

**WATERSHED RESTORATION PROGRAM**

**STREAM REHABILITATION  
2001 AS-BUILT REPORT FOR  
GRILSE CREEK**

*Submitted to*

**Renewal Investment Corporation  
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*"This document represents a typical report to be used as a guide for developing FIA Aquatic Restoration and Rehabilitation outputs as per the FIA Aquatic Restoration and Rehabilitation Standards (<http://wlapwww.gov.bc.ca/wld/fia/instream.html>). It has been reproduced with the consent of the authors. It is not intended to be used as a universal product for all projects."*

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## **ACKNOWLEDGMENTS**

Overall coordination of the instream and groundwater channel projects was undertaken by Allan Chapman and Brad Bodnar, Renewal Investment Corporation. Allan Chapman also supervised construction of the alcove. Monica and Lance Stewardson of Mainstream Biological Consulting assisted with environmental monitoring. LWD anchoring was completed by John Price and Jim Price of C&B Silviculture, and Jeremy Gaboury. Len Masson of Nu Creek Developments and Ken Kennedy of K&D Excavating operated the excavators used in the construction of the LWD structures and backwater alcove. Trucks were provided by Alpine Excavating and Wakiwa Construction Ltd. All of these individuals and companies were instrumental in the successful completion of this project.

## **1.0 INTRODUCTION**

Grilse Creek, a tributary to the Salmon River, was selected by Weyerhaeuser to restore fish habitat impacted by logging. The project was funded under the BC Watershed Restoration Program (Forest Renewal BC) and managed for Weyerhaeuser by Renewal Investment Corporation.

Level 1 Fish Habitat Assessments (FHAP) of Tributaries G02 and G03 within the Grilse Creek watershed were conducted by Wong and Komori (1999), and Level 2 Restoration prescriptions were prepared by Wong et al. (2000) and Gaboury (2001). The Level 2 prescriptions (Wong et al. 2000) for the tributaries clearly described the biological rationale for undertaking restoration works in Tributaries G02 and G03.

This report provides details of instream and off-channel restoration works completed during the 2001 construction window for Grilse Creek. The restoration objectives for the instream rehabilitation work in Grilse Creek mainstem, Tributaries G02 and G03, and an off-channel alcove were to:

- \$ increase the amount of preferred juvenile summer rearing and wintering refuge for coho and trout by creating a 1200 m<sup>2</sup> off-channel alcove; and
- \$ improve the quality and quantity of holding and rearing habitat for coho and trout by increasing pool frequency and the amount of functional LWD cover in pools along 495 m of stream channel, affecting approximately 3840 m<sup>2</sup> of habitat.

The proposed restoration activities to meet these objectives were to:

- \$ excavate a 75 by 16 m long backwater alcove on the right bank of the Grilse Creek mainstem;
- \$ excavate coarse sediments from pools prior to constructing LWD structures;
- \$ provide cover and promote pool scour by constructing LWD structures at pool sites; and
- \$ construct riffle structures to backwater pools and to increase hydraulic complexity in Tributary G03.

## **2.0 CONSTRUCTED WORKS**

Access by machinery and delivery of materials to the restoration sites in Grilse Creek was very good via Salmon River Main, Grilse Creek Main, South Fork Main and South Fork-Branch 100. Construction supervision and environmental monitoring was provided primarily by Marc Gaboury of LGL Limited. Allan Chapman supervised construction of the alcove. Monica and Lance Stewardson of Mainstream Biological Consulting established block nets and removed juvenile fish from the downstream section of Tributary G03 prior to deactivation of the culvert crossing and instream construction.

LWD anchoring was completed by John Price and Jim Price of C&B Silviculture, and Jeremy Gaboury. Machine work in the tributaries and Grilse Creek mainstem was conducted primarily with a Spyder (walking) excavator (operator: Len Masson of Nu Creek Developments) while a Caterpillar 325 track excavator (operator: Ken Kennedy of K&D Excavating) was used to construct the backwater alcove and the lower mainstem LWD site. A Moxy rock truck (Alpine Excavating) and a tandem truck (Wakiwa Construction Ltd.) were used to haul materials to and from the work sites.

