DMT Geosciences

Final Report

Coal Assessment Report for the Year 2012 for the Murray River Coal Property, Peace River Coalfield, British Columbia

Effective Date: July 31, 2015
DMT File Number: 2012CMAA.038

Prepared for:

HD Mining International Ltd.
Vancouver, British Columbia

Prepared by:

DMT Geosciences Ltd.
Calgary, AB, Canada

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COAL ASSESSMENT REPORT TITLE PAGE AND SUMMARY

Coal Assessment Report for the Year 2012 for the Murray River Coal Property, Peace River Coalfield, British Columbia

TOTAL COST:

$350,000

AUTHOR(S):

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SIGNATURE(S):

The effective date of publication of this report is July 31, 2015.

Peter Cain, Ph.D., P.Eng
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H.D. Mining international Ltd.

NOTICE OF WORK PERMIT NUMBER(S)/DATE(S):

1. May 2012 12-1640549-1018

2. July 2012 : 14675-30

STATEMENT OF WORK EVENT NUMBER(S)/DATE(S):

1. May 2012

2. July 2012

YEAR(S) OF WORK:

2012

PROPERTY NAME:

Murray River Coal Project

CLAIM NAME(S) (on which work was done):

417453, 417448

COMMODITIES SOUGHT:

COAL

MINERAL INVENTORY MINFILE NUMBER(S),IF KNOWN:

093I 035

MINING DIVISION:

Liard Mining Division

NTS / BCGS (at centre of work):

55°00'54"N, 121°02'38"E
UTM Zone 10 (NAD83), 622865E, 6104600N

OWNER AND OPERATOR:

HD MINING INTL. LTD.

MAILING ADDRESS:

Suite 2288 – 1177 West Hastings Street
Vancouver, BC
V6E 2K3

REPORT KEYWORDS

Murray River, Bituminous, Coal, Gates Formation, Underground bulk sample

Section 2.3 remains confidential under the terms of the Coal Act Regulation, and has been removed from the public version.

http://www.bclaws.ca/civix/document/id/complete/statreg/251_2004

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EXECUTIVE SUMMARY

The Murray River Coal Property lies to the southwest of Tumbler Ridge in the northeast of British Columbia. It was acquired by Canadian Dehua International Mines Group Inc. (Dehua) from Kennecott Canada Exploration Inc. (KCEI) in the summer of 2009. In that summer they drilled 11 boreholes and conducted an assessment of previous work. This drilling and assessment was summarized by Norwest (2010), and the Norwest report was accepted as the Coal Assessment Report required by the Coal Act for the 2010 exploration year.

In July 2009, Dehua signed an agreement with Huiyong Holding Group Co., Ltd (Huiyong) to develop the property and build a 6,000,000 tonne per year underground coal mine and associated infrastructure on the property. The property is now operated by HD (Huiyong Dehua) Mining International Ltd (HD) which is currently responsible for filing assessment reports on the property.

HD have retained DMT Geosciences Ltd. (DMT) of Calgary, AB to assist them with regulatory compliance and in late fall of 2014 DMT was requested to assist in the preparation of the assessment reports for 2011, 2012 and 2013. Table 1 describes the work completed on the property in the three years of interest.

This report describes the work conducted in 2012, which included:

- Geotechnical Investigation for Decline Portal Cut
- Hydrogeology Baseline Drilling on CCR Site

Both of these programs were conducted by contractors on behalf of HD. The summary of work and apportioned costs is shown in Table 1.

Table 1: Summary of Work and Apportioned Costs

2012				
TYPE OF WORK IN THIS REPORT		**EXTENT OF WORK (in metric units)**	**ON WHICH CLAIMS**	**PROJECT COSTS APPORTIONED (incl. support)**
DRILLING (total metres, number of holes, size, storage location)				
Core	Total meters: Number of holes: Size: Storage location: Tumbler Ridge	331 10 NQ	417453, 417448	$350,000
			COST	**$350,000**
			TOTAL COST	**$350,000**

The work on the property was carried out to evaluate surface conditions for construction operations supporting the start-up of the Bulk Sample Program permitted by the Ministry of Energy and Mines. Almost all of the drilling conducted during 2012 was restricted to the surficial

materials or to short intercepts of undifferentiated bedrock rock below the aggregates to confirm the bedrock surface beneath the aggregates.

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1.0 INTRODUCTION

1.1 Location

The Project is located 12.5 km southwest of the town of Tumbler Ridge, British Columbia (Figure 1-). The coordinates are W 120°57'48"-121°7'38", N 54°59'42"-55°5'4". The property consists of 57 coal licences covering an area of 16,024 hectares and is situated on Crown land within the Peace River Regional District (PRRD).

The central position of the project area can be arrived at through going south for about 15 km from Tumbler Ridge to the Monkman Park Road, going west for 9 km to the Quintette Mesa mining field road, and going west for 4 km to the Quintette coal washery.

1.2 Accessibility and Infrastructure

The Project falls within the PRRD. The region has well established regional infrastructure to support resource activities, including forestry, oil and gas exploration, coal mining, wind energy. Existing infrastructure in the immediate vicinity of the Project include: BC Hydro transmission line; Pacific Northern Gas distribution system; CN Rail line; and forest service roads. The District of Tumbler Ridge and other regional communities have capacity to support growth.

The Murray River Coal Property lies about 1,184 km northeast of Vancouver and in the administrative district of the Tumbler Ridge (this area is part of the Peace River basin). The adjacent coal mines include Quintette, Perry Creek and Bullmoose. The exploration and development of the petroleum and natural gas in this area are active, and production wells of the natural gas and natural gas pipelines are distributed everywhere in the area. Some infrastructures owned by Quintette coal mine are still preserved in the Murray River Coal Property, including 13 km of belt conveying corridor from the Mesa mining area to the Quintette coal-washing plant closed for standby currently.

There are two Provincial highways from the Murray River Coal Property to Tumbler Ridge: going to the south from Chetwynd, then passing through No. 29 highway (95 km), or going through No. 97 highway from Dawson Creek to the southwest direction first, then passing No. 25 highway (Feller's Heights Road). The population of Tumbler Ridge is about 3,500, however, the infrastructure can accommodate 6,000 people.

The roads of Monkman Park and Quintette Mesa are in good service condition, and the two roads serve for the production of natural gas within the region. The Mast Creek Road traverses the western boundary of the property.

1.3 Physiography

The Murray River Coal Property is situated within the eastern foothills (Inner Foothills Belt) of the Rocky Mountains. The topography is comprised of a belt of hills and low mountains dominated by a series of northeast to southwest elongated ridges. Two major water courses, namely the Murray River in the south and east, and the Wolverine River in the north, flow through the project area and bisect the Inner Foothills Belt (Figure 1-2).

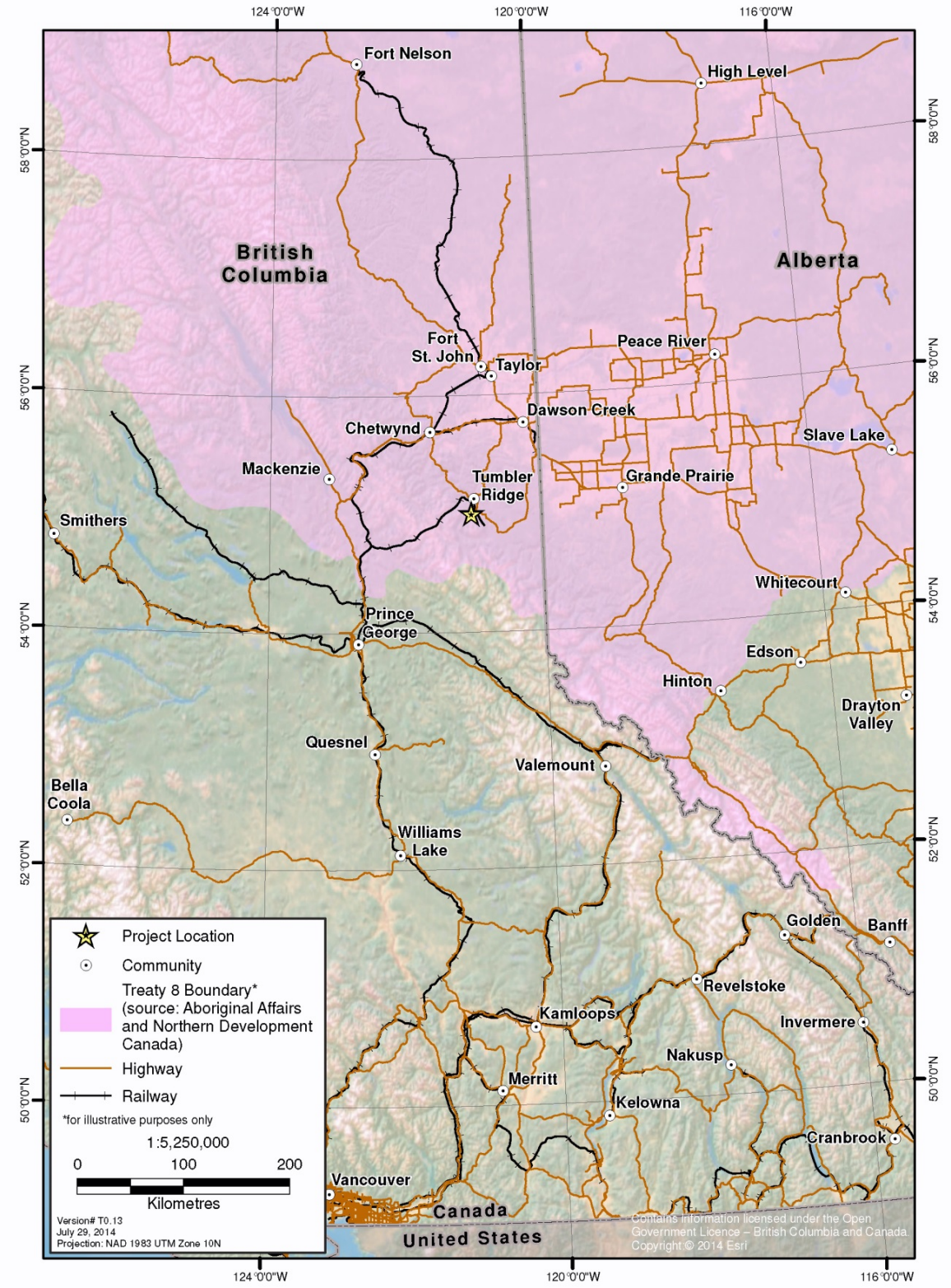

Figure 1-1: Location of the Murray River Project

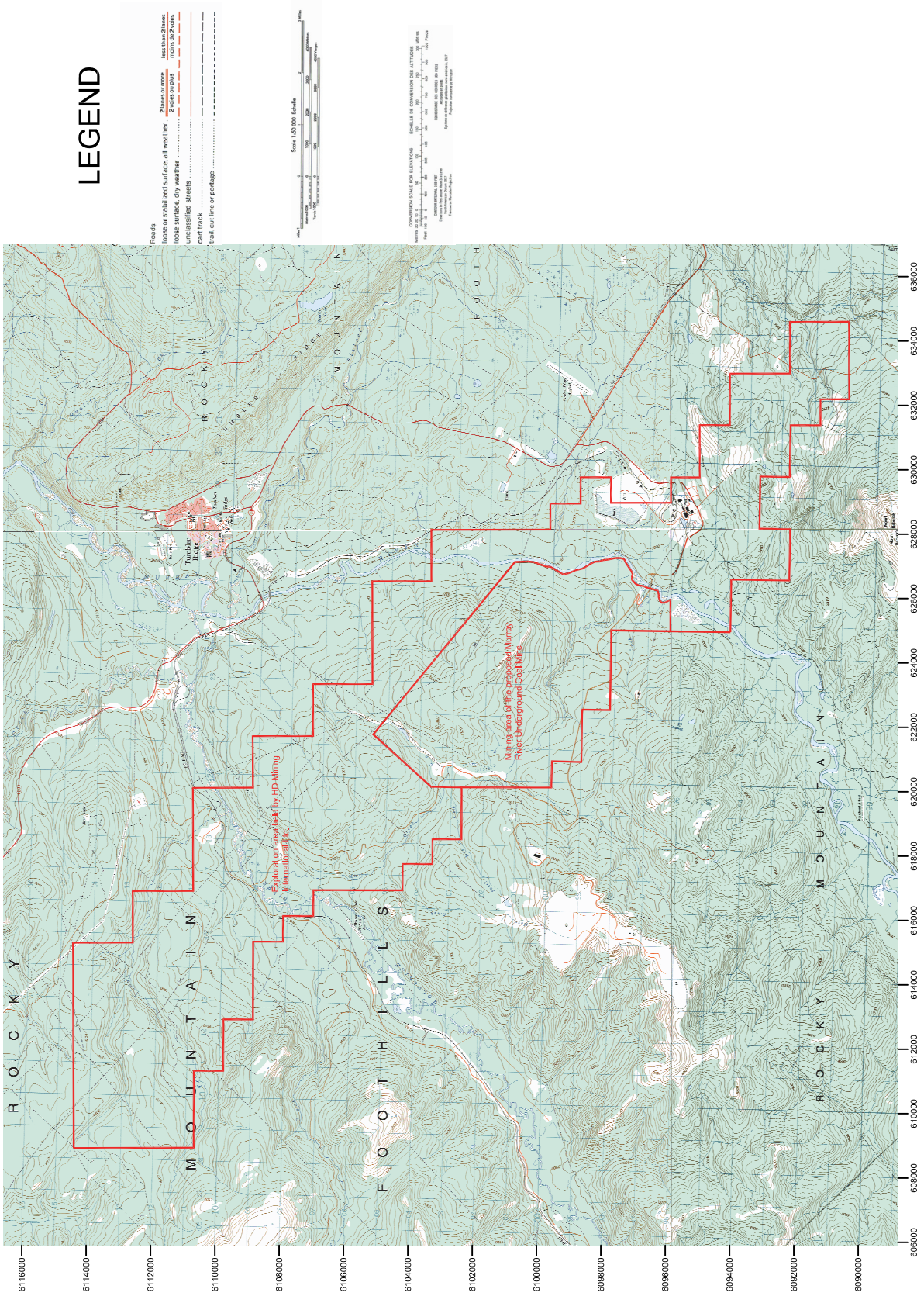

Figure 1-2: Topographic Map of the Exploration Area in the Murray River Coal Property

1.4 Climate

The climate in this area is characterized by a long, cold winter, a warm spring, and a short, cool summer because of the influences of the Rocky Mountains, the Pacific warm current, and the dry cold air from the northern polar region.

The average monthly temperature changes in the year are from -7.2°C to 15.2°C. The highest temperature recorded in history is 34°C and the lowest temperature of the year was -46.0°C, which are typical temperatures in the north east of British Columbia. The average temperatures in July and January in Tumbler Ridge are respectively 21°C and -5°C. Occasionally temperatures between -15 and -30°C occur in winter, generally from January to March.

The average annual rainfall in the area is 334 mm, and the snowfall is 1.85 m. Compared with the other regions in the Murray River Coal Property, the summer in the mountainous areas is cool and with heavy rainfall, and the winter is cold. Ice areas can be seen all year around, with continuous snow accumulation in winters between October and June. The dominant wind direction is southwest wind, and the wind with velocity of over 20 km/h is quite common in the top of the mountain ridge and the higher areas.

1.5 Mineral Tenure, Exploration and Permitting History

1.5.1 Mineral Tenure

The Murray River property consists of 57 coal licenses covering an area of 160 km2. The proposed underground mine and surface facilities are within 19 of the licence areas in the southeast portion of the licence block (Table 1-1 and Figure) with a total area of 37.45 km^2. As part of the Mines Act permitting process, HD Mining International Inc. (HD Mining) will seek to convert these licenses to a coal lease.

1.5.2 Exploration History

Previous exploration in the area was conducted by various major oil and gas companies in the 1970s (Lortie 2010), Quintette Coal Limited (Quintette) and more recently in 2006 and 2007 by Kennecott Coal Exploration Inc. (Kennecott). The exploration programs in the 1970s were generally regional in nature, comprised of widely spaced seismic lines and drilling of a small number of primarily oil and gas wells. These programs helped Quintette and Kennecott identify target areas for more detailed coal exploration and eventual mining. The target seams for the Project are part of the Gates Formation (Fort Saint John Group).

Kennecott's exploration program is the only known coal-specific exploration program previously conducted within the Murray River licence area. It consisted of one rotary (Lane 2006) and three core holes (BC MEMNG 2006) (two others were abandoned), surface mapping and interpretation of two seismic lines. Because of difficulties encountered during drilling, only one core hole was completed through the Gates Formation.

Du Pont completed two holes in 1979 west of the Murray River property as a preliminary investigation of the Gates Formation coal seams. One hole did not penetrate into the zone on contact between upper Gates and Hulcross formations due to the interception of a postulated fault zone (Du Pont of Canada Exploration Ltd. 1980).

Table 1–1: Claims Held by Dehua international forming the Murray River Coal Project

Coal Property No.	Map Sheet No.	Coal Property No.	Map Sheet No.	Coal Property No.	Map Sheet No.
417404	093P014	417423	093P005	417442	093P005
417405	093P014	417424	093P005	417443	093P005
417406	093P014	417425	093P005	417444	093P005
417407	093P014	417426	093P005	417445	093P005
417408	093P014	417427	093P005	417446	093P005
417409	093P014	417428	093P005	417447	093I095
417410	093P014	417429	093P005	417448	093P005
417411	093P014	417430	093P005	417449	093I095
417412	093P014	417431	093P005	417452	093I095
417413	093P014	417432	093P005	417453	093I095
417414	093P014	417433	093P005	417454	093I095
417415	093P014	417434	093P005	417455	093I095
417416	093P005	417435	093P005	417456	093I095
417417	093P015	417436	093P005	417457	093I095
417418	093P005	417437	093P005	417458	093I096
417419	093P005	417438	093P005	417459	093I096
417420	093P015	417439	093P005	417460	093I096
417421	093P005	417440	093P005	417461	093I096
417422	093P005	417441	093P005	417462	093I096

In 2009, Canadian Dehua International Mines Group Inc. obtained the Murray River coal property. Detailed exploration consisting of 12 drill holes was carried out in 2009 and 2010, focusing on the central part of the property (about 37.45 km^2). HD Mining took over responsibility for the exploration program in August 2010, and additional exploration was performed on the property. In total, 20 holes (17,850 m) have been drilled; two of the holes were tested for hydrogeologic properties.

1.5.3 Permitting History

As part of exploration of the coal deposit, HD Mining has received the following approvals from the BC Government to mine a 100,000 tonne bulk sample:

- Coal Exploration Permit CX,9,44 (BC Ministry of Energy, Mines, and Petroleum Resources), initially issued in December 2010, and amended in March 2012 to approve the Bulk Sample program;
- Occupant Licence to Cut (BC MFLNRO), issued in May 2011 to support exploration activities;
- Approval AE105825 under the BC Environmental Management Act (BC MOE), issued in February 2012, authorizes temporary discharge of effluent from the Murray River Bulk Sample initial surface preparation construction activity;

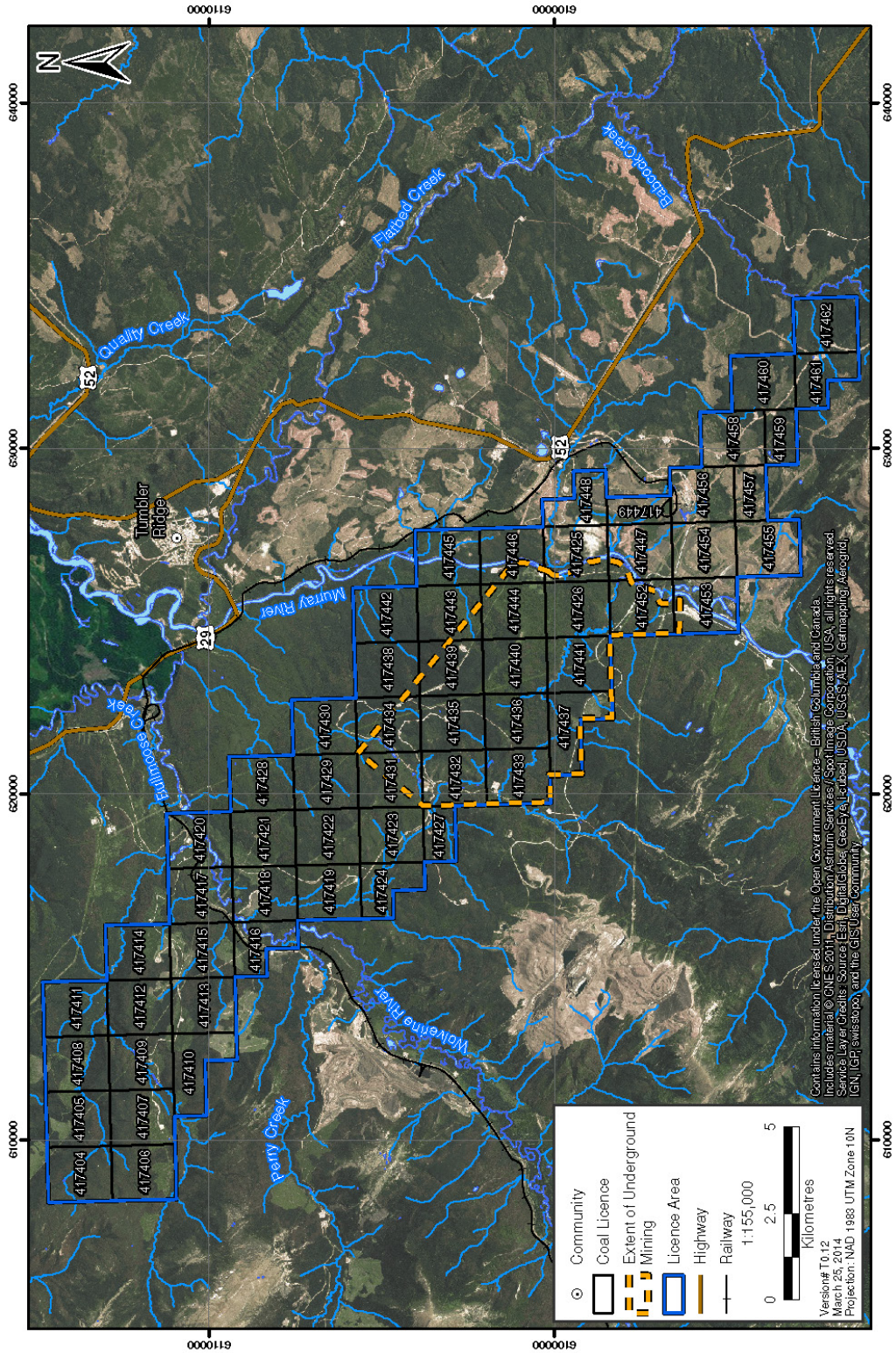

Figure 1-3: Murray River Coal Property and Proposed Underground Mining Area

- Approval AE105878 under the BC Environmental Management Act (BC MOE), issued in March 2012, authorizes discharge of effluents from the Murray River Bulk

- Sample construction and operation activities; and

- Permit 106666 under the BC Environmental Management Act (BC MOE), issued in October 2013, replacing Approval AE105878; authorizes discharge of effluents from the Murray River Bulk Sample construction and operation activities.

The purpose of the Bulk Sample program is to test the coal for use as a coking coal and to perform coal washability testing. The raw coal mined for the bulk sample will be shipped by train directly to the port in Prince Rupert for testing to be completed overseas.

In 2012 and into 2013, HD Mining completed surface preparations to mine the bulk sample. Following approval of mining equipment, underground development of a decline began in January 2014.

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2.0 GEOLOGY

2.1 Regional Setting

The Murray River property is located within the Peace River Coalfield (PRC) in the eastern foothills of the Canadian Rocky Mountains of northeastern BC. The western margin of the Foothills Belt is classified as the easternmost major thrust fault that emplaced Paleozoic strata over Mesozoic strata. The eastern margin is a series of echelon thrust faults that separate the Foothills from the gently dipping strata of the Alberta Plateau (Holland 1976). The Foothills Belt is characterized by folded and faulted Mesozoic sediments. The deformation within the Foothills Belt is variable – mostly decreasing in complexity toward the eastern margin. Deformation within the Rocky Mountains involves complicated folding and faulting. Regional axes for folding and faulting trend northwest, dipping to the southeast. In the Foothills Belt, dips tend to be 20° or less with local folds and undulations significantly modifying this value.

In the PRC there are two main coal-bearing units: the Gates Formation and the Gething Formation (British Columbia Geological Survey n.d.). Both Lower Cretaceous units were subjected to varying degrees of burial prior to the Laramide deformation and mountain-building episodes that took place approximately 40 to 70 million years ago when the Pacific and North American plates collided. The Laramide Orogeny increased the overall maturity of the coal seams. Based on drill core information from the neighbouring Quintette mine (immediately adjacent north of the Murray River Forest Service Road), coal seams of the Gates Formation can be comprised of up to 10 separate seams and the average cumulative thickness of the coal seams is as high as 17 metres.

2.2 Stratigraphy

The regional geology and stratigraphy of the PRC is provided in Figure 2-1 and Figure 2-2. Descriptions of the formations are provided below. The information is sourced primarily from Johnson (1985).

2.2.1 Moosebar Formation

The basal sequence of the Moosebar Formation is a dark grey to black marine shale with sideritic concretions, bentonite, and siltstone. The upper parts comprise banded or fissile sandy shale, very fine-grained sandstone, and sandstone intercalated shale. This transition is a pro-deltaic (highstand systems tract) transition from marine sediments to the massive continental sandstones that mark the overlying Gates Formation. The Bluesky Member is a chert pebble conglomerate that is found locally at the base of the Moosebar Formation.

2.2.2 Gates Formation (Fort St. John Group)

The Gates Formation conformably overlies the Moosebar Formation. The lower portion of the formation is termed the Quintette or Torrens member and consists of massive, light gray, mediumgrained sandstone, with minor carbonaceous and conglomeratic horizons.

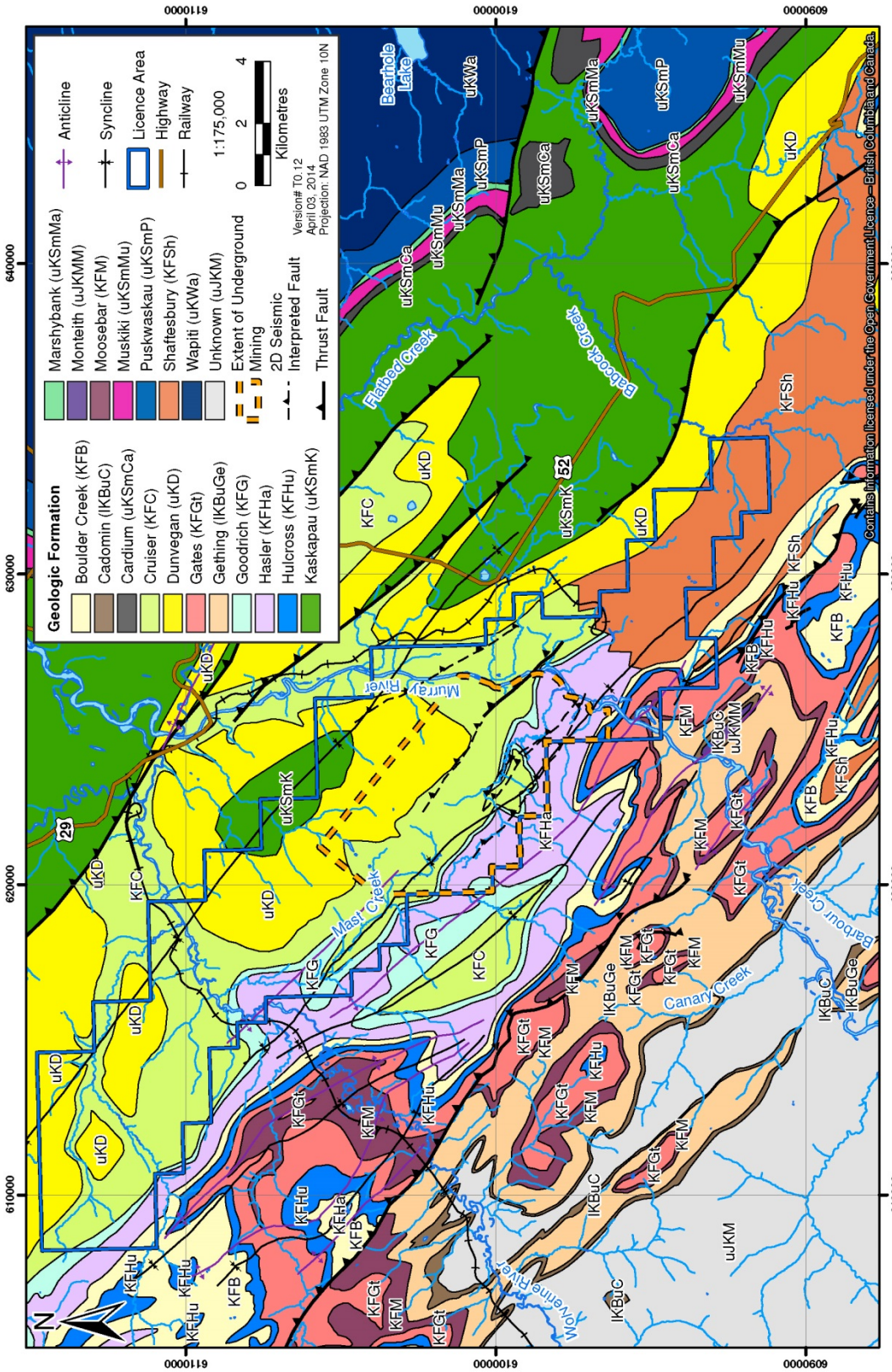

Figure 2-1: Regional Geological Setting of the Murray River Project

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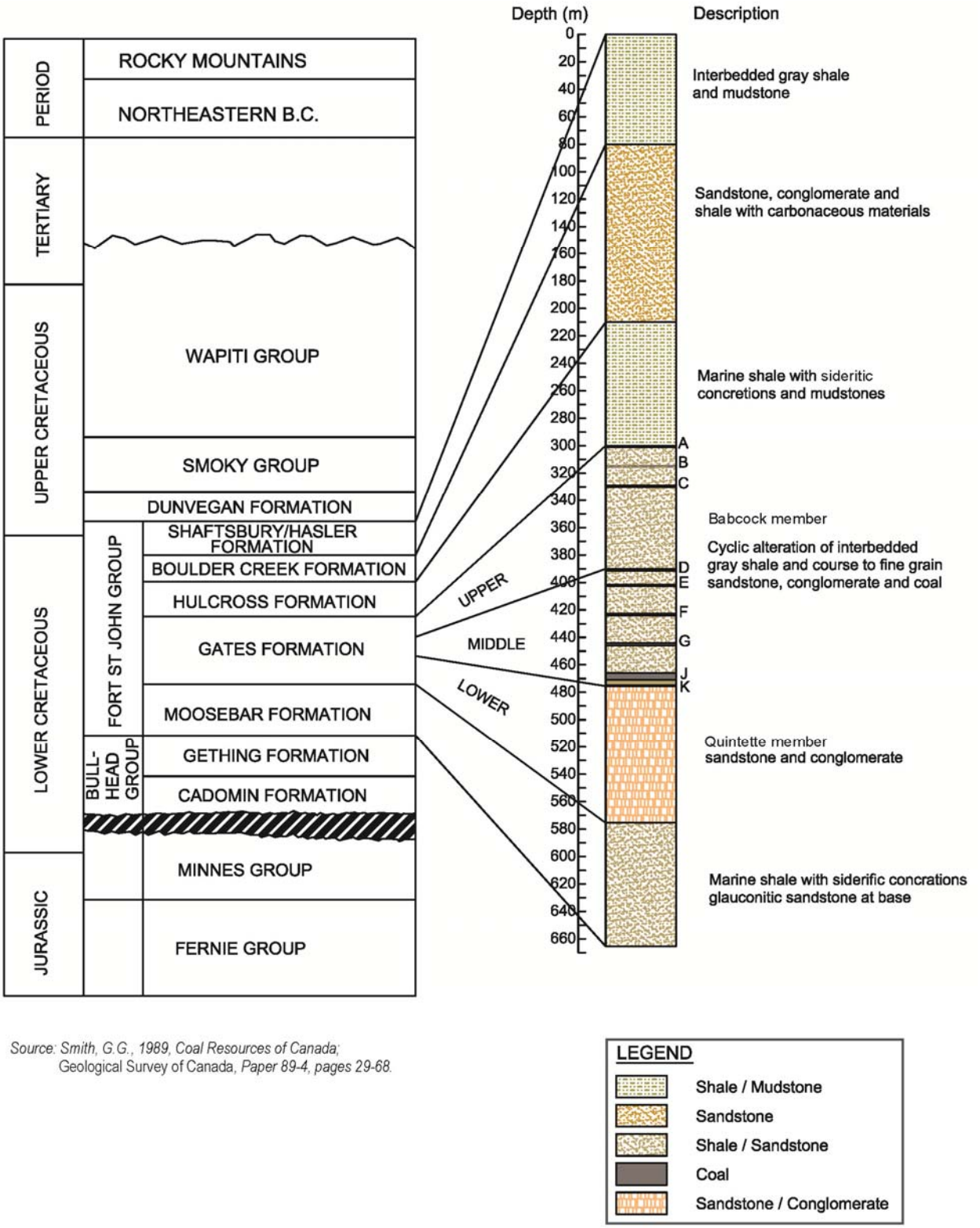

Source: Smith, G.G., 1989, Coal Resources of Canada; Geological Survey of Canada, Paper 89-4, pages 29-68.

Figure 2-2: Typical Stratigraphic Column in the Murray River Project Area

The Quintette member is overlain by several cyclical sequences of coal deposition that occur over a stratigraphic interval of approximately 80 m collectively referred to as the Middle Gates. Each cycle normally begins with laminated, medium- to fine-grained sandstone at the base, transitioning to carbonaceous shale and coal. Coal seams are thickest and more continuous in the lowermost cycle: the D through K seams are economical to mine. Individual coal seams within the higher cycles may coalesce to form a single seam, e.g., the G and I seams are typically referred to as the G/I seam. The lower portion of the Upper Gates is massive, medium- to coarse-grained sandstone and overlain by a predominantly shale sequence containing two to three poorly developed coal seams (A to C) intercalated with sandy shale and very fine sandstone. A very thin bed of chert pebbles with ferruginous cement marks the contact of the Upper Gates with the overlying marine sediments of the Hulcross Formation.

2.2.3 Hulcross Formation

The Hulcross Formation is comprised predominantly of dark grey marine shale approximately 100 metres thick. The base of the Formation is more homogeneous and arenaceous, and can contain sideritic concretions. The upper portion of the Formation is dominated by thinly laminated interbeds of siltstone and very fine-grained sandstone. A few kaolinitic beds have also been observed. The Hulcross Formation is usually distinguished from the Moosebar Formation by the absence of glauconitic sandstones at the base of the Hulcross.

2.2.4 Boulder Creek Formation

The Boulder Creek Formation is a 130 to 200 metre thick sequence of shale, greywacke, and conglomerate that conformably overlies the Hulcross Formation. The Boulder Creek Formation is a coarsening upward sequence with massive conglomerate and conglomeratic sandstone in the upper portions of the Formation and alternating medium- to fine-grained sandstones and shale in the middle of the Formation (Du Pont of Canada Exploration Ltd. 1980).

2.2.5 Hasler Formation

The Hasler Formation is predominantly dark grey marine shale with sideritic concretions and a minor sandstone and pebble conglomerate component; the basal layer is frequently pebbly (British Columbia Ministry of Energy and Mines 2011).

Above the Hasler Formation, the Goodrich and Cruiser Formations form the uppermost units in the Fort St. John Group. According to regional geology maps, the Hasler, Goodrich, and Dunvegan formations comprise the majority of bedrock outcrop on the property.

[redacted]

3.0 HYDROGEOLOGY BASELINE DRILLING ON CCR SITE

Table 3–1 shows the details of the geotechnical investigation for the hydrogeological baseline investigation at the CCR site.

Table 3–1: Summary of the Details of the CCR Site Hydrogeological Investigation

Approval number	12-1640549-1018
Period	May 2012
Claims	417448
Number of boreholes	5
Total meters	752
Size	NQ
Core storage location	Drill Site
Cost	$150,000

ERM Rescan hydrogeologists supervised drilling programs on four occasions from 2011 to 2013, with the objective of logging the recovered materials for hydrogeologic properties, and installing instrumentation for further hydrogeologic characterization. Drilling targets were selected largely based on the locations of proposed mine infrastructure with the potential to interact with the groundwater environment. A number of drilling targets were also set up-gradient of the proposed infrastructure and in the down-gradient receiving environment.

Cuttings and core recovered from drilling were logged to characterize hydrogeologic aspects of the intercepted lithologies. Overburden materials were logged for grain size distribution, plasticity, moisture content, and other properties as appropriate. Recovered rock core logging focused on fracture characterization (textural classification, rock quality designation, weathering grade, fracture type, healing, and infill).

In May 2012, five boreholes were drilled by Geotech Drilling Services Ltd. with monitoring well installation. A rotary air hammer configuration was used to advance the boreholes. Boreholes targeted the perimeter of the bulk sample waste rock facility and storage ponds in the Underground Mine Zone.

Six boreholes were drilled at the CCR Site by Mud Bay Drilling in October 2012. A twinned borehole configuration (one shallow and one deep borehole side-by-side) was established at three sites, for monitoring well installations. The shallow boreholes were drilled using a solid stem auger in the overburden and a rotary air hammer in the shallow bedrock. A diamond mud rotary drilling method (NQ rods) was used to advance the deep boreholes. Packer tests were conducted in the deeper boreholes.

Table 3–2 lists the boreholes, coordinates diameters and depths achieved. Figure 3.2-1 in Appendix 1-D attached shows the locations of all the monitoring wells, including those listed in Table 3–2.

Table 3–2: Hydrogeology Borehole Locations and Depths

Hole ID	Collar Location, Zone 10 U (NAD83)			Diameter (mm)	EOH (mbgs)
	Northing (m)	Easting (m)	El. (masl)		
MW-H17	6097925	625520	829.300	105	8.50
MW-H18	6097953	625740	830.877	105	17.06
MW-H19	6098131	625663	832.574	105	8.70
MW-H22	6096815	624960	783.572	105	25.10
MW-H23	6096618	624942	784.898	105	25.10
MW-H24			Abandoned		
MW-H24A	6099756	628116	831.200	76	67.10
MW-H24B	6099756	628119	831.100	105	8.60
MW-H24C	6099625	627954	824.080	96	13.72
MW-H25A	6099615	627334	765.300	76	80.00
MW-H25B	6099615	627332	765.300	105	6.10
MW-H26A	6098990	627478	791.220	76	64.30
MW-H26B	6098987	627485	791.350	105	6.10

Details of the work are described in Appendix 1-A through 1-D. Appendices 1-A to 1-C contain the field reports associated with the drilling and testing programs carried out in 2012.

A hydrogeological report was compiled by ERM Rescan in 2014 summarising all of the hydrogeological modelling and testwork completed to that date for the project. This report is attached as Appendix 1-D.

4.0 GEOTECHNICAL INVESTIGATION FOR DECLINE PORTAL CUT

In July and August, 2012, Golder Associates Ltd. (Golder) supervised a geotechnical investigation in support of decline portal cut design and portal structure development for the proposed Murray River Coal Project near Tumbler Ridge, BC. Details are shown in Table 4–1 below.

Table 4–1: Summary of Investigation Details

Approval number	14675-30 File: 1640549
Period	July - August 2012
Claims	417453
Number of boreholes	5
Total meters	91
Size	NQ
Number of test pits	5
Core storage location	HD Mining's core storage yard in Tumbler Ridge
Cost	$200,000

The field investigation consisted of drilling five boreholes (BH12-01 to BH12-05) and excavating five test pits (TP12-01 to TP12-05) into surficial materials. No coal seams were intersected. Details of the boreholes and test pits are provided in Table 4–2.

Table 4–2: Location of Boreholes and Test Pits

Hole ID	Collar Location, Zone 10 U (NAD83)			Diameter (mm)	EOH (mbgs)
	Northing (m)	Easting (m)	El. (masl)		
BH12-01	6,096,943.72	624,890.98	790.220	96	26.55
BH12-02	6,096,932.69	624,789.17	809.660	96	31.38
BH12-03	6,096,785.38	624,885.79	782.790	No Rock Core	33.83
BH12-04	6,096,922.89	624,953.47	780.980	96	28.04
BH12-05	6,096,869.87	624,885.46	783.790	96	29.90
TP12-01	6,096,881.86	624,794.27	794.484	NA	6.00
TP12-02	6,096,888.68	624,816.25	792.357	NA	8.50
TP12-03	6,096,854.03	624,792.28	791.915	NA	9.80
TP12-04	6,096,743.73	624,787.42	791.463	NA	9.30
TP12-05	6,096,631.30	624,833.48	787.100	NA	5.50

The drilling portion of the field investigation was conducted from July 31 to August 7, 2012, with a truck mounted Mobil 53 drill rig supplied and operated by Sea to Sky Drilling of Coquitlam, BC. The drilling program advanced to depths ranging between 26.55 m and 33.83 m below existing ground surface (mbgs). Standard Penetration Tests (SPTs) were conducted at selected depths

using a 51 mm diameter drive-open split spoon sampler, to obtain soil samples and provide an index measure of relative density and/or consistency of the soil. Standard piezometers were installed in three of the five boreholes.

The test pits were excavated on August 10 to 12, 2012 to depth ranging from 6.0 m to 9.8 m.

The report on the investigation prepared by Golder is attached as Appendix 2

5.0 CERTIFICATES

5.1 Peter Cain, Ph.D., P.Eng.

As the co-author of this report entitled "Coal Assessment Report for the Year 2012 for the Murray River Coal Property, Peace River Coalfield, British Columbia" dated \July 31, 2015 ("the Report"), I, Peter Cain, do hereby certify that:

1. I am employed by and carried out this assignment for:

   DMT Geosciences Ltd.,
   Suite 415 – 708 11th Avenue SW,
   Calgary, Alberta, T2R 0E4, Canada.
   Telephone: (403) 264-9496
   Fax: (403) 263-7641

2. I hold the following academic qualifications:

   - Bachelor of Science – University of Wales, University College Cardiff, 1977
   - Doctor of Philosophy – University of Wales, 1982

3. I am a registered member of the:

   - Association of Professional Engineers and Geoscientists of British Columbia, Licence - 37663.
   - Association of Professional Engineers, Geologists and Geophysicists of Alberta, Member - 63684.
   - Association of Professional Engineers and Geoscientists of Saskatchewan, Licence - 25843.

4. I have worked as a mining engineer for a total of 38 years since my undergraduate degree from university. I have worked in grassroots to advanced stage mining projects. I have experience with underground and open pit and quarry operations from the pre-production stage to closure. I have the following experience in coal and coal mining:

   - I hold a First Class Certificate of Competency – Underground Coal - from the Province of BC.
   - I hold an Underground Coal Mine Manager's Certificate from the Province of Alberta.
   - Preparation of a coal resource/coal reserve estimate of the PT Senemas Energindo Mineral coal mine in Kalimantan, Indonesia for Agritrade Resources Ltd (2012)
   - Completed a due diligence review of coal lands owned by Chugach Alaska Corporation in the Chugach hills for Canada Coal Inc.
   - Engineering work on the feasibility study for a new underground coal mine development near Cucuta in Norte de Santander Department in northwest Colombia for Compañia Minera Cerro Tasajero (2010-2011).
   - Engineering lead for DMT on the PT Indika Energy technical team working on the potential acquisition of PT Bayan Resources, Citibank as financial advisor (2010).

- Engineering lead for DMT on the PT Indika Energy technical team working on the potential acquisition of PT Berau, Citibank as financial advisor (2009).
- Due diligence review of certain coal assets in Cordoba Department, Colombia, on behalf of Prime Natural Resources.
- A technical review of various coal assets in Norte del Santander Department, Colombia on behalf of Vitol SA.
- Technical assistance to several coal mines in the Cucuta area in Norte del Santander Department, Colombia on behalf of a potential investor. Included safety audits and operational assistance as well as reviewing the design of exploration projects.
- Review of certain coal assets on the island of Borneo on behalf of Indika Energy Inc. (2007-2008) including the South Gobi and PT Berau properties.
- Technical due diligence on the assets of the Taiyuan Sanxing Coal Gasification (Group) Co Ltd. owned by China Coal Energy Holdings Ltd. of Hong Kong. Completed for Pine Street Capital (Elliott Advisors (HK) Ltd.

5. Prior to joining DMT I spent six months designing an underground coal mine in Iran and two months writing an NI 43-101 Technical Report on coal mining properties in Colombia.
6. From 2000 to 2004 I was Mine Manager for Grande Cache Coal Corporation responsible for all aspects of mine design, planning and costing for their No. 7 Mine, including preparation for a successful stock market launch in 2004. Prior work experience includes:

1998 – 2000	**Smoky River Coal Limited**	Senior Geotechnical Engineer.
1993 – 1998	**NRCan – CANMET-CRL**	Group Leader - Strata Control.
1987 – 1993	**Jacques Whitford and Associates Ltd.**	Senior Mining Engineer.
1986 – 1987	**Webster Machine Company Ltd.**	Mining Engineer.
1982 – 1986	**NRCan – CANMET-CRL**	Research Scientist.

Dated at Calgary, AB. this 31st Day of July, 2015.

Peter Cain, Ph.D., P.Eng.
Director, Engineering and Consulting
DMT Geosciences Ltd.

APPENDIX 1-A

"Summary of Field Activities, April 30 to May 15, 2012" Memorandum to HD Mining International from Rescan Environmental Service (now ERM Rescan) dated May 16, 2012

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Rescan™ Environmental Services Ltd.

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ATTENTION:	**Jody Shimkus, HD Mining, Vice President, Environmental and Regulatory Affairs**
FROM:	**Anne Currie, Rescan Project Manager** **Korina Houghton, Rescan Project Coordinator**
DATE:	**16 May 2012**
PROJECT:	**Murray River Coal Project**
PROJECT #:	**0791-02-03-05**
TRIP DATES:	**April 30 – May 15, 2012**
PERSONNEL:	**Rusto Martinka (30 April to 15 May)**
ASSISTANTS:	**Jaclyn Browman (9 May to 15 May)**

OBJECTIVES:

Hydrogeology

- To drill additional six monitoring wells:
  - three at the north waste-rock storage area, and three at the south bulk storage area.
- To complete the spring 2012 groundwater quality sampling assessment.

TASKS:

Monday, April 30, 2012

- Rusto Martinka arrived in Tumbler, met with HD mining and checked in to the hotel.
- Conducted a site visit late in the afternoon.
- Completed a safety check-in with Korina Houghton.

Tuesday, May 1, 2012

- Initiated drilling program with GeoTech Drilling.
- Both trucks and the drill rig got stuck at the access roads due to soft/saturated road conditions
  - A local contractor (Roy Barrett) was retained to improve the road

access and to pull the trucks and the rig out of the mud.

- Drilling at monitoring well location MW-H19 started following a 'kick-off' safety meeting that afternoon.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Wednesday, May 2, 2012

- Continued to drill MW-H19; well was installed in the afternoon.
- Moved to location MW-H18 and began drilling.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Thursday, May 3, 2012

- Completed the drilling and installation of monitoring well MW-H18.
- Began to drill monitoring well MW-17.
- Went to assess the site access to existing monitoring wells.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Friday, May 4, 2012

- Completed the drilling and installation of monitoring wells MW-H17.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Saturday, May 5, 2012

- No drilling (the rig down).
- Worked on well development of the newly installed wells.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Sunday, May 6, 2012

- Rusto and GeoTech attended a visitor orientation at the TECK Coal Mine facility to access the south area road.
- Began to drill monitoring well MW-H24.
- At approximately noon, the drillers punctured a small hydrogen sulphide (H2S) pocket at a depth of 87 feet (26.5 m).
  - Halted drilling
  - Pulled drill rods
  - Back-filled the borehole with cuttings and capped at the surface using a bentonite seal
- Contacted Korina Houghton and Freddie Li regarding the near miss.

Monday, May 7, 2012

- Completed an incident/near miss report on the H_2S near miss.
- Participated in a conference call safety meeting with Rescan, GeoTech, and HD Mining.
- Drilling resumed in the afternoon at monitoring well location MW-H23.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Tuesday, May 8, 2012

- Completed the drilling and installation of monitoring well MW-H23.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Wednesday, May 9, 2012

- Drilled and installed monitoring well MW-H22.
- This completed the drilling program, noting that because the well at location MW-H24 was abandoned due to the H_2S hazard, only five monitoring wells in total were installed: three at the north area and two at the south area.
    - Installation of an additional monitoring well in a previously drilled open borehole TH3 (Golder geotechnical drilling) was unsuccessful due to borehole sloughing/bridging.
- Went to pick up Jacklyn Browman (Rescan) at the Dawson Creek airport.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Thursday, May 10, 2012

- Jaclyn completed the safety orientation at Quented coal mine.
- Encountered access issues (fallen trees) near River Road.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Friday, May 11, 2012

- HD Mining had the access roads cleared near River Road.
- Monitored and sampled wells.
- More access issues (fallen trees) near upper Haul Road.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Saturday, May 12, 2012

- HD Mining ad the access roads near upper Haul Road cleared.
- Groundwater monitoring and sampling.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Sunday, May 13, 2012

- Groundwater monitoring and sampling.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Monday, May 14, 2012

- Groundwater monitoring and sampling.
- Completed the groundwater monitoring and sampling program.
- Shipped water samples and equipment to Vancouver.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Tuesday, May 15, 2012

- Rusto and Jaclyn drove to Fort St. John and then flew back to Vanvouver.

SUMMARY:

The drilling and installation of five monitoring wells and sampling/monitoring of all 16 monitoring wells in May 2012 baseline assessment was successful. Except for abandoning drilling of MW-H24 due to safety hazards (i.e. H_2S exposure), all work was completed three days ahead of the schedule. Minor delays were experienced due to equipment problems (drill rig) and poor/obstructed site access. Monitoring wells MW-H3A/B and wire piezometer MW-H7 were not sampled/monitored due to snow covered access road. The groundwater samples were shipped directly to the laboratory.

Hazardous H_2S gas was encountered while drilling location MW-H24. All work was stopped following the incident and the safety issue was mitigated. The incident was investigated and a full safety report was completed.

A technical summary of the work completed is provided below:

- In total, five monitoring wells were installed: three at the north area and two at the south area.
- Sampled and monitored 16 monitoring wells (11 existing and 5 newly installed).

Fieldwork Photographs

Plate 1. Poor road conditions into the work site; stuck drill rig and the truck.

Plate 2. Drilling monitoring well MW-H19.

Plate 3. Drilling monitoring well MW-H22.

APPENDIX 1-B

"Summary of Field Activities, August 20 30 to August 27, 2012" Memorandum to HD Mining International from Rescan Environmental Service (now ERM Rescan) dated August 28, 2012

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Rescan™ Environmental Services Ltd.

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ATTENTION:	**Jody Shimkus, HD Mining, Vice President, Environmental and Regulatory Affairs**
FROM:	**Anne Currie, Rescan Project Manager** **Korina Houghton, Rescan Project Coordinator**
DATE:	**28 August 2012**
PROJECT:	**Murray River Coal Project**
PROJECT #:	**0791-007-24-12**
TRIP DATES:	**August 20 – August 27, 2012**
PERSONNEL:	**Rusto Martinka**
ASSISTANTS:	**Bea Paton**

OBJECTIVES:

Hydrogeology

- Sample and monitor hydrogeologic locations at and surrounding the project site.
- Conduct hydrogeological testing (slug testing) on five wells installed in May 2012.
- Collect geographical spatial data (GPS survey) of all hydrogelogic locations and hydrology stations.

Geochemistry

- Sample the four leach pad/barrels.

TASKS:

Monday, August 20, 2012

- Rusto Martinka arrived in Tumbler Ridge, checked into the hotel, picked up equipment, and made site visits to the north site.
- Completed a safety check-in with Korina Houghton.

Tuesday, August 21, 2012

- Bea Paton arrived in Tumbler Ridge.

- Conducted a kick-off health and safety meeting.
- Made a site visit to locations off the River Road; identified fallen trees obstructing the access roads.
- Sampled and slug tested location MW-H23 and -H22.
- Sampled location MW-PNB.
- Monitored location MW-H16
    - A local contractor (Roy Barrett) was retained to improve the road access and to pull the trucks and the rig out of the mud.
- Drilling at monitoring well location MW-H19 started following a 'kick-off' safety meeting that afternoon.
- Sampled the four leach barrels.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Wednesday, August 22, 2012

- Directed faller to clear trees to allow access from River Road.
- Sampled location MW-H20 and monitored locations MW-H21 and -H13.
- Sampled locations MW-H17, -H18, and -H19.
- Slug tested location MW-H17.
- Sampled location MW-H5.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Thursday, August 23, 2012

- Surveyed locations MW-H2A/B and -H7, and hydrology stations MH-1 and -2.
- Sampled locations MW-H2A/B, -H15, and SHAFT.
- Assessed site access to existing monitoring wells.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Friday, August 24, 2012

- Monitored location MW-H7.
- Continued to survey monitoring wells.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Saturday, August 25, 2012

- Monitored location MW-H12.
- Slug tested location MW-H18.
- Surveyed remaining monitoring wells and hydrology stations.
- Bea Paton departed Tumbler Ridge as her work was completed.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Sunday, August 26, 2012

- Health and Safety meeting at the south site with BCEGI crew.
- Additional static water level monitoring and surveying (Golder wells).
- Completed the slug test at location MW-H18 and additional surveying.

- Completed safety check-ins with Freddie Li and Korina Houghton.

Monday, August 27, 2012

- Shipped equipment and water samples.
- Checked out the hotel.
- Went to the BCEGI office to drop of keys.
- Drove to Fort St John airport, dropped off the truck, and flew back to Vancouver.
- Completed safety check-ins with Korina Houghton.

SUMMARY:

The sampling, monitoring and surveying of all hydrogeologic locations and hydrologic stations were successful. Similarly, hydrogeologic testing of monitoring wells installed in May 2012 was successful.

Minor delays were experienced due to locked gates at the north and south site snd fallen trees off River Road. The groundwater samples and leach barrels samples were shipped directly to the laboratory in Burnaby.

Hazardous H_2S gas was not encountered during the August field work. Operation of an all-terrain vehicle was completed safely and effectively.

A technical summary of the work completed is provided below:

- Five monitoring wells, three at the north area and two at the south area, were slug tested successfully.
- Sampled, monitored and surveyed 16 monitoring wells.
- Sampled leach barrels.
- Surveyed five hydrology stations.

Hydrogeology August 2012 Fieldwork Photographs

Plate 1. Groundwater sampling at location MW-H18.

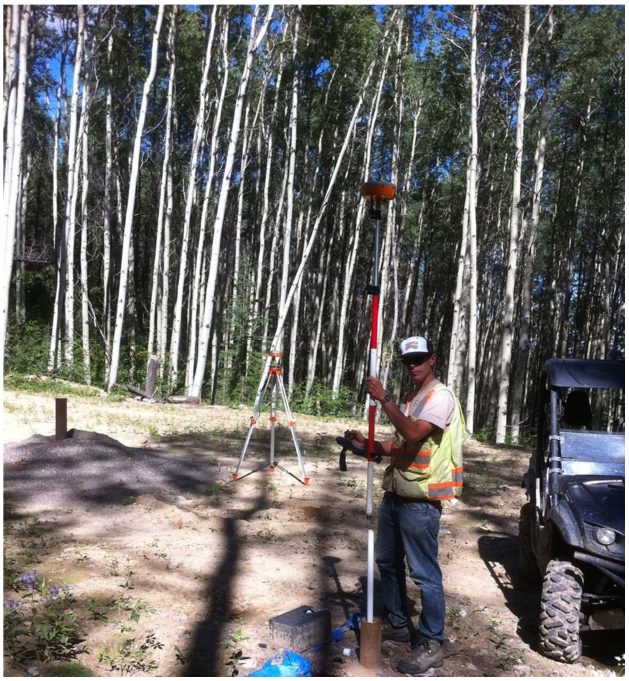

Plate 2. Surveying monitoring well MW-H13.

Plate 3. Monitoring vibrating wire piezometer MW-H12.

Plate 4. Sampling Leach Barrels.

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APPENDIX 1-C

"Summary of Field Activities, October 11 to November 1, 2012" Memorandum to HD Mining International from Rescan Environmental Service (now ERM Rescan) dated November 6, 2012

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Rescan™ Environmental Services Ltd.

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ATTENTION:	**Jody Shimkus, HD Mining, Vice President, Environmental and Regulatory Affairs**
FROM:	**Anne Currie and Jason Rempel, Rescan Project Managers** **Korina Houghton, Rescan Project Coordinator**
DATE:	**November 6, 2012**
PROJECT:	**Murray River Coal Project**
PROJECT #:	**0791-007-24-13**
TRIP DATES:	**October 11 – November 1, 2012**
PERSONNEL:	**Rusto Martinka and Gerry Papini (four days only)**
ASSISTANTS:	**Worked with Mud Bay Drilling**

OBJECTIVES:

Hydrogeology

- Drill groundwater wells to support baseline studies around the CCR area.
- Conduct hydrogeological testing; packer tests of deep wells (>200') and slug tests of shallow wells (<20').
- Collect water samples from the new wells and the five existing wells located at the north and south sites.

TASKS:

Thursday, October 11, 2012

- Rusto Martinka and Gerry Papini arrived in Tumbler Ridge, organized equipment and met with HD staff for a safety orientation.

Friday, October 12, 2012

- Met with drillers and completed HD orientation.
- Visited work site and walked to all drill locations.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Saturday, October 13, 2012

- Helped drillers source out a loader.
- Retained surveyors to survey north and south site wells.
- Checked the packer set up.
- Started to drill MW-H24A at 15:00.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Sunday, October 14, 2012

- Encountered problems with site access and vehicles getting stuck.
- Drilled MW-H24A down to 82'.
- Conducted a packer leak test.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Monday, October 15, 2012

- Completed two packer tests; drillers continued to advance borehole MW-H25A.
- Rusto drove Gerry to Dawson Creek airport.
- Completed safety check-ins with Korina Houghton.

Tuesday, October 17, 2012

- Received a call from Jason Rempel (project manager) requesting a halt to drilling activities until permits were acquired.

Wednesday, October 18, 2012

- No work.

Thursday, October 19, 2012

- No work.

Friday, October 19, 2012

- Site access road improvements began.
- Conducted two more packer tests.
- Borehole drilled to final depth of 220'.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Saturday, October 20, 2012

- Completed well install and well flush.
- Drilled and installed shallow well MW-H24B.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Sunday, October 21, 2012

- Moved to a new drilling location for MW-H25A.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Monday, October 22, 2012

- Started to drill MW-H25A.
- Drilled 155' into stiff clay; more rods needed to continue.
- Drilled and installed shallow well MW-H25B.
- Completed safety check-ins with Korina Houghton.

Tuesday, October 23, 2012

- More site access improvements and bridge install occurred.
- Sampled MW-H24B and MW-H25B.
- Drillers moved to a new site.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Wednesday, October 24, 2012

- Started to drill MW-H26A.
- Slug tested MW-H24B and –H25B.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Thursday, October 25, 2012

- Support vehicle down; drillers went to Dawson Creek to get a part.
- Sampled MW-H17, -H18 and –H19.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Friday, October 26, 2012

- Continued to drill MW-H26A.
- Conducted a single packer test.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Saturday, October 27, 2012

- End of borehole reached.
- Conducted another packer test.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Sunday, October 28, 2012

- Completed well installation and flush.
- Drilling and install of shallow MW-H26B.
- Sampled MW-H22 and –H23.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Monday, October 29, 2012

- Road access to the final drill site was poor; the site was abandoned following discussion with Rescan Project Manager and Senior Hydrogeologist.
- Sampled MW-H26A and –H26B.
- Completed safety check-ins with Korina Houghton.

Tuesday, October 30, 2012

- Drillers moved back to MW-H25A.
- Slug tested MW-H26B.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Wednesday, October 31, 2012

- Continued to drill MW-H25A.
- Conducted packer tests.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Thursday, November 1, 2012

- Installed, flushed and sampled MW-H25B.
- Packed up equipment and shipped it.
- Completed safety check-ins with Freddie Li and Korina Houghton.

Friday, November 2, 2012

- Shipped water samples.
- Drove to FSJ airport and returned to Vancouver.
- Completed safety check-ins with Korina Houghton.

SUMMARY: The drilling progress and production was slow due to poor road conditions and cold temperatures (-10 to -25C). Similarly, sampling groundwater in negative temperatures was challenging and slow. However, the work was completed successfully.

A technical summary of the work completed is provided below:

- Sucessfully installed three deep and three shallow monitoring wells surrounding the proposed Coarse Coal Reject footprint area.
- Completed hydrogeological testing of the new boreholes/wells.
- Sampled and monitored 11 monitoring wells (the six new and five existing).
- Surveyed the five existing wells at the north and south sites.

Hydrogeology October 2012 Fieldwork Photographs

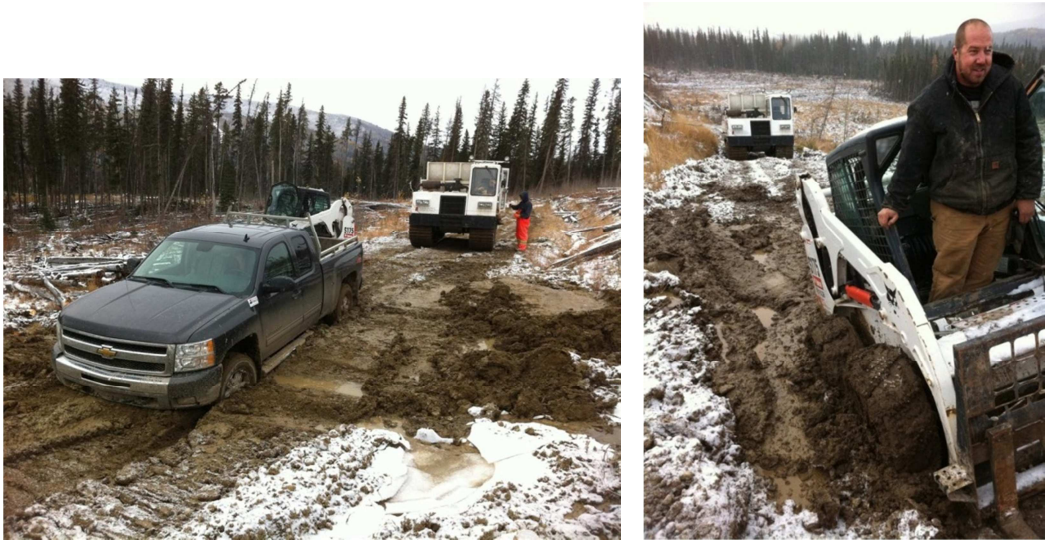

Plate 1. Poor road access conditions.

Plate 2. Drilling MW-H24A.

Plate 3. Road improvements and bridge install.

Plate 4. Sampling MW-H18.

Plate 5. Drilling MW-H26B.

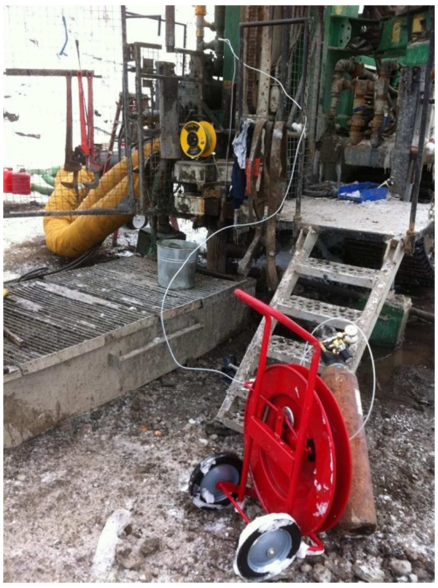

Plate 6. Packer testing MW-H25A.

APPENDIX 1-D

"Murray River Coal Project – Hydrogeology Baseline Report" for HD Mining International ltd. by ERM Rescan, Vancouver, BC, dated July, 2014.

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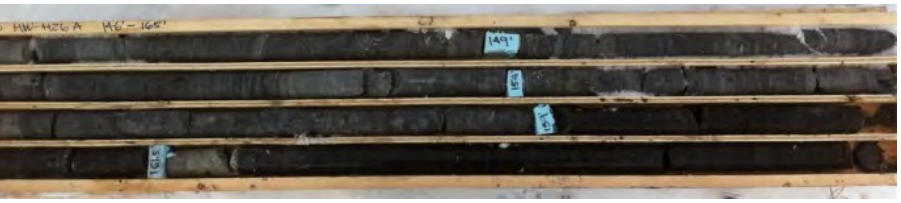
Appendix 7-A

Murray River Coal Project: Hydrogeology Baseline Report

HD Mining International Ltd.

MURRAY RIVER COAL PROJECT
Hydrogeology Baseline Report



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July 2014

MURRAY RIVER COAL PROJECT
HYDROGEOLOGY BASELINE REPORT

July 2014
Project #0194106-0002-0005

Citation:
ERM Rescan. 2014. *Murray River Coal Project: Hydrogeology Baseline Report*. Prepared for HD Mining International Ltd. by ERM Rescan: Vancouver, British Columbia.

Prepared for:

HD Mining International Ltd.

Prepared by:

ERM Rescan
Vancouver, British Columbia

Executive Summary

ERM

Executive Summary

This report presents a cumulative summary of hydrogeologic information assembled for the Murray River Coal Project (the Project) to date. The assembled information includes a compilation of information from other environmental components providing context to the hydrogeologic environment (climate, geology, hydrology), hydrogeologic data collected for other nearby projects, deep hydrogeologic data derived from mine inflow studies conducted for the Project (AMEC 2010; 2012), and the findings of a baseline hydrogeology study conducted for the Project.

Field programs conducted as early as 1977 (for the Quintette Coal project prior to development) and as late as 2014 have generated datasets consisting of overburden and bedrock geologic properties, hydraulic conductivities, groundwater levels, and groundwater chemistry.

Soil and rock samples recovered during borehole advancement were used to characterise geologic conditions and develop hydrostratigraphic delineations. Core recovered from 34 exploration boreholes, ranging in depth from 500 to 1350 m, have been used to characterise the deep lithologies in the Underground Mine Zone. Soil and shallow bedrock samples have been collected from an additional 30 boreholes, which were drilled as a focussed effort to study the baseline hydrogeologic conditions for the Project.

Hydraulic tests were conducted as drilling advanced through bedrock horizons, and used to measure hydraulic conductivity (K) of the medium. Hydraulic tests were used to measure K along ten deep (up to 955 metres below grade (mbg)) test intervals. Falling-head tests were conducted in packer zones along 26 intervals in nine boreholes during the baseline hydrogeology study. 23 K measurements derived from single well response tests conducted for other Projects (Quintette and Hermann Coal Projects) within the local study area have also been used.

Individual standpipe piezometers (wells) were installed in 30 boreholes following completion of drilling. Two vibrating wire piezometers (VWPs) were installed in each of two additional boreholes following completion of drilling. Wells were developed by air lifting with compressed air or surging and over pumping with an inertial pump. Single well response tests (rising and falling head slug tests) were conducted in 21 installed wells, serving to further characterise K of the saturated geologic materials. Groundwater levels were measured using an electric water level meter in all wells, and using a read-out box for VWPs. Continuous water level records were acquired using pressure transducers deployed in five wells.

The hydrogeology baseline study included collection of groundwater samples from 23 wells for characterisation of groundwater quality. Samples collected for the Hermann and Quintette Coal Projects within the local study area have been reviewed in characterising groundwater quality trends as well. Most wells were sampled on a seasonal basis to capture seasonal variability over a hydrologic year. Wells were purged sufficiently prior to collection of samples. Field hydrochemical parameters were measured, and stabilisation criteria were used to determine completion of purging. Quality control protocol included collection of duplicate samples, and use of field, travel, and equipment blanks.

The tested hydraulic conductivities of the overburden materials were highly variable, as is generally expected for glacial deposition environments. A coarse granular deposit situated at the southern end of

the Underground Mine Zone produced the highest estimate (4E-4 m/s). Tests conducted in morainal and colluvial sediments ranged three orders of magnitude (4E-9 to 2E-6 m/s).

The tested hydraulic conductivities of the bedrock were also highly variable. Bedrock K measurements ranged from 6E-6 m/s to 4E-10 m/s. Measurements on the scale of E-6 and E-7 m/s have only been observed in the top 100 m of the subsurface, and indicate relatively high joint densities of fractures. Measurements on the scale of E-10 m/s, which have been measured at the full range of tested depths, likely approach K of the rock matrix, where joint density is very low.

Groundwater level measurements indicate that groundwater flows from foothill highland areas towards the Murray River. Vertical hydraulic gradients measured using twinned wells indicate that the Murray River acts as a regional discharge zone and smaller tributaries act as localized discharge zones for shallow groundwater.

Groundwater levels vary seasonally by one to two metres. The periods of greatest recharge and highest water levels occur following spring freshet, major summer convective storm cycles, and mid-winter warm spells.

Groundwater throughout the local study area is slightly basic (mean pH of 7.2 to 8.4). Calcium and bicarbonate tend to be the dominant ions in the shallow groundwater (less than 50 mbg), and sodium and bicarbonate dominate in the deeper groundwater. TDS trends upwards with depth.

Concentrations of dissolved barium, iron, lithium, and manganese have consistently exceeded the BC Ministry of Environment's guidelines for the protection of freshwater aquatic life or raw drinking water supply in samples collected from a number of well. Elevated concentrations of the aforementioned metals are considered natural baseline occurrences. Positive detections of aluminum, arsenic, chromium, copper, and selenium have exceeded guidelines for the protection of freshwater aquatic life or drinking water in isolated samples.

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ERM

MURRAY RIVER COAL PROJECT
HYDROGEOLOGY BASELINE REPORT

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Glossary and Abbreviations

ERM

Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

AMEC	AMEC Earth and Infrastructure
ARD	Acid Rock Drainage
BC MOE	British Columbia Ministry of Environment
BCWQG FAL	British Columbia Water Quality Guidelines for Fresh Water Aquatic Life
CDDL	Canadian Dehua Drilling Ltd.
CDIMG	Canadian Dehua International Mines Group Inc.
FWAL	Fresh water aquatic life
GPS	Global Positioning System
ID	Identification
K	Hydraulic conductivity
LSA	Local Study Area
masl	metres above mean sea level
mbg	metres below grade
MPa	Megapascals
Mtpa	Million tons per annum
PAH	Polycyclic Aromatic Hydrocarbons
PRC	Peace River Coalfield
PVC	Polyvinyl Chloride
ERM-Rescan	ERM Canada Ltd.
RSA	Regional Study Area
VWP	Vibrating Wire Piezometer

1. Introduction

ERM

1. Introduction

HD Mining International Ltd. (HD Mining) proposes to develop the Murray River Coal Project (the Project) as a 6 million tonne per annum (6 Mtpa) underground metallurgical coal mine. The property is located approximately 12.5 km south of Tumbler Ridge, British Columbia (Figure 1-1), and consists of 57 coal licences covering an area of 16,024 hectares. The Project is located within the Peace River Coalfield (PRC), an area with a long history of metallurgical grade coal mining, mainly open pit mining. HD Mining is proposing to access deeper zones of the coal field (600 to 1,000 m below surface) using underground mining techniques.

In October 2011, HD Mining submitted an application to the BC Ministry of Energy and Mines and Ministry of Environment seeking permission to complete a bulk sampling program as part of exploration of the property. In March 2012, HD Mining received approval to conduct a 100,000 tonne bulk sample for the purpose of conducting testing to assist in developing markets for the coal.

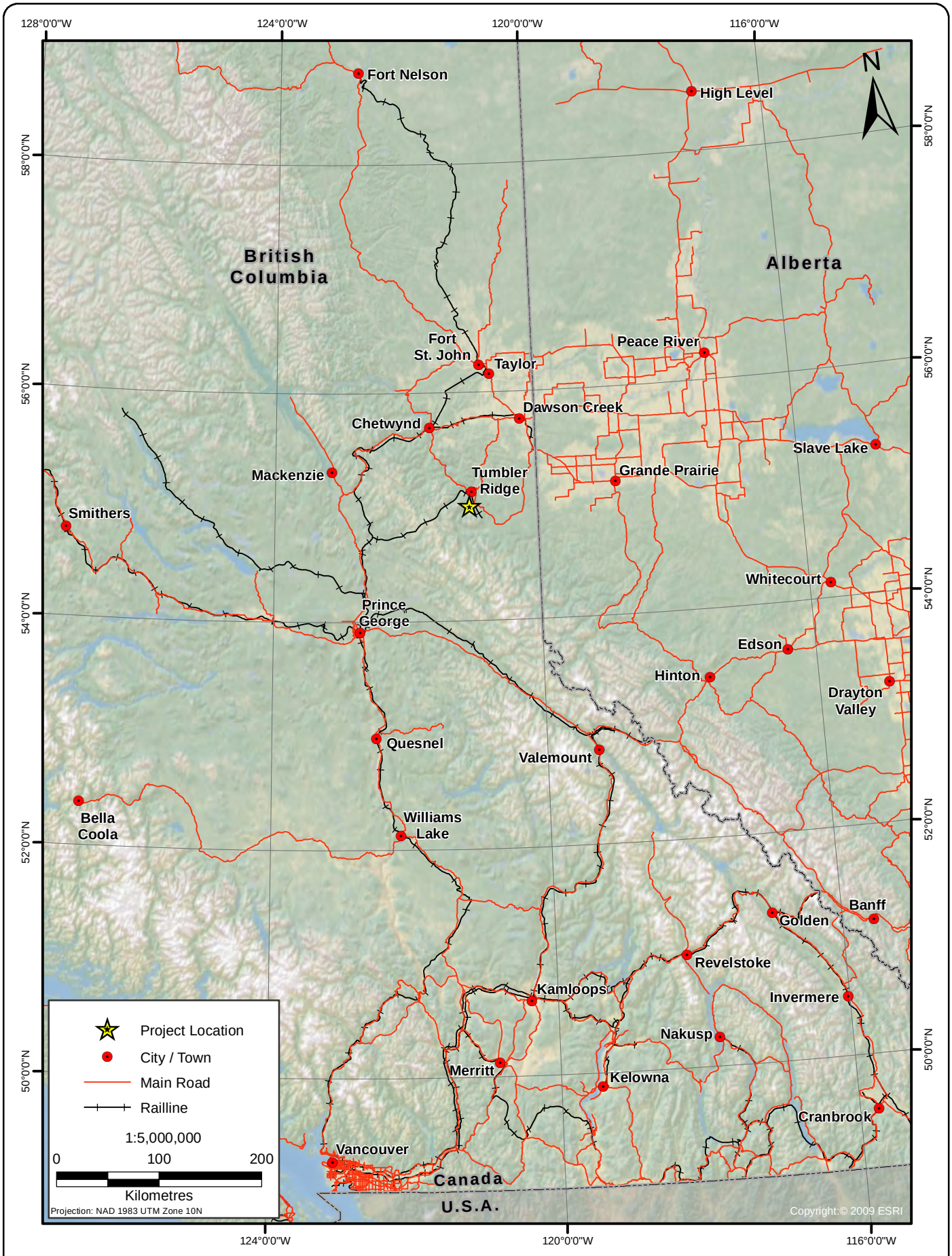
Beyond the bulk sample program, in order to develop a full mine at the proposed 6 Mtpa production level, the Project is subject to both the BC and Canadian environmental assessment processes. Development of any infrastructure for the full mine is not permitted before the requirements of these processes are met.

To support HD Mining's planning and development of the Project, and to contribute to the environmental assessment process, environmental and socio-economic baseline studies were initiated by ERM Consultants Canada Ltd. (ERM Rescan). Project-specific studies began in 2010 and have continued through 2014. As appropriate and available, historical data from government sources and neighbouring projects, as well as traditional use/knowledge information, have been compiled and incorporated into the analysis.

In order to help guide the scope of baseline studies, regional and local study areas (RSA and LSA, respectively) have been developed (Figures 1-2 and 1-3). The RSA is intended to encompass an area beyond-which effects of the Project would not be expected. It is also intended to be hdyrogeologically relevant, based on the groundwater catchment divides indicated by terrain and rivers / streams in the region. The LSA encompasses an area surrounding the proposed Project infrastructure within-which direct effects from the Project may be anticipated. The LSA boundary has also been developed following natural terrain and drainage boundaries in order to be hydrogeologically relevant.

This report presents a cumulative summary of all hydrogeology information compiled for the Project to date.

An understanding of the Project hydrogeology is necessary in order to conduct a sound assessment of potential effects of the Project on the environment, as well as for the design and implementation of an appropriate groundwater monitoring plan.



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Project Location

Figure 1-1

Rescan Engineers & Scientists

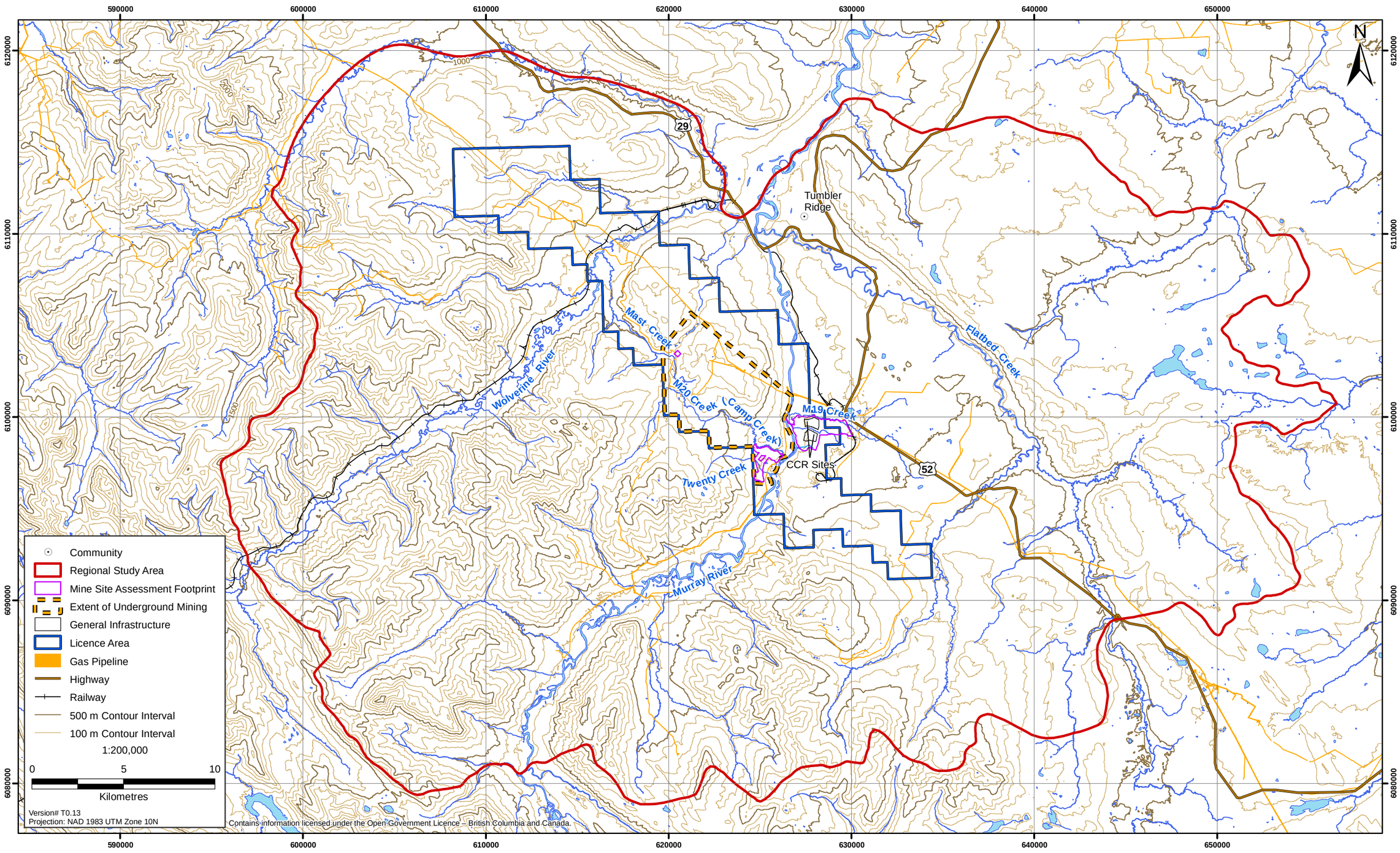

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Figure 1-2

Baseline Hydrogeology Regional Study Area

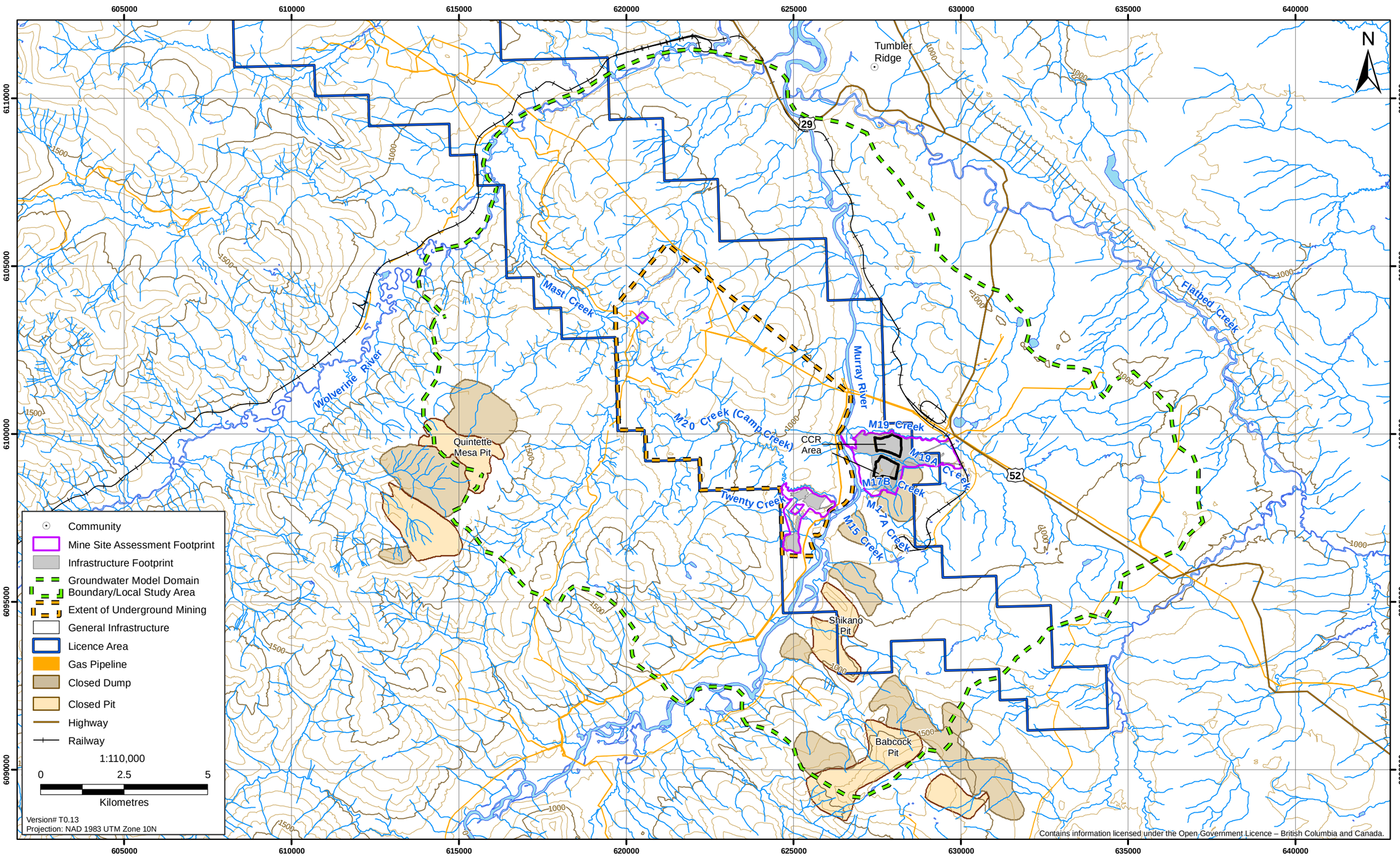

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Figure 1-3

Baseline Hydrogeology Local Study Area

The objectives of the hydrogeology baseline program were to:

- characterize the baseline, pre-development groundwater conditions;
- characterize the overburden and bedrock types present and their hydraulic conductivities, and identify hydrostratigraphic units;
- characterize groundwater levels and groundwater flow directions, recharge and discharge zones, and groundwater quality;
- evaluate seasonal variability in groundwater levels and groundwater quality; and
- provide sufficient baseline information upon-which to base assessment of the Project's potential environmental effects and to design an appropriate groundwater monitoring program.

The following chapters outline the available background information that supports the hydrogeology baseline study (Chapter 2); rationale used to identify and place the monitoring sites and a description of the methods used to collect the Project-specific data (Chapter 3); the results of data collection (Chapter 4); and a summary that synthesizes the findings of the baseline program (Chapter 5).

2. Background Information

ERM

2. Background Information

Information provided by other resources that are pertinent to the characterisation of baseline hydrogeology conditions for the Project is presented here. Existing pertinent geologic, meteorologic, and hydrologic conditions that influence the groundwater environment are summarized, with reference to primary sources for additional detail. The regional hydrogeologic context is presented with reference to other nearby projects with existing data. Finally, results of other hydrogeology site investigations conducted at the Project site are presented.

2.1 GEOLOGY

2.1.1 Bedrock

The proposed mine site is located within the Peace River Coalfield (PRC) in the eastern foothills of the Canadian Rocky Mountains, in the transition area between the more faulted and tightly folded areas in the west to the less structurally complex areas in the east (Norwest 2010). The western margin of the foothills belt is usually classified as the easternmost major thrust fault that emplaced Paleozoic strata over Mesozoic strata. The eastern margin of the foothills is a series of en echelon thrust faults that separate the foothills from the gently dipping strata of the Alberta Plateau (Norwest 2010). The foothills belt is characterized by folded and faulted Mesozoic sedimentary rock.

The stratigraphic column observed in core recovered during exploration drilling consists of formations belonging to the Lower Cretaceous Fort St. John Group (Table 2.1-1). The Hasler formation has consistently been documented as the shallowest member, however this shallowest member is also being regarded as an undifferentiated group which may include other younger members. The Gates formation contains the target coal beds, and is typically the deepest member documented in exploration boreholes. The Moosebar and Gething formations have been observed below the Gates formation in deeper boreholes.

Table 2.1-1. Stratigraphy Observed at the Murray River Coal Project Site (Norwest 2010)

Epoch	Group	Formation	Lithology
Upper Cretaceous	Dunvegan		Coarse clastic sedimentary rocks
Lower Cretaceous	Fort St. John	Cruiser	Mudstone, siltstone, shale, fine clastic sedimentary rocks
		Goodrich	Coarse clastic sedimentary rocks
		Hasler	Silty dark grey marine shale with sideritic concretions; minor sandstone and conglomerate; siltstone in lower part; basal conglomerate
		Boulder Creek	Fine-grained, well-sorted sandstone; carbonaceous sandstone; massive conglomerate; siltstone; mudstone; minor coal
		Hulcross	Dark Grey marine shale and siltstone with sideritic concretions
		Gates	Fine-grained, well-sorted sandstone; carbonaceous sandstone and mudstone; coal; shale; minor conglomerate
		Moosebar	Dark grey marine shale with sideritic concretions; siltstone; glauconitic sandstone; chert conglomerate at base
	Bullhead	Gething	Fine- to coarse-grained calcareous, carbonaceous sandstone; coal; carbonaceous shale and conglomerate; siltstone

Regional geologic mapping indicates the Cruiser and Goodrich formations overlie the Hasler formation at the CCR site (Massey et al. 2005). The Cruiser and Goodrich formations may also overly the Hasler along northeastern reaches of the Project site on the western side of the Murray River.

Folding and faulting have been documented within and around the local study area (Appendix F). A sequence of anticlines and synclines with northwest/southeast axes span the study area. The Mesa thrust fault outcrops a few kilometres west of the south mine site, striking southeast. Less extensive strike-slip faults have been observed along fold limbs, with traces trending northwest/southeast.

A sequence of cross-sections generated from geologic modelling exercises is provided in Appendix F. Additional information documenting bedrock geology at the Project site may be found in Norwest (2010).

2.1.2 Quaternary Geology

Sediments in the LSA are dominated by glacial deposits with lesser amounts of fluvials, colluvials and organics (surficial distributions are shown in Figure 2.1-1). Morainal sediments cover approximately half the LSA, consisting of well-compacted, non-stratified mixtures of sand, silt, and clay, with a heterogeneous mixture of sub-rounded to angular coarse fragments. Glaciofluvial materials are found along the slopes of the Murray River valley, consisting of stratified sands and silts with frequent rounded to sub-rounded coarse fragments. Fluvial deposits dominate the flood plains of the Murray River valley, consisting largely of well-sorted, stratified sands and gravels, and sometimes containing considerable fractions of silt and clay.Colluvial materials are found along moderate to steep slopes throughout the LSA, consisting of poorly sorted, heterogeneous materials. Organic materials are found in wet lowlands, consisting of poorly to moderately decomposed peat.

Additional information documenting overburden materials found on the Project site may be found in the Terrain and Soils Baseline Report (ERM 2013).

2.2 CLIMATE AND METEOROLOGY

Meteorological conditions in the Tumbler Ridge region are heavily influenced by the orographic shadow created by the Rocky Mountains, which are situated to the west and southwest. In general, moist coastal air masses from the west release precipitation on the western side of the Rocky Mountains, resulting in drier conditions to the east. Mean annual precipitation at weather stations near the project site range from 450 to 800 mm.

Precipitation amounts are greatest during the summer months, when convective weather systems bring thunderstorms (Figure 2.2-1). The majority of precipitation from November to April occurs as snow and represents about 30 to 50% of the annual total precipitation.

Mean monthly temperatures in the region range from a high of 15˚C in July to a low of -10˚C in January (Figure 2.2-1). Temperatures are generally above freezing from April to October; however, freezing conditions may occur at any time of the year at higher elevations. Mid-winter thaws may also occur on occasion due to Chinook winds.

Additional information documenting climate and meteorology in the Tumbler Ridge Region and at the Project site may be found in the Meteorology Baseline Report (Rescan 2013a).

610000 615000 620000 625000 630000 635000

6105000 6100000 6095000 6090000

Wolverine River
Mast Creek
Flatbed Creek
Murray River
M20 Creek / Camp Creek
M19 Creek
M17A Creek
M15 Creek
Twenty Creek
CCR Sites
52
N

Community
Groundwater Model Domain Boundary/Local Study Area
Mine Site Assessment Footprint
Extent of Underground Mining
Licence Area
General Infrastructure
Gas Pipeline
Highway
Railway

Surficial Material Type
Anthropogenic
Colluvial
Weathered Bedrock
Fluvial
Glaciofluvial
Morainal
Bedrock
Organic
Water

1:75,000
0 2 4
Kilometres

Version# T0.13
Projection: NAD 1983 UTM Zone 10N

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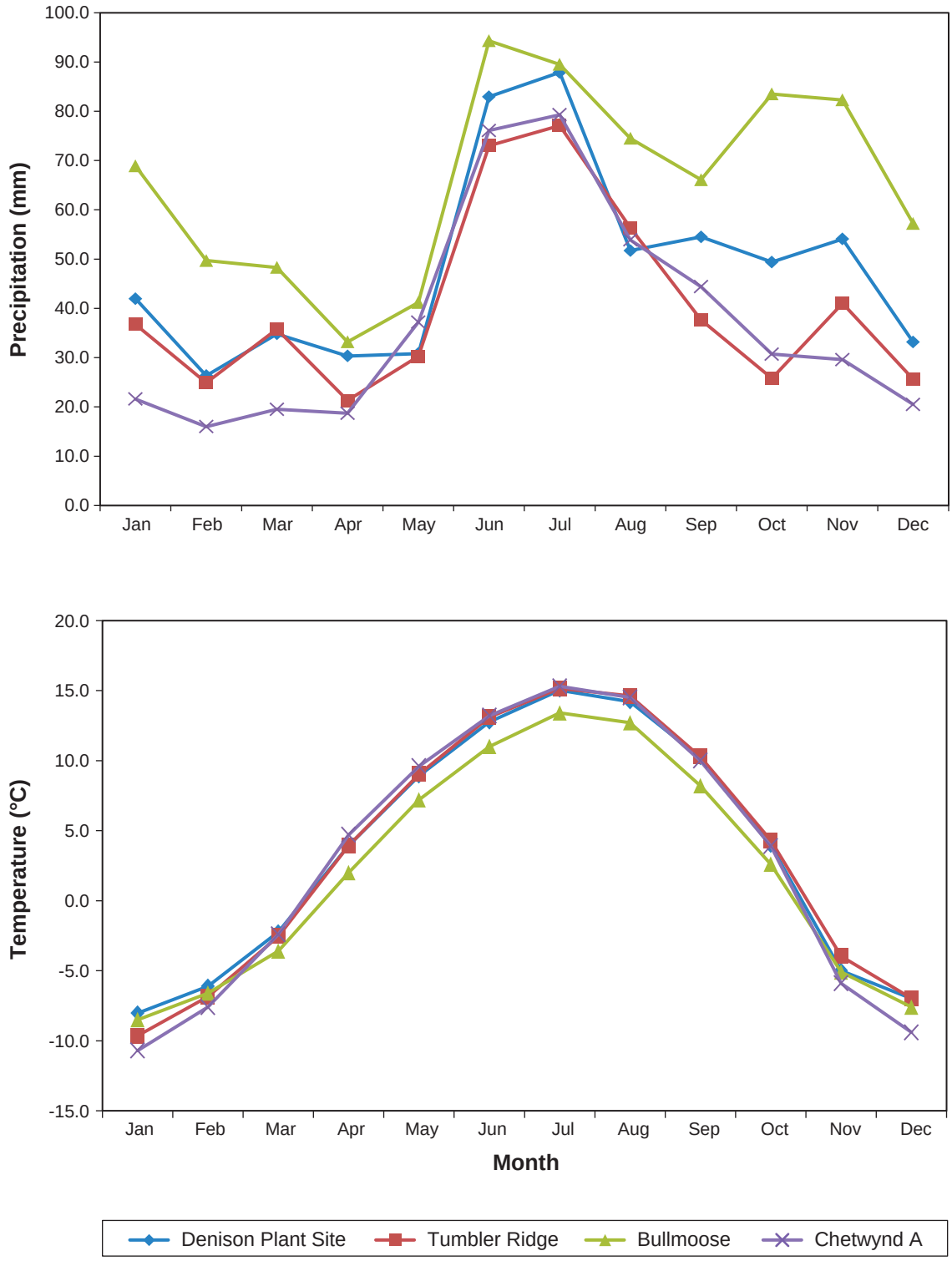
Figure 2.1-1

Distribution of Surficial Sediments in the Local Study Area

Figure 2.2-1

Monthly Precipitation and Temperature Data Obtained from Meteorology Stations within and near the Local Study Area



2.3 HYDROLOGY

On the west side of Murray River, the mine sites are situated within the Twenty and M20 Creek (also referred to as Camp Creek) drainage basins. The CCR site is situated within the drainage basins of two small creeks (M17 and M19A), which report eastward to the Murray River.

The Murray River flows northward, discharging into the Pine River 40 km downstream from the Village of Chetwynd, BC. Both the Pine and Murray Rivers belong to the greater Peace River drainage system, which drains into the Arctic Ocean via the Slave and Mackenzie Rivers.

Streams generally peak during spring freshet (April), with high flow rates continuing into mid-summer, as sustained by convective rainfall events. Moderate flow rates are generally observed from late summer to mid-fall. Low flows occur from mid-fall through early spring, as sustained by groundwater discharge.

Additional information documenting the hydrologic setting for the Project may be found in the Hydrology Baseline Report (ERM Rescan 2014).

2.4 EXISTING HYDROGEOLOGY DATA FOR NEARBY PROJECTS

Three nearby mineral projects have generated baseline hydrogeology data within the RSA and LSA. Components of the Quintette and Hermann Projects are situated within the LSA. Other components of the Quintette and Hermann Projects are situated within the RSA, as well as the Roman and Trend Projects. Hydrogeology data collected for these projects that are situated within the catchment basins with potential to interact with the Project are briefly summarized herein. Monitoring wells installed to support these projects that are within the LSA for the Murray River Project are shown on Figure 2.4-1.

2.4.1 Hermann Coal Project

Baseline groundwater conditions established for the Hermann Mine project are presented in full in Western Canadian Coal (2007). Ten monitoring wells were installed in the upper M20 Creek basin, with collection of permeability, water level, and water quality data. Available data are summarized in Table 2.4-1.

Table 2.4-1. Permeability and Water Level Measurements Obtained in Baseline Studies Conducted for the Hermann Coal Project (Adapted from Western Canadian Coal 2007)

Monitoring Well ID	Ground Elevation	Screen Depth				Groundwater Level (masl) A		
		From	To	K (m/s)	Screened lithology	Dec-05	Feb-06	Aug-06
MW05-1A	1422.46	48.92	55.02	8.0E-08	Siltstone	1415.68	1413.51	1413.86
MW05-1B	1422.46	14.63	20.73	1.0E-08	Siltstone	1417.82	1415.73	1415.78
MW05-2A	1262.82	57.9	60.96	1.0E-09	Sandstone	1233.65	1251.21	1247.85
MW05-2B	1262.82	24.08	27.13	7.0E-07	Sandstone	1260.66	1259.05	1259.51
MW05-3A	1291.58	48.46	51.51	6.0E-06	Siltstone	1299.18	1298.18	1292.18
MW05-3B	1291.58	23.16	26.21	4.0E-08	Siltstone	1292.54	1292.44	1292.24
MW05-4A	1201.44	78.64	81.69	1.0E-07	Siltstone	1200.85	1200.87	na
MW05-4B	1201.44	48.16	51.21	6.0E-06	Siltstone	1198.86	1199.35	1198.94
MW05-4C	1201.44	9.9	12.95	2.0E-06	Morainal Sediments	1194.96	1194.67	1194.47
HR005-11 [A]	1231.06	na	204.5	2.0E-06	various	1231.21	na	1230.21

na indicates data not available
[A] Open borehole

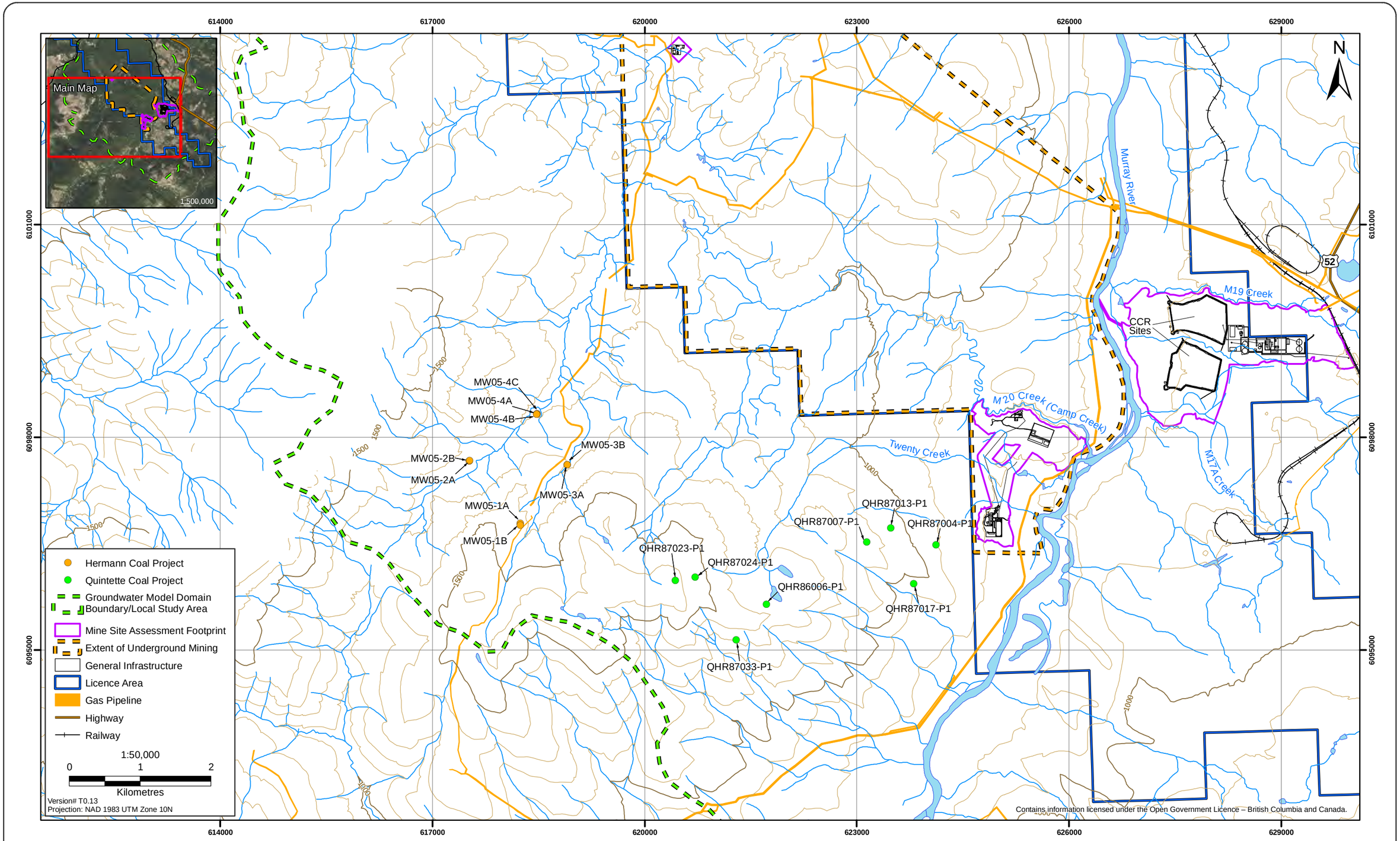


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Figure 2.4-1

Existing Groundwater Monitoring Instrumentation Installed at Nearby Mining Projects

Recharge zones were established spanning most of the project area, with a local discharge zone along M20 Creek. Water level records are only available for one monitoring event, conducted in December 2005. Measured water levels ranged from 7 mbg in recharge areas to 7 m above grade (artesian) near M20 creek.

Hydraulic conductivity estimates ranged from 1E-9 m/s to 6E-6 m/s for the eight measurements conducted along intervals of bedrock (depths ranging 15 to 80 mbg in siltstone and sandstone formations). The single measurement conducted in overburden material (morainal sediments) was 2E-6 m/s. The wide ranging of hydraulic conductivities measured in the bedrock indicates a strong influence of fractures and fault zones on permeability.

Groundwater quality data indicate the fluids in bedrock fractures is fresh (total dissolved solids ranging from 294 to 789 mg/L) with neutral pH (ranging 7.4 to 8.3). Calcium and bicarbonate are the dominant anions in the shallower groundwater, with a transition from calcium towards sodium dominance in the deeper groundwater. Total dissolved solids generally increase with depth. Dissolved metals concentrations are generally below BC Ministry of Environment's guidelines for the protection of freshwater aquatic life and raw drinking water supply, and the occasional exceedances that have been documented may be artefacts of sampling practices.

2.4.2 Quintette Coal Project

The Quintette Project includes historic mining activities that occurred from 1982 to 2000, and a proposed expansion that has not commenced construction at the time of writing. Historic activities included development of the Mesa and Wolverine Pits and adjacent waste dumps that partially lie within the upper M20 Creek drainage basin, and a tailings storage facility immediately up-slope of the proposed CCR site (referred to as the Old Tailings Storage Facility). Numerous other decommissioned workings are present east and southeast of the Murray River, outside of the catchment basins that may interact with the Murray River Project.

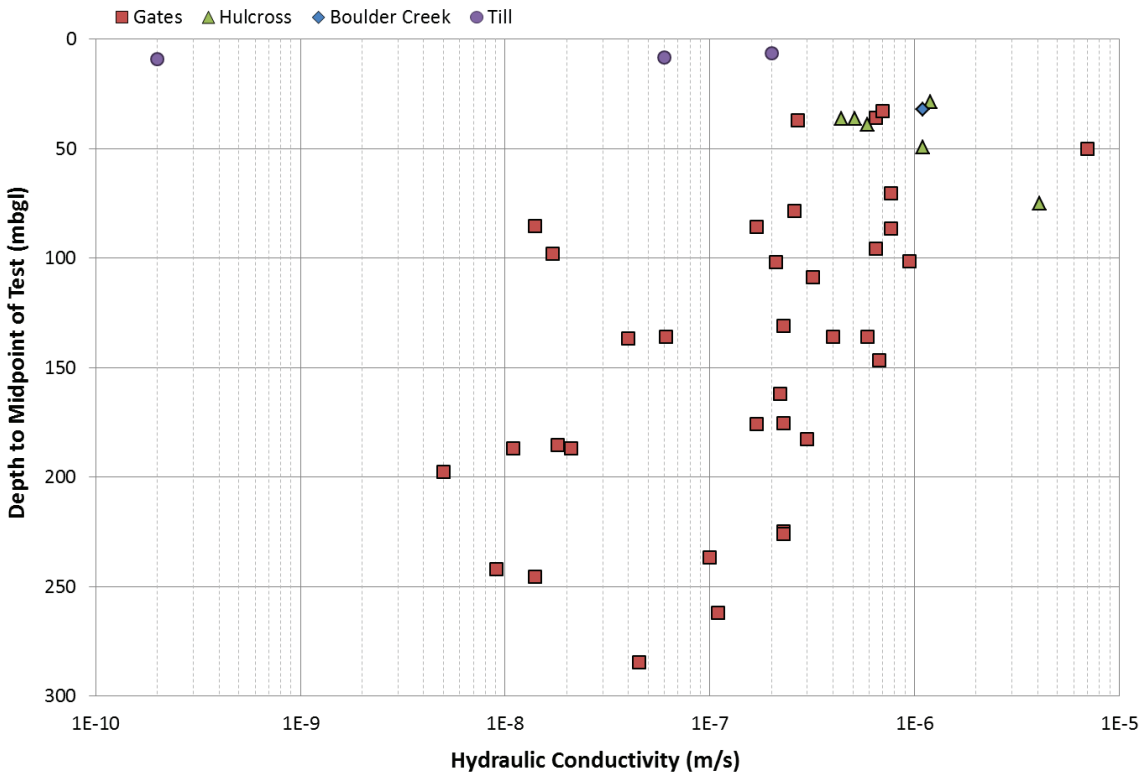
A number of hydrogeology studies have been carried out in relation to the Quintette Project development, dating as early as 1977. Findings of most of these studies are documented in SRK (2012) which presents the baseline groundwater conditions established for the proposed Quintette Mine expansion project. Most proposed workings and related hydrogeology data are not within the catchment basins that may interact with the Murray River Project, as M17 creek and the Murray River provide discharge zones that isolate project components associated with the two projects from one-another. The exception is the Old Tailings Storage Facility, which is up-gradient of the proposed CCR site. No documentation of hydrogeological investigation with coverage of the the Old Tailings Storage Facility has been identified.

SRK (2012) documents 43 hydraulic conductivity measurements for the Mount Babcock area of the Quintette Project Site (southeast of the Murray River). Hydraulic conductivities ranged from 5E-9 m/s to 6E-6 m/s in the bedrock (Gates and Hulcross formations), and from 2E-10 m/s to 2E-7 m/s in the overburden. A general decline in hydraulic conductivity with depth is suggested by the dataset (Figure 2.4-2), which includes tests up to depths of 250 to 300 mbg. While the Gates and Hulcross formations are also found on the Murray River Project site, they are at greater depths and in the presence of different structural features. Hydraulic conductivity of the bedrock is expected to be influenced by a combination of depth, geologic composition, and the structural setting.

Water level measurements documented in SRK (2012) do not capture seasonal variability, as the frequency of measurement is not adequate.

Figure 2.4-2

Hydraulic Conductivity Estimates
Published for the Nearby Quintette Coal Project



In addition to the studies documented in SRK (2012), a field study was carried out in the upper M20 creek catchment basin in 1987 to support mine inflow design and baseline groundwater quality characterisation for the proposed Grizzly and Transfer pits and associated waste rock dumps (findings summarized in Table 2.4-2, adopted from Section 8 in Hermann Mien Project EA Certificate Application). Two groundwater samples collected from 115 and 130 mbg reflect slightly alkaline (pH 8.1 and 8.3), hard (hardness of 2.5 and 272 mg/L as $CaCO_3$) groundwater with bicarbonate and calcium as the dominant ions. Hydraulic conductivities were consistently low, ranging from 6E-6 to 9E-10 m/s.

Table 2.4-2. Permeability and Water Level Measurements Obtained in the Previously Proposed Grizzly and Transfer Pit Area

Monitoring Well ID	Ground Elevation	Screen Depth		K (m/s)	Screened lithology	Groundwater Level (masl)[A]
		From	To			
QHR87004-P1	931.67	100.4	92.1	2.0E-07	Coal (J seam)	894.55
QHR87004-P2		64.34	57.04	2.0E-07	na	924.91
QHR87004-S3		52.8	49.75	-	na	924.4
QHR87007-P1	1117.65	169.75	166.45	2.0E-08	na	1060.75
QHR87007-P2		133.6	122.6	-	Coal (G seam)	1059.19
QHR87007-S3		110	106.95	-	na	1059.19
QHR87013-P1	1041.15	139.63	131.83	8.0E-09	na	1037.49
QHR87013-P2 [A]		118.02	110.12	6.0E-06	na	1044.24 (artesian)
QHR87013-S3		100.7	97.65	-	na	flowing artesian
QHR87017-P1	1014.93	161.35	158.3	4.0E-09	na	997.05
QHR87017-P2 [A]		135.15	128.45	6.0E-06	na	1016.27 (artesian)
QHR87017-S3		127.2	119.5	-	na	flowing artesian
QHR87023-P1	1601.62	169.5	162.5	3.0E-09	na	1520.64
QHR87023-P2		130.5	124.7	3.0E-09	Coal (G seam)	1520.89
QHR87023-S3		104.8	101.75	-	Coal (F seam)	1579.94
QHR87024-P1	1564.25	97.3	88.7	1.0E-09	na	1524.1
QHR87024-P2		69.45	62.75	9.0E-10	na	1532.56
QHR87024-S3		37.8	34.75	-	na	1551.22
QHR87033-P1	1437.7	99	93.9	5.0E-08	na	1386.34
QHR87033-S2		71.6	68.55	-	Coal (J seam)	1383.25
QHR86006-P1	1325.06	99.2	94.6	-	siltstone	1326.99
QHR86006-P2		69.3	61.5	7.0E-08	Coal (J seam)	1331.5 (artesian)
QHR86006-S3		38.7	35.65	-	Siltstone	flowing artesian

na indicates data not available
[A] Groundwater sample collected

2.5 RESULTS OF OTHER HYDROGEOLGY SITE INVESTIGATIONS CONDUCTED FOR THE PROJECT

AMEC Environmental and Infrastructure (AMEC) conducted packer and pumping tests in deep boreholes at the project site. The results provide data that may be used to estimate permeability of the deeper formations that would be encountered in underground mine workings (AMEC 2010, 2012). The calculated hydraulic conductivities are presented in Table 2.5-1.

Table 2.5-1. Hydrogeologic Properties Obtained from Deep Borehole Tests (Adapted from AMEC 2010; 2012)

Borehole ID	Test no.	Formation [C]	Ground elevation (masl)	Test Interval Location (masl)		Test Type [B]	Hydraulic Conductivity (m/s)	Storativity	Interpreted Pieometric Head (masl)
				Top	Bottom				
H2	1	Boulder Creek	1111.9	510.0	240.0	CD-R	5.E-09	-	1094
	2	Hasler		910.0	530.0	CD-R	2.E-09	-	> 1134
	4	Hasler and Overburden		1090.0	530.0	CH-R	4.E-10	-	-
H16W	1	Gates	835.5	40.0	-120.0	CH-R	6.E-09	3.E-04	831.5
	2	Gates/Hulcross/ Boulder Creek		260.0	-120.0	CH-R	2.E-09	2.E-05	-
	3	Hasler		610.0	570.0	CD-R	3.E-08	-	815.4
H16 [A]	OW	Boulder Creek / Hulcross	836	250.0	120.0	-	-	-	853.8
H16A	OW	Tertiary	839.3	65.0	72.0	-	-	-	784.9
P1R35	1	Gates	1083	482.0	413.0	P-DR	5.E-10	-	1097.7
	2	Gates		531.0	483.0	P-I	2.E-07	-	-
	3	Gates		617.0	563.0	P-I	3.E-08	-	-
	4	Boulder Creek		811.0	728.0	P-I	3.E-08	-	-

Prior to most tests and after setting packers to isolate the test interval, the hydraulic head in the test zone was allowed to equilibrate. The equilibration period was generally too short to attain true static water levels, therefore the measurements are considered estimates and have only been used in a qualitative sense for more involved interpretation of the hydrogeologic system. Water levels reported for certain tests have been omitted from Table 2.5-1, because the documentation does not clarify that an equilibration period was sustained prior to commencement of the test.

Two different types of packer tests were performed at different intervals in one borehole (P1R35). One shut-in test was performed (referred to as a recovery and discharge test in AMEC 2010), followed by three injection (lugeon) tests. A shut-in test involves monitoring change in pressure in the test interval without displacement of a water column, and was used for one very low permeability test interval. Injection packer tests involve attaining steady zone pressures while injecting fluids into the test zone at multiple sustained discharge rates.

Two different types of pumping tests were conducted: constant discharge and constant head. Pumping was conducted for 40 to 48 hours, followed by monitoring for 24 to 56 hours during recovery. Further documentation of the methodologies is provided in the report prepared by AMEC, which is included in Appendix A.

The packer configuration used to isolate test intervals in borehole P1R35 did not provide for verifiable isolation of the test interval from below. Bentonite grout was backfilled into the borehole up to the base of the test interval, and capped with a Van Ruth Plug. Data were not collected to indicate adequacy of interval hydraulic isolation. As such, the reported hydraulic conductivities may be over-estimations.

Considerable amounts of dissolved gases were observed in the discharge fluids during the pumping tests. The presence of gas complicated the attainment of constant discharge. A gas separator was used

during constant-head tests, which prevented the use of a packer to isolate test intervals. A complete discussion of limitations imposed on the results is discussed in Appendix A.

Measured piezometric heads ranged from 54 mbg at H16A to flowing artesian within the top test interval at H2. Measured hydraulic conductivities were generally low, ranging from 3E-8 m/s to 4E-10 m/s.

Water samples collected from fluids recovered during pumping tests provide information pertaining to groundwater quality along the test intervals. However, given the large volumes of the test intervals and low flow rates attained during the pumping tests, it is likely that recovered fluids contained some proportion of drilling fluids. Samples were rather alkaline (pH ranging 7.6 to 10.6) and depleted in dissolved oxygen (field measurements all below 1 mg/L). Dominant ions were consistently bicarbonate/carbonate and sodium, with lesser but significant concentrations of chloride, sulphate, and calcium. Dissolved concentrations of iron, cadmium, and lithium exceeded guidelines with some consistency. Tabulated laboratory analytical chemistry results are presented in Appendix A.

3. Methodology

ERM

3. Methodology

3.1 BOREHOLE DRILLING AND LOGGING

ERM Rescan hydrogeologists supervised drilling programs on four occasions from 2011 to 2013, with the objective of logging the recovered materials for hydrogeologic properties, and installing instrumentation for further hydrogeologic characterization. Drilling targets were selected largely based on the locations of proposed mine infrastructure with the potential to interact with the groundwater environment. A number of drilling targets were also set up-gradient of the proposed infrastructure and in the down-gradient receiving environment.

Cuttings and core recovered from drilling were logged to characterize hydrogeologic aspects of the intercepted lithologies. Overburden materials were logged for grain size distribution, plasticity, moisture content, and other properties as appropriate. Recovered rock core logging focused on fracture characterization (textural classification, rock quality designation, weathering grade, fracture type, healing, and infill).

ERM Rescan hydrogeologists supervised the advancement of 12 boreholes over a six month period in 2011, situated at various elevations within the M20 creek drainage basin. Seven boreholes were drilled by Canadian Dehua International Mines Group (CDIMG) using a rotary air hammer system, with target depths ranging from 100 m to 10 m. Packer tests were conducted in one of the air hammer boreholes (packer testing methodology discussed in section 3.4). Five boreholes were drilled by CDIMG using a diamond rotary (water circulation) configuration, and served the dual purpose of coal exploration and hydrogeologic data collection. The diamond rotary configuration was used to install two deep wells and two deep vibration wire piezometers (VWP; well and VWP installation methods are discussed in section 3.2), at depths up to 210 m. Packer tests were conducted in one of the diamond rotary boreholes.

In May 2012, five boreholes were drilled by Geotech Drilling Services Ltd. with monitoring well installation. A rotary air hammer configuration was used to advance the boreholes. Boreholes targeted the perimeter of the bulk sample waste rock facility and storage ponds in the Underground Mine Zone.

Six boreholes were drilled at the CCR Site by Mud Bay Drilling in October 2012. A twinned borehole configuration (one shallow and one deep borehole side-by-side) was established at three sites, for monitoring well installations. The shallow boreholes were drilled using a solid stem auger in the overburden and a rotary air hammer in the shallow bedrock. A diamond mud rotary drilling method (NQ rods) was used to advance the deep boreholes. Packer tests were conducted in the deeper boreholes.

In July 2013, seven boreholes were drilled at the CCR Site by Mud Bay Drilling. These boreholes served the dual purpose of geotechnical and hydrogeologic data collection. Drilling was supervised by a hydrogeologist from ERM Rescan and a geotechnical engineer from Ausenco Canada Inc. (Ausenco). A diamond mud-rotary drilling method (HQ rods) was used to advance the boreholes. Five boreholes had target depths of approximately 30 m, while two had target depths in the range of 100 m. Packer tests were conducted at various depths in each borehole as drilling progressed.

Geologic borehole logs prepared by CDIMG for coal resource exploration boreholes have been reviewed and used to prepare the hydrogeologic conceptual model described in Chapter 5 of this report. Data derived from the geologic logs are limited to bedrock lithology interpretation and inference of fault zone locations.

3.2 MONITORING WELL AND VIBRATING WIRE PIEZOMETER INSTALLATION

Monitoring wells or VWPs were installed in boreholes following completion of drilling. Installations were conducted by drill crews under the supervision of an ERM Rescan hydrogeologist. A total of 30 monitoring wells and four VWPs were installed (Table 3.2-1; Figure 3.2-1). Well construction diagrams are provided alongside borehole logs in Appendix B.

VWPs were installed in two boreholes in 2011. Two VWPs were installed in each borehole, including one rated to a maximum pressure of 1.0 megapascal (MPa) at a depth of approximately 100 m below grade (mbg), and one rated to 2.0 MPa at a depth of 200 mbg. VWPs were calibrated in a laboratory prior to shipment to the field, and tested in the field prior to installation. The VWPs were taped to a PVC support pipe and lowered down the borehole to the target depths. Boreholes were then backfilled with grout to ground surface.

Hydrogeologic borehole logs were used to design the monitoring wells. Screens were generally installed along zones interpreted to exhibit the highest hydraulic conductivity in the borehole (e.g. heavily fractured bedrock or sand deposits), or along lithologies of interest.

Well materials consistent of schedule 40 PVC pipe with diameters of one inch (25 mm), 1.25 inches (32 mm) or two inches (51 mm). Well screens consisted of slotted pipe with 0.246 mm slot sizes (size no. 10).

A filter sand pack was installed along the slotted pipe and extending above and below. Bentonite chips or coated pellets were placed above the sand pack, and sometimes also below. The borehole was then backfilled up to ground surface with bentonite, a bentonite/cuttings mix, or grout. A well cap was provided for each well and a steel well monument was installed.

3.3 WELL DEVELOPMENT

Monitoring wells were developed by one of air-lifting, mechanical surging, or over-pumping methods (Table 3.3-1). For each development method, attempts were made to remove a target water volume in the range of ten well volumes. Turbidities were monitored, and development was deemed adequate when field parameters (turbidity, specific conductance, pH, and ORP) approached equilibrium.

Air-lifting was conducted using a gasoline-powered, 120 psi air compressor. A 5/8” high-density polyethylene (HDPE) tube was fitted to the compressor outlet, fixed to the well collar, and lower into the well such that the outlet was located at the centre of the well screen. Air was allowed to flow continuously into wells that yielded adequate water volume to maintain flow. Lower-yielding wells were developed intermittently: Water was removed down to the HDPE tubing inlet, and then allowed to recover prior to further removal. Water was channeled into a cup upon arrival at the well collar to assess field parameters.

Mechanical surging was conducted using a mechanical inertial pumping system. A one-inch diameter check valve was fixed to the end of a 5/8” HDPE tube, and lowered into the well to the centre of the well screen. Repetitive up and down motion of the check valve created a surging action, and purged water from the well.

Over pumping was conducted using a peristaltic pump in wells with slow recharge. Pumping was conducted at a flow rate that produced considerable drawdown in the well. Flow was sustained for at least ten well volumes, and field parameters were assessed for approach to equilibrium conditions.

