WATERSHED REVIEW
UPPER NADINA RIVER WATERSHED
Draft March 16, 2012

Ministry Contract No: CS12NRH-012

BIOPHYSICAL AND LAND-USE CHARACTERISTICS OF THE WATERSHED

Table 1. Summary Information – Watershed Characteristics – (see Figures 1 and 2)

Size (km^2)	Dominant BEC Zones	Dominant NDT	Elevation Range (m)	Surficial Geology near the Mouth (i.e. sensitive area)	Stream Density (km/km^2)	Biggest % of watershed in same elevation band[1]	Distribution of slope gradients within the watershed (% of watershed)			
							<10% slope	10 to 30% slope	30 to 60% slope	>60% slope
143.3	ESSF	NDT2	940-2236	Medium textured till	3.30	62	43.8	35.6	16.3	4.3

[1] The entire watershed is divided into 300 m elevation bands. The less elevation bands there are and the more area is represented by any given single elevation band, then the greater will likely be the effect of forest harvesting on increased peak flows due to the theoretical concept of "synchronization" (i.e. the melt from the cutblocks is synchronized as much of it comes from the same elevation), and the greater sensitivity it will have.

Table 2. Rating of "Sensitivity" of Watershed to Increased Peak Flow at the lower reaches

Rosgen Stream Channel Type	Rosgen Stream Channel Sensitivity Score	Sensitivity score relative to topography	Sensitivity score relative to lateral connectivity	Sensitivity score relative to vertical conductivity	Sensitivity score relative to climate	Sensitivity score relative to flow synchroniza-tion potential	Sensitivity score relative to NDT type	Sensit-ivity Score	Sensitivity Rating
D3-Stable	4	1	1.05	1	1.1	1.12	1.03	5.35	Very High

Table 3. Rating of "Sensitivity" of Watershed to Increased Production of Fine Sediment at lower reaches

Stream Channel Type	Reach Sensitivity Score	Sensitivity score relative to topography	Sensitivity score relative to lateral connectivity	Sensitivity score relative to drainage density	Sensitivity score relative to climate	Sensitivity score relative to soils	Sensitivity Score	Sensitivity Rating
Riffle pool cobble	4	1	1.1	1.05	1.1	1	5.1	Very High

Table 4. Rating of "Sensitivity" of Watershed to a Loss In riparian Function.

Stream Channel Type	Reach Sensitivity Score	Sensitivity score relative to Aspect	Sensitivity score relative to climate	Overall watershed sensitivity to loss of riparian	Loss of Riparian Sensitivity Rating
C3-C6	4.82	0.9	0.9	3.90	Mod

Table 5. Peak Flow Hazard Rating, as indexed by HEDA – current scenario (i.e. no proposed harvesting considered)

Watershed area (km^2)	Total area Pine Leading (km^2)	Total area Pine Mixed (km^2)	Total area harvest (km^2)[1]	Total HEDA from Pine Beetle alone (%)	Total HEDA from logging alone (%)	Total HEDA from logging and Pine Beetle mortality (%)
143.3	39.0	8.46	14.08	15.38	9.11	24.49

[1]Note: This includes openings from VRI database, and non-overlapping openings from RESULTS and FTEN databases.

Table 5 (continued)

Total area in Agriculture (km^2)	Total area in Agriculture (% of watershed)	Total area in Proposed Harvest (km^2)	Total HEDA (%)	HEDA Hazard rating Score	HEDA Hazard Rating
0.00	0.00	0.00	24.49	2.15	Low

Table 6. Fine Sediment Hazard Rating, as indexed by the Stream Crossing Density

Watershed area (km^2)	# of x-ings	#of fish bearing X-ings[1]	#of non-fish bearing X-ings	density of x-ings (#/km^2)	Density of fish bearing X-ings (#/km^2)	Density of non-fish bearing X-ings (#/km^2)	Hazard Rating Score	Hazard Rating
143.3	117	115	2	0.8	0.8	0.01	3.71	High

[1]Note: The information on stream crossings was provided by MoE and was generated with a GIS model, not fieldwork.

Table 7. Loss of Riparian Function Hazard Rating (See Figures 4 to 9)

Reach Number	Rosgen Stream Type	Reach Length (m)	% riparian logged (as interpreted from air photos)	Apparent stability and other comments (as viewed from air photos)
1	D3-Stable	144	0.0	Stable
2	D3-Stable	1275	0.0	Stable
3	D3-Stable	2100	0.0	Stable
4	C4- Stable	1969	0.0	Stable
5	C4- Stable	2955	0.0	Very Stable
6	E4-Stable	3905	0.0	Very Stable
7	E4- Stable	1108	0.0	Very Stable
8	E4-Stable	3339	0.0	Very Stable
9	C3/D3- Mod unstable/disturbed	1979	0.0	Moderately De-stabilized
10	C3/D3- Mod unstable/disturbed	1392	0.0	Moderately De-stabilized
11	C3/D3- Mod unstable/disturbed	1644	0.0	Moderately De-stabilized
12	C3/D3- Mod unstable/disturbed	1280	0.0	Moderately De-stabilized
Upper small streams	B3/C3	1600	50%	Destabilized (Fig 14)
Upper small streams	B3/C3	1600	50%	Destabilized (Fig 15)
Hazard Scores:			Hazard Rating Score	Hazard Rating
			2	Low

Table 8. Risk Rankings for the Different Hazards in the watershed current scenario (i.e. no proposed harvesting considered)

Watershed Hazard Types	Sensitivity Score	Sensitivity Rating	Hazard Score	Hazard Rating	Risk Score	Risk Rating
Increased Peak Flow	5.35	Very High	2.15	Low	11.5	Mod
Increase in Production of Fine Sediment	5.08	Very High	3.71	High	18.9	High
Loss of Riparian function	3.90	Mod	2	Low	7.8	Mod

Table 9. Summary Table for Fish Values[1,2]

Watershed Name	Size (km^2)	FID	Species	Productivity	Diversity	Significant Species	Ranking[3]	Comments
Upper Nadina River	143.3	57	DV, RB, CO, KO		x	x	VH	

[1] Note: The "Fish Values" were assessed and provided by Fisheries Biologists from the Ministry of Forest, Lands, and Natural Resource Operations. Fisheries value score (High, Very High, or Extreme) is based on the occurrence of (1) exceptional fisheries productivity, or (2) high fish species diversity (more than three species), or (3) notable significance of fish species (i.e. listed species, stock at risk, large piscivorous rainbows), or (4) a combination of 1, 2, and/or 3.If none of these characteristics occurred in the watershed it was not considered for FSW status

[2] Note: This table was extracted from Tables 26 and 27 provided in Appendix 1 of the methodology document.

