

Columbia River Project Water Use Plan

Arrow Lakes Reservoir Wildlife Management Plan

Arrow Lakes Reservoir: Implementation of Wildlife Physical Works

Implementation Year 2

Reference: CLBWORKS-30

Site 6A – Airport Outflow – As Built Report

**Golder Associates
Watson Engineering Ltd.**

February 12, 2014



February 12, 2014

SITE 6A - AIRPORT OUTFLOW

As Built Report for Arrow Lakes Wildlife Physical Works

Submitted to:

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BC Hydro
Project Delivery
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Burnaby, BC V3N 4X8



REPORT



Report Number: 1314340002-001-R-Rev0

Distribution:

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WATSON ENGINEERING
LTD.



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This Report was prepared for the exclusive use by BC Hydro, the Proponent and owner of the proposed works, and describes the as-built conditions following the construction of the Wildlife Physical Works, Site 6a Airport located within the Arrow Lakes Reservoir (the Project).

In preparing this report, Golder Associates Ltd. (Golder) has relied on information provided by BC Hydro. Golder accepts no responsibility for any deficiency or inaccuracy contained in this document as a result of our reliance on the aforementioned information.

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Results from Analysis of Rock Samples



1.0 INTRODUCTION

Construction of the Hugh Keenleyside Dam in 1968 resulted in the impoundment of the Arrow Lakes, establishing the present day reservoir. The importance of the area known as Revelstoke Reach to wildlife has been well documented (Golder 2009, 2009b, Jarvis and Woods 2001, CBA 2011a, CBA 2011b, CBA 2011c, Hawkes et al 2010). Historical information suggests that pre-impoundment conditions at the delta formed by the Columbia River where it met Upper Arrow Lake may have once been an important staging area for migratory birds.

The impoundment of the Arrow Lakes effectively moved this delta-like habitat farther upstream in the watershed to the flat floodplain of Revelstoke Reach. Revegetation of unvegetated barren floodplain as part of BC Hydro's dust control program within Revelstoke Reach has made the floodplain more productive habitat. A variety of aquatic and terrestrial animals utilize this habitat for breeding and rearing, including herptiles and resident and migratory waterbirds (Golder 2009a, 2009b, CBA 2011a, CBA 2011b, CBA 2011c, Hawkes et al 2010).

The Columbia River Water Use Plan (WUP) was developed as a result of a multi-stakeholder consultative process to determine how to manage the operations of BC Hydro's Mica, Revelstoke, and Keenleyside facilities (reservoirs and dams). The goal of the WUP is to accommodate environmental, recreation, power generation, culture/heritage, navigation, and flood control interests for the Columbia River; either through incremental changes to how water control facilities store and release water, or to undertake physical works in lieu of changes to reservoir operations to meet the specific interests. During the WUP, the Consultation Committee supported the implementation of wildlife physical works in the mid-Columbia River in lieu of changes to reservoir operations to help mitigate the impact of Arrow Lakes Reservoir operations on wildlife and wildlife habitat.

Construction of these Wildlife Physical Works (WPW), detailed herein, was the culmination of a multi phased study involving review and assessment of the forty-four sites originally identified in the Columbia River Water Use Plan (WUP 2005) in the context of risks, feasibility, planning, and public consultation (Golder 2009a). Previous phases involved detailed site prescriptions for select sites, acquiring permits from regulators for the construction of these projects, and development of Issued for Construction Drawings (Golder 2013).

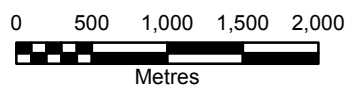
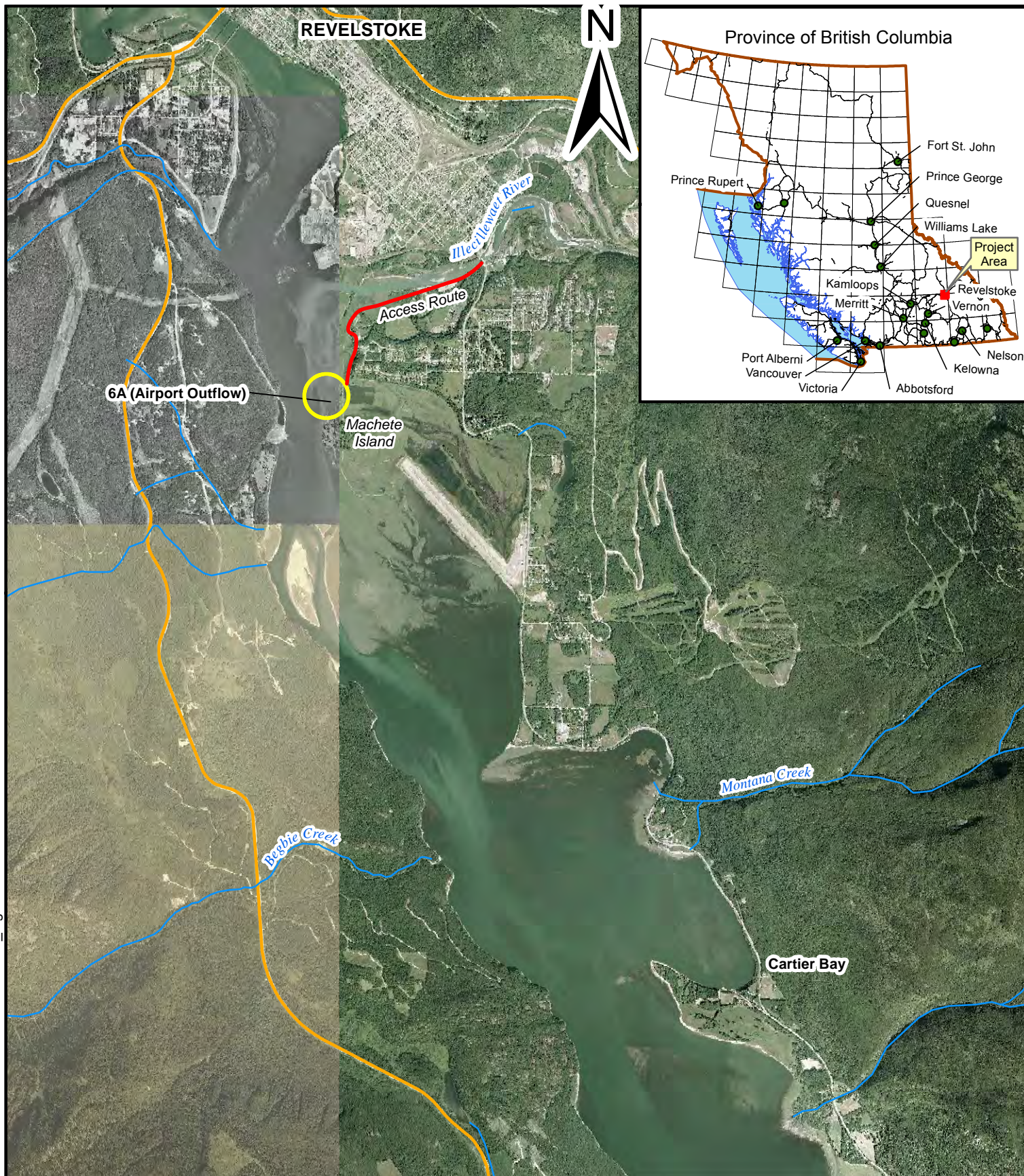
Construction of these WPW was proposed in lieu of changes to the operating regime of the reservoir, as it will provide and/or protect habitat that can be utilized by various wildlife species when the drawdown area is not inundated.

2.0 PROJECT AREA DESCRIPTION

Site 6A, which BC Hydro completed in 2013, is located along the eastern shore of the main channel of the Columbia River south of Revelstoke, BC (Figure 1). The site is within a section of the Columbia River known as Revelstoke Reach, a 40 km long section of the Columbia River flowing north to south from Revelstoke Dam to the historical town site of Arrowhead on the Upper Arrow Lake.

Site 6A is a small 0.18 hectare erosion channel located 3.8 km downstream of the Highway 1 bridge crossing the Columbia River near the City of Revelstoke (Table 1). The site is located ~125 m west of a deactivated road (formerly the Arrowhead Highway), and north west of Machete Island (Figure 2). The channel begins at the north west edge of Machete Island and runs north east towards the Old Arrowhead Highway roadbed before splitting into north east and north west arms. The north west arm is eroding into the surrounding floodplain, whereas the north east arm was eroding towards the old Arrowhead Highway roadbed.

N:\Graphics\2013\1434-0002\DRAWING\GIS\1314340002_Figure 1 6a.mxd



REFERENCE

- Base mapping and detailed air photography provided by client.
- Background ortho photography provided by Province of BC web mapping service.

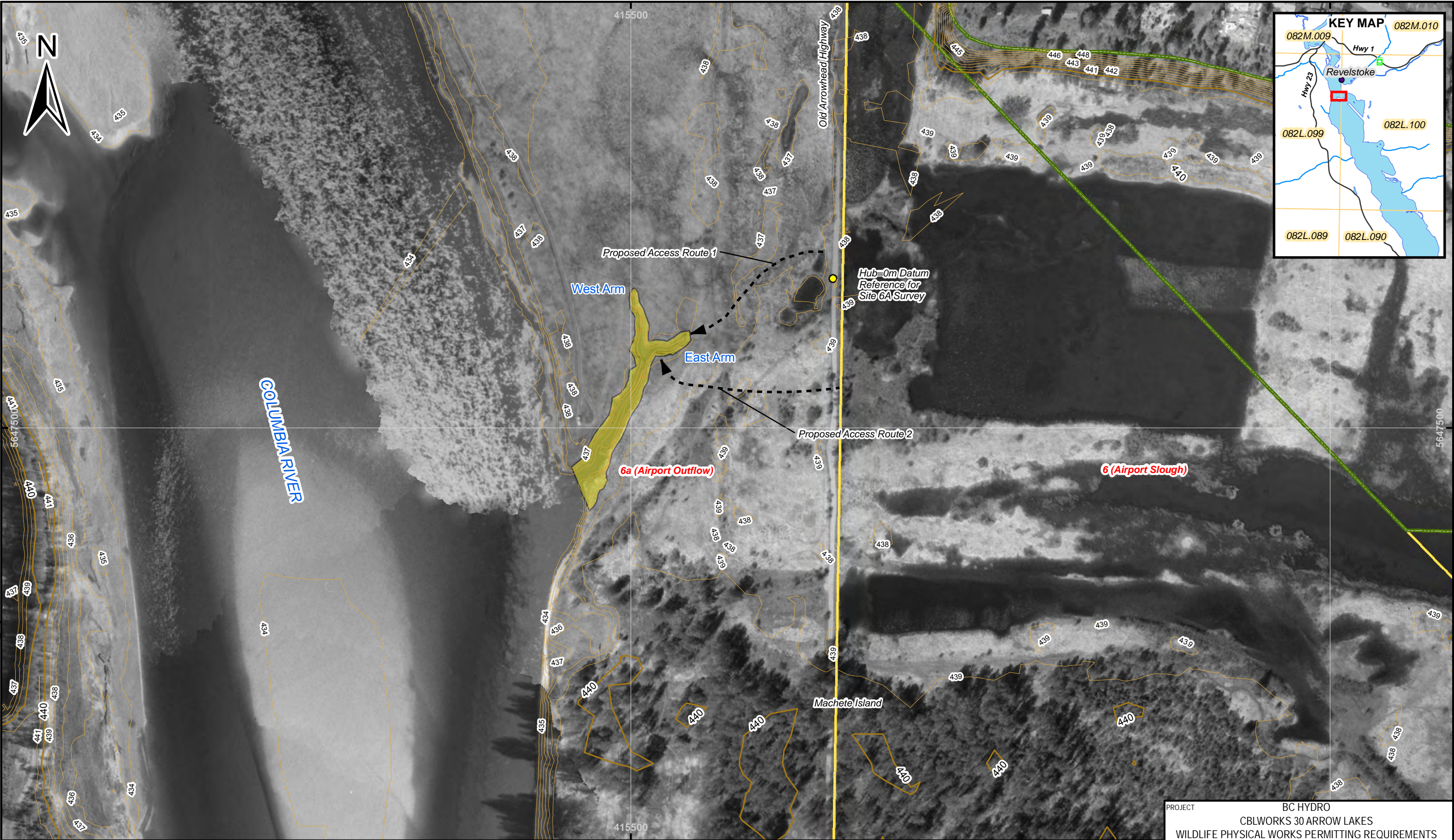
PROJECT BC HYDRO
CBLWORKS 30 ARROW LAKES
WILDLIFE PHYSICAL WORKS PERMITTING REQUIREMENTS
TITLE
**LOCATION OF SITE 6A AIRPORT LAGOON
WITHIN REVELSTOKE REACH**



PROJECT NO.	13-1434-0002	SCALE:	1:50,000	REV.	0
DESIGN	MG	28 NOV. 2012			
GIS	BKL	28 NOV. 2012			
CHECK	MG	12 FEB. 2014			
REVIEW	MT	12 FEB. 2014			

FIGURE: 1

N:\Graphics\2013\1434\13-1434-0002\DRAWING\GIS\1314930002 Figure 2 6a.mxd



Legend

10m Index Contour

1m Contour

Waterbodies

Roads

Feature Captured by Digitized Linework

Feature Captured by GPS Traverse

Feature Extent

Area of Observed Wave Wash

Potential Inundation Area

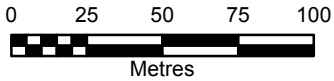
Trimble GPS Points

Property Ownership

- Municipal
- Private

REFERENCE

- Base mapping and airphotos provided by BC Hydro.