Containment equipment was kept on site in the event of a fuel or oil spill. The Spyder had biodegradable hydraulic oil installed while the Caterpillar excavator had conventional hydraulic oil. An environmental monitor was on site during all periods of instream construction. Particular care was taken to minimize disturbance to the riparian areas.

Instream construction commenced on 2 August 2001 and was completed by 11 August. A crew of three people was employed to fasten the LWD to boulders and streambank trees. Photos of the restoration works and as-built longitudinal and cross section level surveys of the backwater alcove and riffle structures were completed by 11 August 2001. The cost breakdown for the constructed works was:

Labour	\$27,928
Machinery and materials	\$45,622
Total	\$73,550

Labour costs also include coordination costs by Renewal Investment Corporation, field per diem costs of supervisor and labourers, and some material purchases.

In general, construction followed the procedures and specifications stipulated in Gaboury (2001). Table 1 summarizes the quantity of materials specified and used in the project. A total of 14 sites were constructed in Tributary G02, six in Tributary G03, and two in the Grilse Creek mainstem (Figures 1 to 3). Restoration plans for two sites in each of Tributaries G02 and G03 were revised due to site conditions and as a result were not constructed. Photos 1 to 28, showing constructed LWD and riffle structures, are cross-referenced to specific structures in Table 1. Red cedar, douglas fir and hemlock were used in the LWD structures. All LWD were ballasted with boulders. Holes were drilled into the rock and the cable fastened to the rock using epoxy. Cables were also fastened to the LWD using 10 cm staples. Crosby clamps were used when cabling multiple pieces of LWD together or anchoring LWD to live trees on the streambank.

Figure 4 shows the longitudinal profile, cross section and elevations of the riffles constructed in Tributary G03 (Photo 17). Riffle construction generally followed the prescription report (Gaboury 2001). Riffle crest elevations and locations were modified slightly from the prescription plan due to site conditions. The pool located upstream of the rock riffles was extended 25 m further upstream (Figure 4). A riffle was constructed using parent materials at the upstream end of the pool (chainage 0+115 m) to stabilize the streambed and reduce head-cutting (Photo 20).

The alcove was constructed with a width of between 14 and 18 m, and a length of 75 m (Figures 3 and 5). Photos 29 and 30 show the constructed backwater alcove with LWD that had been added to provide cover. The maximum depth of excavation below the existing ground level was about 2.7 m. Most of the excavated material was loaded on a truck and dumped along the deactivated spur road on the South side of the alcove. Also, spoil was placed around the perimeter of the alcove. Residual pool depths in the alcove were between 1.0 and 1.3 m. The alcove pool was complexed with about 56 pieces of large and small woody debris. Some of the woody debris was obtained during the clearing for the alcove. Three logs were crossed and anchored at the outlet of the alcove pool to prevent the woody debris from floating out of the channel during high water levels (Photos 31 and 32). The height of the spoil around the perimeter of the alcove averaged about 1.5 m above the existing ground surface. At the completion of the backwater alcove project, the berm area was seeded to grass.

### **3.0 PRELIMINARY MONITORING PLAN**

Well designed and properly implemented monitoring is a prerequisite to determining the success or failure of watershed restoration. The most important step in developing a monitoring plan is to clearly define the objectives. A hierarchical framework for effectiveness monitoring within watersheds has been proposed by Gaboury and Wong (1999). Using their terminology and protocols, effectiveness monitoring involves three types or levels of monitoring: routine, intensive and operational techniques refinement. A preliminary monitoring plan for Grilse Creek falls into the category of routine monitoring and includes:

- \$ based on the restoration works summary (Table 2) and the protocol established by Koning et al. (1998), implement routine monitoring of all structures after one winter flood season and then subsequently every five years or after a 1 in 10 year flood event;
- \$ undertake snorkel, Gee trap and/or electrofishing surveys to document fry, juvenile and adult fish utilization of riffle and pool structures, and the alcove; and
- \$ establish a staff gauge in the backwater alcove and monitor during run-off events and through dry periods to assess the variability in water levels and fish access.