[3] Ranking System:

- 3x = Extreme (E)
- 2x = Very High (VH)
- 1x = High (H)

Table 10. Fisheries Sensitive Watershed Score and Rating

Name	Size (km^2)	Peak Flow Sensitivity	Sed Sensitivity Rating	Riparian Sensitivity	Fish Value[1]	FSW Score PF vs Fish	FSW Score Seds vs Fish	FSW Score Rip vs Fish	Overall FSW Score	Overall FSW Rating
Upper Nadina River	143.3	Very High	Very High	Mod	Very High	4	4	3	11	High

[1] Note: The fish value class is obtained from Table 9 above.

INTERPRETATIONS AND RECOMMENDATIONS FOR MANAGEMENT STRATEGIES FOR PROTECTION OF WATER RESOURCES IN THIS WATERSHED

Brief Watershed Description (Table 1 and Figures 1 and 2)

The Upper Nadina River watershed is a higher elevation watershed which flows directly into the south side of Nadina Lake. It has a mix of topography with flat to rolling terrain in the front end and steep mountains in the back end as it rises into the Sibola Range. Elevations in this watershed range between 940 and 2236 m. The watershed is distributed over several 300 m elevation bands, with biggest proportion of the watershed (62%) being in the elevation band between 940 and 1240 m. There are some steep slopes in this watershed, mostly located in the Sibolas, with 21% of the watershed having slopes greater than 30% (Table 1). The dominant biogeoclimatic zones in this watershed are the ESSFmc and SBSmc2.

The headwaters of the stream network begin in the alpine areas of the watershed in the Sibola Mountains. There are numerous small, steep channels that flow down v-shaped valleys and gullies to the flatter plateau area and then join together around Reach 12 (Figure 4). These steeper channel sections appear to transport large volumes of fine and coarse sediments to the

lower elevation reaches (Figure 13). Reaches 9, 10, 11 and 12 are active, braided channels that have been classified as a mix of Rosgen C3 and C4 channel types and also appear to transport large volumes of sediments. Reaches 8, 7 and 6 are low gradient meandering E4 type channels that flow through a network of wetlands and organic soils. This area appears to be a sink for much of the coarse sediments transported from the higher elevations (Figures 9 and 10). Reaches 5, 4 and 3 are a bit steeper C4/B4 channel types and appear to be quite stable. Reach 2 is a wide, braided channel that is very active and appears to be somewhat unstable. Reach 1 is the lowest reach and is short and flows directly into Nadina Lake. The lower five reaches are quite sensitive to increases in peak flows.

The surficial geology of this watershed is dominated by a mixture of fine and moderately coarse morainal tills with some coarser textured fluvial deposits and organics along the mainstem and at the mouth (Figure 1 and 2).

Sensitivities, Hazards and Risks in this Watershed

The overall sensitivity of the watershed to increases in peak flows has been classified as very high (Table 2). This is mostly due to a combination of the sensitive nature of the lower stream channels and the steeper terrain in the upper watershed. The peak flow risk rating is Moderate, based on a current HEDA of 24.5%.

The sensitivity of the watershed to increases in fine sediments is also classified as very high which is driven by the sensitive channel type and the relatively high drainage density in the watershed. The current sediment risk is high because of the high stream crossing density.

The sensitivity to a loss in riparian function is classified as moderate because the dominant mainstem channel type is a wide D3/D4 active channel type which is less dependent on intact riparian for proper functioning. The mainstem of the Upper Nadina River has been well protected from riparian harvesting. However, some of the upper smaller headwater streams, located on steeper terrain, have been completely harvested and have caused significant instability and channel degradation (Figures 14 and 15). These types of channels are sensitive to riparian removal.

When considering both the overall physical sensitivities in this watershed and the fisheries values, the Fisheries Sensitive Watershed (FSW) rating is assessed as High (Tables 9 and 10).

Suggested Management Objectives and Strategic Directions for this Watershed

1) Given that the overall sensitivity of this watershed to increases in peak flows has been assessed as a high, I suggest that this is an important hazard that must be carefully managed for this watershed. If this watershed is designated as a fisheries sensitive, then I suggest that peak flow risk should be maintained at a Low level, or lower. Since the risk is already at a moderate level, this means that no further forest harvesting could occur in this watershed for several years until adequate hydrological recovery has occurred. The current HEDA value is 24.5% and this would have to be lowered to below 16.5% before further harvesting could be initiated in this watershed, if this watershed was designated as "Fisheries Sensitive".

2) The sensitivity to increases in sediment is rated as a high with a current risk rating of high. Given the high sensitivity and risk ratings it is important that management of erosion and sediment transport be given a high priority in this watershed. If this watershed is designated as a Fisheries Sensitive, then minimizing erosion and the delivery of fine sediments at all stream crossings should be a management priority along with the monitoring of this. I recommend that the Water Quality Effectiveness Evaluation (WQEE) tool be used and that the WQEE rating be maintained below a moderate level for all crossing in this watershed (i.e. low or very low). The most recent WQEE protocol can be found at the following web link: http://www.for.gov.bc.ca/ftp/hfp/external/!publish/frep/indicators/Indicators-WaterQuality-Protocol-2009.pdf

3) Although the riparian sensitivity has been classified as only moderate (Table 8), evidence of problems with past riparian management practices in this watershed (Figures 14 and 15) suggest that greater protection should be given to small headwater streams. If this watershed is designated as fisheries sensitive I suggest that for all S4 streams wider than 0.5 m to maintain long term large woody debris (LWD) recruitment to the stream channel by retaining at least 90% of the riparian area in a state undisturbed by primary forest activities. Note that the riparian area refers to the management area measured from the closest streambank to a distance 15m upslope from the streambank.

