Holmes Hydro Inc.

CONSTRUCTED BY ARCTIC CONSTRUCTION LTD.

Feasibility Study

CONDUCTED IN 2016

Confidential

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This Feasibility Study (the "Study") has been prepared by Holmes Hydro Inc. ("HHI") for the sole purpose of internal project evaluation. Delivery of this Study does not constitute an offer to sell or a solicitation of an offer to purchase securities under the securities laws of any jurisdiction, including the United States Securities Act of 1933, as amended, or any U.S. state securities laws, or a solicitation to enter into any other transaction. While the information herein is believed to be accurate, HHI expressly disclaims all liability for representations or warranties, expressed or implied, contained in, or for omissions from this Study or any other written or oral communication transmitted or made available to any party. Interested parties will be permitted to conduct their own due diligence prior to providing binding commitments and must rely solely on their own investigations and on representations, warranties or undertakings contained in any final agreements.

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The information contained in this Study is submitted to parties on a confidential basis for use solely in connection with their consideration of the associated financing opportunity and is subject to the Confidentiality Agreement ("CA") between HHI and the recipient. By its acceptance hereof, and in accordance with the executed CA, the recipient agrees that neither it nor any of its employees or advisors shall use the information for any purpose other than the evaluation of the opportunity, nor shall it divulge the information or distribute this Study to any other party, in whole or in part, at any time without the prior written consent of HHI. Upon request, the recipient will promptly return all material received from HHI (including this Study) without retaining any copy thereof. In furnishing this Study, HHI assumes no obligation to provide the recipient with any additional information.

FUTURE ORIENTED FINANCIAL INFORMATION

This Study includes certain financial estimates and projections provided by HHI with respect to its future performance. Such estimates and projections reflect various assumptions made by HHI concerning its anticipated results and actions, which assumptions may or may not prove to be correct. The actual results achieved during the projection period will vary from the projected results and such variations may be material. There is no representation, warranty or other assurance that any of the estimates, forecasts or projections will be realized.

PROCEDURE

Recipients of this Study should direct any questions or requests for additional information to the undersigned. HHI will arrange for appropriate due diligence by qualified potential investors, and will consider financing proposals only from potential investors who meet certain qualifications. HHI reserves the right at any time and without providing notice or reason, to (i) amend or terminate the process; (ii) decline to permit any interested party to participate in the process; (iii) terminate discussions with any and all interested parties; (iv) reject any and all proposals; or (v) negotiate with any party with respect to a financing involving HHI.

Recipients who do not wish to pursue this matter are requested to return this Study to the undersigned at their earliest convenience.

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All financial information included in this document is expressed in Canadian dollars unless otherwise noted.

1 Executive Summary

Holmes Hydro (HHI) is a Canadian company committed to responsible development, management, and operation of energy infrastructure. The following feasibility study supports the company's intent to construct ten run-of-river projects and associated power lines on the Holmes River starting 3 kilometers east of the village of McBride, British Columbia adjacent to Hwy 16. The plants range from 2 to 10 MW with an average total generating capacity of 31 MW and a peak capacity of 73 MW.

The project has completed all permitting and authorizations with the exception of Occupant Licences to Cut that will be obtained prior to commencement of construction. These include: BC Environmental Assessment Office review upheld by the BC Supreme Court, Transport Canada Navigable Waters Protection, Forest, Lands, and Natural Resource Operations lands tenures and water licences, and Fisheries and Oceans.

McBride requires improved power reliability for the area and the opportunity for regional economic development of the McBride to Barriere corridor. In 2013 / 2014 HHI and BC Hydro negotiations included the completion of a draft Electricity Purchase Agreement (EPA); however, a combination of political pressure, coalition with other businesses and power generators in the area, and/or partnering with First Nations will be required in order for BC Hydro to reopen negotiations on all ten facilities. Otherwise, HHI will be limited by the Standing Offer Program at a total of 15MW of power. (The current Standing Offer Program doesn't contemplate a generating capacity greater than 15MW of power.) Alternatively, power from the project can be run east to Alberta, especially if marketed as green power, providing transmission to Alberta can be achieved.

Extensive technical vetting is complete on all aspects of the project including design, environmental, geotechnical, production, transmission, and constructability. Typicals are included and further reports and documentation are available on request. The project is shovel ready.

Project capex is $193.4M including 15% construction contingency. Total annual operating costs are $2.3M. With 60:40 debt to equity ratio, the project returns an NPV of $77M and pre tax IRR of 6.7% over a 30 year operating life. This does not contemplate the value of carbon credits this project generates.

HHI is fully designed, permitted, and is shovel ready. The project offers a significant opportunity for a partner with expertise in the areas of green infrastructure financing, financing businesses with First Nations ownership and/or partnership, and with the positioning to influence BC Hydro policy regarding run-of-river clustering.

2 Project Description

This following study examines feasibility of the Holmes Hydro Project from a market, technical, and financial perspective and concludes with associated findings and recommendations.

Holmes Hydro (HHI) is a Canadian company committed to responsible development, management, and operation of energy infrastructure. The following feasibility study supports the company's intent to construct ten run-of-river projects on Holmes River near McBride, British Columbia.

HHI consists of ten run-of-river hydroelectric facilities on tributaries to the Holmes River located approximately 30 kilometers east of the village of McBride, British Columbia. The plants range from 2 to 10 MW with an average total generating capacity of 31 MW and a peak capacity of 73 MW.

Holmes River is located in British Columbia just to the west of the British Columbia and Alberta border. The projects are on smaller rivers that form part of the Holmes River drainage basin. Holmes River flows east to west while the ten smaller rivers flow either southerly or northerly and discharge into the Holmes River as shown in Appendix A – Overview Map and Appendix B – Site Plans

Construction also includes forty-eight kilometers of new 138 KV transmission line connecting the project to the BC Hydro transmission grid at the Highway 16 corridor crossing of the Holmes River. Additionally, forty-five kilometers of 35 KV powerline will built to tie the ten sites into the main 138 KV transmission line.

2.1 Regulatory Framework

The project has completed all permitting and authorizations related to the project with the exception of Occupant Licences to Cut that will be obtained prior to commencement of construction:

1. BC Environmental Assessment Office – BCEAO considers each of the ten sites to be separate and less than 15MW of generation and therefore do not require an Environmental Assessment. The BCEAO's decision has been upheld by the BC Supreme Court.
2. Transport Canada Navigable Waters Protection – TCNW provided written confirmation that all ten site intakes and associated works reside on non-navigable waters and therefore applications are not required under the Navigable Waters Projection Act.
3. Forest, Lands, and Natural Resource Operations (Lands) – land tenures have been attained for all ten sites and the transmission line.
4. Forest, Lands, and Natural Resource Operations (Water) – water licences have been attained for all ten sites.
5. Fisheries and Oceans – letters of advice have been attained for all ten sites. The letters confirm that construction and operations of works is not likely to result in harmful alteration, disruption, or destruction of fish habitat.
6. Forest, Lands, and Natural Resource Operations (Forests) – Occupant Licences to Cut will be obtained prior to construction for clearing works.

2.2 Land, Environment, and First Nations

The project has undergone extensive environmental assessment by Triton Environmental Consultants to satisfy federal and provincial regulatory requirements. Additionally, a series of monitoring plans, development, construction, and operating plans have also been developed by Triton to cover construction and ongoing stewardship. Plans include:

- Fish Monitoring
- Haller's Apple Moss Monitoring
- Water Quality Monitoring
- Aquatic Invertebrate Monitoring
- Construction Environmental Management, and
- Operations Management

First Nations and stakeholder consultations were conducted throughout the FrontCounter BC application process. Additionally, extensive archaeological assessments have been conducted and no sensitive areas were found in the project area including assessment of prehistoric settlement patterns.

HHI has a Letter of Intent (LOI) with the Simpcw First Nation to investigate the potential of advancing the project together through a partnership. This may also address the BC Hydro cluster policy as outlined further in the Market Feasibility section.

3 Market Feasibility

The following section examines the market feasibility of the project.

3.1 Market History

Through the conception and permitting phase of the project, the Province of British Columbia and BC Hydro were actively pursing private sector independent power projects to help British Columbia meet its goals of energy self sufficiency and BC Government Green Plan. Further, provincial economic studies at the time showed a positive return for associated power infrastructure upgrades in the area. Support for green power solutions continues provincially, federally, and globally.

The projects were advanced through the 2008 BC Hydro Clean Power Call to provide energy for domestic and industrial purposes. Further support by BC Hydro was evidenced by their commitment to upgrade the associated Valemount substation to support the 138 kV transmission line to McBride. In October 2013, BC Hydro removed the HHI project from their Standing Offer Program and opened a one-off negotiated with HHI including a completed draft Electricity Purchase Agreement (EPA). In March 2014, BC Hydro reversed its decision to upgrade the Valemount substation and negotiations with HHI waned.

3.2 Market Potential

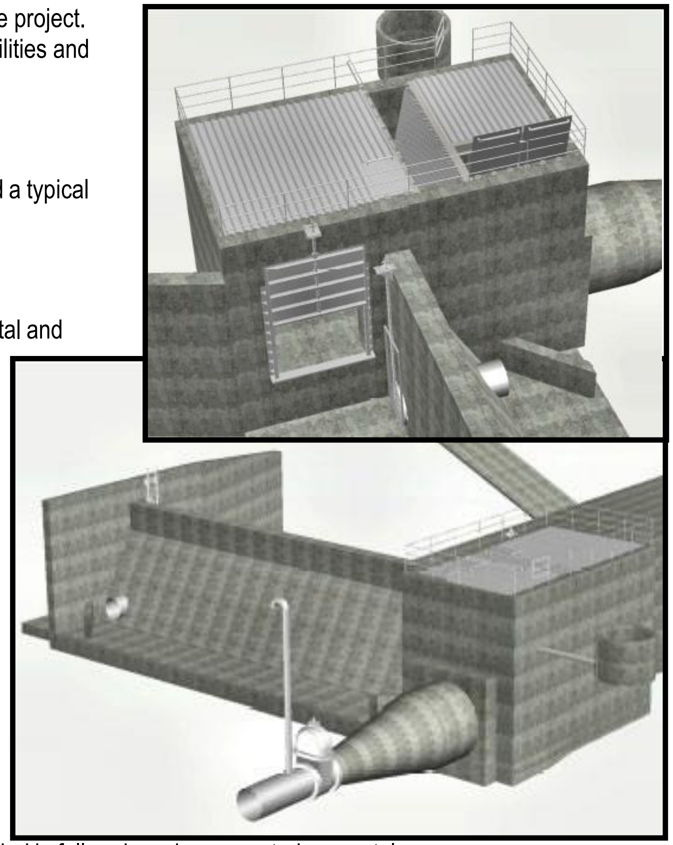
The fundamentals for power and upgrades to power infrastructure near McBride remain; namely, the requirement for improved power reliability for the area and the opportunity for regional economic development of the McBride to Barriere corridor.

HHI recently attempted resumption of negotiations with BC Hydro to complete EPAs for all ten sites. The attempt was met with some resistance from BC Hydro middle management claiming that the Standing Offer Program is open to HHI, but limited to a total of 15MW of power. A combination of political pressure and coalitions with other businesses and power generators in the area will be required in order for BC Hydro to reopen negotiations in earnest. An additional and similar option is to challenge the BC Hydro cluster policy limiting total power generation at 15MW by advancing a significant First Nations ownership of the project in its final state.

Power from the project could be run east to Alberta especially if it can be marketed as green power; however, the issue of limited peak-time access to the Alberta grid, with the possible exception of the City of Jasper's fair weather power requirements, or the requirement for new Alberta-bound transmission line will need to be resolved.

4 Technical Feasibility

The following section examines the technical feasibility of the project. Extensive analysis are complete on all aspects of the ten facilities and associated transmission line.



4.1 General Arrangements

Design work was completed by MA McLean Engineering and a typical set of plans is included in Appendix C.

4.2 Environmental

Environmental services were provided by Triton Environmental and supported obtaining all project approvals and authorizations. Environmental Assessment information and management plans are extensive and can be requested separately.

4.3 Geophysical

A terrain overview study was conducted by Amec Earth and Environmental and detailed stability, geohazard, geotechnical, and site appraisals were conducted by Firth Hollin. A typical geotechnical report is included in Appendix D.

4.4 Production

Hydrologic review and energy production report were conducted by JEM Energy Ltd. The report's cover letter is attached in Appendix E. The document is too large to be added in full and can be requested separately.

4.5 Transmission Line

The transmission system for the project will consist of a 138 KV mainline and a 35 KV distribution line to the ten individual powerhouses. The main transmission line consist of 138 KV line following the Holmes Forest Service Road to 48 km, at which a 138 KV substation will be located. From the substation, 35 KV distribution lines will continue along the Holmes Forest Service Road and branch off to the individual facility sites.

4.6 Construction

Arctic Construction Ltd. has been retained to build all associated facilities. Arctic has been serving the resource and transportation sectors of Northern British Columbia, the Yukon, and the Northwest Territories for sixty years. The company provides a full range of services from resource site development and civil construction, to mine and energy facility commissioning and reclamation. Arctic has an excellent safety record and an outstanding history of delivering high quality results in the most logistically challenging regions of Canada. An overview of Arctic Construction is attached in Appendix F.

Arctic Construction has completed a constructability study on the facilities and provided a detailed construction quote. A summary overview of the budget and plan from Arctic is attached in Appendix G.

5 Financial Feasibility

The following financial section summarizes the potential cash flows and returns for the project based on estimates for capital expenditure, operating expenses, revenues, a number of financial and economic assumptions, expected returns, and financial analysis.

5.1 Capital Expenditure

Capital expenditures include all materials, construction – including 15% contingency, development costs, and insurance and interest during construction.

Capital Costs (CAD$ '000s)	
35 KV Holmes Valley Transmission Line	**12,000**
138 KV Transmission Line	**22,000**
Holmes POI Switch	**400**
Hwy Transmission Line & Substation	**16,380**
Road Freight & Office	**3,847**
Powerhouses & Other	**4,300**
Generators Turbines & Supplies	**19,000**
Engineering & Professional	**2,000**
Equipment & Penstock	**5,139**
Construction	**82,608**
Contingency	**16,645**
RoR Flywheels (HHI @ 50%)	**1,725**
Development Costs	**3,000**
Insurance During Construction	**605**
Interest During Construction	**3,743**
Total Construction Costs	**193,392**

5.2 Operating & Maintenance Expenditure Estimates

Operating expenses include consumables, equipment rental, insurance, materials & supplies, office, rent, maintenance, professional fees, property taxes, travel, wages, and utilities.

Annual Operating Costs (CAD$ '000s)	
O&M	**1,851**
Management	**180**
Insurance	**200**
Maintenance	**50**
Total Operating Costs	**2,281**

5.3 Revenues

Revenues are calculated based on per creek monthly flow data.

5.4 Financial Assumptions

The financial model includes the following assumptions:

- Corporate income tax rates are based on a combined 15% federal corporate tax rate and an 11% provincial tax rate.
- CPI index rate is estimated at 2.1%.
- Discount rate is set at 5%.
- Interest rate of 5%.
- 60:40 debt to equity ratio.
- Funding fees and placement costs at 5%.
- 10th year maintenance reserve of $150,000 and 20th year maintenance reserve of $200,000.
- 30 year straight line depreciation for original facilities and 10 year straight line depreciation for maintenance reserve funds.

5.5 Returns

The chart below reflects Net Present Value (NPV), at 5% discount rate, and Internal Rate of Return (IRR) for investors generated by the project cash flows, as modeled for 30 years of operation.

Returns (CAD $ '000s)	
NPV (@ 5% Discount Rate)	$77,005
IRR - Pre Tax	6.70%
IRR - Post Tax	4.60%

5.6 Summary Financials

Income Statement

					Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Rate Per MWh delivered to BC Hydro	2.00%		first 6 months		107.09	108.17	109.25	110.34	111.44	112.56	113.68	114.82	115.97	117.13
		30 Year Total	last 6 months		108.17	109.25	110.34	111.44	112.56	113.68	114.82	115.97	117.13	118.30
Notional normalized output production at average EPA					171,641	171,641	171,641	171,641	171,641	171,641	171,641	171,641	171,641	171,641
Power Sales to BCH		642,604			18,474	18,658	18,845	19,033	19,224	19,416	19,610	19,806	20,004	20,204
Operating Costs (incl BC CPI)		(76,291)			(1,851)	(1,890)	(1,930)	(1,970)	(2,012)	(2,054)	(2,097)	(2,141)	(2,186)	(2,232
Management fee		(7,418)			(180)	(184)	(188)	(192)	(196)	(200)	(204)	(208)	(213)	(217
Insurance		(8,242)			(200)	(204)	(208)	(213)	(217)	(222)	(227)	(231)	(236)	(241
Maintenance (incl BC CPI)		(2,060)			(50)	(51)	(52)	(53)	(54)	(55)	(57)	(58)	(59)	(60
Operating income		548,593			16,192	16,329	16,467	16,605	16,745	16,885	17,026	17,168	17,310	17,454
Interest on debt		(116,223)			(6,190)	(6,096)	(5,997)	(5,893)	(5,783)	(5,669)	(5,548)	(5,421)	(5,288)	(5,147
Interest on line of credit		(96)												(8
Depreciation		(194,678)			(6,478)	(6,478)	(6,478)	(6,478)	(6,478)	(6,478)	(6,478)	(6,478)	(6,478)	(6,478
Amortization financing fees		(6,231)			(208)	(208)	(208)	(208)	(208)	(208)	(208)	(208)	(208)	(208
Income before income taxes		231,365			3,317	3,548	3,785	4,027	4,276	4,531	4,793	5,061	5,338	5,614
Income tax provision	26.0%	(60,155)			(863)	(923)	(984)	(1,047)	(1,112)	(1,178)	(1,246)	(1,316)	(1,388)	(1,460
Net income		171,210			2,455	2,626	2,801	2,980	3,164	3,353	3,547	3,745	3,950	4,154

Cash Flow Statement

Operating Activities		30 Year Total			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Net income		171,210			2,455	2,626	2,801	2,980	3,164	3,353	3,547	3,745	3,950	4,154
add back non-cash items														
Depreciation		194,328		0	6,478	6,478	6,478	6,478	6,478	6,478	6,478	6,478	6,478	6,478
Depreciation 10th year refurbishment		150		0	0	0	0	0	0	0	0	0	0	0
Depreciation 20th year refurbishment		200		0	0	0	0	0	0	0	0	0	0	0
Amortization financing fees		6,231		0	208	208	208	208	208	208	208	208	208	208
Deferred income taxes - estimated timing differential (Y1 TO Y10)		(0)	0.50	0	431	461	492	524	556	589	623	658	694	730
Change in accounts receivable		(0)		0	(1,539)	(15)	(16)	(16)	(16)	(16)	(16)	(16)	(17	(17
Change accounts payable		(0)		0	924	9	9	9	10	10	10	10	10	10
Total operating activities		372,119		0	8,956	9,766	9,972	10,183	10,399	10,621	10,848	11,082	11,322	11,563
Investing Activities - plant, property and equipment														
Construction of facilities		(194,678)		(194,328)	0	0	0	0	0	0	0	0	0	(150)
Other		0		0	0	0	0	0	0	0	0	0	0	0
Total Investing Activities		(194,678)		(194,328)	0	0	0	0	0	0	0	0	0	(150)
Financing activities														
Debt financing - mortgage basis		124,628		124,628	0	0	0	0	0	0	0	0	0	0
Line of credit for 10th and 20th year refurbishing		350		0	0	0	0	0	0	0	0	0	0	150
Equity Financing - mortgage basis	203,909	78,931		78,931	0	0	0	0	0	0	0	0	0	0
Financing fees		(6,231)		(6,231)	0	0	0	0	0	0	0	0	0	0
Repayment of debt principal portion - mortgage basis		(124,628)		0	(1,839)	(1,933)	(2,032)	(2,136)	(2,245)	(2,360)	(2,480)	(2,607)	(2,741	(2,881)
Repay of refurbish - line of credit		(350)												
Equity distribution - principal portion	(203,909)	(78,931)		0	(2,631)	(2,631)	(2,631)	(2,631)	(2,631)	(2,631)	(2,631)	(2,631)	(2,631	(2,631)
Total Financing Activities		(6,231)		197,328	(4,470)	(4,564)	(4,663)	(4,767)	(4,876)	(4,991)	(5,111)	(5,238)	(5,372	(5,362)
Increase decrease in cash		171,210		3,000	4,486	5,202	5,309	5,416	5,523	5,630	5,737	5,844	5,951	6,051
Cash beginning of year		**0**		0	3,000	7,486	12,688	17,998	23,414	28,937	34,567	40,304	46,148	52,098
Cash end of year		**171,210**		**3,000**	**7,486**	**12,688**	**17,998**	**23,414**	**28,937**	**34,567**	**40,304**	**46,148**	**52,098**	**58,149**

Balance Sheet

Balance Sheets	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Assets										
Current assets:										
Cash - before any common share dividends	7,486	12,688	17,998	23,414	28,937	34,567	40,304	46,148	52,098	58,149
Accounts Receivable	1,539	1,555	1,570	1,586	1,602	1,618	1,634	1,651	1,667	1,684
Long Lived Assets	169,028	169,028	169,028	169,028	169,028	169,028	169,028	169,028	169,028	169,178
Accumulated Depreciation	(6,478)	(12,955)	(19,433)	(25,910)	(32,388)	(38,866)	(45,343)	(51,821)	(58,298)	(64,776)
Deferred Charges										
Financing Charges	6,231	6,231	6,231	6,231	6,231	6,231	6,231	6,231	6,231	6,231
Acc. Amortization Financing	(208)	(415)	(623)	(831)	(1,039)	(1,246)	(1,454)	(1,662)	(1,869)	(2,077)
Total Assets	177,599	176,131	174,771	173,517	172,371	171,332	170,400	169,575	168,856	168,388
Liabilities										
Accounts payable	924	933	942	952	961	971	981	990	1,000	1,010
Future income taxes	431	893	1,385	1,908	2,464	3,053	3,676	4,334	5,028	5,758
Debt financing	122,789	120,856	118,825	116,689	114,444	112,084	109,604	106,996	104,256	101,375
Refurb financing	0	0	0	0	0	0	0	0	0	150
Equity financing	76,300	73,669	71,038	68,407	65,776	63,145	60,514	57,883	55,252	52,621
	200,444	196,351	192,189	187,956	183,645	179,253	174,774	170,204	165,536	160,913
Common Equity										
opening Balance	0	2,455	5,081	7,882	10,862	14,026	17,379	20,926	24,671	28,621
Net income to common	2,455	2,626	2,801	2,980	3,164	3,353	3,547	3,745	3,950	4,154
Ending balance	2,455	5,081	7,882	10,862	14,026	17,379	20,926	24,671	28,621	32,775

6 Findings and Recommendations

Findings and recommendations are broken into the main aspects of the study and followed by a conclusion.