Table 3.2-1. Groundwater Monitoring Instrumentation Completion Details

Instrument ID [A]	Collar Location			Ground Elevation (masl)	Stick-up Height (m)	Borehole Diameter (m)	Depth of Hole (mbgs)	Well Diameter (m)	Sand Pack		Screened Interval [B]		General Area	Drilling Method	Screened Lithology
	Northing (m) Zone 10U (NAD83)	Easting (m) Zone 10U (NAD83)	Elevation (masl)						Top (mbgs)	Bottom (mbgs)	Top (mbgs)	Bottom (mbgs)			
MW-H2A	6,101,837	620,575	1,104.341	1103.141	1.20	0.105	90.80	0.051	82.30	88.00	83.43	88.00	Drainage basin	Rotary air hammer	Shale
MW-H2B	6,101,831	620,567	1,103.370	1102.900	0.47	0.105	15.20	0.051	9.20	13.00	9.90	12.90	Drainage basin	Rotary air hammer	Glacial Till
MW-H3A	6,102,191	621,818	1,215.700	1215.250	0.45	0.076	200.00	0.025	170.00	193.00	183.00	193.00	Drainage basin	NQ mud rotary	Sandstone
MW-H3B	6,102,191	621,821	1,215.700	1215.250	0.45	0.105	8.80	0.025	4.50	8.80	5.30	8.50	Drainage basin	Rotary air hammer	Overburden
MW-H5	6,100,571	620,658	1,102.500	1101.820	0.68	0.105	30.50	0.051	26.15	30.50	27.50	30.50	Drainage basin	Rotary air hammer	Gravelly Sand
VWP-H7-1MPa	6,100,872	622,015	1,131.500		-	0.076	250.00	-	-	-	92.45		Drainage basin	NQ mud rotary	Siltstone
VWP-H7-2MPa											210.33				Siltstone/Mudstone
WWP-H12-1MPa	6,100,659	624,446	1,120.800		-	0.076	250.00	-	-	-	115.92		Drainage basin	NQ mud rotary	Siltstone
WWP-H12-2MPa											210.26				Siltstone/Mudstone
MW-H13	6,098,569	626,086	821.580	820.800	0.78	0.076	250.00	0.025	65.00	69.00	65.95	69.00	Drainage basin	NQ mud rotary	Shale
MW-H15	6,098,253	624,907	854.397	853.177	1.22	0.105	104.22	0.051	89.00	100.00	93.90	100.00	North Site	Rotary air hammer	Sandstone
MW-H16	6,097,821	624,891	839.467	838.597	0.87	0.105	70.60	0.051	66.80	70.60	67.45	70.50	North Site	Rotary air hammer	Sandstone (Boulder Creek Formation)
MW-H17	6,097,925	625,520	829.960	829.300	0.66	0.105	8.50	0.051	4.90	8.50	5.45	8.50	North Site	Rotary air hammer	Mudstone
MW-H18	6,097,953	625,740	831.697	830.877	0.82	0.105	17.06	0.051	10.00	13.60	10.45	13.50	North Site	Rotary air hammer	Mudstone
MW-H19	6,098,131	625,663	833.344	832.574	0.77	0.105	8.70	0.051	5.10	8.70	5.65	8.70	North Site	Rotary air hammer	Mudstone
MW-H20	6,099,766	624,397	954.200	953.405	0.80	0.960	101.00	0.051	37.20	41.00	37.75	40.80	Drainage basin	NQ mud rotary	Sandstone
MW-H21	6,100,259	625,390	917.000	917.000	0	0.076	121.00	0.025	50.10	54.00	50.65	53.70	Drainage basin	NQ mud rotary	Mudstone
MW-H22	6,096,815	624,960	784.422	783.572	0.85	0.105	25.10	0.051	21.60	25.10	22.05	25.10	South Site	Rotary air hammer	Sandy silt
MW-H23	6,096,618	624,942	785.698	784.898	0.80	0.105	25.10	0.051	21.60	25.10	22.05	25.10	South Site	Rotary air hammer	Sand
MW-H24A	6,099,756	628,116	832[C]	831.200	0.80	0.076	67.10	0.032	44.20	48.50	44.85	47.90	CCR Site	NQ mud rotary	Mudstone and siltstone
MW-H24B	6,099,756	628,119	832[C]	831.100	0.90	0.105	8.60	0.032	5.00	8.60	5.55	8.60	CCR Site	Rotary air hammer	siltstone
MW-H24C	6,099,625	627,954	825[C]	824.080	0.92	0.096	13.72	0.032	8.80	13.72	9.23	12.28	CCR Site	NQ mud rotary	siltstone
MW-H25A	6,099,615	627,334	766[C]	765.300	0.70	0.076	80.00	0.032	58.20	62.00	58.95	62.00	CCR Site	NQ mud rotary	Mudstone and fine sandstone
MW-H25B	6,099,615	627,332	766[C]	765.300	0.70	0.105	6.10	0.032	1.30	4.70	1.55	4.60	CCR Site	Auger	Glacial till
MW-H26A	6,098,990	627,478	792[C]	791.220	0.78	0.076	64.30	0.032	29.20	33.00	29.84	32.89	CCR Site	NQ mud rotary	Mudstone and fine sandstone
MW-H26B	6,098,987	627,485	792[C]	791.350	0.65	0.105	6.10	0.032	1.30	4.60	1.55	4.60	CCR Site	Auger	Well graded sand
MW-H27	6,098,578	627,607	810[C]	809.530	0.47	0.096	39.20	0.032	34.03	37.63	34.58	37.63	CCR Site	NQ mud rotary	Mudstone and fine sandstone
MW-H28	6,098,772	627,715	819[C]	818.300	0.70	0.096	93.27	0.032	13.37	17.07	13.92	16.97	CCR Site	NQ mud rotary	Mudstone and fine sandstone
MW-H29	6,099,198	627,938	826[C]	825.300	0.70	0.096	98.45	0.032	7.71	11.61	8.26	11.31	CCR Site	NQ mud rotary	Mudstone and fine sandstone
MW-H30	6,098,501	627,372	793[C]	792.270	0.73	0.096	22.86	0.032	10.91	14.81	11.46	14.51	CCR Site	NQ mud rotary	Glacial Till (Silty Clay)
MW-H31	6,099,893	627,456	798[C]	797.320	0.68	0.096	32.31	0.032	26.82	30.42	27.37	30.42	CCR Site	NQ mud rotary	Glacial Till (Silty Clay)
MW-H32	6,099,810	628,333	840[C]	839.630	0.37	0.096	30.48	0.032	26.53	30.13	27.08	30.13	CCR Site	NQ mud rotary	Mudstone and fine sandstone
MW-PNB	6,097,114	625,101	778.853	777.713	1.14	0.105	49.60	0.051	44.90	48.60	45.45	48.50	South Site	Rotary air hammer	Glacial Till
MW-Shaft	6,098,150	625,176	846.032	845.212	0.82	0.105	5.10	0.051	1.90	5.10	2.05	5.10	North Site	Rotary air hammer	Glacial Till

[A] *MW in ID number indicates monitoring well; VWP in ID number indicates vibrating wire piezometer*
[B] *screen slot size 10 (0.246 mm)*
[C] *geodetic data collected using a hand-held GPS*

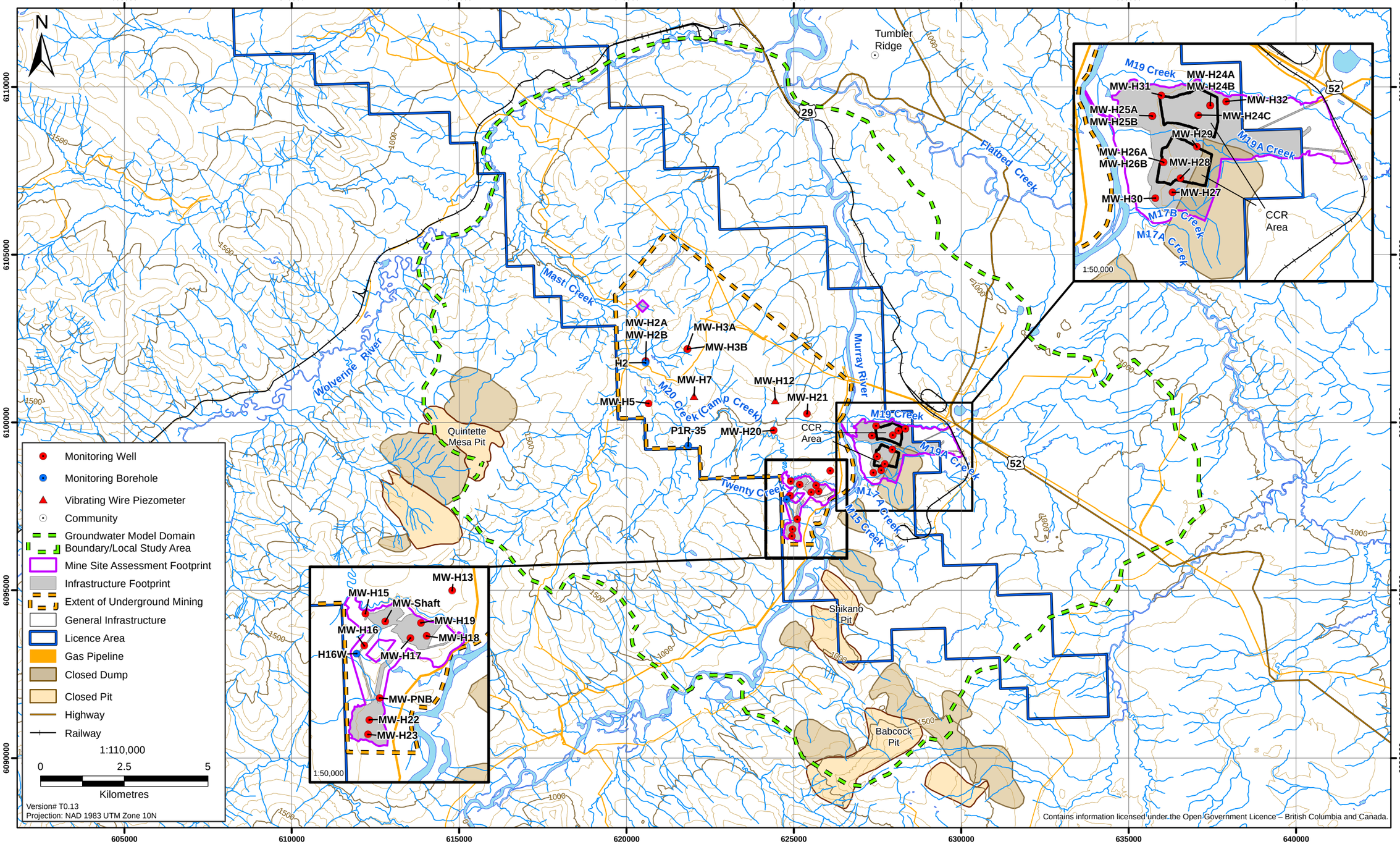


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Figure 3.2-1

Groundwater Monitoring Instrumentation Installed at the Project Site

Table 3.3-1. Well Development Details

Well ID	General Area	Date Developed	Development Method	Approximate Well Volume (L)	Approximate Purged Volume (L)
MW-H2A	Camp Ck. basin	1-Jul-11	Air-lift	160	400
MW-H2B	Camp Ck. basin	2-Jul-11	Air-lift	15	250
MW-H3A	Camp Ck. basin	not developed			-
MW-H3B	Camp Ck. basin	not developed			-
MW-H5	Camp Ck. basin	2-Jul-11	Air-lift	60	250
MW-H13	Camp Ck. basin	not developed			-
MW-H15	Underground Mine Zone	2-Jul-11	Air-lift	100	400
MW-H16	Underground Mine Zone	2-Jul-11	Air-lift	80	400
MW-H17	Underground Mine Zone	5-May-2012	Mechanical surging	7	200
MW-H18	Underground Mine Zone	5-May-2012	Mechanical surging	10	200
MW-H19	Underground Mine Zone	5 & 6-May-2012	Mechanical surging	3	20
MW-H20	Camp Ck. basin	2-Jul-11	Air-lift	30	300
MW-H21	Camp Ck. basin	not developed			-
MW-H22	Underground Mine Zone	9-May-2012	Mechanical surging	15	150
MW-H23	Underground Mine Zone	9-May-2012	Mechanical surging	10	150
MW-H24A	CCR Site	20-Oct-2012	Air-lift	25	30
MW-H24B	CCR Site	21-Oct-2012	Mechanical surging	3	40
MW-H24C	CCR Site	23-Jul-2013	Air-lift	9	100
MW-H25A	CCR Site	31-Oct-2012	Air-lift	50	150
MW-H25B	CCR Site	21-Oct-2012	Mechanical surging	3	25
MW-H26A	CCR Site	28-Oct-2012	Air-lift	30	140
MW-H26B	CCR Site	30-Oct-2012	Mechanical surging	3	70
MW-H27	CCR Site	26 & 27-Oct-2013	Air-lift	22	60
MW-H28	CCR Site	1-Aug-2013	Air-lift	4	35
MW-H29	CCR Site	1-Aug-2013	Air-lift	5	60
MW-H30	CCR Site	not developed			-
MW-H31	CCR Site	21-Jul-13	Air-lift	12	12
MW-H32	CCR Site	22-Jul-13	Air-lift	15	15
MW-PNB	Underground Mine Zone	2-Jul-11	Air-lift	75	350
MW-Shaft	Underground Mine Zone	9-Feb-14	over-pumping	1.1	10

3.4 HYDRAULIC CONDUCTIVITY TESTING

Single well and open hole response tests were conducted to assess the permeability of overburden and bedrock geologic materials. Testing methodologies included rising and falling-head tests in installed monitoring wells, and falling-head tests conducted in open borehole intervals isolated with inflatable packers. Packer tests were conducted at intermediate stages as drilling advanced.

Single well response tests were conducted in installed monitoring wells following development and settlement of the water level to natural equilibrium. Rising-head tests were initiated by removing a slug of water from a monitoring well using a bailer. Falling-head tests were initiated by adding a slug of

water into a well. The hydraulic response to the induced change in water level was monitored using a pressure transducer. Static water levels were established prior to test initiation using an electric water level meter.

Open-hole falling-head slug tests were conducted while drilling was advancing. For each test, two packers were inflated with nitrogen gas to isolate the top of the test zone. The water level in the zone was allowed to stabilize for an hour prior to testing. Tests were initiated by adding water to the drill rods, and the hydraulic response recorded using a pressure transducer. The packers and drill rods were leak-tested at each borehole. Up to four tests were conducted in a given borehole.

Hydraulic conductivities were estimated by analysing the hydraulic responses using the Hvorslev (1951) and Bouwer & Rice (1976) methods. Sensitivity analyses were conducted for a subset of the tests to assess the effects of certain input parameters with a high level of uncertainty on the resulting hydraulic conductivity estimates. These included aquifer thickness, sand pack porosity, and aquifer type (unconfined or confined).

3.5 WATER LEVELS, HYDRAULIC GRADIENTS, FLOW DIRECTIONS AND POTENTIOMETRIC SURFACE

Groundwater levels in all monitoring wells were measured on a seasonal basis, except where prevented by access limitations. Water levels were measured manually in wells using an electric water level meter, and in VWPs using a portable electronic readout box.

A potentiometric surface contour map was developed using mean water level measurements from each well, as well as VWP measurements and static water levels estimated for deep hydrogeologic testing (refer to Appendix A). A single mean level was calculated to represent twinned well pairs. Water levels were spatially-referenced using surveyed well collar locations. Surfer 8 (Godler Software® 2008) was used to generate spatial contours of water level from the data points. Groundwater flow directions and horizontal hydraulic gradients were interpreted from the potentiometric contour map. Adjustment and extrapolation of the contour lines have been made using professional judgment with consideration for the terrain, surface water features, and trends within the spatial extents of the dataset.

Differences in water levels between twinned shallow and deep wells were used to measure vertical hydraulic gradients. The vertical hydraulic gradients aided in identification of groundwater recharge and discharge zones.

3.6 GROUNDWATER SAMPLING

The objectives of groundwater sampling, as discussed in the Water and Air Baseline Monitoring Guidance Document for Mine Proponents (BC MOE 2012), were as follows:

- to assess the ambient groundwater conditions before potential effects from the proposed mine occur;
- to identify whether baseline concentrations naturally exceed provincial water quality guidelines and whether site-specific water quality objectives may need to be established;
- to use baseline information to predict and assess future impacts;
- to determine the need for groundwater monitoring and management during the life of the mine; and
- to allow the comparison of baseline with operational and post-closure water quality data in order to identify whether water quality is affected by mine-related activities.

All groundwater sampling was conducted in accordance with guidance provided in the *BC Field Sampling Manual* (BC MOE 2003). Prior to sampling, water was purged from wells until field parameters attained prescribed equilibrium conditions and at least one full well volume was purged. Purging methods that minimized turbidity and water level depression were used as much as possible.

Pumping technologies used to purge wells included inertial pumps, peristaltic pumps, and bladder pumps. Inertial pumps were used for early sampling, and were phased out of use in sampling activities due to their tendency to generate turbidity. A peristaltic pump was used where water levels less than 8 mbg could be sustained. A bladder pump was used where water levels were greater than 8 mbg.

Field parameters were measured using a YSI multi-parameter probe. A variety of models were used, and as a minimum the measurable field parameters included pH, specific conductance (SC), temperature, and oxidation-reduction potential (ORP). Field parameters were temperature-corrected by formulas integrated into the tool. Inspection of calibration was conducted on a regular basis, with a target frequency of once each day the tool is used.

Groundwater samples were collected in a suite of bottles, and preserved as follows:

- **General chemistry**: 1 L plastic bottle with no preservative added;
- **Total metals**: 250 ml plastic bottle with a capsule of 1:4 solution of nitric acid preservative added;
- **Dissolved metals**: 250 ml plastic bottle with a capsule of 1:4 solution of nitric acid preservative added following field filtering with a 45 µm disposable paper filter;
- **Total mercury**: 40 mL glass vial with a capsule of 1:1 hydrochloric acid;
- **Dissolved mercury**: 40 mL glass vial with a capsule of 1:1 hydrochloric acid added following field filtering with a 45 µm disposable paper filter;
- **Total organic carbon (TOC)**: 125 ml glass bottle with a capsule of 1:1 solution of hydrochloric acid preservative added;
- **Chemical Oxygen Demand**: 250 mL glass bottle with a capsule of 1:1 solution of sulfuric acid;
- **Nutrients**: 250-mL amber glass bottle with a capsule of 1:1 solution of sulfuric acid added;
- **Phenols**: 250 mL amber glass bottle with a capsule of 1:1 solution of sulfuric acid added; and
- **Polycyclic Aromatic Hydrocarbons**: 500-mL amber glass bottle preserved with sodium bisulfate.

One in every ten groundwater samples was collected as a blind duplicate for quality assurance/quality control (QA/QC). Blind duplicates were analysed for laboratory precision using relative percent difference (RPD) calculations. Target RPDs were 20% for analyte concentrations more than five times the detection limit, and 100% for lesser concentrations.

A suite of blanks were submitted to the laboratory to establish controls on potential sources of sample contamination. Field blanks were collected by decanting deionized water (provided by ALS Environmental of Burnaby, BC) into sample bottles using the corresponding preservation methods. Trip blanks were prepared by the laboratory and carried throughout a given site visit. An equipment blank was prepared for the bladder pump by passing deionized water through the stainless steel system prior to decanting it into sample bottles.

The groundwater quality results were screened against guidelines published by the British Columbia Ministry of Environment for the protection of freshwater aquatic life and for raw drinking water supply (BC MOE 2014). Approved chronic exposure guidelines were used where they existed. Working Water Quality Guidelines for the protection for freshwater aquatic life were used where approved guidelines did not exist. Drinking water quality guidelines published by Health Canada (Health Canada 2012) were used where no approved BC raw drinking water supply guidelines existed.

Analysis and discussion generally focuses on dissolved species. The majority of suspended solids entrained in groundwater samples are sampling artefacts, and not representative of particulate truly suspended in the seeping groundwater. Concentrations of total metals and other analytes that include a particulate component are skewed as a result of artificial entrainment of solids. Guidelines intended for application to total concentrations have been applied to dissolved components.

4. Results

4. Results

4.1 HYDROGEOLOGIC BOREHOLE LOGGING

Overburden and bedrock materials observed in the boreholes logged by ERM Rescan hydrogeologists were generally consistent with the test pit materials documented in terrain and soils evaluations (Rescan 2013b), and coal exploration boreholes. Logs derived from the hydrogeologic drilling programs are provided in Appendix B.

Overburden thickness varied from 1 m to 57 m. Thickness was generally greater along valley bottoms and at lower elevations. Materials generally consists with morainal, glaciofluvial, and colluvial deposits. Well-graded sands with significant fines content were frequently observed at higher elevations in the M20 Creek basin and throughout the proposed Underground Mine Zone. Fines (silt and clay) were observed along steep slopes in the M20 creek basin (MW-H20 and H21), and throughout the CCR site.

Mudstones and siltstones belonging to the Hassler formation were observed immediately beneath the overburden. Occasional sandstone layers were observed in the shallow bedrock (less than 50 mbg). Sandstones and siltstones observed in the deeper bedrock core may belong to the Boulder Creek Formation. Fracture densities were generally quite low, with RQD ranging from 75% to 100%. Lower RQD (60 to 75%) was sometimes logged over the top ten metres of bedrock, coinciding with moderate weathering. Fracture zones (multiple intersecting joints, or RQD less than 50%) were rare.

The lithologies observed in borehole samples were used in the development of a hydrogeologic conceptual model for the local study area, as discussed in Chapter 5.

4.2 HYDRAULIC CONDUCTIVITY MEASUREMENTS

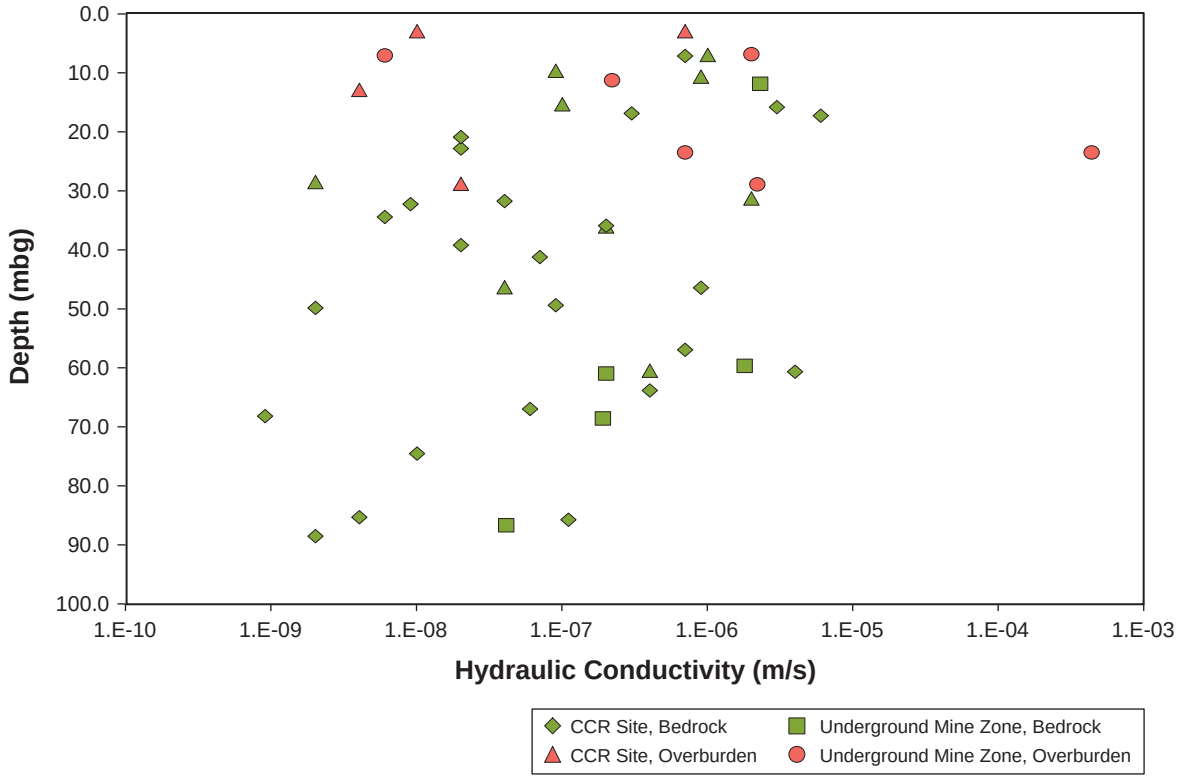
Hydraulic conductivity estimates are presented in Figure 4.2-1. Tabulated estimates and analysis reports are provided in Appendix C.

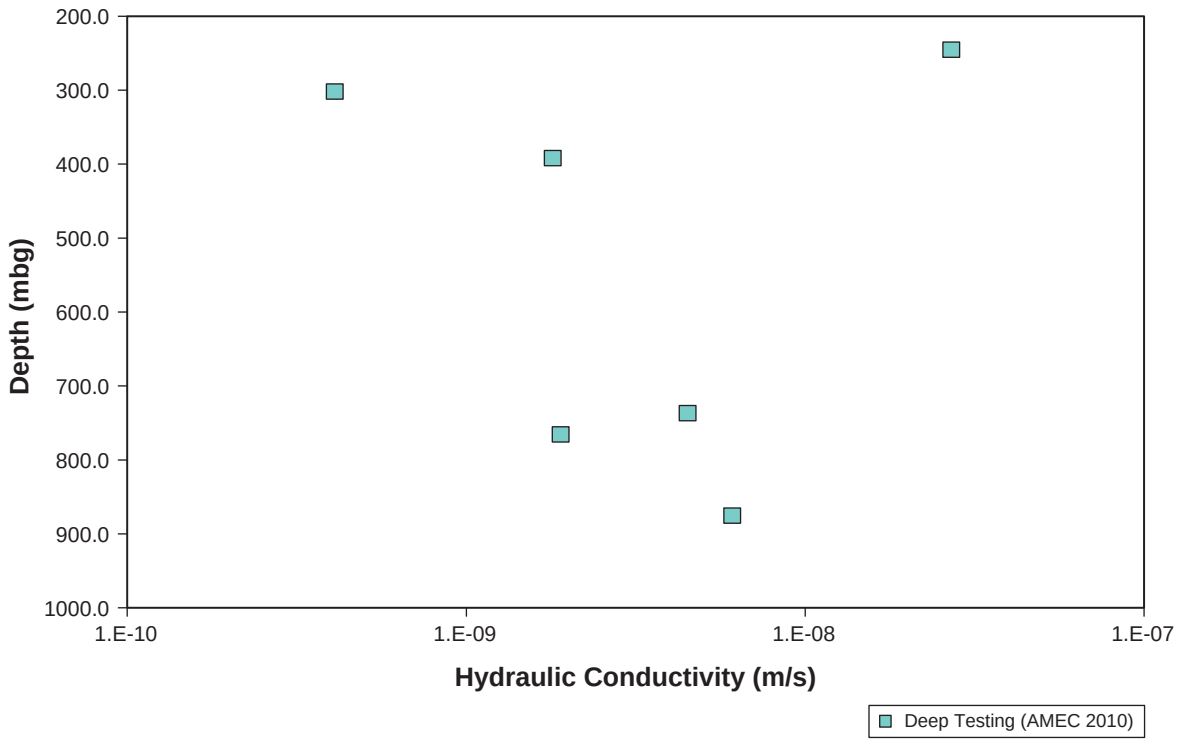
Hydraulic conductivity of the overburden was highly variable, as is generally expected for glacial deposition environments. A coarse granular deposit situated at the southern end of the Underground Mine Zone produced the highest estimate (4E-4 m/s). Tests conducted in morainal and colluvial sediments ranged three orders of magnitude (4E-9 to 2E-6 m/s).

The data suggest poor relations between fracture zones / depth and the measured hydraulic conductivities of the bedrock at depths up to 100 mbg, due to spatial heterogeniety in the extent of weathering. At depths less than 20 m, where moderate weathering and relatively low RQD have been commonly observed, K varied from 2E-8 to 6E-6 m/s (geometric mean of 1E-6 m/s). At depths ranging 20 to 100 m, where occasional moderate RQD and fracture zones have been observed, K estimates range from 9E-10 m/s to 4E-6 m/s (geometric mean of 5E-8 m/s).

The lower K measurements (on the scale of 1E-9 to 1E-10 m/s) observed occasionally at depths exceeding 30 m are interpreted to approach values attributable to fractured bedrock, where joint frequency is very low and lithostatic pressure sustains very tight joint aperture. Higher K measurements observed in the bedrock are interpreted to indicate presence of joints and fracture zones with adequate aperture and frequency to transmit fluids more rapidly than the competent rock mass.

Figure 4.2-1
Hydraulic Conductivity Estimates





Tests conducted at 57 – 62 mbg in MW-H2A, 54 – 67 mbg in MW-H24A, and 225 – 265 mbg in H16W may coincide with brittle deformational structures, as suggested by K values that are considerably greater than the dataset.

4.3 GROUNDWATER LEVELS, FLOW DIRECTIONS, HYDRAULIC GRADIENTS, AND POTENTIOMETRIC SURFACE

Time series of groundwater level records are presented in Figures 4.3-1 (highlands in the Underground Mine Zone), 4.3-2 (Southern Underground Mine Zone), 4.3-3 (CCR Site), 4.3-4 and 4.3-5 (pressure transducer records). Manual measurements are also tabulated in Appendix D.

The data indicate that the water table follows the regional topography. Higher water levels were measured in wells installed at higher elevations, and lower at lower elevations. Wells installed atop local steep slopes exhibited rather low water levels (53 m at MW-H13, 54 m at MW-H15, and 61 m at MW-H16), indicating that local variation in topography has little relation to the water table elevation. Artesian conditions have been observed at MW-H5, situated near the geographic centre of the M20 Creek Basin, at mid-slope relative to the creek and watershed divide.

Seasonal variability demonstrated in the dataset is interpreted to be driven by precipitation and snowmelt. Water levels tend to be at annual highs between May and August, when freshet and convective storms bring the greatest recharge. However the pressure transducer data have also shown considerable recharge events following mid-winter warm spells. Seasonal variability in groundwater levels is on the scale of one to two metres (Figures 4.3-4 and 4.3-5).

Calculated vertical hydraulic gradients (Table 4.3-1) indicate downward flow at most twinned wells, which are situated located at higher elevations and mid to upper-slopes. Downward gradients are interpreted as groundwater recharge zones, where precipitation and snowmelt provide input to the groundwater system. An upward gradient has been measured at MW-H26. MW-H26 is located adjacent to a wetland connected to the Murray River, and is interpreted to be a groundwater discharge zone. Therefore the data support the hypothesis that the Murray River (and associated low-lying wetlands) acts as the dominant groundwater discharge zone for the local study area.

Inspection of the potentiometric surface map (Figure 4.3-6) indicates that groundwater flows along regional topographic relief, from upper to lower elevations. Groundwater within the Camp Creek drainage basin generally trends eastward towards the Murray River, with some convergence towards Camp Creek at the centre of the basin. Groundwater beneath the CCR site flows westward towards the Murray River, discharging in the adjacent wetland that reports to the river.

Water level measurements indicate a local groundwater divide is present beneath the site of the bulk sample waste rock dump and Shaft. Recharge reporting to the northern reaches of this area would flow northward; recharge reporting to the southern reaches would flow southward. Shallow groundwater would discharge to the nearby streams. Deeper groundwater would mix with that arriving from upper reaches of the corresponding catchment basin and flow eastward towards the Murray River.

Shallow groundwater is expected to flow under greater influence from tributary creeks. Shallow groundwater near Camp, M19A, M17, and other small creeks is expected to report to these creeks. Artesian conditions observed at MW-H5 (screened 30 mbg in confined granular sediments) suggest a quite extensive capture zone for Camp Creek. Deeper groundwater is expected to converge towards the Murray River. Shallow flow systems discharging into tributary creeks and deeper regional flow systems discharging into the Murray River are present in both the Underground Mine Zone and CCR Site.

Figure 4.3-1

Water Level Measurements for Wells Installed throughout the Underground Mine Zone

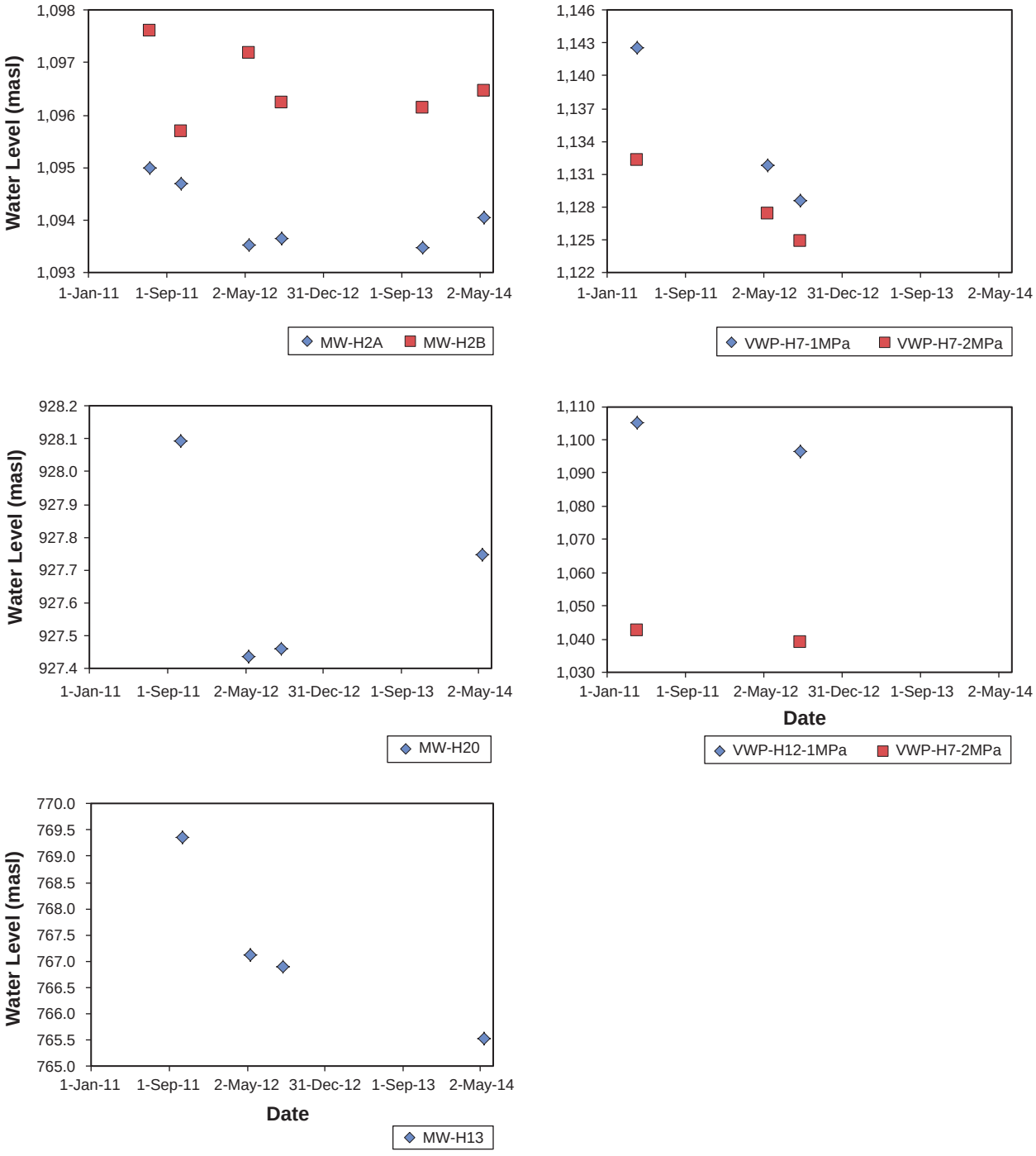


Figure 4.3-2

Water Level Measurements for Wells Installed at the Southern End of the Underground Mine Zone

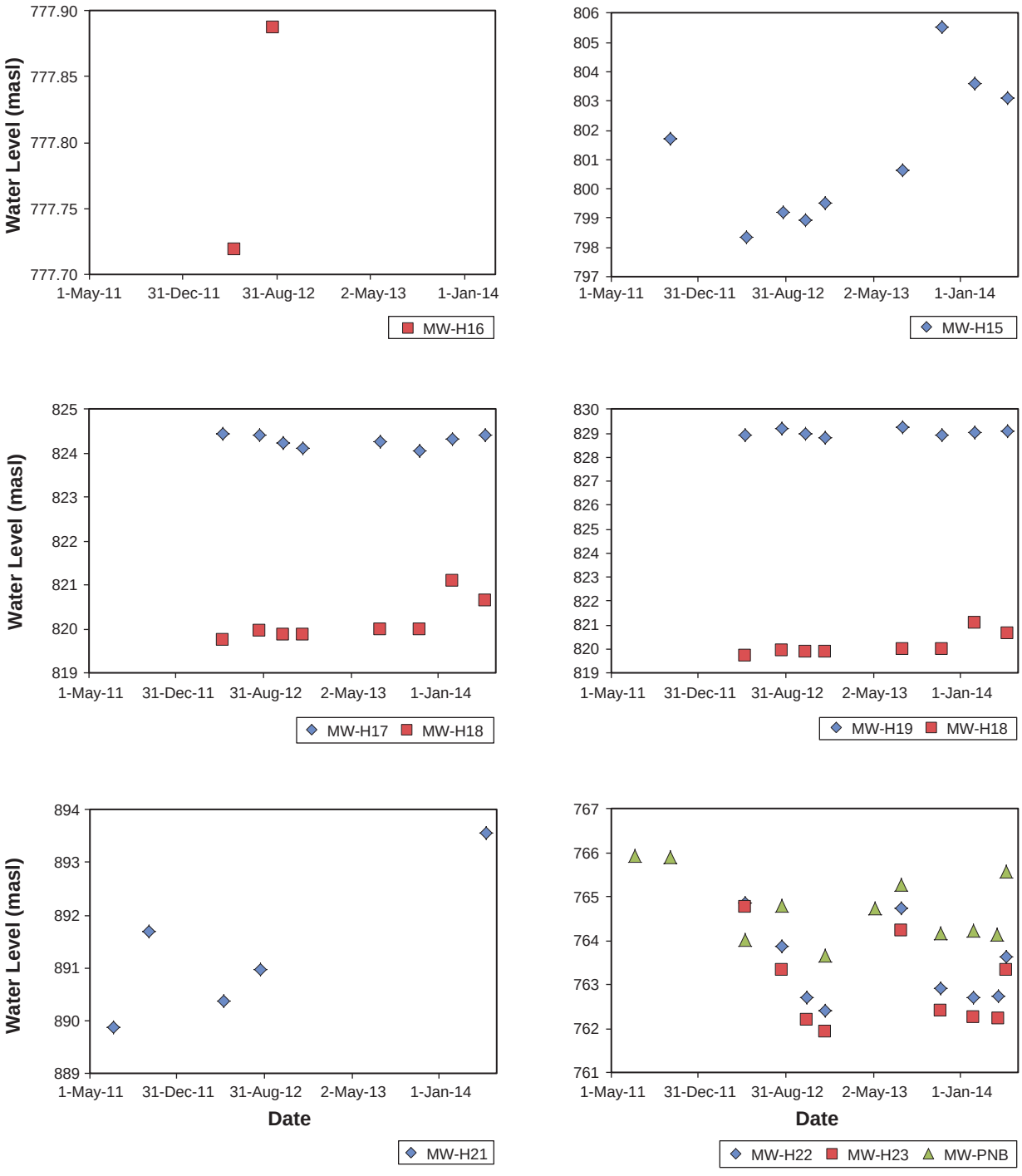


Figure 4.3-3

Water Level Measurements for Wells Installed at the Coarse Coal Reject Site

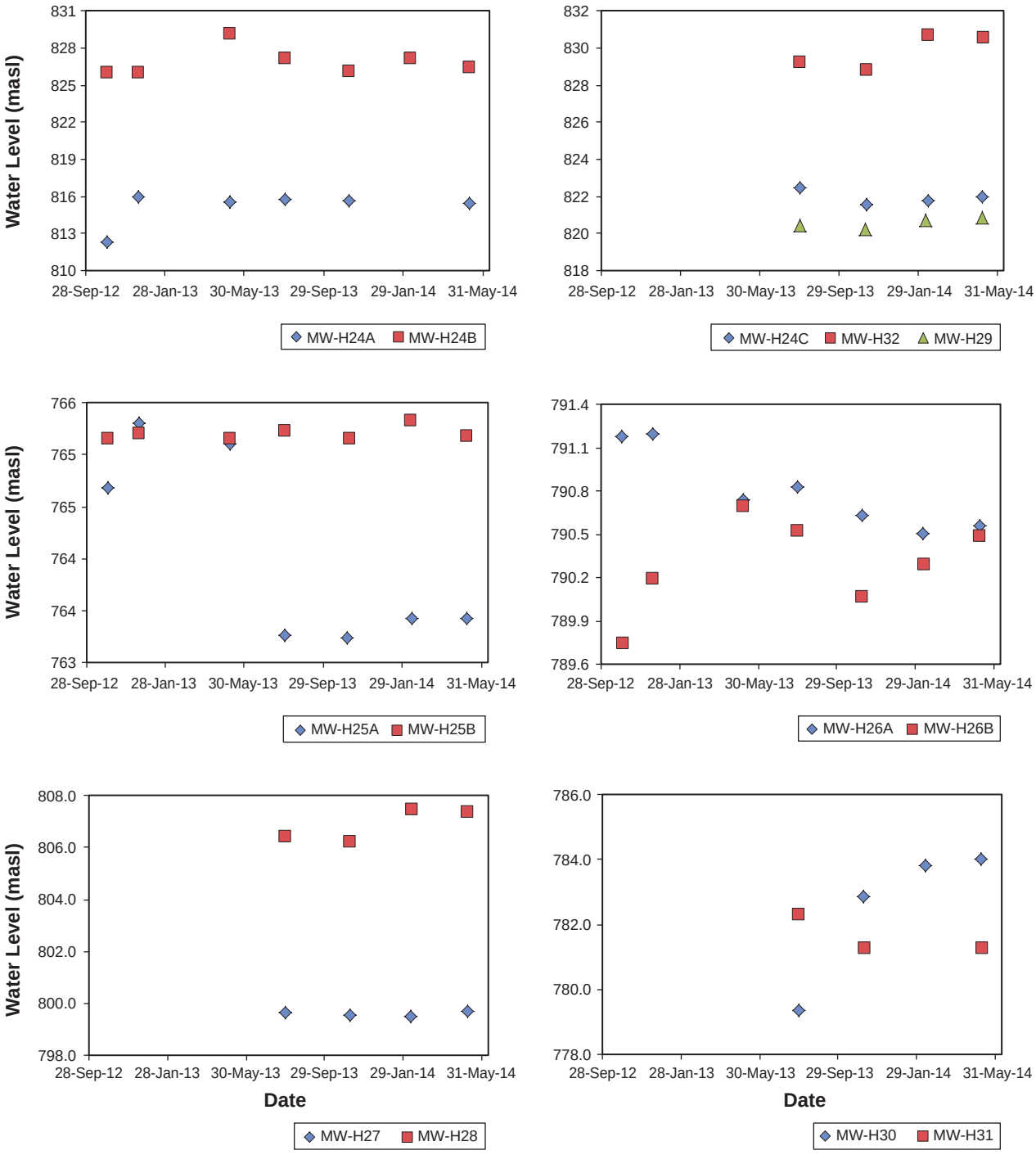
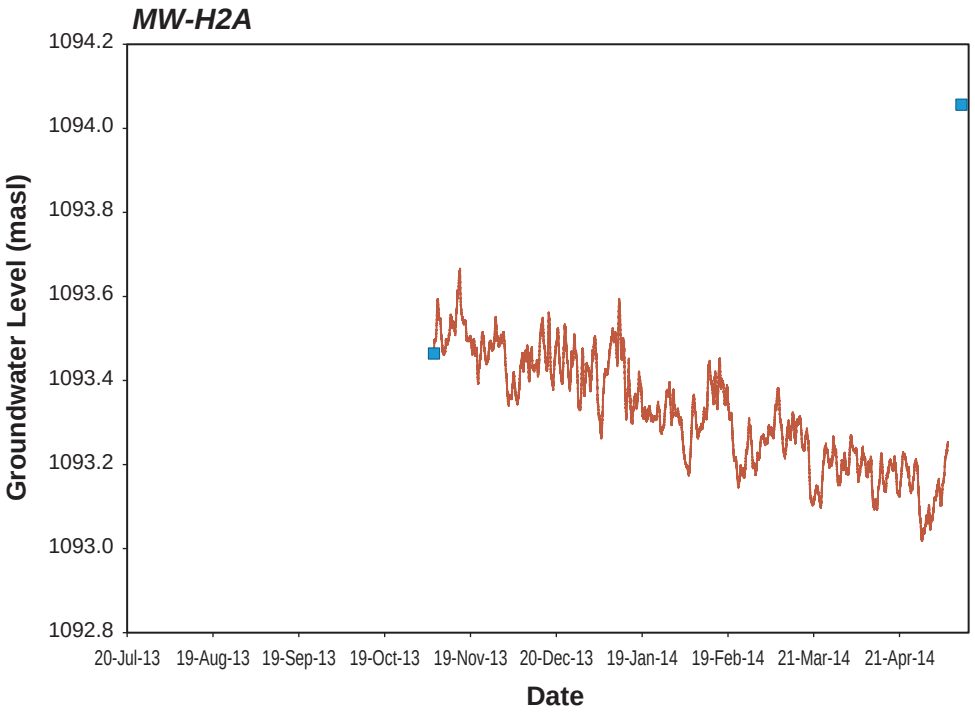
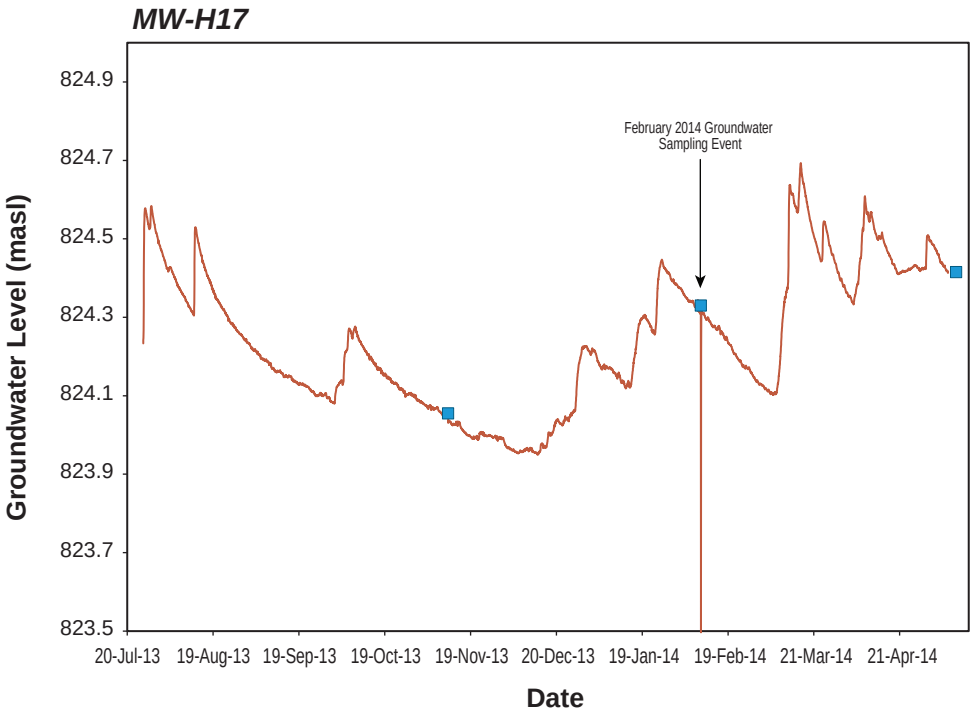


Figure 4.3-4

Continuous Water Level Timeseries Obtained from Deployed Pressure Transducers: MW-H2A and MW-H17

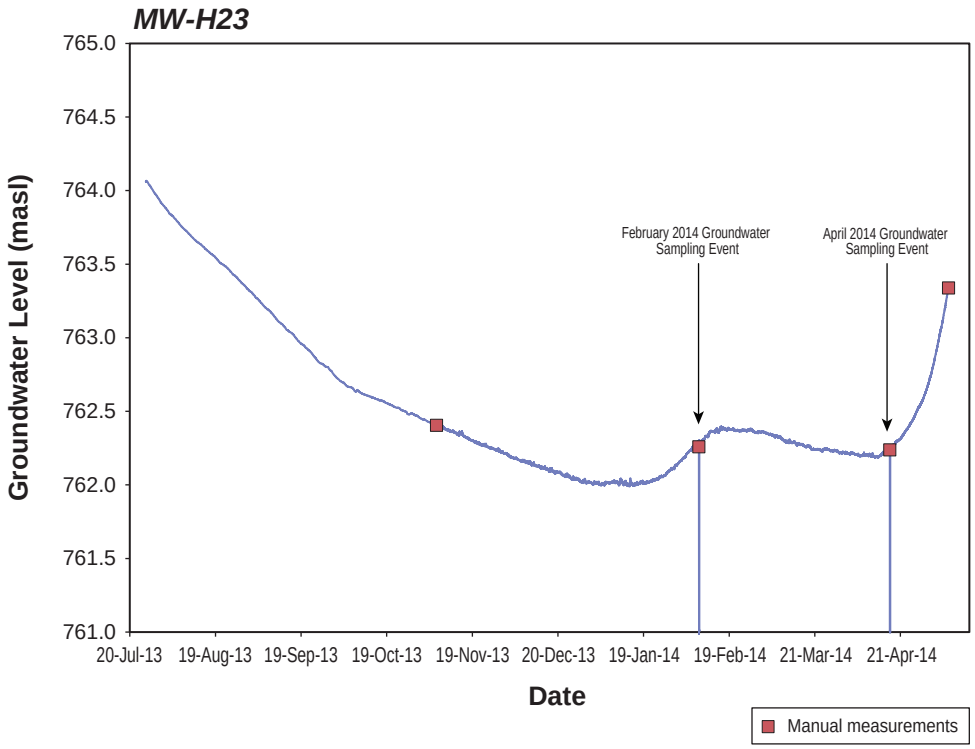


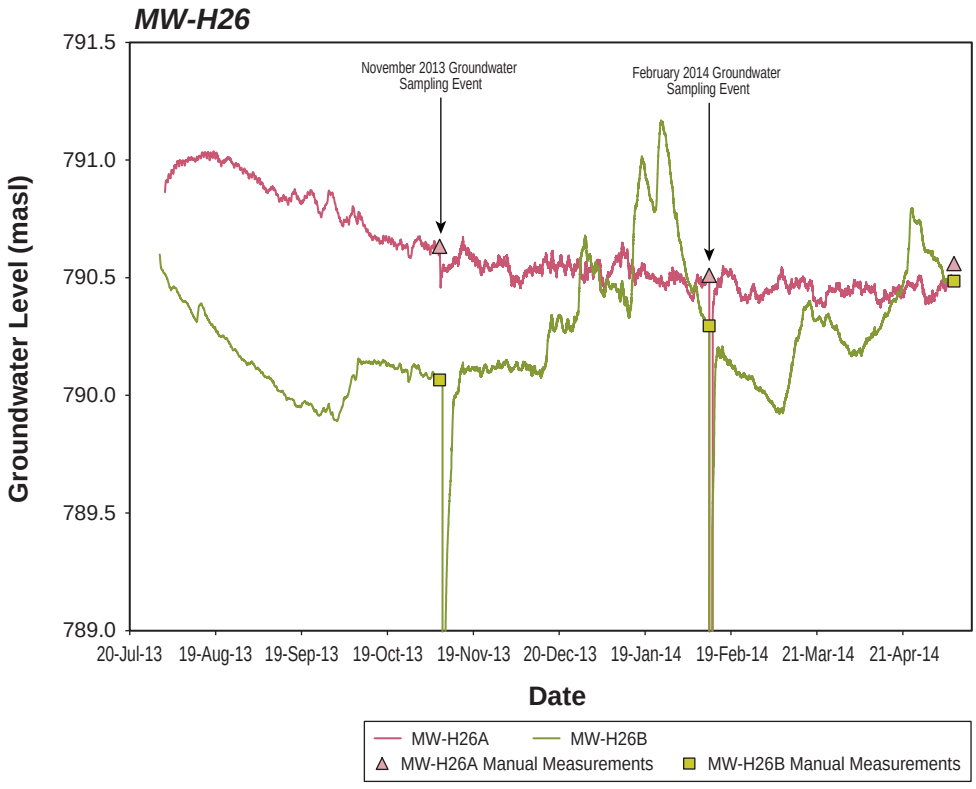


Note: Blue squares represent manual measurements.

Figure 4.3-5

Continuous Water Level Timeseries Obtained from Deployed Pressure Transducers: MW-H23 and MW-H26





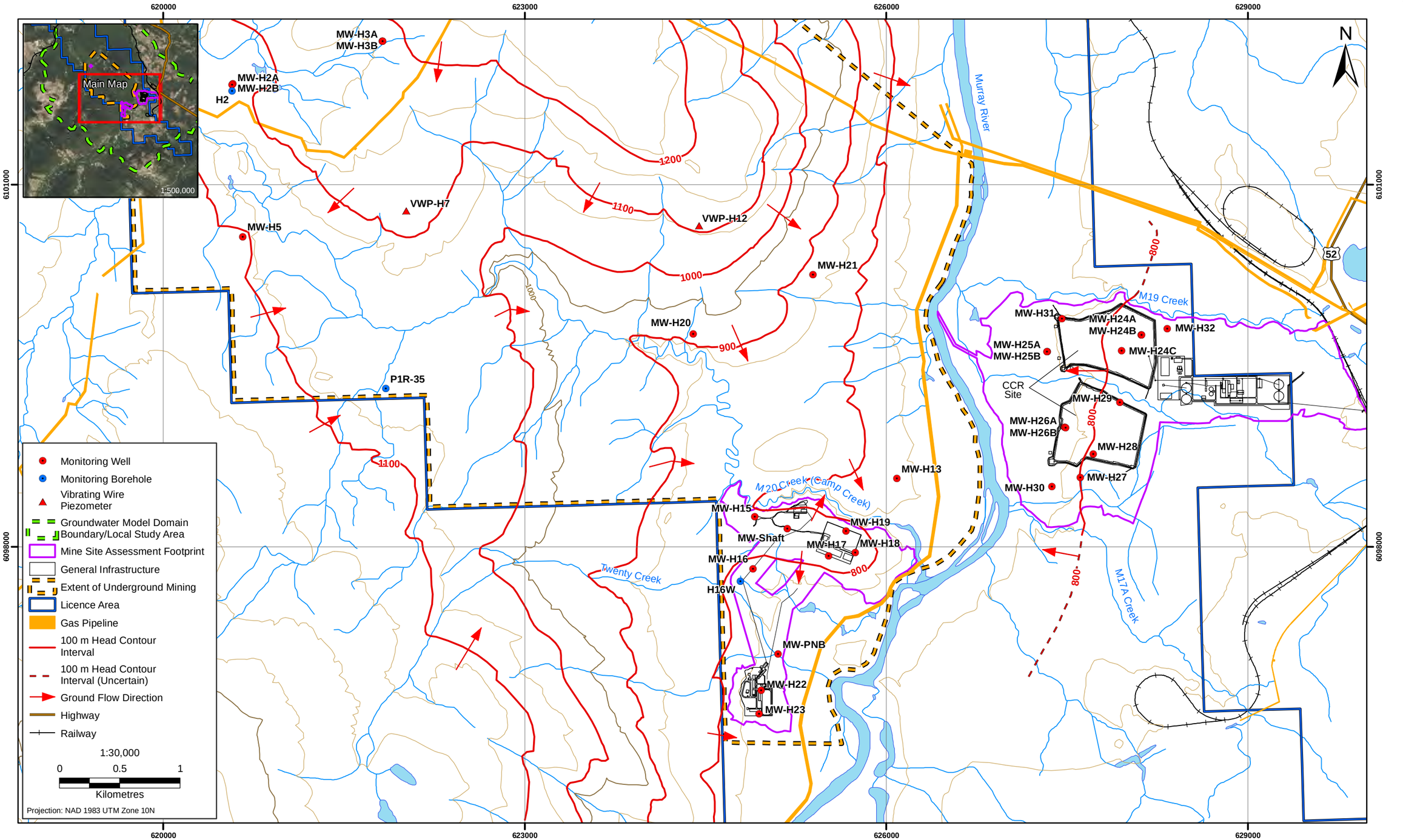


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Figure 4.3-6

Potentiometric Surface Map

Table 4.3-1. Vertical Hydraulic Gradients

Twinned Monitoring Well Site	Date	Deep Well Groundwater Elevation (masl)	Shallow Well Groundwater Elevation (masl)	Vertical Distance Between Screen Midpoints (m)	Vertical Gradients	Flow Direction
MW-H2	10-Jul-11	1,094.991	1,097.600	74.10	0.035	Down
	18-Oct-11	1,094.701	1,095.680		0.013	
	13-May-12	1,093.523	1,097.178		0.049	
	23-Aug-12	1,093.646	1,096.230		0.035	
	6-Nov-13	1,093.464	1,096.145		0.036	
	13-May-14	1,094.056	1,096.470		0.033	
MW-H3	7-Jul-11	1,189.010	1,213.870	174.85	0.142	Down
VWP-H7	4-Apr-11	1,132.240	1,142.600	117.50	0.088	Down
	13-May-12	1,127.420	1,131.790		0.037	
	24-Aug-12	1,124.860	1,128.620		0.032	
VWP-H12	4-Apr-11	1,042.510	1,105.190	94.00	0.667	Down
	24-Aug-12	1,039.140	1,096.610		0.611	
MW-H24	1-Nov-12	812.280	826.044	39.55	0.348	Down
	18-Dec-12	815.975	826.027		0.254	
	7-May-13	815.538	829.158		0.344	
	31-Jul-13	815.800	827.140		0.287	
	7-Nov-13	815.655	826.102		0.264	
	11-May-14	815.460	826.465		0.278	
MW-H25	1-Nov-12	764.685	765.160	57.10	0.008	Down
	18-Dec-12	765.300	765.210		-0.002	Up
	7-May-13	765.110	765.158		0.001	Down
	31-Jul-13	763.256	765.158		0.033	
	5-Nov-13	763.235	765.160		0.034	
	13-Feb-14	763.430	765.330		0.033	
	9-May-14	763.425	765.175		0.031	
MW-H26	29-Oct-12	791.178	789.742	29.75	-0.048	Up
	18-Dec-12	791.200	790.190		-0.034	
	7-May-13	790.735	790.693		-0.001	
	31-Jul-13	790.825	790.524		-0.010	
	7-Nov-13	790.633	790.065		-0.019	
	10-Feb-14	790.510	790.295		-0.007	
	9-May-14	790.560	790.485		-0.003	

Data at depths exceeding 100 mbg is limited. It is expected that, compared to shallow groundwater, deep groundwater flow is driven by regional topographic features or regional geology structures (e.g. folds and faults).

4.4 GROUNDWATER QUALITY

A summary of the number of monitoring wells and the number of samples collected from each well over the course of the baseline study is provided in Table 4.4-1. Certain wells were not accessible on occasion due to unsafe access conditions or damage to the well, or were found frozen during winter months.

Laboratory analytical reports for all groundwater samples are provided in Appendix E, along with tabulated guideline screening results and QA/QC calculations.

This section begins with a discussion of the implications of the laboratory QA/QC assessment (section 4.4.1). The discussion of groundwater quality follows (section 4.4.2), drawing from laboratory results to generate summary statistics and develop general trends, and drawing from guideline screening results to assign meaning to the results.

4.4.1 Quality Assurance/Quality Control

Tabualted RPD, CBE, and laboratory analyses for blanks are provided in Appendix E.

In most cases, the RPD values for blind duplicates were below thresholds, indicating adequate precision for the laboratory analyses. Two or more RPD values exceeded thresholds for acidity (4), carbonate alkalinity (2), turbidity (4), and total suspended solids (2). A number of RPDs for total metals exceeded thresholds in conjunction with those for turbidity and total suspended solids; however, the precision remained adequate for dissolved metals in these cases. Total alkalinity precision was acceptable (RPDs of 2.4 % and 0.3 % where carbonate alkalinity exceeded threshold RPD, likely indicating adjustment of carbonate species balance in response to exposure to the atmosphere.

Laboratory results for all field, trip, and equipment blanks consistently reported analyte concentrations below detection limits. This suggests that no detectable sample contamination arose from transport, handling, or re-usable sampling equipment.

4.4.2 Analyte Concentrations and Guideline Exceedances

Summary statistics for physical parameters, anions, nutrients, and dissolved metals have been calculated for each of the Underground Mine Zone (Tables 4.4-2 and 4.4-3), the Southern Underground Mine Zone (Tables 4.4-4 and 4.4-5), and the Coarse Coal Reject Site (Tables 4.4-6 and 4.4-7). These baseline summary statistics provide a general indication of groundwater quality at the corresponding sites.

Groundwater samples collected from MW-H24A, which is located at the CCR site, indicate contamination with cement grout, which is sourced in the borehole backfill material (very basic pH, anomalously high dissolved ion concentrations). Results from MW-H24A have been omitted from further discussion and calculation of summary statistics.

4.4.2.1 Physical Parameters

Hardness: Hardness of the groundwater varied, but generally shallow groundwater was hard (> 100 mg/L) and reported one order of magnitude greater concentrations relative to groundwater in the deeper bedrock. Although there are no guidelines for hardness, total metal concentrations guidelines for freshwater aquatic life are hardness depended for certain parameters: cadmium, copper, lead, manganese, nickel, silver, and zinc.

pH: pH values tended to be on the basic side of neutral, with mean values of 8.2 in the Underground Mine Zone, 7.4 at the Southern Underground Mine Zone, and 8.1 at the CCR site. The slightly alkaline tendency likely reflects the prevalence of bicarbonate found throughout the site.

Table 4.4-1. Groundwater Samples Collected During the Hydrogeology Baseline Study

Well	Location	Middle Screen Depth (mbg)	Screened Lithology	Summer 2011	Fall 2011	Winter 2011/12	Spring 2012	Summer 2012	Fall 2012	Winter 2012/13	Spring 2013	Summer 2013	Fall 2013	Winter 2014	Spring 2014
MW-H2A	Camp Ck. Basin	85.7	Mudstone												
MW-H2B	Camp Ck. Basin	11.4	Overburden												
MW-H5	Camp Ck. Basin	29.0	Overburden												
MW-H15	Underground Mine Zone	97.0	Sandstone												
MW-H16	Underground Mine Zone	69.0	Sandstone												
MW-H17	Underground Mine Zone	7.0	Mudstone												
MW-H18	Underground Mine Zone	12.0	Mudstone												
MW-H19	Underground Mine Zone	7.2	Mudstone												
MW-H20	Camp Ck. Basin	39.3	Sandstone												
MW-H22	Underground Mine Zone	23.6	Overburden												
MW-H23	Underground Mine Zone	23.6	Sand												
MW-H24A	CCR Site	46.4	Mudstone and siltstone												
MW-H24B	CCR Site	7.1	siltstone												
MW-H24C	CCR Site	10.8	siltstone												
MW-H25A	CCR Site	60.5	Siltstone												
MW-H25B	CCR Site	3.1	Overburden												
MW-H26A	CCR Site	31.4	Siltstone												
MW-H26B	CCR Site	3.1	Overburden												
MW-H27	CCR Site	36.1	Siltstone												
MW-H28	CCR Site	15.4	Siltstone												
MW-H29	CCR Site	9.8	Siltstone												
MW-PNB	Underground Mine Zone	47.0	Overburden												
MW-Shaft	Underground Mine Zone	3.6	Overburden												

Grey highlighting indicates a groundwater sample was collected.

Table 4.4-2. Groundwater Quality Summary Statistics for the Underground Mine Zone: Physical Tests, Anions, and Nutrients

Parameter	Units	# Samples	# samples below detection limit	Mean [J]	Standard Deviation [J]	Minimum	Maximum	DW Guidelines [A]	FWAL Guideline [A]
Field Measurements									
pH	-	10	0	8.21	0.63	6.87	9.00	6.5-8.5	6.5-9.0 [D, G]
Oxidation-Reduction Potential	mV	4	0	30	88	-30	190		ng
Specific Conductance	µS/cm	10	0	1000	550	271	1600		ng
Physical Tests (Laboratory)									
Hardness (as $CaCO_3$)	mg/L	13	0	130	120	7.3	310		ng
Total Dissolved Solids	mg/L	4	0	650	430	160	1200		ng
Anions and Nutrients									
Acidity (as $CaCO_3$)	mg/L	13	9	1.6	1.7	*1.0*	5.1		ng
Alkalinity, Total (as $CaCO_3$)	mg/L	13	0	490	300	130	940		ng
Ammonia, Total (as N)	mg/L	10	3	0.19	0.22	*0.0050*	0.72		0.45 to 29 [H]
Bromide (Br)	mg/L	13	13	na	na	*0.50*	*0.50*		ng
Chloride (Cl)	mg/L	13	3	5.4	4.2	*0.50*	13	250	150 [C]
Fluoride (F)	mg/L	13	0	0.77	0.77	0.084	2.1	1 [C]	K
Nitrate (as N)	mg/L	13	9	0.038	0.094	*0.0050*	0.41	10 [L]	3 [C]
Nitrite (as N)	mg/L	13	13	0.0025	0.0028	*0.0010*	0.010	1	0.02 [C]
Total Nitrogen	mg/L	10	0	0.66	0.35	0.17	1.4		ng
Orthophosphate-Dissolved (as P)	mg/L	13	1	0.10	0.13	*0.0010*	0.43		ng
Phosphorus (P)-Total Dissolved	mg/L	13	1	0.13	0.15	*0.0020*	0.44	0.01 [E]	between 0.005 and 0.015 [B, E]
Sulfate (SO_4)	mg/L	13	4	8.8	6.6	*0.50*	29	500	128 to 429 [F]

ng = no approved water quality guideline

na = not applicable

underlined values exceed FWAL guidelines

Red values exceed Drinking Water Guidelines

shaded/italic values are below reported detection limits.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[J] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

Table 4.4-3. Groundwater Quality Summary Statistics for the Underground Mine Zone: Dissolved Metals

Parameter	Units	# Samples	# samples below detection limit	Mean [S]	Standard Deviation [S]	Minimum	Maximum	FWAL Guideline [A]	DW Guidelines [A]
Aluminum (Al)-Dissolved	mg/L	13	3	0.45	1.2	*0.0030*	5.0	0.05 [B,E]	0.2
Antimony (Sb)-Dissolved	mg/L	13	6	0.00087	0.0018	*0.00010*	0.0077	0.02 [B, R]	0.06 [B, T]
Arsenic (As)-Dissolved	mg/L	13	1	0.0017	0.0016	*0.00020*	0.0060	0.005 [B]	0.025 [B]
Barium (Ba)-Dissolved	mg/L	13	0	0.72	0.73	0.12	2.7	1 [B, C, R]	1 [B, T]
Beryllium (Be)-Dissolved	mg/L	13	13	na	na	*0.00010*	*0.00010*	0.0053 [B, C, R]	
Bismuth (Bi)-Dissolved	mg/L	13	13	na	na	*0.00050*	*0.00050*	ng	
Boron (B)-Dissolved	mg/L	13	3	0.10	0.09	*0.010*	0.20	1.2 [B]	5 [B]
Cadmium (Cd)-Dissolved	mg/L	13	8	0.000015	0.000014	*0.000010*	0.000060	B, R, N	0.005 [B, T]
Calcium (Ca)-Dissolved	mg/L	13	0	33	30	1.9	79	na	
Chromium (Cr)-Dissolved	mg/L	13	8	0.00028	0.00054	*0.00010*	0.0023	0.0089 [B, P]	0.05 [B, T]
Cobalt (Co)-Dissolved	mg/L	13	4	0.00028	0.00023	*0.00010*	0.00087	4 [B, C]	
Copper (Cu)-Dissolved	mg/L	13	9	0.0067	0.022	*0.00050*	0.094	0.0004 to 0.002 [B, C, F]	0.5 [B]
Iron (Fe)-Dissolved	mg/L	13	6	0.28	0.39	*0.030*	1.1	0.35	0.3 [B, T]
Lead (Pb)-Dissolved	mg/L	13	7	0.00016	0.00027	*0.000050*	0.0010	B, C, H	0.05 [B]
Lithium (Li)-Dissolved	mg/L	13	4	0.50	0.55	0.0020	1.3	0.096 [R]	
Magnesium (Mg)-Dissolved	mg/L	13	0	11	11	0.62	28	ng	
Manganese (Mn)-Dissolved	mg/L	13	0	0.21	0.24	0.0017	0.63	B, C, J	0.05 [B, T]
Mercury (Hg)-Dissolved	mg/L	13	13	na	na	*0.000010*	*0.000010*	0.0000125 to 0.0002 [B, C, K]	0.001 [B]
Molybdenum (Mo)-Dissolved	mg/L	13	0	0.0047	0.0064	0.00025	0.025	1 [B, C]	0.25 [B]
Nickel (Ni)-Dissolved	mg/L	13	3	0.0011	0.0011	*0.00050*	0.0042	0.025 to 0.15 [B, C, R, Q]	
Potassium (K)-Dissolved	mg/L	13	0	0.93	0.46	0.47	2.5	195 [R]	
Selenium (Se)-Dissolved	mg/L	13	4	0.00021	0.00022	*0.00010*	0.00081	0.002 [B]	0.01 [B]
Silicon (Si)-Dissolved	mg/L	13	0	4.4	2.5	2.4	12	ng	
Silver (Ag)-Dissolved	mg/L	13	12	*0.000010*	0.0000056	*0.000010*	0.000028	0.0005 to 0.0015 [B, C, L]	
Sodium (Na)-Dissolved	mg/L	13	2	170	170	*1.0*	390	ng	200 [B, T]
Strontium (Sr)-Dissolved	mg/L	13	0	0.21	0.15	0.066	0.64	ng	
Thallium (Tl)-Dissolved	mg/L	13	10	*0.000010*	0.0000089	*0.000010*	0.000042	0.0003 [B, R]	
Tin (Sn)-Dissolved	mg/L	13	11	0.00012	0.00018	*0.00010*	0.00083	ng	
Titanium (Ti)-Dissolved	mg/L	13	11	0.017	0.036	*0.010*	0.16	2 [B, R]	
Uranium (U)-Dissolved	mg/L	13	0	0.0027	0.0034	0.00012	0.010	0.3 [B, R]	0.02 [B, T]
Vanadium (V)-Dissolved	mg/L	13	8	0.0028	0.0052	*0.0010*	0.022	0.006 [B, R]	
Zinc (Zn)-Dissolved	mg/L	13	10	0.012	0.029	*0.0030*	0.12	B, C, M	5 [B]

ng = no approved water quality guideline

na = not applicable

underlined values exceed guidelines

shaded/italic values are below reported detection limits.

red values exceed drinking water guidelines

(continued)

Table 4.4-3. Groundwater Quality Summary Statistics for the Underground Mine Zone: Dissolved Metals (completed)

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[G] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 log_{10}(Hardness)].*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[log_{10}(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

Table 4.4-4. Groundwater Quality Summary Statistics for the Southern Underground Mine Zone: Physical Tests, Anions, and Nutrients

Parameter	Units	# Samples	# samples below detection limit	Mean [J]	Standard Deviation [J]	Minimum	Maximum	DW Guidelines [A]	FWAL Guideline [A]
Field Measurements									
pH	-	28	0	7.39	0.59	7.00	9.00	6.5-8.5	6.5-9.0 [D, G]
Oxidation-Reduction Potential	mV	20	0	75	92	0	250		ng
Specific Conductance	µS/cm	28	0	720	426	247	1956		ng
Physical Tests (Laboratory)									
Hardness (as $CaCO_3$)	mg/L	36	0	230	130	7.3	650		ng
Total Dissolved Solids	mg/L	9	0	470	350	250	1250		ng
Anions and Nutrients									
Acidity (as $CaCO_3$)	mg/L	36	16	6.9	20	*1.0*	120		ng
Alkalinity, Total (as $CaCO_3$)	mg/L	36	0	360	160	188	770		ng
Ammonia, Total (as N)	mg/L	33	12	0.14	0.21	*0.0050*	0.81		0.45 to 29 [H]
Bromide (Br)	mg/L	35	34	na	na	*0.50*	1.4		ng
Chloride (Cl)	mg/L	36	17	46	63	*0.50*	220	250	150 [C]
Fluoride (F)	mg/L	36	1	0.35	0.48	0.05	2.1	1 [C]	K
Nitrate (as N)	mg/L	36	13	0.12	0.15	*0.0050*	0.49	10 [L]	3 [C]
Nitrite (as N)	mg/L	36	26	0.0047	0.0070	*0.0010*	0.033	1	0.02 [C]
Total Nitrogen	mg/L	33	0	0.72	0.86	0.08	4.1		ng
Orthophosphate-Dissolved (as P)	mg/L	36	13	0.035	0.10	*0.0010*	0.43		ng
Phosphorus (P)-Total Dissolved	mg/L	34	13	0.037	0.09	*0.0020*	0.44	0.01 [E]	between 0.005 and 0.015 [B, E]
Sulfate (SO_4)	mg/L	36	1	26	32	*5.0*	170	500	128 to 429 [F]

ng = no approved water quality guideline

na = not applicable

underlined values exceed FWAL guidelines

red values exceed drinking water guidelines

shaded/italic values are below reported detection limits.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here*

[H] *Ammonia guidelines temperature and pH dependent.*

[J] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

Table 4.4-5. Groundwater Quality Summary Statistics for the Southern Underground Mine Zone: Dissolved Metals

Parameter	Units	# Samples	# samples below detection limit	Mean [S]	Standard Deviation [S]	Minimum	Maximum	FWAL Guideline [A]	DW Guidelines [A]
Aluminum (Al)-Dissolved	mg/L	36	18	0.066	0.33	*0.0030*	2.0	0.05 [D,E]	0.2
Antimony (Sb)-Dissolved	mg/L	36	16	0.00073	0.0017	*0.00010*	0.0077	0.02 [D, K]	0.06 [D, I]
Arsenic (As)-Dissolved	mg/L	36	7	0.0010	0.0013	*0.00010*	0.0060	0.005 [D]	0.025 [D]
Barium (Ba)-Dissolved	mg/L	36	0	0.57	0.52	0.11	2.7	1 [D, C, K]	1 [D, I]
Beryllium (Be)-Dissolved	mg/L	35	36	na	na	*0.00010*	*0.00010*	0.0053 [D, C, K]	
Bismuth (Bi)-Dissolved	mg/L	35	36	na	na	*0.00050*	*0.00050*	ng	
Boron (B)-Dissolved	mg/L	36	14	0.067	0.083	*0.010*	0.25	1.2 [D]	5 [D]
Cadmium (Cd)-Dissolved	mg/L	36	8	0.000037	0.000030	*0.000010*	0.00015	B, R, N	0.005 [D, I]
Calcium (Ca)-Dissolved	mg/L	36	0	66	38	4.9	190	na	
Chromium (Cr)-Dissolved	mg/L	34	18	0.00019	0.00024	*0.00010*	0.00096	0.0089 [D, F]	0.05 [D, I]
Cobalt (Co)-Dissolved	mg/L	36	8	0.00052	0.00049	*0.00010*	0.0018	4 [D, C]	
Copper (Cu)-Dissolved	mg/L	36	20	0.0033	0.016	*0.00050*	0.094	0.0004 to 0.002 [D,	0.5 [D]
Iron (Fe)-Dissolved	mg/L	36	21	0.10	0.20	*0.030*	0.97	0.35	0.3 [D, I]
Lead (Pb)-Dissolved	mg/L	36	31	0.000063	0.00012	*0.000050*	0.00071	B, C, H	0.05 [D]
Lithium (Li)-Dissolved	mg/L	36	0	0.21	0.35	0.0031	1.1	0.096 [K]	
Magnesium (Mg)-Dissolved	mg/L	36	0	17	8.5	1.3	41	ng	
Manganese (Mn)-Dissolved	mg/L	36	0	0.15	0.26	0.00066	1.1	B, C, J	0.05 [D, I]
Mercury (Hg)-Dissolved	mg/L	35	35	na	na	*0.000020*	0.000017	0.0002 [B, C, K]	0.001 [B]
Molybdenum (Mo)-Dissolved	mg/L	36	0	0.0071	0.011	0.00025	0.053	1 [D, C]	0.25 [D]
Nickel (Ni)-Dissolved	mg/L	36	5	0.0024	0.0020	*0.00050*	0.0080	0.025 to 0.15 [D, C,	
Potassium (K)-Dissolved	mg/L	36	0	1.1	0.50	0.55	2.7	195 [K]	
Selenium (Se)-Dissolved	mg/L	36	6	0.00044	0.00044	*0.00010*	0.0026	0.002 [D]	0.01 [D]
Silicon (Si)-Dissolved	mg/L	36	0	3.6	0.73	2.3	5.4	ng	
Silver (Ag)-Dissolved	mg/L	36	36	na	na	*0.000010*	*0.000010*	[D, C, E]	
Sodium (Na)-Dissolved	mg/L	36	5	97	140	*1.0*	440	ng	200 [D, I]
Strontium (Sr)-Dissolved	mg/L	36	0	0.26	0.24	0.088	0.94	ng	
Thallium (Tl)-Dissolved	mg/L	36	25	0.000012	0.000011	*0.000010*	0.000056	0.0003 [D, K]	
Tin (Sn)-Dissolved	mg/L	36	28	0.00020	0.00036	*0.00010*	0.0020	ng	
Titanium (Ti)-Dissolved	mg/L	36	31	0.0072	0.0062	*0.010*	0.039	2 [D, K]	
Uranium (U)-Dissolved	mg/L	36	0	0.0018	0.0024	0.00024	0.010	0.3 [D, K]	0.02 [D, I]
Vanadium (V)-Dissolved	mg/L	36	32	0.00088	0.0013	*0.0010*	0.0081	0.006 [D, K]	
Zinc (Zn)-Dissolved	mg/L	36	28	0.0064	0.020	*0.0030*	0.12	B, C, M	5 [B]

ng = no approved water quality guideline

na = not applicable

underlined values exceed guidelines

shaded/italic values are below reported detection limits.

red values exceed drinking water guidelines

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

(continued)

Table 4.4-5. Groundwater Quality Summary Statistics for the Southern Underground Mine Zone: Dissolved Metals (completed)

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[G] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 log_{10}(Hardness)].*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[log_{10}(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

Table 4.4-6. Groundwater Quality Summary Statistics for the Coarse Coal Reject Site: Physical Tests, Anions, and Nutrients

Parameter	Units	# Samples	# samples below detection limit	Mean [J]	Standard Deviation [J]	Minimum	Maximum	DW Guidelines [X]	FWAL Guideline [A]
Field Measurements									
pH	-	36	0	8.05	0.65	7.02	9.21	6.5-8.5	6.5-9.0 [D, G]
Oxidation-Reduction Potential	mV	36	0	-5	79	-150	140		ng
Specific Conductance	µS/cm	36	0	780	340	270	1900		ng
Physical Tests (Laboratory)									
Hardness (as $CaCO_3$)	mg/L	38	0	150	150	8.4	390		ng
Total Dissolved Solids	mg/L	6	0	650	340	310	1300		1290
Anions and Nutrients									
Acidity (as $CaCO_3$)	mg/L	38	22	3.0	3.6	*1.0*	13		ng
Alkalinity, Total (as $CaCO_3$)	mg/L	38	0	450	160	240	760		ng
Ammonia, Total (as N)	mg/L	38	0	0.26	0.17	0.0071	0.51		0.45 to 29 [H]
Bromide (Br)	mg/L	38	36	na	na	*0.50*	2.10		ng
Chloride (Cl)	mg/L	38	19	3.5	5.2	*0.50*	30	250	150 [C]
Fluoride (F)	mg/L	38	0	0.46	0.33	0.09	1.1	1 [C]	K
Nitrate (as N)	mg/L	38	28	0.021	0.026	*0.0050*	0.12	10 [L]	3 [C]
Nitrite (as N)	mg/L	38	27	0.0040	0.0032	*0.0010*	0.014	1	0.02 [C]
Total Nitrogen	mg/L	38	0	0.61	0.85	0.13	5.4		ng
Orthophosphate-Dissolved (as P)	mg/L	38	11	0.036	0.065	*0.0010*	0.38		ng
Phosphorus (P)-Total Dissolved	mg/L	38	11	0.041	0.068	*0.0020*	0.39	0.01 [E]	between 0.005 and 0.015 [B, E]
Sulfate (SO_4)	mg/L	38	9	36	75	1.0	410	500	128 to 429 [F]

ng = no approved water quality guideline

na = not applicable

underlined values exceed BC FWAL guidelines

shaded/italic values are below reported detection limits.

Red values exceed drinking water guidelines

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[J] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

Table 4.4-7. Groundwater Quality Summary Statistics for the Coarse Coal Reject Site: Dissolved Metals

Parameter	Units	# Samples	# samples below detection limit	Mean [S]	Standard Deviation [S]	Minimum	Maximum	FWAL Guideline [A]	DW Guidelines [A]
Aluminum (Al)-Dissolved	mg/L	38	8	0.018	0.032	*0.0030*	0.13	0.05 [B,E]	0.2
Antimony (Sb)-Dissolved	mg/L	38	17	0.00030	0.00037	*0.00010*	0.0017	0.02 [B, R]	0.06 [B, T]
Arsenic (As)-Dissolved	mg/L	38	3	0.0024	0.0066	*0.00010*	0.041	0.005 [B]	0.025 [B]
Barium (Ba)-Dissolved	mg/L	38	0	0.59	0.44	0.04	1.4	1 [B, C, R]	1 [B, T]
Beryllium (Be)-Dissolved	mg/L	38	38	na	na	*0.00010*	*0.00010*	0.0053 [B, C, R]	
Bismuth (Bi)-Dissolved	mg/L	38	38	na	na	*0.00050*	*0.00050*	ng	
Boron (B)-Dissolved	mg/L	38	1	0.12	0.087	*0.010*	0.22	1.2 [B]	5 [B]
Cadmium (Cd)-Dissolved	mg/L	38	22	0.000022	0.000026	*0.000010*	0.00011	B, R, N	0.005 [B, T]
Calcium (Ca)-Dissolved	mg/L	38	0	39	39	2.7	99	na	
Chromium (Cr)-Dissolved	mg/L	38	28	0.00012	0.00017	*0.00010*	0.0011	0.0089 [B, P]	0.05 [B, T]
Cobalt (Co)-Dissolved	mg/L	38	13	0.00077	0.00083	*0.00010*	0.0034	4 [B, C]	
Copper (Cu)-Dissolved	mg/L	38	28	0.00050	0.00048	*0.00050*	0.0019	0.0004 to 0.002 [B, C, F]	0.5 [B]
Iron (Fe)-Dissolved	mg/L	38	11	0.39	0.72	*0.030*	3.7	0.35	0.3 [B, T]
Lead (Pb)-Dissolved	mg/L	38	25	0.000065	0.00010	*0.000050*	0.00064	B, C, H	0.05 [B]
Lithium (Li)-Dissolved	mg/L	38	0	0.25	0.27	0.0012	0.76	0.096 [R]	
Magnesium (Mg)-Dissolved	mg/L	38	0	13	13	0.31	37	ng	
Manganese (Mn)-Dissolved	mg/L	38	0	0.30	0.38	0.0051	1.5	B, C, J	0.05 [B, T]
Mercury (Hg)-Dissolved	mg/L	38	37	na	na	*0.000010*	0.000012	0.0000125 to 0.0002 [B, C, K]	0.001 [B]
Molybdenum (Mo)-Dissolved	mg/L	38	0	0.0055	0.0060	0.00016	0.023	1 [B, C]	0.25 [B]
Nickel (Ni)-Dissolved	mg/L	38	11	0.0026	0.0025	*0.00050*	0.0095	0.025 to 0.15 [B, C, R, Q]	
Potassium (K)-Dissolved	mg/L	38	0	1.0	0.60	0.30	2.5	195 [R]	
Selenium (Se)-Dissolved	mg/L	38	18	0.00024	0.00039	*0.00010*	0.0021	0.002 [B]	0.01 [B]
Silicon (Si)-Dissolved	mg/L	38	0	4.3	1.3	2.7	6.7	ng	
Silver (Ag)-Dissolved	mg/L	38	36	na	0.0000070	*0.000010*	0.000048	0.0005 to 0.0015 [B, C, L]	
Sodium (Na)-Dissolved	mg/L	38	0	160	140	6.2	360	ng	200 [B, T]
Strontium (Sr)-Dissolved	mg/L	38	0	0.21	0.12	0.024	0.52	ng	
Thallium (Tl)-Dissolved	mg/L	38	30	0.000011	0.000016	*0.000010*	0.00010	0.0003 [B, R]	
Tin (Sn)-Dissolved	mg/L	38	26	0.00013	0.00015	*0.00010*	0.00076	ng	
Titanium (Ti)-Dissolved	mg/L	38	34	0.0055	0.002	*0.010*	0.012	2 [B, R]	
Uranium (U)-Dissolved	mg/L	38	0	0.0015	0.0019	0.00002	0.0076	0.3 [B, R]	0.02 [B, T]
Vanadium (V)-Dissolved	mg/L	38	34	0.00081	0.00080	*0.0010*	0.0042	0.006 [B, R]	
Zinc (Zn)-Dissolved	mg/L	38	27	0.0022	0.0015	*0.0030*	0.0077	B, C, M	5 [B]

ng = no approved water quality guideline

na = not applicable

underlined values exceed guidelines

shaded/italic values are below reported detection limits.

red values exceed drinking water guidelines

(continued)

Table 4.4-7. Groundwater Quality Summary Statistics for the Coarse Coal Reject Site: Dissolved Metals (completed)

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[G] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 log_{10}(Hardness)].*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[log_{10}(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

Turbidity and Total Suspended Solids: Elevated turbidity has been measured at a number of wells, and is interpreted to be a sampling artefact in most cases. Elevated turbidity was generally observed during the early sampling events, prior to identification of the need to implement low-flow sampling methods throughout the site. Samples that meet the turbidity target of 50 NTU or less have been attained at 22 of 23 sampled monitoring wells at least once.

4.4.2.2 Nutrients

Ammonia concentrations were consistently below guideline concentrations and occasionally below detection limits. Nitrate and nitrite concentrations were consistently an order of magnitude or more below guideline concentrations, and occasionally below detection limits.

Dissolved phorphorus concentrations were generally outside the guideline range intended for lake ecosystems, and above the drinking water guideline intended for that sourced in lakes. Natural groundwater is typically depleted of phosphorous, and little relation exists between stable concentrations in the aquatic habitats for-which the guideline is intended, and the concentration in the groundwater discharging into these environments.

4.4.2.3 Major Anions

Bicarbonate was the dominant anion in groundwater samples collected throughout the Project site, with concentrations ranging from 134 to 937 mg/L as $CaCO_3$.

Elevated concentrations of sulphate have been observed sporadically at wells located in the southern half of the CCR site, where concentrations ranged from non-detection (< 5 mg/L) to 223 mg/L. Otherwise sulphate concentrations were typically less than 30 mg/L.

Chloride concentrations were quite low (less than 15 mg/L) in the Underground Mine Zone and at the CCR site. In contrast, the mean chloride concentration at the Southern Underground Mine Zone was 46 mg/L.

Fluoride concentrations were frequently elevated in wells screening deeper bedrock. Concentrations exceeded the hardness-dependent guideline on occasion in the Underground Mine Zone and on the CCR site.

4.4.2.4 Dissolved Metals

Cations were dominated by sodium or calcium, depending on depth. Shallower groundwater contained highest concentrations of calcium, while deeper groundwater contained greater concentrations of sodium. Magnesium was also frequently found at considerable concentrations, with a mean concentration around 12 mg/L throughout the Project site. Potassium and strontium, two ions commonly found in nature, were present at lower concentrations (maximum of 2.7 mg/L for potassium, 0.94 mg/L for strontium).

The majority of trace metals were frequently not detected and generally at concentrations well below both drinking water and freshwater aquatic life guidelines. Metals for-which no guidelines were exceeded in any groundwater samples include antimony, beryllium, bismuth, boron, cadmium, cobalt, lead, mercury, molybdenum, nickel, silver, thallium, tin, titanium, uranium, and zinc. Others are discussed individually below.

Certain trace metals were reported at levels exceeding guidelines for the first sample collected from the well following installation, and reported at much lower concentrations there-after. These

anomalous exceedances are interpreted as artefacts of drilling, possibly impurities leached from the drilling equipment or circulation fluid additives. Anomalous concentrations falling into this category have been dis-regarded in characterizing the natural baseline groundwater conditions.

Aluminum: six wells screened in deeper bedrock reported dissolved aluminum concentrations in exceedance of the 0.05 mg/L guideline for the protection of freshwater aquatic life. Two of these samples also exceeded the guideline of 0.2 mg/L for drinking water, with concentrations an order of magnitude greater than the guideline. With the exception of samples collected at MW-H26A, the exceedances occurred in samples collected shortly following drilling, and may reflect residual drilling impact. The exceedances observed at MW-H26A are interpreted as a natural baseline condition.

Arsenic: dissolved arsenic concentrations above the 0.005 mg/L total arsenic guideline for aquatic life were reported for three groundwater samples: one collected from each of MW-H20, MW-H24C, and MW-H28. The sole exceedance at MW-H24C also exceeded the drinking water guideline for total arsenic. Baseline dissolved arsenic concentrations were generally on the scale of micrograms per litre throughout the site.

Barium: The total barium guideline concentration of 1 mg/L (for both aquatic life and drinking water) is exceeded for a number of samples at a number of wells. The calculated mean concentrations for barium are 0.7, 0.6, and 0.6 mg/L at the Underground Mine Zone, Southern Underground Mine Zone, and CCR Site respectively. The reported concentrations of barium near or slightly above the guidelines are interpreted as natural baseline conditions.

Chromium: Exceedances of the total chromium guidelines (both aquatic life and drinking water) were reported for two wells at the CCR site: MW-H25A and MW-H26A. The single exceedance reported for MW-H25A was for the first sample collected from the well, and is interpreted as a drilling artefact. Non-detects have been reported for all subsequent samples from MW-H25A. Two exceedances have been reported at MW-H26A, as well as consistent detections. The elevated chromium levels at MW-H26A are interpreted as a baseline groundwater occurrence.

Copper: Dissolved copper concentrations frequently exceeded guideline concentrations for the protection of aquatic life (not for drinking water). The laboratory detection limit (0.05 µg/L for most samples) exceeded the chronic exposure guideline concentration applicable when hardness is greater than 50 mg/L as $CaCO_3$ (0.04 µg/L). The mean copper concentrations calculated for the Underground Mine Zone (0.0067 mg/L) and Southern Underground Mine Zone (0.0033 mg/L) were above the upper chronic exposure guideline (0.002 mg/L for hardness < 50 mg/L as $CaCO_3$), while it was well below this benchmark at the CCR Site (0.00050 mg/L).

Iron: the maximum dissolved iron concentrations exceeded both drinking water and aquatic life guidelines (0.3 and 0.35 mg/L respectively) in a number of wells, including a subset of the wells in the Underground Mine Zone, the Southern Underground Mine Zone, and CCR Site. The mean iron concentration at the CCR site (0.39 mg/L) exceeded both guidelines marginally. Mean concentrations in the Underground Mine Zone (0.28 mg/L) and in the Southern Underground Mine Zone (0.10 mg/L) were somewhat below both guidelines.

Lithium: Lithium concentrations exceed the 0.096 mg/L guideline for aquatic life at a number of wells throughout the project site. These are interpreted as a natural baseline occurrence. Mean concentrations ranged from 0.21 mg/L at the Southern Underground Mine Zone to 0.50 in the Underground Mine Zone.

Manganese: dissolved manganese concentrations frequently exceeded the drinking water guideline (0.05 mg/L) published by Health Canada, which is intended as an aesthetic guideline (Health Canada 2012). The observed manganese levels are interpreted as natural baseline concentrations. Mean values ranged from 0.15 mg/L at the Southern Underground Mine Zone to 0.30 mg/L at the CCR site.

Selenium: dissolved selenium concentrations in exceedance of the total selenium guideline for aquatic life (0.002 mg/L) were reported for the first samples collected from two wells located at the CCR Site and three wells at the Underground Mine Zone. Exceedances were not reported for subsequent samples at these wells or any others. These exceedences are interpreted as artefacts of drilling, possibly impurities leached from the drill bit or rods, as selenium is used in certain metal alloys.

4.4.3 Site-wide Groundwater Quality

The sampled groundwater may be classified under two different groundwater facies (as shown in Figure 4.4-1): Ca-HCO_3 type, and Na-HCO_3 type. The calcium bicarbonate facies is typical of the shallow groundwater, whereas the sodium-bicarbonate facies is typical of the groundwater deeper in the bedrock.

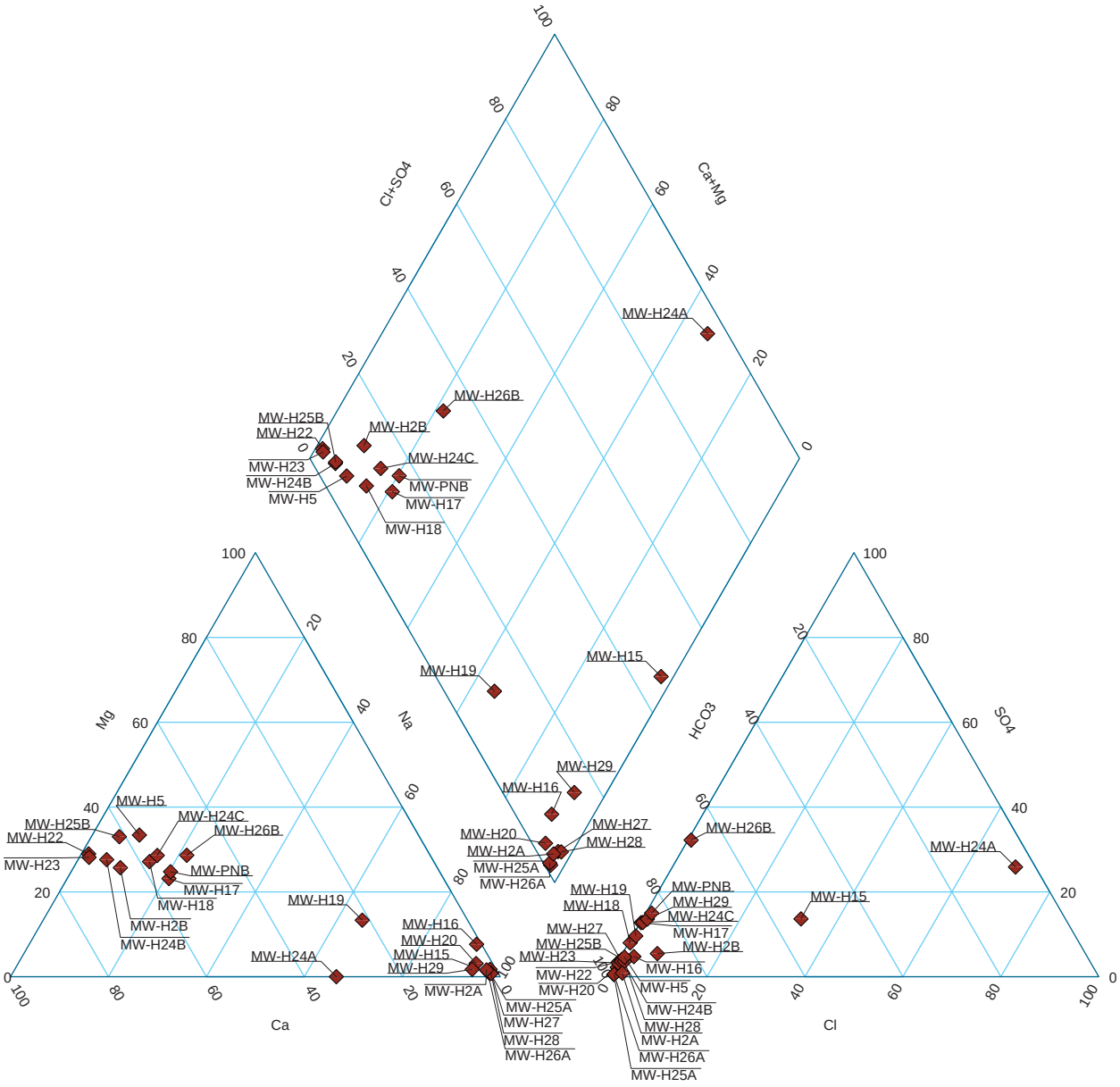
Groundwater throughout the project site is slightly alkaline (mean pH of 8.4 to 7.2). Shallow groundwater is hard due to the dominance of calcium among the cations, whereas the deeper groundwater is soft due to the replacement of calcium with sodium. Total dissolved solids (TDS) increases with depth. The shallow groundwater may be classified as fresh (TDS less than 1000 mg/L). At depths exceeding 50 mbg the TDS begins to surpass the transition from fresh to brakish.

The dissolved metal concentrations in the groundwater are generally at suitable levels to support aquatic habitat in discharge zones and drinking water in supply wells. Naturally elevated levels of barium, iron, lithium, and manganese have been demonstrated in the groundwater sampling data. Elevated concentrations of barium and lithium are tied to TDS, and seasonally consistent guideline exceedances are limited to the deeper (greater than 50 mbg) groundwater. Iron concentrations exceeding the dissolved iron guidelines have been reported at a range of depths, and are likely driven by local variability in sediment and bedrock minerology.

Positive detections of aluminum, arsenic, chromium, copper, and selenium have exceeded aquatic life or drinking water guidelines in isolated cases. Guideline exceedances for these metals were generally reported for samples collected shortly after drilling and installation of the wells, and are interpreted as drilling artefacts. The detection limit for copper frequently exceeded the aquatic life guideline (detection limit of 0.05 µg/L, guideline of 0.04 µg/L in many cases), and copper concentrations could not be concluded to be below the guideline where this was the case.

Figure 4.4-1

Piper Plot of Major Ion Concentrations in Groundwater



5. Hydrogeologic Conceptual Model

ERM

5. Hydrogeologic Conceptual Model

A hydrogeologic conceptual model has been developed based on the available meteorological, geological, and hydrological information and data as summarized in Chapter 2, and the findings of the hydrogeology baseline studies present throughout this report. The conceptual model described here has been refined for use in the development of a numerical groundwater model and for effects assessments of groundwater quantity and quality for the Project.

Figures 5-1, 5-2, 5-3, and 5-4 show the geologic setting with conceptual groundwater flow directions, water levels, and areas of groundwater recharge and discharge.

5.1 HYDROSTRATIGRAPHIC FEATURES AND PROPERTIES

The Project is situated within a folded and faulted series of Lower Cretaceous clastic sedimentary rocks, underlying a covering dominated by glacially-derived sediments and river sediments. The majority of the rock mass is composed of mudstones and siltstones, which are inter-bedded with sandstone and coal seams. The geometry of the strata is controlled by two principal factors: structural features (presence of synclines, antyclines, faults and dense joint sets) and erosion (presence of river and creek valleys dissecting the bedrock formations).

The bedrock is saturated except where it crops above the water table, and as such constitutes a fractured bedrock medium for saturated groundwater flow. Most of the formations are characterized by low hydraulic conductivity.

The Hasler formation (and other undifferentiated sediments above the Boulder Creek Formation) has hosted 40 hydraulic conductivity (K) measurements within the LSA, which show K ranging from 6E-6 m/s to 9E-10 m/s (geometric mean of 8E-8 m/s). The range in the Hasler formation is interpreted to represent variability in joint density, where the lower measurements approach the permeability of the rock matrix.

The permeability appears to generally decrease with depth. The two K measurements in the Boulder Creek formation were 5E-9 m/s and 3E-8 m/s. Two measurements spanning the lower Boulder Creek, Hulcross, and upper Gates formations were 6E-9 m/s, and 2E-9 m/s. The extent of the Gates formation containing Coal Seams may present an isolated exception to the K versus depth trend: K has been reported to be as high as 2E-7 m/s (Appendix A) in the extent of the Gates Formation containing the F, G, and I coal seams.

Due to a sizeable presence of sandstone in the stratigraphic columns of the Boulder Creek and Gates formations, they may behave as aquifers on a regional scale. The Hasler and Hulcross formations may behave as regional aquitards due to the dominance of mudstones and siltstones in these formations. The limited hydraulic conductivity data available for the deeper strata of the Project area is not sufficient to clearly designate bedrock formations within the project area as aquifers or aquitards.

Surficial deposits vary greatly in thickness and lithological character from place to place. Principal deposit types include fluvial, glaciofluvial, morainal, colluvial and wetland sediments. Fluvial and glaciofluvial sediments are present mainly along the bottoms of river valleys, morainal sediments cover much of the ground surface of the hills and mountains, colluvial sediments are common along steeper slopes, while wetland sediments accumulated in terrain depressions or at the base of significant groundwater seeps.

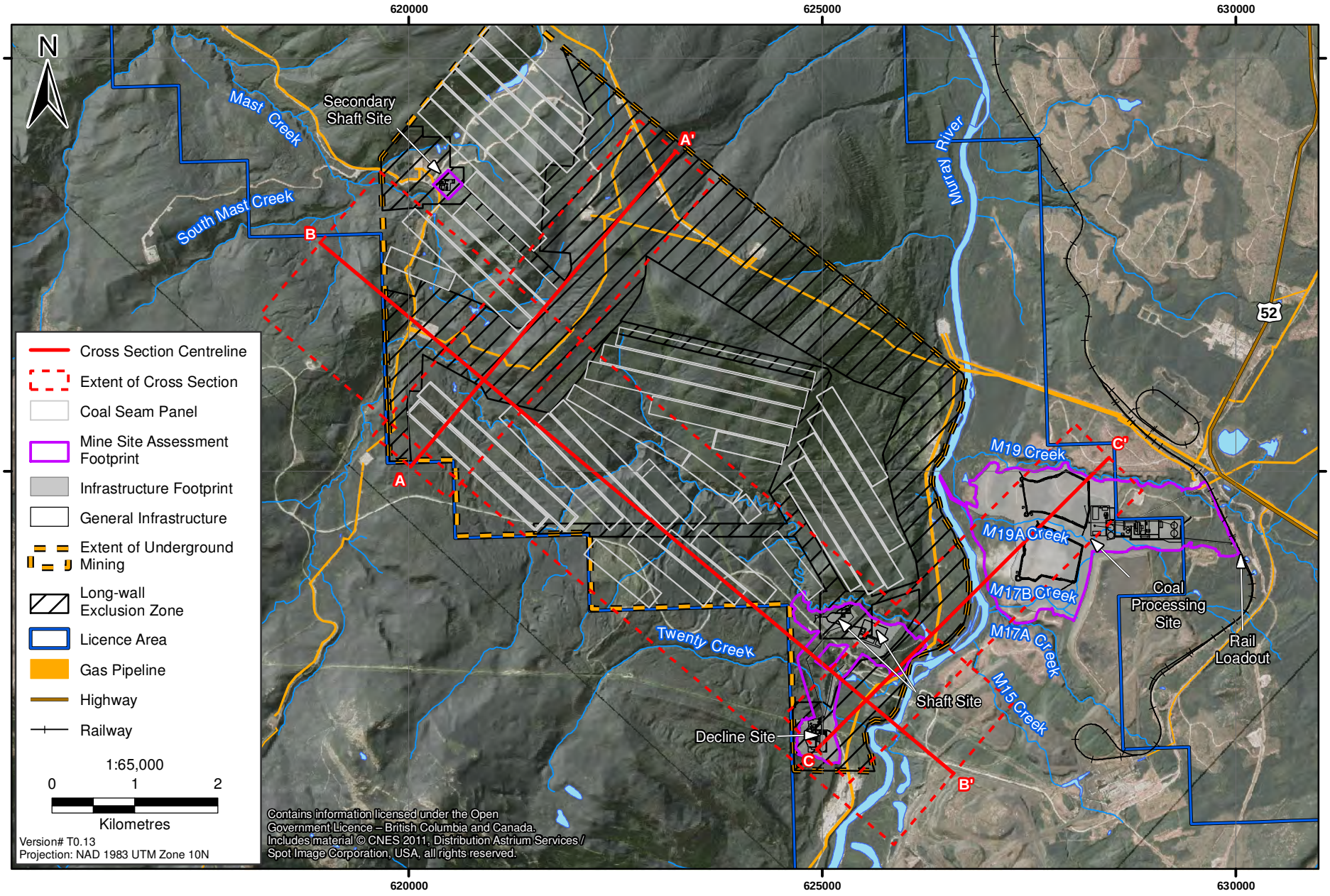


Figure 5-1

hd Mining

MURRAY RIVER COAL PROJECT

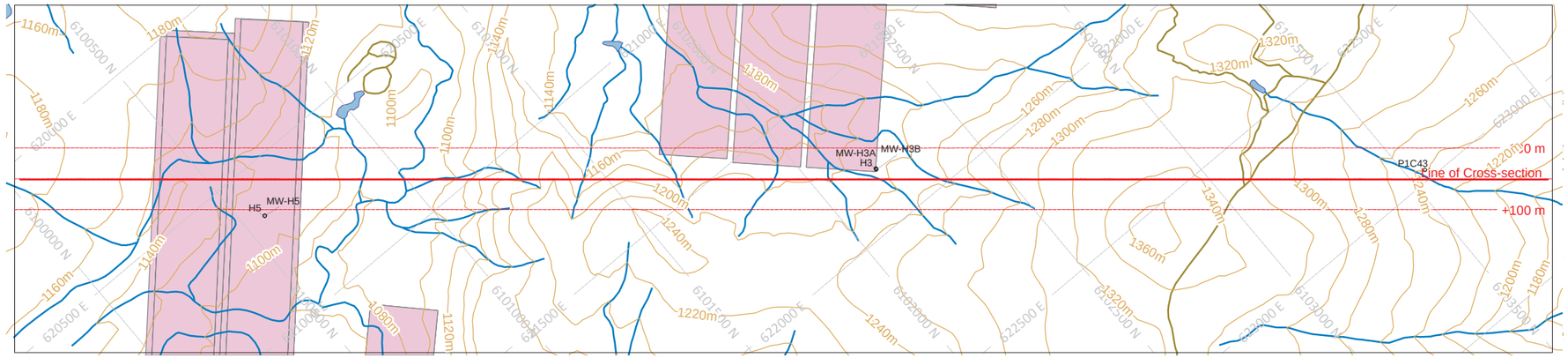
Location of Cross Sections

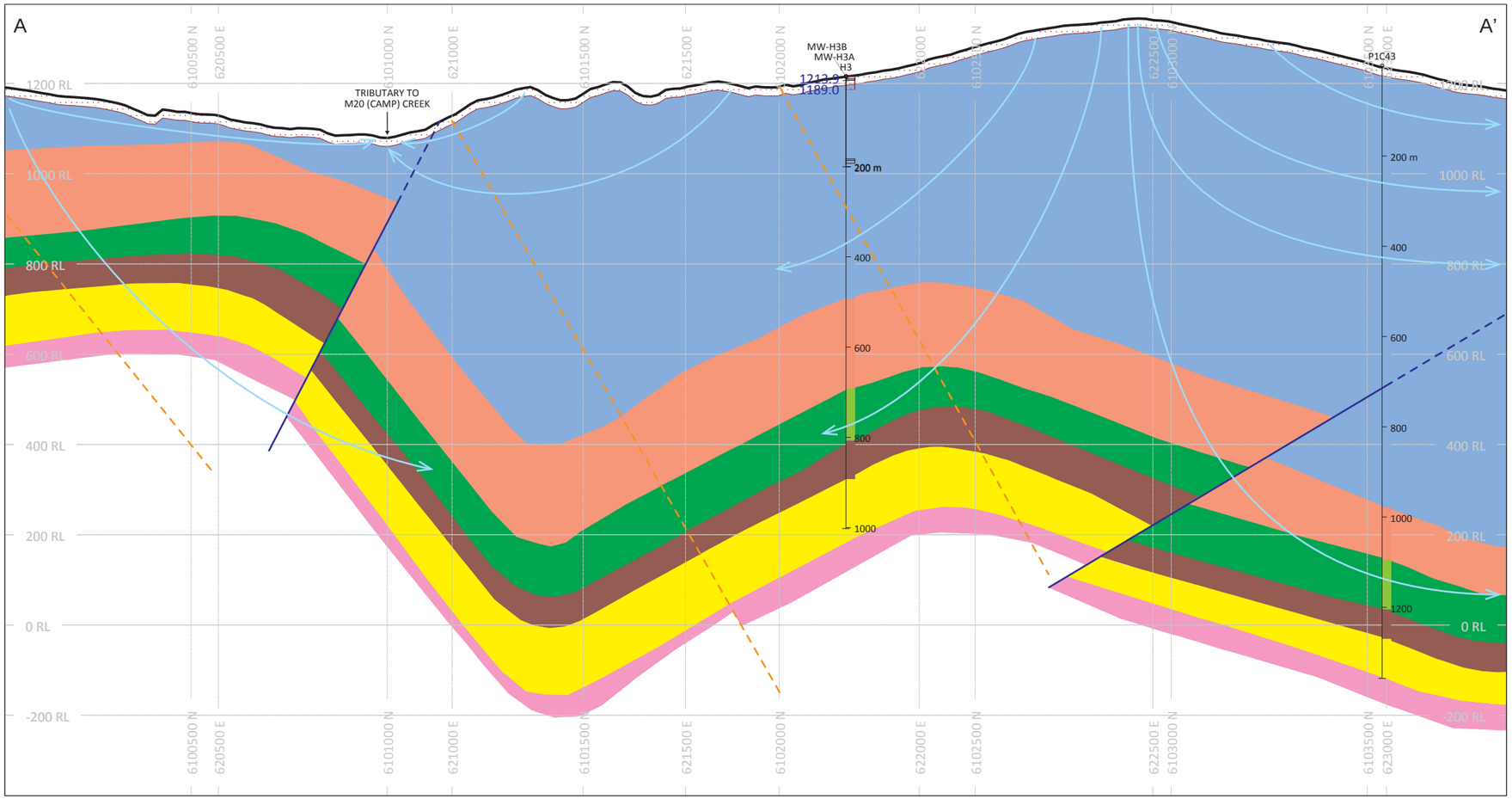
Figure 5-1

Rescan an ERM company

Figure 5-2

Hydrogeologic Conceptual Model: Cross-Section in the Underground Mine Zone along Upper Reaches of the Camp Creek Drainage Basin (A – A')





HOLES PLOTTED

TOTAL 4

H3 MW-H3A MW-H3B P1C43

- Contours
- Transportation
- Stream
- Coal Seam Panel
- Water/Wetlands
- Topography
- Groundwater Flow Line
- Overburden
- Hasler and undifferentiated
- Boulder Creek
- Hulcross
- Upper Gates
- Middle Gates
- Lower Gates
- Hydrogeology Well
- 777.8 Water Table
- Fault, Interpretted from Geophysics
- Fault, Inferred

SECTION SPECS:

REF. PT. E, N	621650 m	6101940 m
EXTENTS	5000 m	1754 m
SECTION TOP, BOT	1375 m	-378.5 m
TOLERANCE +/-	100 m	
VERTICAL EXAG.	1.5 m	

SCALE (m)

-100 0 100 200 300 400 500

NAD83 / UTM zone 10

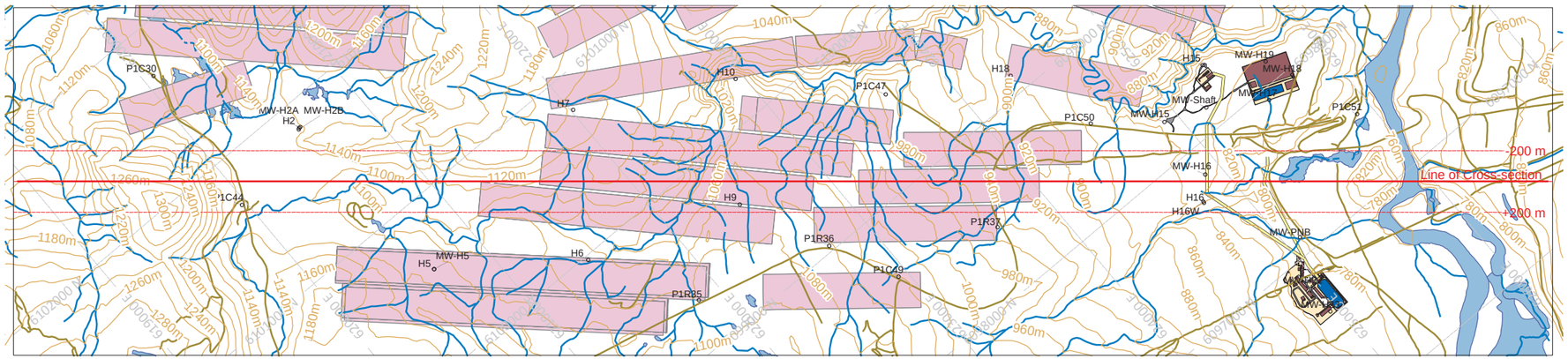
AZIMUTH = 45°

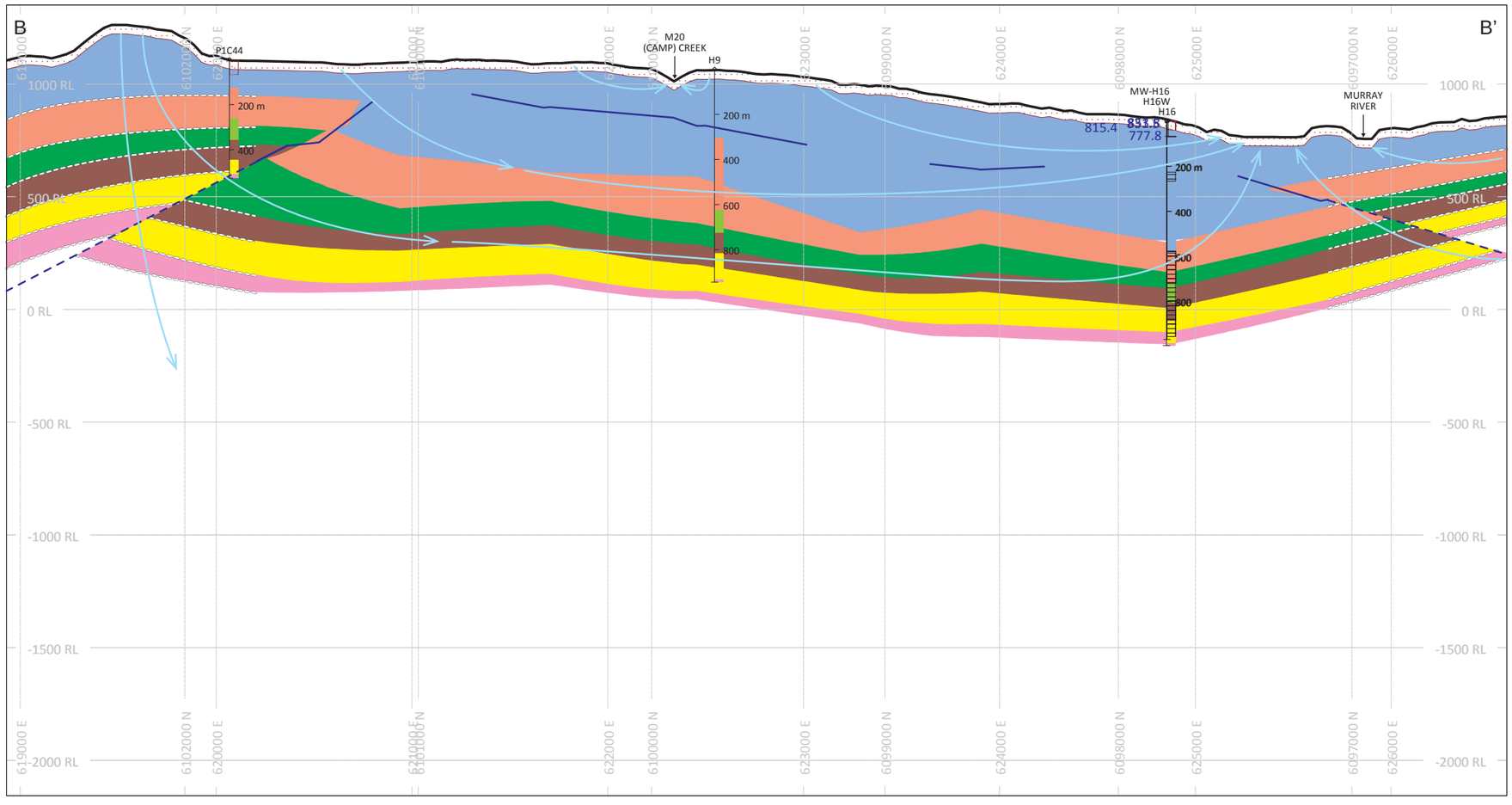
N W E S

Figure 5-3

Hydrogeologic Conceptual Model:
Cross-Section along the Camp Creek Drainage Basin (B — B')

ERM





HOLES PLOTTED

TOTAL 5

H16 P1C44 | H16W | H9 | MW-H16

- Contours
- Transportation
- Stream
- Coal Seam Panel
- Water/Wetlands
- Powerline
- Conveyor
- Structure
- Concrete Paving
- Coarse Coal Reject Pile
- Pad
- Pond
- Collection Pipe
- Diversion Channel
- Topography
- Groundwater Flow Line
- Overburden
- Hasler and undifferentiated
- Boulder Creek
- Hulcross
- Upper Gates
- Middle Gates
- Lower Gates
- Hydrogeology Well
- 777.8 Water Table
- Fault, Interpretted from Geophysics
- Fault, Inferred
- Interpretted Stratigraphic Contact

SECTION SPECS:

REF. PT. E, N	622760 m	6099550 m
EXTENTS	10000 m	3508 m
SECTION TOP, BOT	1351 m	-2157 m
TOLERANCE +/-	200 m	
VERTICAL EXAG.	1.5 m	

SCALE

(m)

-200 0 200 400 600 800 1000

NAD83 / UTM zone 10

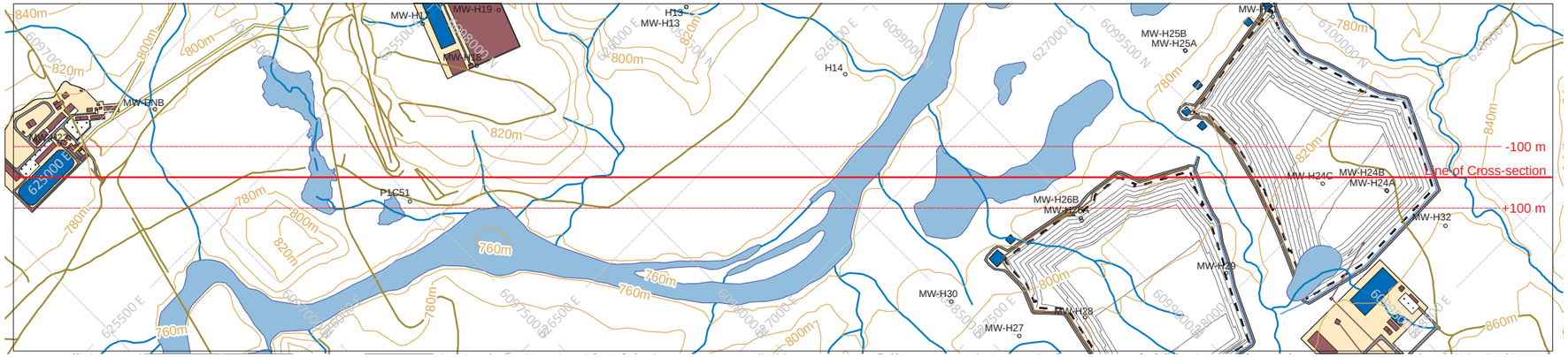
AZIMUTH = 130°

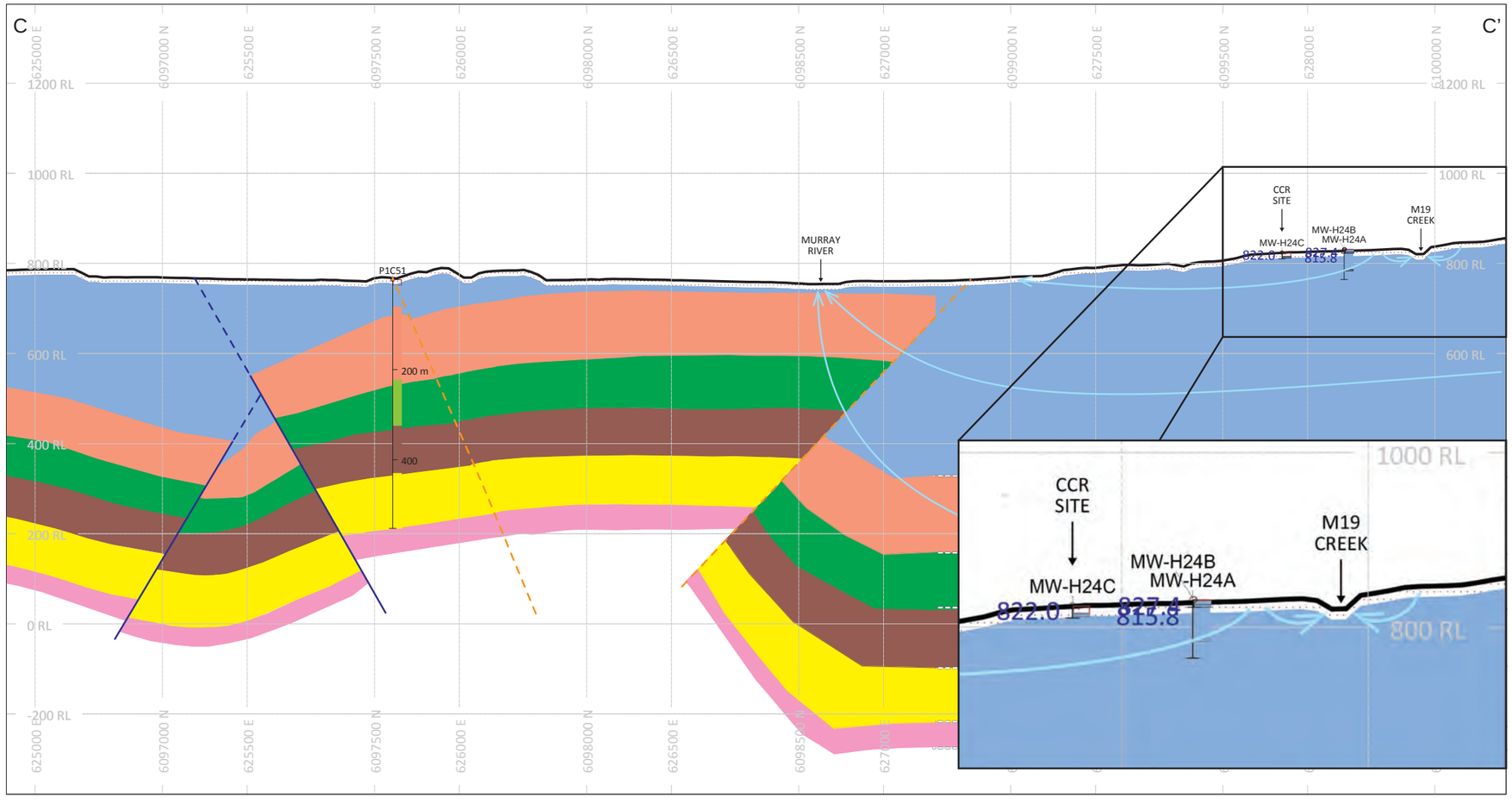
N W E S

Figure 5-4

Hydrogeologic Conceptual Model: Cross-Section along the Southern Underground Mine Zone and Coarse Coal Reject Site (C – C′)

ERM





HOLES PLOTTED

TOTAL 4

MW-H24A MW-H24B MW-H24C P1C51

- Contours
- Transportation
- Stream
- Coal Seam Panel
- Water/Wetlands
- Powerline
- Conveyor
- Structure
- Concrete Paving
- Coarse Coal Reject Pile
- Pad
- Pond
- Collection Pipe
- Diversion Channel
- Topography
- Groundwater Flow Line
- Overburden
- Hasler and undifferentiated
- Boulder Creek
- Hulcross
- Upper Gates
- Middle Gates
- Lower Gates
- Hydrogeology Well
- 777.8 Water Table
- Fault, Interpretted from Geophysics
- Fault, Inferred
- Interpretted Stratigraphic Contact

SECTION SPECS:

REF. PT., E, N	626700 m	6098400 m
EXTENTS	5000 m	1754 m
SECTION TOP, BOT	1375 m	-378.5 m
TOLERANCE +/-	100 m	
VERTICAL EXAG.	1.5 m	

SCALE

(m)

-100 0 100 200 300 400 500

NAD83 / UTM zone 10

AZIMUTH = 45°

N W E S

Grain size distribution is the primary factor determining hydraulic properties of surficial sediments. Sand/gravel and clay/silt are at the opposite ends of a spectrum of high- and low-K sediments, respectively. K of gravelly sand situated in the southern Underground Mine Zone have ranged as high as 4E-4 m/s, and measurements in fines in the CCR site are as low as 4E-9 m/s.

Groundwater levels in bedrock formations indicate confined conditions, except near bedrock outcrop / sub-crop areas close to deeply incised valleys. Groundwater in overburden deposits is most often present under unconfined conditions, although some wells at the CCR Site exhibit confined conditions where a clay layer overlies a granular deposit.

5.2 GROUNDWATER FLOW REGIME (DIRECTION AND GRADIENTS)

The Project is located in a Mountain foothill area dissected by the broad valleys containing the Murray and Wolverine Rivers. Foothills within the regional study areas rise over 1,000 meters above the valley bottoms: Mount Babcock 1,855 masl) rises 1,080 m above the Murray River (770 masl).

Such terrain results in certain consequences to a groundwater flow system. Groundwater is recharged by greater precipitation at higher elevations, while valley bottoms constitute discharge zones. Local groundwater flow systems develop above intermediate and regional flow systems, whereby localized groundwater flow discharges to small tributaries, and deeper groundwater discharges to larger streams and rivers. However, folding and faulting formations may modify these patterns.

Thus, the groundwater flow system in the Project area is characterized by groundwater flowing from the upper foothills towards the Murray River, with anisotropy introduced by folds, faults and local topography (Figures 5-2 to 5-4). Local topography creates intermediate and shallow systems existing above regional systems (Figures 5-2 to 5-4). The Camp Creek basin behaves as an intermediate catchment basin. The small watersheds containing M19A, M17B, and M19 creeks behave as local catchment basins for shallow groundwater flow in the CCR site and adjacent areas. The watersheds of Twenty Creek, and other minor tributaries within the Underground Mine Zone behave as local catchment basins as well.

5.3 SPATIAL AND TEMPORAL VARIATIONS IN RECHARGE AND DISCHARGE

Recharge to groundwater is a function of range of variables, such as precipitation, temperature, evapotranspiration, soil type, land use, and slope aspect. On a regional scale, variability in precipitation is expected to play a dominating role, whereby greater precipitation (and by extension greater recharge) is received at greater elevations due to the orographic effect.

Temporal variations in natural recharge and discharge are expected to be minor. Documented seasonal variations in groundwater levels have been as high as 2 m. Given the scale of topographic relief within the local study area, these water level variations are expected to be too small to give rise to meaningful changes in hydraulic gradients or the patterns of groundwater flow.

5.4 SURFACE WATER – GROUNDWATER INTERACTIONS

All streams are fed to a varying degree by overland flow, interflow (lateral movement of water below ground surface but above the water table) and groundwater discharge. Stream flow is dominated by groundwater discharge (often referred to as base flow) during the winter or prolonged periods of low precipitation. During periods of flooding (e.g. freshet), streams may be recharging groundwater, particularly along reaches at higher elevations. Stream reaches at lower elevations are predominantly situated in groundwater discharge zones. The groundwater likely supports wetlands found along the flood plains of the Murray River during non-peak flow periods.

6. Conclusions

6. Conclusions

The contents of this hydrogeology baseline report for the Project were derived from the field information and other relevant information collected between 2010 and 2014. Groundwater monitoring instruments were installed to characterize baseline groundwater conditions, and to provide the means for long-term groundwater level and quality monitoring, once mine operations commence.

Key baseline hydrogeological observations for the Project include the following:

- At the scale of the local study area, groundwater flows from foothill highland areas towards the Murray River, which acts as a regional groundwater discharge zone. At a more localized scale, shallower groundwater reports to Camp Creek and other tributaries bordering and splitting the Underground Mine Zone and the CCR site.
- The groundwater levels vary seasonally by one to two metres. The periods of greatest recharge and highest water levels occur following freshet, major convective storm cycles during the summer, and mid-winter warm spells.
- The vertical hydraulic gradients calculated for twinned wells indicate groundwater recharge zones are present at topographic highs and discharge zones at topographic lows. A portion of the shallow groundwater passing through the Underground Mine Zone and CCR site discharges to tributaries of the Murray River, while the remainder flows towards the base of the Murray River basin.
- The site containing the bulk sample waste rock facility and proposed shaft is underlain by a thin layer of glacial till, followed by mudstone. The water table at this site is found between 4 and 11 mbg, beneath the overburden. This site behaves as a local groundwater divide, whereby groundwater flows towards the southwest and northeast from the centre of the site. Hydraulic conductivity measurements have ranged from E-6 to E-9 m/s.
- The far southern reaches of the Underground Mine Zone (containing the bulk sample portal) is underlain by a layer of granual glaciofluvial sediments followed by mudstones and siltstones. The water table is around 15 to 20 mbg, giving rise to an unconfined aquifer in the sediments with K of E-4 to E-6 m/s. Groundwater flows to the south-east towards the Murray River.
- The CCR site is underlain by morainal deposits (well graded fine sands and tight clay) followed by siltstones, fine sandstones, and mudstones. The water table situated in the bedrock at upper elevations, and overburden at lower elevations. The tight clay unit acts as a semi-confining layer, and was observed to be thickest at lower elevations and pinching out up-slope. Groundwater flows westward towards the Murray River, and the lower reaches of the CCR site are within a discharge zone adjacent to a wetland connected with the Murray River. The estimated K of the overburden materials ranges from E-6 m/s (sands) to E-9 m/s (clays). Bedrock K measurements range from E-6 to E-9 m/s.
- Groundwater throughout the local study area is slightly basic (mean pH of 7.2 to 8.4). Calcium and bicarbonate tend to be the dominant ions in the shallow groundwater (less than 50 mbg), and sodium and bicarbonate dominate in the deeper groundwater. TDS trends upwards with depth.
- Concentrations of dissolved barium, iron, lithium, and manganese have consistently exceeded guidelines for the protection of freshwater aquatic life or drinking water in samples collected from a number of well. Elevated concentrations of the aforementioned metals are considered natural baseline occurrences. Positive detections of aluminum, arsenic, chromium, copper, and selenium have exceeded the BC MOE guidelines for the protection of freshwater aquatic life or raw drinking water supply in isolated samples.

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Definitions of the acronyms and abbreviations used in this reference list can be found in the Glossary and Abbreviations section.

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Appendix A

Hydrogeologic Site Investigation Reports Prepared by AMEC

ERM

April 1, 2010

Project No. KX13432

Canadian Dehua International Mines Group Inc.
1411 – 409 Granville Street
Vancouver, British Columbia
V6C 1T2

Attention: Mr. James Luo

Re: Packer Testing to Assess Bedrock Permeability
Tumbler Ridge, B.C.

