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FINAL REPORT

OTTER CREEK WATERSHED ASSESSMENT

Prepared for:

Weyerhaeuser Canada Ltd.
Vavenby Division
P.O. Box 130, KP Road
Vavenby, B.C.
V03 3A0

Prepared by:

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Project #753.2

December 1998

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December 1, 1998

Reference: **753.2**

Mr. Kevin Bonnett, R.P.F.
Weyerhaeuser Canada Ltd.
Vavenby Division
P.O. Box 130, KP Road
Vavenby, B.C.
V03 3A0

Dear Mr. Bonnett:

Re: Otter Creek Watershed Assessment

Please find enclosed our final report of the Otter Creek Watershed Assessment. The report follows the format outlined in the most recent interim guidelines provided by the Ministry of Forests.

The report concludes that the proposed forest development in the Upper Otter sub-basin can proceed with only negligible risk of impacts from changes in peak flow. Although no development is planned for South Otter sub-basin, we recommend that harvesting not occur until the sub-basin ECA falls below 20%. At that time the situation can be re-assessed.

Please call if you have any questions.

Yours truly,

Summit Environmental Consultants Ltd.

Hugh Hamilton, Ph.D., P.Ag.
Senior Environmental Scientist

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1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

Otter Creek is a tributary of the North Thompson River, and is thus part of the Thompson-Fraser River system. The creek flows into the North Thompson River approximately 28 km north-east of Vavenby at 51° 41' N latitude and 119° 26' W longitude. The total area of the watershed is 126 km^2. Under the *Forest Practices Code of B.C. Act*, Watershed Assessments (WAPs) are required for all Community Watersheds as well as streams with significant downstream fisheries values or licenced domestic water users. Otter Creek is deemed to have significant fisheries values[1], and a WAP is required before review of Forest Development Plans. This report presents the results of the WAP completed in 1998.

Between 1996 and 1997 a series of watershed investigations were completed by the forest licensee, Weyerhaeuser Canada Ltd., Vavenby Division (Weyerhaeuser), with funding from Forest Renewal B.C. (FRBC). These included a Level 1 Interior Watershed Assessment (Dobson Engineering, 1997), a channel assessment procedure (CAP) (Summit, 1998a), a sediment source survey and access management strategy (Summit, 1998b), and a fisheries inventory (Arc Environmental, 1997). Given the availability of this recent information, the current WAP is primarily based on the results of those studies, particularly the CAP and sediment source survey completed by Summit Environmental Consultants Ltd. (Summit) in fall 1997. These sources were supplemented by a reconnaissance inspection of Otter Creek in October 1998, a review of most-recent aerial photographs, and a review of up-to-date equivalent clearcut area (ECA) data. The report follows the recommended format provided in the Interim Watershed Assessment Procedures guidelines (MOF, 1998). It is accompanied by two maps: Map #1 – Channel Assessment Procedure Map; and Map #2 – Watershed Overview Map.

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[1] Bull trout (*Salvelinus confluentus*), rainbow trout (*Oncorhynchus mykiss*), and coho salmon (*Oncorhynchus kisutch*) are found in Otter Creek (Arc Environmental, 1997). Coho are limited to the lower reaches (about 1.5 km from the mouth), but bull trout and possibly rainbow trout are present in Reaches 7 through 9 upstream. The distribution of confirmed and suspected fish-bearing streams is shown on Map #1.

1.2 PROJECT OBJECTIVES

The general objectives of this report are to characterize the Otter Creek watershed, and provide recommendations on constraints to and opportunities for forest development. Specific objectives are to:

1. Describe the hydrology, geomorphology, and sediment transport characteristics of the Otter Creek watershed;
2. Review previous watershed assessment studies;
3. Describe any existing watershed impacts from forestry and other land use activities, and identify their probably cause;
4. Assess channel sensitivity to future harvest or road building activities;
5. Identify risks to water quality and fish habitat from the current (1998-2002) five-year forest development plan;
6. Provide recommendations concerning maximum ECA; and
7. Provide recommendations regarding watershed management and follow-up studies, if required.