PROJECT

BC HYDRO

TITLE

CBLWORKS 30 ARROW LAKES
WILDLIFE PHYSICAL WORKS PERMITTING REQUIREMENTS

SITE 6A AND ASSOCIATED FEATURES

Golder Associates

Kamloops, BC

PROJECT No.	13-1434-0002	SCALE: 1:2,500	REV. 0
DESIGN	MG 28 Nov. 2012		
GIS	BKL 28 Nov. 2012		
CHECK	MG 12 Feb. 2014		
REVIEW	MT 12 Feb. 2014		

FIGURE 2



Table 1: Summary descriptive and location information for Site 6A.

Parameter	Datum
UTM East Channel Head (Zone 11)	415538 (E) 5647555 (N)
UTM Confluence Main Erosion Channel with Columbia River (Zone 11)	415634 (E) 5647556 (N)
Site 6A Channel Bank height (Floodplain Elevation) masl*.	437.4 (Mean), 438.1 (Max), 436.7 (Min).
East Channel Elevations (masl)	434.8 (Mean), 435.4 (Max), 434.6 (Min).
East Channel Invert Elevation	434.6 masl
Approximate Area (ha)	0.18 ha.
Recommended Reservoir Elevation (without coffer dam) for Construction	≤ 434 masl

*masl – metres above sea level

The erosion channel at Site 6A is approximately 120 m long, and occurs in a “Y” configuration with two small channels branching off the main channel (Figure 2). The main channel is approximately 70 m in length and each of the two arms is 40 – 45 m in length. The width of the main channel varies from 25 m near its confluence with the Columbia River to 18 m where the north east and north west arms meet. The north east and north west arms vary between 5 m and 11 m wide. The main channel at its confluence with the Columbia River is approximately 4.5 m (~432.5 masl) below the surrounding grasslands and rises approximately 2.0 m to the point where it branches into the smaller north east and north west channels. Recent GPS surveys in the fall of 2012 indicate the grasslands surrounding the channel have an average elevation of 437.4 masl and the mean elevation of the east channel is approximately 434.8 masl.

3.0 CONSTRUCTION SPECIFICATIONS

Site 6A was constructed in the fall of 2013. As Built Drawings 212-C22-00050 through to 212-C22-00053, are provided in Appendix A.

3.1 GENERAL

- 1) A contract to construct the physical works in the north east erosion channel was awarded by BC Hydro to Landmark Contracting Ltd. through Yucwmenlúcwu (Caretakers of the Land) in August of 2013.
- 2) Watson Engineering Ltd. (WEL), acting as sub-consultant to Golder Associates Ltd. (Golder), originally visited and surveyed Site 6A in 2009.
- 3) WEL and Golder provided technical specifications, including a preliminary design and cost estimate for construction of Site 6A to BC Hydro in 2009 (Golder 2009).
- 4) The original survey was completed to a local elevation datum which was subsequently modified to Geodatic from a resurvey of Site 6A using a survey grade real time kinetic (RTK) GPS unit in 2012.
- 5) WEL and Golder updated preliminary drawings and construction specifications into Issue for Construction format, submitted to BC Hydro in January of 2013 (Golder 2013).
- 6) The intent was to carry out the works in Spring 2013; however, due to river/lake water levels the work was not carried out until Fall 2013.



- 7) Small modifications were made to WEL specifications in the contract document for the work including the following:
 - a. Isolation of the work area in the contractual document specified use of a sheet pile coffer dam as this was considered the most environmentally prudent means of isolation.
 - b. An on-site survey of the grubbed area and final constructed structure was not employed as a means of measuring the volume of delivered rip rap. Instead a truck count based upon a mutually agreed upon load size of 8 m³/truck, was used to estimate the quantity of delivered rip rap.
- 8) There was some question as to the potential Acid Rock Drainage (ARD) characteristics of both the Rip-Rap and Granular Filter Blanket Materials (Section 3.3). Just prior to the start of work in the field, based on lab results, it was learned that the proposed Granular Filter Blanket Materials, which were to be mixed on a 50/50 basis with the rip-rap, were inappropriate for use in an aquatic setting due to potential for metal leachate in a non-acid environment. A request was made to replace the Granular Filter Blanket Materials with 100% Rip-Rap over a layer of geotextile. WEL and Golder agreed to the 100% Rip-Rap over two layers of Amoco 4553 filter fabric, or an approved equivalent. Due to availability and time restraints WEL and Golder agreed to use Mirafi 180 N filter fabric.

3.2 CONSTRUCTION

Construction was basically carried out in two stages, determined by the availability of equipment. The Contractor made extensive use of wood swamp mats to minimize the impact of the work on the underlying grass cover (Appendix B - Photographs 1 to 18).

3.2.1 Stage 1

- 1) Stage 1 involved the driving of a temporary steel sheet pile cofferdam, in place of the earthen cofferdam originally proposed by WEL, across the downstream end of the north east erosion channel adjacent to its confluence with the main erosion channel. The intent of the temporary cofferdam was to allow the work in the north east erosion channel to continue without becoming inundated should the river/lake water level suddenly increase due to discharges from the Revelstoke Generating Station upstream. Final design of the coffer dam was completed by the contractor, based upon design specifications of a Professional Engineer retained by Landmark Contracting Ltd.
- 2) The field work for Stage 1 was carried out on September 19 and on September 23 and 24, 2013.

3.2.2 Stage 2

Stage two involved the balance of the work, which included the following:

- 1) Excavating soft muck like materials from the north east erosion channel and offsite disposal.
- 2) Peeling back the tangled grass with its topsoil bed from around the top of the north east erosion channel perimeter.



- 3) Placing and pinning down the two layers of geotextile.
- 4) Placing of 59 loads (472 m³) of rip-rap.
- 5) Pulling the temporary steel sheet pile cofferdam.
- 6) Rolling back the tangled grass and its mat of topsoil.
- 7) General site cleanup.
- 8) The field work for Stage 2 was carried out between October 15 to 18, 2013.
- 9) The work in the field was carried out in an acceptable and efficient manner by a cooperative contractor.

3.3 RESULTS FROM ANALYSIS OF ROCK

A series of four rip-rap (rock) samples and one aggregate sample were collected and forwarded to ALS laboratories for Acid Based Analysis to determine acid rock drainage (ARD) potential (Table 2). Shake flask tests (metal leachate) were also completed on the same samples to determine metal content in the rock relative to BC Water Quality Guidelines for Freshwater Aquatic Life (BCWQG for FAL) (Table 2). Results of analysis of all samples are presented in Appendix C.

Table 2: Summary of rock samples submitted for Acid Based Analysis and Metal Content to ALS laboratories.

Sample Details			Lab Analysis Details			Comments
Name	Description	Source	Certificate No.	Received	Report Date	
Rip-rap	Rip-rap	Jake and Jays	VA13161941	Sept. 4, 2013	Sept. 10, 2013	Forwarded by courier from Jake and Jay's
Sample 1	Pit run	Jake and Jays	VA13167768	Sept. 23, 2013 ⁽¹⁾	Oct. 7, 2013	Provided to M. Galesloot by D. Lingenfelter
Sample 2	Rip-rap	Jake and Jays	VA13167769	Sept. 23, 2013 ⁽¹⁾	Oct. 7, 2013	Collected by M. Galesloot.
Sample 3	Rip-rap	Jake and Jays	VA13167769	Sept. 23, 2013 ⁽¹⁾	Oct. 7, 2013	Collected by M. Galesloot.
Sicamous 1	Rip-rap	Sicamous (B. Oddy)	VA13181490	Oct. 2, 2013	Oct. 15, 2013	Delivered by B. Oddy.

(1) Lost sample. Date of shipment was September 20.

More samples of Jake and Jay's rip-rap were required since the original single rip-rap sample sent on September 4 indicated it had borderline potential for generation of short term acid rock drainage (ARD) due to a low presence of inorganic carbon (carbonate) present in the rock. The availability of such carbonate acts as an additional buffer against the short term flush of ARD after initial placement of the rock. For this reason, Golder did not recommend use of this rock based upon results of a single sample. Provision of additional samples was advised by Golder to better identify potential variability of the ARD potential for Jake and Jay's rip-rap. Unfortunately, analysis of two additional rip-rap samples and a sample of pit run sent to ALS on September 20 were misplaced by ALS, delaying completion of the sample analysis until October 7, 2013. Results from these additional rip-rap samples indicated Samples 2 and 3 had much lower sulphate content than the September 4 rip-rap sample. Samples 2 and 3 also had sufficient carbonate to provide additional neutralization of short term



acid generation from sulphide discharge. Consequently, when averaged over the three rip-rap samples taken from the Jake and Jay's quarry, concerns regarding potential ARD for this rock were alleviated.

Results from the sample of pit run also sent in on September 23, although not ARD generating, did indicate a higher presence of potential leachable metals, including aluminum, which was 54 times that identified in the BCWQG for FAL, chromium which was five times that identified in the BCWQG for FAL, and iron which was 13 times that identified in the BCWQG for FAL. Verification of the leachability of these metals in a non-acid environment required kinetic tests, such as humidity cells which could take as long as a few months to complete. Consequently, the decision was made to replace use of aggregate as a filter blanket, due to the substantial time requirement for further testing, with double layers of Mirafi 180 N geotextile and use only rip-rap for infilling the erosion channel as discussed in Point 8 of Section 3.1.

The final sample of rip-rap (Sicamous 1 shipped on October 2) was sent to ALS while still awaiting the delayed results of the second set of rip-rap samples taken from the Jake and Jay's quarry. The Sicamous 1 rip-rap source had no detectable inorganic carbon in it and hence, it could not be determined if there was enough carbon to buffer the small amount of sulphate in the sample. Additionally, the Sicamous 1 rip-rap sample exceeded BCWQG for FAL for metals similar to those found in the pit run sample provided by Jake and Jay's.

3.3.1 Recommendations

Golder advises that a resample of pit run material from by Jake and Jay's, tested for metal leachate potential, occur. This is to confirm that the material does not present a risk for metal leachate, regardless of its ARD potential. The same material is likely the best available source of aggregate for use in construction of Sites 14 and 15a, scheduled to be constructed in the Spring of 2014, hence the suitability of this material should be confirmed.

The rationale for this recommendation is that only one (1) sample was taken, and multiple (3) samples may provide a better indication of variability between samples, similar to what was done for the Jake and Jay's rip-rap samples. Additionally, there was anecdotal evidence that the bucket the sample that was provided in may have been contaminated (upon opening the sample, a distinct smell of diesel was noted). This potential contamination may have affected the results of the metal leachate sample of the pit run aggregate. Further to this, if results from metal leachate sampling are still unacceptable, then kinetic tests should be considered to verify the metal is bound in the rock and not prone to leaching in a non-acid environment. Kinetic tests can take a period of months; therefore, completion of such sampling is time sensitive in regards to the schedule for potential construction of Sites 14 and 15a.



4.0 CLOSURE

Should you have any questions regarding the material contained within this document, please contact the undersigned 250-828-6116.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Mike Galesloot, B.Sc. R.P.Bio.
Senior Fisheries Biologist

ORIGINAL SIGNED

Matthew Thibeault, P.Eng.
Associate, Senior Geotechnical Engineer

WATSON ENGINEERING LTD.

ORIGINAL SIGNED

John Watson, P.Eng.