1.0 INTRODUCTION

AMEC Earth & Environmental, a division of AMEC Americas Limited (AMEC), has completed a packer testing program within an NQ (75.7 mm diameter) diamond drilled hole (Borehole PIR-35, hereafter referenced as the 'Site',) approximately 12.5 km south of Tumbler Ridge, BC (Figure 1).

This report is submitted following comments and questions received concerning a draft report dated March 29, 2010. The data, contents, and conclusions provided herein supercedes the contents of the March 29, 2010 draft report.

2.0 BACKGROUND

AMEC understands that Canadian Dehua International Mines Group (CDIMG) Inc. is proposing to develop an underground mine to extract metallurgical (coking) coal. A drill program to collect and analyze core samples was on-going at the time AMEC's services were requested.

Upon AMEC's arrival on-site on February 23, 2010, borehole PIR-35 had been drilled to 671 m below grade by Black Hawk Drilling Ltd. (BHDL). AMEC personnel were introduced to Jinquean Zheng, CDIMG mine manager and provided with a copy of CDIMG's borehole log for PIR-35. The PIR-35 borehole lithology between 200 m and 671 m below grade, as recorded by CDIMG personnel, is provided in Figure 2. Generally, the borehole lithology between 200 m and 671 m below grade was reported as mudstone with occasional layers of sandstone. BHDL reported flowing conditions from borehole PIR-35 below 316 m below grade. CDIMG requested that packer tests be performed at PIR-35 adjacent sandstone layers between 601-650 m (zone 1), 552-600 m (zone 2), 466-520 m (zone 3) and 272-355 (zone 4).

3.0 OBJECTIVE AND SCOPE

The objective of packer testing is to estimate the permeability of bedrock along discrete intervals in a borehole using pneumatic inflatable packers. AMEC understands that these estimates of

bedrock permeability will be used with other more detailed estimates of bedrock permeability for mine feasibility and design.

To meet the stated objective, AMEC has completed the following scope of work:

- Reviewed bedrock lithology as presented on the PIR-35 borehole log and recorded by CDIMG in order to determine the discrete interval for each packer test;
- Recorded the shut-in pressure to determine the static head of water above-grade;
- Lowered NQ packers into borehole PIR-35 using the driller's wireline and conducted rising head and injection tests at the following depth intervals: 601-670 m bgl, 552-600 m bgl, 465-520m bgl, and 272-355m bgl;
- Compiled and interpreted the packer testing data; and
- Prepared this report.

4.0 SITE DESCRIPTION AND SURROUNDING LAND USE

The site is located approximately 12.5 km southwest of Tumbler Ridge and is situated within the sub-alpine of the northern Rocky Mountains. Global Positioning Satellite (GPS) coordinates of the borehole at ground surface are as follows:

- 621852 E
- 6099308 N
- 1083 m above sea level (asl)

Access to the site from Tumbler Ridge is along 30 km of gravel-surfaced forestry roads. The ground immediately adjacent to the borehole consisted of sandy silts and clay. Based on visual observations, surface drainage and overland runoff at the site is toward the southeast. A small unnamed creek was located approximately 20 m southwest of the site and flowed southeast. Water from this unnamed creek was used for the drilling and injection testing.

Surrounding land use consists of forested crown land. The site is located approximately 20 km northeast of the former Quintette coal mine.

5.0 FIELD WORK

On February 23, 2010 AMEC personal mobilized from Prince George to Tumbler Ridge and met with Jinquan Zheng, Mine Manager with CDIMG. AMEC was provided a borehole log for borehole PIR-35. Borehole PIR-35 was drilled to 671 m below grade and was reported to be flowing. AMEC and CDIMG agreed that packer tests would be conducted between 601-670 m bgl (zone 1), 552-600 m bgl (zone 2), 466-520 m bgl (zone 3) and 272-355 bgl (zone 4).

BHDL was requested to raise the diamond drill bit to the top of Test Zone 1 (600 m below grade) and record the shut-in pressure of the open flowing borehole. Use of a three-packer system, whereby, the lower two packers sealed off a discrete interval was considered. Since there was some risk of losing the lower packer of the three packer configuration down the hole

as a consequence of caving in the borehole, a two packer configuration was used. The packer assembly was provided by RST Instruments of Coquitlam, B.C.

Test Zone 1 was hydraulically isolated by inflating the two packer configuration at the top of the test zone. The base of the remaining test zones were hydraulically isolated by grouting up the base of the borehole with a bentonite grout using a tremie pipe extending from the base of the drill bit and setting a Van Ruth cementing and wedging plug at the base of the test zone. The Van Ruth cementing and wedging (CW) plug was used as opposed to a Van Ruth Cementing and Wedging Bottom Packer (CWBP) since the CWBP was not available on-site at the time the testing took place. The upper limit of each test zone was hydraulically isolated from the remainder of the borehole by inflating the two packer configuration at that depth.

The two packer configuration consists of two NQ sized packers separated by a seating cone (Figure 3). A 0.3 m long 25 mm diameter perforated galvanized steel pipe extends below the lower packer. The perforated pipe is capped at one end and houses a 1500 PSI P-25 pressure transducer and datalogger supplied by Pioneer Petro-tech of Calgary, Alberta. The packer assembly was lowered to the drill bit using the drill rig wireline. The seating cone of the packer assembly is designed to sit upon the drill bit such that the upper packer remained within the NQ drill rods and the lower packer and the pressure transducer extend below the drill bit into the open borehole. A 6 mm diameter high-pressure Teflon tube connected the packer assembly to a nitrogen gas cylinder at grade. To facilitate the insertion and extraction of the high-pressure gas line and to minimize the potential for it to become tangled with the wire line, black electrical tape was used to attach the gas line to the wire line along 20 m intervals. Gas flow to the packer assembly was controlled using a gas regulator capable of providing pressures up to 13,800 kPa (2000 psi).

Packers were inflated using an appropriate inflation pressure accounting for the static head of water (equivalent to the shut-in pressure $\mathbf{P_1}$), the pressure required to expand the packer to the borehole wall (the expansion pressure = 110 psi from RST unconfined N packer inflation curve) and the pressure required to form a tight seal against the borehole wall (the sealing pressure = 750 psi from RST confined N packer inflation curve). The range of suitable inflation pressures as outlined in the RST packer manual is calculated as follows:

$\mathbf{P_1}$ = Static head of water
$\mathbf{P_2}$ = 100 psi + Head of water in shaft

$$\mathbf{Pp_{max}} = \mathbf{P_1} + \text{Sealing Pressure (750 psi)}$$

$$\mathbf{Pp_{min}} = \mathbf{P_2} + \text{Expansion Pressure (110 psi)}$$

Inflation pressure ($\mathbf{P_i}$) needed is:

$$\mathbf{Pp_{max} > P_i > Pp_{min}}$$

After the packers had been inflated and the gas regulator showed that the gas levels were maintaining a constant pressure, the stuffing box (comprised of a threaded steel casing and four rubber disks) sealed the top of the drill rods (Figure 3). A 25 mm diameter high density hydraulic hose connected the stuffing box to a manifold housing a GPI G2 Industrial Grade

digital flow meter, and a by-pass valve. The inlet of the manifold was attached to a pump by a high pressure hydraulic hose.

The digital flow meter was calibrated by pumping water into a container of known volume and recording the time taken to fill the container while simultaneously recording the flow rate using the flow meter. The flow rate recorded using the stop watch was consistent with the flow rate recorded by the flow meter.

Following completion of each test, packers were disconnected from the nitrogen gas cylinder and deflated while the nitrogen gas cylinder was turned off.

The tests performed at each Test Zone are summarized in Table 1:

Table 1
Packer Test Summary

Test Zone	Test Interval (m bgl)		Test Zone Length (m)	Shut-In Test	Discharge Test	Recovery Test	Injection Test
	Top	Bottom					
1	601	670	69	x	x	x	
2	552	600	48	x			x
3	466	520	54	x			x
4	272	355	83	x			x

At Test Zone 1, a recovery test followed by discharge test was performed. Rationale for performing these tests is based on the following:

- Test Zone 1 had a static water level above grade (the test zone flowing); and
- The flow rate from Test Zone 1 was recorded at 0.17 m^3/day (generally considered to be a low flow rate). Since flow rate is directly proportional to the permeability, the permeability was thought to be too low to be suitable for an injection test;

The recovery test was performed by closing the by-pass valve and recording the increase in pressure over a period of time until the maximum pressure was achieved and held constant. This maximum pressure was the shut-in pressure and equivalent to the static groundwater level above-grade. After the maximum pressure was held constant the discharge test began by opening the by-pass valve and recording the rate of decrease in pressure.

Injection tests were performed at Test Zones 2, 3 and 4. Rationale for performing injection tests at Test Zones 2, 3, and 4 is based on the following:

- The flow rate from Test Zone 2 was recorded at 31 m^3/day (generally considered to be a high flow rate). Since flow rate is directly proportional to the permeability, the permeability was thought to be higher and suitable for an injection test; and
- Flow rates were not recorded at Test Zones 3 and 4. However, flow rates were considered to be higher than observed at Test Zone 1 and consequently suitable for an injection test;

Injection testing consisted of pumping water into the Test Zone at a constant flow rate over a period of approximately 10 minutes. The pressure in the borehole corresponding to this constant flow rate was recorded using the pressure transducer. The flow rate was increased two or three additional increments and the corresponding pressure in the borehole was recorded. Following injection of the maximum flow rate, the flow rate was decreased by one or two increments and the corresponding decreasing pressure in the borehole was recorded.

6.0 RESULTS AND INTERPRETATION

Packer testing data is presented in Appendix A. During the discharge test, the change in flow rate was not recorded with change in pressure immediately following opening of the by-pass valve. As such, the discharge test data interpretation is not presented here.

However, recovery test data was interpreted using the Cooper-Jacob solution of the modified non-equilibrium equation.

$$KL = \frac{2.3Q}{4\pi\Delta P}$$

Where:

K = permeability (hydraulic conductivity) in m/sec
L = test length in m
Q = mean flow rate from the test zone in m^3/sec
ΔP = change in pressure over one log cycle on a pressure vs. log (T/T') plot
T = elapsed time since the start of the discharge test
T' = elapsed time since the by-pass valve is closed

ΔP is determined graphically by plotting the pressure versus the ratio of T/T' on a semi-logarithmic graph.

For Test Zones 2-4, the differential head pressure (**H** = test pressure less the shut-in pressure) was plotted versus flow rate for each flow rate injected into the borehole. A linear best fit trend-line was applied to the graph. The arithmetic mean flow rate (**Q**) was calculated and the corresponding differential head (**H**) was picked off the graph using the trend line. The permeability of the test zone was estimated using the following formula:

$$K = \frac{Q \ln (L/R)}{2 \pi LH}$$

Where:

K = permeability (hydraulic conductivity) in m/sec
Q = flow rate in m^3/sec
L = test length in m
R = borehole radius in m
H = differential head in m

Using the interpretive formulas provided above, the estimated permeability for each Test Zone is presented in Table 2.

Table 2
Permeability Test Results

Test Zone	Test Interval (m bgl)		Test Zone Length (m)	Static Water Level (m above grade)	Recorded Flow Rate (m^3/day) from Test Zone	Differential Head (m) from Appendix A Graphs	ΔP (m of water)	Permeability K (m/sec)
	Top	Bottom						
1	601	670	69	14.7	0.17	n/a	11.7	4.5×10^{-10}
2	552	600	48	14.7	31	40.0	n/a	2.1×10^{-7}
3	466	520	54	15.9	-	50.0	n/a	3.0×10^{-8}
4	272	355	83	15.8	-	34.4	n/a	2.9×10^{-8}

Notes: - denotes flow rate from the test zone not recorded in the field.
n/a indicates differential head or change in pressure not applicable.

Table 2 also presents the calculated static water level above grade for the PIR-35 flowing well at each test zone. These levels were calculated based on the difference between the test zone pressure (converted to metres of water above the pressure transducer) and the depth below grade of the pressure transducer. Test zone pressures are not presented in Table 2, since they are dependent upon the depth of the pressure transducer.

Table 2 also presents recorded flow rates from PIR-35 at Test Zones 1 and 2. Flow rates from Test Zones 3 and 4 were not recorded by AMEC field personnel. Table 2 presents the differential head used to calculate the permeability at Test Zones 2, 3 and 4 and the change in pressure over one log cycle (**ΔP**) used to calculate the permeability at Test Zone 1.

The permeabilities presented in Table 2 were generally consistent with the flow rates observed, or recorded, at grade.

7.0 CONCLUSION

The permeability estimates provided in Table 2 are considered preliminary and insufficient for detailed mine design. Since the permeability estimates were recorded only at one location (borehole PIR-35), the permeability estimates provided above are also considered insufficient to assess mine feasibility. The permeability estimates are considered to have the following limitations:

- The length of the test zones ranged between 48 m and 83 m and transected both mudstone and sandstone layers (as described by CDIMG). As a consequence of these long test zones straddling different lithologies, the estimated permeabilities can only be considered bulk permeability estimates and are not considered to be representative of any one lithologic unit;
- A test to assess the tightness of the drill rods was not performed as part of this assessment. Leakage from the drill rods may have occurred during permeability

testing. If some leakage is assumed to have occurred across the drill rod joints, then the permeability estimates would generally be greater (more conservative) than the representative permeability; and

- The testing was performed after the borehole had been drilled and consequently, the base of Test Zones 2, 3, and 4 were grouted beneath a Van Ruth cement and wedging plug. Generally, the Van Ruth cement and wedging plug is not considered to be water tight. For water tight applications, the manufacturer recommends use of a Van Ruth Cementing and Wedging Bottom Packer. Consequently during testing some leakage may have occurred through the base of the borehole. If this did occur, the permeability estimates would generally be greater (more conservative) than the representative permeability.

8.0 CLOSURE

This report has been prepared for the exclusive use of the Canadian Dehua International Mines Group Inc. and its authorized agents for which this project was commissioned. The preliminary permeability testing was conducted in accordance with industry standard practices and the proposed scope of work for this project. No other warranty, expressed or implied, is made. The general limitations of this report are specified in Appendix B.

We trust this information meets your current requirements. If you have any questions or concerns, please contact the undersigned at your convenience.

Respectfully submitted,

AMEC Earth & Environmental
a division of AMEC Americas Limited

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
Apr 9 | 2010
D.S. GREEN

Tammera Kostya, BSc, GIT
Hydrogeologist

Scott Green, P.Eng.
Associate Hydrogeologist

Reviewed By:

Dan Emerson, P.Geo.
Associate Hydrogeologist

Attachments:

Figure 1: Site Location Map
Figure 2: PIR-35 Borehole Log
Figure 3: Wireline Double Packer Setup

Appendix A: Packer Testing Results
Appendix B: General Limitations

9.0 REFERENCES

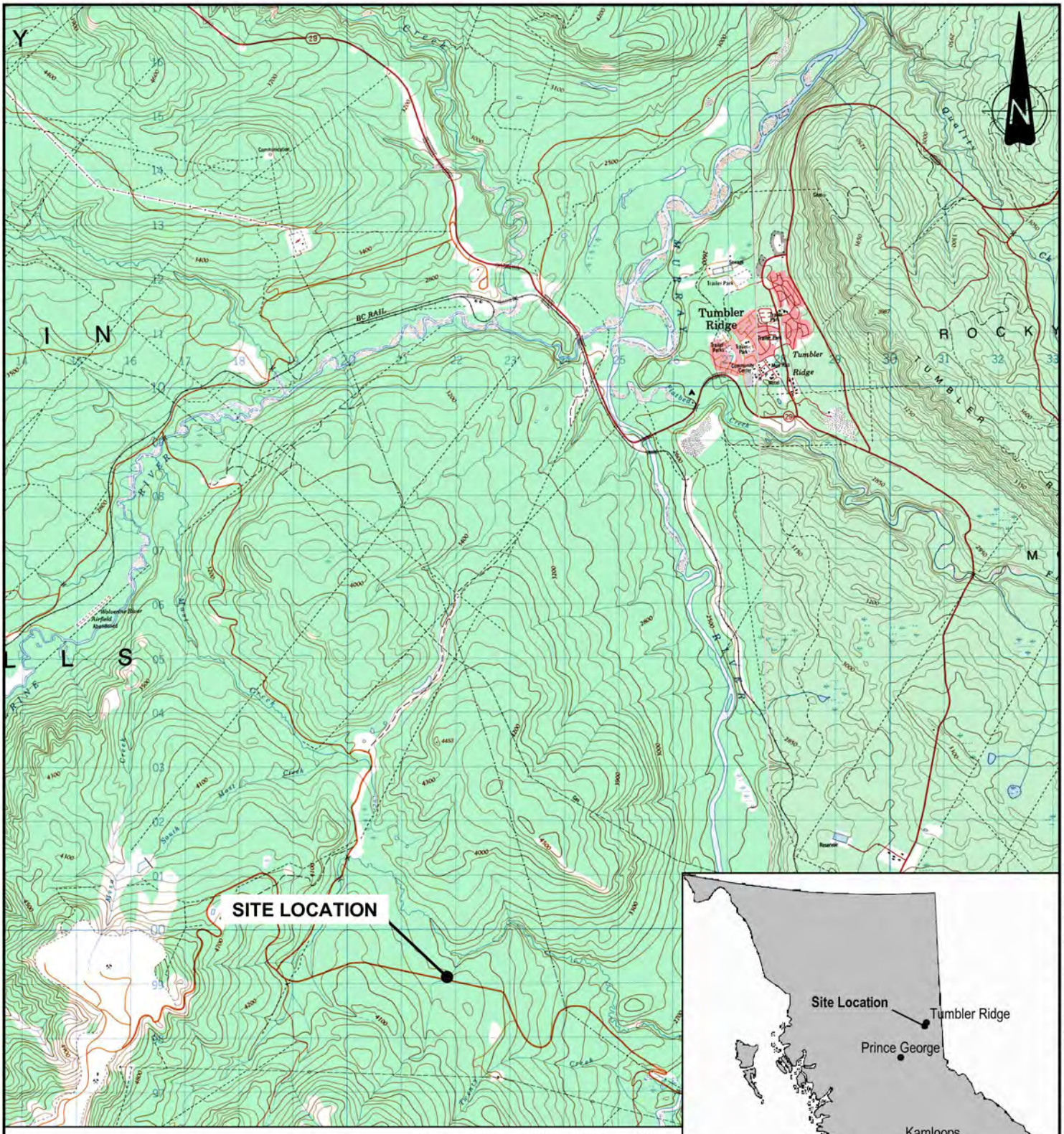
AMEC Earth and Environmental, 2008, ***AMEC Geotechnical Manual***.

Freeze, R.A., and J.A. Cherry, 1979, ***Groundwater***, Prentice-Hall Inc., 604 p.

Royle, M. ***Standard Operating Procedures for Borehole Packer Testing***. 23 p***.***

RST Instruments Ltd., 2005. ***Borehole Packers Instruction Manual,*** 25 p.

FIGURES



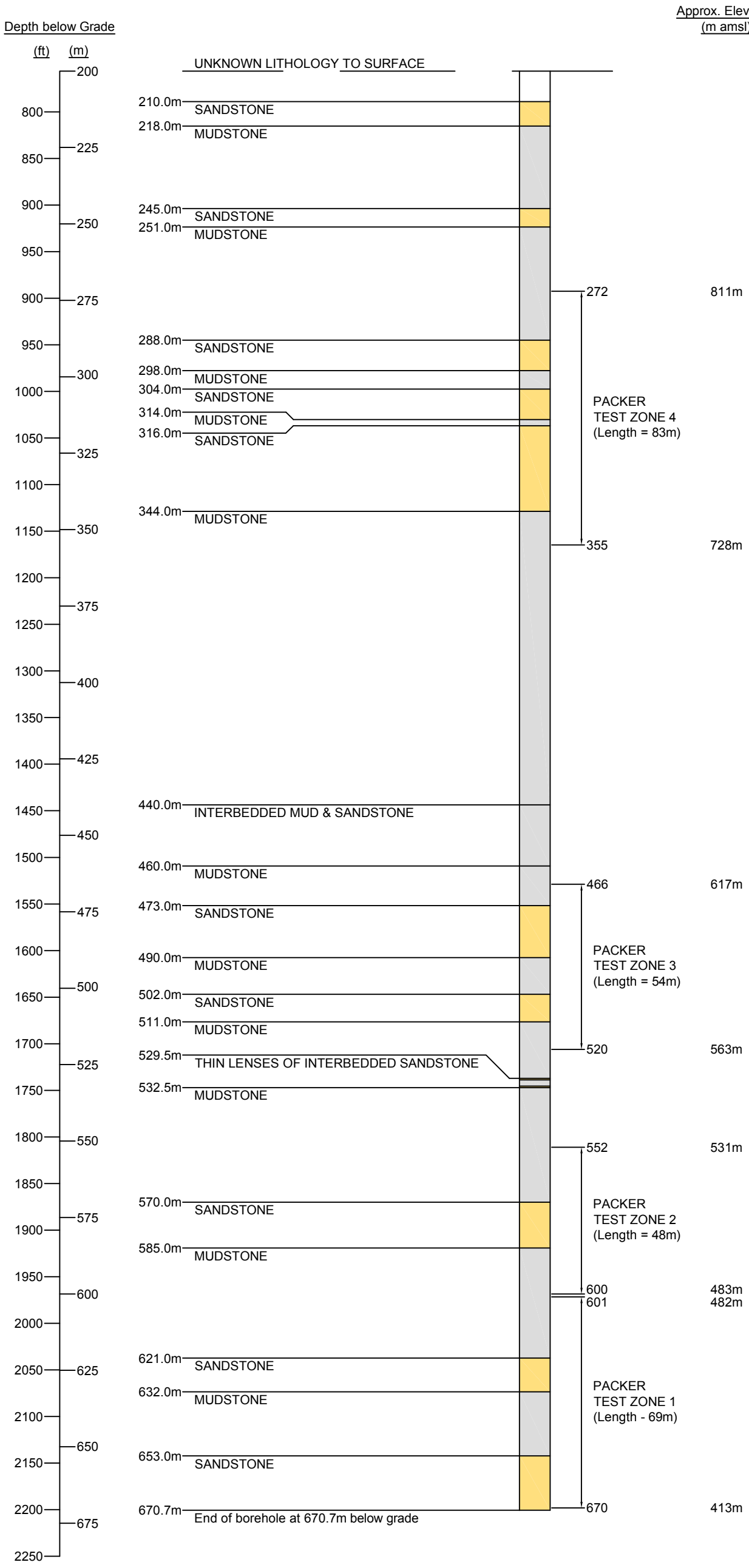
Note: Image provided by Spectrum Digital Mapping
NTS map sheets 93P2 (1989 Edition 3, contour interval 50') & 93P3 (1989 Edition 3, contour interval 100')

AMEC Earth & Environmental
3456 Opie Crescent
Prince George, BC, CANADA V2N 2P9
Tel. (250) 564-3243
Fax (250) 562-7045

CLIENT
CANADIAN DEHUA INTERNATIONAL MINES GROUP INC.

TITLE: **SITE LOCATION PLAN**	DWN BY: B.Brown	DATUM: NAD27	DATE: MARCH 2010
PROJECT: PACKER TESTING TUMBLER RIDGE, BC	CHK'D BY: T.Kostya	REV. NO.: A	PROJECT NO: KX13432
	PROJECTION: UTM Zone 10	SCALE: 1:100 000	FIGURE 1

S:\External\KX13432-CDI-TR-CAD\KX13432-Fig1-NTS.dwg - PRG-fig1 - Mar. 25, 2010 1:12pm - ben.brown

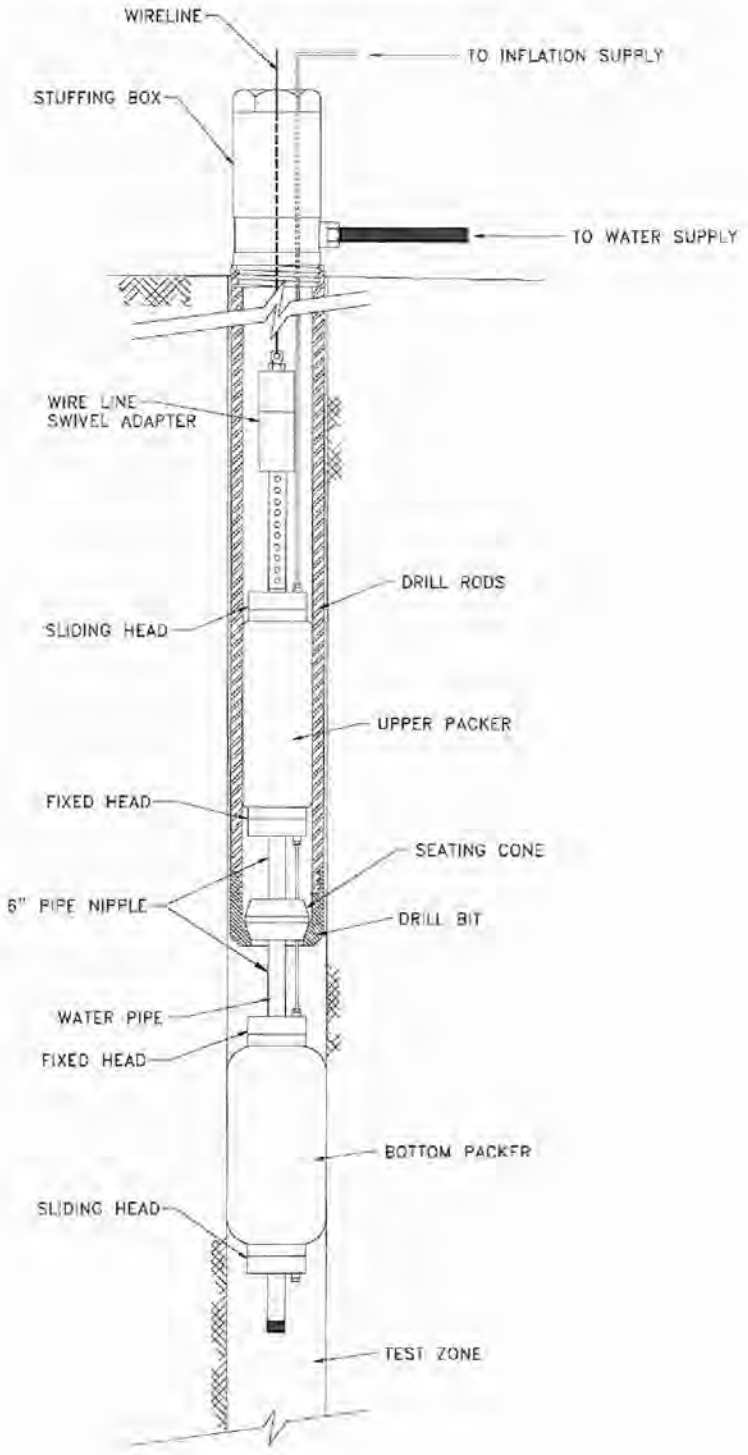


NOTES

1. Borehole cemented & sealed upon completion of packing testing.
2. Borehole stratigraphy recorded by Canadian Dehua International Mines Group Inc. personnel.
3. Location: 621852E, 6099308N, approximate ground-level elevation 1083m recorded using a hand-held GPS unit.

CLIENT LOGO	CLIENT CANADIAN DEHUA INTERNATIONAL MINES GROUP INC.	DWN BY: B.Brown CHK'D BY: T.Kostya	TITLE PIR-35 BOREHOLE LOG	REV. NO.: A DATE: MARCH 2010	
AMEC Earth & Environmental 3456 Opie Crescent Prince George, BC, CANADA V2N 2P9 Tel. (250) 564-3243 Fax (250) 562-7045		DATUM: NAD83 PROJECTION: N/A SCALE: AS SHOWN	PROJECT PACKER TESTING TUMBLER RIDGE, BC	PROJECT NO: KX13432 FIGURE 2	

This drawing was originally produced in colour.



NOTES
1. Figure taken from RST Instuments Ltd. 'Borehole Packers Instruction Manual'.

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CLIENT
CANADIAN DEHUA INTERNATIONAL MINES GROUP INC.

TITLE	DWN BY:	DATUM:	DATE:
WIRELINE DOUBLE PACKER SETUP	B.Brown	NAD83	MARCH 2010
PROJECT	CHK'D BY:	REV. NO.:	PROJECT NO:
PACKER TESTING TUMBLER RIDGE, BC	S.Green	A	KX13432
	PROJECTION: UTM Zone 10	SCALE: N.T.S.	FIGURE 3

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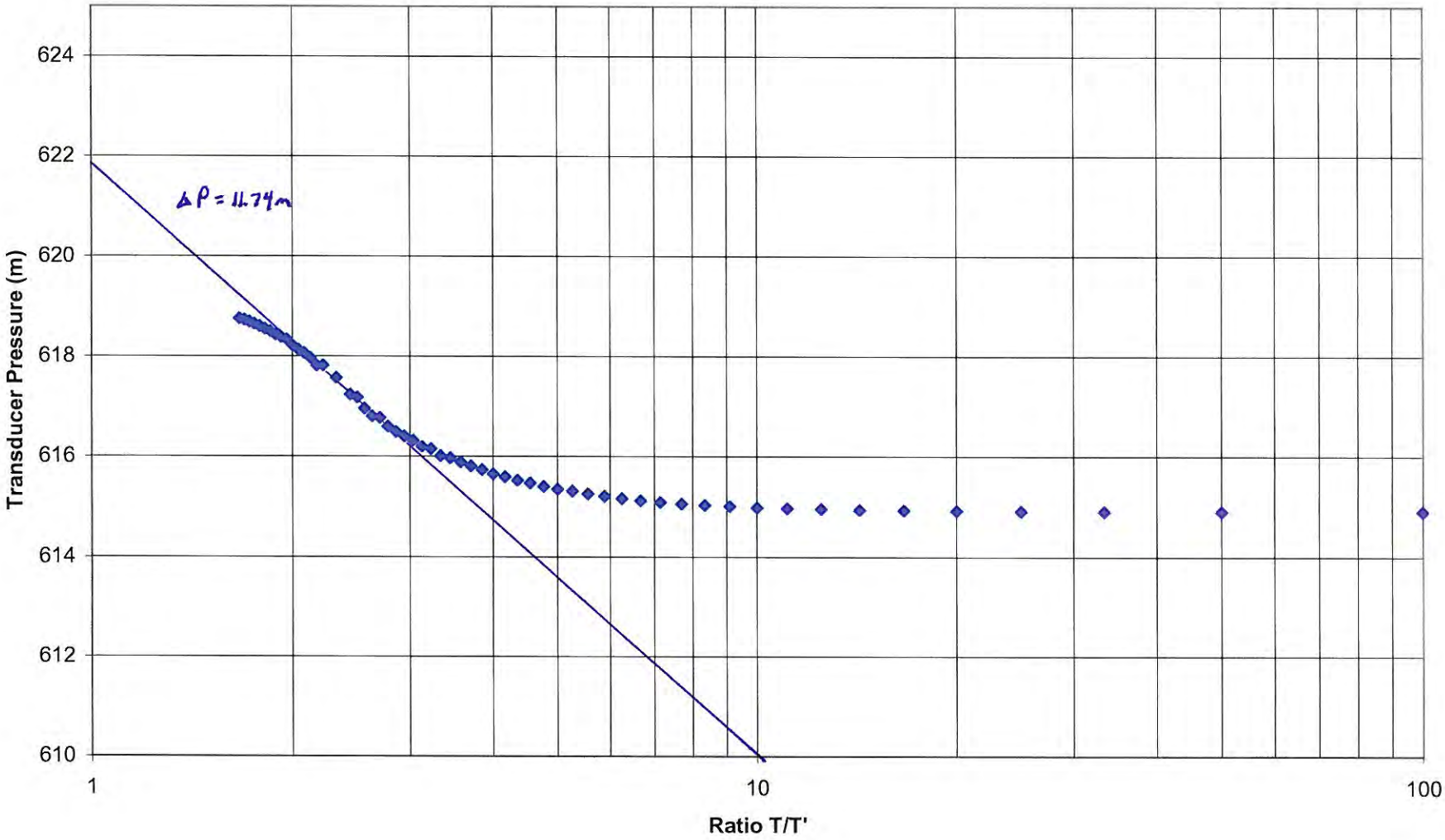
This drawing was originally produced in colour.

APPENDIX A

PACKER TESTING DATA

Murray River Coal Project PIR-35 Packer Testing
Test Zone 1 Recovery Test



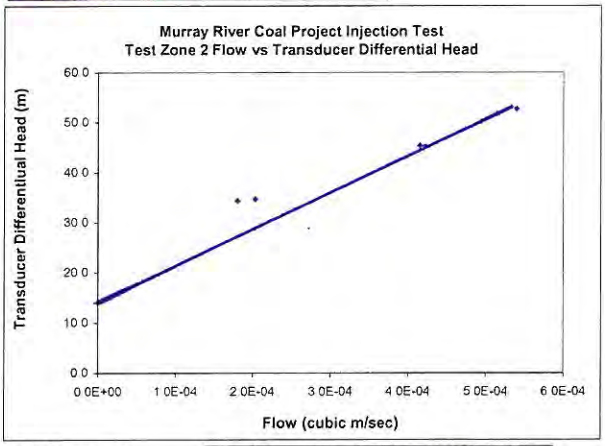
SHEET 1 OF 1

HYDROLOGIC TEST FIELD DATA SHEET

PROJECT:	Murray River Coal Project	PROJECT NO:	KX13432	DRILLHOLE:	PIR-35
AREA:	Tumbler Ridge	TEST DATE:	26-Feb-10	TEST NO:	2
DIP:	90 ° (FROM HORIZONTAL)	STATIC WATER DEPTH: (Estimated downhole)	-13.7 m	TOP OF TEST INTERVAL:	551.50 m (DOWN HOLE)
HOLE DIA.	75.7 mm	GAUGE HEIGHT (Above Ground)	2.0 m	BOTTOM OF TEST INTERVAL:	600.00 m (DOWN HOLE)

INJECTION TEST

GAUGE PRESSURE (psi)	EFFECTIVE TEST ZONE PRESSURE (m head)	STEADY FLOW (litres / min)	K (m/s)
50	24.0	12.20	1.38E-07
80	45.4	25.36	2.19E-07
100	59.7	32.37	2.40E-07
80	45.4	24.93	2.15E-07
50	24.0	10.82	1.23E-07



INTERPRETATION REFERENCE: "Field Permeability Test Methods and Applications to Solution Mining" - USB of Mines, 1977

INTERPRETATION TYPE OF FLOW:

LAMINAR	NO
TURBULENT	NO
DILATION	NO
WASH-OUT	NO
VOID FILLING	YES

Hydraulic Conductivity	m/s
MAX k=	2.40E-07
MIN k=	1.23E-07
AVG k=	1.87E-07
Interpreted k =	2.1E-07

OBSERVATIONS:

FALLING HEAD TEST

PERMEABILITY COEFICIENT CALCULATIONS

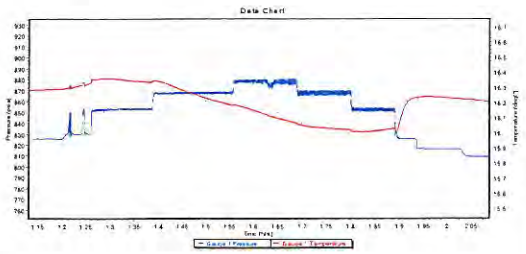
STATIC WATER PRESSURE (psi)	
BORE HOLE RADIUS (m)	
DRILL ROD RADIUS (m)	
TEST INTERVAL LENGTH (m)	

TEST PARAMETERS

DURATION OF FALLING HEAD TEST (s)	
INITIAL PRESSURE READING (psi)	
FINAL PRESSURE READING (psi)	
FINAL PRESSURE RATIO RECORDED	

INTERPRETATION REFERENCE:

OBSERVATIONS:



Single Packer was TEST BY:

REVIEWED BY:

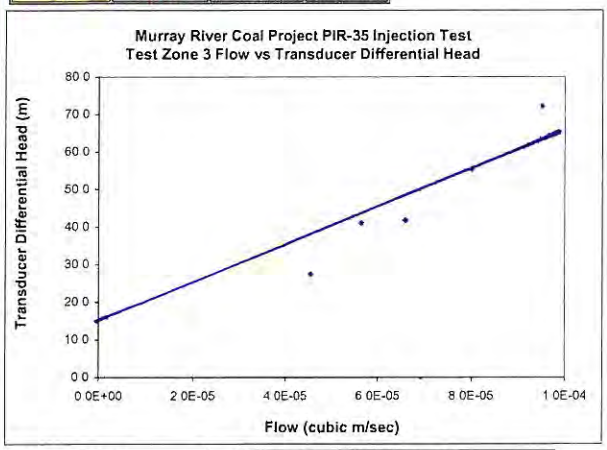
SHEET 1 OF 1

HYDROLOGIC TEST FIELD DATA SHEET

PROJECT:	Murray River Coal Project	PROJECT NO:	KX13432	DRILLHOLE:	PIR-35
AREA:	Tumbler Ridge	TEST DATE:	28-Feb-10	TEST NO:	3
DIP:	90 ° (FROM HORIZONTAL)	STATIC WATER DEPTH: (Estimated downhole)	-15.1 m	TOP OF TEST INTERVAL:	466.50 m (DOWN HOLE)
HOLE DIA.	75.7 mm	GAUGE HEIGHT (Above Ground)	2.0 m	BOTTOM OF TEST INTERVAL:	520.00 m (DOWN HOLE)

INJECTION TEST

GAUGE PRESSURE (psi)	EFFECTIVE TEST ZONE PRESSURE (m head)	STEADY FLOW (litres / min)	K (m/s)
40	15.5	2.73	3.59E-08
60	29.8	3.96	3.41E-08
80	44.1	4.79	3.12E-08
100	58.4	5.70	2.84E-08
60	29.8	3.39	2.98E-08



INTERPRETATION REFERENCE: "Field Permeability Test Methods and Applications to Solution Mining" - USB of Mines, 1977

INTERPRETATION TYPE OF FLOW:

LAMINAR	NO
TURBULENT	NO
DILATION	NO
WASH-OUT	NO
VOID FILLING	YES

Hydraulic Conductivity	m/s
MAX k =	3.59E-08
MIN k =	2.84E-08
AVG k =	3.19E-08
Interpreted k =	3.0E-08

OBSERVATIONS:

FALLING HEAD TEST

PERMEABILITY COEFICIENT CALCULATIONS

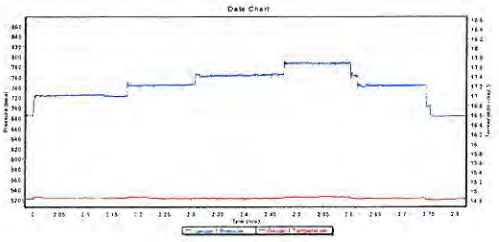
STATIC WATER PRESSURE (psi)	
BORE HOLE RADIUS (m)	
DRILL ROD RADIUS (m)	
TEST INTERVAL LENGTH (m)	

TEST PARAMETERS

DURATION OF FALLING HEAD TEST (s)	
INITIAL PRESSURE READING (psi)	
FINAL PRESSURE READING (psi)	
FINAL PRESSURE RATIO RECORDED	

INTERPRETATION REFERENCE:

OBSERVATIONS:



Single Packer was
TEST BY:

REVIEWED BY: Scott Green

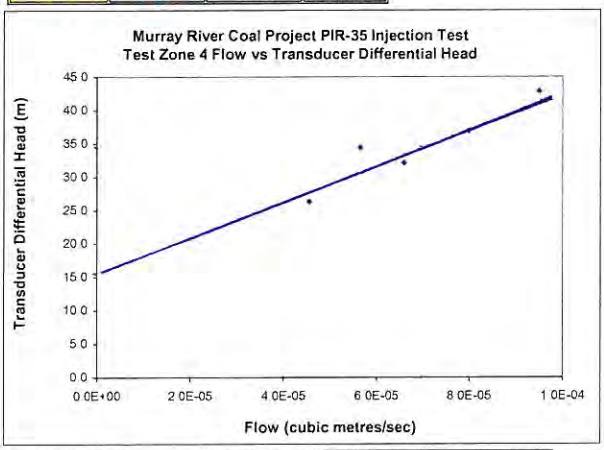
SHEET 1 OF 1

HYDROLOGIC TEST FIELD DATA SHEET

PROJECT:	Murray River Coal Project	PROJECT NO:	KX13432	DRILLHOLE:	PIR-35
AREA:	Tumbler Ridge	TEST DATE:	1-Mar-10	TEST NO:	4
DIP:	90 ° (FROM HORIZONTAL)	STATIC WATER DEPTH: (Estimated downhole)	-15.3 m	TOP OF TEST INTERVAL:	271.50 m (DOWN HOLE)
HOLE DIA.	75.7 mm	GAUGE HEIGHT (Above Ground)	2.0 m	BOTTOM OF TEST INTERVAL:	355.00 m (DOWN HOLE)

INJECTION TEST

GAUGE PRESSURE (psi)	EFFECTIVE TEST ZONE PRESSURE (m head)	STEADY FLOW (litres / min)	K (m/s)
40	15.2	2.73	2.54E-08
60	29.5	3.96	3.02E-08
80	43.8	4.79	3.18E-08
100	58.1	5.70	3.26E-08
60	29.5	3.39	2.41E-08



INTERPRETATION REFERENCE: "Field Permeability Test Methods and Applications to Solution Mining" - USB of Mines, 1977

INTERPRETATION TYPE OF FLOW:

LAMINAR	NO
TURBULENT	NO
DILATION	NO
WASH-OUT	NO
VOID FILLING	YES

Hydraulic Conductivity	m/s
MAX k=	3.26E-08
MIN k=	2.41E-08
AVG k=	2.88E-08
Interpreted k =	2.9E-08

OBSERVATIONS:

FALLING HEAD TEST

PERMEABILITY COEFICIENT CALCULATIONS

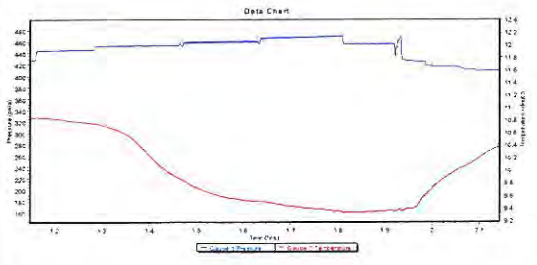
STATIC WATER PRESSURE (psi)	
BORE HOLE RADIUS (m)	
DRILL ROD RADIUS (m)	
TEST INTERVAL LENGTH (m)	

TEST PARAMETERS

DURATION OF FALLING HEAD TEST (s)	
INITIAL PRESSURE READING (psi)	
FINAL PRESSURE READING (psi)	
FINAL PRESSURE RATIO RECORDED	

INTERPRETATION REFERENCE:

OBSERVATIONS:



Single Packer was TEST BY:

REVIEWED BY:

APPENDIX B

GENERAL LIMITATIONS

Limitations

1. The work performed in this report was carried out in accordance with the AMEC's proposal PK09-179 to Canadian Dehua International Mines Group and AMEC's Professional Services Agreement. The conclusions presented herein are based solely upon the scope of services and time and budgetary limitations described in our contract.

2. The report has been prepared in accordance with generally accepted engineering practice. No other warranty, either expressed or implied, is made as to the professional service provided under the terms of our contract and included in this report.

3. The services performed and outlined in this report were based upon data collected, in part, by others at the locations identified at the time that sampling was performed. Our opinion cannot be extended to portions of the site which were not sampled or tested.

4. The objective of this report was to estimate permeability at the locations tested at the site, within the context of our contract and existing environmental regulations within the applicable jurisdiction. Evaluating compliance of past or future owners with applicable local, provincial and federal government laws and regulations was not included in our contract for services.

5. Conclusions relating to the lithology at the site are made based on data collected by others, and assumptions described in this report. It should be noted that bedrock permeabilities at locations other than those locations described could be different than the locations tested.

6. The conclusions of this report are based in part, on the information provided by others. The possibility remains that unexpected environmental conditions may be encountered at the site in locations not specifically investigated. Should such an event occur, AMEC Earth & Environmental must be notified in order that we may determine if modifications to our conclusions are necessary.

SINGLE WELL RESPONSE TESTS
PROPOSED MURRAY RIVER UNDERGROUND COAL MINE
TUMBLER RIDGE, B.C.

Submitted to:
Canadian Dehua International Mines Group Inc.
820 – 1130 West Pender Street
Vancouver, British Columbia
V6E 4A4

Submitted by:
AMEC Environment & Infrastructure
a division of AMEC Americas Limited
913 Laval Crescent
Kamloops, B.C.
V2C 5P4

6 January 2012

KX13505

EXECUTIVE SUMMARY

AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC), has completed several single well response tests at two PW diameter boreholes (H2 and H16W). The test boreholes are located between 10.9 km southwest and 12.3 km south of Tumbler Ridge, BC.

The objectives of the project are to obtain a preliminary estimate of hydraulic conductivity, piezometric head, sustainable groundwater discharge rates and groundwater quality at each test zone based on pumping tests performed at three test zones at each borehole location. A further objective is to estimate groundwater inflows to underground mine workings (the Decline, the Men and Materials Shaft, the Bulk Sample Area and Ancillary Drifts).

Two observation wells (H16A and H16) were completed within 135 m and 27 m of Borehole H16W, respectively. Test zones were specified by Canadian Dehua International Mines Group (CDIMG) based on their interpretation of borehole lithology, previously mapped stratigraphic units, geophysical borehole logs and drilling constraints. Generally, each test zone was subject to a 24 hour period for equilibration of piezometric head, followed by a 40 to 48 hour constant head or constant discharge test, followed by a recovery period of between 24 and 57 hours. Each borehole was tested from the bottom up such that the deepest test zone in each borehole was tested first and the shallowest test zone at each borehole was tested last. Pump and packer assemblies were arranged in different configurations depending upon the depth of the test interval and whether a constant discharge, or constant head test was performed.

During each constant discharge and constant head test (except at Test 4 at Borehole H2), groundwater discharge field parameters (temperature, specific conductance, pH, dissolved oxygen and oxidation-reduction potential) were recorded to monitor groundwater quality. Following between 16 hours and 48 hours of pumping a groundwater discharge sample was collected from each test zone and submitted for laboratory analysis of a suite of parameters specified by Rescan Environmental Services Ltd.

Interpreted Results

Although the piezometric heads at each test zone did not equilibrate within the 24 hour monitoring period, the interpreted piezometric heads in bedrock at both Borehole H2 and Borehole H16W ranged between 1,134 m above mean sea level (Hasler Formation at Borehole H2) and 815.4 m above mean sea level (Hasler Formation at Borehole H16W). The piezometric head in the tertiary sediments at Borehole H16A was recorded at 784.9 m above mean sea level (amsl).

Based on recovery test data collected from each test zone, aquifer transmissivities ranged between 0.02 m^2/day (in the Hasler Formation between 1,090 m and 530 m amsl at Borehole H2) and 0.11 m^2/day (in the Boulder Creek Formation between 510 m and 240 m amsl at Borehole H2). The estimated transmissivity at each test zone is converted to hydraulic conductivity using the length of each test zone. Storativity in the Gates and Hulcross formations

adjacent Borehole H16W was estimated using time-drawdown data to range between 3.1×10^{-4} and 2.4×10^{-5}.

Groundwater Quality

Comparison of analytical chemistry results with B.C. *Approved and Working Water Quality Guidelines* (BCWQG) identified between 10 analytes (from between 510 m and 240 m amsl at Borehole H2) and 14 analytes (from between 260 m and -120 m amsl and between 40 m and -120 m amsl at Borehole H16W) exceeding the BCWQG for freshwater aquatic life.

Groundwater Inflows to Underground Mine Workings

Using the Goodman approximation and dimensions provided on Norwest Drawings 4.1 and 4.2 dated June 2011, preliminary groundwater inflows to the Decline are estimated to range between 0.03 m^3/day (11 L/hour) in the Boulder Creek Formation and 0.08 m^3/day (34 L/hour) in the Hasler Formation. Using the Thiem equation and Norwest Drawings 3.1 and 3.6 dated June 2011, preliminary groundwater inflows to the Men and Materials Shaft are estimated to range between 13.7 m^3/day (570 L/hour) in the Gates Formation and 9.9 m^3/day (412 L/hour) in the Hasler Formation. Using the Goodman approximation and dimensions provided on Norwest Drawings 5.7, 5.8 and Table 5.1 dated June 2011, groundwater inflows to the Bulk Sample Area (BSA) and Ancillary Drifts are estimated to be 0.11 m^3/day (41 L/hour) from the Gates Formation.

Groundwater inflow rates into underground mine workings (such as the decline, the men and materials shaft, the bulk sample area and ancillary drifts) have been estimated based on interpreted piezometric heads, transmissivities and hydraulic conductivities at borehole H16W. Borehole H16W is located 840 m from the decline portal, 760 m from the decline's intersection with the F seam, 540 m from the Men and Materials shaft and the most proximal location of the BSA, and 1,300 m from the most distal point of the BSA. Since the piezometric head and transmissivity in the Gates formation was only tested at Borehole H16W, the variability of these parameters in the Gates formation is unknown. Consequently, groundwater inflow rates into underground mine workings provided in this report assume that the hydraulic conductivity, transmissivity and piezometric head estimated based on data collected from the Gates formation at Borehole H16W is representative of these parameters for the entire Gates formation. Given this uncertainty, the estimated groundwater inflows presented in this report can only be considered approximate.

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1.0 INTRODUCTION

AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC), has completed several single well response tests at two PW (143.5 mm) diameter boreholes (H2 and H16W). The test boreholes are located between 10.9 km southwest and 12.3 km south of Tumbler Ridge, BC (Figure 1).

2.0 BACKGROUND

Canadian Dehua International Mines Group Inc. (CDIMG) would like to develop an underground mine to extract metallurgical (coking) coal. As part of a pre-feasibility assessment of dewatering the mine areas, CDIMG retained AMEC to perform packer testing on Borehole P1R-35 during February 2010. AMEC compiled and interpreted the packer testing results and provided CDIMG with a letter report dated 1 April 2010. The purpose of the packer testing was to provide a preliminary estimate of the hydraulic conductivity of the stratigraphy intersected at P1R-35 as a component of mine feasibility and design.

Borehole P1R-35 is located between 2.8 km (H2) and 3.4 km (H16W) from the boreholes designated for pumping tests. Borehole P1R-35 was observed to be flowing above grade across stratigraphic units between 270 m and 670 m below grade. Based on shut-in pressure tests, hydraulic heads ranged between 14.7 m and 15.9 m above grade. The maximum flow rate recorded during packer testing at P1R-35 was 31 m^3/day (1,300 L/hour or 5.7 USgpm) between 550 m and 600 m below grade.

AMEC understands that CDIMG has commissioned Norwest Corporation (Norwest) of Salt Lake City, Utah to design the Murray River mine. Further, AMEC understands that an environmental impact assessment (EIA) is the responsibility of Rescan Environmental Services Ltd. (RESL) of Vancouver, B.C. In addition to characterizing the hydraulic conductivity of the rock across various test zones, CDIMG would also like to characterize the groundwater discharge quality from various test zones.

3.0 OBJECTIVES AND SCOPE OF WORK

The objectives of the project are to develop a preliminary estimate of hydraulic conductivity, piezometric head, sustainable groundwater discharge rates and groundwater quality at each test zone. A further objective is to estimate groundwater inflows to underground mine workings (the Decline, the Men and Materials Shaft, the Bulk Sample Area and Ancillary Drifts).

To achieve the stated objective, AMEC has performed the following scope of work:

- Purchased two submersible pumps (Grundfos 16S100 – 75DS c/w Franklin 575 Volt, 3 phase, 10 HP motors) and two inflatable packers (IPI 120 mm OD Riser Packer Assembly);

- Purchased two additional submersible pumps (Grundfos 5S15-31DS c/w Franklin 230 Volt, single Phase, 1.5 HP motors);
- Purchased a 25 mm diameter stainless steel flow meter (up to 10 USgpm);
- Purchased a Karlington 120 mm diameter stainless steel rotating gas separator;
- Reviewed bedrock core collected from H2 and H16W;
- Prepared a groundwater discharge management plan for submission to the Prince George office of the Environmental Protection Division of B.C. Ministry of Environment;
- Coordinated with Foraco Drilling and CDIMG drilling staff on drilling progress and borehole design and preparation;
- Lowered and removed submersible pump and packer assembly on 50 mm diameter steel drop pipe on four different occasions to three different depths at borehole H2,
- Lowered and removed submersible pump on NQ diameter (70 mm o.d.) steel drop pipe on three different occasions to two different depths at borehole H16W,
- Recorded piezometric head at each zone tested;
- During testing performed at Borehole H16W, monitored depth to groundwater at two observation wells (Borehole H16 and Borehole H16A);
- Conducted a 40 hour constant discharge test at three test zones (Test 1 and 2 at Borehole H2 and Test 3 at Borehole H16W);
- Conducted a constant head test at three test zones (Test 4 at Borehole H2 and Tests 1 and 2 at Borehole H16W);
- Conducted a recovery test at each zone tested;
- At a selected test zone at borehole H2 conducted a step test (Test 3);
- Recorded groundwater discharge quality field parameters (temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential) from each test zone;
- Collected a groundwater discharge sample from each test zone;
- Commissioned laboratory analysis of each groundwater discharge sample;
- Compiled field and laboratory groundwater discharge quality data;
- Compiled pumping test data;
- Interpreted pumping test data from each test zone; and
- Prepared this report.

Generally, the scope of work was performed in accordance with the scope of work outlined in AMEC's December 1, 2010 proposal to CDIMG, with the following exceptions:

- Testing at Borehole H14 was not performed as a consequence of restricted use of the access road by Spectra Energy (road authority) and safety concerns related to reported elevated methane concentrations in the area.
- At Borehole H2, constant discharge tests were performed at two test zones (600 m – 870 m and 200 m – 575 m). In place of a third constant discharge test at a shallower depth, CDIMG requested that a constant head test be conducted using methodology specified by CDIMG personnel at the interval between 20 m (the depth of the surface casing) and 575 m. A packer was not used for this test.
- At Borehole H16W, a constant discharge test was performed at one test zone (230 m – 270 m). Two of the tests conducted were constant head tests and followed test methodology specified by CDIMG personnel (797 m – 960 m and 600 m – 730 m). A packer was not used for either constant head test performed at Borehole H16W.

- At Borehole H2, a step test was performed between 200 m and 580 m below grade, whereby the pump discharged at rates of 0.06 L/sec (1 USgpm), 0.09 L/sec (1.5 USgpm), 0.13 L/sec (2 USgpm), and 0.16 L/sec (2.5 USgpm), each for approximately 30 minutes.
- In order to have more control with pumping rates and more representative flow rates during constant head tests, additional equipment was purchased on behalf of CDIMG. Specifically, this equipment included two 1.5 hp Grundfos submersible pumps, one 25 mm diameter flow meter and a 120 mm diameter rotating gas separator.
- During testing performed at Borehole H16W, monitored depth to groundwater at two observation wells (Borehole H16 and Borehole H16A).
- At the request of CDIMG, developed a groundwater discharge management plan and submitted the groundwater discharge management plan to B.C. Environment Prince George office for their information.

4.0 BOREHOLE LOCATIONS AND ACCESS

The Murray River lease is located approximately 12.5 km southwest of Tumbler Ridge and is situated within the sub-alpine bio-geoclimatic zone of the northern Rocky Mountains. Surveyed UTM coordinates (relative to a NAD 83 Zone 10 N coordinate reference system) and ground level elevations (to an accuracy of ±0.05 m using a Trimble GNSS R8 RTK base station) of each tested borehole (as provided by Integrated Pro-Action Corporation – IPaC) are summarized in Table 1.

Table 1
Borehole Location Summary
(as provided by IPaC)

Borehole	Northing	Easting	Ground Elevation (m amsl)
H2	6101836.4	620583.7	1,111.9
H16W	6097712.7	624789.1	835.5
H16A	6097821.5	624890.9	839.3

A surveyed location and ground elevation for Borehole H16 was not provided by IPaC. However, AMEC measured the distance from Borehole H16W to Borehole H16 using a surveyor's chain (measuring tape) at 27 m.

The straight-line distance from Tumbler Ridge to Borehole H2 and Borehole H16W is 12.3 km and 10.9 km, respectively. Road access to each borehole from Tumbler Ridge is between 24 km (H16W) and 46 km (H2) following the local asphalt and gravel surfaced road network. From Tumbler Ridge, drive south for 13 km along the Grand Prairie Highway 29, west along the Murray River forest service road until kilometre 9.4. The Murray River forest service road is surfaced with asphalt until kilometre 4, where it becomes surfaced with graded gravel. At kilometre 9.4, turn right onto the Mast forestry service road. Access to borehole H16W is on

the left hand side at kilometre 1.6 of the Mast Road. Access to borehole H2 requires further travel along the Mast Road to kilometre 11.2, where one turns right onto an unnamed forest service road. Access to borehole H2 is on the right hand side at kilometre 2.8 along the unnamed forest service road.

5.0 GROUNDWATER DISCHARGE MANAGEMENT PLAN

In response to concern expressed by representatives of the Environmental Protection Division (EPD) of B.C. Environment's Prince George office in an e-mail dated December 2, 2010, and at the request of CDIMG, AMEC prepared a groundwater discharge management plan in a letter dated December 10, 2010. A copy of the groundwater discharge management plan is provided in Appendix A.

The groundwater discharge management plan described anticipated groundwater discharge rates and test period durations from each test zone proposed at each borehole. As per B.C. Environment's request, the groundwater discharge management plan called for excavation of pits in the shallow soils adjacent each borehole having the capacity to store 150 % of the anticipated groundwater discharge volume, assuming no exfiltration of the water from the base of the pit. Further, the groundwater discharge management called for AMEC personnel to record dimensions of, and photograph, each pit excavated. The letter detailed that it was AMEC's responsibility to make sure that adequate storage capacity was available in the excavated pits, prior to starting the pumping test. Prior to the start of each pumping test, AMEC personnel forwarded copies of pit dimensions and pit photographs to the appropriate representatives of EPD of B.C. Environment.

6.0 TEST METHODOLOGY

6.1 TEST ZONES

Test zones were specified by CDIMG based on their interpretation of borehole lithology, previously mapped stratigraphic units, geophysical borehole logs and drilling constraints. Specification of test zone lengths and depths was beyond AMEC's scope of work. Test zones for each borehole are summarized in Table 2.

Table 2
Test Zones (as specified by CDIMG)

Borehole	Test No.	Test Interval (m amsl)		Test Zone Length (m)	Test Zone Diameter (mm)	CDIMG Interpreted Geological Formation
		Bottom	Top			
H2	1	240	510	270	143.5	Boulder Creek
	2	530	910	380	143.5	Hasler
	3	530	910	380	143.5	Hasler
	4	530	1090	580	143.5	Hasler and Overburden
H16W	1	-120	40	160	96.1	Gates
	2	-120	260	380	96.1 – 127	Gates/Hulcross/ Boulder Creek
	3	560	600	40	127	Hasler

Table 2 shows that test zone lengths ranged between 40 m and 560 m. At some test zones, more than one test method was applied. For example, Borehole H2 test numbers 2 and 3 were performed at the same test zone, but different test methods were applied.

6.2 TEST METHODS

6.2.1 Borehole Drilling Summary

Borehole drilling details were specified by CDIMG and were beyond AMEC's scope of work. However, in order to conceptualize groundwater recharge to the boreholes, AMEC provides this summary of its understanding of borehole drilling details. Conceptualized borehole details based on information provided by CDIMG and Foraco and Guardian Drilling are provided in Appendix B. The procedure used to drill Borehole H2 was different from the procedure used to drill Borehole H16W.

Borehole H2 Drilling

Borehole H2 was drilled by Foraco Drilling of Kamloops, B.C. At Borehole H2, a PQ diameter (122.8 mm or 4.835 inches) borehole was drilled to 240 m amsl (total depth). Upon achievement of total depth, the drill string was tripped out and the borehole was widened (reamed) from between the SWT surface casing and 5 m below the top of the lowermost test zone (507 m amsl). The borehole diameter after reaming was 143.5 mm (5.65 inches). After reaming, Borehole H2 was flushed with water in order to remove silt and fine-grained sand from the borehole. Finally, the borehole was lined with PWT casing to the top of the first test zone (600 m below grade as shown in Appendix B). After completion of the first test at H2 (between 510 m and 240 m amsl), AMEC observed large quantities of driller's grease in the borehole. AMEC learned after testing of Borehole H2 had been completed, that Foraco had applied the

grease to the outside of the PWT casing as it was lowered into the borehole. AMEC understands that the purpose of the driller's grease was 1) to facilitate installation and removal of the PWT casing and 2) to reduce the risk of caving of the open borehole. A consequence of the addition of the driller's grease is that it is considered likely to have reduced the permeability of each test zone by some unquantifiable amount.

Borehole H16W Drilling

Borehole H16W was drilled by Guardian Drilling of Saskatoon, Saskatchewan using a VD5000 diamond drill rig. Borehole H16W was drilled to a total depth of -120 m amsl and had a progressively reducing diameter with depth. A summary of the Borehole H16W diameters with depth is provided in Table 3.

Table 3
H16W Diameters with Depth

Depth (m below grade)		Elevation (m amsl)		Installation Type	Clear Inside Diameter (mm)
Top	Bottom	Top	Bottom		
Grade	34	835	801	SWT Casing	153.4
34	500	801	336	PWT Casing	127.0
500	792	336	44	PQ drill rod	103.2
792	960	44	-124	HQ Open Hole	96.1

In order to isolate the Gates Formation during the first pumping test, a grout plug comprised of a mixture of cement and Sikka 212 is reported to have been installed at Borehole H16W in the annular space between the PQ drill rod and the borehole wall between 48 m and 38 m amsl. Immediately following completion of Test No. 1 (with the pump set at 356 m amsl), the submersible pump, rotating gas separator and memory gauge were lost down the hole. During recovery efforts, pieces of the pump were recovered. However, the pump motor, rotating gas separator and memory gauge remained in the borehole. Based on information provided by the Guardian driller, the smashed pump was wedged in the borehole at 785 m below grade. Since the PQ drill rods could not be removed from the borehole (as a consequence of the grout plug set at the perimeter of the casing between 48 m and 38 m amsl), the PQ drill rods were perforated, using a casing perforator, between 260 m and 220 m amsl. However, based on information provided by the driller following completion of Test 2, AMEC learned that no grout was placed in the borehole prior to performance of Test 2. Since the smashed pump is not considered to be an adequate hydraulic seal, the Test 2 interval is taken to be between 260 m and 220 m amsl plus the open borehole that comprised Test Zone I (between 40 m and -120 m amsl).

Since the drillers were not able to pull the PWT casing, Test Zone III was created by injection of grout into the borehole to 412 m below grade. Following injection of grout, the PWT casing was perforated between 233 m and 273 m below grade, using a casing perforator.

Observation Well Installations

Two observation wells (H16 and H16A) were completed adjacent to Borehole H16W. Based on information provided by CDIMG, conceptualized borehole details for each observation well are provided in Appendix B. Borehole H16 is reportedly drilled to 966 m below grade in the Gates formation. An HQ diameter drill rod is reportedly installed to 587 m below grade. The annular space at the base of the HQ drill rod, is reported to be sealed with a cement plug between 572 m and 587 m below grade. Borehole H16 is reported to be HQ open hole between 587 m and 657 m below grade and NQ open hole between 657 m and 966 m below grade. Since a ground level elevation at Borehole H16 was not available, installation details could only be reported in depths below grade and could not be reported relative to a geodetic reference.

Borehole H16A is completed as a 50 mm diameter PVC monitoring well with 6 m of slotted screen set between 767.5 m and 773.5 m amsl. A sand pack is completed in the borehole annulus immediately adjacent the well screen and to a depth of 777.5 m amsl. The sand pack is overlain by a 5.5 m thick bentonite seal set between 783.0 m and 777.5 m below grade.

6.2.2 Test Descriptions

Each borehole was tested from the bottom up such that the deepest test zone in each borehole was tested first and the shallowest test zone at each borehole was tested last. Pump and packer assemblies were arranged in different configurations depending upon the depth of the test interval and whether a constant discharge, or constant head test was performed. The various pump and packer configurations are presented in Figure 3. The maximum outside diameter of each pump and packer assembly was consistently 120 mm.

For constant discharge tests, the pump and packer assembly consisted of either a 1.2 m long (1.5 hp) or 2.5 m (10 hp) submersible pump threaded onto a 2.1 m long inflatable packer. For constant head test methods, the pump assembly consisted of the same submersible pumps with a rotating gas separator installed between the pump end and the pump motor. No packer was used during the CDIMG specified constant head tests. The 1.5 hp submersible pump was used for shallow pump settings (220 m and less), while the 10 hp submersible pump was used for deep pump settings (greater than 220 m).

In all configurations, a Pioneer Petrotech PPS25 electronic memory gauge was set within a perforated pipe clamped a short distance above the pump intake. The Pioneer Petrotech memory gauge consisted of a non-vented pressure transducer, thermometer and datalogger contained in a stainless-steel housing 25 mm (1 inch) diameter and 279 mm (11 inches) long. Since the memory gauge was non-vented, pressure transducer data was compensated for atmospheric pressure using an additional PPS25 memory gauge dedicated to recording atmospheric pressure at ground surface adjacent each borehole tested. For each test performed the memory gauges were synchronized, and programmed, to record pressure and temperature at 1 minute intervals.

At Borehole H2 AMEC's sub-contractor, Ingram Well and Pump Service (IWPS), lowered the appropriate submersible pump and packer assembly on 50 mm diameter galvanized steel drop pipe to the appropriate pump setting. At Borehole H16W, pump and packer assemblies were lowered using NQ drill rod (60.5 mm inside diameter) provided by Guardian Drilling. Submersible pump and packer settings, test methodology and pump and/or packer configuration used is summarized in Table 4.

Table 4
Test Methodologies, Pump and Packer Assembly and Pump Setting Summary

Borehole	Test No.	Submersible Pump Intake Elevation (m amsl)	Packer Depth (m below grade)	Test Method Specified By	Head Equilibration	Constant Discharge	Recovery	Step Test	Constant Head	Pump and Packer Configuration (see Fig. 3)
H2	1	508	511	AMEC	√	√	√			2
	2	908	911	AMEC	√	√	√			1
	3	908	911	AMEC				√		1
	4	1010	n/a	CDIMG			√		√	4
H16W	1	356	n/a	CDIMG	√		√		√	3
	2	350	n/a	CDIMG			√		√	3
	3	624	627	AMEC	√	√	√			1

Test Methods Specified by AMEC

AMEC specified test methodology for constant discharge tests consisted of having IWPS lower the pump and packer assembly to the top of the test zone. At Borehole H2, the specified pump setting was such that the top of the packer was set generally 1 m below the PWT casing drive shoe. For Test 1 performed at Borehole H2, the pump intake was set 3.6 m below the PWT casing. After the pump and packer were set at the specified depth, the packer was inflated using nitrogen gas. The purpose of the packer was to prevent groundwater from flowing along the perimeter of the PWT casing into the test zone, effectively sealing the test zone from external sources of recharge. Each test performed according to AMEC methodology consisted of the following sequence of tests:

- A 24 hour period following inflation of the packer whereby the piezometric pressure of the test zone was allowed to equilibrate;
- A 40 hour constant discharge test whereby groundwater was discharged at a constant flow rate; and
- A 24 hour recovery test whereby the recovery of the water level was monitored.

Test Methods Specified by CDIMG

CDIMG test methodology for constant head tests consisted of having IWPS lower the submersible pump and rotating gas separator assembly to the base of the test zone. The purpose of the rotating gas separator was to separate dissolved gases from the groundwater prior to discharge in the drop pipe. This separation at the pump intake allowed for better control of the discharge rate. The rotating gas separator could not be used in the AMEC specified methodology because no effective means of allowing the gas to pass across the packer was available at the time of testing. A rotating gas separator was not used during Test 4 at borehole H2 since it was during the performance of this test, that the extent of dissolved gases in the groundwater, and the requirement for better control of the groundwater discharge rate became apparent. Each test performed according to CDIMG methodology consisted of the following sequence of tests:

- A 40 to 48 hour constant head test whereby the discharge rate was adjusted in order to achieve a constant head;
- A 24 hour recovery test whereby the recovery of the water level was monitored.

Test 1 at Borehole H16W included a 24 hour period of piezometric head equilibration prior to starting the constant head test. Otherwise, piezometric head equilibration was not performed prior to constant head tests.

Piezometric Head Equilibration

Piezometric head equilibration was performed as part of Tests 1 and 2 at Borehole H2 and Tests 1 and 3 at Borehole H16W. The test was performed prior to conducting any pumping and immediately following inflation of the packer. Rationale for performing this test prior to performance of any pumping is to obtain the baseline piezometric head of the test interval to which the piezometric head can be compared during recovery. For test zones having piezometric pressures below the top of the steel drop pipe, real-time piezometric pressure was recorded using a calibrated electric sounder as depth below the top of the steel drop pipe. For test zones having piezometric pressures above the top of the steel drop pipe, real-time piezometric pressure was recorded using a pressure gauge threaded into a steel top cap threaded into the drop pipe. Except during Test 3 at Borehole H16W, real-time piezometric pressure data was recorded in addition to pressure data recorded using the PPS25 Memory Gauge. The real-time pressure data was monitored in order to know when the piezometric pressure in each test zone had equilibrated to its static level.

The piezometric head at Observation Well H16A (approximately 135 m north of Borehole H16W) was recorded simply by lowering the calibrated electric sounder to the depth of the piezometric surface. Water levels at Borehole H16A were only recorded three days prior to, and during, Test 3 at Borehole H16W. Water levels were not recorded at Borehole H16A during Tests 1 and 2 performed at Borehole H16W.

Since Observation Well H16 was flowing above-grade and was noticeably releasing gas (bubbling), some additional effort was required to record the piezometric head at this location (approximately 27 m south of Borehole H16W). Over the three days leading up to the start of Test 3 at Borehole H16W, a 9.1 m length of HQ drill rod was threaded vertically above-grade (Appendix C, Photo 1). After the piezometric head was observed flowing above 9.1 m above grade, an apparatus was manufactured that allowed gas pressure to be released from the borehole, while a hydraulic head was recorded. HQ rod was sealed at 0.35 m above grade and two 19 mm diameter steel pipes extended above the HQ rod cap (Appendix C, Photo 2). A pressure gauge was threaded into one of the 19 mm diameter stand pipes at approximately 0.6 m above grade, while a pressure release valve was threaded into the top of the other 19 mm diameter stand pipe at approximately 1.3 m above-grade (Appendix C, Photos 3). The intake of the 19 mm diameter pipe having the pressure release valve was at grade, while the intake of the 19 mm diameter pipe having the pressure gauge was approximately 0.9 m below grade and connected to a flexible polyethylene 19 mm pipe that was bent vertically upward such that its intake was approximately 0.8 m below grade (Appendix C, Photo 4). The purpose of the polyethylene pipe is to prevent gas from becoming trapped in that pipe so that the pressure gauge measures only water pressure. The purpose of the pressure release valve is to release gas from the wellhead. The trick was to adjust the pressure release valve to allow sufficient gas to pass out of the wellhead such that the water level in the well remained above the lower 19 mm diameter pipe intake (0.8 m below grade) to the pressure gauge but below the pressure release valve (1.3 m above grade). This method was only used to measure piezometric head above-grade at Observation Well H16.

Constant Discharge Test

Constant discharge tests were performed as part of Tests 1 and 2 at Borehole H2 and at Test 3 at Borehole H16W. Submersible pumps were powered by either a 3 phase (for the GS100-75DS pumps) or a single phase (for the 5S15-31 pumps) diesel-powered generator. Discharged groundwater was directed from the drill rods via an elbow fitting into flat-lay discharge hose. The flat-lay discharge hose was directed into a plastic pail of known volume. Overflow water from the plastic pail, was allowed to runoff overland into the excavated pit.

Routinely throughout the test, the flow rate was recorded by directing the discharge from the flat-lay pipe to a plastic pail having a known volume. The time taken for the groundwater discharge to fill the pail of known volume was recorded in order to obtain an estimate of the groundwater flow rate.

Real-time drawdown was recorded during each test at Borehole H2 and Tests 1 and 2 at Borehole H16W using a calibrated electric sounder. Further, the change in piezometric pressure was recorded at 1 minute intervals by the PPS25 Memory gauge.

Groundwater from each test zone was discharged for 40 hours. Generally, groundwater discharge rates from each test zone fluctuated by ±0.06 L/sec (±1 USgpm). Mean flow rates at each test zone are presented in Table 5.

Table 5
Mean Constant Discharge Test Pumping Rates

Borehole	Test No.	Test Zone (m amsl)		Pumping Rate (L/sec)			Pumping Rate (USgpm)		
		Bottom	Top	Max	Min	Average	Max	Min	Average
H2	1	240	510	0.32	0.17	0.19	5.0	2.7	3.0
	2	530	910	1.4	0.06	0.16	22	1.0	2.5
H16	3	560	600	0.38	0.04	0.07	6.0	0.7	1.2

Pumping rates were generally not held constant throughout the constant discharge test since a mixture of methane gas and groundwater was discharged simultaneously. Since a mixture of gas and water recharges the drop pipe, the flow rate from the test zone decreases and the pump is not able to discharge at its rated capacity. One of the impacts of the water and gas mixture on the test data was such that following an initial rapid lowering of the piezometric pressure in the test zone, the piezometric pressure typically recovers for the remainder of the constant discharge test.

To remedy this problem, consideration was given to using the rotating gas separator during constant discharge tests. However, no effective means of discharging the separated gas across the packer was available at the time that testing was performed. Consequently, the rotating gas separator was not used when the packer was inflated in the borehole.

While pumping from H16W during Test No. 3, piezometric pressures were monitored at Observation Well H16 (27 m south from H16W) and H16A (135 m north from H16W).

Recovery Test

A recovery test was performed at each test zone. After the 40 hour pumping period, the pump was turned off and the water level in the test zone was allowed to recover. Recovery test durations ranged between 24 hours and 56 hours and are summarized in Table 6.

Table 6
Recovery Test Durations

Borehole	Test No.	Test Zone (m amsl)		Recovery Test Duration (Hours)
		Bottom	Top	
H2	1	240	510	29.5
	2	530	910	56
	3	530	1,090	57
H16W	1	-120	40	53
	2	-120	260	54
	3	570	610	24

Step Test

In order to characterize the specific capacity at Borehole H2 between 200 m and 580 m below grade (Test 3), a step test was performed that consisted of pumping this test zone at four different pumping rates at 30 minute intervals (1 USgpm, 1.5 USgpm, 2 USgpm, and 2.5 USgpm). Thirty minute intervals were selected since it was considered likely that if the pumping rates were held constant for a period longer than 30 minutes, the piezometric pressure would have been drawn down to the pump intake.

No further step tests were performed as part of the single well response test program, since the results of the H2 step test showed that the storage component of the bedrock was significant enough that drawdown for each incremental increase in flow rate was inconsistent.

Constant Head Test Specified by CDIMG

During an April 12, 2011 conference call between AMEC and CDIMG representatives, it was agreed that a supplementary test would be performed using the test methodology specified by CDIMG.

The constant head test was performed as part of Test 4 at Borehole H2 and Tests 1 and 2 at Borehole H16W. Packers were not used in the performance of any of the constant head tests. At Test 4 at Borehole H2, the test was performed using only the submersible pump set at 712 m amsl. No rotating gas separator was used in the performance of Test 4 at Borehole H2. A rotating gas separator was used in-line with the submersible pump intake and motor in the performance of Tests 1 and 2 at Borehole H16W.

The test consisted of adjusting the pumping rate in order to maintain a constant head for the test interval. At Test 4 of Borehole H2, the pump was actually turned off for two periods of 72 minutes and the recovery of the test interval was monitored during these periods.

AMEC understands that some effort was made by CDIMG to set a concrete seal in the annular space between the borehole wall and the outside perimeter of the PQ casing between 50 m and 40 m amsl (at the top of Test Interval 1 at Borehole H16W). However, as a consequence the fact that there was no testing performed to assess the integrity of the concrete seals, there is some question whether concrete at this depth formed an effective seal to prevent water from infiltrating the test zone.

6.3 FIELD-RECORDED GROUNDWATER DISCHARGE QUALITY

During constant discharge tests and constant head tests (except at Test 4 of Borehole H2), AMEC recorded groundwater discharge quality field parameters (temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential). These parameters were recorded in the field, since they are known to change between the time that the sample is collected and the time that the sample is tested in the analytical laboratory.

Groundwater discharge quality was recorded in the field at H2 between 600 m and 870 m below grade and each test performed at H16W using a YSI 556 MDS. Groundwater discharge quality was recorded in the field at H2 between 200 m and 575 m below grade using YSI pro-plus. Calibration records for the YSI 556 MDS are provided in Appendix D.

Field groundwater discharge quality was recorded by discharging groundwater into a clean 22 litre (5 Igal.) plastic pail. The YSI instrument was inserted in the plastic pail and pre-programmed to record temperature, specific conductance, pH, dissolved oxygen, and oxidation-reduction potential at 2 minute intervals. Groundwater was allowed to overflow from the plastic pail. Field recorded groundwater discharge quality immediately prior to groundwater sample collection is presented on field sampling sheets presented in Appendix D. Continuous monitoring of groundwater discharge quality at two minute intervals throughout each test is presented graphically in Appendix E.

6.4 GROUNDWATER SAMPLE COLLECTION

Groundwater discharge samples were collected from each test interval following between 16 hours (Test 2, Borehole H2) and 49.5 hours (Test 1, Borehole H16W) of pumping. In fact, two groundwater discharge samples were collected from the Test 1 interval at Borehole H2 (600 m – 870 m below grade). The first sample collected from this test interval was collected after two hours of pumping, and the second sample collected from this test interval was collected after 36 hours of pumping. This first sample was collected after only two hours of pumping because at the time the groundwater discharge rate was decreasing significantly, and it was not clear that the borehole was capable of sustaining groundwater discharge for the entire 40 hour pumping period.

Each groundwater discharge sample was collected simply by placing the mouth of each sample bottle into the flow of water discharging from the flat-lay discharge hose. None of the samples were filtered in the field. Sample filtration, when appropriate, was performed at the analytical laboratory. Immediately following groundwater sample collection, field personnel completed a field data sheet that outlines field water quality recorded at the time of groundwater sample collection. Completed field data sheets are presented in Appendix D.

Each collected groundwater discharge sample was submitted for analytical testing of the following analytical suite at ALS Environmental.

- General chemistry
- Dissolved Metals
- Total Metals
- Dissolved Methane
- Total organic carbon
- Total cyanides
- Dissolved Hydrogen Sulphide
- Ammonia

Dissolved methane in groundwater discharge samples was analysed at ALS analytical laboratory in Calgary, Alberta, within 24 hours of sample collection. The remainder of parameters were analysed at ALS analytical laboratory in Burnaby, B.C.

Following AMEC's delivery of analytical testing results to CDIMG on May 6, 2011, AMEC received an e-mail from CDIMG on May 9, 2011 requesting that collected groundwater discharge samples be analyzed for the following additional total and dissolved metals concentrations:

- Beryllium
- Bismuth
- Cobalt
- Lithium
- Molybdenum
- Nickel
- Phosphorus
- Silicon
- Strontium
- Thallium
- Tin
- Titanium
- Vanadium

Furthermore, the May 9 2011 e-mail also requested analysis of the following total and dissolved metals to lower detection limits as listed:

- Selenium (0.001 mg/L)
- Mercury (0.00001 mg/L)
- Cadmium (0.000017 mg/L)

7.0 RESULTS

7.1 PIEZOMETRIC EQUILIBRATION

Piezometric head equilibration test results are presented graphically in Appendix F. Only the piezometric heads recorded during Test 3 at Borehole H16W equilibrated during the test period to a constant head. The other three test intervals where piezometric head equilibration was performed, either oscillated about some interval (Test 1 Borehole H2 and Test 1 Borehole H16W), or (in the case of Test 2 Borehole H2) asymptotically approached a constant head that was not quite achieved during the test period.

7.2 CONSTANT DISCHARGE TEST

Graphs showing constant discharge test data are presented in Appendix G. Based on review of the graphs presented in Appendix G, the following observations were made:

- Each constant discharge test data set showed rapid drawdown (to the top of the packer at Tests 1 and 2 performed at Borehole H2 and to 735 m amsl at Test 3 performed at Borehole H16W) during the initial 40 minutes of pumping;
- At Borehole H2, water levels in the test zone 510 m – 240 m amsl (Test 1) began to recover after 60 minutes of pumping when pumping rates were 0.19 L/sec (3 USgpm) or less.

- At Borehole H2, water levels in the test zone 910 m – 530 m amsl (Test 2) began to recover after 53 minutes of pumping when pumping rates were 0.19 L/sec (3 USgpm) or less.
- At Borehole H16W, water levels in the test zone 610 m – 570 m amsl (Test 3) began to recover after 6 minutes of pumping when pumping rates were 0.09 L/sec (1.4 USgpm) or less.
- As a consequence of variable flow rates throughout each constant discharge test, trends apparent in the constant discharge data sets were inconsistent and could not be used to reliably estimate the transmissivity of either test zone.
- Pumping during Test 3 at Borehole H16W at the average pumping rate of 0.07 L/sec did not affect the groundwater level at Borehole H16A (completed in the tertiary sediments).
- Pumping from Borehole H16W during Test 1, 2, and 3 lowered water levels at Borehole H16 by 67 m, 61m, and 1.7 m, respectively.

7.3 RECOVERY TEST

Graphs showing recovery test data are presented in Appendix H. Based on review of the graphs presented in Appendix H, the following observations were made:

- Recovery test data collected from most recovery tests (except Test No. 4 at Borehole H2 and Test No. 1 at Borehole H16W) show dual-porosity trends with an initial early-time trend indicative of recovery of secondary fractures and a mid-time trend indicative of recovery of primary intra-granular porosity.
- Recovery test data collected from Test No. 4 at Borehole H2 and Test No. 1 at Borehole H16W were similar in that they did not show an early-time trend indicative of recovery of secondary fracture porosity.
- With the exceptions of Test No. 4 at Borehole H2 and Test No. 1 at Borehole H16W, the extent of recovery at all other intervals tested suggests incomplete recovery of storage and that the pumping tests caused some de-watering of the test interval.
- During recovery of Test No. 4 at Borehole H2, some unknown external influence was exerted upon the aquifer while it was recovering between 3,750 minutes and 4,250 minutes following the start of the test. A similar unknown external influence was observed in the water level during the Test No. 2 Borehole H2 Constant Discharge Test after 75 minutes of pumping. These unknown external influences may be a correction of the piezometric heads following discharge of gas from the borehole.

7.4 CONSTANT HEAD TEST

Graphs showing constant head test data are presented in Appendix I. Based on review of the graphs presented in Appendix I, the following observation was made:

- The constant head test data was collected during Test No. 1 at Borehole H16W is considered to have the best quality of the tests performed. This test was the first test performed using the rotating gas separator.

Table 7 presents the range of pumping rates within which the constant head for each test interval was achieved.

Table 7
Range of Pumping Rates and Resultant Range of Heads
for Constant Head Tests Performed

Borehole	Test No.	Test Interval (m amsl)		Pumping Range for Constant Head (L/Sec)		Constant Head Range (m below grade)	
		Top	Bottom	Max	Min	Max	Min
H2	4	1,090	530	<0.06	n/a	60	70
H16W	1	40	-120	0.08	0.08	281	284
	2	260	-120	0.15	0.13	250	267

7.5 FIELD-RECORDED GROUNDWATER DISCHARGE QUALITY

Field-recorded groundwater discharge quality results are presented graphically in Appendix E. Based on review of the graphs presented in Appendix E, the following observations were made:

- *In-situ* groundwater temperatures at each zone generally increased throughout the test period. Gradual consistent increases of *in-situ* groundwater temperature are attributed to heat imparted to the water in the test zone originating from the submersible pump. Abrupt infrequent increases in *in-situ* temperature may be indicative of positive, or negative recharge boundaries in the aquifer;
- Early-time *in-situ* groundwater temperatures are considered to be most representative of *in-situ* groundwater temperature;
- Early time *in-situ* groundwater temperatures ranged between 9 ºC (200 m – 600 m at Borehole H2) and 18 ºC (600 m – 870 m at Borehole H2). Generally, *in-situ* groundwater temperatures were higher at the deeper test intervals.
- As a consequence of the method of groundwater discharge temperature measurement, groundwater discharge temperatures are influenced by both *in-situ* groundwater temperatures and air temperature.
- Generally, specific conductance data recorded for each test began at a relatively low magnitude then increased abruptly at elapsed pumping times ranging between 20 minutes (Test 2 at Borehole H16W and Test 1 at Borehole H2) and 600 minutes (Test 2 Borehole H2);
- Following the initial abrupt increase, specific conductance data appeared to achieve, or trended toward, a consistent value at each test performed at Borehole H16W. Specific conductance reported in groundwater discharge at Test 1 at Borehole H2 increased at a constant rate. No clear trend is apparent in the specific conductance data collected from Test 2 and Borehole H2;
- Late-time specific conductance data is considered to be most representative of the *in-situ* specific conductance at each test interval;
- Late-time specific conductance data ranged between 990 µS/cm (Test 2 Borehole H2) and 1,960 µS/cm (Test 1 Borehole H2). At each borehole, higher specific conductance values were reported from the deeper test zones.
- Generally, where late-time pH data shows a relatively consistent trend, this late-time pH data is considered to be most representative of the *in-situ* pH. However, since late-time

pH data reported at Test 1 Borehole H16W exhibited a clear downward trend at the end of the test, a representative *in-situ* groundwater pH is considered to be less than 7.9.

- Late-time pH data ranged between 7.5 (Test 2 Borehole H16W) and 9.3 (Test 3 Borehole H16W); At each borehole, higher pH values were reported in shallower test zones.
- Generally, dissolved oxygen (DO) concentrations decreased gradually throughout the test period to some consistently low DO concentration. Late–time DO concentrations are considered to be most representative of the *in-situ* DO concentration. The exception was DO concentrations reported at Test 2 at Borehole H2 where no clear trend was apparent;
- Late-time representative DO concentrations ranged between 0.1 mg/L (Test 1 Borehole H2) and 1.1 mg/L (Test 3 Borehole H16W); No clear DO concentration trend could be identified with depth;
- Positive oxidation-reduction potential (ORP) values in groundwater discharge suggests that groundwater discharge originates from an oxidized chemical environment, whereas negative ORP values suggests that groundwater discharge originates from a reduced chemical environment.
- Since groundwater in the borehole is expected to be oxidized, generally ORP is expected to trend downward throughout each test from a positive value to, or toward an increasingly negative value. This general trend was observed at each of the tests performed at Borehole H16W. Generally, a reverse trend (from reduced conditions to oxidized conditions) was observed in the tests performed at Borehole H2.
- Late-time ORP values are considered to be representative of the chemical environment of the aquifer. At each borehole tested, groundwater became more oxidized toward the ground surface. At the end of most tests performed (except Test 3 at Borehole H16W) the groundwater discharge at the end of the test (when the sample was collected) originated from a reduced chemical environment. Groundwater discharged at the end of Test 3 Borehole H16W originated from an oxidized chemical environment.

7.6 ANALYTICAL TESTING

Analytical chemistry results for samples collected from Borehole H2 are presented in Table 8 and results for samples collected from Borehole H16W are presented in Table 9 (both tables are presented at the back of the text). Analytical laboratory reports are presented in Appendix J.

Analytical chemistry results presented in Tables 8 and 9 are compared with the B.C. Approved and Working Water Quality Guidelines (BCWQG) 30 day average concentration for the preservation of freshwater aquatic life. The BCWQG freshwater aquatic life guidelines are considered to be the water quality threshold for discharge into local surface water bodies. Since the groundwater samples originate from an oxygen-poor (reducing chemical) environment below the ground surface, many of the analytes tested exceeded the BCWQG freshwater aquatic life guidelines.

Analytes in groundwater samples collected from Borehole H2 after 40 hours of pumping listed in Table 10 were beyond acceptable limits for discharge into surface water bodies.

Table 10
H2 Groundwater Discharge Analytes Exceeding BCWQG Freshwater Aquatic Guidelines

Test 1 600 m – 870 m	Test 2 200 m – 580 m	Test 4 20 m – 580 m
• Dissolved Oxygen	• Dissolved Oxygen	• pH
• True Colour	• pH	• Turbidity
• Turbidity	• Turbidity	• Total Alkalinity
• Total Alkalinity	• Total Alkalinity	• Fluoride
• Fluoride	• Ammonia	• Total Cadmium
• Total Calcium	• Total Calcium	• Total Calcium
• Total and Dissolved Iron	• Total Copper	• Total Chromium
• Total and Dissolved Lithium	• Total Iron	• Total Copper
• Total Zinc	• Total Lead	• Total Iron
• Dissolved Aluminum	• Total and Dissolved Lithium	• Total Lead
	• Total Zinc	• Total and Dissolved Lithium
	• Dissolved Aluminum	• Total Zinc
		• Dissolved Aluminum

Total alkalinity and total calcium exceedances listed above are dependent upon the sensitivity of the receiving environment to acid inputs. All dissolved cadmium concentrations and the total cadmium concentration in samples collected from 200 m – 580 m below grade and 600 m – 870 m below grade were reported by the analytical laboratory as less than the analytical detection limit (ranging between 0.0010 mg/L and 0.000020 mg/L) that was greater than the BCWQG freshwater aquatic life guideline (0.000010 mg/L).

The dissolved tin concentration (0.00020 mg/L) in the groundwater discharge sample collected from 600 m – 870 m at H2 (Test 1) after thirty-six hours of pumping exceeded the BCWQG working freshwater aquatic life guideline for tri-butyl tin (0.000008 mg/L), tri-phenyl tin (0.000022 mg/L), and Di-n-butyl tin (0.00008 mg/L), but was less than the working freshwater aquatic life guideline for tri-ethyl tin (0.0004 mg/L). However, the recorded dissolved tin concentration is equal to the analytical detection limit for tin (0.00020 mg/L). Consequently, several of the tin species guidelines are less than the laboratory analytical detection limit.

Analytes in groundwater samples collected from Borehole H16W after 24 hours of pumping listed in Table 11 were beyond acceptable limits for discharge into surface water bodies.

Table 11
H16W Groundwater Discharge Analytes Exceeding BCWQG Freshwater Aquatic Guidelines

Test 1 800 m – 960 m	Test 2 580 m – 960 m	Test 3 230 m – 270 m
• Dissolved Oxygen	• Dissolved Oxygen	• Dissolved Oxygen
• True Colour	• True Colour	• True Colour
• pH	• Turbidity	• pH
• Turbidity	• Total Alkalinity	• Turbidity
• Total Alkalinity	• Fluoride	• Total Alkalinity
• Fluoride	• Ammonia	• Fluoride
• Dissolved Sulfide	• Total Calcium	• Ammonia
• Ammonia	• Total Chromium	• Total Copper
• Total Cadmium	• Total Copper	• Total Iron
• Total Calcium	• Total and Dissolved Iron	• Total and Dissolved Lead
• Total Iron	• Total and Dissolved Lead	• Total and Dissolved Lithium
• Total and Dissolved Lithium	• Total and Dissolved Lithium	• Dissolved Aluminum
• Total Zinc	• Total Silver	
• Dissolved Aluminum	• Total Zinc	

Total alkalinity and total calcium exceedances listed above are dependent upon the sensitivity of the receiving environment to acid inputs. All dissolved cadmium concentrations and the total cadmium concentration in samples collected from 500 m – 960 m below grade and 230 m – 270 m below grade were reported by the analytical laboratory as less than an analytical detection limit (0.000085 mg/L) that was greater than the BCWQG freshwater aquatic life guideline (0.000010 mg/L). The laboratory attributed the increase in analytical detection limit to a requirement for dilution of the sample.

Concentrations of all other analytes tested were within the acceptable limits of the BCWQG freshwater aquatic life guidelines.

Several of the exceedances at both H2 and H16W were total metals concentrations. Generally, the majority of the BCWQG metals guidelines are listed for total metals, as opposed to dissolved metals. Generally, when groundwater samples are collected from a reducing chemical environment and brought into an oxidized chemical environment, metals have been known to precipitate from a dissolved state and (by the time they are analysed at the analytical laboratory) are recorded as a total metal concentration. When dissolved metals precipitate, they increase the turbidity in the sample. Consequently, we would expect turbidity levels in the sample to change from the time that the sample is collected in the field to the time that the sample is analyzed at the laboratory.

Unfortunately, turbidity was not recorded in the field when the sample was collected. Laboratory turbidity values for representative aquifer samples ranged between 8.25 NTU (Test 3 Borehole

H16W) and 186 NTU (Test 2, Borehole H16W). Comparing total and dissolved Iron concentrations in representative aquifer samples, the total iron concentrations are consistently greater than the dissolved iron concentrations (as is expected). At some test intervals (such as Test 1 at Borehole H2 and Test 3 at Borehole H16W), the total iron concentration is the same order of magnitude as the dissolved iron concentration. Based on this comparison, it is unlikely that the total metals exceedances from these test intervals are a consequence of precipitation of metals from solution due to changing oxidation-reduction conditions. At the remaining test intervals, the total iron concentrations are either one, or two, orders of magnitude greater than the dissolved iron concentration. At these test intervals, it is likely that some (since some metals precipitate quicker than other metals) of the total metals exceedances listed in Tables 10 and 11) are a consequence of changing oxidation-reduction conditions.

8.0 INTERPRETATION

8.1 HYDRAULIC GRADIENTS

Numerically, Table 12 summarizes the measured and interpreted piezometric head results for each test interval. The interpreted piezometric heads for Borehole H2 are presented graphically on Figure 4 and for Borehole H16W on Figure 5.

Table 12
Piezometric Head Equilibration Summary

Borehole	Test No.	Test Zone (m amsl)		Formation (as interpreted by CDIMG)	Monitoring Period (Hours)	Measured Piezometric Head Range (m amsl)		Interpreted Piezometric Head (m amsl)
		Top	Bottom			Max	Min	
H2	1	510	240	Boulder Creek	45.63	1,116.5	1,093.1	1,094
	2	910	530	Hasler	40.92	1,134.2	1,111.2	>1,134
H16W	1	40	-120	Gates	23.55	832.7	826.5	831.5
	3	610	570	Hasler	22.55	819.2	815.4	815.4
H16*	3	250	120	Boulder Creek/Hulcross	1.5	859.4	853.8	853.8
H16A	3	65	72	Tertiary	140.4	785.2	784.8	784.9

Note: * Ground level elevation at Borehole H16 is assumed to be equal to the ground level elevation at Borehole H16W.

The equilibrated piezometric head was not recorded at the start of the following tests:

- Test 4 (between 1,090 m amsl and 530 m amsl) at Borehole H2;
- Test 2 (between 260 m amsl and -120 m amsl) at Borehole H16W or Borehole H16.

Consequently piezometric heads for these Test Zones are not presented in Table 12 or on Figures 4 and 5.

The measured piezometric head for Test 2 at Borehole H2 (presented in Table 12) is likely greater than the representative piezometric head, based on the following rationale:

- The fluid in Borehole H2 was, in fact, a mixture of methane gas and groundwater;
- The methodology used to record piezometric pressures at this test zone (using a pressure gauge), likely recorded a combination of gas pressure and groundwater pressure;
- The fluid density is likely less than the density of water; and
- Piezometric head is inversely proportional to fluid density.

The extent to which it is greater than the representative piezometric head is unknown. Although the measured piezometric head at Test 2, Borehole H2 did not equilibrate to a steady-state within the 24 hour test period, the measured piezometric head appeared to asymptotically approach a steady-state less than 24 m above-grade (but greater than the maximum measured piezometric head). Since the maximum measured piezometric head was less than the equilibrated piezometric head and the measured piezometric head is interpreted to be greater than the representative piezometric head, the interpreted piezometric head was simply taken to be the maximum measured piezometric head.

Based on the results presented in Table 12 and in Figure 4, a downward vertical gradient of 0.12 m/m was calculated across the contact between the Hasler and Boulder Creek formations at Borehole H2. A vertical gradient cannot be interpreted at Borehole H16W since a piezometric equilibration test was not performed for Test 2 at Borehole H16W and because the test interval for Test 2 at Borehole H16W was interpreted to be 260 m to -120 m below grade (no impermeable seal was installed at the base of the intended Test 2 Interval). Since three piezometric pressures (required to define a plane) were not recorded in the same geological formation, a horizontal hydraulic gradient and groundwater flow direction could not be defined.

8.2 TRANSMISSIVITY

As a consequence of the storage capacity of the sedimentary bedrock and the relatively long test zones, it is unlikely that the storage capacity of the bedrock aquifers intersected by H2 or H16W were ever depleted sufficiently during either the constant discharge tests or constant head tests to estimate the bedrock aquifer transmissivity using these data sets. Consequently, only recovery test data has been used to estimate transmissivity.

Recovery test data is presented as Ratio t/t' vs. residual drawdown. These recovery test graphs are presented such that the start of the recovery test begins at the highest value of t/t'. As the recovery test proceeds, time elapses from right to left across the recovery test curve. Consequently the late-time recovery test slope is furthest to the left side of the graph and the early-time recovery test slope is furthest to the right side of the graph.

Recovery test data set (except at Test 4, Borehole H2 and Test 1, Borehole H16W) shows the classic dual porosity recovery trend, whereby the early-time recovery slope is affected by storage, the mid-time recovery slope shows the effect of the primary porosity of the bedrock and the late-time recovery slope is considered representative of the bedrock aquifer transmissivity based primarily on secondary porosity.

Using the Cooper-Jacob approximation of the modified non-equilibrium well equation, the formation transmissivity (**T**) is estimated (in m^2/day) using a plot of residual drawdown and elapsed time on semi-logarithmic paper and the following relationship:

$$\mathbf{T=0.183Q/\Delta s}$$

Where **Q** is the mean pumping rate (m^3/day) during the constant discharge test and **Δs** is the residual drawdown (m) across one logarithmic cycle. Since the late-time residual drawdown is considered to be most representative of the transmissivity of the bedrock aquifer, **Δs** is determined from the slope of the late-time recovery curve.

The hydraulic conductivity (**K**) of the bedrock is estimated using the transmissivity (**T**) and the thickness (**b**) of the test zone and the following relationship:

$$\mathbf{K=T/b}$$

Based on the late-time recovery slopes presented in Appendix H, the input variables and resultant transmissivities and hydraulic conductivities for each test performed are provided in Table 13.

Table 13
Interpreted Transmissivities and Hydraulic Conductivities

Borehole	Test Interval (m amsl)		Test Zone Thickness (m)	Formation	Hydraulic Conductivity (m/sec)	Transmissivity (m^2/day)
	Top	Bottom				
Constant Rate Recovery Tests						
H2	510	240	270	Boulder Creek	4.5×10^{-9}	0.11
	910	530	380	Hasler	1.8×10^{-9}	0.06
H16W	610	570	40	Hasler	2.7×10^{-8}	0.10
Constant Head Recovery Tests						
H2	1,090	530	560	Hasler	4.1×10^{-10}	0.02
H16W	40	-120	160	Gates	6.1×10^{-9}	0.08
H16W	260	-120	380	Gates/Hulcross /Boulder Creek	1.9×10^{-9}	0.03

Hydraulic conductivities and transmissivities presented in Table 13 are estimates based strictly on the data collected. However calculated transmissivities and hydraulic conductivities have likely been affected by field conditions at the time that testing was performed and, in some cases, may not be representative. Field conditions that may have affected the calculated hydraulic conductivity and transmissivity data are as follows:

- **All Tests performed at Borehole H2**: AMEC's subcontractor, IWPS, observed excessive amounts of grease on their equipment upon removal from the open borehole. Upon further investigation of the source of the grease, Foraco Drilling indicated that grease was applied to the outer circumference of the PW casing in order to prevent the casing from becoming stuck in the hole. The residual grease on the borehole wall is likely to have impeded the flow of groundwater into the H2 test intervals and it is considered likely that transmissivities and hydraulic conductivities presented in Table 13 for Borehole H2 are lower than the representative hydraulic conductivities and transmissivities. As a consequence of the fact that most of the movement of the casing in the borehole would have taken place at the top of the borehole (when compared to the bottom of the borehole), the grease is likely to have affected hydraulic conductivities and transmissivities to a greater extent at the top of the borehole and to a lesser extent at the bottom of the borehole. This may explain the fact that Borehole H2 hydraulic conductivities and transmissivities presented in Table 13 increase with depth.
- **All Constant Head Recovery Tests**: Since inflatable packers were not used to isolate test zones during performance of constant head recovery tests, the source of groundwater recharge to the test interval is not clearly defined. As a consequence of this, the estimated hydraulic conductivities may be greater than the representative hydraulic conductivity.
- **Borehole H2 Test Interval 20 m – 580 m**: The top of the test interval was defined as the base of the SW casing (at 20 m below grade.). However, since there was no seal applied to the base of the SW casing, it is conceivable that some groundwater recharge to the test interval originated from above 20 m below grade and was introduced to the

test interval via the annular space between the borehole wall and the SW casing. If, in actual fact, there was groundwater recharge from above the test interval, then the hydraulic conductivity and transmissivity presented for the constant head recovery test at Borehole H2 in Table 13 is likely an over-estimate of the representative hydraulic conductivity and transmissivity.

- **Borehole H16W, Test Interval 800 m – 960 m**: AMEC understands that Guardian Drilling installed a seal (between 787 m and 797 m below grade) comprised of concrete with some Sikka 212 grout in the annular space between the PQ drill rod and the PQ borehole wall, above the HQ open borehole. A contact (or bond) log was not developed for this concrete plug and consequently, there is no way to know if the concrete seal was fractured or not. The estimated hydraulic conductivity and transmissivity presented in Table 13 for this test interval assumes that the concrete plug was adequately set and did not fracture after it was set. If the plug did not adequately set, or did fracture, then the hydraulic conductivity and transmissivity results presented in Table 13 would be an over-estimate of the representative hydraulic conductivity and transmissivity.
- **Borehole H16W, Test Interval 580 m – 960 m**: Following completion of Test 1 at Borehole H16W, the submersible pump, rotating gas separator, and NQ drill rod fell down the borehole. Although the drill rod was recovered, the pump and gas separator were never recovered and were reported by the driller to be wedged against the PQ drill rods at below 785 m below grade. Although the PQ drill rod was perforated between 577 m and 617 m below grade, AMEC learned through discussions with the Guardian driller following completion of Test 2, that the base of borehole H16W was never grouted. Since the smashed pump and gas separator are not considered to be a suitable hydraulic seal to define the base of the test interval, groundwater recharge during Test 2 originated from between 577 m and 617 m and from the HQ open borehole between 800 m and 960 m below grade. As such, the aquifer thickness used to define the hydraulic conductivity was 200 m (={960 m-800 m}+{617 m-577 m}). Since the resultant transmissivity (0.03 m^2/day) and hydraulic conductivity (1.9 x 10^{-9} m/sec) of this aggregate Test 2 interval is less than the transmissivity (0.08 m^2/day) and hydraulic conductivity (6.1 x 10^{-9} m/sec) of the Test 1 interval (800 m – 960 m), the representative transmissivity and hydraulic conductivity of the Test 2 upper component interval (577 m – 617 m) is likely less than the estimated transmissivity and hydraulic conductivity presented in Table 13.
- **Methane Gas Discharging from Each Test Interval (except Test 3 at Borehole H16W)**. For those tests where methane gas was observed discharging from the test interval (in addition to groundwater), fluid released from the geological formations is, in fact, a two-phase mixture (gas and water). AMEC has reported hydraulic conductivity results, assuming that the density and viscosity of the fluid is equal to the density and fluid of water. However, since the fluid discharged from the formation is a two-phase fluid comprised of gas and water, the density of the fluid discharged during these tests was likely less than the density of groundwater and the viscosity of the fluid is likely less than the viscosity of groundwater. However, since the fluid density is directly proportional to hydraulic conductivity and fluid viscosity is indirectly proportional to hydraulic conductivity, the extent to which the estimated hydraulic conductivities are

representative of field conditions, is not immediately clear and is dependent upon the relative magnitudes of the density and viscosity of the fluid mixture.

8.3 STORAGE COEFFICIENT

During Tests 1 and 2 at Borehole H16W, drawdown was monitored at Borehole H16 (27 m south southeast of Borehole H16W). Using the time-drawdown data and a transformation of the Cooper-Jacob approximation of the modified non-equilibrium well equation:

$$S=(2.25\ T\ t_o)/r^2$$

the storativity (**S**) was estimated, where **T** is the aquifer transmissivity (in m^2/day), **r** is the distance of the observation well from the pumping well (in m), and $\mathbf{t_o}$ is the intercept of the observation well straight line projection at zero drawdown (in days).

This calculation was performed for drawdown recorded at Borehole H16 during both Test 1 and Test 2. The estimated storativities are presented in Table 14.

Table 14
Interpreted Storativities at Borehole H16W

Borehole	Test No.	Formation	Interpreted Storativity
H16W	1	Boulder Creek/ Hulcross/Gates	3.1×10^{-4}
	2	Boulder Creek/ Hulcross/Gates	2.4×10^{-5}

In order to confirm the storativity estimates presented in Table 14, storativities were also calculated using a distance-drawdown curve based on drawdown recorded at Borehole H16 following 3000 minutes of pumping at Borehole H16W (Test 2) and 4000 minutes of pumping (Test 1) and the slope of the time-drawdown curve. The resultant storativities based on the distance-drawdown curves were on the order of 4×10^{-6} and could not confirm the storativities presented in Table 14. Since the storativity estimated based on distance-drawdown graphs (4×10^{-6}) is based on drawdown at only one point, this storativity is not considered to be representative of the storativity of the aquifer. Although the storativities presented in Table 14 are considered to be affected by methane gas mixed in with the groundwater in the formation, these storativities are considered to be more representative than the storativity estimated based on the distance-drawdown graph.

8.4 ESTIMATED INFLOW RATES

Based on the estimated hydraulic conductivities, transmissivities, and piezometric heads, inflow rates from underground mine workings (the decline, the shaft, and the Bulk Sample Area - BSA) have been estimated.

8.4.1 Decline

Estimated inflow rates to the decline have been estimated using the following information:

- dimensions provided on Figures 4.1 and 4.2 by Norwest Corporation (the Murray River Underground Mine Designer) and attached as Appendix K; and
- The Goodman Approximation (Freeze and Cherry, 1979) for estimating flows into tunnels:

$$q = \frac{2\pi K \Delta h}{\ln(2\Delta h / r)}$$

where **q** is the groundwater flux (in m^2/sec) into the tunnel per m of tunnel, **K** is the hydraulic conductivity (in m/sec), ***Δh*** is the distance (in m) between the center of the tunnel and the piezometric head and **r** is the radius of the tunnel (in m).

Based on the surveyed elevations of the ground level at the decline portal (788.7 m amsl) and Borehole H16W (835.5 m amsl) provided by Integrated Pro-Action Corporation (IPaC), the distances between the centre of the decline and the piezometric head (***Δh***) were estimated. Since the hydraulic conductivity for the Hasler formation at Borehole H16W was based on a relatively short test interval (40 m), this hydraulic conductivity was taken to be representative of the formation and no factor of safety was applied. However, since the Test 1 and 2 intervals across the Gates, Hulcross and Boulder Creek formations at Borehole H16W were 160 m and 380 m, respectively, the hydraulic conductivities for these formations are uncertain and a factor of safety of ½ an order of magnitude has been applied to these hydraulic conductivities to estimate the groundwater inflow rates from the Boulder Creek, Hulcross and Gates formations. Since a representative piezometric head was not recorded at the Hulcross formation, the Hulcross formation was assumed to have the same piezometric head as that recorded for the Gates formation.

Based on these assumptions, and the estimated hydraulic conductivities and piezometric heads presented above, the estimated groundwater flow rates into the decline are presented in Table 15.

Table 15
Preliminary Estimate of Groundwater Flow Rates into the Decline

Formation	Groundwater Inflows to Decline			Cumulative Groundwater Inflows to Decline		
	USgpm	L/Hour	m^3/day	USgpm	L/Hour	m^3/day
Hasler	135	30,700	738	135	30,700	738
Boulder Creek	8	1,720	41	143	32,400	779
Hulcross	6	1,390	33	149	33,800	812
Gates	44	10,100	242	193	43,900	1,054

Since the groundwater inflows presented in Table 15 are dependent upon the distance between the centre of the tunnel and the piezometric head (***Δh***), this ***Δh*** term increases as one moves further away from the portal along the decline. Since ***Δh*** is directly proportional to the flow rate, the flow rate also increases as one moves further away from the portal along the decline. Consequently, groundwater flow rates presented in Table 15 are maximum flow rates anticipated in each formation using the maximum ***Δh*** for that formation.

Norwest Figure 4.1 entitled Belt Decline Cross Section (dated June 22, 2011), shows two faults crossing the proposed location of the decline. Since, to the best of AMEC's knowledge, Borehole H16W did not intersect any fault zone, hydraulic conductivities estimated based on testing at Borehole H16W will not be representative of hydraulic conductivities at either fault zone. Fractures associated with fault zones can be associated with increased permeability and therefore are expected to contribute groundwater inflows to the decline significantly greater than those inflows presented in Table 15. Since none of the boreholes tested (H2 or H16W) intersected a fault zone, it is not possible to estimate the groundwater inflows to the decline originating from these fault zones with any confidence. In order to estimate groundwater inflows at locations where the faults transect the proposed alignment of the decline, a pumping test would be required at a test interval that intersects a fault zone.

8.4.2 Men and Materials Shaft

Groundwater inflows to the men and materials shaft have been estimated using the following information:

- Dimensions provided on Figures 3.1 and 3.6 by Norwest Corporation and attached as Appendix K; and
- The Cooper-Jacob approximation was used to estimate the sustainable yield from each formation tested at Borehole H16W;
- The flow rate (**Q**) for each formation was estimated using the piezometric heads, the stratigraphic elevation provided in Norwest's Figure 3.1, and the 11.2 m diameter men and materials shaft the expanded diameter men and materials shaft, using the Thiem equation:

$$Q=\frac{2.73\ T\ (H-h)}{Log\ R/r}$$

where **r** is the radius of the well, **R** is the radius of influence of the pumping well, **H-h** is the available drawdown (piezometric head less the base elevation of the formation) in the pumping well, and **T** is the transmissivity of the aquifer. To estimate the sustainable yield from the men and materials shaft, the radius of influence from Borehole H16W was assumed to be the same as the radius of influence from the men and materials shaft.

The resultant estimated flow rates from each test interval at Borehole H16W and each formation to be intersected by the shaft are presented on Table 16.

Table 16
Preliminary Estimate of Groundwater Flow Rates into the Men and Materials Shaft

Formation	Groundwater Inflows			Cumulative Groundwater Inflows		
	USgpm	L/Hour	m^3/day	USgpm	L/Hour	m^3/day
Hasler	1.8	412	10	1.8	412	10
Boulder Creek	2.0	461	11	3.8	873	21
Hulcross	2.4	544	13	6.2	1,420	34
Gates	2.5	571	14	8.8	1,990	48

Estimated groundwater in-flows presented in Table 16 are based on pump intakes (and total available drawdowns) set at the base of each formation. Consequently, groundwater flow rates presented in Table 16 are maximum flow rates anticipated in each formation using the maximum total available drawdown for that formation.

While removing the pump and packer assembly, AMEC field personnel reported the water in the wells to be 'boiling' as significant volumes of methane gas discharged from the water. The fluid discharged from the men and materials shaft is expected to be a mixture of methane and groundwater. For this reason, the sustainable pumping rates are considered to be preliminary and assume that a gas separator will be connected in-line with the submersible pump.

Norwest Figure 3.1 Men & Materials Shaft Cross Section (dated April 27, 2011) shows no mapped faults across the proposed Shaft alignment. In the event that a fault zone is intersected by the men and materials shaft, then groundwater inflow rates can be expected to be greater than those presented in Table 16.

8.4.3 Bulk Sample Area and Ancillary Drifts

Groundwater inflows to the bulk sample area (BSA) and Ancillary Drifts are based on the following information:

- Entry and cross-cut dimensions provided on Table 5.1 on page 5-9 of Norwest's document entitled *4827- Murray River Bulk Sample Plan*;
- Norwest Figure Nos. 5.7 and 5.8 dated June 20, 2011 and June 17, 2011, respectively (attached as Appendix K); and
- The Goodman Approximation (Freeze and Cherry, 1979) for estimating flows into tunnels:

$$q = \frac{2\pi K \Delta h}{\ln(2\Delta h / r)}$$

where **q** is the groundwater flux (in m^2/sec) into the tunnel per m of tunnel, ,**K** is the hydraulic conductivity (in m/sec), ***Δh*** is the distance (in m) between the center of the tunnel and the piezometric head and **r** is the radius of the tunnel (in m).

Since the bulk sample target area is understood to be the F seam in the Gates formation, the hydraulic conductivity used to estimate groundwater inflows to the BSA and Ancillary Drifts is the estimated hydraulic conductivity (6.1×10^{-9} m/sec) based on testing in the Gates formation at H16W plus a factor of safety equal to ½ an order of magnitude (1.1×10^{-8} m/sec). Furthermore, the ***Δh*** used to estimate groundwater inflows to the BSA and Ancillary Drifts is based on the piezometric head recorded in the Gates formation at Borehole H16W (4.0 m below grade), and an assumed elevation of the F seam at the BSA (323 m amsl).

The BSA is configured as 5 rectangular entries (3.5 m x 6 m in cross-section) and a dozen rectangular cross-cuts (same sectional dimensions as cross-cuts) separated by large rectangular pillars. Entries are understood to be on 45 m centres, while cross-cuts are understood to be on 52 m centres. Since neither the entries, nor cross-cuts are "tunnels" (as referenced in Goodman Approximation), and since groundwater inflows via pillar walls is expected to be minimal relative to entry and cross-cut ceilings and floors, the Goodman tunnel radius **r** was estimated as follows:

1. The combined external surface area of the ceilings, floors, and external walls of the entries and cross-cuts was calculated (32,100 m^2);
2. An equivalent surface area of a cylinder was determined using a range of radii;
3. The equivalent radius of a tunnel (8.9 m) having a length equal to the length of the BSA shown on Norwest drawings (572 m) was used to estimate groundwater inflows to the BSA. The surface area of such a tunnel is equivalent to the combined external surface area of the entries and cross-cuts.

Ancillary drifts connecting the men and materials shaft with the BSA were shown on Norwest's Figure 5.7. Although no detailed dimensions for the ancillary drifts were provided in Norwest's Figure nos. 5.7 and 5.8, AMEC has assumed that these drifts will have the same dimensions as the entries in the BSA (specifically 3.5 m x 6 m) and that the total length of these drifts is 860 m. To estimate groundwater inflows to the ancillary drifts, the equivalent radius (**r**) was estimated to be 1.5 m. The resultant inflows into the BSA and ancillary drifts are presented in Table 17.

Table 17
Preliminary Estimate of Groundwater Inflows to the BSA and Ancillary Drifts

UMW	Equivalent Radius (m)	Groundwater Inflow			Cumulative Groundwater Inflow		
		USgpm	L/Hour	m^3/day	USgpm	L/Hour	m^3/day
Bulk Sample Area	8.9	67	15,300	367	67	15,300	367
Ancillary Drifts	1.5	74	16,700	401	141	32,000	768

Flow rates presented in Table 17 are based (in part) on testing performed at Borehole H16W, where no fault zones were intersected. Norwest's Figure nos. 5.7 and 5.8 do not show the presence of any faults in the BSA. In the event that a fault zone is intersected in the BSA or by ancillary drifts, flows greater than those presented in Table 17 can be expected.

9.0 CONCLUSIONS

Estimates of piezometric head, transmissivity, and hydraulic conductivity have been made at six test intervals at two locations (H16W and H2 separated by 5.9 km) and are summarized on Table 18 (attached at the back of the text). Interpreted piezometric heads in bedrock ranged between 22 m above grade (Hasler Formation at Borehole H2) to 20 m below grade (Hasler Formation borehole H16W). At the only location where the depth to groundwater was recorded in the Tertiary sediments (Observation Well H16A), the depth to groundwater was recorded at 54 m below grade.

Estimated transmissivities ranged between 0.02 m^2/day (Hasler Formation at Borehole H2) to 0.11 m^2/day (Boulder Creek Formation at Borehole H2). Estimated hydraulic conductivities ranged between 2.7 x 10^{-8} m/sec (Hasler Formation at Borehole H16W) and 4.1 x 10^{-10} m/sec (Hasler Formation at Borehole H2). The estimated hydraulic conductivities were based, in part, on the length of the test intervals. As a consequence of the long test intervals, the transmissivities are considered to be more representative than the hydraulic conductivities. The fact that the maximum and minimum hydraulic conductivities were both recorded in the Hasler Formation at different locations, suggests that some variability exists in the hydraulic conductivity across that formation.

Generally, hydraulic conductivities and transmissivities estimated at Borehole H2 are considered to be under-estimated as a consequence of the grease that driller's applied to the borehole casing in order to facilitate it's movement in and out of the borehole. The degree to which these hydraulic conductivities and transmissivities are under-estimated is unknown. However, the degree to which they are under-estimated is expected to decrease with depth (that is the hydraulic conductivity and transmissivity estimated for the Boulder Creek formation at Borehole H2 is considered to be more representative than the hydraulic conductivity and transmissivity estimated for the Hasler Formation at Borehole H2).

Hydraulic conductivities and transmissivities estimated based on constant head test data is considered to be over-estimated since packers were not used during these tests. Although a concrete plug was installed at the top of one of these test intervals, since a contact (or bond) log of this concrete plug was not performed, it is unknown if the concrete acted as a suitable plug during this test (Test 1 at Borehole H16W). Methane gas observed discharging from each test interval (except from the Hasler formation at H16W), indicates that the fluid discharged from these test intervals is, in fact, a two phase system. The gas is expected to decrease the viscosity of the fluid to something less than water, and is expected to decrease the density of the fluid to something less than water. Since the fluid density is directly proportional to hydraulic conductivity and fluid viscosity is indirectly proportional to hydraulic conductivity, the effect of the gas on the hydraulic conductivity is unknown.

Groundwater inflow rates originating from each stratigraphic unit and cumulative groundwater inflow rates into underground mine workings (the decline, the men and materials shaft, the bulk sample area and ancillary drifts) have been estimated based on interpreted piezometric heads, transmissivities and hydraulic conductivities at Borehole H16W and are summarized on Table

19 (provided at the back of the text). Borehole H16W is located 840 m from the decline portal, 760 m from the base of the decline, 540 m from the Men and Materials shaft and the most proximal location of the BSA, and 1,300 m from the most distal point of the BSA. Since the piezometric head and transmissivity in the Gates formation was only tested at Borehole H16W, the variability of these parameters in the Gates formation is unknown. Consequently, groundwater inflow rates into underground mine workings provided in this report assume that the hydraulic conductivity, transmissivity and piezometric head estimated based on data collected from the Gates formation at Borehole H16W is representative of these parameters for the entire Gates formation. Given this uncertainty, the estimated groundwater inflows presented in this report can only be approximate.

Furthermore, since Borehole H16W did not intersect any faults, no hydraulic conductivity testing has been conducted in a fault zone. Consequently, faults mapped transecting the proposed decline alignment (and any unmapped faults intersecting the BSA and men and materials shaft) are expected to increase the groundwater inflow rate at these locations. The extent to which the groundwater inflows increase in a fault zone is unknown and will be dependent upon the hydraulic conductivity of these faults and the continuity of the fractures associated with these faults.

10.0 CLOSURE

This report has been prepared for the exclusive use of the Canadian Dehua International Mines Group Inc. and its authorized agents for which this project was commissioned. The preliminary single well response testing was conducted in accordance with industry standard practices and the proposed scope of work for this project. No other warranty, expressed or implied, is made. The general limitations of this report are specified in Appendix L.

We trust this information meets your current requirements. If you have any questions or concerns, please contact the undersigned at your convenience.