6.1 Market

The fundamentals for power and upgrades to power infrastructure near McBride remain; namely, the requirement for improved power reliability for the area and the opportunity for regional economic development of the McBride to Barriere corridor. A combination of political pressure, coalition with other businesses and power generators in the area, and/or partnering with First Nations will be required in order for BC Hydro to reopen negotiations on all ten facilities. Otherwise, HHI will be limited by the Standing Offer Program at a total of 15MW of power. Alternatively, power from the project can be run east to Alberta, especially if marketed as green power, providing transmission to Alberta can be achieved.

6.2 Technical

The project has completed all permitting and authorizations related to the project. Extensive technical vetting is complete on all aspects of the project including: design, environmental, geotechnical, production, transmission, and constructability. The project is shovel ready.

Helping meet the growing demand for green sustainable energy

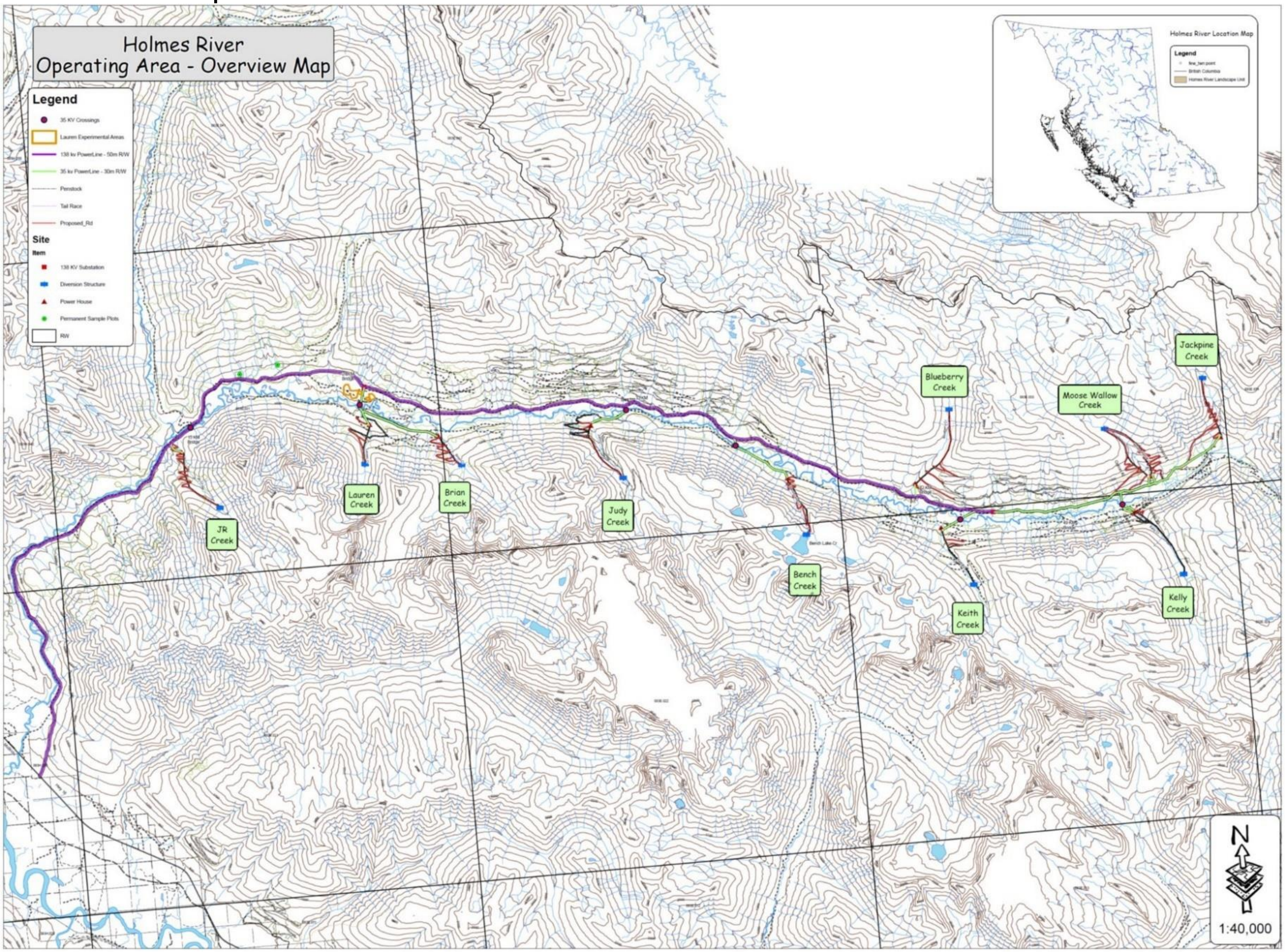
6.3 Financial

Project capex is $193.4M including 15% construction contingency. Total annual operating costs are $2.3M. With 60:40 debt to equity ratio, the project returns an NPV of $77M and pre tax IRR of 6.7% over a 30 year operating life.

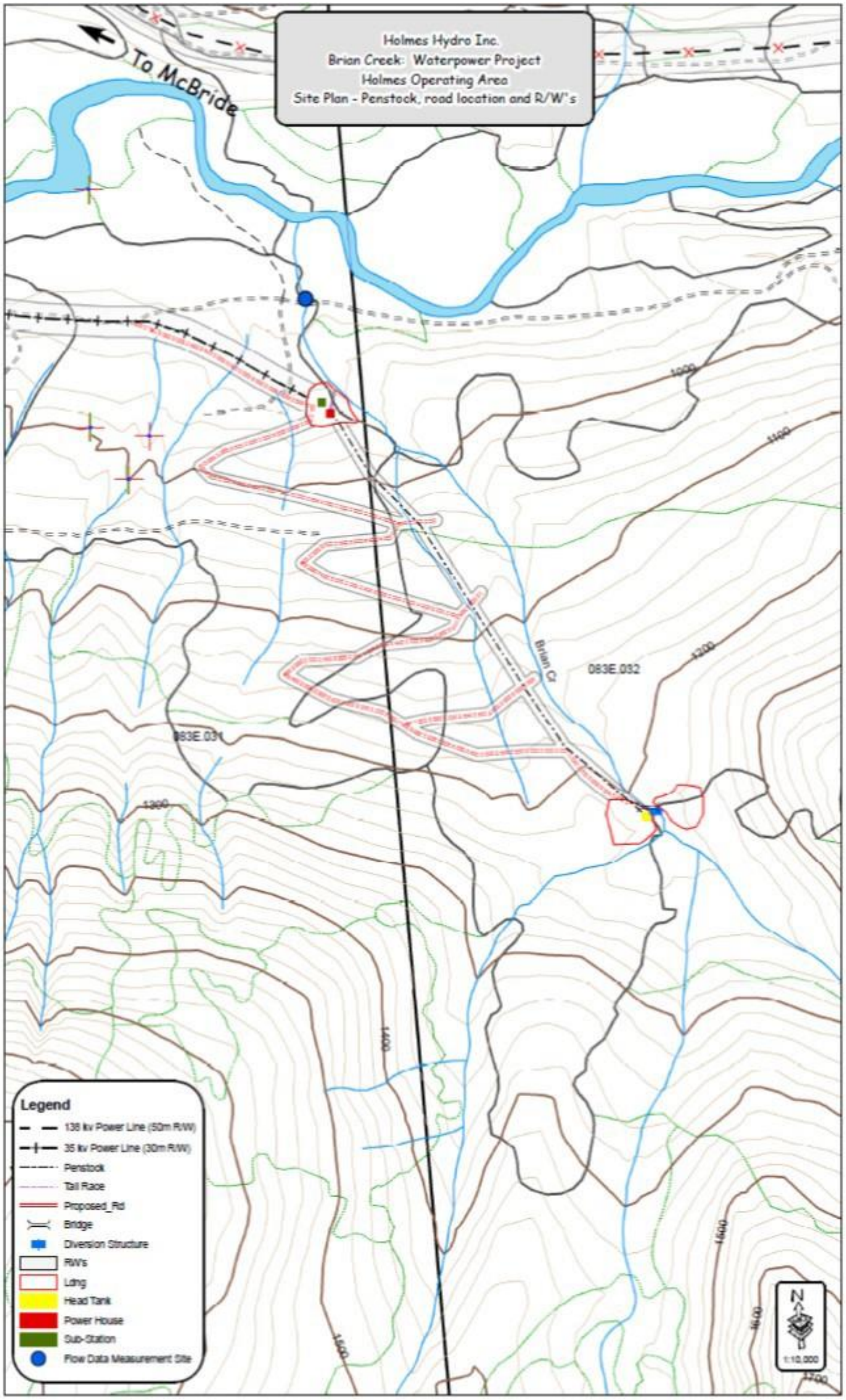
6.4 Conclusion

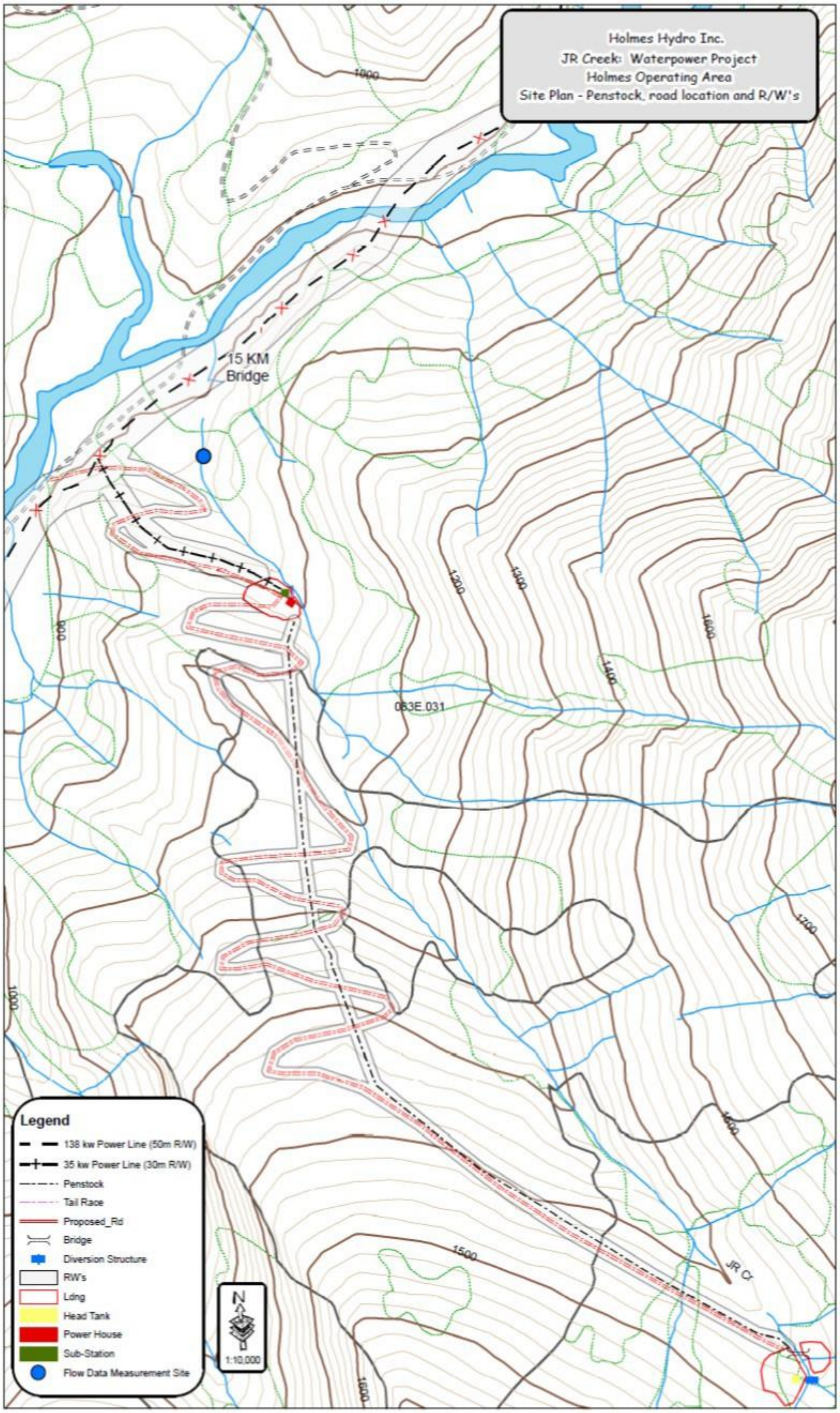
HHI is fully designed, permitted, and is shovel ready. The project offers a significant opportunity for a partner with expertise in the areas of green infrastructure financing, financing businesses with First Nations ownership and/or partnership, and with the positioning to influence BC Hydro policy regarding run-of-river clustering.

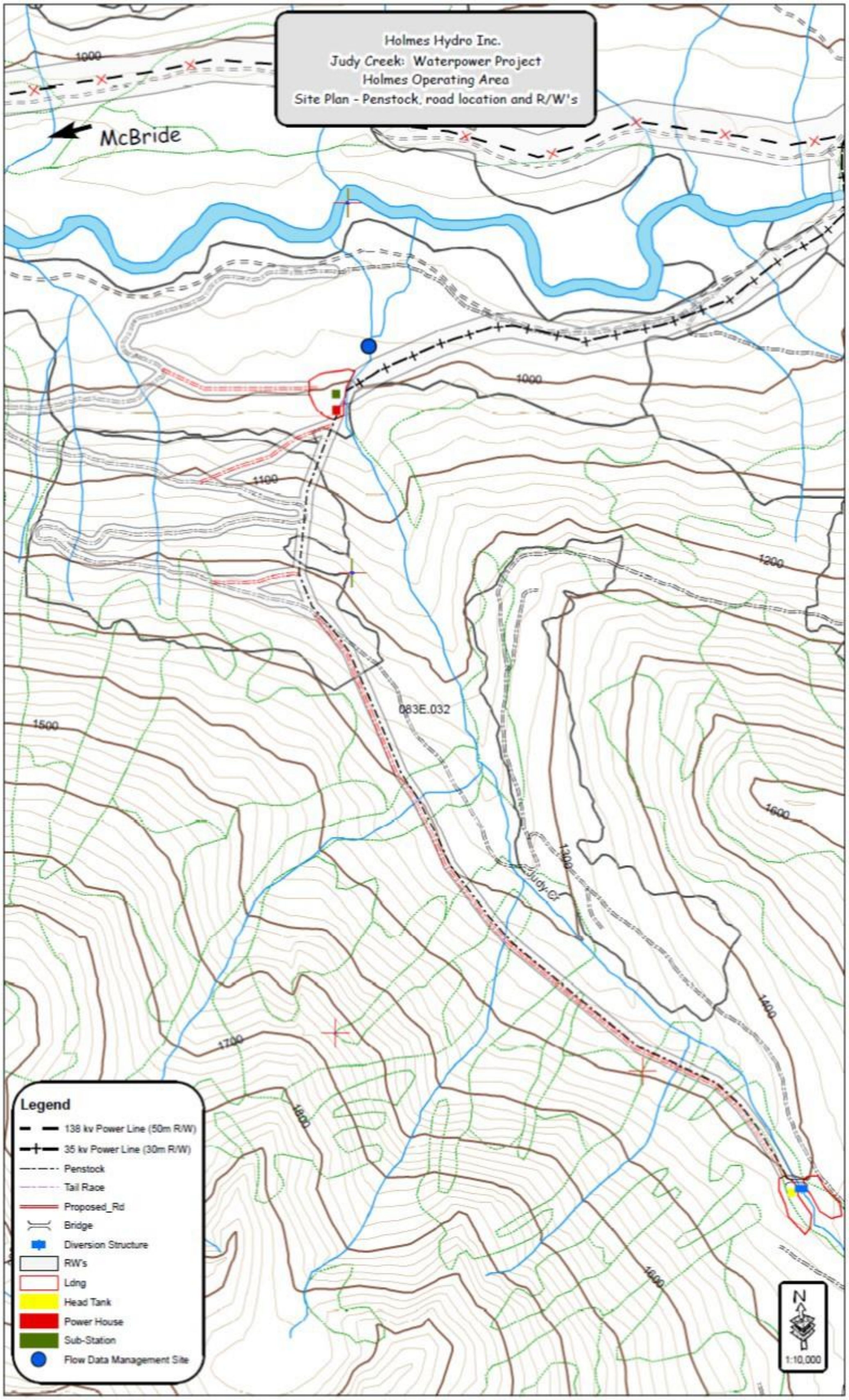
Appendix A – Overview Map



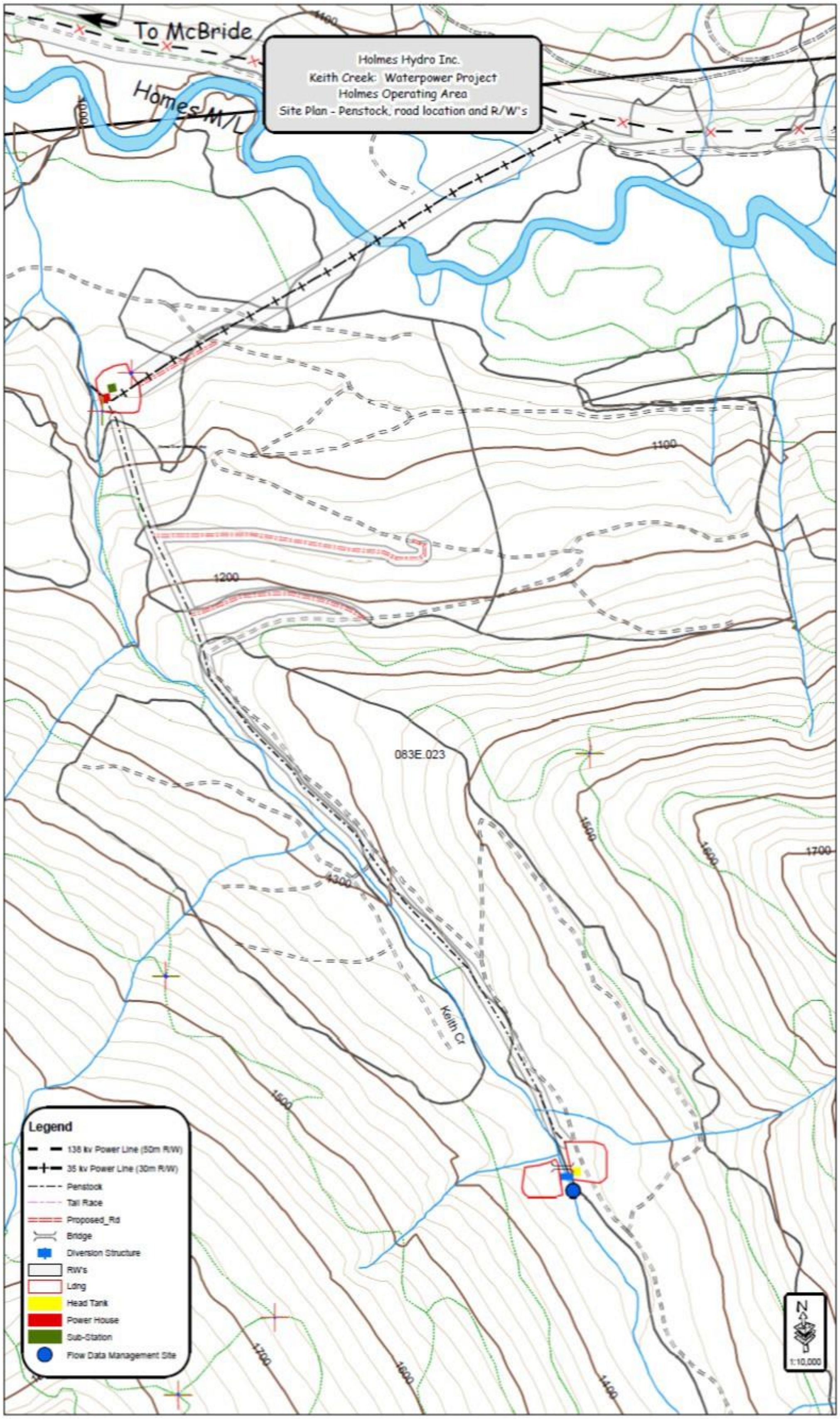
Appendix B – Site Plans




Holmes Hydro Inc.
JR Creek: Waterpower Project
Holmes Operating Area
Site Plan - Penstock, road location and R/W's
15 KM
Bridge
083E.031
JR Cr
1000
1200
1300
1400
1500
1600
1700
900
Legend
138 kw Power Line (50m R/W)
35 kw Power Line (30m R/W)
Penstock
Tail Race
Proposed_Rd
Bridge
Diversion Structure
RW's
Ldng
Head Tank
Power House
Sub-Station
Flow Data Measurement Site
N
1:10,000