MG/MT/JW/tc

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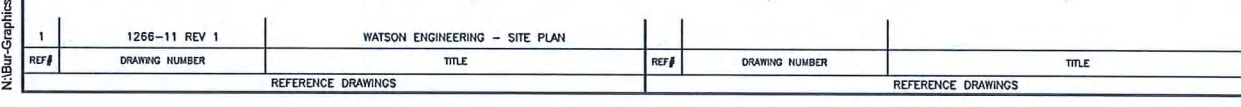
5.0 REFERENCES

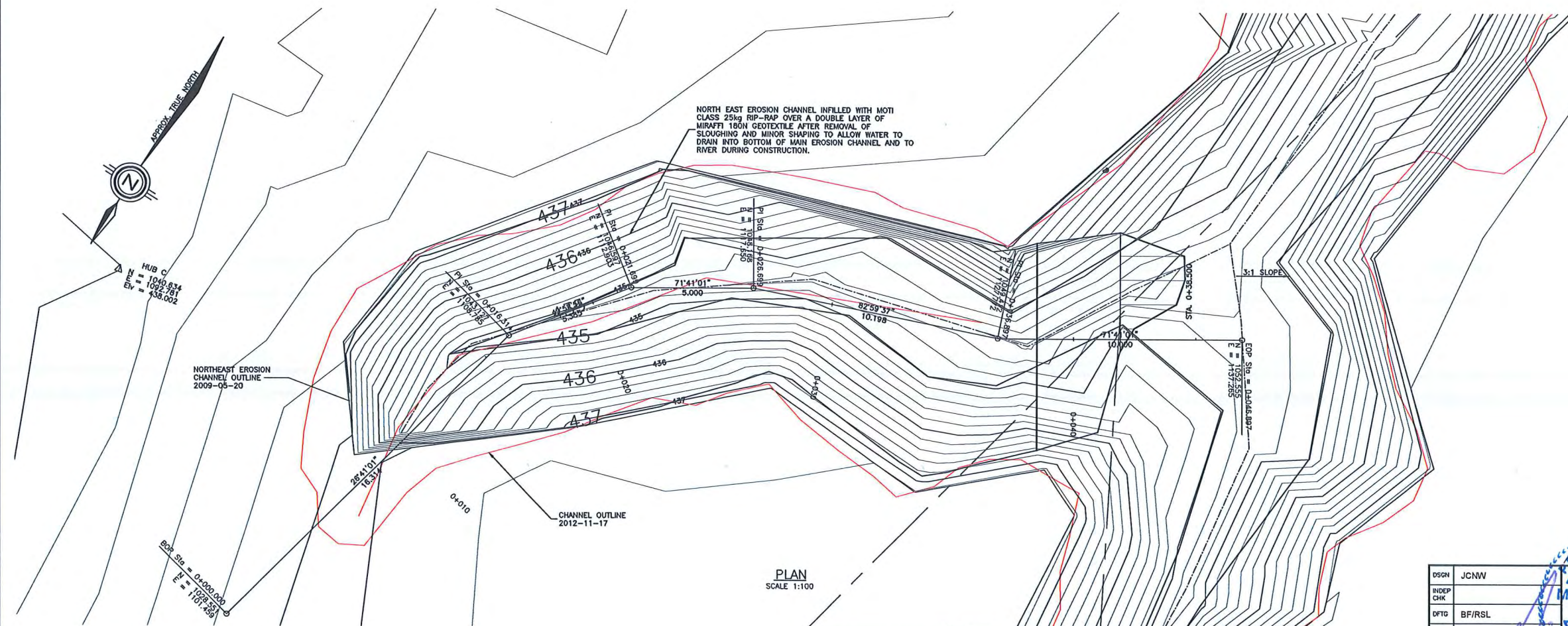
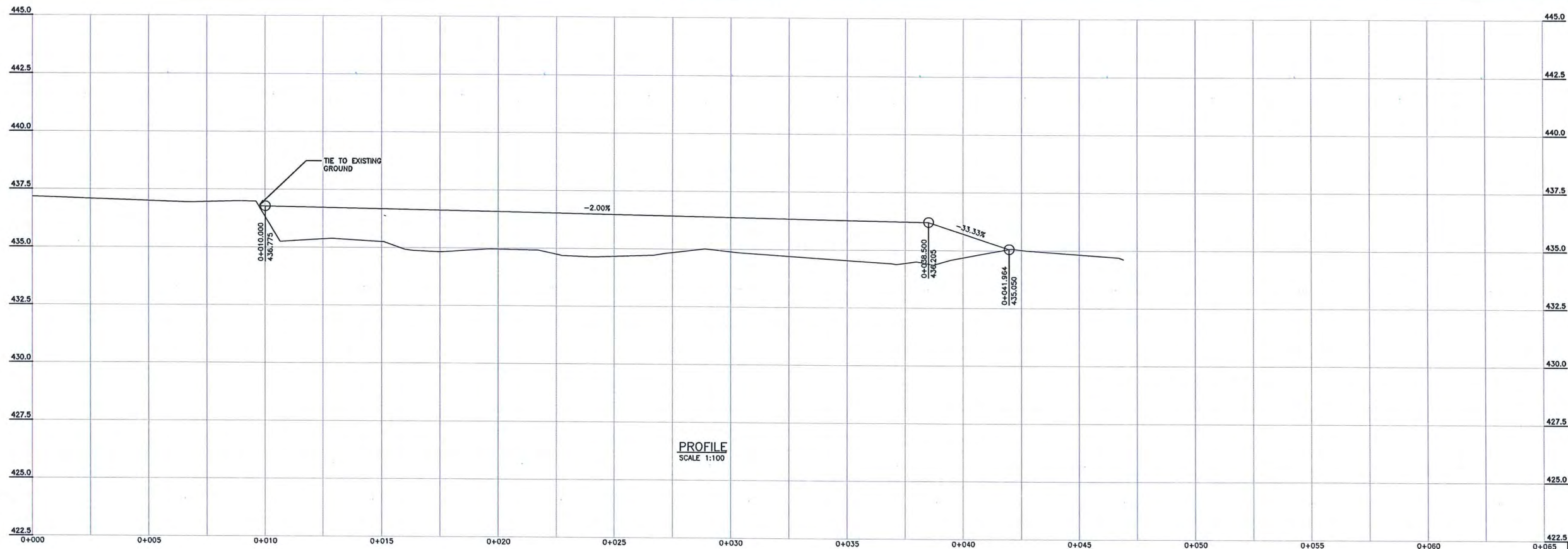
- BC Hydro. 2005. Consultative Committee report: Columbia River Water Use Plan, Volumes 1 and 2. Report prepared for the Columbia River Water Use Plan Consultative Committee by BC Hydro, Burnaby, BC. 924 pp.
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- Golder, 2009b. CLBWORKS-29A - Arrow Lakes Reservoir Wildlife Physical Works Feasibility Study Phase II. Prod. For BC Hydro. Castlegar. Prod. By Golder Associates, Kamloops, BC.
- Hawkes, V.C., and K. Tuttle. 2010. Kinbasket and Arrow Lakes Reservoirs: amphibian and reptile life history and habitat use assessment. Annual Report – 2009. LGL Report EA3075. Unpublished report by LGL Limited environmental research associates, Sidney, B.C., for BC Hydro Generations, Water License Requirements, Burnaby, B.C.
- Jarvis, J. and J. Woods. 2001. Waterbirds of the Revelstoke Reach Wetlands, Upper Arrow Lakes Reservoir, Revelstoke, British Columbia, Canada. Unpublished report for BC Hydro, Burnaby, BC.
- Columbia River Water Use Plan (WUP) Consultative Committee. 2005. Columbia River project water use plan, Arrow Lakes Reservoir wildlife management plan, Physical works terms of reference. BC Hydro, Revelstoke, British Columbia, Canada.



APPENDIX A

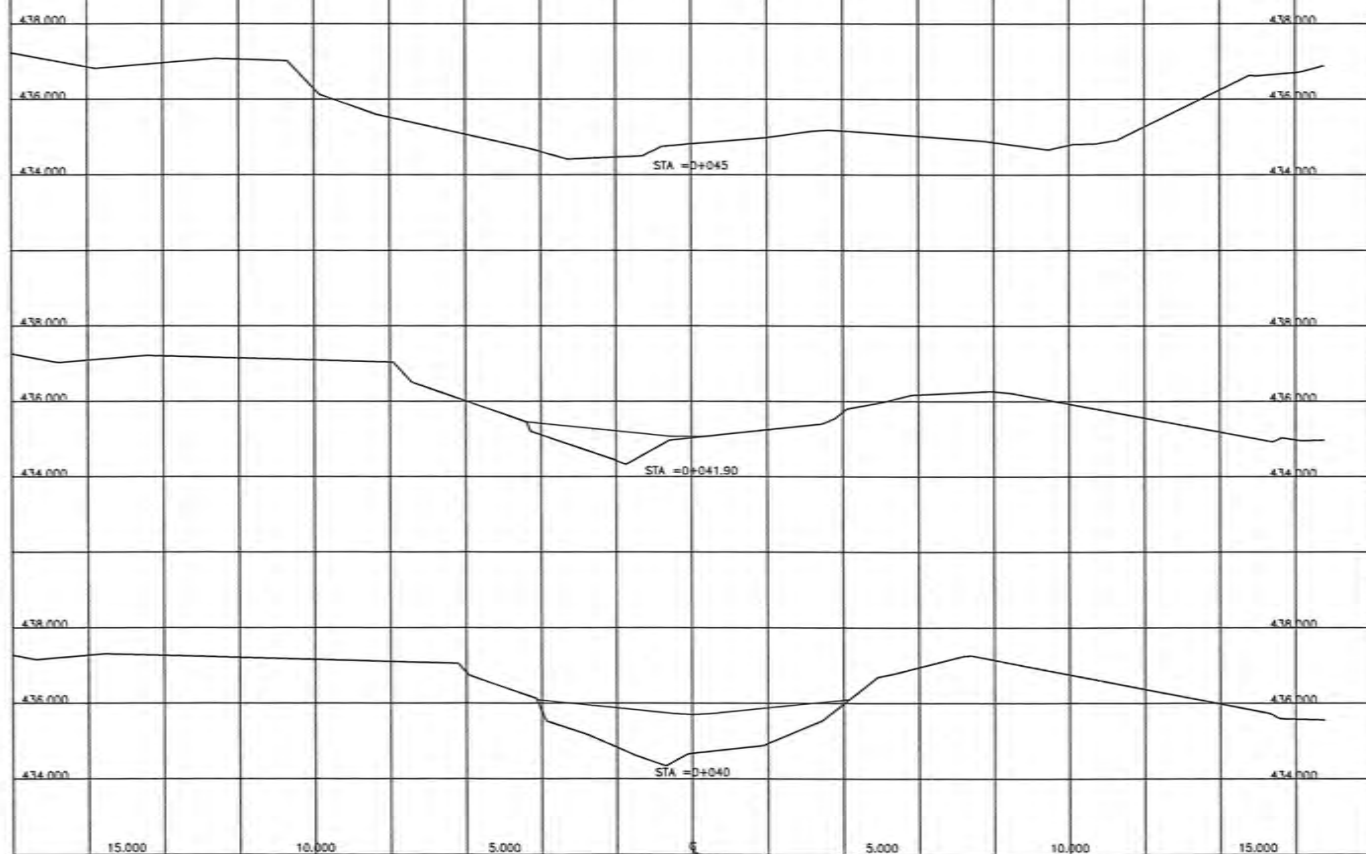
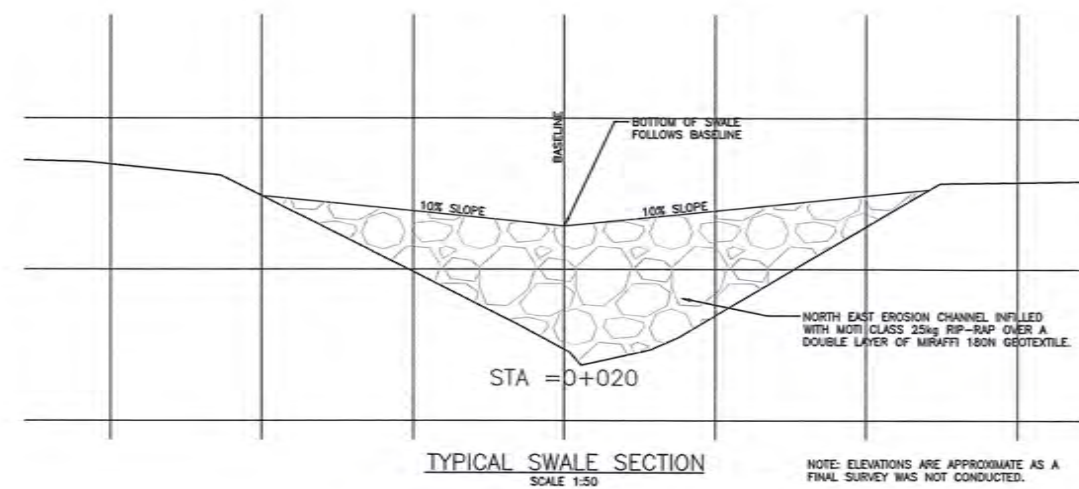
As Built Design Drawings





* BASED ON AVAILABLE INFORMATION.

