit from rehabilitation or enhancement measures, site-specific restoration prescriptions were made and are presented in the Restoration and Enhancement Design Report (AEE 1997b).

2.2 FISH ASSESSMENT

Fish species composition, distribution, and relative abundance were determined to help identify heavily-used habitats by sampling representative sections of the reaches with Category 2 sites. Sites sampled contained habitat representative of the reach.

Reach 2 of Maxan Creek was sampled with a Smith Root Model 12 B, programmable output waveform, backpack electrofisher. Electrofisher output was operated at minimum settings of 90 Hz and 4 ms pulse width. Voltage was varied between 300 and 400 V.

Fish immobilized with the electrofisher were retrieved with a dipnet and placed into a pail filled with water from the creek. Fish were enumerated, identified to species, and fork length (FL) was measured to the nearest millimeter. Once sampled, fish were released unharmed. Age was assigned to individual size classes of rainbow trout based on fork length distribution.

Trout fry were abundant in Maxan Creek and were easily harmed by electrofishing. Changing electrofisher settings did not appear to change the effect on fry, and electrofishing was discontinued in riffle areas or where fry appeared abundant to minimize mortality. Only one riffle was sampled for fry. Minnow traps were used at other sites sampled to help reduce mortality of fry and because they are effective in a wide range of habitats. Baited minnow traps were set overnight in glide, riffle, and pool habitats in Foxy Creek. Fish caught were identified and enumerated and then released.

The relative abundance of fish at sites sampled was not compared between streams in the study area. Where eletrofishing was done, catch-per-unit-effort (CPUE) was represented by electrofisher CPUE and was calculated as the number of fish caught and observed per m^2 of sampling area.

3.0 RESULTS AND DISCUSSION

3.1 FISH HABITAT

Within the study area, three reaches were identified with category 2 impacts: reaches 1 and 2 of Maxan Creek and reach 1 of Foxy Creek. Characteristics of the study reaches are presented in Table 1 and Appendix A. Major impacts found are described in the Restoration and Enhancement Design Report (AEE 1997b). Examples of typical habitats are shown in Appendix B.

TABLE 1
REACH CHARACTERISTICS WITHIN MAXAN AND FOXY CREEKS

Characteristic	Maxan Creek		Foxy Creek
	Reach 1	Reach 2	Reach 1
Reach Length (m)	7294	6901	2513
Channel Bankfull Width (W_b) (m)	20.2	17.8	12.8
Mean Wetted Width (m)	8.1	7.8	5.8
Reach Area (m^2)	147339	122838	32166
Wb per Reach	361	388	196
Riffle % Area of W_b	18	20	30
Pool % Area of W_b	13	5	2
Glide % Area of W_b	20	31	14
Riffle Length (m)[1]	26 ± 21 (88)	31 ± 27 (37)	36 ± 34 (37)
Pool Length (m)[1]	21 ± 13 (61)	15 ± 7(9)	6 ± 4 (11)
Glide Length (m)[1]	30 ± 26 (78)	39 ± 26 (25)	19 ± 12 (37)

[1] Mean Length ± standard deviation (N) of category 1 habitat types

Wetted channel width varied between one third and one half of bankfull channel width during the survey. The stage of discharge was low, being < 30% of bankfull depth (Habitat Survey Data Forms, Appendix C). Flood signs were abundant in all three reaches surveyed and included rafted debris and newly deposited fluvial sediments.

The most abundant habitat type within reach 2 of Maxan Creek and reach 1 of Foxy Creek was riffle (Table 2). Pools were the most abundant habitat type in reach 1 of Maxan Creek and were larger on average than pools in reach 2 and Foxy Creek. Foxy Creek reach 1 had the fewest and smallest pools.

Primary riffle and glide habitat types were more abundant than secondary and tertiary units in the reaches examined (Table 2). Tertiary pools were more abundant than riffles or glides within each reach.

TABLE 2
NUMBER OF HABITAT UNITS WITHIN STUDY REACHES IN MAXAN AND FOXY CREEKS

Stream Reach	Habitat Type	Habitat Unit		
		Riffle	Pool	Glide
Maxan Creek				
1	Primary	110	80	104
	Secondary	21	9	17
	Tertiary	5	61	4
	Total	136	160	125
	Sampled	11	10	11
	% Sampled	8	7	9
2	Primary	97	37	92
	Secondary	15	4	14
	Tertiary	3	45	3
	Total	115	86	109
	Sampled	10	8	9
	% Sampled	9	9	8
Foxy Creek				
1	Primary	37	11	35
	Secondary	9	2	6
	Tertiary	1	15	0
	Total	47	28	41
	Sampled	16	14	16
	% Sampled	34	50	39

Maxan Creek Reach 1

Reach 1 of Maxan Creek had a low gradient (<3%), irregular meandering channel occasionally confined between unarmored banks. Riparian vegetation included grasses, willow, alder, cottonwood, and spruce, and the canopy was open. Habitat consisted of large riffle/pool/glide sequences (e.g., Appendix B). Backwater and side channel habitat has been created by abandoned channels. Substrate was frequently embedded with fines, but water clarity was clear to lightly turbid at the time of the survey. Boulders were present but rare. Fines (including sand and silt) were abundant along channel margins, back eddies, pools, and downstream ends of gravel bars and were common in glides and riffles. In addition, fines were dominant in the lower part of the reach. Clay was present in areas along the reach. Distribution of LWD was clumped, and few (less than one piece per W_b) pieces of functional LWD were present over the reach. Cover was provided mainly by overstream vegetation, woody debris, and large cobbles. Filamentous algae was observed frequently in the reach.

Disturbance indicators found included eroding banks, LWD parallel to banks, log jams, and extensive sediment wedges. Land surrounding reach 1 is used for agriculture, and livestock have free access to the creek throughout the reach. Bank erosion was most extensive along areas cleared to the banks, but was present in uncleared areas also. In the few areas where clay was present in v-shaped to almost vertical banks, downslope movement of the banks was occurring.

Maxan Creek Reach 2

Maxan Creek reach 2 was slightly narrower than reach 1 but also had a low gradient (<3%), irregular meandering channel that was frequently confined between unarmored banks. Riparian vegetation included grasses, willow, alder, cottonwood, and spruce, but mixed forest was dominant. Canopy closure was up to 20%, in contrast to reach 1, which was open. Habitat consisted of large riffle/glide sequence and smaller, less frequent pools. Substrate in riffles and glides was dominated by cobbles and gravels and was rarely embedded with fines. Sand was present along channel margins, in pools, and along and in bars. Water clarity was clear at the time of the survey. Distribution of LWD was clumped, and more than one piece of functional LWD per W_b was present. Large and small woody debris, overstream vegetation, and large cobbles provided the main types of cover for fish.

Disturbance indicators found included some eroding banks, LWD parallel to banks, log jams, and extensive bars. Land surrounding reach 2 is used for agriculture and forestry. Bank erosion was also present in uncleared areas on outside cutbanks and meander bends but was less extensive than in reach 1.

Foxy Creek Reach 1

Reach 1 of Foxy Creek had a low gradient (<3%), irregular wandering channel occasionally confined between unarmored banks. Multiple channels and channel shifting is common. Riparian vegetation included willow, alder, cottonwood, and spruce. Canopy closure was generally up to 20%, but some areas were open. Habitat consisted of large riffle/glide sequences. Pools were infrequent and most were formed behind woody debris and some boulders. Beaver activity within the reach had created two extensive flooded sections. Substrate was dominated by cobbles and gravels except in pools within the reach, which contained fines. Boulders were more common than in Maxan Creek. Water was clear at the time of the survey. Distribution of LWD was clumped and abundant (more than one piece of functional LWD per W_b). Overstream vegetation, woody debris, cutbanks, and large cobbles provided fish cover.

Disturbance indicators found included some eroding banks, LWD parallel to banks, mid-channel bars, log jams, and extensive sediment wedges. Land surrounding reach 1 is used for forestry and agriculture. Livestock has access, primarily within the lower part of the reach. Bank erosion and undercutting was present along outside meander bends. Most banks were stabilized by riparian vegetation including willows, spruce, and cottonwood. The reach had more natural forested, stable banks than Maxan Creek.

3.2 FISH ASSESSMENT

In total, five species of fish were sampled from Maxan and Foxy Creeks (Appendix C). Rainbow trout and longnose sucker (*Catostomus catostomus*) were found in Foxy and Maxan Creek. In addition, mountain whitefish (*Prosopium williamsoni*), Pacific lamprey ammocoetes (*Lampetra tridentata*), and longnose dace (*Rhinichthys cataractae*) were caught in Maxan Creek. Rainbow trout dominated the catch.

Catch within the two creeks was comprised of immature fish, most of which were fry and one year old rainbow trout (Appendix C). Fry rainbow trout (29 to 33 mm FL, N= 6) were the most abundant life-stage observed during electrofishing in Maxan Creek and during the ground survey. Most fish caught in both creeks were one year old rainbow trout (67 to 89 mm FL, N=24). The other rainbow trout caught were also juveniles, likely age 2 (94 to 112 mm FL, N=8). The sizes of the fry and juvenile rainbow trout were similar to those reported by Bustard (1984) for rainbow trout caught in Foxy Creek in September (fry 25-48 mm FL; age 1+ 61-101 mm FL).

Rainbow trout fry were found and observed in shallow riffle habitat in Maxan Creek and some pools and backwater areas. Juveniles were most often found in deeper water in glides and riffles, but were also observed in pools. Other species, including suckers and minnows, were observed throughout the reaches sampled, typically in isolated pools in backwater areas or side channels isolated from the main channel and in glides and pools (Appendix A).

High numbers of juvenile rainbow trout, compared to other streams in adjacent areas, have been reported in Foxy Creek (Bustard 1989). The density of rainbow trout fry caught in Maxan Creek during this study was comparable to densities in other Bulkley River tributaries but was low compared to the high density found in Foxy Creek in September, 1984 (Table 3).

TABLE 3
RAINBOW TROUT DENSITY (NUMBER/m^2)
ESTIMATES FOR BULKLEY RIVER TRIBUTARIES

Stream	Fry	Parr	Reference
Maxan Creek reach 2	0.1	<0.01	this study
Foxy Creek reach 1	1.27	0.95	Bustard 1984
Crow Creek	0.08	-	Tredger 1982
Buck Creek	0.14	-	Tredger 1982
Maxan Creek	0.3	0.19	Tredger 1982

Bustard (1989) suggested that the fry and juvenile rainbow trout are the progeny of resident rainbow trout, possibly from Maxan Lake. Adult rainbow trout were found in Foxy Creek in July 1984, which were likely resident rainbow trout (Bustard 1984). Lower Foxy Creek and Maxan Creek provide important rearing habitat for fry and parr of other salmonids (AEE 1996, Bustard 1984). Juvenile coho, chinook, and sockeye salmon have been found in Maxan Creek, and juvenile chinook salmon and Dolly Varden were found in the lower portion of Foxy Creek in September 1984 (Bustard 1984).

3.3 HABITAT EVALUATION

Habitat conditions within Maxan and Foxy Creek were evaluated by identifying habitat needs of the life history stages of the target fish and determining if the available habitat meets the habitat requirements of the fish. Critical habitat needs of the life history stages present within the study creeks are:

- migration corridors, which includes adult holding habitat,
- spawning habitat, including egg incubation and hatching needs,
- rearing habitat, and
- overwintering habitat.