The main objectives of this recommended monitoring are to:

- \$ assess whether the works are functioning as intended;
- \$ determine if remedial work is needed; and
- \$ identify specific areas which may warrant more detailed monitoring or specific investigation.

The best maintenance is dependable routine monitoring. By definition, routine monitoring will identify whether more intensive monitoring is necessary. It will also assist with the refinement of instream restoration techniques that will be applied to proposed restoration structures in the Grilse Creek mainstem in 2002.

**4.0 LITERATURE CITED**

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- Gaboury, M. 2001. Fish Habitat Restoration Designs for Grilse Creek Watershed. Prepared by LGL Limited for Renewal Investment Corporation, Campbell River, BC.
- Koning, C.W., M.N. Gaboury, M.D. Feduk and P.A. Slaney. 1998. Techniques to evaluate the effectiveness of fish habitat restoration works in streams impacted by logging activities. Canadian Water Resources Journal 23(2) 191-203.
- Wong, R. and V. Komori. 1999. Level I Fish Habitat Assessment and Restoration Opportunities for Grilse Creek and Upper Salmon River. Prepared for Renewal Investment Corp., Campbell River, BC.
- Wong, R., V. Komori and B. Chilibeck. 2000. Level II Fish Habitat Restoration Prescriptions and Cost Summary for Grilse Creek and Upper Salmon River. Prepared for Renewal Investment Corp., Campbell River, BC.

**TABLES**

Table 1. Summary of materials specified and used in construction of restoration projects in Tributaries G02 and G03, the alcove, and Grilse Creek.