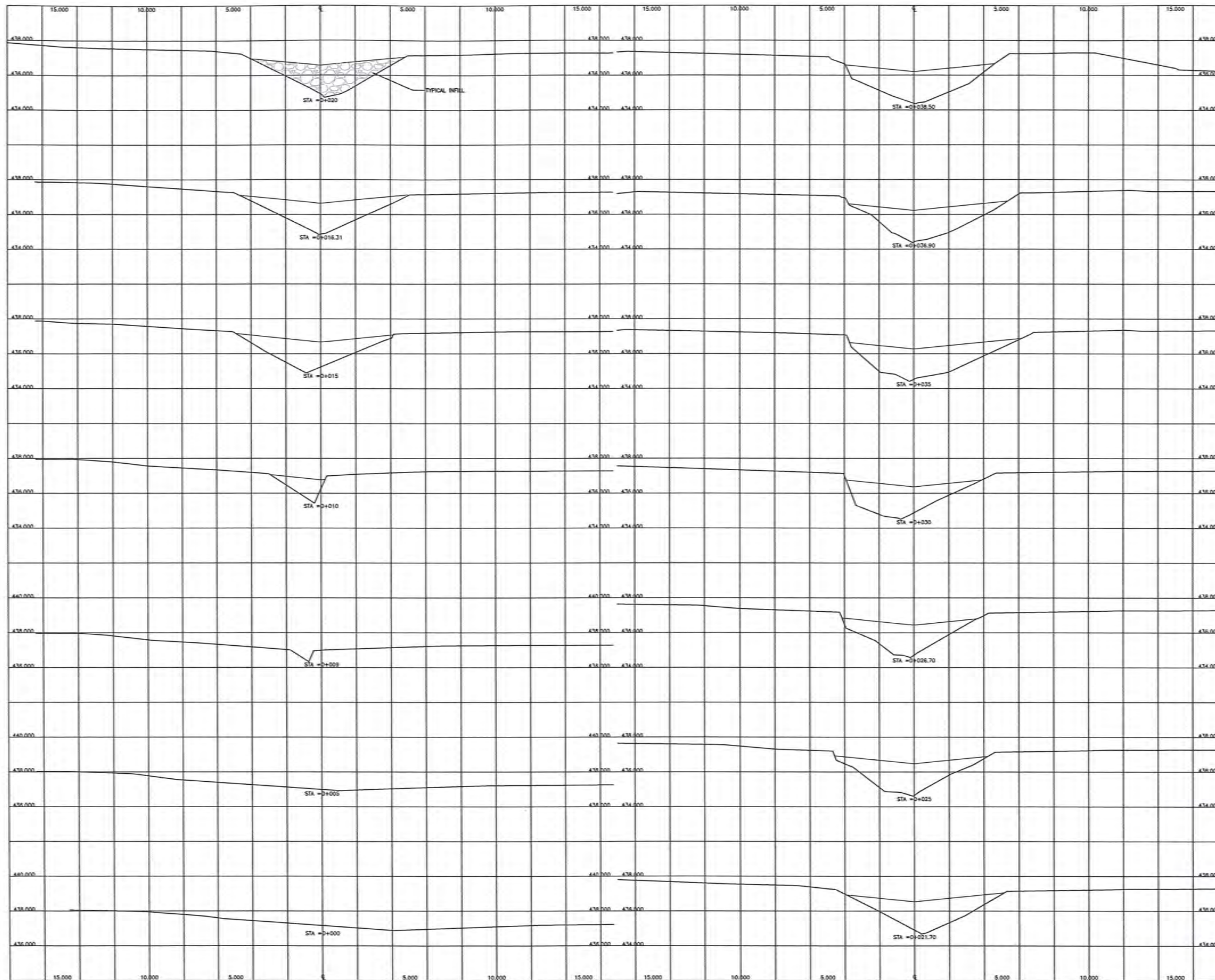
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INDEP	CHK		COLUMBIA RIVER PROJECT WATER USE PLAN																
DFTG	BF/RSL		ARROW LAKES RESERVOIR WILDLIFE PHYSICAL WORKS																
DFTG	CHK		SITE 6A AIRPORT OUTFLOW																
INSP			PLAN, PROFILE																
REV																			
ACPT		DATE	12/11/27	DIST		DWG NO	212-C22-00051									SIZE	D	R	0



SECTIONS
SCALE 1:100

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APPENDIX B

Selected Photographs



APPENDIX B

Selected Photographs of Construction at Site 6A - Airport Outfall



Photograph 1: Muck removed from the channel perimeter, grass stripped off and site prepared for geotextile.



Photograph 2: Commencing placement of geotextile.



APPENDIX B

Selected Photographs of Construction at Site 6A - Airport Outfall



Photograph 3: Placing geotextile.



Photograph 4: Geotextile placement completed.



APPENDIX B

Selected Photographs of Construction at Site 6A - Airport Outfall



Photograph 5: Commencing placement of rip rap.



Photograph 6: First rip rap placed.



APPENDIX B

Selected Photographs of Construction at Site 6A - Airport Outfall



Photograph 7: Placing rip rap continues.



Photograph 8: Most rip rap replaced.



APPENDIX B

Selected Photographs of Construction at Site 6A - Airport Outfall



Photograph 9: Trimming rip rap.



Photograph 10: Trimming rip rap.



APPENDIX B

Selected Photographs of Construction at Site 6A - Airport Outfall



Photograph 11: Completion of trimming rip rap.



Photograph 12: Completed rip rap.



APPENDIX B

Selected Photographs of Construction at Site 6A - Airport Outfall



Photograph 13: Extracting sheet piles.



Photograph 14: Extracting sheet piles.



APPENDIX B

Selected Photographs of Construction at Site 6A - Airport Outfall



Photograph 15: Downstream end of surface rip rap with steel sheet piling removed and removing swamp mats.



Photograph 16: Downstream end of rip rap.



APPENDIX B

Selected Photographs of Construction at Site 6A - Airport Outfall



Photograph 17: Completed rip rap and some removed swamp mats.



Photograph 18: Completed project.



APPENDIX C

Results from Analysis of Rock Samples



ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: GOLDER ASSOCIATES LTD.
500 - 4260 STILL CREEK DR.
BURNABY BC V5C 6C6

Page: 1
Finalized Date: 10- SEP- 2013
Account: HGC

CERTIFICATE VA13161941

Project: 13- 1434- 0002

P.O. No.: 881410- 1417- 6000

This report is for 1 Pulp sample submitted to our lab in Vancouver, BC, Canada on 4- SEP- 2013.

The following have access to data associated with this certificate:

ANETT BRIGGS

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
LOG- 24	Pulp Login - Rcd w/o Barcode

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION
OA- VOL08	Basic Acid Base Accounting
S- IR08	Total Sulphur (Leco) LECO
OA- ELE07	Paste pH
S- GRA06	Sulfate Sulfur- carbonate leach WST- SEQ
S- IR07	Sulphide Sulphur (Leco) LECO
C- GAS05	Inorganic Carbon (CO2)
S- GRA06a	Sulfate Sulfur (HCl leachable) WST- SEQ

To: GOLDER ASSOCIATES LTD.
ATTN: ANETT BRIGGS
500 - 4260 STILL CREEK DR.
BURNABY BC V5C 6C6

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



ALS Canada Ltd.
 2103 Dollarton Hwy
 North Vancouver BC V7H 0A7
 Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: GOLDER ASSOCIATES LTD.
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 BURNABY BC V5C 6C6

Page: 2 - A
 Total # Pages: 2 (A)
 Plus Appendix Pages
 Finalized Date: 10- SEP- 2013
 Account: HGC

Project: 13- 1434- 0002

CERTIFICATE OF ANALYSIS VA13161941

Sample Description	Method Analyte Units LOR	WEI- 21 Recvd Wt. kg 0.02	OA- VOL08 FIZZ RAT Unity 1	OA- VOL08 MPA tCaCO3/1000 0.3	OA- VOL08 NNP tCaCO3/1000 1	OA- VOL08 NP tCaCO3/1000 1	OA- ELE07 pH Unity 0.1	OA- VOL08 Ratio (N) Unity 0.01	S- IR08 S % 0.01	S- GRA06 S % 0.01	S- GRA06a S % 0.01	S- IR07 Sulphide % 0.01	C- GAS05 C % 0.05	C- GAS05 CO2 % 0.2
Rip Rap		0.44	2	14.1	23	37	8.5	2.63	0.45	0.02	<0.01	0.34	0.22	0.8



ALS Canada Ltd.

2103 Dollarton Hwy
North Vancouver BC V7H 0A7

Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: GOLDER ASSOCIATES LTD.
500 - 4260 STILL CREEK DR.
BURNABY BC V5C 6C6

Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 10- SEP- 2013
Account: HGC

Project: 13- 1434- 0002

CERTIFICATE OF ANALYSIS VA13161941

CERTIFICATE COMMENTS

LABORATORY ADDRESSES

Applies to Method:

Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C- GAS05

LOG- 24

OA- ELE07

OA- VOL08

S- GRA06

S- GRA06a

S- IR07

S- IR08

WEI- 21



GOLDER ASSOCIATES LTD.
ATTN: Anette Briggs
500 - 4260 Still Creek Drive
Burnaby BC V5C 6C6

Date Received: 03-SEP-13
Report Date: 16-SEP-13 13:52 (MT)
Version: FINAL

Client Phone: 604-298-6623

Certificate of Analysis

Lab Work Order #: L1357013
Project P.O. #: 881410-1417-6000
Job Reference: 13-1434-0002
C of C Numbers:
Legal Site Desc:

Amber Springer
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID Description Sampled Date Sampled Time Client ID	L1357013-1 Other 29-AUG-13 RIP RAP				
Grouping	Analyte						
SOIL							
Physical Tests	Moisture (%)	<0.25					
Leachable Anions & Nutrients	pH (pH)	9.01					
Leachable Metals	Aluminum (Al)-Leachable (mg/L)	1.30					
	Antimony (Sb)-Leachable (mg/L)	0.00010					
	Arsenic (As)-Leachable (mg/L)	<0.0010					
	Barium (Ba)-Leachable (mg/L)	0.0087					
	Beryllium (Be)-Leachable (mg/L)	<0.00050					
	Bismuth (Bi)-Leachable (mg/L)	<0.00050					
	Boron (B)-Leachable (mg/L)	0.013					
	Cadmium (Cd)-Leachable (mg/L)	<0.000050					
	Calcium (Ca)-Leachable (mg/L)	7.47					
	Chromium (Cr)-Leachable (mg/L)	0.00065					
	Cobalt (Co)-Leachable (mg/L)	0.00010					
	Copper (Cu)-Leachable (mg/L)	<0.0010					
	Iron (Fe)-Leachable (mg/L)	0.257					
	Lead (Pb)-Leachable (mg/L)	0.00013					
	Lithium (Li)-Leachable (mg/L)	0.0092					
	Magnesium (Mg)-Leachable (mg/L)	0.753					
	Manganese (Mn)-Leachable (mg/L)	0.00323					
	Mercury (Hg)-Leachable (mg/L)	<0.000050					
	Molybdenum (Mo)-Leachable (mg/L)	0.00274					
	Nickel (Ni)-Leachable (mg/L)	<0.00050					
	Phosphorus (P)-Leachable (mg/L)	<0.30					
	Potassium (K)-Leachable (mg/L)	19.7					
	Selenium (Se)-Leachable (mg/L)	<0.00050					
	Silicon (Si)-Leachable (mg/L)	2.65					
	Silver (Ag)-Leachable (mg/L)	<0.000050					
	Sodium (Na)-Leachable (mg/L)	4.14					
	Strontium (Sr)-Leachable (mg/L)	0.0443					
	Thallium (Tl)-Leachable (mg/L)	<0.00010					
	Tin (Sn)-Leachable (mg/L)	<0.00050					
	Titanium (Ti)-Leachable (mg/L)	0.021					
	Uranium (U)-Leachable (mg/L)	0.000251					
	Vanadium (V)-Leachable (mg/L)	0.0095					
	Zinc (Zn)-Leachable (mg/L)	<0.010					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Silicon (Si)-Leachable	MS-B	L1357013-1
Matrix Spike	Calcium (Ca)-Leachable	MS-B	L1357013-1
Matrix Spike	Magnesium (Mg)-Leachable	MS-B	L1357013-1
Matrix Spike	Manganese (Mn)-Leachable	MS-B	L1357013-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-SHKFLSK-CVAFS-VA	Soil	Mercury by CVAFS (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES
This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
MET-SHKFLSK-ICP-VA	Soil	Metals by ICPOES (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES
This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).			
MET-SHKFLSK-MS-VA	Soil	Metals by ICPMS (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES
This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using inductively coupled plasma - mass spectrophotometry (EPA Method 6020A).			
MOISTURE-VA	Soil	Moisture content	ASTM D2974-00 Method A
This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.			
PH-SHKFLSK-MAN-VA	Soil	pH by Manual Meter (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES
This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water. The extract is then allowed to settle and subsequently analysed using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1357013

Report Date: 16-SEP-13

Page 1 of 4

Client: GOLDER ASSOCIATES LTD.

