Puntledge River Side-Channel Development
Vancouver Island Highway to Comox Logging Road

06Pun.02

Prepared for:

Comox Valley Project Watershed Society
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Prepared with financial support of:

BC Hydro Bridge Coastal Fish and Wildlife Restoration Program

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EXECUTIVE SUMMARY

Construction of the Comox Lake impoundment dam and the Puntledge River diversion dam in 1912 has resulted in a significant reduction in gravel recruitment to the river below the dam from upstream sources. This has affected the quantity and quality of spawning habitat below the dam which is now limited to small pockets that are utilized by several species of salmon. Rearing habitat below the dam is also affected due to the reduction in LWD recruitment, but this is less critical in the bedrock reaches of the river. The trapping of gravel behind the diversion dam is considered a footprint impact from hydroelectric development in the watershed, and is being addressed through a BCRP funded project to construct stable off-channel spawning habitat as well as summer rearing and over-wintering habitat for coho salmon and trout species.

The Forbidden Plateau side-channel is located in the Diversion Reach (Reach C) of the Puntledge River. The upstream end of the side-channel ties into an existing channel constructed in 2001 by Ministry of Transportation (MOT). The side-channel discharges approximately 550 m downstream into Bevan Creek, at a location 100 m upstream of the confluence with the Puntledge River. A site reconnaissance of the area was conducted in 2003 by Fisheries and Oceans Canada Resource Restoration Division (DFO RRD) and final designs for an extension of the MOT channel to increase spawning and rearing habitat was completed in 2005.

Construction of the Forbidden Plateau side-channel, including road access, was carried out between June 14 and July 6, 2006. Only a portion (~100 m) of the access road needed to be cleared and ballasted, while the majority of road construction consisted of reactivating an existing spur road on Comox Timber property that was originally used when the area was harvested. Project construction included the excavation of approximately 3000m^3 of fill which was used to construct a setback dyke between the side-channel and the Puntledge River, placement of 210 m^3 of rip rap and boulder for construction of weirs, channel banks and habitat complexing, and 688 tonnes of screened and washed gravel. The Forbidden Plateau side-channel construction project has created a total of 1200 m^2 of new spawning habitat (including spawning habitat created in Bevan Creek) and over 9000 m^2 of pool area for salmonid rearing.

Post-construction field staff observed beaver activity within the side-channel that has backflooded some of the spawning area. Lower than anticipated flows through the channel were also observed and may have partially been due to beaver activity. These issues will be further investigated so that strategies can be developed to address these problems in the coming months.

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1 INTRODUCTION

In an ongoing effort to address declining salmon stocks in the Puntledge River, caused in part by a lack of appropriate spawning and rearing sites, several side-channel projects were undertaken between 1984 and 2001. These projects added 1.57 km of constructed side-channel habitat, yielding approximately 9000 m^2 of stable summer and over-wintering habitat for juvenile coho salmon and trout and spawning habitat for pink and coho salmon. A new side-channel development opportunity was identified in 2003 on the south side of the Puntledge River upstream of Stotan Falls between the Vancouver Island Hwy and Comox Logging Road. This report summarizes the activities and outcomes of a side-channel project, known as the *Forbidden Plateau Side-Channel*, constructed in 2006.

1.1 Background

Since the construction of the Puntledge River diversion dam in 1912 at elevation 130 m (430 ft) asl, a large proportion of gravel deposits (post-glacial deltaic gravel and sand sediments) located mainly around the present 150 m (500 ft) contour became isolated from downstream reaches. As a result, the river below the dam lacks gravel recruitment and now spawning habitat is limited to the lower-most reach of the river below the powerhouse (Reach D), and small pockets in the reach between the powerhouse and the diversion dam (Reach C). The reduction in good quality spawning gravel is further aggravated by the repeated use of the same spawning habitat by different species, mainly pink and chum salmon (MacKinnon et al., 1979) in Reach D and coho and chinook in Reach C.

1.2 Goals and Objectives

Construction of the Forbidden Plateau side-channel in Reach C, addresses the reduction in spawning and rearing habitat below the diversion dam by providing critical stable off-channel spawning habitat as well as summer rearing and over-wintering habitat for coho salmon and trout species.

2 STUDY AREA

The Forbidden Plateau side-channel is located in the Diversion Reach (also known as Reach C) of the Puntledge River, which encompasses the section from the diversion

dam downstream to the Browns River confluence. This is typically a bedrock reach with an average gradient of 2% (range 0.5 – 15%). Two major waterfalls are located in this reach: Nib Falls and Stotan Falls (Figure 1).

The upstream end of the side-channel connects to an existing side-channel constructed in 2001 by Ministry of Transportation (MOT), referred to in this report as the VIHP channel. The Forbidden Plateau side-channel flows through private land owned by Hancock Forest Management. The surrounding land was harvested sometime between 1999 and 2000 and has since been replanted. The side-channel discharges into Bevan Creek, which is a small tributary of the Puntledge River containing significant headwater wetland habitat. Bevan Creek joins the Puntledge mainstem just upstream of the Comox Logging Bridge (Figure 1).

3 METHODS

3.1 Project Design

Fisheries and Oceans Canada Resource Restoration Division (DFO RRD) conducted a site reconnaissance of the area in 2003 with the intent to extend the existing VIHP channel further downstream to increase spawning and rearing habitat. A survey was completed 2004 with detailed designs for the "Forbidden Plateau side-channel" finalized in 2005 (Appendix E).

3.2 Site Access

An old spur road on Comox Timber (Hancock property) was used to access the side-channel construction site. Major works commenced on June 14, 2006 with the construction of a short access road from BC Hydro's penstock maintenance road approximately 50m beyond the yellow gate on the southwest side of Comox Logging Road leading to the existing spur road (Figure 2). This site was selected because it avoided crossing Bevan Creek. The spur road required minimal clearing and preparation for equipment use. The road extension from the penstock road is approximately 50 m long. All vehicles traveling along the penstock road were required to operate at speeds of less than 15 km/hr to minimize risk to the penstock. Traffic control was necessary at the junction of the Comox Logging Road and the BC Hydro penstock maintenance road for the duration of the project.