Stream	Design Specifications								As-Built							
	LWD Structures				Riffle Boulders				LWD Structures				Riffle Boulders			
	Chainage (m)	Structure Type	Right or Left Bank	LWD Required	LWD Size (m)	Boulders Required	Diameter (m)	Diameter (m)	Volume (m <sup>3</sup> )	LWD (Logs + Separate Rootwads)	Log Size: Diameter x Length (m)	Boulders: No. & Diameter (m)	Diameter (m)	Volume (m <sup>3</sup> )	Comments	Photo Plate Number
G02	0+000	DJ-5	Right	5	0.5 x 8-10	0	0.8			8	0.4 x 6	1-0.4, 1-0.5, 1-0.6, 3-0.8, 3-0.9, 1-1.0			Logs without rootwads	1
G02	0+038	LT-6	Right	6	0.5 x 6-8	0	0.8			7	0.3-0.6 x 4	3-0.4, 5-0.5, 2-0.7, 2-1.0			Logs without rootwads	2
G02	0+076	LT-6	Left	6	0.5 x 6-8	0	0.8			7+3	0.3-0.6 x 7-8	1-0.5, 2-0.6, 2-0.7, 4-0.8, 1-0.9			Logs without rootwads	3
G02	0+101	LT-3	Right	3	0.5 x 6-8	0	0.8			4+1	0.4-0.6 x 5-6	1-0.7, 2-0.8, 1-1.0, 2-1.1			Logs without rootwads	4
G02	0+110	Riffle	Fullspan					0.6-0.7	30						Not constructed	
G02	0+120	UL-1	Fullspan	1	0.5-0.7 x 10	0	0.8			0					Not constructed	
G02	0+136	LT-3	Left	3	0.5 x 6-8	0	0.8			4+1	0.5-0.7 x 5-7	1-0.5, 2-0.8, 1-0.9, 1-1.0			Logs without rootwads	5
G02	0+160	DJ-5	Right	10	0.5 x 6-8	0	0.8			3	0.4-1.0 x 7-8	2-0.8, 1-0.9, 1-1.0, 1-1.1			Two logs with rootwads	6
G02	0+191	LT-3	Left	3	0.5 x 6-8	0	0.8			4+2	0.4-0.6 x 3-8	3-0.6, 1-0.8, 1-0.9, 1-1.0			Logs without rootwads	7
G02	0+217	LT-3	Right	3	0.5 x 6-8	0	0.8			4+1	0.5-0.6 x 6-8	1-0.8, 2-0.9, 2-1.2			Logs without rootwads	8
G02	0+244	LT-6	Left	6	0.5 x 6-8	0	0.8			6	0.3-0.5 x 6	4-0.5, 3-0.7, 1-1.0, 1-1.2			Two logs with rootwads	9
G02	0+255	UL-1	Fullspan	1	0.5-0.7 x 12	0	0.8			1	0.4 x 7.5	1-0.3, 1-0.4, 1-0.5, 1-0.6			Spanning 1/2 the creek width	10
G02	0+274	LT-6	Right	6	0.5 x 6-8	0	0.8			7	0.3-0.5 x 6	4-0.5, 4-0.6, 3-0.8, 1-0.9			Logs without rootwads	11
G02	0+280	UL-1	Fullspan	1	0.5-0.7 x 12	0	0.8			1	5 x 6.5	1-0.5, 1-0.7			Spanning 1/2 the creek width	12
G02	0+297	LT-6	Left	6	0.5 x 6-8	0	0.8			8	0.3-0.6 x 6	3-0.4, 1-0.5, 3-0.6, 1-0.8, 1-0.9, 3-1.0, 1-1.1			Logs without rootwads	13
G02	0+360	DJ-5	Left	10	0.5 x 6-8	0	0.8			9+2	0.4-0.5 x 6-7	2-0.6, 6-0.7, 2-0.8, 2-0.9, 2-1.0			Logs without rootwads	14
G03	0+010	LT-3	Right	3	0.5 x 6-8	0	0.8			3+1	0.5 x 7	2-0.6, 1-0.7, 1-0.8			Logs without rootwads	15
G03	0+040*	LT-3	Left	3	0.5 x 6-8	0	0.8			3+1	0.5 x 7	1-0.5, 2-0.8			Logs without rootwads	16
G03	0+050*	Riffle	Fullspan					0.6-0.7	15				0.6-0.7	15		17
G03	0+062*	Riffle	Fullspan					0.6-0.7	15				0.6-0.7	15		17
G03	0+063	LT-3	Right	3	0.5 x 6-8	0	0.8								Not constructed	
G03	0+070	LT-3	Left	3	0.5 x 6-8	0	0.8								Not constructed	
G03	0+080*	LT-3	Right	3	0.5 x 6-8	0	0.8			2+1	0.4 x 10	1-0.6, 2-0.7, 1-0.8			One log with rootwad	18
G03	0+105	LT-3	Left	3	0.5 x 6-8	0	0.8			4	0.3-0.5 x 4-6	2-1.0, 1-1.1			Logs without rootwads	19
Alcove	U/S of G03	LWD	Left	60	0.5 x 6-10	0	0.8			50+6	0.3-0.6 x 4-	2-0.9, 2-1.0			Most logs without rootwads	29-32
Grilse	U/S of G03	LT-6	Right	12	0.5 x 8-10	0	0.8			11+3	0.6-1.1 x 10-15	3-0.5, 4-0.6, 3-0.7, 3-0.8, 4-0.9, 7-1.0, 5-1.2			Logs without rootwads	21-25
Grilse	Near Alcove Outlet	LSP-5	Right	10	0.5 x 6	0	0.8			8	0.5-1.1 x 7-15	1-0.6, 1-0.7, 2-0.8, 2-0.9, 4-1.1, 6-1.0, 1-1.1			One log with rootwad	26-28
			<b>Total</b>	160		0			60	154+22				30		

Note: \* - denotes revised chainage, where structure was moved slightly from prescription location

Table 2. Restoration works summary for Tributaries G02 and G03, the alcove, and Grilse Creek, 2001.