500 - 4260 Still Creek Drive

Burnaby BC V5C 6C6

Contact: Anette Briggs

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-SHKFLSK-CVAFS-VA Soil								
Batch	R2693479							
WG1739459-1 MB								
Mercury (Hg)-Leachable			<0.000050		mg/L		0.00005	14-SEP-13
WG1747385-1 MB								
Mercury (Hg)-Leachable			<0.000050		mg/L		0.00005	14-SEP-13
WG1747385-2 MB								
Mercury (Hg)-Leachable			<0.000050		mg/L		0.00005	14-SEP-13
MET-SHKFLSK-ICP-VA Soil								
Batch	R2692959							
WG1739459-1 MB								
Iron (Fe)-Leachable			<0.030		mg/L		0.03	12-SEP-13
Phosphorus (P)-Leachable			<0.30		mg/L		0.3	12-SEP-13
Silicon (Si)-Leachable			<0.050		mg/L		0.05	12-SEP-13
Titanium (Ti)-Leachable			<0.010		mg/L		0.01	12-SEP-13
WG1739459-3 MS		L1354595-1						
Iron (Fe)-Leachable			104.7		%		70-130	12-SEP-13
Phosphorus (P)-Leachable			103.9		%		70-130	12-SEP-13
Silicon (Si)-Leachable			N/A	MS-B	%		-	12-SEP-13
Titanium (Ti)-Leachable			103.2		%		70-130	12-SEP-13
MET-SHKFLSK-MS-VA Soil								
Batch	R2694062							
WG1739459-1 MB								
Aluminum (Al)-Leachable			<0.0050		mg/L		0.005	13-SEP-13
Antimony (Sb)-Leachable			<0.00010		mg/L		0.0001	13-SEP-13
Arsenic (As)-Leachable			<0.0010		mg/L		0.001	13-SEP-13
Barium (Ba)-Leachable			<0.0010		mg/L		0.001	13-SEP-13
Beryllium (Be)-Leachable			<0.00050		mg/L		0.0005	13-SEP-13
Bismuth (Bi)-Leachable			<0.00050		mg/L		0.0005	13-SEP-13
Boron (B)-Leachable			<0.010		mg/L		0.01	13-SEP-13
Cadmium (Cd)-Leachable			<0.000050		mg/L		0.00005	13-SEP-13
Calcium (Ca)-Leachable			<0.10		mg/L		0.1	13-SEP-13
Chromium (Cr)-Leachable			<0.00050		mg/L		0.0005	13-SEP-13
Cobalt (Co)-Leachable			<0.00010		mg/L		0.0001	13-SEP-13
Copper (Cu)-Leachable			<0.0010		mg/L		0.001	13-SEP-13
Lead (Pb)-Leachable			<0.00010		mg/L		0.0001	13-SEP-13
Lithium (Li)-Leachable			<0.0050		mg/L		0.005	13-SEP-13
Magnesium (Mg)-Leachable			<0.050		mg/L		0.05	13-SEP-13



Quality Control Report

Workorder: L1357013

Report Date: 16-SEP-13

Page 2 of 4

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFLSK-MS-VA								
Soil								
Batch	R2694062							
WG1739459-1	MB							
Manganese (Mn)-Leachable			<0.00050		mg/L		0.0005	13-SEP-13
Molybdenum (Mo)-Leachable			<0.00010		mg/L		0.0001	13-SEP-13
Nickel (Ni)-Leachable			<0.00050		mg/L		0.0005	13-SEP-13
Potassium (K)-Leachable			<0.050		mg/L		0.05	13-SEP-13
Selenium (Se)-Leachable			<0.00050		mg/L		0.0005	13-SEP-13
Silver (Ag)-Leachable			<0.000050		mg/L		0.00005	13-SEP-13
Sodium (Na)-Leachable			<0.050		mg/L		0.05	13-SEP-13
Strontium (Sr)-Leachable			<0.00050		mg/L		0.0005	13-SEP-13
Thallium (Tl)-Leachable			<0.00010		mg/L		0.0001	13-SEP-13
Tin (Sn)-Leachable			<0.00050		mg/L		0.0005	13-SEP-13
Uranium (U)-Leachable			<0.000010		mg/L		0.00001	13-SEP-13
Vanadium (V)-Leachable			<0.0010		mg/L		0.001	13-SEP-13
Zinc (Zn)-Leachable			<0.010		mg/L		0.01	13-SEP-13
WG1739459-3	MS	L1354595-1						
Aluminum (Al)-Leachable			97.3		%		70-130	13-SEP-13
Antimony (Sb)-Leachable			104.1		%		70-130	13-SEP-13
Arsenic (As)-Leachable			100.7		%		70-130	13-SEP-13
Barium (Ba)-Leachable			108.9		%		70-130	13-SEP-13
Beryllium (Be)-Leachable			99.2		%		70-130	13-SEP-13
Bismuth (Bi)-Leachable			92.4		%		70-130	13-SEP-13
Boron (B)-Leachable			85.4		%		70-130	13-SEP-13
Cadmium (Cd)-Leachable			100.7		%		70-130	13-SEP-13
Calcium (Ca)-Leachable			N/A	MS-B	%		-	13-SEP-13
Chromium (Cr)-Leachable			97.2		%		70-130	13-SEP-13
Cobalt (Co)-Leachable			97.9		%		70-130	13-SEP-13
Copper (Cu)-Leachable			94.8		%		70-130	13-SEP-13
Lead (Pb)-Leachable			96.2		%		70-130	13-SEP-13
Lithium (Li)-Leachable			93.5		%		70-130	13-SEP-13
Magnesium (Mg)-Leachable			N/A	MS-B	%		-	13-SEP-13
Manganese (Mn)-Leachable			N/A	MS-B	%		-	13-SEP-13
Molybdenum (Mo)-Leachable			94.8		%		70-130	13-SEP-13
Nickel (Ni)-Leachable			93.8		%		70-130	13-SEP-13
Potassium (K)-Leachable			98.3		%		70-130	13-SEP-13
Selenium (Se)-Leachable			96.2		%		70-130	13-SEP-13



Quality Control Report

Workorder: L1357013

Report Date: 16-SEP-13

Page 3 of 4

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFLSK-MS-VA		Soil						
Batch	R2694062							
WG1739459-3	MS	L1354595-1						
Silver (Ag)-Leachable			86.1		%		70-130	13-SEP-13
Sodium (Na)-Leachable			92.3		%		70-130	13-SEP-13
Strontium (Sr)-Leachable			85.7		%		70-130	13-SEP-13
Thallium (Tl)-Leachable			97.3		%		70-130	13-SEP-13
Tin (Sn)-Leachable			75.8		%		70-130	13-SEP-13
Vanadium (V)-Leachable			101.6		%		70-130	13-SEP-13
Zinc (Zn)-Leachable			96.4		%		70-130	13-SEP-13
MOISTURE-VA		Soil						
Batch	R2690744							
WG1744247-2	LCS							
Moisture			99.2		%		70-130	10-SEP-13
WG1744247-1	MB							
Moisture			<0.25		%		0.25	10-SEP-13

Quality Control Report

Workorder: L1357013

Report Date: 16-SEP-13

Page 4 of 4

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: GOLDER ASSOCIATES LTD.
500 - 4260 STILL CREEK DR.
BURNABY BC V5C 6C6

Page: 1
Finalized Date: 28- SEP- 2013
Account: HGC

CERTIFICATE VA13167768

Project: 13- 1434- 0002

P.O. No.: 13- 1434- 0002

This report is for 2 Rock samples submitted to our lab in Vancouver, BC, Canada on 23- SEP- 2013.

The following have access to data associated with this certificate:

ANETT BRIGGS

MICHAEL GALESLOOT

MATTHEW THIBEAULT

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
PUL- QC	Pulverizing QC Test
LOG- 22	Sample login - Rcd w/o BarCode
CRU- 31	Fine crushing - 70% < 2mm
SPL- 21	Split sample - riffle splitter
PUL- 31	Pulverize split to 85% < 75 um
SPL- 21X	Crush split for send out

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
S- GRA06	Sulfate Sulfur- carbonate leach	WST- SEQ
S- IR07	Sulphide Sulphur (Leco)	LECO
C- GAS05	Inorganic Carbon (CO2)	
S- GRA06a	Sulfate Sulfur (HCl leachable)	WST- SEQ
OA- VOL08	Basic Acid Base Accounting	
S- IR08	Total Sulphur (Leco)	LECO
OA- ELE07	Paste pH	

To: GOLDER ASSOCIATES LTD.
ATTN: MICHAEL GALESLOOT
500 - 4260 STILL CREEK DR.
BURNABY BC V5C 6C6

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



ALS Canada Ltd.
 2103 Dollarton Hwy
 North Vancouver BC V7H 0A7
 Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: GOLDER ASSOCIATES LTD.
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 BURNABY BC V5C 6C6

Page: 2 - A
 Total # Pages: 2 (A)
 Plus Appendix Pages
 Finalized Date: 28- SEP- 2013
 Account: HGC

Project: 13- 1434- 0002

CERTIFICATE OF ANALYSIS VA13167768

Sample Description	Method Analyte Units LOR	WEI- 21 Recvd Wt. kg 0.02	OA- VOL08 FIZZ RAT Unity 1	OA- VOL08 MPA tCaCO3/1000 0.3	OA- VOL08 NNP tCaCO3/1000 1	OA- VOL08 NP tCaCO3/1000 1	OA- ELE07 pH Unity 0.1	OA- VOL08 Ratio (N) Unity 0.01	S- IR08 S % 0.01	S- GRA06 S % 0.01	S- GRA06a S % 0.01	S- IR07 Sulphide % 0.01	C- GAS05 C % 0.05	C- GAS05 CO2 % 0.2
Sample 1		16.00	1	0.3	7	7	8.3	22.40	0.01	<0.01	0.01	<0.01	<0.05	<0.2
Sample 2		27.64	3	8.1	106	114	8.9	14.03	0.26	0.01	<0.01	0.20	0.76	2.8



ALS Canada Ltd.
2103 Dollarton Hwy
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Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: GOLDER ASSOCIATES LTD.
500 - 4260 STILL CREEK DR.
BURNABY BC V5C 6C6

Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 28- SEP- 2013
Account: HGC

Project: 13- 1434- 0002

CERTIFICATE OF ANALYSIS VA13167768

CERTIFICATE COMMENTS

Applies to Method:

LABORATORY ADDRESSES
Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.
C- GAS05 CRU- 31
OA- VOL08 PUL- 31
S- GRA06a S- IR07
SPL- 21X WEI- 21

OA- ELE07
S- GRA06
SPL- 21



ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: GOLDER ASSOCIATES LTD.
500 - 4260 STILL CREEK DR.
BURNABY BC V5C 6C6

Page: 1
Finalized Date: 28- SEP- 2013
Account: HGC

CERTIFICATE VA13167769

Project: 13- 1434- 0002
P.O. No.: 13- 1434- 0002
This report is for 1 Rock sample submitted to our lab in Vancouver, BC, Canada on 24- SEP- 2013.