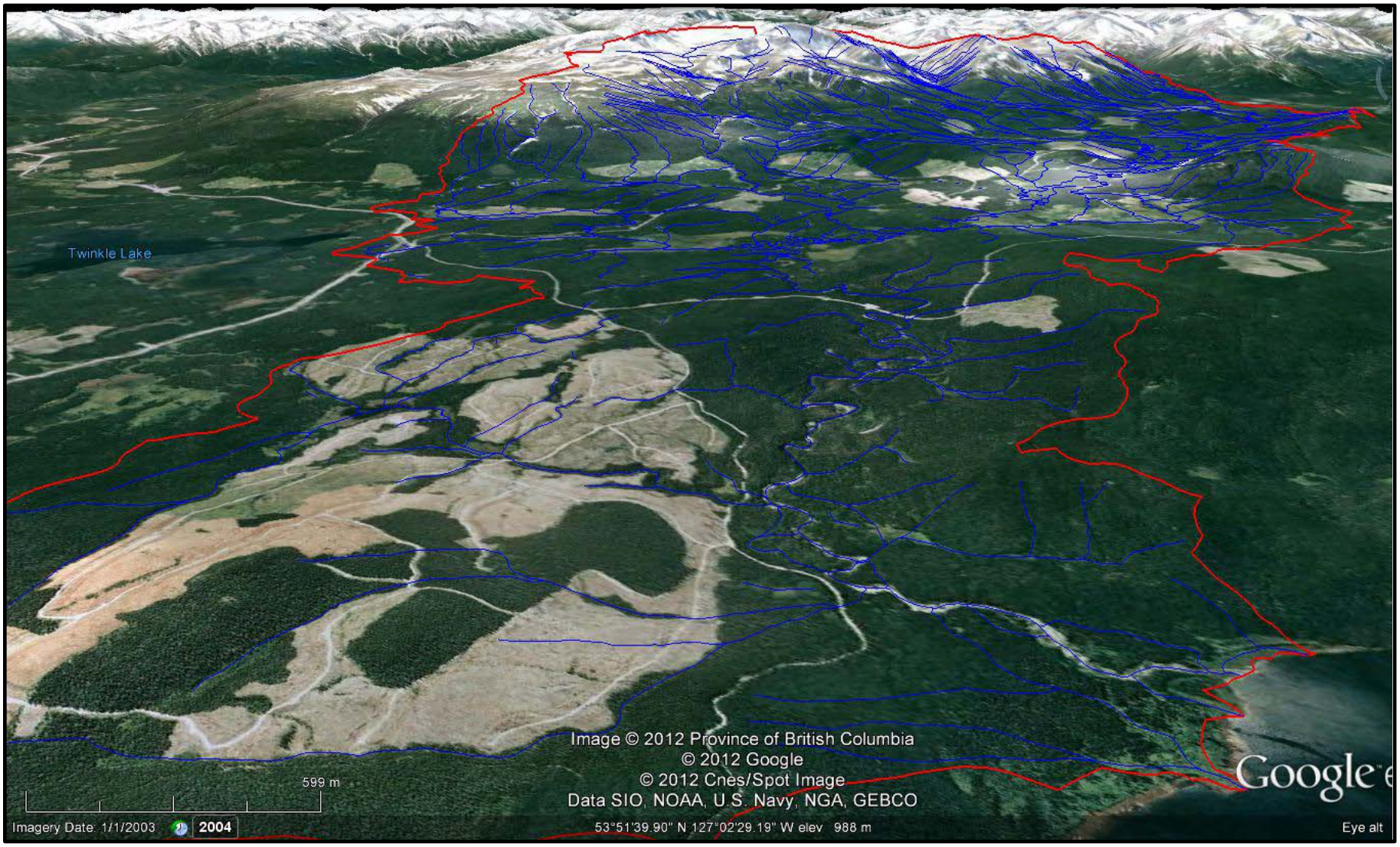

Figure 1. Google earth overview image of Upper Nadina River watershed, looking upstream into the watershed.

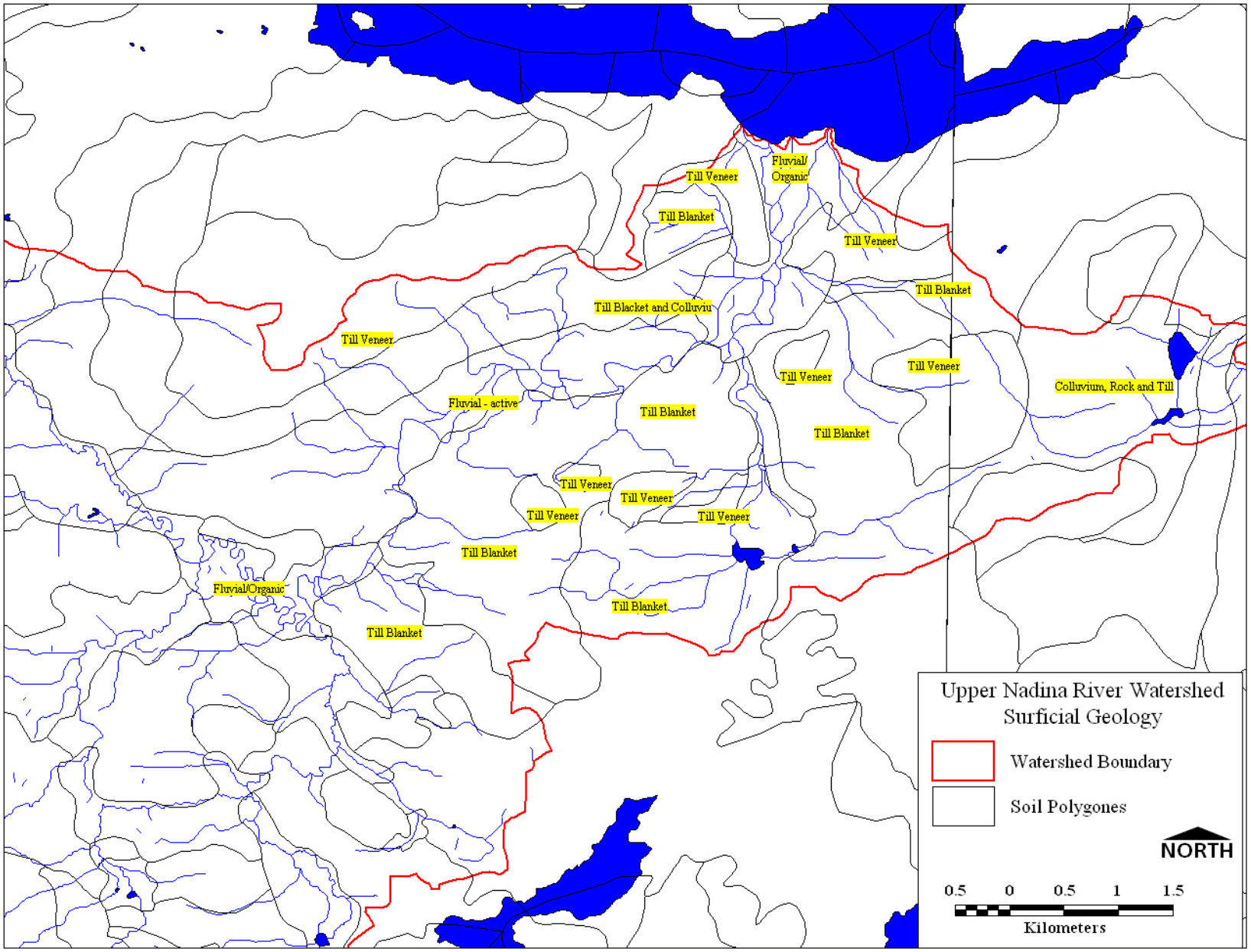

Figure 2. Distribution of surficial geology types near the mouth of Upper Nadina River watershed.