Holmes Hydro Inc.
Judy Creek: Waterpower Project
Holmes Operating Area
Site Plan - Penstock, road location and R/W's
McBride
1000
1100
1200
1300
1400
1500
1600
1700
1800
083E.032
Judy Cr
Legend
138 kv Power Line (50m R/W)
35 kv Power Line (30m R/W)
Penstock
Tail Race
Proposed_Rd
Bridge
Diversion Structure
RW's
Ldng
Head Tank
Power House
Sub-Station
Flow Data Management Site
N
1:10,000


To McBride
Holmes Hydro Inc.
Keith Creek: Waterpower Project
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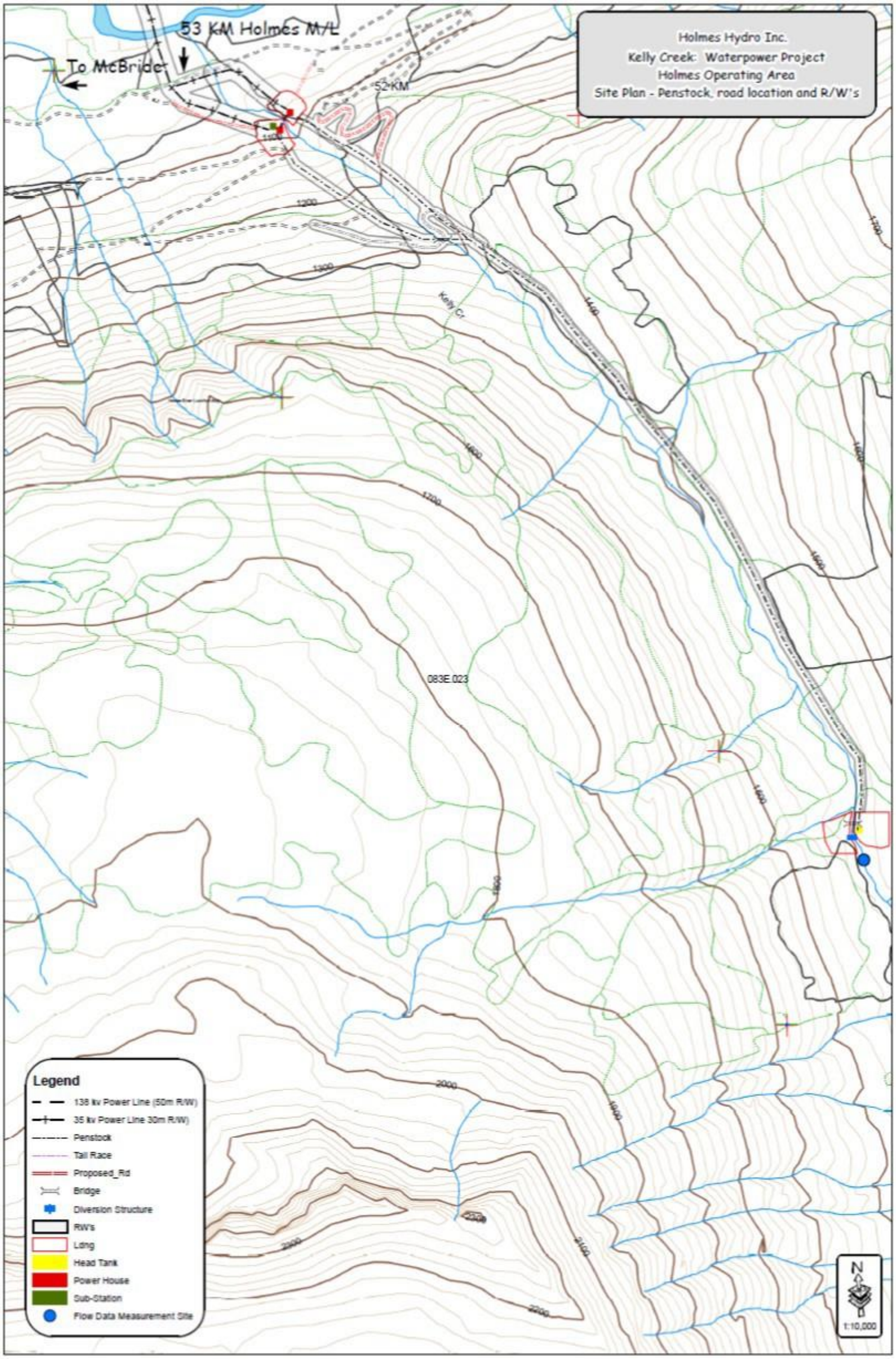
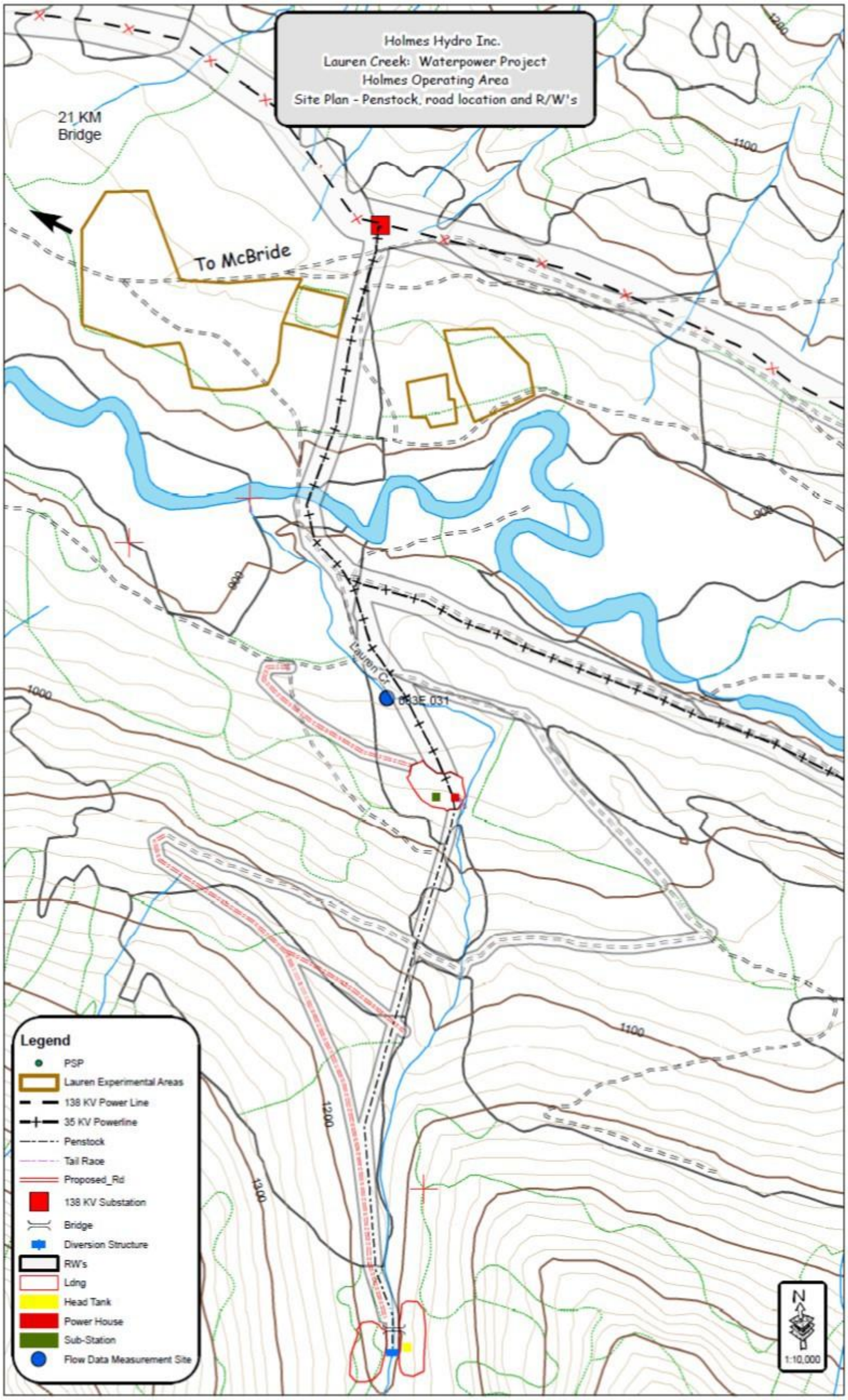
Site Plan - Penstock, road location and R/W's
Homes M/L
1100
1200
083E.023
1300
1500
1600
1700
Keith Cr
Legend
138 kv Power Line (50m R/W)
35 kv Power Line (30m R/W)
Penstock
Tail Race
Proposed_Rd
Bridge
Diversion Structure
RW's
Ldng
Head Tank
Power House
Sub-Station
Flow Data Management Site
N
1:10,000
1400


Holmes Hydro Inc.
Kelly Creek: Waterpower Project
Holmes Operating Area
Site Plan - Penstock, road location and R/W's
53 KM Holmes M/L
To McBride
52 KM
Kelly Cr.
083E.023
Legend
138 kv Power Line (50m R/W)
35 kv Power Line 30m R/W)
Penstock
Tail Race
Proposed_Rd
Bridge
Diversion Structure
RW's
Ldng
Head Tank
Power House
Sub-Station
Flow Data Measurement Site
N
1:10,000


Holmes Hydro Inc.
Lauren Creek: Waterpower Project
Holmes Operating Area
Site Plan - Penstock, road location and R/W's
21 KM
Bridge
To McBride
Lauren Cr.
1200
1100
900
1000
1300
Legend
PSP
Lauren Experimental Areas
138 KV Power Line
35 KV Powerline
Penstock
Tail Race
Proposed_Rd
138 KV Substation
Bridge
Diversion Structure
RW's
Ldng
Head Tank
Power House
Sub-Station
Flow Data Measurement Site
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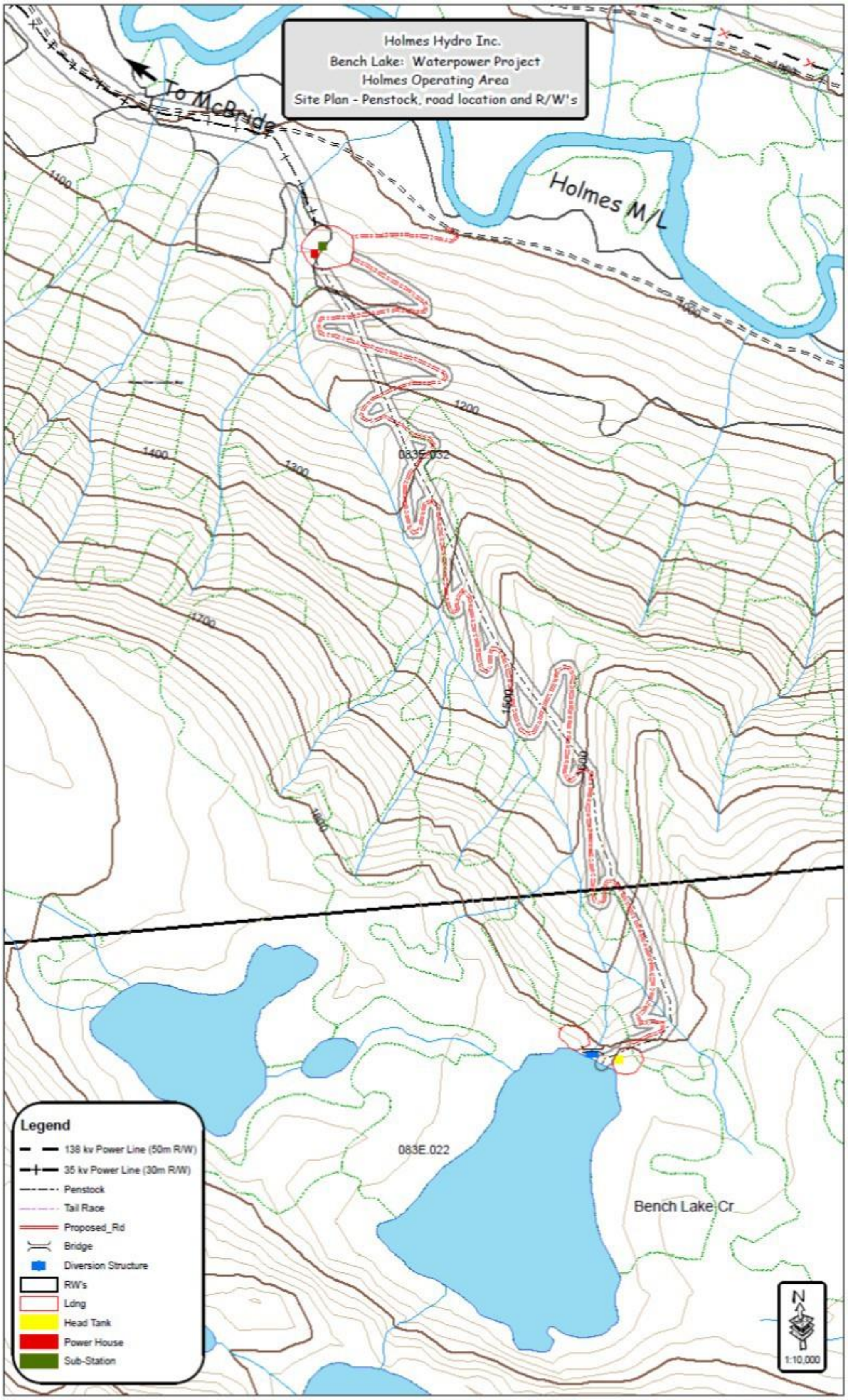
Holmes Hydro Inc.
Bench Lake: Waterpower Project
Holmes Operating Area
Site Plan - Penstock, road location and R/W's
To McBride
Holmes M/L
083E.032
083E.022
Bench Lake Cr
Legend
138 kv Power Line (50m R/W)
35 kv Power Line (30m R/W)
Penstock
Tail Race
Proposed_Rd
Bridge
Diversion Structure
RW's
Ldng
Head Tank
Power House
Sub-Station
N
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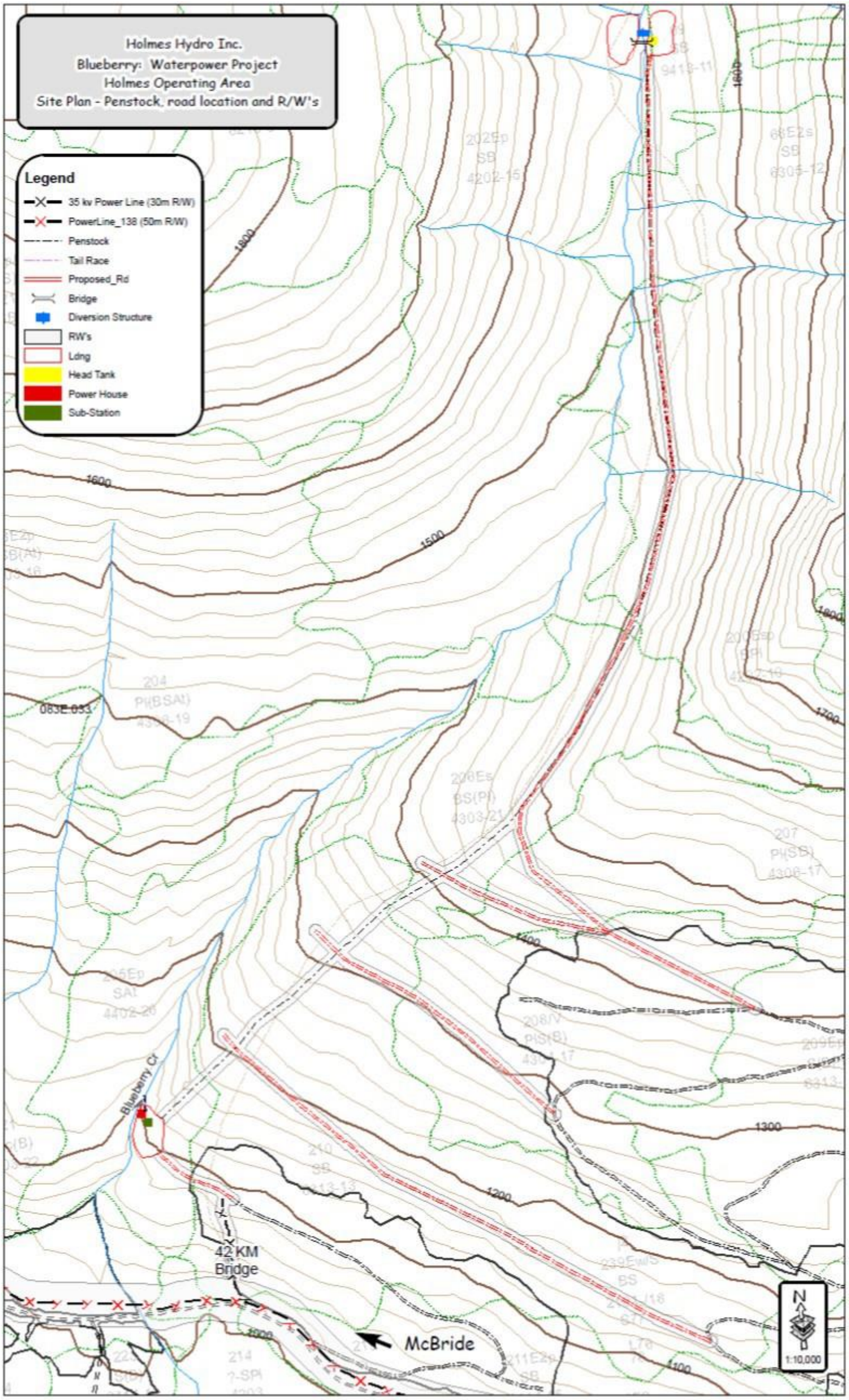
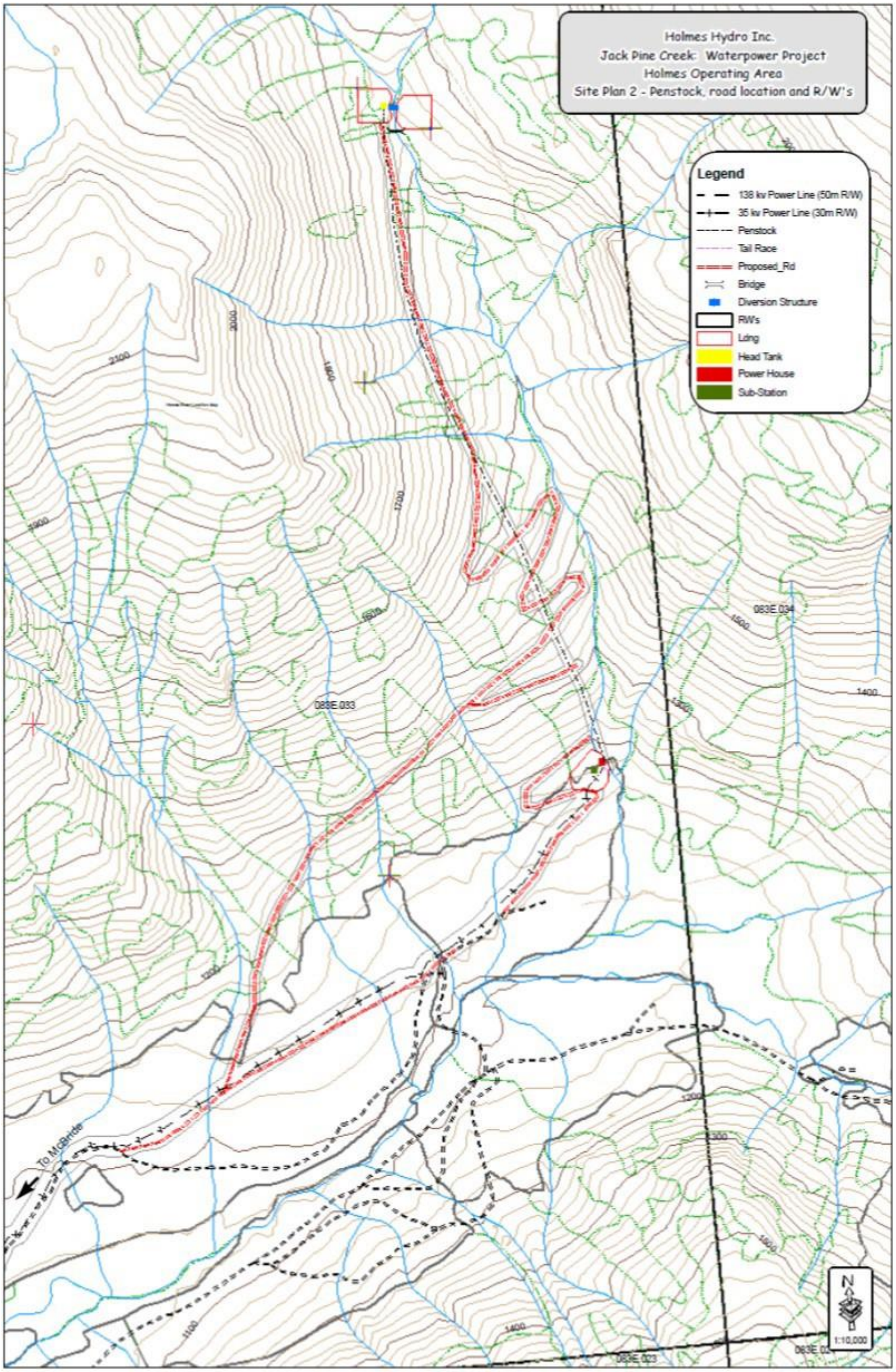
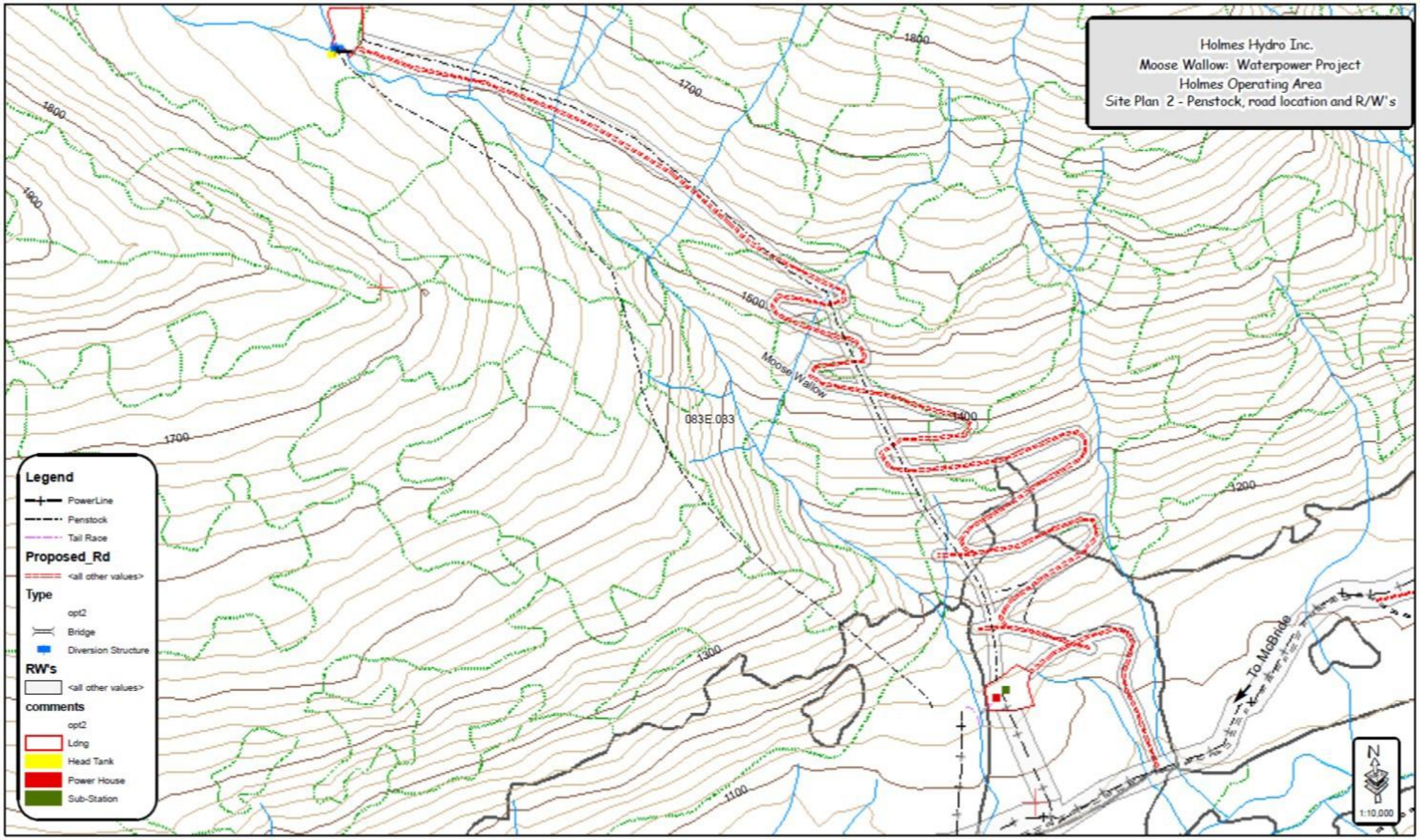