Stream	Distance (m)	Structure Type	Performance Objectives																Comments
			Physical								Biological								
			Pool	Riffle	Substrate Cover	Off-channel Access	Channel Platform	High Flow	Low Flow	Species	Life Stage	Overwinter	Rearing	Spawning	Incubation	Material Quantities & Stream Plan View	Typical Structure Cross Section & Plan View	Detailed River Survey Drawings	
G02	0+000	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G02	0+038	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G02	0+076	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G02	0+101	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G02	0+136	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G02	0+160	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x			
G02	0+191	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G02	0+217	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G02	0+244	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G02	0+255	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G02	0+274	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G02	0+280	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G02	0+297	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G02	0+360	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G03	0+010	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G03	0+040	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G03	0+050	Riffle	○	○	○			○	○	Co Ct Rb	Ad Ju	○	○			x	x	x	
G03	0+062	Riffle	○	○	○			○	○	Co Ct Rb	Ad Ju	○	○			x	x	x	Backwaters pool between 0+000 to 0+110
G03	0+080	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
G03	0+105	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
Alcove	U/S of G03	LWD cover	○		○	○		○	○	Co Ct Rb	Ad Ju	○	○			x	x	x	75 m long x 15 m wide backwater alcove
Grilse	U/S of G03	LWD cover	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		
Grilse	Near Alcove	Two LWD spurs	○		○			○	○	Co Ct Rb	Ad Ju	○	○			x	x		