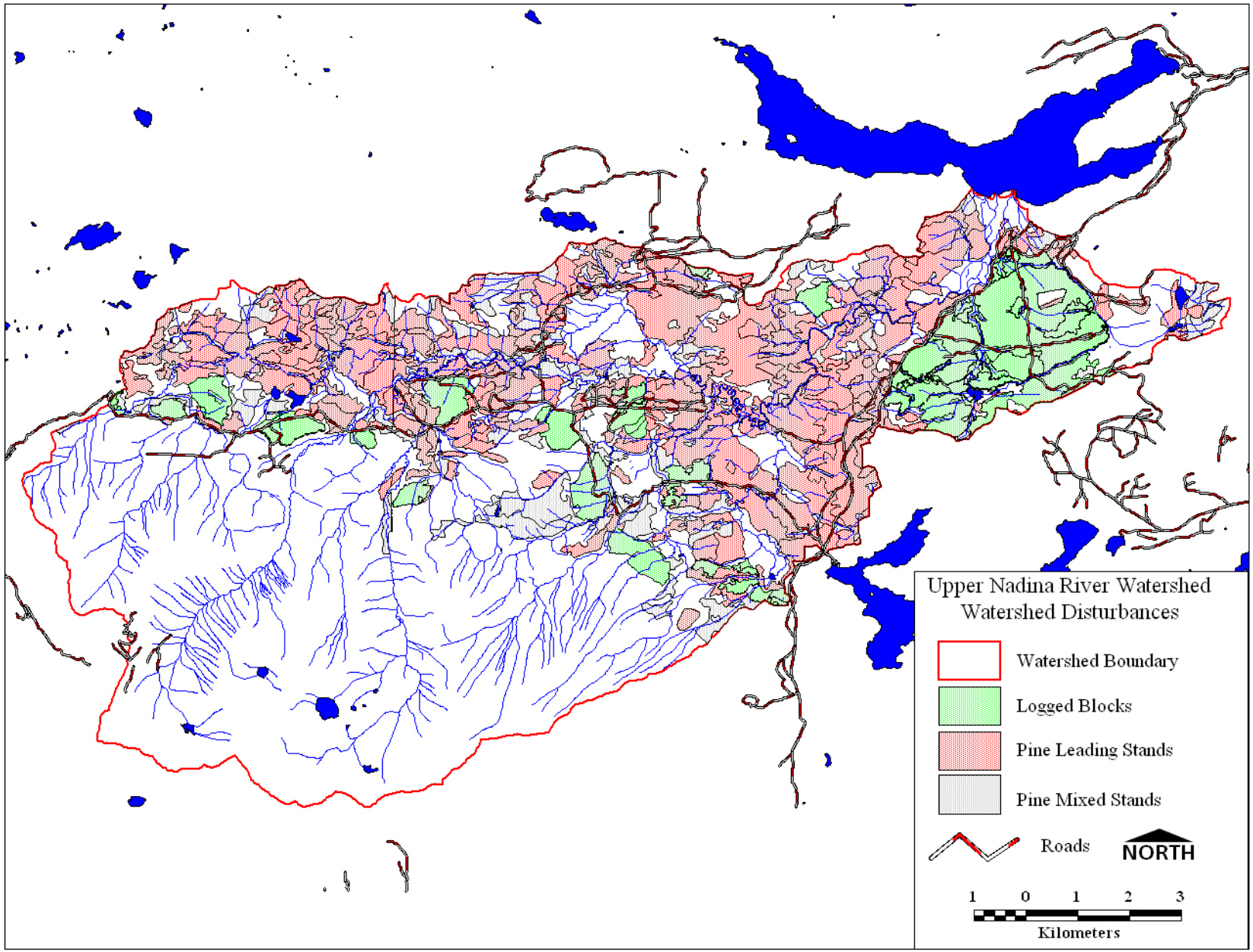

Figure 3. Land-use related and large natural disturbances in the Upper Nadina River Watershed