Holmes Hydro Inc.
Blueberry: Waterpower Project
Holmes Operating Area
Site Plan - Penstock, road location and R/W's
Legend
35 kv Power Line (30m R/W)
PowerLine_138 (50m R/W)
Penstock
Tail Race
Proposed_Rd
Bridge
Diversion Structure
RW's
Ldng
Head Tank
Power House
Sub-Station
1800
1600
1500
1400
1300
1200
1100
1000
1700
Blueberry Cr
42 KM
Bridge
McBride
N
1:10,000


Holmes Hydro Inc.
Jack Pine Creek: Waterpower Project
Holmes Operating Area
Site Plan 2 - Penstock, road location and R/W's
Legend
138 kv Power Line (50m R/W)
35 kv Power Line (30m R/W)
Penstock
Tail Race
Proposed_Rd
Bridge
Diversion Structure
R/W's
Ldng
Head Tank
Power House
Sub-Station
To McBride
083E.033
083E.034
083E.023
1:10,000
N



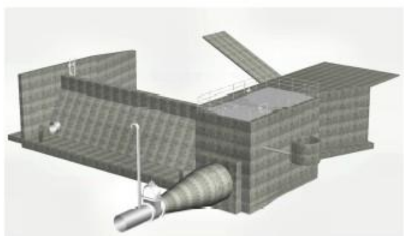
Holmes Hydro Inc.
Moose Wallow: Waterpower Project
Holmes Operating Area
Site Plan 2 - Penstock, road location and R/W's
Legend
PowerLine
Penstock
Tail Race
Proposed_Rd
<all other values>
Type
opt2
Bridge
Diversion Structure
RW's
<all other values>
comments
opt2
Ldng
Head Tank
Power House
Sub-Station
1800
1700
1900
1600
1500
1400
1300
1200
1100
Moose Wallow
083E.033
To McBride
N
1:10,000

Appendix C – Typical Design Plans

HOLMES HYDRO INC.

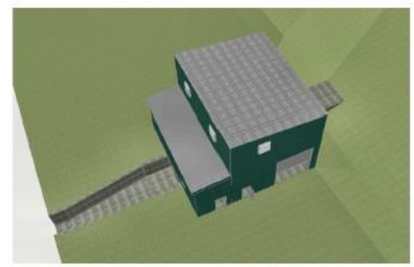
Holmes River Hydro Projects

Blueberry Creek Site: Preliminary Design Plans



CONTENTS

DWG NO.	DESCRIPTION
800-1-A	Cover Sheet and Contents
800-1-B	P1 & P2: Plan Views of Intake Structure & Notes
800-1-C	E1: Right-Side Elevation of Intake Structure and Spillway
	S1–S4: Cross Sections Through Intake Structure & Spillway
800-1-D	E2–E5: Elevation Views of Intake Structure and Spillway
800-1-E	P3: Layout Plan of Penstock Alignment & General Site Development
	PR-1: Profile for Penstock Design
800-1-F	P5 & P6: Plan Views of Double Turbine Powerhouse
800-1-G	S5 & S6: Long Sections Through Double Turbine Powerhouse
800-1-H	S7–S11: Cross Sections Through Double Turbine Powerhouse
800-1-I	S12–S15: Cross Sections Through Double Turbine Powerhouse
	D1: Detail of Powerhouse Steel Column Baseplate
800-1-J	D2–D5: Details of Powerhouse Steel Column Baseplates
	E6–E7: Elevation Views of Double Turbine Powerhouse
800-1-K	E8–E9: Elevation Views of Double Turbine Powerhouse & Notes



CLIENT: **HOLMES HYDRO INC.**
P.O. Box 99
McBride, B.C., V0J 2E0

C.A.M.
E.W.
SEP-22-2010

Holmes River Hydro Projects
Blueberry Creek Site
Preliminary Design Plans

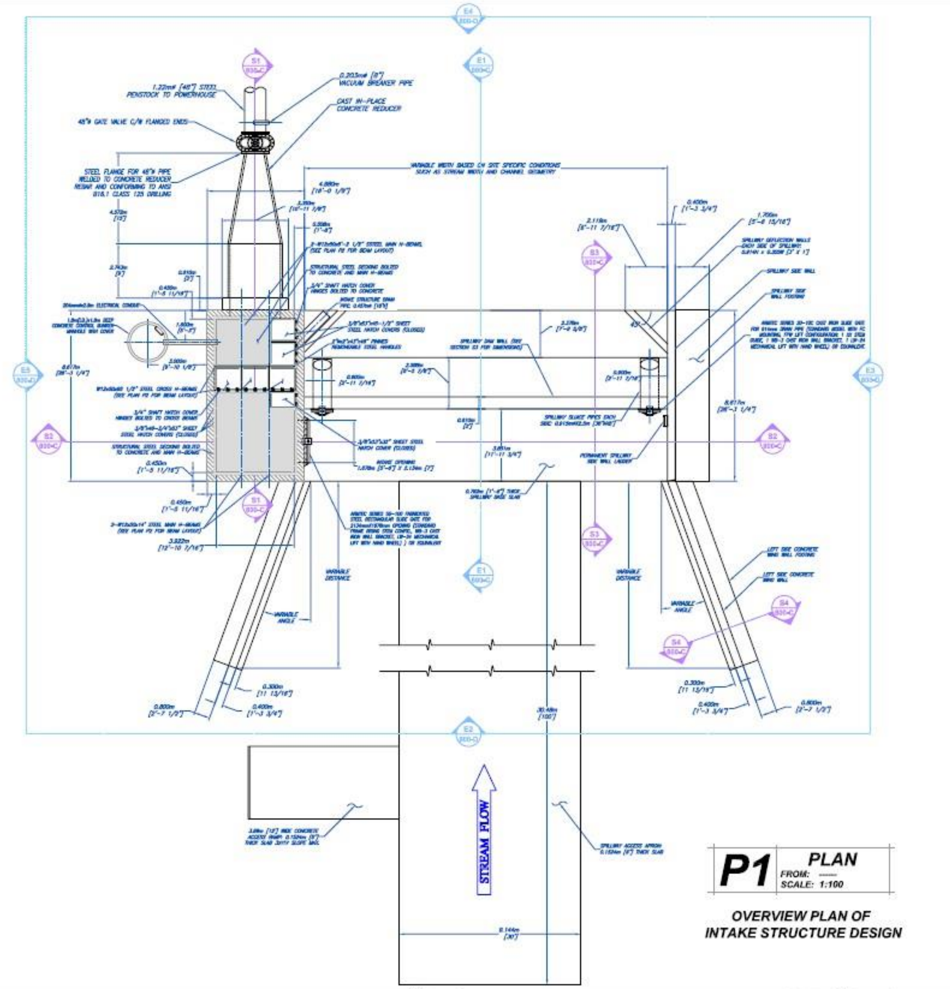
0800
As Noted
As Noted
ANSI-D
1 of 11

NO.	DATE	REVISION	DR.	CHK.	APPR.

CA MCLEAN ENGINEERING
7610 CROYDON FERRY ROAD
DUNSTER, BC V0J 1J0
PH. 250 9684310

DRAWING NO.: 800-6-A
REVISION:

DATE STAMP: September-22-10 11:10:43 AM

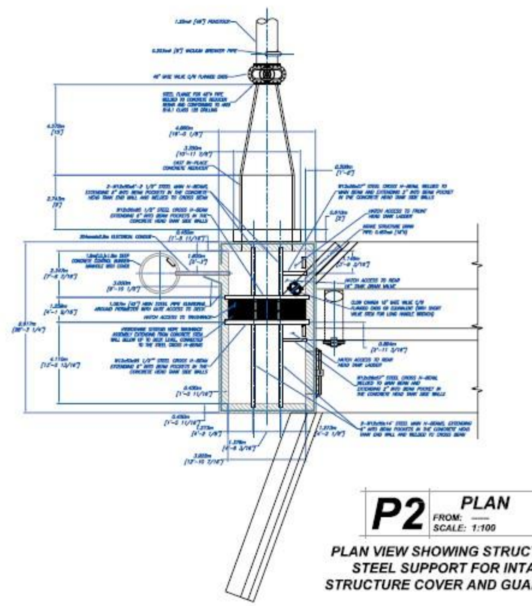


P1 PLAN
FROM: —
SCALE: 1:100

OVERVIEW PLAN OF INTAKE STRUCTURE DESIGN

INTAKE STRUCTURE: DESIGN & CONSTRUCTION NOTES

1. Exact design specifications to be completed after thorough geotechnical analysis of site and soils, and will be based on surveyed topography and site conditions. These specifications to include overall dimensions of spillway width, side walls, and wing walls.
2. CONCRETE: Concrete to attain at least 25mPa yield strength or strength as otherwise specified. Strength is to be determined by 28 day test cylinder destructive compression testing. No concrete pour is to be done at temperatures of 0°C or less. Aggregate source must be tested and approved for concrete work.
3. STEEL REINFORCEMENT: 40,000 psi yield strength deformed steel bars with specified size, pattern, and location to be determined.
4. SOIL MECHANICS: Bearing capacity, cut and fill slopes, backfill material, and compaction are to be determined on site before commencement of construction.
5. TO BE DETERMINED IN FINAL DESIGN PLANS: Bills of materials, rebar schedule, concrete isolation/control joints, concrete pour schedules, structural connections and other details.



P2 PLAN
FROM: —
SCALE: 1:100

PLAN VIEW SHOWING STRUCTURAL STEEL SUPPORT FOR INTAKE STRUCTURE COVER AND GUARDRAIL

CLIENT: **HOLMES HYDRO INC.**
P.O. Box 99
McBride, B.C., V0J 2E0

DESIGN: C.A.M. | DRAWN BY: E.W. | ISSUE DATE: SEP-22-2010

Holmes River Hydro Projects
Blueberry Creek Preliminary Design Plan:
Plan Views of Intake Structure Designs