Rainbow trout and salmon prefer fast-moving water over bedrock or substrate interspersed with clean gravel and cobble for spawning. Salmonids have specific habitat requirements for successful spawning with regard to substrate, temperature, oxygen content, water depth, and velocity (Table 4), as well as for rearing and adult habitat (e.g., refer to Behnke 1992, Bjornn and Reiser 1991, Scott and Crossman 1973 for more detail descriptions of habitat requirements).

TABLE 4
PREFERRED HABITAT CHARACTERISTICS FOR SPAWNING AND REARING SALMONIDS (BJORNN AND REISER 1991)

Habitat Parameter	Habitat Requirement			
	Rainbow Trout	Chinook Salmon	Coho Salmon	Sockeye Salmon
Spawning/Incubation				
Water Depth (cm)	>18	>24	>18	>15
Water Velocity (cm/s)	48-91	30-109	30-91	21-101
Substrate Size (cm)	0.4-10	1.3-10.2	1.3-10.2	1.3-10.2
Area (m^2)	0.2	3.3-10	2.8	1.8
Dissolved Oxygen (mg/L)	>5	-	>7	-
Rearing/Feeding				
Water Velocity (cm/s)	juvenile: 8-20 adult: 20-30	-	-	-
Substrate	juvenile: cobble/gravel adult: cobble/gravel	-	-	-

Generic descriptors of habitat quality (Johnston and Slaney 1996) were used to help identify limiting or poor habitat conditions in order to rate whether available habitat is suitable for the life stages of the target fish species (Table 5). In general, habitat within lower Maxan Creek and reach 1 of Foxy Creek is suitable for salmonids and does provide required conditions for different life stages. Habitat conditions in terms or rearing, spawning, and adult migration are discussed in the sections below.

Summer Rearing

Although lower Maxan Creek is a large stream (>15 m mean bankfull width), it has a low pool frequency, and pool area is only a small portion of available habitat. Foxy Creek also has small, infrequent pools. Pools provide important resting and feeding habitat, and the transition zone between pools and riffles creates conditions for maintaining gravel quality. Functional LWD is important for pool formation, channel geometry, and channel stability, and LWD was rated limited within reach 1 of Maxan and Foxy Creeks. Therefore, habitat condition for pools and functional LWD tally was rated only poor to fair for rearing salmonids.

Overhead cover, which includes LWD, boulders, cutbanks, instream vegetation, and overhanging vegetation, was frequently less than 20% of wetted width in reach 1 of Maxan Creek and less than 40% in reach 2. Some long habitat units, particularly glides and riffles, had little cover and were featureless. However, average % cover was greater than 10% and therefore rated fair to good. The majority of pools had adequate SWD and LWD cover.

TABLE 5
HABITAT DIAGNOSIS SUMMARY FOR MAXAN CREEK AND FOXY CREEK

Habitat Parameter	Fish Use	Maxan Creek				Foxy Creek	
		Reach 1		Reach 2		Reach 1	
		Value	Rating	Value	Rating	Value	Rating
Pool area (%)	rearing	13	Poor	5	Poor	2	Poor
Pool frequency (channel widths/pool)	rearing	2.5	Fair	4.5	Poor	0.7	Poor
LWD (pieces per Wb)	rearing	0.8	Poor	2	Fair	1.2	Poor
% Wood cover in pools (average % LWD+SWD cover in pool habitat)	rearing	16	Fair	43	Good	29	Fair
Boulder cover in gravel-cobble riffles	rearing	trace	Poor	trace	Poor	trace	Poor
Cobble cover in riffles (%)	fry rearing juvenile rearing	9 (5-25)[1]	Good Fair	11 (5-25)	Good Fair	15	Fair
Pool overhead cover (%)	rearing	32 (5-33)	Good	40 (19-76)	Good	14 (2-25)	Poor
Riffle overhead cover (%)	rearing	10 (5-25)	Fair	22 (5-80)	Good	22 (5-50)	Good
Glide overhead cover (%)	rearing	12 (5-25)	Fair	26 (15-40)	Fair	21 (10-40)	Fair
Off-channel habitat (#/km)	winter rearing spring rearing	none 3	Poor Fair	none 6	Poor Fair	none 9.5	Poor Good
Holding pools (pools > 1m deep/km)	adult migration	5	Fair	3	Poor	2	Poor
Access to spawning areas	spring adult migration fall adult migration	no blockage low flow	Good Fair	no blockage low flow	Good Fair	no blockage low flow	Good Fair
Gravel quality (gravel-cobble riffles with no fines)	spawning and incubation	moderate amounts; fines abundant	Poor to Fair	extensive amounts	Good	extensive amounts	Good
Gravel quantity (% of riffles with extensive amounts of potential spawning gravel)	spawning and incubation	45	Good	50	Good	31	Fair
Water velocity (cm/s)	rearing	34	Good	-		25	Good
Redd scour	spring spawning and incubation	-	Fair	-	Fair	-	Fair

[1] Average (range)

Although boulder cover was rare, overall cover within rearing habitat was considered fair to good, although pool habitat was limited.

Winter Rearing

Reach 1 of Maxan Creek appears to have adequate pools > 1 m deep with cover for overwintering habitat. Foxy Creek and reach 2 of Maxan Creek have limited holding pools. However, fish can move downstream to Maxan Lake or Bulkley Lake to overwinter. Based on the results of the ground survey, off-channel habitat connected to mainstem was limited and access was poor at low water levels. Reach 1 of Maxan Creek had fines as the subdominant or dominant substrate in riffles with cobble, and infilling of cobble cover would limit available habitat. Low water levels and velocities may limit overwinter survival of fry or incubating eggs in some years.

Juvenile Migration

Access for fry and parr to off-channel habitat within Maxan Creek and Foxy Creek depends on water levels. This type of habitat is seasonal; reduced connections with tributaries and off-channel habitats were observed during the summer low flow period. Fish, mostly minnows, were observed stranded in the side-channels and flood-channels that were no longer connected to the main channel. These off-channel areas are more likely to provide habitat during spring runoff and function as fish sensitive zones. Access to these areas is likely good in spring and during high water levels but is low during late summer and winter. Based on access conditions, winter rearing in off-channel habitat was rated poor, and spring rearing was rated fair.

No permanent barriers to fish movement were found during the survey. The LWD jams were not barriers; flow was observed around or under log jams. Some log jams may be partial obstructions depending on water levels. The beaver dams found during the survey may also be obstructions at low flows but are not permanent. Trout and salmon have been caught upstream of obstructions to fish movement that were present within Maxan and Foxy Creek (e.g., Bustard 1984), including beaver dams and log jams, indicating that such obstructions are not barriers.

No evidence of channel dewatering or isolated pools were found, except within Foxy Creek approximately 1700 m upstream from the confluence where the channel was dry. Water had been diverted outside of the original channel at a log jam, likely during high water levels. Beaver dams were present within the area also. Fish movement within this section of the creek would be limited until the flow returns to its original channel.

Adult Migration

Access to spawning areas by adult salmonids was rated good for rainbow trout in Maxan and lower Foxy Creek. A natural obstruction to upstream fish movement is present in Foxy Creek approximately 10 to 12 km upstream from its confluence (Bustard 1984). No other permanent fish barriers was found during the survey. Beaver dams within Maxan Creek and Bulkley River would be partial obstructions at low flows. Low flows in late summer and fall may limit fall spawners (salmon) if water depths and velocities are too low.

Adult Holding Habitat

Holding habitat for adult fish during the spawning migration was rated fair in reach 1 of Maxan Creek, which had 5 pools/km with residual depths greater than 1 m during low flow (summer). Fewer holding pools were available in reach 2 and in Foxy Creek.

Spawning and Incubation

Some general spawning areas known from historical information and areas of potential spawning gravels were identified. Bustard (1984) found newly emerged rainbow trout fry in lower Foxy Creek, which suggests suitable spawning gravel was present. Gravel and cobbles were abundant within Foxy Creek and reach 2 of Maxan Creek. Sands, including silts, were common in reach 1 of Maxan Creek, and glides and riffles had cobbles with fines filling interstices. Spawning habitat was rated poor to fair for reach 1. Based on the diagnostics of habitat condition for salmonids, reach 1 of Foxy Creek was rated only fair for spawning gravel abundance but did have higher quality spawning habitat that the lower reach in Maxan Creek.

Low flows in late summer and fall may limit spawning if water depths and velocities are too low. Minimum preferred water depth for spawning areas for the target fish species is 15 cm, and average riffle depth within the study reaches was 13 to 16 cm in riffles and 30 to 32 cm in glides in all three reaches.

No redds were found during the survey, but potential for redd scour exists. Water velocities and depths for fall spawners may be limiting during years of low flow. Mean water depth within riffles was less than 16 cm when surveyed in August. Bustard (1984) found average riffle water depths of 15 to 20 cm within reach 1 of Foxy Creek at the end of September, 1984, indicating suitable water depths may be present.

5.0 CONCLUSIONS

The dominant fish use within Maxan and Foxy Creek is rearing. Limiting rearing habitat conditions included pool area and frequency, lack of functional LWD, minimal off-channel habitat, some infilling of gravels and cobbles, and limited holding pools. Channel aggradation and channel widening from bank erosion has occurred, especially in reach 1 of Maxan Creek. Common disturbances indicators found were eroding banks, sediment wedges, extensive bars, and LWD parallel to banks. Habitat condition within Maxan Creek reach 1 was rated poor for functional LWD and off-channel habitat, and within reach 2 was rated poor for pools and off-channel habitat. Reach 1 had abundant fines, and infilling of cobble and gravel was occurring. Foxy Creek habitat condition was rated poor for those habitat parameters also, in addition to holding pools.

These limiting or poor habitat conditions are caused by loss of riparian vegetation and LWD, erosion, and resulting sedimentation. Land use practices within a watershed, such as forestry and agriculture, can lead to these types of habitat degradations in addition to loss of habitat heterogeneity and changes in water quality and hydrological regime (Chamberlain et al. 1991).

Sites of habitat degradation in reaches with category 2 sites selected for restoration were found primarily where fields, roads, and cattle impacts occurred and had poorly or unvegetated, unstable banks. Most areas selected contained relatively large areas of actively eroding banks. In addition, sites that contained some bank erosion but had minimal cover and areas where log jams have diverted flow and have caused accelerated erosion of unstable banks were also selected for stream habitat restoration. Most of these areas selected for prescription work had inadequate riparian cover.

Sites within the reaches with only some impact, such as minimal bank erosion or low instream cover, were not considered as high priority for prescriptions (e.g., site at cattle guard access) because habitat problems were minimal compared to other sites. Bank erosion within all three reaches was common and related to bank texture. Other reaches within Foxy Creek, Maxan Creek, and the Bulkley River had been examined in 1996, and no other sites were selected for enhancement work. Although important resource values occur within the other reaches within Maxan and Foxy Creeks (migration corridor, rearing and spawning habitat), impacts were not rated as requiring immediate prescription work. The site approximately 1700 m upstream from the confluence of Foxy Creek should be reassessed after spring freshet; if the water diversion is still present, enhancement or restoration work may be necessary.

Major habitat degradation sites identified were selected for restoration work. Riparian management of lower Maxan Creek would help to restore and minimize minor impacts in other areas not selected. Riparian management will lead to increased stream cover, input of woody debris (which in turn can lead to increase habitat complexity and new pool formation), and bank stability. Vegetation with good root mats resists erosion and traps sediments which stabilizes and rebuilds banks and will help reduce erosion in other areas not enhanced. Long term goals for improving and maintaining fish habitat within the creeks should include riparian management (refer to the Restoration and Enhancement Design Reports).