The following have access to data associated with this certificate:

ANETT BRIGGS

MICHAEL GALESLOOT

MATTHEW THIBEAULT

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
PUL- QC	Pulverizing QC Test
LOG- 22	Sample login - Rcd w/o BarCode
CRU- 31	Fine crushing - 70% < 2mm
SPL- 21	Split sample - riffle splitter
PUL- 31	Pulverize split to 85% < 75 um
SPL- 21X	Crush split for send out

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
S- GRA06	Sulfate Sulfur- carbonate leach	WST- SEQ
S- IR07	Sulphide Sulphur (Leco)	LECO
C- GAS05	Inorganic Carbon (CO2)	
S- GRA06a	Sulfate Sulfur (HCl leachable)	WST- SEQ
OA- VOL08	Basic Acid Base Accounting	
S- IR08	Total Sulphur (Leco)	LECO
OA- ELE07	Paste pH	

To: GOLDER ASSOCIATES LTD.
ATTN: MICHAEL GALESLOOT
500 - 4260 STILL CREEK DR.
BURNABY BC V5C 6C6

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



ALS Canada Ltd.
 2103 Dollarton Hwy
 North Vancouver BC V7H 0A7
 Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: GOLDER ASSOCIATES LTD.
 500 - 4260 STILL CREEK DR.
 BURNABY BC V5C 6C6

Page: 2 - A
 Total # Pages: 2 (A)
 Plus Appendix Pages
 Finalized Date: 28- SEP- 2013
 Account: HGC

Project: 13- 1434- 0002

CERTIFICATE OF ANALYSIS VA13167769

Sample Description	Method Analyte Units LOR	WEI- 21 Recvd Wt. kg 0.02	OA- VOL08 FIZZ RAT Unity 1	OA- VOL08 MPA tCaCO3/1000t 0.3	OA- VOL08 NNP tCaCO3/1000 1	OA- VOL08 NP tCaCO3/1000 1	OA- ELE07 pH Unity 0.1	OA- VOL08 Ratio (N) Unity 0.01	S- IR08 S % 0.01	S- GRA06 S % 0.01	S- GRA06a S % 0.01	S- IR07 Sulphide % 0.01	C- GAS05 C % 0.05	C- GAS05 CO2 % 0.2
Sample 3 - Rock		26.68	3	7.2	98	105	9.0	14.61	0.23	0.02	<0.01	0.18	0.60	2.2



ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: GOLDER ASSOCIATES LTD.
500 - 4260 STILL CREEK DR.
BURNABY BC V5C 6C6

Page: Appendix 1
Total # Appendix Pages: 1
Finalized Date: 28- SEP- 2013
Account: HGC

Project: 13- 1434- 0002

CERTIFICATE OF ANALYSIS VA13167769

CERTIFICATE COMMENTS

LABORATORY ADDRESSES

Applies to Method:

Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.

C- GAS05

CRU- 31

LOG- 22

OA- ELE07

OA- VOL08

PUL- 31

PUL- QC

S- GRA06

S- GRA06a

S- IR07

S- IR08

SPL- 21

SPL- 21X

WEI- 21



GOLDER ASSOCIATES LTD.
ATTN: Anette Briggs
500 - 4260 Still Creek Drive
Burnaby BC V5C 6C6

Date Received: 04-OCT-13
Report Date: 07-OCT-13 16:25 (MT)
Version: FINAL

Client Phone: 604-298-6623

Certificate of Analysis

Lab Work Order #: L1373216
Project P.O. #: NOT SUBMITTED
Job Reference: 13-1434-0002
C of C Numbers:
Legal Site Desc:

Amber Springer
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1373216-1 Crushed Rock	L1373216-2 Crushed Rock	L1373216-3 Crushed Rock		
Grouping	Analyte					
SOIL						
Leachable Anions & Nutrients	pH (pH)	7.69	8.52	8.56		
Leachable Metals	Aluminum (Al)-Leachable (mg/L)	5.41	0.442	0.554		
	Antimony (Sb)-Leachable (mg/L)	0.00023	0.00235	0.00013		
	Arsenic (As)-Leachable (mg/L)	<0.0010	<0.0010	<0.0010		
	Barium (Ba)-Leachable (mg/L)	0.0744	0.0045	0.0044		
	Beryllium (Be)-Leachable (mg/L)	<0.00050	<0.00050	<0.00050		
	Bismuth (Bi)-Leachable (mg/L)	<0.00050	<0.00050	<0.00050		
	Boron (B)-Leachable (mg/L)	0.010	0.019	0.013		
	Cadmium (Cd)-Leachable (mg/L)	<0.000050	<0.000050	<0.000050		
	Calcium (Ca)-Leachable (mg/L)	4.75	16.0	16.4		
	Chromium (Cr)-Leachable (mg/L)	0.00595	<0.00050	<0.00050		
	Cobalt (Co)-Leachable (mg/L)	0.00232	<0.00010	<0.00010		
	Copper (Cu)-Leachable (mg/L)	0.0101	<0.0010	<0.0010		
	Iron (Fe)-Leachable (mg/L)	4.54	<0.030	<0.030		
	Lead (Pb)-Leachable (mg/L)	0.00566	<0.00010	<0.00010		
	Lithium (Li)-Leachable (mg/L)	<0.0050	0.0103	0.0076		
	Magnesium (Mg)-Leachable (mg/L)	1.66	1.76	1.57		
	Manganese (Mn)-Leachable (mg/L)	0.109	0.00102	0.00098		
	Mercury (Hg)-Leachable (mg/L)	<0.000050	<0.000050	<0.000050		
	Molybdenum (Mo)-Leachable (mg/L)	0.00318	0.00376	0.00238		
	Nickel (Ni)-Leachable (mg/L)	0.00510	<0.00050	<0.00050		
	Phosphorus (P)-Leachable (mg/L)	<0.30	<0.30	<0.30		
	Potassium (K)-Leachable (mg/L)	8.84	20.4	20.1		
	Selenium (Se)-Leachable (mg/L)	<0.00050	<0.00050	<0.00050		
	Silicon (Si)-Leachable (mg/L)	12.7	2.24	2.07		
	Silver (Ag)-Leachable (mg/L)	<0.000050	<0.000050	<0.000050		
	Sodium (Na)-Leachable (mg/L)	6.22	4.06	3.42		
	Strontium (Sr)-Leachable (mg/L)	0.0212	0.0863	0.0775		
	Thallium (Tl)-Leachable (mg/L)	<0.00010	<0.00010	<0.00010		
	Tin (Sn)-Leachable (mg/L)	<0.00050	<0.00050	<0.00050		
	Titanium (Ti)-Leachable (mg/L)	0.216	<0.010	<0.010		
	Uranium (U)-Leachable (mg/L)	0.00170	0.000300	0.000169		
	Vanadium (V)-Leachable (mg/L)	0.0098	0.0019	0.0021		
	Zinc (Zn)-Leachable (mg/L)	<0.010	<0.010	<0.010		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Aluminum (Al)-Leachable	MS-B	L1373216-1, -2, -3
Matrix Spike	Calcium (Ca)-Leachable	MS-B	L1373216-1, -2, -3
Matrix Spike	Magnesium (Mg)-Leachable	MS-B	L1373216-1, -2, -3
Matrix Spike	Iron (Fe)-Leachable	MS-B	L1373216-1, -2, -3
Matrix Spike	Silicon (Si)-Leachable	MS-B	L1373216-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-SHKFLSK-CVAFS-VA	Soil	Mercury by CVAFS (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES
This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
MET-SHKFLSK-ICP-VA	Soil	Metals by ICPOES (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES
This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).			
MET-SHKFLSK-MS-VA	Soil	Metals by ICPMS (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES
This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using inductively coupled plasma - mass spectrophotometry (EPA Method 6020A).			
MOISTURE-VA	Soil	Moisture content	ASTM D2974-00 Method A
This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.			
PH-SHKFLSK-MAN-VA	Soil	pH by Manual Meter (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES
This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water. The extract is then allowed to settle and subsequently analysed using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg wwt - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1373216

Report Date: 07-OCT-13

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Client: GOLDER ASSOCIATES LTD.

500 - 4260 Still Creek Drive

Burnaby BC V5C 6C6

Contact: Anette Briggs

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-SHKFLSK-CVAFS-VA Soil								
Batch	R2710843							
WG1761694-2 DUP		L1373216-3						
Mercury (Hg)-Leachable		<0.000050	<0.000050	RPD-NA	mg/L	N/A	30	07-OCT-13
WG1761694-1 MB								
Mercury (Hg)-Leachable			<0.000050		mg/L		0.00005	07-OCT-13
WG1762904-1 MB								
Mercury (Hg)-Leachable			<0.000050		mg/L		0.00005	07-OCT-13
MET-SHKFLSK-ICP-VA Soil								
Batch	R2710860							
WG1761694-2 DUP		L1373216-3						
Iron (Fe)-Leachable		<0.030	<0.030	RPD-NA	mg/L	N/A	30	07-OCT-13
Phosphorus (P)-Leachable		<0.30	<0.30	RPD-NA	mg/L	N/A	30	07-OCT-13
Silicon (Si)-Leachable		2.07	2.04		mg/L	1.1	30	07-OCT-13
Titanium (Ti)-Leachable		<0.010	<0.010	RPD-NA	mg/L	N/A	30	07-OCT-13
WG1761694-1 MB								
Iron (Fe)-Leachable			<0.030		mg/L		0.03	07-OCT-13
Phosphorus (P)-Leachable			<0.30		mg/L		0.3	07-OCT-13
Silicon (Si)-Leachable			<0.050		mg/L		0.05	07-OCT-13
Titanium (Ti)-Leachable			<0.010		mg/L		0.01	07-OCT-13
WG1761694-3 MS		L1373216-1						
Iron (Fe)-Leachable			N/A	MS-B	%		-	07-OCT-13
Phosphorus (P)-Leachable			101.4		%		70-130	07-OCT-13
Silicon (Si)-Leachable			N/A	MS-B	%		-	07-OCT-13
Titanium (Ti)-Leachable			93.9		%		70-130	07-OCT-13
MET-SHKFLSK-MS-VA Soil								
Batch	R2710852							
WG1761694-2 DUP		L1373216-3						
Aluminum (Al)-Leachable		0.554	0.539		mg/L	2.8	30	07-OCT-13
Antimony (Sb)-Leachable		0.00013	0.00014		mg/L	8.3	30	07-OCT-13
Arsenic (As)-Leachable		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	07-OCT-13
Barium (Ba)-Leachable		0.0044	0.0045		mg/L	2.9	30	07-OCT-13
Beryllium (Be)-Leachable		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	07-OCT-13
Bismuth (Bi)-Leachable		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	07-OCT-13
Boron (B)-Leachable		0.013	0.013		mg/L	4.9	30	07-OCT-13
Cadmium (Cd)-Leachable		<0.000050	<0.000050	RPD-NA	mg/L	N/A	30	07-OCT-13
Calcium (Ca)-Leachable		16.4	16.7		mg/L	1.8	30	07-OCT-13
Chromium (Cr)-Leachable		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	07-OCT-13



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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFLSK-MS-VA		Soil						
Batch	R2710852							
WG1761694-2	DUP	L1373216-3						
Cobalt (Co)-Leachable		<0.00010	<0.00010	RPD-NA	mg/L	N/A	30	07-OCT-13
Copper (Cu)-Leachable		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	07-OCT-13
Lead (Pb)-Leachable		<0.00010	<0.00010	RPD-NA	mg/L	N/A	30	07-OCT-13
Lithium (Li)-Leachable		0.0076	0.0076		mg/L	0.4	30	07-OCT-13
Magnesium (Mg)-Leachable		1.57	1.55		mg/L	1.6	30	07-OCT-13
Manganese (Mn)-Leachable		0.00098	0.00088		mg/L	11	30	07-OCT-13
Molybdenum (Mo)-Leachable		0.00238	0.00240		mg/L	0.6	30	07-OCT-13
Nickel (Ni)-Leachable		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	07-OCT-13
Potassium (K)-Leachable		20.1	19.7		mg/L	2.0	30	07-OCT-13
Selenium (Se)-Leachable		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	07-OCT-13
Silver (Ag)-Leachable		<0.000050	<0.000050	RPD-NA	mg/L	N/A	30	07-OCT-13
Sodium (Na)-Leachable		3.42	3.18		mg/L	7.2	30	07-OCT-13
Strontium (Sr)-Leachable		0.0775	0.0827		mg/L	6.5	30	07-OCT-13
Thallium (Tl)-Leachable		<0.00010	<0.00010	RPD-NA	mg/L	N/A	30	07-OCT-13
Tin (Sn)-Leachable		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	07-OCT-13
Uranium (U)-Leachable		0.000169	0.000184		mg/L	8.1	30	07-OCT-13
Vanadium (V)-Leachable		0.0021	0.0022		mg/L	1.6	30	07-OCT-13
Zinc (Zn)-Leachable		<0.010	<0.010	RPD-NA	mg/L	N/A	30	07-OCT-13
WG1761694-1	MB							
Aluminum (Al)-Leachable			<0.0050		mg/L		0.005	07-OCT-13
Antimony (Sb)-Leachable			<0.00010		mg/L		0.0001	07-OCT-13
Arsenic (As)-Leachable			<0.0010		mg/L		0.001	07-OCT-13
Barium (Ba)-Leachable			<0.0010		mg/L		0.001	07-OCT-13
Beryllium (Be)-Leachable			<0.00050		mg/L		0.0005	07-OCT-13
Bismuth (Bi)-Leachable			<0.00050		mg/L		0.0005	07-OCT-13
Boron (B)-Leachable			<0.010		mg/L		0.01	07-OCT-13
Cadmium (Cd)-Leachable			<0.000050		mg/L		0.00005	07-OCT-13
Calcium (Ca)-Leachable			<0.10		mg/L		0.1	07-OCT-13
Chromium (Cr)-Leachable			<0.00050		mg/L		0.0005	07-OCT-13
Cobalt (Co)-Leachable			<0.00010		mg/L		0.0001	07-OCT-13
Copper (Cu)-Leachable			<0.0010		mg/L		0.001	07-OCT-13
Lead (Pb)-Leachable			<0.00010		mg/L		0.0001	07-OCT-13
Lithium (Li)-Leachable			<0.0050		mg/L		0.005	07-OCT-13
Magnesium (Mg)-Leachable			<0.050		mg/L		0.05	07-OCT-13