PROJECT NO.: 0950 | SCALE: As Noted | SHEET SIZE: ANSI-D | SHEET NO.: 2 of 11

CA MCLEAN ENGINEERING
7610 CROYDON FERRY ROAD
DUNSTER, BC V0J 1J0
PH. 250 9684310

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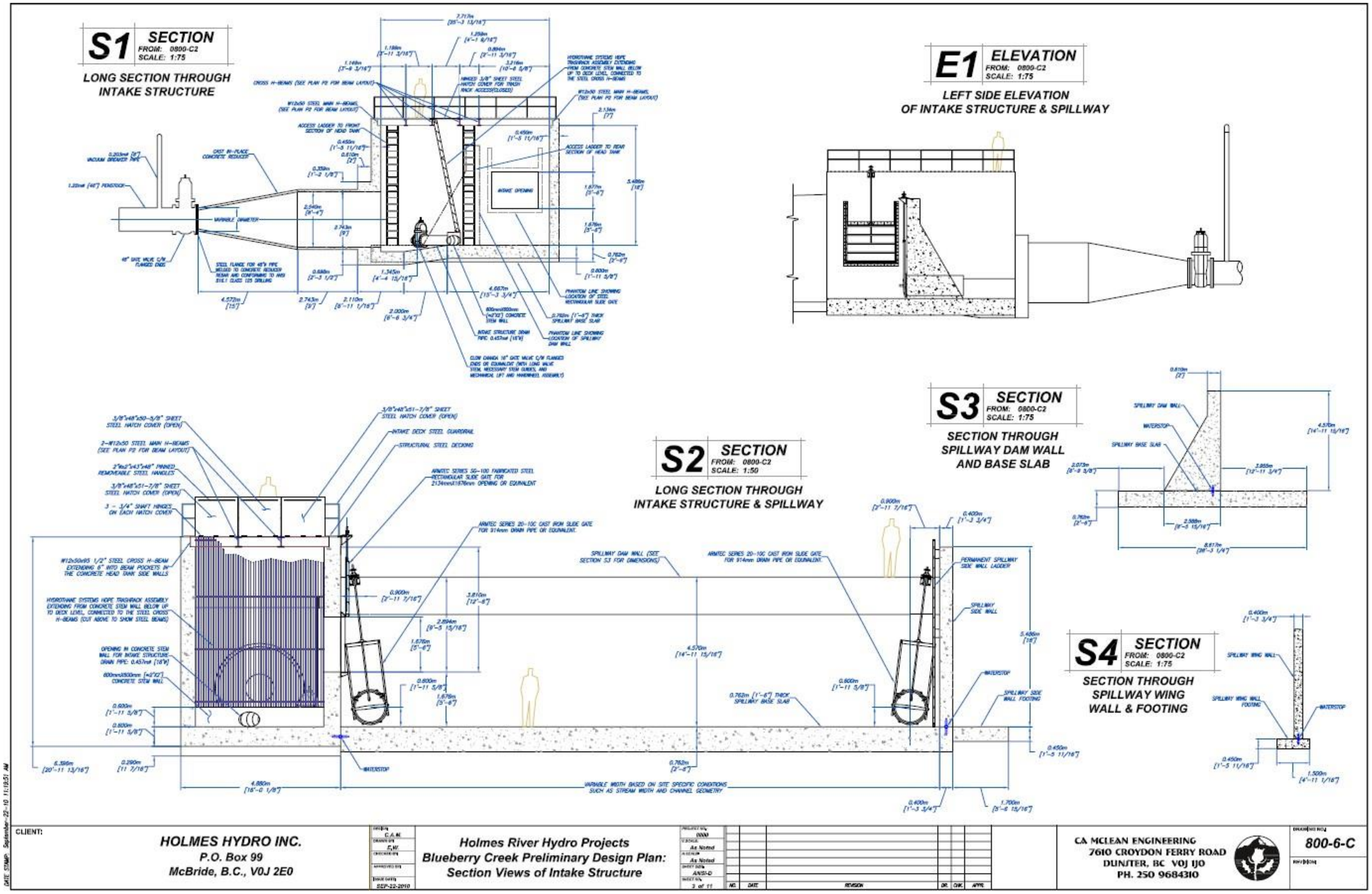
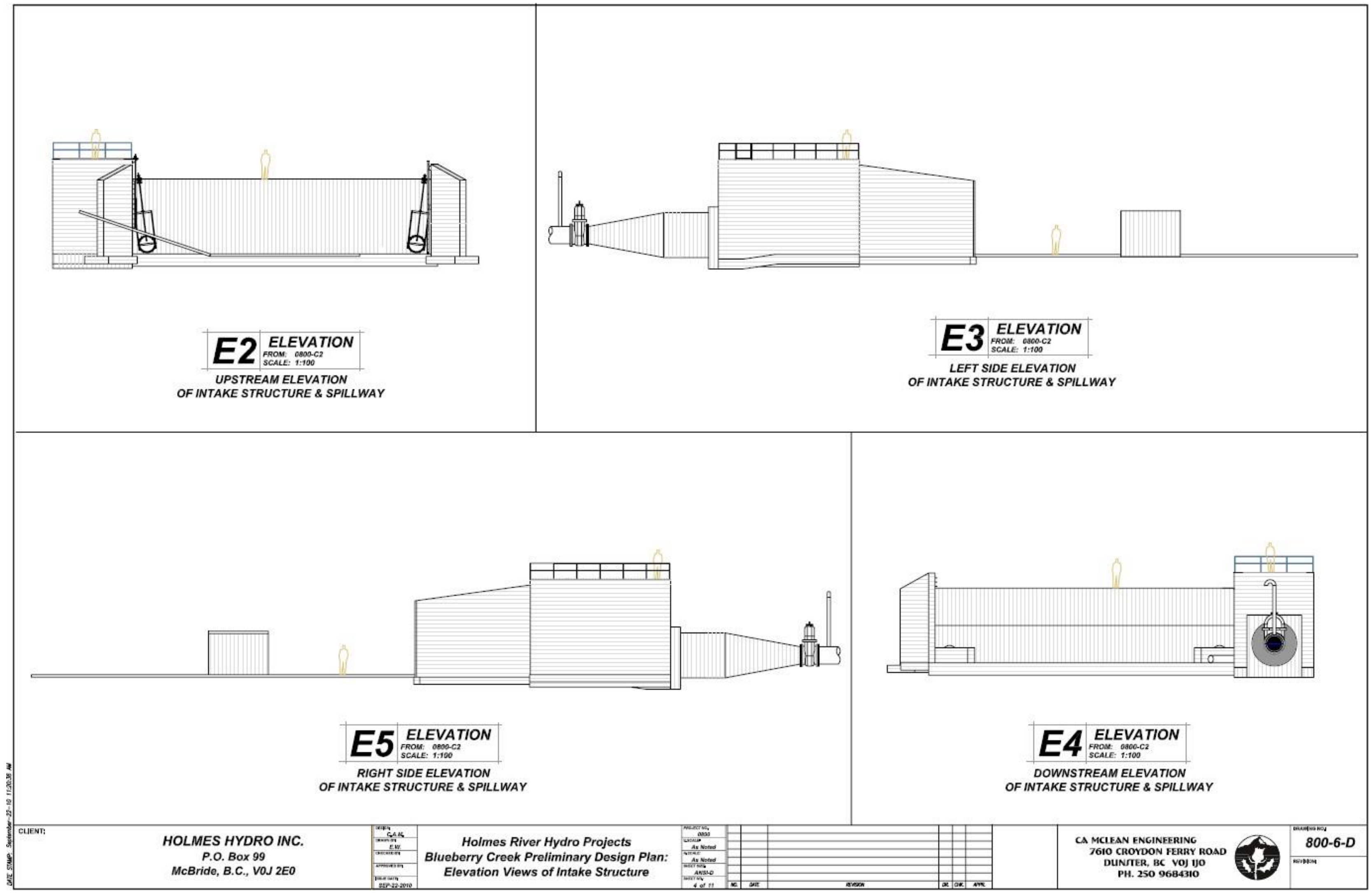
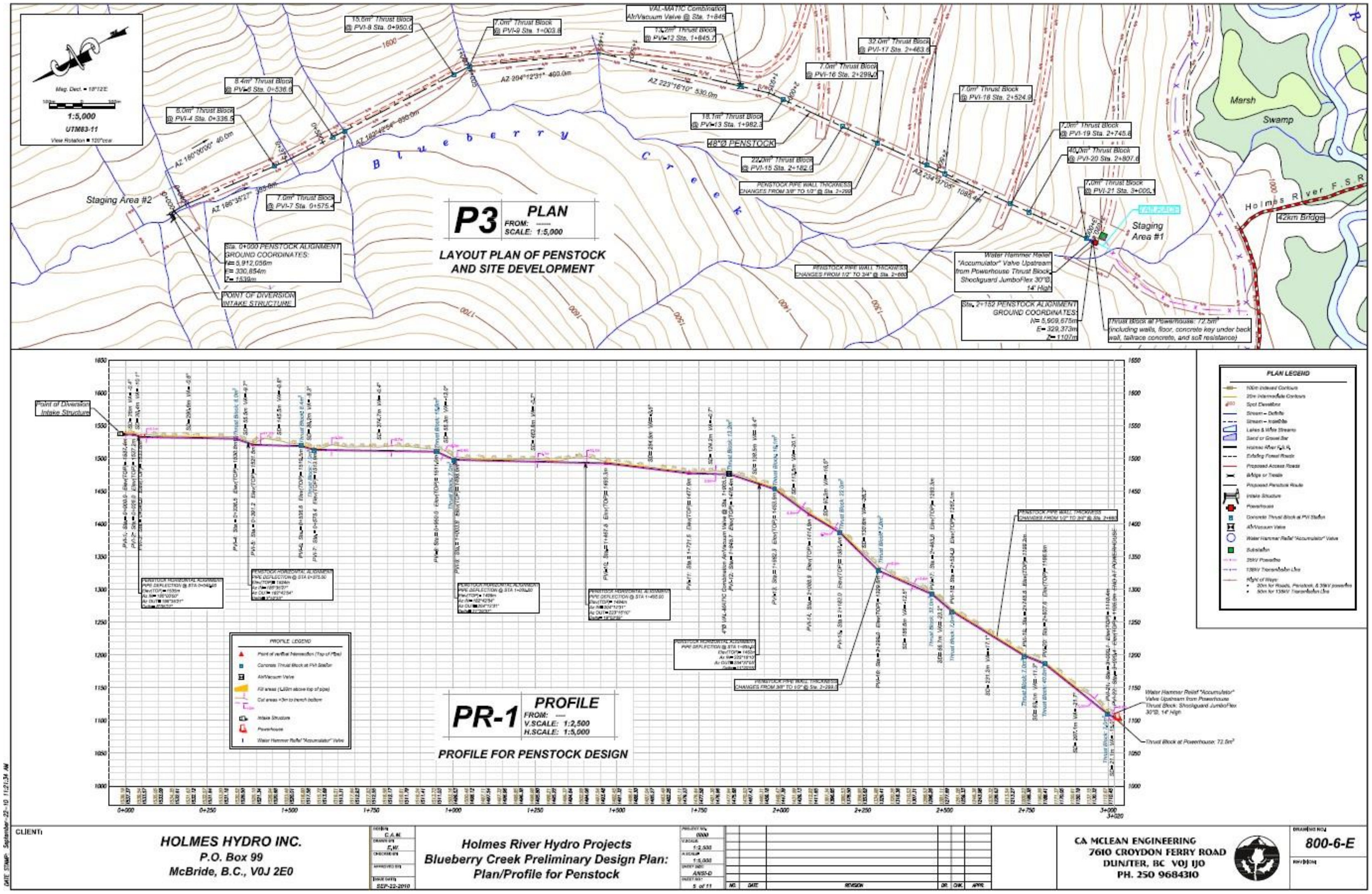
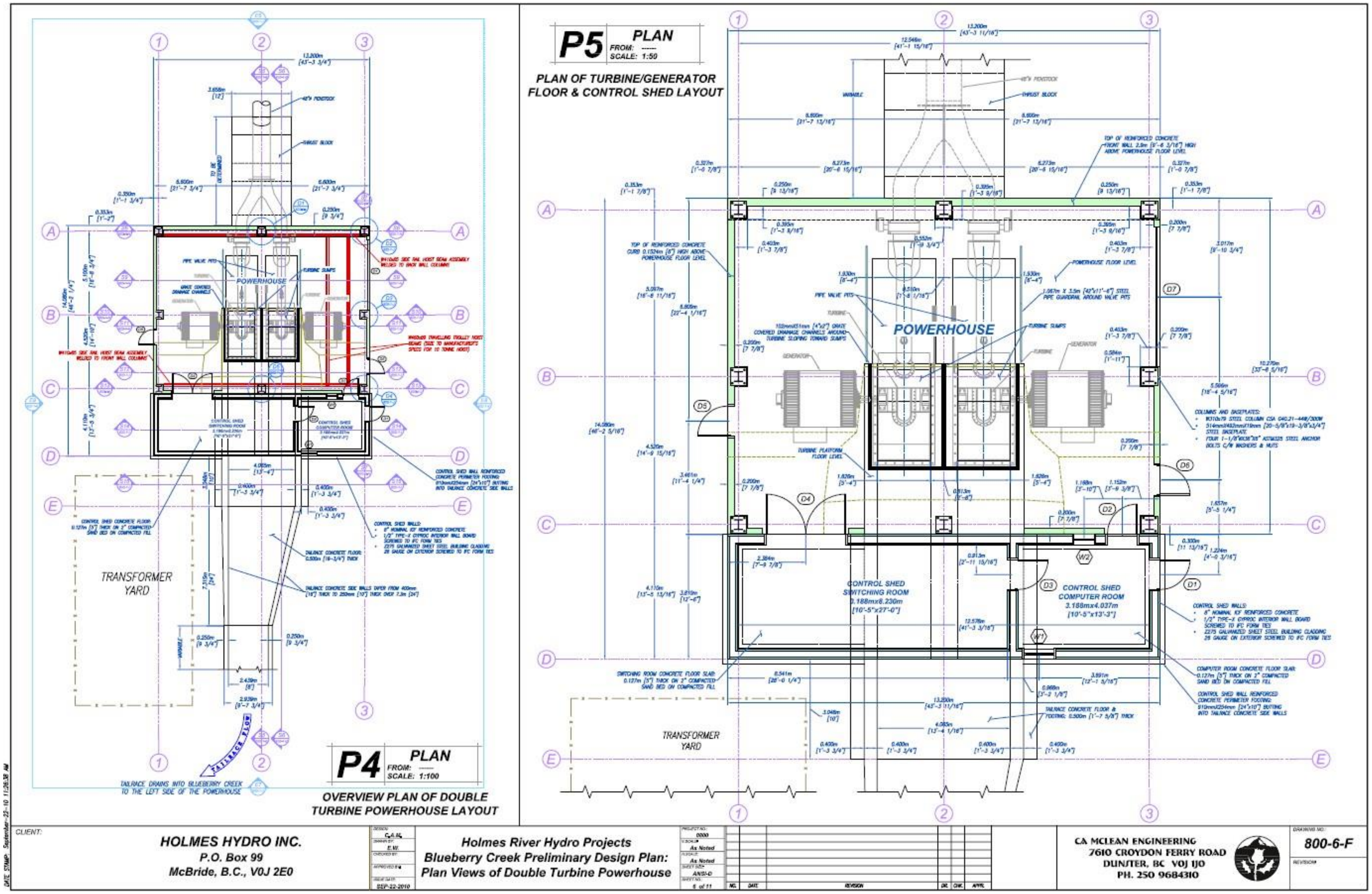
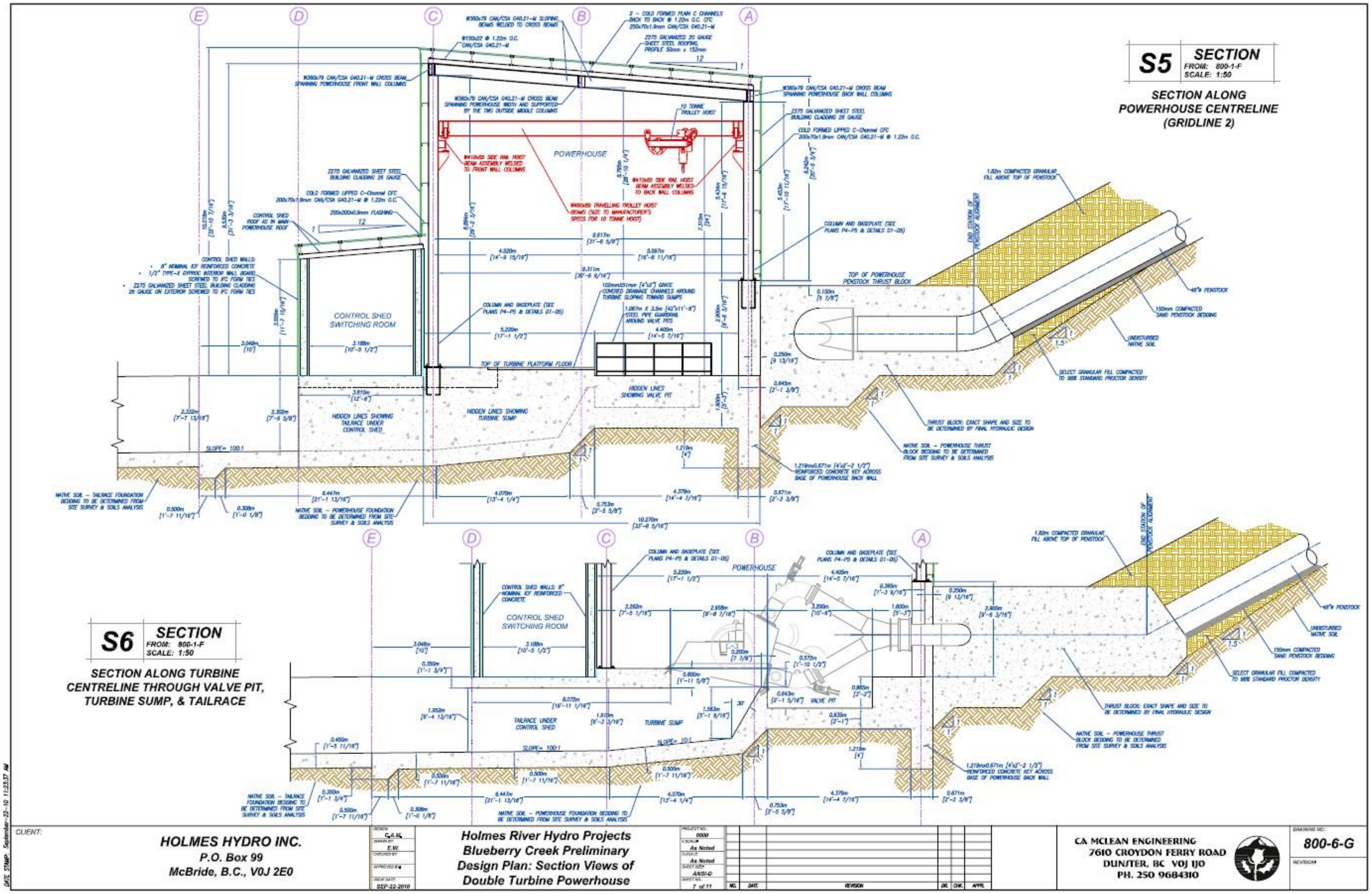

S1 SECTION
FROM: 0800-C2
SCALE: 1:75
LONG SECTION THROUGH INTAKE STRUCTURE
E1 ELEVATION
FROM: 0800-C2
SCALE: 1:75
LEFT SIDE ELEVATION OF INTAKE STRUCTURE & SPILLWAY
S3 SECTION
FROM: 0800-C2
SCALE: 1:75
SECTION THROUGH SPILLWAY DAM WALL AND BASE SLAB
S2 SECTION
FROM: 0800-C2
SCALE: 1:50
LONG SECTION THROUGH INTAKE STRUCTURE & SPILLWAY
S4 SECTION
FROM: 0800-C2
SCALE: 1:75
SECTION THROUGH SPILLWAY WING WALL & FOOTING
CLIENT:
HOLMES HYDRO INC.
P.O. Box 99
McBride, B.C., V0J 2E0
Holmes River Hydro Projects
Blueberry Creek Preliminary Design Plan:
Section Views of Intake Structure
SEP-22-2010
CA MCLEAN ENGINEERING
7610 CROYDON FERRY ROAD
DUNSTER, BC V0J 1J0
PH. 250 9684310
800-6-C


E2 ELEVATION
FROM: 0800-C2
SCALE: 1:100
UPSTREAM ELEVATION
OF INTAKE STRUCTURE & SPILLWAY
E3 ELEVATION
FROM: 0800-C2
SCALE: 1:100
LEFT SIDE ELEVATION
OF INTAKE STRUCTURE & SPILLWAY
E5 ELEVATION
FROM: 0800-C2
SCALE: 1:100
RIGHT SIDE ELEVATION
OF INTAKE STRUCTURE & SPILLWAY
E4 ELEVATION
FROM: 0800-C2
SCALE: 1:100
DOWNSTREAM ELEVATION
OF INTAKE STRUCTURE & SPILLWAY
CLIENT:
HOLMES HYDRO INC.
P.O. Box 99
McBride, B.C., V0J 2E0
C.A.M.
E.W.
SEP-22-2010
Holmes River Hydro Projects
Blueberry Creek Preliminary Design Plan:
Elevation Views of Intake Structure
0800
As Noted
As Noted
ANSI-D
4 of 11
CA MCLEAN ENGINEERING
7610 CROYDON FERRY ROAD
DUNSTER, BC V0J 1J0
PH. 250 9684310
800-6-D


P3 PLAN
FROM: —
SCALE: 1:5,000
LAYOUT PLAN OF PENSTOCK AND SITE DEVELOPMENT
1:5,000
UTM83-11
Staging Area #2
Staging Area #1
Blueberry Creek
48"Ø PENSTOCK
POINT OF DIVERSION INTAKE STRUCTURE
Marsh
Swamp
Holmes River F.S.R.
42km Bridge
PR-1 PROFILE
FROM: —
V.SCALE: 1:2,500
H.SCALE: 1:5,000
PROFILE FOR PENSTOCK DESIGN
Point of Diversion Intake Structure
PLAN LEGEND
PROFILE LEGEND
Thrust Block at Powerhouse: 72.5m³
CLIENT:
HOLMES HYDRO INC.
P.O. Box 99
McBride, B.C., V0J 2E0
Holmes River Hydro Projects
Blueberry Creek Preliminary Design Plan:
Plan/Profile for Penstock
CA MCLEAN ENGINEERING
7610 CROYDON FERRY ROAD
DUNSTER, BC V0J 1J0
PH. 250 9684310
800-6-E
SEP-22-2010



P4 PLAN FROM: ---- SCALE: 1:100
OVERVIEW PLAN OF DOUBLE TURBINE POWERHOUSE LAYOUT
POWERHOUSE
TRANSFORMER YARD
TAILRACE DRAINS INTO BLUEBERRY CREEK TO THE LEFT SIDE OF THE POWERHOUSE
P5 PLAN FROM: ---- SCALE: 1:50
PLAN OF TURBINE/GENERATOR FLOOR & CONTROL SHED LAYOUT
POWERHOUSE
CONTROL SHED SWITCHING ROOM
CONTROL SHED COMPUTER ROOM
TRANSFORMER YARD
CLIENT:
HOLMES HYDRO INC.
P.O. Box 99
McBride, B.C., V0J 2E0
Holmes River Hydro Projects
Blueberry Creek Preliminary Design Plan:
Plan Views of Double Turbine Powerhouse
CA MCLEAN ENGINEERING
7610 CROYDON FERRY ROAD
DUNSTER, BC V0J 1J0
PH. 250 9684310
800-6-F