6.0 LITERATURE CITED

AGRA Earth & Environmental Limited (AEE). 1996. Level 1 Fish Population and Riverine Habitat Assessment Maxan Watershed. Prepared for Yin Waghunlee Habitat Enhancement Corporation, Burns Lake, B.C.

AGRA Earth & Environmental Limited (AEE). 1997a. 1996 Maxan Watershed Stream Habitat Restoration and Enhancement Design Report. Prepared for Dz'ilh K'Az Kwa Development Corporation, Burns Lake, B.C.

AGRA Earth & Environmental Limited (AEE). 1997b. Maxan Watershed Stream Habitat Restoration and Enhancement Level 2 Design Report, 1997. Prepared for Dz'ilh K'Az Kwa Development Corporation, Burns Lake, B.C.

Behnke, R.J. 1992. Native Trout of Western North America. American Fisheries Society Monograph. U.S. Department of Agriculture.

Bjornn, T.C., and D.W. Reiser. 1991. Habitat requirements of salmonids in streams. In: Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. American Fisheries Society Special Publication 19:83-138.

Bustard, D. 1984. Assessment of Benthic Invertebrate and Juvenile Fish Populations in Foxy and Buck Creeks, September 1984. Prepared for Equity Silver Mines Limited, Houston, B.C. by David Bustard & Associates.

Bustard, D. 1989. Fish Population Monitoring in Foxy and Buck Creeks, September 1989. Prepared for Equity Silver Mines Limited, Houston, B.C. by D. Bustard & Associates.

Chamberlin, T.W., R.D. Harr, and F.H. Everest. 1991. Timber harvesting, silviculture, and watershed processes. In: Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. American Fisheries Society Special Publication 19:181-204.

Johnson, N.T. and P.A. Slaney. 1996. Fish Habitat Assessment Procedures. Watershed Restoration Program. Revised April 1996. Ministry of Environment, Lands and Parks and Ministry of Forests. Watershed Restoration Technical Circular No. 8.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada Bulletin 184.

Tredger, C.D. 1982. Upper Bulkley River reconnaissance with reference to juvenile steelhead carrying capacity. Unpubl. MS Fish and Wildlife Branch, Ministry of Environment, B.C.

APPENDIX A

HABITAT UNITS AND GENERAL DESCRIPTION OF THE MAXAN CREEK STUDY AREA

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
Bulkley Lake							gravel compaction loose; > 70 cm deep
R	27	0					extensive gravel bar
G	23	27			P	4	No cover for 156 m to lake
R	43	50			P	3	extensive sand wedge
G	63	93			P/P		
P	9	156					
R	10	165					
G	9	175					
P	8	184					
R	24	192			P		small backwater (<2 m); clean gravel
G	7	216					
P	13	223					
G	12	236					
P	14	248					
R	14	262					
P	11	276					P substrate fines
G	59	287					
R	37	346					
G	8	383					
P	23	391					
G	42	414					
R	3	456	R/G	7/16			
G	5	459					
P	12	464					
G	8	476					Riparian veg. willow, grass
P	34	484					substrate includes clay
R	18	518					RB erosion; SWD abundant; backwater
G	19	536					
P	31	555					
G	27	586					
P	4	613					
G	4	617					
R	11	621					backwater 10 m long; good access
G	9	632					
P	7	641					
R	12	648					
G	3	660					
P	12	663					
G	4	675					

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
R	26	679					
P	22	705					
G	31	727					PD along LB
R	23	758					
G	22	781			P		wood crib wall along both banks
R	49	803					clean gravel
G	29	852					flood signs: rafting 1.5 m
R	11	881					
G	15	892			P		
R	12	907			P		
G	9	919					
P	17	928					
R	21	945					
G	15	966					
P	22	981	G	59			side channel
R	45	1003	G		P	3	side channel; log jam at LB
P	53	1048					extensive sand wedges and gravel bars;
R	14	1101					40 cm falls over clay; 60 cm deep at base of falls
G	21	1115					2 m high clay RB eroding; clay across half of channel
R	31	1136	R/P	6			
G	74	1167	P/G/R/G	9/11/2	P		RB of side channel eroding; SWD abundant
P	48	1241			G		
R	51	1289			P		12 m backwater, poor access
P	35	1340	G				LWD abundant
G	13	1375			P		numerous minnows observed
R	20	1388			P		Riparian vegetation mature mixed forest to 470 m upstream from lake
P	20	1408					
G	48	1428			P		LB eroding; fines deposited along gravel bar
R	14	1476					
G	20	1490					
R	26	1510					large boulders; algae on boulders and cobbles
G	7	1536					
P	12	1543					
G	63	1555					
R	75	1618					algae in channel; sod clumps; fines and clay substrate
G	113	1693			R/P/P		2 m high LB eroding by field; substrate S and G
R	17	1806					
G	5	1823	R/G	10			
P	6	1828					LWD abundant

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
G	5	1834					
R	16	1839			P		
G	50	1855					44 m RB 3 to 10 m high, v-shaped, texture fines with clay, eroding and collapsing. LB 0.5 m high, s-shaped
R	12	1905					
P	18	1917					
R	23	1935					LB collasping, 2 m high RB eroding along field; riparian vegetation grasses; algae in riffles
G	6	1958					
P	29	1964					LWD abundant includes spruce tree with root wad
R	27	1993					
G	15	2020					
P	21	2035			G		
G	16	2056			P		
R	12	2072			P	1	
P	12	2084	R				
R	19	2096					
G	7	2115					
P	20	2122					
R	21	2142					
G	14	2163					
P	39	2177					
R	10	2216	R	27			old trail crossing, gentle slope to creek
G	94	2226					
P	22	2320					LB erosion
R	14	2342					
P	11	2356					
R	24	2367					
	2391	2391					
G	92	2391					
R	45	2483	G				
P	36	2528					
G	41	2564					
R	25	2605			G		
G	23	2630					
P	37	2653					
R	52	2690					
G	13	2742	R				
P	25	2755					
R	14	2780					

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
G	10	2794					
R	7	2804	P		P		
G	17	2811	R	9			
P	11	2828					
R	13	2839					
G	69	2852			P	11	
R	21	2921					
P	24	2942	R/P	8			
R	37	2966					LB erosion, cattle crossing
G	20	3003					algae and sedges instream; riparian vegetation grass and shrub
P	12	3023					
G	55	3035					
P	4	3090					
R	6	3094					
P	71	3100			R		
R	55	3171			P		
G	9	3226					
P	18	3235					
R	14	3253					
G	24	3267			P		
P	14	3291					
R	58	3305					Farmer's field access; trail to creek and cattle watering; minimal erosion
G							
P							
G		3385			P		LB erosion along field; grasses and shrubs
P	7	3392					
R	115	3399			P		RB erosion; algae abundant; extensive gravel bar; abandoned channels
P							
R							
G	99	3492					
R	42	3591	P	80			partially dry side channel
G	87	3633			P		SWD and LWD abundant
R	71	3720			P		P under root wad
G	72	3791					LB erosion; inadequate riparian vegetation along field (grasses); willow and alder along bank
R							tributary from LB (E) through field
P							
G							
R							
G					P		LWD and SWD abundant

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
R	23	3890					
P	12	3913					1.1 m deep; 0.95 m residual depth
R	14	3925					
G	29	3939					side channel, isolated pool
R	28	3968					
G	21	3996					
R	13	4017					
G	40	4030			P		side channel, isolated pool
P	18	4070					LWD accumulation at corner
R	22	4088					undercut LB
P	23	4110					pool under LWD, LWD PD
R	31	4133			P		pool under LWD, LWD PD
G	10	4164					
P	13	4174					
G	26	4187					
R	22	4213					clean gravels
G	24	4235					
P	15	4259					LWD along LB
R	14	4274			P		LWD
G	47	4288			P		LWD and SWD abundant
R	19	4335					undercut RB
P	36	4354					LWD and SWD abundant along RB
G	61	4390			P/R/P		SWD and LWD along RB
R					P		
G							cutblock at top of valley wall on RB - no impact observed
R	6	4467			P		LWD and SWD abundant
G	43	4473	R/G/P		P		undercut RB
R	11	4516					clean gravels and cobbles
G	12	4527					
P							> 1.5 m deep
R							
G							
P			G/P				side channel along field
R	51	4627			P		
P	18	4678					log jam at corner; LB erosion along field, cattle watering
R	15	4696					backwater present, good access; minnows observed
G							algae abundant
P							LB erosion and lateral movement of channel; exposed pipeline, fines abundant
R	7	4823			P		SWD abundant

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
G	47	4830			P/P		SWD abundant along RB
R	27	4877	R		P		SWD abundant; clean gravels and cobble
G	59	4904					substrate fines; algae abundant
R	26	4963					
G					P		
R			R				boulders; RB > 5 m high texture fines and clay; surface erosion
P	15	5049					
R	6	5064	G/R	31			
P	25	5070	R/P/R				LWD abundant, log jam at LB corner; pool >1.2 m deep
R	4	5095					
G	19	5099					shallow (10-30 cm) cobble and gravel
P	16	5118					
R	1	5134					
P	13	5135					
R	8	5148					
G							
P							pool created by LWD across channel (> 0.75 m deep)
G	14	5176			P		
P	18	5190					log jam
R	32	5208					clean cobbles and gravel
G							
P							water light brown color, turbidity low
G							RB large sand/gravel bar
R			G		P		LB erosion; SWD along LB; BD 0.4 m high
P							
G		5356			P		old road crossing, buried culvert; Ralph Johnson property access; log jam
R	105	5461					LB erosion
G			R/G	3/14			
R		5494					
G	40	5534					
R	21	5574					RB undercutting
G	30	5595					
P	49	5625					
R	20	5674					
P							RB 1.5 m; eroding and collasping; sod clumps falling; vegetation along field grasses
R							SWD piled on LB
G							
R	13	5838					
P	38	5851					log jam; small back channel

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
G							
P							
R	63	5928					
P	3	5991					
R	2	5994					
P	44	5996					RB vegetation grasses and willows; stumps of cottonwoods
R	34	6040			P		side channel
G	100	6074					clumps eroded from RB in creek
R	47	6174			P		
G	20	6221					
R	4	6241					
P	16	6245					RB erosion
R	24	6261					
G	34	6285			P		
R							
P							SWD and root wads; clearing on RB with reserve
R	12	6366	G/R				
G	30	6378			P		LWD on RB including spruce and alder
R	63	6408					extensive sediment wedges
P	24	6471					LWD
R	15	6495					
G							
P							
R							
G							
R							
P			G/R				log jam
R	52	6643	G				side channel
G	41	6695					
R	21	6736					LB 45 m long > 12 m high; v-shape; surface erosion
G							
P							
G	10	6784					
P	10	6794					LB >12 m high, texture fines with clay/G; spruce trees fallen into channel functioning as revetment
R	30	6804					
G	13	6834			P		
P	18	6847					
G	60	6865			P		algae on cobble
P							RB undercut