2.0 METHODS

As described above, this report is based largely on information collected during the 1997 CAP and sediment source survey (SSS). The Otter Creek CAP followed the procedures outlined in the most recent Forest Practices Code guidebooks (MOF/MELP, 1996a; 1996b), and included detailed aerial photography analysis and field inspection of all stream reaches downstream of logging activity. The SSS followed procedures described by Moore (1994). and included inspection of more than 95% of the road network by truck, ATV, or on foot. Landslides in the watershed were inspected and characterized (length, width, slope angle, surface materials, drainage, risk of on-going instability). For both the SSS and CAP, the level of effort of the field work exceeded the requirements of the current WAP interim procedures (MOF, 1998).

To guide recommendations for future forest development (Section 4.0), the results of the channel assessment have been utilized to develop a qualitative channel sensitivity rating (Low, Moderate, High) for each reach. "Sensitivity" is the potential for the reach to be impacted by changes in the timing and/or magnitude of peak flows. In bedrock-controlled reaches sensitivity is dependent on bed stability and the amount of erodible sediment on the channel bed. In alluvial reaches, sensitivity is dependent on the interaction between the type of channel and bank deposits, bank stability (e.g. presence/absence of tree with large roots and in-bank LWD), and the supply of sediment and woody debris. For example, a reach with high sensitivity would have all or some of the following characteristics: reduced channel capacity due to aggradation, little in-stream LWD or boulders to dissipate flow energy, and few large trees along the banks. A low sensitivity reach would have banks comprised of bedrock or boulders, adequate channel capacity to carry peak flows, and mature riparian vegetation.

Maximum recommended ECAs for each sub-basin were determined by considering both hydrologic hazard (a function of sensitivity) and consequence. **Hazard** is the probability that channel changes resulting from future forest harvest will lead to changes in water quality or fish habitat in the sub-basin. Hazard considers the length of sensitive reaches within the sub-basin and their proximity to areas of interest (i.e., spawning beds). **Consequence** is the severity of impacts if they occur. Table 2.1 lists the maximum recommended ECA for each **risk** (hazard × consequence) category. Given the presence of salmonids (especially coho salmon and bull trout) in Otter Creek, consequence was rated high for all sub-basins. Thus the maximum possible recommended ECA for any Otter Creek sub-basin is 30% (e.g., if the hazard was "low").

Table 2.1. Hydrologic risk and recommended maximum ECA (%) as a function of hazard and consequence.

		CONSEQUENCE		
		H	**M**	**L**
HAZARD	**H**	High Risk *20%*	Moderate-High Risk *25%*	Moderate Risk *30%*
	M	High-Moderate Risk *25%*	Moderate Risk *30%*	Low-Moderate Risk *35%*
	L	Moderate Risk *30%*	Moderate-Low Risk *35%*	Low Risk *40%*

3.0 WATERSHED DESCRIPTION & PREVIOUS STUDIES

3.1 WATERSHED HYDROLOGY

No streamflow records are available for Otter Creek. The streams in the region, however, have a flow regime dominated by nival (i.e. snow-melt) flood events in May and June. Low flows generally occur during late winter. There are no glaciers in the watershed, although there are some small areas with yearly snow pack at higher elevations near the headwaters.

In previous watershed studies the Otter Creek basin was subdivided into three sub-basins: South Otter Creek, Upper Otter Creek, and Residual (Map #1). That terminology is maintained in this report.

3.2 WATERSHED MORPHOLOGY, SURFICIAL GEOLOGY & SOILS

Otter Creek originates in the Shuswap Highlands in the Monashee mountain range of the Columbia Mountains and Highlands physiographic region. Bedrock geology within the watershed consists of gneiss and granitic material (Okulitch, 1979) which is considered to be generally resistant to erosion. Surficial materials include morainal and colluvial deposits varying in thickness from veneers to blankets. Glaciofluvial deposits are found along the mainstem of the Upper Otter sub-basin, and in the southern and central portions of the South Otter Creek sub-basin (Dobson Engineering, 1997). Glaciolacustrine and morainal (ablation and lodgment till) deposits were found above the mainstem canyons in the both Upper and South Otter Creek sub-basins during the IWRP field inspections.