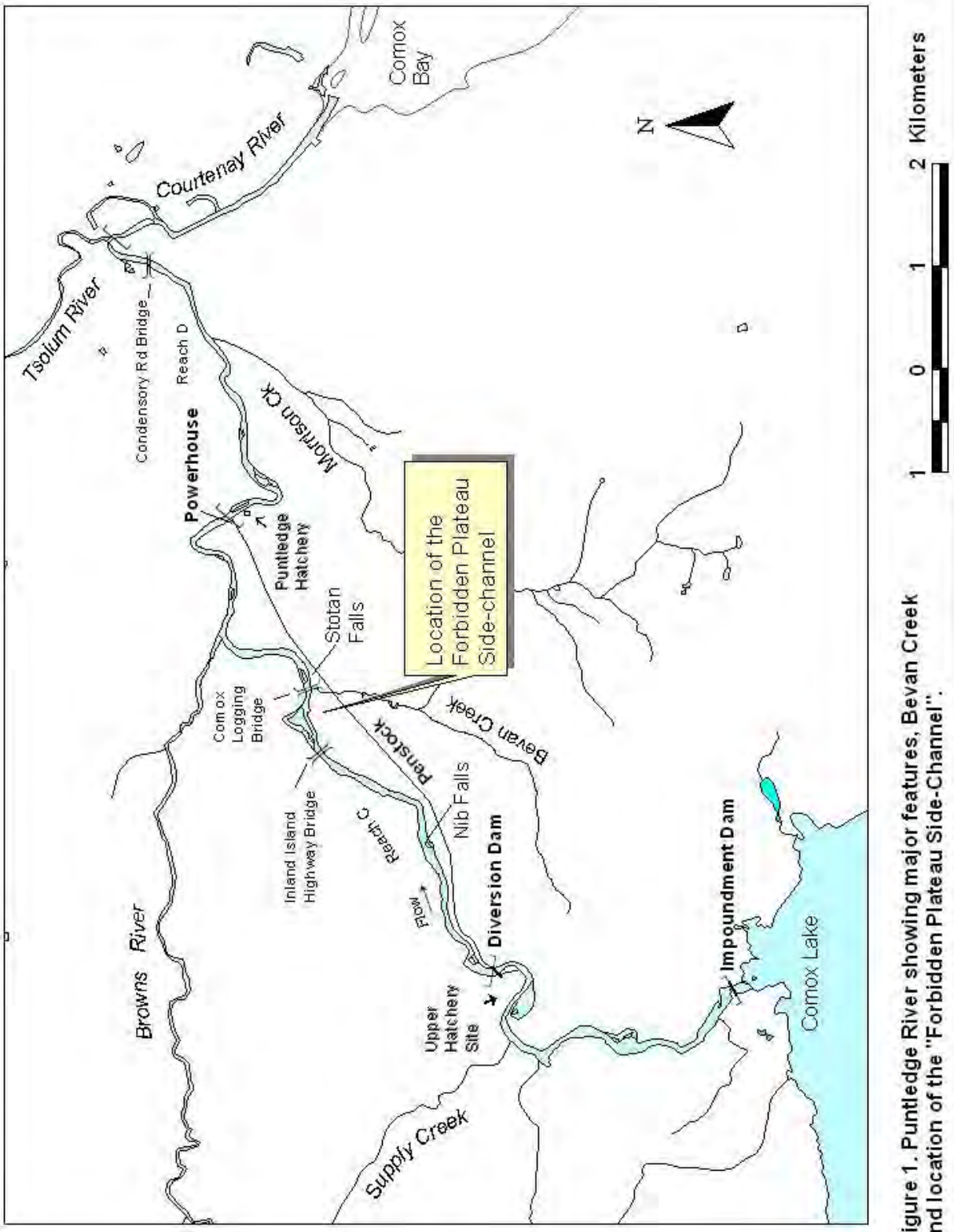


Figure 1. Puntledge River showing major features, Bevan Creek and location of the "Forbidden Plateau Side-Channel".