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
R					P		
P	33	6827					
R	5	6832					RB cleared, wetland; cattle trail to creek
G	4	6836					channel joins (split at 7294 m upstream)
R							elevated bars
G							1.5 m LB erosion
P							
R							
G							
R					P		RB wetland 20 m from creek, backwater 5 m, poor access
G							LB erosion
R							
G							
R							
G							
R							
G							
R							
P							
R							
G							
P							main flow through trees, roots exposed; erosion
R							some flow seeping through ground, with small side channels
G							flow through mixed forest creating new channel
P		7294					channel splits at JM (joins at 6836 m downstream) most flow in main channel
							other channel dewatered in areas (R/P/G/R/R/P/R/G)
							REACH 1 END
R							clean gravel
G							LB extensive sand/gravel bar with abundant SWD
R	55	7393	G/R		P		side channel with BD along RB; LB side channel
P	25	7448			G		
R	12	7473					clean gravels
P	17	7485	R/G				log jam; RB erosion; LB side channel with tributary
R	9	7502					
G	27	7511			P		dry tributary enters from LB with isolated pools with minnows
R	49	7538			P	2	clean gravel
G	12	7587			P		cliff ~ 60 m from creek
R	4	7599					
G	32	7603			P/P		RB erosion and undercutting; pool >1.3 m

AGRA Earth Environmental

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
G	12	8381			R/P/R		log jam; some LWD PD; pool > 1.2 m deep
P			R				
R							
G							substate C/G infilled with sand
R	16	8458	R				RB cattle access; riparian vegetation grasses
G	105	8474			P		RB 2 m high eroding
R							
G					P		LB under cut; LWD PD
P	11	8510					LB tributary - dry
R	24	8521					
G	84	8545	R/G/R/G		P/P		fines accumulation at base of side channel
P	18	8629					
R	25	8647			P		
G	14	8672					cattleguard access; cattle access to creek
P							
R							RB extensive gravel bar
G					P		
R							
G					P		
P							
R			R				
G							
R					P		cattle access; bank texture gravel
G							extensive sediment wedge; SWD and LWD; back water
P							
R							
G					P		
R		8984			P		JM; WG upstream of JM; extensive gravel bar; back channel stagnant water; LWD abundant
G					P		tributary from RB at 9012 m
R							extensive gravel bar along G, R, P, R
P							log jam
R							LB undercut; inactive BD remnants
G					P		
R			G				RB undercut; clean gravels
G					P		LWD abundant
R	68	9272	R				backwater stagnant; extensive sediment wedges; cattle access
G		9340					RB undercut
P							
R							LWD log jam

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
G					P		1 m high LB erosion
R							
G							
R			G		P		LWD abundant; LB erosion; cattle access
G		9472			P		RB sediment wedge; tributary at 9497 m
R	25				P		
G					P		
R			G				
G			G				
R					P		
P		9572					BD with pond; LWD and SWD abundant
R							clean cobble
G		9631			P		RB undercut
R	19	9650	G		P		log jam; clean gravel
G	58	9708					change rip. vegetation from mature deciduous dominant upstream to willow, sedges, alder
R	124	9832			P		flood signs 1.3 m; log jam - old channel bed only little flow stagnant water
G	10	9842			P		1.5 m RB erosion; texture fines with clay; cattle access; LWD PD
R	105	9947			P		RB undercut; backwater poor access
G							
R	10	10046					
G					P/R/P		RB extensive gravel bar, no canopy cover; LB erosion; filamentous algae abundant
R	4	10127			G		LB tributary
G	41	10131			P		RB undercut; large gravel bar
R	26	10172					RB undercut; large gravel bar
G	44	10198					
R		10242	R/P/R/G/R/G				extensive gravel bars; main channel riffle, 2 side channels; backwater access poor
G					P		
R	18	10356					clean cobble and gravels
G	19	10374			P		LWD abundant
R		10393	G				LWD abundant then log jam farther upstream; filamentous algae abundant
G					P		LWD abundant
R							
G		10538					RB erosion
R					P		large gravel bar
G	55	10557			P		some boulders
R		10612					clean gravel
G					P		
P			R				LWD adundant
R	44	10645					15 m high RB texture clay and G; forbs, grass, moss. Seeping water. Clay extends 0.5 m into creek

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
G		10689					
P							LWD
R	24	10698					large gravel bar; RB clay with gravel, seeping water
G		10727			P		RB erosion
R							clean gravel; backwater stagnant water with algae; large gravel bar
G	64	10795	R				LB erosion; willows and grass clump eroded into main channel; side channel with WG
R	50	10831					extensive gravel bars
G		10881					log jam at gravel bar 10930 m; backwater with stagnant water
P					G		
R		10980	G				RB side channel; small beaver dam
G					P		
R							clean gravel
G		11010					algae covered cobble
P					G		
G					P		Pool under LWD
R		11116					backwater with filamentous algae
P							
R		11171					clean cobble/gravel
G							
R		11286					
G							LB off-channel full of algae; numerous minnows 15-25 mm
R					P		Pool 0.90 m deep at LB; multiple channels through gravel bars
G							
R	67	11476			P		func. LWD; side channels with R and G
G		11543					Spruce tree partially protecting RB
R							LWD along bank
G					P		
R							LWD with gravel bar along LB
G		11760					logjam
P					R		P upstream of log jam > 1.2 m deep
R	59	11780	R		P		riparian vegetation shrubs and saplings
G	34	11839			P		P 1 m deep
R	12	11873			P		clean cobble/gravel in riffle
P		11885					LWD
G					P		field on LB with spruce tree buffer
R							
G		11958					RB gravel bars; undercut bank; JM on abandoned channel
R							
G							only grassess along LB

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
R							field along LB, EB
P							> 1 m deep
R							tributary from LB; extensive gravel bar
G					P		
R			R/G/R				
G							RB EB 1.5 m high
R					P		
G			G/P		R		LWD functional; gravel bar
R							logjam
G							
R							
G							
R					P		
G							LWD functional
R							log jam; elevated gravel bars
P							P at LWD
G					P		P at rootwad; sandbar at LB
R					P		clean cobble/gravel
G							LB flow eroding bank 1.5 m
P					P		clean cobble/gravel; minimal cover
R							RB undercut; LB gravel bar
G							
R							
G							
R					P		backchannel along RB; RB undercut
G					P		part of RB bedrock, other part fines, EB
R							
P							
G							gravel bars and LWD
R							
G	33	13429					Thompson Road Bridge; side channel; gravel bar
R	11	13462					
G					P		RB backwater substrate fines; fry observed in riffles; fines and SWD; LB pool with LWD
R							
G							LB side channel; cobbles and fines; elevated gravel bar with island
P							at log jam; holding RB
R							
G							LWD abundant
R	18	13614					LWD along RB; undercut bank 60-70 cm; roots holding bank; gravel bar LB

Maxan Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
G	22	13631					flood signs 1.2 m (rafting); LB gravel bars; SWD PD; scour under logs across stream
R							RB cobble/gravel
G							stable banks, clean gravel; LB side channel, fines; WG ; LB EB under cottonwood
R		13714					LWD PD; clean gravel
G							LWD; LB some erosion cottonwood roots exposed
R	60	13776					LB EB; cattle access; trout fry observed
G	29	13838					elevated bar; undercut bank; LWD
P							at LWD
R		13867					LB 2 m high; RB 0.2 m high
G							LB 2 m high; RB 0.2 m high; LB EB; minimal cover.
R							
G							LWD and SWD along RB
R	22	13993					vegetated bar; sidechannel trickle water only
G	10	14014					
R							
G					P		
P	6	14045					RB EB
G							
P	60	14195					beaver dam; confluence Foxy Creek
G	91	14255					
R							
G							
R							
G	18	14471					
P	12	14489					
R	5	14494					
G							
P							
R	3	14525					
P	22	14528					
G	31	14550					
R	3	14581					
G							
P							
R							
G	12	14598					
R	3	14610					
G		14613					
O		15316					

Foxy Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
G	24	0			P		Tertiary P with LWD and OV
R	46	24					Cobbles and fines. Undercut RB. Canopy cover 0, few LWD, cover 10%
							channel splits in two at 70 m upstream
R	5	70	R/P				Left bank channel new; meandering
G	9	75					
P	7	84					JM - water flowing through and around - only partial barrier
G	18	91			R	2	
O	38	109					BD 90 cm high flooding riparian vegetation
G	30	147					off-channel wetland to beaver pond; another BD with pond. Rip veg. alders, willows, LWD.
P	1	177					JM at 182 m - not barrier
R	31	178					old road crossing (prescription site)
G	32	209					off channel habitat - wetland - access P 30 m long; cattle access LB
R	45	241	R/P				
G	17	286			P		JM near LB
R	7	303					
G	18	310			P		
R	8	328					
G	17	336			P		
R	17	353					
G	29	370	G/R/G				
R	11	399					RB EB and undercut; cottonwood roots exposed
P	3	410					at JM
R	35	413					
G	33	448			P		JM at 460 m
R	105	481	R				no LWD or pools. RB undercut with side channels; cover OV, C, B
G	28	586					
R	59	614	R/G				
G	5	673					
R	147	678					RB EB and LWD
G	22	825					side channel 15 m P access
R	13	847					WG; JM along LB
G	41	860	G/P/R				side channel no flow; RB 3 m high EB
R	41	901					
G	2	942			P		RB EB 2 m high, under cutting; fines on gravel
R	5	944	R/G				algae abundant
G	16	949					

Foxy Creek

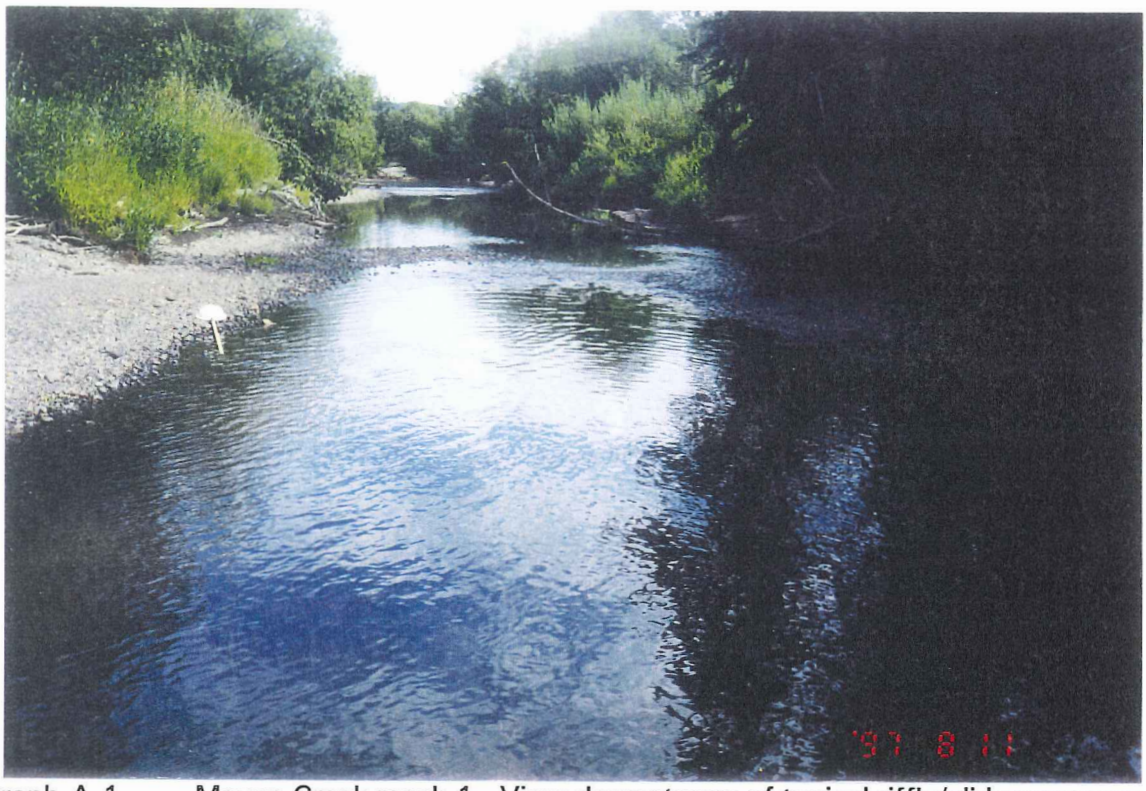
Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
R	62	965			P		LWD abundant; LB EB; moss on cobble
G	37	1027					some RB and LB erosion; cattle access
R	15	1064					LB EB
P	9	1079					
R	9	1088					RB EB
G	13	1097					
R	37	1110					RB EB and undercut 30 cm in places
G	28	1147					
R	13	1175					
G	28	1188					cattle access
R	42	1216					
G	21	1258					with boulder clusters prescription site
R	60	1279					
G	50	1339					
R	50	1389			P		BRIDGE
P	2	1439					
R	23	1441					
G	8	1464					
P	3	1472					
G	9	1475					RB undercut 1 m
R	40	1484	R/R		P/P		undercut RB 75 cm; small falls 20 cm
G	15	1524					side channel (old channel) 46 m
P	5	1539					under JM debris
R	37	1544			P		
G	10	1581					
R	3	1591					
G	23	1594					
R	37	1617			P/P		backwater at JM, G access, 15 m
G	7	1654					
R	110	1661			P/P		sidechannel P access, > 10 m
O	377	1771					stream branches flow through trees; if water goes back into original channel would be R/G sequence
P	10	2148					
G	33	2158					
R	15	2191					
G	12	2206					
R	31	2218					beaver dam across half of channel