The South Otter Creek sub-basin contains gently sloping terrain with steep slopes along the lower reaches of the creek channel. Approximately five percent of the terrain was estimated to be potentially unstable (Dobson Engineering, 1997). Slopes are generally steeper in the Upper Otter Creek sub-basin where 15% of the slopes are potentially unstable. Steep V-shaped valley walls exist along the creek in the Residual area, where 19% of the slopes were classed as potentially unstable.

3.3 Watershed Assessment Results: 1996-97

3.3.1 Level 1 IWAP

A Level 1 Interior Watershed Assessment Procedure (IWAP) report for Otter Creek Watershed was prepared for Weyerhaeuser by Dobson Engineering Ltd. in June 1997. The results of the Level 1 suggested that follow-up field investigations be completed in all three sub-basins, based on hazard indices >0.5. ECAs (unweighted) were estimated to be 18% in the Residual, 29% in Upper Otter Creek, and 39% in South Otter Creek (33% overall). The 1997 IWAP report cards are provided in Appendix A of this report for reference.

The ECA and Level 1 results, which suggested moderate risk of peak flow impacts in Upper Otter and high risk in South Otter, prompted Weyerhaeuser to re-examine the tree-height data used in the ECA calculations. The data were suspected to be out of date in a significant number of cutblocks, and a field program was implemented to verify tree heights, and thus hydrologic recovery, in the watershed. Field checking in 21 polygons (out of 227, or 9.3%) verified that actual tree heights exceeded those in the data base. ECAs were re-calculated and **projected to the year 2000** using Ministry of Forests tree growth tables. Revised ECA estimates are:

• Residual	7%
• South Otter	21%
• Upper Otter	13%
• Whole watershed	17%

3.3.2 Channel Assessment

A stream channel assessment (CAP) was completed in 1997 as part of the IWRP. The CAP documented channel conditions, identified disturbed areas, and established priorities for restoration. Following are brief summaries of CAP results for each sub-basin. The CAP map, showing the location of reach breaks, channel morphology, and degree of disturbance, is included with this report (Map 1, attached).

Otter Creek Residual Sub-basin

Both Reaches 1 and 2 are currently stable but are moderately sensitive to peak flow increases, based on channel morphology (dominant cobble with gravel bed) and the mobility of the bed and banks (mainly the alluvial banks in Reach 1), as well as the degree of hillside coupling. Three natural landslides in Reach 2 are a major sediment sources within this sub-basin. No past harvesting activities have occurred in the riparian zone adjacent to these reaches, and no signs of direct channel disturbances were observed.

Upper Otter Creek Sub-basin

Channel morphologies range from step-pool boulder to riffle-pool with gravel (functional LWD) throughout the reaches of Upper Otter Creek. Windfall and past harvesting of riparian stands appears to be the major impacts in this sub-basin. Historically, beaver activity was high throughout the middle reaches (Arc Environmental Ltd., 1997) of Upper Otter Creek. However, evidence of recent beaver activity is minimal. Three potential restoration sites (Sites 1, 2, and 3) were identified (see Summit, 1998a,b). Site 1 is a high risk/high work priority site comprised of a single large debris jam.

South Otter Creek Sub-basin

The majority of channel disturbances and sites needing restoration in the Otter Creek watershed are located in the South Otter Creek sub-basin. Unstable terrain and erodible hillslopes coupled to the channel, combined with forestry activity, appear to be the main source of disturbance. Effects of high peak flows were evident in the field. Locations of channel scour, sediment deposition, debris jams, and undercut banks were numerous throughout the reaches of South Otter Creek. Four sites (Sites 4b, 5, 6a, and 7) are high risk and high work priority (see Summit, 1998a,b).