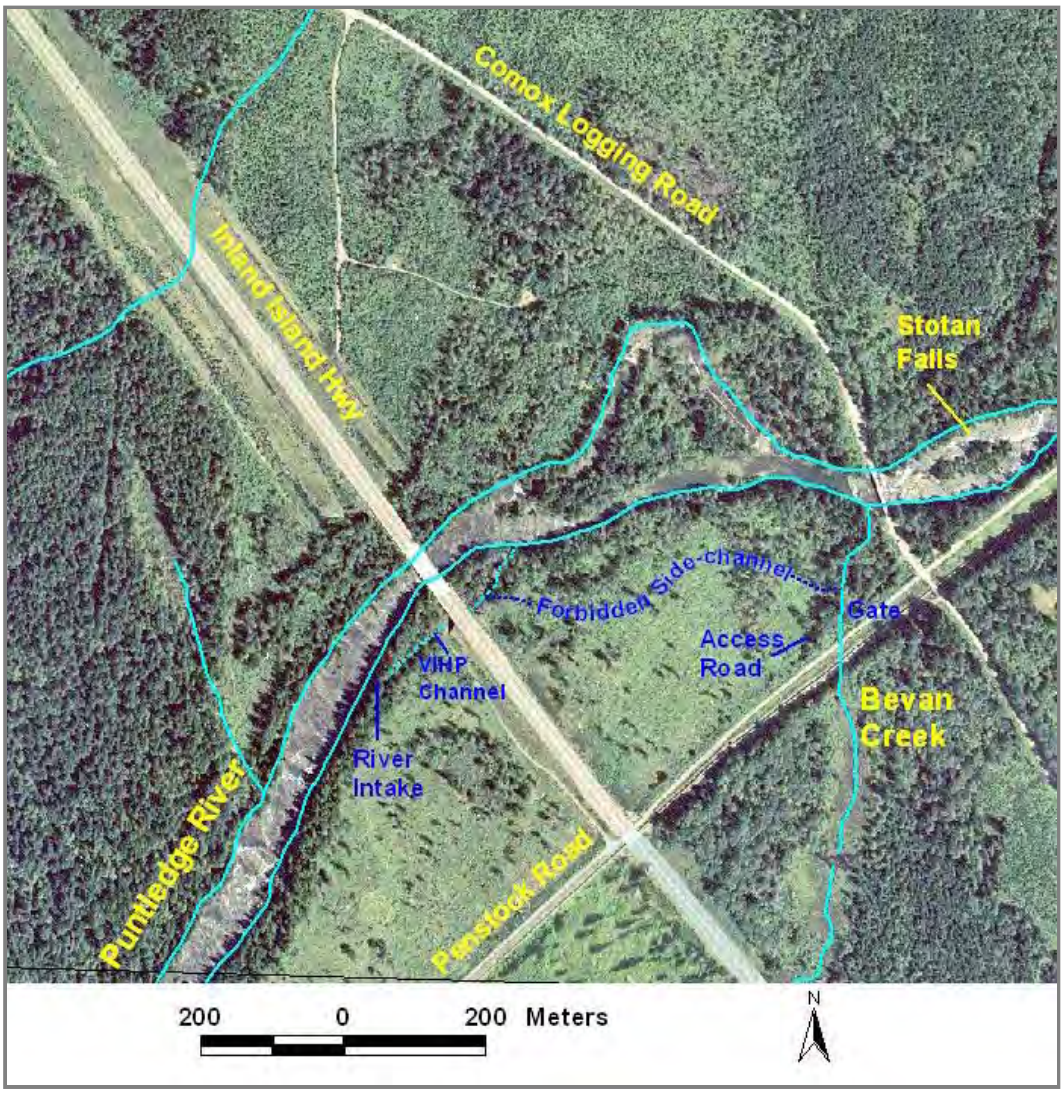


Figure 2. Location of the Forbidden Plateau side-channel showing access route, river and VIHP channel intakes and downstream connection with Bevan Creek.

3.3 Site Isolation and Fry Salvage

The entire channel excavation work was completed in the "dry", thus eliminating the need for silt control during project construction. During channel excavation at the upstream end, an earthen berm was constructed to prevent flow entering from the VIHP channel. Activities at the side-channel outlet at Bevan Creek and activities in the creek itself required site isolation and fry salvage. A 3 inch trash pump, sandbags and plastic sheeting were used to divert flow in the creek around the work site. The area was fish

salvaged with dip nets as the water level receded. Only a few lamprey were present and recovered from the isolated work site in Bevan Creek. The absence of salmonid fry in the area was likely due to a beaver dam located downstream of the main work site. The dam was removed to construct a Newbury weir and spawning habitat in the creek (see Section 5 for further discussion).

3.4 Channel construction

The channel required significant excavation from 1 + 55 m to 2 + 25 m and from 4 + 40 m to 5 + 15 m (Appendix D; Photos 1 through 6). The depth of the cut at these locations ranged from 0 to 3 m (Appendix F). A layer of shale in the upper 30 metres of channel was easily broken with a Deere EX 225 excavator (rather than a rock breaker) during channel excavation. The excavated material (approximately 3000 m^3 in total) was loaded into an articulating off-road gravel truck. The material was used to construct a setback dyke between the river and the lower section of the side-channel. A bridge spanning the side-channel at 4 + 50 m was constructed using logs salvaged on-site to provide access to the upper end of the channel for post monitoring and maintenance activities. Two large pool areas were backwatered to increase their depth and wetted area, one upstream of the channel crossing and one downstream.

A Deere EX160 was used to construct 4 rock weirs with 600 mm minus (diameter) rip rap – three in the lower side channel and one in Bevan Creek (Appendix D; Photos 7 & 8). Additional boulder/cobble was used for habitat complexing in the channel. Spawning habitat was created upstream of the constructed weirs by placing screened and washed gravel of a suitable mix for coho salmon and trout (Table 1). Channel construction was completed on July 6, 2006. Total amounts of materials and equipment are summarized in Table 2.

Table 1. Grading limits for screened and washed spawning gravel for the Forbidden Plateau Side-channel Project.

% by Volume	Gravel Size mm	Gravel Size inches
10	10	3/8"
60	13 - 20	½" to ¾"
30	20 - 38	¾" to 1 ½"

Table 2. Summary of equipment and material used for the Forbidden Plateau Side-channel construction project in the Puntledge River, June - July 2006.

Equipment	Description	Quantity
Deere Excavator (Ex225)	Road access, channel excavation	139 hours
Deere Excavator (Ex160)	Weir construction	120.5 hours
Off-Road Gravel Truck	Dyke construction	30 hours
Gravel Trucks	Delivery of pit run and spawning gravel	64 hours
Spawning Gravel	Single-washed	688 tonnes
Rock	Rip rap and cobble	210 m^3

3.5 Post-construction site rehabilitation and monitoring

Areas of exposed soil along the channel and setback dyke network were seeded after the summer drought with a sheep pasture mix in early September. The area will be reseeded in Spring 2007 because of poor germination and/or erosion of seed. A riparian planting program was planned for early spring 2007 with assistance from a class of Grade 5 students, but had to be postponed until fall 2007 due to the wet and unstable soils.

Post-construction monitoring at the Forbidden Plateau side-channel has been carried out between October and December 2006. This included surveying the channel for spawning activity, fry recruitment, beaver activity, and measuring discharge under varying flows in the Puntledge River mainstem.