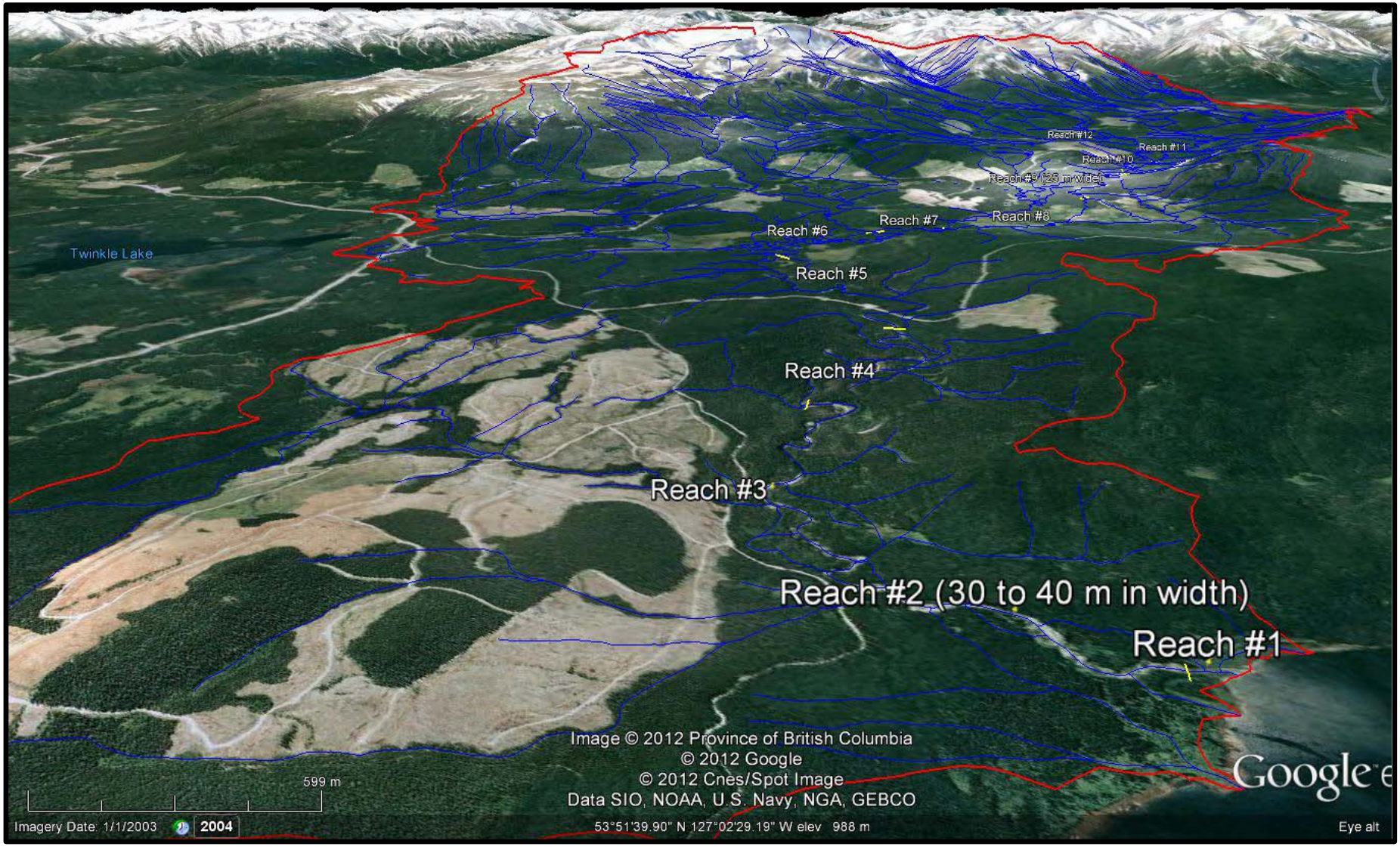

Figure 4. Identification of reaches along the mainstem of Upper Nadina River watershed

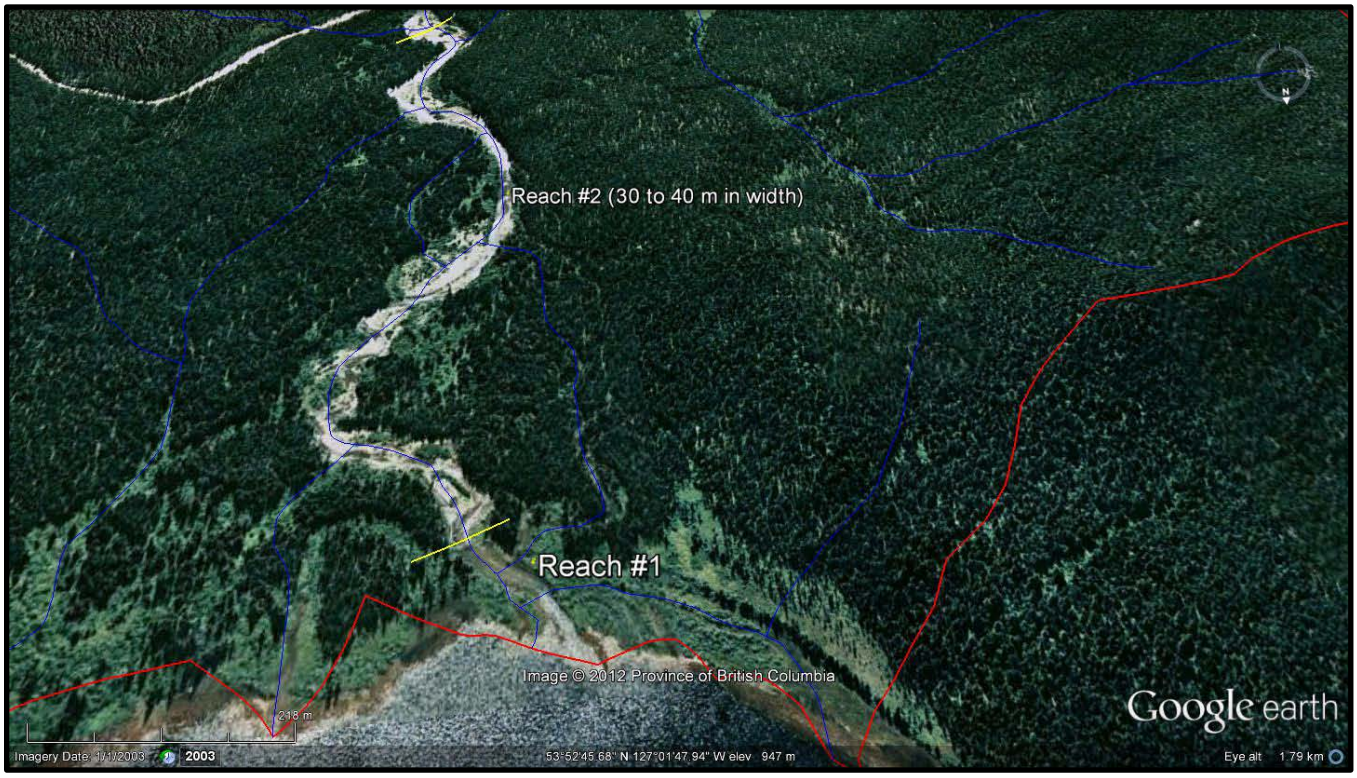

Figure 5. Google Earth image looking upstream along Reach #1 and 2 of Upper Nadina River.