Foxy Creek

Primary Habitat Unit	Unit Length (m)	Distance from mouth (m)	Secondary Habitat Unit	Length (m)	Tertiary Habitat Unit	Length (m)	Habitat Comments
G	7	2249					
P	8	2256					
R	21	2264					
G	9	2285					
R	7	2294	R/G				70 cm cutbank
G	6	2301					
P	13	2307					
R	2	2320					
G	9	2322					
R	106	2331					
G	8	2437					
P	7	2445					
R	17	2452					
G	8	2469					
R	23	2477					
G	13	2500					
	2513						

APPENDIX B

PHOTOGRAPHS OF TYPICAL HABITAT IN MAXAN AND FOXY CREEKS



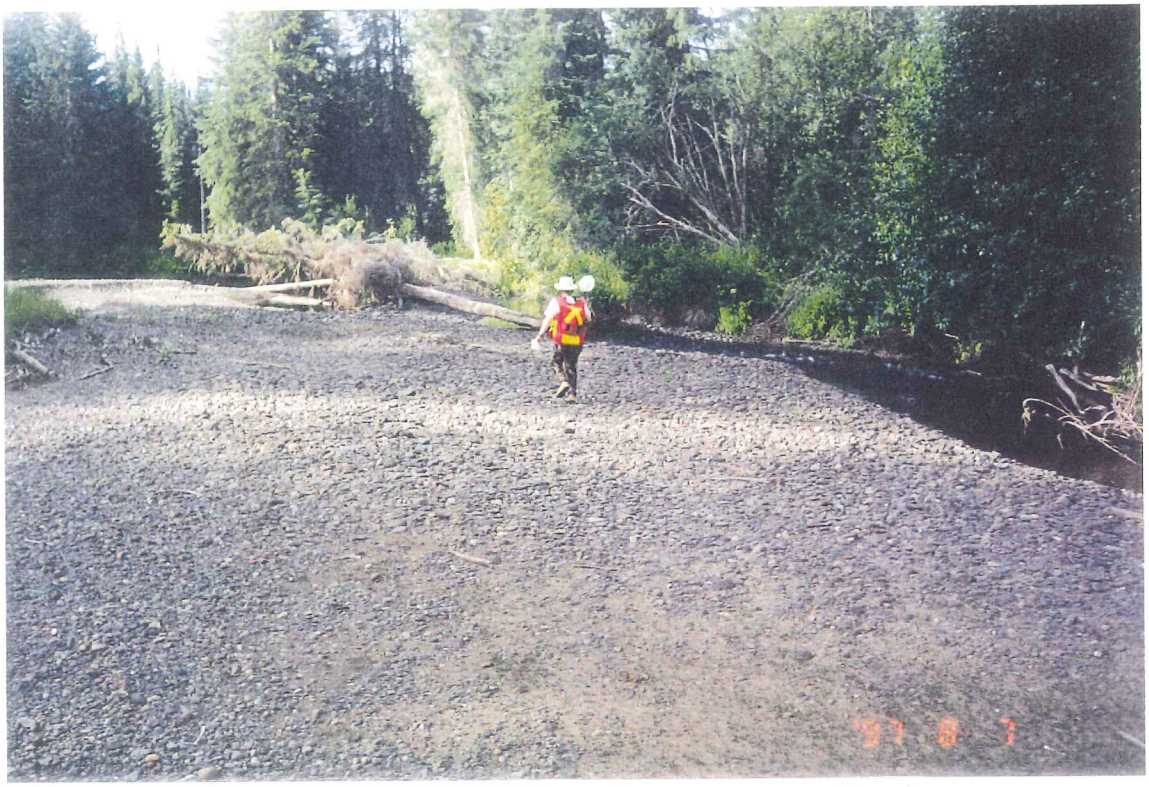
Photograph A-1. Maxan Creek reach 1. View downstream of typical riffle/glide sequence.

Photograph A-2. Maxan Creek reach 1. View downstream of riffle.

Photograph A-3. Maxan Creek reach 1. View upstream of side channel with fines.

Photograph A-4. Maxan Creek reach 1. View downstream of fines accumulation along bar and bank.

Photograph A-5. Maxan Creek reach 2. View downstream of riffle and LWD



Photograph A-6. Maxan Creek reach 2. View downstream of gravel bar

Photograph A-9. Foxy Creek reach 1. View upstream of riffle. Right downstream bank is undercut.

Photograph A-10. Foxy Creek reach 1. View upstream of cover .

APPENDIX C

HABITAT SURVEY DATA FORM

Forest District:
NTS map sheet: 93L/8
Survey Date (dd/mm/yy): August 10, 11, 1997

Watershed: Maxan
Weather: sunny, calm
Survey Crew: T-LJ/CG-S

Sub-Basin: Maxan Creek
Discharge (m^3s^{-1}): 0.3
Subsampling Fractions: R11/47:P9/39:G11/50

	Reach	Distance (m)	Habitat Type	Habitat Unit	Length (m)	Gradient (%)	Mean Depth Bankfull (m)	Mean Depth Water (m)			Mean Width Bankfull (m)	Mean Width Wetted (m)	Pools Only Depth (m)	Pools Only Crest (m)	Pools Only Residual (m)	Pools Only Pool Type	Bed Material Type Dom	Bed Material Type Sub Dom	Bed Material Type Spawning Gravel		Total LWD	Functional LWD Tally 10-20 cm	Functional LWD Tally 20-50 cm	Functional LWD Tally >50 cm
3	1	3267	G	1	17.9	2.6	0.55	0.28	0.37	0.25	15.75	8.80					G	S	N		0			
8	1	3035	G	1	54.8	2.6	0.69	0.30	0.21	0.20	24.25	8.10					S	C	N		0			
11	1	2852	G	1	68.1	2.6	0.65	0.19	0.28	0.29	9.85	9.54					C	G	AR	L	0			
14	1	2811	G	1	16.9	2.6	0.65	0.3	0.32	0.44	23.2	6.4					S	C	N		0			
17	1	2742	G	1	13.0	1.6	0.75	0.3	0.31	0.15	21.1	6.95					C	G	AR	L	1			1
20	1	2630	G	1	23.0	1.6	0.26	0.2	0.19	0.25	14.0	14.0					G	C	R	L	0			
22	1	2599	G	3	19.5	1.6	0.59	0.2	0.28	0.39	18.05	4.83					C	G	AR	L	0			
23	1	2564	G	1	41.2	1.6	1.08	0.34	0.39	0.41	16.30	9.70					S	C	N		1			
26	1	2391	G	1	92.0	1.6	0.49	0.39	0.25	0.38	17.30	5.10					S	G	N		1			1
29	1	2226	G	1	94.0	1.6	0.80	0.50	0.28	0.42	26.70	8.60					S	G	N		2			
32	1	2163	G	1	14.0	1.6	0.40	0.35	0.28	0.36	18.10	9.80					C	S	N		5	1	3	
2	1	3291	P	1	14.1	2.6	0.60	0.69	0.82	0.81	22.25	7.20	0.82	0.20	0.62	S	S	G	N		0			
4	1	3245	P	3	5.7	2.6	0.37	0.68	0.65	0.60	15.75	4.40	0.68	0.17	0.51	S	S	G	N		0			
6	1	3131	P	3	2.4	2.6	0.79	0.49	0.50	0.53	18.10	1.90	0.53	0.19	0.34	S	G	S	N		2	1		1
10	1	2881	P	2	14.0	2.6	0.60	0.62	0.58	0.41	13.40	4.10	0.62	0.20	0.42	S	C	S	N		0			
13	1	2828	P	1	10.8	2.6	2.32	1.2	1.3	1.5	22.5	6.55	1.5+	0.22	>1	S	S	C	N		JM		10	
16	1	2755	P	1	24.6	2.6	1.35	0.7	1.05	1.1	20.65	8.9	1.5+	0.2	>1	S	S	C	N		JM			
19	1	2653	P	1	37	1.6	1.08	0.8	0.79	0.81	15.5	8.4	0.81	0.19	0.62	S	S	C	N		2	2		
24	1	2528	P	1	36.7	1.6	0.65	1.00	0.90	1.25	16.00	16.00	1.25	0.15	1.10	S	S	C	N		JM		10	
28	1	2356	P	1	11.0	1.6	0.75	0.68	0.65	0.73	31.10	5.60	0.73	0.15	0.58	S	S	C	N		2		1	
31	1	2177	P	1	39.0	1.6	0.37	0.71	0.76	0.79	35.00	1.50	0.79	0.17	0.62	S	S	G	N		1	1		
1	1	3305	R	1	58.0	2.6	0.69	0.09	0.11	0.07	22.55	17.70					G	C	AR	H	1	1		
5	1	3171	R	1	39.3	2.6	0.81	0.08	0.22	0.19	17.60	14.55					G	C	AR	L	0			
7	1	3091	R	1	6.1	2.6	0.60	0.18	0.21	0.20	28.90	5.60					G	C	AR	L	0			
9	1	2888	R	2	7.7	2.6	0.44	0.05	0.04	0.04	11.90	4.70					C	G	R	L	0			
12	1	2839	R	1	13.8	1.6	0.47	0.10	0.18	0.09	29.60	10.50					C	G	AR	H	0			
15	1	2804	R	1	7.4	1.6	0.54	0.10	0.11	0.05	24.1	6.5					C	G	R	L	0			
18	1	2736	R	2	7.1	1.6	0.65	0.15	0.19	0.12	28.05	1.8					C	G	AR	H	0			
21	1	2605	R	1	25.2	1.6	0.41	0.18	0.03	0.12	18.05	12					C	G	AR	H	0			
25	1	2423	R	2	15.0	1.6	0.55	0.10	0.11	0.09	15.00	2.90					C	G	R	L	0			
27	1	2367	R	1	29.0	1.6	0.42	0.16	0.15	0.19	19.40	5.74					C	G	AR	H	1		1	
30	1	2205	R	2	27.0	1.6	1.60	0.13	0.19	0.12	17.45	3.70					G	C	AR	L	0			