3.6 Communications

A Communications Plan was implemented by staff of Comox Valley Project Watershed Society to advise the public and immediate community of the upcoming project. This included notices in local newspapers, temporary signage during the project construction, displays at a BC Rivers Day Open House Event at Puntledge Hatchery, and an article in the *Watershed News* (Appendix C). A more detailed Community Outreach Program associated with this and three other BCRP projects in the Puntledge River watershed is summarized in a separate report.

4 RESULTS

The Forbidden Plateau side-channel construction project has created a total of 1200 m^2 of new spawning habitat (including spawning habitat created in Bevan Creek) and over 9000 m^2 of pool area for salmonid rearing, as measured in December 2006 (Appendix F). The new side-channel joins the existing VIHP channel 150 m downstream of the river intake and flows for an additional 555 m before discharging into Bevan Creek. The existing 600 mm river intake has a maximum capacity of 15 cfs and is designed to divert 5% of the low summer flow from the Puntledge mainstem. This will provide year round flow for the lower 100 m of Bevan Creek, improving coho smolt downstream migration out of Bevan Ck, juvenile immigration into Bevan Ck from the mainstem in the fall, and adult access into Bevan Ck during the spawning season.

Discharge measured in the Forbidden side-channel on July 19, 2006 was 0.08 cms (2.8 cfs) during a minimum fisheries flow (~6 cms or 210 cfs) in the mainstem measured at WSC 08HB084, also known as BC Hydro Gauge 6 (Table 3). This was 67% of the total flow (0.12 cms or 4.2 cfs) delivered from the river intake, measured at the box culvert under the highway bridge on the same day. Discharge measured in the side-channel in September 2006 during a mainstem flow of 13 cms (450 cfs) was not significantly different than the July measurement, suggesting that a doubling of mainstem flow had little influence on side-channel discharge. Discharge in the side-channel was slightly lower in March 2007 when mainstem flow was at 15 cms. This could possibly be due to changes in channel morphology over the winter, but is more likely due to the back-watering effect from beaver activity.

Table 3. Discharge measured at the Forbidden Plateau Side-channel and VIHP channel July 2006 – March 2007.

Date	Discharge (cms)	Location of Measurement	Puntledge Flow Reach C* (cms)	Proportion of total intake flow delivered to Forbidden SC
19-Jul-06	0.08	side-channel	6	67%
19-Jul-06	0.12	box culvert	6	
6-Sep-06	0.07	side-channel	13	
16-Mar-07	0.05	side-channel	15	45%
16-Mar-07	0.11	box culvert	15	

* discharge at WSC 08HB084 (BCH Gauge 6) provided by BCH Power Records.

The average coho smolt density for many constructed side-channels in B.C. and the Pacific Northwest is 0.67 smolts/m^2 (Koning and Keeley, 1997). Using this biostandard, the expected coho smolt production from the Forbidden Plateau side-channel is over 6000 smolts.

5 DISCUSSION

Construction of the side-channel was slightly modified from the original 2005 DFO design. The original design incorporated smaller rock weirs and no instream work in Bevan Creek. However, the addition of a Newbury weir in Bevan Creek increased the invert at the confluence of the channel and the creek, thereby allowing more spawning habitat to be created in the lower 100 m of side-channel due to a lower gradient in this section (1.4% versus 3.3 % as originally planned). It also allowed spawning gravel to be added upstream of the weir in Bevan Creek creating ~200 m^2 of additional spawning habitat. Removal of the beaver dam in Bevan Creek to accommodate this work improved access into this significant wetland system for coho overwintering.

There is some concern expressed by DFO RRD that flows in the channel are less than anticipated and may be insufficient to attract spawners into the side-channel under minimum fish flows (5.7 cms or 200 cfs) in the mainstem. It has been suggested that doubling the flow in the side-channel during the fall would provide more adequate attraction for spawners (from 0.08 to 0.16 cms or 2.8 to 5.6 cfs). This would likely require replacement of or modification to the existing river intake, or addition of a second intake to provide the additional flow.

Beaver activity at the side-channel was evident by December 2006. Beavers have constructed a small dam approximately 60 m upstream of the channel outlet, further enlarging the pool upstream, and drowning about 420 m^2 of spawning area and reducing the quality of 180 m^2 of spawning habitat downstream. The dam was removed frequently during the winter, but was usually rebuilt within a few days. Beaver activity at constructed side channels is not uncommon and while the activities of beavers create positive benefits to fish and wildlife ecosystems, they can also have negative effects, such as flooding of roads and lands, barriers to fish migration and the backwatering of spawning habitat as witnessed at the Forbidden Plateau side-channel. Managing beaver impacts can be a frustrating and laborious task. A number of design strategies have been developed that can address these circumstances and provide effective alternatives to removal of these barriers (Finnigan and Marshall 1997). The site will be monitored to

determine the full extent of beaver activity and evaluate the options (if any) for beaver management that would be best suited to the site.

6 RECOMMENDATIONS

1. Evaluate the side-channel site for beaver management, and produce a list of suitable management strategies that can be discussed with the private landowner, relevant agencies and the community.

2. Replant the area in early Fall 2007 with a suitable conifer mix and native species of shrubs that have optimal soil binding and shade producing characteristics, and are not preferred food for beavers.

3. Evaluate the feasibility of modifying or doubling the existing river intake for augmenting attraction flow in the Forbidden Plateau side-channel.

7 ACKNOWLEDGEMENTS

This project was made possible through the financial support of the B.C. Hydro Bridge Coastal Fish and Wildlife Restoration Program (BCRP) and Ministry of Transportation. We are also indebted to Fisheries and Oceans Canada Resource Restoration Division (Nanaimo) for technical support and construction supervision, and Hancock Forest Management (Comox Timber Ltd.), the private landowner, for allowing the project to proceed on their property.

8 REFERENCES

Finnigan, R.J. and D.E. Marshall. 1997. Managing beaver habitat for salmonids: working with beavers. *In* P.A. Slaney and D. Zaldokas [eds.] Fish Habitat Rehabilitation Procedures. Watershed Restoration Technical Circular No. 9.