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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFLSK-MS-VA	Soil							
Batch	R2710852							
WG1761694-1 MB								
Manganese (Mn)-Leachable			<0.00050		mg/L		0.0005	07-OCT-13
Molybdenum (Mo)-Leachable			<0.00010		mg/L		0.0001	07-OCT-13
Nickel (Ni)-Leachable			<0.00050		mg/L		0.0005	07-OCT-13
Potassium (K)-Leachable			<0.050		mg/L		0.05	07-OCT-13
Selenium (Se)-Leachable			<0.00050		mg/L		0.0005	07-OCT-13
Silver (Ag)-Leachable			<0.000050		mg/L		0.00005	07-OCT-13
Sodium (Na)-Leachable			<0.050		mg/L		0.05	07-OCT-13
Strontium (Sr)-Leachable			<0.00050		mg/L		0.0005	07-OCT-13
Thallium (Tl)-Leachable			<0.00010		mg/L		0.0001	07-OCT-13
Tin (Sn)-Leachable			<0.00050		mg/L		0.0005	07-OCT-13
Uranium (U)-Leachable			<0.000010		mg/L		0.00001	07-OCT-13
Vanadium (V)-Leachable			<0.0010		mg/L		0.001	07-OCT-13
Zinc (Zn)-Leachable			<0.010		mg/L		0.01	07-OCT-13
WG1761694-3 MS		L1373216-1						
Aluminum (Al)-Leachable			N/A	MS-B	%		-	07-OCT-13
Antimony (Sb)-Leachable			101.2		%		70-130	07-OCT-13
Arsenic (As)-Leachable			99.0		%		70-130	07-OCT-13
Barium (Ba)-Leachable			107.2		%		70-130	07-OCT-13
Beryllium (Be)-Leachable			103.7		%		70-130	07-OCT-13
Bismuth (Bi)-Leachable			99.2		%		70-130	07-OCT-13
Boron (B)-Leachable			92.6		%		70-130	07-OCT-13
Cadmium (Cd)-Leachable			99.9		%		70-130	07-OCT-13
Calcium (Ca)-Leachable			N/A	MS-B	%		-	07-OCT-13
Chromium (Cr)-Leachable			97.0		%		70-130	07-OCT-13
Cobalt (Co)-Leachable			97.1		%		70-130	07-OCT-13
Copper (Cu)-Leachable			95.0		%		70-130	07-OCT-13
Lead (Pb)-Leachable			99.5		%		70-130	07-OCT-13
Lithium (Li)-Leachable			97.0		%		70-130	07-OCT-13
Magnesium (Mg)-Leachable			N/A	MS-B	%		-	07-OCT-13
Manganese (Mn)-Leachable			96.1		%		70-130	07-OCT-13
Molybdenum (Mo)-Leachable			99.6		%		70-130	07-OCT-13
Nickel (Ni)-Leachable			96.2		%		70-130	07-OCT-13
Potassium (K)-Leachable			91.1		%		70-130	07-OCT-13
Selenium (Se)-Leachable			98.0		%		70-130	07-OCT-13



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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFLSK-MS-VA	Soil							
Batch	R2710852							
WG1761694-3 MS		L1373216-1						
Silver (Ag)-Leachable			98.2		%		70-130	07-OCT-13
Sodium (Na)-Leachable			94.1		%		70-130	07-OCT-13
Strontium (Sr)-Leachable			92.8		%		70-130	07-OCT-13
Thallium (Tl)-Leachable			96.9		%		70-130	07-OCT-13
Tin (Sn)-Leachable			82.8		%		70-130	07-OCT-13
Vanadium (V)-Leachable			101.2		%		70-130	07-OCT-13
Zinc (Zn)-Leachable			102.5		%		70-130	07-OCT-13
PH-SHKFLSK-MAN-VA	Soil							
Batch	R2709786							
WG1761694-2 DUP		L1373216-3						
pH		8.56	8.53		pH	0.4	25	06-OCT-13

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Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.



L1373216-COFC

**ALS Minerals**

L1373216

Analysis Request Form

Date:	Sep 25 th , 2013
Analyzing Laboratory:	ALSE
Client Contact:	Attn: Anett Briggs
Company Name:	Golder Associates Ltd
Project:	13-1434-0002
Number of Samples & Country of Origin:	3 samples, Canada
Sample IDs:	Sample 1 (VA13167768) Sample 2 (VA13167768) Sample 3 – Rock (VA13167769)
Sample Type:	<input type="checkbox"/> Drill Core <input type="checkbox"/> Percussion <input type="checkbox"/> Rock <input type="checkbox"/> Soil <input checked="" type="checkbox"/> Crushed Rock
Analysis Required:	Shake Flask Extraction/ML
Special Instructions:	SEND OUT ONLY Re: VA13167768 & VA13167769-HGC
Sample Disposition:	<input type="checkbox"/> Return <input type="checkbox"/> Dispose after analysis
Results to:	Attention: Anett Briggs Address: 500 - 4260 Still Creek Dr. Burnaby, BC V5C 6C6, Canada Phone: +1 (604) 298-6623 Fax: +1 (604) 298-5253 Email: abriggs@golder.com <i>Golder 200</i>
Invoice to:	Attention: Anett Briggs Address: 500 - 4260 Still Creek Dr. Burnaby, BC V5C 6C6, Canada Phone: +1 (604) 298-6623 Fax: +1 (604) 298-5253 Email: abriggs@golder.com



ALS Canada Ltd.
2103 Dollarton Hwy
North Vancouver BC V7H 0A7
Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: GOLDER ASSOCIATES LTD.
500 - 4260 STILL CREEK DR.
BURNABY BC V5C 6C6

Page: 1
Finalized Date: 13- OCT- 2013
This copy reported on
15- OCT- 2013
Account: HGC

CERTIFICATE VA13181490

Project: 13- 1434- 0002

P.O. No.:

This report is for 1 Rock sample submitted to our lab in Vancouver, BC, Canada on 2- OCT- 2013.

The following have access to data associated with this certificate:

ANETT BRIGGS

MICHAEL GALESLOOT

MATTHEW THIBEAULT

SAMPLE PREPARATION

ALS CODE	DESCRIPTION
WEI- 21	Received Sample Weight
CRU- QC	Crushing QC Test
LOG- 22	Sample login - Rcd w/o BarCode
CRU- 31	Fine crushing - 70% < 2mm
SPL- 21	Split sample - riffle splitter
PUL- 31	Pulverize split to 85% < 75 um
SPL- 21X	Crush split for send out

ANALYTICAL PROCEDURES

ALS CODE	DESCRIPTION	INSTRUMENT
S- GRA06	Sulfate Sulfur- carbonate leach	WST- SEQ
S- IR07	Sulphide Sulphur (Leco)	LECO
C- GAS05	Inorganic Carbon (CO2)	
S- GRA06a	Sulfate Sulfur (HCl leachable)	WST- SEQ
OA- VOL08	Basic Acid Base Accounting	
S- IR08	Total Sulphur (Leco)	LECO
OA- ELE07	Paste pH	

To: GOLDER ASSOCIATES LTD.
ATTN: MICHAEL GALESLOOT
500 - 4260 STILL CREEK DR.
BURNABY BC V5C 6C6

This is the Final Report and supersedes any preliminary report with this certificate number. Results apply to samples as submitted. All pages of this report have been checked and approved for release.

***** See Appendix Page for comments regarding this certificate *****

Signature:

Colin Ramshaw, Vancouver Laboratory Manager



ALS Canada Ltd.
 2103 Dollarton Hwy
 North Vancouver BC V7H 0A7
 Phone: 604 984 0221 Fax: 604 984 0218 www.alsglobal.com

To: GOLDER ASSOCIATES LTD.
 500 - 4260 STILL CREEK DR.
 BURNABY BC V5C 6C6

Page: 2 - A
 Total # Pages: 2 (A)
 Plus Appendix Pages
 Finalized Date: 13- OCT- 2013
 Account: HGC

Project: 13- 1434- 0002

CERTIFICATE OF ANALYSIS VA13181490

Sample Description	Method Analyte Units LOR	WEI- 21 Recvd Wt. kg 0.02	OA- VOL08 FIZZ RAT Unity 1	OA- VOL08 MPA tCaCO3/1000 0.3	OA- VOL08 NNP tCaCO3/1000 1	OA- VOL08 NP tCaCO3/1000 1	OA- ELE07 pH Unity 0.1	OA- VOL08 Ratio (N Unity 0.01	S- IR08 S % 0.01	S- GRA06 S % 0.01	S- GRA06a S % 0.01	S- IR07 Sulphide % 0.01	C- GAS05 C % 0.05	C- GAS05 CO2 % 0.2
Sicamous 1		18.26	1	0.6	8	9	9.3	14.40	0.02	<0.01	<0.01	0.02	<0.05	<0.2



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Page: Appendix 1
Total # Appendix Pages: 1
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CERTIFICATE OF ANALYSIS VA13181490

CERTIFICATE COMMENTS

Applies to Method:

LABORATORY ADDRESSES
Processed at ALS Vancouver located at 2103 Dollarton Hwy, North Vancouver, BC, Canada.
C- GAS05 CRU- 31
OA- ELE07 OA- VOL08
S- GRA06a S- IR07
SPL- 21X WEI- 21

CRU- QC
PUL- 31
S- IR08

LOG- 22
S- GRA06
SPL- 21



GOLDER ASSOCIATES LTD.
ATTN: Anette Briggs
500 - 4260 Still Creek Drive
Burnaby BC V5C 6C6

Date Received: 08-OCT-13
Report Date: 10-OCT-13 17:57 (MT)
Version: FINAL

Client Phone: 604-298-6623

Certificate of Analysis

Lab Work Order #: L1374936
Project P.O. #: NOT SUBMITTED
Job Reference: 13-1434-0002
C of C Numbers:
Legal Site Desc:

Amber Springer
Account Manager

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ADDRESS: 8081 Lougheed Hwy, Suite 100, Burnaby, BC V5A 1W9 Canada | Phone: +1 604 253 4188 | Fax: +1 604 253 6700
ALS CANADA LTD Part of the ALS Group A Campbell Brothers Limited Company

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID Description Sampled Date Sampled Time Client ID		L1374936-1 Crushed Rock				
Grouping	Analyte					
SOIL						
Physical Tests	Moisture (%)	<0.25				
Leachable Anions & Nutrients	pH (pH)	9.32				
Leachable Metals	Aluminum (Al)-Leachable (mg/L)	6.33				
	Antimony (Sb)-Leachable (mg/L)	0.00013				
	Arsenic (As)-Leachable (mg/L)	<0.0010				
	Barium (Ba)-Leachable (mg/L)	0.123				
	Beryllium (Be)-Leachable (mg/L)	<0.00050				
	Bismuth (Bi)-Leachable (mg/L)	<0.00050				
	Boron (B)-Leachable (mg/L)	<0.010				
	Cadmium (Cd)-Leachable (mg/L)	<0.000050				
	Calcium (Ca)-Leachable (mg/L)	5.26				
	Chromium (Cr)-Leachable (mg/L)	0.00143				
	Cobalt (Co)-Leachable (mg/L)	0.00322				
	Copper (Cu)-Leachable (mg/L)	0.0132				
	Iron (Fe)-Leachable (mg/L)	6.58				
	Lead (Pb)-Leachable (mg/L)	0.00149				
	Lithium (Li)-Leachable (mg/L)	0.0075				
	Magnesium (Mg)-Leachable (mg/L)	2.19				
	Manganese (Mn)-Leachable (mg/L)	0.147				
	Mercury (Hg)-Leachable (mg/L)	<0.000050				
	Molybdenum (Mo)-Leachable (mg/L)	0.00169				
	Nickel (Ni)-Leachable (mg/L)	0.00082				
	Phosphorus (P)-Leachable (mg/L)	<0.30				
	Potassium (K)-Leachable (mg/L)	8.09				
	Selenium (Se)-Leachable (mg/L)	<0.00050				
	Silicon (Si)-Leachable (mg/L)	16.8				
	Silver (Ag)-Leachable (mg/L)	<0.000050				
	Sodium (Na)-Leachable (mg/L)	5.45				
	Strontium (Sr)-Leachable (mg/L)	0.0448				
	Thallium (Tl)-Leachable (mg/L)	<0.00010				
	Tin (Sn)-Leachable (mg/L)	<0.00050				
	Titanium (Ti)-Leachable (mg/L)	0.482				
	Uranium (U)-Leachable (mg/L)	0.000549				
	Vanadium (V)-Leachable (mg/L)	0.0380				
	Zinc (Zn)-Leachable (mg/L)	<0.010				

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Iron (Fe)-Leachable	MS-B	L1374936-1
Matrix Spike	Silicon (Si)-Leachable	MS-B	L1374936-1
Matrix Spike	Titanium (Ti)-Leachable	MS-B	L1374936-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-SHKFLSK-CVAFS-VA	Soil	Mercury by CVAFS (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES
This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).			
MET-SHKFLSK-ICP-VA	Soil	Metals by ICPOES (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES
This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).			
MET-SHKFLSK-MS-VA	Soil	Metals by ICPMS (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES
This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water. The extract is then allowed to settle and subsequently filtered through a 0.45 micron membrane filter and analysed using inductively coupled plasma - mass spectrophotometry (EPA Method 6020A).			
MOISTURE-VA	Soil	Moisture content	ASTM D2974-00 Method A
This analysis is carried out gravimetrically by drying the sample at 105 C for a minimum of six hours.			
PH-SHKFLSK-MAN-VA	Soil	pH by Manual Meter (SHAKEFLASK)	BC MINISTRY OF ENERGY AND MINES
This analysis is based upon the extraction procedure outlined in "Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia" BC Ministry of Energy and Mines, (Dr. William A. Price, 1997). In summary, the sample is extracted at a 3:1 liquid to solids ratio for 24 hours using deionized water. The extract is then allowed to settle and subsequently analysed using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.

mg/kg - milligrams per kilogram based on dry weight of sample.

mg/kg ww - milligrams per kilogram based on wet weight of sample.

mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.

mg/L - milligrams per litre.