3.3.3 Sediment Source Survey & Subsequent Restoration Work

Landslides and gullies in the Otter Creek watershed were assessed for their capability to contribute sediment to the stream channel as part of the sediment source survey. Seventeen landslides were identified as sediment sources in the watershed. Five gullies were also identified in the study area. Two landslides, both on South Otter Creek, were identified as high priority for restoration. The road from which these slides originated (old Otter Creek FSR) has been permanently deactivated (with full pull back) and the slides repaired through improved drainage and seeding. As of October 1998, silt fencing was in place at the toe of the slides to minimize sediment transport to the creek while the site stabilizes. Two gullies (each with two branches) were also identified as high priority, and one additional landslide was considered medium priority. Restoration prescriptions are currently in development at these high and medium priority sites, and they are to be stabilized in 1999 (subject to funding).

Inspections of the **road network** found 17 road segments to be "high to very high risk" to water quality and "high priority" for repair/restoration. A further 31 segments were identified as "moderate risk – medium priority". As with the landslides and gullies, restoration planning is underway and these sites are expected to be stabilized by 1999 (some have been completed). A number of other "low risk-low priority" sites were also identified and are being dealt with during regular maintenance.

The Access Management Strategy (AMS), which built upon the SSS, resulted in the identification and prioritization of 45 roads or road segments for **deactivation**. By 1999, about 25 to 30 km of roads will have been deactivated in the Otter Creek drainage (subject to funding).

The Watershed Assessment Overview – Otter Creek map, which shows locations of landslides, gullies, and roads with high priority sites, is included with this report (Map #2, attached).

3.4 WATERSHED & CHANNEL SENSITIVITY

Summaries of channel sensitivity to change for each reach and the overall "hydrologic hazard" for Otter Residual, Upper Otter, and South Otter Creek sub-basins are presented in Tables 3.1, 3.2, and 3.3, respectively. Channel sensitivity has been determined based on channel morphology, observed channel stability, and the level of disturbance at the time of the CAP survey. The hydrologic hazard is defined as the probability that effects on channels,

Table 3.1. Channel sensitivity for Otter Creek Residual sub-basin.

Reach	Percentage of reach with high, moderate and low sensitivity to change[1]			Overall reach sensitivity[2]
	High (%)	Moderate (%)	Low (%)	
1	30	60	10	M-H
2	25	55	20	M
Hydrologic Hazard for Otter Creek Residual: **Moderate**				

1. The sensitivity values were derived according to percentage of reach surveyed during the Channel Assessment Procedure (CAP) field inspections in 1997.
2. Dominant sensitivity class comes first, followed by subdominant (if applicable).

Table 3.2. Channel sensitivity for Upper Otter Creek sub-basin.

Reach	Percentage of reach with high, moderate and low sensitivity to change[1]			Overall reach sensitivity[2]
	High (%)	Moderate (%)	Low (%)	
3	0	30	70	L
4	0	40	60	L-M
5	5	55	40	M-L
6	40	50	10	M-H
7	55	40	5	H-M
8	55	40	5	H-M
9	60	40	0	H-M
10	30	50	20	M
11	30	50	20	M
12	20	60	20	M
13	20	50	30	M
14 (Trib A)	70	25	5	H
15 (Trib A)	0	35	65	L-M
16 (Trib A)	0	45	55	L-M
Hydrologic Hazard for Upper Otter Creek: **Moderate**				

1. The sensitivity values were derived according to percentage of reach surveyed during the Channel Assessment Procedure (CAP) field inspections in 1997.
2. Dominant sensitivity class comes first, followed by subdominant (if applicable).

Table 3.3. Channel sensitivity summary for South Otter Creek sub-basin.

Reach	Percentage of reach with high, moderate and low sensitivity to change[1]			Overall reach sensitivity[2]
	High (%)	Moderate (%)	Low (%)	
1	5	55	40	M-L
2	30	70	0	M-H
3	45	50	5	M-H
4a	25	50	25	M
4	20	50	30	M
5 (Trib B)	0	30	70	L
6 (Trib B)	30	65	5	M-H
Hydrologic Hazard for South Otter Creek: **Moderate – High**				

1. The sensitivity values were derived according to percentage of reach surveyed during the Channel Assessment Procedure (CAP) field inspections in 1997.
2. Dominant sensitivity class comes first, followed by subdominant (if applicable).