Koning, C.W. and E.R. Keeley. 1997. Salmonid biostandards for estimating production benefits of fish habitat rehabilitation techniques. In P.A. Slaney and D. Zaldokas [eds.] Fish Habitat Rehabilitation Procedures. Watershed Restoration Technical Circular No. 9.

MacKinnon, C.N., H. Genoe and D.C. Sinclair. 1979. Puntledge River Project 1972 - 1977. Fish. and Mar. Serv. Tech. Rep. No. 842, Enhancement Services Branch, Vancouver, 126 p.

Appendix A - Financial Statement Form **Project #: 06.Pun.02**

	BUDGET			ACTUAL		
INCOME	**BCRP**	**Other (Cash)**	**Other (in-kind)**	**BCRP**	**Other (cash)**	**Other (in-kind)**
Total by Source	$97,977.00		$27,893.00	$97,977.00		$13,405.00
Grand Total Income (BCRP + Other)	**$125,870.00**			**$111,382.00**		
EXPENSES						
Project Personnel						
Biologist (contractor)	$5,160.00			$4,278.40		
Construction Labour	$6,000.00			$2,035.74		
Construction Supervision	$2,000.00		$10,000.00	$1,088.00		$6,000.00
Communications Technician	$4,050.00			$4,050.00		
DFO Biologist/Engineer			$4,000.00			$1,600.00
DFO Technicians			$2,100.00			$2,100.00
Honoraria			$100.00			
Volunteers			$4,000.00			$1,000.00
Material and Equipment						
Heavy Equipment	$52,060.00			$44,816.45		
Gravel/rock	$6,400.00			$20,489.10		
Small Tools/supplies & equipment rental	$10,000.00			$3,010.20		
LWD			$5,000.00			$1,000.00
Salmon People performance	$1,400.00			$1,400.00		
Theatre Rental	$650.00			$650.00		
Advertising	$350.00			$350.00		
Travel	$1,000.00		$350.00	$159.75		$450.00
Adiministration						
Office Supplies	$50.00					
10%	$8,857.00		$2,343.00	$8,632.77		$1,255.00
Total Expenses	**$97,977.00**	**$0.00**	**$27,893.00**	**$90,960.41**	**$0.00**	**$13,405.00**
Grand Total Expenses (BCRP + others)	**$125,870.00**			**$104,365.41**		
Balance (Grand Total Income - Grand Total Expenses	**$0.00**			**$7,016.59**		
BCRP Balance (surplus)	**($7,016.59)**					

* Any unspent BCRP financial contribution to be returned to: BC Hydro, BCRP
6911 Southpoint Drive (E14)
Burnaby, B.C. V3N 4X8

APPENDIX B - PERFORMANCE MEASURES

Project # 06.Pun.02

Using the performance measures applicable to your project, please indicate the amount of habitat actually restored/enhanced for each of the specified areas (e.g. riparian, tributary, mainstream).

Performance Measures – Target Outcomes													
Project Type	**Primary Habitat Benefit Targeted of Project (m^2)**	**Primary Target Species**	**Habitat (m^2)**										
			Estuarine	In-Stream Habitat – Mainstream	In-stream Habitat – Tributary	Riparian	Reservoir Shoreline Complexes	Riverine	Lowland Deciduous	Lowland Coniferous	Upland	Wetland
Impact Mitigation												
Fish passage technologies	Area of habitat made available to target species											
Drawdown zone revegetation/stabilization	Area turned into productive habitat											
Wildlife migration improvement	Area of habitat made available to target species											
Prevention of drowning of nests, nestlings	Area of wetland habitat created outside expected flood level (1:10 year)											
Habitat Conservation												
Habitat conserved – general	Functional habitat conserved/replaced through acquisition and mgmt											
	Functional habitat conserved by other measures (e.g. riprapping)											
Designated rare/special habitat	Rare/special habitat protected											
Maintain or Restore Habitat forming process												
Artificial gravel recruitment	Area of stream habitat improved by gravel plmt.											
Artificial wood debris recruitment	Area of stream habitat improved by LWD plcmt											
Small-scale complexing in existing habitats	Area increase in functional habitat through complexing											
Prescribed burns or other upland habitat enhancement for wildlife	Functional area of habitat improved											
Habitat Development												
New Habitat created	Functional area created	**CO & Trout spawning & rearing**			**10,200**							

APPENDIX C: Confirmation of BCRP Recognition

Article in the Comox Valley Record announcing the Puntledge Side-channel Project, June 21, 2006.

A2 Wednesday, June 21, 2006 COMOX VALLEY RECORD

Assistance coming for Puntledge coho, trout

Coho and trout in the Puntledge River are about to get some new habitat.

The Bridge Coastal Fish and Wildlife Restoration Program (BC Hydro) has funded a project to create a side-channel spawning and rearing habitat for coho and trout. The site is located on the south side of the Puntledge River, upstream of Stotan Falls, between Vancouver Island Highway and Comox Logging Road. This Comox Valley Project Watershed Society initiative will take place between June 19 and July 5 and rely on Fisheries and Oceans Canada (DFO) for project design and construction supervision. DFO, along with the Ministry of Transportation, is also providing numerous in-kind contributions to the project.

"This side-channel is expected to support 700 spawning pairs of coho and approximately 7,000 coho smolts," says project coordinator Esther Guimond. "Coho and trout have much more complex watershed needs and have difficulty competing for spawning sites with other species in the river," says Guimond.