Respectfully submitted,

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TABLES

TABLE 8: H2 ANALYTICAL CHEMISTRY RESULTS

		P2C21 (H2) D 600-870m		#2 P2C21 (H2) D 600-870m		#3 P2C21 (H2) D 200-600m		#4 P2C21 (H2) D 20-600m		30 day Average BCWQG for Freshwater Aquatic Life	
Analytical Report		L991762 / L991723-1	L991723-2	L992415 / L992288-1	L992288-3	L993814 / L993769-1	L993769-3	L995935 / L996144-1	L996144-3	Workng	Approved
Date		April 3, 2011; 11:00		April 4, 2011; 21:00		April 11, 2011; 00:00		April 16, 2011; 17:00			
Sampled by:		AMEC		AMEC		AMEC		AMEC			
Physical Tests	**Units**										
Temperature (Field)	deg. Celsius	6.2	nr	5.2	nr	3.3	nr	nr	nr	ng	18[F]
Dissolved Oxygen (Field)	mg/L	**0.21**	nr	**0.24**	nr	**0.80**	nr	nr	nr	ng	>8
True Colour	CU	<5.0	na	**10.7**	na	<5.0	na	<5.0	na	ng	5
Conductivity (Lab)	µS/cm	1130	na	1800	na	1080	na	1720	na	ng	ng
Specific Conductance (Field)	µS/cm	927	nr	1990	nr	983	nr	nr	nr	ng	ng
Total Dissolved Solids (Lab)	mg/L	667	na	1140	na	675	na	993	na	ng	ng
Hardness	CaCO3	111	137	32.1	32.5	39.2	45.1	14.1	30.2	ng	ng
pH (Lab)	pH units	8.32	na	8.25	na	**9.19**	na	**10.60**	na	ng	6.5-9.0
pH (Field)	pH units	8.3	nr	8.1	nr	**9.2**	nr	nr	nr	ng	6.5-9.0
Turbidity (Lab)	NTU	**354**	na	**21.5**	na	**66.5**	na	**124**	na	ng	8
Dissolved Anions and Nutrients											
Alkalinity - Total CaCO3	mg/L	**496**	na	**989**	na	**362**	na	**728**	na	20[A]	ng
Chloride	mg/L	64.8	na	26.9	na	105	na	79	na	ng	150
Fluoride	mg/L	<0.20	na	**2.89**	na	<0.20	na	**1.09**	na	ng	0.2[D]
Sulphide as S (Dissolved)	mg/L	<0.020	na	<0.020	na	<0.020	na	na	na	0.002	ng
Sulphate	mg/L	38.5	na	17.6	na	43.6	na	52	na	ng	100
Ammonia as N	mg/L	0.359	na	0.496	na	**0.488**	na	1.69	na	ng	0.132-0.942[G]
Nitrate Nitrogen	mg/L	<0.050	na	<0.050	na	<0.050	na	<0.10	na	ng	3.0
Nitrite Nitrogen	mg/L	<0.010	na	<0.010	na	<0.010	na	<0.020	na	ng	0.2[H]
Organic/Inorganic Parameters											
Sulphide as S (Un-ionized)	mg/L	<0.020	na	<0.020	na	<0.020	na	na	na	0.002	ng
Total Organic Carbon	mg/L	7.26	na	5.09	na	5.56	na	12.8	na	ng	±20 % of median
Cyanides											
Cyanide, Total	mg/L	<0.0050	na	<0.0050	na	<0.0050	na	na	na	ng	ng
Total Metals											
Aluminum	mg/L	17.2	20.9	0.231	0.259	2.05	2.16	2.72	2.87	ng	ng
Antimony	mg/L	<0.0025	0.00044	<0.0025	<0.00020	<0.0025	0.00160	<0.0025	0.00168	0.014	ng
Arsenic	mg/L	**0.00500**	**0.00505**	0.00111	0.00121	0.00316	0.00294	0.002	0.00249	ng	0.005
Barium	mg/L	2.60	2.70	2.15	2.23	0.776	0.835	0.669	0.722	5	ng
Beryllium	mg/L	na	<0.0010	na	<0.0010	na	<0.0010	na	<0.0010	0.0053	ng
Bismuth	mg/L	na	<0.0010	na	<0.0010	na	<0.0010	na	<0.0010	ng	ng
Boron	mg/L	0.16	0.171	0.30	0.311	0.14	0.155	0.16	0.176	ng	1.2
Cadmium	mg/L	<0.0010	**0.000076**	<0.0010	<0.000020	<0.0010	<0.000020	<0.0010	**0.000049**	0.00001[B]	ng
Calcium	mg/L	33.1	33.1	8.07	8.07	10.2	10.2	8.12	8.12	8[A]	ng
Chromium	mg/L	**0.049**	**0.0508**	<0.010	0.00245	<0.010	0.00749	**0.012**	**0.0131**	0.0089	ng
Cobalt	mg/L	na	0.00338	na	<0.00020	na	0.00044	na	0.00069	ng	0.004
Copper	mg/L	**0.0143**	**0.0140**	<0.0050	<0.0010	<0.0050	**0.0035**	<0.0050	**0.0045**	ng	0.002[D]
Iron	mg/L	**11.4**	**11.4**	**2.94**	**2.94**	**1.37**	**1.37**	**1.63**	**1.64**	0.3	1
Lead	mg/L	**0.0068**	**0.00694**	<0.0025	0.00029	<0.0025	**0.00096**	<0.0025	**0.00138**	0.0004-0.000007[C]	0.0046[J]
Lithium	mg/L	na	**0.514**	na	**0.509**	na	**0.716**	na	**0.929**	0.096	ng
Magnesium	mg/L	13.2	13.2	3.00	3.00	4.76	4.76	2.41	2.41	ng	ng
Manganese	mg/L	0.126	0.134	0.040	0.0467	0.017	0.0165	0.015	0.0172	ng	0.82[K]
Mercury	mg/L	<0.00020	<0.000050	<0.00020	<0.000010	<0.00020	<0.000010	<0.00020	<0.000010	ng	0.00002[L]
Molybdenum	mg/L	na	0.0205	na	0.00714	na	0.0131	na	0.0172	ng	1
Nickel	mg/L	na	**0.0260**	na	<0.0010	na	0.0036	na	0.0050	0.025[D]	ng
Phosphorus	mg/L	na	0.40	na	<0.30	na	<0.30	na	<0.30	ng	ng
Potassium	mg/L	8.72	9.82	1.79	2.05	2.26	2.34	2.86	3.26	373-432[E]	ng
Selenium	mg/L	<0.0050	0.00078	<0.0050	<0.00020	<0.0050	0.00085	<0.0050	0.00037	ng	0.002
Silicon	mg/L	na	47.0	na	5.36	na	8.52	na	11.0	ng	ng
Silver	mg/L	na	**0.000146**	na	<0.000020	na	<0.000020	na	0.000023	ng	0.00005[D]
Sodium	mg/L	217	206	466	436	238	231	393	382	ng	ng
Strontium	mg/L	na	0.538	na	0.580	na	0.191	na	0.139	ng	ng
Thallium	mg/L	na	<0.00020	na	<0.00020	na	<0.00020	na	<0.00020	0.0063	ng
Tin	mg/L	na	**0.00047**	na	<0.00020	na	<0.00020	na	<0.00020	0.0004-0.00008[C]	ng
Titanium	mg/L	na	0.581	na	<0.010	na	0.026	na	0.033	2.0-4.6[E]	ng
Uranium	mg/L	0.00120	0.00118	<0.00050	0.000263	0.00084	0.000763	<0.00050	0.000372	0.3	ng
Vanadium	mg/L	na	0.0648	na	<0.0020	na	0.0113	na	0.0145	0.02	ng
Zinc	mg/L	**0.110**	**0.115**	<0.050	**0.0285**	<0.050	**0.0380**	<0.050	**0.0402**	ng	0.0075[M]
Dissolved Metals											
Aluminum	mg/L	**0.153**	**0.0857**	**0.168**	**0.168**	**0.324**	**0.324**	**0.466**	**0.467**	ng	0.05
Antimony	mg/L	<0.0025	0.00027	<0.0025	0.00021	<0.0025	0.00177	<0.0025	0.00184	0.014	ng
Arsenic	mg/L	0.00140	0.00148	0.00112	0.00102	0.00296	0.00236	0.00191	0.00202	ng	ng
Barium	mg/L	1.41	1.47	2.02	2.19	0.625	0.659	0.270	0.297	5	ng
Beryllium	mg/L	na	<0.00050	na	<0.0010	na	<0.0010	na	<0.0010	0.0053	ng
Bismuth	mg/L	na	<0.00050	na	<0.0010	na	<0.0010	na	<0.0010	ng	ng
Boron	mg/L	0.10	0.108	0.28	0.288	0.14	0.167	0.15	0.174	ng	ng
Cadmium	mg/L	<0.0010	**0.000011**	<0.0010	<0.000020	<0.0010	<0.000020	<0.0010	<0.000020	0.00001[B]	ng
Calcium	mg/L	28.5	28.5	8.02	8.02	8.36	8.36	3.46	3.46	8[A]	ng
Chromium	mg/L	<0.010	0.00102	<0.010	0.00043	<0.010	0.00127	<0.010	0.00245	0.0089	ng
Cobalt	mg/L	na	0.00016	na	<0.00020	na	<0.00020	na	<0.00020	ng	ng
Copper	mg/L	<0.0050	<0.00050	<0.0050	<0.0010	<0.0050	<0.001 0	<0.0050	<0.0010	ng	ng
Iron	mg/L	**1.71**	**1.72**	**2.55**	**2.55**	0.069	0.069	0.052	0.052	0.3	ng
Lead	mg/L	<0.0025	0.000061	<0.0025	0.00010	<0.0025	<0.00010	<0.0025	<0.00010	0.0004-0.000007[C]	ng
Lithium	mg/L	na	**0.300**	na	**0.511**	na	**0.736**	na	**0.927**	0.096	ng
Magnesium	mg/L	9.69	9.69	2.93	2.93	4.44	4.44	1.33	1.33	ng	ng
Manganese	mg/L	0.075	0.0778	0.039	0.0409	<0.010	0.00496	<0.010	0.00030	ng	ng
Mercury	mg/L	<0.00020	<0.000010	<0.00020	<0.000010	<0.00020	<0.000010	<0.00020	<0.000010	ng	ng
Molybdenum	mg/L	na	0.0195	na	0.00697	na	0.0125	na	0.0161	ng	ng
Nickel	mg/L	na	0.00182	na	<0.0010	na	0.0015	na	<0.0010	0.025[D]	ng
Phosphorus	mg/L	na	<0.30	na	<0.30	na	<0.30	na	<0.30	ng	ng
Potassium	mg/L	2.50	2.88	1.79	2.03	1.72	1.73	2.30	2.63	373-432[E]	ng
Selenium	mg/L	<0.0050	0.00022	<0.0050	<0.00020	<0.0050	0.00076	<0.0050	0.00038	ng	ng
Silicon	mg/L	na	3.67	na	5.20	na	5.82	na	7.70	ng	ng
Silver	mg/L	na	<0.000010	na	<0.000020	na	<0.000020	na	<0.000020	ng	ng
Sodium	mg/L	166	167	454	446	239	243	398	405	ng	ng
Strontium	mg/L	na	0.405	na	0.552	na	0.167	na	0.0894	ng	ng
Thallium	mg/L	na	<0.00010	na	<0.00020	na	<0.00020	na	<0.00020	0.0063	ng
Tin	mg/L	na	**0.00022**	na	0.00020	na	<0.00020	na	<0.00020	0.0004-0.00008[C]	ng
Titanium	mg/L	na	<0.010	na	<0.010	na	<0.010	na	<0.010	2.0-4.6[E]	ng
Uranium	mg/L	<0.00050	0.000374	<0.00050	0.000245	0.00076	0.000661	<0.00050	0.000227	0.3	ng
Vanadium	mg/L	na	<0.0010	na	<0.0020	na	0.0051	na	0.0067	0.02	ng
Zinc	mg/L	<0.050	0.0100	<0.050	0.0074	<0.050	<0.0060	<0.050	<0.0060	ng	ng
Hydrocarbons											
Dissolved Methane	mg/L	3.59	na	14.5	na	18.9	na	9.14	na	ng	ng

Notes:

nr	not recorded in the field
na	not analyzed at the laboratory
ng	No guideline listed
<	Less than analytical detection limit
CU	Colour Units
µS/cm	Micro siemens per centimetre
NTU	Nephelometric turbidity units
mg/L	Milligrams per litre equivalent to parts per million by volume
A	Dependent on sensitivity of surface water body to acid inputs as described in *Second Report on Chemical Sensitivity of BC Lakes to Acidic Inputs* dated September, 1987
B	Hardness dependent guideline=10exp(0.86[log{hardness}]-3.2
C	Dependent on type of organo-metallic compound
D	Hardness dependent guideline
E	Dependent upon *Daphnia Magna* toxicity testing
F	Mean weekly maximum discharge temperature into streams with unknown fish distribution
G	pH and temperature dependent
H	Chloride dependent
J	Hardness dependent guideline=3.31+EXP(1.273*LN(Average hardness)-4.705)
K	Hardness dependent guideline=(0.0044*Average Hardness)+0.605
L	Dependent on type of organo-metallic compound. Guideline assumes that <0.5% of total mercury is methyl mercury
M	Assumes hardness of receiving environment is less than 90 mg/L. If hardness of receiving environment exceeds 90 mg/L, guideline in µg/L=7.5 +0.75*(hardness-90)
BCWQG	British Columbia Water Quality Guidelines taken from: *A Compendium of Working Water Quality Guidelines for British Columbia* , Science and Information Branch, Ministry of Environment, August 2006 *Approved Water Quality Guidelines* , Environmental Protection Division, Ministry of Environment, January 2010
Bold	Indicates concentration exceeds BCWQG Approved Water Quality Guideline
Bold and Underlined	Indicates concentration exceeds BCWQG Working Water Quality Guideline
Shaded	Indicates method detection limit exceeds BCWQG Approved or Working Water Quality Guideline

TABLE 9: H16W ANALYTICAL CHEMISTRY RESULTS

		H16W D 800-1000 m	#2 H16W 500-730m	H16W 233m-273m	30 day Average BCWQG for Freshwater Aquatic Life	
Analytical Report		**L1023033/L1022659**	**L1039171/L1039100**	**L1044658/L1044535**	**Working**	**Approved**
Date		**June 23, 2011; 11:00**	**August 1, 2011; 13:00**	**August 14, 2011; 14:00**		
Sampled by:		**AMEC**	**AMEC**	**AMEC**		
Physical Tests	**Units**					
Temperature (Field)	deg. Celsius	10.4	10.4	10	ng	18[F]
Dissolved Oxygen (Field)	mg/L	**0.37**	**0.10**	**0.94**	ng	>8
True Colour	CU	**7**	**13.2**	**5.5**	ng	5
Conductivity (Lab)	µS/cm	1810	1850	1460	ng	ng
Specific Conductance (Field)	µS/cm	1810	1900	1390	ng	ng
Total Dissolved Solids (Lab)	mg/L	1170	1210	842	ng	ng
Hardness	CaCO3	11	22.5	14.4	ng	ng
pH (Lab)	pH units	**9.5**	8.18	**9.43**	ng	6.5-9.0
pH (Field)	pH units	**9.5**	7.60	**9.4**	ng	6.5-9.0
Turbidity (Lab)	NTU	**75.5**	**186**	**8.25**	ng	8
Dissolved Anions and Nutrients						
Alkalinity - Total CaCO3	mg/L	868	985	787	20[A]	ng
Bromide	mg/L	<0.50	<1.0	<0.50	ng	ng
Chloride	mg/L	79.7	75	11.5	ng	150
Fluoride	mg/L	**0.64**	**3.82**	**1.82**	ng	0.2[D]
Sulphide as S (Dissolved)	mg/L	**0.118**	<0.020	<0.020	0.002	ng
Sulphate	mg/L	20.1	<10	<5.0	ng	100
Ammonia as N	mg/L	**0.939**	**2.9**	**1.04**	ng	0.131-2.09[G]
Nitrate Nitrogen	mg/L	<0.050	<0.10	<0.050	ng	3.0
Nitrite Nitrogen	mg/L	<0.010	<0.020	<0.010	ng	0.2[H]
Organic/Inorganic Parameters						
Sulphide as S (Un-ionized)	mg/L	<0.020	<0.020	<0.020	0.002	ng
Total Organic Carbon	mg/L	27.9	15.9	5.23	ng	±20 % of median
Cyanides						
Cyanide, Total	mg/L	<0.0050	0.0889	0.0756	ng	ng[O]
Total Metals						
Aluminum	mg/L	0.933	1.12	0.314	ng	ng[N]
Antimony	mg/L	<0.0025	<0.0025	<0.0025	0.014	ng
Arsenic	mg/L	0.0033	<0.0025	<0.0025	ng	0.005
Barium	mg/L	0.61	1.74	0.455	5	ng
Beryllium	mg/L	<0.0050	<0.0050	<0.0050	0.0053	ng
Bismuth	mg/L	<0.20	<0.20	<0.20	ng	ng
Boron	mg/L	0.26	0.33	0.30	ng	1.2
Cadmium	mg/L	**0.000112**	<0.000085	<0.000085	0.00001[B]	ng
Calcium	mg/L	**10.1**	**11.6**	6.19	8[A]	ng
Chromium	mg/L	0.0088	**0.0127**	<0.0050	0.0089	ng
Cobalt	mg/L	<0.0015	<0.0015	<0.0015	ng	0.004
Copper	mg/L	0.0113	**3.96**	**0.0614**	ng	0.002[D]
Iron	mg/L	**1.57**	**11.1**	**0.577**	0.3	1
Lead	mg/L	<0.0025	**1.41**	**0.0318**	0.0004-0.000007[C]	0.0036[J]
Lithium	mg/L	**0.926**	**1.23**	**1.32**	0.096	ng
Magnesium	mg/L	1.31	2.19	0.99	ng	ng
Manganese	mg/L	0.0301	0.170	0.0159	ng	0.68[K]
Mercury	mg/L	<0.000010	<0.000010	<0.000010	ng	0.00002[L]
Molybdenum	mg/L	0.0223	0.0108	0.0053	ng	1
Nickel	mg/L	0.0064	0.0092	<0.0050	0.025[D]	ng
Phosphorus	mg/L	<0.30	0.52	<0.30	ng	ng
Potassium	mg/L	4.7	<2.0	3.2	373-432[E]	ng
Selenium	mg/L	<0.0050	<0.0050	<0.0050	ng	0.002
Silicon	mg/L	9.54	7.35	4.50	ng	ng
Silver	mg/L	<0.00010	**0.00017**	<0.00010	ng	0.00005[D]
Sodium	mg/L	412	497	364	ng	ng
Strontium	mg/L	0.12	0.276	0.116	ng	ng
Thallium	mg/L	<0.0010	<0.0010	<0.0010	0.0063	ng
Tin	mg/L	<0.0025	<0.0025	<0.0025	0.0004-0.00008[C]	ng
Titanium	mg/L	0.016	0.023	<0.010	2.0-4.6[E]	ng
Uranium	mg/L	<0.0010	<0.0010	<0.0010	0.3	ng
Vanadium	mg/L	0.006	<0.0050	<0.0050	0.02	ng
Zinc	mg/L	**0.0937**	**0.889**	<0.050	ng	0.0075[M]
Dissolved Metals						
Aluminum	mg/L	**0.257**	0.032	**0.123**	ng	0.05
Antimony	mg/L	<0.0025	<0.0025	<0.0025	0.014	ng
Arsenic	mg/L	0.003	<0.0025	<0.0025	ng	ng
Barium	mg/L	0.295	0.997	0.380	5	ng
Beryllium	mg/L	<0.0050	<0.0050	<0.0050	0.0053	ng
Bismuth	mg/L	<0.20	<0.20	<0.20	ng	ng
Boron	mg/L	0.25	0.33	0.29	ng	ng
Cadmium	mg/L	<0.000085	<0.000085	<0.000085	0.00001[B]	ng
Calcium	mg/L	2.82	6.09	4.33	8[A]	ng
Chromium	mg/L	<0.0050	<0.0050	<0.0050	0.0089	ng
Cobalt	mg/L	<0.0015	<0.0015	<0.0015	ng	ng
Copper	mg/L	<0.0050	0.0750	0.0167	ng	ng
Iron	mg/L	0.161	**0.667**	0.144	0.3	ng
Lead	mg/L	<0.0025	**0.0358**	**0.0029**	0.0004-0.000007[C]	ng
Lithium	mg/L	**0.927**	**1.26**	**1.16**	0.096	ng
Magnesium	mg/L	0.96	1.76	0.88	ng	ng
Manganese	mg/L	0.006	0.107	0.0067	ng	ng
Mercury	mg/L	<0.000010	<0.000010	<0.000010	ng	ng
Molybdenum	mg/L	0.0216	0.0100	0.0050	ng	ng
Nickel	mg/L	<0.0050	<0.0050	<0.0050	0.025[D]	ng
Phosphorus	mg/L	<0.30	<0.30	<0.30	ng	ng
Potassium	mg/L	4.4	<2.0	3.0	373-432[E]	ng
Selenium	mg/L	<0.0050	<0.0050	<0.0050	ng	ng
Silicon	mg/L	8.6	5.25	4.01	ng	ng
Silver	mg/L	<0.00010	<0.00010	<0.00010	ng	ng
Sodium	mg/L	406	481	349	ng	ng
Strontium	mg/L	0.0796	0.226	0.101	ng	ng
Thallium	mg/L	<0.0010	<0.0010	<0.0010	0.0063	ng
Tin	mg/L	<0.0025	<0.0025	<0.0025	0.0004-0.00008[C]	ng
Titanium	mg/L	<0.010	<0.010	<0.010	2.0-4.6[E]	ng
Uranium	mg/L	<0.0010	<0.0010	<0.0010	0.3	ng
Vanadium	mg/L	<0.0050	<0.0050	<0.0050	0.02	ng
Zinc	mg/L	0.0138	0.159	<0.0050	ng	ng
Hydrocarbons						
Dissolved Methane	mg/L	7.88	22.0	11.0	ng	ng

Notes:

nr	not recorded in the field
na	not analyzed at the laboratory
ng	No guideline listed
<	Less than analytical detection limit
CU	Colour Units
µS/cm	Micro siemens per centimetre
NTU	Nephelometric turbidity units
mg/L	Milligrams per litre equivalent to parts per million by volume
A	Dependent on sensitivity of surface water body to acid inputs as described in *Second Report on Chemical Sensitivity of*
B	Hardness dependent guideline=10exp(0.86[log{hardness}]-3.2
C	Dependent on type of organo-metallic compound
D	Hardness dependent guideline
E	Dependent upon *Daphnia Magna* toxicity testing
F	Mean weekly maximum discharge temperature into streams with unknown fish distribution
G	pH and temperature dependent
H	Chloride dependent
J	Hardness dependent guideline=3.31+EXP(1.273*LN(Average hardness)-4.705)
K	Hardness dependent guideline=(0.0044*Average Hardness)+0.605
L	Dependent on type of organo-metallic compound. Guideline assumes that <0.5% of total mercury is methyl mercury
M	Assumes hardness of receiving environment is less than 90 mg/L. If hardness of receiving environment exceeds 90 mg
N	Since pH exceeds 6.5
O	Approved guideline only provided for weak acid dissociable cyanide
BCWQG	British Columbia Water Quality Guidelines taken from:
	A Compendium of Working Water Quality Guidelines for British Columbia , Science and Information Branch, Ministry of
	Approved Water Quality Guidelines , Environmental Protection Division, Ministry of Environment, January 2010
Bold	Indicates concentration exceeds BCWQG Approved Water Quality Guideline
Bold and Underlined	Indicates concentration exceeds BCWQG Working Water Quality Guideline
Shaded	Indicates method detection limit exceeds BCWQG Approved or Working Water Quality Guideline

Table 18: Test Intervals and Aquifer Properties Summary Table

Borehole	Elevation at Grade (m amsl)	Test Number	Test Interval (m amsl) Bottom	Test Interval (m amsl) Top	Length (m)	Formation	Piezometric Head (m)	Transmissivity (m^2/day)	Hydraulic Conductivity (m/sec)	Storativity
H2	1,111.90	1	240	510	270	Boulder Creek	1,094	0.11	$4.5x10^{-9}$	-
		2	530	910	380	Hasler	>1,134	0.06	$1.8x10^{-9}$	-
		4	530	1090	560	Hasler and Tertiary	nm	0.02	$4.1x10^{-10}$	-
H16W	835.5	1	-120	40	160	Gates	831	0.08	$6.1x10^{-9}$	$3.1x10^{-4}$
		2	-120	260	380	Gates/Hulcross/Boulder Creek	nm	0.03	$1.9x10^{-9}$	$2.4x10^{-5}$
		3	560	600	40	Hasler	815	0.10	$2.7x10^{-8}$	-

Notes:

- Storativity not calculated due to insufficient data

nm piezometric head equilibration not performed at the request of CDIMG

Table 19: Estimated Groundwater Inflow Rates to Underground Mine Workings

UMW	Equivalent Radius (m)	Maximum Differential Head (m)	Formation	Hydraulic Conductivity (m/sec)	Length (m)	GW Flux (q)	Estimated Groundwater Flow Rate			Cumulative Groundwater Flow Rate			Reference Methodology
						m^2/sec	USgpm	L/Hour	m^3/day	USgpm	L/Hour	m^3/day	
Decline	3.2	285	Hasler	2.70E-08	915	9.3E-06	135	30725	738	135	30725	738	Goodman, 1965
		375	Boulder Creek	6.90E-09	160	3.0E-06	8	1716	41	143	32441	779	
		367	Hulcross	1.10E-08	83	4.7E-06	6	1394	33	149	33835	812	
		497	Gates	1.10E-08	467	6.0E-06	44	10062	242	193	43897	1054	
Bulk Sample Area	8.9	509	Gates	1.10E-08	572	7.4E-06	67	15282	367	67	15282	367	
Ancillary Drifts	1.5	509	Gates	1.10E-08	860	5.4E-06	74	16702	401	141	31983	768	
		Available Drawdown (m)		**Transmissivity (m^2/day)**	**Radius of Influence (m)**								
Men and Materials Shaft	5.6	128	Hasler	0.10	$1.3x10^4$	1.1E-04	1.8	412	9.9	1.8	412	10	Thiem, 1906
		284	Boulder Creek	0.03	$9.9x10^2$	1.3E-04	2.0	461	11.0	3.8	873	21	
		357	Hulcross	0.03	$9.9x10^2$	1.5E-04	2.4	544	13.0	6.2	1417	34	
		506	Gates	0.09	$7.1x10^9$	1.6E-04	2.5	571	13.7	8.8	1988	48	
					Preliminary Estimate of Maximum Combined Flow Rate from Decline, Men and Materials Shaft, BSA and Ancillary Drifts=					343	77868	1869	

FIGURES

0 100 200 300 400km

1 : 10,000,000 (approx. scale)

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Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT LOGO:

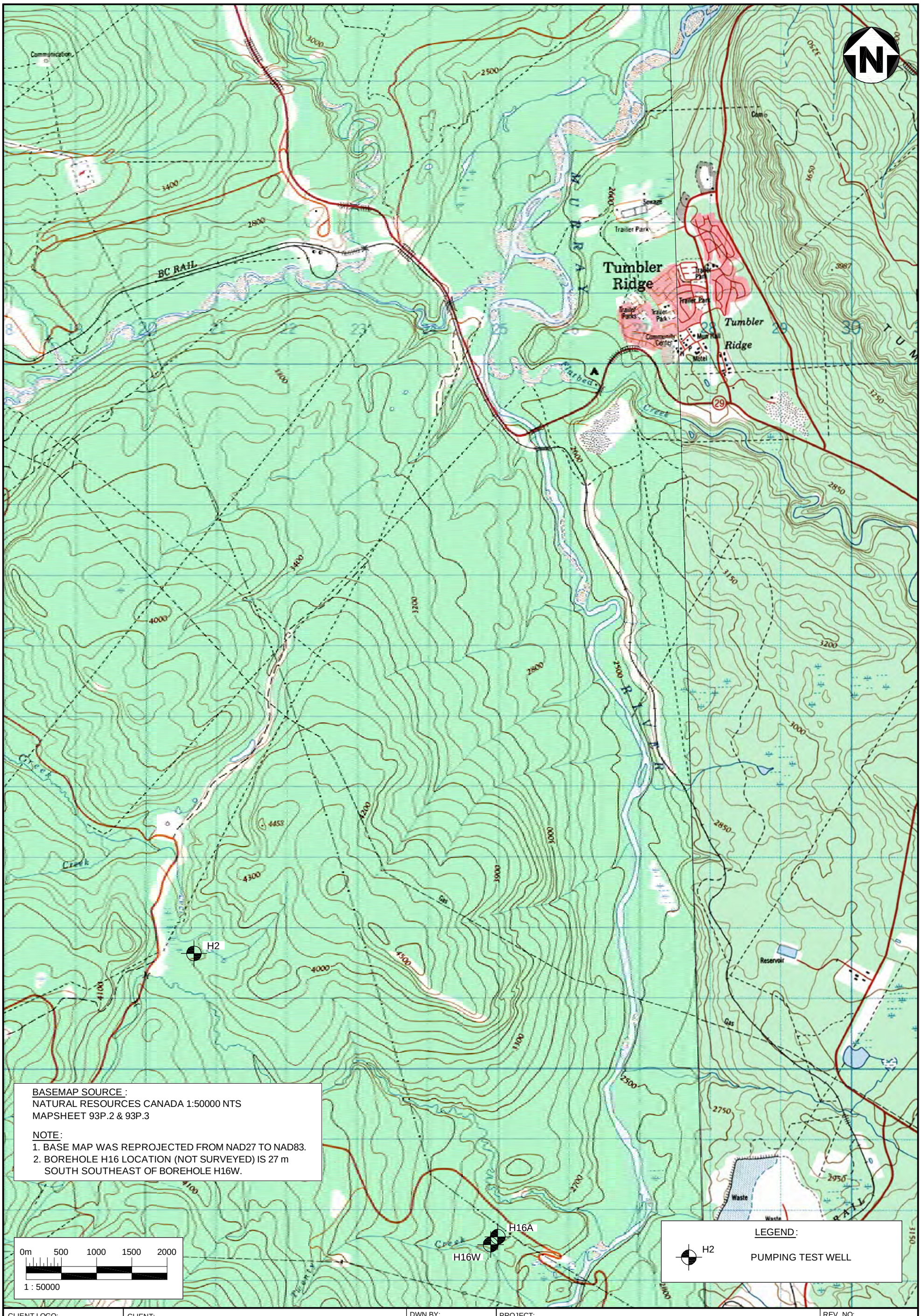
CLIENT:
CANADIAN DEHUA INTERNATIONAL MINES GROUP

PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS

TITLE: SITE LOCATION

DWN BY:	DATUM:	DATE:
MW	--	NOVEMBER 2011
CHK'D BY:	REV. NO:	PROJECT NO:
SG	A	KX13505.050
PROJECTION:	SCALE:	FIGURE NO:
--	NOT TO SCALE	1

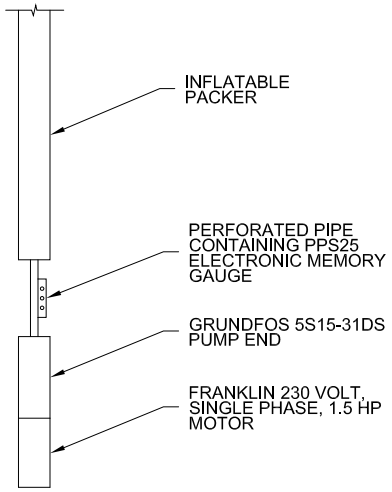
G:\PROJECTS\Other Offices\KX-Kamloops & Prince George\KX13505 - Murray River\Drafting\CAD\KX13505-001_Site Location.dwg - Fig 1 - Nov. 16, 2011 1:08pm - michael.m.wong



CLIENT LOGO: DEHUA	CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP	DWN BY: MW CHK'D BY: SG DATUM: NAD 83 PROJECTION: UTM Zone 10 SCALE: AS SHOWN	PROJECT: MURRAY RIVER SINGLE WELL REPONSE TESTS	REV. NO: A DATE: NOVEMBER 2011 PROJECT NO: KX13505.050
AMEC Environment & Infrastructure Suite 600 - 4445 Lougheed Highway Burnaby, BC V5C 0E4 Tel. 604-294-3811 Fax 604-294-4664	amec		TITLE: BOREHOLE LOCATION PLAN	FIGURE NO: 2

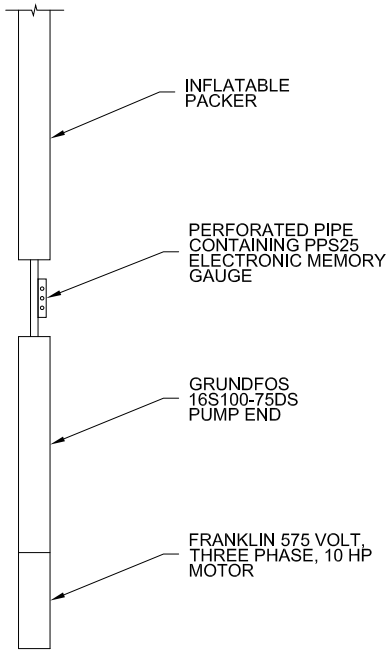
G:\PROJECTS\Other Offices\KX-Kamloops & Prince George\KX13505 - Murray River\Drafting\CAD\KX13505.050-002.dwg - Fig 2 - Nov. 29, 2011 12:24pm - michael.m.wong

SHALLOW SET 1.5 HP PUMP WITH PACKER



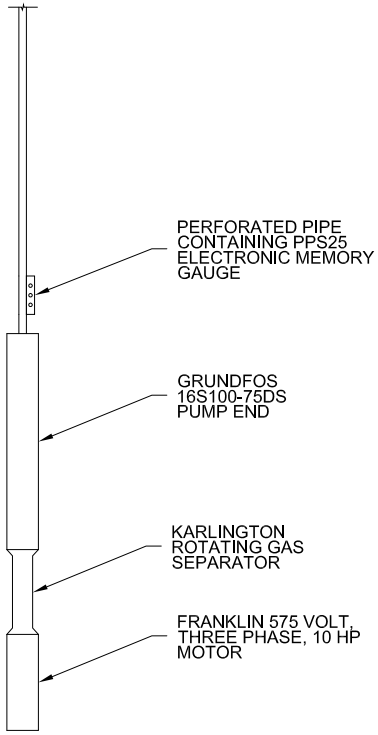
CONFIGURATION 1

DEEP SET 10 HP PUMP WITH PACKER



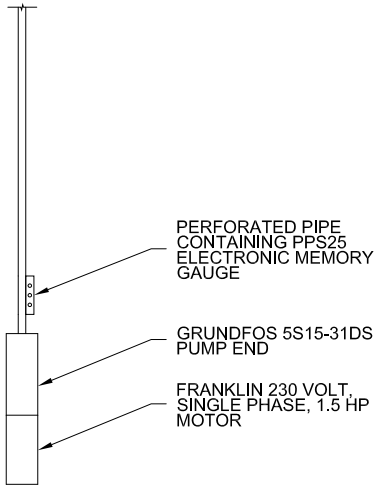
CONFIGURATION 2

DEEP SET CONSTANT HEAD TEST WITHOUT PACKER



CONFIGURATION 3

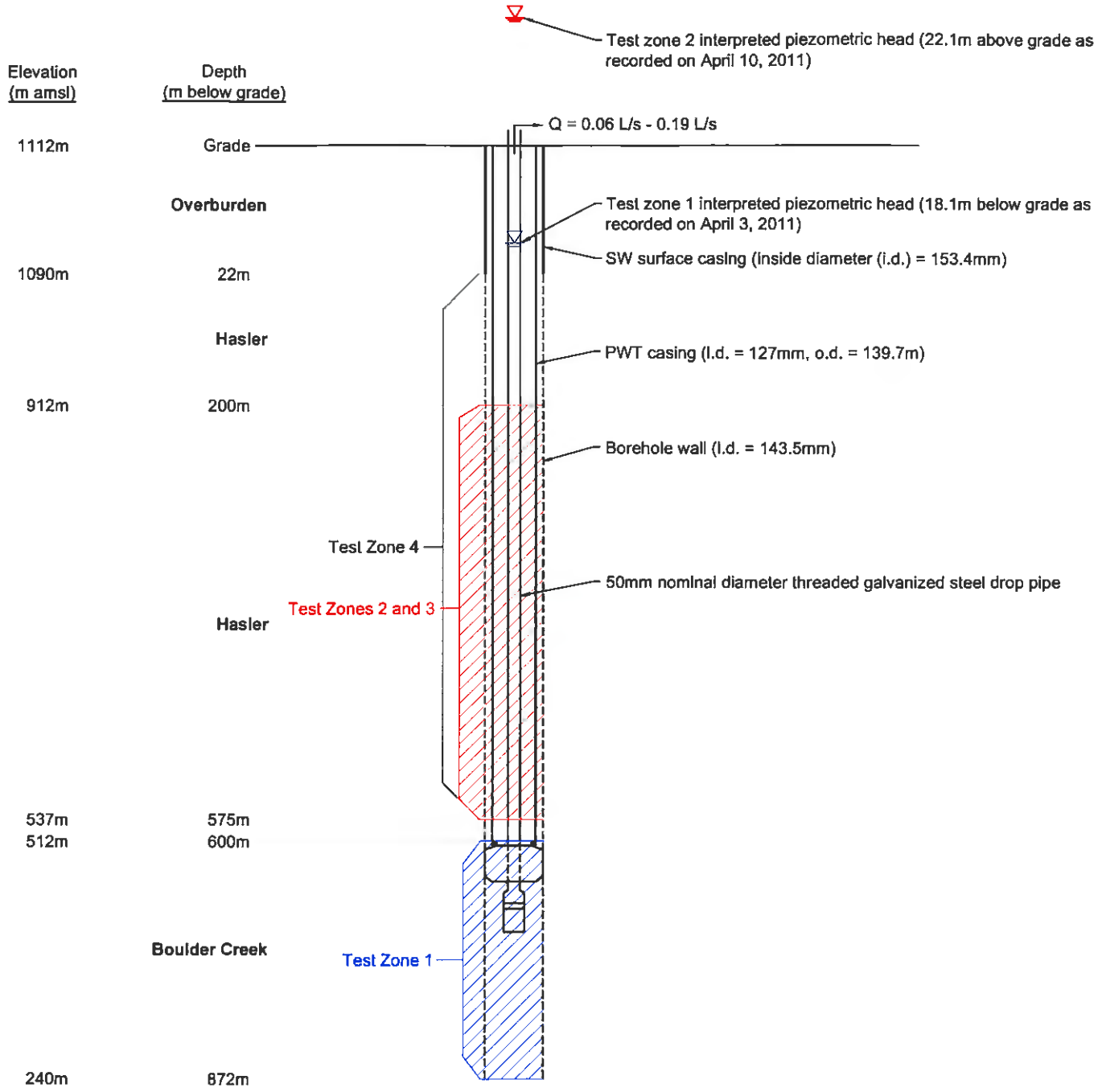
SHALLOW SET CONSTANT HEAD TEST WITHOUT PACKER



CONFIGURATION 4

CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP	DWN BY: MW	PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS	REV. NO: A
	CHK'D BY: SG		DATE: NOVEMBER 2011
AMEC Environment & Infrastructure Suite 600 - 4445 Lougheed Highway Burnaby, BC V5C 0E4 Tel. 604-294-3811 Fax 604-294-4664	DATUM: –	TITLE: PUMP AND PACKER CONFIGURATONS	PROJECT NO: KX13505.050
	PROJECTION: --		FIGURE NO: 3
	SCALE: NOT TO SCALE		

G:\PROJECTS\Other Offices\KX-Kamloops & Prince George\KX13505 - Murray River\Drafting\CAD\KX13505-003.dwg - Fig 3 - Nov. 15, 2011 12:13pm - michael.m.wong



Notes:

1. Borehole H2 stratigraphy provided by Canadian Dehua International Mines Group Inc.
2. Borehole H2 location (based on information provided by IPAC using a Trimble GNSS R8 RTK base station to +/- 0.05m accuracy) relative to UTM Zone 10N map projection.
3. Northing: 6101836.4, Easting: 620583.7

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913 Laval Crescent
Kamloops, BC, CANADA V2C 5P4
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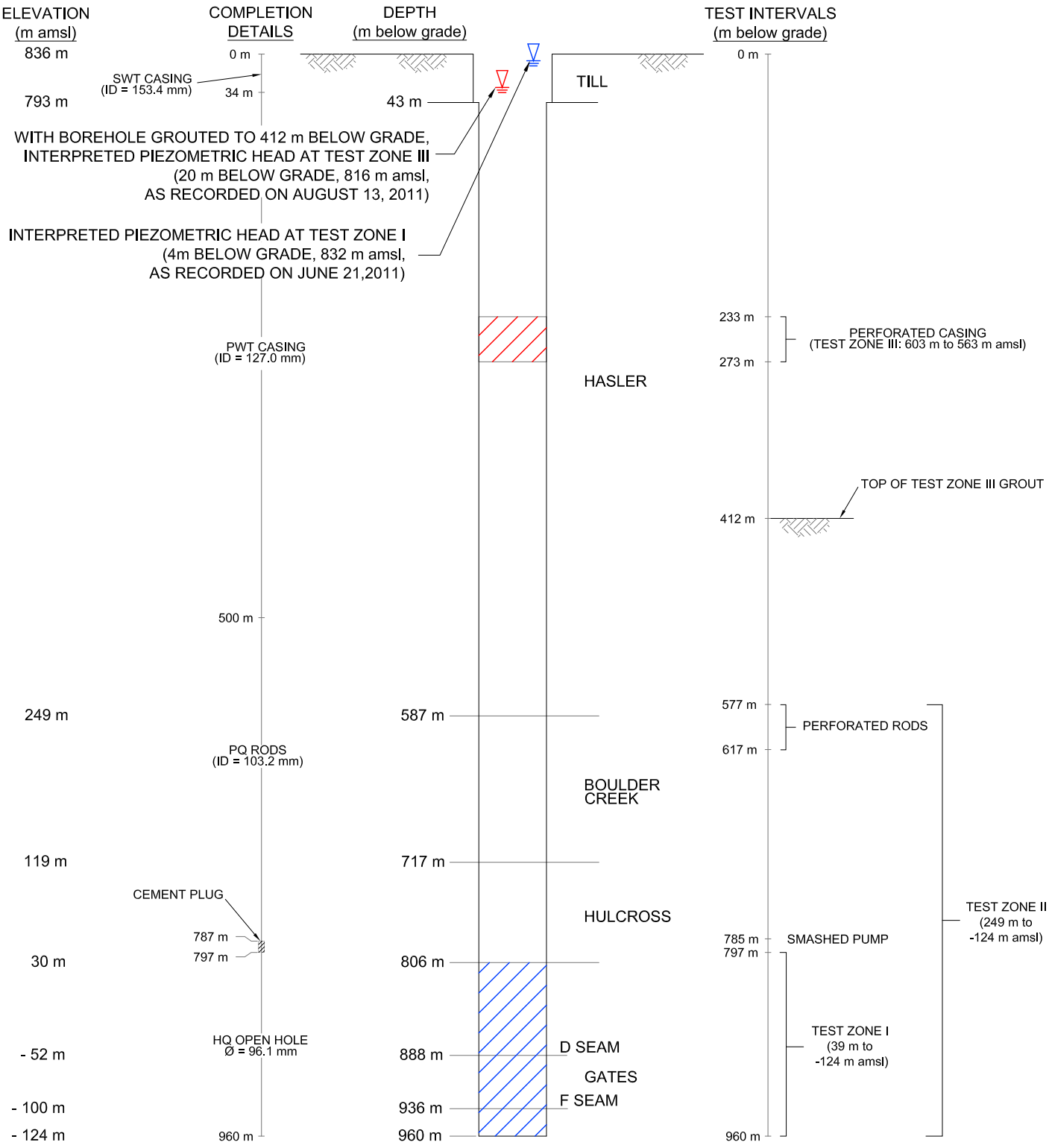
Fax (250) 374-2944

CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP

TITLE: BOREHOLE H2 TEST ZONES AND INTERPRETED PIEZOMETRIC HEAD	DRAWN BY: I.Macleod	DATUM: NAD83	DATE: DECEMBER 2011
	CHECKED BY: S.Green	REV. No: A	PROJECT No.: KX13505
PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS	PROJECTION: UTM Zone 10	SCALE: NTS	FIGURE No.: 4

P:\DRAFTING\Kamloops - Drafting\KX13500 - KX13598\KX13505-Drafting\KX13505-Fig4-BOREHOLE.dwg - 8.5 X 11 - Portrait - Dec. 08, 2011 4:49pm - ian.j.macleod



NOTES:
1. BOREHOLE H16W STRATIGRAPHY PROVIDED BY CANADIAN DEHUA INTERNATIONAL MINES GROUP (CDIMG) INC.
2. BOREHOLE H16W LOCATION (BASED ON INFORMATION PROVIDED BY IPaC USING A TRIMBLE GNSS R8 RTK BASE STATION TO ±0.05 m ACCURACY) RELATIVE TO UTM ZONE 10N MAP PROJECTION.
3. NORTHING: 6097712.7 EASTING: 624789.1
4. amsl - ABOVE MEAN SEA LEVEL

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Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT LOGO:

CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP

PROJECT:	DWN BY:	DATUM:	DATE:
MURRAY RIVER SINGLE WELL RESPONSE TESTS	MW	–	NOVEMBER 2011
TITLE: BOREHOLE H16W TEST ZONES AND INTERPRETED PIEZOMETRIC HEADS	CHK'D BY: SG	REV. NO: A	PROJECT NO: KX13505.050
	PROJECTION: –	SCALE: NOT TO SCALE	FIGURE NO: 5

APPENDIX A

GROUNDWATER DISCHARGE MANAGEMENT PLAN

10 December 2010

AMEC Project No. KX13505

Canadian Dehua International Mines Group Inc.
820 – 1130 West Pender Street
Vancouver, British Columbia
V6E 4A4

Attention: Mr. Vincent Li, P.Eng. P.Geo.

RE: Groundwater Discharge Management Plan
Single Well Response Tests
Proposed Murray River Underground Coal Mine
Tumbler Ridge, B.C.

AMEC Earth and Environmental, a division of AMEC Americas Limited (AMEC) has prepared this groundwater discharge containment plan for the consideration of the Canadian Dehua International Mines Group (CDIMG) and the Environmental Protection Division (EPD) of B.C. Environment. The groundwater discharge containment plan is provided in preparation of single well response tests to be performed at three locations on CDIMG's mineral claim approximately 12 km south of Tumbler Ridge, B.C.

1.0 OBJECTIVE AND LOCATION

The objective of the single well response tests is to develop a preliminary estimate of groundwater flow and transmissivity of the rock at each test zone and to develop a preliminary characterization of groundwater quality from each test zone.

Seven pumping tests are proposed at three boreholes (P2C21, P2C24, and P2C27). A borehole location plan is attached as Figure 1. Three pumping tests will be performed at discrete intervals at each of two boreholes (P2C21 and P2C24) and a single pumping test will be performed across a fault zone at P2C24. P2C21 is located approximately 450 m north of an unnamed creek. P2C24 is located approximately 1 km north of the same unnamed creek. P2C27 is located approximately 150 m west of the Murray River.

At the time of release of this letter, AMEC had not inspected the proposed borehole locations in the field. However, based on the locations presented in Figure 1, borehole P2C21 appears to be located on the fringe of the floodplain of the unnamed creek and between 25 m and 30 m above the elevation of the unnamed creek. Borehole P2C24 appears to be located in the uplands on a south facing slope and at least 270 m above the elevation of the unnamed creek.

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Borehole P2C27 appears to be located within the Murray River floodplain. The ground level elevation above the Murray River is unknown but expected to be less than 15 m above the elevation of the Murray River. Generally, the shallow soil stratigraphy in the unnamed creek and Murray River floodplains is expected to consist of permeable alluvial sediments comprised of gravel, sand, and some silt. The shallow soil stratigraphy in the uplands adjacent P2C24 is expected to consist of less permeable well-graded glacial till deposits comprised of gravel, sand, silt and clay.

Although the actual test interval depth will be dependent upon the bedrock lithology intersected at each borehole, the approximate test intervals and borehole locations relative to surface water bodies are summarized in Table 1.

Table 1
Proposed Single Well Response Tests

Borehole	Distance to Most Proximal Surface Water Body (m)	Proposed Test Interval (m below ground surface)		Maximum Anticipated Groundwater Discharge Volume (m^3)
		Top	Bottom	
P2C21	450	320	520	180
		520	720	180
		720	920	180
P2C24	1,000	400	600	180
P2C27	150	220	360	180
		360	560	180
		560	760	180

2.0 TEST PROGRAM

A submersible pump and inflatable packer will be lowered to the top of each test zone. After the packer is inflated, 24 hours will be allowed to pass in order for the piezometric pressure of the test zone to be restored to its pressure prior to having drilled the borehole. The piezometric pressure (also known as the shut-in pressure) will be recorded 24 hours following inflation of the packer. Each single well response test will consist of pumping the borehole for a 40 hour period at a constant flow rate ranging between 2.3 m^3/hour (10 USgpm) and 4.5 m^3/hour (20 USgpm). The projected flow rates are based on the physical limitations of the submersible pump that will be installed to conduct each test. The actual flow rate will be dependent upon the depth of the pump and the piezometric pressure of the test zone. The transmissivity of the test zone may not allow the test zone to be pumped for the entire 40 hour duration. If the transmissivity of the test zone is too low, then the water level in the borehole could draw down to the top of the test zone before the end of the 40 hour test period. If this condition is experienced, then the

submersible pump will be turned off and the rate at which the groundwater level in the borehole recovers after the pump is turned off will be recorded.

Under the proposed test plan, the groundwater discharge volumes per test are expected to range between 92 m^3 and 180 m^3. Consequently, for seven proposed single well response tests, a total maximum groundwater volume to be extracted is 1,260 m^3 (Table1).

The groundwater discharge quality is currently unknown. Part of the proposed scope of work is to collect samples of the groundwater discharge during the final hour of each pumping test to characterize its quality. Throughout each pumping test, field groundwater quality parameters (temperature, specific conductance, pH, dissolved oxygen and oxidation-reduction potential) will be recorded in the groundwater discharge. As a consequence of the depths of proposed test intervals, groundwater discharge quality is expected to be highly mineralized, having elevated total dissolved solids (TDS) concentrations.

3.0 GROUNDWATER DISCHARGE MANAGEMENT PLAN

During each pumping test, groundwater will be discharged into large pits excavated into the shallow soils. Prior to the initiation of each test, pits having the capacity to store 150 % of the maximum discharge volume (assuming no exfiltration from the base and walls of the pit) for the test will be completed (as per EPD's request via e-mail dated December 2, 2010). AMEC understands that a tracked excavator will be available on-site prior to each pumping test in order to excavate one or more pit(s). AMEC personnel will be on-site during and prior to initiation of each pumping test. AMEC will record the approximate pit dimensions using a measuring tape and will calculate each pit volume. AMEC will photograph the excavated pit(s) 4 days prior to each initiation of each pumping test and send photographs via e-mail to Bruce.Carmichael@gov.bc.ca and copied to John.Clark@gov.bc.ca.

It is expected that some water will exfiltrate from the base and walls of each pit during the pumping test. The exfiltration rate will be dependent upon the permeability of the soils within which the pit is excavated. Since the permeability of the alluvial sediments is expected to be greater than the permeability of the glacial till, less exfiltration is expected from pits excavated in the glacial till than from pits excavated in the alluvial sediments. As a consequence of the proximity of borehole P2C27 (150 m) to the Murray River, and the expected higher permeability in the alluvial sediments in the Murray River floodplain, pits excavated to accept groundwater discharge from P2C27 will be excavated between 150 m and 200 m west of P2C27 near the fringe of the floodplain. Rationale for this location of the groundwater discharge pits is to allow for more mixing (and dilution) of groundwater exfiltrating from the base of the pits prior to its discharge into the Murray River.

AMEC understands that two pits having approximate dimensions 2 m x 3 m x 15 m have been excavated adjacent the location of P2C21. In order for the capacity of these pits to meet B.C.

Environment EPD requirements for having adequate capacity prior to the start of the first pumping test, at least one additional pit (2 m x 3 m x 15 m) will have to be excavated. AMEC personnel will measure the dimensions of these pits and photograph them upon arrival on-site. AMEC will forward photographs to B.C. Environment EPD via e-mail, 4 days prior to initiation of pumping.

4.0 CLOSURE

We trust this information meets your current requirements. If you have any questions or concerns, please contact the undersigned at your convenience.

Sincerely,

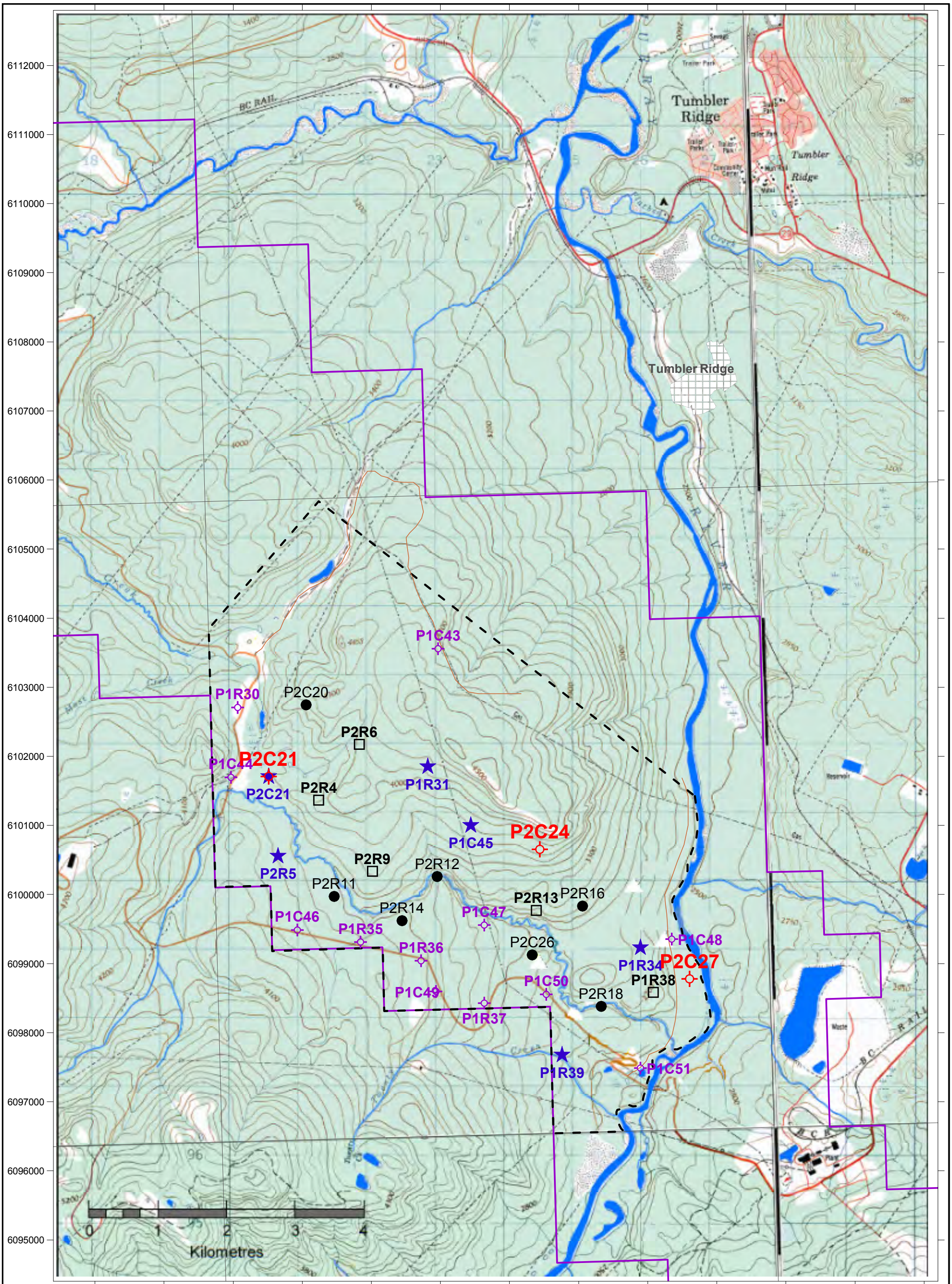
AMEC Earth & Environmental,
A division of AMEC Americas Limited

Scott Green, P.Eng.
Associate Hydrogeologist

Tammera Kostya, G.I.T.
Hydrogeologist

SG/TK/sw
Attachment:

Figure 1: Phase II Coal Exploration Drilling Status to Date (as provided by Canadian Dehua International Mines Group Inc.)



Completed Drill Hole Locations in Phase I

Dehua Pumping Test Well Locations in Phase II

Completed Drill Hole Locations in Phase II

Drilling in Progressing Locations in Phase II

Planned, but not Drilled Drill Hole Locations in Phase II

Phase II Coal Exploration

Drilling Status To Date

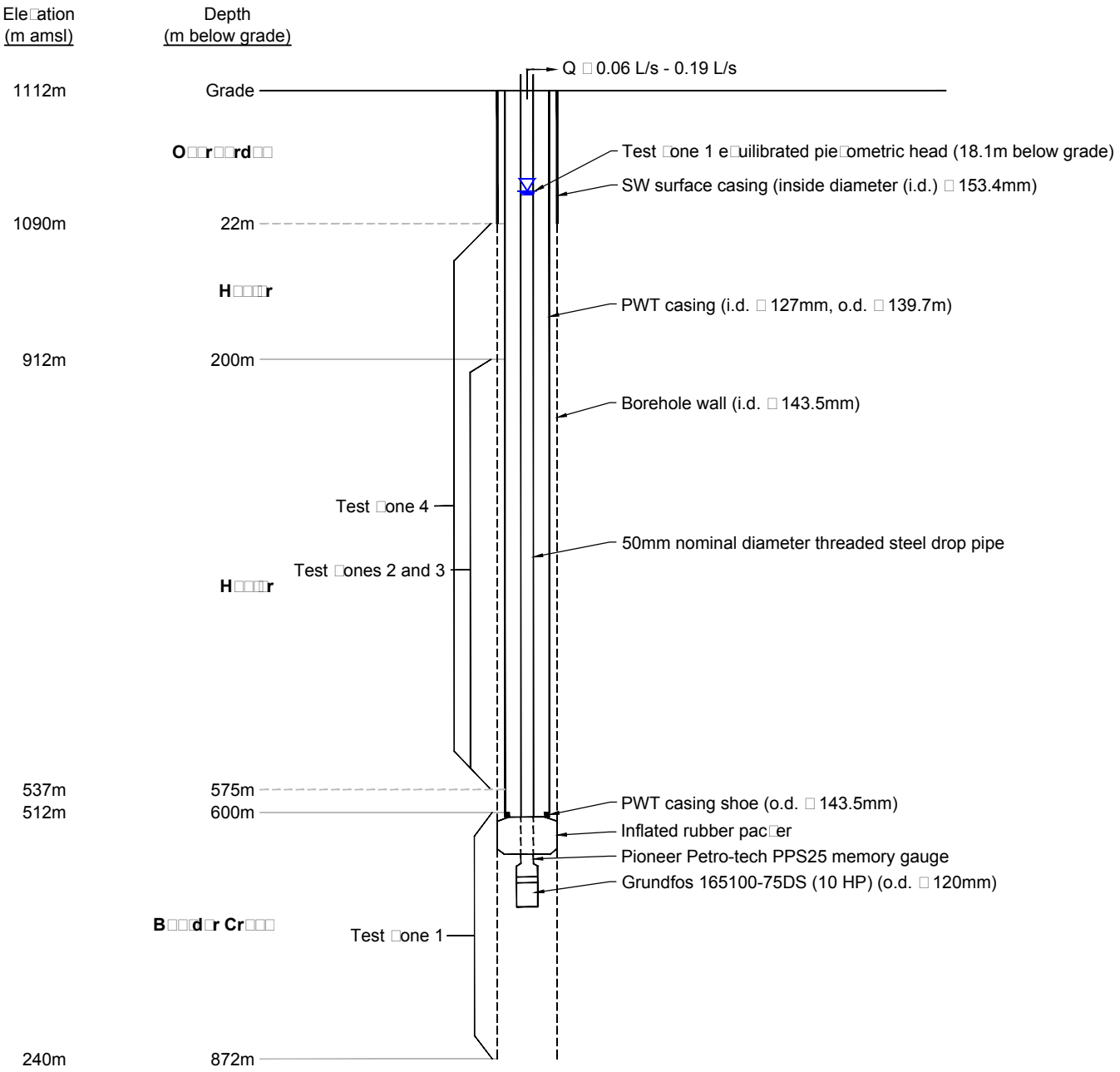
Canadian Dehua International Mines Group Inc.

820 - 1130 West Pender Street
Vancouver, BC V6E 4A4 Canada
Tel: 1-604-697-0118
Fax: 1-604-697-0113

Prepared By: Vincent Li	2010.12.02	Figure: 1

APPENDIX B

CONCEPTUALIZED BOREHOLE INSTALLATION DETAILS



Notes:

1. Borehole H2 stratigraphy provided by Canadian Dehua International Mines Group Inc.
2. Borehole H2 location (based on information provided by IPAC using a Trimble GNSS R8 RTK base station to +/- 0.05m accuracy) relative to UTM zone 10N map projection.
3. Northing: 6101836.4, Easting: 620583.7

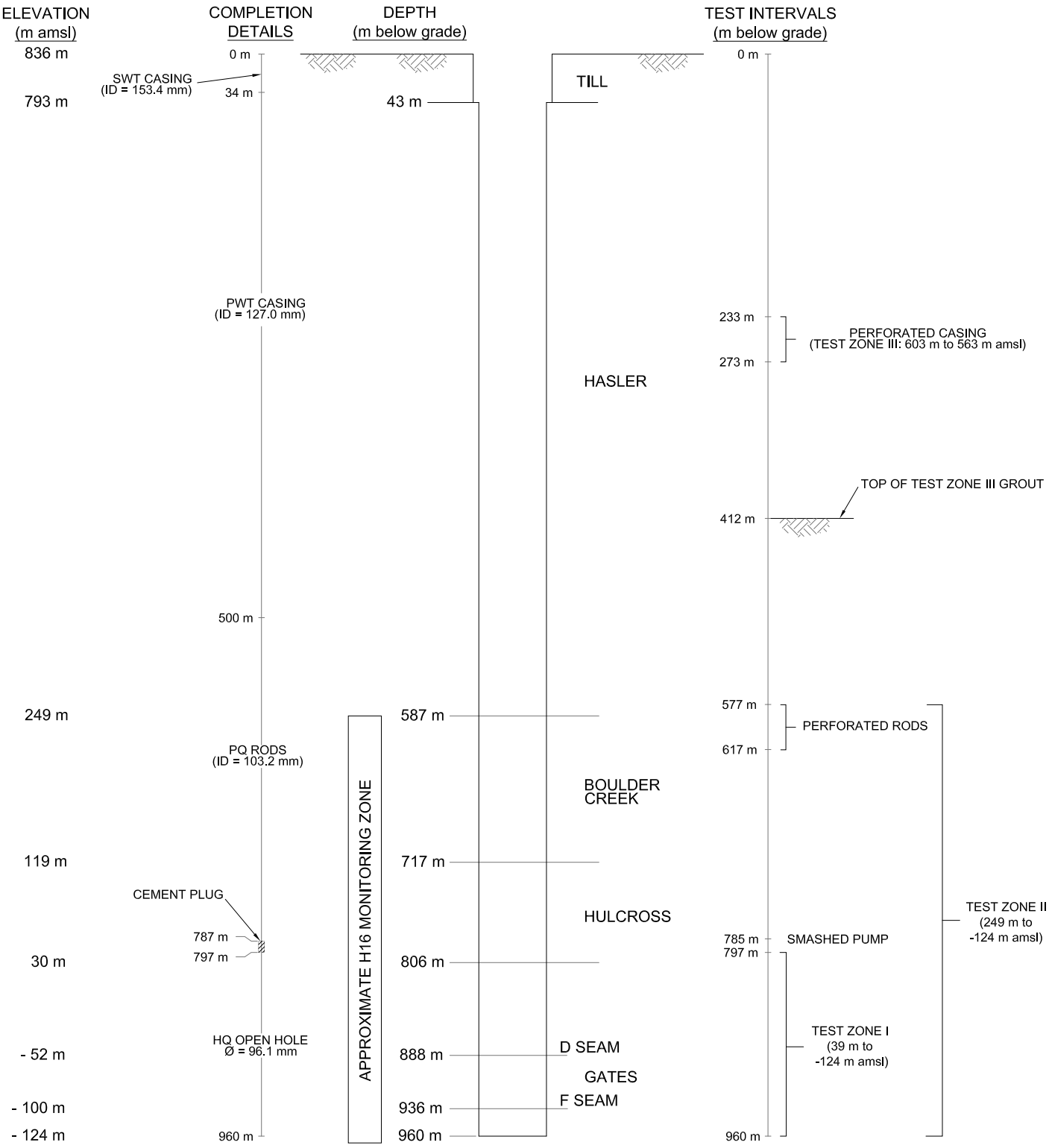
AMEC Environment & Infrastructure
913 Laval Crescent
Kamloops, BC, CANADA V2C 5P4
Tel. (250) 374-1347
Fax (250) 374-2944

CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP

TITLE: BOREHOLE H2 TEST ZONES AND CONSTANT HEAD TEST CONFIGURATION

PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS

DRAWN BY:	DATUM:	DATE:
I.Macleod	NAD83	DECEMBER 2011
CHECKED BY:	REV. No.:	PROJECT No.:
S.Green	A	KX13505
PROJECTION:	SCALE:	FIGURE No.:
UTM Zone 10	NTS	B-1



NOTES:
1. BOREHOLE H16W STRATIGRAPHY PROVIDED BY CANADIAN DEHUA INTERNATIONAL MINES GROUP (CDIMG) INC.
2. BOREHOLE H16W LOCATION (BASED ON INFORMATION PROVIDED BY IPaC USING A TRIMBLE GNSS R8 RTK BASE STATION TO ±0.05 m ACCURACY) RELATIVE TO UTM ZONE 10N MAP PROJECTION.
3. NORTHING: 6097712.7 EASTING: 624789.1

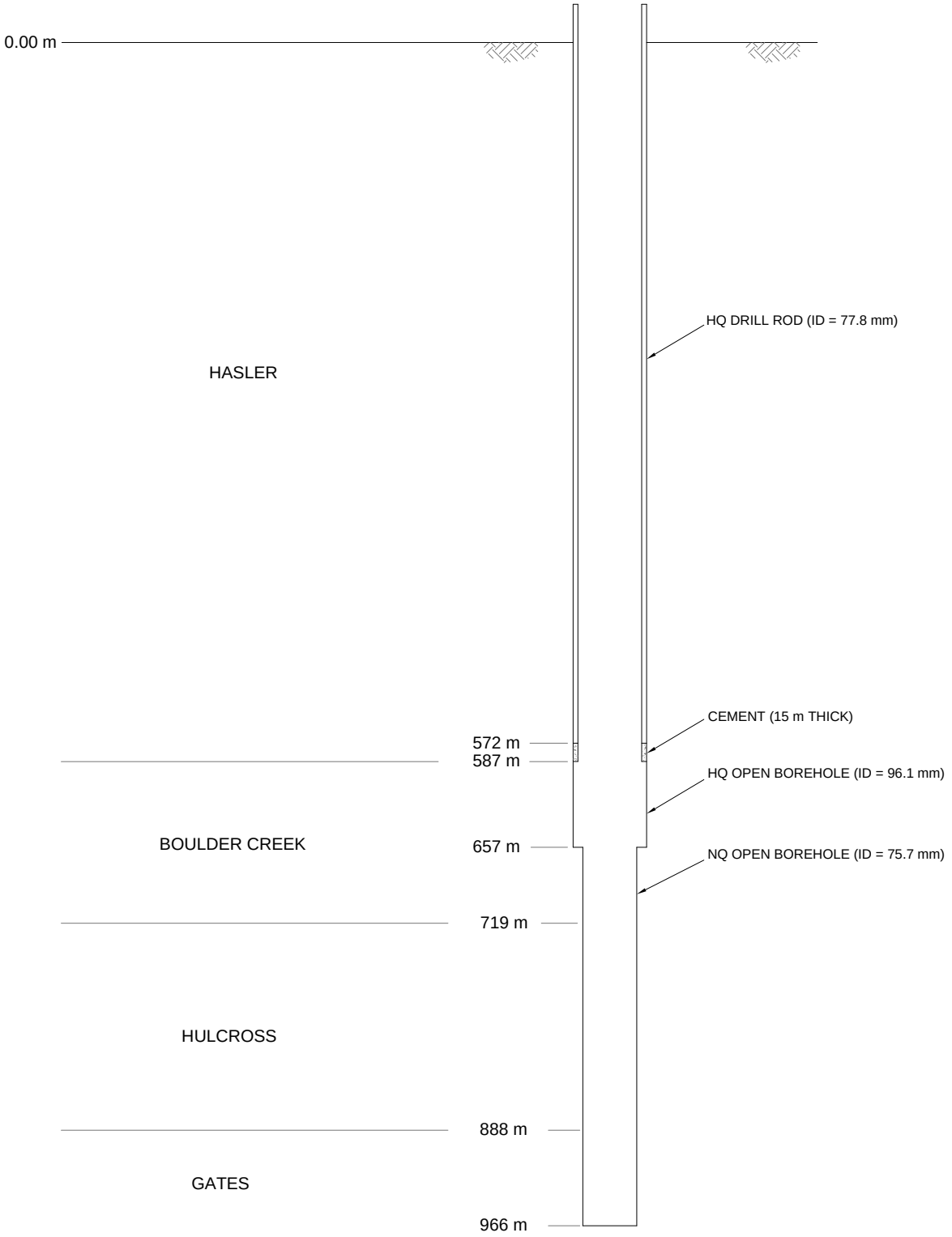
AMEC Environment & Infrastructure
Suite 600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT LOGO:

CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP

PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS	DWN BY: MW	DATUM: –	DATE: NOVEMBER 2011
TITLE: BOREHOLE H16W TEST ZONES	CHK'D BY: SG	REV. NO: A	PROJECT NO: KX13505.050
	PROJECTION: –	SCALE: NOT TO SCALE	FIGURE NO: B-2

H16 OBSERVATION WELL COMPLETION DETAILS
(AS PROVIDED BY CDIMG)



NOTE: BOREHOLE H16 STRATIGRAPHY PROVIDED BY CANADIAN DEHUA INTERNATIONAL MINES GROUP (CDIMG) INC.

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Burnaby, BC V5C 0E4
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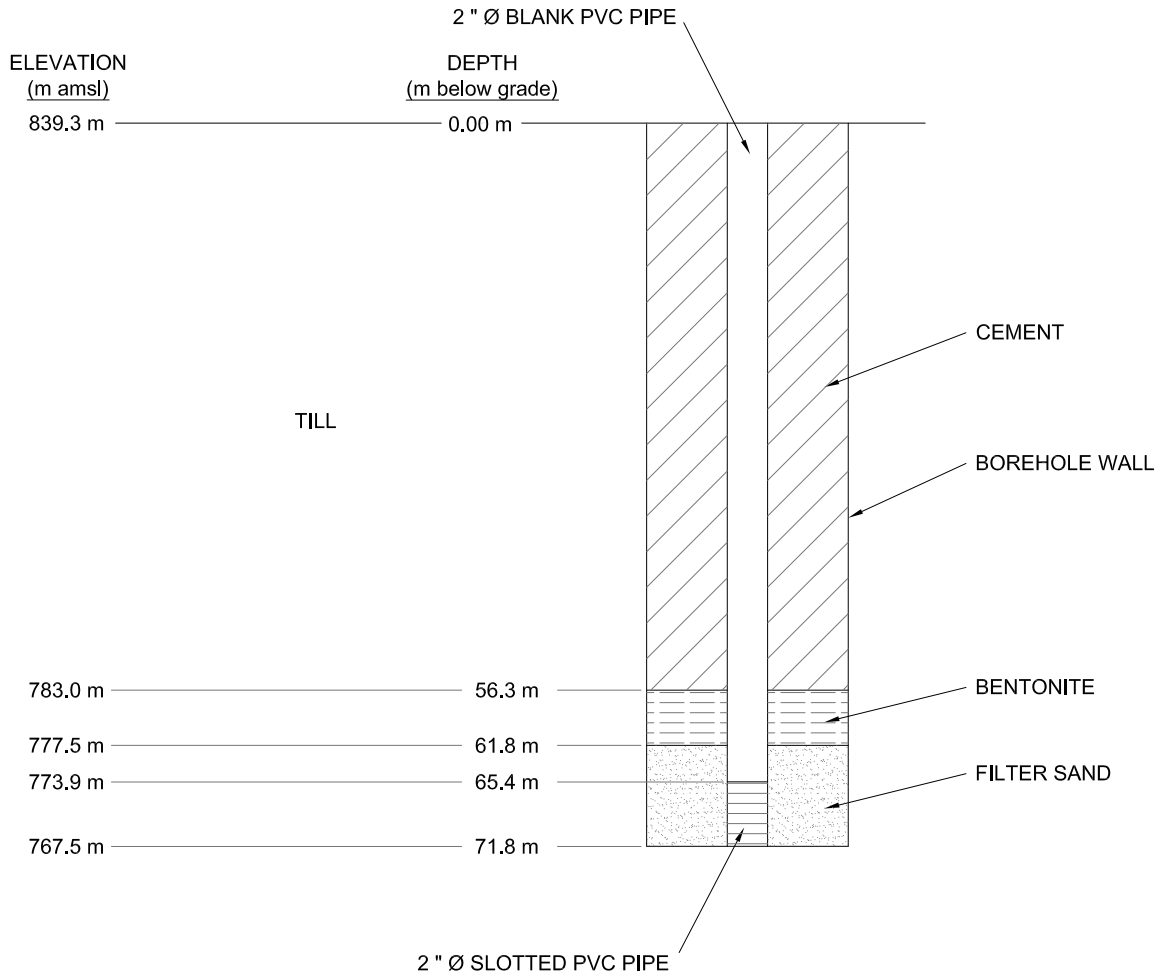
CLIENT LOGO:

CLIENT:
CANADIAN DEHUA INTERNATIONAL MINES GROUP

PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS	DWN BY: MW	DATUM: --	DATE: NOVEMBER 2011
TITLE: H16 OBSERVATION WELL COMPLETION DETAILS	CHK'D BY: SG	REV. NO: A	PROJECT NO: KX13505.050
	PROJECTION: --	SCALE: NOT TO SCALE	FIGURE NO: B-3

H16A OBSERVATION WELL COMPLETION DETAILS
(AS PROVIDED BY CDIMG)



NOTES:

1. M AMSL: METRES ABOVE MEAN SEA LEVEL.
2. BOREHOLE H16A STRATIGRAPHY PROVIDED BY CANADIAN DEHUA INTERNATIONAL MINES GROUP (CDIMG) INC.
3. BOREHOLE H16W LOCATION (BASED ON INFORMATION PROVIDED BY IPaC USING A TRIMBLE GNSS R8 RTK BASE STATION TO ±0.05 m ACCURACY) RELATIVE TO UTM ZONE 10N MAP PROJECTION.
4. NORTHING: 6097821.5 EASTING: 624890.9

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Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fax 604-294-4664

CLIENT LOGO:	CLIENT: CANADIAN DEHUA INTERNATIONAL MINES GROUP		
PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS	DWN BY: MW	DATUM: –	DATE: NOVEMBER 2011
TITLE: H16A OBSERVATION WELL COMPLETION DETAILS	CHK'D BY: SG	REV. NO: A	PROJECT NO: KX13505.050
	PROJECTION: –	SCALE: NOT TO SCALE	FIGURE NO: B-4

APPENDIX C

SITE PHOTOGRAPHS

Photo 1: View toward the south southeast from Borehole H16W. The drill rig in the centre of the photo is supporting 9.1 m of HQ drill rod (above-grade) threaded into the top of Observation Well H16. Groundwater is flowing over the top of the extended drill rod.

Photo 2: Photo shows two 19 mm diameter steel pipes extending above grade from the threaded HQ top cap. The shorter of the 19 mm diameter steel pipes is capped with a pressure gauge and the taller of the 19 mm diameter steel pipes is capped with a pressure release valve such that methane gas can escape from the system.

Photo 3: Close-up photograph showing the detail of the pressure release valve threaded into the top of the longer 19 mm diameter pipe. The yellow handles are ball valves to release water from the system when the groundwater head rises too high in the system.

Photo 4: Photo showing the length of the short 19 mm diameter steel rod below the threaded HQ top cap. The photo shows the short 19 mm diameter pipe extends some distance (approximately 0.6 m) below the HQ top cap. The bottom of the short 19 mm diameter steel rod has a flexible polyethylene tube affixed to its base. The purpose of the flexible polyethylene tube is to prevent an air-lock from occurring within the short 19 mm diameter tube (dedicated to measuring water pressure).

NOTE:
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE AMEC ENVIRONMENT □ INFRASTRUCTURE REPORT No. KX13505.050 DATED DECEMBER 2011.

CLIENT LOGO:

CLIENT:
CANADIAN DEHUA INTERNATIONAL MINES GROUP

AMEC En□ironment □ Infrastructure
Suite 600 - 4445 Lougheed Highway
Burnaby, BC V5C 0E4
Tel. 604-294-3811 Fa□604-294-4664

DWN BY:	MW
CHK'D BY:	SG
DATUM:	--
PROJECTION:	--
SCALE:	NOT TO SCALE

PROJECT: MURRAY RIVER SINGLE WELL RESPONSE TESTS

TITLE: SITE PHOTOGRAPHS

DATE:	NOVEMBER 2011
PROJECT NO:	KX13505.050
REV. NO:	A
FIGURE NO:	C1

APPENDIX D

FIELD SAMPLING SHEETS AND YSI CERTIFICATES OF CALIBRATION

FIELD REPORT

amec

Client	Project No. KX13505	Well/Site ID H2 600m-870m
ODIN.G	Facility Murray River Coal	Date (d.m.y) April 3, 2011

Site Description ☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☐ Borehole, ☐ Probe, ☐ Other: Test #1

Air Temp.: 0	☒ °C ☐ °F Weather:
Well Locked? ☐ Yes	☒ No Damaged/Repairs Needed:
☐ TOC ☒ MP	Description: Top of NQ Drill Rod
TOC/MP Stickup: < 2	☒ m ☐ ft above/below ground Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☒ Other: 5.65"
Site Remarks (nearby wells pumping, tide, stream stage, etc.)	

Water Level Data Measurement Units: ☐ m, ☐ ft Well or Borehole Total Depth (TD) from MP or TOC:

☐ E-Tape, # PPS 25 ☐ Steel Tape ☒ Other Memory Gauge	Initial	Confirmed	At start of purging	At end of sampling		Remarks
Time (hh:mm)	Mar 31/11 23:20	Apr 2/11 20:55				
Depth to Water	-4.6	18.0				
Water Level (WL)	-	-				
Tape Correction	-	-				
Depth to Product	-	-				
Prod. Recovery ☐ litres ☐ gallons	-	-				

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

Field WQ Data Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump Description: Grundfos 16S100-7S05

Casing Volume:[___(TD) - ___(WL)]x3.14x[___(ID)/2]²x[___(Unit conv. factor)] = ___ ☐ Litres ☐ gallons (2L/m for a 2" Casing, is a close approximation) 30 60 70 80 90						☐ Well goes dry while purging	
☐ Cum. Vol., ☒ Pump Rate 1.5 gpm	4	3	3	3	(final)	Meter/ Probe	Remarks
Time Measured (hh:mm)	10:20	10:30	10:40	10:50	11:00		
pH ☒ Temp. Compensated	8.38	8.36	8.33	8.31	8.32		
Temperature ☒ °C, ☐ °F	5.61	5.71	5.77	5.94	6.14		
Dissolved Oxygen (mg/L)	0.31	0.27	0.34	0.26	0.21		
Conductivity ☒ SC or ☐ EC (µS/cm)	3,043	2,310	1,644	1,277	1,017		
Redox Potential (Eh)	-363	-348	-272	-275	-285		
Turbidity (NTU)	-	-	-	-	-		
Colour/Tint	-	-	-	-	-		
Odour	-	-	-	-	-		

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

Sample Data Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☐ Pump; Description: Grundfos 16S100-7S05

Field Sample ID (unique ID on bottles)	Result Code	Date (d.m.y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45µm)	Lab ID	Case ID	SDG ID	Remarks
P2c21(H2) 600m	870m	Apr. 3/11	11.00	10	0				ALS Lab No: L991723
									/L991762

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

Sampled By (print) Tammara Hartyo	Signature	Entered into Database / / by	Page 1 of 1

FIELD REPORT

amec

Client	Project No.	Well/Site ID
COIM G	KX13505	H2 600m-870m
	Facility Murray River Coal	Date (d.m.y) April 4, 2011

Site Description ☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☒ Borehole, ☐ Probe, ☐ Other: Test #1

Air Temp.: 11.4 ☒ °C ☐ °F	Weather:
Well Locked? ☐ Yes ☒ No	Damaged/Repairs Needed: None
☐ TOC ☒ MP	Description: Top of NQ drill rod
TOC/MP Stickup: ~2 ☒ m ☐ ft above/below ground	Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☒ Other: 5.65"
Site Remarks (nearby wells pumping, tide, stream stage, etc.)	

Water Level Data Measurement Units: ☒ m, ☐ ft Well or Borehole Total Depth (TD) from MP or TOC: 872m below grade

☐ E-Tape, #PPS 25 ☐ Steel Tape ☐ Other	Initial Mar 31/11	Confirmed Apr 2/11	At start of purging	At end of sampling		Remarks
Time (hh:mm)	23:20	20.55				
Depth to Water	-4.6	18.0				
Water Level (WL)	-	-				
Tape Correction	-	-				
Depth to Product	-	-				
Prod. Recovery ☐ litres ☐ gallons	-	-				

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

Field WQ Data Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump Description: Grundfos 16S100-75D5

Casing Volume: [870(TD) - ___(WL)]x3.14x[143(ID)/2]^{2}x[0.1(Unit conv. factor)] = 4,365 ☒ Litres ☐ gallons (2L/m for a 2" Casing, is a close approximation) ☐ Well goes dry while purging

☐ Cum. Vol., ☒ Pump Rate USGPM	3	3	3	3	(final)	Meter/ Probe	Remarks
Time Measured (hh:mm)	20:20	20:30	20:40	20:50	21:00		
pH ☒ Temp. Compensated	8.14	8.13	8.13	8.13	8.07		
Temperature ☒ °C, ☐ °F	5.12	5.19	5.2	5.2	5.19		
Dissolved Oxygen (mg/L)	0.18	0.16	0.15	0.18	0.25		
Conductivity ☒ SC or ☐ EC (µS/cm)	1,978	1,980	1,982	1,985	1,982		
Redox Potential (Eh)	-232	-232	-232	-232	-222		
Turbidity (NTU)		-	-	-	-		
Colour/Tint		-	-	-			
Odour	-	-	-	-	-		

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

Sample Data Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump; Description: Grundfos 16S100-75D5

Field Sample ID (unique ID on bottles)	Result Code	Date (d.m.y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45µm)	Lab ID	Case ID	SDG ID	Remarks
PZC21(H2)600-870m		Apr 4/11	21:00	10	none				ALS Lab # L992288 /L992415

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

Sampled By (print) Tammera Kostyn	Signature	Entered into Database / / by	Page 1 of 1

FIELD REPORT

amec

Client	Project No.	Well/Site ID
CDIMG	KX13505	H2 202m 575m
	Facility Murray River Coal	Date (d.m.y) April 11 2011

Site Description ☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☐ Borehole, ☐ Probe, ☐ Other: Test #2

Air Temp.: 3.0 ☒ °C ☐ °F	Weather:
Well Locked? ☐ Yes ☒ No	Damaged/Repairs Needed: None
☐ TOC ☒ MP	Description: Top of drill rod
TOC/MP Stickup: ☐ m ☐ ft above/below ground	Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☒ Other: 5.65"
Site Remarks (nearby wells pumping, tide, stream stage, etc.)	

Water Level Data Measurement Units: ☒ m, ☐ ft Well or Borehole Total Depth (TD) from MP or TOC: 575m below grade

☒ E-Tape, #P11-25 Memory Gauge ☐ Steel Tape ☒ Other	Initial	Confirmed	At start of purging	At end of sampling		Remarks
Time (hh:mm)	Apr. 8 15:00	Apr. 10 6:19				
Depth to Water	0.67	-22.13				Head never completely
Water Level (WL)	0.67	-22.13				equilibrated. 22.13m
Tape Correction	-	-				assumed.
Depth to Product	-	-				
Prod. Recovery ☐ litres ☐ gallons	-	-				

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

Field WQ Data Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump Description: Grundfos 16S100-75DS

Casing Volume: [375 (TD) - 22.13 (WL)] x 3.14 x [14.3 (ID)/2]² x [0.1 (Unit conv. factor)] = 6,416 ☒ Litres ☐ gallons (2L/m for a 2" Casing, is a close approximation) ☐ Well goes dry while purging

☐ Cum. Vol., ☒ Pump Rate USgpm	1	1	1	1	1 (final)	Meter/ Probe	Remarks
Time Measured (hh:mm)	22:01	22:11	22:21	22:30	22:42		
pH ☒ Temp. Compensated	9.08	9.08	9.08	9.47	9.23		
Temperature ☒ °C, ☐ °F	3.4	3.4	3.3	3.6	3.3		
Dissolved Oxygen (mg/L)	0.7	0.7	0.7	4.3	0.8		
Conductivity ☒ SC or ☐ EC (µS/cm)	903	906	905	987	983		
Redox Potential (Eh)	-19.9	-19.0	-18.1	-32.6	-101.4		
Turbidity (NTU)	-	-	-	-	-		
Colour/Tint	-	-	-	-	-		
Odour	-	-	-	-	-		
				-	-		

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

Sample Data Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump; Description: Grundfos 16S100-75DS

Field Sample ID (unique ID on bottles)	Result Code	Date (d.m.y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45µm)	Lab ID	Case ID	SDG ID	Remarks
									ALS Lab Report Nos.
P2C21(H2)202m-602m		Apr 11/11	0:00	10	0				L993769 / L993814

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

Sampled By (print) Tamara Kaelin	Signature	Entered into Database / / by	Page 1 of 1

FIELD REPORT

amec

Client	Project No. KX13505	Well/Site ID H2 20m - 580m
CDIMG	Facility Murray River Coal	Date (d.m.y) 16 April, 2011

Site Description ☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☒ Borehole, ☐ Probe, ☐ Other: Test #4

Air Temp.: 7.9 ☒ °C ☐ °F	Weather:
Well Locked? ☐ Yes ☒ No	Damaged/Repairs Needed: None
☐ TOC ☒ MP	Description: Top of NQ drill Rod
TOC/MP Stickup: ☐ m ☐ ft above/below ground	Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☒ Other: 5.65"
Site Remarks (nearby wells pumping, tide, stream stage, etc.)	

Water Level Data Measurement Units: ☒ m, ☐ ft Well or Borehole Total Depth (TD) from MP or TOC: 580m below grade

☒ E-Tape, #PPS 25 Memory Gauge ☐ Steel Tape ☐ Other	Initial Apr 15/11	Confirmed	At start of purging	At end of sampling		Remarks
Time (hh:mm)	11:44					
Depth to Water	0.5m					
Water Level (WL)						
Tape Correction						
Depth to Product						
Prod. Recovery ☐ litres ☐ gallons						

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

Field WQ Data Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump Description: Grundfos 5S15-31DS

Casing Volume: [582(TD) - 0.5(WL)] x 3.14 x [143(ID)/2]^2 x [0.1(Unit conv. factor)] = 9.370 ☒ Litres ☐ gallons (2L/m for a 2" Casing, is a close approximation) ☐ Well goes dry while purging

☐ Cum. Vol., ☒ Pump Rate	1	1	1	1	(final)	Meter/ Probe	Remarks
Time Measured (hh:mm)	16:20	16:30	16:40	16:50	17:00		
pH ☒ Temp. Compensated	nr	nr	nr	nr	nr		
Temperature ☒ °C, ☐ °F	nr	nr	nr	nr	nr		
Dissolved Oxygen (mg/L)	nr	nr	nr	nr	nr		
Conductivity ☒ SC or ☐ EC (µS/cm)	nr	nr	nr	nr	nr		
Redox Potential (Eh)	nr	nr	nr	nr	nr		
Turbidity (NTU)	-	-	-	-	-		nr = not recorded
Colour/Tint	-	-	-	-	-		
Odour	-	-	-	-	-		

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

Sample Data Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump; Description: Grundfos 5S15-31DS

Field Sample ID (unique ID on bottles)	Result Code	Date (d.m.y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45µm)	Lab ID	Case ID	SDG ID	Remarks
P2021(42) 20-600m		16 Apr/11	17:00	10	0				ALS Lab # L996144 /L995935

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

Sampled By (print) Tammara Kostyo	Signature	Entered into Database / / by	Page 1 of 1

Sample # 1 960
Test Zone - 800 - [redacted] m
Gates Formation

FIELD REPORT

amec

Client	Project No.	Well/Site ID
Dehua	KX13505.3	H16W
	Facility: Well site	Date (d.m.y): 23/06/11 11 AM

Site Description
☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☑ Borehole, ☐ Probe, ☐ Other: Test F1

Air Temp.: 13 ☑ °C ☐ °F Weather: Warm, Overcast

Well Locked? ☐ Yes ☑ No Damaged/Repairs Needed: N/A

☐ TOC ☐ MP Description:

TOC/MP Stickup: 1 ☑ m ☐ ft above/below ground Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☑ Other: [redacted]" 3.78"

Site Remarks (nearby wells pumping, tide, stream stage, etc.) Coal Exploration Area

Water Level Data
Measurement Units: ☑ m, ☐ ft Well or Borehole Total Depth (TD) from MP or TOC: 960m below grade

☐ E-Tape, #____ ☐ Steel Tape ☑ Other	Initial	Confirmed	At start of purging	At end of sampling		Remarks
Time (hh:mm)			June 21/11 9:30am	June 23/11 11am		- Recorded By data logger (TC) BF Pumping test) - Sample Collected ~49 hrs into the test.
~~Depth to Water~~ WL			3.8mbg	2.80mbg		
Water Level (WL)						
Tape Correction						
Depth to Product						
Prod. Recovery ☐ litres ☐ gallons						

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

Field WQ Data
Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☐ Pump Description: Pumping test - 49 hrs into test

Casing Volume:[____(TD) - ____(WL)]x3.14x[____(ID)/2]^{2}x[____(Unit conv. factor)] = ____ ☐ Litres ☐ gallons
(2L/m for a 2" Casing, is a close approximation)

☐ Well goes dry while purging

Insitu Field data Chem by YSI 556

☐ Cum. Vol., ☑ Pump Rate					(final)	Meter/ Probe	Remarks
Time Measured (hh:mm)	11am						
pH ☐ Temp. Compensated	9.46						
Temperature ☑ °C, ☐ °F	10.37						→ Influenced by air temperature & overal distance ground water must travel to YSI * Downhole datalogger Recorded GW Temp @ time of sampling. = 31.3 °C
Dissolved Oxygen (mg/L) (~~µS/cm~~)	0.37						
Conductivity ☑ SC or ☐ EC ~~(µS/cm)~~	1.811						
Redox Potential (Eh) ORP (mV)	-163						
Turbidity (NTU)	NA						
Colour/Tint	slightly Turbid * @ time of sampling						
Odour	Methane gas						

During 1st 36 m³ of pumping visual water quality was white murky (very turbid) & high pH ~11.3

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

Sample Data
Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☐ Pump; Description:

Field Sample ID (unique ID on bottles)	Result Code	Date (d.m.y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45µm)	Lab ID	Case ID	SDG ID	Remarks
H16W 800-1000		3/4/11	11am	10					SEE ALS Reports
									L1022659/L1023033

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

Sampled By (print) T. Kostiya	Signature J. Kostiya	Entered into Database / / by	Page 1 of 1

FIELD REPORT

amec

Client	Project No.	Well/Site ID
Daehan	KX13505.03	H16 W 577m-960m
	Facility Wellsite	Date (d.m.y) Aug 1/11 1pm

Site Description

☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☐ Borehole, ☐ Probe, ☐ Other: Test #2

Air Temp.: ~15 ☑°C ☐°F Weather: Clear, Sunny, Warm

Well Locked? ☐ Yes ☑ No Damaged/Repairs Needed:

☐ TOC ☐ MP Description:

TOC/MP Stickup: 2 ☑ m ☐ ft above/below ground Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☐ Other: [redacted] 3.78" - 4.06"

Site Remarks (nearby wells pumping, tide, stream stage, etc.) Coal Exploration Area

Water Level Data

Measurement Units: ☐ m, ☐ ft Well or Borehole Total Depth (TD) from MP or TOC:

☐ E-Tape, #____ ☐ Steel Tape ☐ Other	Initial	Confirmed	At start of ~~purging~~	At end of sampling		Remarks
Time (hh:mm)			July 30/11 2 PM	Aug 2/11 2 AM		- Recorded by datalogger (~60 hrs Pumping test)
Depth to Water WL			~8 mbg			
Water Level (WL)						- sample collected ~47 hrs into Pumping test
Tape Correction						
Depth to Product						
Prod. Recovery ☐ litres ☐ gallons						

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

Field WQ Data

Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☐ Pump Description: Pumping test - 47 hrs into test

Casing Volume:[____(TD) - ____(WL)]x3.14x[____(ID)/2]^{2}x[____(Unit conv. factor)] = ____ ☐ Litres ☐ gallons (2L/m for a 2" Casing, is a close approximation)

☐ Well goes dry while purging

Insitu Field Data Chem by YSI 556

☐ Cum. Vol., ☑ Pump Rate	2GPM				(final)	Meter/ Probe	Remarks
Time Measured (hh:mm)	1PM						
pH ☐ Temp. Compensated	7.65						
Temperature ☐ °C, ☐ °F	10.10°C						→ Influenced by air temp.
Dissolved Oxygen (mg/L) (mS/cm)	0.10						* overal distance groundwater must travel to YSI
Conductivity ☐ SC or ☑ EC ~~(µS/cm)~~	1.898						
Redox Potential (Eh) ORP(mV)	-197.6						
Turbidity (NTU)	NA						→ Downhole Datalogger recorded GW Temp @ time of sampling = 17°C
Colour/Tint	Turbid black						
Odour	Smell of gas						

1st hr water colour was milky - within the next couple hrs colour turned to turbid black

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

Sample Data

Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☐ Pump; Description:

Field Sample ID (unique ID on bottles)	Result Code	Date (d.m.y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45µm)	Lab ID	Case ID	SDG ID	Remarks
#2 H16W 500730		1/8/11	1pm	10					SEE ALS Reports

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

Sampled By (print) T. Koshyq	Signature	Entered into Database __/__/__ by	Page 1 of 1

FIELD REPORT

amec

Client	Project No.	Well/Site ID
Canadian Dehua International Mines	KX13505.030	H16W 233m-273m
	Facility Murray River Coal	Date (d.m.y) August 14 2011

Site Description

☐ Monitoring Well, ☐ Extraction Well, ☐ Irrigation Well, ☐ Spring, ☒ Borehole, ☐ Probe, ☐ Other: Test #3

Air Temp.: ☐ °C ☐ °F Weather:

Well Locked? ☐ Yes ☒ No Damaged/Repairs Needed:

☐ TOC ☒ MP Description: Top of NQ drill rod / drop pipe

TOC/MP Stickup: 1.2 ☒ m ☐ ft above/below ground Well Inside Diameter (ID): ☐ 2 inch ☐ 4 inch ☒ Other: 5.0"

Site Remarks (nearby wells pumping, tide, stream stage, etc.)

Water Level Data

Measurement Units: ☒ m, ☐ ft Well or Borehole Total Depth (TD) from MP or TOC: 412 m below grade

☐ E-Tape, #____ ☐ Steel Tape ☐ Other 2225 Memory Gauge	Initial	Confirmed	At start of purging	At end of sampling		Remarks
Time (hh:mm)	Aug 12 17:20	Aug 13 11:47				
Depth to Water (m below TOC)	113.9	22.11				
Water Level (WL)	–	22.11				
Tape Correction	–	–				
Depth to Product	–	–				
Prod. Recovery ☐ litres ☐ gallons	–	–				

Measure water level from fixed measuring point (MP) or top of well casing (TOC). Record depth to the nearest 0.002 m or 0.01 ft, with minus (-) sign if level is above MP or TOC. If no mark on MP or TOC, measure depth from north side of casing. Measure static or pre-purging water level twice; record initial and confirmation measurements and measurement times (in 24 hour clock format). MP/TOC stickup measurement is from ground surface to nearest 0.01 m or 0.1 ft. Depth to water codes: N-not measured, D-dry, O-obstructed, P-pumping, F-flowing (artesian condition), R-recently pumped, C-cascading. Water Level (WL)=Depth to Water-Tape Correction Factor. Record free product presence at time of water level measurement, use: S-product sheen observed. If free product is removed from the well, record the volume removed in litres or gallons, list product type in "Remarks" column.

Field WQ Data

Purge Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☒ Pump Description: Grundfos 5S15-31QS

Casing Volume:[____(TD) - ____(WL)]x3.14x[____(ID)/2]^{2}x[____(Unit conv. factor)] = ____ ☐ Litres ☐ gallons
(2L/m for a 2" Casing, is a close approximation)

☐ Well goes dry while purging

☐ Cum. Vol., ☒ Pump Rate Usgpm					(final)	Meter/ Probe	Remarks
Time Measured (hh:mm)	13:20	13:30	13:40	13:50	14:00		
pH ☒ Temp. Compensated	9.37	9.36	9.36	9.36	9.37		
Temperature ☒ °C, ☐ °F	9.83	9.65	9.68	9.94	10.03		
Dissolved Oxygen (mg/L)	2.96	1.00	1.00	0.97	0.94		
Conductivity ☒ SC or ☐ EC (µS/cm)	1390	1389	1389	1390	1392		
Redox Potential (Eh)	52	53	52	52	51.6		
Turbidity (NTU)	–	–	–	–	–		
Colour/Tint	–	–	–	–	clear		
Odour	–	–	–	–	None		

Record time purging starts and ends in Water Level Data section. Cum. Vol.: cumulative volume purged before sampling, in litres or gallons. Pumping rate is Lpm or gpm, depending on box checked in casing volume calculation. Use "final" column above for recording sample field measurements, total volume purged before sampling or average pumping rate during purging. Record equipment details and calibration methods, decontamination procedures, equipment failures, purge water disposal method, etc. in daily field notes. SC: Specific conductance corrected for temperature (µS/cm=µmho). 3.785 L = 0.833 Imp.gall. = 1 US gall.

Sample Data

Sample Depth: ☐ Grab, ☐ Waterra, ☐ Bailer, ☐ Pump; Description:

Field Sample ID (unique ID on bottles)	Result Code	Date (d.m.y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45µm)	Lab ID	Case ID	SDG ID	Remarks
H16W 233-273		Aug.14	14:00	10	0				

Sample ID may be up to 15 characters. Sample Result Code, Date and Time must be entered. Result Codes: PO-Primary Sample, D#-Duplicate Sample, S#-Split sample (sent to second lab), FB#-Field Blank, EB#-Equipment Rinsate, TB#-Travel Blank, FS#-Field Spike. Lab ID is name of laboratory that will analyse the sample. Case ID and SDG ID (sample delivery group) are required for blanks. Case ID may be the lab service request number or yy-mm. SDG may be lab's SDG, a cooler ID number, or mmddyy. Enter sample preservation and handling data on chain-of-custody form. Also record detailed information about duplicate, split, rinsate, spike and/or blank sample collection/handling in daily field notes.

Sampled By (print) Scott Green	Signature	Entered into Database __/__/__ by	Page 1 of 1

YSI 556
Calibration Sheet

amec

This is to certify that this instrument has been calibrated to the manufacturer's specifications.

Project Number	KX13463
Project Location	Mcleod Lake
Employee	Tammera Kostyk

Calibrated by Matt Sarkar

Date Checked Out	15 March 2011
Date Returned	

Procedures Prior to Departure (check-off steps and record results in the table below as necessary).

- ✓ 1 Check flow cell fit by installing probe in flow cell
- ✓ 2 Check for broken or loose probes.
- ✓ 3 Check DO membrane visually.
- ✓ 4 Check pH probe reservoir for contamination visually
- ✓ 5 Check that correct parameters are displayed on the handset
- ✓ 6. Check for correct date and adjust accordingly.
- ✓ 7 Check that handset memory is clear
- ✓ 8 Perform a three point manual pH calibration (Use 7.01 buffer solution first)
- ✓ 9. Perform a specific conductance calibration
- ✓ 10 Perform an ORP check with 240 mV solution

Procedures Every two weeks (or as required)

1 Check to see if the unit will be in use in the near future. The pH probe will need to be stored differently (See Manual) if unit is not in use for more than 1 month

Procedures Upon Return (record results in the tables below)

1 Clean probes (store multi-probe in calibration cell with approximately 1/8" of water, ensure that probes are not submerged)
2 Clean and inspect 20 m cable
3. Clean and inspect flow cell
4. Ensure there are no errors or problems with the instrument.
5 Ensure that at least one full bottle of each calibration solution is on hand and has not expired
6 Ensure that extra batteries are on hand
7 Download memory from the handset (clear the handset memory after downloading)
8. Place completed copies of this sheet in the project file and YSI clip-board

Calibration Information						
Para	pH			Sp. Cond	DO	ORP
Calibration Solution Value	7.01	4.01	10.01	1413 µS/cm	100%	240 mV
Reading Following Calibration	7.03	3.95	10.05	1413	92.7	237.5

Packing List	
Manual	
Carrying Case	
Cal Sol'ns	
Flow Cell	✓
Barb Fittings	✓
Extra Batteries	✓
Other (Membrane kit)	
Other	

If additional calibration solutions are required, let Jen Mathie know and she will order them (speak to Matt Sarkor if Jen is not available).

If the instrument is not working properly, contact Matt Sarkor.

YSI 556
Calibration Sheet

amec

This is to certify that this instrument has been calibrated to the manufacturer's specifications.

Project Number	KX13463
Project Location	Mcleod Lake
Employee	Tammera Kostyk

Calibrated by Matt Sarkar

Date Checked Out	15 March 2011
Date Returned	

Procedures Prior to Departure (check-off steps and record results in the table below as necessary).

- ✓ 1 Check flow cell fit by installing probe in flow cell
- ✓ 2 Check for broken or loose probes.
- ✓ 3 Check DO membrane visually.
- ✓ 4 Check pH probe reservoir for contamination visually
- ✓ 5 Check that correct parameters are displayed on the handset
- ✓ 6. Check for correct date and adjust accordingly.
- ✓ 7 Check that handset memory is clear
- ✓ 8 Perform a three point manual pH calibration (Use 7.01 buffer solution first)
- ✓ 9. Perform a specific conductance calibration
- ✓ 10 Perform an ORP check with 240 mV solution

Procedures Every two weeks (or as required)

1 Check to see if the unit will be in use in the near future. The pH probe will need to be stored differently (See Manual) if unit is not in use for more than 1 month

Procedures Upon Return (record results in the tables below)

1 Clean probes (store multi-probe in calibration cell with approximately 1/8" of water, ensure that probes are not submerged)
2 Clean and inspect 20 m cable
3. Clean and inspect flow cell
4. Ensure there are no errors or problems with the instrument.
5 Ensure that at least one full bottle of each calibration solution is on hand and has not expired
6 Ensure that extra batteries are on hand
7 Download memory from the handset (clear the handset memory after downloading)
8. Place completed copies of this sheet in the project file and YSI clip-board

Calibration Information						
Para	pH			Sp. Cond	DO	ORP
Calibration Solution Value	7.01	4.01	10.01	1413 µS/cm	100%	240 mV
Reading Following Calibration	7.03	3.95	10.05	1413	92.7	237.5

Packing List	
Manual	
Carrying Case	
Cal Sol'ns	
Flow Cell	✓
Barb Fittings	✓
Extra Batteries	✓
Other (Membrane kit)	
Other	

If additional calibration solutions are required, let Jen Mathie know and she will order them (speak to Matt Sarkor if Jen is not available).

If the instrument is not working properly, contact Matt Sarkor.

YSI 556
Calibration Sheet

This is to certify that this instrument has been calibrated to the manufacturer's specifications.

Project Number	KX13528
Project Location	Fort Ware
Employee	Matt Sarkor

Date Checked Out	May 25, 2011
Date Returned	

Procedures Prior to Departure (check-off steps and record results in the table below as necessary):

- ✓ 1. Check flow cell fit by installing probe in flow cell.
- ✓ 2. Check for broken or loose probes.
- ✓ 3. Check DO membrane visually.
- ✓ 4. Check pH probe reservoir for contamination visually.
- ✓ 5. Check that correct parameters are displayed on the handset
- ✓ 6. Check for correct date and adjust accordingly.
- ✓ 7. Check that handset memory is clear.
- ✓ 8. Perform a three point manual pH calibration **(Use 7.01 buffer solution first).**
- ✓ 9. Perform a specific conductance calibration
- ✓ 10. Perform an ORP check with 240 mV solution

Procedures Every two weeks (or as required):

1. Check to see if the unit will be in use in the near future. The pH probe will need to be stored differently (See Manual) if unit is not in use for more than 1 month

Procedures Upon Return (record results in the tables below):

1. Clean probes (store multi-probe in calibration cell with approximatey 1/8" of water; ensure that probes are not submerged)
2. Clean and inspect 20 m cable
3. Clean and inspect flow cell
4. Ensure there are no errors or problems with the instrument
5. Ensure that at least one full bottle of each calibration solution is on hand and has not expired
6. Ensure that extra batteries are on hand
7. Download memory from the handset (clear the handset memory after dowloading)
8. Place completed copies of this sheet in the project file and YSI clip-board

Calibration Information						
Para	pH			Sp. Cond	DO	ORP
Calibration Solution Value	7.02 7.01 7.00	4.01 4.03	10.01 10.01	1413 µS/cm 1431	100% 101.6	235 248 mV 241.1 ← Before Cal
Reading Following Calibration	7.02	4.00	10.01	1413	93.7	236.0

Packing List	
Manual	
Carrying Case	✓
Cal Sol'ns	
Flow Cell	✓
Barb Fittings	✓
Extra Batteries	✓
Other (Membrane kit)	
Other	

If additional calibration solutions are required, let Jen Mathie know and she will order them (speak to Matt Sarkor if Jen is not available).

If the instrument is not working properly, contact Matt Sarkor.

YSI 556
Calibration Sheet

This is to certify that this instrument has been calibrated to the manufacturer's specifications.

Project Number	KX13505
Project Location	H16W - Timber Ridge
Employee	Scott Gro

Date Checked Out	June 2011
Date Returned	August 16 2011

Field Calibration Date: August 10 2011

Procedures Prior to Departure (check-off steps and record results in the table below as necessary):

	1. Check flow cell fit by installing probe in flow cell.
	2. Check for broken or loose probes.
	3. Check DO membrane visually.
	4. Check pH probe reservoir for contamination visually.
	5. Check that correct parameters are displayed on the handset.
	6. Check for correct date and adjust accordingly.
	7. Check that handset memory is clear.
✓	8. Perform a three point manual pH calibration **(Use 7.01 buffer solution first).**
✓	9. Perform a specific conductance calibration
✓	10. Perform an ORP check with 240 mV solution

Procedures Every two weeks (or as required):

1. Check to see if the unit will be in use in the near future. The pH probe will need to be stored differently (See Manual) if unit is not in use for more than 1 month.

Procedures Upon Return (record results in the tables below):

1. Clean probes (store multi-probe in calibration cell with approximatey 1/8" of water; ensure that probes are not submerged)
2. Clean and inspect 20 m cable
3. Clean and inspect flow cell
4. Ensure there are no errors or problems with the instrument.
5. Ensure that at least one full bottle of each calibration solution is on hand and has not expired
6. Ensure that extra batteries are on hand
7. Downolad memory from the handset (clear the handset memory after dowloading)
8. Place completed copies of this sheet in the project file and YSI clip-board

Calibration Information						
Para	pH			Sp. Cond	DO	ORP
Calibration Solution Value	7.01	4.01	10.01	1413 µS/cm	100%	240 mV
Reading Following Calibration	6.995	4.002	na	1440	90.2	235
Temperature (°C) at Calibration	28.00	28.00		26.00	26.78	

Pressure (mm Hg) at DO calibration = 685.6 mm Hg

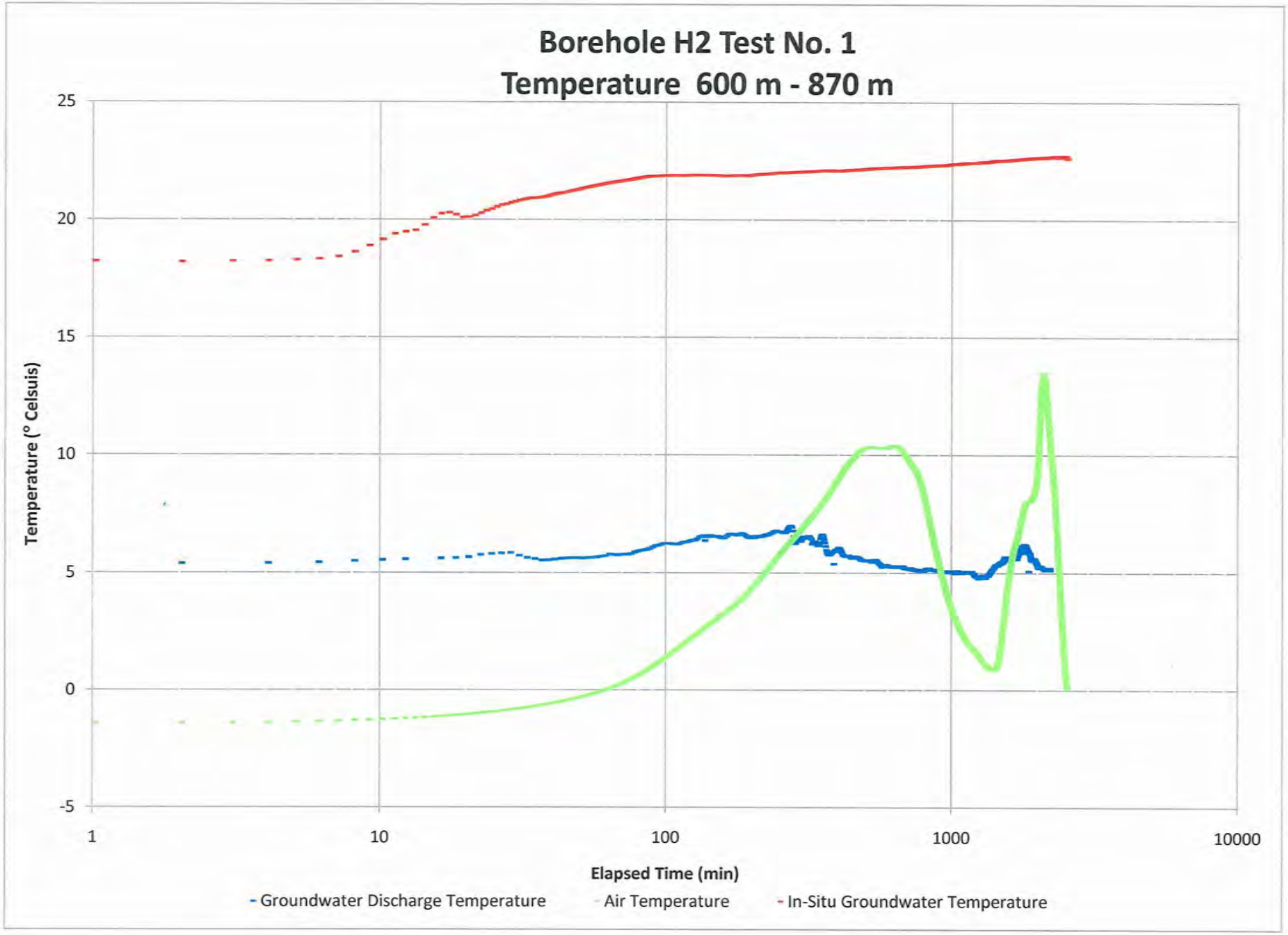
Packing List	
Manual	
Carrying Case	
Cal Sol'ns	
Flow Cell	
Barb Fittings	
Extra Batteries	
Other (Membrane kit)	
Other	

If additional calibration solutions are required, let Jen Mathie know and she will order them (speak to Matt Sarkor if Jen is not available).

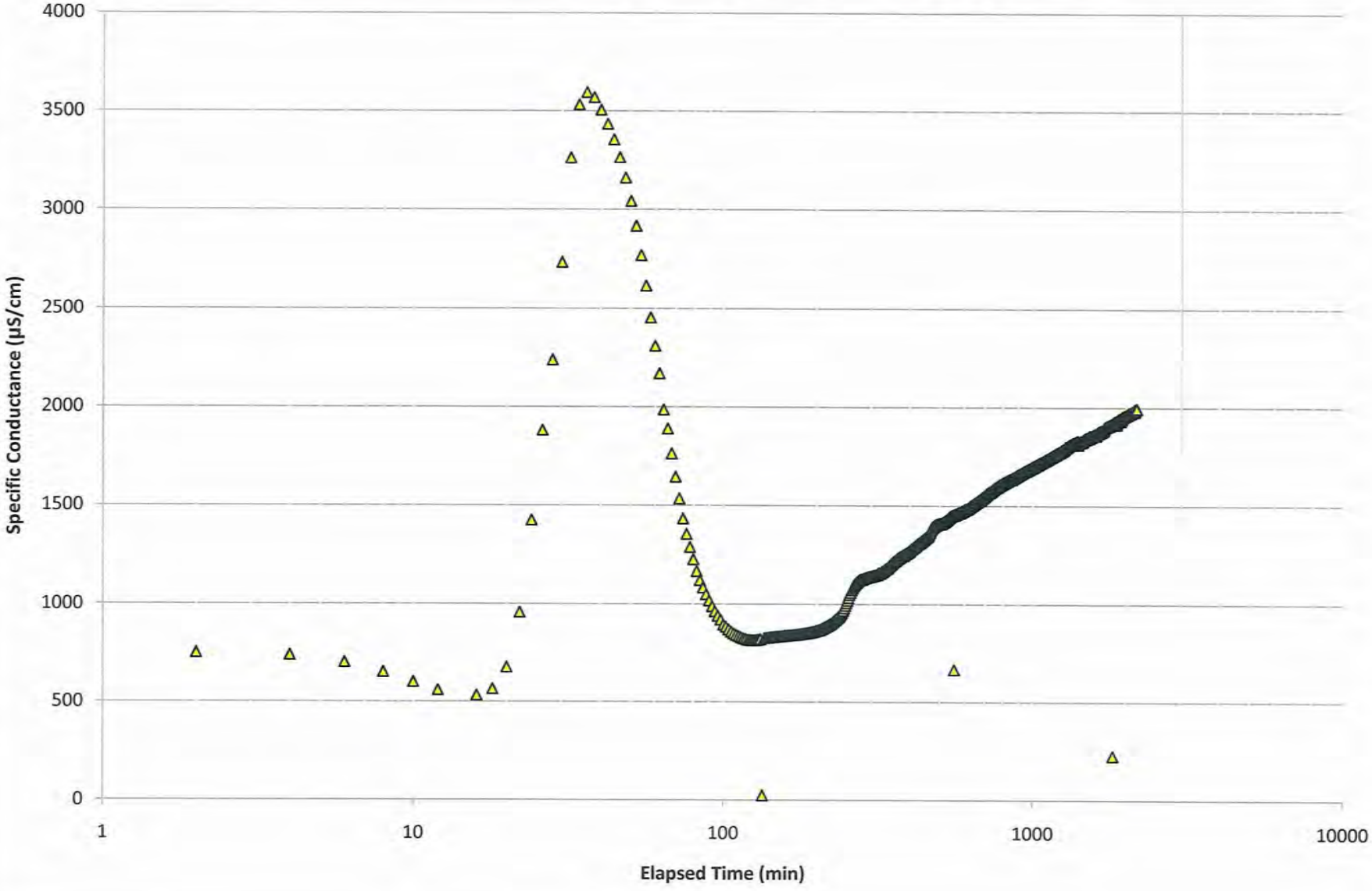
If the instrument is not working properly, contact Matt Sarkor.