and thus on water-related resources (e.g. fish or fish habitat, water quality, or water quantity) will occur if forestry-related hydrologic changes occur in the future. A hydrologic hazard rating is derived for each sub-basin from the individual reach sensitivities. These are:

- Residual sub-basin Moderate hazard
- Upper Otter sub-basin Moderate hazard
- South Otter sub-basin Moderate to High hazard

4.0 IMPLICATIONS FOR WATERSHED MANAGEMENT

4.1 PROPOSED FOREST DEVELOPMENT

The current five-year forest development plan for the Otter Creek watershed only calls for harvesting in the Upper Otter sub-basin (total sub-basin area 5,402 ha). No harvest is planned for either South Otter or the Residual. The plan shows 164.1 ha of planned partial cut and 4.3 ha of clearcut, for a total of 168.4 ha. Assuming that 30-60% of the basal area is removed in the partial cut areas, the ECA for those areas is discounted by 50% to 82.1 ha. The total proposed additional ECA is thus 86.4 ha (82.1 + 4.3). When added to the estimated year 2000 ECA of 694.6 ha, the total estimated ECA is 781 ha or 15%.

4.2 RISK ASSESSMENT

As outlined in Table 3.2, the overall hydrologic hazard rating for Upper Otter is "moderate". From Table 2.1, a "moderate" hazard combined with a "high" consequence results in a recommended maximum ECA of 25%. The proposed development in Upper Otter would maintain an ECA within this recommended upper limit. Thus the proposed development can proceeded with only negligible risk to the channel from changes in peak flow. Management/mitigation strategies for other potential effects are outlined in Section 4.3 below.

The estimated ECA which was used to guide this risk assessment was based on Weyerhaeuser's updated calculations which give a year 2000 ECA figure of 13%, down from the estimated 29% in the IWAP report. The revised figures are based on field checks of about 9% (9 of 96) of the polygons. Given the rather large discrepancy between the old and new estimates, and the sample size, some caution is warranted. However the projected ECA of 15%, which assumes that all proposed development is implemented, is well below the recommended maximum and thus should provide an adequate margin of safety.

For future planning in the watershed, ECA is a constraint on development in the South Otter sub-basin. The hydrologic hazard rating is moderate to high, suggesting a maximum ECA in the range 20-25%. The year 2000 projected ECA is 21%, close to the upper recommended limit. We recommend that development in South Otter be delayed until the ECA drops below 20% (the lower limit of the recommended range) and the areas restored in 1997-99 have stabilized. At that point it may be possible to revise the maximum recommended ECA to 25% (the upper limit of the recommended range).

4.3 MITIGATION STRATEGIES

The risk assessment in Section 4.1 emphasizes peak flow impacts. Given the evidence of historic channel impacts and riparian logging in Upper Otter, it is important that the planned development proceed with due care to avoid direct impacts via sedimentation and reductions in riparian cover. This can be achieved through a combination of best management practices for road development and maintenance, and continuing to implement the restoration and road deactivation plans that were recommended by the IWRP process. Future restoration and deactivation work is subject to funding.

5.0 CONCLUSIONS AND RECOMMENDATIONS

This WAP report summarizes the results of a series of watershed assessments, including detailed channel and sediment source assessments, completed between 1996 and 1998 in the Otter Creek watershed. Those assessments were supplemented in October 1998 by a reconnaissance inspection of the lower reaches of each stream, aerial photography review, and review of updated ECA data. From the WAP analyses the following conclusions are drawn:

1. The Otter Creek stream channels in the Upper Otter and Residual sub-basins are moderately sensitive to peak flow impacts, based on their natural characteristics and evidence of historic impacts. Thus the hazard associated with changes in peak flow is moderate;
2. The South Otter sub-basin is moderately to highly sensitive to peak flow impacts, and the hazard rating is moderate-high;
3. The consequence of impacts to the channel is considered high, based on the presence of salmonid spawning habitat in the lower reaches;
4. As of 1997, the watershed did contain a number of forestry-related sediment sources that contributed sediment directly to the stream. Sediment sources were prioritized and several of the high priority sites were restored in 1998. Prescriptions are under development for the remaining high and medium priority sites.