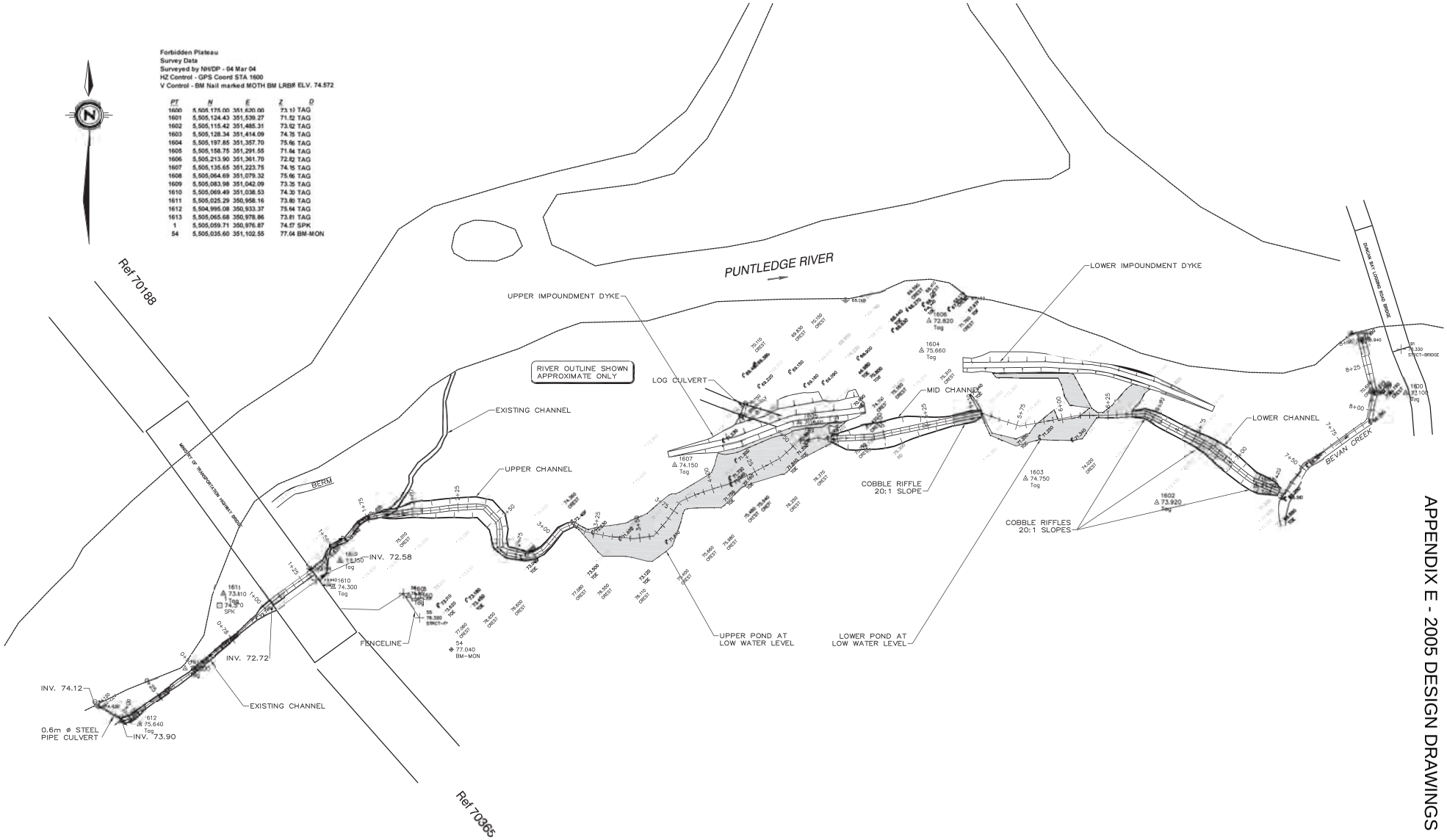
The excavated material from the channel site will be used to create a setback berm to protect the channel against flooding from the river. Boulders and woody debris unearthed from the site will be salvaged to further enhance the channel.

"Just like humans, most salmon and trout species prefer a relatively calm, predictable environment for having offspring," says Guimond. "The stumps and boulders within the channel will create a more complex habitat of pools, shaded areas and hiding cover. Insects that thrive on the decomposing wood will also provide food for the young fish."

The side-channel is a critical addition to a section of the river that currently offers very little spawning habitat for anadromous fish. The two major waterfalls located in this area of the river flow over smooth bedrock and rocky ledges. The natural flow of the river in this section has been replaced with a regulated flow; however, 17 two-day pulse flows throughout the year allow fish to migrate over these river obstacles and access spawning areas in the upper river. Once the side channel is complete, fish that swim up the rocky ledges will be rewarded with an ideal habitat for spawning.

The multi-use Puntledge River has undergone a great deal of change over the last century. In 1912 Canadian Collieries (Dunsmuir) Ltd. developed the hydroelectric potential of Comox Lake and the Puntledge River to provide electricity for the operation of its coal mines in the Cumberland area.

At that time, the fish stocks were abundant and there was little knowledge of the impact dams might have on watershed ecosystems.



APPENDIX E - 2005 DESIGN DRAWINGS

FISHERIES AND OCEANS CANADA
OCEANS, HABITAT AND ENHANCEMENT - SCD

DWG. NO.	REFERENCE DRAWINGS

NOTES
1. SURVEYED BY N. HILL AND DOUG POOLE MARCH 04, 2004 AND MAGNETIC NORTH ADJUSTED FOR MAGNETIC DECLINATION..
2. HORIZONTAL CONTROL BASED ON GPS COORDINATES FOR STA 1600 OF N5505175 E351620.
3. VERTICAL CONTROL BASED ON ELEVATION OF BENCH MARK NAIL IN TREE NEAR EXISTING CHANNEL MARKED AS "MOTH BM LRBM ELV. 74.572"