**FIGURES**

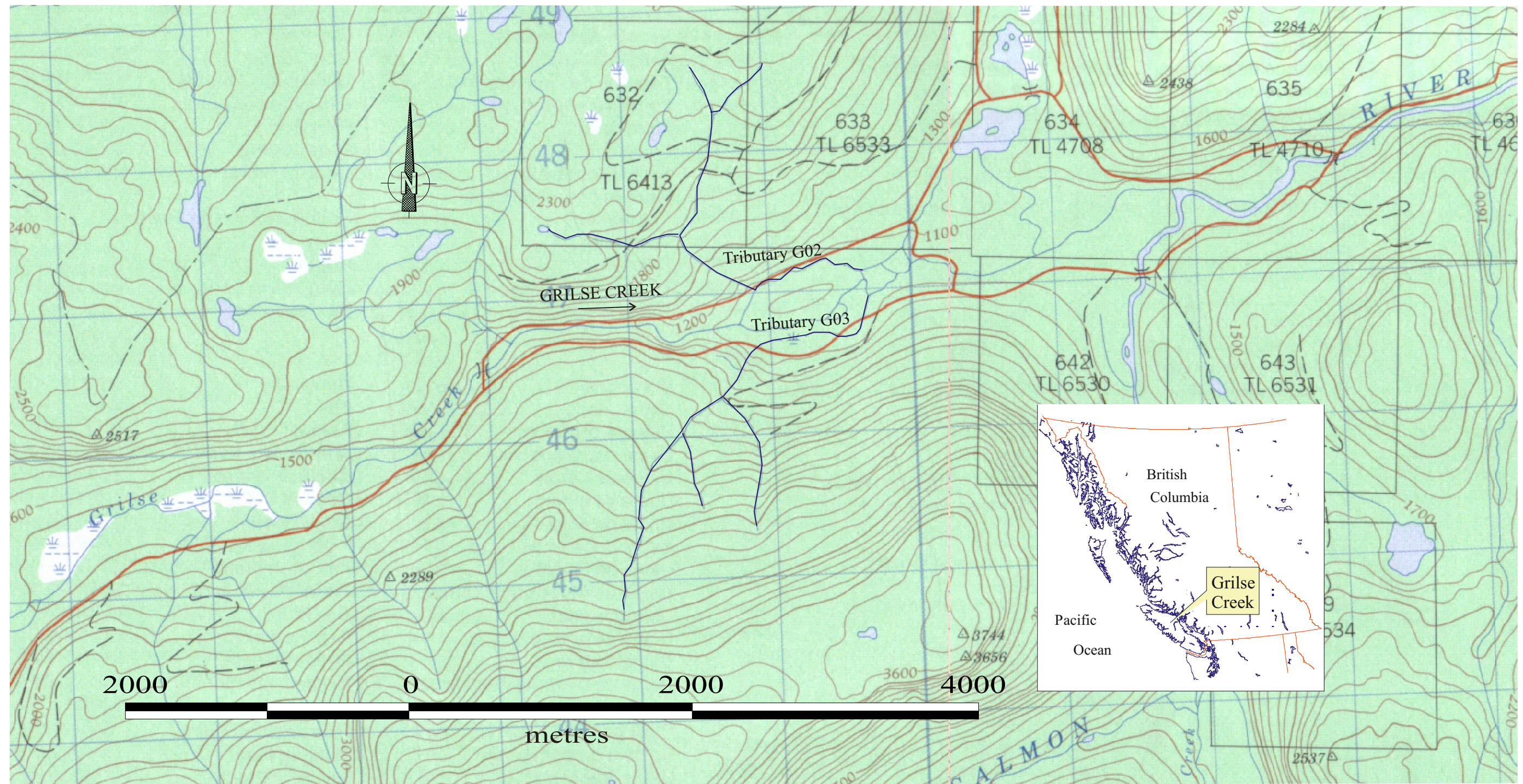


Figure 1. Index map of Grilse Creek watershed showing locations of Tributaries G02 and G03.