Derived from these conclusions are the following recommendations: Replaced by Jan 29/99 Letter

1. Given the combinations of hazard and consequence, the maximum recommended ECA in the Residual sub-basin is 25%. No forest development currently is planned for 1998-2003 in the Residual sub-basin;
2. The maximum recommended ECA in Upper Otter is 25%. Since the 1998-2003 development proposed for Upper Otter will only increase the ECA to 15%, the proposed development can proceed with negligible risk to water quality and fish habitat from peak flow effects;
3. The maximum recommended ECA in South Otter is 20%. No forest development is currently planned for 1998-2003 in the South Otter sub-basin.
4. Forest development in South Otter should be delayed until the ECA drops below 20% and areas restored or deactivated in 1997-99 have stabilized.

5. A follow-up assessment of South Otter (ECA update, sediment source survey, and channel inspection) should be undertaken no later than 2001. Depending on the outcome, it may be possible to revise the maximum recommended ECA;
6. Follow-up watershed assessments should also be conducted by 2001 in Residual and Upper Otter sub-basins; and
7. Major restoration sites, especially landslides, in Otter Creek should be inspected annually and maintained ~~(subject to funding)~~, as required.

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6.0 REFERENCES

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APPENDIX A

Watershed Report Cards (1997)

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?	Upper Otter			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	54.02	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1298.00	m.		
ECA above H60?	6.85	sq.km.	*	
ECA below H60?	8.76	sq.km.	*	
Road length above H60?	33.85	km.	*	
Road length below H60?	59.71	km.	*	
Surface Erosion				
Length of road on erodable soils?	0.01	km.	*	
Length of road within 100 m. of stream?	14.70	km.	*	
Length of road on erodable soils within 100 m. of stream?	0.00	km.	*	
Number of active stream crossings?	32		*	
Riparian Buffer				
Total stream length?	51.88	km.	*	
Length of stream logged?	15.95	km.	*	
Total length of fish bearing streams?	9.77	km.	*	
Length of fish bearing streams logged?	2.95	km.	*	
Landslides				
Number of landslides?	4		*	
Length of road on unstable slopes?	4.26	km.	*	
Length of stream with logged banks and on slopes > 60%	0.00	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?	N			
Is there mining close to streams?	N			
Is there ATV use close to streams?	N			
Hydrologic zone?	25.00			
Percent area of crown land?	100.0%			
Percent area of private land?	0.0%			
Percent area with unstable slopes?	14.7%			
Percent area with erodable soils?	1.8%			
Dominant bedrock geology?	0.00			
Is there a fisheries (DFO or MoE) thermal concern?	N			

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

Upper Otter
Map units were identified as: km. and sq.km.

	Indicator	(5) Score	(6) Hazard Index
Peak Flow			
Index above H60	0.19		
Index below H60	0.16		
1 Total Peak Flow Index	0.35	0.59	
2 Road density above H60	0.63 km/sq.km.	0.63	
3 Total road density (See note below)	1.73 km/sq.km.	0.56	0.60
Surface Erosion			
4 Roads on erodable soils	0.00 km/sq.km.	0.00	
5 Roads within 100 m of a stream	0.27 km/sq.km.	0.64	
6 Roads that are both of the above	0.00 km/sq.km.	0.00	
7 Active stream crossings	0.59 no./sq.km.	0.69	
8 Total road density (See note below)	1.73 km/sq.km.	0.61	0.67
Riparian Buffer			
9 Portion of stream logged?	0.31 km/km.	1.00	
10 Portion of fish bearing streams logged?	0.30 km/km.	0.60	1.00
Landslides			
11 Landslide density	0.07 no./sq.km.	0.37	
12 Roads on unstable slopes	0.08 km/sq.km.	0.26	
13 Streams >60% and banks logged	0.00 km/sq.km.	0.00	0.37

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.

IMPORTANT: Provided for information only. ECA data in this table is out of date. See Report Section 3.3.1 for discussion.