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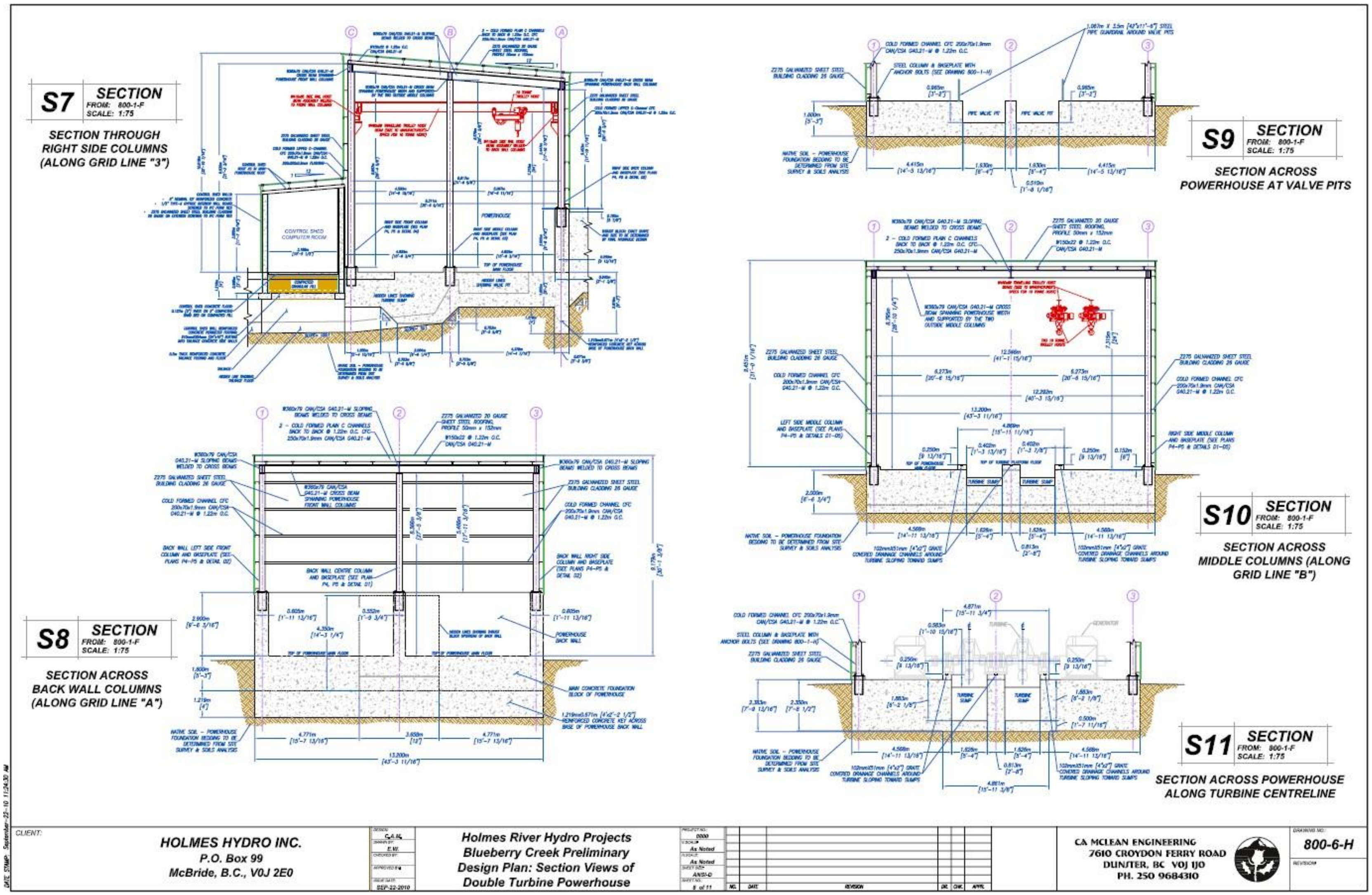
SECTION ALONG POWERHOUSE CENTRELINE (GRIDLINE 2)
S6 SECTION
FROM: 800-1-F
SCALE: 1:50
SECTION ALONG TURBINE CENTRELINE THROUGH VALVE PIT, TURBINE SUMP, & TAILRACE
CONTROL SHED SWITCHING ROOM
POWERHOUSE
CLIENT:
HOLMES HYDRO INC.
P.O. Box 99
McBride, B.C., V0J 2E0
Holmes River Hydro Projects
Blueberry Creek Preliminary Design Plan: Section Views of Double Turbine Powerhouse
SEP-22-2010
As Noted
ANSI-D
7 of 11
CA MCLEAN ENGINEERING
7610 CROYDON FERRY ROAD
DUNSTER, BC V0J 1J0
PH. 250 9684310
800-6-G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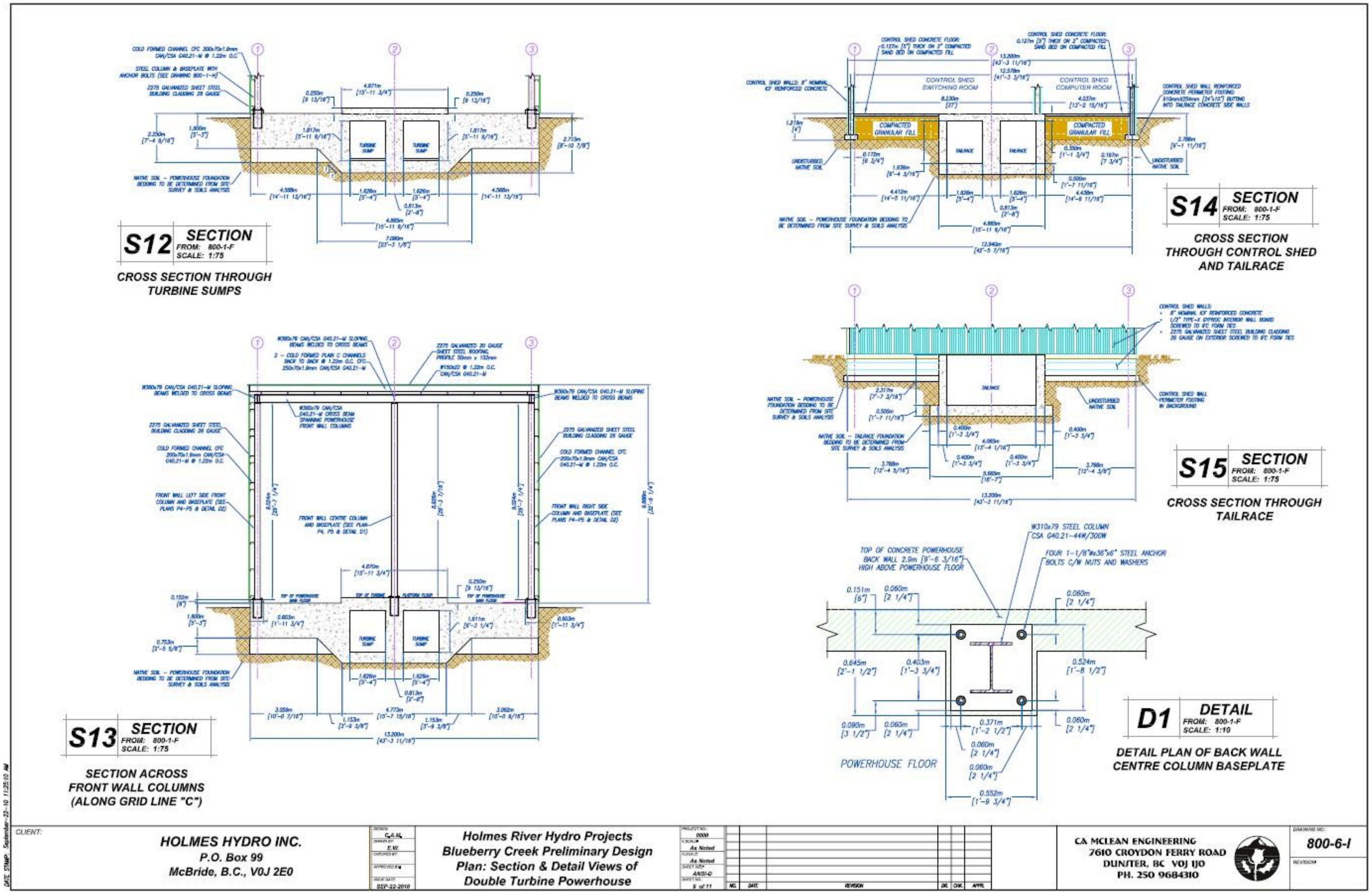
SECTION THROUGH RIGHT SIDE COLUMNS (ALONG GRID LINE "3")
S8 SECTION
FROM: 800-1-F
SCALE: 1:75
SECTION ACROSS BACK WALL COLUMNS (ALONG GRID LINE "A")
S9 SECTION
FROM: 800-1-F
SCALE: 1:75
SECTION ACROSS POWERHOUSE AT VALVE PITS
S10 SECTION
FROM: 800-1-F
SCALE: 1:75
SECTION ACROSS MIDDLE COLUMNS (ALONG GRID LINE "B")
S11 SECTION
FROM: 800-1-F
SCALE: 1:75
SECTION ACROSS POWERHOUSE ALONG TURBINE CENTRELINE
CLIENT:
HOLMES HYDRO INC.
P.O. Box 99
McBride, B.C., V0J 2E0
Holmes River Hydro Projects
Blueberry Creek Preliminary
Design Plan: Section Views of
Double Turbine Powerhouse
CA MCLEAN ENGINEERING
7610 CROYDON FERRY ROAD
DUNSTER, BC V0J 1J0
PH. 250 9684310
800-6-H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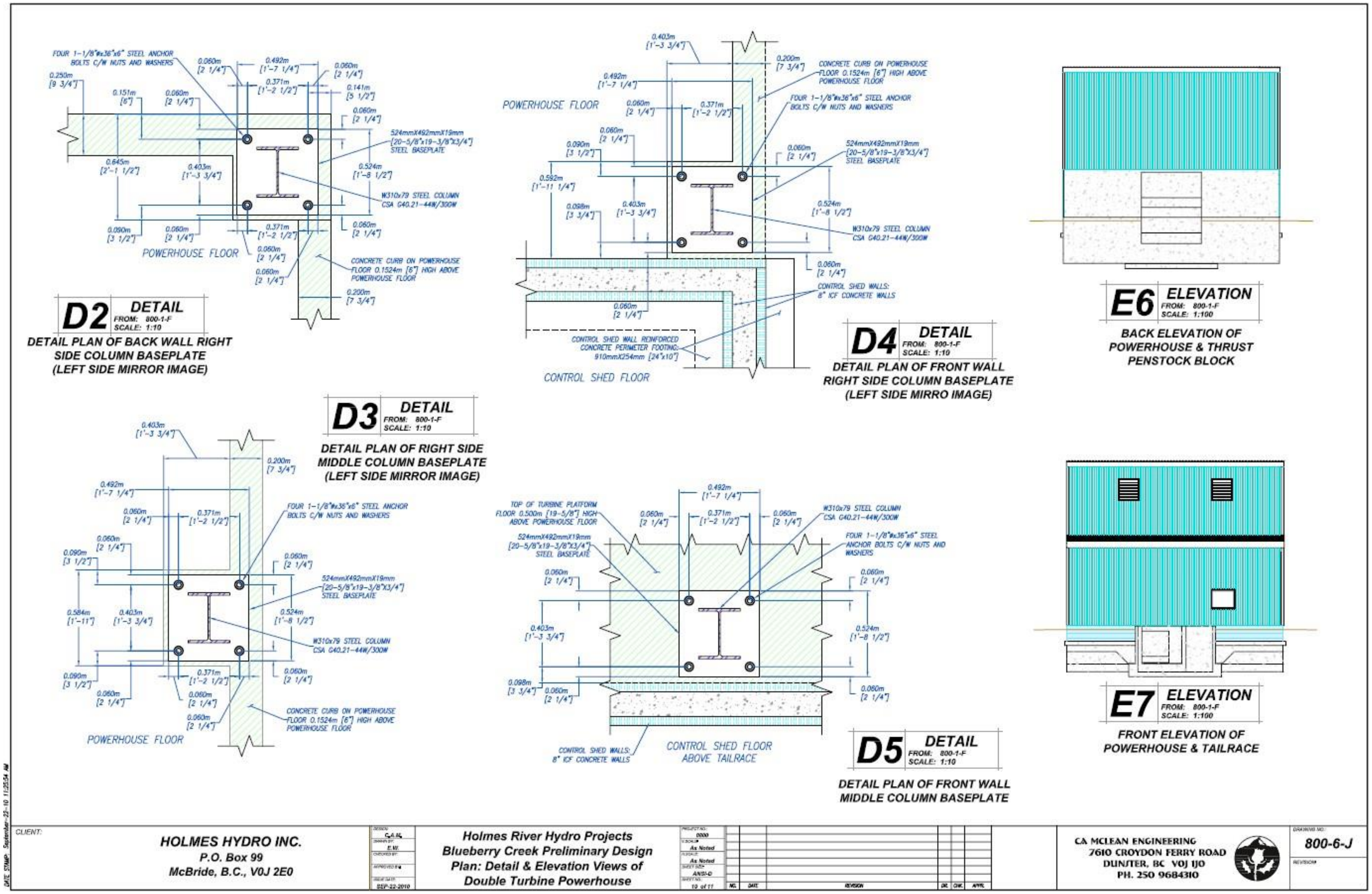
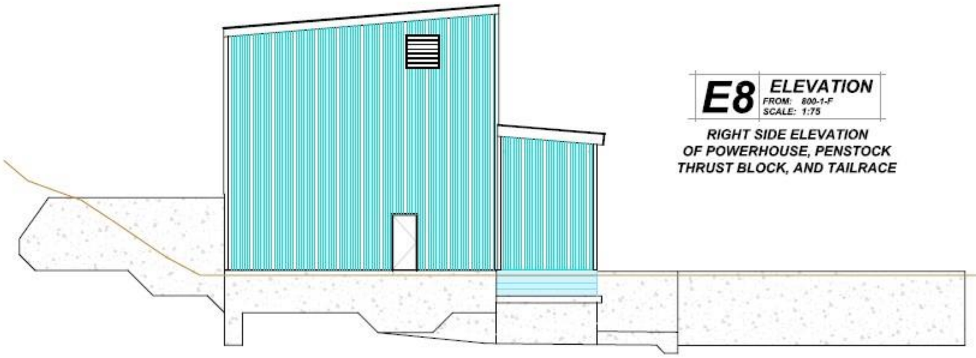
CROSS SECTION THROUGH TURBINE SUMPS
S13 SECTION FROM: 800-1-F SCALE: 1:75
SECTION ACROSS FRONT WALL COLUMNS (ALONG GRID LINE "C")
S14 SECTION FROM: 800-1-F SCALE: 1:75
CROSS SECTION THROUGH CONTROL SHED AND TAILRACE
S15 SECTION FROM: 800-1-F SCALE: 1:75
CROSS SECTION THROUGH TAILRACE
D1 DETAIL FROM: 800-1-F SCALE: 1:10
DETAIL PLAN OF BACK WALL CENTRE COLUMN BASEPLATE
POWERHOUSE FLOOR
CLIENT:
HOLMES HYDRO INC.
P.O. Box 99
McBride, B.C., V0J 2E0
Holmes River Hydro Projects
Blueberry Creek Preliminary Design
Plan: Section & Detail Views of
Double Turbine Powerhouse
CA MCLEAN ENGINEERING
7610 CROYDON FERRY ROAD
DUNSTER, BC V0J 1J0
PH. 250 9684310
800-6-I


D2 DETAIL
FROM: 800-1-F
SCALE: 1:10
DETAIL PLAN OF BACK WALL RIGHT SIDE COLUMN BASEPLATE (LEFT SIDE MIRROR IMAGE)
POWERHOUSE FLOOR
D3 DETAIL
FROM: 800-1-F
SCALE: 1:10
DETAIL PLAN OF RIGHT SIDE MIDDLE COLUMN BASEPLATE (LEFT SIDE MIRROR IMAGE)
POWERHOUSE FLOOR
D4 DETAIL
FROM: 800-1-F
SCALE: 1:10
DETAIL PLAN OF FRONT WALL RIGHT SIDE COLUMN BASEPLATE (LEFT SIDE MIRRO IMAGE)
POWERHOUSE FLOOR
CONTROL SHED FLOOR
D5 DETAIL
FROM: 800-1-F
SCALE: 1:10
DETAIL PLAN OF FRONT WALL MIDDLE COLUMN BASEPLATE
CONTROL SHED FLOOR ABOVE TAILRACE
E6 ELEVATION
FROM: 800-1-F
SCALE: 1:100
BACK ELEVATION OF POWERHOUSE & THRUST PENSTOCK BLOCK
E7 ELEVATION
FROM: 800-1-F
SCALE: 1:100
FRONT ELEVATION OF POWERHOUSE & TAILRACE
CLIENT:
HOLMES HYDRO INC.
P.O. Box 99
McBride, B.C., V0J 2E0
Holmes River Hydro Projects
Blueberry Creek Preliminary Design
Plan: Detail & Elevation Views of
Double Turbine Powerhouse
CA MCLEAN ENGINEERING
7610 CROYDON FERRY ROAD
DUNSTER, BC V0J 1J0
PH. 250 9684310
800-6-J



E8 ELEVATION
FROM: 800-1-F
SCALE: 1:75

RIGHT SIDE ELEVATION OF POWERHOUSE, PENSTOCK THRUST BLOCK, AND TAILRACE

WINDOW SCHEDULE						
TAG	SIZE		SILL HEIGHT	TYPE	MATERIAL	REMARKS
	WIDTH	HEIGHT				
W1	36"	24"	38"	Double Glazed Single Casement	Metal Frame	Opening, Right Side Hinge
W2	24"	18"	54"	Double Glazed Single Casement	Metal Frame	

DOOR SCHEDULE					
TAG	SIZE		TYPE	MATERIAL	REMARKS
	WIDTH	HEIGHT			
D1	36"	82"	Insulated Metal Exterior	Steel	Insulated
D2	36"	82"	Insulated Metal Exterior	Steel	Insulated, Fire-Resistant
D3	36"	82"	Insulated Metal Exterior	Steel	Insulated, Fire-Resistant
D4	48"	96"	Insulated Metal Exterior - Double	Steel	Insulated, Fire-Resistant
D5	36"	82"	Insulated Metal Exterior	Steel	Insulated
D6	36"	82"	Insulated Metal Exterior	Steel	Insulated
D7	14'	14'	Industrial Rolling Overhead	Steel	

POWERHOUSE: DESIGN & CONSTRUCTION NOTES

1. These powerhouse drawings represent a generic double turbine and generator powerhouse, with the tailrace draining to the left side. Exact design specifications to be completed after thorough geotechnical analysis of site and soils, and will be based on surveyed topography and site conditions.
2. CONCRETE: Concrete to attain at least 25mPa yield strength or strength as otherwise specified. Strength is to be determined by 28 day test cylinder destructive compression testing. No concrete pour is to be done at temperatures of 0°C or less. Aggregate source must be tested and approved for concrete work.
3. STEEL REINFORCEMENT: 40,000 psi yield strength deformed steel bars with specified size, pattern, and location to be determined.
4. SOIL MECHANICS: Bearing capacity, cut and fill slopes, backfill material, and compaction are to be determined on site before commencement of construction.
5. TO BE DETERMINED IN FINAL DESIGN PLANS: Bills of materials, rebar schedule, concrete isolation/control joints, concrete pour schedules, details of structural connections, thrust block size, shape and dimensions, perimeter drainage, tailrace parameters, trolley hoist details, exhaust fan sizing and locations, and other information pertinent to the design.

E9 ELEVATION
FROM: 800-1-F
SCALE: 1:75

LEFT SIDE ELEVATION OF POWERHOUSE. PENSTOCK THRUST BLOCK, AND TAILRACE

DATE STAMP: September-22-10 11:26:38 AM

CLIENT:

HOLMES HYDRO INC.
P.O. Box 99
McBride, B.C., V0J 2E0

C.A.M.
E.W.
SEP-22-2010

Holmes River Hydro Projects
Blueberry Creek Preliminary Design
Plan: Notes & Elevation Views of
Double Turbine Powerhouse

0000
As Noted
As Noted
ANSI-D
11 of 11

NO. | DATE | REVISION | DR. | CHK. | APPR.

CA MCLEAN ENGINEERING
7610 CROYDON FERRY ROAD
DUNSTER, BC V0J 1J0
PH. 250 9684310

DRAWING NO.: 800-6-K
REVISION:

Appendix D – Typical Geotechnical Report

Firth Hollin
RESOURCE SCIENCE CORP.

Engineering Geomorphology

June 23, 2009 2271

Mr. Brian Shawara,
Homes Hydro Inc.,
PO Box 99,
McBride BC, V0J 2E0

Terrain Stability and Geohazards Field Assessment of Linear Development Corridors and Point Infrastructure Locations, plus, Preliminary Geotechnical Engineering Site Investigation and Design Appraisal,
Proposed Hydro-Electric Project, Blueberry Creek,
East Central British Columbia

1.0 INTRODUCTION

For the referenced Blueberry Creek drainage, Firth Hollin Resource Science Corp (FHRS), has completed visual site review as it pertains to stability assessment along linear development corridors and at point infrastructure locations. Such exercises necessarily include assessment of bounding and proximal conditions to the extent wherein natural landscape processes or distinct natural hazards may affect the proposed developments.

A plethora of landscape attributes were considered for both short and long term scenarios as the site is to be a minimum 50 year service life development with much large scale and expensive infrastructure.

The field work was completed June 10, 11, 2009 by Mr. Len Ginnever, P.Eng. of FHRS with Mr. Brian Shawara and others from Holmes Hydro Inc.

1.1 Scope of Work and Project Coordination

The scope of work included field examination, measurement and estimation of:

- soil textures, provenance and moisture conditions,
- rock lithologies, soundness and structures where observable,
- tertiary[A] surface water channel habit, gradients and substrate characteristics,
- evidence of seepage expression, and associated variation of herb and shrub species as indicators,
- slope aspects, repose angles and lengths, and their directional relations to the proposed linear and point developments,
- ecological associations, specifically timber, shrub, herb and moss layers in context with soil associations, moisture conditions and like details,
- review of stereo aerial photographs, published literature and consultant reports on the area,
- review of the constructed geometry and performance of proximal existing roads, for maintenance or upgrade necessities thereon, plus as useful input into design and construction considerations for new roads,

The project coordinator for all activities is Mr. Brian Shawara of Homes Hydro Inc.