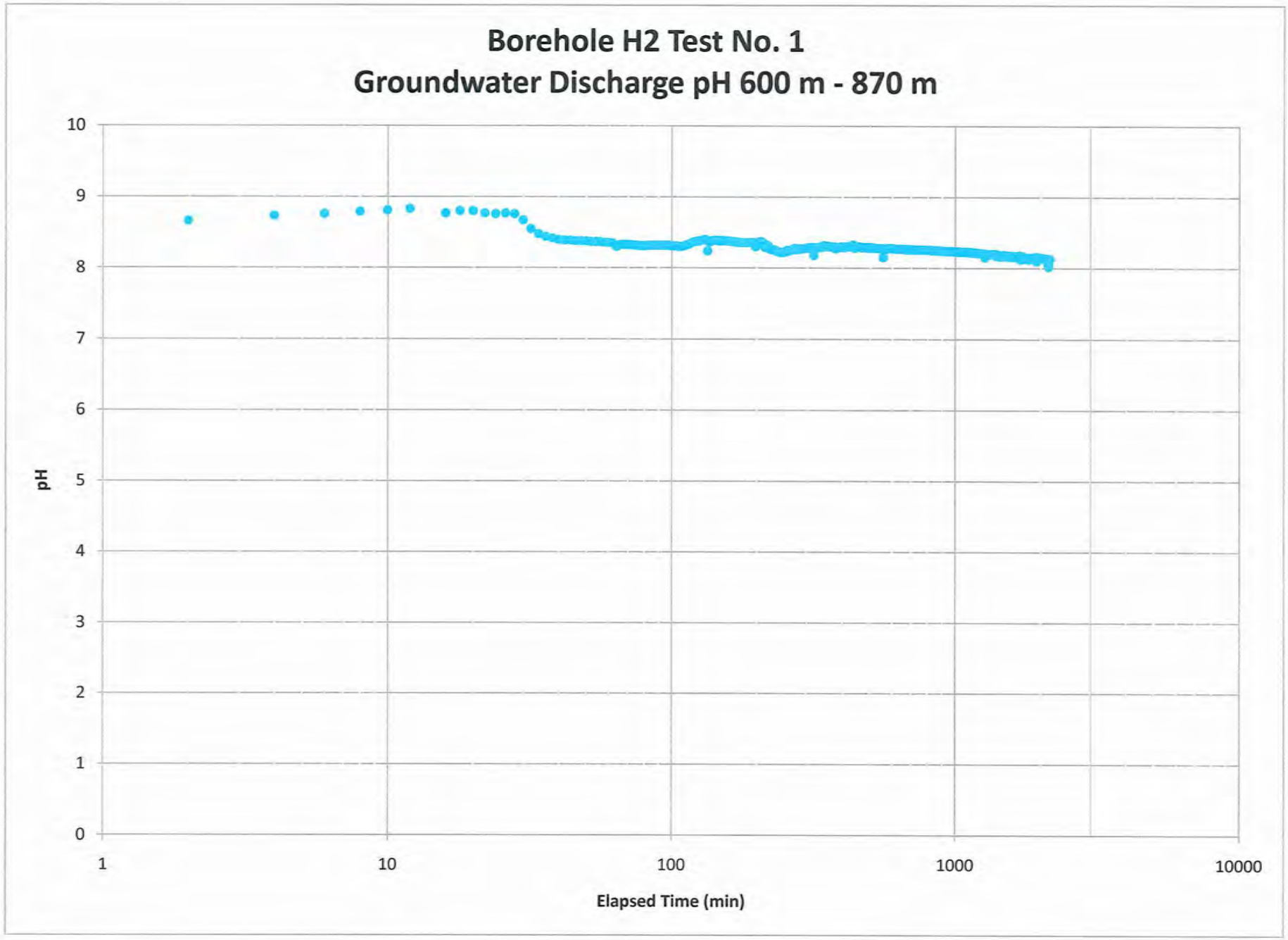
APPENDIX E

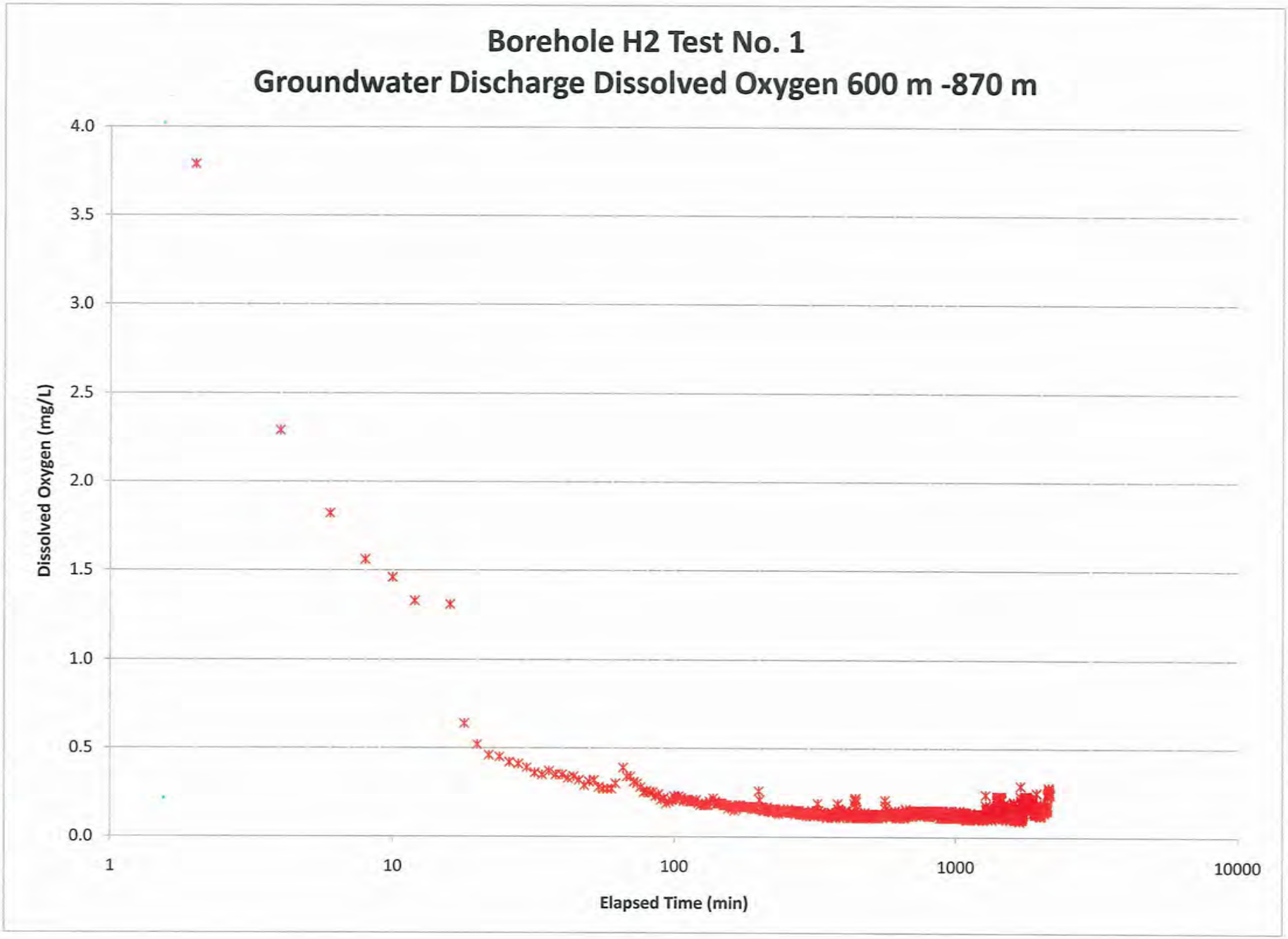
FIELD RECORDED GROUNDWATER DISCHARGE QUALITY GRAPHS


Borehole H2 Test No. 1
Temperature 600 m - 870 m
25
20
15
10
5
0
-5
Temperature (° Celsuis)
1
10
100
1000
10000
Elapsed Time (min)
Groundwater Discharge Temperature
Air Temperature
In-Situ Groundwater Temperature

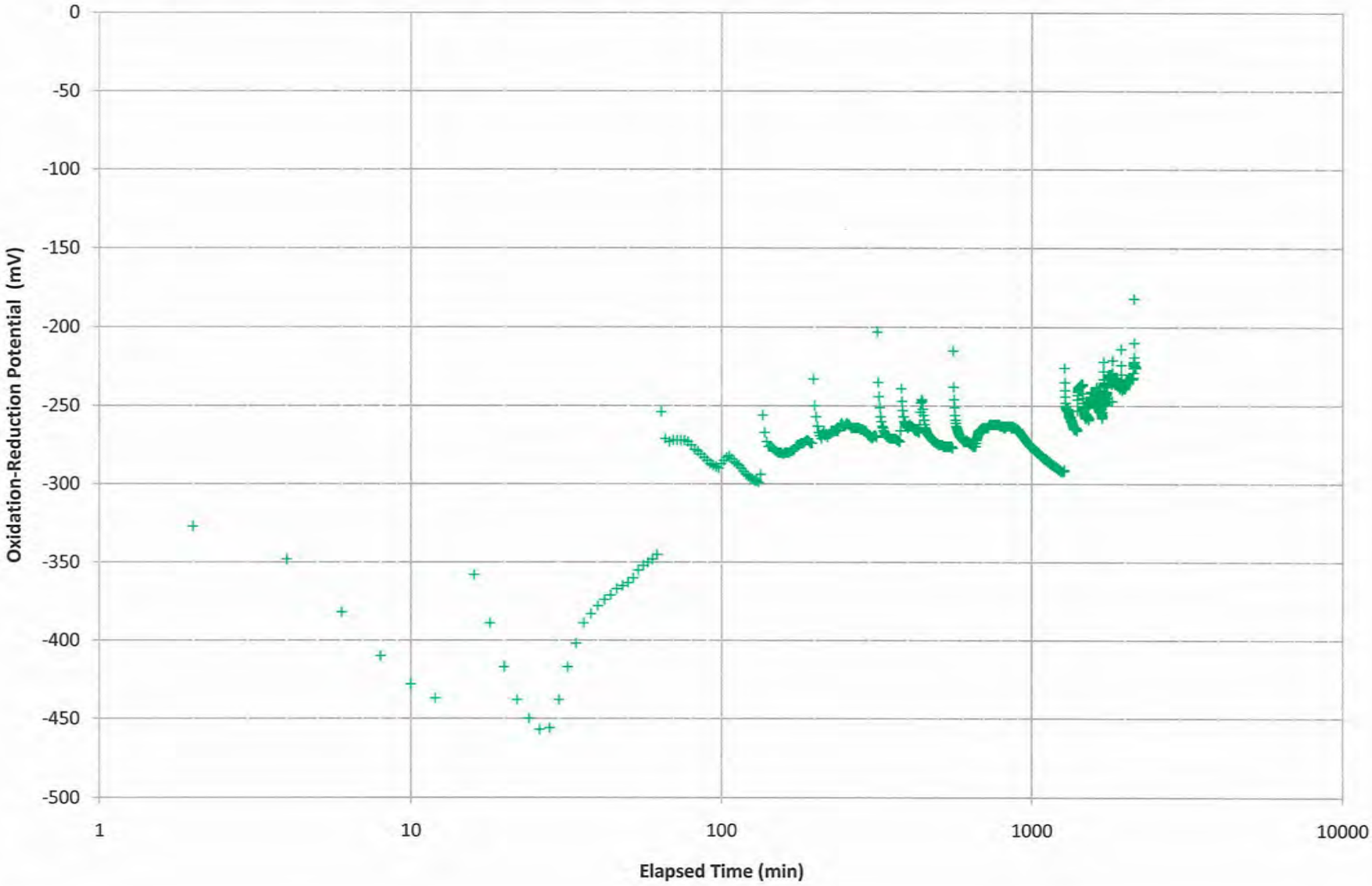
Borehole H2 Test No.1
Groundwater Discharge Specific Conductance 600 m-870 m

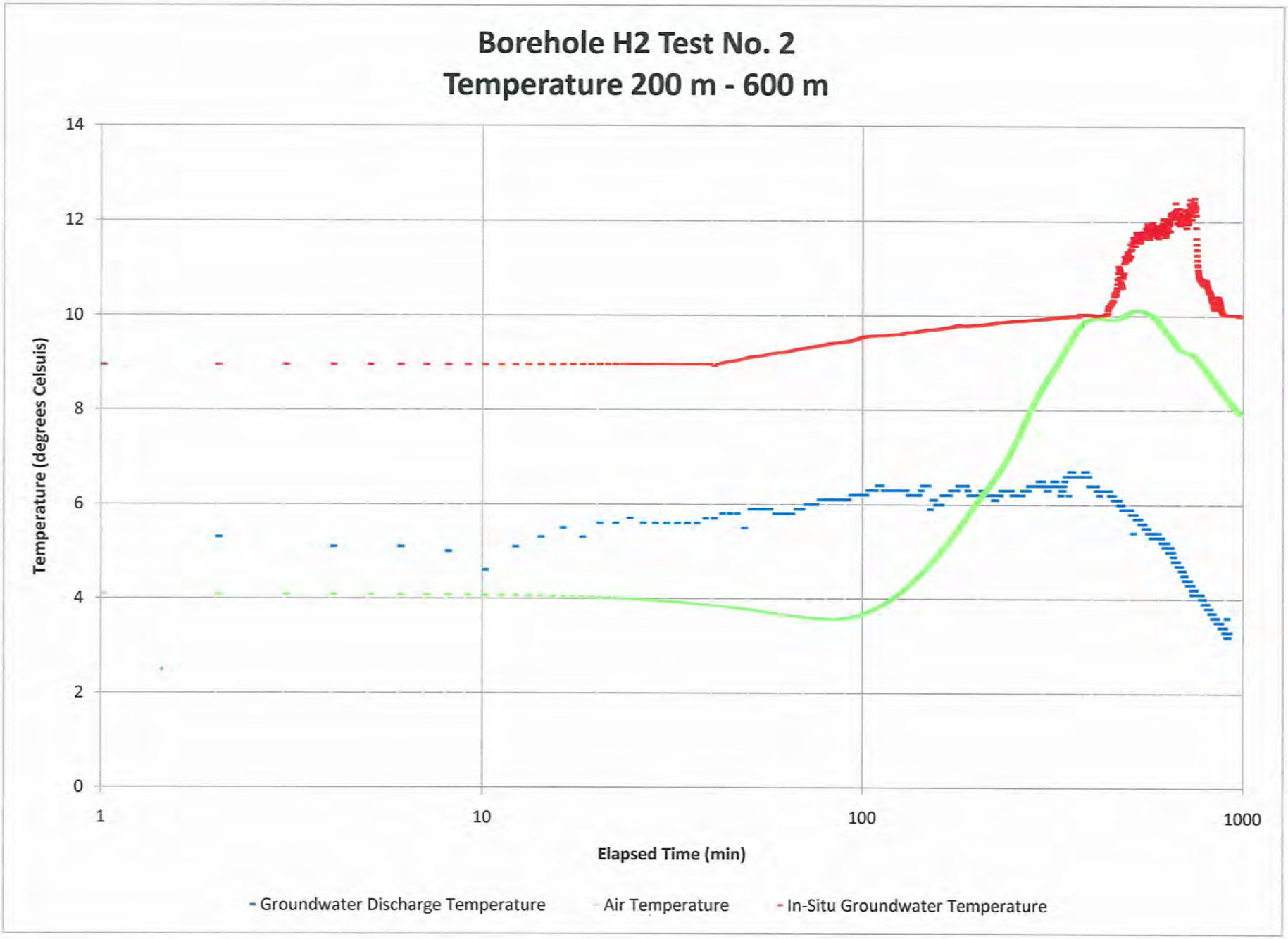


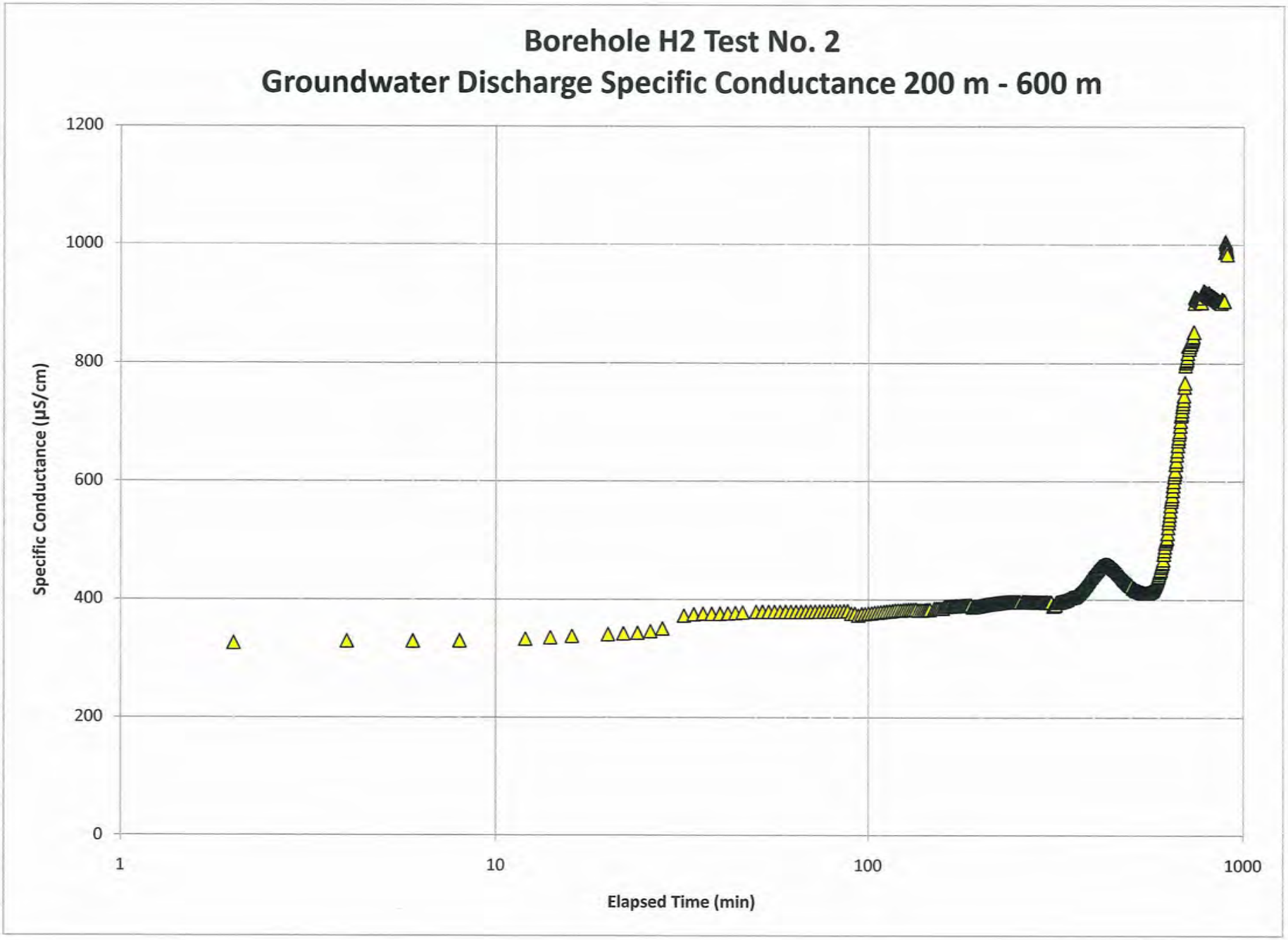

Borehole H2 Test No. 1
Groundwater Discharge pH 600 m - 870 m
pH
10
9
8
7
6
5
4
3
2
1
0
1
10
100
1000
10000
Elapsed Time (min)

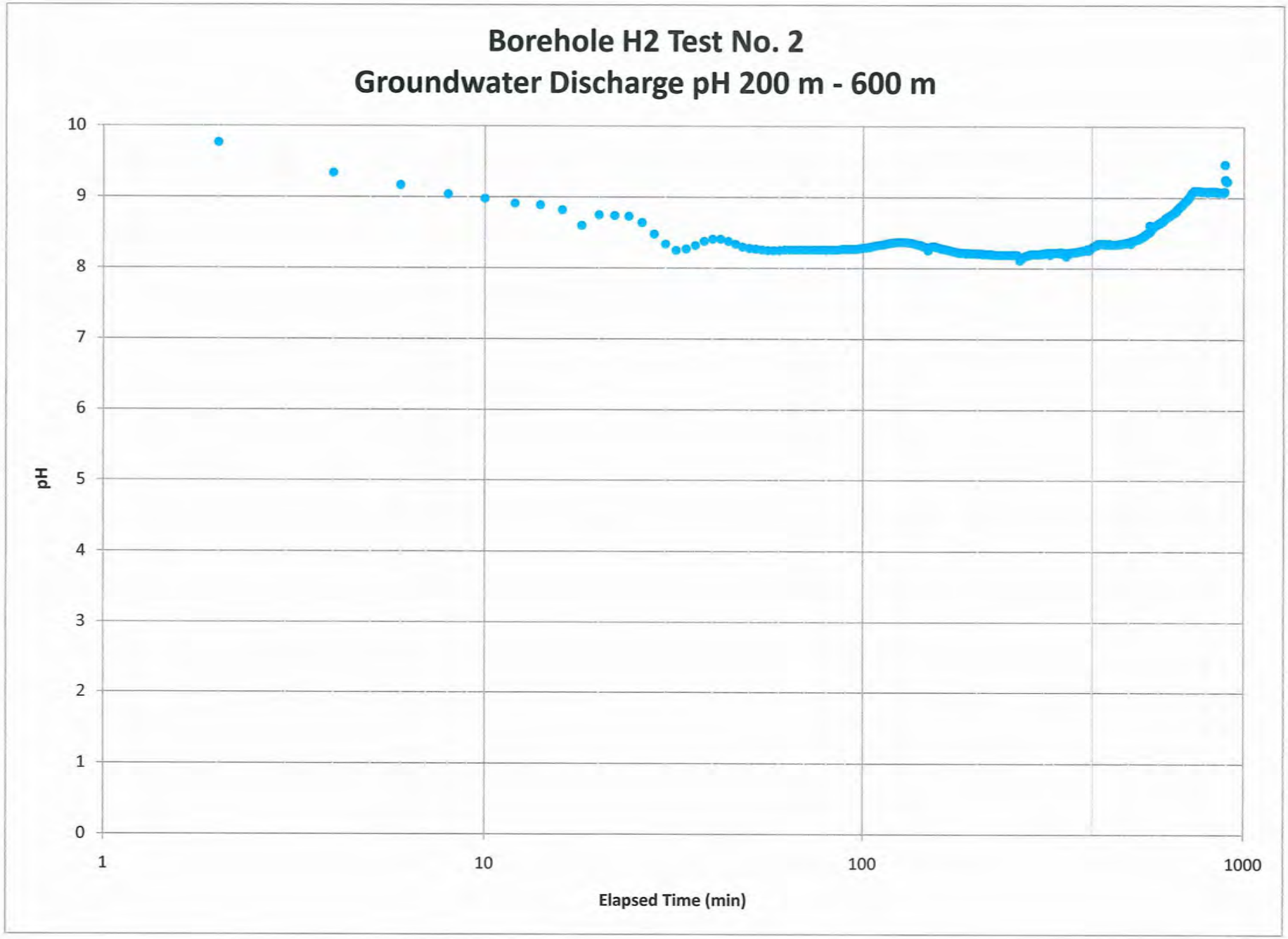

Borehole H2 Test No. 1
Groundwater Discharge Dissolved Oxygen 600 m -870 m
Dissolved Oxygen (mg/L)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
10
100
1000
10000
Elapsed Time (min)

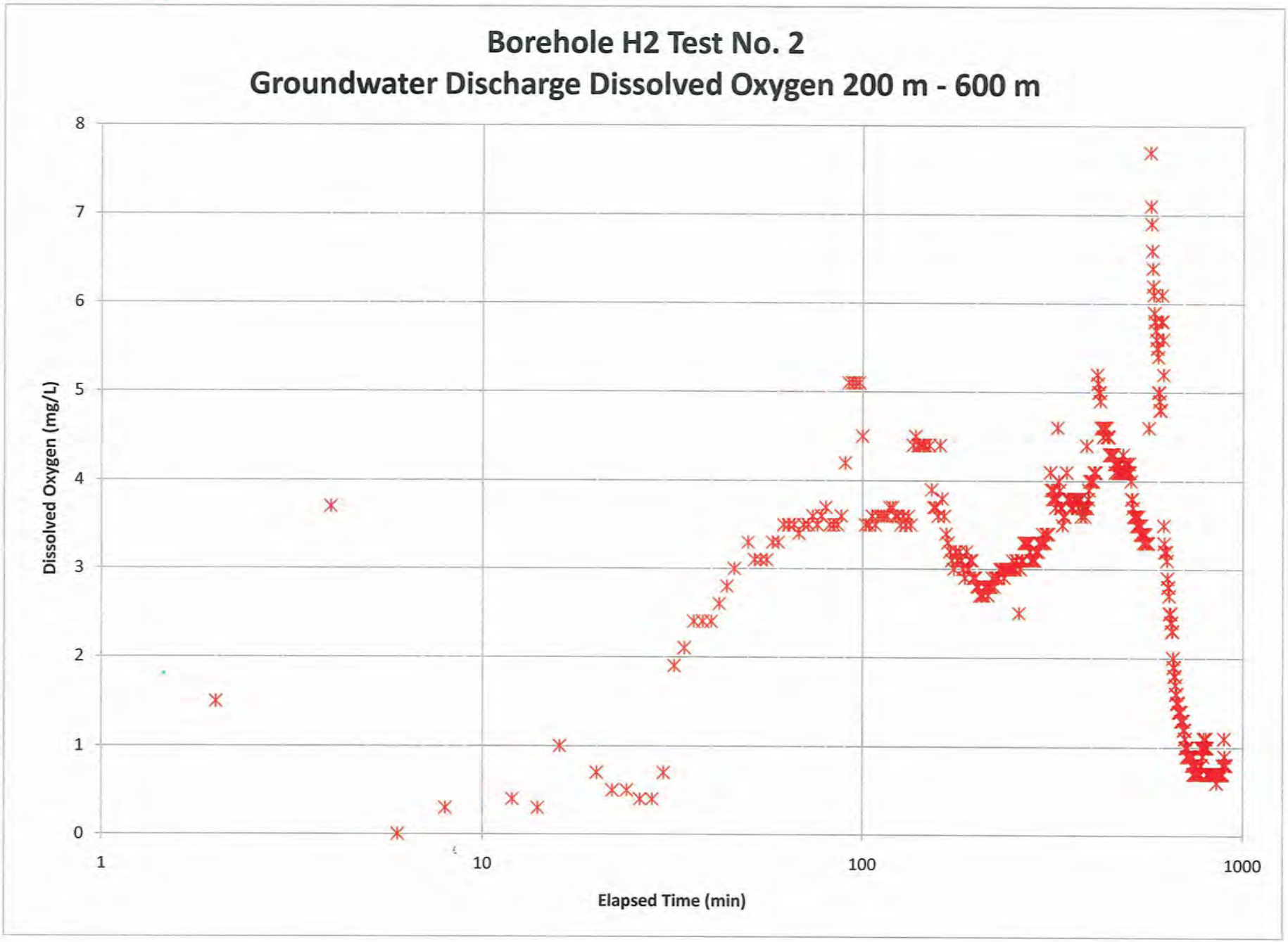
Borehole H2 Test No. 1
Groundwater Discharge Oxidation Reduction Potential 600 m -870 m

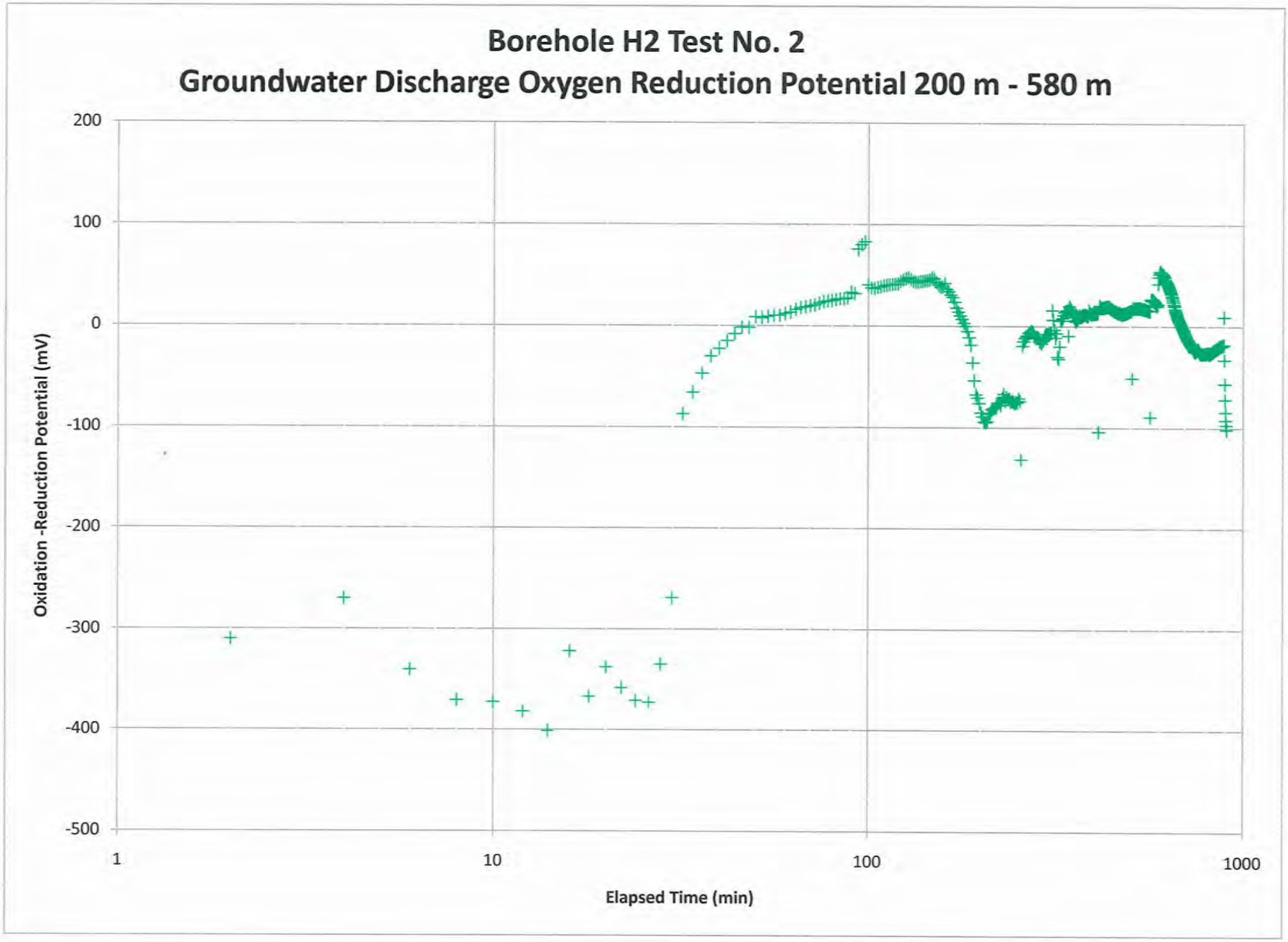


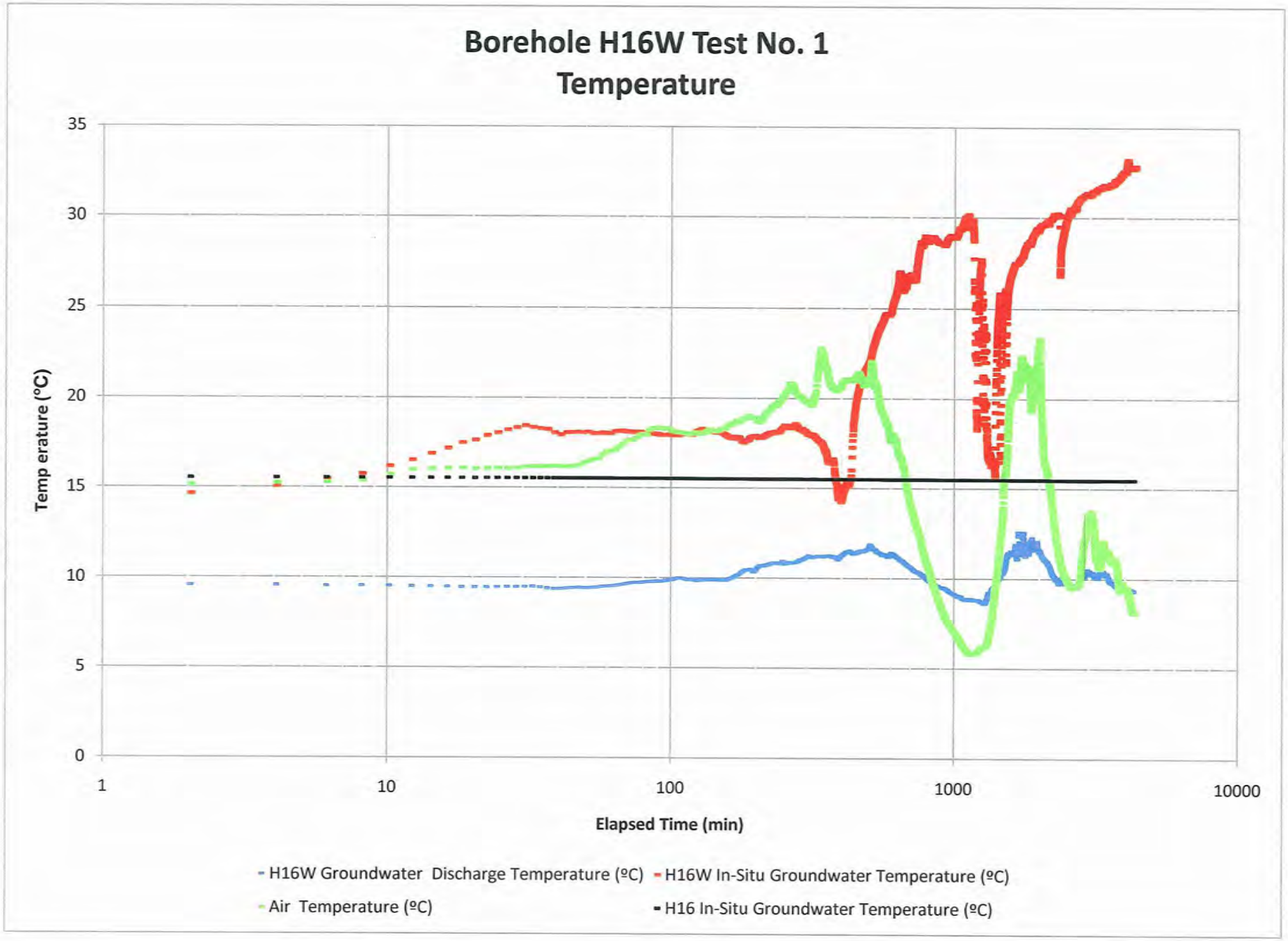

Borehole H2 Test No. 2
Temperature 200 m - 600 m
Temperature (degrees Celsuis)
14
12
10
8
6
4
2
0
1
10
100
1000
Elapsed Time (min)
Groundwater Discharge Temperature
Air Temperature
In-Situ Groundwater Temperature


Borehole H2 Test No. 2
Groundwater Discharge Specific Conductance 200 m - 600 m
Specific Conductance (µS/cm)
1200
1000
800
600
400
200
0
1
10
100
1000
Elapsed Time (min)

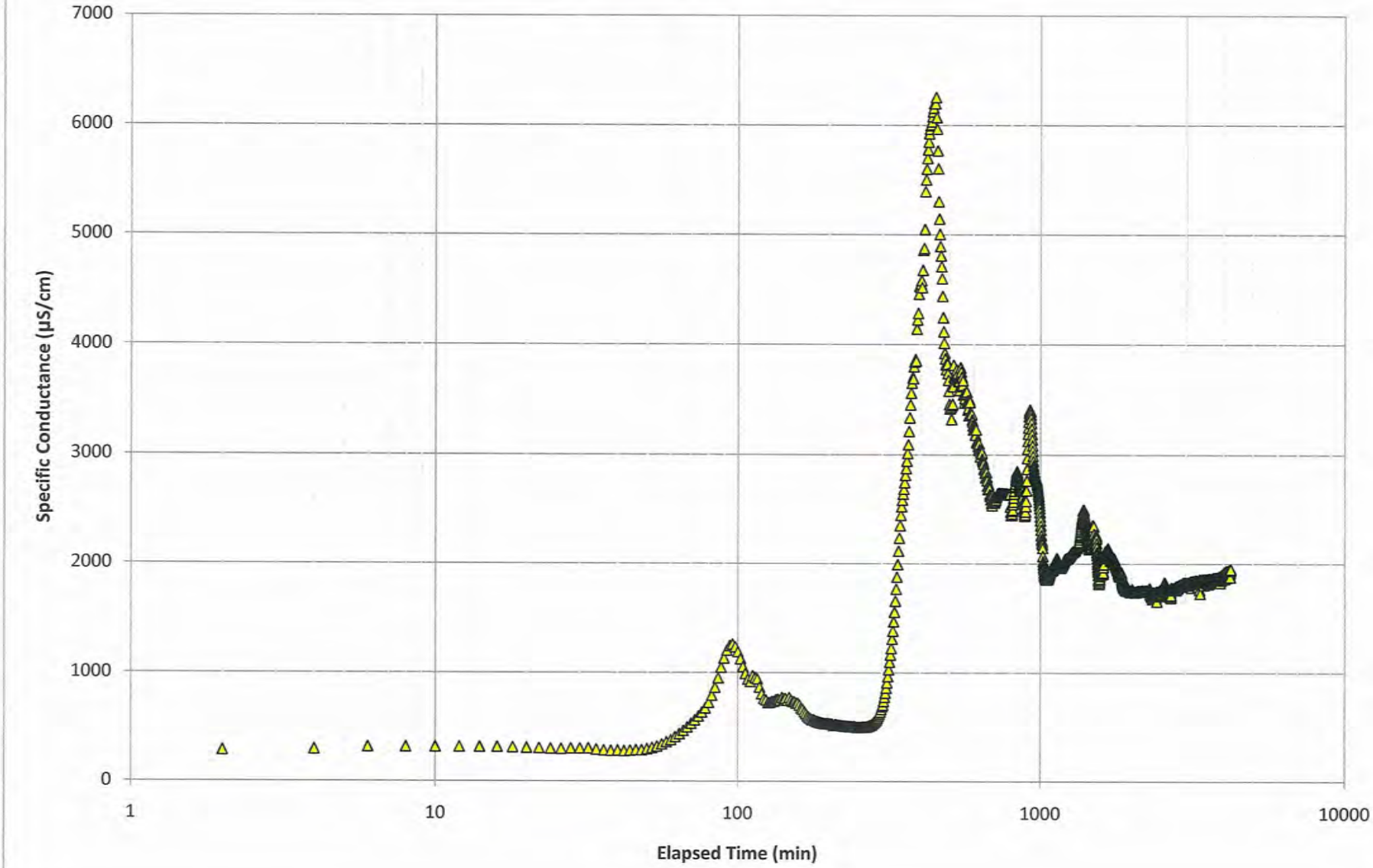

Borehole H2 Test No. 2
Groundwater Discharge pH 200 m - 600 m
pH
10
9
8
7
6
5
4
3
2
1
0
1
10
100
1000
Elapsed Time (min)

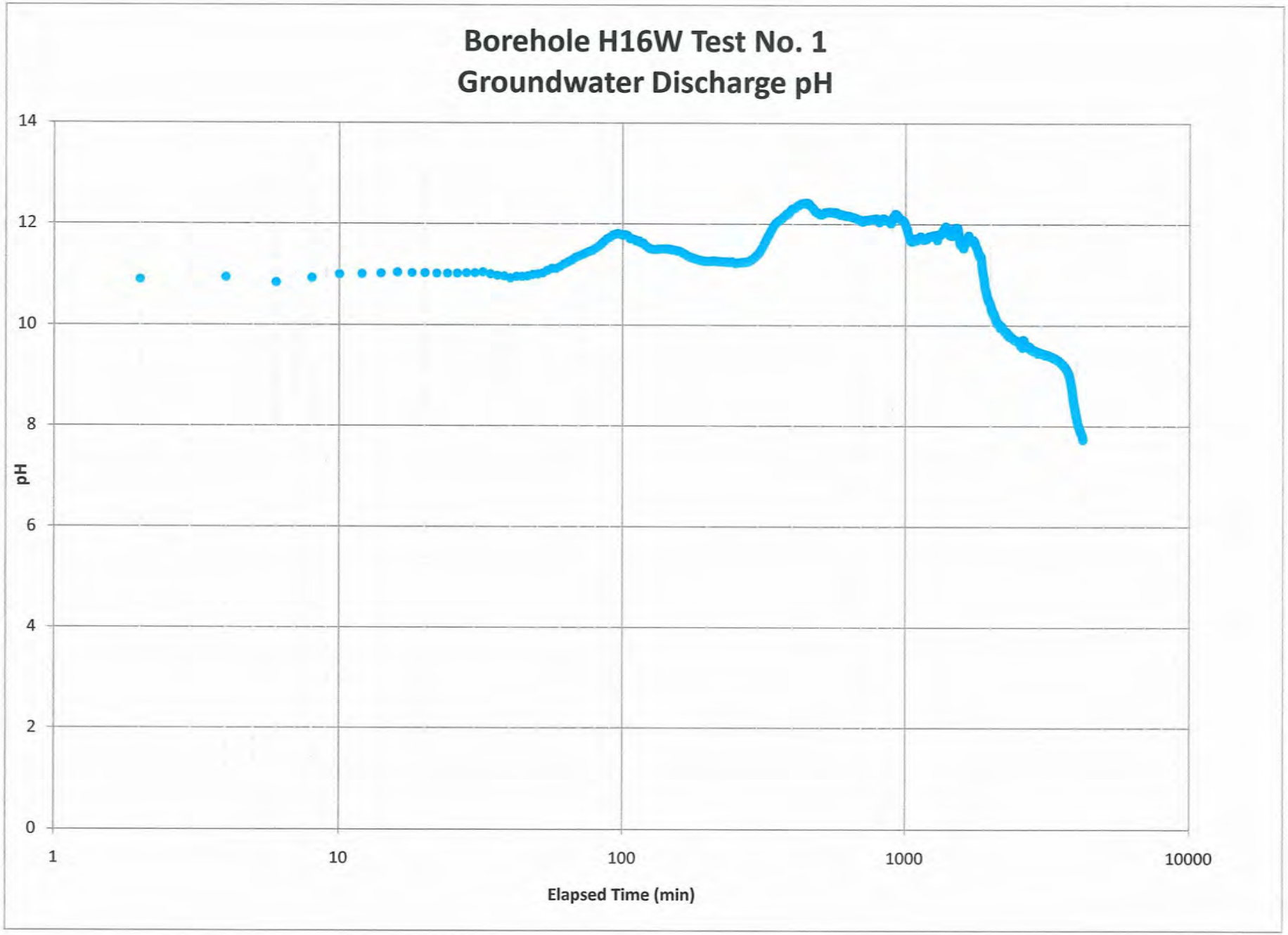

Borehole H2 Test No. 2
Groundwater Discharge Dissolved Oxygen 200 m - 600 m
Dissolved Oxygen (mg/L)
0
1
2
3
4
5
6
7
8
1
10
100
1000
Elapsed Time (min)

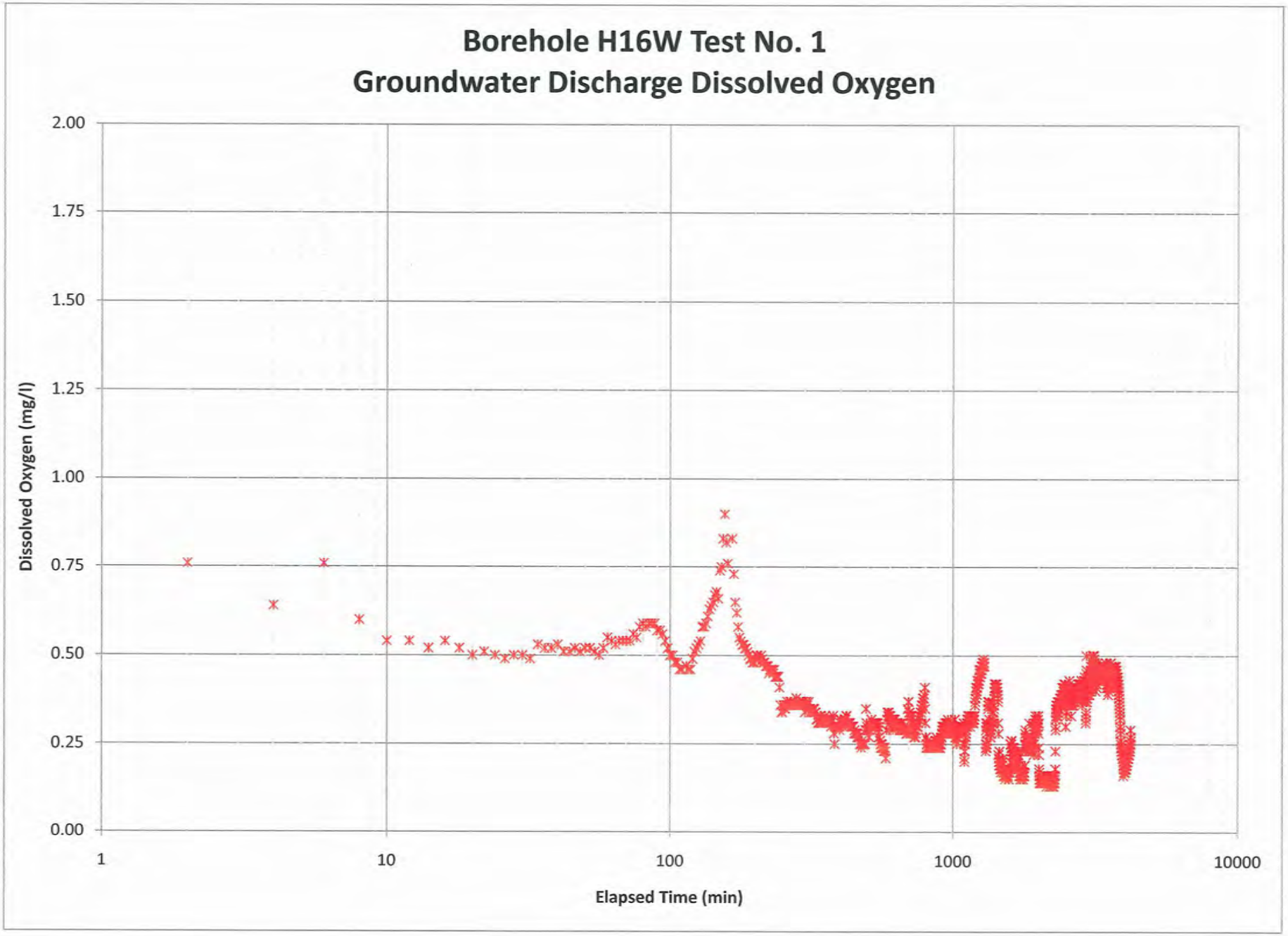

Borehole H2 Test No. 2
Groundwater Discharge Oxygen Reduction Potential 200 m - 580 m
200
100
0
-100
-200
-300
-400
-500
Oxidation -Reduction Potential (mV)
1
10
100
1000
Elapsed Time (min)

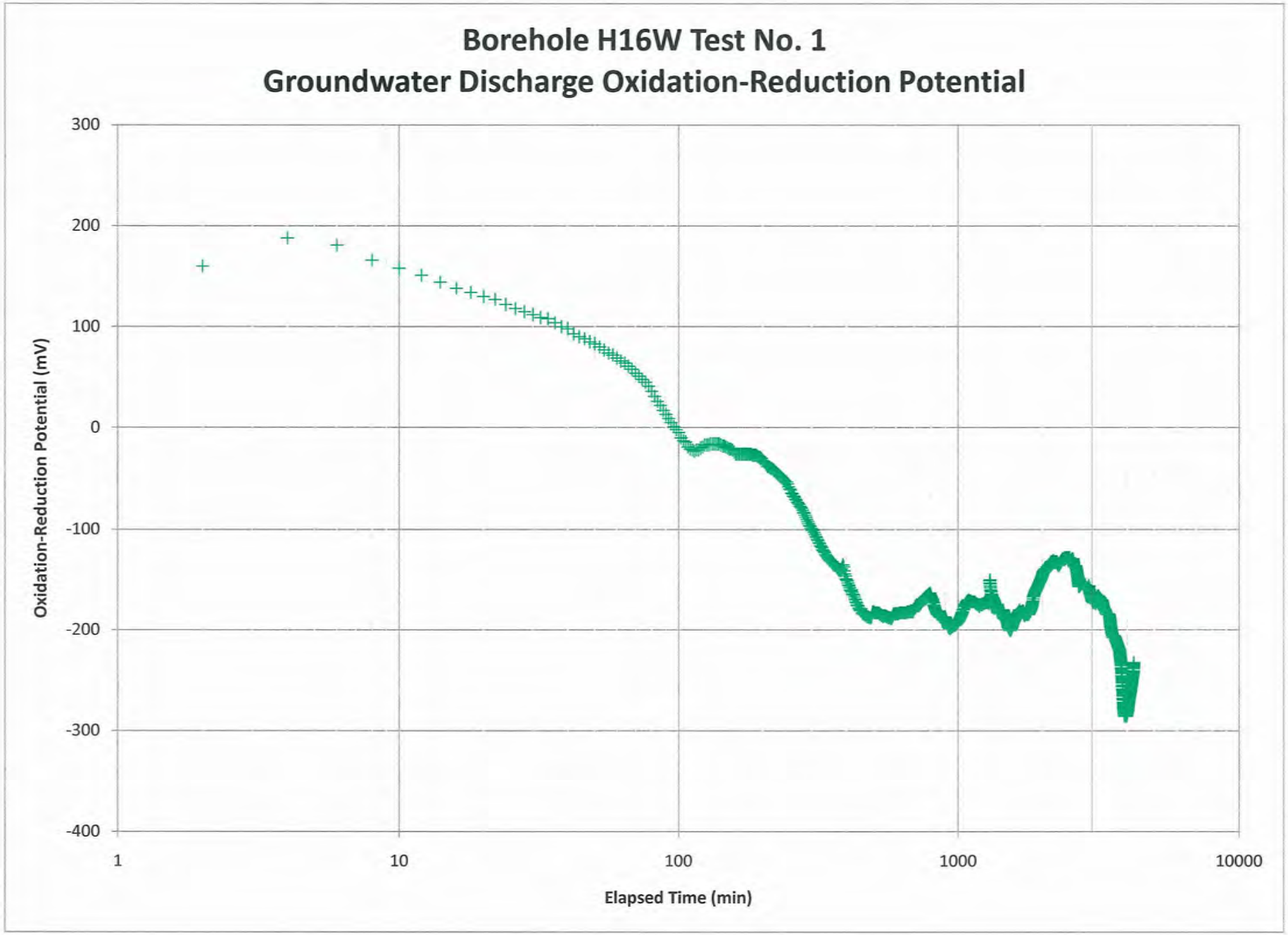

Borehole H16W Test No. 1
Temperature
Temp erature (°C)
35
30
25
20
15
10
5
0
1
10
100
1000
10000
Elapsed Time (min)
H16W Groundwater Discharge Temperature (ºC)
H16W In-Situ Groundwater Temperature (ºC)
Air Temperature (ºC)
H16 In-Situ Groundwater Temperature (ºC)

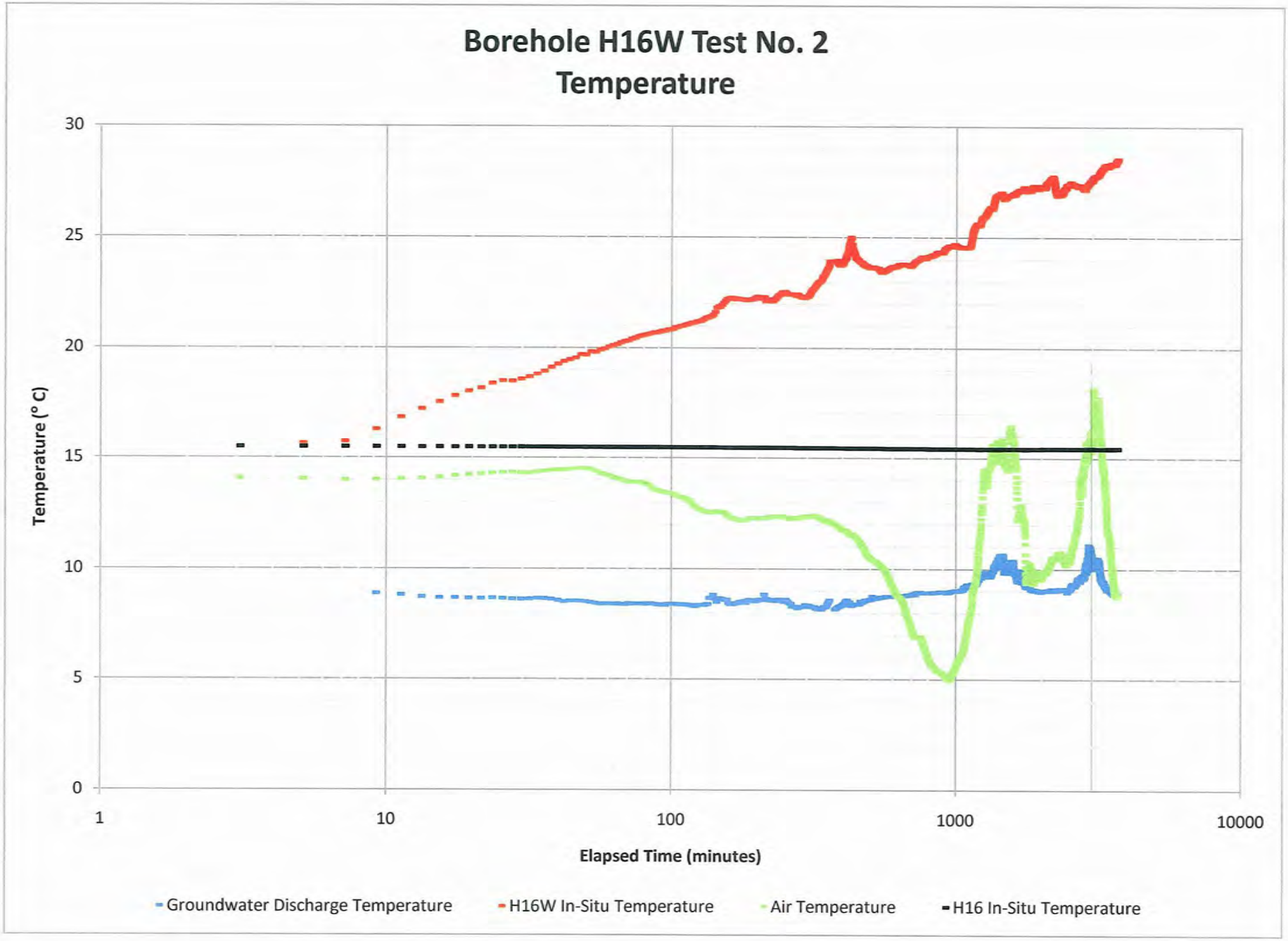
Borehole H16W Test No. 1
Groundwater Discharge Specific Conductance

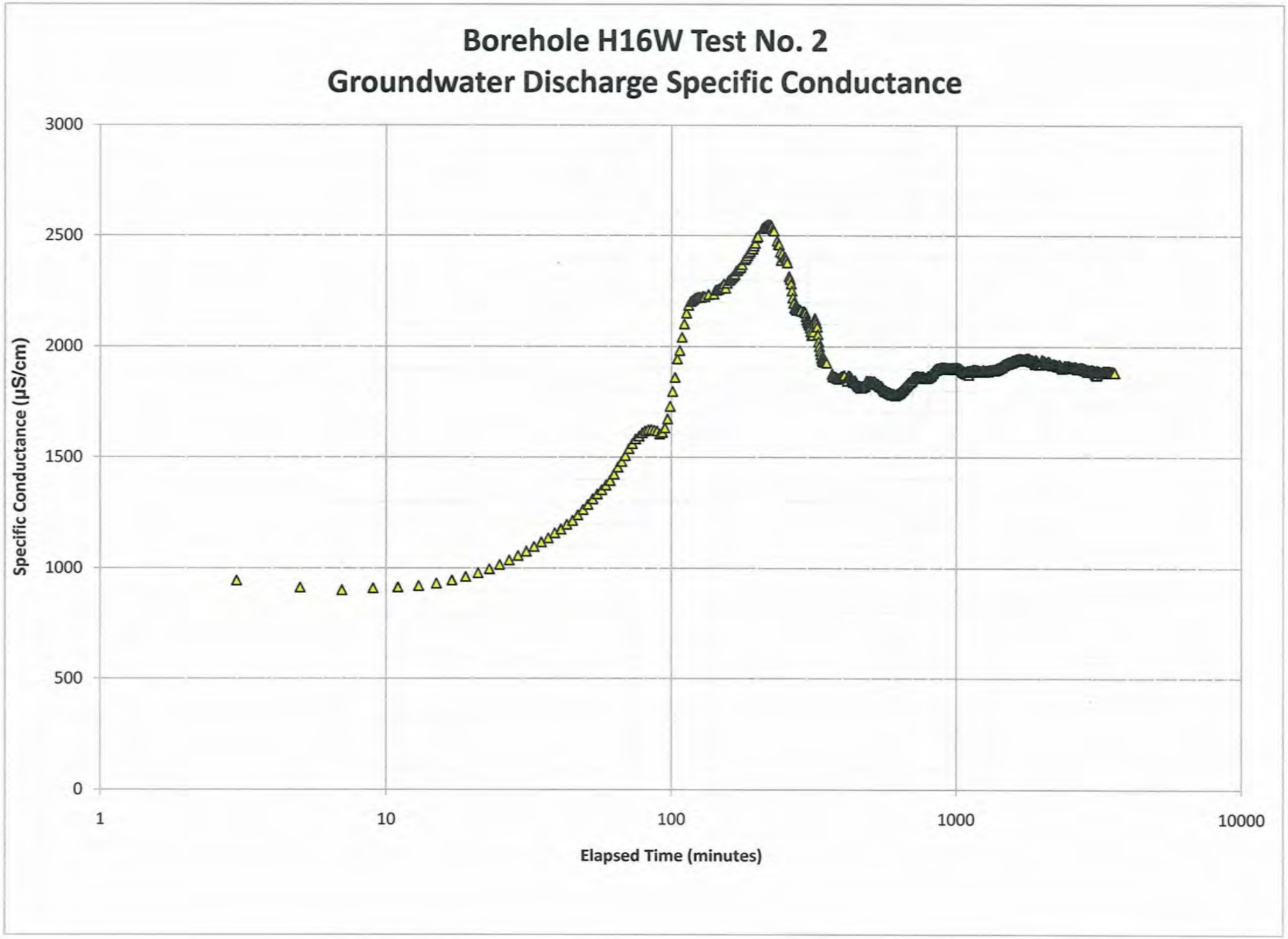


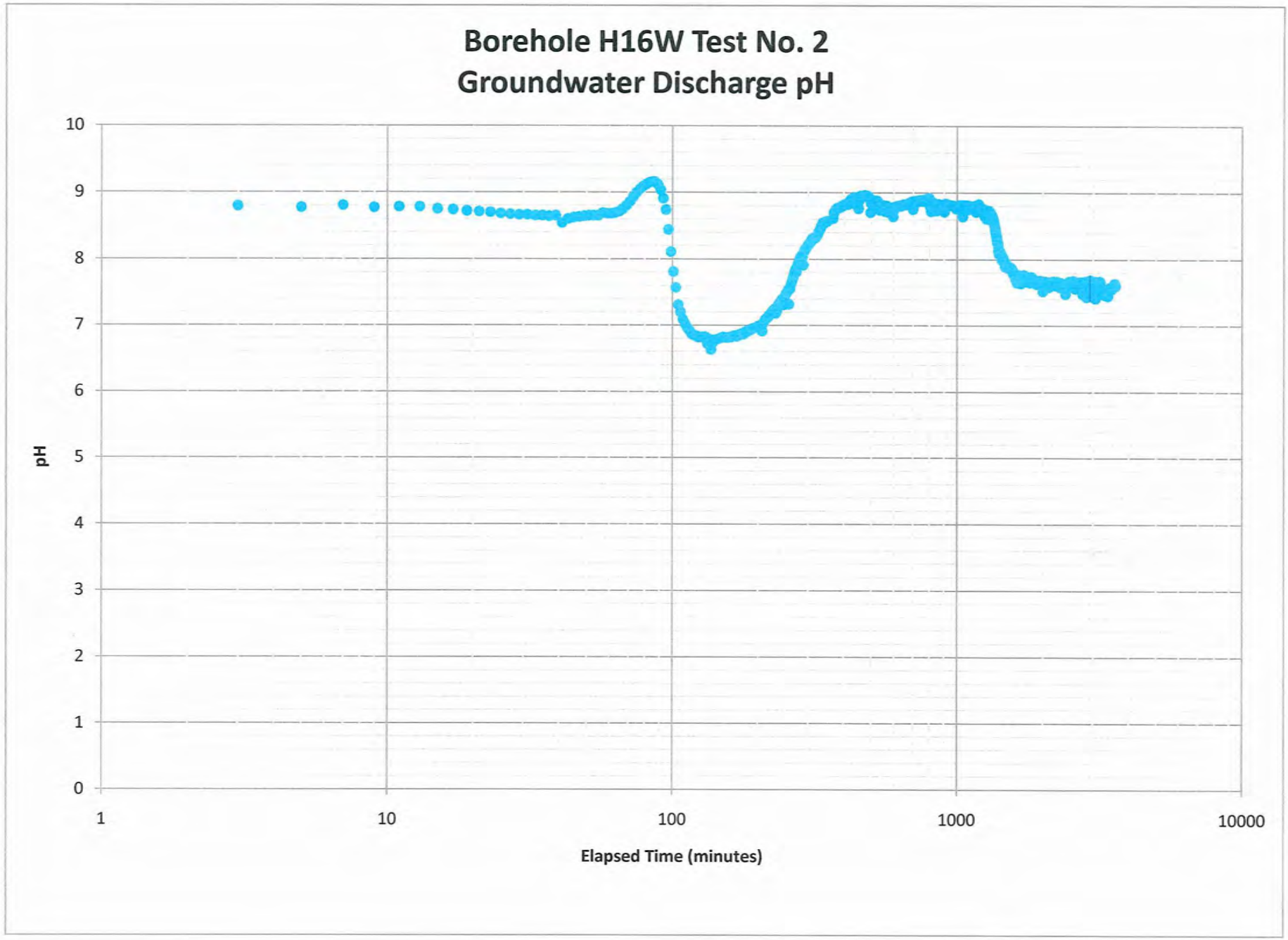

Borehole H16W Test No. 1
Groundwater Discharge pH
14
12
10
8
6
4
2
0
pH
1
10
100
1000
10000
Elapsed Time (min)

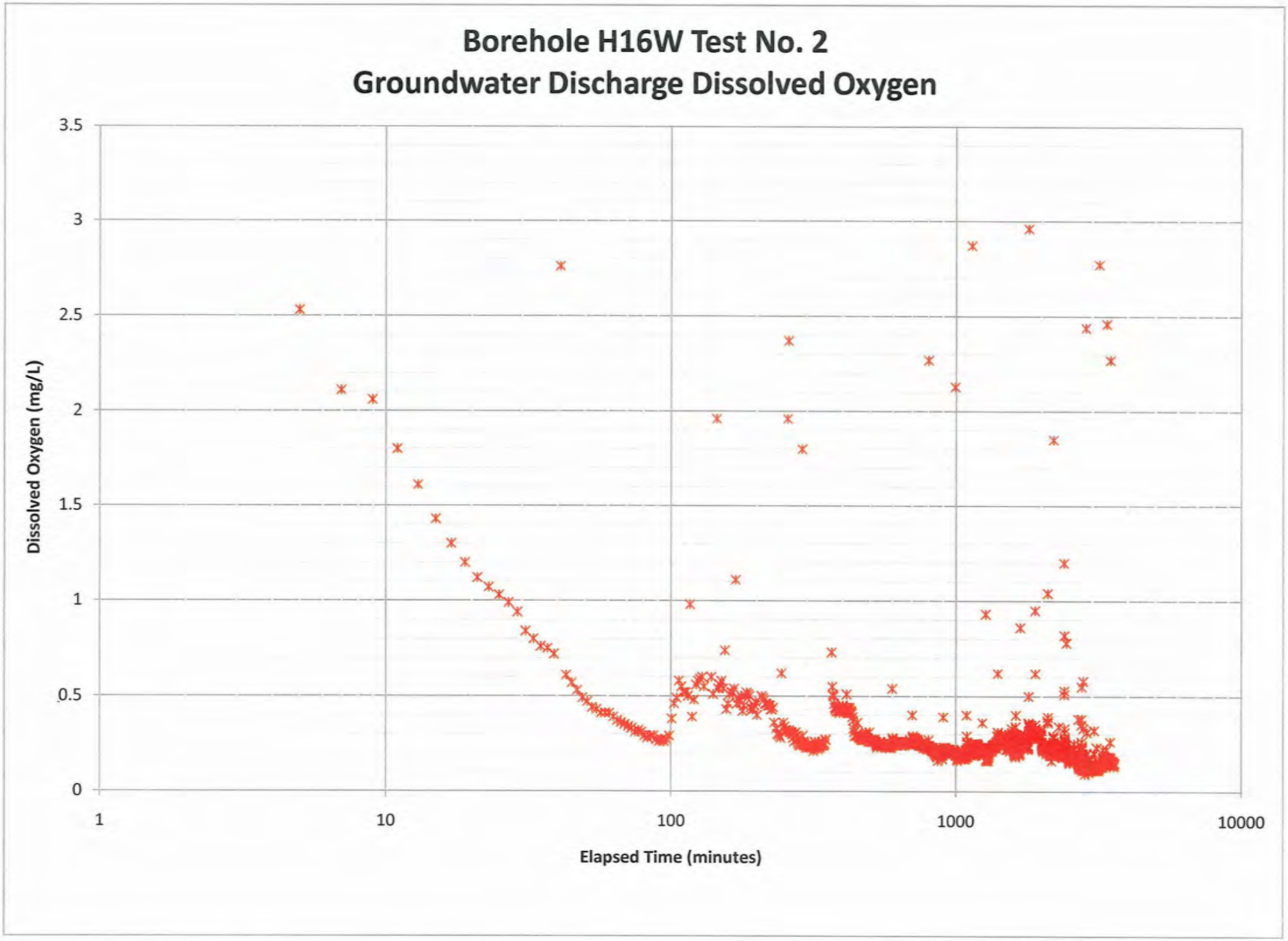

Borehole H16W Test No. 1
Groundwater Discharge Dissolved Oxygen
Dissolved Oxygen (mg/l)
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1
10
100
1000
10000
Elapsed Time (min)


Borehole H16W Test No. 1
Groundwater Discharge Oxidation-Reduction Potential
300
200
100
0
-100
-200
-300
-400
Oxidation-Reduction Potential (mV)
1
10
100
1000
10000
Elapsed Time (min)

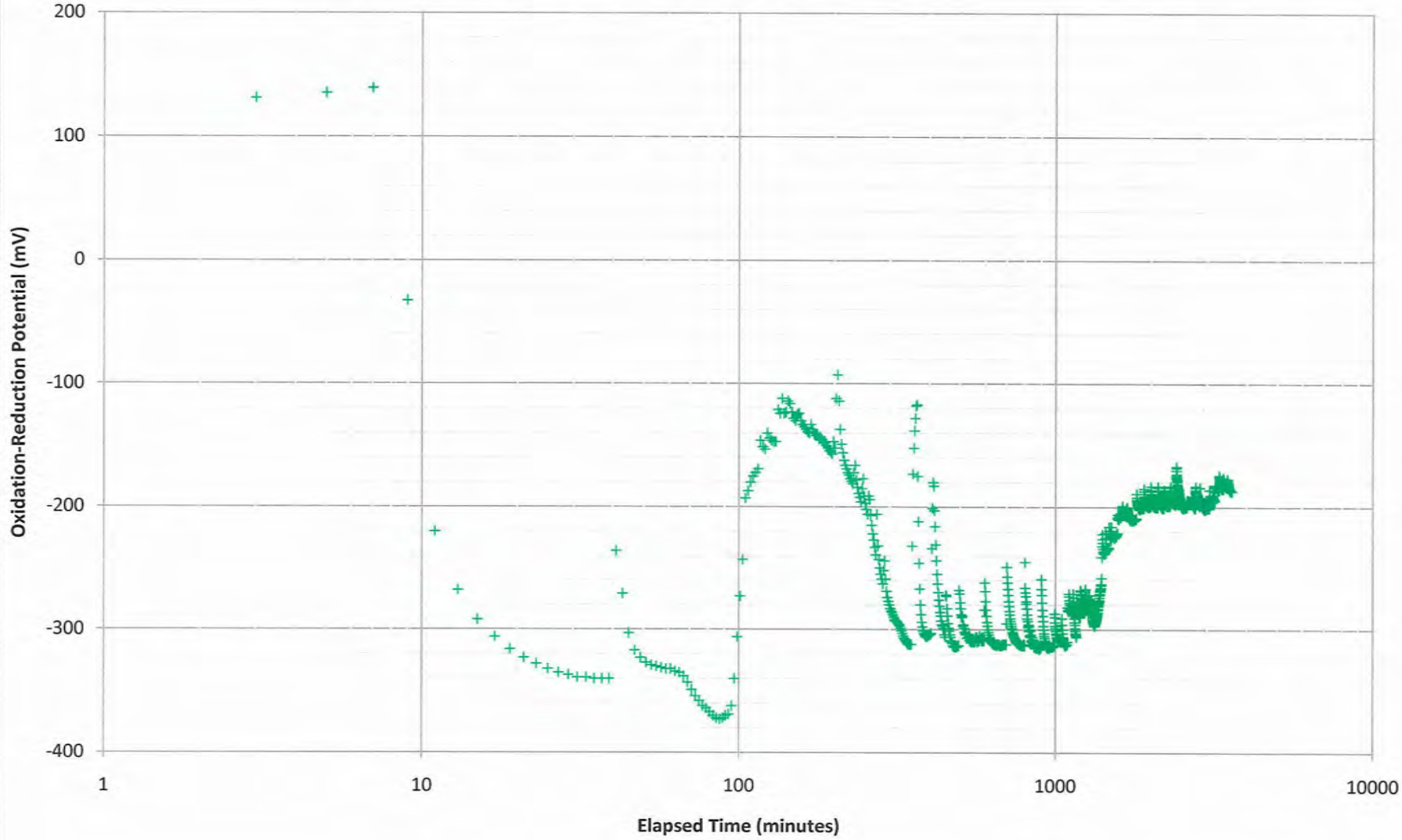

Borehole H16W Test No. 2
Temperature
30
25
20
15
10
5
0
Temperature (° C)
1
10
100
1000
10000
Elapsed Time (minutes)
Groundwater Discharge Temperature
H16W In-Situ Temperature
Air Temperature
H16 In-Situ Temperature

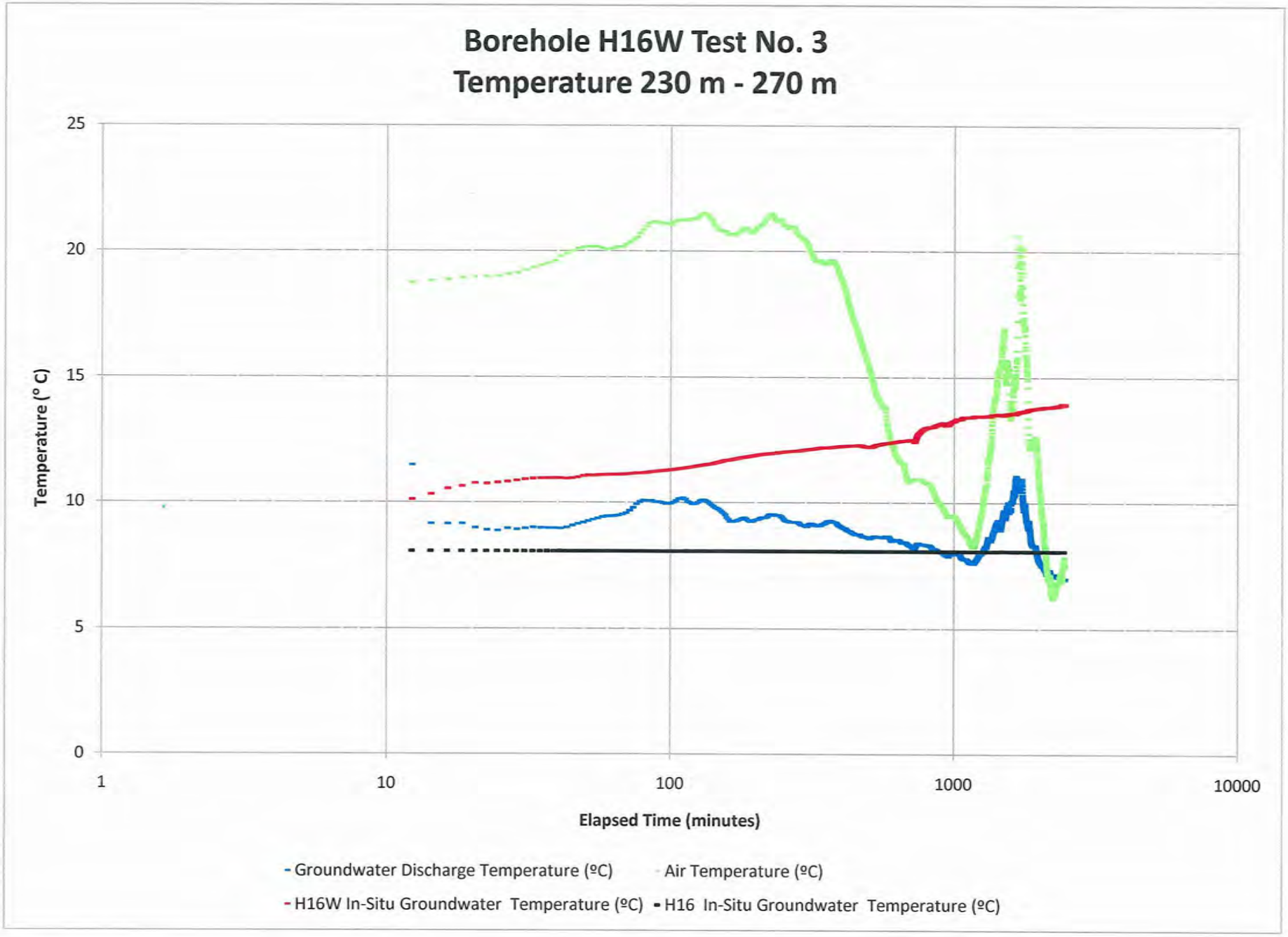

Borehole H16W Test No. 2
Groundwater Discharge Specific Conductance
Specific Conductance (µS/cm)
3000
2500
2000
1500
1000
500
0
1
10
100
1000
10000
Elapsed Time (minutes)


Borehole H16W Test No. 2
Groundwater Discharge pH
pH
10
9
8
7
6
5
4
3
2
1
0
1
10
100
1000
10000
Elapsed Time (minutes)

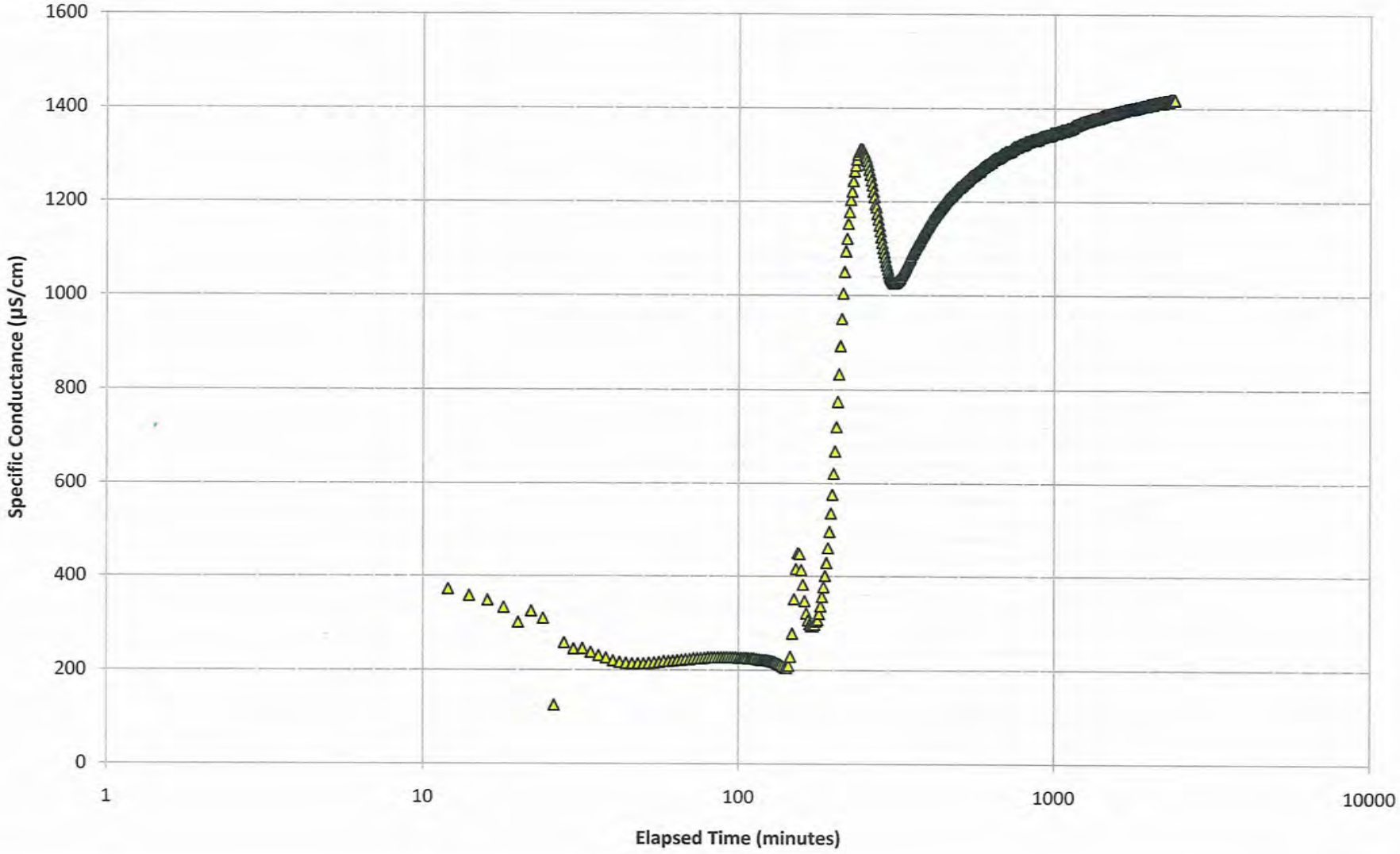

Borehole H16W Test No. 2
Groundwater Discharge Dissolved Oxygen
Dissolved Oxygen (mg/L)
3.5
3
2.5
2
1.5
1
0.5
0
1
10
100
1000
10000
Elapsed Time (minutes)

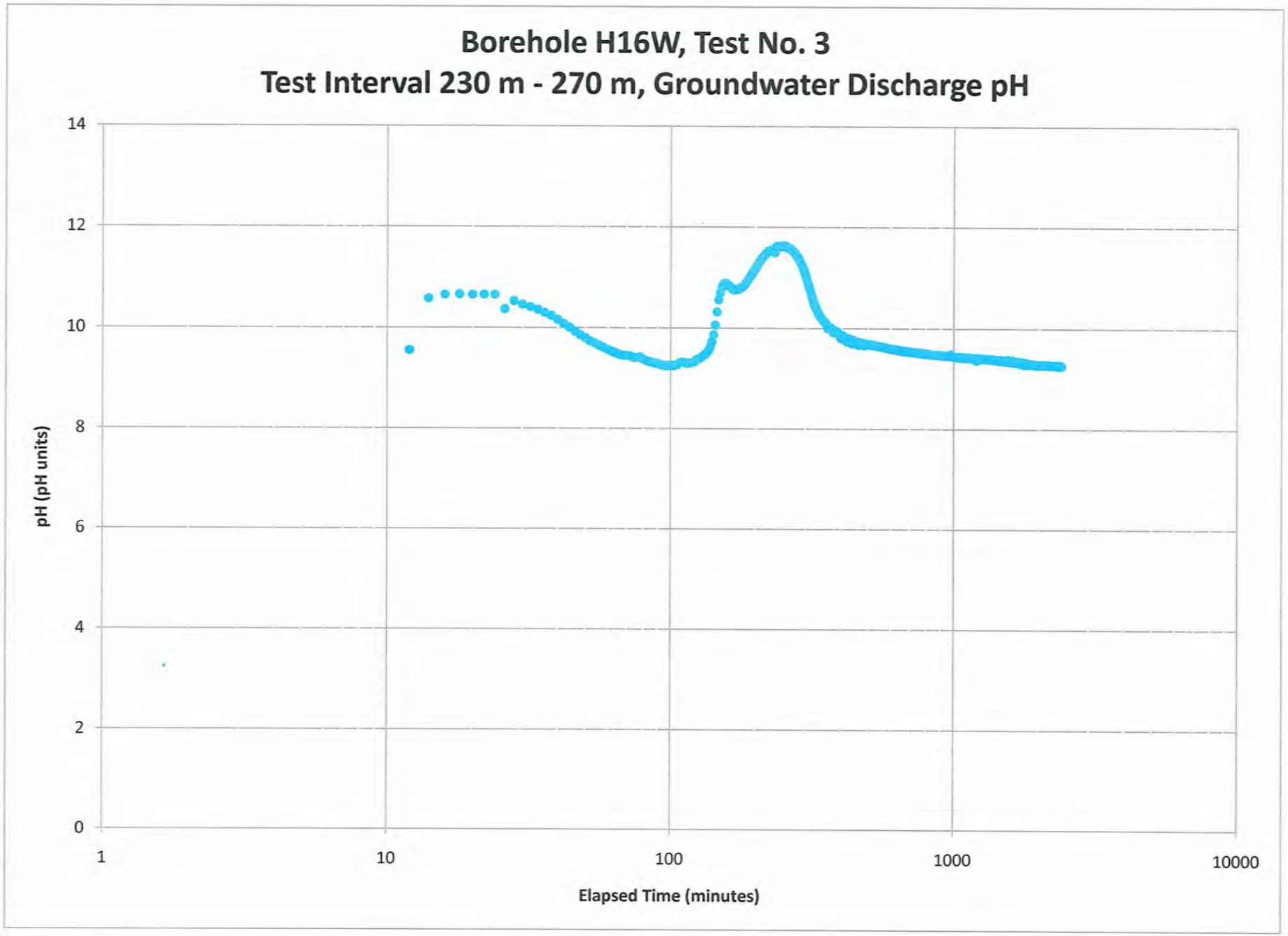
Borehole H16W Test No. 2
Groundwater Discharge Oxidation-Reduction Potential



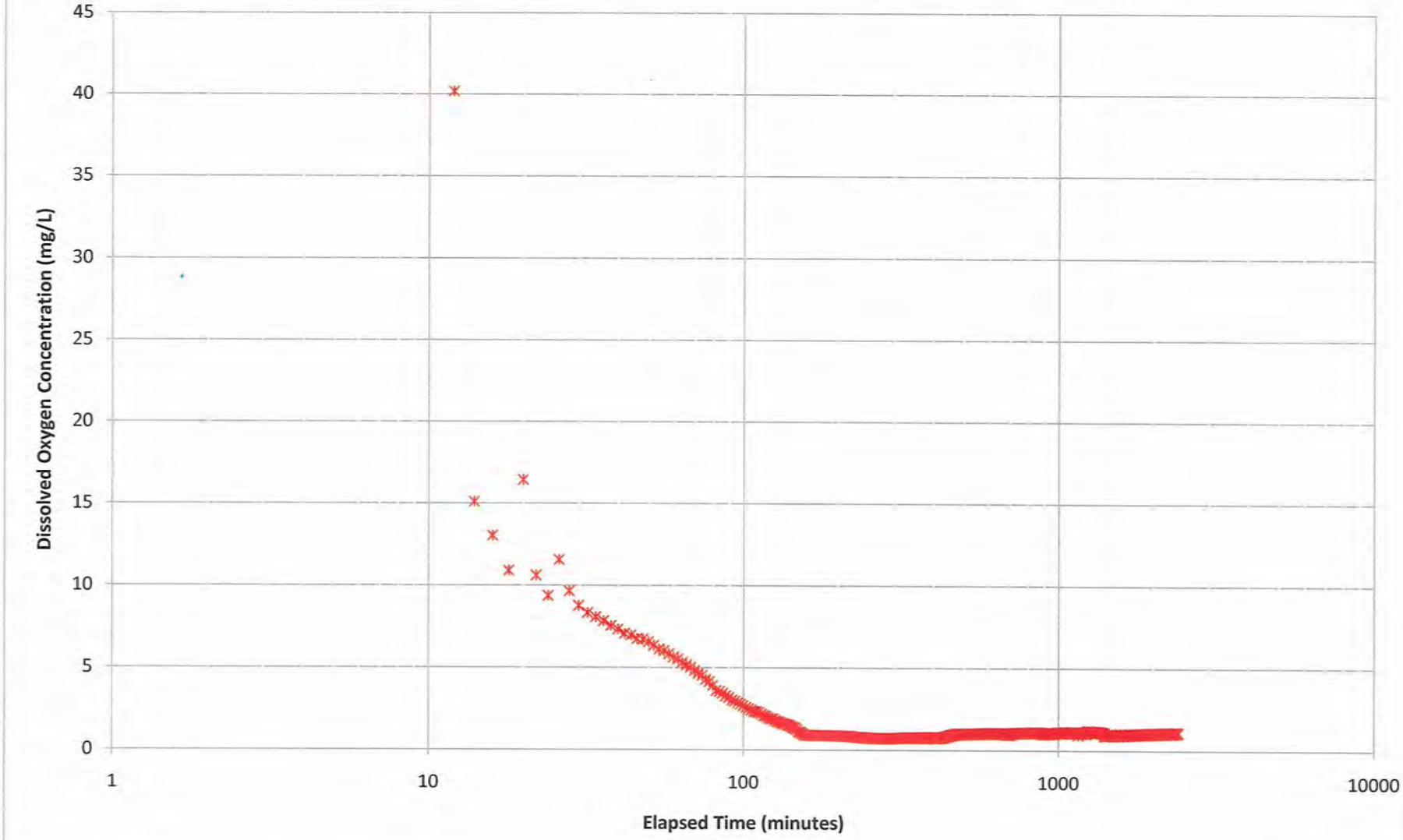

Borehole H16W Test No. 3
Temperature 230 m - 270 m
Temperature (° C)
25
20
15
10
5
0
1
10
100
1000
10000
Elapsed Time (minutes)
Groundwater Discharge Temperature (ºC)
Air Temperature (ºC)
H16W In-Situ Groundwater Temperature (ºC)
H16 In-Situ Groundwater Temperature (ºC)

Borehole H16W Test No. 3
Test Interval 230 m - 270 m
Groundwater Discharge Specific Conductance

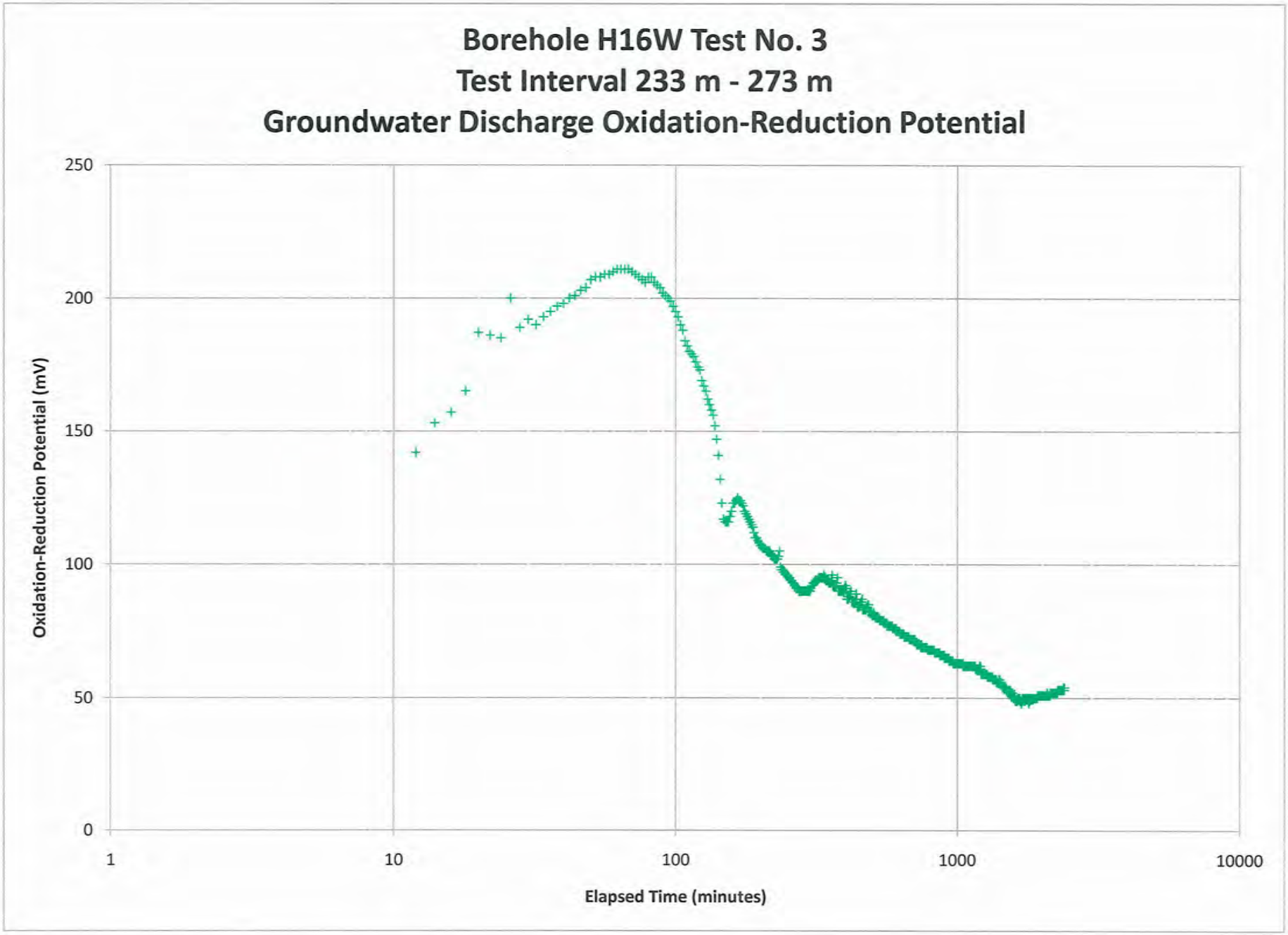



Borehole H16W, Test No. 3
Test Interval 230 m - 270 m, Groundwater Discharge pH
pH (pH units)
14
12
10
8
6
4
2
0
1
10
100
1000
10000
Elapsed Time (minutes)

Borehole H16W Test No. 3
Test Interval 230 m - 270 m
Groundwater Discharge Dissolved Oxygen Concentration

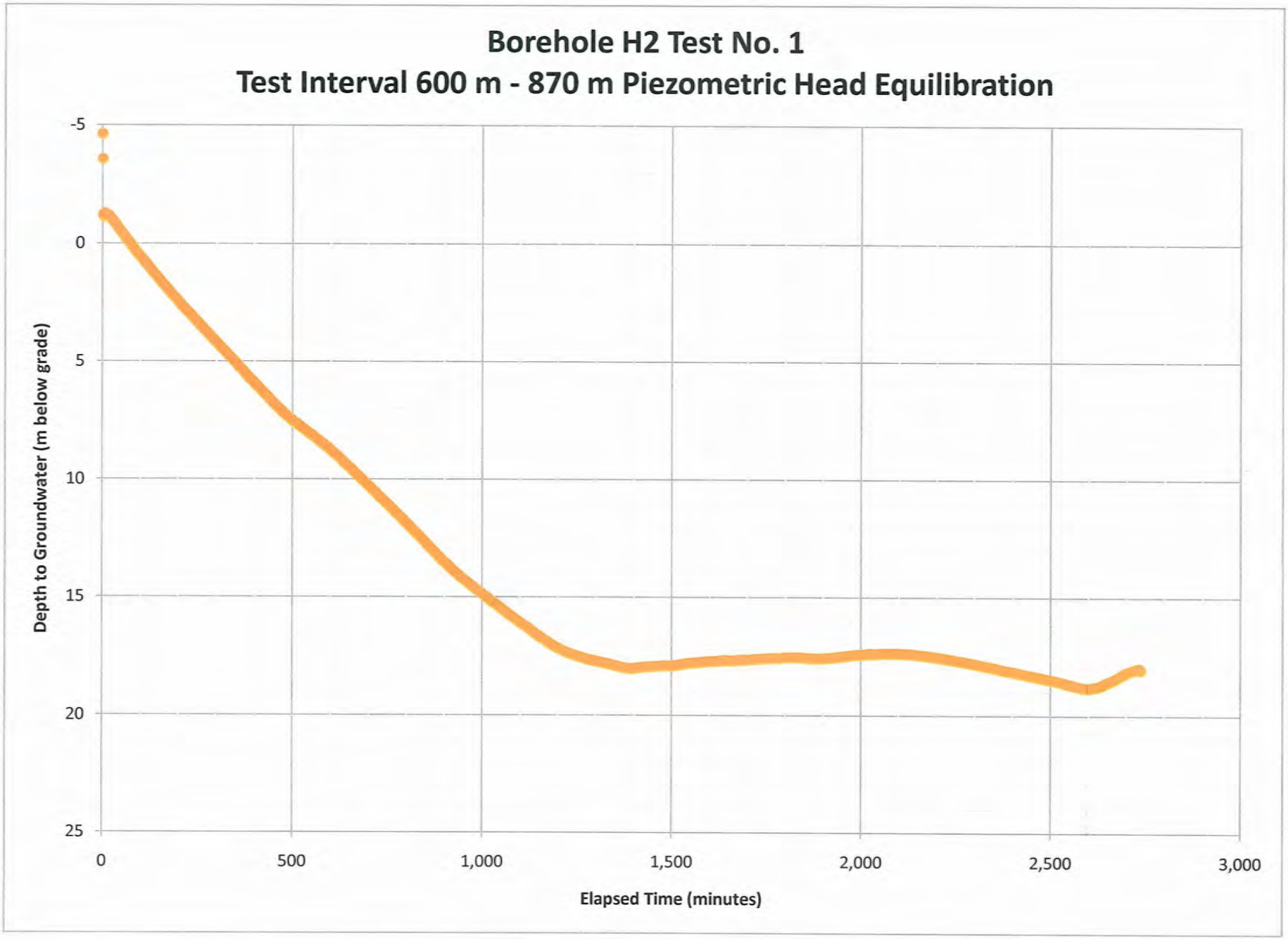


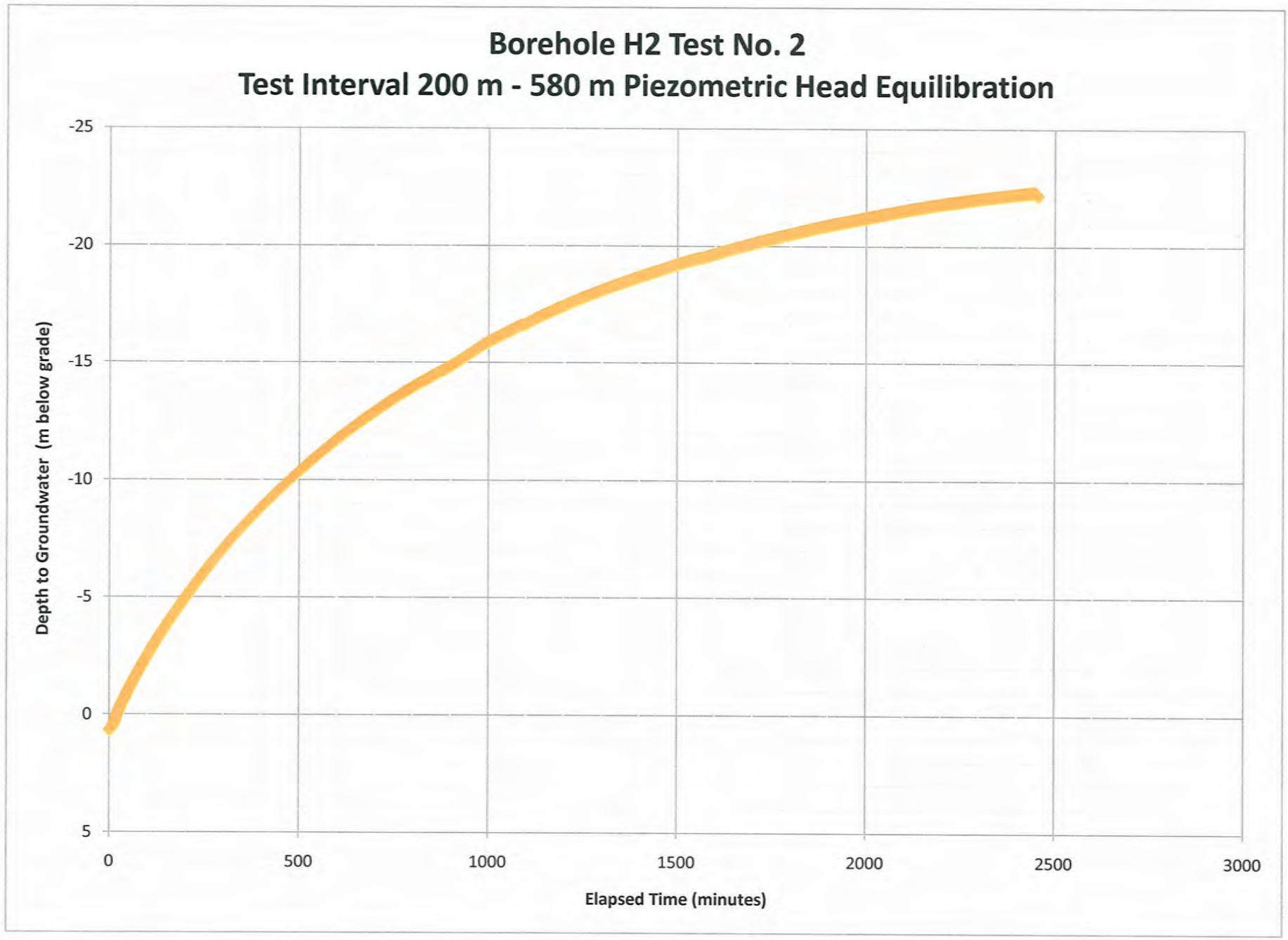
Borehole H16W Test No. 3
Test Interval 233 m - 273 m
Groundwater Discharge Oxidation-Reduction Potential

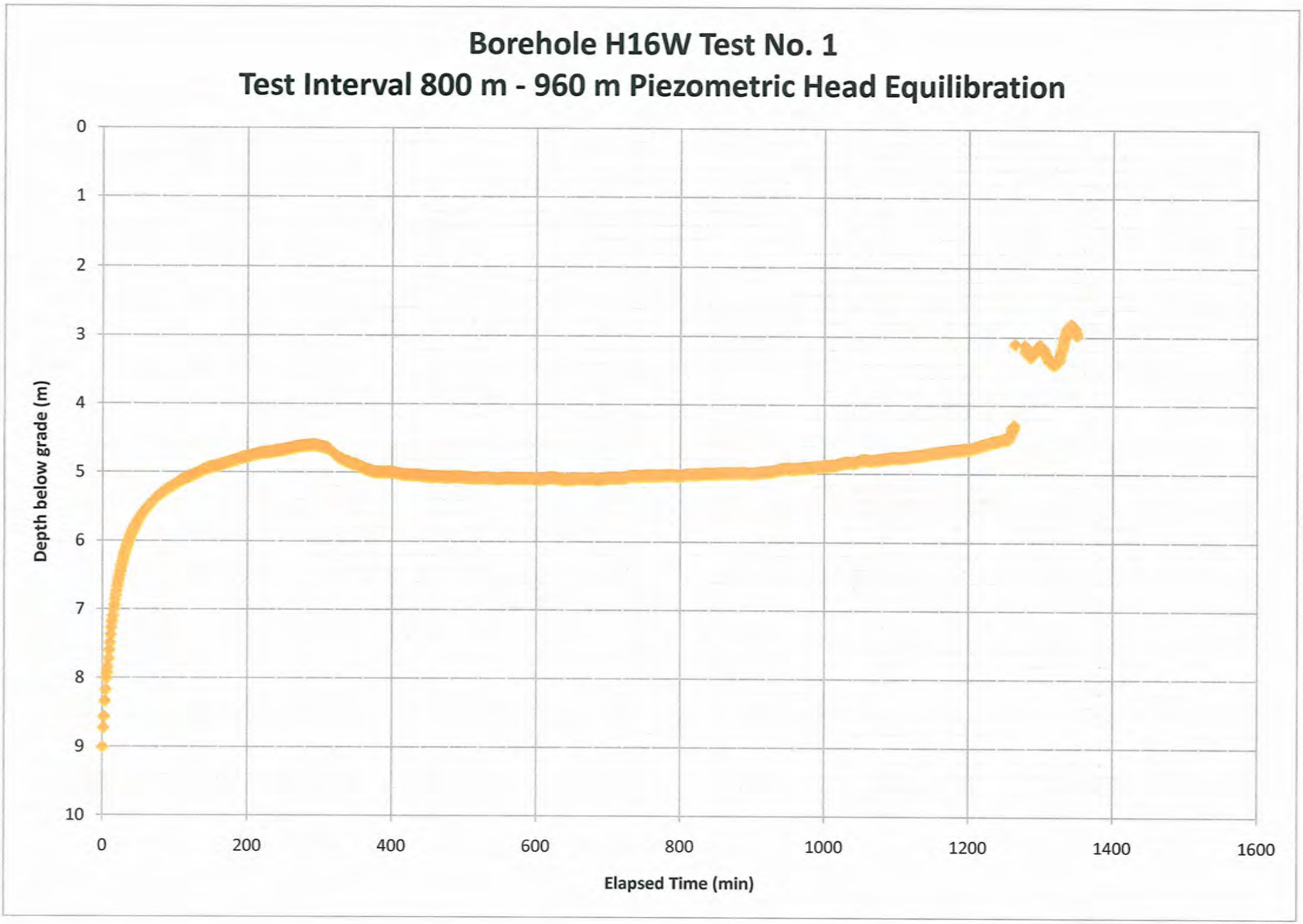


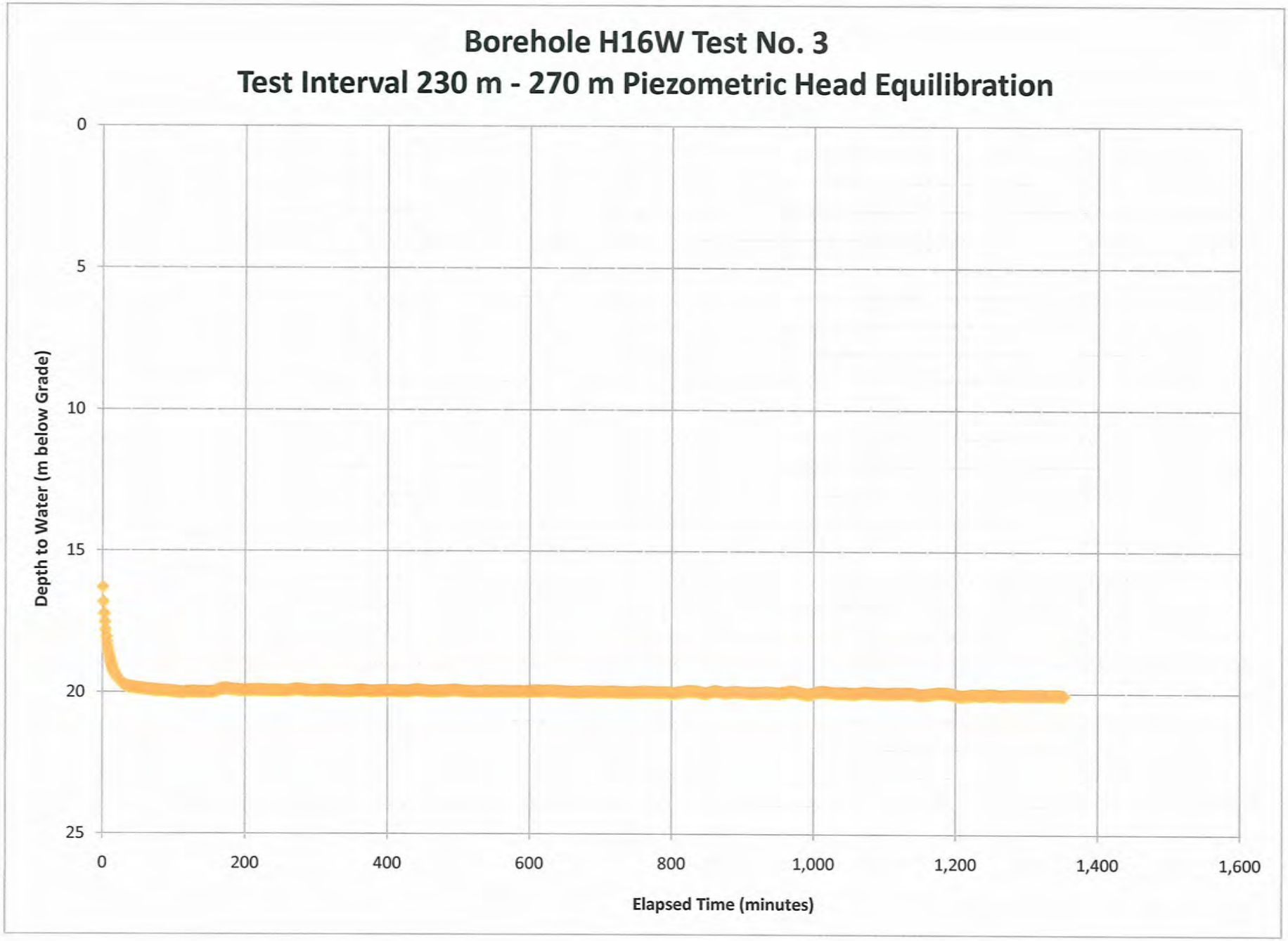
APPENDIX F

EQUILIBRATED PIEZOMETRIC HEADS

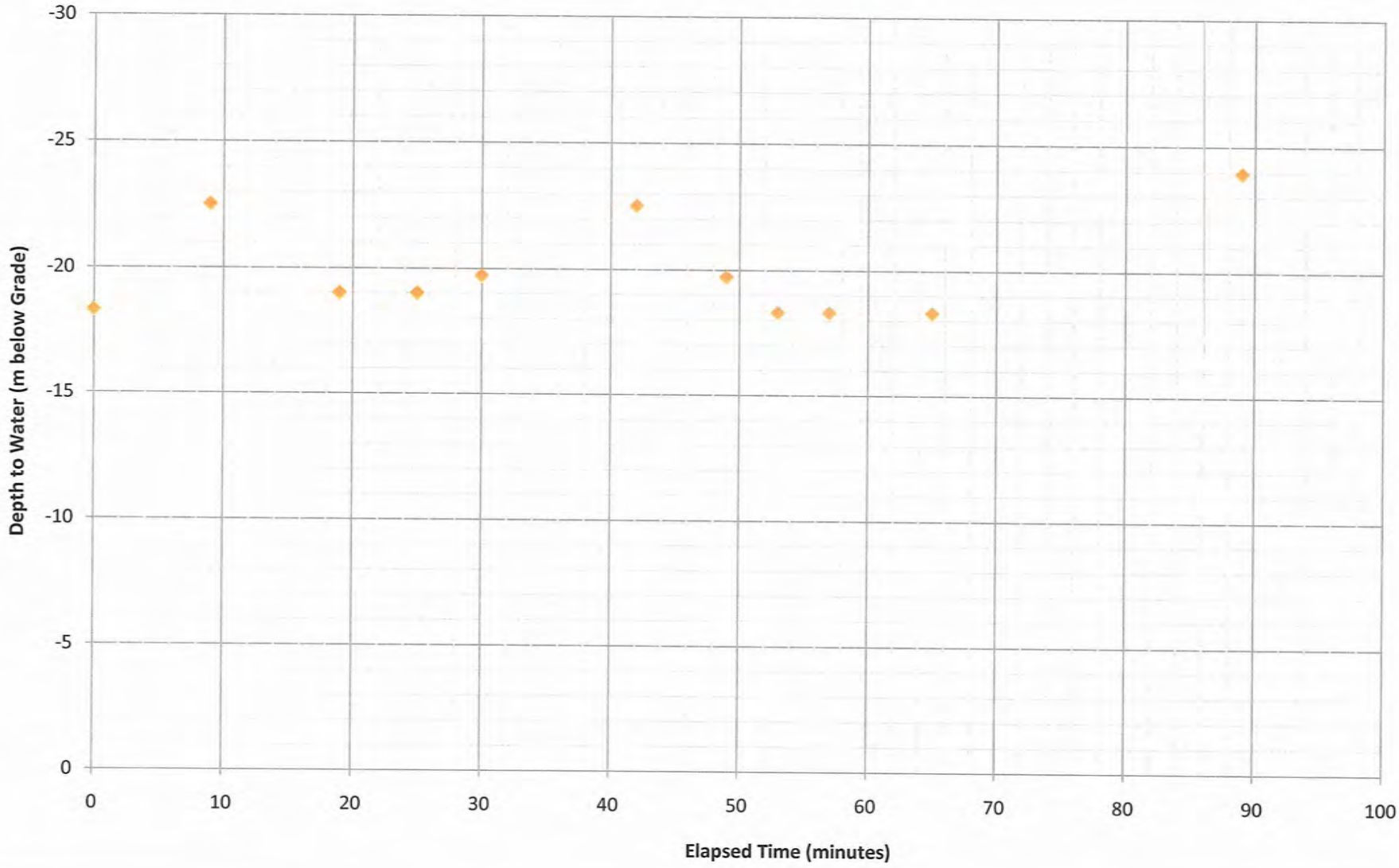

Borehole H2 Test No. 1
Test Interval 600 m - 870 m Piezometric Head Equilibration
Depth to Groundwater (m below grade)
-5
0
5
10
15
20
25
0
500
1,000
1,500
2,000
2,500
3,000
Elapsed Time (minutes)

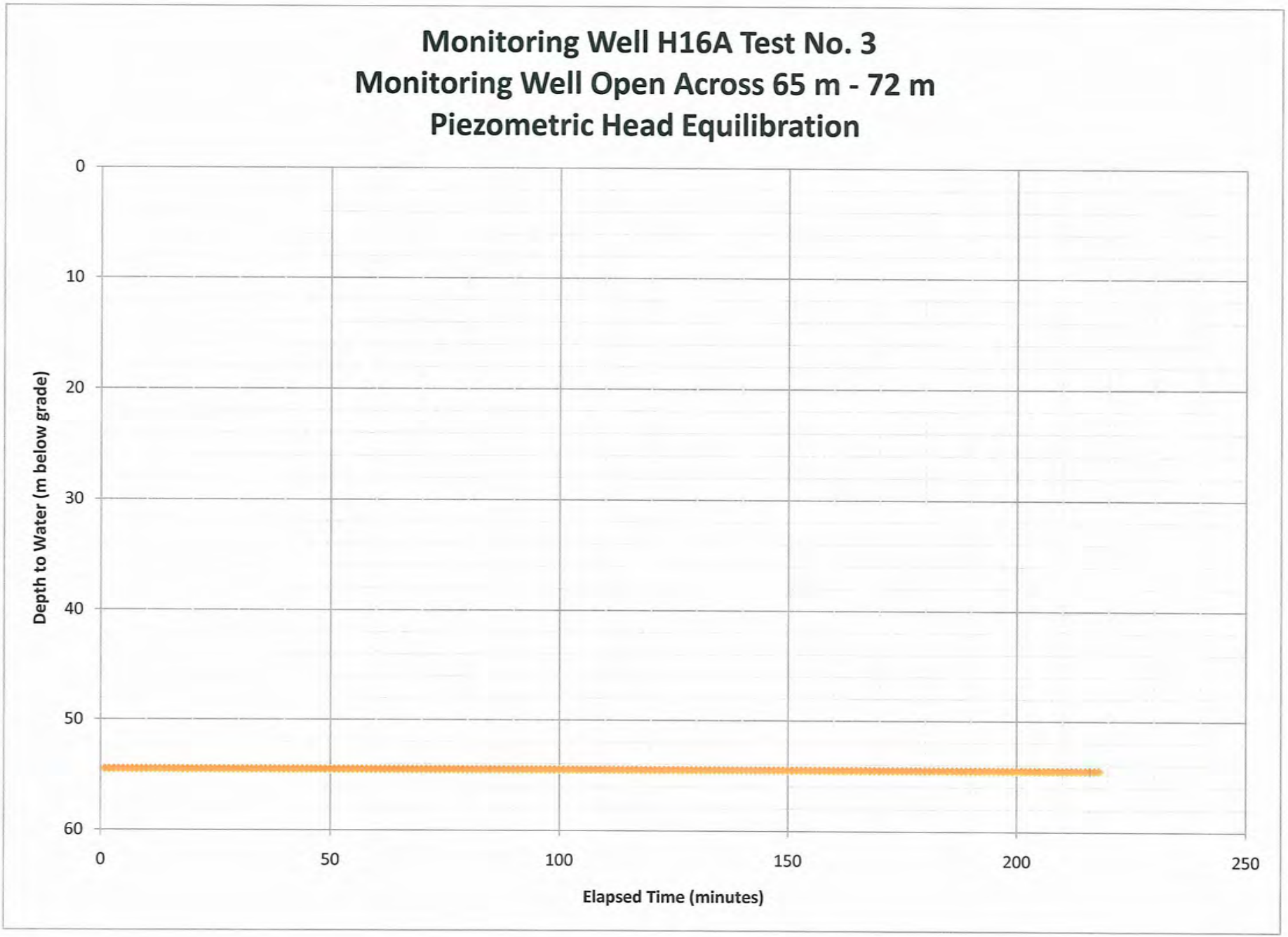

Borehole H2 Test No. 2
Test Interval 200 m - 580 m Piezometric Head Equilibration
Depth to Groundwater (m below grade)
-25
-20
-15
-10
-5
0
5
0
500
1000
1500
2000
2500
3000
Elapsed Time (minutes)


Borehole H16W Test No. 1
Test Interval 800 m - 960 m Piezometric Head Equilibration
Depth below grade (m)
0
1
2
3
4
5
6
7
8
9
10
0
200
400
600
800
1000
1200
1400
1600
Elapsed Time (min)


Borehole H16W Test No. 3
Test Interval 230 m - 270 m Piezometric Head Equilibration
Depth to Water (m below Grade)
0
5
10
15
20
25
0
200
400
600
800
1,000
1,200
1,400
1,600
Elapsed Time (minutes)

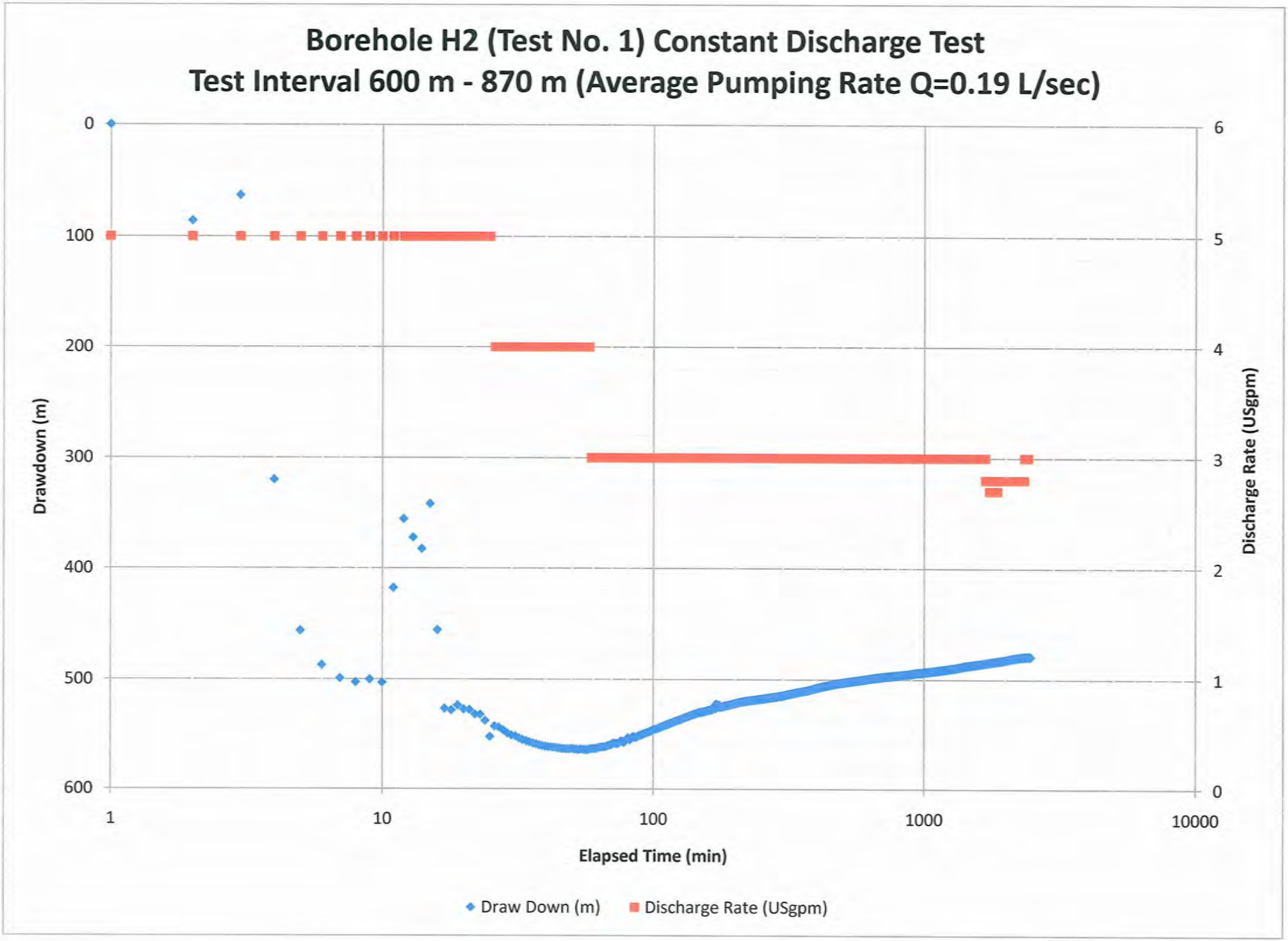
Monitoring Well H16 Test No. 3
Monitoring Well Open Across 590 m - 720 m
Piezometric Head Equilibration

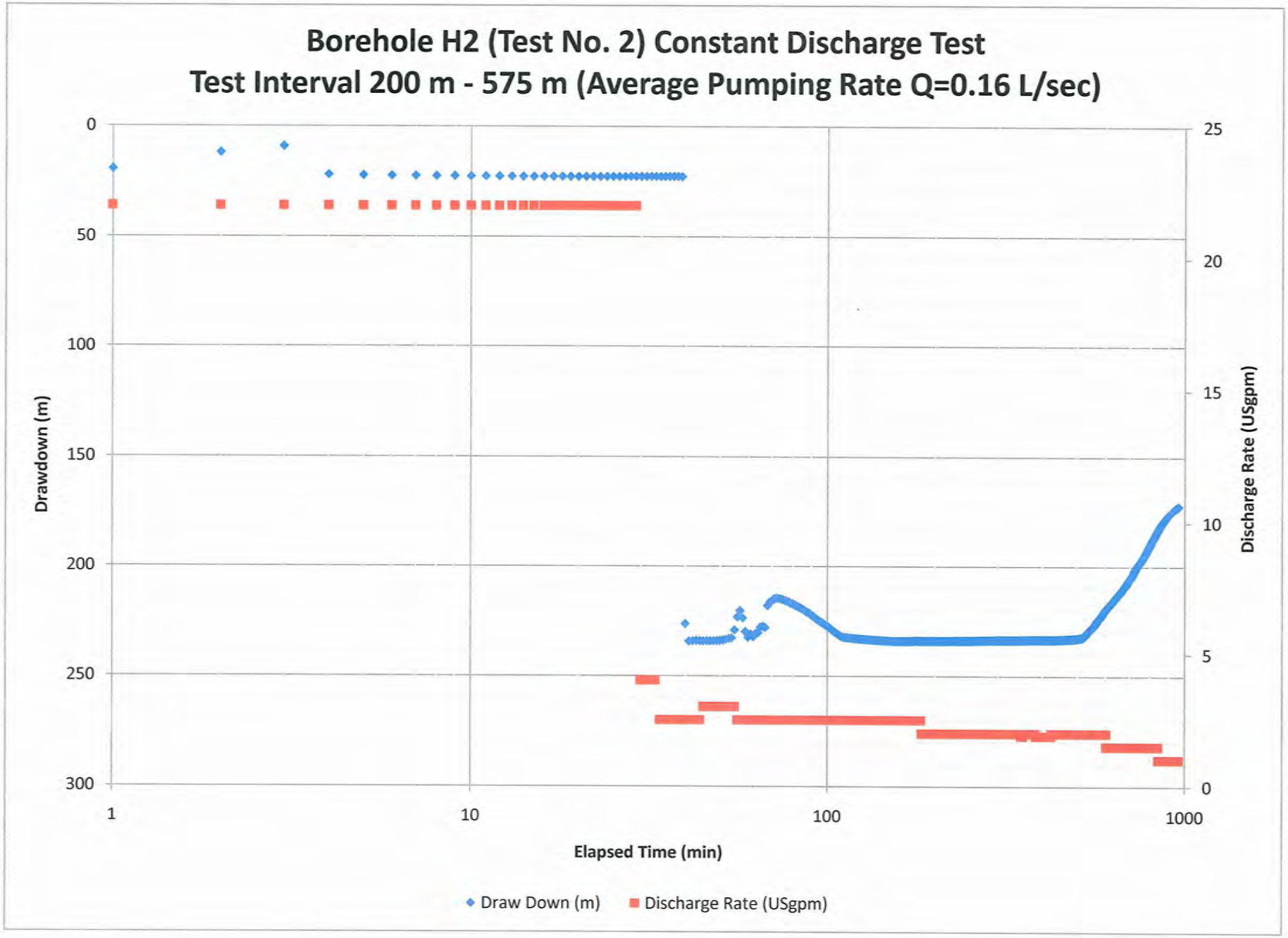


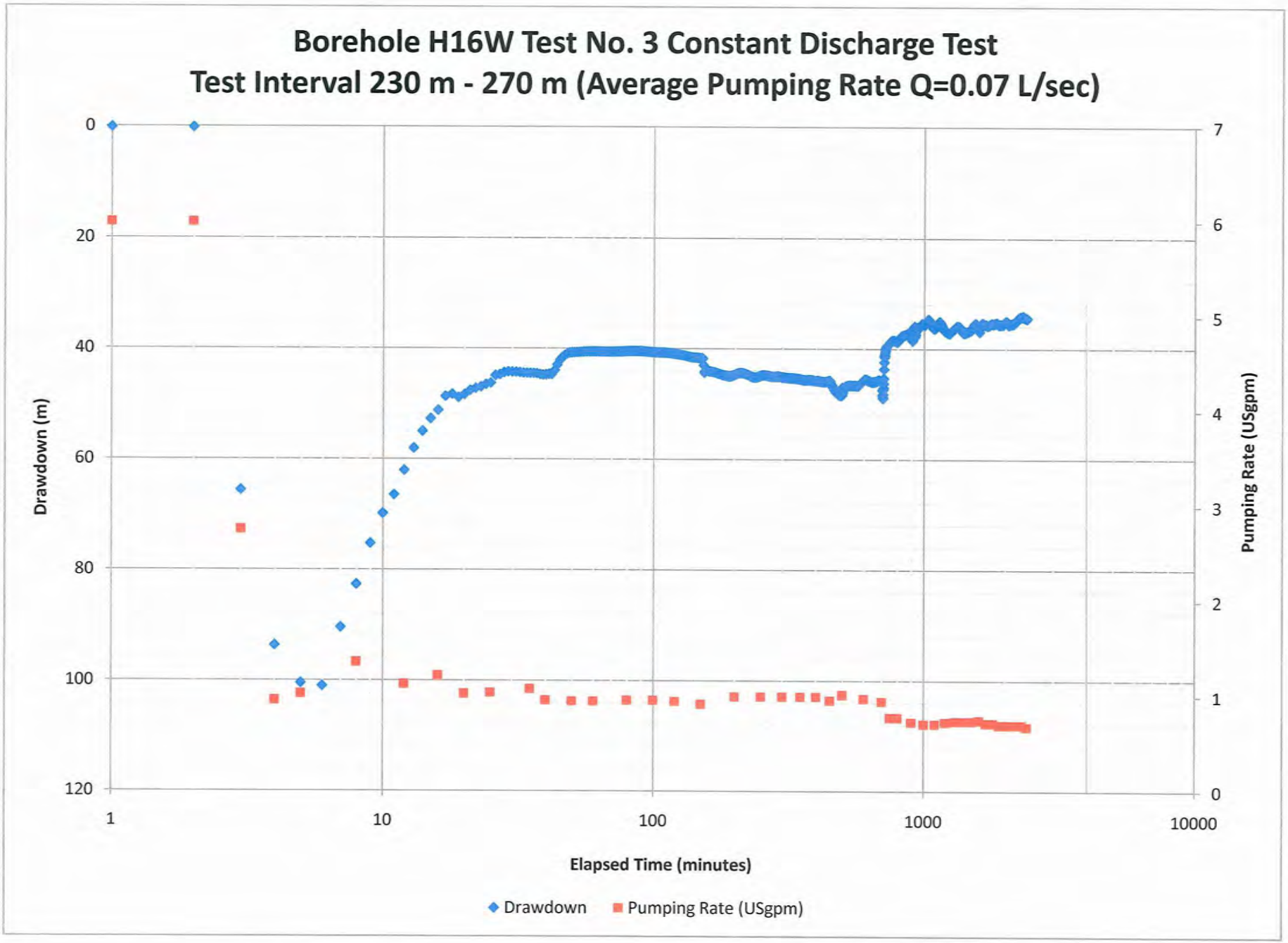

Monitoring Well H16A Test No. 3
Monitoring Well Open Across 65 m - 72 m
Piezometric Head Equilibration
Depth to Water (m below grade)
0
10
20
30
40
50
60
0
50
100
150
200
250
Elapsed Time (minutes)

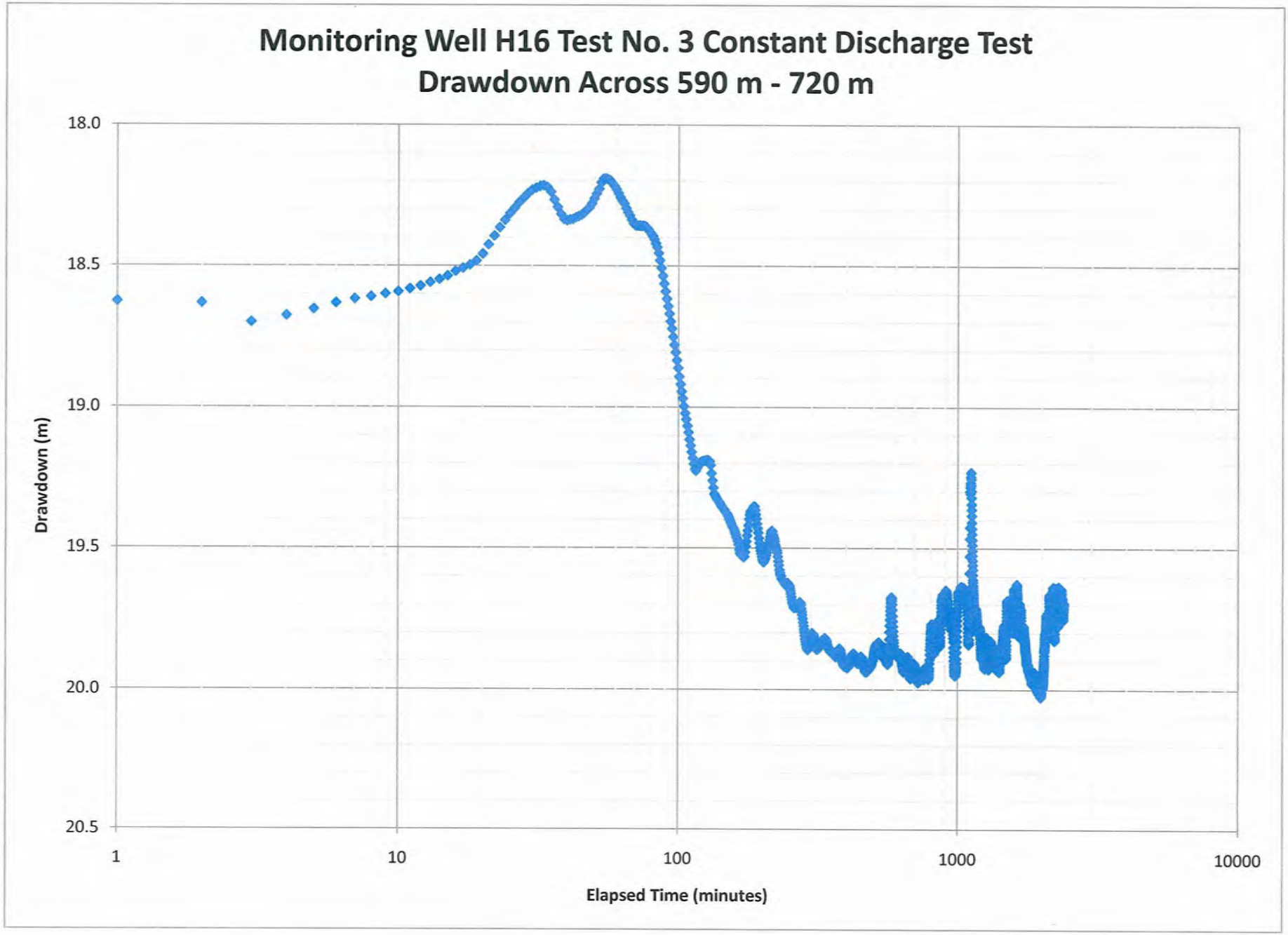
APPENDIX G

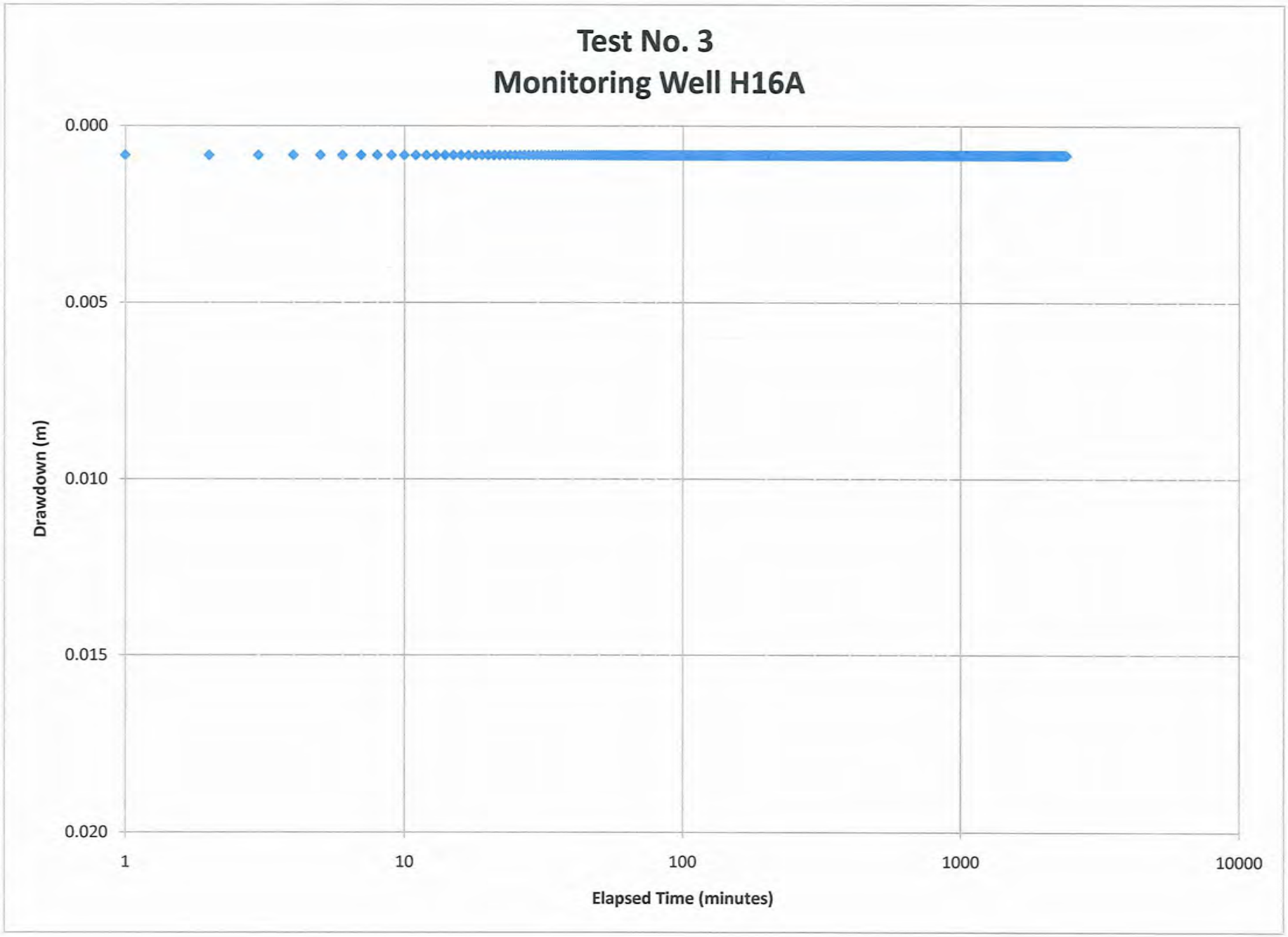
CONSTANT DISCHARGE HEAD DATA


Borehole H2 (Test No. 1) Constant Discharge Test
Test Interval 600 m - 870 m (Average Pumping Rate Q=0.19 L/sec)
Drawdown (m)
0
100
200
300
400
500
600
Discharge Rate (USgpm)
6
5
4
3
2
1
0
1
10
100
1000
10000
Elapsed Time (min)
Draw Down (m)
Discharge Rate (USgpm)


Borehole H2 (Test No. 2) Constant Discharge Test
Test Interval 200 m - 575 m (Average Pumping Rate Q=0.16 L/sec)
Drawdown (m)
0
50
100
150
200
250
300
Discharge Rate (USgpm)
25
20
15
10
5
0
1
10
100
1000
Elapsed Time (min)
Draw Down (m)
Discharge Rate (USgpm)

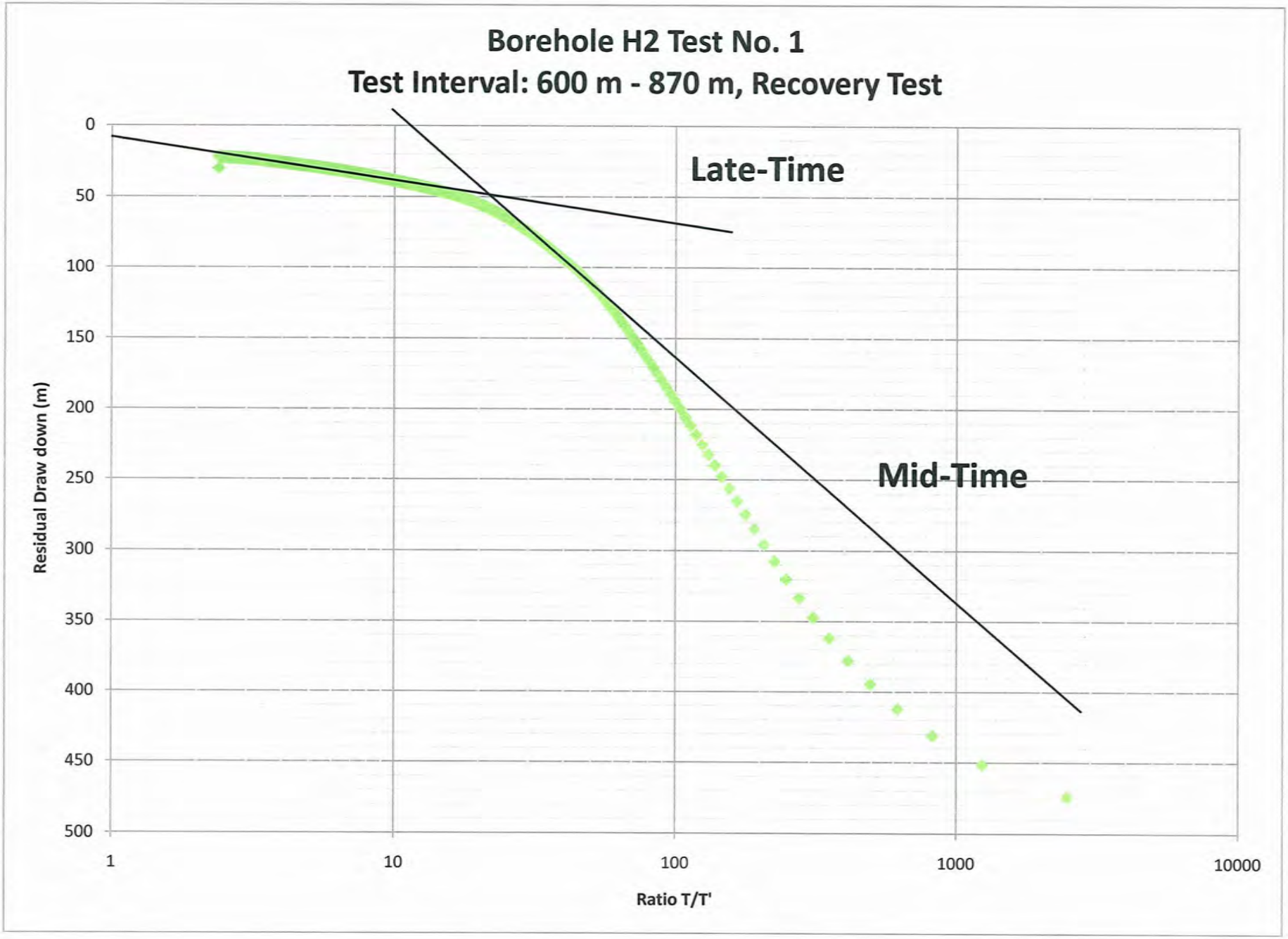

Borehole H16W Test No. 3 Constant Discharge Test
Test Interval 230 m - 270 m (Average Pumping Rate Q=0.07 L/sec)
Drawdown (m)
0
20
40
60
80
100
120
Pumping Rate (USgpm)
7
6
5
4
3
2
1
0
1
10
100
1000
10000
Elapsed Time (minutes)
Drawdown
Pumping Rate (USgpm)

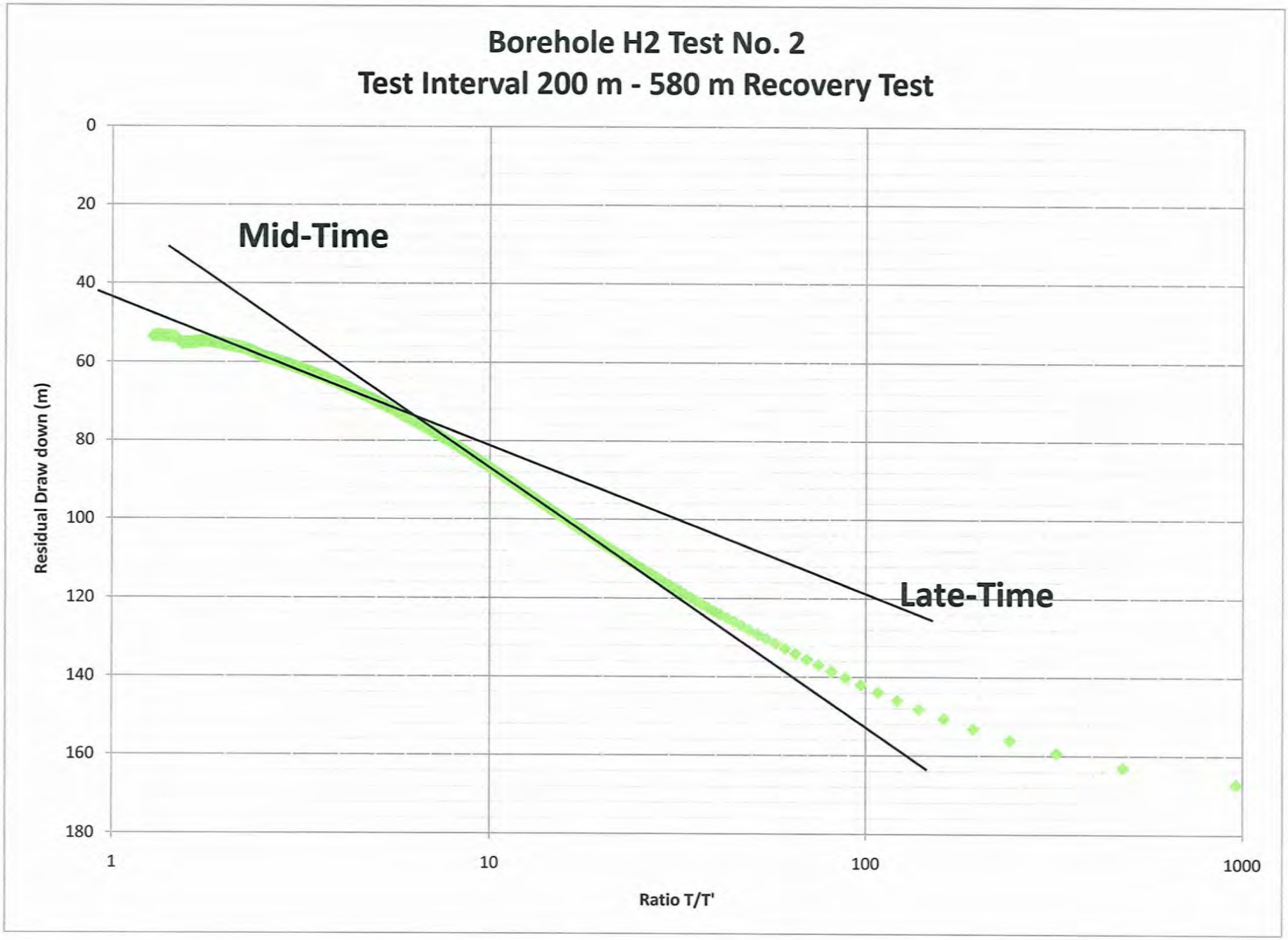

Monitoring Well H16 Test No. 3 Constant Discharge Test
Drawdown Across 590 m - 720 m
18.0
18.5
19.0
19.5
20.0
20.5
Drawdown (m)
1
10
100
1000
10000
Elapsed Time (minutes)