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?	Otter Ck South			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	64.22	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1298.00	m.		
ECA above H60?	16.78	sq.km.	*	
ECA below H60?	8.27	sq.km.	*	
Road length above H60?	66.39	km.	*	
Road length below H60?	40.92	km.	*	
Surface Erosion				
Length of road on erodable soils?	4.70	km.	*	
Length of road within 100 m. of stream?	20.57	km.	*	
Length of road on erodable soils within 100 m. of stream?	1.26	km.	*	
Number of active stream crossings?	36		*	
Riparian Buffer				
Total stream length?	58.61	km.	*	
Length of stream logged?	11.69	km.	*	
Total length of fish bearing streams?	1.35	km.	*	
Length of fish bearing streams logged?	0.02	km.	*	
Landslides				
Number of landslides?	2		*	
Length of road on unstable slopes?	1.37	km.	*	
Length of stream with logged banks and on slopes > 60%	0.00	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?	N			
Is there mining close to streams?	N			
Is there ATV use close to streams?	N			
Hydrologic zone?	25.00			
Percent area of crown land?	100.0%			
Percent area of private land?	0.0%			
Percent area with unstable slopes?	5.3%			
Percent area with erodable soils?	3.8%			
Dominant bedrock geology?	0.00			
Is there a fisheries (DFO or MoE) thermal concern?	N			

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

Otter Ck South
Map units were identified as: km. and sq.km.

	Indicator	(5) Score	(6) Hazard Index
Peak Flow			
Index above H60	0.39		
Index below H60	0.13		
1 Total Peak Flow Index	0.52	0.87	
2 Road density above H60	1.03 km/sq.km.	1.00	
3 Total road density (See note below)	1.67 km/sq.km.	0.56	0.87
Surface Erosion			
4 Roads on erodable soils	0.07 km/sq.km.	0.15	
5 Roads within 100 m of a stream	0.32 km/sq.km.	0.74	
6 Roads that are both of the above	0.02 km/sq.km.	0.10	
7 Active stream crossings	0.56 no./sq.km.	0.66	
8 Total road density (See note below)	1.67 km/sq.km.	0.58	0.70
Riparian Buffer			
9 Portion of stream logged?	0.20 km/km.	0.66	
10 Portion of fish bearing streams logged?	0.02 km/km.	0.03	0.66
Landslides			
11 Landslide density	0.03 no./sq.km.	0.16	
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	0.16

Notes:
The calculations of scores for #3 and #8 above are slightly different.
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IMPORTANT: Provided for information only. ECA data in this table is out of date. See Report Section 3.3.1 for discussion.

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?	Otter Residual			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	7.50	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1298.00	m.		
ECA above H60?	0.01	sq.km.	*	
ECA below H60?	1.32	sq.km.	*	
Road length above H60?	0.00	km.	*	
Road length below H60?	13.02	km.	*	
Surface Erosion				
Length of road on erodable soils?	1.31	km.	*	
Length of road within 100 m. of stream?	3.33	km.	*	
Length of road on erodable soils within 100 m. of stream?	0.95	km.	*	
Number of active stream crossings?	4		*	
Riparian Buffer				
Total stream length?	7.54	km.	*	
Length of stream logged?	0.18	km.	*	
Total length of fish bearing streams?	3.92	km.	*	
Length of fish bearing streams logged?	0.00	km.	*	
Landslides				
Number of landslides?	1		*	
Length of road on unstable slopes?	0.20	km.	*	
Length of stream with logged banks and on slopes > 60%	0.00	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?	N			
Is there mining close to streams?	N			
Is there ATV use close to streams?	N			
Hydrologic zone?	25.00			
Percent area of crown land?	98.9%			
Percent area of private land?	1.1%			
Percent area with unstable slopes?	19.1%			
Percent area with erodable soils?	19.6%			
Dominant bedrock geology?	0.00			
Is there a fisheries (DFO or MoE) thermal concern?	N			

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

Otter Residual
Map units were identified as: km. and sq.km.