A: tributaries to Blueberry Creek are tertiary streams relative to the mainstem of the Holmes River

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1.2 Nomenclature

Various terms from the geological science and engineering disciplines are used in this report. For the most part, correct names and material properties of rocks and soil can be found in introductory level texts on geology, soil mechanics or other disciplines. A complete glossary of terms is not practical to provide. Readers will have to educate themselves as they see fit. It is not essential for the practical pursuit of the current objectives that readers know all definitions of these scientific terms. Appendix 1 gives some definitions of terms as they relate specifically to hazard, consequence and risk on the landscape, and further how these terms relate to planning and specification for this site. Much additional terminology will be appropriately interpreted by the various other professional consulting agents (for example.. pipeline design consultant), through the course of their necessary involvement in the project.

1.3 Location Data

The subject Blueberry Creek and associated proposed developments are shown on Figure 1, appended. Our Ground Review path is shown thereon. Both walking and ATV routes are shown.

2.0 GEOLOGY and GEOMORPHOLOGY

Bedrock and soils for the subject area are well described in the literature[1-4].

2.1 Bedrock Formations

The Geological Survey of Canada (GSC)[1,3], maps Miette and Gog Formation lithologies in the Holmes River and its tributary watersheds. These rock groups are varied sandstones, silt and mud stones, argyllites and quartz granule conglomerates. The latter conglomerates were notable in the field, plus sandstones at lower elevations. Some extrusive and lime rocks are also remarked in the GSC data however; would not be expected locally, based on our extensive prior experience in parts of the Holmes watershed. Argyllites were notable at high elevations on the southerly Holmes River trough aspects about 3km east of the mouth of Blueberry Creek[4]. Hughes-Games[2] et al report similar details for bedrock. Bedrock, its lithologies, structures and conditions are discussed in further detail below in conjunction with the geomorphology, topography and vegetation of the Blueberry Creek drainage. The listed characteristics of the bedrock regime are intrinsically tied to the geomorphology of the area. We have found through experience that separating the different subjects into distinct report sections commonly results in a less than coherent discussion.

2.2 Soil Types

Pleistocene and Recent glacial period soils and Quaternary soils for the Blueberry Creek development reaches are described below. No differentiation between Pleistocene and Recent glaciation depositions is made or inferred. Quaternary deposits and formations are those which have developed or otherwise resulted since the last disappearance of ice, roughly 8,000 to 12,000 years ago. As with bedrock, soils commentary is given in conjunction with discussion on geomorphology and topography. Vegetation is also discussed conjunctly as the occurrence of various species is strongly related to soil textural, moisture and drainage properties.

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2.3 Geomorphology

Geomorphology of the subject watershed is discussed starting from the confluence of Blueberry Creek and Holmes River and thence proceeding upstream on the former.

2.3.1 Holmes Mainstem

The mainstem of the Holmes River at the mouth of Blueberry Creek drains generally azimuth 280°. The valley bottom presents broad expanses of modern fluvial deposits of the Holmes River. These would be expected to vary across the spectrum of fine grained sands or silty sands, to coarse graded sands and gravels plus lesser expanses of lag boulder deposits, gravel and boulder levies and numerous other typical fluvial forms. These formations are largely of plain fluvial expression and aside from normal bedload processes, channel migrations, avulsions and bar processes, are not deemed extraordinary. Nor would any such processes negatively affect the proposed developments as all but the transmission line are, in general, estimated in excess of 30m elevation above the peak flood stage of the Holmes River. The transmission line can be suitably located to avoid or minimize risk from such hazards.

2.3.2 Blueberry Fan

A large alluvial fan of moderately well drained silty sand and gravel to well drained cleaner sand and gravel evidently historically emerged from the Blueberry Creek drainage, likely in conjunction with the closure of the last ice age (8 – 12 thousand yrs, as noted). It has subsequently been truncated by the modern fluvial processes of the Holmes River. Presently the truncated south end near the mouth of Blueberry Creek is estimated as 26m – 28m height and presents a ravelled 35° face. This material can likely provide ample quantities of granular borrow for various uses in construction. Some further discussion on this subject is included below. The subject fan narrows upstream, forming an apex and terminating near and just downstream and below the powerhouse location. See Figure 1.

2.3.3 Initial Incised Reach

Further upstream, the Blueberry channel is steeply incised in bedrock to variably 4m – 8m above the channel. See Photo 1, left. Some portion of this height is commonly exposed and near vertical.

Further above on the east bank, shallow rock is judged to continue, as slopes exceed 40° for in excess of 50m slope length.

It is further judged that the east slopes present only thin biophysical soil development over rock, or thin draped glaciofluvial materials over rock as in Photo 2, below left.

Slopes rise at:

- 47° for ~ 21m planar slope length
- 40° for ~ 25m planar slope length
- 30°±2° for 25m-100m+ subplanar slope

with all of the above showing azimuth 258° aspect at the power house, then coming around upstream to aspect 280°. The upper sub-planar lengths present a maximum 1m surface relief. Thickening soils would be expected. At higher elevations above the channel and powerhouse location, slopes flatten dramatically to gentle or barely moderate repose and present more southerly aspects (210°±~8°).

The deeply incised reach extends about 850m – 900m thalweg length upstream to the 1,300m elevation. Thereafter the east trough walls flatten significantly and the trough overall is much broader and less deep.

The west bank on this initial incised reach is more benign generally. Thin soils over steep shallow rock are less apparent, rather, once above the initial 4m – 8m height of rock out of the channel, significantly less steep rock overlain by remnant tills in turn overlain by draped glaciofluvial, or sporadic colluvial veneers seem evident[5]. Draped glaciofluvial soils would not extend far upslope. As none of the project elements lie on the west side of Blueberry Creek, further commentary on the west valley slopes is limited.

Comparison to Data from the Literature

The above remarks are in part consistent Hughes-Games et al[2] who classify moderately steep to steep undifferentiated materials with gullying on the east side. From the walking review along the penstock route locally and out to the crest of the incised trough walls, pronounced or deeply down cut side gullying is not evident on the east side. This is perhaps further evidence of continuing steep, shallow rock on this side.

Across the trough on the west side, thicker soils are apparent from observation points on the east side, and also on the aerial photographs[5]. Some historical gullying *is* evident though it is neither widespread nor dramatic. One site presents an exposed soil chute indicative of shallow translation type processes. The chute is perhaps 15m breadth and 25m slope length. This site would not be expected to influence the long term operation of the powerhouse, its outfall, access road and departing transmission line. Significantly lesser slope repose occurs above it for long distances. It will likely recover to shrubbery over the long term. Its presence does however; indicate that other zones of similar repose, seepage conditions (if any), and soil textures, could display similar behaviour over the project life.

It is notable that the penstock corridor is above the crest line of the incised reach length on Blueberry Creek, except for the final 75m± of its length, where it necessarily descends these slopes to the turbine and powerhouse facilities.

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2.3.4 Middle Development Reach: 1,300m Elevation & to Penstock GPS Station #77 + 1km

We have defined the middle development reach as commencing at the 1,300m elevation on Blueberry channel (See Figure 1). Thither and upstream, the channel is in a broadening valley invert. Slopes off the channel are much less than downstream, commonly 12° - 24° with long intervals at lesser repose and only a very few locales presenting short length steeper pitches possibly to 30°±2°.

East Side

From 1,300m elevation on Blueberry channel and for roughly 950m upstream (see Figure 1), the ground review observed gentle and barely moderate slopes descending from the penstock corridor WNW to the channel. Morainic deposits (tills), were continuous on the surface. Soil textures were gravelly sandy silt. The gravel fraction was platy to subrounded. These soils were moderately drained to well drained. Perennial surface creeks are absent and broad expanses of elevated soil moisture are not present. A few small ephemeral watercourses are present. This overall condition is consistent with the presence of False Azalea, Cornus, Five Point Bramble and Stiff Club Moss, all of which favour drained, drier conditions. Timber is mixed mature Spruce and Pine with scattered true Firs. Declensions or nutant boles do not occur, indicating that at and near surface ground displacements due to shallow processes such as solifluction, nivation, cryoturbation have not been a factor. Evidence of other mechanisms of instability either shallow or more deeply seated are similarly absent. The typical condition is shown in Photo 3.

Slopes above and east of this interval encompass the turn from the azimuth 210° Holmes River aspects and around through to azimuth 280° facing Blueberry Creek. These slopes are fully forested through approximately 1,800m elevation, above which sub-alpine conditions progressively limit timber. Some bare rock is exposed above 1,800m. The aerial photographs present little if any evidence of instability over the full ascent length.

West Side

The west valley slopes above this interval similarly turn from southerly facing the Holmes River but around through to azimuth 090° facing Blueberry channel. This arc however; is much larger radius than on the east valley slopes. The west valley slopes do not become a fully eastern aspect until 300m further north in the Upper Development Reach (discussed below).

These slopes are persistently less than 3H:1V for 200m – 400m slope length above Blueberry channel on the topographic mapping and also appear thus from eastward vantages in the field.

They are similarly fully forested through approximately 1,800m elevation but show mixed deciduous-coniferous stands, with the former dominant at higher elevations. Mixed age classes are also present.

A plethora of south trending lineations are present on the Holmes aspects and continue through the turn onto the easterly aspects. Hence on the latter aspects they present strongly raked orientations from the steepest descent directions facing Blueberry Creek.

From the arc centre of the turn into Blueberry valley and from the 1,800m elevation, a long rising ridge crest trends about azimuth 300°, thus slopes north of this descend obsequent to both the Holmes River and Blueberry valley. This feature is mapped in the GSC data[3] as an upright anticline on the rising Holmes aspects thence an overturned syncline (along the ridge crest), plunging locally easterly at shallow angles, but levelling westerly by a point north and roughly opposite Judy Creek. At the foot of the noted obsequent descents, an overturned anticline forms an east trending tributary drainage into Blueberry Creek.

Thus the above described lineations are deemed to be typical transverse cleavage common to such synclinal (and/or anticlinal), features with axial curvature. Thus they are not erosional features, nor quaternary in age, but of much much older rock structural provenance, and thus not likely to represent any significant issue with respect to recurrent landscape hazards, recent or active instability or erosion, nor to be portent of similar future processes.

2.3.5 Upper Development Reach: GPS Stn #77 and North to Intake Facility Location

The upper development reach is indicated on Figure 1. The topography is benign within an estimated 400m maximum either side of the Blueberry channel and over the full length of this reach. Slopes out of the channel are persistently less than about 3H:1V for 100m – 400m upslope both east and west.

Above variably 200m – 400m out of the channel, the west valley slopes then steepen to 26° - 30° based on topographic map data, but remain forested. Cirque features or very steep rock fronts are not present at the highest elevations thus it is unlikely that avalanche hazards develop on these slopes. The upper elevations rather present a gradual rounded morphology to become the axial ridge of the above described overturned syncline.

On the east side, and beyond variably 100m - 400m slope length above Blueberry channel, discrete sites with steep bluffs to 30m – 40m height and/or long rough rock slopes estimated at 30° - 40°+ do occur and continue to the apparent summits as visible from the penstock corridor elevation. The highest visible forms are steep tors and deep ghylls without vegetation. Vegetation is very limited overall on these upper slopes. Much loose rock is seemingly also present on the uppermost portions.

The lower slopes are benign topographically and not an initiation zone for the geomorphology that can and does affect them. Over the length of the upper development reach, the lower slopes are covered by a patchy boulder mantle. It is judged that more of the area is covered than is not. These materials can include a finer gravelly to sandy matrix, though certainly many deposits are apparently clearer boulder composition.

The upper summit areas are mapped as a tight chevron fold in the GSC[3] data at the eastern end of the previously described most northerly and east plunging overturned anticline. The folding results in the middle leg of the chevron becoming an overturned syncline and the trailing leg is returned to an overturned anticlinal form. Such tight compound folding would easily produce extensive rupturing and cleavage development regionally, and extensive and complex jointing at more localized scales. Later subject to glacial processes, large volumes of displaced blocks, face slabs and like forms would result. It is judged that this mechanism is responsible for the evidently large supply of coarse loose rock at elevation.

With bare rock and 30° - 40° slope angles, vegetation has not generally developed, as already remarked. The prevalence to avalanched behaviour annually is thus set, and borne out by the noted boulder colluvium scattered in the patchy array over the surface at lower elevations. Also, at lower elevations mature timber is generally absent. Young Balsam dominate along with Alnus. Both are pioneer species. Many boles were clearly bent to ground level in the past winter or three. Upslope bole presentations are stripped of bark and limbs, and fresher boulder heaps or mixed organics, sand, silt and minor gravel depositions are present in conjunction. The stand is very open and early seral at best. It is judged that avalanche free years are the exception rather than the rule, and that mid to late seral or climax stands have not likely developed locally for many decades, centuries or at all since the last ice (8-12 thousand years).

The small scale topography along the penstock corridor direction is thus wavy with low relief of about 0.6m – 2m and with long wave lengths (5m – 30m). This is consistent with narrow shallow scour paths and narrow and parallel long form deposition of detritus entrained upslope during the course of discrete avalanche events.

2.3.6 Intake Facility Location

Photos, 4,5 and 6 look upstream, downstream, and across to the west at the proposed intake location.

At the intake, the channel is 4°- 5°, with width estimated as 5.5m at mean annual peak flow, based on discernible highwater marks. An additional 0.3m - 0.4m bank height is present on both sides followed by gentle ascents of 6° - 12° either side for about 20m. Slopes then steepen to 12° - 18° either side for several additional tens of metres and are then more generally 20° - 26° for many more tens of metres.

Soils are sandy with boulders plus organics, the later having developed due to the long presence of deciduous shrubbery (Alnus), and the associated annual litter thus produced. Young Balsam and some Spruce are also present. False Azalea, Cornus and Stiff Club Moss are also present. At low relief off the channel but down stream about 300m, some wetted soils occur sporadically and present Cow Parsnip, but such occurrences are not widespread.

Photo 5 shows that the channel takes a significant right turn within 15m± downstream of the proposed intake. This is convenient as it will allow a straight line departure of the penstock route and immediate and quick divergence of the two alignments.

2.3.7 Proposed and Existing Road Alignments

New Roads

From GPS Station #77 and northerly to the intake facility the required new road access is coincident with the penstock route. Low cross relief occurs over this full length and will allow for straightforward conventional cut/fill construction over prepared subgrade. This interval is further discussed below in the design and construction context.

South of GPS Station #77, the penstock continues southerly toward the power house, while access bends easterly and links to existing logging road networks. This interval is similarly simplistic though with some steeper sidehill considerations to 26° - 30°+ on discrete short intervals. Soils are drained tills with intermittent thin colluvial veneers at some locations. Some zones of gently sloping at-surface bedrock also occur. Similarly straightforward construction will be available. This interval is also discussed more thoroughly below.

Four new short spur roads will be required departing from existing logging access and/or the initial lengths along the new intake access route. These are necessary for construction access to the southern portion of the penstock route. The top three spurs lie along the drained southerly aspects and should similarly not be problematic. They acquire gentle bench widths trending westerly to their intersection points with the penstock alignment.

The lowest spur accesses the powerhouse location. In its final 100m or so it will necessarily cross moderately steep and steep sidehills. Additional site investigation and design will be necessary, however the proposed alignment is not untenable.

All of the proposed new routes are demarcated on Figure 1.

Existing Roads

The existing logging access from the Holmes FSR Main Line presented conventional cut and fill construction throughout the length to be used. Cuts were typically 45°, and variably 1m – 4m height in gravelly sandy silt tills. At intervals they obviously also intersected the thin surficial colluvial veneers as were noted. Well preserved planar habit of cuts was generally ubiquitous. Fills were generally sidecast and likely without prior stripping beneath to mineral soil. Despite this assertion, fills were not overly high anywhere and seem to have performed well. This is likely due to the generally dry southerly aspects and absence of extensive shallow seepage phenomena.

Some ditching and culvert installations were slightly degraded but such had not resulted in other than minor partial dysfunction.

Significant lengths on the highest elevation spurs had been installed without a permanent ditch. Drainage thereon while obviously less than ideal still had not caused any significant sediment entrainment issues. By appearance it is judged that a general cross fall to the low side may have been implemented as a partial or temporary deactivation or drainage maintenance tactic.

2.3.8 Transmission Line Corridor

Presently the transmission line corridor is shown coursing southward down the alluvial fan of Blueberry Creek. Broad rights of way trending in down fan directions should generally be avoided. Such installations can be prone to encourage channel routing in the event of avulsions, debris flooding or like stream processes. Observing the aerial photographs, the route to connect with the main Holmes valley line can easily be changed to one of several options thus avoiding this problem. Significant additional construction lengths or difficulties would not be expected.

2.4 Hazard, Risk and Statement of Supporting Rationale

Soils are generally granular everywhere insofar as performance with respect to soil mechanics is concerned. Soils present varied compositions of fine non plastic silts, fine to medium sands, and platy through angular gravel and cobble fractions.

2.4.1 Slope Stability and Erosion

Local morainic soils contain all component types, are of lodgement till provenance and thus well densified. Established channelized surface runoff and significant evidence of groundwater input to these soils is limited or absent. With high densities and limited water input mechanisms, these soils are strong frictionally, and, in conjunction with root bound contributions to strength and generally gentle, moderate and barely moderately steep repose, are adequately resistant to shear failure mechanisms in their natural conditions and under designed development alterations. Thus low hazards are assigned with respect to slope stability. Any construction period or operational period events are expected to be small scale and certainly manageable with little or no consequences beyond right of way limits. These are considered to be low consequences. Similar arguments are applicable for erosion, sediment entrainment and transport.

Draped glaciofluvial and colluvial veneers are thin, discontinuous and generally comprised of sand, gravel and coarser constituents. They certainly have lesser fines fractions than observed morainic soils. Insitu densities are less than for morainic soils. Their distribution and thicknesses are however; such that from the construction and long term operational viewpoint, they will in general be eliminated as a consideration for the medium and long term site management requirements.

Coarse boulder colluvium also occurs. These materials are clean, stable and erosion resistant and will similarly be of little management consequence.

With proper and necessary engineering design and conventional erosion control measures and tactics for construction periods, and for long-term site management, the proposed development plans for Blueberry Creek drainage are considered to be low risk with respect to slope stability and erosion, either due to improvements or from the current or future natural condition.

2.4.2 Avalanche Hazards

It is clear that avalanche hazards are real and cannot be considered as other than annual. They are limited to the east valley slopes upstream of penstock GPS Station 77 + say 450m, and northward. They evidently also mobilize rock debris regularly however; the gross volume for each event may be limited to a few tens of cubic metres. Vast mounds or lengthy and voluminous lateral depositional heaps are not apparent. Rather smaller depositional forms are evident in great number. While these processes damage and in some instances evidently destroy narrow swaths of seral stands, vast scale recent or historical destruction is not evident. The aerial photographs indicate that most events stop completely on the long, gentle and barely moderate apron slopes present above Blueberry Channel and which extend upslope variably 100m – 400m. Hughes-Games et al[2] indicate one area where historical runouts have reached and crossed Blueberry channel and certainly this may occur again locally, or elsewhere. This indicated location in their report is estimated as 500m – 600m downstream of the intake location. At the intake location runout terminus locations appear to be generally 150m slope length easterly upslope. Based on the field review, we would not modify these determinations. This results in our evaluation of hazard and consequence for avalanche processes as follows.

The hazard for avalanche occurrence annually (likely November through March) is high, however; the evident damage in the depositional zone along the east slope toe above Blueberry channel is neither large scale, nor widespread on an annual basis. Recovery of vegetation is apparently quick and the likelihood that vast areas of soil remain exposed for long periods of time is low. These are considered low or very low consequences. Thus risk due to avalanche processes for the development interests is at most moderate, and likely lesser. It is further judged that adequate measures for infrastructure can be developed and implemented so that these installations can withstand potential damage.

2.4.3 Channelized Processes

The western valley slopes are fully forested to generally 1,800m elevation and, there is a distinct paucity of evidence either historical, ongoing, or portent of future events, to expect that destructive channelized processes originating upslope have historically occurred, are presently regular, or will develop in the future. On the east slopes normal frost free period drainage occurs as runoff of water. Above the elevation of the toe area colluvial apron, there is little if any volume of material available for mobilization by normal water flows at high elevations. Only avalanche processes with a net higher dynamic viscosity apparently have the capacity to mobilize the previously described loose rock volumes from time to time.

On Blueberry channel, the substrate is a threshold status[5] boulder substrate and evidently long established. Some peak flows on multi year return periods very likely exceed the current bank-full stage however; low gradients and thick cover of shrubbery, wiry young conifers and varied surface relief are not conducive to such events causing significant scour and mobilization of material beyond the existing perennial channel, nor is any significant historical activity as such, apparent.

Further downstream, below the 1,300m elevation, Blueberry channel becomes incised and confined as previously described. While huge volume discharges built the previously described alluvial fan at the confluence to the Holmes River, this process was judged to be associated in general with the early post glacial melt period. While some aggradation of the fan since the early post glacial period must necessarily be acknowledged, the scale and frequency of such events are judged to be very small. Thus such phenomena are considered to be low or very low hazard for occurrence.