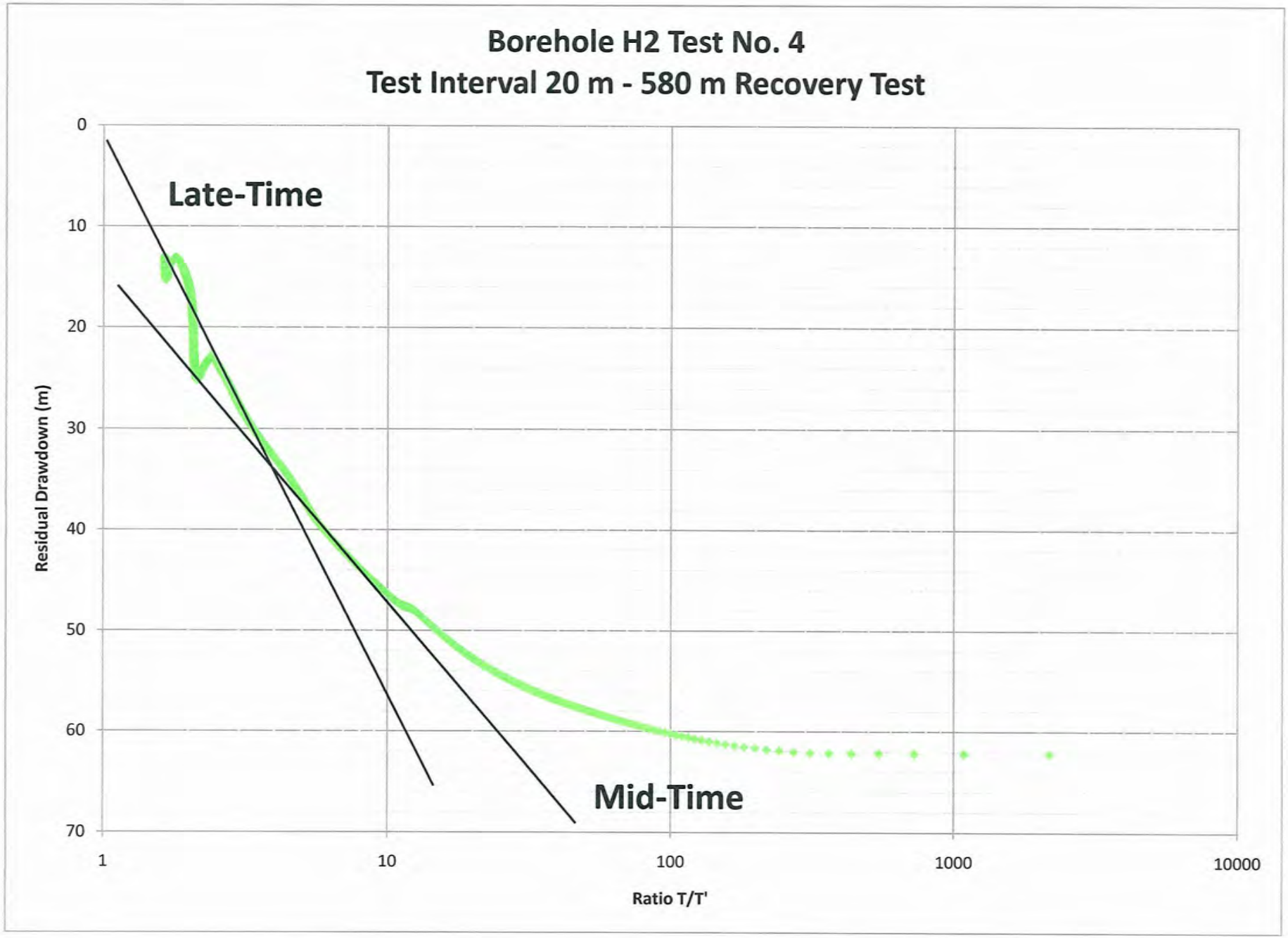

Test No. 3
Monitoring Well H16A
0.000
0.005
0.010
0.015
0.020
Drawdown (m)
1
10
100
1000
10000
Elapsed Time (minutes)

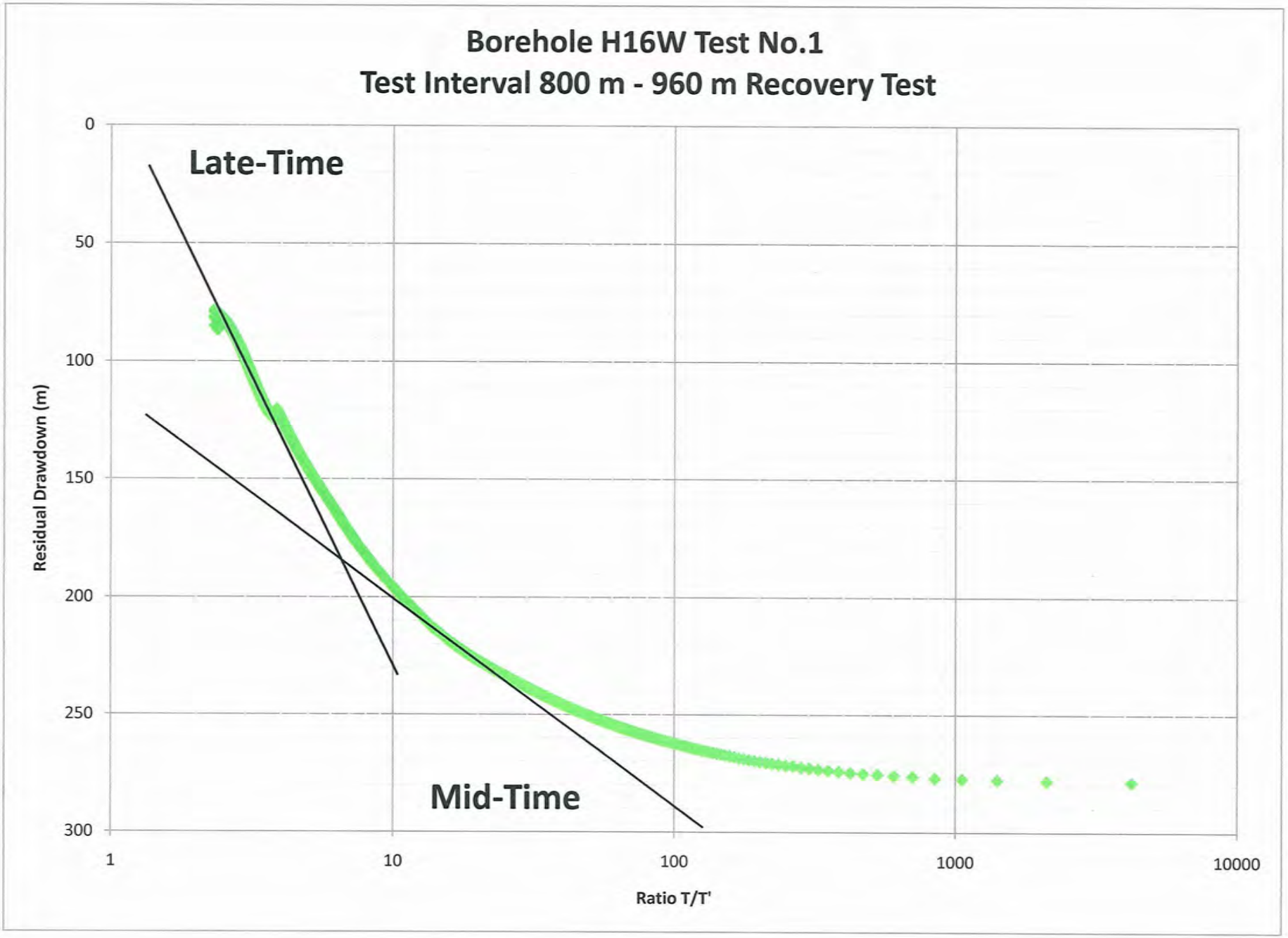
APPENDIX H

RECOVERY TEST DATA

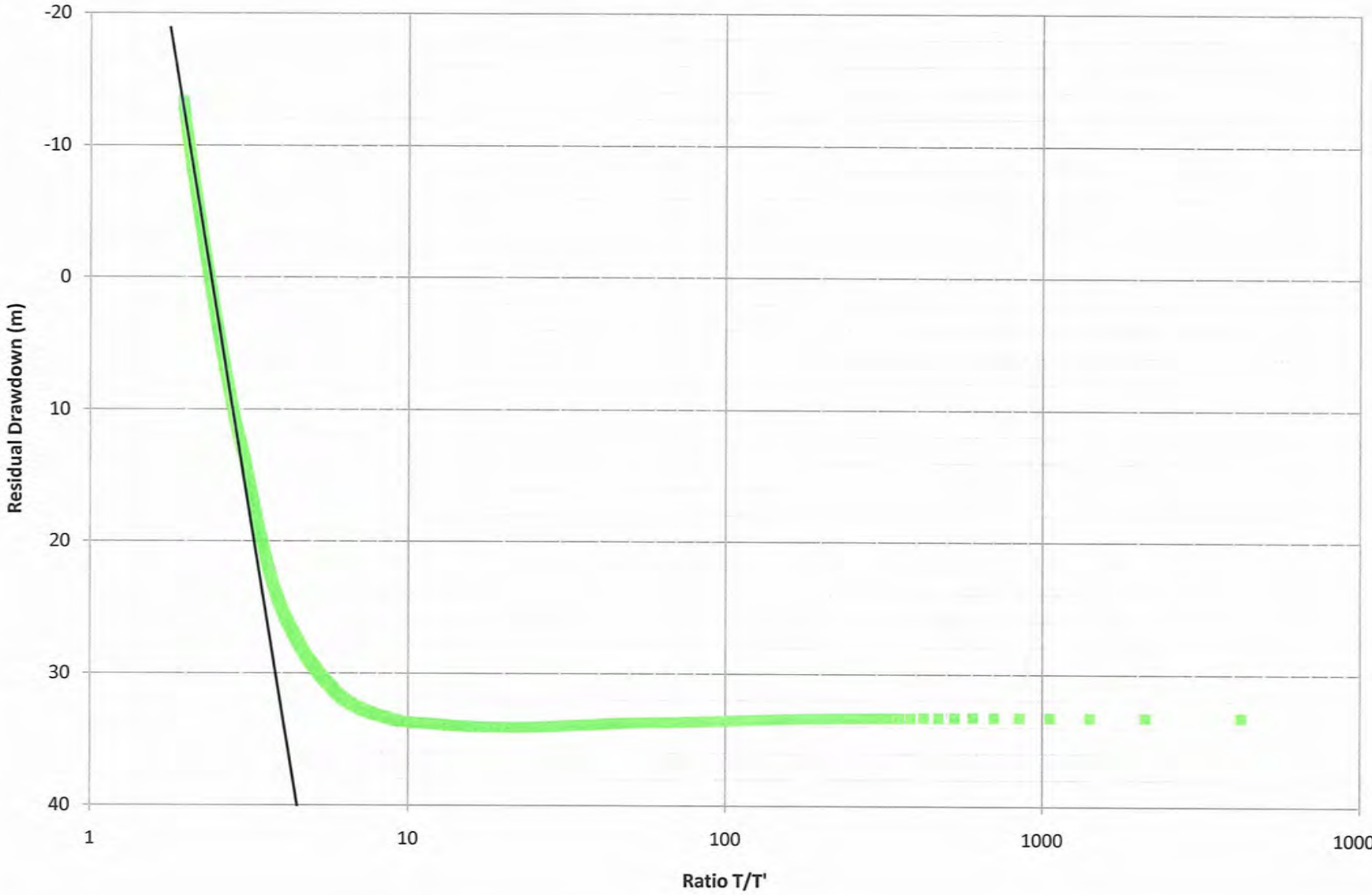

Borehole H2 Test No. 1
Test Interval: 600 m - 870 m, Recovery Test
Late-Time
Mid-Time
Residual Draw down (m)
0
50
100
150
200
250
300
350
400
450
500
1
10
100
1000
10000
Ratio T/T'


Borehole H2 Test No. 2
Test Interval 200 m - 580 m Recovery Test
Mid-Time
Late-Time
Residual Draw down (m)
0
20
40
60
80
100
120
140
160
180
1
10
100
1000
Ratio T/T'

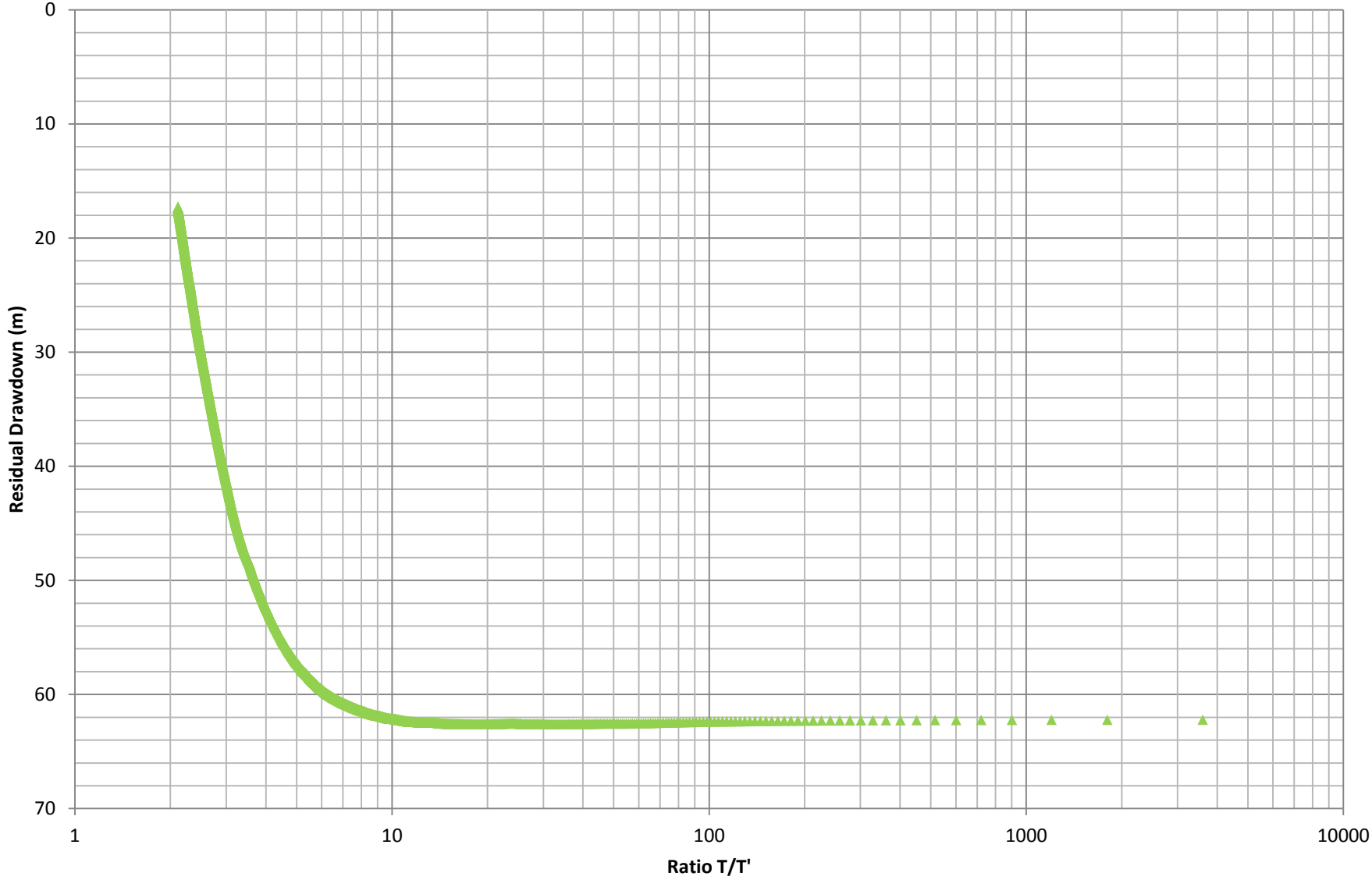

Borehole H2 Test No. 4
Test Interval 20 m - 580 m Recovery Test
Late-Time
Mid-Time
Residual Drawdown (m)
0
10
20
30
40
50
60
70
1
10
100
1000
10000
Ratio T/T'

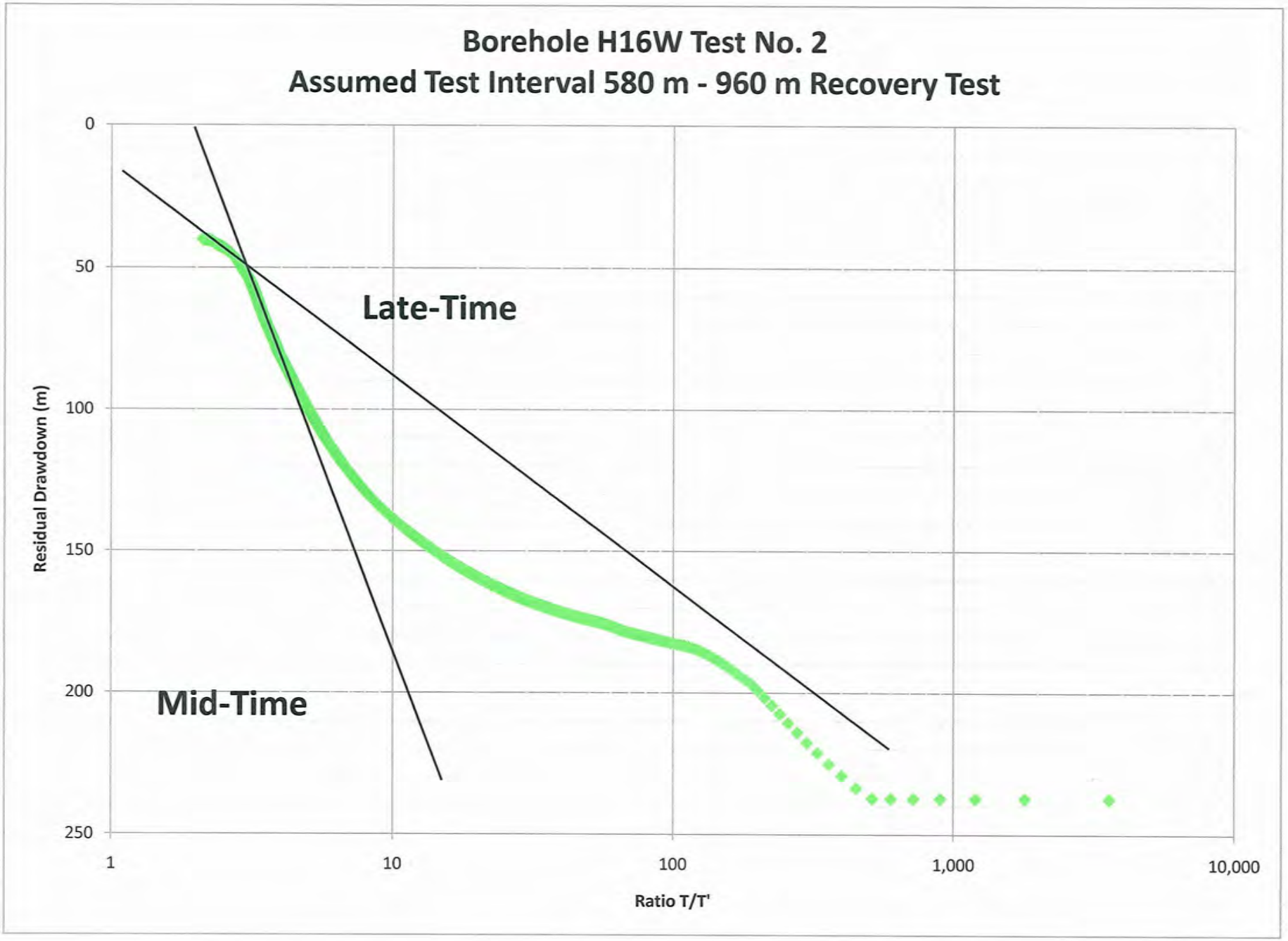

Borehole H16W Test No.1
Test Interval 800 m - 960 m Recovery Test
Late-Time
Mid-Time
Residual Drawdown (m)
0
50
100
150
200
250
300
1
10
100
1000
10000
Ratio T/T'

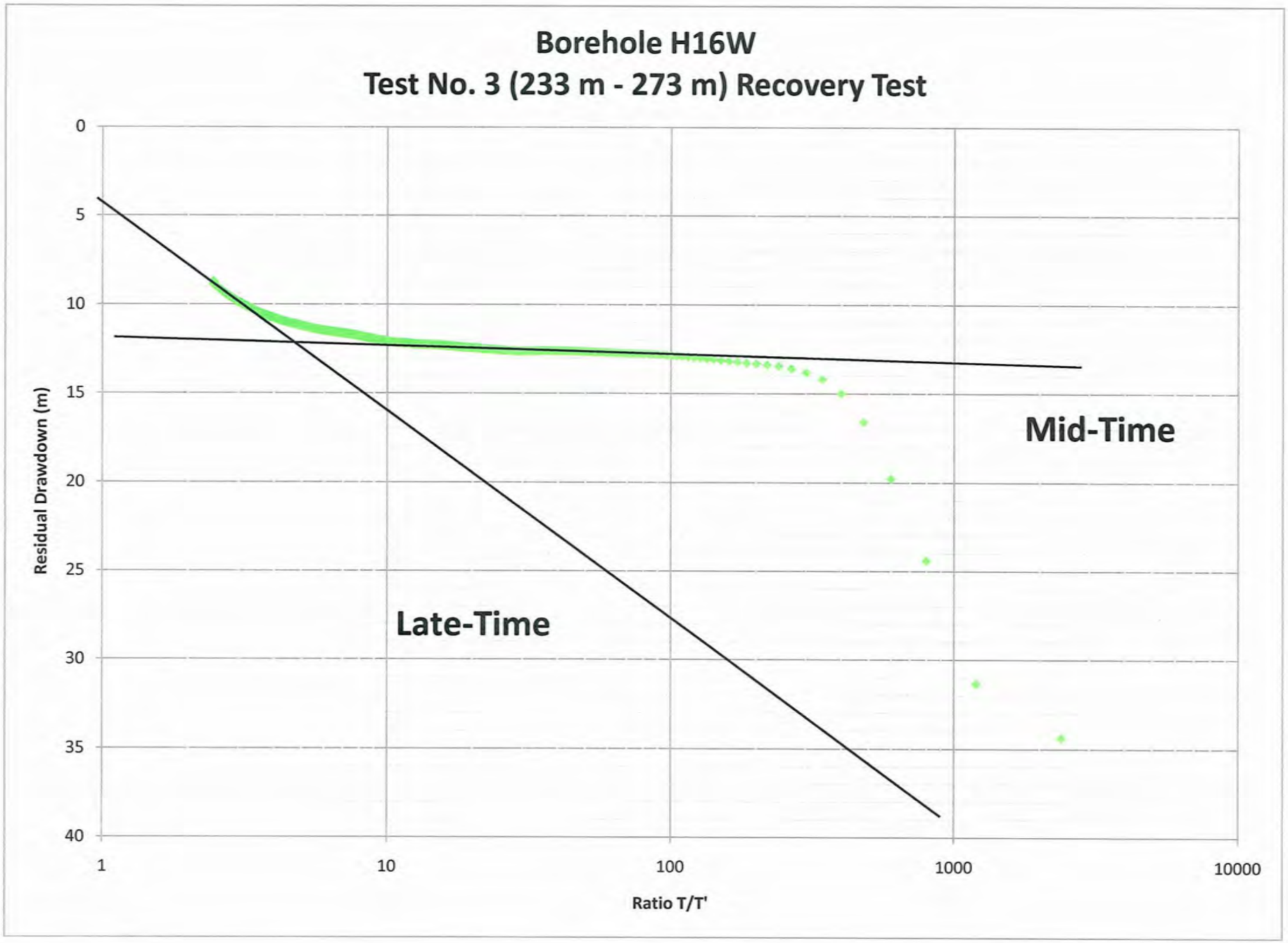
Borehole H16 Observation Well Test No. 1
Recovery Test



Borehole H16 Observation Well Test No. 2
Recovery Test

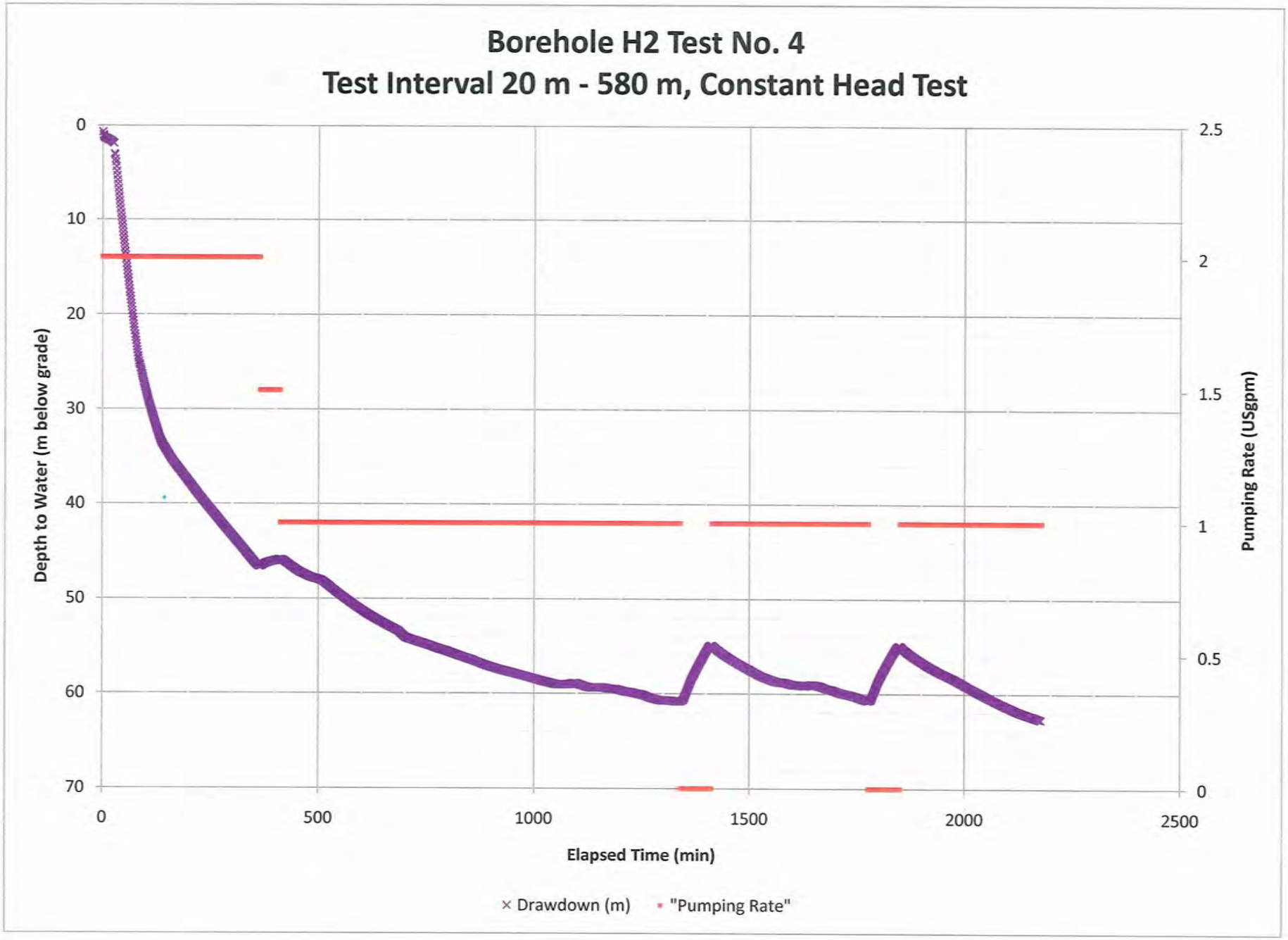


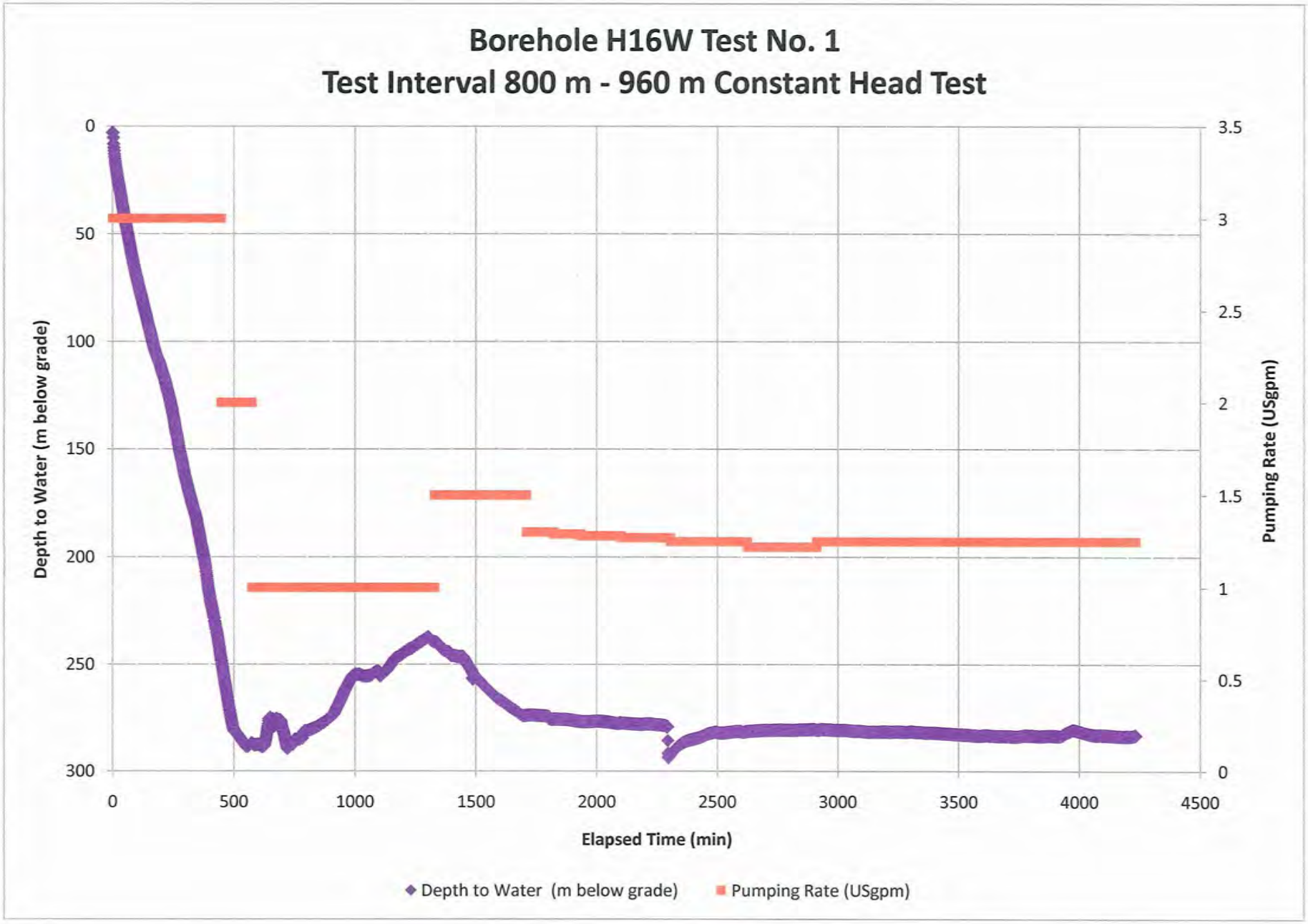

Borehole H16W Test No. 2
Assumed Test Interval 580 m - 960 m Recovery Test
Late-Time
Mid-Time
Residual Drawdown (m)
0
50
100
150
200
250
1
10
100
1,000
10,000
Ratio T/T'

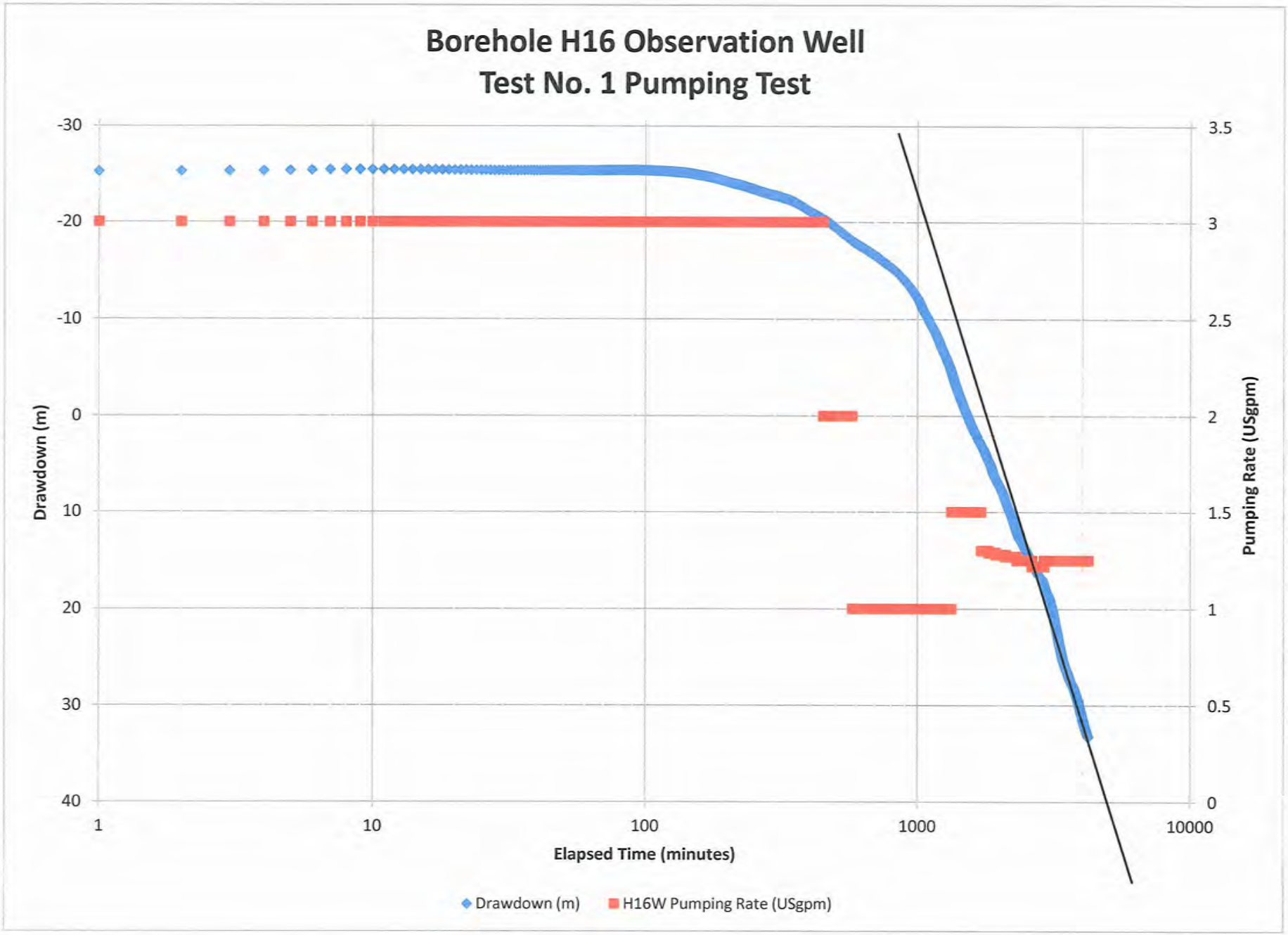

Borehole H16W
Test No. 3 (233 m - 273 m) Recovery Test
Residual Drawdown (m)
0
5
10
15
20
25
30
35
40
1
10
100
1000
10000
Ratio T/T'
Mid-Time
Late-Time

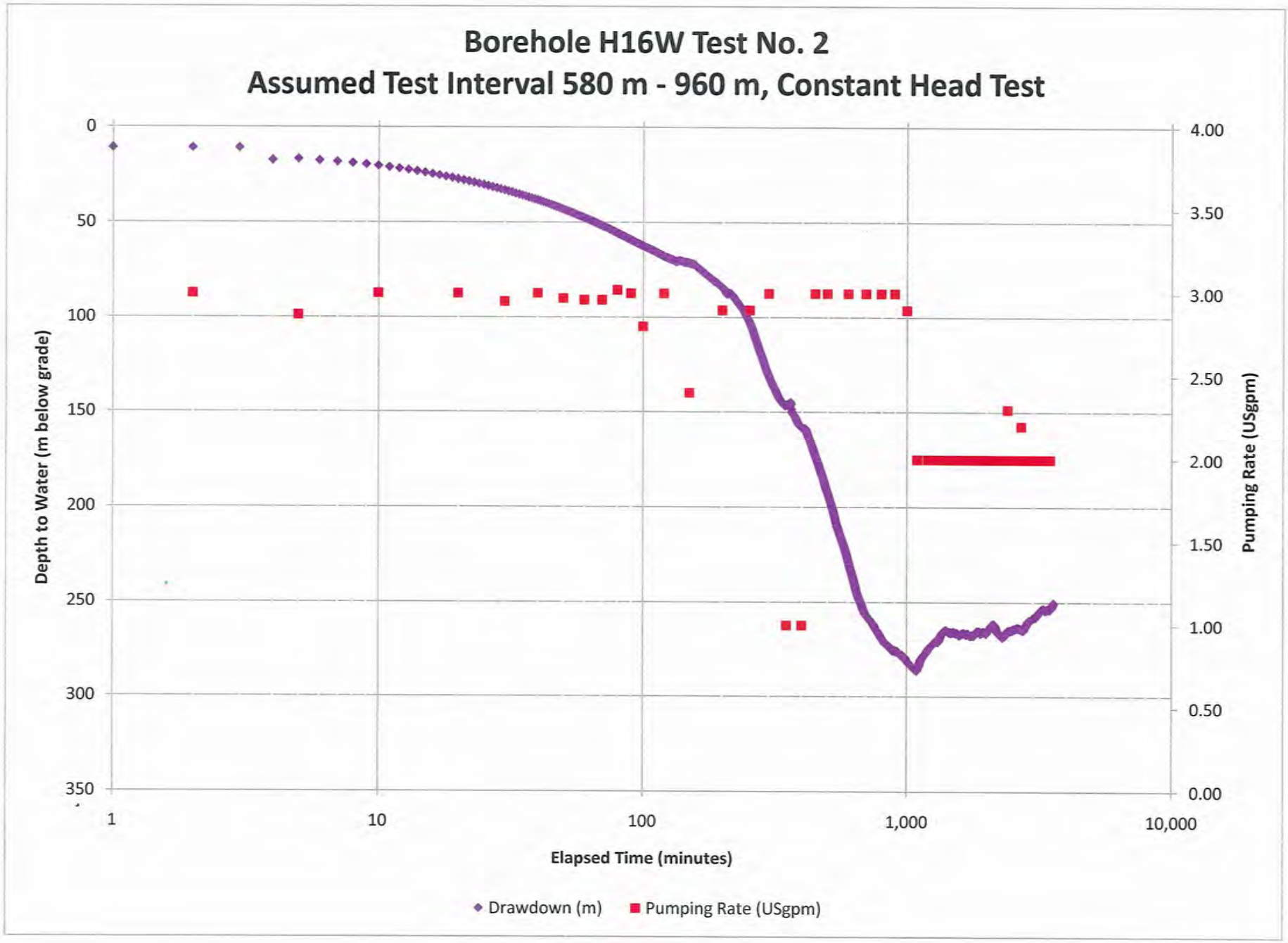
APPENDIX I

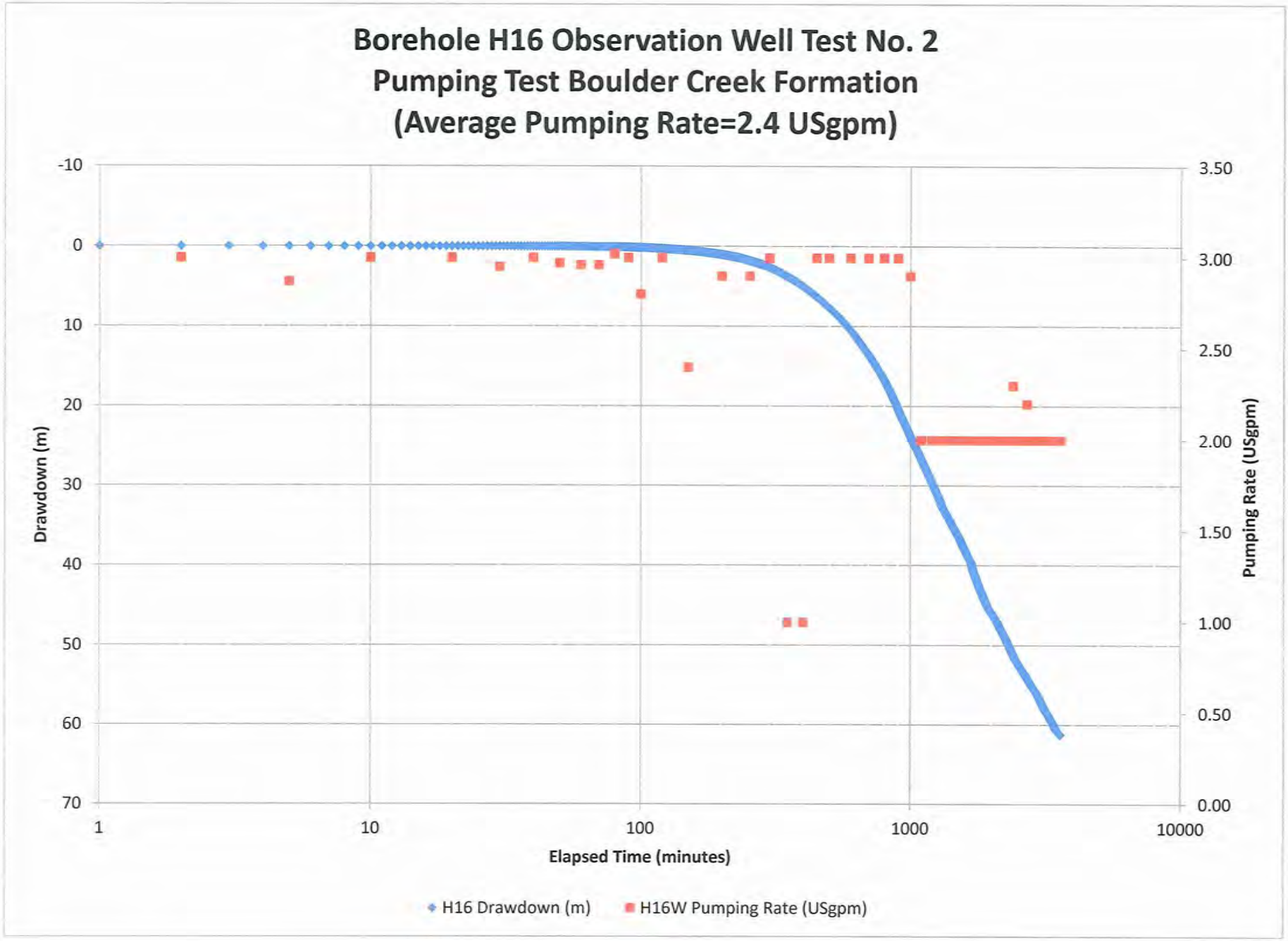
CONSTANT HEAD TEST DATA


Borehole H2 Test No. 4
Test Interval 20 m - 580 m, Constant Head Test
Depth to Water (m below grade)
0
10
20
30
40
50
60
70
Pumping Rate (USgpm)
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
2500
Elapsed Time (min)
Drawdown (m)
"Pumping Rate"


Borehole H16W Test No. 1
Test Interval 800 m - 960 m Constant Head Test
Depth to Water (m below grade)
0
50
100
150
200
250
300
Pumping Rate (USgpm)
3.5
3
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Elapsed Time (min)
Depth to Water (m below grade)
Pumping Rate (USgpm)


Borehole H16 Observation Well
Test No. 1 Pumping Test
Drawdown (m)
-30
-20
-10
0
10
20
30
40
Pumping Rate (USgpm)
3.5
3
2.5
2
1.5
1
0.5
0
1
10
100
1000
10000
Elapsed Time (minutes)
Drawdown (m)
H16W Pumping Rate (USgpm)


Borehole H16W Test No. 2
Assumed Test Interval 580 m - 960 m, Constant Head Test
Depth to Water (m below grade)
0
50
100
150
200
250
300
350
Pumping Rate (USgpm)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1
10
100
1,000
10,000
Elapsed Time (minutes)
Drawdown (m)
Pumping Rate (USgpm)


Borehole H16 Observation Well Test No. 2
Pumping Test Boulder Creek Formation
(Average Pumping Rate=2.4 USgpm)
-10
0
10
20
30
40
50
60
70
Drawdown (m)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Pumping Rate (USgpm)
1
10
100
1000
10000
Elapsed Time (minutes)
H16 Drawdown (m)
H16W Pumping Rate (USgpm)

APPENDIX J

ANALYTICAL LABORATORY REPORTS

AMEC EARTH & ENVIRONMENTAL
ATTN: TAMMERA KOSTYA
3456 Opie Crescent
Prince George BC V2N 2P9

Date Received: 04-APR-11
Report Date: 19-MAY-11 17:45 (MT)
Version: FINAL REV. 2

Client Phone: 250-564-3243

Certificate of Analysis

Lab Work Order #: L991723
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-051120

Comments: ADDITIONAL 17-MAY-11 16:37
ADDITIONAL 11-MAY-11 12:46

Selam Worku
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L991723-1	L991723-2			
	Description					
	Sampled Date	03-APR-11	03-APR-11			
	Sampled Time	11:00	11:00			
	Client ID	P2C21 (H2) DEPTH:600-870M	P2C21 (H2) DEPTH:600-870M			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0				
	Conductivity (uS/cm)	1130				
	Hardness (as CaCO3) (mg/L)	111	137			
	pH (pH)	8.32				
	Total Dissolved Solids (mg/L)	667				
	Turbidity (NTU)	354				
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	496				
	Ammonia as N (mg/L)	0.359				
	Chloride (Cl) (mg/L)	64.8				
	Fluoride (F) (mg/L)	<0.20				
	Nitrate (as N) (mg/L)	<0.050				
	Nitrite (as N) (mg/L)	<0.010				
	Sulfate (SO4) (mg/L)	38.5				
	Sulphide as S (Dissolved) (mg/L)	<0.020				
Cyanides	Cyanide, Total (mg/L)	<0.0050				
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	7.26				
Inorganic Parameters	Sulphide As S (Un-ionized) (mg/L)	<0.020				
Total Metals	Aluminum (Al)-Total (mg/L)	17.2	20.9			
	Antimony (Sb)-Total (mg/L)	<0.0025 DLA	0.00044			
	Arsenic (As)-Total (mg/L)	0.00500	0.00505			
	Barium (Ba)-Total (mg/L)	2.60	2.70			
	Beryllium (Be)-Total (mg/L)		<0.0010 DLA			
	Bismuth (Bi)-Total (mg/L)		<0.0010 DLA			
	Boron (B)-Total (mg/L)	0.16	0.171			
	Cadmium (Cd)-Total (mg/L)	<0.0010 DLA	0.000076			
	Calcium (Ca)-Total (mg/L)	33.1	33.1			
	Chromium (Cr)-Total (mg/L)	0.049	0.0508			
	Cobalt (Co)-Total (mg/L)		0.00338			
	Copper (Cu)-Total (mg/L)	0.0143	0.0140			
	Iron (Fe)-Total (mg/L)	11.4	11.4			
	Lead (Pb)-Total (mg/L)	0.0068	0.00694			
	Lithium (Li)-Total (mg/L)		0.514			
	Magnesium (Mg)-Total (mg/L)	13.2	13.2			
	Manganese (Mn)-Total (mg/L)	0.126	0.134			
	Mercury (Hg)-Total (mg/L)	<0.00020	<0.000050 DLM			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L991723-1	L991723-2			
	Description					
	Sampled Date	03-APR-11	03-APR-11			
	Sampled Time	11:00	11:00			
	Client ID	P2C21 (H2) DEPTH:600-870M	P2C21 (H2) DEPTH:600-870M			
Grouping	**Analyte**					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)		0.0205			
	Nickel (Ni)-Total (mg/L)		0.0260			
	Phosphorus (P)-Total (mg/L)		0.40			
	Potassium (K)-Total (mg/L)	8.72	9.82			
	Selenium (Se)-Total (mg/L)	<0.0050 DLA	0.00078			
	Silicon (Si)-Total (mg/L)		47.0			
	Silver (Ag)-Total (mg/L)		0.000146			
	Sodium (Na)-Total (mg/L)	217	206			
	Strontium (Sr)-Total (mg/L)		0.538			
	Thallium (Tl)-Total (mg/L)		<0.00020 DLA			
	Tin (Sn)-Total (mg/L)		0.00047			
	Titanium (Ti)-Total (mg/L)		0.581			
	Uranium (U)-Total (mg/L)	0.00120	0.00118			
	Vanadium (V)-Total (mg/L)		0.0648			
	Zinc (Zn)-Total (mg/L)	0.110	0.115			
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.153	0.0857			
	Antimony (Sb)-Dissolved (mg/L)	<0.0025 DLA	0.00027			
	Arsenic (As)-Dissolved (mg/L)	0.00140	0.00148			
	Barium (Ba)-Dissolved (mg/L)	1.41	1.47			
	Beryllium (Be)-Dissolved (mg/L)		<0.00050			
	Bismuth (Bi)-Dissolved (mg/L)		<0.00050			
	Boron (B)-Dissolved (mg/L)	0.10	0.108			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0010 DLA	0.000011			
	Calcium (Ca)-Dissolved (mg/L)	28.5	28.5			
	Chromium (Cr)-Dissolved (mg/L)	<0.010 DLA	0.00102			
	Cobalt (Co)-Dissolved (mg/L)		0.00016			
	Copper (Cu)-Dissolved (mg/L)	<0.0050 DLA	<0.00050			
	Iron (Fe)-Dissolved (mg/L)	1.71	1.72			
	Lead (Pb)-Dissolved (mg/L)	<0.0025 DLA	0.000061			
	Lithium (Li)-Dissolved (mg/L)		0.300			
	Magnesium (Mg)-Dissolved (mg/L)	9.69	9.69			
	Manganese (Mn)-Dissolved (mg/L)	0.075	0.0778			
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)		0.0195			
	Nickel (Ni)-Dissolved (mg/L)		0.00182			
	Phosphorus (P)-Dissolved (mg/L)		<0.30			
	Potassium (K)-Dissolved (mg/L)	2.50	2.88			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L991723-1	L991723-2			
	Description					
	Sampled Date	03-APR-11	03-APR-11			
	Sampled Time	11:00	11:00			
	Client ID	P2C21 (H2) DEPTH:600-870M	P2C21 (H2) DEPTH:600-870M			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.0050 DLA	0.00022			
	Silicon (Si)-Dissolved (mg/L)		3.67			
	Silver (Ag)-Dissolved (mg/L)		<0.000010			
	Sodium (Na)-Dissolved (mg/L)	166	167			
	Strontium (Sr)-Dissolved (mg/L)		0.405			
	Thallium (Tl)-Dissolved (mg/L)		<0.00010			
	Tin (Sn)-Dissolved (mg/L)		0.00022			
	Titanium (Ti)-Dissolved (mg/L)		<0.010			
	Uranium (U)-Dissolved (mg/L)	<0.00050 DLA	0.000374			
	Vanadium (V)-Dissolved (mg/L)		<0.0010			
	Zinc (Zn)-Dissolved (mg/L)	<0.050	0.0100			

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

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-COL-VA	Water	Alkalinity by Colourimetric (Automated)	APHA 310.2
This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.			
ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
C-TOT-ORG-LOW-CL	Water	Total Organic Carbon	APHA 5310 C-Instrumental
CN-T-MID-HH-COL-VA	Water	Total Cyanide by HH Distillation	APHA 4500-CN Cyanide
This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	APHA 2120 "Color"
This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	APHA 2120 Color
This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-DIS-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS	EPA SW-846 3005A & EPA 245.7
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).			
HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).			
HG-TOT-CVAFS-VA	Water	Total Mercury in Water by CVAFS	EPA 245.7

Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-LOW-MS-VA Water Dissolved Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-LOW-MS-VA Water Total Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

S2-D-COL-VA Water Dissolved Sulphide by Colorimetric APHA 4500-S2 D. - SULPHIDE

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

S2-UNION-MANCALC-VA Water Un-ionized Hydrogen sulphide (Man. calc) APHA -4500-S2 H.

This analysis is carried out using procedures adapted from APHA Method 4500-S2 H. "Calculation of Un-ionized Hydrogen Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

Reference Information

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

10-051120

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

Client: AMEC EARTH & ENVIRONMENTAL
3456 Opie Crescent
Prince George BC V2N 2P9
Contact: TAMMERA KOSTYA

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-COL-VA	**Water**							
Batch R2154083								
WG1262048-11 CRM		**VA-ALKL-CONTROL**						
Alkalinity, Total (as CaCO3)			97		%		85-115	06-APR-11
WG1262048-14 CRM		**VA-ALKM-CONTROL**						
Alkalinity, Total (as CaCO3)			95		%		85-115	06-APR-11
WG1262048-17 CRM		**VA-ALKH-CONTROL**						
Alkalinity, Total (as CaCO3)			98		%		85-115	06-APR-11
WG1262048-2 CRM		**VA-ALKL-CONTROL**						
Alkalinity, Total (as CaCO3)			98		%		85-115	06-APR-11
WG1262048-20 CRM		**VA-ALKL-CONTROL**						
Alkalinity, Total (as CaCO3)			100		%		85-115	06-APR-11
WG1262048-23 CRM		**VA-ALKM-CONTROL**						
Alkalinity, Total (as CaCO3)			102		%		85-115	06-APR-11
WG1262048-26 CRM		**VA-ALKH-CONTROL**						
Alkalinity, Total (as CaCO3)			98		%		85-115	06-APR-11
WG1262048-29 CRM		**VA-ALKL-CONTROL**						
Alkalinity, Total (as CaCO3)			97		%		85-115	06-APR-11
WG1262048-5 CRM		**VA-ALKM-CONTROL**						
Alkalinity, Total (as CaCO3)			98		%		85-115	06-APR-11
WG1262048-8 CRM		**VA-ALKH-CONTROL**						
Alkalinity, Total (as CaCO3)			100		%		85-115	06-APR-11
WG1262048-1 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	06-APR-11
WG1262048-10 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	06-APR-11
WG1262048-13 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	06-APR-11
WG1262048-16 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	06-APR-11
WG1262048-19 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	06-APR-11
WG1262048-22 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	06-APR-11
WG1262048-25 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	06-APR-11
WG1262048-28 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	06-APR-11
WG1262048-4 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	06-APR-11
WG1262048-7 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-COL-VA	**Water**							
Batch R2154083								
WG1262048-7 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	06-APR-11
ANIONS-CL-IC-VA	**Water**							
Batch R2149505								
WG1261471-10 CRM		**VA-IC-IVA2-ION23110**						
Chloride (Cl)			100		%		85-115	05-APR-11
WG1261471-2 CRM		**VA-IC-IVA2-ION23110**						
Chloride (Cl)			100		%		85-115	05-APR-11
WG1261471-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	05-APR-11
WG1261471-3 MB								
Chloride (Cl)			<0.50		mg/L		0.5	05-APR-11
WG1261471-5 MB								
Chloride (Cl)			<0.50		mg/L		0.5	05-APR-11
WG1261471-7 MB								
Chloride (Cl)			<0.50		mg/L		0.5	05-APR-11
WG1261471-9 MB								
Chloride (Cl)			<0.50		mg/L		0.5	05-APR-11
ANIONS-F-IC-VA	**Water**							
Batch R2149505								
WG1261471-10 CRM		**VA-IC-IVA2-ION23110**						
Fluoride (F)			99		%		85-115	05-APR-11
WG1261471-2 CRM		**VA-IC-IVA2-ION23110**						
Fluoride (F)			99		%		85-115	05-APR-11
WG1261471-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	05-APR-11
WG1261471-3 MB								
Fluoride (F)			<0.020		mg/L		0.02	05-APR-11
WG1261471-5 MB								
Fluoride (F)			<0.020		mg/L		0.02	05-APR-11
WG1261471-7 MB								
Fluoride (F)			<0.020		mg/L		0.02	05-APR-11
WG1261471-9 MB								
Fluoride (F)			<0.020		mg/L		0.02	05-APR-11
ANIONS-NO2-IC-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-NO2-IC-VA	**Water**							
Batch R2149505								
WG1261471-10 CRM		**VA-IC-IVA2-ION23110**						
Nitrite (as N)			96		%		85-115	05-APR-11
WG1261471-2 CRM		**VA-IC-IVA2-ION23110**						
Nitrite (as N)			97		%		85-115	05-APR-11
WG1261471-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	05-APR-11
WG1261471-3 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	05-APR-11
WG1261471-5 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	05-APR-11
WG1261471-7 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	05-APR-11
WG1261471-9 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	05-APR-11
ANIONS-NO3-IC-VA	**Water**							
Batch R2149505								
WG1261471-10 CRM		**VA-IC-IVA2-ION23110**						
Nitrate (as N)			102		%		85-115	05-APR-11
WG1261471-2 CRM		**VA-IC-IVA2-ION23110**						
Nitrate (as N)			103		%		85-115	05-APR-11
WG1261471-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	05-APR-11
WG1261471-3 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	05-APR-11
WG1261471-5 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	05-APR-11
WG1261471-7 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	05-APR-11
WG1261471-9 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	05-APR-11
ANIONS-SO4-IC-VA	**Water**							
Batch R2149505								
WG1261471-10 CRM		**VA-IC-IVA2-ION23110**						
Sulfate (SO4)			101		%		85-115	05-APR-11
WG1261471-2 CRM		**VA-IC-IVA2-ION23110**						
Sulfate (SO4)			101		%		85-115	05-APR-11
WG1261471-1 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	05-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-SO4-IC-VA	**Water**							
Batch R2149505								
WG1261471-3 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	05-APR-11
WG1261471-5 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	05-APR-11
WG1261471-7 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	05-APR-11
WG1261471-9 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	05-APR-11
C-TOT-ORG-LOW-CL	**Water**							
Batch R2162852								
WG1263546-5 DUP		**L991723-1**						
Total Organic Carbon		7.26	7.39		mg/L	1.9	20	08-APR-11
WG1263546-2 LCS								
Total Organic Carbon			89		%		80-120	08-APR-11
WG1263546-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	08-APR-11
CN-T-MID-HH-COL-VA	**Water**							
Batch R2146304								
WG1261386-2 CRM		**VA-HH-TCN-CONTROL**						
Cyanide, Total			106		%		80-120	05-APR-11
WG1261386-1 MB								
Cyanide, Total			<0.0050		mg/L		0.005	05-APR-11
COLOUR-TRUE-VA	**Water**							
Batch R2146043								
WG1261366-10 CRM		**VA-COL-C-25**						
Colour, True			105		%		85-115	05-APR-11
WG1261366-13 CRM		**VA-COL-C-25**						
Colour, True			103		%		85-115	05-APR-11
WG1261366-2 CRM		**VA-COL-C-25**						
Colour, True			98		%		85-115	05-APR-11
WG1261366-5 CRM		**VA-COL-C-25**						
Colour, True			102		%		85-115	05-APR-11
WG1261366-7 CRM		**VA-COL-C-25**						
Colour, True			104		%		85-115	05-APR-11
WG1261366-1 MB								
Colour, True			<5.0		CU		5	05-APR-11
WG1261366-12 MB								
Colour, True			<5.0		CU		5	05-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
COLOUR-TRUE-VA	**Water**							
Batch R2146043								
WG1261366-4 MB								
Colour, True			<5.0		CU		5	05-APR-11
WG1261366-6 MB								
Colour, True			<5.0		CU		5	05-APR-11
WG1261366-9 MB								
Colour, True			<5.0		CU		5	05-APR-11
EC-PCT-VA	**Water**							
Batch R2153544								
WG1261990-9 CRM		**VA-EC-PCT-CONTROL**						
Conductivity			98		%		90-110	06-APR-11
WG1261990-1 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
WG1261990-2 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
WG1261990-3 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
WG1261990-4 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
WG1261990-5 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
WG1261990-6 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
WG1261990-7 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
HG-DIS-CVAFS-VA	**Water**							
Batch R2140644								
WG1261086-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Dissolved			94		%		80-120	04-APR-11
WG1261086-1 MB								
Mercury (Hg)-Dissolved			<0.000050		mg/L		0.00005	04-APR-11
Batch R2146084								
WG1261008-1 MB								
Mercury (Hg)-Dissolved			<0.000050		mg/L		0.00005	05-APR-11
HG-DIS-LOW-CVAFS-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-DIS-LOW-CVAFS-VA	**Water**							
Batch R2140644								
WG1261086-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Dissolved			94		%		80-120	04-APR-11
WG1261086-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	04-APR-11
Batch R2146084								
WG1261008-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	05-APR-11
HG-TOT-CVAFS-VA	**Water**							
Batch R2140644								
WG1261086-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Total			94		%		80-120	04-APR-11
WG1261086-1 MB								
Mercury (Hg)-Total			<0.000050		mg/L		0.00005	04-APR-11
HG-TOT-LOW-CVAFS-VA	**Water**							
Batch R2188255								
WG1278364-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Total			98		%		80-120	12-MAY-11
WG1278364-1 MB								
Mercury (Hg)-Total			<0.000010		mg/L		0.00001	12-MAY-11
MET-D-CCMS-VA	**Water**							
Batch R2151463								
WG1261008-1 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	05-APR-11
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	05-APR-11
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	05-APR-11
Barium (Ba)-Dissolved			<0.000050		mg/L		0.00005	05-APR-11
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	05-APR-11
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	05-APR-11
Boron (B)-Dissolved			<0.010		mg/L		0.01	05-APR-11
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	05-APR-11
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	05-APR-11
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	05-APR-11
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	05-APR-11
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	05-APR-11
Lithium (Li)-Dissolved			<0.0050		mg/L		0.005	05-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R2151463								
WG1261008-1 MB								
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	05-APR-11
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	05-APR-11
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	05-APR-11
Potassium (K)-Dissolved			<0.050		mg/L		0.05	05-APR-11
Selenium (Se)-Dissolved			<0.00010		mg/L		0.0001	05-APR-11
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	05-APR-11
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	05-APR-11
Strontium (Sr)-Dissolved			<0.00010		mg/L		0.0001	05-APR-11
Thallium (Tl)-Dissolved			<0.00010		mg/L		0.0001	05-APR-11
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	05-APR-11
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	05-APR-11
Vanadium (V)-Dissolved			<0.0010		mg/L		0.001	05-APR-11
Zinc (Zn)-Dissolved			<0.0030		mg/L		0.003	05-APR-11
MET-DIS-ICP-VA	**Water**							
Batch R2144305								
WG1261008-2 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Dissolved			100		%		80-120	04-APR-11
Boron (B)-Dissolved			99		%		80-120	04-APR-11
Calcium (Ca)-Dissolved			102		%		80-120	04-APR-11
Iron (Fe)-Dissolved			97		%		80-120	04-APR-11
Magnesium (Mg)-Dissolved			100		%		80-120	04-APR-11
Phosphorus (P)-Dissolved			100		%		80-120	04-APR-11
Silicon (Si)-Dissolved			107		%		80-120	04-APR-11
Sodium (Na)-Dissolved			102		%		80-120	04-APR-11
Titanium (Ti)-Dissolved			105		%		80-120	04-APR-11
Zinc (Zn)-Dissolved			97		%		80-120	04-APR-11
WG1261008-1 MB								
Barium (Ba)-Dissolved			<0.010		mg/L		0.01	04-APR-11
Boron (B)-Dissolved			<0.10		mg/L		0.1	04-APR-11
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	04-APR-11
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	04-APR-11
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	04-APR-11
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	04-APR-11
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	04-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2144305								
WG1261008-1 MB								
Sodium (Na)-Dissolved			<2.0		mg/L		2	04-APR-11
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	04-APR-11
Zinc (Zn)-Dissolved			<0.0050		mg/L		0.005	04-APR-11
MET-DIS-LOW-MS-VA	**Water**							
Batch R2146489								
WG1261008-1 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	05-APR-11
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	05-APR-11
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	05-APR-11
Cadmium (Cd)-Dissolved			<0.000050		mg/L		0.00005	05-APR-11
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	05-APR-11
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	05-APR-11
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	05-APR-11
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	05-APR-11
Potassium (K)-Dissolved			<0.050		mg/L		0.05	05-APR-11
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	05-APR-11
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	05-APR-11
MET-T-CCMS-VA	**Water**							
Batch R2151463								
WG1261119-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	05-APR-11
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	05-APR-11
Arsenic (As)-Total			<0.00010		mg/L		0.0001	05-APR-11
Barium (Ba)-Total			<0.000050		mg/L		0.00005	05-APR-11
Beryllium (Be)-Total			<0.00050		mg/L		0.0005	05-APR-11
Bismuth (Bi)-Total			<0.00050		mg/L		0.0005	05-APR-11
Boron (B)-Total			<0.010		mg/L		0.01	05-APR-11
Cadmium (Cd)-Total			<0.000010		mg/L		0.00001	05-APR-11
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	05-APR-11
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	05-APR-11
Copper (Cu)-Total			<0.00050		mg/L		0.0005	05-APR-11
Lead (Pb)-Total			<0.000050		mg/L		0.00005	05-APR-11
Lithium (Li)-Total			<0.0050		mg/L		0.005	05-APR-11
Manganese (Mn)-Total			<0.000050		mg/L		0.00005	05-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R2151463								
WG1261119-1 MB								
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	05-APR-11
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	05-APR-11
Potassium (K)-Total			<0.050		mg/L		0.05	05-APR-11
Selenium (Se)-Total			<0.00010		mg/L		0.0001	05-APR-11
Silver (Ag)-Total			<0.000010		mg/L		0.00001	05-APR-11
Sodium (Na)-Total			<0.050		mg/L		0.05	05-APR-11
Strontium (Sr)-Total			<0.00010		mg/L		0.0001	05-APR-11
Thallium (Tl)-Total			<0.00010		mg/L		0.0001	05-APR-11
Tin (Sn)-Total			<0.00010		mg/L		0.0001	05-APR-11
Uranium (U)-Total			<0.000010		mg/L		0.00001	05-APR-11
Vanadium (V)-Total			<0.0010		mg/L		0.001	05-APR-11
Zinc (Zn)-Total			<0.0030		mg/L		0.003	05-APR-11
Batch R2155983								
WG1261119-4 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Total			106		%		80-120	06-APR-11
Antimony (Sb)-Total			92		%		80-120	06-APR-11
Arsenic (As)-Total			90		%		80-120	06-APR-11
Barium (Ba)-Total			91		%		80-120	06-APR-11
Beryllium (Be)-Total			91		%		80-120	06-APR-11
Bismuth (Bi)-Total			87		%		80-120	06-APR-11
Boron (B)-Total			83		%		80-120	06-APR-11
Cadmium (Cd)-Total			89		%		80-120	06-APR-11
Chromium (Cr)-Total			88		%		80-120	06-APR-11
Cobalt (Co)-Total			87		%		80-120	06-APR-11
Copper (Cu)-Total			86		%		80-120	06-APR-11
Lead (Pb)-Total			90		%		80-120	06-APR-11
Lithium (Li)-Total			90		%		80-120	06-APR-11
Manganese (Mn)-Total			88		%		80-120	06-APR-11
Molybdenum (Mo)-Total			93		%		80-120	06-APR-11
Nickel (Ni)-Total			88		%		80-120	06-APR-11
Potassium (K)-Total			88		%		80-120	06-APR-11
Selenium (Se)-Total			91		%		80-120	06-APR-11
Silver (Ag)-Total			93		%		80-120	06-APR-11
Sodium (Na)-Total			89		%		80-120	06-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R2155983								
WG1261119-4 CRM		**VA-HIGH-WATRM**						
Strontium (Sr)-Total			91		%		80-120	06-APR-11
Thallium (Tl)-Total			88		%		80-120	06-APR-11
Tin (Sn)-Total			92		%		80-120	06-APR-11
Uranium (U)-Total			93		%		80-120	06-APR-11
Vanadium (V)-Total			90		%		80-120	06-APR-11
Zinc (Zn)-Total			88		%		80-120	06-APR-11
MET-TOT-ICP-VA	**Water**							
Batch R2144305								
WG1261119-4 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Total			100		%		80-120	04-APR-11
Boron (B)-Total			98		%		80-120	04-APR-11
Calcium (Ca)-Total			101		%		80-120	04-APR-11
Iron (Fe)-Total			98		%		80-120	04-APR-11
Magnesium (Mg)-Total			100		%		80-120	04-APR-11
Phosphorus (P)-Total			99		%		80-120	04-APR-11
Silicon (Si)-Total			105		%		80-120	04-APR-11
Sodium (Na)-Total			101		%		80-120	04-APR-11
Titanium (Ti)-Total			105		%		80-120	04-APR-11
Zinc (Zn)-Total			94		%		80-120	04-APR-11
WG1261119-1 MB								
Barium (Ba)-Total			<0.010		mg/L		0.01	04-APR-11
Boron (B)-Total			<0.10		mg/L		0.1	04-APR-11
Calcium (Ca)-Total			<0.050		mg/L		0.05	04-APR-11
Iron (Fe)-Total			<0.030		mg/L		0.03	04-APR-11
Magnesium (Mg)-Total			<0.10		mg/L		0.1	04-APR-11
Phosphorus (P)-Total			<0.30		mg/L		0.3	04-APR-11
Silicon (Si)-Total			<0.050		mg/L		0.05	04-APR-11
Sodium (Na)-Total			<2.0		mg/L		2	04-APR-11
Titanium (Ti)-Total			<0.010		mg/L		0.01	04-APR-11
Zinc (Zn)-Total			<0.0050		mg/L		0.005	04-APR-11
MET-TOT-LOW-MS-VA	**Water**							
Batch R2146489								
WG1261119-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	05-APR-11
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	05-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-LOW-MS-VA	**Water**							
Batch R2146489								
WG1261119-1 MB								
Arsenic (As)-Total			<0.00010		mg/L		0.0001	05-APR-11
Cadmium (Cd)-Total			<0.000050		mg/L		0.00005	05-APR-11
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	05-APR-11
Copper (Cu)-Total			<0.00050		mg/L		0.0005	05-APR-11
Lead (Pb)-Total			<0.000050		mg/L		0.00005	05-APR-11
Manganese (Mn)-Total			<0.000050		mg/L		0.00005	05-APR-11
Potassium (K)-Total			<0.050		mg/L		0.05	05-APR-11
Selenium (Se)-Total			<0.0010		mg/L		0.001	05-APR-11
Uranium (U)-Total			<0.000010		mg/L		0.00001	05-APR-11
Batch R2156323								
WG1261119-4 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Total			99		%		80-120	06-APR-11
Antimony (Sb)-Total			94		%		80-120	06-APR-11
Arsenic (As)-Total			96		%		80-120	06-APR-11
Cadmium (Cd)-Total			96		%		80-120	06-APR-11
Chromium (Cr)-Total			97		%		80-120	06-APR-11
Copper (Cu)-Total			95		%		80-120	06-APR-11
Lead (Pb)-Total			94		%		80-120	06-APR-11
Manganese (Mn)-Total			95		%		80-120	06-APR-11
Potassium (K)-Total			96		%		80-120	06-APR-11
Selenium (Se)-Total			97		%		80-120	06-APR-11
Uranium (U)-Total			98		%		80-120	06-APR-11
NH3-F-VA	**Water**							
Batch R2150703								
WG1262176-2 CRM		**VA-NH3-F**						
Ammonia as N			101		%		85-115	06-APR-11
WG1262176-4 CRM		**VA-NH3-F**						
Ammonia as N			103		%		85-115	06-APR-11
WG1262176-6 CRM		**VA-NH3-F**						
Ammonia as N			102		%		85-115	06-APR-11
WG1262176-1 MB								
Ammonia as N			<0.0050		mg/L		0.005	06-APR-11
WG1262176-3 MB								
Ammonia as N			<0.0050		mg/L		0.005	06-APR-11
WG1262176-5 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-F-VA	**Water**							
Batch R2150703								
WG1262176-5 MB								
Ammonia as N			<0.0050		mg/L		0.005	06-APR-11
WG1262176-8 MS		**L991860-6**						
Ammonia as N			96		%		75-125	06-APR-11
PH-PCT-VA	**Water**							
Batch R2158204								
WG1262551-10 CRM		**VA-PH7-BUF**						
pH			6.99		pH		6.9-7.1	07-APR-11
S2-D-COL-VA	**Water**							
Batch R2149565								
WG1261924-2 DUP		**L991723-1**						
Sulphide as S (Dissolved)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	05-APR-11
WG1261924-1 MB								
Sulphide as S (Dissolved)			<0.020		mg/L		0.02	05-APR-11
S2-UNION-MANCALC-VA	**Water**							
Batch R2154523								
WG1262109-1 DUP		**L991723-1**						
Sulphide As S (Un-ionized)		<0.020	<0.020	RPD-NA	mg/L	N/A	25	05-APR-11
TDS-VA	**Water**							
Batch R2167723								
WG1263487-2 LCS								
Total Dissolved Solids			95		%		85-115	08-APR-11
WG1263487-5 LCS								
Total Dissolved Solids			98		%		85-115	08-APR-11
WG1263487-8 LCS								
Total Dissolved Solids			99		%		85-115	08-APR-11
WG1263487-1 MB								
Total Dissolved Solids			<10		mg/L		10	08-APR-11
WG1263487-4 MB								
Total Dissolved Solids			<10		mg/L		10	08-APR-11
WG1263487-7 MB								
Total Dissolved Solids			<10		mg/L		10	08-APR-11
TURBIDITY-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TURBIDITY-VA	**Water**							
Batch R2146103								
WG1261475-11 CRM		**VA-TURB-SPK-8**						
Turbidity			105		%		85-115	05-APR-11
WG1261475-2 CRM		**VA-TURB-SPK-8**						
Turbidity			109		%		85-115	05-APR-11
WG1261475-5 CRM		**VA-TURB-SPK-8**						
Turbidity			109		%		85-115	05-APR-11
WG1261475-8 CRM		**VA-TURB-SPK-8**						
Turbidity			105		%		85-115	05-APR-11
WG1261475-1 MB								
Turbidity			<0.10		NTU		0.1	05-APR-11
WG1261475-10 MB								
Turbidity			<0.10		NTU		0.1	05-APR-11
WG1261475-4 MB								
Turbidity			<0.10		NTU		0.1	05-APR-11
WG1261475-7 MB								
Turbidity			<0.10		NTU		0.1	05-APR-11

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
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH by Meter (Automated)							
	1	03-APR-11 11:00	07-APR-11 13:20	0.25	98	hours	EHTR-FM
Total Metals							
Total Mercury in Water by CVAFS(Low)							
	2	03-APR-11 11:00	12-MAY-11 13:21	28	39	days	EHT

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L991723 were received on 04-APR-11 11:30.

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 Laboratory G
ANALYTICAL CHEMISTRY & TESTING SERVIC

Environmental Division

Chain of Custody / Analytical Reque
Canada Toll Free: 1 800 668 98
www.alsglobal.com

L91723-COFC

10-051120

Page ___ of ___

Report To	AMEC	**Report Format / Distribution**	(to availability)
Company:		Standard: ✓ Other (specify):	Regular (Standard Turnaround Times))
Contact:	T. Kostya	Select: PDF ✓ Excel ✓ Digital Fax	Priority, Date Req'd: _____ (Surcharges apply)
Address:	3456 Opie Cres	Email 1: Tammera.kostya@amec.com	Emergency (1 Business Day) - 100% Surcharge
	Prince George BC V2N 2P9	Email 2: Scott.green@amec.com	For Emergency < 1 Day, ASAP or Weekend - Contact ALS
Phone:	(250) 564-3243 Fax:		**Analysis Request**
Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	(Indicate Filtered or Preserved, F/P)
	Copy of Invoice with Report? (circle) Yes or No	Job #: KX13505	
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	
Lab Work Order # (lab use only)	L91723	**ALS Contact:**	**Sampler:**

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Gen. Chem.	Diss. Metals	Total Metals	TOC	Cyanides	NH3 (Ammonia)	S2- (Union - MANUAL) VA	S2- D-(02-VA					Number of Containers
	P2C21(H2) Depth: 600-832m	April 3/11	11am	H_2O	X	X	X	X	X	X	X	X					

Special Instructions / Regulations / Hazardous Details

See Selam Worku 4 directions (Dissolved H_2S)

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
J. Kostya	April 3/11	4:30pm	JP	Apr 4/11	11:30	2 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: T. KOSTYA
3456 OPIE CRST
PRINCE GEORGE BC V2N 2P9

Date Received: 04-APR-11
Report Date: 11-APR-11 13:53 (MT)
Version: FINAL

Client Phone: 250-564-3243

Certificate of Analysis

Lab Work Order #: L991762
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-051119

KELLY HUNT
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L991762-1 P2 C21 (H2) DEPTH 600-870M Sampled By: CLIENT on 03-APR-11 @ 11:00 Matrix: WATER							
Miscellaneous Parameters							
Methane, dissolved	3.59		0.0050	mg/L	05-APR-11	05-APR-11	R2158283

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
METHANE-DIS-CL	Water	Methane, dissolved	EPA 5021/8015-HEADSPACE GC-FID
Results reported in			

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

10-051119

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
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
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
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.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

L991762 10-051119

Page ___ of ___

Report To AMEC	**Report Format / Distribution**	**Service Requested:** (Rush subject to availability)
Company:	Standard: ✓ Other (specify):	Regular (Standard Turnaround Times))
Contact: T. Kostyg	Select: PDF ✓ Excel ✓ Digital Fax	Priority, Date Req'd: _____ (Surcharges apply)
Address: 3456 Opie Cres. Prince George BC, V2N 2P9	Email 1: tammera.kostyg@amec.com	Emergency (1 Business Day) - 100% Surcharge
Phone: (250) 564-3243 Fax:	Email 2: Scott.green@amec.com	For Emergency < 1 Day, ASAP or Weekend - Contact ALS
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: KX13505	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
	ALS Contact:	**Sampler:**

Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Diss. Methane	Number of Containers
P2C21 (H2) Depth 600-870m	April 3/11	11am	H_2O	X	

Special Instructions / Regulations / Hazardous Details

See Selam Worku for direction

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
J. Kostyg	April 3/11	4:30 pm	D. Mouchi	04-April-11	13:54	17 °C				

AMEC EARTH & ENVIRONMENTAL
ATTN: TAMMERA KOSTYA
3456 Opie Crescent
Prince George BC V2N 2P9

Date Received: 05-APR-11
Report Date: 19-MAY-11 17:48 (MT)
Version: FINAL REV. 3

Client Phone: 250-564-3243

Certificate of Analysis

Lab Work Order #: L992288
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-051118

Comments: ADDITIONAL 17-MAY-11 16:40
ADDITIONAL 11-MAY-11 14:02

Selam Worku
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L992288-1	L992288-2			
	Description					
	Sampled Date	04-APR-11	04-APR-11			
	Sampled Time	21:00	21:00			
	Client ID	#2 P2C21 (H2) 600-870M	#2 P2C21 (H2) 600-870M			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	10.7				
	Conductivity (uS/cm)	1800				
	Hardness (as CaCO3) (mg/L)	32.1	32.5			
	pH (pH)	8.25				
	Total Dissolved Solids (mg/L)	1140				
	Turbidity (NTU)	21.5				
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	989				
	Ammonia as N (mg/L)	0.496				
	Chloride (Cl) (mg/L)	26.9				
	Fluoride (F) (mg/L)	2.89				
	Nitrate (as N) (mg/L)	<0.050				
	Nitrite (as N) (mg/L)	<0.010				
	Sulfate (SO4) (mg/L)	17.6				
	Sulphide as S (Dissolved) (mg/L)	<0.020				
Cyanides	Cyanide, Total (mg/L)	<0.0050				
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	5.09				
Inorganic Parameters	Sulphide As S (Un-ionized) (mg/L)	<0.020				
Total Metals	Aluminum (Al)-Total (mg/L)	0.231	0.259			
	Antimony (Sb)-Total (mg/L)	<0.0025 DLA	<0.00020 DLA			
	Arsenic (As)-Total (mg/L)	0.00111	0.00121			
	Barium (Ba)-Total (mg/L)	2.15	2.23			
	Beryllium (Be)-Total (mg/L)		<0.0010 DLA			
	Bismuth (Bi)-Total (mg/L)		<0.0010 DLA			
	Boron (B)-Total (mg/L)	0.30	0.311			
	Cadmium (Cd)-Total (mg/L)	<0.0010 DLA	<0.000020 DLA			
	Calcium (Ca)-Total (mg/L)	8.07	8.07			
	Chromium (Cr)-Total (mg/L)	<0.010 DLA	0.00245			
	Cobalt (Co)-Total (mg/L)		<0.00020 DLA			
	Copper (Cu)-Total (mg/L)	<0.0050 DLA	<0.0010 DLA			
	Iron (Fe)-Total (mg/L)	2.94	2.94			
	Lead (Pb)-Total (mg/L)	<0.0025 DLA	0.00029			
	Lithium (Li)-Total (mg/L)		0.509			
	Magnesium (Mg)-Total (mg/L)	3.00	3.00			
	Manganese (Mn)-Total (mg/L)	0.040	0.0467			
	Mercury (Hg)-Total (mg/L)	<0.00020	<0.000010			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L992288-1	L992288-2			
	Description					
	Sampled Date	04-APR-11	04-APR-11			
	Sampled Time	21:00	21:00			
	Client ID	#2 P2C21 (H2) 600-870M	#2 P2C21 (H2) 600-870M			
Grouping	**Analyte**					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)		0.00714			
	Nickel (Ni)-Total (mg/L)		<0.0010 DLA			
	Phosphorus (P)-Total (mg/L)		<0.30			
	Potassium (K)-Total (mg/L)	1.79	2.05			
	Selenium (Se)-Total (mg/L)	<0.0050 DLA	<0.00020 DLA			
	Silicon (Si)-Total (mg/L)		5.36			
	Silver (Ag)-Total (mg/L)		<0.000020 DLA			
	Sodium (Na)-Total (mg/L)	466	436			
	Strontium (Sr)-Total (mg/L)		0.580			
	Thallium (Tl)-Total (mg/L)		<0.00020 DLA			
	Tin (Sn)-Total (mg/L)		<0.00020 DLA			
	Titanium (Ti)-Total (mg/L)		<0.010			
	Uranium (U)-Total (mg/L)	<0.00050 DLA	0.000263			
	Vanadium (V)-Total (mg/L)		<0.0020 DLA			
	Zinc (Zn)-Total (mg/L)	<0.050	0.0285			
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.168	0.168			
	Antimony (Sb)-Dissolved (mg/L)	<0.0025 DLA	0.00021			
	Arsenic (As)-Dissolved (mg/L)	0.00112	0.00102			
	Barium (Ba)-Dissolved (mg/L)	2.02	2.19			
	Beryllium (Be)-Dissolved (mg/L)		<0.0010 DLA			
	Bismuth (Bi)-Dissolved (mg/L)		<0.0010 DLA			
	Boron (B)-Dissolved (mg/L)	0.28	0.288			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0010 DLA	<0.000020 DLA			
	Calcium (Ca)-Dissolved (mg/L)	8.02	8.02			
	Chromium (Cr)-Dissolved (mg/L)	<0.010 DLA	0.00043			
	Cobalt (Co)-Dissolved (mg/L)		<0.00020 DLA			
	Copper (Cu)-Dissolved (mg/L)	<0.0050 DLA	<0.0010 DLA			
	Iron (Fe)-Dissolved (mg/L)	2.55	2.55			
	Lead (Pb)-Dissolved (mg/L)	<0.0025 DLA	0.00010			
	Lithium (Li)-Dissolved (mg/L)		0.511			
	Magnesium (Mg)-Dissolved (mg/L)	2.93	2.93			
	Manganese (Mn)-Dissolved (mg/L)	0.039	0.0409			
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)		0.00697			
	Nickel (Ni)-Dissolved (mg/L)		<0.0010 DLA			
	Phosphorus (P)-Dissolved (mg/L)		<0.30			
	Potassium (K)-Dissolved (mg/L)	1.79	2.03			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L992288-1	L992288-2			
	Description					
	Sampled Date	04-APR-11	04-APR-11			
	Sampled Time	21:00	21:00			
	Client ID	#2 P2C21 (H2) 600-870M	#2 P2C21 (H2) 600-870M			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.0050 DLA	<0.00020 DLA			
	Silicon (Si)-Dissolved (mg/L)		5.20			
	Silver (Ag)-Dissolved (mg/L)		<0.000020 DLA			
	Sodium (Na)-Dissolved (mg/L)	454	446			
	Strontium (Sr)-Dissolved (mg/L)		0.552			
	Thallium (Tl)-Dissolved (mg/L)		<0.00020 DLA			
	Tin (Sn)-Dissolved (mg/L)		0.00020			
	Titanium (Ti)-Dissolved (mg/L)		<0.010			
	Uranium (U)-Dissolved (mg/L)	<0.00050 DLA	0.000245			
	Vanadium (V)-Dissolved (mg/L)		<0.0020 DLA			
	Zinc (Zn)-Dissolved (mg/L)	<0.050	0.0074			

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
C-TOT-ORG-LOW-CL	Water	Total Organic Carbon	APHA 5310 C-Instrumental
CN-T-MID-HH-COL-VA	Water	Total Cyanide by HH Distillation	APHA 4500-CN Cyanide
This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	APHA 2120 "Color"
This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	APHA 2120 Color
This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-DIS-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS	EPA SW-846 3005A & EPA 245.7
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).			
HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold			

Reference Information

vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-CVAFS-VA Water Total Mercury in Water by CVAFS EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-LOW-MS-VA Water Dissolved Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-LOW-MS-VA Water Total Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

S2-D-COL-VA Water Dissolved Sulphide by Colorimetric APHA 4500-S2 D. - SULPHIDE

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

S2-UNION-MANCALC-VA Water Un-ionized Hydrogen sulphide (Man. calc) APHA -4500-S2 H.

This analysis is carried out using procedures adapted from APHA Method 4500-S2 H. "Calculation of Un-ionized Hydrogen Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

Reference Information

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

10-051118

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

Client: AMEC EARTH & ENVIRONMENTAL
3456 Opie Crescent
Prince George BC V2N 2P9
Contact: TAMMERA KOSTYA

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-PCT-VA	**Water**							
Batch R2173370								
WG1264195-8 CRM		**VA-ALK-PCT-CONTROL**						
Alkalinity, Total (as CaCO3)			104		%		85-115	12-APR-11
WG1264195-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	12-APR-11
WG1264195-2 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	12-APR-11
WG1264195-3 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	12-APR-11
WG1264195-4 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	12-APR-11
WG1264195-5 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	12-APR-11
WG1264195-6 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	12-APR-11
ANIONS-CL-IC-VA	**Water**							
Batch R2154503								
WG1261998-2 CRM		**VA-IC-IVA2-ION23110**						
Chloride (Cl)			100		%		85-115	06-APR-11
WG1261998-9 CRM		**VA-IC-IVA2-ION23110**						
Chloride (Cl)			100		%		85-115	06-APR-11
WG1261998-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	06-APR-11
WG1261998-4 MB								
Chloride (Cl)			<0.50		mg/L		0.5	06-APR-11
WG1261998-6 MB								
Chloride (Cl)			<0.50		mg/L		0.5	06-APR-11
WG1261998-8 MB								
Chloride (Cl)			<0.50		mg/L		0.5	06-APR-11
ANIONS-F-IC-VA	**Water**							
Batch R2154503								
WG1261998-2 CRM		**VA-IC-IVA2-ION23110**						
Fluoride (F)			99		%		85-115	06-APR-11
WG1261998-9 CRM		**VA-IC-IVA2-ION23110**						
Fluoride (F)			99		%		85-115	06-APR-11
WG1261998-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	06-APR-11
WG1261998-4 MB								
Fluoride (F)			<0.020		mg/L		0.02	06-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-F-IC-VA	**Water**							
Batch R2154503								
WG1261998-6 MB								
Fluoride (F)			<0.020		mg/L		0.02	06-APR-11
WG1261998-8 MB								
Fluoride (F)			<0.020		mg/L		0.02	06-APR-11
ANIONS-NO2-IC-VA	**Water**							
Batch R2154503								
WG1261998-2 CRM		**VA-IC-IVA2-ION23110**						
Nitrite (as N)			94		%		85-115	06-APR-11
WG1261998-9 CRM		**VA-IC-IVA2-ION23110**						
Nitrite (as N)			94		%		85-115	06-APR-11
WG1261998-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	06-APR-11
WG1261998-4 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	06-APR-11
WG1261998-6 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	06-APR-11
WG1261998-8 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	06-APR-11
ANIONS-NO3-IC-VA	**Water**							
Batch R2154503								
WG1261998-2 CRM		**VA-IC-IVA2-ION23110**						
Nitrate (as N)			101		%		85-115	06-APR-11
WG1261998-9 CRM		**VA-IC-IVA2-ION23110**						
Nitrate (as N)			103		%		85-115	06-APR-11
WG1261998-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	06-APR-11
WG1261998-4 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	06-APR-11
WG1261998-6 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	06-APR-11
WG1261998-8 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	06-APR-11
ANIONS-SO4-IC-VA	**Water**							
Batch R2154503								
WG1261998-2 CRM		**VA-IC-IVA2-ION23110**						
Sulfate (SO4)			101		%		85-115	06-APR-11
WG1261998-9 CRM		**VA-IC-IVA2-ION23110**						
Sulfate (SO4)			101		%		85-115	06-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-SO4-IC-VA	**Water**							
Batch R2154503								
WG1261998-1 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	06-APR-11
WG1261998-4 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	06-APR-11
WG1261998-6 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	06-APR-11
WG1261998-8 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	06-APR-11
C-TOT-ORG-LOW-CL	**Water**							
Batch R2163703								
WG1263692-2 LCS								
Total Organic Carbon			86		%		80-120	09-APR-11
WG1263692-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	09-APR-11
CN-T-MID-HH-COL-VA	**Water**							
Batch R2163889								
WG1263065-2 CRM		**VA-HH-TCN-CONTROL**						
Cyanide, Total			103		%		80-120	08-APR-11
WG1263065-4 CRM		**VA-HH-TCN-CONTROL**						
Cyanide, Total			109		%		80-120	08-APR-11
WG1263065-1 MB								
Cyanide, Total			<0.0050		mg/L		0.005	08-APR-11
COLOUR-TRUE-VA	**Water**							
Batch R2151563								
WG1261982-2 CRM		**VA-COL-C-25**						
Colour, True			100		%		85-115	06-APR-11
WG1261982-5 CRM		**VA-COL-C-25**						
Colour, True			98		%		85-115	06-APR-11
WG1261982-1 MB								
Colour, True			<5.0		CU		5	06-APR-11
WG1261982-4 MB								
Colour, True			<5.0		CU		5	06-APR-11
EC-PCT-VA	**Water**							
Batch R2153544								
WG1261990-9 CRM		**VA-EC-PCT-CONTROL**						
Conductivity			98		%		90-110	06-APR-11
WG1261990-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-PCT-VA	**Water**							
Batch R2153544								
WG1261990-1 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
WG1261990-2 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
WG1261990-3 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
WG1261990-4 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
WG1261990-5 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
WG1261990-6 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
WG1261990-7 MB								
Conductivity			<2.0		uS/cm		2	06-APR-11
HG-DIS-CVAFS-VA	**Water**							
Batch R2150343								
WG1262156-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Dissolved			88		%		80-120	06-APR-11
WG1261689-1 MB								
Mercury (Hg)-Dissolved			<0.000050		mg/L		0.00005	06-APR-11
WG1262156-1 MB								
Mercury (Hg)-Dissolved			<0.000050		mg/L		0.00005	06-APR-11
HG-DIS-LOW-CVAFS-VA	**Water**							
Batch R2150343								
WG1262156-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Dissolved			88		%		80-120	06-APR-11
WG1261689-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	06-APR-11
WG1262156-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	06-APR-11
HG-TOT-CVAFS-VA	**Water**							
Batch R2155524								
WG1262679-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Total			95		%		80-120	07-APR-11
WG1262679-1 MB								
Mercury (Hg)-Total			<0.000050		mg/L		0.00005	07-APR-11
HG-TOT-LOW-CVAFS-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-TOT-LOW-CVAFS-VA	**Water**							
Batch R2188255								
WG1278364-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Total			98		%		80-120	12-MAY-11
WG1278364-1 MB								
Mercury (Hg)-Total			<0.000010		mg/L		0.00001	12-MAY-11
MET-D-CCMS-VA	**Water**							
Batch R2191350								
WG1261689-1 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	06-APR-11
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	06-APR-11
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	06-APR-11
Barium (Ba)-Dissolved			<0.000050		mg/L		0.00005	06-APR-11
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	06-APR-11
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	06-APR-11
Boron (B)-Dissolved			<0.010		mg/L		0.01	06-APR-11
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	06-APR-11
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	06-APR-11
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	06-APR-11
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	06-APR-11
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	06-APR-11
Lithium (Li)-Dissolved			<0.0050		mg/L		0.005	06-APR-11
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	06-APR-11
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	06-APR-11
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	06-APR-11
Potassium (K)-Dissolved			<0.050		mg/L		0.05	06-APR-11
Selenium (Se)-Dissolved			<0.00010		mg/L		0.0001	06-APR-11
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	06-APR-11
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	06-APR-11
Strontium (Sr)-Dissolved			<0.00010		mg/L		0.0001	06-APR-11
Thallium (Tl)-Dissolved			<0.00010		mg/L		0.0001	06-APR-11
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	06-APR-11
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	06-APR-11
Vanadium (V)-Dissolved			<0.0010		mg/L		0.001	06-APR-11
Zinc (Zn)-Dissolved			<0.0030		mg/L		0.003	06-APR-11
MET-DIS-ICP-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2150684								
WG1261689-2 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Dissolved			99		%		80-120	05-APR-11
Boron (B)-Dissolved			99		%		80-120	05-APR-11
Calcium (Ca)-Dissolved			102		%		80-120	05-APR-11
Iron (Fe)-Dissolved			98		%		80-120	05-APR-11
Magnesium (Mg)-Dissolved			99		%		80-120	05-APR-11
Phosphorus (P)-Dissolved			101		%		80-120	05-APR-11
Silicon (Si)-Dissolved			102		%		80-120	05-APR-11
Sodium (Na)-Dissolved			102		%		80-120	05-APR-11
Titanium (Ti)-Dissolved			105		%		80-120	05-APR-11
Zinc (Zn)-Dissolved			97		%		80-120	05-APR-11
WG1261689-1 MB								
Barium (Ba)-Dissolved			<0.010		mg/L		0.01	05-APR-11
Boron (B)-Dissolved			<0.10		mg/L		0.1	05-APR-11
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	05-APR-11
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	05-APR-11
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	05-APR-11
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	05-APR-11
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	05-APR-11
Sodium (Na)-Dissolved			<2.0		mg/L		2	05-APR-11
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	05-APR-11
Zinc (Zn)-Dissolved			<0.0050		mg/L		0.005	05-APR-11
MET-DIS-LOW-MS-VA	**Water**							
Batch R2149464								
WG1261689-1 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	06-APR-11
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	06-APR-11
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	06-APR-11
Cadmium (Cd)-Dissolved			<0.000050		mg/L		0.00005	06-APR-11
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	06-APR-11
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	06-APR-11
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	06-APR-11
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	06-APR-11
Potassium (K)-Dissolved			<0.050		mg/L		0.05	06-APR-11
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	06-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-LOW-MS-VA	**Water**							
Batch R2149464								
WG1261689-1 MB								
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	06-APR-11
Batch R2156323								
WG1261689-2 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Dissolved			95		%		80-120	06-APR-11
Antimony (Sb)-Dissolved			90		%		80-120	06-APR-11
Arsenic (As)-Dissolved			94		%		80-120	06-APR-11
Cadmium (Cd)-Dissolved			92		%		80-120	06-APR-11
Chromium (Cr)-Dissolved			94		%		80-120	06-APR-11
Copper (Cu)-Dissolved			91		%		80-120	06-APR-11
Lead (Pb)-Dissolved			89		%		80-120	06-APR-11
Manganese (Mn)-Dissolved			91		%		80-120	06-APR-11
Potassium (K)-Dissolved			92		%		80-120	06-APR-11
Selenium (Se)-Dissolved			92		%		80-120	06-APR-11
Uranium (U)-Dissolved			90		%		80-120	06-APR-11
MET-TOT-ICP-VA	**Water**							
Batch R2156084								
WG1262078-4 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Total			101		%		80-120	06-APR-11
Boron (B)-Total			100		%		80-120	06-APR-11
Calcium (Ca)-Total			103		%		80-120	06-APR-11
Iron (Fe)-Total			98		%		80-120	06-APR-11
Magnesium (Mg)-Total			101		%		80-120	06-APR-11
Phosphorus (P)-Total			101		%		80-120	06-APR-11
Silicon (Si)-Total			101		%		80-120	06-APR-11
Sodium (Na)-Total			102		%		80-120	06-APR-11
Titanium (Ti)-Total			107		%		80-120	06-APR-11
Zinc (Zn)-Total			96		%		80-120	06-APR-11
WG1262078-1 MB								
Barium (Ba)-Total			<0.010		mg/L		0.01	06-APR-11
Boron (B)-Total			<0.10		mg/L		0.1	06-APR-11
Calcium (Ca)-Total			<0.050		mg/L		0.05	06-APR-11
Iron (Fe)-Total			<0.030		mg/L		0.03	06-APR-11
Magnesium (Mg)-Total			<0.10		mg/L		0.1	06-APR-11
Phosphorus (P)-Total			<0.30		mg/L		0.3	06-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-ICP-VA	**Water**							
Batch R2156084								
WG1262078-1 MB								
Silicon (Si)-Total			<0.050		mg/L		0.05	06-APR-11
Sodium (Na)-Total			<2.0		mg/L		2	06-APR-11
Titanium (Ti)-Total			<0.010		mg/L		0.01	06-APR-11
Zinc (Zn)-Total			<0.0050		mg/L		0.005	06-APR-11
MET-TOT-LOW-MS-VA	**Water**							
Batch R2156643								
WG1262078-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	07-APR-11
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	07-APR-11
Arsenic (As)-Total			<0.00010		mg/L		0.0001	07-APR-11
Cadmium (Cd)-Total			<0.000050		mg/L		0.00005	07-APR-11
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	07-APR-11
Copper (Cu)-Total			<0.00050		mg/L		0.0005	07-APR-11
Lead (Pb)-Total			<0.000050		mg/L		0.00005	07-APR-11
Manganese (Mn)-Total			<0.000050		mg/L		0.00005	07-APR-11
Potassium (K)-Total			<0.050		mg/L		0.05	07-APR-11
Selenium (Se)-Total			<0.0010		mg/L		0.001	07-APR-11
Uranium (U)-Total			<0.000010		mg/L		0.00001	07-APR-11
Batch R2158743								
WG1262078-4 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Total			100		%		80-120	07-APR-11
Antimony (Sb)-Total			95		%		80-120	07-APR-11
Arsenic (As)-Total			96		%		80-120	07-APR-11
Cadmium (Cd)-Total			94		%		80-120	07-APR-11
Chromium (Cr)-Total			99		%		80-120	07-APR-11
Copper (Cu)-Total			97		%		80-120	07-APR-11
Lead (Pb)-Total			93		%		80-120	07-APR-11
Manganese (Mn)-Total			98		%		80-120	07-APR-11
Potassium (K)-Total			99		%		80-120	07-APR-11
Selenium (Se)-Total			94		%		80-120	07-APR-11
Uranium (U)-Total			94		%		80-120	07-APR-11
NH3-F-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-F-VA	**Water**							
Batch R2163923								
WG1263698-2 CRM Ammonia as N		**VA-NH3-F**	104		%		85-115	10-APR-11
WG1263698-4 CRM Ammonia as N		**VA-NH3-F**	100		%		85-115	10-APR-11
WG1263698-6 CRM Ammonia as N		**VA-NH3-F**	106		%		85-115	10-APR-11
WG1263698-1 MB Ammonia as N			<0.0050		mg/L		0.005	10-APR-11
WG1263698-3 MB Ammonia as N			<0.0050		mg/L		0.005	10-APR-11
WG1263698-5 MB Ammonia as N			<0.0050		mg/L		0.005	10-APR-11
WG1263698-10 MS Ammonia as N		**L992473-5**	103		%		75-125	10-APR-11
WG1263698-8 MS Ammonia as N		**L993278-3**	105		%		75-125	10-APR-11
PH-PCT-VA	**Water**							
Batch R2153544								
WG1261990-10 CRM pH		**VA-PH7-BUF**	7.00		pH		6.9-7.1	06-APR-11
S2-D-COL-VA	**Water**							
Batch R2149565								
WG1261924-1 MB Sulphide as S (Dissolved)			<0.020		mg/L		0.02	05-APR-11
TDS-VA	**Water**							
Batch R2174245								
WG1264239-2 LCS Total Dissolved Solids			98		%		85-115	11-APR-11
WG1264239-5 LCS Total Dissolved Solids			99		%		85-115	11-APR-11
WG1264239-8 LCS Total Dissolved Solids			101		%		85-115	11-APR-11
WG1264239-1 MB Total Dissolved Solids			<10		mg/L		10	11-APR-11
WG1264239-4 MB Total Dissolved Solids			<10		mg/L		10	11-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TDS-VA	**Water**							
Batch R2174245								
WG1264239-7 MB								
Total Dissolved Solids			<10		mg/L		10	11-APR-11
TURBIDITY-VA	**Water**							
Batch R2151663								
WG1262063-2 CRM		**VA-TURB-SPK-8**						
Turbidity			106		%		85-115	06-APR-11
WG1262063-5 CRM		**VA-TURB-SPK-8**						
Turbidity			103		%		85-115	06-APR-11
WG1262063-8 CRM		**VA-TURB-SPK-8**						
Turbidity			104		%		85-115	06-APR-11
WG1262063-1 MB								
Turbidity			<0.10		NTU		0.1	06-APR-11
WG1262063-4 MB								
Turbidity			<0.10		NTU		0.1	06-APR-11
WG1262063-7 MB								
Turbidity			<0.10		NTU		0.1	06-APR-11

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
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH by Meter (Automated)							
	1	04-APR-11 21:00	06-APR-11 13:15	0.25	40	hours	EHTR-FM
Total Metals							
Total Mercury in Water by CVAFS(Low)							
	2	04-APR-11 21:00	12-MAY-11 13:21	28	38	days	EHT

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L992288 were received on 05-APR-11 16:50.

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 Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Short Holding Tim

10-051118

Page 1 of 1

Environmental Division

Rush Processing

L992288-COFC

Report To	AMEC	Other (specify):	**Service Requested:** (Rush subject to availability)
Company:		Select: PDF ✓ Excel ✓ Digital Fax	Regular (Standard Turnaround Times))
Contact:	T. Kostya	Email 1: tammera.kostya@amec.com	Priority, Date Req'd: _____ (Surcharges apply)
Address:	3456 Opie Cres. Prince George, BC, V2N 2P9	Email 2: scott.green@amec.com	Emergency (1 Business Day) - 100% Surcharge
Phone:	(250) 5643243 Fax:		For Emergency < 1 Day, ASAP or Weekend - Contact ALS
Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	**Analysis Request**
	Copy of Invoice with Report? (circle) Yes or No	Job #: KX13505	(Indicate Filtered or Preserved, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	
Lab Work Order # (lab use only)	L992288	**ALS Contact:**	**Sampler:**

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Gen. Chem	Diss. Metals	Tot. Metals	TOC	Cyanides	NH3 (Ammonia)	S2-Union-MANCAL-VA	S2-D-COL-VA	Number of Containers
	#2 P2C21 (H2) 600-870m	04-04-11	9 pm - 9:30	H2O	X	X	X	X	X	X	X	X	
	✱ 9:30pm pH = 8.13 Temp (°C) = 5.21												

Special Instructions / Regulations / Hazardous Details

bottles stated 10pm but really sampled @ 9pm / Gen Chem ⇒ + H2S Diss + all other inquires Please see Selam Worku

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
J. Kostya	April 5/11	10am		11/4/5	4:50pm	5 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: T. KOSTYA
3456 OPIE CRST
PRINCE GEORGE BC V2N 2P9

Date Received: 06-APR-11
Report Date: 12-APR-11 14:06 (MT)
Version: FINAL

Client Phone: 250-564-3243

Certificate of Analysis

Lab Work Order #: L992415
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-051117

KELLY HUNT
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L992415-1 #2 P2C21 (H2) 600-870CM Sampled By: CLIENT on 04-APR-11 @ 21:00 Matrix: WATER							
Miscellaneous Parameters							
Methane, dissolved	14.5		0.0050	mg/L	06-APR-11	06-APR-11	R2158283

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
METHANE-DIS-CL	Water	Methane, dissolved	EPA 5021/8015-HEADSPACE GC-FID
Results reported in			

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

10-051117

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
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
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
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.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

10-051117

L992415 Page 1 of 1

Report To	AMEC
Company:	
Contact:	T. Kostya
Address:	3456 Opie Cres. Prince George, BC, V2N 2P9
Phone: (250) 564-3243 Fax:	
Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)
	Copy of Invoice with Report? (circle) Yes or No
Company:	
Contact:	
Address:	
Phone: Fax:	

Report Format / Distribution	
Standard: ✓ Other (specify):	
Select: PDF ✓ Excel ✓ Digital Fax	
Email 1: tammera.kostya@amec.com	
Email 2: scott.green@amec.com	
Client / Project Information	
Job #: KX13505	
PO / AFE:	
LSD:	
Quote #:	
ALS Contact:	**Sampler:**

Service Requested: (Rush subject to availability)

- ✓ Regular (Standard Turnaround Times))
- Priority, Date Req'd: _____ (Surcharges apply)
- Emergency (1 Business Day) - 100% Surcharge
- For Emergency < 1 Day, ASAP or Weekend - Contact ALS

Analysis Request

(Indicate Filtered or Preserved, F/P)

Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Diss. Methane	Number of Containers
#2 P2C2 (H2) 600-870m	4-4-11	9:00 pm	H_2O	X	

Special Instructions / Regulations / Hazardous Details

Please contact Salam Work for directions

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
T. Kostya	April 5/11	10am	Laura C	6-Apr-11	8:35	14 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: TAMMERA KOSTYA
3456 Opie Crescent
Prince George BC V2N 2P9

Date Received: 11-APR-11
Report Date: 19-MAY-11 17:49 (MT)
Version: FINAL REV. 3

Client Phone: 250-564-3243

Certificate of Analysis

Lab Work Order #: L993769
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-140410

Comments: ADDITIONAL 17-MAY-11 16:39
ADDITIONAL 11-MAY-11 14:05
Note that the Cyanide sample was preserved upon receipt at ALS FSJ.

Selam Worku
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L993769-1	L993769-2			
	Description					
	Sampled Date	11-APR-11	11-APR-11			
	Sampled Time					
	Client ID	#3 P2C21(H2) D 200-600 M	#3 P2C21(H2) D 200-600 M			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0				
	Conductivity (uS/cm)	1080				
	Hardness (as CaCO3) (mg/L)	39.2	45.1			
	pH (pH)	9.19				
	Total Dissolved Solids (mg/L)	675				
	Turbidity (NTU)	66.5				
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	362				
	Ammonia as N (mg/L)	0.488				
	Chloride (Cl) (mg/L)	105				
	Fluoride (F) (mg/L)	<0.20				
	Nitrate (as N) (mg/L)	<0.050				
	Nitrite (as N) (mg/L)	<0.010				
	Sulfate (SO4) (mg/L)	43.6				
	Sulphide as S (Dissolved) (mg/L)	<0.020				
Cyanides	Cyanide, Total (mg/L)	<0.0050				
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	5.56				
Inorganic Parameters	Sulphide As S (Un-ionized) (mg/L)	<0.020				
Total Metals	Aluminum (Al)-Total (mg/L)	2.05	2.16			
	Antimony (Sb)-Total (mg/L)	<0.0025 DLA	0.00160			
	Arsenic (As)-Total (mg/L)	0.00316	0.00294			
	Barium (Ba)-Total (mg/L)	0.776	0.835			
	Beryllium (Be)-Total (mg/L)		<0.0010 DLA			
	Bismuth (Bi)-Total (mg/L)		<0.0010 DLA			
	Boron (B)-Total (mg/L)	0.14	0.155			
	Cadmium (Cd)-Total (mg/L)	<0.0010 DLA	<0.000020 DLA			
	Calcium (Ca)-Total (mg/L)	10.2	10.2			
	Chromium (Cr)-Total (mg/L)	<0.010 DLA	0.00749			
	Cobalt (Co)-Total (mg/L)		0.00044			
	Copper (Cu)-Total (mg/L)	<0.0050 DLA	0.0035			
	Iron (Fe)-Total (mg/L)	1.37	1.37			
	Lead (Pb)-Total (mg/L)	<0.0025 DLA	0.00096			
	Lithium (Li)-Total (mg/L)		0.716			
	Magnesium (Mg)-Total (mg/L)	4.76	4.76			
	Manganese (Mn)-Total (mg/L)	0.017	0.0165			
	Mercury (Hg)-Total (mg/L)	<0.00020	<0.000010			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L993769-1	L993769-2			
	Description					
	Sampled Date	11-APR-11	11-APR-11			
	Sampled Time					
	Client ID	#3 P2C21(H2) D 200-600 M	#3 P2C21(H2) D 200-600 M			
Grouping	**Analyte**					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)		0.0131			
	Nickel (Ni)-Total (mg/L)		0.0036			
	Phosphorus (P)-Total (mg/L)		<0.30			
	Potassium (K)-Total (mg/L)	2.26	2.34			
	Selenium (Se)-Total (mg/L)	<0.0050 DLA	0.00085			
	Silicon (Si)-Total (mg/L)		8.52			
	Silver (Ag)-Total (mg/L)		<0.000020 DLA			
	Sodium (Na)-Total (mg/L)	238	231			
	Strontium (Sr)-Total (mg/L)		0.191			
	Thallium (Tl)-Total (mg/L)		<0.00020 DLA			
	Tin (Sn)-Total (mg/L)		<0.00020 DLA			
	Titanium (Ti)-Total (mg/L)		0.026			
	Uranium (U)-Total (mg/L)	0.00084	0.000763			
	Vanadium (V)-Total (mg/L)		0.0113			
	Zinc (Zn)-Total (mg/L)	<0.050	0.0380			
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.324	0.324			
	Antimony (Sb)-Dissolved (mg/L)	<0.0025 DLA	0.00177			
	Arsenic (As)-Dissolved (mg/L)	0.00296	0.00236			
	Barium (Ba)-Dissolved (mg/L)	0.625	0.659			
	Beryllium (Be)-Dissolved (mg/L)		<0.0010 DLA			
	Bismuth (Bi)-Dissolved (mg/L)		<0.0010 DLA			
	Boron (B)-Dissolved (mg/L)	0.14	0.167			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0010 DLA	<0.000020 DLA			
	Calcium (Ca)-Dissolved (mg/L)	8.36	8.36			
	Chromium (Cr)-Dissolved (mg/L)	<0.010 DLA	0.00127			
	Cobalt (Co)-Dissolved (mg/L)		<0.00020 DLA			
	Copper (Cu)-Dissolved (mg/L)	<0.0050 DLA	<0.0010 DLA			
	Iron (Fe)-Dissolved (mg/L)	0.069	0.069			
	Lead (Pb)-Dissolved (mg/L)	<0.0025 DLA	<0.00010 DLA			
	Lithium (Li)-Dissolved (mg/L)		0.736			
	Magnesium (Mg)-Dissolved (mg/L)	4.44	4.44			
	Manganese (Mn)-Dissolved (mg/L)	<0.010 DLA	0.00496			
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)		0.0125			
	Nickel (Ni)-Dissolved (mg/L)		0.0015			
	Phosphorus (P)-Dissolved (mg/L)		<0.30			
	Potassium (K)-Dissolved (mg/L)	1.72	1.73			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L993769-1	L993769-2			
	Description					
	Sampled Date	11-APR-11	11-APR-11			
	Sampled Time					
	Client ID	#3 P2C21(H2) D 200-600 M	#3 P2C21(H2) D 200-600 M			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.0050 DLA	0.00076			
	Silicon (Si)-Dissolved (mg/L)		5.82			
	Silver (Ag)-Dissolved (mg/L)		<0.000020 DLA			
	Sodium (Na)-Dissolved (mg/L)	239	243			
	Strontium (Sr)-Dissolved (mg/L)		0.167			
	Thallium (Tl)-Dissolved (mg/L)		<0.00020 DLA			
	Tin (Sn)-Dissolved (mg/L)		<0.00020 DLA			
	Titanium (Ti)-Dissolved (mg/L)		<0.010			
	Uranium (U)-Dissolved (mg/L)	0.00076	0.000661			
	Vanadium (V)-Dissolved (mg/L)		0.0051			
	Zinc (Zn)-Dissolved (mg/L)	<0.050	<0.0060 DLA			

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

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
SFPL	Sample was Filtered and Preserved at the laboratory - sample # 1 - Dissolved Metals

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-COL-VA	Water	Alkalinity by Colourimetric (Automated)	APHA 310.2

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

C-TOT-ORG-LOW-CL	Water	Total Organic Carbon	APHA 5310 C-Instrumental
CN-T-MID-HH-COL-VA	Water	Total Cyanide by HH Distillation	APHA 4500-CN Cyanide

This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method.