Cover											Offchannel Habitat			Disturbance Indicators	Riparian Vegetation			Barriers	Comments
Total %	Type	%	Type	%	Type	%	Type	%	Type	%	Type	Access	Length (m)		Type	Structure	Canopy Closure		
10	SWD	20			OV	80									S	INIT	0		cattle access
25	SWD	50			OV	50								ER (LB)	M	MF	0		flood sign 1.5 m
5					OV	100								EB	S	SHR	0		
10			B	100							W	G/P	20	EB, BC	M	MF	0		seasonally flooded; RB access P; LB access G
20	LWD	100												2 DW	M	MF	0		
10	SWD	50	B	50											M	MF	0		
5	SWD	5	B	90	OV	5									M	MF	0		
10	LWD	30			OV	40	C	30						PD, EB	S	SHR	0		field LB, cattle access
5			B	90	OV	10								EB	S	SHR	0		
25	SWD	70			OV	25	C	5						EB	M	YF	1		some undercut banks
5	LWD	25	B	50	SWD	25								EB (RB)	S	SHR	0		grasses along RB; bankful depth 1.7 m
10	SWD	25			DP	50	OV	25							S	INIT	0		cattle access
40	SWD	20			DP	60	OV	20							S	INIT	0		cattle access
50	LWD	50			DP	45	OV	5						ER	S	SHR	0		
25					DP	70	OV	30							S	INIT	0		
60	LWD	10	SWD	25	DP	60	OV	5						PD, EB	M	MF	1		
75	LWD	20	SWD	10	DP	70								JM, EB	M	MF	1		
50	LWD	5	SWD	5	DP	85	OV	5						EB (LB)	S	SHR	0		
60	LWD	30			DP	70								JM, PD	S	SHR	0		cattle access
50	LWD	10	SWD	30	DP	55	OV	5						EB	S	SHR	0		
60	SWD	45			DP	50	OV	5						EB (RB), PD	S	SHR	0		undercut RB
10	SWD	20	B	80										EB	G	INIT	0		road crossing and cattle access
10	SWD	25	B	50	OV	25								EB (RB)	M	YF	1		cattle access
5			B	100										ER (LB)	M	MF	0		
5			B	100											S	INIT	0		
5			B	100											M	MF	0		
25			B	100										MB	M	MF	0		
5			B	100											M	MF	0		
5			B	90	OV	10									M	MF	0		
20			B	100										EB (RB)	S	SHR	0		side channel with isolated pools; field RB EB
15	LWD	10	B	90							W, SC	G	30	MB, WG (fines)	S	SHR	0		algae
5	SWD	10	B	90										EB (RB)	S	SHR	0		cattle access; algae

Forest District:
NTS map sheet: 93L/8
Survey Date (dd/mm/yy): August 7, 8, 9, 1997

Watershed: Maxan
Weather: windy/partly cloudy
Survey Crew: CG-S/T-LJ

Sub-Basin: Maxan Creek
Discharge (m^3s-1): 0.08
Subsampling Fractions: R:10/22:P8/17:G9/20

	Reach	Distance (m)	Habitat Type	Habitat Unit	Length (m)	Gradient (%)	Mean Depth Bankfull (m)	Mean Depth Water (m)			Mean Width Bankfull (m)	Mean Width Wetted (m)	Pools Only Depth (m)	Pools Only Crest (m)	Pools Only Residual (m)	Pools Only Pool Type	Bed Material Type Dom	Bed Material Type Sub Dom	Bed Material Type Spawning Gravel		Total LWD	Functional LWD Tally 10-20 cm	Functional LWD Tally 20-50 cm	Functional LWD Tally >50 cm
2	2	13547	G	1	43.3	1.4	0.61	0.24	0.41	0.39	16.40	4.50					C	G	L	AR	2		1	
5	2	13631	G	1	22.2	1.4	0.92	0.20	0.25	0.32	18.95	3.70					C	G	L	AR	2			
8	2	13784	G	2	33.0	1.4	2.49	0.09	0.19	0.16	24.80	5.90					S	G	N		4	2	1	
9	2	13838	G	1	29.4	1.7	0.65	0.58	0.60	0.42	24.10	15.00					C	G	L	AR	8		1	1
11	2	14015	G	1	9.5	1.7	0.99	0.17	0.28	0.39	18.80	11.20					C	G	L	AR	1			
15	2	8545	G	1	84.0	1.7	0.82	0.32	0.21	0.25	14.45	11.20					C	G	N		2			2
18	2	8474	G	1	105.2	1.7	0.82	0.23	0.29	0.32	14.20	8.40					C	G	L	AR	9		2	
22	2	8381	G	1	12.0	1.7	0.69	0.19	0.29	0.17	12.50	10.51					C	G	N		7			7
26	2	8314	G	1	20.1	1.7	1.10	0.25	0.50	0.60	21.03	7.00					C	S	N		11			3
3	2	13529	P	3	13.0	1.4	1.02	1.00	0.75	0.82	16.40	1.50	1.00	0.19	0.81	S	C	G	N		7		7	
6	2	13640	P	3	13.0	1.4	1.60	0.75	0.80	1.00	18.90	1.60	1.00	0.18	0.82	S	C	S	N		4		3	1
12	2	14046	P	3	5.8	1.7	2.31	0.60	0.80	1.11	30.00	6.10	1.11	0.20	0.91	S	C	G	N		0			
14	2	8642	P	3	2.5	1.7	1.49	0.79	0.72	0.65	12.25	2.60	0.79	0.50	0.29	S	C	G	N		0			
17	2	8510	P	1	10.7	1.7	1.20	0.79	0.94	1.00	16.10	6.75	1.00	0.38	0.62	S	S	C	N		1			
19	2	8396	P	3	5.1	1.7	1.22	0.75	0.78	0.82	13.85	1.90	0.82	0.48	0.34	S	C	S	N		3	1	2	
23	2	8370	P	1	10.9	1.7	1.80	1.15	1.10	1.40	12.50	12.00	1.40	0.15	1.25	S	C	S	N		JM			10
27	2	8256	P	3	9.0	1.7	2.10	1.20	0.82	1.40	14.15	6.70	1.40	0.11	1.29	S	C	S	N		4	2		2
1	2	13467	R	1	11.0	1.4	0.30	0.05	0.10	0.09	20.90	18.70					C	G	L	AR	2			
4	2	13614	R	1	17.8	1.4	1.18	0.20	0.20	0.28	19.85	2.30					C	G	L	AR	JM		10	
7	2	13776	R	1	59.9	1.9	0.57	0.25	0.28	0.27	24.80	5.80					C	G	L	AR	3		3	
10	2	13993	R	1	21.6	1.7	1.05	0.22	0.25	0.18	14.80	6.15					C	G	H	AR	0			
13	2	8647	R	1	24.1	1.7	1.20	0.18	0.10	0.20	15.00	3.35					G	C	H	AR	0			
16	2	8521	R	1	23.9	3.5	0.28	0.12	0.18	0.11	16.00	5.20					C	G	H	AR	1			1
20	2	8458	R	1	15.6	1.7	1.11	0.17	0.20	0.21	16.05	3.50					G	C	H	AR	0			
21	2	8370	R	2	9.1	1.7	0.94	0.03	0.04	0.04	16.05	2.15					G	C	L	AR	0			
24	2	8365	R	1	5.0	1.7	0.88	0.18	0.11	0.10	19.17	6.05					C	G	L	AR	0			
25	2	8334	R	1	21.2	1.7	0.72	0.10	0.22	0.12	17.40	3.65					G	C	H	AR	JM			10

Cover											Offchannel Habitat			Disturbance Indicators	Riparian Vegetation			Barriers	Comments
Total %	Type	%	Type	%	Type	%	Type	%	Type	%	Type	Access	Length (m)		Type	Structure	Canopy Closure		
30	LWD	10	SWD	10	OV	15	B	60	C	5				PD	M	MF	1		No boulders, cover is cobble
30			SWD	20	OV	20	B	40	C	20				PD, DW	M	MF	1		RDB erosion
20	LWD	40	SWD	40	IV	20								EB, PD, MB	M	YF	1		bankfull width includes cat 1 + 2; YF LB
20	LWD	80	IV	10	OV	TR	B	5	C	5				PD, MB	M	YF	1		
15			SWD	80			B	80						PD, DW	M	MF	1		
40	LWD	10	IV	30	OV	10	B	40	C	10				EB, DW	M	MF	1		
20	LWD	5	IV	5	OV	15	B	75	C	TR				PD	M	MF	1		
25	LWD	50	SWD	40	OV	10								WG, MB	M	MF	1		
35	LWD	20	SWD	5	OV	5	B	10	C	60				PD, EB, MB	M	MF	1		deep cutbank
70	LWD	40			DP	60								PD	M	MF	1		PD along LDB
80	LWD	40	SWD	10	DP	50								PD, SC	M	MF	1		
80			OV	5	DP	90	B	5						EB, 2 DW	M	MF	1		
80			OV	TR	DP	90			C	10				EB	M	MF	1		
80			OV	5	DP	95					TRIB	P	is dry	MB	M	MF	1		
90	LWD	10	SWD	30	DP	60								PD	M	MF	1		
95	LWD	40	SWD	40	DP	20								JM	M	MF	1		max. depth under JM could be >1.4 m
85	LWD	40	SWD	30	DP	30								PD	M	MF	1		
10							B	100						MB	M	MF	1		
80	LWD	50					B	20	C	30				PD, DW	M	MF	1		wetted width includes CT width
20	LWD	5					B	90	C	5	SC	G	59.9	PD, MB	M	MF	1		MF RB
25					OV	tr	B	95	C	5	SC	G	66.2	EB, BC, DW	M	MF	1		side channel is abandoned
30					OV	10	B	60	C	30				EB, DW	M	MF	1		
15	LWD	10					B	90			SC	G	30	MB	M	MF	1		
10	SWD	70					B	30						EB, DW	M	MF	1		
5	SWD	10					B	90							M	MF	1		grass, shrubs, trees; cows eroding bank
5							B	100						DW (2)	M	MF	1		
20	LWD	20	SWD	60			B	20						JM, DW	M	MF	1		

Forest District:

Watershed: Maxan

Sub-Basin: Foxy

NTS map sheet: 93L/8

Weather: hot/partly cloudy

Discharge (m^3s^{-1}): 0.22

Survey Date (dd/mm/yy): August 8, 12,13, 1997

Survey Crew: TLJ/CGS

Subsampling Fractions: R16/44:P14/18:G16/35

Foxy Creek upstream from mouth

	Reach	Distance (m)	Habitat Type	Habitat Unit	Length (m)	Gradient (%)	Mean Depth Bankfull (m)	Mean Depth Water (m)			Mean Width Bankfull (m)	Mean Width Wetted (m)	Pools Only Depth (m)	Pools Only Crest (m)	Pools Only Residual (m)	Pools Only Pool Type	Bed Material Type Dom	Bed Material Type Sub Dom	Bed Material Type Spawning Gravel		Total LWD	Functional LWD Tally 10-20 cm	Functional LWD Tally 20-50 cm	Functional LWD Tally >50 cm
3	1	273	G	1	17	1.5	0.60	0.40	0.32	0.22	16.76	3.80					C	G	L	AR	7		4	
6	1	328	G	1	17	1.5	1.50	0.40	0.30	0.28	17.30	4.80					C	G	N		0			
8	1	391	G	2	9	1.5	0.75	0.15	0.16	0.25	21.00	4.30					C	G	L	AR	4		3	
11	1	578	G	1	28	1.5	1.10	0.26	0.39	0.40	12.20	6.25					C	G	L	AR	0			
13	1	847	G	1	22	1.5	0.85	0.30	0.35	0.28	17.15	6.40					C	G	N		2			
15	1	964	G	1	32	1.5	0.50	0.19	0.20	0.16	13.05	8.85					C	G	L	AR	3		1	
18	1	1079	G	1	37	1.5	0.76	0.26	0.22	0.19	12.20	5.60					C	G	L	AR	3			
22	1	1199	G	1	28	1.5	0.83	0.24	0.43	0.22	8.95	8.30					C	S	N		0			
5	1	1536	G	1	8.3	2.0	0.60	0.25	0.30	0.20	7.10	5.25					C	S	N		2		1	
9	1	1596	G	1	15.1	2.0	0.88	0.35	0.40	0.38	2.25	2.40					S	C	N		1			
11	1	1653	G	1	9.2	2.0	0.81	0.30	0.50	0.58	5.86	4.70					S	G	N		4	3	1	
1	1	2674	G	1	13	0.5	0.71	0.33	0.31	0.28	7.45	6.65					C	G	L	AR	1	1		
4	1	2602	G	1	8	0.5	0.71	0.28	0.49	0.45	8.85	4.75					C	S	N		0			
7	1	2377	G	1	6	0.5	0.44	0.22	0.40	0.25	19.60	6.70					C	G	L	AR	2			
10	1	2325	G	1	7	0.5	0.41	0.34	0.20	0.39	12.05	8.85					G		L	R	1			
12	1	2233	G	1	33	0.5	0.66	0.60	0.41	0.38	17.00	3.30					G	G	N		0			
2	1	264	P	2	4	1.5	1.10	0.50	0.40	0.50	10.43	2.10	0.50	0.10	0.40	S	C	S	N		4		3	
4	1	313	P	3	11	1.5	1.39	1.09	0.95	0.85	19.90	3.25	1.09	0.10	0.99	S	C	G	N		3		1	
9	1	402	P	1	3	1.5	1.35	0.85	0.76	0.70	25.50	4.00	0.85	0.12	0.73	S	C	G	N		JM		10	
16	1	985	P	3	3	1.5	0.40	0.68	0.66	0.58	13.05	2.00	0.68	0.15	0.53	S	C	S	N		3		1	
20	1	1131	P	1	9	1.5	1.40	0.80	0.89	0.90	11.00	4.14	0.90	0.11	0.79	S	C	B	N		JM			2
1	1	1489	P	3	1.7	2.0	0.70	0.50	0.40	0.50	8.20	3.45	0.50	0.20	0.30	S	S	G	N		1			1
2	1	1491	P	1	2.0	2.0	0.95	0.85	0.80	0.65	10.52	5.03	0.85	0.20	0.55	O	S	G	N		2		1	1
4	1	1516	P	3	2.8	2.0	0.68	0.81	0.68	0.65	11.96	2.05	0.81	0.18	0.63	S	S	C	N		1	1		
6	1	1544	P	1	3.3	2.0	0.85	0.90	0.95	0.75	14.90	4.40	0.95	0.30	0.63	S	S	C	N		6	1	3	
8	1	1580	P	3	6.4	2.0	1.05	0.51	0.55	0.52	6.19	2.40	0.55	0.20	0.35	S	S	C	N		3	3		
3	1	2610	P	1	6	0.5	0.68	0.71	0.75	0.70	11.20	4.10	0.75	0.23	0.52	S	C	B	N		1		1	
6	1	2383	P	1	13	0.5	0.30	0.78	0.80	0.73	26.00	2.45	0.80	0.10	0.70	S	C	G	L	R	0			
9	1	2332	P	1	8	0.5	0.40	1.02	1.20	0.50	6.30	5.70	1.20	0.20	1.00	S	S	C	N		2		2	
13	1	2223	P	1	10	0.5	1.32	0.90	0.91	0.95	15.90	7.10	0.95	0.20	0.75	S	G	S	N		JM		10	

	Reach	Distance (m)	Habitat Type	Habitat Unit	Length (m)	Gradient (%)	Mean Depth Bankfull (m)	Mean Depth Water (m)			Mean Width Bankfull (m)	Mean Width Wetted (m)	Pools Only Depth (m)	Pools Only Crest (m)	Pools Only Residual (m)	Pools Only Pool Type	Bed Material Type Dom	Bed Material Type Sub Dom	Bed Material Type Spawning Gravel		Total LWD	Functional LWD Tally 10-20 cm	Functional LWD Tally 20-50 cm	Functional LWD Tally >50 cm
1	1	250	R	2	20	1.5	0.50	0.10	0.09	0.08	11.81	2.21					C	G	L	AR	2			
5	1	320	R	1	8	1.5	1.13	0.08	0.11	0.13	23.00	9.45					C	G	L	AR	2			
7	1	384	R	2	7	1.5	0.62	0.08	0.12	0.11	20.65	5.70					C	G	L	AR	0			
10	1	405	R	1	35	1.0	0.75	0.10	0.11	0.15	14.75	6.25					C	G	H	AR	7		4	1
12	1	606	R	1	59	1.5	0.70	0.08	0.20	0.15	10.62	6.15					C	G	H	AR	17			1
14	1	869	R	1	13	1.5	0.55	0.15	0.15	0.10	16.75	5.20					C	C	L	AR	2			
17	1	996	R	1	5	1.5	0.55	0.08	0.08	0.15	17.00	5.65					C	G	H	AR	1			
19	1	1116	R	1	15	1.5	0.41	0.11	0.11	0.10	9.15	3.65					C	G	L	AR	2			
21	1	1162	R	1	37	1.5	0.82	0.10	0.20	0.22	8.65	3.80					C	G	L	AR	0			
3	1	1493	R	1	23.0	2.0	0.90	0.30	0.20	0.10	3.90	4.90					C	S	L	AR	JM	10		
7	1	1556	R	1	39.9	2.0	1.28	0.20	0.15	0.20	5.67	4.65					C		H	AR	1	1		
10	1	1616	R	1	36.8	2.0	0.69	0.25	0.30	0.32	4.65	2.86					S	C	N		6			
2	1	2651	R	1	23	0.5	0.34	0.20	0.23	0.10	9.05	8.10					C	B	N		0			
5	1	2496	R	1	106	0.5	0.36	0.11	0.20	0.18	10.45	6.30					C	G	AR	H	10		5	
8	1	2370	R	1	7	0.5	0.33	0.10	0.05	0.09	19.60	4.90					C	G	L	AR	1			
11	1	2294	R	1	31	0.5	0.29	0.09	0.24	0.10	13.60	10.20					C	G	L	AR	3	1		

Cover											Offchannel Habitat				Riparian Vegetation				
Total %	Type	%	Type	%	Type	%	Type	%	Type	%	Type	Access	Length (m)	Disturbance Indicators	Type	Structure	Canopy Closure	Barriers	Comments
35	LWD	10	SWD	5	B	80			OV	5				PD, DW	M	MF	1		
20					B	90			OV	10				EB	M	MF	1		
15	LWD	5	SWD	5	B	90								PD, MB	M	MF	1		bar 40 cm high
15			SWD	10	B	80			OV	10				EB	M	MF	1		
20			SWD	25	B	65			OV	10	SC	P		SWD, EB	M	MF	1		old side channel
10	LWD	5	SWD	10	B	85								PD, EB	M	MF	1		erosion of topsoil on right bank
15			SWD	5	B	80	IV	10	OV	5				EB, PD	M	MF	1		
15					B	85	CT	10	OV	5				EB	M	MF	1		
20	LWD	35			B	35			OV	30					M	MF	1		
30							CT	50	OV	50				EB	S	SHR	0		grasses, shrubs
15	LWD	15	SWD	25					OV	50				PD, EB	D	YF	2		
20					CT	5	B	85	OV	10				EB (RB)	M	MF	1		boulders; cutbank 60 cm; snag with roots functioning as LWD
20					CT	5	B	70	OV	25					M	MF	0		
20	LWD	10	SWD	10			B	80						DW	D	MF	0		
20	LWD	30	SWD	40					OV	30				EB (RB)	M	MF	0		
40			SWD	35	CT	30			OV	35	SC to W	P	>20	EB (RB), DW	M	MF	1		gravel bar 14 m wide; cutbank 40 cm
30	LWD	30	SWD	50			DP	10	OV	10				PD	M	MF	1		
80	LWD	40	SWD	30			DP	30						PD, EB	M	MF	1		
60	LWD	50	SWD	30			DP	20						JM	M	MF	1		
30	LWD	5	SWD	90			DP	5						PD	M	MF	0		bankfull depths - right 2 m, left 0.4 m
25	LWD	10	SWD	60			DP	30						PD, EB	M	MF	1		
50	LWD	40					DP	50	OV	10				LWD	M	MF	1		alder, spruce
40	LWD	40					DP	50	OV	10				LWD	M	MF	1		
20	LWD	50					DP	50						EB	M	YF	1		cutbank >13 cm; poplar
40	LWD	20	SWD	20			DP	60							M	YF	1		
50	LWD	55	SWD	5			DP	40						EB	D	YF	1		
40			SWD	25	CT	25	B	25	DP	25				EB (LB)	D	MF	1		cutbank 1.5m
40			SWD	20	DP	80								EB (LB)	D	MF	1		SWD parallel to banks
40	LWD	5	SWD	5	DP	85			OV	5	SC	G	>20	EB (RB)	M	MF	1		
50	LWD	60	SWD	10	DP	20			OV	20	W	P		JM, DW	M	MF	1		Muskeg wetland RB

Cover											Offchannel Habitat			Disturbance Indicators	Riparian Vegetation			Barriers	Comments
Total %	Type	%	Type	%	Type	%	Type	%	Type	%	Type	Access	Length (m)		Type	Structure	Canopy Closure		
5			SWD	10	B	90								DW	M	MF	1		
20			SWD	5	B	90			OV	5				EB	M	MF	1		
35					B	90			OV	10				EB	M	MF	1		
15	LWD	15	SWD	10	B	65			OV	10				PD	M	MF	1		
10	LWD	5	SWD	5	B	85			OV	5				EB, PD	M	MF	1		
10			SWD	15	B	85								JM	M	MF	0		
10			SWD	25	B	75									M	MF	0		
15			SWD	15	B	85					SC/trib			EB	M	MF	1		
10					B	90	CT	5	OV	5				EB	M	MF	1		
50	LWD	30	SWD	30			CT	20	OV	20				JM	M	MF	1		cutbank LB 70 cm included in wetted width; alder, spruce
20	LWD	20	SWD	30	B	30	CT	20						EB	M	YF	1		tree masses with dirt; alders
40			SWD	50			CT	50			SC	P	30		M	YF	1		
20					B	95			OV	5					M	MF	0		caddisflies and alder abundant
40	LWD	15			B	80	CT	5			SC	P	20	PD	M	MF	1		cutbank 20 cm
20					B	100								DW	M	MF	0		
25			SWD	10	B	85			OV	5	SC to W	P	>20	all PD	M	MF	0		