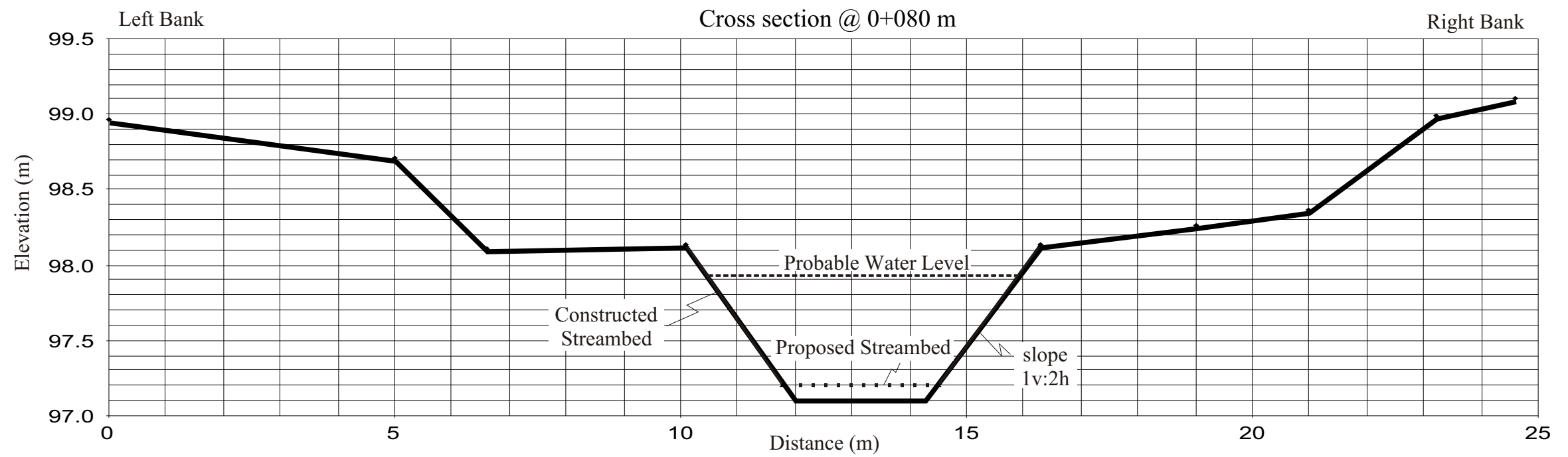
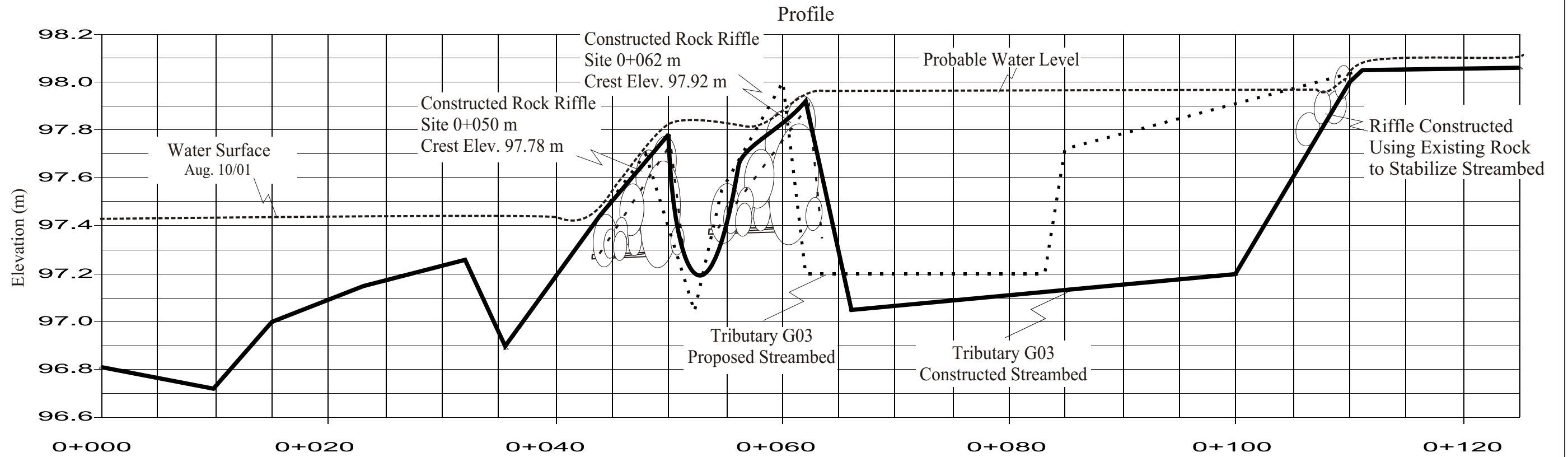
Figure 2. Aerial photo of Tributary G02 showing location of restoration section.

Not to Scale



Figure 3. Aerial photo showing location of Tributary G03 restoration section, alcove and Grilse Creek mainstem sites.

Not to Scale



Benchmark: 100.00 m  
 (Nail on top of cedar stump  
 on right bank, downstream of  
 deactivated culvert crossing)

Figure 4. As-built profile and cross section in Tributary G03.