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	APHA 2120 "Color"

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	APHA 2120 Color

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States

Reference Information

Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-CVAFS-VA Water Total Mercury in Water by CVAFS EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-LOW-MS-VA Water Dissolved Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-LOW-MS-VA Water Total Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

S2-D-COL-VA Water Dissolved Sulphide by Colorimetric APHA 4500-S2 D. - SULPHIDE

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

S2-UNION-MANCALC-VA Water Un-ionized Hydrogen sulphide (Man. calc) APHA -4500-S2 H.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-S2 H. "Calculation of Un-ionized Hydrogen Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

10-140410

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: L993769 Report Date: 19-MAY-11

Client: AMEC EARTH & ENVIRONMENTAL
3456 Opie Crescent
Prince George BC V2N 2P9
Contact: TAMMERA KOSTYA

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-COL-VA	**Water**							
Batch R2176582								
WG1265717-11 CRM		**VA-ALKL-CONTROL**						
Alkalinity, Total (as CaCO3)			95		%		85-115	14-APR-11
WG1265717-14 CRM		**VA-ALKM-CONTROL**						
Alkalinity, Total (as CaCO3)			100		%		85-115	14-APR-11
WG1265717-17 CRM		**VA-ALKH-CONTROL**						
Alkalinity, Total (as CaCO3)			108		%		85-115	14-APR-11
WG1265717-2 CRM		**VA-ALKL-CONTROL**						
Alkalinity, Total (as CaCO3)			106		%		85-115	14-APR-11
WG1265717-20 CRM		**VA-ALKL-CONTROL**						
Alkalinity, Total (as CaCO3)			99		%		85-115	14-APR-11
WG1265717-23 CRM		**VA-ALKM-CONTROL**						
Alkalinity, Total (as CaCO3)			104		%		85-115	14-APR-11
WG1265717-26 CRM		**VA-ALKH-CONTROL**						
Alkalinity, Total (as CaCO3)			103		%		85-115	14-APR-11
WG1265717-5 CRM		**VA-ALKM-CONTROL**						
Alkalinity, Total (as CaCO3)			111		%		85-115	14-APR-11
WG1265717-8 CRM		**VA-ALKH-CONTROL**						
Alkalinity, Total (as CaCO3)			98		%		85-115	14-APR-11
WG1265717-1 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	14-APR-11
WG1265717-10 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	14-APR-11
WG1265717-13 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	14-APR-11
WG1265717-16 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	14-APR-11
WG1265717-19 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	14-APR-11
WG1265717-22 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	14-APR-11
WG1265717-25 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	14-APR-11
WG1265717-4 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	14-APR-11
WG1265717-7 MB								
Alkalinity, Total (as CaCO3)			<2.0		mg/L		2	14-APR-11
ANIONS-CL-IC-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-CL-IC-VA	**Water**							
Batch R2173747								
WG1264699-11 CRM		**VA-IC-IVA2-ION23110**						
Chloride (Cl)			98		%		85-115	12-APR-11
WG1264699-2 CRM		**VA-IC-IVA2-ION23110**						
Chloride (Cl)			99		%		85-115	12-APR-11
WG1264699-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	12-APR-11
WG1264699-10 MB								
Chloride (Cl)			<0.50		mg/L		0.5	12-APR-11
WG1264699-4 MB								
Chloride (Cl)			<0.50		mg/L		0.5	12-APR-11
WG1264699-6 MB								
Chloride (Cl)			<0.50		mg/L		0.5	12-APR-11
WG1264699-8 MB								
Chloride (Cl)			<0.50		mg/L		0.5	12-APR-11
ANIONS-F-IC-VA	**Water**							
Batch R2173747								
WG1264699-11 CRM		**VA-IC-IVA2-ION23110**						
Fluoride (F)			99		%		85-115	12-APR-11
WG1264699-2 CRM		**VA-IC-IVA2-ION23110**						
Fluoride (F)			103		%		85-115	12-APR-11
WG1264699-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	12-APR-11
WG1264699-10 MB								
Fluoride (F)			<0.020		mg/L		0.02	12-APR-11
WG1264699-4 MB								
Fluoride (F)			<0.020		mg/L		0.02	12-APR-11
WG1264699-6 MB								
Fluoride (F)			<0.020		mg/L		0.02	12-APR-11
WG1264699-8 MB								
Fluoride (F)			<0.020		mg/L		0.02	12-APR-11
ANIONS-NO2-IC-VA	**Water**							
Batch R2173747								
WG1264699-11 CRM		**VA-IC-IVA2-ION23110**						
Nitrite (as N)			99		%		85-115	12-APR-11
WG1264699-2 CRM		**VA-IC-IVA2-ION23110**						
Nitrite (as N)			97		%		85-115	12-APR-11
WG1264699-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	12-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-NO2-IC-VA	**Water**							
Batch R2173747								
WG1264699-10 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	12-APR-11
WG1264699-4 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	12-APR-11
WG1264699-6 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	12-APR-11
WG1264699-8 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	12-APR-11
ANIONS-NO3-IC-VA	**Water**							
Batch R2173747								
WG1264699-11 CRM		**VA-IC-IVA2-ION23110**						
Nitrate (as N)			100		%		85-115	12-APR-11
WG1264699-2 CRM		**VA-IC-IVA2-ION23110**						
Nitrate (as N)			100		%		85-115	12-APR-11
WG1264699-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	12-APR-11
WG1264699-10 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	12-APR-11
WG1264699-4 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	12-APR-11
WG1264699-6 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	12-APR-11
WG1264699-8 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	12-APR-11
ANIONS-SO4-IC-VA	**Water**							
Batch R2173747								
WG1264699-11 CRM		**VA-IC-IVA2-ION23110**						
Sulfate (SO4)			102		%		85-115	12-APR-11
WG1264699-2 CRM		**VA-IC-IVA2-ION23110**						
Sulfate (SO4)			103		%		85-115	12-APR-11
WG1264699-1 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	12-APR-11
WG1264699-10 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	12-APR-11
WG1264699-4 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	12-APR-11
WG1264699-6 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	12-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-SO4-IC-VA	**Water**							
Batch R2173747								
WG1264699-8 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	12-APR-11
CN-T-MID-HH-COL-VA	**Water**							
Batch R2174417								
WG1265278-2 CRM		**VA-HH-TCN-CONTROL**						
Cyanide, Total			85		%		80-120	13-APR-11
WG1265278-5 CRM		**VA-HH-TCN-CONTROL**						
Cyanide, Total			100		%		80-120	13-APR-11
WG1265278-1 MB								
Cyanide, Total			<0.0050		mg/L		0.005	13-APR-11
WG1265278-4 MB								
Cyanide, Total			<0.0050		mg/L		0.005	13-APR-11
COLOUR-TRUE-VA	**Water**							
Batch R2172900								
WG1264615-2 CRM		**VA-COL-C-25**						
Colour, True			94		%		85-115	12-APR-11
WG1264615-4 CRM		**VA-COL-C-25**						
Colour, True			95		%		85-115	12-APR-11
WG1264615-7 CRM		**VA-COL-C-25**						
Colour, True			98		%		85-115	12-APR-11
WG1264615-1 MB								
Colour, True			<5.0		CU		5	12-APR-11
WG1264615-3 MB								
Colour, True			<5.0		CU		5	12-APR-11
WG1264615-6 MB								
Colour, True			<5.0		CU		5	12-APR-11
EC-PCT-VA	**Water**							
Batch R2173370								
WG1264195-9 CRM		**VA-EC-PCT-CONTROL**						
Conductivity			96		%		90-110	12-APR-11
WG1264195-1 MB								
Conductivity			<2.0		uS/cm		2	12-APR-11
WG1264195-2 MB								
Conductivity			<2.0		uS/cm		2	12-APR-11
WG1264195-3 MB								
Conductivity			<2.0		uS/cm		2	12-APR-11
WG1264195-4 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-PCT-VA	**Water**							
Batch R2173370								
WG1264195-4 MB								
Conductivity			<2.0		uS/cm		2	12-APR-11
WG1264195-5 MB								
Conductivity			<2.0		uS/cm		2	12-APR-11
WG1264195-6 MB								
Conductivity			<2.0		uS/cm		2	12-APR-11
HG-DIS-CVAFS-VA	**Water**							
Batch R2175588								
WG1264808-1 MB								
Mercury (Hg)-Dissolved			<0.000050		mg/L		0.00005	14-APR-11
WG1264808-4 MB								
Mercury (Hg)-Dissolved			<0.000050		mg/L		0.00005	14-APR-11
Batch R2176934								
WG1266529-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Dissolved			93		%		80-120	15-APR-11
WG1266529-1 MB								
Mercury (Hg)-Dissolved			<0.000050		mg/L		0.00005	15-APR-11
HG-DIS-LOW-CVAFS-VA	**Water**							
Batch R2175588								
WG1264808-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	14-APR-11
WG1264808-4 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	14-APR-11
Batch R2176934								
WG1266529-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Dissolved			93		%		80-120	15-APR-11
WG1266529-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	15-APR-11
HG-TOT-CVAFS-VA	**Water**							
Batch R2174104								
WG1265303-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Total			112		%		80-120	13-APR-11
WG1265303-1 MB								
Mercury (Hg)-Total			<0.000050		mg/L		0.00005	13-APR-11
HG-TOT-LOW-CVAFS-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-TOT-LOW-CVAFS-VA	**Water**							
Batch R2188255								
WG1278364-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Total			98		%		80-120	12-MAY-11
WG1278364-1 MB								
Mercury (Hg)-Total			<0.000010		mg/L		0.00001	12-MAY-11
MET-D-CCMS-VA	**Water**							
Batch R2174403								
WG1264808-1 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	13-APR-11
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Barium (Ba)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	13-APR-11
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	13-APR-11
Boron (B)-Dissolved			<0.010		mg/L		0.01	13-APR-11
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	13-APR-11
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	13-APR-11
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Lithium (Li)-Dissolved			<0.0050		mg/L		0.005	13-APR-11
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	13-APR-11
Potassium (K)-Dissolved			<0.050		mg/L		0.05	13-APR-11
Selenium (Se)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	13-APR-11
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	13-APR-11
Strontium (Sr)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Thallium (Tl)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	13-APR-11
Vanadium (V)-Dissolved			<0.0010		mg/L		0.001	13-APR-11
Zinc (Zn)-Dissolved			<0.0030		mg/L		0.003	13-APR-11
WG1264808-4 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	13-APR-11
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R2174403								
WG1264808-4 MB								
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Barium (Ba)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	13-APR-11
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	13-APR-11
Boron (B)-Dissolved			<0.010		mg/L		0.01	13-APR-11
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	13-APR-11
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	13-APR-11
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Lithium (Li)-Dissolved			<0.0050		mg/L		0.005	13-APR-11
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	13-APR-11
Potassium (K)-Dissolved			<0.050		mg/L		0.05	13-APR-11
Selenium (Se)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	13-APR-11
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	13-APR-11
Strontium (Sr)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Thallium (Tl)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	13-APR-11
Vanadium (V)-Dissolved			<0.0010		mg/L		0.001	13-APR-11
Zinc (Zn)-Dissolved			<0.0030		mg/L		0.003	13-APR-11
Batch R2176931								
WG1264808-3 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Dissolved			103		%		80-120	14-APR-11
Antimony (Sb)-Dissolved			101		%		80-120	14-APR-11
Arsenic (As)-Dissolved			105		%		80-120	14-APR-11
Barium (Ba)-Dissolved			99		%		80-120	14-APR-11
Beryllium (Be)-Dissolved			101		%		80-120	14-APR-11
Bismuth (Bi)-Dissolved			115		%		80-120	14-APR-11
Boron (B)-Dissolved			93		%		80-120	14-APR-11
Cadmium (Cd)-Dissolved			97		%		80-120	14-APR-11
Chromium (Cr)-Dissolved			101		%		80-120	14-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R2176931								
WG1264808-3 CRM		**VA-HIGH-WATRM**						
Cobalt (Co)-Dissolved			102		%		80-120	14-APR-11
Copper (Cu)-Dissolved			101		%		80-120	14-APR-11
Lead (Pb)-Dissolved			102		%		80-120	14-APR-11
Lithium (Li)-Dissolved			101		%		80-120	14-APR-11
Manganese (Mn)-Dissolved			97		%		80-120	14-APR-11
Molybdenum (Mo)-Dissolved			103		%		80-120	14-APR-11
Nickel (Ni)-Dissolved			103		%		80-120	14-APR-11
Potassium (K)-Dissolved			100		%		80-120	14-APR-11
Selenium (Se)-Dissolved			103		%		80-120	14-APR-11
Silver (Ag)-Dissolved			102		%		80-120	14-APR-11
Sodium (Na)-Dissolved			96		%		80-120	14-APR-11
Strontium (Sr)-Dissolved			98		%		80-120	14-APR-11
Thallium (Tl)-Dissolved			99		%		80-120	14-APR-11
Tin (Sn)-Dissolved			95		%		80-120	14-APR-11
Uranium (U)-Dissolved			99		%		80-120	14-APR-11
Vanadium (V)-Dissolved			104		%		80-120	14-APR-11
Zinc (Zn)-Dissolved			95		%		80-120	14-APR-11
MET-DIS-ICP-VA	**Water**							
Batch R2174387								
WG1264808-3 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Dissolved			99		%		80-120	12-APR-11
Boron (B)-Dissolved			101		%		80-120	12-APR-11
Calcium (Ca)-Dissolved			104		%		80-120	12-APR-11
Iron (Fe)-Dissolved			96		%		80-120	12-APR-11
Magnesium (Mg)-Dissolved			101		%		80-120	12-APR-11
Phosphorus (P)-Dissolved			101		%		80-120	12-APR-11
Silicon (Si)-Dissolved			108		%		80-120	12-APR-11
Sodium (Na)-Dissolved			100		%		80-120	12-APR-11
Titanium (Ti)-Dissolved			104		%		80-120	12-APR-11
Zinc (Zn)-Dissolved			96		%		80-120	12-APR-11
WG1264808-1 MB								
Barium (Ba)-Dissolved			<0.010		mg/L		0.01	12-APR-11
Boron (B)-Dissolved			<0.10		mg/L		0.1	12-APR-11
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	12-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2174387								
WG1264808-1 MB								
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	12-APR-11
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	12-APR-11
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	12-APR-11
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	12-APR-11
Sodium (Na)-Dissolved			<2.0		mg/L		2	12-APR-11
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	12-APR-11
Zinc (Zn)-Dissolved			<0.0050		mg/L		0.005	12-APR-11
WG1264808-4 MB								
Barium (Ba)-Dissolved			<0.010		mg/L		0.01	12-APR-11
Boron (B)-Dissolved			<0.10		mg/L		0.1	12-APR-11
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	12-APR-11
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	12-APR-11
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	12-APR-11
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	12-APR-11
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	12-APR-11
Sodium (Na)-Dissolved			<2.0		mg/L		2	12-APR-11
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	12-APR-11
Zinc (Zn)-Dissolved			<0.0050		mg/L		0.005	12-APR-11
MET-DIS-LOW-MS-VA	**Water**							
Batch R2174408								
WG1264808-1 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	13-APR-11
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Cadmium (Cd)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	13-APR-11
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	13-APR-11
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Potassium (K)-Dissolved			<0.050		mg/L		0.05	13-APR-11
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	13-APR-11
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	13-APR-11
WG1264808-4 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	13-APR-11
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-LOW-MS-VA	**Water**							
Batch R2174408								
WG1264808-4 MB								
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	13-APR-11
Cadmium (Cd)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	13-APR-11
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	13-APR-11
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	13-APR-11
Potassium (K)-Dissolved			<0.050		mg/L		0.05	13-APR-11
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	13-APR-11
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	13-APR-11
Batch R2176931								
WG1264808-3 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Dissolved			103		%		80-120	14-APR-11
Antimony (Sb)-Dissolved			101		%		80-120	14-APR-11
Arsenic (As)-Dissolved			105		%		80-120	14-APR-11
Cadmium (Cd)-Dissolved			97		%		80-120	14-APR-11
Chromium (Cr)-Dissolved			101		%		80-120	14-APR-11
Copper (Cu)-Dissolved			101		%		80-120	14-APR-11
Lead (Pb)-Dissolved			102		%		80-120	14-APR-11
Manganese (Mn)-Dissolved			97		%		80-120	14-APR-11
Potassium (K)-Dissolved			100		%		80-120	14-APR-11
Selenium (Se)-Dissolved			103		%		80-120	14-APR-11
Uranium (U)-Dissolved			99		%		80-120	14-APR-11
MET-T-CCMS-VA	**Water**							
Batch R2174403								
WG1264801-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	13-APR-11
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	13-APR-11
Arsenic (As)-Total			<0.00010		mg/L		0.0001	13-APR-11
Barium (Ba)-Total			<0.000050		mg/L		0.00005	13-APR-11
Beryllium (Be)-Total			<0.00050		mg/L		0.0005	13-APR-11
Bismuth (Bi)-Total			<0.00050		mg/L		0.0005	13-APR-11
Boron (B)-Total			<0.010		mg/L		0.01	13-APR-11
Cadmium (Cd)-Total			<0.000010		mg/L		0.00001	13-APR-11
Chromium (Cr)-Total			<0.00010		mg/L		0.0001	13-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R2174403								
WG1264801-1 MB								
Cobalt (Co)-Total			<0.00010		mg/L		0.0001	13-APR-11
Copper (Cu)-Total			<0.00050		mg/L		0.0005	13-APR-11
Lead (Pb)-Total			<0.000050		mg/L		0.00005	13-APR-11
Lithium (Li)-Total			<0.0050		mg/L		0.005	13-APR-11
Manganese (Mn)-Total			<0.000050		mg/L		0.00005	13-APR-11
Molybdenum (Mo)-Total			<0.000050		mg/L		0.00005	13-APR-11
Nickel (Ni)-Total			<0.00050		mg/L		0.0005	13-APR-11
Potassium (K)-Total			<0.050		mg/L		0.05	13-APR-11
Selenium (Se)-Total			<0.00010		mg/L		0.0001	13-APR-11
Silver (Ag)-Total			<0.000010		mg/L		0.00001	13-APR-11
Sodium (Na)-Total			<0.050		mg/L		0.05	13-APR-11
Strontium (Sr)-Total			<0.00010		mg/L		0.0001	13-APR-11
Thallium (Tl)-Total			<0.00010		mg/L		0.0001	13-APR-11
Tin (Sn)-Total			<0.00010		mg/L		0.0001	13-APR-11
Uranium (U)-Total			<0.000010		mg/L		0.00001	13-APR-11
Vanadium (V)-Total			<0.0010		mg/L		0.001	13-APR-11
Zinc (Zn)-Total			<0.0030		mg/L		0.003	13-APR-11
Batch R2176931								
WG1264801-4 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Total			101		%		80-120	14-APR-11
Antimony (Sb)-Total			99		%		80-120	14-APR-11
Arsenic (As)-Total			98		%		80-120	14-APR-11
Barium (Ba)-Total			94		%		80-120	14-APR-11
Beryllium (Be)-Total			99		%		80-120	14-APR-11
Bismuth (Bi)-Total			110		%		80-120	14-APR-11
Boron (B)-Total			94		%		80-120	14-APR-11
Cadmium (Cd)-Total			92		%		80-120	14-APR-11
Chromium (Cr)-Total			95		%		80-120	14-APR-11
Cobalt (Co)-Total			97		%		80-120	14-APR-11
Copper (Cu)-Total			96		%		80-120	14-APR-11
Lead (Pb)-Total			99		%		80-120	14-APR-11
Lithium (Li)-Total			99		%		80-120	14-APR-11
Manganese (Mn)-Total			93		%		80-120	14-APR-11
Molybdenum (Mo)-Total			100		%		80-120	14-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-T-CCMS-VA	**Water**							
Batch R2176931								
WG1264801-4 CRM		**VA-HIGH-WATRM**						
Nickel (Ni)-Total			97		%		80-120	14-APR-11
Potassium (K)-Total			95		%		80-120	14-APR-11
Selenium (Se)-Total			100		%		80-120	14-APR-11
Silver (Ag)-Total			101		%		80-120	14-APR-11
Sodium (Na)-Total			94		%		80-120	14-APR-11
Strontium (Sr)-Total			95		%		80-120	14-APR-11
Thallium (Tl)-Total			96		%		80-120	14-APR-11
Tin (Sn)-Total			92		%		80-120	14-APR-11
Uranium (U)-Total			97		%		80-120	14-APR-11
Vanadium (V)-Total			97		%		80-120	14-APR-11
Zinc (Zn)-Total			90		%		80-120	14-APR-11
MET-TOT-ICP-VA	**Water**							
Batch R2174387								
WG1264801-4 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Total			101		%		80-120	12-APR-11
Boron (B)-Total			101		%		80-120	12-APR-11
Calcium (Ca)-Total			104		%		80-120	12-APR-11
Iron (Fe)-Total			97		%		80-120	12-APR-11
Magnesium (Mg)-Total			103		%		80-120	12-APR-11
Phosphorus (P)-Total			101		%		80-120	12-APR-11
Silicon (Si)-Total			109		%		80-120	12-APR-11
Sodium (Na)-Total			102		%		80-120	12-APR-11
Titanium (Ti)-Total			105		%		80-120	12-APR-11
Zinc (Zn)-Total			95		%		80-120	12-APR-11
WG1264801-1 MB								
Barium (Ba)-Total			<0.010		mg/L		0.01	12-APR-11
Boron (B)-Total			<0.10		mg/L		0.1	12-APR-11
Calcium (Ca)-Total			<0.050		mg/L		0.05	12-APR-11
Iron (Fe)-Total			<0.030		mg/L		0.03	12-APR-11
Magnesium (Mg)-Total			<0.10		mg/L		0.1	12-APR-11
Phosphorus (P)-Total			<0.30		mg/L		0.3	12-APR-11
Silicon (Si)-Total			<0.050		mg/L		0.05	12-APR-11
Sodium (Na)-Total			<2.0		mg/L		2	12-APR-11
Titanium (Ti)-Total			<0.010		mg/L		0.01	12-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-ICP-VA	**Water**							
Batch R2174387								
WG1264801-1 MB								
Zinc (Zn)-Total			<0.0050		mg/L		0.005	12-APR-11
MET-TOT-LOW-MS-VA	**Water**							
Batch R2174408								
WG1264801-1 MB								
Aluminum (Al)-Total			<0.0030		mg/L		0.003	13-APR-11
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	13-APR-11
Arsenic (As)-Total			<0.00010		mg/L		0.0001	13-APR-11
Cadmium (Cd)-Total			<0.000050		mg/L		0.00005	13-APR-11
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	13-APR-11
Copper (Cu)-Total			<0.00050		mg/L		0.0005	13-APR-11
Lead (Pb)-Total			<0.000050		mg/L		0.00005	13-APR-11
Manganese (Mn)-Total			<0.000050		mg/L		0.00005	13-APR-11
Potassium (K)-Total			<0.050		mg/L		0.05	13-APR-11
Selenium (Se)-Total			<0.0010		mg/L		0.001	13-APR-11
Uranium (U)-Total			<0.000010		mg/L		0.00001	13-APR-11
Batch R2176931								
WG1264801-4 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Total			101		%		80-120	14-APR-11
Antimony (Sb)-Total			99		%		80-120	14-APR-11
Arsenic (As)-Total			98		%		80-120	14-APR-11
Cadmium (Cd)-Total			92		%		80-120	14-APR-11
Chromium (Cr)-Total			95		%		80-120	14-APR-11
Copper (Cu)-Total			96		%		80-120	14-APR-11
Lead (Pb)-Total			99		%		80-120	14-APR-11
Manganese (Mn)-Total			93		%		80-120	14-APR-11
Potassium (K)-Total			95		%		80-120	14-APR-11
Selenium (Se)-Total			100		%		80-120	14-APR-11
Uranium (U)-Total			97		%		80-120	14-APR-11
NH3-F-VA	**Water**							
Batch R2174145								
WG1265287-2 CRM		**VA-NH3-F**						
Ammonia as N			104		%		85-115	13-APR-11
WG1265287-4 CRM		**VA-NH3-F**						
Ammonia as N			102		%		85-115	13-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-F-VA	**Water**							
Batch R2174145								
WG1265287-6 CRM		**VA-NH3-F**						
Ammonia as N			99		%		85-115	13-APR-11
WG1265287-1 MB								
Ammonia as N			<0.0050		mg/L		0.005	13-APR-11
WG1265287-3 MB								
Ammonia as N			<0.0050		mg/L		0.005	13-APR-11
WG1265287-5 MB								
Ammonia as N			<0.0050		mg/L		0.005	13-APR-11
WG1265287-8 MS		**L993420-12**						
Ammonia as N			96		%		75-125	13-APR-11
PH-PCT-VA	**Water**							
Batch R2173370								
WG1264195-10 CRM		**VA-PH7-BUF**						
pH			6.98		pH		6.9-7.1	12-APR-11
S2-D-COL-VA	**Water**							
Batch R2173589								
WG1264582-2 DUP		**L993769-1**						
Sulphide as S (Dissolved)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	12-APR-11
WG1264582-1 MB								
Sulphide as S (Dissolved)			<0.020		mg/L		0.02	12-APR-11
S2-UNION-MANCALC-VA	**Water**							
Batch R2173629								
WG1264757-1 DUP		**L993769-1**						
Sulphide As S (Un-ionized)		<0.020	<0.020	RPD-NA	mg/L	N/A	25	12-APR-11
TDS-VA	**Water**							
Batch R2177711								
WG1266601-10 LCS								
Total Dissolved Solids			101		%		85-115	15-APR-11
WG1266601-2 LCS								
Total Dissolved Solids			100		%		85-115	15-APR-11
WG1266601-4 LCS								
Total Dissolved Solids			100		%		85-115	15-APR-11
WG1266601-7 LCS								
Total Dissolved Solids			100		%		85-115	15-APR-11
WG1266601-1 MB								
Total Dissolved Solids			<10		mg/L		10	15-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TDS-VA	**Water**							
Batch R2177711								
WG1266601-3 MB								
Total Dissolved Solids			<10		mg/L		10	15-APR-11
WG1266601-6 MB								
Total Dissolved Solids			<10		mg/L		10	15-APR-11
WG1266601-9 MB								
Total Dissolved Solids			<10		mg/L		10	15-APR-11
TURBIDITY-VA	**Water**							
Batch R2174388								
WG1265079-2 CRM		**VA-TURB-SPK-8**						
Turbidity			104		%		85-115	13-APR-11
WG1265079-5 CRM		**VA-TURB-SPK-8**						
Turbidity			102		%		85-115	13-APR-11
WG1265079-8 CRM		**VA-TURB-SPK-8**						
Turbidity			104		%		85-115	13-APR-11
WG1265079-1 MB								
Turbidity			<0.10		NTU		0.1	13-APR-11
WG1265079-4 MB								
Turbidity			<0.10		NTU		0.1	13-APR-11
WG1265079-7 MB								
Turbidity			<0.10		NTU		0.1	13-APR-11

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
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH by Meter (Automated)							
	1	11-APR-11	12-APR-11 09:27	0.25	24	hours	EHTR-FM
Total Metals							
Total Mercury in Water by CVAFS(Low)							
	2	11-APR-11	12-MAY-11 13:21	28	31	days	EHT

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L993769 were received on 11-APR-11 09:35.

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.

~~10~~ 140410

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

L993769

Page 1 of 1

Report To	AMEC	**Report Format / Distribution**	**Service Request:** (Rush subject to availability - Contact ALS to confirm TAT)
Company:		Standard: ✓ Other (specify):	Regular (Standard Turnaround Times - Business Days)
Contact:	T. Kostya	Select: PDF ✓ Excel ✓ Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	3456 Opie Cres. Prince George, BC, V2N ~~2Z~~ 2P9	Email 1: tammera.kostya@amec.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
		Email 2: Scott.green@amec.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	(250) 564-3243 Fax:		
Invoice To	Same as Report ? (circle) (Yes) or No (if No, provide details)	**Client / Project Information**	**Analysis Request**
	Copy of Invoice with Report? (circle) Yes or No	Job #: KX13505	(Indicate Filtered or Preserved, F/P)
Company:		PO / AFE:	
Contact:		LSD:	
Address:			
Phone:	Fax:	Quote #:	
Lab Work Order # (lab use only)		**ALS Contact:**	**Sampler:**

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	* Gen Chem	* Diss. Metals	Tot. Metals	TOC	Cyanides	Ammonia	H2S - Union Manganese-VA	S2- - COL-VA	Number of Containers
	#3 P2C21 (H2) D: 200-600m	11-04-11	12 AM	H_2O	X	X	X	X	X	X	X	X	

pH = Temp = — will call with info

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

* See Selam Worku * Preservative added 8hrs later (April 11/11 @9am) of Diss. Metals NOT Filtered & Pres

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
T. Kosty	April 11/11	9:30am	MRB	April 11	9:35	1 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: T. KOSTYA
3456 OPIE CRST
PRINCE GEORGE BC V2N 2P9

Date Received: 11-APR-11
Report Date: 14-APR-11 16:01 (MT)
Version: FINAL

Client Phone: 250-564-3243

Certificate of Analysis

Lab Work Order #: L993814
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-140409

Nikolce Trajanoski
Supervisor

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L993814-1 #3 P2C21(H2) D 200-600M Sampled By: NOT PROVIDED on 11-APR-11 Matrix: WATER							
Miscellaneous Parameters							
Methane, dissolved	18.9		0.0050	mg/L	12-APR-11	13-APR-11	R2175444

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
METHANE-DIS-CL	Water	Methane, dissolved	EPA 5021/8015-HEADSPACE GC-FID
Results reported in			

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

10-140409

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
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
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
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.

10-140409

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L993814

Page 1 of ___

Report To	AMEC
Company:	
Contact:	T. Kostyg
Address:	3456 Opie Cres. Prince George, BC, V2N 2P9
Phone:	(250) 564-3243 Fax:
Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)
	Copy of Invoice with Report? (circle) Yes or No
Company:	
Contact:	
Address:	
Phone:	Fax:
Lab Work Order # (lab use only)	

Report Format / Distribution	
Standard: ✓	Other (specify): ✓
Select: PDF	Excel ✓ Digital Fax
Email 1:	tammera.kostyg@amec.com
Email 2:	scott.green@amec.com
Client / Project Information	
Job #:	
PO / AFE:	
LSD:	
Quote #:	
ALS Contact:	**Sampler:**

Service Request: (Rush subject to availability - Contact ALS to confirm TAT)

- Regular (Standard Turnaround Times - Business Days)
- Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
- Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
- Same Day or Weekend Emergency - Contact ALS to confirm TAT

Analysis Request

(Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Diss. Methane	Number of Containers
	#3 P2C21 (#2) D: 200-600m	11-04-11	12am	H2O		

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

* See Selam Work for details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
J. Kostyg	April 11/11	9:30am	MQ	Apr. 11/11	9:30	6 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: TAMMERA KOSTYA
3456 Opie Crescent
Prince George BC V2N 2P9

Date Received: 18-APR-11
Report Date: 19-MAY-11 17:50 (MT)
Version: FINAL REV. 3

Client Phone: 250-564-3243

Certificate of Analysis

Lab Work Order #: L996144
Project P.O. #: TUMBLER RIDGE
Job Reference: KX13505
Legal Site Desc:
C of C Numbers:

Comments: ADDITIONAL 17-MAY-11 16:41
ADDITIONAL 11-MAY-11 14:06
Although Cyanide analysis is requested for, note that the required sample bottle was not submitted.

Selam Worku
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L996144-1	L996144-2			
	Description					
	Sampled Date	16-APR-11	16-APR-11			
	Sampled Time	17:00	17:00			
	Client ID	#4 P2C21 (H2)D 20-600M	#4 P2C21 (H2)D 20-600M			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0				
	Conductivity (uS/cm)	1720				
	Hardness (as CaCO3) (mg/L)	14.1	30.2			
	pH (pH)	10.60				
	Total Dissolved Solids (mg/L)	993				
	Turbidity (NTU)	124				
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	728				
	Ammonia as N (mg/L)	1.69				
	Chloride (Cl) (mg/L)	79				
	Fluoride (F) (mg/L)	1.09				
	Nitrate (as N) (mg/L)	<0.10				
	Nitrite (as N) (mg/L)	<0.020				
	Sulfate (SO4) (mg/L)	52				
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	12.8				
Total Metals	Aluminum (Al)-Total (mg/L)	2.72	2.87			
	Antimony (Sb)-Total (mg/L)	<0.0025 DLA	0.00168			
	Arsenic (As)-Total (mg/L)	0.00200	0.00249			
	Barium (Ba)-Total (mg/L)	0.669	0.722			
	Beryllium (Be)-Total (mg/L)		<0.0010 DLA			
	Bismuth (Bi)-Total (mg/L)		<0.0010 DLA			
	Boron (B)-Total (mg/L)	0.16	0.176			
	Cadmium (Cd)-Total (mg/L)	<0.0010 DLA	0.000049			
	Calcium (Ca)-Total (mg/L)	8.12	8.12			
	Chromium (Cr)-Total (mg/L)	0.012	0.0131			
	Cobalt (Co)-Total (mg/L)		0.00069			
	Copper (Cu)-Total (mg/L)	<0.0050 DLA	0.0045			
	Iron (Fe)-Total (mg/L)	1.63	1.64			
	Lead (Pb)-Total (mg/L)	<0.0025 DLA	0.00138			
	Lithium (Li)-Total (mg/L)		0.929			
	Magnesium (Mg)-Total (mg/L)	2.41	2.41			
	Manganese (Mn)-Total (mg/L)	0.015	0.0172			
	Mercury (Hg)-Total (mg/L)	<0.00020	<0.000010			
	Molybdenum (Mo)-Total (mg/L)		0.0172			
	Nickel (Ni)-Total (mg/L)		0.0050			
	Phosphorus (P)-Total (mg/L)		<0.30			
	Potassium (K)-Total (mg/L)	2.86	3.26			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L996144-1	L996144-2			
	Description					
	Sampled Date	16-APR-11	16-APR-11			
	Sampled Time	17:00	17:00			
	Client ID	#4 P2C21 (H2)D 20-600M	#4 P2C21 (H2)D 20-600M			
Grouping	**Analyte**					
WATER						
Total Metals	Selenium (Se)-Total (mg/L)	<0.0050 DLA	0.00037			
	Silicon (Si)-Total (mg/L)		11.0			
	Silver (Ag)-Total (mg/L)		0.000023			
	Sodium (Na)-Total (mg/L)	393	382			
	Strontium (Sr)-Total (mg/L)		0.139			
	Thallium (Tl)-Total (mg/L)		<0.00020 DLA			
	Tin (Sn)-Total (mg/L)		<0.00020 DLA			
	Titanium (Ti)-Total (mg/L)		0.033			
	Uranium (U)-Total (mg/L)	<0.00050 DLA	0.000372			
	Vanadium (V)-Total (mg/L)		0.0145			
	Zinc (Zn)-Total (mg/L)	<0.050	0.0402			
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.466	0.467			
	Antimony (Sb)-Dissolved (mg/L)	<0.0025 DLA	0.00184			
	Arsenic (As)-Dissolved (mg/L)	0.00191	0.00202			
	Barium (Ba)-Dissolved (mg/L)	0.270	0.297			
	Beryllium (Be)-Dissolved (mg/L)		<0.0010 DLA			
	Bismuth (Bi)-Dissolved (mg/L)		<0.0010 DLA			
	Boron (B)-Dissolved (mg/L)	0.15	0.174			
	Cadmium (Cd)-Dissolved (mg/L)	<0.0010 DLA	<0.000020 DLA			
	Calcium (Ca)-Dissolved (mg/L)	3.46	3.46			
	Chromium (Cr)-Dissolved (mg/L)	<0.010 DLA	0.00245			
	Cobalt (Co)-Dissolved (mg/L)		<0.00020 DLA			
	Copper (Cu)-Dissolved (mg/L)	<0.0050 DLA	<0.0010 DLA			
	Iron (Fe)-Dissolved (mg/L)	0.052	0.052			
	Lead (Pb)-Dissolved (mg/L)	<0.0025 DLA	<0.00010 DLA			
	Lithium (Li)-Dissolved (mg/L)		0.927			
	Magnesium (Mg)-Dissolved (mg/L)	1.33	1.33			
	Manganese (Mn)-Dissolved (mg/L)	<0.010 DLA	0.00030			
	Mercury (Hg)-Dissolved (mg/L)	<0.00020	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)		0.0161			
	Nickel (Ni)-Dissolved (mg/L)		<0.0010 DLA			
	Phosphorus (P)-Dissolved (mg/L)		<0.30			
	Potassium (K)-Dissolved (mg/L)	2.30	2.63			
	Selenium (Se)-Dissolved (mg/L)	<0.0050 DLA	0.00038			
	Silicon (Si)-Dissolved (mg/L)		7.70			
	Silver (Ag)-Dissolved (mg/L)		<0.000020 DLA			
	Sodium (Na)-Dissolved (mg/L)	398	405			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L996144-1	L996144-2			
	Description					
	Sampled Date	16-APR-11	16-APR-11			
	Sampled Time	17:00	17:00			
	Client ID	#4 P2C21 (H2)D 20-600M	#4 P2C21 (H2)D 20-600M			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Strontium (Sr)-Dissolved (mg/L)		0.0894			
	Thallium (Tl)-Dissolved (mg/L)		<0.00020 DLA			
	Tin (Sn)-Dissolved (mg/L)		<0.00020 DLA			
	Titanium (Ti)-Dissolved (mg/L)		<0.010			
	Uranium (U)-Dissolved (mg/L)	<0.00050 DLA	0.000227			
	Vanadium (V)-Dissolved (mg/L)		0.0067			
	Zinc (Zn)-Dissolved (mg/L)	<0.050	<0.0060 DLA			

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

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
SFPL	Sample was Filtered and Preserved at the laboratory - sample # 1 - Dissolved Metals

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
MB-LOR	Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required.
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**
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	APHA 2120 "Color"

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	APHA 2120 Color

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold

Reference Information

vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-CVAFS-VA Water Total Mercury in Water by CVAFS EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-DIS-LOW-MS-VA Water Dissolved Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures involves preliminary sample treatment by filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-LOW-MS-VA Water Total Metals in Water by ICPMS(Low) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

Reference Information

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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, BC, 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

Client: AMEC EARTH & ENVIRONMENTAL
3456 Opie Crescent
Prince George BC V2N 2P9
Contact: TAMMERA KOSTYA

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-PCT-VA	**Water**							
Batch R2182757								
WG1271304-8 CRM		**VA-ALK-PCT-CONTROL**						
Alkalinity, Total (as CaCO3)			109		%		85-115	28-APR-11
WG1271304-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	28-APR-11
ANIONS-CL-IC-VA	**Water**							
Batch R2178206								
WG1266961-11 CRM		**VA-IC-IVA2-ION23110**						
Chloride (Cl)			101		%		85-115	18-APR-11
WG1266961-2 CRM		**VA-IC-IVA2-ION23110**						
Chloride (Cl)			101		%		85-115	18-APR-11
WG1266961-9 DUP		**L996144-1**						
Chloride (Cl)		79	78		mg/L	0.19	20	18-APR-11
WG1266961-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	18-APR-11
WG1266961-10 MB								
Chloride (Cl)			<0.50		mg/L		0.5	18-APR-11
WG1266961-4 MB								
Chloride (Cl)			<0.50		mg/L		0.5	18-APR-11
WG1266961-6 MB								
Chloride (Cl)			<0.50		mg/L		0.5	18-APR-11
WG1266961-8 MB								
Chloride (Cl)			<0.50		mg/L		0.5	18-APR-11
ANIONS-F-IC-VA	**Water**							
Batch R2178206								
WG1266961-11 CRM		**VA-IC-IVA2-ION23110**						
Fluoride (F)			110		%		85-115	18-APR-11
WG1266961-2 CRM		**VA-IC-IVA2-ION23110**						
Fluoride (F)			109		%		85-115	18-APR-11
WG1266961-9 DUP		**L996144-1**						
Fluoride (F)		1.09	1.11		mg/L	1.6	20	18-APR-11
WG1266961-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	18-APR-11
WG1266961-10 MB								
Fluoride (F)			<0.020		mg/L		0.02	18-APR-11
WG1266961-4 MB								
Fluoride (F)			<0.020		mg/L		0.02	18-APR-11
WG1266961-6 MB								
Fluoride (F)			<0.020		mg/L		0.02	18-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-F-IC-VA	**Water**							
Batch R2178206								
WG1266961-8 MB								
Fluoride (F)			<0.020		mg/L		0.02	18-APR-11
ANIONS-NO2-IC-VA	**Water**							
Batch R2178206								
WG1266961-11 CRM		**VA-IC-IVA2-ION23110**						
Nitrite (as N)			99		%		85-115	18-APR-11
WG1266961-2 CRM		**VA-IC-IVA2-ION23110**						
Nitrite (as N)			100		%		85-115	18-APR-11
WG1266961-9 DUP		**L996144-1**						
Nitrite (as N)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	18-APR-11
WG1266961-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	18-APR-11
WG1266961-10 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	18-APR-11
WG1266961-4 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	18-APR-11
WG1266961-6 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	18-APR-11
WG1266961-8 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	18-APR-11
ANIONS-NO3-IC-VA	**Water**							
Batch R2178206								
WG1266961-11 CRM		**VA-IC-IVA2-ION23110**						
Nitrate (as N)			102		%		85-115	18-APR-11
WG1266961-2 CRM		**VA-IC-IVA2-ION23110**						
Nitrate (as N)			102		%		85-115	18-APR-11
WG1266961-9 DUP		**L996144-1**						
Nitrate (as N)		<0.10	<0.10	RPD-NA	mg/L	N/A	20	18-APR-11
WG1266961-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	18-APR-11
WG1266961-4 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	18-APR-11
WG1266961-6 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	18-APR-11
WG1266961-8 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	18-APR-11
ANIONS-SO4-IC-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-SO4-IC-VA	**Water**							
Batch R2178206								
WG1266961-11 CRM		**VA-IC-IVA2-ION23110**						
Sulfate (SO4)			104		%		85-115	18-APR-11
WG1266961-2 CRM		**VA-IC-IVA2-ION23110**						
Sulfate (SO4)			105		%		85-115	18-APR-11
WG1266961-9 DUP		**L996144-1**						
Sulfate (SO4)		52	49		mg/L	6.2	20	18-APR-11
WG1266961-1 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	18-APR-11
WG1266961-10 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	18-APR-11
WG1266961-4 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	18-APR-11
WG1266961-6 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	18-APR-11
WG1266961-8 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	18-APR-11
CARBONS-TOC-VA	**Water**							
Batch R2180491								
WG1270216-1 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			93		%		80-120	21-APR-11
WG1270216-3 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			93		%		80-120	21-APR-11
WG1270216-5 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			94		%		80-120	21-APR-11
WG1270216-7 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			93		%		80-120	21-APR-11
WG1270216-2 MB								
Total Organic Carbon			<0.50		mg/L		0.5	21-APR-11
WG1270216-4 MB								
Total Organic Carbon			<0.50		mg/L		0.5	21-APR-11
WG1270216-6 MB								
Total Organic Carbon			<0.50		mg/L		0.5	21-APR-11
WG1270216-10 MS		**L995883-1**						
Total Organic Carbon			N/A	MS-B	%		-	21-APR-11
COLOUR-TRUE-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
COLOUR-TRUE-VA	**Water**							
Batch R2178289								
WG1267710-2 CRM		**VA-COL-C-25**						
Colour, True			100		%		85-115	19-APR-11
WG1267710-4 CRM		**VA-COL-C-25**						
Colour, True			100		%		85-115	19-APR-11
WG1267710-1 MB								
Colour, True			<5.0		CU		5	19-APR-11
WG1267710-3 MB								
Colour, True			<5.0		CU		5	19-APR-11
EC-PCT-VA	**Water**							
Batch R2178452								
WG1267739-9 CRM		**VA-EC-PCT-CONTROL**						
Conductivity			98		%		90-110	19-APR-11
WG1267739-1 MB								
Conductivity			<2.0		uS/cm		2	19-APR-11
WG1267739-2 MB								
Conductivity			<2.0		uS/cm		2	19-APR-11
WG1267739-3 MB								
Conductivity			<2.0		uS/cm		2	19-APR-11
WG1267739-4 MB								
Conductivity			<2.0		uS/cm		2	19-APR-11
WG1267739-5 MB								
Conductivity			<2.0		uS/cm		2	19-APR-11
WG1267739-6 MB								
Conductivity			<2.0		uS/cm		2	19-APR-11
HG-DIS-CVAFS-VA	**Water**							
Batch R2181346								
WG1270976-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Dissolved			92		%		80-120	27-APR-11
WG1270976-1 MB								
Mercury (Hg)-Dissolved			<0.000050		mg/L		0.00005	27-APR-11
HG-DIS-LOW-CVAFS-VA	**Water**							
Batch R2178301								
WG1267052-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	19-APR-11
WG1267052-5 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	19-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-DIS-LOW-CVAFS-VA	**Water**							
Batch R2181346								
WG1270976-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Dissolved			92		%		80-120	27-APR-11
WG1270976-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	27-APR-11
HG-TOT-CVAFS-VA	**Water**							
Batch R2178301								
WG1267876-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Total			98		%		80-120	19-APR-11
WG1267876-1 MB								
Mercury (Hg)-Total			<0.000050		mg/L		0.00005	19-APR-11
HG-TOT-LOW-CVAFS-VA	**Water**							
Batch R2188764								
WG1278985-2 CRM		**VA-HG-WATRM**						
Mercury (Hg)-Total			99		%		80-120	13-MAY-11
WG1278985-1 MB								
Mercury (Hg)-Total			<0.000010		mg/L		0.00001	13-MAY-11
MET-D-CCMS-VA	**Water**							
Batch R2178844								
WG1267052-1 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	19-APR-11
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Barium (Ba)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	19-APR-11
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	19-APR-11
Boron (B)-Dissolved			<0.010		mg/L		0.01	19-APR-11
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	19-APR-11
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	19-APR-11
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Lithium (Li)-Dissolved			<0.0050		mg/L		0.005	19-APR-11
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	19-APR-11
Potassium (K)-Dissolved			<0.050		mg/L		0.05	19-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R2178844								
WG1267052-1 MB								
Selenium (Se)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	19-APR-11
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	19-APR-11
Strontium (Sr)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Thallium (Tl)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	19-APR-11
Vanadium (V)-Dissolved			<0.0010		mg/L		0.001	19-APR-11
Zinc (Zn)-Dissolved			<0.0030		mg/L		0.003	19-APR-11
WG1267052-5 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	19-APR-11
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Barium (Ba)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Beryllium (Be)-Dissolved			<0.00050		mg/L		0.0005	19-APR-11
Bismuth (Bi)-Dissolved			<0.00050		mg/L		0.0005	19-APR-11
Boron (B)-Dissolved			<0.010		mg/L		0.01	19-APR-11
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.00001	19-APR-11
Chromium (Cr)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Cobalt (Co)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	19-APR-11
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Lithium (Li)-Dissolved			<0.0050		mg/L		0.005	19-APR-11
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Molybdenum (Mo)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Nickel (Ni)-Dissolved			<0.00050		mg/L		0.0005	19-APR-11
Potassium (K)-Dissolved			<0.050		mg/L		0.05	19-APR-11
Selenium (Se)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Silver (Ag)-Dissolved			<0.000010		mg/L		0.00001	19-APR-11
Sodium (Na)-Dissolved			<0.050		mg/L		0.05	19-APR-11
Strontium (Sr)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Thallium (Tl)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Tin (Sn)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	19-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-D-CCMS-VA	**Water**							
Batch R2178844								
WG1267052-5 MB								
Vanadium (V)-Dissolved			<0.0010		mg/L		0.001	19-APR-11
Zinc (Zn)-Dissolved			<0.0030		mg/L		0.003	19-APR-11
MET-DIS-ICP-VA	**Water**							
Batch R2178266								
WG1267052-4 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Dissolved			98		%		80-120	18-APR-11
Boron (B)-Dissolved			99		%		80-120	18-APR-11
Calcium (Ca)-Dissolved			100		%		80-120	18-APR-11
Iron (Fe)-Dissolved			97		%		80-120	18-APR-11
Magnesium (Mg)-Dissolved			100		%		80-120	18-APR-11
Phosphorus (P)-Dissolved			100		%		80-120	18-APR-11
Silicon (Si)-Dissolved			103		%		80-120	18-APR-11
Sodium (Na)-Dissolved			101		%		80-120	18-APR-11
Titanium (Ti)-Dissolved			104		%		80-120	18-APR-11
Zinc (Zn)-Dissolved			95		%		80-120	18-APR-11
WG1267052-1 MB								
Barium (Ba)-Dissolved			<0.010		mg/L		0.01	18-APR-11
Boron (B)-Dissolved			<0.10		mg/L		0.1	18-APR-11
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	18-APR-11
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	18-APR-11
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	18-APR-11
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	18-APR-11
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	18-APR-11
Sodium (Na)-Dissolved			<2.0		mg/L		2	18-APR-11
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	18-APR-11
Zinc (Zn)-Dissolved			<0.0050		mg/L		0.005	18-APR-11
WG1267052-5 MB								
Barium (Ba)-Dissolved			<0.010		mg/L		0.01	18-APR-11
Boron (B)-Dissolved			<0.10		mg/L		0.1	18-APR-11
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	18-APR-11
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	18-APR-11
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	18-APR-11
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	18-APR-11
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	18-APR-11
Sodium (Na)-Dissolved			<2.0		mg/L		2	18-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2178266								
WG1267052-5 MB								
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	18-APR-11
Zinc (Zn)-Dissolved			<0.0050		mg/L		0.005	18-APR-11
MET-DIS-LOW-MS-VA	**Water**							
Batch R2178825								
WG1267052-1 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	19-APR-11
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Cadmium (Cd)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	19-APR-11
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	19-APR-11
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Potassium (K)-Dissolved			<0.050		mg/L		0.05	19-APR-11
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	19-APR-11
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	19-APR-11
WG1267052-5 MB								
Aluminum (Al)-Dissolved			<0.0030		mg/L		0.003	19-APR-11
Antimony (Sb)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Arsenic (As)-Dissolved			<0.00010		mg/L		0.0001	19-APR-11
Cadmium (Cd)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Chromium (Cr)-Dissolved			<0.00050		mg/L		0.0005	19-APR-11
Copper (Cu)-Dissolved			<0.00050		mg/L		0.0005	19-APR-11
Lead (Pb)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Manganese (Mn)-Dissolved			<0.000050		mg/L		0.00005	19-APR-11
Potassium (K)-Dissolved			<0.050		mg/L		0.05	19-APR-11
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	19-APR-11
Uranium (U)-Dissolved			<0.000010		mg/L		0.00001	19-APR-11
MET-TOT-ICP-VA	**Water**							
Batch R2178266								
WG1267412-3 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Total			101		%		80-120	18-APR-11
Boron (B)-Total			101		%		80-120	18-APR-11
Calcium (Ca)-Total			101		%		80-120	18-APR-11
Iron (Fe)-Total			98		%		80-120	18-APR-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-ICP-VA	**Water**							
Batch R2178266								
WG1267412-3 CRM		**VA-HIGH-WATRM**						
Magnesium (Mg)-Total			102		%		80-120	18-APR-11
Phosphorus (P)-Total			102		%		80-120	18-APR-11
Silicon (Si)-Total			105		%		80-120	18-APR-11
Sodium (Na)-Total			103		%		80-120	18-APR-11
Titanium (Ti)-Total			106		%		80-120	18-APR-11
Zinc (Zn)-Total			95		%		80-120	18-APR-11
WG1267412-1 MB								
Barium (Ba)-Total			<0.010		mg/L		0.01	18-APR-11
Boron (B)-Total			<0.10		mg/L		0.1	18-APR-11
Calcium (Ca)-Total			<0.050		mg/L		0.05	18-APR-11
Iron (Fe)-Total			<0.030		mg/L		0.03	18-APR-11
Magnesium (Mg)-Total			<0.10		mg/L		0.1	18-APR-11
Phosphorus (P)-Total			<0.30		mg/L		0.3	18-APR-11
Silicon (Si)-Total			<0.050		mg/L		0.05	18-APR-11
Sodium (Na)-Total			<2.0		mg/L		2	18-APR-11
Titanium (Ti)-Total			<0.010		mg/L		0.01	18-APR-11
Zinc (Zn)-Total			<0.0050		mg/L		0.005	18-APR-11
MET-TOT-LOW-MS-VA	**Water**							
Batch R2178825								
WG1267412-1 MB								
Antimony (Sb)-Total			<0.00010		mg/L		0.0001	19-APR-11
Arsenic (As)-Total			<0.00010		mg/L		0.0001	19-APR-11
Cadmium (Cd)-Total			<0.000050		mg/L		0.00005	19-APR-11
Chromium (Cr)-Total			<0.00050		mg/L		0.0005	19-APR-11
Copper (Cu)-Total			<0.00050		mg/L		0.0005	19-APR-11
Lead (Pb)-Total			<0.000050		mg/L		0.00005	19-APR-11
Manganese (Mn)-Total			<0.000050		mg/L		0.00005	19-APR-11
Potassium (K)-Total			<0.050		mg/L		0.05	19-APR-11
Selenium (Se)-Total			<0.0010		mg/L		0.001	19-APR-11
Uranium (U)-Total			<0.000010		mg/L		0.00001	19-APR-11
Batch R2178844								
WG1267412-1 MB								
Aluminum (Al)-Total			0.0056	MB-LOR	mg/L		0.003	19-APR-11
NH3-F-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-F-VA	**Water**							
Batch R2179335								
WG1269024-2 CRM		**VA-NH3-F**						
Ammonia as N			94		%		85-115	21-APR-11
WG1269024-4 CRM		**VA-NH3-F**						
Ammonia as N			95		%		85-115	21-APR-11
WG1269024-6 CRM		**VA-NH3-F**						
Ammonia as N			95		%		85-115	21-APR-11
WG1269024-8 CRM		**VA-NH3-F**						
Ammonia as N			94		%		85-115	21-APR-11
WG1269024-1 MB								
Ammonia as N			<0.0050		mg/L		0.005	21-APR-11
WG1269024-3 MB								
Ammonia as N			<0.0050		mg/L		0.005	21-APR-11
WG1269024-5 MB								
Ammonia as N			<0.0050		mg/L		0.005	21-APR-11
WG1269024-7 MB								
Ammonia as N			<0.0050		mg/L		0.005	21-APR-11
WG1269024-10 MS		**L996197-10**						
Ammonia as N			96		%		75-125	21-APR-11
WG1269024-12 MS		**L995862-5**						
Ammonia as N			88		%		75-125	21-APR-11
PH-PCT-VA	**Water**							
Batch R2178452								
WG1267739-10 CRM		**VA-PH7-BUF**						
pH			6.99		pH		6.9-7.1	19-APR-11
TDS-VA	**Water**							
Batch R2179637								
WG1269212-10 LCS								
Total Dissolved Solids			99		%		85-115	21-APR-11
WG1269212-13 LCS								
Total Dissolved Solids			105		%		85-115	21-APR-11
WG1269212-2 LCS								
Total Dissolved Solids			102		%		85-115	21-APR-11
WG1269212-5 LCS								
Total Dissolved Solids			102		%		85-115	21-APR-11
WG1269212-7 LCS								
Total Dissolved Solids			98		%		85-115	21-APR-11
WG1269212-1 MB								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TDS-VA	**Water**							
Batch R2179637								
WG1269212-1 MB								
Total Dissolved Solids			<10		mg/L		10	21-APR-11
WG1269212-12 MB								
Total Dissolved Solids			<10		mg/L		10	21-APR-11
WG1269212-4 MB								
Total Dissolved Solids			<10		mg/L		10	21-APR-11
WG1269212-6 MB								
Total Dissolved Solids			<10		mg/L		10	21-APR-11
WG1269212-9 MB								
Total Dissolved Solids			<10		mg/L		10	21-APR-11
TURBIDITY-VA	**Water**							
Batch R2178291								
WG1267711-2 CRM		**VA-TURB-SPK-8**						
Turbidity			105		%		85-115	19-APR-11
WG1267711-5 CRM		**VA-TURB-SPK-8**						
Turbidity			105		%		85-115	19-APR-11
WG1267711-8 CRM		**VA-TURB-SPK-8**						
Turbidity			104		%		85-115	19-APR-11
WG1267711-1 MB								
Turbidity			<0.10		NTU		0.1	19-APR-11
WG1267711-4 MB								
Turbidity			<0.10		NTU		0.1	19-APR-11
WG1267711-7 MB								
Turbidity			<0.10		NTU		0.1	19-APR-11

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
J	Duplicate results and limits are expressed in terms of absolute difference.
MB-LOR	Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required.
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.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH by Meter (Automated)							
	1	16-APR-11 17:00	19-APR-11 14:31	0.25	70	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L996144 were received on 18-APR-11 14:13.

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.

Short Holding Time

Rush Processing

ALS Environmen

10-140411

L996144-COFC

Page 1 of 1

Report To	AMEC	**Report Format / Distribution**	**Service Request:** (Rush subject to availability - Contact ALS to confirm TAT)
Company:		Standard: ✓ Other (specify):	Regular (Standard Turnaround Times - Business Days) ✓
Contact:	J. Kostya	Select: PDF ✓ Excel ✓ Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	3456 Opie Cres. Prince George, BC, V2N 2P9	Email 1: tammera.kostya@amec.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
		Email 2: scott.green@amec.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	Fax:		**Analysis Request**
Invoice To	Same as Report ? (circle) (Yes) or No (if No, provide details)	**Client / Project Information**	(Indicate Filtered or Preserved, F/P)
	Copy of Invoice with Report? (circle) Yes or No	Job #: KX13505	
Company:		PO / AFE:	
Contact:		LSD: Tumblers Ridge	
Address:			
Phone:	Fax:	Quote #:	
Lab Work Order # (lab use only)	L996144	**ALS Contact:**	**Sampler:**

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Potability Package (H.T. Metals)	Diss. Metals	TOC	Cyanides	Ammonia							Number of Containers
	#4 P2c21 (H2)D 20-600m	16-04-11	5pm	H_2O												

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

* No Diss. H_2S samples to analyze * Please see Selam Work when received for details.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
J. Kostya	April 17/11	10am	JP	Apr 18/11	11:40	7 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: T.KOSTYA
3456 OPIE CRST
PRINCE GEORGE BC V2N 2P9

Date Received: 18-APR-11
Report Date: 26-APR-11 15:48 (MT)
Version: FINAL

Client Phone: 250-564-3243

Certificate of Analysis

Lab Work Order #: L995935
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505
Legal Site Desc:
C of C Numbers: 10-051116

KELLY HUNT
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L995935-1 #4 P2C21(H2) D20-600M Sampled By: T.KOSTYA on 16-APR-11 @ 17:00 Matrix: WATER							
Miscellaneous Parameters							
Methane, dissolved	9.14		0.0050	mg/L	21-APR-11	21-APR-11	R2180040

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
METHANE-DIS-CL	Water	Methane, dissolved	EPA 5021/8015-HEADSPACE GC-FID
Results reported in			

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

10-051116

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
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
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
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.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

4121

Chain of Custody / Analytical Request Form

Canada Toll Free: 1 800 668 9878

www.alsglobal.com

L995935

10-051116

Page 1 of 1

Report To	AMEC
Company:	
Contact:	T. Kostya
Address:	#3456 Opie Cres. Prince George, BC, V2N 2P9
Phone:	(250) 564-3243 Fax:
Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)
	Copy of Invoice with Report? (circle) Yes or No
Company:	
Contact:	
Address:	
Phone:	Fax:

Report Format / Distribution

Standard: ✓ Other (specify):

Select: PDF ✓ Excel ✓ Digital Fax

Email 1: tammera.kostya@amec.com

Email 2: Scott.green@amec.com

Client / Project Information

Job #: KX13505

PO / AFE:

LSD:

Quote #:

ALS Contact: Selam Worku

Sampler: T. Kostya

Service Requested: (Rush subject to availability)

Regular (Standard Turnaround Times)) ✓

Priority, Date Req'd: _____ (Surcharges apply)

Emergency (1 Business Day) - 100% Surcharge

For Emergency < 1 Day, ASAP or Weekend - Contact ALS

Analysis Request

(Indicate Filtered or Preserved, F/P)

Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Diss. Methane	Number of Containers
#4 P2C21 (H2) D 20 - 600m	16-04-11	5PM	H2O	X	

Special Instructions / Regulations / Hazardous Details

Please See Selam Worku when received for details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
T. Kostya	April 17	10am	SR	18 Apr	8:55	14 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

AMEC EARTH & ENVIRONMENTAL
ATTN: Tammera Kostya
3456 Opie Crescent
Prince George BC V2N 2P9

Date Received: 24-JUN-11
Report Date: 19-JUL-11 17:38 (MT)
Version: FINAL REV. 2

Client Phone: 250-564-3243

Certificate of Analysis

Lab Work Order #: L1023033
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505.300
Legal Site Desc:
C of C Numbers: C037617

Comments: ADDITIONAL 15-JUL-11 14:57
Alkalinity analysis has been added.

19-JUL-11: Revised report

Andre Langlais
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1023033-1				
	Description	WATER				
	Sampled Date	23-JUN-11				
	Sampled Time	11:00				
	Client ID	H16W 800-1000M				
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	7.0				
	Conductivity (uS/cm)	1810				
	Hardness (as CaCO3) (mg/L)	11.0				
	pH (pH)	9.50				
	Total Dissolved Solids (mg/L)	1170				
	Turbidity (NTU)	75.5				
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	868				
	Ammonia (as N) (mg/L)	0.939				
	Bromide (Br) (mg/L)	<0.50				
	Chloride (Cl) (mg/L)	79.7				
	Fluoride (F) (mg/L)	0.64				
	Nitrate (as N) (mg/L)	<0.050				
	Nitrite (as N) (mg/L)	<0.010				
	Sulfate (SO4) (mg/L)	20.1				
	Sulphide as S (Dissolved) (mg/L)	0.118				
Cyanides	Cyanide, Total (mg/L)	<0.0050				
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	27.9				
Inorganic Parameters	Sulphide As S (Un-ionized) (mg/L)	<0.020				
Total Metals	Aluminum (Al)-Total (mg/L)	0.933				
	Antimony (Sb)-Total (mg/L)	<0.0025 DLA				
	Arsenic (As)-Total (mg/L)	0.0033				
	Barium (Ba)-Total (mg/L)	0.610				
	Beryllium (Be)-Total (mg/L)	<0.0050 DLA				
	Bismuth (Bi)-Total (mg/L)	<0.20				
	Boron (B)-Total (mg/L)	0.26				
	Cadmium (Cd)-Total (mg/L)	0.000112				
	Calcium (Ca)-Total (mg/L)	10.1				
	Chromium (Cr)-Total (mg/L)	0.0088				
	Cobalt (Co)-Total (mg/L)	<0.0015 DLA				
	Copper (Cu)-Total (mg/L)	0.0113				
	Iron (Fe)-Total (mg/L)	1.57				
	Lead (Pb)-Total (mg/L)	<0.0025 DLA				
	Lithium (Li)-Total (mg/L)	0.926				
	Magnesium (Mg)-Total (mg/L)	1.31				
	Manganese (Mn)-Total (mg/L)	0.0301				
	Mercury (Hg)-Total (mg/L)	<0.000010				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1023033-1				
		Description	WATER				
		Sampled Date	23-JUN-11				
		Sampled Time	11:00				
		Client ID	H16W 800-1000M				
Grouping	**Analyte**						
WATER							
Total Metals	Molybdenum (Mo)-Total (mg/L)		0.0223				
	Nickel (Ni)-Total (mg/L)		0.0064				
	Phosphorus (P)-Total (mg/L)		<0.30				
	Potassium (K)-Total (mg/L)		4.7				
	Selenium (Se)-Total (mg/L)		<0.0050 DLA				
	Silicon (Si)-Total (mg/L)		9.54				
	Silver (Ag)-Total (mg/L)		<0.00010 DLA				
	Sodium (Na)-Total (mg/L)		412				
	Strontium (Sr)-Total (mg/L)		0.120				
	Thallium (Tl)-Total (mg/L)		<0.0010 DLA				
	Tin (Sn)-Total (mg/L)		<0.0025 DLA				
	Titanium (Ti)-Total (mg/L)		0.016				
	Uranium (U)-Total (mg/L)		<0.0010 DLA				
	Vanadium (V)-Total (mg/L)		0.0059				
	Zinc (Zn)-Total (mg/L)		0.0937				
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)		0.257				
	Antimony (Sb)-Dissolved (mg/L)		<0.0025 DLA				
	Arsenic (As)-Dissolved (mg/L)		0.0030				
	Barium (Ba)-Dissolved (mg/L)		0.295				
	Beryllium (Be)-Dissolved (mg/L)		<0.0050 DLA				
	Bismuth (Bi)-Dissolved (mg/L)		<0.20				
	Boron (B)-Dissolved (mg/L)		0.25				
	Cadmium (Cd)-Dissolved (mg/L)		<0.000085 DLA				
	Calcium (Ca)-Dissolved (mg/L)		2.82				
	Chromium (Cr)-Dissolved (mg/L)		<0.0050 DLA				
	Cobalt (Co)-Dissolved (mg/L)		<0.0015 DLA				
	Copper (Cu)-Dissolved (mg/L)		<0.0050 DLA				
	Iron (Fe)-Dissolved (mg/L)		0.161				
	Lead (Pb)-Dissolved (mg/L)		<0.0025 DLA				
	Lithium (Li)-Dissolved (mg/L)		0.927				
	Magnesium (Mg)-Dissolved (mg/L)		0.96				
	Manganese (Mn)-Dissolved (mg/L)		0.0060				
	Mercury (Hg)-Dissolved (mg/L)		<0.000010				
	Molybdenum (Mo)-Dissolved (mg/L)		0.0216				
	Nickel (Ni)-Dissolved (mg/L)		<0.0050 DLA				
	Phosphorus (P)-Dissolved (mg/L)		<0.30				
	Potassium (K)-Dissolved (mg/L)		4.4				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1023033-1				
	Description	WATER				
	Sampled Date	23-JUN-11				
	Sampled Time	11:00				
	Client ID	H16W 800-1000M				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.0050 DLA				
	Silicon (Si)-Dissolved (mg/L)	8.60				
	Silver (Ag)-Dissolved (mg/L)	<0.00010 DLA				
	Sodium (Na)-Dissolved (mg/L)	406				
	Strontium (Sr)-Dissolved (mg/L)	0.0796				
	Thallium (Tl)-Dissolved (mg/L)	<0.0010 DLA				
	Tin (Sn)-Dissolved (mg/L)	<0.0025 DLA				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.0010 DLA				
	Vanadium (V)-Dissolved (mg/L)	<0.0050 DLA				
	Zinc (Zn)-Dissolved (mg/L)	0.0138				

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

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
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**
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
CN-T-MID-HH-COL-VA	Water	Total Cyanide by HH Distillation	APHA 4500-CN Cyanide
This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	APHA 2120 "Color"
This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	APHA 2120 Color
This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).			

Reference Information

HG-TOT-LOW-CVAFS-VA	Water	Total Mercury in Water by CVAFS(Low)	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-DIS-CCME-MS-VA	Water	Diss. Metals in Water by ICPMS (CCME)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-CCME-MS-VA	Water	Total Metals in Water by ICPMS (CCME)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

S2-D-COL-VA	Water	Dissolved Sulphide by Colorimetric	APHA 4500-S2 D. - SULPHIDE

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

S2-UNION-MANCALC-VA	Water	Un-ionized Hydrogen sulphide (Man. calc)	APHA -4500-S2 H.

This analysis is carried out using procedures adapted from APHA Method 4500-S2 H. "Calculation of Un-ionized Hydrogen Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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

Reference Information

VA ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

C037617

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: L1023033 Report Date: 19-JUL-11

Client: AMEC EARTH & ENVIRONMENTAL
3456 Opie Crescent
Prince George BC V2N 2P9
Contact: Tammera Kostya

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-PCT-VA	**Water**							
Batch R2221050								
WG1314258-8 CRM		**VA-ALK-PCT-CONTROL**						
Alkalinity, Total (as CaCO3)			102		%		85-115	18-JUL-11
WG1314258-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-JUL-11
WG1314258-2 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-JUL-11
WG1314258-3 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-JUL-11
WG1314258-4 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-JUL-11
WG1314258-5 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-JUL-11
WG1314258-6 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-JUL-11
WG1314258-7 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-JUL-11
ANIONS-BR-IC-VA	**Water**							
Batch R2210229								
WG1301747-11 CRM		**VA-IC-IVA2-ION23110**						
Bromide (Br)			95		%		85-115	24-JUN-11
WG1301747-2 CRM		**VA-IC-IVA2-ION23110**						
Bromide (Br)			99		%		85-115	24-JUN-11
WG1301747-1 MB								
Bromide (Br)			<0.050		mg/L		0.05	24-JUN-11
WG1301747-10 MB								
Bromide (Br)			<0.050		mg/L		0.05	24-JUN-11
WG1301747-4 MB								
Bromide (Br)			<0.050		mg/L		0.05	24-JUN-11
WG1301747-6 MB								
Bromide (Br)			<0.050		mg/L		0.05	24-JUN-11
WG1301747-8 MB								
Bromide (Br)			<0.050		mg/L		0.05	24-JUN-11
ANIONS-CL-IC-VA	**Water**							
Batch R2210229								
WG1301747-11 CRM		**VA-IC-IVA2-ION23110**						
Chloride (Cl)			102		%		85-115	24-JUN-11
WG1301747-2 CRM		**VA-IC-IVA2-ION23110**						
Chloride (Cl)			102		%		85-115	24-JUN-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-CL-IC-VA	**Water**							
Batch R2210229								
WG1301747-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	24-JUN-11
WG1301747-10 MB								
Chloride (Cl)			<0.50		mg/L		0.5	24-JUN-11
WG1301747-4 MB								
Chloride (Cl)			<0.50		mg/L		0.5	24-JUN-11
WG1301747-6 MB								
Chloride (Cl)			<0.50		mg/L		0.5	24-JUN-11
WG1301747-8 MB								
Chloride (Cl)			<0.50		mg/L		0.5	24-JUN-11
ANIONS-F-IC-VA	**Water**							
Batch R2210229								
WG1301747-11 CRM		**VA-IC-IVA2-ION23110**						
Fluoride (F)			102		%		85-115	24-JUN-11
WG1301747-2 CRM		**VA-IC-IVA2-ION23110**						
Fluoride (F)			107		%		85-115	24-JUN-11
WG1301747-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	24-JUN-11
WG1301747-10 MB								
Fluoride (F)			<0.020		mg/L		0.02	24-JUN-11
WG1301747-4 MB								
Fluoride (F)			<0.020		mg/L		0.02	24-JUN-11
WG1301747-6 MB								
Fluoride (F)			<0.020		mg/L		0.02	24-JUN-11
WG1301747-8 MB								
Fluoride (F)			<0.020		mg/L		0.02	24-JUN-11
ANIONS-NO2-IC-VA	**Water**							
Batch R2210229								
WG1301747-11 CRM		**VA-IC-IVA2-ION23110**						
Nitrite (as N)			99		%		85-115	24-JUN-11
WG1301747-2 CRM		**VA-IC-IVA2-ION23110**						
Nitrite (as N)			100		%		85-115	24-JUN-11
WG1301747-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	24-JUN-11
WG1301747-10 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	24-JUN-11
WG1301747-4 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	24-JUN-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-NO2-IC-VA	**Water**							
Batch R2210229								
WG1301747-6 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	24-JUN-11
WG1301747-8 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	24-JUN-11
ANIONS-NO3-IC-VA	**Water**							
Batch R2210229								
WG1301747-11 CRM		**VA-IC-IVA2-ION23110**						
Nitrate (as N)			99		%		85-115	24-JUN-11
WG1301747-2 CRM		**VA-IC-IVA2-ION23110**						
Nitrate (as N)			96		%		85-115	24-JUN-11
WG1301747-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	24-JUN-11
WG1301747-10 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	24-JUN-11
WG1301747-4 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	24-JUN-11
WG1301747-6 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	24-JUN-11
WG1301747-8 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	24-JUN-11
ANIONS-SO4-IC-VA	**Water**							
Batch R2210229								
WG1301747-11 CRM		**VA-IC-IVA2-ION23110**						
Sulfate (SO4)			105		%		85-115	24-JUN-11
WG1301747-2 CRM		**VA-IC-IVA2-ION23110**						
Sulfate (SO4)			104		%		85-115	24-JUN-11
WG1301747-1 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	24-JUN-11
WG1301747-10 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	24-JUN-11
WG1301747-4 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	24-JUN-11
WG1301747-6 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	24-JUN-11
WG1301747-8 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	24-JUN-11
CARBONS-TOC-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CARBONS-TOC-VA	**Water**							
Batch R2214629								
WG1307653-1 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			96		%		80-120	05-JUL-11
WG1307653-3 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			95		%		80-120	05-JUL-11
WG1307653-5 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			93		%		80-120	05-JUL-11
WG1307653-7 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			95		%		80-120	05-JUL-11
WG1307653-9 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			96		%		80-120	05-JUL-11
WG1307653-2 MB								
Total Organic Carbon			<0.50		mg/L		0.5	05-JUL-11
WG1307653-4 MB								
Total Organic Carbon			<0.50		mg/L		0.5	05-JUL-11
WG1307653-6 MB								
Total Organic Carbon			<0.50		mg/L		0.5	05-JUL-11
WG1307653-8 MB								
Total Organic Carbon			<0.50		mg/L		0.5	05-JUL-11
WG1307653-11 MS		**L1023213-2**						
Total Organic Carbon			97		%		70-130	05-JUL-11
WG1307653-13 MS		**L1023435-9**						
Total Organic Carbon			N/A	MS-B	%		-	05-JUL-11
WG1307653-16 MS		**L1024161-12**						
Total Organic Carbon			110		%		70-130	05-JUL-11
CN-T-MID-HH-COL-VA	**Water**							
Batch R2212348								
WG1305163-2 CRM		**VA-HH-TCN-CONTROL**						
Cyanide, Total			99		%		80-120	30-JUN-11
WG1305163-4 CRM		**VA-HH-TCN-CONTROL**						
Cyanide, Total			96		%		80-120	30-JUN-11
WG1305163-1 MB								
Cyanide, Total			<0.0050		mg/L		0.005	30-JUN-11
COLOUR-TRUE-VA	**Water**							
Batch R2209759								
WG1302299-2 CRM		**VA-COL-C-25**						
Colour, True			97		%		85-115	25-JUN-11
WG1302299-5 CRM		**VA-COL-C-25**						
Colour, True			99		%		85-115	25-JUN-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
COLOUR-TRUE-VA	**Water**							
Batch R2209759								
WG1302299-1 MB								
Colour, True			<5.0		CU		5	25-JUN-11
WG1302299-4 MB								
Colour, True			<5.0		CU		5	25-JUN-11
EC-PCT-VA	**Water**							
Batch R2211301								
WG1302856-9 CRM		**VA-EC-PCT-CONTROL**						
Conductivity			100		%		90-110	27-JUN-11
WG1302856-14 DUP		**L1023033-1**						
Conductivity		1810	1820		uS/cm	0.33	10	27-JUN-11
WG1302856-1 MB								
Conductivity			<2.0		uS/cm		2	27-JUN-11
WG1302856-2 MB								
Conductivity			<2.0		uS/cm		2	27-JUN-11
WG1302856-3 MB								
Conductivity			<2.0		uS/cm		2	27-JUN-11
WG1302856-4 MB								
Conductivity			<2.0		uS/cm		2	27-JUN-11
WG1302856-5 MB								
Conductivity			<2.0		uS/cm		2	27-JUN-11
WG1302856-6 MB								
Conductivity			<2.0		uS/cm		2	27-JUN-11
HG-DIS-LOW-CVAFS-VA	**Water**							
Batch R2210343								
WG1302061-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	27-JUN-11
WG1302061-5 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	27-JUN-11
WG1303135-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	27-JUN-11
HG-TOT-LOW-CVAFS-VA	**Water**							
Batch R2210343								
WG1303135-1 MB								
Mercury (Hg)-Total			<0.000010		mg/L		0.00001	27-JUN-11
MET-DIS-CCME-MS-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-CCME-MS-VA	**Water**							
Batch	**R2210685**							
WG1302061-1	**MB**							
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	27-JUN-11
Antimony (Sb)-Dissolved			<0.00050		mg/L		0.0005	27-JUN-11
Arsenic (As)-Dissolved			<0.00050		mg/L		0.0005	27-JUN-11
Beryllium (Be)-Dissolved			<0.0010		mg/L		0.001	27-JUN-11
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.0002	27-JUN-11
Chromium (Cr)-Dissolved			<0.0010		mg/L		0.001	27-JUN-11
Cobalt (Co)-Dissolved			<0.00030		mg/L		0.001	27-JUN-11
Copper (Cu)-Dissolved			<0.0010		mg/L		0.001	27-JUN-11
Lead (Pb)-Dissolved			<0.00050		mg/L		0.001	27-JUN-11
Lithium (Li)-Dissolved			<0.0050		mg/L		0.01	27-JUN-11
Manganese (Mn)-Dissolved			<0.00030		mg/L		0.001	27-JUN-11
Molybdenum (Mo)-Dissolved			<0.0010		mg/L		0.001	27-JUN-11
Nickel (Ni)-Dissolved			<0.0010		mg/L		0.001	27-JUN-11
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	27-JUN-11
Silver (Ag)-Dissolved			<0.000020		mg/L		0.0001	27-JUN-11
Thallium (Tl)-Dissolved			<0.00020		mg/L		0.001	27-JUN-11
Tin (Sn)-Dissolved			<0.00050		mg/L		0.001	27-JUN-11
Vanadium (V)-Dissolved			<0.0010		mg/L		0.005	27-JUN-11
Uranium (U)-Dissolved			<0.00020		mg/L		0.0002	27-JUN-11
WG1302061-5	**MB**							
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	27-JUN-11
Antimony (Sb)-Dissolved			<0.00050		mg/L		0.0005	27-JUN-11
Arsenic (As)-Dissolved			<0.00050		mg/L		0.0005	27-JUN-11
Beryllium (Be)-Dissolved			<0.0010		mg/L		0.001	27-JUN-11
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.0002	27-JUN-11
Chromium (Cr)-Dissolved			<0.0010		mg/L		0.001	27-JUN-11
Cobalt (Co)-Dissolved			<0.00030		mg/L		0.001	27-JUN-11
Copper (Cu)-Dissolved			<0.0010		mg/L		0.001	27-JUN-11
Lead (Pb)-Dissolved			<0.00050		mg/L		0.001	27-JUN-11
Lithium (Li)-Dissolved			<0.0050		mg/L		0.01	27-JUN-11
Manganese (Mn)-Dissolved			<0.00030		mg/L		0.001	27-JUN-11
Molybdenum (Mo)-Dissolved			<0.0010		mg/L		0.001	27-JUN-11
Nickel (Ni)-Dissolved			<0.0010		mg/L		0.001	27-JUN-11
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	27-JUN-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-CCME-MS-VA	**Water**							
Batch R2210685								
WG1302061-5 MB								
Silver (Ag)-Dissolved			<0.000020		mg/L		0.0001	27-JUN-11
Thallium (Tl)-Dissolved			<0.00020		mg/L		0.001	27-JUN-11
Tin (Sn)-Dissolved			<0.00050		mg/L		0.001	27-JUN-11
Vanadium (V)-Dissolved			<0.0010		mg/L		0.005	27-JUN-11
Uranium (U)-Dissolved			<0.00020		mg/L		0.0002	27-JUN-11
Batch R2210891								
WG1302061-3 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Dissolved			101		%		80-120	27-JUN-11
Antimony (Sb)-Dissolved			98		%		80-120	27-JUN-11
Arsenic (As)-Dissolved			99		%		80-120	27-JUN-11
Beryllium (Be)-Dissolved			103		%		80-120	27-JUN-11
Cadmium (Cd)-Dissolved			100		%		80-120	27-JUN-11
Chromium (Cr)-Dissolved			101		%		80-120	27-JUN-11
Cobalt (Co)-Dissolved			99		%		80-120	27-JUN-11
Copper (Cu)-Dissolved			98		%		80-120	27-JUN-11
Lead (Pb)-Dissolved			98		%		80-120	27-JUN-11
Lithium (Li)-Dissolved			104		%		80-120	27-JUN-11
Manganese (Mn)-Dissolved			101		%		80-120	27-JUN-11
Molybdenum (Mo)-Dissolved			99		%		80-120	27-JUN-11
Nickel (Ni)-Dissolved			104		%		80-120	27-JUN-11
Selenium (Se)-Dissolved			102		%		80-120	27-JUN-11
Silver (Ag)-Dissolved			100		%		80-120	27-JUN-11
Thallium (Tl)-Dissolved			102		%		80-120	27-JUN-11
Tin (Sn)-Dissolved			100		%		80-120	27-JUN-11
Vanadium (V)-Dissolved			101		%		80-120	27-JUN-11
Uranium (U)-Dissolved			98		%		80-120	27-JUN-11
Batch R2213748								
WG1302061-4 DUP		**L1023033-1**						
Antimony (Sb)-Dissolved		<0.0025	<0.0025	RPD-NA	mg/L	N/A	20	04-JUL-11
Arsenic (As)-Dissolved		0.0030	0.0029		mg/L	2.5	20	04-JUL-11
Beryllium (Be)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	04-JUL-11
Cadmium (Cd)-Dissolved		<0.000085	0.000077		mg/L	6.9	20	04-JUL-11
Chromium (Cr)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	04-JUL-11
Cobalt (Co)-Dissolved		<0.0015	<0.0015	RPD-NA	mg/L	N/A	20	04-JUL-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-CCME-MS-VA	**Water**							
Batch R2213748								
WG1302061-4 DUP		**L1023033-1**						
Copper (Cu)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	04-JUL-11
Lead (Pb)-Dissolved		<0.0025	<0.0025	RPD-NA	mg/L	N/A	20	04-JUL-11
Lithium (Li)-Dissolved		0.927	0.905		mg/L	2.5	20	04-JUL-11
Manganese (Mn)-Dissolved		0.0060	0.00676		mg/L	12	20	04-JUL-11
Molybdenum (Mo)-Dissolved		0.0216	0.0217		mg/L	0.36	20	04-JUL-11
Nickel (Ni)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	04-JUL-11
Selenium (Se)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	04-JUL-11
Silver (Ag)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	04-JUL-11
Thallium (Tl)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	04-JUL-11
Tin (Sn)-Dissolved		<0.0025	<0.0025	RPD-NA	mg/L	N/A	20	04-JUL-11
Vanadium (V)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	04-JUL-11
Uranium (U)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	04-JUL-11
Batch R2215915								
WG1302061-4 DUP		**L1023033-1**						
Aluminum (Al)-Dissolved		0.257	0.255		mg/L	0.81	20	07-JUL-11
MET-DIS-ICP-VA	**Water**							
Batch R2211054								
WG1302061-3 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Dissolved			98		%		80-120	27-JUN-11
Bismuth (Bi)-Dissolved			99		%		80-120	27-JUN-11
Boron (B)-Dissolved			100		%		80-120	27-JUN-11
Calcium (Ca)-Dissolved			103		%		80-120	27-JUN-11
Iron (Fe)-Dissolved			97		%		80-120	27-JUN-11
Magnesium (Mg)-Dissolved			101		%		80-120	27-JUN-11
Phosphorus (P)-Dissolved			102		%		80-120	27-JUN-11
Potassium (K)-Dissolved			101		%		80-120	27-JUN-11
Silicon (Si)-Dissolved			107		%		80-120	27-JUN-11
Sodium (Na)-Dissolved			103		%		80-120	27-JUN-11
Strontium (Sr)-Dissolved			102		%		80-120	27-JUN-11
Titanium (Ti)-Dissolved			101		%		80-120	27-JUN-11
Zinc (Zn)-Dissolved			96		%		80-120	27-JUN-11
WG1302061-1 MB								
Barium (Ba)-Dissolved			<0.010		mg/L		0.01	27-JUN-11
Bismuth (Bi)-Dissolved			<0.20		mg/L		0.2	27-JUN-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2211054								
WG1302061-1 MB								
Boron (B)-Dissolved			<0.10		mg/L		0.1	27-JUN-11
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	27-JUN-11
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	27-JUN-11
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	27-JUN-11
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	27-JUN-11
Potassium (K)-Dissolved			<2.0		mg/L		2	27-JUN-11
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	27-JUN-11
Sodium (Na)-Dissolved			<2.0		mg/L		2	27-JUN-11
Strontium (Sr)-Dissolved			<0.0050		mg/L		0.005	27-JUN-11
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	27-JUN-11
Zinc (Zn)-Dissolved			<0.0050		mg/L		0.005	27-JUN-11
WG1302061-5 MB								
Barium (Ba)-Dissolved			<0.010		mg/L		0.01	27-JUN-11
Bismuth (Bi)-Dissolved			<0.20		mg/L		0.2	27-JUN-11
Boron (B)-Dissolved			<0.10		mg/L		0.1	27-JUN-11
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	27-JUN-11
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	27-JUN-11
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	27-JUN-11
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	27-JUN-11
Potassium (K)-Dissolved			<2.0		mg/L		2	27-JUN-11
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	27-JUN-11
Sodium (Na)-Dissolved			<2.0		mg/L		2	27-JUN-11
Strontium (Sr)-Dissolved			<0.0050		mg/L		0.005	27-JUN-11
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	27-JUN-11
Zinc (Zn)-Dissolved			<0.0050		mg/L		0.005	27-JUN-11
Batch R2215223								
WG1302061-4 DUP		**L1023033-1**						
Barium (Ba)-Dissolved		0.295	0.292		mg/L	0.89	20	07-JUL-11
Bismuth (Bi)-Dissolved		<0.20	<0.20	RPD-NA	mg/L	N/A	20	07-JUL-11
Boron (B)-Dissolved		0.25	0.25		mg/L	0.015	20	07-JUL-11
Calcium (Ca)-Dissolved		2.82	2.82		mg/L	0.053	20	07-JUL-11
Iron (Fe)-Dissolved		0.161	0.151		mg/L	6.8	20	07-JUL-11
Magnesium (Mg)-Dissolved		0.96	0.96		mg/L	1.0	20	07-JUL-11
Phosphorus (P)-Dissolved		<0.30	<0.30	RPD-NA	mg/L	N/A	20	07-JUL-11
Potassium (K)-Dissolved		4.4	4.4		mg/L	1.1	20	07-JUL-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2215223								
WG1302061-4 DUP		**L1023033-1**						
Silicon (Si)-Dissolved		8.60	8.52		mg/L	0.91	20	07-JUL-11
Sodium (Na)-Dissolved		406	405		mg/L	0.39	20	07-JUL-11
Strontium (Sr)-Dissolved		0.0796	0.0795		mg/L	0.15	20	07-JUL-11
Titanium (Ti)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	07-JUL-11
Zinc (Zn)-Dissolved		0.0138	0.0136		mg/L	1.4	20	07-JUL-11
MET-TOT-CCME-MS-VA	**Water**							
Batch R2211355								
WG1303050-4 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Total			109		%		80-120	28-JUN-11
Antimony (Sb)-Total			103		%		80-120	28-JUN-11
Arsenic (As)-Total			104		%		80-120	28-JUN-11
Beryllium (Be)-Total			103		%		80-120	28-JUN-11
Cadmium (Cd)-Total			103		%		80-120	28-JUN-11
Chromium (Cr)-Total			102		%		80-120	28-JUN-11
Cobalt (Co)-Total			103		%		80-120	28-JUN-11
Copper (Cu)-Total			99		%		80-120	28-JUN-11
Lead (Pb)-Total			101		%		80-120	28-JUN-11
Lithium (Li)-Total			104		%		80-120	28-JUN-11
Manganese (Mn)-Total			105		%		80-120	28-JUN-11
Molybdenum (Mo)-Total			103		%		80-120	28-JUN-11
Nickel (Ni)-Total			103		%		80-120	28-JUN-11
Selenium (Se)-Total			103		%		80-120	28-JUN-11
Silver (Ag)-Total			102		%		80-120	28-JUN-11
Thallium (Tl)-Total			102		%		80-120	28-JUN-11
Tin (Sn)-Total			105		%		80-120	28-JUN-11
Uranium (U)-Total			104		%		80-120	28-JUN-11
Vanadium (V)-Total			106		%		80-120	28-JUN-11
Batch R2211707								
WG1303050-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	28-JUN-11
Antimony (Sb)-Total			<0.00050		mg/L		0.0005	28-JUN-11
Arsenic (As)-Total			<0.00050		mg/L		0.0005	28-JUN-11
Beryllium (Be)-Total			<0.0010		mg/L		0.001	28-JUN-11
Cadmium (Cd)-Total			<0.000010		mg/L		0.0002	28-JUN-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-CCME-MS-VA	**Water**							
Batch R2211707								
WG1303050-1 MB								
Chromium (Cr)-Total			<0.0010		mg/L		0.001	28-JUN-11
Cobalt (Co)-Total			<0.00030		mg/L		0.001	28-JUN-11
Copper (Cu)-Total			<0.0010		mg/L		0.001	28-JUN-11
Lead (Pb)-Total			<0.00050		mg/L		0.001	28-JUN-11
Lithium (Li)-Total			<0.0050		mg/L		0.01	28-JUN-11
Manganese (Mn)-Total			<0.00030		mg/L		0.001	28-JUN-11
Molybdenum (Mo)-Total			<0.0010		mg/L		0.001	28-JUN-11
Nickel (Ni)-Total			<0.0010		mg/L		0.001	28-JUN-11
Selenium (Se)-Total			<0.0010		mg/L		0.001	28-JUN-11
Silver (Ag)-Total			<0.000020		mg/L		0.0001	28-JUN-11
Thallium (Tl)-Total			<0.00020		mg/L		0.001	28-JUN-11
Tin (Sn)-Total			<0.00050		mg/L		0.001	28-JUN-11
Uranium (U)-Total			<0.00020		mg/L		0.0002	28-JUN-11
Vanadium (V)-Total			<0.0010		mg/L		0.005	28-JUN-11
MET-TOT-ICP-VA	**Water**							
Batch R2211640								
WG1303050-4 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Total			100		%		80-120	28-JUN-11
Bismuth (Bi)-Total			100		%		80-120	28-JUN-11
Boron (B)-Total			101		%		80-120	28-JUN-11
Calcium (Ca)-Total			108		%		80-120	28-JUN-11
Iron (Fe)-Total			99		%		80-120	28-JUN-11
Magnesium (Mg)-Total			104		%		80-120	28-JUN-11
Phosphorus (P)-Total			103		%		80-120	28-JUN-11
Potassium (K)-Total			104		%		80-120	28-JUN-11
Silicon (Si)-Total			110		%		80-120	28-JUN-11
Sodium (Na)-Total			105		%		80-120	28-JUN-11
Strontium (Sr)-Total			103		%		80-120	28-JUN-11
Titanium (Ti)-Total			103		%		80-120	28-JUN-11
Zinc (Zn)-Total			97		%		80-120	28-JUN-11
WG1303050-1 MB								
Barium (Ba)-Total			<0.010		mg/L		0.01	28-JUN-11
Bismuth (Bi)-Total			<0.20		mg/L		0.2	28-JUN-11
Boron (B)-Total			<0.10		mg/L		0.1	28-JUN-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-ICP-VA	**Water**							
Batch R2211640								
WG1303050-1 MB								
Calcium (Ca)-Total			<0.050		mg/L		0.05	28-JUN-11
Iron (Fe)-Total			<0.030		mg/L		0.03	28-JUN-11
Magnesium (Mg)-Total			<0.10		mg/L		0.1	28-JUN-11
Phosphorus (P)-Total			<0.30		mg/L		0.3	28-JUN-11
Potassium (K)-Total			<2.0		mg/L		2	28-JUN-11
Silicon (Si)-Total			<0.050		mg/L		0.05	28-JUN-11
Sodium (Na)-Total			<2.0		mg/L		2	28-JUN-11
Strontium (Sr)-Total			<0.0050		mg/L		0.005	28-JUN-11
Titanium (Ti)-Total			<0.010		mg/L		0.01	28-JUN-11
Zinc (Zn)-Total			<0.0050		mg/L		0.005	28-JUN-11
NH3-F-VA	**Water**							
Batch R2215715								
WG1307733-10 CRM		**VA-NH3-F**						
Ammonia (as N)			98		%		85-115	08-JUL-11
WG1307733-2 CRM		**VA-NH3-F**						
Ammonia (as N)			98		%		85-115	08-JUL-11
WG1307733-4 CRM		**VA-NH3-F**						
Ammonia (as N)			89		%		85-115	08-JUL-11
WG1307733-6 CRM		**VA-NH3-F**						
Ammonia (as N)			94		%		85-115	08-JUL-11
WG1307733-8 CRM		**VA-NH3-F**						
Ammonia (as N)			95		%		85-115	08-JUL-11
WG1307733-1 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	08-JUL-11
WG1307733-3 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	08-JUL-11
WG1307733-5 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	08-JUL-11
WG1307733-7 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	08-JUL-11
WG1307733-9 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	08-JUL-11
WG1307733-12 MS		**L1022280-17**						
Ammonia (as N)			93		%		75-125	08-JUL-11
WG1307733-14 MS		**L1022303-25**						
Ammonia (as N)			98		%		75-125	08-JUL-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PH-PCT-VA	**Water**							
Batch R2211301								
WG1302856-10 CRM		**VA-PH7-BUF**						
pH			7.09		pH		6.9-7.1	27-JUN-11
WG1302856-14 DUP		**L1023033-1**						
pH		9.50	9.51	J	pH	0.01	0.2	27-JUN-11
S2-D-COL-VA	**Water**							
Batch R2210878								
WG1303226-6 DUP		**L1023033-1**						
Sulphide as S (Dissolved)		0.118	0.114		mg/L	3.4	20	27-JUN-11
WG1303226-1 MB								
Sulphide as S (Dissolved)			<0.020		mg/L		0.02	27-JUN-11
WG1303226-3 MB								
Sulphide as S (Dissolved)			<0.020		mg/L		0.02	27-JUN-11
TDS-VA	**Water**							
Batch R2213663								
WG1305968-2 LCS								
Total Dissolved Solids			102		%		85-115	04-JUL-11
WG1305968-5 LCS								
Total Dissolved Solids			100		%		85-115	04-JUL-11
WG1305968-1 MB								
Total Dissolved Solids			<10		mg/L		10	04-JUL-11
WG1305968-4 MB								
Total Dissolved Solids			<10		mg/L		10	04-JUL-11
TURBIDITY-VA	**Water**							
Batch R2209760								
WG1302329-2 CRM		**VA-TURB-SPK-8**						
Turbidity			106		%		85-115	25-JUN-11
WG1302329-5 CRM		**VA-TURB-SPK-8**						
Turbidity			106		%		85-115	25-JUN-11
WG1302329-1 MB								
Turbidity			<0.10		NTU		0.1	25-JUN-11
WG1302329-4 MB								
Turbidity			<0.10		NTU		0.1	25-JUN-11

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
J	Duplicate results and limits are expressed in terms of absolute difference.
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.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Total Dissolved Solids by Gravimetric							
	1	23-JUN-11 11:00	04-JUL-11 14:19	7	11	days	EHT
pH by Meter (Automated)							
	1	23-JUN-11 11:00	27-JUN-11 16:36	0.25	102	hours	EHTR-FM
Anions and Nutrients							
Alkalinity by Auto. Titration							
	1	23-JUN-11 11:00	18-JUL-11 13:11	14	25	days	EHT

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1023033 were received on 24-JUN-11 12:30.

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.

Short Holding Time

Rush Processing

CHAIN OF CUSTO
CANADA TO
WWW

L10230033-COFC

COC # C037617

REPORT TO:	REPORT FORMAT / DISTRIBUTION	REQUESTED
COMPANY: AMEC	STANDARD ✓ OTHER	✓ REGULAR SERVICE (DEFAULT)
CONTACT: T. Kostya	PDF ✓ EXCEL ✓ CUSTOM FAX	RUSH SERVICE (2-3 DAYS)
ADDRESS: 3456 Opie Cres.	EMAIL 1: tammera.kostya@amec.com	PRIORITY SERVICE (1 DAY or ASAP)
Prince George, BC, V2N 2P9	EMAIL 2: Scott.green@amec.com	EMERGENCY SERVICE (<1 DAY / WEEKEND) - CONTACT ALS
PHONE (250) 564-3243 FAX: (250) 562-7045		ANALYSIS REQUEST
INVOICE TO: SAME AS REPORT ? (YES) / NO	INDICATE BOTTLES: FILTERED / PRESERVED (F/P) → → →	
COMPANY:	CLIENT / PROJECT INFORMATION:	
CONTACT:	JOB #: KX13505.300	
ADDRESS:	PO /AFE:	
	Legal Site Description:	
PHONE: FAX:	QUOTE #: AMEC quote	
Lab Work Order # (lab use only): L10230033	SAMPLER (Initials):	

Sample #	SAMPLE IDENTIFICATION (This description will appear on the report)	DATE	TIME	SAMPLE TYPE	Potability	Total Metals	Dissolved Metals	TOC	NH_3	Cyanide	S2-(UNION-MANUAL)	S2-(COL-VA)				HAZARDOUS ?	HIGHLY CONTAMINATED ?	NUMBER OF CONTAINERS
[redacted]	H16W 800-1000m	June 23/11	11am	H_2O	X	X	X	X	X	X	X	X						
[redacted]																		
[redacted]																		
[redacted]	pH=	9.48																
[redacted]	Temp=	10.43°C																
[redacted]																		
[redacted]																		
[redacted]																		
[redacted]	metals to include vanadium, molybdenum, cobalt & silver																	

GUIDELINES / REGULATIONS	SPECIAL INSTRUCTIONS / HAZARDOUS DETAILS
* CCME & BC CSR	Potability = pH, Hardness, TDS, conductivity, turbidity, colour, Diss. Anions (Cl, F, S, Sulphate), Nutrients # Please see Selam 4 Details

Failure to complete all portions of this form may delay analysis. Please fill in this form *LEGIBLY*.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the reverse page of the white report copy.

RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME:	SAMPLE CONDITION (lab use only)	
J. Kostya	June 23/11 11am	HD 11:06/24	12:30	TEMPERATURE	SAMPLES RECEIVED IN GOOD CONDITION ? YES / NO (If no provide details)
RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME:	5	

AMEC EARTH & ENVIRONMENTAL
ATTN: T. KOSTYA
3456 OPIE CRES
PRINCE GEORGE BC V2N 2P9

Date Received: 24-JUN-11
Report Date: 04-JUL-11 12:37 (MT)
Version: FINAL

Client Phone: 250-564-3243

Certificate of Analysis

Lab Work Order #: L1022659
Project P.O. #: NOT SUBMITTED
Job Reference: KX13505.300
Legal Site Desc:
C of C Numbers: C037618

Kelly Hunt
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1022659-1 H16W 800-1000M Sampled By: CLIENT on 23-JUN-11 @ 11:00 Matrix: WATER							
Miscellaneous Parameters							
Methane, dissolved	7.88		0.0050	mg/L	27-JUN-11	27-JUN-11	R2210316

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
METHANE-DIS-CL	Water	Methane, dissolved	EPA 5021/8015-HEADSPACE GC-FID
Results reported in			

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

C037618

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
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
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
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.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

CANADA TOLL FREE 1-800-668-9878

www.alsenviro.com

COC # C037618

L1022659

Page 1 of 1

REPORT TO:	REPORT FORMAT / DISTRIBUTION	SERVICE REQUESTED
COMPANY: AMEC	STANDARD ✓ OTHER ____	✓ REGULAR SERVICE (DEFAULT)
CONTACT: T. Kostyn	PDF ✓ EXCEL ____ CUSTOM ____ FAX ____	RUSH SERVICE (2-3 DAYS)
ADDRESS: 3456 Opie Cres.	EMAIL 1: tammera.kostyn@amec.com	PRIORITY SERVICE (1 DAY or ASAP)
Prince George, BC V2N 2P7	EMAIL 2: scott.greene@amec.com	EMERGENCY SERVICE (<1 DAY / WEEKEND) - CONTACT ALS
PHONE: (250) 564-3243 FAX: (250) 562-7045		ANALYSIS REQUEST
INVOICE TO: SAME AS REPORT ? (YES) NO	INDICATE BOTTLES: FILTERED / PRESERVED (F/P) → → →	
COMPANY:	CLIENT / PROJECT INFORMATION:	
CONTACT:	JOB #: Kx13505.300	
ADDRESS:	PO /AFE:	
	Legal Site Description:	
PHONE: FAX:	QUOTE #: AMEC Quote	
	SAMPLER (Initials):	

SAMPLE IDENTIFICATION (This description will appear on the report)	DATE	TIME	SAMPLE TYPE	Diss. Metals	HAZARDOUS ?	HIGHLY CONTAMINATED ?	NUMBER OF CONTAINERS
HHW 800-1000m	June 23/11	11am	H_2O	X			

GUIDELINES / REGULATIONS

CCME & BC CSR

SPECIAL INSTRUCTIONS / HAZARDOUS DETAILS

See Selam 4 details

Failure to complete all portions of this form may delay analysis. Please fill in this form *LEGIBLY*.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the reverse page of the white report copy.

RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME:	TEMPERATURE	SAMPLES RECEIVED IN GOOD CONDITION ? YES / NO (If no provide details)
J. Kostyn	11am June 23/11	Laura C	24-Jun-11	9°C	
RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME: 08:50		

REFER TO BACK PAGE FOR REGIONAL LOCATIONS AND SAMPLING INFORMATION

WHITE - REPORT COPY, PINK - FILE COPY, YELLOW - CLIENT COPY

GENF14.00

AMEC EARTH & ENVIRONMENTAL
ATTN: Tammera Kostya
3456 Opie Crescent
Prince George BC V2N 2P9

Date Received: 02-AUG-11
Report Date: 17-AUG-11 17:52 (MT)
Version: FINAL

Client Phone: 250-564-3243

Certificate of Analysis

Lab Work Order #: L1039171

Project P.O. #: NOT SUBMITTED
Job Reference: KX13505.03
C of C Numbers: C037609
Legal Site Desc:

Selam Worku
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1039171-1				
	Description	H2O				
	Sampled Date	01-AUG-11				
	Sampled Time	13:00				
	Client ID	#2 H16W 500-730M				
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	13.2				
	Conductivity (uS/cm)	1850				
	Hardness (as CaCO3) (mg/L)	22.5				
	pH (pH)	8.18				
	Total Dissolved Solids (mg/L)	1210				
	Turbidity (NTU)	186				
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	985				
	Ammonia (as N) (mg/L)	2.9				
	Bromide (Br) (mg/L)	<1.0				
	Chloride (Cl) (mg/L)	75				
	Fluoride (F) (mg/L)	3.82				
	Nitrate (as N) (mg/L)	<0.10				
	Nitrite (as N) (mg/L)	<0.020				
	Sulfate (SO4) (mg/L)	<10				
	Sulphide as S (Dissolved) (mg/L)	<0.020				
Cyanides	Cyanide, Total (mg/L)	0.0889				
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	15.9				
Inorganic Parameters	Sulphide As S (Un-ionized) (mg/L)	<0.020				
Total Metals	Aluminum (Al)-Total (mg/L)	1.12				
	Antimony (Sb)-Total (mg/L)	<0.0025 DLA				
	Arsenic (As)-Total (mg/L)	<0.0025 DLA				
	Barium (Ba)-Total (mg/L)	1.74				
	Beryllium (Be)-Total (mg/L)	<0.0050 DLA				
	Bismuth (Bi)-Total (mg/L)	<0.20				
	Boron (B)-Total (mg/L)	0.33				
	Cadmium (Cd)-Total (mg/L)	<0.000085 DLA				
	Calcium (Ca)-Total (mg/L)	11.6				
	Chromium (Cr)-Total (mg/L)	0.0127				
	Cobalt (Co)-Total (mg/L)	<0.0015 DLA				
	Copper (Cu)-Total (mg/L)	3.96				
	Iron (Fe)-Total (mg/L)	11.1				
	Lead (Pb)-Total (mg/L)	1.41				
	Lithium (Li)-Total (mg/L)	1.23				
	Magnesium (Mg)-Total (mg/L)	2.19				
	Manganese (Mn)-Total (mg/L)	0.170				
	Mercury (Hg)-Total (mg/L)	<0.000010				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1039171-1
	Description	H2O
	Sampled Date	01-AUG-11
	Sampled Time	13:00
	Client ID	#2 H16W 500-730M
Grouping	**Analyte**	
WATER		
Total Metals	Molybdenum (Mo)-Total (mg/L)	0.0108
	Nickel (Ni)-Total (mg/L)	0.0092
	Phosphorus (P)-Total (mg/L)	0.52
	Potassium (K)-Total (mg/L)	<2.0
	Selenium (Se)-Total (mg/L)	<0.0050 DLA
	Silicon (Si)-Total (mg/L)	7.35
	Silver (Ag)-Total (mg/L)	0.00017
	Sodium (Na)-Total (mg/L)	497
	Strontium (Sr)-Total (mg/L)	0.276
	Thallium (Tl)-Total (mg/L)	<0.0010 DLA
	Tin (Sn)-Total (mg/L)	<0.0025 DLA
	Titanium (Ti)-Total (mg/L)	0.023
	Uranium (U)-Total (mg/L)	<0.0010 DLA
	Vanadium (V)-Total (mg/L)	<0.0050 DLA
	Zinc (Zn)-Total (mg/L)	0.889
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.032
	Antimony (Sb)-Dissolved (mg/L)	<0.0025 DLA
	Arsenic (As)-Dissolved (mg/L)	<0.0025 DLA
	Barium (Ba)-Dissolved (mg/L)	0.997
	Beryllium (Be)-Dissolved (mg/L)	<0.0050 DLA
	Bismuth (Bi)-Dissolved (mg/L)	<0.20
	Boron (B)-Dissolved (mg/L)	0.33
	Cadmium (Cd)-Dissolved (mg/L)	<0.000085 DLA
	Calcium (Ca)-Dissolved (mg/L)	6.09
	Chromium (Cr)-Dissolved (mg/L)	<0.0050 DLA
	Cobalt (Co)-Dissolved (mg/L)	<0.0015 DLA
	Copper (Cu)-Dissolved (mg/L)	0.0750
	Iron (Fe)-Dissolved (mg/L)	0.667
	Lead (Pb)-Dissolved (mg/L)	0.0358
	Lithium (Li)-Dissolved (mg/L)	1.26
	Magnesium (Mg)-Dissolved (mg/L)	1.76
	Manganese (Mn)-Dissolved (mg/L)	0.107
	Mercury (Hg)-Dissolved (mg/L)	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.0100
	Nickel (Ni)-Dissolved (mg/L)	<0.0050 DLA
	Phosphorus (P)-Dissolved (mg/L)	<0.30
	Potassium (K)-Dissolved (mg/L)	<2.0

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1039171-1				
	Description	H2O				
	Sampled Date	01-AUG-11				
	Sampled Time	13:00				
	Client ID	#2 H16W 500-730M				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.0050 DLA				
	Silicon (Si)-Dissolved (mg/L)	5.25				
	Silver (Ag)-Dissolved (mg/L)	<0.00010 DLA				
	Sodium (Na)-Dissolved (mg/L)	481				
	Strontium (Sr)-Dissolved (mg/L)	0.226				
	Thallium (Tl)-Dissolved (mg/L)	<0.0010 DLA				
	Tin (Sn)-Dissolved (mg/L)	<0.0025 DLA				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.0010 DLA				
	Vanadium (V)-Dissolved (mg/L)	<0.0050 DLA				
	Zinc (Zn)-Dissolved (mg/L)	0.159				

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

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
CN-T-MID-HH-COL-VA	Water	Total Cyanide by HH Distillation	APHA 4500-CN Cyanide
This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	APHA 2120 "Color"
This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	APHA 2120 Color
This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).			
HG-TOT-LOW-CVAFS-VA	Water	Total Mercury in Water by CVAFS(Low)	EPA 245.7

Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-DIS-CCME-MS-VA	Water	Diss. Metals in Water by ICPMS (CCME)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-CCME-MS-VA	Water	Total Metals in Water by ICPMS (CCME)	EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

S2-D-COL-VA	Water	Dissolved Sulphide by Colorimetric	APHA 4500-S2 D. - SULPHIDE

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

S2-UNION-MANCALC-VA	Water	Un-ionized Hydrogen sulphide (Man. calc)	APHA -4500-S2 H.

This analysis is carried out using procedures adapted from APHA Method 4500-S2 H. "Calculation of Un-ionized Hydrogen Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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

Reference Information

VA ALS ENVIRONMENTAL - VANCOUVER, BC, CANADA

Chain of Custody Numbers:

C037609

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

Client: AMEC EARTH & ENVIRONMENTAL
3456 Opie Crescent
Prince George BC V2N 2P9
Contact: Tammera Kostya

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-PCT-VA	**Water**							
Batch R2228859								
WG1323382-8 CRM		**VA-ALK-PCT-CONTROL**						
Alkalinity, Total (as CaCO3)			101		%		85-115	03-AUG-11
WG1323382-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	03-AUG-11
WG1323382-2 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	03-AUG-11
WG1323382-3 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	03-AUG-11
WG1323382-4 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	03-AUG-11
WG1323382-5 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	03-AUG-11
WG1323382-6 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	03-AUG-11
ANIONS-BR-IC-VA	**Water**							
Batch R2229331								
WG1323459-15 LCS								
Bromide (Br)			91		%		70-130	03-AUG-11
WG1323459-2 LCS								
Bromide (Br)			88		%		70-130	03-AUG-11
WG1323459-1 MB								
Bromide (Br)			<0.050		mg/L		0.05	03-AUG-11
WG1323459-10 MB								
Bromide (Br)			<0.050		mg/L		0.05	03-AUG-11
WG1323459-13 MB								
Bromide (Br)			<0.050		mg/L		0.05	03-AUG-11
WG1323459-4 MB								
Bromide (Br)			<0.050		mg/L		0.05	03-AUG-11
WG1323459-7 MB								
Bromide (Br)			<0.050		mg/L		0.05	03-AUG-11
WG1323459-11 MS		**L1038624-5**						
Bromide (Br)			108		%		75-125	03-AUG-11
WG1323459-14 MS		**L1038624-23**						
Bromide (Br)			87		%		75-125	03-AUG-11
WG1323459-5 MS		**L1039147-12**						
Bromide (Br)			85		%		75-125	03-AUG-11
ANIONS-CL-IC-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-CL-IC-VA	**Water**							
Batch R2229331								
WG1323459-15 LCS								
Chloride (Cl)			106		%		85-115	03-AUG-11
WG1323459-2 LCS								
Chloride (Cl)			106		%		85-115	03-AUG-11
WG1323459-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	03-AUG-11
WG1323459-10 MB								
Chloride (Cl)			<0.50		mg/L		0.5	03-AUG-11
WG1323459-13 MB								
Chloride (Cl)			<0.50		mg/L		0.5	03-AUG-11
WG1323459-4 MB								
Chloride (Cl)			<0.50		mg/L		0.5	03-AUG-11
WG1323459-7 MB								
Chloride (Cl)			<0.50		mg/L		0.5	03-AUG-11
WG1323459-11 MS		**L1038624-5**						
Chloride (Cl)			108		%		75-125	03-AUG-11
WG1323459-14 MS		**L1038624-23**						
Chloride (Cl)			112		%		75-125	03-AUG-11
WG1323459-5 MS		**L1039147-12**						
Chloride (Cl)			110		%		75-125	03-AUG-11
ANIONS-F-IC-VA	**Water**							
Batch R2229331								
WG1323459-15 LCS								
Fluoride (F)			114		%		85-115	03-AUG-11
WG1323459-2 LCS								
Fluoride (F)			115		%		85-115	03-AUG-11
WG1323459-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	03-AUG-11
WG1323459-10 MB								
Fluoride (F)			<0.020		mg/L		0.02	03-AUG-11
WG1323459-13 MB								
Fluoride (F)			<0.020		mg/L		0.02	03-AUG-11
WG1323459-4 MB								
Fluoride (F)			<0.020		mg/L		0.02	03-AUG-11
WG1323459-7 MB								
Fluoride (F)			<0.020		mg/L		0.02	03-AUG-11
WG1323459-11 MS		**L1038624-5**						
Fluoride (F)			120		%		75-125	03-AUG-11
WG1323459-14 MS		**L1038624-23**						

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-F-IC-VA	**Water**							
Batch R2229331								
WG1323459-14 MS		**L1038624-23**						
Fluoride (F)			124		%		75-125	03-AUG-11
WG1323459-5 MS		**L1039147-12**						
Fluoride (F)			122		%		75-125	03-AUG-11
ANIONS-NO2-IC-VA	**Water**							
Batch R2229331								
WG1323459-15 LCS								
Nitrite (as N)			109		%		85-115	03-AUG-11
WG1323459-2 LCS								
Nitrite (as N)			113		%		85-115	03-AUG-11
WG1323459-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	03-AUG-11
WG1323459-10 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	03-AUG-11
WG1323459-13 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	03-AUG-11
WG1323459-4 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	03-AUG-11
WG1323459-7 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	03-AUG-11
WG1323459-11 MS		**L1038624-5**						
Nitrite (as N)			108		%		75-125	03-AUG-11
WG1323459-14 MS		**L1038624-23**						
Nitrite (as N)			115		%		75-125	03-AUG-11
WG1323459-5 MS		**L1039147-12**						
Nitrite (as N)			106		%		75-125	03-AUG-11
ANIONS-NO3-IC-VA	**Water**							
Batch R2229331								
WG1323459-15 LCS								
Nitrate (as N)			111		%		85-115	03-AUG-11
WG1323459-2 LCS								
Nitrate (as N)			111		%		85-115	03-AUG-11
WG1323459-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	03-AUG-11
WG1323459-10 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	03-AUG-11
WG1323459-13 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	03-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-NO3-IC-VA	**Water**							
Batch R2229331								
WG1323459-4 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	03-AUG-11
WG1323459-7 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	03-AUG-11
WG1323459-11 MS		**L1038624-5**						
Nitrate (as N)			115		%		75-125	03-AUG-11
WG1323459-14 MS		**L1038624-23**						
Nitrate (as N)			118		%		75-125	03-AUG-11
WG1323459-5 MS		**L1039147-12**						
Nitrate (as N)			116		%		75-125	03-AUG-11
WG1323459-8 MS		**L1039411-4**						
Nitrate (as N)			114		%		75-125	03-AUG-11
ANIONS-SO4-IC-VA	**Water**							
Batch R2229331								
WG1323459-15 LCS								
Sulfate (SO4)			103		%		85-115	03-AUG-11
WG1323459-2 LCS								
Sulfate (SO4)			103		%		85-115	03-AUG-11
WG1323459-1 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	03-AUG-11
WG1323459-10 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	03-AUG-11
WG1323459-13 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	03-AUG-11
WG1323459-4 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	03-AUG-11
WG1323459-7 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	03-AUG-11
WG1323459-11 MS		**L1038624-5**						
Sulfate (SO4)			105		%		75-125	03-AUG-11
WG1323459-14 MS		**L1038624-23**						
Sulfate (SO4)			110		%		75-125	03-AUG-11
WG1323459-5 MS		**L1039147-12**						
Sulfate (SO4)			108		%		75-125	03-AUG-11
CARBONS-TOC-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CARBONS-TOC-VA	**Water**							
Batch R2229806								
WG1325129-10 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			106		%		80-120	04-AUG-11
WG1325129-12 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			105		%		80-120	04-AUG-11
WG1325129-2 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			100		%		80-120	04-AUG-11
WG1325129-4 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			104		%		80-120	04-AUG-11
WG1325129-6 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			102		%		80-120	04-AUG-11
WG1325129-8 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			97		%		80-120	04-AUG-11
WG1325129-1 MB								
Total Organic Carbon			<0.50		mg/L		0.5	04-AUG-11
WG1325129-11 MB								
Total Organic Carbon			<0.50		mg/L		0.5	04-AUG-11
WG1325129-3 MB								
Total Organic Carbon			<0.50		mg/L		0.5	04-AUG-11
WG1325129-5 MB								
Total Organic Carbon			<0.50		mg/L		0.5	04-AUG-11
WG1325129-7 MB								
Total Organic Carbon			<0.50		mg/L		0.5	04-AUG-11
WG1325129-9 MB								
Total Organic Carbon			<0.50		mg/L		0.5	04-AUG-11
CN-T-MID-HH-COL-VA	**Water**							
Batch R2231142								
WG1326616-2 CRM		**VA-HH-TCN-CONTROL**						
Cyanide, Total			100		%		80-120	09-AUG-11
WG1326616-5 CRM		**VA-HH-TCN-CONTROL**						
Cyanide, Total			97		%		80-120	09-AUG-11
WG1326616-1 MB								
Cyanide, Total			<0.0050		mg/L		0.005	09-AUG-11
WG1326616-4 MB								
Cyanide, Total			<0.0050		mg/L		0.005	09-AUG-11
COLOUR-TRUE-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
COLOUR-TRUE-VA	**Water**							
Batch R2228612								
WG1323439-2 CRM		**VA-COL-C-25**						
Colour, True			102		%		85-115	03-AUG-11
WG1323439-5 CRM		**VA-COL-C-25**						
Colour, True			104		%		85-115	03-AUG-11
WG1323439-3 DUP		**L1039171-1**						
Colour, True		13.2	13.2		CU	0.30	20	03-AUG-11
WG1323439-1 MB								
Colour, True			<5.0		CU		5	03-AUG-11
WG1323439-4 MB								
Colour, True			<5.0		CU		5	03-AUG-11
EC-PCT-VA	**Water**							
Batch R2228859								
WG1323382-9 CRM		**VA-EC-PCT-CONTROL**						
Conductivity			99		%		90-110	03-AUG-11
WG1323382-1 MB								
Conductivity			<2.0		uS/cm		2	03-AUG-11
WG1323382-2 MB								
Conductivity			<2.0		uS/cm		2	03-AUG-11
WG1323382-3 MB								
Conductivity			<2.0		uS/cm		2	03-AUG-11
WG1323382-4 MB								
Conductivity			<2.0		uS/cm		2	03-AUG-11
WG1323382-5 MB								
Conductivity			<2.0		uS/cm		2	03-AUG-11
WG1323382-6 MB								
Conductivity			<2.0		uS/cm		2	03-AUG-11
HG-DIS-LOW-CVAFS-VA	**Water**							
Batch R2229295								
WG1323258-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	04-AUG-11
Batch R2230037								
WG1323258-2 DUP		**L1039171-1**						
Mercury (Hg)-Dissolved		<0.000010	<0.000010	RPD-NA	mg/L	N/A	20	05-AUG-11
WG1325386-2 LCS								
Mercury (Hg)-Dissolved			87		%		80-120	05-AUG-11
WG1325386-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	05-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
HG-DIS-LOW-CVAFS-VA	**Water**							
Batch R2230037								
WG1325386-10 MS		**L1039945-1**						
Mercury (Hg)-Dissolved			90		%		70-130	05-AUG-11
WG1325386-11 MS		**L1039949-8**						
Mercury (Hg)-Dissolved			91		%		70-130	05-AUG-11
WG1325386-12 MS		**L1039952-2**						
Mercury (Hg)-Dissolved			92		%		70-130	05-AUG-11
WG1325386-18 MS		**L1040222-5**						
Mercury (Hg)-Dissolved			87		%		70-130	05-AUG-11
WG1325386-20 MS		**L1039955-13**						
Mercury (Hg)-Dissolved			89		%		70-130	05-AUG-11
WG1325386-24 MS		**L1039680-11**						
Mercury (Hg)-Dissolved			88		%		70-130	05-AUG-11
WG1325386-32 MS		**L1039680-23**						
Mercury (Hg)-Dissolved			88		%		70-130	05-AUG-11
WG1325386-42 MS		**L1039171-1**						
Mercury (Hg)-Dissolved			75		%		70-130	05-AUG-11
WG1325386-44 MS		**L1040275-2**						
Mercury (Hg)-Dissolved			82		%		70-130	05-AUG-11
WG1325386-45 MS		**L1040275-12**						
Mercury (Hg)-Dissolved			90		%		70-130	05-AUG-11
WG1325386-48 MS		**L1040370-5**						
Mercury (Hg)-Dissolved			84		%		70-130	05-AUG-11
WG1325386-49 MS		**L1040389-5**						
Mercury (Hg)-Dissolved			85		%		70-130	05-AUG-11
WG1325386-52 MS		**L1040291-5**						
Mercury (Hg)-Dissolved			90		%		70-130	05-AUG-11
WG1325386-8 MS		**L1040136-4**						
Mercury (Hg)-Dissolved			90		%		70-130	05-AUG-11
WG1325386-9 MS		**L1038427-2**						
Mercury (Hg)-Dissolved			98		%		70-130	05-AUG-11
HG-TOT-LOW-CVAFS-VA	**Water**							
Batch R2228567								
WG1323898-2 LCS								
Mercury (Hg)-Total			91		%		80-120	03-AUG-11
WG1323898-1 MB								
Mercury (Hg)-Total			<0.000010		mg/L		0.00001	03-AUG-11
MET-DIS-CCME-MS-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-CCME-MS-VA	**Water**							
Batch R2229379								
WG1323258-3 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Dissolved			91		%		80-120	03-AUG-11
Antimony (Sb)-Dissolved			90		%		80-120	03-AUG-11
Arsenic (As)-Dissolved			88		%		80-120	03-AUG-11
Beryllium (Be)-Dissolved			87		%		80-120	03-AUG-11
Cadmium (Cd)-Dissolved			89		%		80-120	03-AUG-11
Chromium (Cr)-Dissolved			88		%		80-120	03-AUG-11
Cobalt (Co)-Dissolved			88		%		80-120	03-AUG-11
Copper (Cu)-Dissolved			84		%		80-120	03-AUG-11
Lead (Pb)-Dissolved			88		%		80-120	03-AUG-11
Lithium (Li)-Dissolved			84		%		80-120	03-AUG-11
Manganese (Mn)-Dissolved			88		%		80-120	03-AUG-11
Molybdenum (Mo)-Dissolved			88		%		80-120	03-AUG-11
Nickel (Ni)-Dissolved			89		%		80-120	03-AUG-11
Selenium (Se)-Dissolved			88		%		80-120	03-AUG-11
Silver (Ag)-Dissolved			87		%		80-120	03-AUG-11
Thallium (Tl)-Dissolved			89		%		80-120	03-AUG-11
Tin (Sn)-Dissolved			90		%		80-120	03-AUG-11
Vanadium (V)-Dissolved			89		%		80-120	03-AUG-11
Uranium (U)-Dissolved			88		%		80-120	03-AUG-11
WG1323258-1 MB								
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	03-AUG-11
Antimony (Sb)-Dissolved			<0.00050		mg/L		0.0005	03-AUG-11
Arsenic (As)-Dissolved			<0.00050		mg/L		0.0005	03-AUG-11
Beryllium (Be)-Dissolved			<0.0010		mg/L		0.001	03-AUG-11
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.0002	03-AUG-11
Chromium (Cr)-Dissolved			<0.0010		mg/L		0.001	03-AUG-11
Cobalt (Co)-Dissolved			<0.00030		mg/L		0.001	03-AUG-11
Copper (Cu)-Dissolved			<0.0010		mg/L		0.001	03-AUG-11
Lead (Pb)-Dissolved			<0.00050		mg/L		0.001	03-AUG-11
Lithium (Li)-Dissolved			<0.0050		mg/L		0.01	03-AUG-11
Manganese (Mn)-Dissolved			<0.00030		mg/L		0.001	03-AUG-11
Molybdenum (Mo)-Dissolved			<0.0010		mg/L		0.001	03-AUG-11
Nickel (Ni)-Dissolved			<0.0010		mg/L		0.001	03-AUG-11
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	03-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-CCME-MS-VA	**Water**							
Batch R2229379								
WG1323258-1 MB								
Silver (Ag)-Dissolved			<0.000020		mg/L		0.0001	03-AUG-11
Thallium (Tl)-Dissolved			<0.00020		mg/L		0.001	03-AUG-11
Tin (Sn)-Dissolved			<0.00050		mg/L		0.001	03-AUG-11
Vanadium (V)-Dissolved			<0.0010		mg/L		0.005	03-AUG-11
Uranium (U)-Dissolved			<0.00020		mg/L		0.0002	03-AUG-11
Batch R2233780								
WG1323258-2 DUP		**L1039171-1**						
Aluminum (Al)-Dissolved		0.032	0.035		mg/L	12	20	12-AUG-11
Antimony (Sb)-Dissolved		<0.0025	<0.0025	RPD-NA	mg/L	N/A	20	12-AUG-11
Arsenic (As)-Dissolved		<0.0025	<0.0025	RPD-NA	mg/L	N/A	20	12-AUG-11
Beryllium (Be)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	12-AUG-11
Cadmium (Cd)-Dissolved		<0.000085	<0.000050	RPD-NA	mg/L	N/A	20	12-AUG-11
Chromium (Cr)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	12-AUG-11
Cobalt (Co)-Dissolved		<0.0015	<0.0015	RPD-NA	mg/L	N/A	20	12-AUG-11
Copper (Cu)-Dissolved		0.0750	0.0770		mg/L	2.7	20	12-AUG-11
Lead (Pb)-Dissolved		0.0358	0.0395		mg/L	9.7	20	12-AUG-11
Lithium (Li)-Dissolved		1.26	1.28		mg/L	1.8	20	12-AUG-11
Manganese (Mn)-Dissolved		0.107	0.104		mg/L	3.2	20	12-AUG-11
Molybdenum (Mo)-Dissolved		0.0100	0.0097		mg/L	3.6	20	12-AUG-11
Nickel (Ni)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	12-AUG-11
Selenium (Se)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	12-AUG-11
Silver (Ag)-Dissolved		<0.00010	<0.00010	RPD-NA	mg/L	N/A	20	12-AUG-11
Thallium (Tl)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	12-AUG-11
Tin (Sn)-Dissolved		<0.0025	<0.0025	RPD-NA	mg/L	N/A	20	12-AUG-11
Vanadium (V)-Dissolved		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	12-AUG-11
Uranium (U)-Dissolved		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	12-AUG-11
MET-DIS-ICP-VA	**Water**							
Batch R2229155								
WG1323258-3 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Dissolved			99		%		80-120	03-AUG-11
Bismuth (Bi)-Dissolved			99		%		80-120	03-AUG-11
Boron (B)-Dissolved			98		%		80-120	03-AUG-11
Calcium (Ca)-Dissolved			105		%		80-120	03-AUG-11
Iron (Fe)-Dissolved			96		%		80-120	03-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2229155								
WG1323258-3 CRM		**VA-HIGH-WATRM**						
Magnesium (Mg)-Dissolved			99		%		80-120	03-AUG-11
Phosphorus (P)-Dissolved			101		%		80-120	03-AUG-11
Potassium (K)-Dissolved			101		%		80-120	03-AUG-11
Silicon (Si)-Dissolved			106		%		80-120	03-AUG-11
Sodium (Na)-Dissolved			99		%		80-120	03-AUG-11
Strontium (Sr)-Dissolved			103		%		80-120	03-AUG-11
Titanium (Ti)-Dissolved			101		%		80-120	03-AUG-11
Zinc (Zn)-Dissolved			97		%		80-120	03-AUG-11
WG1323258-1 MB								
Barium (Ba)-Dissolved			<0.010		mg/L		0.01	03-AUG-11
Bismuth (Bi)-Dissolved			<0.20		mg/L		0.2	03-AUG-11
Boron (B)-Dissolved			<0.10		mg/L		0.1	03-AUG-11
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	03-AUG-11
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	03-AUG-11
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	03-AUG-11
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	03-AUG-11
Potassium (K)-Dissolved			<2.0		mg/L		2	03-AUG-11
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	03-AUG-11
Sodium (Na)-Dissolved			<2.0		mg/L		2	03-AUG-11
Strontium (Sr)-Dissolved			<0.0050		mg/L		0.005	03-AUG-11
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	03-AUG-11
Zinc (Zn)-Dissolved			<0.0050		mg/L		0.005	03-AUG-11
Batch R2231963								
WG1323258-2 DUP		**L1039171-1**						
Barium (Ba)-Dissolved		0.997	0.998		mg/L	0.066	20	09-AUG-11
Bismuth (Bi)-Dissolved		<0.20	<0.20	RPD-NA	mg/L	N/A	20	09-AUG-11
Boron (B)-Dissolved		0.33	0.32		mg/L	2.5	20	09-AUG-11
Calcium (Ca)-Dissolved		6.09	6.06		mg/L	0.51	20	09-AUG-11
Iron (Fe)-Dissolved		0.667	0.726		mg/L	8.6	20	09-AUG-11
Magnesium (Mg)-Dissolved		1.76	1.76		mg/L	0.37	20	09-AUG-11
Phosphorus (P)-Dissolved		<0.30	<0.30	RPD-NA	mg/L	N/A	20	09-AUG-11
Potassium (K)-Dissolved		<2.0	<2.0	RPD-NA	mg/L	N/A	20	09-AUG-11
Silicon (Si)-Dissolved		5.25	5.25		mg/L	0.071	20	09-AUG-11
Sodium (Na)-Dissolved		481	481		mg/L	0.00093	20	09-AUG-11
Strontium (Sr)-Dissolved		0.226	0.226		mg/L	0.20	20	09-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2231963								
WG1323258-2 DUP		**L1039171-1**						
Titanium (Ti)-Dissolved		<0.010	<0.010	RPD-NA	mg/L	N/A	20	09-AUG-11
Zinc (Zn)-Dissolved		0.159	0.157		mg/L	1.3	20	09-AUG-11
MET-TOT-CCME-MS-VA	**Water**							
Batch R2229379								
WG1323317-4 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Total			96		%		80-120	03-AUG-11
Antimony (Sb)-Total			98		%		80-120	03-AUG-11
Arsenic (As)-Total			94		%		80-120	03-AUG-11
Beryllium (Be)-Total			96		%		80-120	03-AUG-11
Cadmium (Cd)-Total			95		%		80-120	03-AUG-11
Chromium (Cr)-Total			94		%		80-120	03-AUG-11
Cobalt (Co)-Total			95		%		80-120	03-AUG-11
Copper (Cu)-Total			90		%		80-120	03-AUG-11
Lead (Pb)-Total			94		%		80-120	03-AUG-11
Lithium (Li)-Total			92		%		80-120	03-AUG-11
Manganese (Mn)-Total			94		%		80-120	03-AUG-11
Molybdenum (Mo)-Total			96		%		80-120	03-AUG-11
Nickel (Ni)-Total			95		%		80-120	03-AUG-11
Selenium (Se)-Total			94		%		80-120	03-AUG-11
Silver (Ag)-Total			95		%		80-120	03-AUG-11
Thallium (Tl)-Total			95		%		80-120	03-AUG-11
Tin (Sn)-Total			97		%		80-120	03-AUG-11
Uranium (U)-Total			99		%		80-120	03-AUG-11
Vanadium (V)-Total			95		%		80-120	03-AUG-11
WG1323317-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	03-AUG-11
Antimony (Sb)-Total			<0.00050		mg/L		0.0005	03-AUG-11
Arsenic (As)-Total			<0.00050		mg/L		0.0005	03-AUG-11
Beryllium (Be)-Total			<0.0010		mg/L		0.001	03-AUG-11
Cadmium (Cd)-Total			<0.000010		mg/L		0.0002	03-AUG-11
Chromium (Cr)-Total			<0.0010		mg/L		0.001	03-AUG-11
Cobalt (Co)-Total			<0.00030		mg/L		0.001	03-AUG-11
Copper (Cu)-Total			<0.0010		mg/L		0.001	03-AUG-11
Lead (Pb)-Total			<0.00050		mg/L		0.001	03-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-CCME-MS-VA	**Water**							
Batch R2229379								
WG1323317-1 MB								
Lithium (Li)-Total			<0.0050		mg/L		0.01	03-AUG-11
Manganese (Mn)-Total			<0.00030		mg/L		0.001	03-AUG-11
Molybdenum (Mo)-Total			<0.0010		mg/L		0.001	03-AUG-11
Nickel (Ni)-Total			<0.0010		mg/L		0.001	03-AUG-11
Selenium (Se)-Total			<0.0010		mg/L		0.001	03-AUG-11
Silver (Ag)-Total			<0.000020		mg/L		0.0001	03-AUG-11
Thallium (Tl)-Total			<0.00020		mg/L		0.001	03-AUG-11
Tin (Sn)-Total			<0.00050		mg/L		0.001	03-AUG-11
Uranium (U)-Total			<0.00020		mg/L		0.0002	03-AUG-11
Vanadium (V)-Total			<0.0010		mg/L		0.005	03-AUG-11
Batch R2233780								
WG1323317-2 DUP		**L1039171-1**						
Aluminum (Al)-Total		1.12	1.17		mg/L	3.7	20	12-AUG-11
Antimony (Sb)-Total		<0.0025	<0.0025	RPD-NA	mg/L	N/A	20	12-AUG-11
Arsenic (As)-Total		<0.0025	<0.0025	RPD-NA	mg/L	N/A	20	12-AUG-11
Beryllium (Be)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	12-AUG-11
Cadmium (Cd)-Total		<0.000085	<0.000050	RPD-NA	mg/L	N/A	20	12-AUG-11
Chromium (Cr)-Total		0.0127	0.0133		mg/L	4.6	20	12-AUG-11
Cobalt (Co)-Total		<0.0015	<0.0015	RPD-NA	mg/L	N/A	20	12-AUG-11
Copper (Cu)-Total		3.96	4.18		mg/L	5.2	20	12-AUG-11
Lead (Pb)-Total		1.41	1.37		mg/L	3.4	20	12-AUG-11
Lithium (Li)-Total		1.23	1.27		mg/L	3.7	20	12-AUG-11
Manganese (Mn)-Total		0.170	0.166		mg/L	2.3	20	12-AUG-11
Molybdenum (Mo)-Total		0.0108	0.0110		mg/L	2.1	20	12-AUG-11
Nickel (Ni)-Total		0.0092	0.0090		mg/L	1.7	20	12-AUG-11
Selenium (Se)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	12-AUG-11
Silver (Ag)-Total		0.00017	0.00019		mg/L	8.0	20	12-AUG-11
Thallium (Tl)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	12-AUG-11
Tin (Sn)-Total		<0.0025	<0.0025	RPD-NA	mg/L	N/A	20	12-AUG-11
Uranium (U)-Total		<0.0010	<0.0010	RPD-NA	mg/L	N/A	20	12-AUG-11
Vanadium (V)-Total		<0.0050	<0.0050	RPD-NA	mg/L	N/A	20	12-AUG-11
MET-TOT-ICP-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-ICP-VA	**Water**							
Batch R2229155								
WG1323317-4 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Total			102		%		80-120	03-AUG-11
Bismuth (Bi)-Total			102		%		80-120	03-AUG-11
Boron (B)-Total			101		%		80-120	03-AUG-11
Calcium (Ca)-Total			106		%		80-120	03-AUG-11
Iron (Fe)-Total			100		%		80-120	03-AUG-11
Magnesium (Mg)-Total			103		%		80-120	03-AUG-11
Phosphorus (P)-Total			103		%		80-120	03-AUG-11
Potassium (K)-Total			106		%		80-120	03-AUG-11
Silicon (Si)-Total			109		%		80-120	03-AUG-11
Sodium (Na)-Total			109		%		80-120	03-AUG-11
Strontium (Sr)-Total			107		%		80-120	03-AUG-11
Titanium (Ti)-Total			105		%		80-120	03-AUG-11
Zinc (Zn)-Total			98		%		80-120	03-AUG-11
WG1323317-1 MB								
Barium (Ba)-Total			<0.010		mg/L		0.01	03-AUG-11
Bismuth (Bi)-Total			<0.20		mg/L		0.2	03-AUG-11
Boron (B)-Total			<0.10		mg/L		0.1	03-AUG-11
Calcium (Ca)-Total			<0.050		mg/L		0.05	03-AUG-11
Iron (Fe)-Total			<0.030		mg/L		0.03	03-AUG-11
Magnesium (Mg)-Total			<0.10		mg/L		0.1	03-AUG-11
Phosphorus (P)-Total			<0.30		mg/L		0.3	03-AUG-11
Potassium (K)-Total			<2.0		mg/L		2	03-AUG-11
Silicon (Si)-Total			<0.050		mg/L		0.05	03-AUG-11
Sodium (Na)-Total			<2.0		mg/L		2	03-AUG-11
Strontium (Sr)-Total			<0.0050		mg/L		0.005	03-AUG-11
Titanium (Ti)-Total			<0.010		mg/L		0.01	03-AUG-11
Zinc (Zn)-Total			<0.0050		mg/L		0.005	03-AUG-11
Batch R2231963								
WG1323317-2 DUP		**L1039171-1**						
Barium (Ba)-Total		1.74	1.70		mg/L	2.6	20	09-AUG-11
Bismuth (Bi)-Total		<0.20	<0.20	RPD-NA	mg/L	N/A	20	09-AUG-11
Boron (B)-Total		0.33	0.32		mg/L	2.1	20	09-AUG-11
Calcium (Ca)-Total		11.6	11.4		mg/L	1.8	20	09-AUG-11
Iron (Fe)-Total		11.1	11.0		mg/L	0.87	20	09-AUG-11
Magnesium (Mg)-Total		2.19	2.15		mg/L	1.9	20	09-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-ICP-VA	**Water**							
Batch R2231963								
WG1323317-2 DUP		**L1039171-1**						
Phosphorus (P)-Total		0.52	0.51		mg/L	1.2	20	09-AUG-11
Potassium (K)-Total		<2.0	<2.0	RPD-NA	mg/L	N/A	20	09-AUG-11
Silicon (Si)-Total		7.35	7.25		mg/L	1.3	20	09-AUG-11
Sodium (Na)-Total		497	483		mg/L	2.9	20	09-AUG-11
Strontium (Sr)-Total		0.276	0.269		mg/L	2.7	20	09-AUG-11
Titanium (Ti)-Total		0.023	0.023		mg/L	2.2	20	09-AUG-11
Zinc (Zn)-Total		0.889	0.878		mg/L	1.2	20	09-AUG-11
NH3-F-VA	**Water**							
Batch R2228657								
WG1323344-2 CRM		**VA-NH3-F**						
Ammonia (as N)			101		%		85-115	03-AUG-11
WG1323344-4 CRM		**VA-NH3-F**						
Ammonia (as N)			96		%		85-115	03-AUG-11
WG1323344-6 CRM		**VA-NH3-F**						
Ammonia (as N)			97		%		85-115	03-AUG-11
WG1323344-8 CRM		**VA-NH3-F**						
Ammonia (as N)			97		%		85-115	03-AUG-11
WG1323344-1 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	03-AUG-11
WG1323344-3 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	03-AUG-11
WG1323344-5 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	03-AUG-11
WG1323344-7 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	03-AUG-11
WG1323344-9 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	03-AUG-11
WG1323344-13 MS		**L1039022-1**						
Ammonia (as N)			93		%		75-125	03-AUG-11
WG1323344-15 MS		**L1037476-1**						
Ammonia (as N)			96		%		75-125	03-AUG-11
PH-PCT-VA	**Water**							
Batch R2228859								
WG1323382-10 CRM		**VA-PH7-BUF**						
pH			7.00		pH		6.9-7.1	03-AUG-11
	Water							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
S2-D-COL-VA	**Water**							
Batch R2229813								
WG1325218-5 DUP		**L1039171-1**						
Sulphide as S (Dissolved)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	04-AUG-11
WG1325218-1 MB								
Sulphide as S (Dissolved)			<0.020		mg/L		0.02	04-AUG-11
WG1325218-3 MB								
Sulphide as S (Dissolved)			<0.020		mg/L		0.02	04-AUG-11
TDS-VA	**Water**							
Batch R2232858								
WG1327354-2 LCS								
Total Dissolved Solids			101		%		85-115	09-AUG-11
WG1327354-5 LCS								
Total Dissolved Solids			100		%		85-115	09-AUG-11
WG1327354-8 LCS								
Total Dissolved Solids			104		%		85-115	09-AUG-11
WG1327354-1 MB								
Total Dissolved Solids			<10		mg/L		10	09-AUG-11
WG1327354-4 MB								
Total Dissolved Solids			<10		mg/L		10	09-AUG-11
WG1327354-7 MB								
Total Dissolved Solids			<10		mg/L		10	09-AUG-11
TURBIDITY-VA	**Water**							
Batch R2228628								
WG1323872-2 CRM		**VA-TURB-SPK-8**						
Turbidity			102		%		85-115	03-AUG-11
WG1323872-5 CRM		**VA-TURB-SPK-8**						
Turbidity			100		%		85-115	03-AUG-11
WG1323872-1 MB								
Turbidity			<0.10		NTU		0.1	03-AUG-11
WG1323872-4 MB								
Turbidity			<0.10		NTU		0.1	03-AUG-11

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
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
Total Dissolved Solids by Gravimetric							
	1	01-AUG-11 13:00	09-AUG-11 12:54	7	8	days	EHT
pH by Meter (Automated)							
	1	01-AUG-11 13:00	03-AUG-11 09:27	0.25	44	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1039171 were received on 02-AUG-11 16:25.