		Indicator	
Peak Flow			
	Index above H60	0.00	
	Index below H60	0.18	
1	Total Peak Flow Index	0.18	
2	Road density above H60	0.00 km/sq.km.	
3	Total road density (See note below)	1.74 km/sq.km.	.30
Surface Erosion			
4	Roads on erodable soils	0.18 km/sq.km.	
5	Roads within 100 m of a stream	0.44 km/sq.km.	
6	Roads that are both of the above	0.13 km/sq.km.	
7	Active stream crossings	0.53 no./sq.km.	
8	Total road density (See note below)	1.74 km/sq.km.	.81
Riparian Buffer			
9	Portion of stream logged?	0.02 km/km.	
10	Portion of fish bearing streams logged?	0.00 km/km.	.08
Landslides			
11	Landslide density	0.13 no./sq.km.	
12	Roads on unstable slopes	0.03 km/sq.km.	
13	Streams >60% and banks logged	0.00 km/sq.km.	.56

Notes:
The calculations of scores for #3 and #8 above are slightly different.
This spreadsheet is based on the IWAP Guidebook dated September 1995

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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?	Otter Total			
Map units are in: (1=km. and sq.km.; 2=m. and ha.)	1			
Watershed area?	125.75	sq.km.	*	
Peak Flow and Surface Erosion				
Elevation of H60?	1298.00	m.		
ECA above H60?	23.65	sq.km.	*	
ECA below H60?	18.35	sq.km.	*	
Road length above H60?	100.24	km.	*	
Road length below H60?	113.65	km.	*	
Surface Erosion				
Length of road on erodable soils?	6.03	km.	*	
Length of road within 100 m. of stream?	38.61	km.	*	
Length of road on erodable soils within 100 m. of stream?	2.20	km.	*	
Number of active stream crossings?	72		*	
Riparian Buffer				
Total stream length?	118.03	km.	*	
Length of stream logged?	27.82	km.	*	
Total length of fish bearing streams?	15.04	km.	*	
Length of fish bearing streams logged?	2.97	km.	*	
Landslides				
Number of landslides?	7		*	
Length of road on unstable slopes?	5.83	km.	*	
Length of stream with logged banks and on slopes > 60%	0.00	km.	*	
Other Land Use and Watershed Characteristics				
Is there range use next to streams?	N			
Is there mining close to streams?	N			
Is there ATV use close to streams?	N			
Hydrologic zone?	25.00			
Percent area of crown land?	100.0%			
Percent area of private land?	0.1%			
Percent area with unstable slopes?	10.2%			
Percent area with erodable soils?	3.9%			
Dominant bedrock geology?	0.00			
Is there a fisheries (DFO or MoE) thermal concern?	N			

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

Otter Total
Map units were identified as: km. and sq.km.

	Indicator	(5) Score	(6) Hazard Index
Peak Flow			
Index above H60	0.28		
Index below H60	0.15		
1 Total Peak Flow Index	0.43	0.71	
2 Road density above H60	0.80 km/sq.km.	0.80	
3 Total road density (See note below)	1.70 km/sq.km.	0.57	0.71
Surface Erosion			
4 Roads on erodable soils	0.05 km/sq.km.	0.10	
5 Roads within 100 m of a stream	0.31 km/sq.km.	0.71	
6 Roads that are both of the above	0.02 km/sq.km.	0.09	
7 Active stream crossings	0.57 no./sq.km.	0.67	
8 Total road density (See note below)	1.70 km/sq.km.	0.59	0.69
Riparian Buffer			
9 Portion of stream logged?	0.24 km/km.	0.79	
10 Portion of fish bearing streams logged?	0.20 km/km.	0.40	0.79
Landslides			
11 Landslide density	0.06 no./sq.km.	0.28	
12 Roads on unstable slopes	0.05 km/sq.km.	0.15	
13 Streams >60% and banks logged	0.00 km/sq.km.	0.00	0.28

Notes:
The calculations of scores for #3 and #8 above are slightly different.
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IMPORTANT: Provided for information only. ECA data in this table is out of date. See Report Section 3.3.1 for discussion.