< - Less than.

D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).

N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.

UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.

Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.



Quality Control Report

Workorder: L1374936

Report Date: 10-OCT-13

Page 1 of 4

Client: GOLDER ASSOCIATES LTD.

500 - 4260 Still Creek Drive

Burnaby BC V5C 6C6

Contact: Anette Briggs

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-SHKFLSK-CVAFS-VA Soil								
Batch	R2714100							
WG1764206-2 DUP		L1374936-1						
Mercury (Hg)-Leachable		<0.000050	<0.000050	RPD-NA	mg/L	N/A	30	10-OCT-13
WG1764206-1 MB								
Mercury (Hg)-Leachable			<0.000050		mg/L		0.00005	10-OCT-13
WG1765692-1 MB								
Mercury (Hg)-Leachable			<0.000050		mg/L		0.00005	10-OCT-13
WG1765692-2 MB								
Mercury (Hg)-Leachable			<0.000050		mg/L		0.00005	10-OCT-13
MET-SHKFLSK-ICP-VA Soil								
Batch	R2714246							
WG1764206-2 DUP		L1374936-1						
Iron (Fe)-Leachable		6.58	6.97		mg/L	5.7	30	10-OCT-13
Phosphorus (P)-Leachable		<0.30	<0.30	RPD-NA	mg/L	N/A	30	10-OCT-13
Silicon (Si)-Leachable		16.8	17.8		mg/L	5.8	30	10-OCT-13
Titanium (Ti)-Leachable		0.482	0.525		mg/L	8.5	30	10-OCT-13
WG1764206-1 MB								
Iron (Fe)-Leachable			<0.030		mg/L		0.03	10-OCT-13
Phosphorus (P)-Leachable			<0.30		mg/L		0.3	10-OCT-13
Silicon (Si)-Leachable			<0.050		mg/L		0.05	10-OCT-13
Titanium (Ti)-Leachable			<0.010		mg/L		0.01	10-OCT-13
WG1764206-3 MS		L1374936-1						
Iron (Fe)-Leachable			N/A	MS-B	%		-	10-OCT-13
Phosphorus (P)-Leachable			101.3		%		70-130	10-OCT-13
Silicon (Si)-Leachable			N/A	MS-B	%		-	10-OCT-13
Titanium (Ti)-Leachable			N/A	MS-B	%		-	10-OCT-13
MET-SHKFLSK-MS-VA Soil								
Batch	R2714155							
WG1764206-2 DUP		L1374936-1						
Aluminum (Al)-Leachable		6.33	6.66		mg/L	5.1	30	10-OCT-13
Antimony (Sb)-Leachable		0.00013	0.00014		mg/L	3.9	30	10-OCT-13
Arsenic (As)-Leachable		<0.0010	<0.0010	RPD-NA	mg/L	N/A	30	10-OCT-13
Barium (Ba)-Leachable		0.123	0.127		mg/L	2.6	30	10-OCT-13
Beryllium (Be)-Leachable		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-OCT-13
Bismuth (Bi)-Leachable		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-OCT-13
Boron (B)-Leachable		<0.010	<0.010	RPD-NA	mg/L	N/A	30	10-OCT-13
Cadmium (Cd)-Leachable		<0.000050	<0.000050	RPD-NA	mg/L	N/A	30	10-OCT-13



Quality Control Report

Workorder: L1374936

Report Date: 10-OCT-13

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFLSK-MS-VA		Soil						
Batch	R2714155							
WG1764206-2	DUP	L1374936-1						
Calcium (Ca)-Leachable		5.26	5.27		mg/L	0.2	30	10-OCT-13
Chromium (Cr)-Leachable		0.00143	0.00156		mg/L	8.2	30	10-OCT-13
Cobalt (Co)-Leachable		0.00322	0.00344		mg/L	6.7	30	10-OCT-13
Copper (Cu)-Leachable		0.0132	0.0134		mg/L	1.6	30	10-OCT-13
Lead (Pb)-Leachable		0.00149	0.00151		mg/L	1.7	30	10-OCT-13
Lithium (Li)-Leachable		0.0075	0.0080		mg/L	6.2	30	10-OCT-13
Magnesium (Mg)-Leachable		2.19	2.33		mg/L	6.0	30	10-OCT-13
Manganese (Mn)-Leachable		0.147	0.153		mg/L	4.3	30	10-OCT-13
Molybdenum (Mo)-Leachable		0.00169	0.00166		mg/L	2.0	30	10-OCT-13
Nickel (Ni)-Leachable		0.00082	0.00086		mg/L	4.5	30	10-OCT-13
Potassium (K)-Leachable		8.09	8.32		mg/L	2.8	30	10-OCT-13
Selenium (Se)-Leachable		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-OCT-13
Silver (Ag)-Leachable		<0.000050	<0.000050	RPD-NA	mg/L	N/A	30	10-OCT-13
Sodium (Na)-Leachable		5.45	5.80		mg/L	6.2	30	10-OCT-13
Strontium (Sr)-Leachable		0.0448	0.0450		mg/L	0.4	30	10-OCT-13
Thallium (Tl)-Leachable		<0.00010	<0.00010	RPD-NA	mg/L	N/A	30	10-OCT-13
Tin (Sn)-Leachable		<0.00050	<0.00050	RPD-NA	mg/L	N/A	30	10-OCT-13
Uranium (U)-Leachable		0.000549	0.000567		mg/L	3.1	30	10-OCT-13
Vanadium (V)-Leachable		0.0380	0.0408		mg/L	7.2	30	10-OCT-13
Zinc (Zn)-Leachable		<0.010	<0.010	RPD-NA	mg/L	N/A	30	10-OCT-13
WG1764206-1	MB							
Aluminum (Al)-Leachable			<0.0050		mg/L		0.005	10-OCT-13
Antimony (Sb)-Leachable			<0.00010		mg/L		0.0001	10-OCT-13
Arsenic (As)-Leachable			<0.0010		mg/L		0.001	10-OCT-13
Barium (Ba)-Leachable			<0.0010		mg/L		0.001	10-OCT-13
Beryllium (Be)-Leachable			<0.00050		mg/L		0.0005	10-OCT-13
Bismuth (Bi)-Leachable			<0.00050		mg/L		0.0005	10-OCT-13
Boron (B)-Leachable			<0.010		mg/L		0.01	10-OCT-13
Cadmium (Cd)-Leachable			<0.000050		mg/L		0.00005	10-OCT-13
Calcium (Ca)-Leachable			<0.10		mg/L		0.1	10-OCT-13
Chromium (Cr)-Leachable			<0.00050		mg/L		0.0005	10-OCT-13
Cobalt (Co)-Leachable			<0.00010		mg/L		0.0001	10-OCT-13
Copper (Cu)-Leachable			<0.0010		mg/L		0.001	10-OCT-13
Lead (Pb)-Leachable			<0.00010		mg/L		0.0001	10-OCT-13



Quality Control Report

Workorder: L1374936

Report Date: 10-OCT-13

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Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-SHKFLSK-MS-VA Soil								
Batch R2714155								
WG1764206-1 MB								
Lithium (Li)-Leachable			<0.0050		mg/L		0.005	10-OCT-13
Magnesium (Mg)-Leachable			<0.050		mg/L		0.05	10-OCT-13
Manganese (Mn)-Leachable			<0.00050		mg/L		0.0005	10-OCT-13
Molybdenum (Mo)-Leachable			<0.00010		mg/L		0.0001	10-OCT-13
Nickel (Ni)-Leachable			<0.00050		mg/L		0.0005	10-OCT-13
Potassium (K)-Leachable			<0.050		mg/L		0.05	10-OCT-13
Selenium (Se)-Leachable			<0.00050		mg/L		0.0005	10-OCT-13
Silver (Ag)-Leachable			<0.000050		mg/L		0.00005	10-OCT-13
Sodium (Na)-Leachable			<0.050		mg/L		0.05	10-OCT-13
Strontium (Sr)-Leachable			<0.00050		mg/L		0.0005	10-OCT-13
Thallium (Tl)-Leachable			<0.00010		mg/L		0.0001	10-OCT-13
Tin (Sn)-Leachable			<0.00050		mg/L		0.0005	10-OCT-13
Uranium (U)-Leachable			<0.000010		mg/L		0.00001	10-OCT-13
Vanadium (V)-Leachable			<0.0010		mg/L		0.001	10-OCT-13
Zinc (Zn)-Leachable			<0.010		mg/L		0.01	10-OCT-13
MOISTURE-VA Soil								
Batch R2713096								
WG1764966-2 LCS								
Moisture			100.6		%		70-130	09-OCT-13
WG1764966-1 MB								
Moisture			<0.25		%		0.25	09-OCT-13
PH-SHKFLSK-MAN-VA Soil								
Batch R2713714								
WG1764206-2 DUP								
pH		L1374936-1 9.32	9.33		pH	0.1	25	10-OCT-13

Quality Control Report

Workorder: L1374936

Report Date: 10-OCT-13

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Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Hold Time Exceedances:

All test results reported with this submission were conducted within ALS recommended hold times.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

**ALS Minerals****Analysis Request Form**

Date:	Oct 7 th 2013
Analyzing Laboratory:	ALSE
Client Contact:	Attn: Selam Worku
Company Name:	Golder Associates Ltd.
Project:	13-1434-0002
Number of Samples & Country of Origin:	1 sample, CANADA
Sample IDs:	Sicamous 1
Sample Type:	<input type="checkbox"/> Drill Core <input type="checkbox"/> Percussion <input type="checkbox"/> Rock <input type="checkbox"/> Soil <input checked="" type="checkbox"/> Crushed rock
Analysis Required:	Shake Flask Extraction Test
Special Instructions:	SEND OUT ONLY Ref: VA13181490-HGC
Sample Disposition:	<input type="checkbox"/> Return <input type="checkbox"/> Dispose after analysis
Results to:	Attention: Anett Briggs Address: 500 - 4260 Still Creek Dr. Burnaby, BC V5C 6C6, Canada Phone: +1 (604) 298-6623 Fax: +1 (604) 298-5253 Email: abriggs@golder.com
Invoice to:	Attention: Anett Briggs Address: 500 - 4260 Still Creek Dr. Burnaby, BC V5C 6C6, Canada Phone: +1 (604) 298-6623 Fax: +1 (604) 298-5253 Email: abriggs@golder.com

RUSH
Priority processing

L1374936-COFC

RUSH

Rec'd by: Chris Oct 8 1030 18.3

At Golder Associates we strive to be the most respected global company providing consulting, design, and construction services in earth, environment, and related areas of energy. Employee owned since our formation in 1960, our focus, unique culture and operating environment offer opportunities and the freedom to excel, which attracts the leading specialists in our fields. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees who operate from offices located throughout Africa, Asia, Australasia, Europe, North America, and South America.

Africa	+ 27 11 254 4800
Asia	+ 86 21 6258 5522
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

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