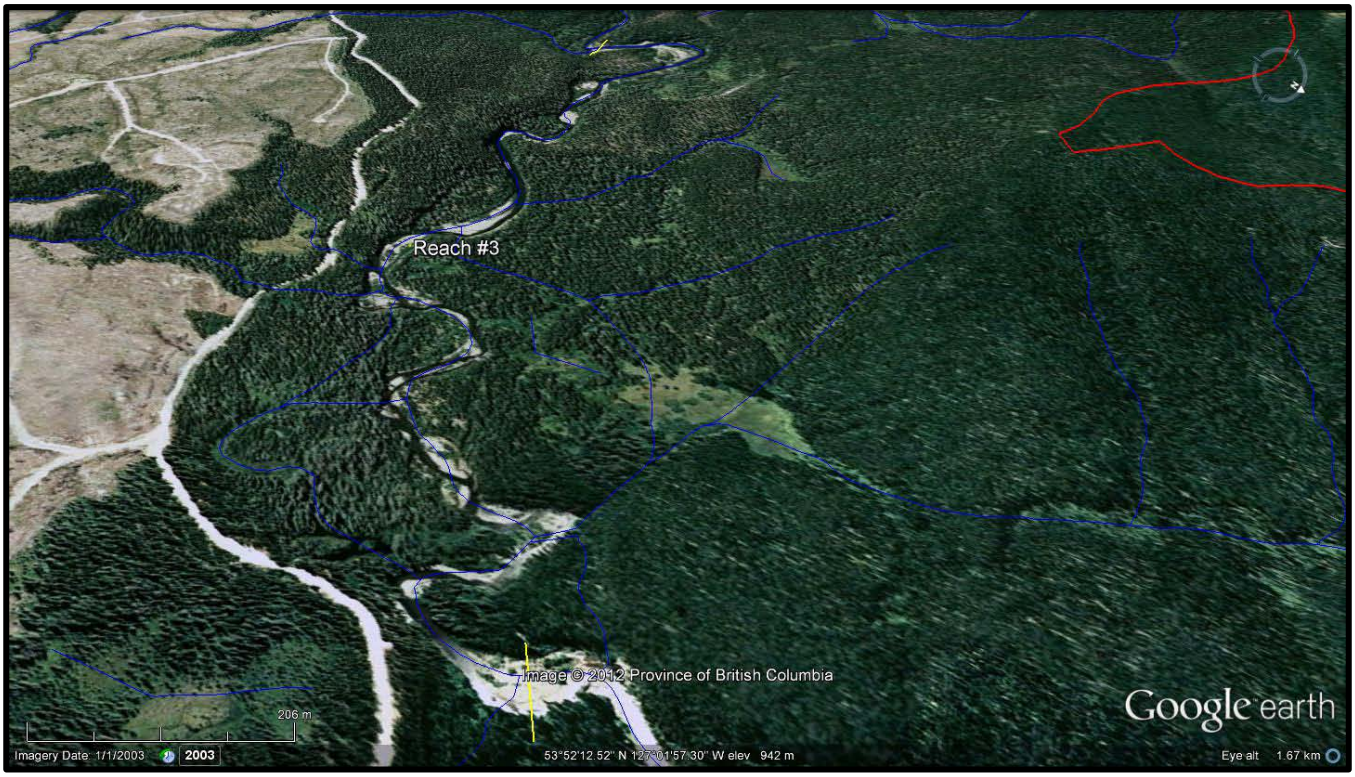

Figure 6. Google Earth image looking upstream along Reach #3 of Upper Nadina River.

Figure 7. Google Earth image looking upstream along Reach #4 of Upper Nadina River.

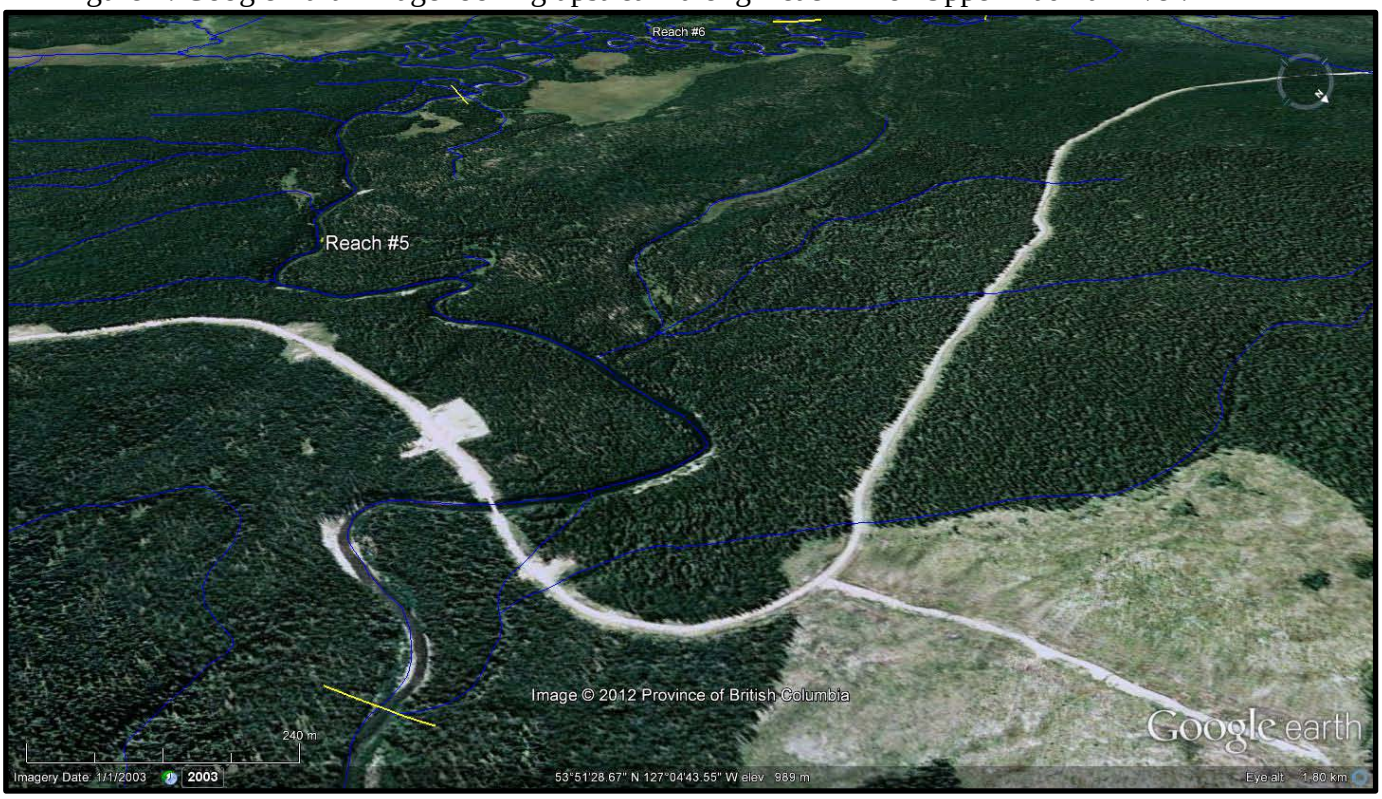

Figure 8. Google Earth image looking upstream along Reach #5 of Upper Nadina River.

Figure 9. Google Earth image looking upstream along Reach #6 and 7 of Upper Nadina River.

Figure 10. Google Earth image looking upstream along Reach #8 of the Upper Nadina River.

Figure 11. Google Earth image looking upstream along Reach #9 of the Upper Nadina River.