APPENDIX D

FISH DATA

Fish Data Collection Form

A. Location Referencing

Gaz Name Foxy Creek **Alias**

Wtrshd Code 000-0000-000-000-000-000-000-000-000-000-000-000 **Seq #** 0

Reach # 1 **Interim Locational ID:** **Project ID** KX02778

(BCGS/NTS) Map # 93L/8 **Locational Point #**

B. Survey Information

Survey Date 1997-08-11 **to** 1997-08-12 **Agency** C063

Crew CGS-TLJ- **Fish Collection Permit #** 34770-20

General Comments

SITE 1: 180 m upstream from confluence; SITE 2 1380 m upstream from confluence. Visibility clear

C. Station Identification and Conditions

Site	Method	#	UTM Coordinates	Temp	Con	Vis	Turb
1	MT	6		12			
2	MT	6		12			

D. Fish Summary

Site	Meth	#	H/P	Species	Stage	Age	Tot #	Min Lgth	Max Lgth	Fish Act
1	MT	6	1	RB	J		17	65	112	R
1	MT	6	1	LSU	J		3	88	91	R
2	MT	6	1	RB	J		7	68	105	R

E. Gear Specifications

Site	Meth	#	H/P	D In	T In	D Out	T Out	EF Sec	EF Lgth	EF Wdth	Encl	Nt Typ	Lgth	Dpth	Mesh	IN Sz	Set	Hab	Volt	Freq	Pul	Make	Model
1	MT	6	1	08-11	1715	08-12	0915																
2	MT	6	1	08-11	1745	08-12	1500																

F. Individual Fish Data

Site	Meth	#	H/P	Species	Lgth	Wgt	Sex	Mat	Age Str	Age Smp #	Age	Vouch #	Gen Str	Gen Smp #	Comments	Roll	Fr
1	MT	6	1	RB	105		U	IM							Glide by riprap		
1	MT	6	1	LSU	90		U	IM							Pool		
1	MT	6	1	RB	100		U	IM							Pool		
1	MT	6	1	RB	73		U	IM							Riffle		
1	MT	6	1	RB	101		U	IM							Riffle		
1	MT	6	1	RB	112		U	IM							Riffle		
1	MT	6	1	RB	88		U	IM							Riffle		
1	MT	6	1	RB	106		U	IM							Riffle		
1	MT	6	1	RB	74		U	IM							Riffle		
1	MT	6	1	RB	94		U	IM							Riffle		
1	MT	6	1	RB	78		U	IM							Glide by riprap		
1	MT	6	1	LSU	88		U	IM							Pool		
1	MT	6	1	RB	75		U	IM							Glide by riprap		
1	MT	6	1	LSU	91		U	IM							Glide by riprap		
1	MT	6	1	RB	72		U	IM							Glide by riprap		
1	MT	6	1	RB	73		U	IM							Glide by riprap		
1	MT	6	1	RB	73		U	IM							Riffle		
1	MT	6	1	RB	68		U	IM							Riffle		
1	MT	6	1	RB	74		U	IM							Riffle		
1	MT	6	1	RB	67		U	IM							Glide by riprap		
2	MT	6	1	RB	75		U	IM							Pool by rock riprap		
2	MT	6	1	RB	74		U	IM							Riffle		
2	MT	6	1	RB	68		U	IM							Glide at overstream vegetation		
2	MT	6	1	RB	74		U	IM							Glide at overstream vegetation		

Fish Data Collection Form

Site	Meth	#	H/P	Species	Lgth	Wgt	Sex	Mat	Age Str	Age Smp #	Age	Vouch #	Gen Str	Gen Smp #	Comments	Roll	Fr
2	MT	6	1	RB			U	IM							Glide at overstream vegetation		
2	MT	6	1	RB	105		U	IM							Pool by rock riprap		
2	MT	6	1	RB	84		U	IM							Pool by rock riprap		

Fish Data Collection Form

A. Location Referencing

Gaz Name Maxan Creek **Alias**

Wtrshd Code 000-0000-000-000-000-000-000-000-000-000-000-000 **Seq #** 0

Reach # 2 **Interim Locational ID:** **Project ID** KXO2778

(BCGS/NTS) Map # 93L/8 **Locational Point #**

B. Survey Information

Survey Date 1997-08-07 **to** 1997-08-07 **Agency** C063

Crew CGS-TLJ- **Fish Collection Permit #** 344770-20

General Comments

Site upstream from Thompson Road Bridge to 256 m upstream from bridge

C. Station Identification and Conditions

Site	Method	#	UTM Coordinates	Temp	Con	Vis	Turb
1	EF	1		18			

D. Fish Summary

Site	Meth	#	H/P	Species	Stage	Age	Tot #	Min Lgth	Max Lgth	Fish Act
1	EF	1	1	C	F		10	20	30	R
1	EF	1	1	LND	J		1	42	42	R
1	EF	1	1	LSU	J		1	104	104	R
1	EF	1	1	MW	J		1	60	60	R
1	EF	1	1	RB	F		30	29	36	R
1	EF	1	1	PL	J		5	90	125	R
1	EF	1	1	RB	J		20	70	134	R

E. Gear Specifications

Site	Meth	#	H/P	D In	T In	D Out	T Out	EF Sec	EF Lgth	EF Wdth	Encl	Nt Typ	Lgth	Dpth	Mesh	IN Sz	Set	Hab	Volt	Freq	Pul	Make	Model
1	EF	1	1	08-07	1030	08-07	1230	918	256	6.9	o								300	90	4	SR	12B

F. Individual Fish Data

Site	Meth	#	H/P	Species	Lgth	Wgt	Sex	Mat	Age Str	Age Smp #	Age	Vouch #	Gen Str	Gen Smp #	Comments	Roll	Fr
1	EF	1	1	RB	73		U	IM									
1	EF	1	1	RB	33		U	IM							in shallow riffle		
1	EF	1	1	RB	34		U	IM							in shallow riffle		
1	EF	1	1	C	23		U	IM									
1	EF	1	1	RB	36		U	IM				3			in shallow riffle		
1	EF	1	1	RB	29		U	IM				2			in shallow riffle		
1	EF	1	1	PL	125		U	IM							in back water		
1	EF	1	1	PL	90		U	IM							in back water		
1	EF	1	1	RB	84		u	IM									
1	EF	1	1	RB	80		U	IM									
1	EF	1	1	LNC	42		U	IM									
1	EF	1	1	RB	79		U	IM									
1	EF	1	1	RB	29		U	IM				1			in shallow riffle		
1	EF	1	1	RB	36		U	IM							in shallow riffle		
1	EF	1	1	MW	60		U	IM							in glide		
1	EF	1	1	RB	70		U	IM									
1	EF	1	1	RB	75		U	IM									
1	EF	1	1	RB	98		U	IM									
1	EF	1	1	RB	89		U	IM									
1	EF	1	1	LSU	104		U	IM									
1	EF	1	1	RB	76		U	IM									

APPENDIX E

GLOSSARY OF TERMS

GLOSSARY

Banks

- LB = left bank facing downstream
- RB = right bank facing downstream.

Barriers to Fish Movement

- N = no barriers
- X = log jams
- CV = culverts
- BR = disused bridges
- BD = beaver dams
- F = falls, vertical drops greater than 2 m
- LS = landslides or downslope movement of banks
- C = cascades or chutes.

Bed Material

- Dom = dominant
- S = sands, silts, clays or fine organic material (<2 mm diameter)
- G = gravels (2 - 64 mm)
- C = cobbles (64 - 256 mm)
- B = boulders (256 - 4000 mm)
- R = bedrock (>4000 mm).

Cover

Cover is structural elements in the wetted channel or within 1 m of the water surface that provides habitats where fish can hide, rest, or feed. It is estimated as a percentage (to nearest 5%) of wetted surface area that is covered by the following cover types:

- B = boulders
- C = cut banks
- DP = deep pools
- OV = overhanging vegetation within 1 m of the water surface
- IV = instream vegetation
- SWD = small woody debris, is a piece of dead wood, having a diameter < 10 cm and a maximum length of 2 m that intrudes into the bankfull channel.
  TR = trace, if the cover is less than 2% of the habitat unit area

Disturbance Indicators

Field indicators of channel degradation and aggradation, changes in sediment supply and transport, bank impacts, and abundance of pools, steps or riffles.

Parameter	Indicator Feature	Code
Bed Characteristics:	1. Extensive areas of scour	SC
	2. Extensive areas of (unvegetated) bar	DW
	3. Large, extensive sediment wedges	WG
	4. Elevated mid-channel bars	MB
	5. Extensive riffle zones	LR
	6. Limited pool frequency and extent	FP
Channel pattern:	1. Multiple channels	MC
Banks:	1. Eroding banks	EB
	2. Isolated sidechannels or backchannels	BC
LWD:	1. Most LWD parallel to banks	PD
	2. Recently formed LWD jams	JM

Functional LWD

LWD pieces that are the primary cause of the formation or geometry of a pool that are attached or embedded in the stream or bank.

Maximum Pool Depth (m)

Measured (or estimated, if necessary) maximum water depth (±0.05 m) within the pool.

Off-channel Habitat

Habitat separate from the main channel that may be used as fish refugia.

- SC = side channels
- SL = sloughs
- PD = ponds
- WL = seasonally flooded wetlands that could be used as refuge during high flows.

Access to off-channel habitat is noted as:

- N = no access to fish
- P = accessible at high flows only
- G = accessible at most flows.

Overstream Canopy Closure

The proportion of the surface area of the stream that is covered by the projecting riparian canopy.

- 1 - 0-20% covered
- 2 - 20-40% covered
- 3 - 40-70% covered
- 4 - 70-90% covered
- 5 - >90% covered.

Pool Type

- S = scour pool, formed by scouring around or adjacent to an obstruction such as a log, boulder, or root wad or by flow convergence where two channels join
- D = dammed pool, formed by impoundment behind a channel-spanning obstruction such as a beaver dam, log or log jam
- U = unknown (unable to classify).

Residual Depth (m)

The residual depth (± 0.05 m) of the pool as the difference between the maximum pool depth and the riffle crest depth (or pool outlet depth). Note that pools must meet both minimum surface areas and minimum residual depth criteria to be counted.

Riffle Crest (Pool Outlet) Depth (m)

The water depth (± 0.05 m) at the pool outlet.

Spawning Gravel

Spawning gravels are gravels that are located in areas where water depths greater than 15 cm and water velocities between about 0.3 and 1.0 m.s $^{-1}$ are expected during spawning season.

- N = no suitable gravel patches in the habitat unit
- L = little suitable spawning gravels (e.g., isolated pockets)
- H = extensive areas of spawning gravels.

The *type* of spawning gravel is:

- R = suitable for resident trout and char (spawning gravel patches for (small) resident trout and char should be greater than 0.1 m^2 in area with particle size between 10-75 mm)
- A = suitable for anadromous salmon (spawning gravel patches should be 1-2 m^2 in area with a particle size between 10-150 mm)
- AR = suitable for both resident trout and anadromous salmon.

Riparian Vegetation

Dominant vegetation type in the riparian area within 20 m of the stream channel. Vegetation Type includes:

- N = largely unvegetated, with much bare mineral soil visible
- G = grasslands or bog
- SH = shrub/herb, dominated by herbaceous or shrubby vegetation
- D = deciduous forest
- C = coniferous forest

- M = mixed deciduous-coniferous forest.

Structural Stage

- INIT = the non-vegetated or initial colonization stage following disturbance, with less than 5% cover
- SHR = shrub/herb stage with less than 10% tree cover
- PS = pole-sapling stage, with trees overtopping the shrub layer, usually less than 15-20 years old
- YF = young forest. Self thinning is evident and the forest canopy is differentiating into distinct layers. Stand age is typically 30-80 years.
- MF = mature forest with well-developed understory.