As all proposed infrastructure will reside above the incised reach, processes on this reach will not generally affect them. At the powerhouse location, and subject to further consideration, some upstream defence against damage from the passage of such events should likely be employed. The necessary strategy will likely be simple technically and similarly simple to install. Such measures could include an angled and thickened upstream wall on the powerhouse and/or anchored footings on rock or soil.

Thus we conclude that hazards from destructive channelized processes are low over the development length. Simple measures can be employed for defences if necessary and so that damage from such events can also be kept low. Thus risk associated with destructive channelized processes is also considered to be low.

2.4.4 Other Landscape Hazards

There are numerous other landscape processes which commonly affect human activity everywhere. The upper watershed of Blueberry Creek upstream of the intake facility has not been scrutinized in detail but subject only to cursory aerial photograph review. The aerial photograph review suggests that historical or active large scale cataclysms are not present. Also, the Blueberry valley bottom is broad and the overall slope southerly very gentle for kilometres of length. Thus the potential for transfer of damage from upper watershed events down to the location of the intake facility is low or very low. Below the intake facility there is yet another kilometre or so of gentle gradient, unconfined channel reach conducive to energy loss and stalling of any channelized event originating in the upper watershed. Hence it is judged that events in the upper watershed have arguably zero probability of affecting the powerhouse vicinity of this project. Overall we conclude that risks to the development interests or the natural condition and due to processes originating in the upper watershed are very low.

3.0 FIELD DESIGN CRITERIA

This section provides preliminary design strategies required and yet to be conducted in order to construct the various project elements, namely the intake facility, penstock, powerhouse, roads and transmission line.

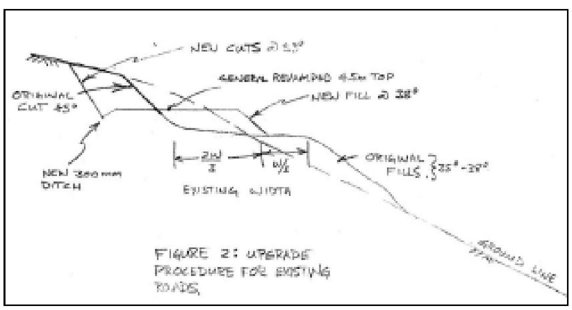

FIGURE 2: UPGRADE PROCEDURE FOR EXISTING ROADS

3.1 Existing Roads

In general modify existing roads to required widths and minimum curve radii by way of accepting that:

- the existing outer ¼ of top width cannot generally be relied upon as the original construction condition is unknown though expected to be excavated cut spoil likely containing plant material and organic soils and sidecast over natural ground downslope, the latter also neither stripped or otherwise cleared of low plant material and organic soils, hence,
- strip organic soils and plant material for 1.5m – 2m upslope of existing cut crest, then excavate new 53° cut and 300mm ditch as shown in Figure 2. Install new raised grade also as shown in Figure 2. Figure 2 is schematic and not to scale.

- strip below new culvert outfalls through remaining width of original fill to ensure conveyance of discharges to points beyond original fill
- Note also from Figure 2, that raised grade and new cut are generally a balanced cut and fill and this will be norm.

3.2 New Roads

Field notes for new roads are provided below and are variably referenced to GPS station numbers and or recorded as estimated lengths from such stations or other identifiable marks. New roads in general will be conventional cut and fill using 53° excavation angles in soils and erection of 38° fill angles over stripped fill footprint areas. Specific sites that require other than these simple straightforward techniques can be found in the notes below. The final 100m or so of the powerhouse access road will require formal design exercises based on yet uncompleted site investigations. These are also more specifically addressed below.

The four new roads are:

1. Intake Access Road
2. Top Spur Penstock Access
3. Middle Spur Penstock Access
4. Low Spur Penstock Access
5. Power House Access Spur

and are demarcated on Figure 1

3.2.1 Intake Access Road

POC: In existing logged block, departs from existing road,

0+000 – 0+200: crossing variable 20° - 26°, drained tills, cut and fill 53°/38° respectively, fill over stripped subgrade

0+200 – 0+330: variable 5° - 10° bench 2m above, ascend to it as feasible, continue cut and fill,

0+330 – 0+390: now acquired described 5° - 10° bench elevation, cut and fill as required,

0+390 – End of Logging

0+390 – 0+450: variable 18°- 26°, cut fill 53°/38°, fill over stripped subgrade

0+450: Junction of Top Spur Penstock Access Route

0+450 – 0+490: 32°↓, 38°↑, cut fill 53°/38°, strip fill subgrade

0+490 – 0+702: shallow bedrock or exposed rock at surface, some ripping possible however; much blasting likely also required, slopes reduce to < 20° past 0+520, very dry generally, Juniper, Rangifer Lichen plus Pine

0+700: Penstock and road Junction = GPS Stn #77, Road and Penstock now coincident henceforth northerly to intake location.

0+702 – GPS Stn # 82 + 200m, variable 5° - 15°, dry, False Azalea, Cornus, Stiff Club Moss, cut and fill 53° - 38°, strip fill footprint

From GPS#82+250m now within avalanche zone as described in report.

From GPS #82 +200m to GPS #82 + 650m: alternating subtle ridges and swales, latter commonly 40m – 50m breadth with 12° - 15° inverts↓, ridges variable 1m – 2m heights, apparently boulder rubble composition, ridges are narrow topped (5m – 6m max), downslope faces commonly 18° - 23°, most apparently terminate thus locally, probable limit of historical avalanching locally: Locally seral Spruce with Alnus plus False Azalea. Cut 53° through ridges, strip alignment through swales and blade fills across from either direction as required, keep fills to 38° or less, Adapt profile as necessary for penstock installation.

GPS # 82 + 650m = GPS #77 + ~ 1,350m:

From GPS #77+1,350m – GPS 77 + 1,450m, locally sand/boulder colluvial veneer over tills, open seral Spruce – Balsam, wetter, occasional Cow Parsnip, local sand may be useful as pipe bedding for penstock installation. Reduce cuts to 38°, keep fills at 30° - 33° over stripped subgrade.

GPS #77 + 1,450m – Intake Facility: drier again, Juniper, Rangifer Lichen, Low Bush Blueberry, boulder rubble plus sands as veneers, cut and fill 45° and 33° respectively.

3.2.2 Top Spur Penstock Access:

POC: departs left and down from Intake Access Road, initial descent on 38° pitch to 15° bench estimated 9m – 11m below... bench is broad, with dozer, blade full bench cut down alignment and ramp out onto bench area below, thus no end haul required, finish cuts to 53°, some bedrock likely present within cut depth.

From acquired bench to POT at Penstock Alignment, easy bench variable 5° - 18°, cut and fill as required for construction, then deactivate as per geotechnical engineer's prescription.

3.2.3 Middle and Lower Penstock Access Spurs

Similar benches over proposed lengths, cut and fill as required for construction period access then deactivate as per geotechnical engineer's prescription.

3.2.4 Powerhouse Spur Access Road

POC – 0+120: reasonable bench or slopes to 26°, either tills or glaciofluvial fan sediments (granular), Cut 45°, fill 38° over stripped subgrade, 0+120 – POT at Powerhouse: running basically along contour on draped glaciofluvial or eroded till front $\frac{({}_{sg}F^{G}/M)_{ks}}{R}$ inventory classification,

Slopes below are a short steep pitch directly into channel. Manually slash 1.2m width trail along centreline then conduct shallow seismic geophysics to map top of underlying rock. Based on results prescribe construction geometry or determine necessity for retaining walls and provide analysis and specifications for construction.

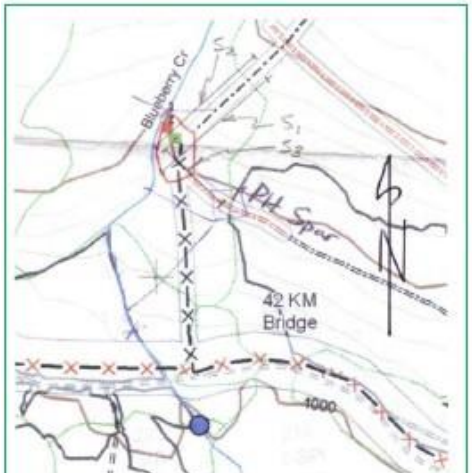

FIGURE 3: GEOPHONE SPREADS
SCALE 1:10,000

3.3 Powerhouse

As with the final interval of the Powerhouse Access Spur Road, the powerhouse location resides on steeply pitching draped glaciofluvial soils and/or on eroded till fronts facing the channel. From the field review it is judged that finished grade at the powerhouse would be approximately 8m± elevation above the local highwater mark on Blueberry Creek channel. There is visible massive outcropping rock below the noted finished grade elevation. Slopes above rise steeply as previously described for some 75m+ of slope length and showing aspect 258°. This ground line will require that supported cuts be designed to varied extents dependent on the presence and proximity of bedrock with increasing elevation. The current slope geometry is such that adequate design cannot proceed until the precise soil stratigraphy, soil rock interface and rock surface isopach are known with certainty. It will not be acceptable to open preliminary excavations and thence proceed dependent on what is revealed. The rock profile must be known beforehand.

Te determine the rock surface, shallow seismic geophysics techniques can be used in two parallel spreads trending directly up the steepest slope direction (azimuth 078° based on the opposing measured downslope aspect), and commencing at the 1/3 points along the length (azimuth 348°), of the proposed powerhouse and peripheral yard/parking footprint. To conduct this exercise, complete the following preparations:

1. check and determine precise aspects of the slope above the powerhouse and upslope to a point where the flattening repose develops and persists, and faces generally azimuth 210° (also as previously described),
2. slash 1.2m breadth trails up the indicated geophone lines from Figure 3 (and also along the final access road length as shown),
3. complete detailed topographic surveys on all three trails sufficient to produce ½m contours at say 1:500 scale,
4. hire a geophysics consultant to complete the shallow seismic field work and concomitant analysis and reporting (we recommend Frontier Geoscience Ltd, with whom we have worked several times over the last fifteen years)

5. submit completed geophysics report to geotechnical engineer who then completes site design with tied back pile walls, cantilever walls and all other necessary foundation design and layout, plus soil dynamics and drawings for construction.

Soil dynamics analysis is required because there will be heavy turbine facilities revolving at high RPM and such must be accounted for in foundation analysis.

We have contacted our colleagues at Frontier Geoscience and requested a preliminary ball park cost for the above geophysics exercise. Upon authorization to proceed, further details and precise costs can be determined.

It is recommended that the above seismic lays (Figure 3: s_1, s_2, s_3), be reviewed by the geotechnical engineer for satisfactory alignments prior to commencing survey exercises and slashing for trails. Based on Figure 3, the seismic spreads are approximately 590m total length for the three spreads.

3.4 Penstock

The penstock route as presently laid out has no untenable problems with respect to landscape hazards or geotechnical engineering. A couple of matters however; require some discussion as follows.

3.4.1 Entrenchment Depth Through Avalanched zone

For the avalanched zone present in the Upper Development Reach (discussed above), the site history indicates that avalanche events commonly stop in approximately the upper half of slope length of the long continuous colluvial apron there present. One interval indicates however; that runout lengths of historical avalanche events have reached and crossed Blueberry channel. It should therefore be acknowledged that the observed shallow scouring over this interval should be accounted over the complete length of the upper development reach.

The pipeline design consultant will determine his penstock profile on the basis of:

- topographic survey along the alignment from the intake to the powerhouse and also,
- any requirements or constraints on the slope of the energy grade line,
- any requirements or constraints on the slope of the hydraulic grade line
- the net energy losses incurred along the length of the penstock
- the total head in the system due to elevation, pressure and velocity

He will subsequently determine pipe section specifications based on this data and confining pressure that he can use by installing a buried pipe lay at some suitable depth. For the avalanche interval subject to scour losses of trench backfill and adjacent insitu overburden, and the consequent loss of overlying confining pressure, a minimum additional 0.6m entrenchment depth is currently recommended over and above that which would provide adequate cover where no losses due to scour processes could occur. This matter should be discussed between the geotechnical engineer and the pipeline engineer, the latter being quite likely to have salient experience in this regard.

3.4.2 Alignment on Final Steep Descent Leg to Powerhouse

The present layout has the route descending the steep cross slopes of the ridge feature on the final 80m – 100m of descent to the powerhouse. This is not a favourable location for construction or post installation backfilling and conduit immobility over the long term. Locally over this interval the current alignment should be very precisely located via GPS exercises, thence picked up (digitally), and moved a minimum 8m, perhaps ten metres southeasterly, ie a direct longitudinal translation of the complete leg perpendicularly away southeasterly. This will result in the adjusted alignment being located more directly atop the descending crown line of the ridged topography, a much more favourable location. This translation of the alignment should not affect the required location of the powerhouse, rather alterations to its floor plan and exact locations of the turbine etc within the structure can be adjusted.

3.4.3 Thrust Blocks and Anchors

Thrust blocks and/or anchor blocks for the penstock may be required at numerous locations as a function of the pipeline consultant's analysis and design. Such blocks work on the principle of soil confining pressure, anchoring lengths in soil or rock or passive wedge theory for soils acting against the trailing face of the block. Once varied consultants determine the locations and forces that will be acting on such blocks, appropriate geotechnical input can be worked out and conveyed to the pipeline design consultant.

3.5 Aggregate

Large volumes of quality aggregate for pipe bedding, trench backfill and numerous other uses will be required for this project. The existing borrow pit near the Holmes FSR bridge across Blueberry Creek can likely provide sufficient quality and volume of material. Some sampling of the current pit face should be completed by the geotechnical engineer when a backhoe is available at the site. In this way representative samples can be retrieved from the undisturbed depths behind the face. Retrieving samples from the ravelled wedge of material now covering the undisturbed portions of the deposit will not provide sufficiently representative samples to determine appropriate processing measures for the material for varied uses.

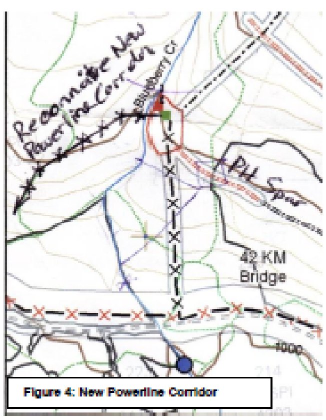

Figure 4: New Powerline Corridor

3.6 Transmission Line

As previously discussed, a long straight transmission line corridor in the down-fan direction is not desirable with respect to landscape management generally nor with associated risk management tactics. It is judged that a more appropriate route can be suitably reconnoitred along the general direction as suggested in Figure 4, ie, an initial short leg westerly, then descend to the main valley route via stable forested regimes beyond the limit of the Blueberry Creek fan. Reconnoitre a new route consistent with the general direction shown on Figure 4.

4.0 CLOSURE

It is believed that the information presented herein is complete and consistent with your present expectations.

If you have any questions or require further information, please call the writer.

This report dated June 23, 2009 and labelled 2271 has been prepared exclusively for Holmes Hydro Inc., and its agents.

Yours truly,

Firth Hollin Resource Science Corp.

Len Ginnever, P.Eng.

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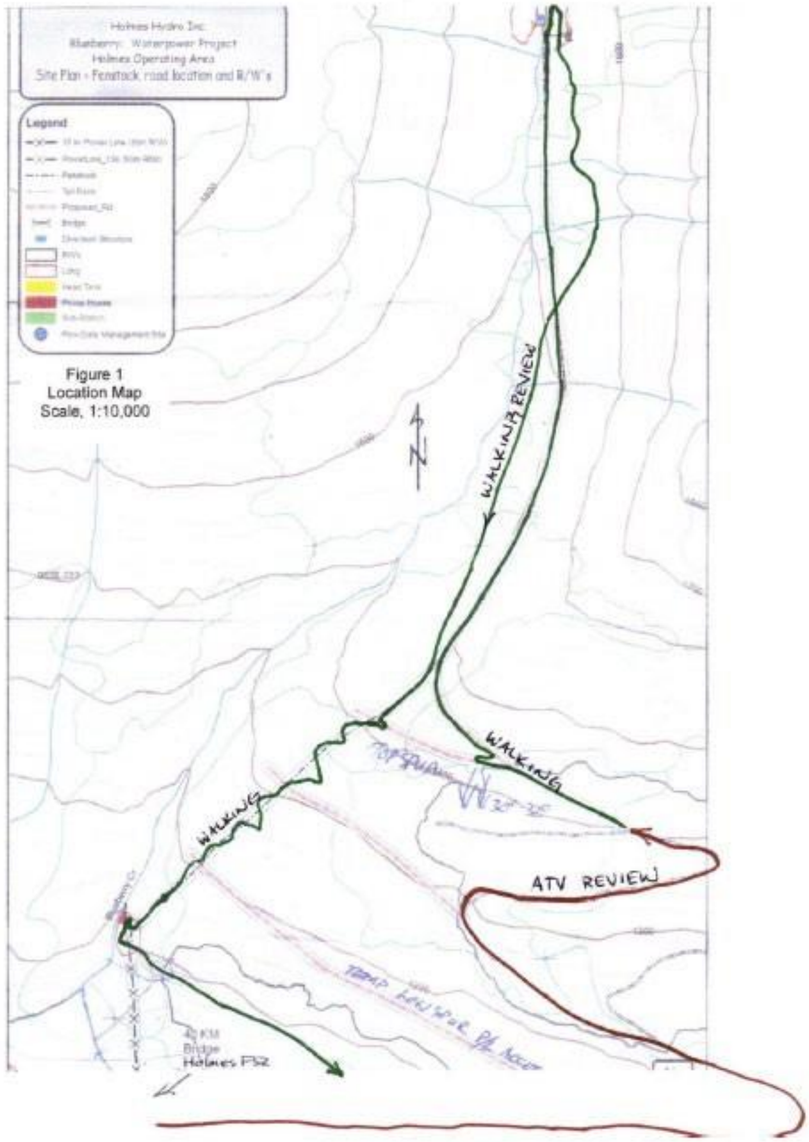

Figure 1
Location Map
Scale, 1:10,000

Appendix One: Definitions

For reporting purposes the following definitions are used:

- "hazard" or "hazard for landslide occurrence" refers to the likelihood of landslide initiation under development impacts or in the natural condition as the case may be…. Hazard ratings can be low, moderate or high. Some examples are: A) a cut and fill road across moderately reposed sidehill terrain is given a specific hazard of low, moderate or high, dependent on soil properties, seepage conditions or other site attributes; B) a proposal to clear cut a steep slope with high lead rigging may be assigned a hazard for the post harvest condition… in the sense that the clear cut condition may affect the stability of the slope, or gouging or scarring due to poor deflection or tower locations may affect the slope and lead to instability; C) a natural slope that is to remain natural but is located below proposed developments may be affected due to the developments upslope and so may locally experience increased hazards due to the developments above.
- "consequence" refers to the type, extent or nature of damage that may result from a landslide, and specifically, which landscape features or improvements may be affected. Consequence ratings are low, moderate or high.
- "risk" refers to the combined result of hazard and consequence ratings and is commonly expressed as the product Hazard X Consequence = Risk. Four risk ratings arise as follows:

<u>Hazard x Consequence = Risk</u>

1: high x high = very high
2: high x moderate = high
3: high x low = moderate
4: moderate x moderate = moderate
5: moderate x low = low
6: low x low = low

The hazard times consequence products are commutative.

Statement of Limitations

The criteria or recommendations promulgated in this report were compiled on the basis of cursory site reviews and/or interpretive skills on aerial photographs. It is possible that landscape and/or soil, moisture, slope or other conditions may be different than those elucidated herein. It is recommended that in the event that conditions different from those herein elucidated are found, that Firth Hollin Resource Science Corp be apprised of the new or different conditions so that it may review its criteria and/or recommendations in the context of the changed conditions and make amendments as necessary.

This report may contain recommendations for additional research, investigation, site reviews, laboratory testing, mechanized geotechnical investigation, sample retrieval, engineering analysis or design, or other requirements, which if not prudently acted upon, relieve Firth Hollin Resource Science Corp of all liability for consequent and/or subsequent problems that may have been avoided had the recommendations been appropriately heeded.

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Appendix E – Cover Letter for Hydrologic Review and Energy Production Report

JEM ENERGY LTD.

16779 Mapletree Close
Vancouver, BC, Canada V4N 5L5
Main: 604.581.4750
Fax: 604.580.5763

November 26, 2008

File No.: 2007-02, 27

True North Energy
30 Catherine Avenue
Aurora, ON
L4G 1K5

Attention: George Steeves, P.Eng.

Dear Sir:

Re: Holmes Hydro Hydroelectric Power Projects
Hydrologic Review and Energy Production

Please find attached a digital copy of the Hydrologic Review and Energy Production Report for the Holmes Hydro Hydroelectric Power Projects.

If you have any further questions, please do not hesitate to contact the undersigned.

Sincerely,

Jennifer McCash

Jennifer McCash, P.Eng.

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Encl.