NO.	DATE	REVISIONS

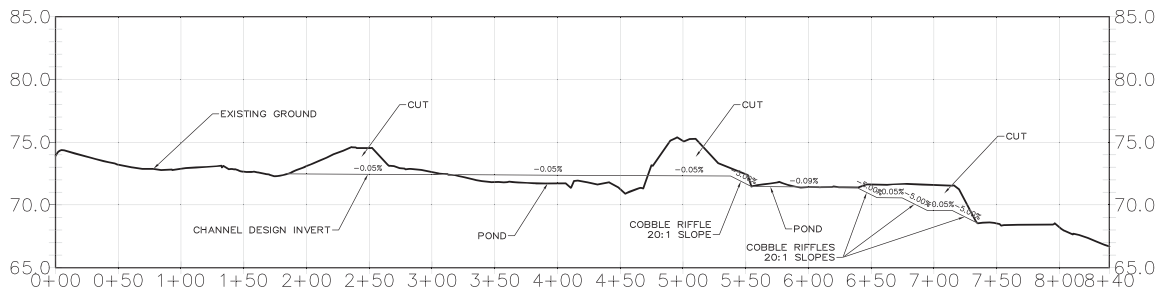
DESIGNED RN/RD
DRAWN NH/DT/RN
CHECKED
RECOMMENDED
APPROVED
APPROVED

PUNTLEDGE RIVER
FORBIDDEN PLATEAU
POND/CHANNEL COMPLEX
PLAN VIEW

SCALE 1000
DATE 14 APR 05
DRAWING NUMBER 31-116-2
REVISION

C:\Projects\EastCoast\Puntledge River\Forbidden Plateau\dwg\31-116-2 AND 3 - FORBIDDEN PLATEAU SIDE CHANNEL.dwg, PLAN, 05/10/2005 10:30:44 AM

CHANNEL AND POND COMPLEX



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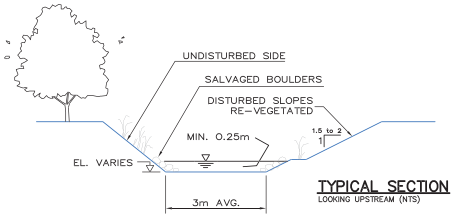
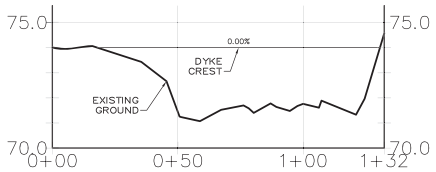


TYPICAL SECTION
LOOKING UPSTREAM (NTS)

UPSTREAM DYKE



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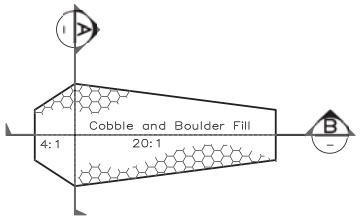
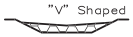
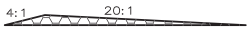




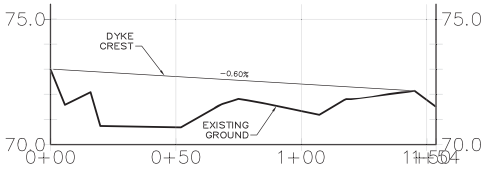
Section A



Section B

TYPICAL COBBLE RIFFLE
4 REQUIRED (NTS)

DOWNSTREAM DYKE



CENTRELINE PROFILE
SCALE H: 1000 V: 100

APPENDIX E - 2005 DESIGN DRAWINGS

FISHERIES AND OCEANS CANADA
OCEANS, HABITAT AND ENHANCEMENT - SCD

DWG. NO. REFERENCE DRAWINGS	NOTES	NO. DATE REVISIONS	DESIGNED RN / DRAWN RN / CHECKED / RECOMMENDED / APPROVED / APPROVED

PUNTLEDGE RIVER
FORBIDDEN PLATEAU
POND/CHANNEL COMPLEX
PROFILE AND SECTIONS

SCALE: AS SHOWN
DATE: 14 APR 05
DRAWING NUMBER: 31-116-3
REVISION

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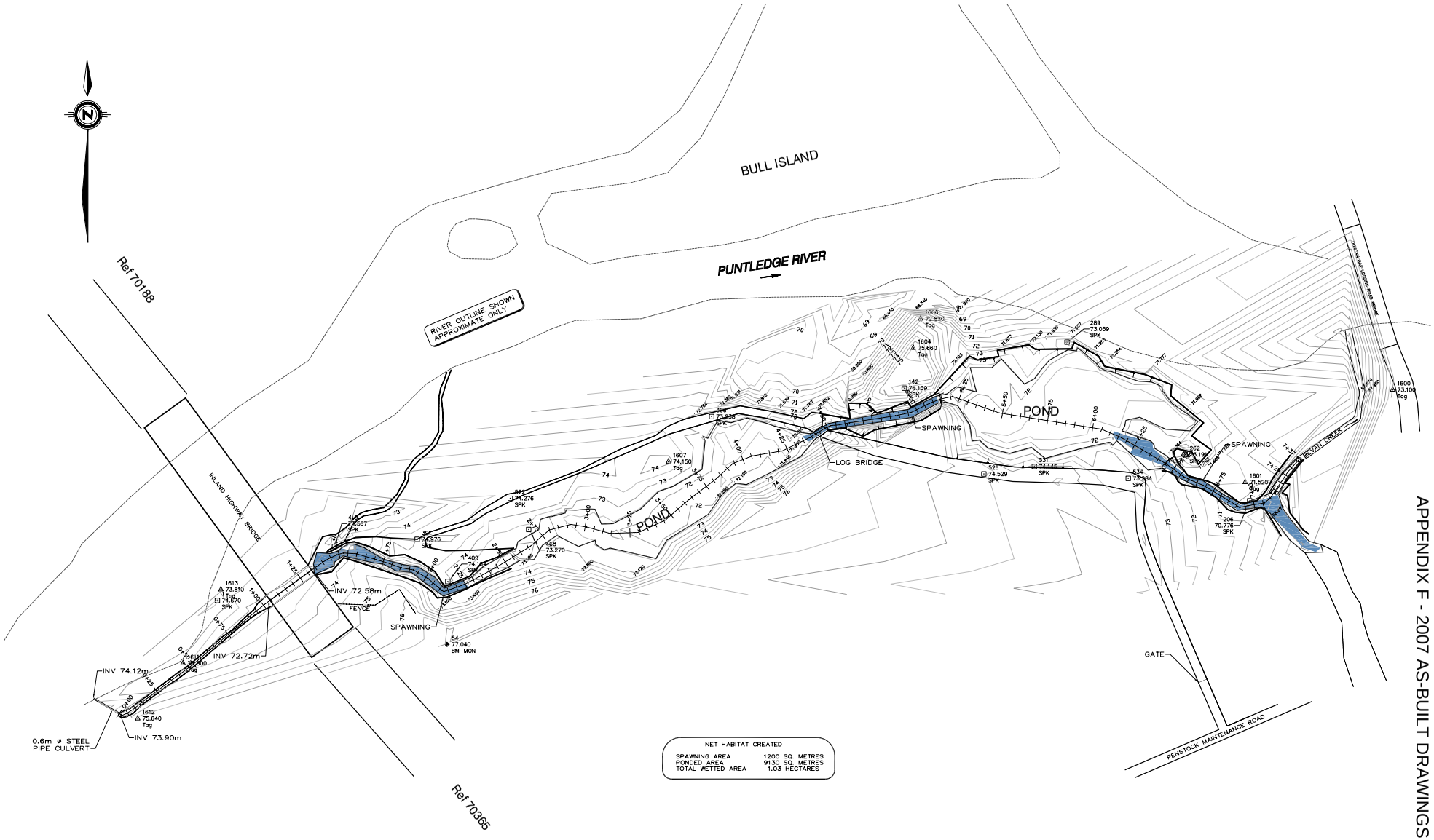