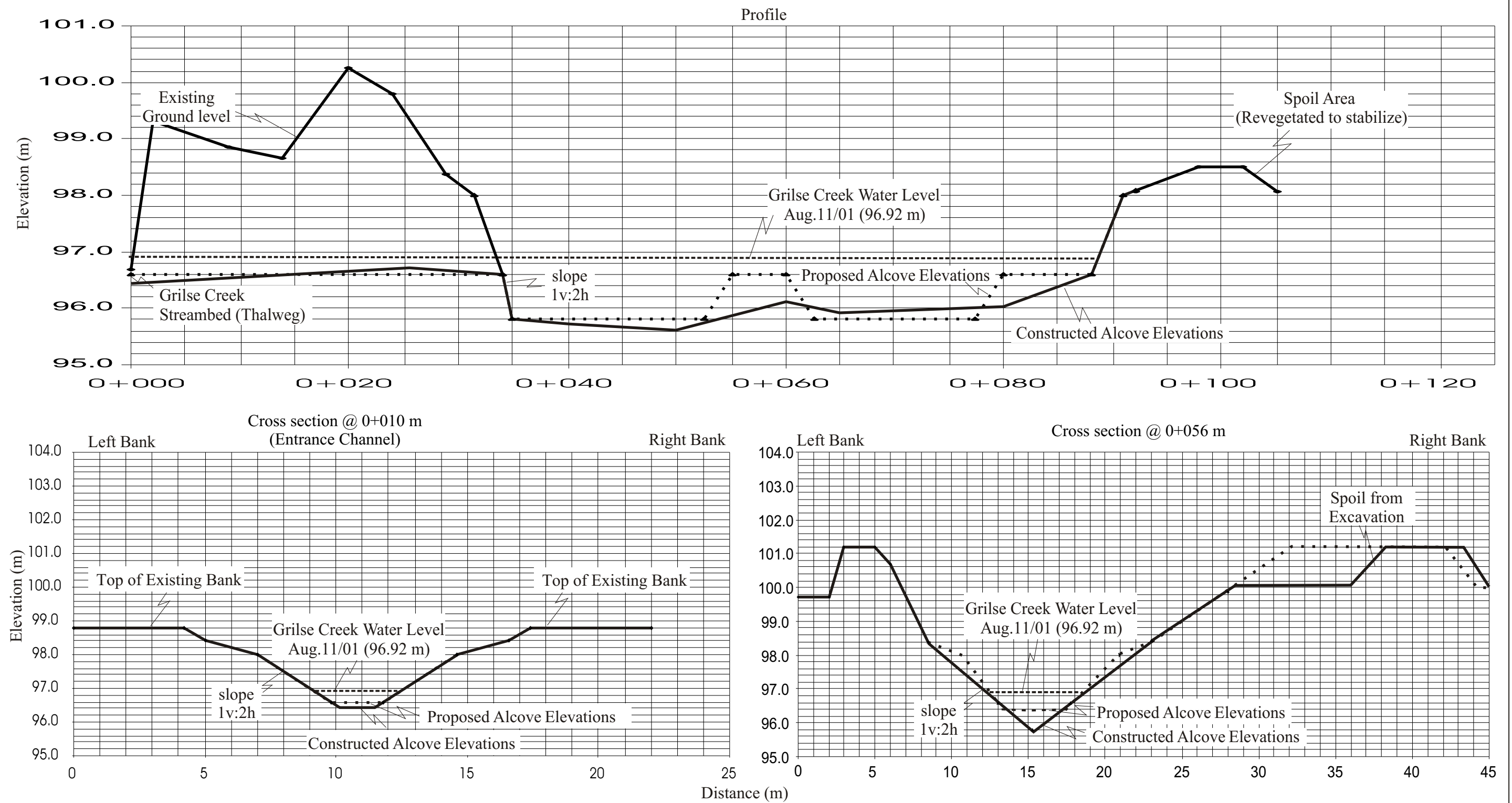


Figure 5. As-built profile and cross sections of the alcove adjacent to Grilse Creek.

**PHOTO PLATES**



Photo 1. Looking downstream at LWD structure located at 0+000 m in Tributary G02.



Photo 2. Looking downstream at LWD structure located at 0+038 m in Tributary G02.



Photo 3. Looking downstream at LWD structure located at 0+076 m in Tributary G02.



Photo 4. Looking downstream at LWD structure located at 0+101 m in Tributary G02.



Photo 5. Looking downstream at LWD structure located at 0+136 m in Tributary G02.



Photo 6. Looking downstream at LWD structure located at 0+160 m in Tributary G02.



Photo 7. Looking downstream at LWD structure located at 0+191 m in Tributary G02.



Photo 8. Looking downstream at LWD structure located at 0+217 m in Tributary G02.