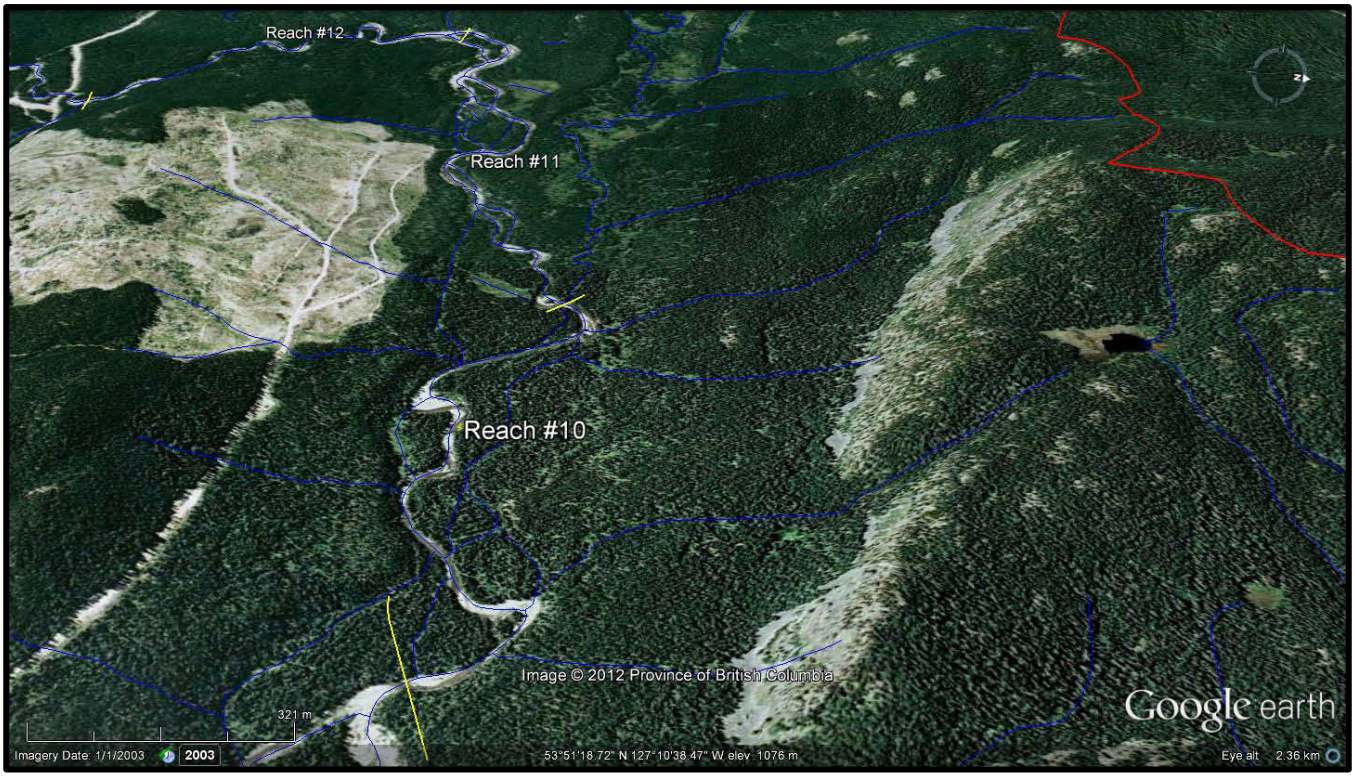

Figure 12. Google Earth image looking upstream along Reach #10 and 11 of the Upper Nadina River.

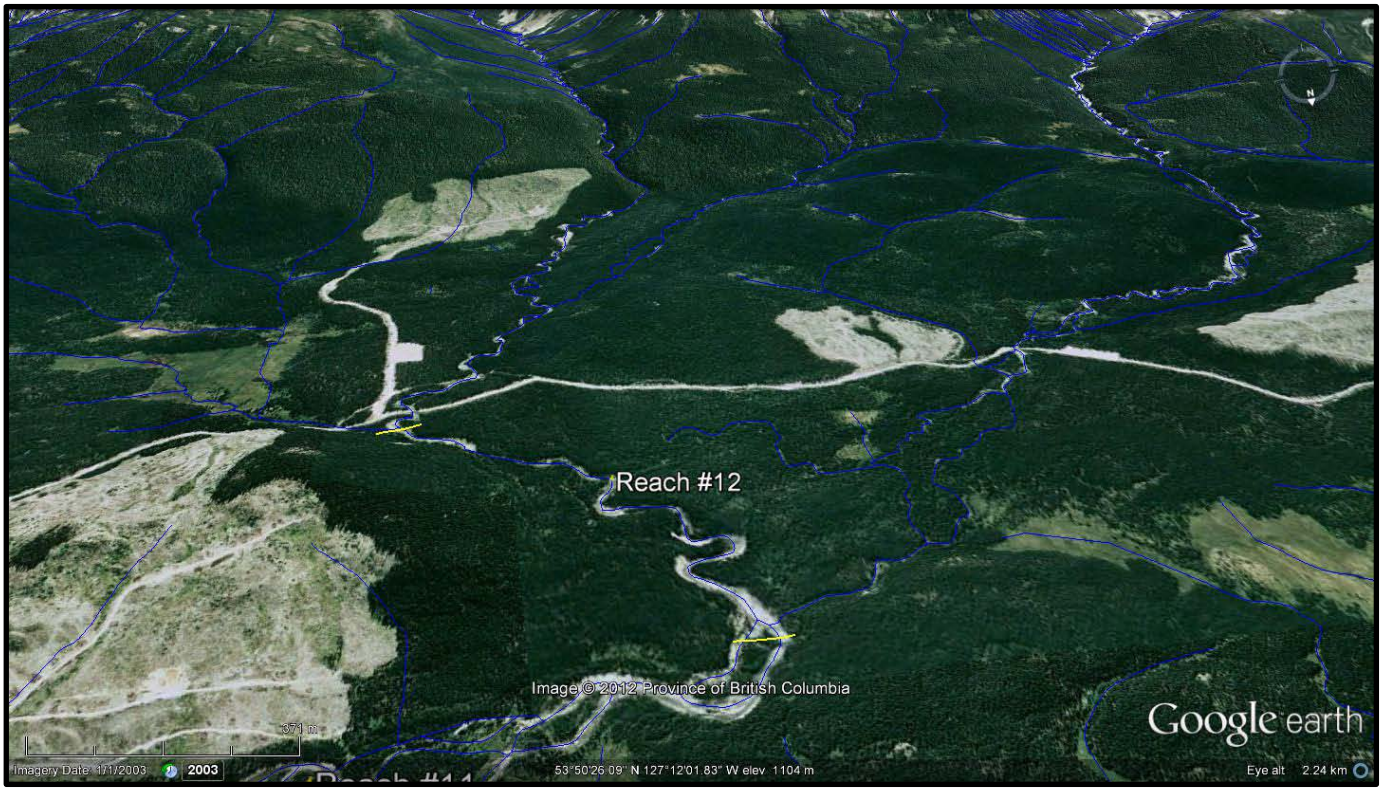

Figure 13. Google Earth image looking upstream along Reach #12 of the Upper Nadina River.