APPENDIX F - 2007 AS-BUILT DRAWINGS

FISHERIES AND OCEANS CANADA
OCEANS, HABITAT AND ENHANCEMENT - SCD

DWG. NO.	REFERENCE DRAWINGS

NOTES

1. SURVEYED BY N.HILL AND DOUG POOLE MARCH 04, 2004 AND MAGNETIC NORTH ADJUSTED FOR MAGNETIC DECLINATION..
2. HORIZONTAL CONTROL BASED ON GPS COORDINATES FOR STA 1600 OF N5505175 E351620.
3. VERTICAL CONTROL BASED ON ELEVATION OF BENCH MARK NAIL IN TREE NEAR EXISTING CHANNEL MARKED AS "MOTH BM LRBM ELV. 74.572"
4. ASBUILT SURVEY BY R.NORGAN AND DOUG POOLE 13 DEC 06 AND 21 DEC 06.

NO.	DATE	REVISIONS
1	05 JAN 07	CHANGED TO REFLECT ASBUILT SURVEY (DEC 06)

DESIGNED RN/RD
DRAWN NH/DT/RN
CHECKED
RECOMMENDED
APPROVED
APPROVED

PUNTLEDGE RIVER
FORBIDDEN PLATEAU
POND/CHANNEL COMPLEX
PLAN VIEW

SCALE 1000
DATE 14 APR 05
DRAWING NUMBER 31-116-2
REVISION

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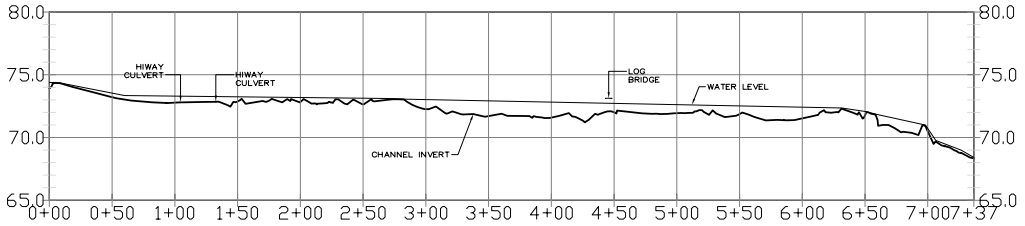
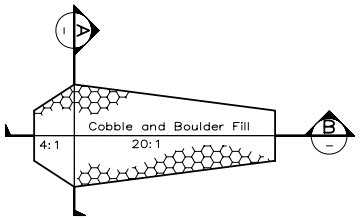
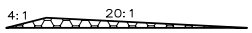


CENTRELINE PROFILE
SCALE H: 2000 V: 200

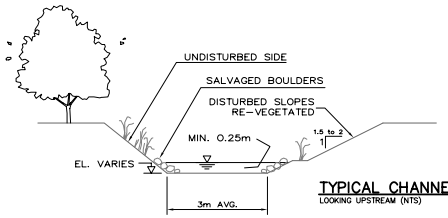


Section A



Section B

TYPICAL COBBLE RIFFLE
4 REQUIRED (NTS)



TYPICAL CHANNEL SECTION
LOOKING UPSTREAM (NTS)

APPENDIX F - 2007 AS-BUILT DRAWINGS

FISHERIES AND OCEANS CANADA
OCEANS, HABITAT AND ENHANCEMENT - SCD

DWG. NO.	REFERENCE DRAWINGS	NOTES	NO.	DATE	REVISIONS
		1. VERTICAL CONTROL BASED ON ELEVATION OF BENCH MARK NAIL IN TREE NEAR EXISTING CHANNEL MARKED AS "MOTH BM LRBM ELV. 74.572" 2. ASBUILT SURVEY BY R.NORGAN AND DOUG POOLE 13 DEC 06 AND 21 DEC 06.	1	05 JAN 07	CHANGED TO REFLECT ASBUILT SURVEY (DEC 06)

DESIGNED RN
DRAWN RN
CHECKED
RECOMMENDED
APPROVED
APPROVED

PUNTLEDGE RIVER
FORBIDDEN PLATEAU
POND/CHANNEL COMPLEX
PROFILE AND SECTIONS

SCALE AS SHOWN
DATE 14 APR 05
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REVISION

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