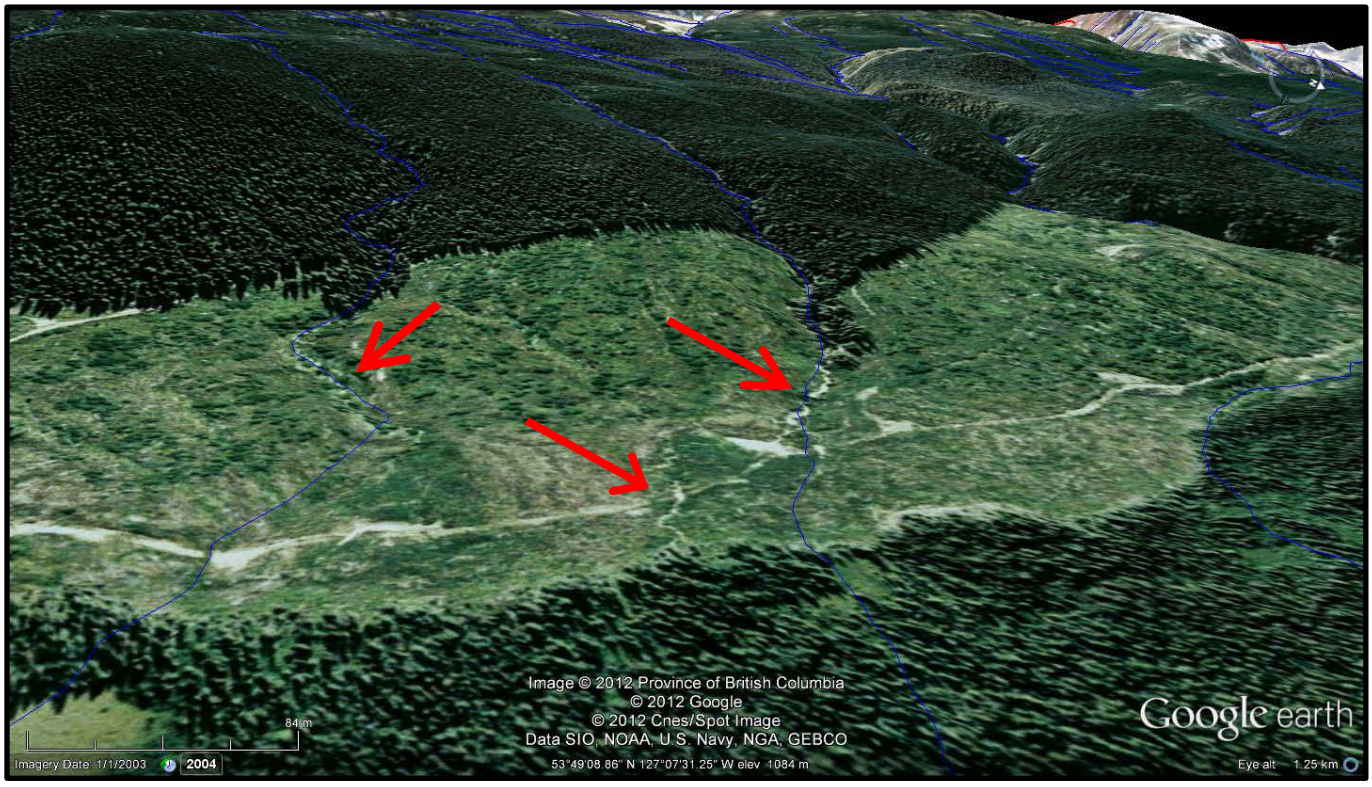

Figure 14. Riparian logging of small streams in the steeper section of the upper Nadina Watershed.

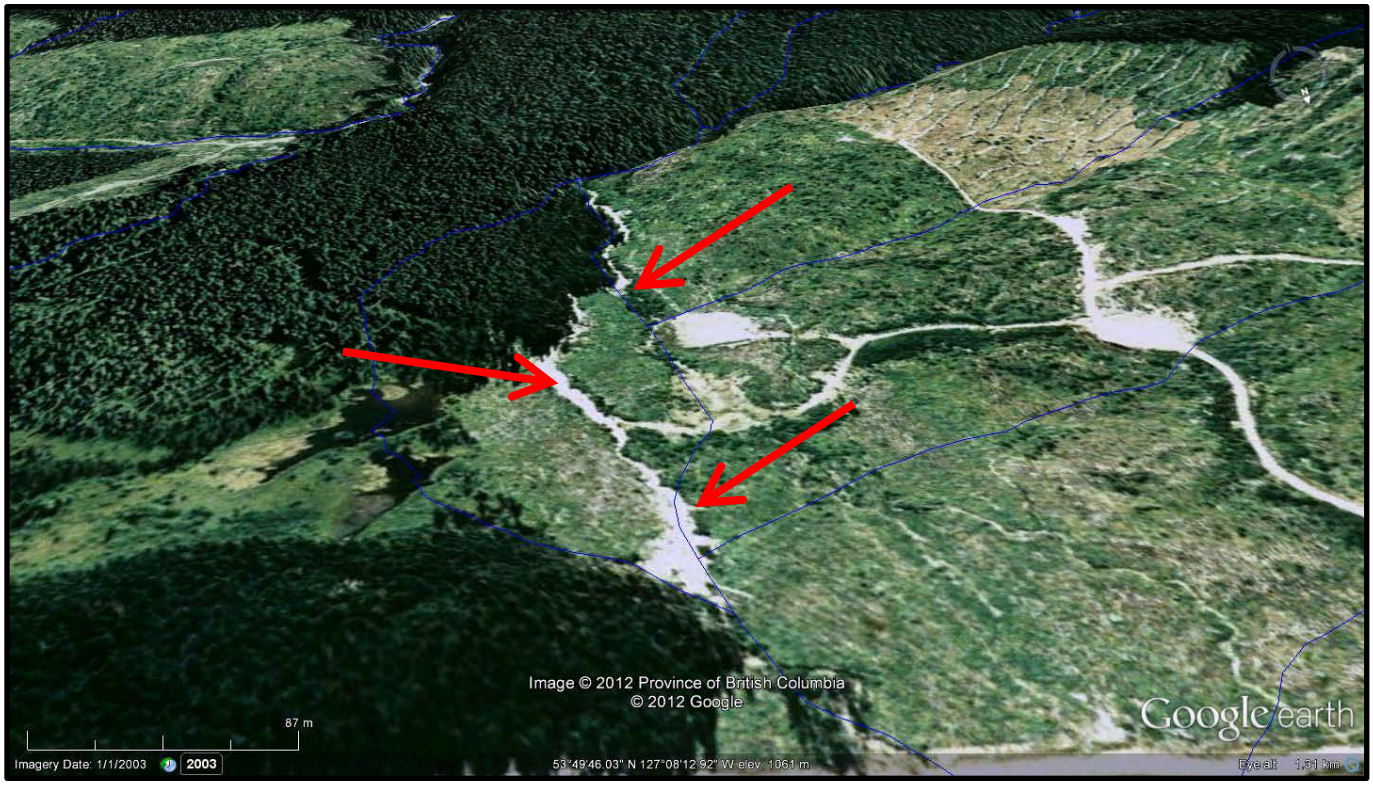

Figure 15. Riparian logging of small streams in the steeper section of the upper Nadina Watershed.