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 Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CHAIN OF CUST
CANADA

COC # C037609

Page 1 of 1

REPORT TO: AMEC	REPORT FORMAT / DISTRIBUTION	SERVICE REQUESTED
COMPANY:	STANDARD ✓ OTHER	✓ REGULAR SERVICE (DEFAULT)
CONTACT: T. Koshya	PDF ✓ EXCEL ✓ CUSTOM FAX	RUSH SERVICE (2-3 DAYS)
ADDRESS: 3456 Opie Cres. Prince George, BC V2N 2P9	EMAIL 1: tammera.koshya@amec.com	PRIORITY SERVICE (1 DAY or ASAP)
PHONE: (250) 564-3243 FAX: (250) 562-7045	EMAIL 2: scott.green@amec.com	EMERGENCY SERVICE (<1 DAY / WEEKEND) - CONTACT ALS
		ANALYSIS REQUEST
INVOICE TO: SAME AS REPORT ? (YES) NO	INDICATE BOTTLES: FILTERED / PRESERVED (F/P) → → →	
COMPANY:	CLIENT / PROJECT INFORMATION:	
CONTACT:	JOB #: KX13505.03	
ADDRESS:	PO /AFE:	
	Legal Site Description:	
PHONE: FAX:	QUOTE #:	
Lab Work Order # (lab use only): [redacted] L1039117	SAMPLER (Initials):	

Sample #	SAMPLE IDENTIFICATION (This description will appear on the report)	DATE	TIME	SAMPLE TYPE	Potability	Total metals	Dissolved metals	TOC	NH_3	Cyanide	S2-UNION-MANCALC-VA	S2-D-COL-VA	HAZARDOUS ?	HIGHLY CONTAMINATED ?	NUMBER OF CONTAINERS
[redacted]	#2 H16W 500-730m	Aug 1/11	1 PM	H_2O	X	X	X	X	X	X	X	X			
[redacted]															
[redacted]															
[redacted]	pH = 7.67														
[redacted]	Temp = 10.34°C														
[redacted]															
[redacted]															
[redacted]															
[redacted]															
[redacted]															

GUIDELINES / REGULATIONS

CCME + BC CSR

*Including vanadium, cobalt, molybdenum + silver

SPECIAL INSTRUCTIONS / HAZARDOUS DETAILS

Potability to include - Alkalinity, Anions (Cl, F, S, Sulphate), pH, Hardness, Colour, Nutrients*
* Please Sekam to confirm all Details & Plus more !!!

Failure to complete all portions of this form may delay analysis. Please fill in this form *LEGIBLY*.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the reverse page of the white report copy.

RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME:	SAMPLE CONDITION (lab use only)	
J. Koshya	Aug 1/11 2PM	Walter - Aug. 2, 2011	8:25	TEMPERATURE	SAMPLES RECEIVED IN GOOD CONDITION ? YES / NO (If no provide details)
RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME:	10.1 9.0 C	

REFER TO BACK PAGE FOR REGIONAL LOCATIONS AND SAMPLING INFORMATION

WHITE - REPORT COPY, PINK - FILE COPY, YELLOW - CLIENT COPY

GENF14.00

AMEC EARTH & ENVIRONMENTAL
ATTN: T. KOSTYA
3456 OPIE CRST
PRINCE GEORGE BC V2N 2P9

Date Received: 02-AUG-11
Report Date: 09-AUG-11 15:21 (MT)
Version: FINAL

Client Phone: 250-564-3243

Certificate of Analysis

Lab Work Order #: L1039100

Project P.O. #: NOT SUBMITTED
Job Reference: KX13505.03
C of C Numbers: C037608
Legal Site Desc:

Kelly Hunt
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1039100-1 #2 H16W 500-730M Sampled By: CLIENT on 01-AUG-11 @ 13:00 Matrix: WATER							
Miscellaneous Parameters							
Methane, dissolved	22.0		0.0050	mg/L	03-AUG-11	09-AUG-11	R2228660

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
METHANE-DIS-CL	Water	Methane, dissolved	EPA 5021/8015-HEADSPACE GC-FID
Results reported in			

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

C037608

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
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
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
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.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

CANADA TOLL FREE 1-800-668-9878

www.alsenviro.com

COC # C037608

REPORT TO:	REPORT FORMAT / DISTRIBUTION	SERVICE REQUESTED
COMPANY: AMEC	STANDARD ✓ OTHER ____	REGULAR SERVICE (DEFAULT) ✓
CONTACT: T. Kostya	PDF ✓ EXCEL ✓ CUSTOM ____ FAX ____	RUSH SERVICE (2-3 DAYS)
ADDRESS: 3456 Opie Cres.	EMAIL 1: tammera.kostya@amec.com	PRIORITY SERVICE (1 DAY or ASAP)
Prince George, BC V2N 2P9	EMAIL 2: scott.gissel@amec.com	EMERGENCY SERVICE (<1 DAY / WEEKEND) - CONTACT ALS
PHONE (250) 564-3243 FAX: (250) 562-7095		
INVOICE TO: SAME AS REPORT ? (YES) NO	INDICATE BOTTLES: FILTERED / PRESERVED (F/P) → → →	ANALYSIS REQUEST
COMPANY:	CLIENT / PROJECT INFORMATION:	
CONTACT:	JOB #: KX13505.03	
ADDRESS:	PO /AFE:	
	Legal Site Description:	
PHONE: FAX:	QUOTE #:	
	SAMPLER (Initials):	

SAMPLE IDENTIFICATION (This description will appear on the report)	DATE	TIME	SAMPLE TYPE	Diss. Methane	HAZARDOUS ?	HIGHLY CONTAMINATED ?	NUMBER OF CONTAINERS
# 2H16W 500-730m	Aug 1/11	1PM	H_2O	X			

GUIDELINES / REGULATIONS

CCME + BC CSR

SPECIAL INSTRUCTIONS / HAZARDOUS DETAILS

* See Selam 4 Details

Failure to complete all portions of this form may delay analysis. Please fill in this form *LEGIBLY*.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the reverse page of the white report copy.

RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME:	TEMPERATURE	SAMPLES RECEIVED IN GOOD CONDITION ? YES / NO (If no provide details)
J. Kostya	Aug 1/11 2pm		Aug 2 15h	11	
RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME:		

REFER TO BACK PAGE FOR REGIONAL LOCATIONS AND SAMPLING INFORMATION

WHITE - REPORT COPY, PINK - FILE COPY, YELLOW - CLIENT COPY

GENF14.00

AMEC EARTH & ENVIRONMENTAL
ATTN: Scott Green
913 Laval Crescent
Kamloops BC V2C 5P4

Date Received: 15-AUG-11
Report Date: 26-OCT-11 17:42 (MT)
Version: DRAFT REV. 2

Client Phone: 250-374-1347

Certificate of Analysis

Lab Work Order #: L1044658

Project P.O. #: NOT SUBMITTED
Job Reference: KX13505.030
C of C Numbers: C037610
Legal Site Desc:

Comments: ADDITIONAL 26-OCT-11 14:32

26-OCT-11: Please note: Bromide and Total and Dissolved Bismuth, Phosphorus, Silicon and Strontium have been added to this report, no other data has been changed.

Selam Worku
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1044658-1				
	Description	WATER				
	Sampled Date	14-AUG-11				
	Sampled Time	14:00				
	Client ID	H16W 233M-273M				
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	5.5				
	Conductivity (uS/cm)	1460				
	Hardness (as CaCO3) (mg/L)	14.4				
	pH (pH)	9.43				
	Total Dissolved Solids (mg/L)	842				
	Turbidity (NTU)	8.25				
Anions and Nutrients	Alkalinity, Total (as CaCO3) (mg/L)	787				
	Ammonia (as N) (mg/L)	1.04				
	Bromide (Br) (mg/L)	<0.50				
	Chloride (Cl) (mg/L)	11.5				
	Fluoride (F) (mg/L)	1.82				
	Nitrate (as N) (mg/L)	<0.050				
	Nitrite (as N) (mg/L)	<0.010				
	Sulfate (SO4) (mg/L)	<5.0				
	Sulphide as S (Dissolved) (mg/L)	<0.020				
Cyanides	Cyanide, Total (mg/L)	0.0756				
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	5.23				
Inorganic Parameters	Sulphide As S (Un-ionized) (mg/L)	<0.020				
Total Metals	Aluminum (Al)-Total (mg/L)	0.314				
	Antimony (Sb)-Total (mg/L)	<0.0025 DLA				
	Arsenic (As)-Total (mg/L)	<0.0025 DLA				
	Barium (Ba)-Total (mg/L)	0.455				
	Beryllium (Be)-Total (mg/L)	<0.0050 DLA				
	Bismuth (Bi)-Total (mg/L)	<0.20				
	Boron (B)-Total (mg/L)	0.30				
	Cadmium (Cd)-Total (mg/L)	<0.000085 DLA				
	Calcium (Ca)-Total (mg/L)	6.19				
	Chromium (Cr)-Total (mg/L)	<0.0050 DLA				
	Cobalt (Co)-Total (mg/L)	<0.0015 DLA				
	Copper (Cu)-Total (mg/L)	0.0614				
	Iron (Fe)-Total (mg/L)	0.577				
	Lead (Pb)-Total (mg/L)	0.0318				
	Lithium (Li)-Total (mg/L)	1.32				
	Magnesium (Mg)-Total (mg/L)	0.99				
	Manganese (Mn)-Total (mg/L)	0.0159				
	Mercury (Hg)-Total (mg/L)	<0.000010				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1044658-1				
	Description	WATER				
	Sampled Date	14-AUG-11				
	Sampled Time	14:00				
	Client ID	H16W 233M-273M				
Grouping	**Analyte**					
WATER						
Total Metals	Molybdenum (Mo)-Total (mg/L)	0.0053				
	Nickel (Ni)-Total (mg/L)	<0.0050 DLA				
	Phosphorus (P)-Total (mg/L)	<0.30				
	Potassium (K)-Total (mg/L)	3.2				
	Selenium (Se)-Total (mg/L)	<0.0050 DLA				
	Silicon (Si)-Total (mg/L)	4.50				
	Silver (Ag)-Total (mg/L)	<0.00010 DLA				
	Sodium (Na)-Total (mg/L)	364				
	Strontium (Sr)-Total (mg/L)	0.116				
	Thallium (Tl)-Total (mg/L)	<0.0010 DLA				
	Tin (Sn)-Total (mg/L)	<0.0025 DLA				
	Titanium (Ti)-Total (mg/L)	<0.010				
	Uranium (U)-Total (mg/L)	<0.0010 DLA				
	Vanadium (V)-Total (mg/L)	<0.0050 DLA				
	Zinc (Zn)-Total (mg/L)	<0.050				
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.123				
	Antimony (Sb)-Dissolved (mg/L)	<0.0025 DLA				
	Arsenic (As)-Dissolved (mg/L)	<0.0025 DLA				
	Barium (Ba)-Dissolved (mg/L)	0.380				
	Beryllium (Be)-Dissolved (mg/L)	<0.0050 DLA				
	Bismuth (Bi)-Dissolved (mg/L)	<0.20				
	Boron (B)-Dissolved (mg/L)	0.29				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000085 DLA				
	Calcium (Ca)-Dissolved (mg/L)	4.33				
	Chromium (Cr)-Dissolved (mg/L)	<0.0050 DLA				
	Cobalt (Co)-Dissolved (mg/L)	<0.0015 DLA				
	Copper (Cu)-Dissolved (mg/L)	0.0167				
	Iron (Fe)-Dissolved (mg/L)	0.144				
	Lead (Pb)-Dissolved (mg/L)	0.0029				
	Lithium (Li)-Dissolved (mg/L)	1.16				
	Magnesium (Mg)-Dissolved (mg/L)	0.88				
	Manganese (Mn)-Dissolved (mg/L)	0.0067				
	Mercury (Hg)-Dissolved (mg/L)	<0.000010				
	Molybdenum (Mo)-Dissolved (mg/L)	0.0050				
	Nickel (Ni)-Dissolved (mg/L)	<0.0050 DLA				
	Phosphorus (P)-Dissolved (mg/L)	<0.30				
	Potassium (K)-Dissolved (mg/L)	3.0				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1044658-1				
	Description	WATER				
	Sampled Date	14-AUG-11				
	Sampled Time	14:00				
	Client ID	H16W 233M-273M				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Selenium (Se)-Dissolved (mg/L)	<0.0050 DLA				
	Silicon (Si)-Dissolved (mg/L)	4.01				
	Silver (Ag)-Dissolved (mg/L)	<0.00010 DLA				
	Sodium (Na)-Dissolved (mg/L)	349				
	Strontium (Sr)-Dissolved (mg/L)	0.101				
	Thallium (Tl)-Dissolved (mg/L)	<0.0010 DLA				
	Tin (Sn)-Dissolved (mg/L)	<0.0025 DLA				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	<0.0010 DLA				
	Vanadium (V)-Dissolved (mg/L)	<0.0050 DLA				
	Zinc (Zn)-Dissolved (mg/L)	<0.0050				

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

Reference Information

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
CN-T-MID-HH-COL-VA	Water	Total Cyanide by HH Distillation	APHA 4500-CN Cyanide
This analysis is carried out using procedures adapted from APHA Method 4500-CN "Cyanide". Total or strong acid dissociable (SAD) cyanide are determined by sample distillation and analysis using the chloramine-T colourimetric method.			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength
This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.			
EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.
This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.			
HARDNESS-CALC-VA	Water	Hardness	APHA 2340B
Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.			
HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).			
HG-TOT-LOW-CVAFS-VA	Water	Total Mercury in Water by CVAFS(Low)	EPA 245.7
This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).			
MET-DIS-CCME-MS-VA	Water	Diss. Metals in Water by ICPMS (CCME)	EPA SW-846 3005A/6020A

Reference Information

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-TOT-CCME-MS-VA Water Total Metals in Water by ICPMS (CCME) EPA SW-846 3005A/6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven, or filtration (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

S2-D-COL-VA Water Dissolved Sulphide by Colorimetric APHA 4500-S2 D. - SULPHIDE

This analysis is carried out using procedures adapted from APHA Method 4500-S2 "Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

S2-UNION-MANCALC-VA Water Un-ionized Hydrogen sulphide (Man. calc) APHA -4500-S2 H.

This analysis is carried out using procedures adapted from APHA Method 4500-S2 H. "Calculation of Un-ionized Hydrogen Sulphide". Sulphide is determined using the methlyene blue colourimetric method.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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, BC, CANADA

Chain of Custody Numbers:

C037610

Reference Information

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

Client: AMEC EARTH & ENVIRONMENTAL
913 Laval Crescent
Kamloops BC V2C 5P4
Contact: Scott Green

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ALK-PCT-VA	**Water**							
Batch R2237167								
WG1332468-8 CRM		**VA-ALK-PCT-CONTROL**						
Alkalinity, Total (as CaCO3)			102		%		85-115	18-AUG-11
WG1332468-1 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-AUG-11
WG1332468-2 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-AUG-11
WG1332468-3 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-AUG-11
WG1332468-7 MB								
Alkalinity, Total (as CaCO3)			<1.0		mg/L		1	18-AUG-11
ANIONS-BR-IC-VA	**Water**							
Batch R2237044								
WG1330926-15 LCS								
Bromide (Br)			99		%		85-115	16-AUG-11
WG1330926-2 LCS								
Bromide (Br)			100		%		85-115	16-AUG-11
WG1330926-1 MB								
Bromide (Br)			<0.050		mg/L		0.05	16-AUG-11
WG1330926-10 MB								
Bromide (Br)			<0.050		mg/L		0.05	16-AUG-11
WG1330926-13 MB								
Bromide (Br)			<0.050		mg/L		0.05	16-AUG-11
WG1330926-4 MB								
Bromide (Br)			<0.050		mg/L		0.05	16-AUG-11
WG1330926-7 MB								
Bromide (Br)			<0.050		mg/L		0.05	16-AUG-11
WG1330926-11 MS		**L1042238-18**						
Bromide (Br)			115		%		75-125	16-AUG-11
WG1330926-5 MS		**L1041405-29**						
Bromide (Br)			98		%		75-125	16-AUG-11
WG1330926-8 MS		**L1041405-39**						
Bromide (Br)			113		%		75-125	16-AUG-11
ANIONS-CL-IC-VA	**Water**							
Batch R2237044								
WG1330926-15 LCS								
Chloride (Cl)			107		%		85-115	16-AUG-11
WG1330926-2 LCS								
Chloride (Cl)			107		%		85-115	16-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-CL-IC-VA	**Water**							
Batch R2237044								
WG1330926-1 MB								
Chloride (Cl)			<0.50		mg/L		0.5	16-AUG-11
WG1330926-10 MB								
Chloride (Cl)			<0.50		mg/L		0.5	16-AUG-11
WG1330926-13 MB								
Chloride (Cl)			<0.50		mg/L		0.5	16-AUG-11
WG1330926-4 MB								
Chloride (Cl)			<0.50		mg/L		0.5	16-AUG-11
WG1330926-7 MB								
Chloride (Cl)			<0.50		mg/L		0.5	16-AUG-11
WG1330926-11 MS		**L1042238-18**						
Chloride (Cl)			109		%		75-125	16-AUG-11
WG1330926-14 MS		**L1043928-1**						
Chloride (Cl)			105		%		75-125	16-AUG-11
ANIONS-F-IC-VA	**Water**							
Batch R2237044								
WG1330926-15 LCS								
Fluoride (F)			107		%		85-115	16-AUG-11
WG1330926-2 LCS								
Fluoride (F)			107		%		85-115	16-AUG-11
WG1330926-1 MB								
Fluoride (F)			<0.020		mg/L		0.02	16-AUG-11
WG1330926-10 MB								
Fluoride (F)			<0.020		mg/L		0.02	16-AUG-11
WG1330926-13 MB								
Fluoride (F)			<0.020		mg/L		0.02	16-AUG-11
WG1330926-4 MB								
Fluoride (F)			<0.020		mg/L		0.02	16-AUG-11
WG1330926-7 MB								
Fluoride (F)			<0.020		mg/L		0.02	16-AUG-11
WG1330926-11 MS		**L1042238-18**						
Fluoride (F)			113		%		75-125	16-AUG-11
WG1330926-14 MS		**L1043928-1**						
Fluoride (F)			106		%		75-125	16-AUG-11
WG1330926-5 MS		**L1041405-29**						
Fluoride (F)			108		%		75-125	16-AUG-11
WG1330926-8 MS		**L1041405-39**						
Fluoride (F)			109		%		75-125	16-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-NO2-IC-VA	**Water**							
Batch R2237044								
WG1330926-15 LCS								
Nitrite (as N)			112		%		85-115	16-AUG-11
WG1330926-2 LCS								
Nitrite (as N)			111		%		85-115	16-AUG-11
WG1330926-1 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	16-AUG-11
WG1330926-10 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	16-AUG-11
WG1330926-13 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	16-AUG-11
WG1330926-4 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	16-AUG-11
WG1330926-7 MB								
Nitrite (as N)			<0.0010		mg/L		0.001	16-AUG-11
WG1330926-11 MS		**L1042238-18**						
Nitrite (as N)			113		%		75-125	16-AUG-11
WG1330926-14 MS		**L1043928-1**						
Nitrite (as N)			98		%		75-125	16-AUG-11
WG1330926-5 MS		**L1041405-29**						
Nitrite (as N)			103		%		75-125	16-AUG-11
WG1330926-8 MS		**L1041405-39**						
Nitrite (as N)			105		%		75-125	16-AUG-11
ANIONS-NO3-IC-VA	**Water**							
Batch R2237044								
WG1330926-2 LCS								
Nitrate (as N)			115		%		85-115	16-AUG-11
WG1330926-1 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	16-AUG-11
WG1330926-10 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	16-AUG-11
WG1330926-13 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	16-AUG-11
WG1330926-4 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	16-AUG-11
WG1330926-7 MB								
Nitrate (as N)			<0.0050		mg/L		0.005	16-AUG-11
WG1330926-11 MS		**L1042238-18**						
Nitrate (as N)			120		%		75-125	16-AUG-11
WG1330926-5 MS		**L1041405-29**						

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
ANIONS-NO3-IC-VA	**Water**							
Batch R2237044								
WG1330926-5 MS		**L1041405-29**						
Nitrate (as N)			117		%		75-125	16-AUG-11
WG1330926-8 MS		**L1041405-39**						
Nitrate (as N)			118		%		75-125	16-AUG-11
ANIONS-SO4-IC-VA	**Water**							
Batch R2237044								
WG1330926-15 LCS								
Sulfate (SO4)			104		%		85-115	16-AUG-11
WG1330926-2 LCS								
Sulfate (SO4)			104		%		85-115	16-AUG-11
WG1330926-1 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	16-AUG-11
WG1330926-10 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	16-AUG-11
WG1330926-13 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	16-AUG-11
WG1330926-4 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	16-AUG-11
WG1330926-7 MB								
Sulfate (SO4)			<0.50		mg/L		0.5	16-AUG-11
WG1330926-11 MS		**L1042238-18**						
Sulfate (SO4)			107		%		75-125	16-AUG-11
WG1330926-5 MS		**L1041405-29**						
Sulfate (SO4)			103		%		75-125	16-AUG-11
WG1330926-8 MS		**L1041405-39**						
Sulfate (SO4)			104		%		75-125	16-AUG-11
CARBONS-TOC-VA	**Water**							
Batch R2237240								
WG1332549-1 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			100		%		80-120	17-AUG-11
WG1332549-3 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			102		%		80-120	17-AUG-11
WG1332549-5 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			100		%		80-120	17-AUG-11
WG1332549-7 CRM		**VA-TOC-C-CAFFEINE**						
Total Organic Carbon			102		%		80-120	17-AUG-11
WG1332549-2 MB								
Total Organic Carbon			<0.50		mg/L		0.5	17-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
CARBONS-TOC-VA	**Water**							
Batch R2237240								
WG1332549-4 MB								
Total Organic Carbon			<0.50		mg/L		0.5	17-AUG-11
WG1332549-6 MB								
Total Organic Carbon			<0.50		mg/L		0.5	17-AUG-11
WG1332549-9 MS		**L1042238-19**						
Total Organic Carbon			121		%		70-130	17-AUG-11
CN-T-MID-HH-COL-VA	**Water**							
Batch R2238672								
WG1334837-2 CRM		**VA-HH-TCN-CONTROL**						
Cyanide, Total			97		%		80-120	22-AUG-11
WG1334837-3 CRM		**VA-HH-TCN-CONTROL**						
Cyanide, Total			102		%		80-120	22-AUG-11
WG1334837-1 MB								
Cyanide, Total			<0.0050		mg/L		0.005	22-AUG-11
COLOUR-TRUE-VA	**Water**							
Batch R2235390								
WG1331049-2 CRM		**VA-COL-C-25**						
Colour, True			104		%		85-115	16-AUG-11
WG1331049-5 CRM		**VA-COL-C-25**						
Colour, True			105		%		85-115	16-AUG-11
WG1331049-1 MB								
Colour, True			<5.0		CU		5	16-AUG-11
WG1331049-4 MB								
Colour, True			<5.0		CU		5	16-AUG-11
EC-PCT-VA	**Water**							
Batch R2235829								
WG1330994-9 CRM		**VA-EC-PCT-CONTROL**						
Conductivity			106		%		90-110	16-AUG-11
WG1330994-1 MB								
Conductivity			<2.0		uS/cm		2	16-AUG-11
WG1330994-2 MB								
Conductivity			<2.0		uS/cm		2	16-AUG-11
WG1330994-3 MB								
Conductivity			<2.0		uS/cm		2	16-AUG-11
WG1330994-4 MB								
Conductivity			<2.0		uS/cm		2	16-AUG-11
WG1330994-5 MB								
Conductivity			<2.0		uS/cm		2	16-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
EC-PCT-VA	**Water**							
Batch R2235829								
WG1330994-6 MB								
Conductivity			<2.0		uS/cm		2	16-AUG-11
HG-DIS-LOW-CVAFS-VA	**Water**							
Batch R2235384								
WG1331347-2 LCS								
Mercury (Hg)-Dissolved			98		%		80-120	16-AUG-11
WG1331347-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	16-AUG-11
Batch R2235978								
WG1330739-1 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	17-AUG-11
WG1330739-4 MB								
Mercury (Hg)-Dissolved			<0.000010		mg/L		0.00001	17-AUG-11
HG-TOT-LOW-CVAFS-VA	**Water**							
Batch R2235384								
WG1331347-2 LCS								
Mercury (Hg)-Total			98		%		80-120	16-AUG-11
WG1331347-1 MB								
Mercury (Hg)-Total			<0.000010		mg/L		0.00001	16-AUG-11
WG1331347-14 MS		**L1043645-4**						
Mercury (Hg)-Total			91		%		70-130	16-AUG-11
WG1331347-15 MS		**L1042238-15**						
Mercury (Hg)-Total			97		%		70-130	16-AUG-11
MET-DIS-CCME-MS-VA	**Water**							
Batch R2236073								
WG1330739-3 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Dissolved			103		%		80-120	16-AUG-11
Antimony (Sb)-Dissolved			102		%		80-120	16-AUG-11
Arsenic (As)-Dissolved			102		%		80-120	16-AUG-11
Beryllium (Be)-Dissolved			103		%		80-120	16-AUG-11
Cadmium (Cd)-Dissolved			107		%		80-120	16-AUG-11
Chromium (Cr)-Dissolved			103		%		80-120	16-AUG-11
Cobalt (Co)-Dissolved			101		%		80-120	16-AUG-11
Copper (Cu)-Dissolved			100		%		80-120	16-AUG-11
Lead (Pb)-Dissolved			102		%		80-120	16-AUG-11
Lithium (Li)-Dissolved			101		%		80-120	16-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-CCME-MS-VA	**Water**							
Batch R2236073								
WG1330739-3 CRM		**VA-HIGH-WATRM**						
Manganese (Mn)-Dissolved			103		%		80-120	16-AUG-11
Molybdenum (Mo)-Dissolved			103		%		80-120	16-AUG-11
Nickel (Ni)-Dissolved			103		%		80-120	16-AUG-11
Selenium (Se)-Dissolved			102		%		80-120	16-AUG-11
Silver (Ag)-Dissolved			99		%		80-120	16-AUG-11
Thallium (Tl)-Dissolved			102		%		80-120	16-AUG-11
Tin (Sn)-Dissolved			105		%		80-120	16-AUG-11
Vanadium (V)-Dissolved			102		%		80-120	16-AUG-11
Uranium (U)-Dissolved			99		%		80-120	16-AUG-11
WG1330739-1 MB								
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	16-AUG-11
Antimony (Sb)-Dissolved			<0.00050		mg/L		0.0005	16-AUG-11
Arsenic (As)-Dissolved			<0.00050		mg/L		0.0005	16-AUG-11
Beryllium (Be)-Dissolved			<0.0010		mg/L		0.001	16-AUG-11
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.0002	16-AUG-11
Chromium (Cr)-Dissolved			<0.0010		mg/L		0.001	16-AUG-11
Cobalt (Co)-Dissolved			<0.00030		mg/L		0.001	16-AUG-11
Copper (Cu)-Dissolved			<0.0010		mg/L		0.001	16-AUG-11
Lead (Pb)-Dissolved			<0.00050		mg/L		0.001	16-AUG-11
Lithium (Li)-Dissolved			<0.0050		mg/L		0.01	16-AUG-11
Manganese (Mn)-Dissolved			<0.00030		mg/L		0.001	16-AUG-11
Molybdenum (Mo)-Dissolved			<0.0010		mg/L		0.001	16-AUG-11
Nickel (Ni)-Dissolved			<0.0010		mg/L		0.001	16-AUG-11
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	16-AUG-11
Silver (Ag)-Dissolved			<0.000020		mg/L		0.0001	16-AUG-11
Thallium (Tl)-Dissolved			<0.00020		mg/L		0.001	16-AUG-11
Tin (Sn)-Dissolved			<0.00050		mg/L		0.001	16-AUG-11
Vanadium (V)-Dissolved			<0.0010		mg/L		0.005	16-AUG-11
Uranium (U)-Dissolved			<0.00020		mg/L		0.0002	16-AUG-11
WG1330739-4 MB								
Aluminum (Al)-Dissolved			<0.0050		mg/L		0.005	16-AUG-11
Antimony (Sb)-Dissolved			<0.00050		mg/L		0.0005	16-AUG-11
Arsenic (As)-Dissolved			<0.00050		mg/L		0.0005	16-AUG-11
Beryllium (Be)-Dissolved			<0.0010		mg/L		0.001	16-AUG-11
Cadmium (Cd)-Dissolved			<0.000010		mg/L		0.0002	16-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-CCME-MS-VA	**Water**							
Batch R2236073								
WG1330739-4 MB								
Chromium (Cr)-Dissolved			<0.0010		mg/L		0.001	16-AUG-11
Cobalt (Co)-Dissolved			<0.00030		mg/L		0.001	16-AUG-11
Copper (Cu)-Dissolved			<0.0010		mg/L		0.001	16-AUG-11
Lead (Pb)-Dissolved			<0.00050		mg/L		0.001	16-AUG-11
Lithium (Li)-Dissolved			<0.0050		mg/L		0.01	16-AUG-11
Manganese (Mn)-Dissolved			<0.00030		mg/L		0.001	16-AUG-11
Molybdenum (Mo)-Dissolved			<0.0010		mg/L		0.001	16-AUG-11
Nickel (Ni)-Dissolved			<0.0010		mg/L		0.001	16-AUG-11
Selenium (Se)-Dissolved			<0.0010		mg/L		0.001	16-AUG-11
Silver (Ag)-Dissolved			<0.000020		mg/L		0.0001	16-AUG-11
Thallium (Tl)-Dissolved			<0.00020		mg/L		0.001	16-AUG-11
Tin (Sn)-Dissolved			<0.00050		mg/L		0.001	16-AUG-11
Vanadium (V)-Dissolved			<0.0010		mg/L		0.005	16-AUG-11
Uranium (U)-Dissolved			<0.00020		mg/L		0.0002	16-AUG-11
MET-DIS-ICP-VA	**Water**							
Batch R2236045								
WG1330739-3 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Dissolved			97		%		80-120	17-AUG-11
Bismuth (Bi)-Dissolved			98		%		80-120	17-AUG-11
Boron (B)-Dissolved			98		%		80-120	17-AUG-11
Calcium (Ca)-Dissolved			99		%		80-120	17-AUG-11
Iron (Fe)-Dissolved			97		%		80-120	17-AUG-11
Magnesium (Mg)-Dissolved			98		%		80-120	17-AUG-11
Phosphorus (P)-Dissolved			100		%		80-120	17-AUG-11
Potassium (K)-Dissolved			101		%		80-120	17-AUG-11
Silicon (Si)-Dissolved			101		%		80-120	17-AUG-11
Sodium (Na)-Dissolved			95		%		80-120	17-AUG-11
Strontium (Sr)-Dissolved			101		%		80-120	17-AUG-11
Titanium (Ti)-Dissolved			100		%		80-120	17-AUG-11
Zinc (Zn)-Dissolved			96		%		80-120	17-AUG-11
WG1330739-1 MB								
Barium (Ba)-Dissolved			<0.010		mg/L		0.01	17-AUG-11
Bismuth (Bi)-Dissolved			<0.20		mg/L		0.2	17-AUG-11
Boron (B)-Dissolved			<0.10		mg/L		0.1	17-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-DIS-ICP-VA	**Water**							
Batch R2236045								
WG1330739-1 MB								
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	17-AUG-11
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	17-AUG-11
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	17-AUG-11
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	17-AUG-11
Potassium (K)-Dissolved			<2.0		mg/L		2	17-AUG-11
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	17-AUG-11
Sodium (Na)-Dissolved			<2.0		mg/L		2	17-AUG-11
Strontium (Sr)-Dissolved			<0.0050		mg/L		0.005	17-AUG-11
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	17-AUG-11
Zinc (Zn)-Dissolved			<0.0050		mg/L		0.005	17-AUG-11
WG1330739-4 MB								
Barium (Ba)-Dissolved			<0.010		mg/L		0.01	17-AUG-11
Bismuth (Bi)-Dissolved			<0.20		mg/L		0.2	17-AUG-11
Boron (B)-Dissolved			<0.10		mg/L		0.1	17-AUG-11
Calcium (Ca)-Dissolved			<0.050		mg/L		0.05	17-AUG-11
Iron (Fe)-Dissolved			<0.030		mg/L		0.03	17-AUG-11
Magnesium (Mg)-Dissolved			<0.10		mg/L		0.1	17-AUG-11
Phosphorus (P)-Dissolved			<0.30		mg/L		0.3	17-AUG-11
Potassium (K)-Dissolved			<2.0		mg/L		2	17-AUG-11
Silicon (Si)-Dissolved			<0.050		mg/L		0.05	17-AUG-11
Sodium (Na)-Dissolved			<2.0		mg/L		2	17-AUG-11
Strontium (Sr)-Dissolved			<0.0050		mg/L		0.005	17-AUG-11
Titanium (Ti)-Dissolved			<0.010		mg/L		0.01	17-AUG-11
Zinc (Zn)-Dissolved			<0.0050		mg/L		0.005	17-AUG-11
MET-TOT-CCME-MS-VA	**Water**							
Batch R2236073								
WG1330735-4 CRM		**VA-HIGH-WATRM**						
Aluminum (Al)-Total			107		%		80-120	16-AUG-11
Antimony (Sb)-Total			84		%		80-120	16-AUG-11
Arsenic (As)-Total			102		%		80-120	16-AUG-11
Beryllium (Be)-Total			84		%		80-120	16-AUG-11
Cadmium (Cd)-Total			106		%		80-120	16-AUG-11
Chromium (Cr)-Total			106		%		80-120	16-AUG-11
Cobalt (Co)-Total			102		%		80-120	16-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-CCME-MS-VA	**Water**							
Batch R2236073								
WG1330735-4 CRM		**VA-HIGH-WATRM**						
Copper (Cu)-Total			101		%		80-120	16-AUG-11
Lead (Pb)-Total			83		%		80-120	16-AUG-11
Lithium (Li)-Total			83		%		80-120	16-AUG-11
Manganese (Mn)-Total			104		%		80-120	16-AUG-11
Molybdenum (Mo)-Total			82		%		80-120	16-AUG-11
Nickel (Ni)-Total			105		%		80-120	16-AUG-11
Selenium (Se)-Total			102		%		80-120	16-AUG-11
Silver (Ag)-Total			81		%		80-120	16-AUG-11
Thallium (Tl)-Total			84		%		80-120	16-AUG-11
Tin (Sn)-Total			86		%		80-120	16-AUG-11
Uranium (U)-Total			82		%		80-120	16-AUG-11
Vanadium (V)-Total			104		%		80-120	16-AUG-11
WG1330735-1 MB								
Aluminum (Al)-Total			<0.0050		mg/L		0.005	16-AUG-11
Antimony (Sb)-Total			<0.00050		mg/L		0.0005	16-AUG-11
Arsenic (As)-Total			<0.00050		mg/L		0.0005	16-AUG-11
Beryllium (Be)-Total			<0.0010		mg/L		0.001	16-AUG-11
Cadmium (Cd)-Total			<0.000010		mg/L		0.0002	16-AUG-11
Chromium (Cr)-Total			<0.0010		mg/L		0.001	16-AUG-11
Cobalt (Co)-Total			<0.00030		mg/L		0.001	16-AUG-11
Copper (Cu)-Total			<0.0010		mg/L		0.001	16-AUG-11
Lead (Pb)-Total			<0.00050		mg/L		0.001	16-AUG-11
Lithium (Li)-Total			<0.0050		mg/L		0.01	16-AUG-11
Manganese (Mn)-Total			<0.00030		mg/L		0.001	16-AUG-11
Molybdenum (Mo)-Total			<0.0010		mg/L		0.001	16-AUG-11
Nickel (Ni)-Total			<0.0010		mg/L		0.001	16-AUG-11
Selenium (Se)-Total			<0.0010		mg/L		0.001	16-AUG-11
Silver (Ag)-Total			<0.000020		mg/L		0.0001	16-AUG-11
Thallium (Tl)-Total			<0.00020		mg/L		0.001	16-AUG-11
Tin (Sn)-Total			<0.00050		mg/L		0.001	16-AUG-11
Uranium (U)-Total			<0.00020		mg/L		0.0002	16-AUG-11
Vanadium (V)-Total			<0.0010		mg/L		0.005	16-AUG-11
MET-TOT-ICP-VA	**Water**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-TOT-ICP-VA	**Water**							
Batch R2236078								
WG1330735-4 CRM		**VA-HIGH-WATRM**						
Barium (Ba)-Total			103		%		80-120	17-AUG-11
Bismuth (Bi)-Total			100		%		80-120	17-AUG-11
Boron (B)-Total			102		%		80-120	17-AUG-11
Calcium (Ca)-Total			102		%		80-120	17-AUG-11
Iron (Fe)-Total			102		%		80-120	17-AUG-11
Magnesium (Mg)-Total			103		%		80-120	17-AUG-11
Phosphorus (P)-Total			102		%		80-120	17-AUG-11
Potassium (K)-Total			105		%		80-120	17-AUG-11
Silicon (Si)-Total			107		%		80-120	17-AUG-11
Sodium (Na)-Total			104		%		80-120	17-AUG-11
Strontium (Sr)-Total			106		%		80-120	17-AUG-11
Titanium (Ti)-Total			105		%		80-120	17-AUG-11
Zinc (Zn)-Total			96		%		80-120	17-AUG-11
WG1330735-1 MB								
Barium (Ba)-Total			<0.010		mg/L		0.01	17-AUG-11
Bismuth (Bi)-Total			<0.20		mg/L		0.2	17-AUG-11
Boron (B)-Total			<0.10		mg/L		0.1	17-AUG-11
Calcium (Ca)-Total			<0.050		mg/L		0.05	17-AUG-11
Iron (Fe)-Total			<0.030		mg/L		0.03	17-AUG-11
Magnesium (Mg)-Total			<0.10		mg/L		0.1	17-AUG-11
Phosphorus (P)-Total			<0.30		mg/L		0.3	17-AUG-11
Potassium (K)-Total			<2.0		mg/L		2	17-AUG-11
Silicon (Si)-Total			<0.050		mg/L		0.05	17-AUG-11
Sodium (Na)-Total			<2.0		mg/L		2	17-AUG-11
Strontium (Sr)-Total			<0.0050		mg/L		0.005	17-AUG-11
Titanium (Ti)-Total			<0.010		mg/L		0.01	17-AUG-11
Zinc (Zn)-Total			<0.0050		mg/L		0.005	17-AUG-11
NH3-F-VA	**Water**							
Batch R2235494								
WG1330736-10 CRM		**VA-NH3-F**						
Ammonia (as N)			98		%		85-115	16-AUG-11
WG1330736-2 CRM		**VA-NH3-F**						
Ammonia (as N)			96		%		85-115	16-AUG-11
WG1330736-4 CRM		**VA-NH3-F**						
Ammonia (as N)			93		%		85-115	16-AUG-11

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH3-F-VA	**Water**							
Batch R2235494								
WG1330736-6 CRM		**VA-NH3-F**						
Ammonia (as N)			99		%		85-115	16-AUG-11
WG1330736-8 CRM		**VA-NH3-F**						
Ammonia (as N)			99		%		85-115	16-AUG-11
WG1330736-1 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	16-AUG-11
WG1330736-3 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	16-AUG-11
WG1330736-5 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	16-AUG-11
WG1330736-7 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	16-AUG-11
WG1330736-9 MB								
Ammonia (as N)			<0.0050		mg/L		0.005	16-AUG-11
WG1330736-14 MS		**L1044178-6**						
Ammonia (as N)			104		%		75-125	16-AUG-11
WG1330736-18 MS		**L1042720-2**						
Ammonia (as N)			100		%		75-125	16-AUG-11
PH-PCT-VA	**Water**							
Batch R2235829								
WG1330994-10 CRM		**VA-PH7-BUF**						
pH			7.01		pH		6.9-7.1	16-AUG-11
S2-D-COL-VA	**Water**							
Batch R2236543								
WG1332739-5 DUP		**L1044658-1**						
Sulphide as S (Dissolved)		<0.020	<0.020	RPD-NA	mg/L	N/A	20	17-AUG-11
WG1332739-1 MB								
Sulphide as S (Dissolved)			<0.020		mg/L		0.02	17-AUG-11
WG1332739-3 MB								
Sulphide as S (Dissolved)			<0.020		mg/L		0.02	17-AUG-11
TDS-VA	**Water**							
Batch R2235865								
WG1330740-11 LCS								
Total Dissolved Solids			99		%		85-115	16-AUG-11
WG1330740-2 LCS								
Total Dissolved Solids			101		%		85-115	16-AUG-11
WG1330740-5 LCS								

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
TDS-VA	**Water**							
Batch R2235865								
WG1330740-5 LCS								
Total Dissolved Solids			101		%		85-115	16-AUG-11
WG1330740-8 LCS								
Total Dissolved Solids			98		%		85-115	16-AUG-11
WG1330740-1 MB								
Total Dissolved Solids			<10		mg/L		10	16-AUG-11
WG1330740-10 MB								
Total Dissolved Solids			<10		mg/L		10	16-AUG-11
WG1330740-4 MB								
Total Dissolved Solids			<10		mg/L		10	16-AUG-11
WG1330740-7 MB								
Total Dissolved Solids			<10		mg/L		10	16-AUG-11
TURBIDITY-VA	**Water**							
Batch R2235192								
WG1331033-2 CRM		**VA-TURB-SPK-8**						
Turbidity			102		%		85-115	16-AUG-11
WG1331033-5 CRM		**VA-TURB-SPK-8**						
Turbidity			101		%		85-115	16-AUG-11
WG1331033-1 MB								
Turbidity			<0.10		NTU		0.1	16-AUG-11
WG1331033-4 MB								
Turbidity			<0.10		NTU		0.1	16-AUG-11

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
J	Duplicate results and limits are expressed in terms of absolute difference.
RPD-NA	Relative Percent Difference Not Available due to result(s) being less than detection limit.

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Physical Tests							
pH by Meter (Automated)							
	1	14-AUG-11 14:00	16-AUG-11 10:22	0.25	44	hours	EHTR-FM

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L1044658 were received on 15-AUG-11 11:10.

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.

Short Holding Time

Rush Processing

ALS

L1044658-COFC

IEST FORM 8

COC # C037610

Page 1 of 1

REPORT TO: AMEC Environment + Infrastructure	REPOR	SERVICE REQUESTED
COMPANY:	STANDARD ✓ OTHER ____	X REGULAR SERVICE (DEFAULT)
CONTACT: Scott Green	PDF ✓ EXCEL ✓ CUSTOM ____ FAX ____	RUSH SERVICE (2-3 DAYS)
ADDRESS: 913 Laval Crescent	EMAIL 1: Scott.green@amec.com	PRIORITY SERVICE (1 DAY or ASAP)
Kamloops, B.C. V2C 5P4	EMAIL 2: Tammera.Kostya@amec.com	EMERGENCY SERVICE (<1 DAY / WEEKEND) - CONTACT ALS
PHONE: 250-374-1347 FAX: 250-374-2944		ANALYSIS REQUEST
INVOICE TO: SAME AS REPORT ? YES / NO	INDICATE BOTTLES: FILTERED / PRESERVED (F/P) → → →	
COMPANY:	CLIENT / PROJECT INFORMATION:	
CONTACT:	JOB #: KX13505.030	
ADDRESS:	PO /AFE:	
	Legal Site Description:	
PHONE: FAX:	QUOTE #:	
Lab Work Order # (lab use only): L1044658	SAMPLER (Initials): Scott Green SG	

Sample #	SAMPLE IDENTIFICATION (This description will appear on the report)	DATE	TIME	SAMPLE TYPE	Potability (No Bacteria)	Total Metals	Dissolved Metals	TOC	Ammonia	Cyanides	S2-UNION-MANCALCVA	S2-D-COL-VA	HAZARDOUS ?	HIGHLY CONTAMINATED ?	NUMBER OF CONTAINERS
[redacted]	HIGW 233m - 273m	August 14, 2011	14:00	Water	X	X	X	X	X	X	X	X			
[redacted]															
[redacted]															
[redacted]	Temp = 10.03 °C														
[redacted]	pH (Temp compensated) = 9.37														
[redacted]	Specific conductance = 1392 µS/cm														
[redacted]	ORP = 51.6 mV														
[redacted]	DO = 0.94 mg/L														
[redacted]															
[redacted]															

GUIDELINES / REGULATIONS

CCME + BC ~~ER~~ Approved and Working Criteria

SPECIAL INSTRUCTIONS / HAZARDOUS DETAILS

Failure to complete all portions of this form may delay analysis. Please fill in this form *LEGIBLY*.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the reverse page of the white report copy.

RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME:	SAMPLE CONDITION (lab use only)	
Scott Green	Aug. 14/2011 15:00	HD	11/08/15	TEMPERATURE 7	SAMPLES RECEIVED IN GOOD CONDITION ? YES / NO (If no provide details)
RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME:		

REFER TO BACK PAGE FOR REGIONAL LOCATIONS AND SAMPLING INFORMATION

WHITE - REPORT COPY, PINK - FILE COPY, YELLOW - CLIENT COPY

GENF14

AMEC EARTH ENVIRONMENTAL
ATTN: SCOTT GREEN
913 LAVAL CRESCENT
KAMLOOPS BC V2C 5P4

Date Received: 15-AUG-11
Report Date: 23-AUG-11 14:52 (MT)
Version: FINAL

Client Phone: 250-374-1347

Certificate of Analysis

Lab Work Order #: L1044535

Project P.O. #: NOT SUBMITTED
Job Reference: KX13505.030
C of C Numbers: C037611
Legal Site Desc:

Kelly Hunt
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L1044535-1 H16W 233M-273M Sampled By: CLIENT on 14-AUG-11 @ 14:00 Matrix: WATER							
Miscellaneous Parameters							
Methane, dissolved	11.0		0.0050	mg/L	23-AUG-11	23-AUG-11	R2239217

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
METHANE-DIS-CL	Water	Methane, dissolved	EPA 5021/8015-HEADSPACE GC-FID
Results reported in			

** 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
CL	ALS ENVIRONMENTAL - CALGARY, ALBERTA, CANADA

Chain of Custody Numbers:

C037611

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
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
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
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.

4077

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division AGR400

CHAIN OF CUSTODY / ANALYTICAL REQUEST FORM

CANADA TOLL FREE 1-800-668-9878

www.alsenviro.com

COC # C037611
L1044535

Page 1 of 1

REPORT TO:	REPORT FORMAT / DISTRIBUTION	SERVICE REQUESTED
COMPANY: AMEC Environment & Infrastructure	STANDARD X OTHER ___	X REGULAR SERVICE (DEFAULT)
CONTACT: 913 Laval Crescent	PDF X EXCEL X CUSTOM ___ FAX ___	RUSH SERVICE (2-3 DAYS)
ADDRESS: Kamloops, B.C V2C 5P4	EMAIL 1: Scott.green@amec.com	PRIORITY SERVICE (1 DAY or ASAP)
Attention: Scott Green	EMAIL 2: Domenico.Kostyo@amec.com	EMERGENCY SERVICE (<1 DAY / WEEKEND) - CONTACT ALS
PHONE: 250-374-1347 FAX: 250-374-2944		ANALYSIS REQUEST
INVOICE TO: SAME AS REPORT ? YES / NO	INDICATE BOTTLES: FILTERED / PRESERVED (F/P) → →	
COMPANY:	CLIENT / PROJECT INFORMATION:	
CONTACT:	JOB #: KX13505.030	
ADDRESS:	PO /AFE:	
	Legal Site Description:	
PHONE: FAX:	QUOTE #:	
	SAMPLER (Initials):	

SAMPLE IDENTIFICATION (This description will appear on the report)	DATE	TIME	SAMPLE TYPE	Dissolved Methane	HAZARDOUS	HIGHLY	NUMBER OF CONTAINERS
H16W 233m-273m	August 14, 2011	14:00	Water	X			

GUIDELINES / REGULATIONS

CCME + BC Approved Working Criteria

SPECIAL INSTRUCTIONS / HAZARDOUS DETAILS

Failure to complete all portions of this form may delay analysis. Please fill in this form *LEGIBLY*.

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RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME:	TEMPERATURE	SAMPLES RECEIVED IN GOOD CONDITION ? YES / NO (If no provide details)
Scott Green	Aug. 14/11 15:00		15 Aug 11	2°C	
RELINQUISHED BY:	DATE & TIME:	RECEIVED BY:	DATE & TIME: 12:12		

REFER TO BACK PAGE FOR REGIONAL LOCATIONS AND SAMPLING INFORMATION

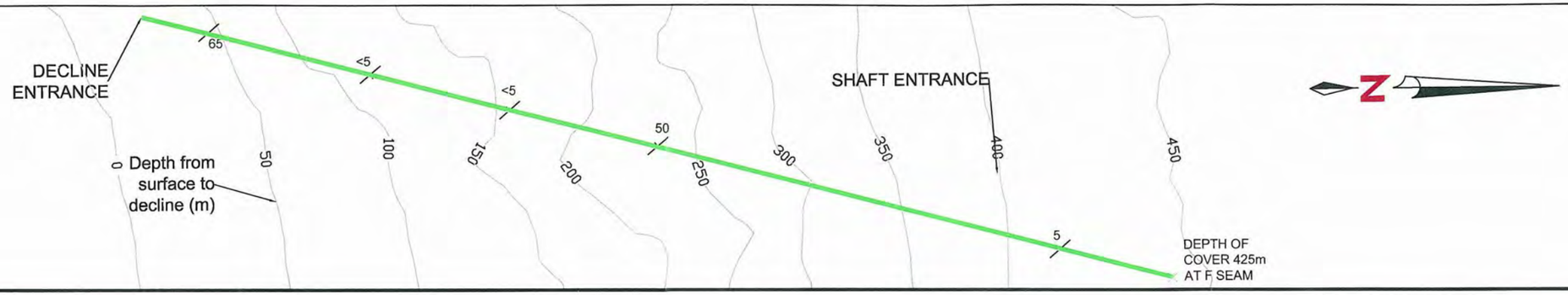
WHITE - REPORT COPY, PINK - FILE COPY, YELLOW - CLIENT COPY

GENF14.00

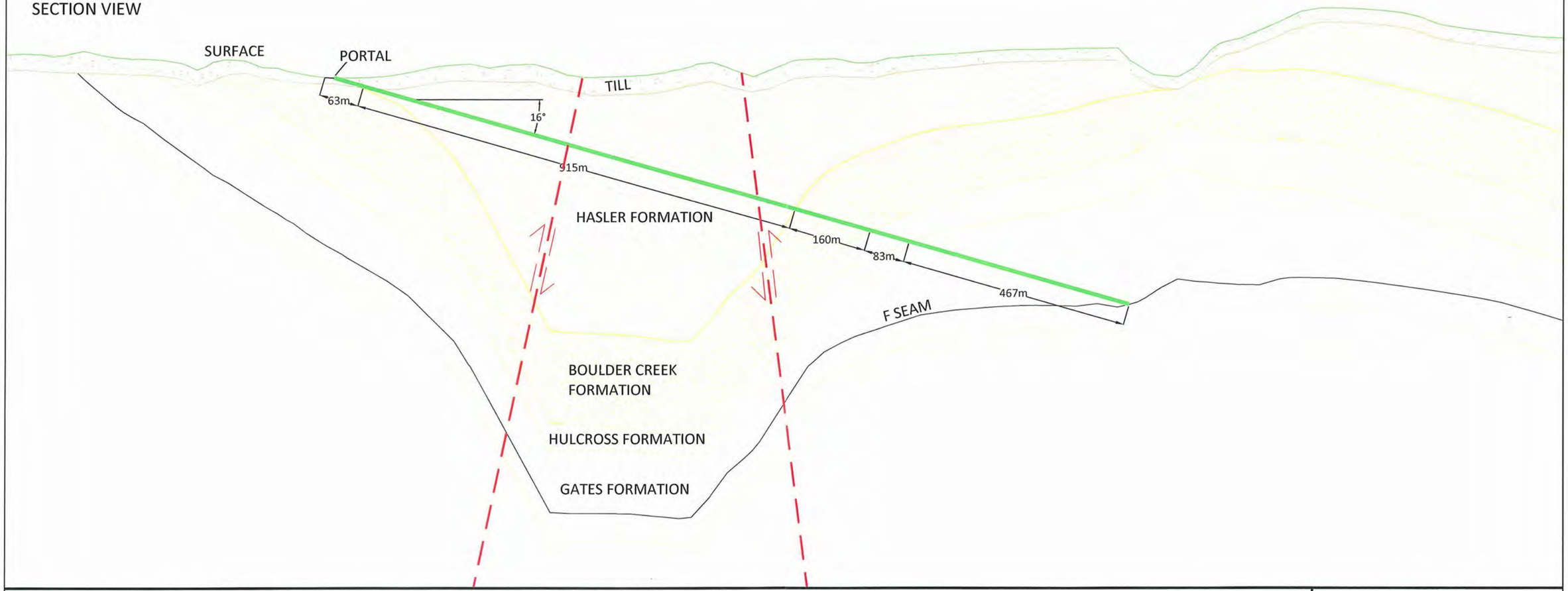
APPENDIX K

UNDERGROUND MINE WORKINGS DESIGN DRAWINGS
(as provided by NORWEST Corporation)

PLAN VIEW



SECTION VIEW



LEGEND

- SURFACE
- BELT DECLINE
- FAULT LINE
- F SEAM
- 50 DEPTH OF COVER CONTOUR LINE

TILL	63m LENGTH	
HASLER FORMATION	915m LENGTH	
BOULDER CREEK FORMATION	160m LENGTH	1,688m
HULCROSS FORMATION	83m LENGTH	
GATES FORMATION	467m LENGTH	

DIP DIRECTION — STRIKE OF BEDS

0 100 200 300 400

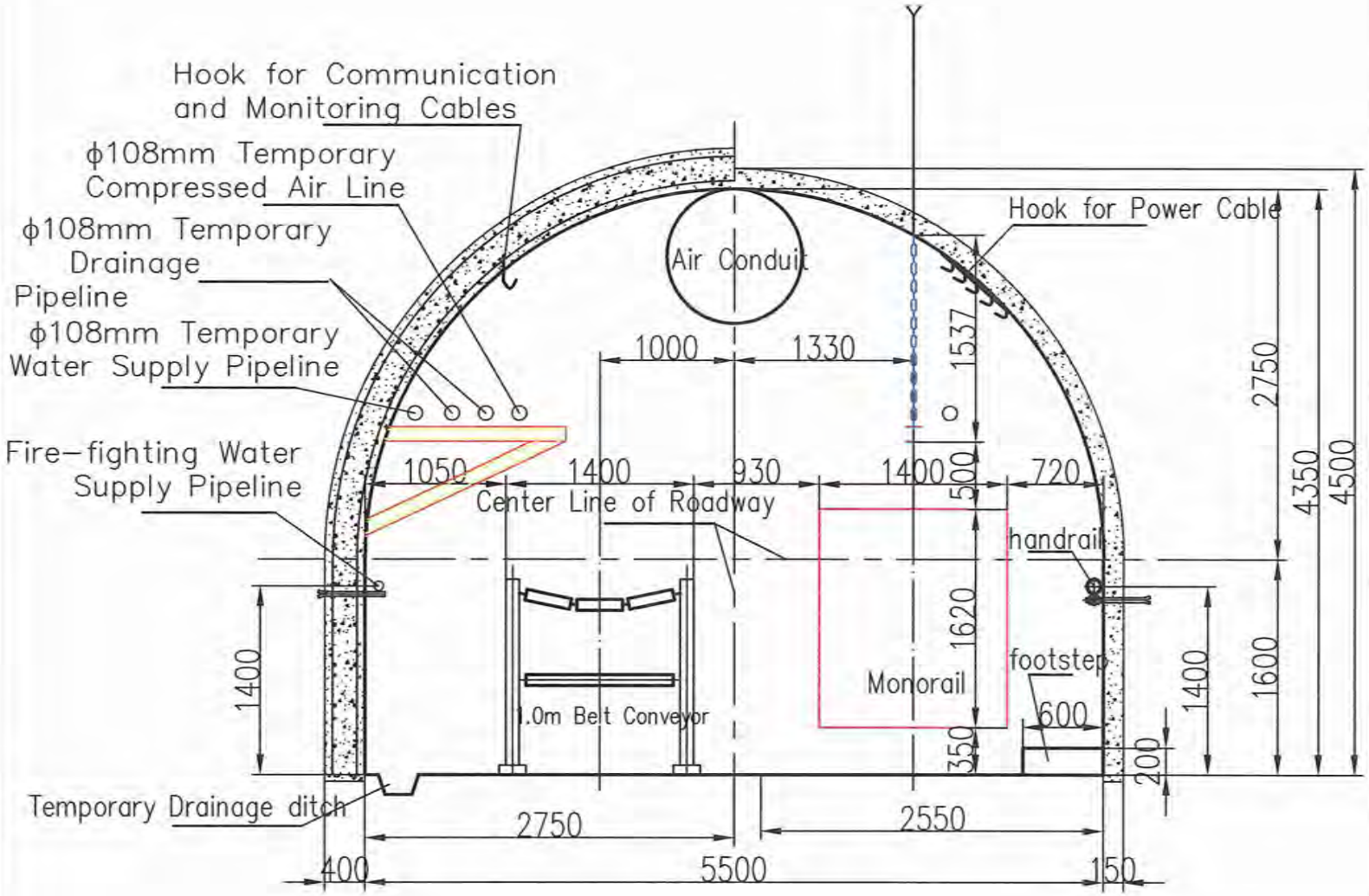
METERS

FIGURE 4.1

BELT DECLINE
CROSS SECTION

DATE: 06/22/2011
FILE: 4827belt-declin
SCALE: 1:200

NORWEST CORPORATION



LEGEND

Note: Drawing from Shenyang Design Institute
Not for Construction

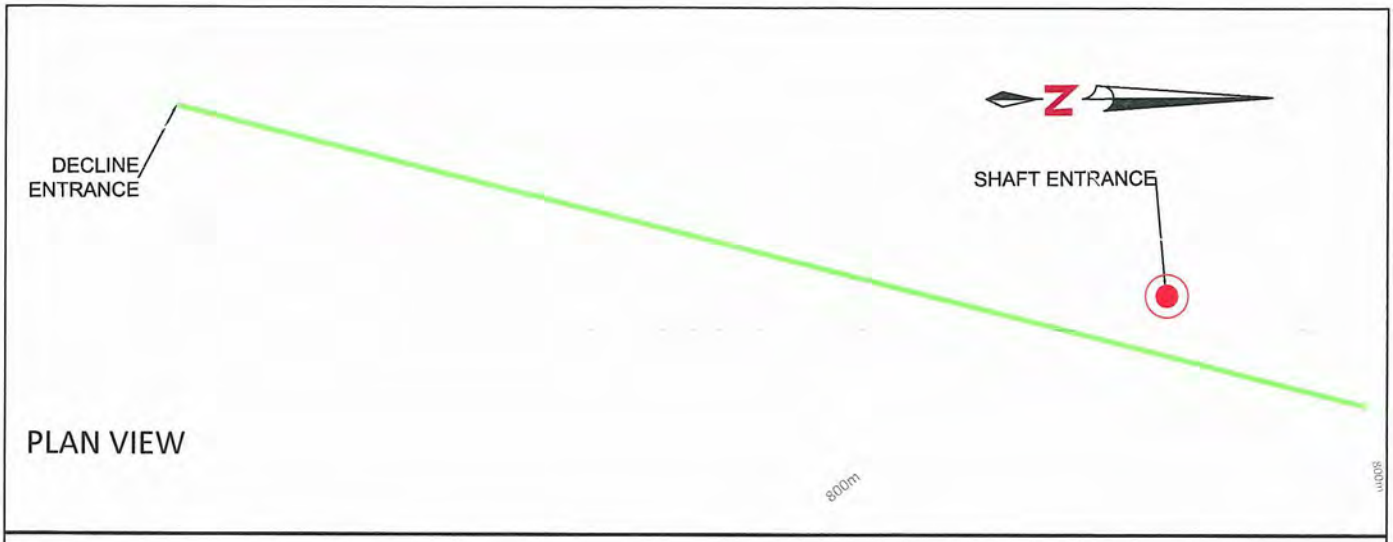
SCALE: 1:1200

FIGURE 4.2

DECLINE TYPICAL PROFILE DURING CONSTRUCTION

DATE: 06/07/2011
FILE: 4627\PROFILE

NORWEST CORPORATION



PLAN VIEW

SECTION VIEW

LEGEND

TILL	7m LENGTH	
HASLER FORMATION	158m LENGTH	
BOULDER CREEK FORMATION	117m LENGTH	527m
HULCROSS FORMATION	73m LENGTH	
GATES FORMATION	172m LENGTH	

HORIZONTAL SCALE = VERTICAL SCALE

0 50 100 150 200

METERS

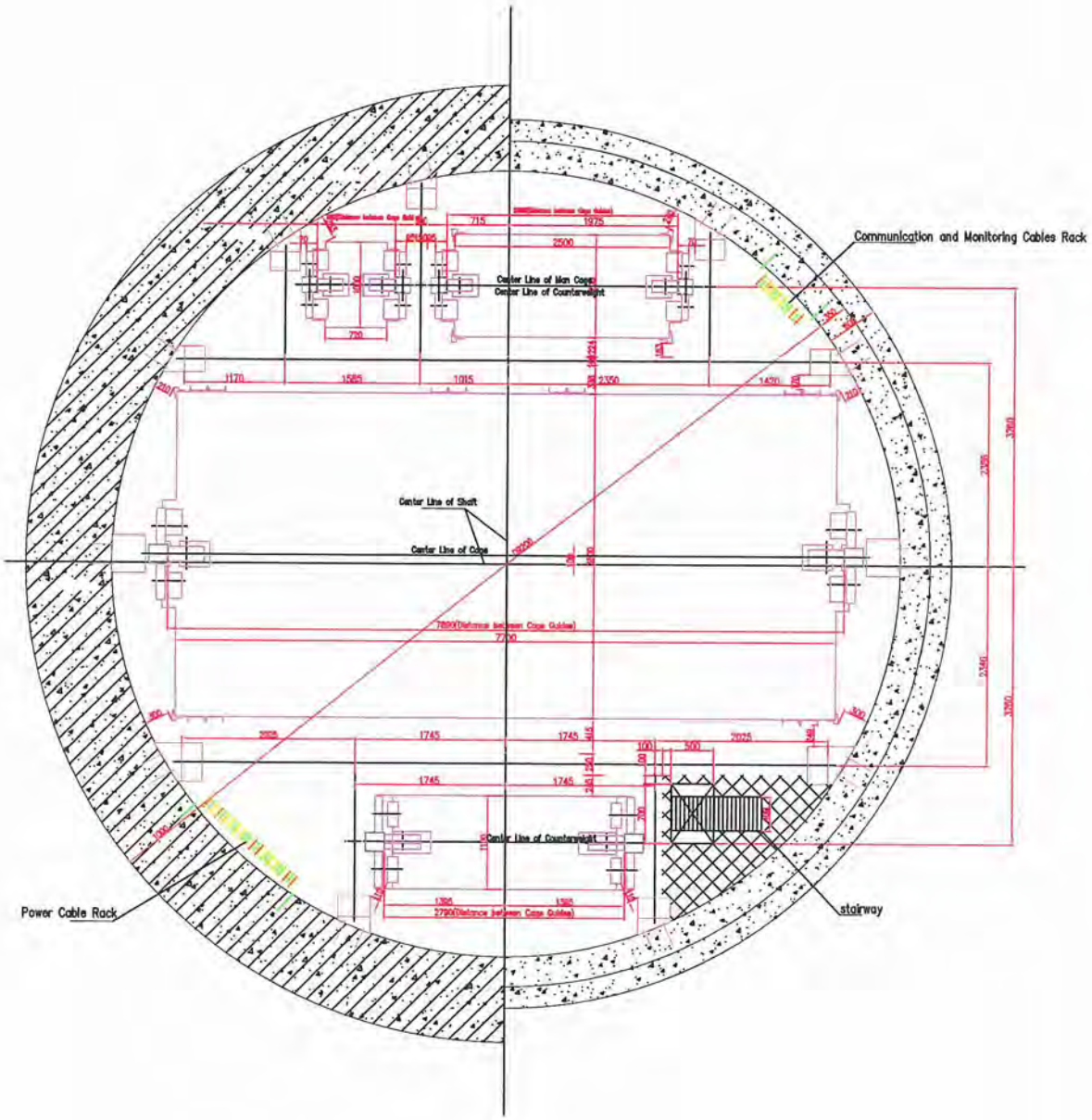
FIGURE 3.1

MEN & MATERIALS SHAFT CROSS SECTION

DATE: 04/27/2011 SCALE: 1: 150

FILE: 4827\BELTDECL

NORWEST CORPORATION



Permanent Shaft Installation

Note: Dimensions are mm

FIGURE 3.6

SHAFT
PERMANENT
INSTALLATION

DATE: 06/23/2011
FILE: 4827\9.2MSHAFT

SCALE: 1:2000

NORWEST CORPORATION

Table 5.1 ARMPS Input Variables

Variable	Value
Entry Height	3.5m
Depth of Cover	525m
Cross Cut Angle	90 Degrees
Entry Width	6m
Number of Entries	5
Crosscut Center Spacing	52m
Entry center spacing	45m

The basic configuration selected for bulk sample mine plan is five entries. Two of these entries are intake air and two are return air. One entry is used for the conveyor belt. The conveyor belt entry is isolated from the intake and return entries by stopping. The air in the conveyor belt entry is directed as return air.

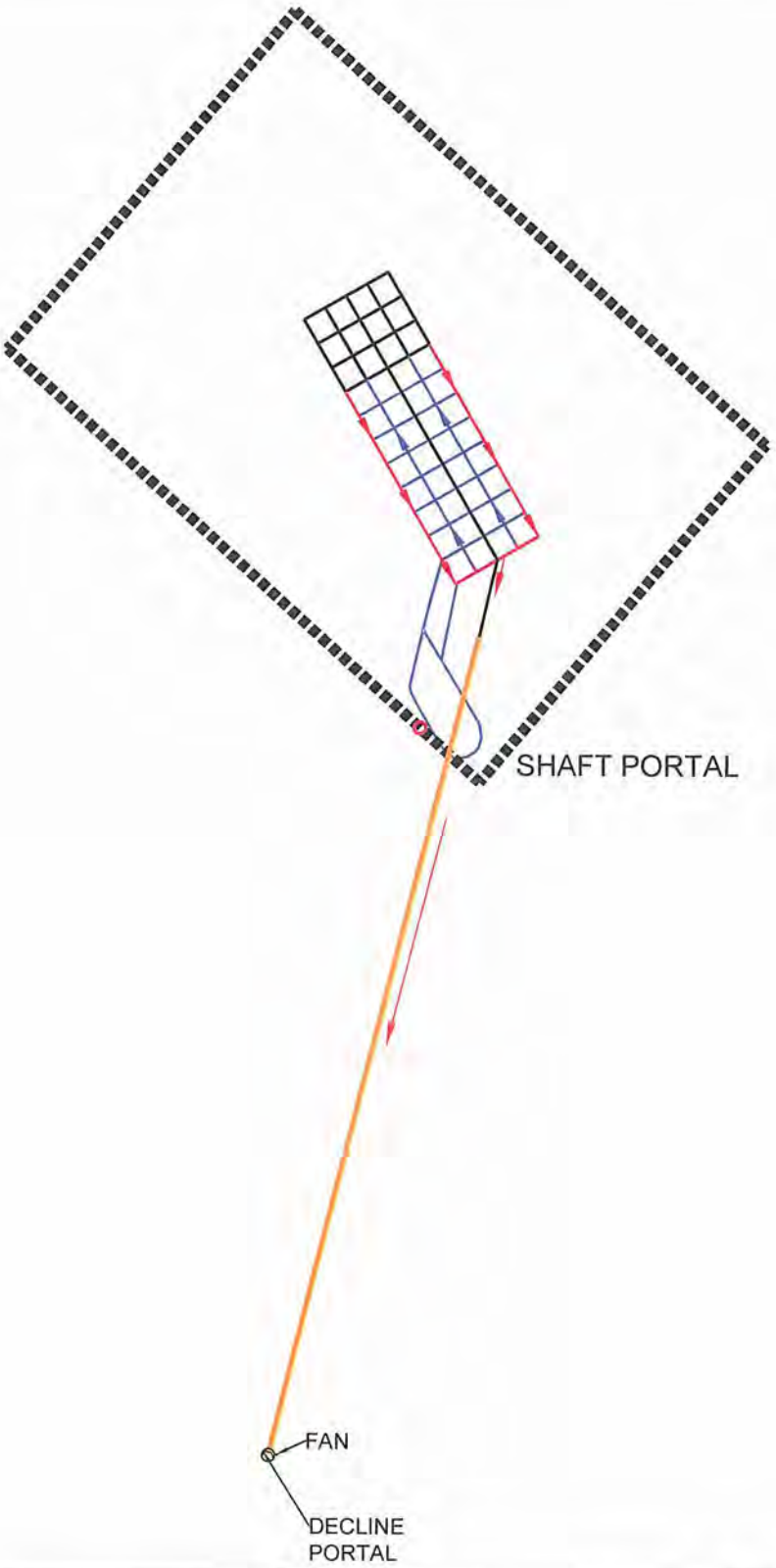
Effect of Limited Data

Given the limited number of samples, the absence of any coal strength testing, the lack of bedding plane properties (joint studies which identify major and minor joint orientation and frequency), the lack of actual ground control measurement data, and the absence of in-situ stress measurements, numerical modeling methods are not indicated at this time.

Based upon the current geologic information the maximum depth of overburden at the Murray River bulks sample projected mining area is 525m. For this ARPMS analysis the maximum overburden depth has been used.

Using the input variables listed in Table 5.1 results in a pillar stability factor of 2.5. It should be noted that this stability factor does not allow for any impacts of future mining along these entries or for multiple seam mining. Increased pillar stability factors may be realized by increasing the cross cut and entry centers.

Figure 5.7 shows the anticipated mining plan area and access from the shaft and decline and general ventilation. Five entries will be driven. Crosscuts are on 52m centers and entries are on 45m centers. This results in pillars that are about 46m long and 39m wide. Appendix A shows the ARMPS output.



LEGEND

- BELT DECLINE
- CONVEYOR BELT
- INTAKE
- RETURN

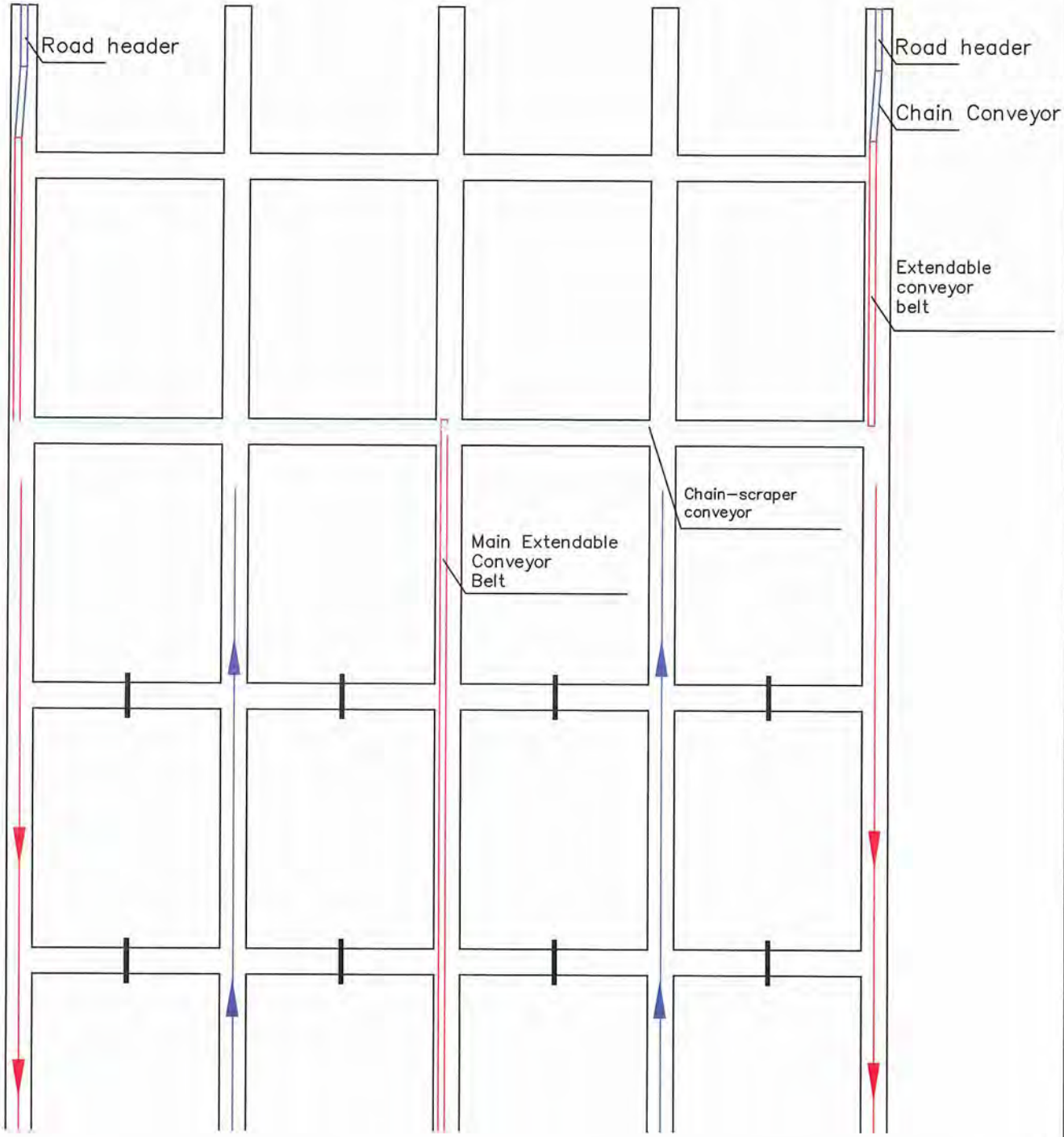
N

0 50 100 150 200
METER

FIGURE 5.7

BULK SAMPLE MINING
VENTILATION
DIAGRAM

DATE: 06/20/2011	SCALE: 1:340	NORWEST CORPORATION
FILE: 4827FIG 5.7		



LEGEND

- Extendable Conveyor Belt
- Chain Conveyor
- Intake air
- Return Air
- Stopping

Note: Face Ventilation devices not shown

FIGURE 5.8

MINE GENERAL VENTILATION DIAGRAM

DATE: 06/17/2011 | SCALE: NTS | NORWEST CORPORATION

FILE:4827\CONVEYOR

APPENDIX L

GENERAL LIMITATIONS

Limitations

1. The work performed in this report was carried out in accordance with the Standard Terms and Conditions made part of our contract. The conclusions presented herein are based solely upon the scope of services and time and budgetary limitations described in our contract.

2. The report has been prepared in accordance with generally accepted engineering practices. No other warranties, either expressed or implied, are made as to the professional services provided under the terms of our contract and included in this report.

3. The services performed and outlined in this report were based upon interpretation of data collected from seven test zones at two boreholes. Interpretations made from data collected at these locations are for these locations. Our opinion cannot be extended to portions of the site not investigated.

4. The objective of this report was to assess hydrogeological conditions at the location indicated, within the context of our contract and generally accepted engineering principles.

5. Our observations relating to the subsurface conditions at the site are described in this report. It should be noted that subsurface conditions other than those described in this report could be present.

6. The conclusions of this report are based in part on the information provided by others. The possibility remains that unexpected subsurface conditions may be encountered at the site in locations not specifically investigated. Should such an event occur, AMEC Environment & Infrastructure must be notified in order that we may determine if modifications to our conclusions are necessary.

Appendix B

Borehole Logs and Monitoring Well Diagrams

ERM

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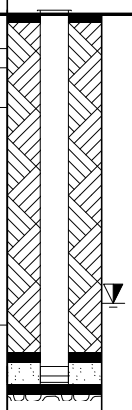
Borehole # MW-H13

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 3/5/11 **COMPLETED** 3/7/11
CASING (TOC) ELEVATION 821.58 m **HOLE SIZE** 0.076 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE Diameter 0.025 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (NQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY Dehua **UTM** 10U, N 6098569 m & E 626086 m
AT TIME OF DRILLING ---
NOTES No protective casing.
AFTER DRILLING 53.908 m 8/22/2012 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0–60					POORLY GRADED SAND, brown, rounded, medium grained, dry, loose, homogeneous, [Glacial Till]
					WELL GRADED SAND WITH GRAVEL, pale brown, subrounded, medium to coarse grained, dry, dense, stratified
					POORLY GRADED SAND, brown, rounded, medium grained, dry, dense, homogeneous
					WELL GRADED SAND WITH GRAVEL, dark brown, subrounded, medium to coarse grained, moist, very dense, stratified
60–185			II		MUSTONE, slightly weathered, massive, dark grey, fine, hard, [Hasler Formation]
185–250			I		MUDSTONE WITH SANDSTONE, unweathered, interbedded, light grey, fine, very hard, [Boulder Creek]



Bottom of hole at 250.00 m.

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Borehole # MW-H15

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 4/18/11 **COMPLETED** 4/18/11
CASING (TOC) ELEVATION 854.397 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Air Rotary
GROUNDWATER LEVELS:
LOGGED BY R. Hughes **UTM** 10U, N 6098376 m & E 625334 m
AT TIME OF DRILLING ---
NOTES
AFTER DRILLING 53.994 m 8/23/2012 measured from surface

Depth (m)	Material Description	Weathering Grade
0	SILTY SAND WITH GRAVEL, light brown, well graded, subrounded, fine to coarse grained, dry, dense, stratified, [Glacial Till]	
10	MUDSTONE, massive, dark grey, fine, medium hard, [Hasler Formation]	II
50	SANDSTONE WITH MUDSTONE, interbedded, light grey, fine, dense, [Boulder Creek]	I
95	SANDSTONE WITH MUDSTONE, interbedded, fossiliferous, light grey, fine, dense	

Bottom of hole at 104.22 m.

WELL DIAGRAM

1.22 m Stickup
Concrete 0 - 0.3 m
0.3 - 87 m Grout
Bentonite 87-89 m
Filter Sand 89-100 m
Screen 94-100 m
Bentonite Plug 100-102 m
Sand Backfill 102-104.2 m

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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Borehole # MW-H16

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 6/22/11 **COMPLETED** 6/23/11
CASING (TOC) ELEVATION 839.467 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Air Rotary
GROUNDWATER LEVELS:
LOGGED BY R. Hughes **UTM** 10U, N 6097821 m & E 624891 m
AT TIME OF DRILLING ---
NOTES Damaged well casing at 50 mbgs. Water level measurements only.
AFTER DRILLING 60.71 m 8/21/2012 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					SILTY SAND WITH GRAVEL, light brown, well graded, subrounded, fine to coarse grained, dry, dense, stratified, [Glacial Till]
10			III		MUDSTONE, moderately weathered, massive, dark grey, fine, hard, [Hasler Formation]
45			I		MUDSTONE WITH SANDSTONE, unweathered, interbedded, light brown, fine, hard, [Boulder Creek]
70					Bottom of hole at 70.60 m.

WELL DIAGRAM

Stickup 0.87 m

Grout 0-65 m

Bentonite
65-66.8 m
Filter Sand
66.8-70.6 m
Screen
67.5-70.5 m

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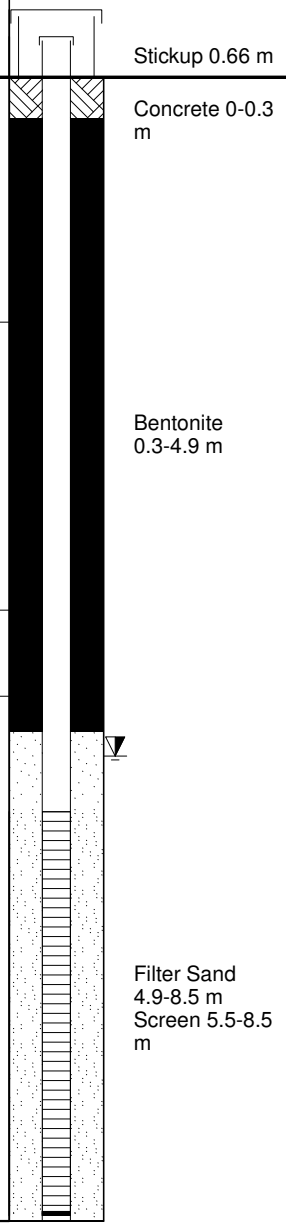
Borehole # MW-H17

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 5/3/12 **COMPLETED** 5/4/12
CASING (TOC) ELEVATION 829.96 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Geotech Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Auger/Air Rotary
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6097925 m & E 625520 m
AT TIME OF DRILLING ---
NOTES
AFTER DRILLING 5.046 m 7/23/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
					SILTY SAND WITH GRAVEL, light brown, well graded, subrounded, fine to coarse grained, dry, loose, stratified, [Glacial Till]
2					SILTY SAND WITH GRAVEL, COBBLES, light brown, well graded, subrounded, fine to coarse grained, moist, medium dense, stratified
4					SILTY SAND, light brown, poorly graded, rounded, fine grained, wet, medium dense, homogeneous
			III		MUDSTONE, moderately weathered, massive, dark grey, fine, medium hard, [Hasler Formation]
6					
8					

Bottom of hole at 8.50 m.

WELL DIAGRAM



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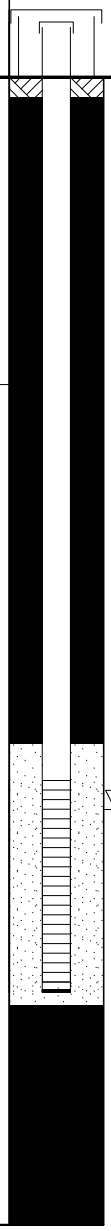
Borehole # MW-H18

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 5/2/12 **COMPLETED** 5/3/12
CASING (TOC) ELEVATION 831.697 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Geotech Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Auger/Air Rotary
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6097953 m & E 625740 m
AT TIME OF DRILLING ---
NOTES
AFTER DRILLING 10.887 m 7/23/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
					SILTY SAND WITH GRAVEL, COBBLES, light brown, well graded, rounded, medium to coarse grained, dry, dense, stratified, [Glacial Till]
5			III		MUDSTONE, moderately weathered, massive, dark grey, fine, medium hard, [Hasler Formation]
10			II		
15			I		

Bottom of hole at 17.06 m.

WELL DIAGRAM



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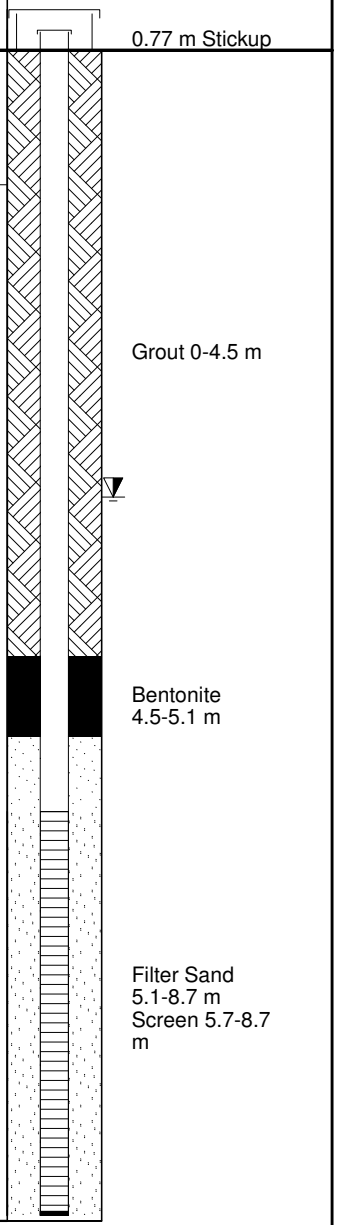
Borehole # MW-H19

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 5/1/12 **COMPLETED** 5/2/12
CASING (TOC) ELEVATION 833.344 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Geotech Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Auger/Air Rotary
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6098131 m & E 625663 m
AT TIME OF DRILLING ---
NOTES Slow groundwater recharge.
AFTER DRILLING 3.32 m 7/23/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
					SILTY SAND WITH GRAVEL, light brown, well graded, rounded, fine to coarse grained, dry, medium dense, stratified, [Glacial Till]
			II		MUDSTONE, highly weathered, massive, dark grey, fine, medium hard, [Hasler Formation]
2					
4			I		
6					
8			I		

Bottom of hole at 8.70 m.

WELL DIAGRAM



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Borehole # MW-H20

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 5/19/11 **COMPLETED** 5/23/11
CASING (TOC) ELEVATION 954.2 m **HOLE SIZE** 0.1
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (HQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Hughes **UTM** 10U, N 6099766 m & E 624397 m
AT TIME OF DRILLING ---
NOTES
AFTER DRILLING 25.945 m 8/22/2012 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					SILT, ORGANICS, brown, poorly graded, fine grained, dry, soft, homogeneous, low plasticity
5					GRAVELLY SILT, brown, well graded, subangular, fine to coarse grained, dry, firm, blocky, non plastic
10			III		GRAVELLY CLAY WITH SAND, brown, well graded, subangular, fine to coarse grained, moist, hard, blocky, medium plasticity
15					SILTSTONE, moderately weathered, dark grey, fine, medium hard, dry, [Hasler Formation]
20			II		MUDSTONE WITH SILTSTONE, slightly weathered, interbedded, light grey, fine, hard, dry
25					
30					
35					
40			I		SANDSTONE, unweathered, dark brown, medium, hard, wet, [Boulder Creek] Major water-bearing zone at 40 m
45					
50					
55			I		MUDSTONE WITH SILTSTONE, unweathered, interbedded, light grey, fine, very hard, dry
60					
65					
70					
75					
80					
85					
90					
95					
100					

WELL DIAGRAM

Stickup 0.80 m
Concrete
Grout 0.3-36 m
Bentonite 36-37.2 m
Filter Sand 37.2-41 m
Screen 37.8-40.8 m
Bentonite Plug 41-42.5 m
Sand Backfill 42.5-101 m

Bottom of hole at 101.00 m.

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Borehole # MW-H21

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 3/1/11 **COMPLETED** 3/1/11
CASING (TOC) ELEVATION 917 m **HOLE SIZE** 0.076 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE Diameter 0.025 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (NQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY Dehua **UTM** 10U, N 6100259 m & E 625390 m
AT TIME OF DRILLING ---
NOTES No well cover; casing is flush with the surface.
AFTER DRILLING 26.02 m 8/22/2012 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					GRAVELLY CLAY WITH SAND, brown, well graded, fine to coarse grained, moist, hard, blocky
40			II		MUDSTONE AND SILTSTONE, slightly weathered, massive, light grey, fine, dry, [Hasler Formation]

WELL DIAGRAM

Concrete

Grout 0.3-49 m

Bentonite
49-50.1 m

Filter Sand
50.1-54 m

Screen
50.7-53.7 m

Bentonite Plug
53.7-56 m

Sand Backfill
56-121m

Bottom of hole at 121.00 m.

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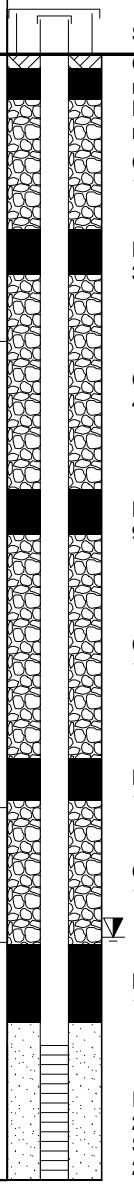
Borehole # MW-H22

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 5/5/12 **COMPLETED** 5/5/12
CASING (TOC) ELEVATION 784.422 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Geotech Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Air Rotary
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6096815 m & E 624960 m
AT TIME OF DRILLING ---
NOTES Turbid water column.
AFTER DRILLING 19.69 m 8/21/2012 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					SILTY SAND WITH GRAVEL, light brown, well graded, rounded, fine to coarse grained, dry, dense, stratified, [Glacial Till]
5					POORLY GRADED SAND, light brown, medium grained, dry, medium dense, homogeneous, [Alluvium]
10					
15					SANDY SILT, light brown, well graded, fine to medium grained, moist, dense, stratified
20					SANDY SILT, light brown, well graded, fine to medium grained, wet, dense, stratified
25					

Bottom of hole at 25.10 m.

WELL DIAGRAM



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Borehole # MW-H23

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 5/5/12 **COMPLETED** 5/9/12
CASING (TOC) ELEVATION 785.698 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Geotech Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Air Rotary
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6096618 m & E 624942 m
AT TIME OF DRILLING ---
NOTES
AFTER DRILLING 21.561 m 8/21/2012 measured from surface

Depth (m)	Material Description	WELL DIAGRAM
		Stickup 0.8 m
	SILTY SAND WITH GRAVEL, light brown, well graded, medium to coarse grained, dry, dense, stratified	Concrete 0-0.3 m Bentonite 0.3-1 m Cuttings Backfill 1-2.8 m
	GRAVELLY SILT WITH SAND, SOME COBBLES, light brown, well graded, medium to coarse grained, dry, very dense, stratified, [Glacial Till]	
	SILTY SAND WITH GRAVEL, light brown, well graded, medium to coarse grained, dry, dense, lensed	Bentonite 2.8-3.8 m
5	GRAVELLY SILT WITH SAND, light brown, well graded, medium to coarse grained, dry, dense, stratified	Cuttings Backfill 3.8-8.8 m
10	POORLY GRADED SAND, light brown, medium grained, dry, medium dense, homogeneous, [Alluvium]	Bentonite 8.8-9.8 m
	SILTY SAND, SOME GRAVEL, light brown, well graded, medium to coarse grained, moist, medium dense, stratified	Cuttings Backfill 9.8-14.8 m
15	SILT WITH GRAVEL, light brown, well graded, fine to coarse grained, moist, medium dense, stratified	Bentonite 14.8-15.8 m
	SANDY SILT, light brown, well graded, medium to coarse grained, moist, dense, stratified	
	GRAVELLY SILT AND SAND, light brown, well graded, coarse grained, moist, dense, lensed	Cuttings Backfill 15.8-19.8 m
20	POORLY GRADED SAND, light brown, medium grained, wet, dense, homogeneous	Bentonite 19.8-21.6 m
		Filter Sand 21.6-25.1 m Screen 22.1-25.1 m
25		

Bottom of hole at 25.10 m.

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Borehole # MW-H24A

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 10/13/12 **COMPLETED** 10/20/12
CASING (TOC) ELEVATION 832 m **HOLE SIZE** 0.076 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (NQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6099756 m & E 628116 m
AT TIME OF DRILLING ---
NOTES Very slow groundwater recharge. High pH level.
AFTER DRILLING 15.44 m 7/30/2013 measured from surface

Depth (m)	Material Description	Weathering Grade
0	SAND WITH SILT AND GRAVEL, ORGANICS, brown, well graded, subrounded, fine to coarse grained, moist, dense, stratified, [Glacial Till]	
5	SILTSTONE, slightly weathered, massive, dark grey, fine, medium hard, [Hasler Formation] Layer RQD = 80%	II
20	SILTSTONE AND MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, hard, Layer RQD = 65%	I
25	SILTSTONE AND MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, very hard, Layer RQD = 85%	I
45		I
50	SILTSTONE AND SANDSTONE, unweathered, interbedded, dark grey, medium, very hard, Layer RQD = 90%	

Bottom of hole at 67.10 m.

WELL DIAGRAM

Stickup 0.80 m

Cement Grout
0-42.7 m

Bentonite
Pellets
43.7-44.9 m

Filter Sand
44.2-48.5 m

Screen
44.9-47.9 m

Bentonite Plug
47.9-49

Grout 49-67.1 m

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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Borehole # MW-H24B

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 10/20/12 **COMPLETED** 10/20/12
CASING (TOC) ELEVATION 832 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Air Rotary
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6099756 m & E 628119 m
AT TIME OF DRILLING ---
NOTES
AFTER DRILLING 3.96 m 7/30/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
					SAND WITH SILT AND GRAVEL, ORGANICS, brown, subrounded, fine to coarse grained, moist, dense, stratified, [Glacial Till]
			II		SILTSTONE, slightly weathered, massive, light grey, fine, hard, [Hasler Formation] Layer RQD = 80%
5					

WELL DIAGRAM

Bottom of hole at 8.60 m.

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Borehole # MW-H24C

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 7/20/13 **COMPLETED** 7/20/13
CASING (TOC) ELEVATION 825 m **HOLE SIZE** 0.096 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (HQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6099625 m & E 627954 m
AT TIME OF DRILLING ---
NOTES
AFTER DRILLING 1.595 m 7/30/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
					GRAVELLY ORGANIC SOIL, dark brown, well graded, angular, fine to coarse grained, dry, loose
					SILT, light brown, poorly graded, fine grained, moist, loose, homogeneous
5					CLAYEY SILT, pale grey, fine grained, moist, firm
10			III		MUDSTONE, moderately weathered, massive, dark gray, very fine, medium hard, wide fracture spacing, Layer RQD = 65%

Bottom of hole at 13.72 m.

WELL DIAGRAM

Stickup 0.92 m
Concrete 0-0.3 m
Bentonite Pellets 0.3-8.8 m
Filter Sand 8.8-13.7 m
Screen 9.2-12.3 m

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Borehole # MW-H25A

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 10/22/12 **COMPLETED** 10/31/12
CASING (TOC) ELEVATION 766 m **HOLE SIZE** 0.076 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (NQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6099615 m & E 627334 m
AT TIME OF DRILLING ---
NOTES Turbid water column.
AFTER DRILLING 2.074 m 7/30/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					GRAVELLY ORGANIC SOIL, light brown, well graded, angular, fine to coarse grained, dry, dense, stratified, [Road Base]
5					HOG FUEL, orange, moist, loose
					SILT, dark brown, poorly graded, moist, firm, homogeneous
10					CLAYEY GRAVEL AND SAND, pale grey, well graded, subrounded, fine to coarse grained, moist, medium dense, stratified
					SILTY CLAY, grey, moist, stiff, homogeneous, [Glaciolacustrine Deposit]
60			II		MUDSTONE WITH SANDSTONE, slightly weathered, interbedded, dark grey, very fine, [Hasler Formation] Layer RQD = 60%
65			I		MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, very fine, Layer RQD = 75%

WELL DIAGRAM

Stickup 0.70 m

Cement Grout 0-56.8 m

Bentonite Pellets 56.8-58.2 m

Filter Sand 58.2-62 m

Screen 58.9-62 m

Bentonite Plug 62-64 m

Grout 64-80 m

Bottom of hole at 80.00 m.

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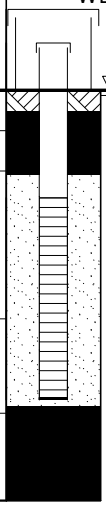
Borehole # MW-H25B

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 10/22/12 **COMPLETED** 10/22/12
CASING (TOC) ELEVATION 766 m **HOLE SIZE** 0.105 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Solid Stem Auger
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6099615 m & E 627332 m
AT TIME OF DRILLING ---
NOTES
AFTER DRILLING 0.076 m 7/30/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
					GRAVELLY ORGANIC SOIL, light brown, well graded, angular, fine to coarse grained, dry, medium dense, stratified, [Road Base]
					HOG FUEL, orange, moist
					SILT, dark brown, poorly graded, moist, firm, homogeneous
					CLAYEY GRAVEL AND SAND, pale grey, well graded, subrounded, fine to coarse grained, moist, dense, stratified
5					SILTY CLAY, grey, moist, stiff, homogeneous, [Glaciolacustrine Deposit]

Bottom of hole at 6.10 m.



WELL DIAGRAM

Stickup 0.70 m
Concrete 0-0.3 m
Bentonite Chips 0.3-1.3 m
Filter Sand 1.3-4.7 m
Screen 1.6-4.6 m
Bentonite 4.7-6.1 m

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Borehole # MW-H26A

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 10/23/12 **COMPLETED** 10/28/12
CASING (TOC) ELEVATION 792 m **HOLE SIZE** 0.076 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (NQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6098990 m & E 627478 m
AT TIME OF DRILLING ---
NOTES Turbid water column.
AFTER DRILLING 0.395 m 7/30/2013 measured from sufrace

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					GRAVELLY ORGANIC SOIL, light brown, well graded, angular, fine to coarse grained, dry, dense, [Road Base]
5					SILTY SAND WITH GRAVEL, brown, well graded, subrounded, fine to coarse grained, dry, dense, stratified
					SANDY SILT WITH GRAVEL, brown, well graded, subrounded, fine to coarse grained, moist, dense, stratified
10					SILTY CLAY, grey, moist, stiff, homogeneous, [Glaciolacustrine Deposit]
15					
20					
25					
30			I		MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, hard, [Hasler Formation] Layer RQD = 90%
35					
40					
45					
50					
55					
60					

WELL DIAGRAM

Stickup 0.78 m

Cement Grout
0-28.4 m

Bentonite
Pellets
28.4-29.2 m
Filter Sand
29.2-33.0 m
Screen
29.8-32.9 m
Bentonite Plug
35-36 m
Sand 36-39.6 m

Grout 39.6-64.3
m

Bottom of hole at 64.30 m.

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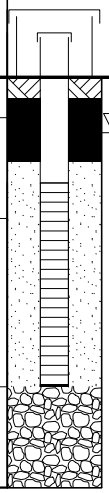
Borehole # MW-H26B

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 10/27/12 **COMPLETED** 10/28/12
CASING (TOC) ELEVATION 792 m **HOLE SIZE** 0.105 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Solid Stem Auger
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6098987 m & E 627485 m
AT TIME OF DRILLING ---
NOTES
AFTER DRILLING 0.826 m 7/30/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
					GRAVELLY ORGANIC SOIL, light brown, well graded, angular, fine to coarse grained, dry, dense, [Road base]
					SILTY SAND WITH GRAVEL, brown, well graded, fine to coarse grained, dry, medium dense, stratified
					SILT WITH GRAVEL, brown, well graded, fine to coarse grained, moist, firm, blocky
5					SILTY CLAY, grey, fine grained, moist, stiff, homogeneous, [Glaciolacustrine Deposit]

Bottom of hole at 6.10 m.

WELL DIAGRAM



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Borehole # MW-H27

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 7/22/13 **COMPLETED** 7/23/13
CASING (TOC) ELEVATION 810 m **HOLE SIZE** 0.096 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (HQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6098578 m & E 627607 m
AT TIME OF DRILLING ---
NOTES Turbid water column.
AFTER DRILLING 9.895 m 7/31/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					ORGANIC SOIL, dark brown, fine to coarse grained, dry
					SILT, light yellow, medium grained, moist, loose, homogeneous
					SILTY CLAY, dark grey, fine to medium grained, moist, firm
5					
					SITLY CLAY, SANDY, dark grey, fine to coarse grained, moist, stiff, uniformly bedded fine sand lenses
					SITLY CLAY, dark grey, fine grained, moist, very stiff
10					
15					
20					
25					
30			I		MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, very fine to fine, medium hard, medium fracture spacing, [Hasler Formation] Layer RQD = 65% fracture zone
35					

WELL DIAGRAM

Stickup 0.47 m
Concrete 0-0.3 m
Bentonite Grout
Bentonite Pellets 33.1-34 m
Filter Sand 34-37.63 m
Screen 34.6-37.6 m

Bottom of hole at 39.20 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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Borehole # MW-H28

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 7/24/13 **COMPLETED** 7/27/13
CASING (TOC) ELEVATION 819 m **HOLE SIZE** 0.096 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (HQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6098772 m & E 627715 m
AT TIME OF DRILLING ---
NOTES Turbid water column and slow well recovery.
AFTER DRILLING 4.878 m 7/31/2013 measured from sufrace

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					ORGANIC SOIL, light brown, fine to coarse grained, dry, loose
3					SILTY SAND, light yellow, well graded, fine to medium grained, moist, dense
5			II		SILTY CLAY, dark grey, fine grained, moist, very stiff
15			I		MUDSTONE WITH SANDSTONE, slightly weathered, interbedded, dark grey, fine, medium hard, medium fracture spacing, 15° bedding angle, [Hasler Formation] Layer RQD = 70% fractured with clay infil
20					MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, very hard, Layer RQD = 100% competent zone
45					Close fracture spacing, Layer RQD = 20% fracture zone with clay infill
46					Layer RQD = 100% competent zone
50					Wide fracture spacing, Layer RQD = 100% long vertical fractures with some clay infill
51					Layer RQD = 100% competent zone
60			I		SILTSTONE WITH SANDSTONE, unweathered, interbedded, light grey, fine to medium, very hard, 15° bedding angle, Layer RQD = 100% competent zone
80					MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, very hard, 15° bedding angle, [Hasler Formation] Layer RQD = 100% competent zone
93.27					Bottom of hole at 93.27 m.

WELL DIAGRAM

Stickup 0.7 m
Concrete 0-0.3 m
Bentonite Grout 0-28.4 m
Bentonite Pellets28.4-29.2 m
Filter Sand 13.4-17.1 m
Screen 13.9-17 m
Bentonite Plug 18.2-20 m
Van Ruth Plug 20 m
Open Hole 20.1-93.3 m

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Borehole # MW-H29

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 7/27/13 **COMPLETED** 8/1/13
CASING (TOC) ELEVATION 826 m **HOLE SIZE** 0.096 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (HQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6099198 m & E 627938 m
AT TIME OF DRILLING ---
NOTES Turbid water column.
AFTER DRILLING 4.878 m 7/31/2013 measured from sufrace

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					ORGANIC SOIL, light brown, fine to coarse grained, dry, loose
5			III		POORLY GRADED SAND, light yellow, coarse grained, moist, dense
					SILTY SAND, GRAVELLY, dark yellow, coarse grained, moist, dense
10			II		MUDSTONE WITH SANDSTONE, moderately weathered, interbedded, dark grey, fine, medium hard, very close fracture spacing, 15° bedding angle, [Hasler Formation] Layer RQD = 20% fracture zone with clay infil
15					MUDSTONE WITH SANDSTONE, slightly weathered, interbedded, dark grey, fine, very hard, close fracture spacing, Layer RQD = 30% fractured with clay infil
20					Close fracture spacing, Layer RQD = 90% competent zone
			I		SILTSTONE WITH SANDSTONE, unweathered, interbedded, light grey, medium, very hard, wide fracture spacing, 15° bedding angle, Layer RQD = 85% some fractures
25					MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, very hard, wide fracture spacing, Layer RQD = 95% competent zone
30					Layer RQD = 100% competent zone
35					
40					
45					
50			I		MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, fine, very hard, [Hasler Formation] Layer RQD = 100% competent zone to bottom of hole
55					
60					
65					
70					
75					
80					
85					
90					
95					

WELL DIAGRAM

Stickup 0.7 m
Concrete 0-0.3 m
Bentonite Pellets 0.3-7.7 m
Filter Sand 7.7-11.6 m
Screen 8.3-11.3 m
Bentonite Plug 11.6-13.1 m
Van Ruth Plug 13.1 m
Open Hole 13.2-98.5 m

Bottom of hole at 98.45 m.

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Borehole # MW-H2A

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 5/13/11 **COMPLETED** 5/14/11
CASING (TOC) ELEVATION 1104.341 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Air Rotary
GROUNDWATER LEVELS:
LOGGED BY J. Castaneda **UTM** 10U, N 6101837 m & E 620575 m
AT TIME OF DRILLING ---
NOTES
AFTER DRILLING 9.495 m 8/23/2012 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					GRAVELLY SILT WITH SAND, brown, well graded, subrounded, fine to coarse grained, moist, dense, stratified, [Glacial Till]
15			III		MUDSTONE AND SILTSTONE, moderately weathered, massive, dark grey, fine, hard, [Hasler Formation]
90					Bottom of hole at 90.80 m.

WELL DIAGRAM

Stickup 1.19 m

Grout 0-81

Bentonite 81-82.3 m

Filter Sand 82.3-88 m

Screen 83.4-88 m

Bentonite 88.1-89.3 m

Slough 89.3-90.8 m

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Borehole # MW-H2B

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 5/13/11 **COMPLETED** 5/13/11
CASING (TOC) ELEVATION 1103.37 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Air Rotary
GROUNDWATER LEVELS:
LOGGED BY J. Castaneda **UTM** 10U, N 6101831 m & E 620567 m
AT TIME OF DRILLING ---
NOTES
AFTER DRILLING 6.67 m 8/23/2012 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
					GRAVELLY SILT WITH SAND, brown, well graded, subrounded, fine to coarse grained, moist, dense, stratified, [Glacial Till]
5					
10					
15					

Bottom of hole at 15.20 m.

WELL DIAGRAM

Stickup 0.47 m

Grout 0-8.1 m

Bentonite 8.1-9.2 m

Filter Sand 9.2-13 m
Screen 9.9-12.9 m

Slough 12.9-15.2 m

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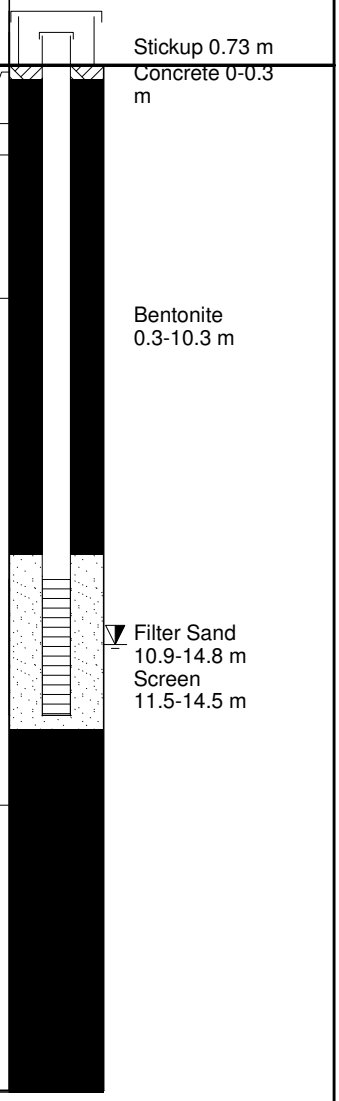
Borehole # MW-H30

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 7/21/13 **COMPLETED** 7/23/13
CASING (TOC) ELEVATION 793 m **HOLE SIZE** 0.096 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (HQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6098501 m & E 627372 m
AT TIME OF DRILLING ---
NOTES Very slow groundwater recharge. Water level measurements only.
AFTER DRILLING 12.914 m 7/31/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
					ORGANIC SOIL, dark brown, fine to coarse grained, dry
					POORLY GRADED SAND, light yellow, fine to medium grained, moist, loose, homogeneous
					POORLY GRADED SAND, dark yellow, medium to coarse grained, moist, dense
					SITLY CLAY, GRAVELLY, dark grey, fine to coarse grained, stiff
5					SITLY CLAY, dark grey, fine grained, very stiff
10					
15			I		MUDSTONE WITH SANDSTONE, unweathered, interbedded, dark grey, very fine to fine, medium hard, very wide fracture spacing, [Hasler Formation] Layer RQD = 100%
20					

WELL DIAGRAM



Bottom of hole at 22.86 m.

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Borehole # MW-H31

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 7/18/13 **COMPLETED** 7/19/13
CASING (TOC) ELEVATION 798 m **HOLE SIZE** 0.096 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (HQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6099893 m & E 627456 m
AT TIME OF DRILLING ---
NOTES Very slow groundwater recharge. Water level measurements only.
AFTER DRILLING 15.02 m 7/31/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
					ORGANIC SOIL, dark brown, fine to coarse grained, dry
					TILL, brown, medium to coarse grained, moist, dense
5					
					SILT, light grey, fine grained, moist, very stiff, homogeneous
					SILT WITH GRAVEL, light grey, fine to coarse grained, moist, hard
					SILT, light brown, fine grained, moist, very stiff, homogeneous
10					
			II		SANDSTONE, slightly weathered, dark yellow, medium to coarse, medium hard
					SITLY CLAY, dark brown, fine to medium grained, moist, very stiff
15					
					SITLY CLAY, GRAVELLY, brown, fine to coarse grained, dry, very dense
20					
					SITLY CLAY, dark brown, fine to medium grained, moist, very stiff
25					
					SITLY CLAY, dark brown, fine to medium grained, moist, very stiff, bedded fine sand lenses
30					

Bottom of hole at 32.31 m.

WELL DIAGRAM

Stickup 0.68 m
Concrete 0-0.3 m
Bentonite Grout 0.3-25.3 m
Bentonite Chips 25.3-26.8 m
Filter Sand 26.8-30.4 m
Screen 27.4-30.4 m

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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Borehole # MW-H32

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 7/17/13 **COMPLETED** 7/18/13
CASING (TOC) ELEVATION 840 m **HOLE SIZE** 0.096 m
DRILLING CONTRACTOR MudBay Drilling Co. Ltd.
CASING TYPE Diameter 0.032 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (HQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Martinka **UTM** 10U, N 6099810 m & E 628333 m
AT TIME OF DRILLING ---
NOTES Very slow groundwater recharge. Water level measurements only.
AFTER DRILLING 10.401 m 7/31/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					GRAVELLY ORGANIC SOIL, dark brown, well graded, fine to coarse grained, dry, dense
					TILL, light brown, well graded, medium to coarse grained, moist, very dense
10			II		SILTSTONE, slightly weathered, light grey, fine, medium hard, medium fracture spacing, Layer RQD = 65%
15			II		SILTSTONE WITH MUDSTONE, unweathered, interbedded, dark grey, fine to very fine, hard, very wide fracture spacing, 0° bedding angle, Layer RQD = 75% fracture zone 17.4-19.8 m
20			I		SILTSTONE WITH SANDSTONE, unweathered, interbedded, light grey, fine to medium, medium hard, medium fracture spacing, 0° bedding angle, Layer RQD = 100%
30					Bottom of hole at 30.48 m.

WELL DIAGRAM

Stickup 0.37 m
Concrete 0-0.3 m
Bentonite Grout 0.3-25.2
Bentonite Pellets 25.2-26.5 m
Filter Sand 26.5-30.1 m
Screen 27.1-30.1 m

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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Borehole # MW-H3A

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 5/15/11 **COMPLETED** 5/15/11
CASING (TOC) ELEVATION 1215.7 m **HOLE SIZE** 0.076 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE Diameter 0.025 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Diamond (NQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY J. Castaneda **UTM** 10U, N 6102191 m & E 621818 m
AT TIME OF DRILLING ---
NOTES Site no longer accessible.
AFTER DRILLING 26.25 m 7/7/2011 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					SILTY SAND WITH GRAVEL, light brown, well graded, rounded, fine to coarse grained, dry, dense, stratified, [Glacial Till]
30			II		SILTSTONE AND MUDSTONE WITH SANDSTONE, slightly weathered, interbedded, light brown, fine, hard, [Boulder Creek]

WELL DIAGRAM

Stickup 0.45 m

Grout 0-165 m

Bentonite 165-170 m

Filter Sand 170-193 m
Screen 183-193 m

Bentonite Seal 193-200m

Bottom of hole at 200.00 m.

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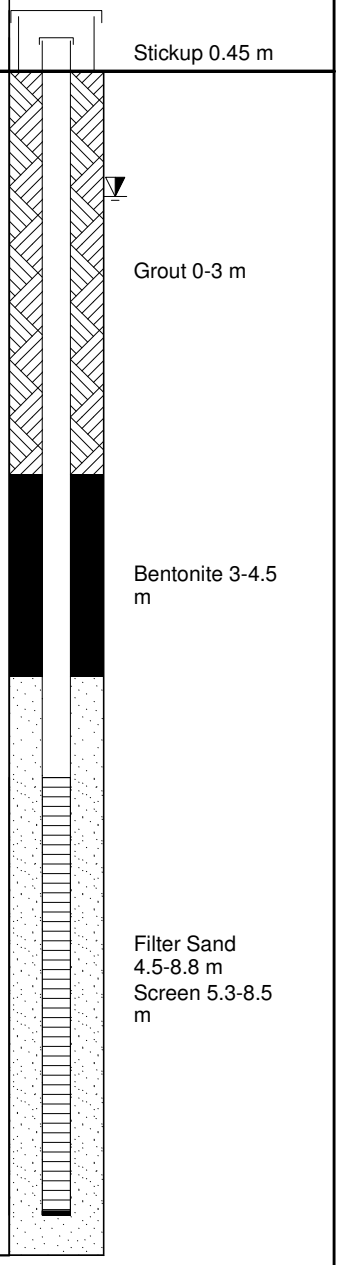
Borehole # MW-H3B

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 5/18/11 **COMPLETED** 5/18/11
CASING (TOC) ELEVATION 1215.7 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Air Rotary
GROUNDWATER LEVELS:
LOGGED BY J. Castaneda **UTM** 10U, N 6102191 m & E 621818 m
AT TIME OF DRILLING ---
NOTES Site no longer accessible.
AFTER DRILLING 0.93 m 7/7/2011 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					SILTY SAND WITH GRAVEL, light brown, well graded, rounded, fine to coarse grained, dry to moist, dense, stratified, [Glacial Till]
2					
4					
6					
8					

Bottom of hole at 8.80 m.



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Borehole # MW-H5

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 4/22/11 **COMPLETED** 4/22/11
CASING (TOC) ELEVATION 1102.5 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Air Rotary
GROUNDWATER LEVELS:
LOGGED BY R. Hughes **UTM** 10U, N 6100571 m & E 620658 m
AT TIME OF DRILLING ---
NOTES Flowing artesian well.
AFTER DRILLING -0.68 m 8/22/2012 Flowing

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					SILTY SAND WITH GRAVEL, light brown, well graded, subrounded, fine to coarse grained, dry, loose, stratified, [Glacial Till]
25					SILTY CLAY, dark grey, moist, stiff, homogeneous, [Glaciolacustrine Deposit]
30					WELL GRADED GRAVEL WITH SAND, brown to black, subangular, medium to coarse grained, dense, stratified

WELL DIAGRAM

Stickup 0.68 m

Grout 0-25.2 m

Bentonite
25.2-26.2 m

Filter Sand
26.15-30.5 m

Screen
27.5-30.5 m

Bottom of hole at 30.50 m.

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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Borehole # MW-PNB

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 4/30/11 **COMPLETED** 4/30/11
CASING (TOC) ELEVATION 778.853 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE Diameter 0.051 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Air Rotary
GROUNDWATER LEVELS:
LOGGED BY R. Hughes **UTM** 10U, N 6097114 m & E 625101 m
AT TIME OF DRILLING ---
NOTES
AFTER DRILLING 12.435 m 7/21/2013 measured from surface

Depth (m)	Material Description
0	SILTY SAND WITH GRAVEL, brown, well graded, rounded, fine to coarse grained, moist, loose, stratified, [Glacial Till]
5	SILT WITH GRAVEL, brown, well graded, subrounded, fine to coarse grained, moist, medium dense, stratified
10	SILTY SAND WITH GRAVEL, brown, well graded, rounded, fine to coarse grained, moist, dense, stratified
20	GRAVELLY SAND, brown, well graded, subrounded, medium to coarse grained, moist, medium dense, stratified
25	SILTY SAND WITH GRAVEL, dark brown, well graded, rounded, fine to coarse grained, wet, dense, stratified
45	Bottom of hole at 49.60 m.

WELL DIAGRAM

Stickup 1.14 m

Grout 0-43.1

Bentonite
43.1-44.9 m

Filter Sand
44.9-48.6 m

Screen
45.5-48.5 m

Bentonite Plug
48.6-49.6 m

ENVIRONMENTAL BH HD MINING ALL LOGS.GPJ GINT STD CANADA.GDT 8/22/13

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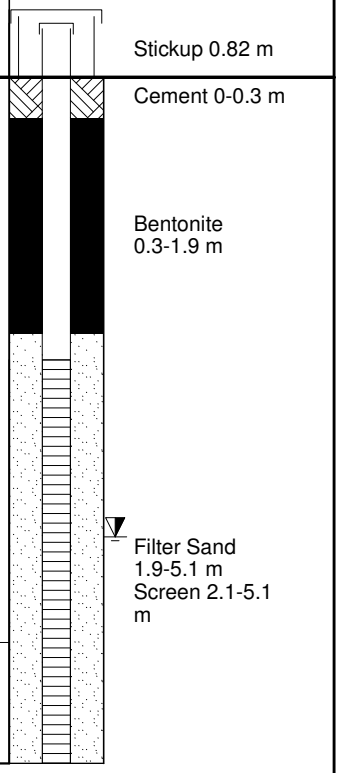
Borehole # MW-Shaft

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 7/9/11 **COMPLETED** 7/9/11
CASING (TOC) ELEVATION 846.032 m **HOLE SIZE** 0.11 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE Diameter 0.025 m Schedule 40 PVC. Slot size 10 screen.
DRILLING METHOD Air Rotary
GROUNDWATER LEVELS:
LOGGED BY R. Hughes **UTM** 10U, N 6098150 m & E 625176 m
AT TIME OF DRILLING ---
NOTES Damaged well casing. Water level measurements only.
AFTER DRILLING 3.415 m 7/23/2013 measured from surface

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					SILTY SAND WITH GRAVEL, brown, well graded, subrounded, fine to coarse grained, moist, loose, stratified, [Glacial Till]
4					SILT WITH GRAVEL, brown, well graded, rounded, fine to coarse grained, moist, medium dense, stratified

Bottom of hole at 5.10 m.

WELL DIAGRAM



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Borehole # VWP-H12

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 4/1/11 **COMPLETED** 4/1/11
CASING (TOC) ELEVATION 1120.8 m **HOLE SIZE** 0.076 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE No casing
DRILLING METHOD Diamond (NQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Hughes **UTM** 10U, N 6100659 m & E 624446 m
AT TIME OF DRILLING ---
NOTES Vibrating Wire Piezometer (VWP), 1.0 MPa and 2.0 MPa
AFTER DRILLING 24.19 m 8/24/2012 measured from surface (1.0 MPa)

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0					SILTY SAND WITH GRAVEL, brown, well graded, rounded, medium to coarse grained, moist, dense, stratified, [Glacial Till]
15			III		SILTSTONE, moderately weathered, massive, dark grey, fine, hard, [Hasler Formation]
115			I		MUDSTONE AND SILTSTONE, unweathered, massive, dark grey, fine, very hard, [Boulder Creek]
250					Bottom of hole at 250.00 m.

WELL DIAGRAM

0 - 0.3 m
Concrete

0.3 - 113.5 m
Grout

113.5 - 115 m
Bentonite
116 m 1.0 MPa
VWP

116.3 - 207.5 m
Grout

207.5 - 209
Bentonite
210 m 2.0 MPa
VWP
Van Ruth Plug
210.5 - 250 m
Grout

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Borehole # VWP-H7

CLIENT HD Mining Ltd.
PROJECT NAME Environmental Baseline - Murray River Coal Project
PROJECT NUMBER 0194106-0002-0005
PROJECT LOCATION 12 km south of Tumbler Ridge, BC
DATE STARTED 4/1/11 **COMPLETED** 4/1/11
CASING (TOC) ELEVATION 1131.5 m **HOLE SIZE** 0.076 m
DRILLING CONTRACTOR Canadian Dehua Drilling
CASING TYPE No casing
DRILLING METHOD Diamond (NQ) Triple Tube Coring
GROUNDWATER LEVELS:
LOGGED BY R. Hughes **UTM** 10U, N 6100782 m & E 622015 m
AT TIME OF DRILLING ---
NOTES Vibrating Wire Piezometer (VWP), 1.0 MPa and 2.0 MPa
AFTER DRILLING 2.88 m 8/24/2012 measured from surface (1.0 MPa)

Depth (m)	Sample Type	Sample Number	Weathering Grade	Graphic Log	Material Description
0			II		SILTY SAND WITH GRAVEL, brown, well graded, rounded, fine to coarse grained, moist, dense, stratified, [Glacial Till]
					SILTSTONE, slightly weathered, massive, dark grey, fine, very hard, Hasler Formation
			I		MUDSTONE AND SILTSTONE, unweathered, massive, dark grey, fine, very hard, Boulder Creek Formation

WELL DIAGRAM

- 0 - 0.3 m Concrete
- 0.3 - 90.5 m Grout
- 90.5 - 92 m Bentonite
- 92.5 m 1.0 MPa VWP
- 92.3 - 207.5 m Grout
- 207.5 - 209 Bentonite
- 210 m 2.0 MPa VWP
- Van Ruth Plug 210.5 - 250 m Grout

Bottom of hole at 250.00 m.

Appendix C

Hydraulic Conductivity Tables and Analysis Reports

ERM

Appendix C. Hydraulic Conductivity Tables and Analysis Reports

Hydraulic Conductivity Estimates Derived from Single Well Response Tests

Monitoring Well ID	Date Tested	General Area	Formation	Vertical Depths Below Ground			Hydraulic Conductivity (m/s)
				Top of Tested Interval (mbg)	Bottom of Tested Interval (mbg)	Vertical Tested Length (mbg)	
MW-H2A	10-Jul-11	Camp Ck. Basin	Hasler	83.4	88.0	4.6	1.1E-07
MW-H2B	10-Jul-11	Camp Ck. Basin	Overburden	9.9	12.9	3.0	2.2E-07
MW-H5	9-Jul-11	Camp Ck. Basin	Overburden	27.5	30.5	3.0	2.2E-06
MW-H20	9-Jul-11	Camp Ck. Basin	Hasler	37.8	40.8	3.0	2.0E-08
MW-H17	22-Aug-12	Underground Mine Zone	Overburden	5.5	8.5	3.0	2.0E-06
MW-H18	23-Aug-12	Underground Mine Zone	Hasler	10.5	13.5	3.0	2.3E-06
MW-H19	25-Aug-12	Underground Mine Zone	Overburden	5.7	8.7	3.0	6.0E-09
MW-H22	21-Aug-12	Underground Mine Zone	Overburden	22.1	25.1	3.0	7.0E-07
MW-H23	21-Jul-13	Underground Mine Zone	Overburden	22.1	25.1	3.0	4.4E-04
MW-H24A	19-Dec-12	CCR Site	Hasler	44.9	47.9	3.0	4.0E-08
MW-H24B	24-Oct-12	CCR Site	Hasler	5.6	8.6	3.0	1.0E-06
MW-H24C	21-Jul-13	CCR Site	Hasler	9.3	12.3	3.0	9.0E-07
MW-H25A	21-Jul-13	CCR Site	Hasler	59.0	62.0	3.0	4.0E-07
MW-H25B	24-Oct-12	CCR Site	Overburden	1.6	4.6	3.0	7.0E-07
MW-H26A	21-Jul-13	CCR Site	Hasler	29.9	32.9	3.0	2.0E-06
MW-H26B	31-Oct-12	CCR Site	Overburden	1.6	4.6	3.0	1.0E-08
MW-H27	28-Jul-13	CCR Site	Hasler	34.6	37.6	3.0	2.0E-07
MW-H28	1-Aug-13	CCR Site	Hasler	14.0	17.0	3.0	1.0E-07
MW-H29	1-Aug-13	CCR Site	Hasler	8.3	11.3	3.0	9.0E-08
MW-H30	24-Jul-13	CCR Site	Overburden	11.5	14.5	3.0	4.0E-09
MW-H31	21-Jul-13	CCR Site	Overburden	27.4	30.4	3.0	2.0E-08
MW-H32	22-Jul-13	CCR Site	Hasler	27.1	30.1	3.0	2.0E-09

Appendix C. Hydraulic Conductivity Tables and Analysis Reports

Hydraulic Conductivity Estimates Derived from Falling-Head Packer Tests

Monitoring Well ID	Date Tested	General Area	Formation	Vertical Depths Below Ground			Hydraulic Conductivity (m/s)
				Top of Tested Interval (mbg)	Bottom of Tested Interval (mbg)	Vertical Tested Length (m)	
MW-H2A Zone 1	10-May-2011	Camp Ck. Basin	Hasler	30.5	91.5	61.0	2.0E-07
MW-H2A Zone 2		Camp Ck. Basin	Hasler	45.7	91.5	45.8	1.9E-07
MW-H20 Zone 1	21-May-2011	Camp Ck. Basin	Hasler	72.6	100.7	28.1	4.1E-08
MW-H20 Zone 2		Camp Ck. Basin	Hasler	57.4	62.0	4.6	1.8E-06
MW-H24A Zone 1	15-Oct-2012	CCR Site	Hasler	9.8	25.0	15.2	6.0E-06
MW-H24A Zone 2		CCR Site	Hasler	25.3	38.4	13.1	4.0E-08
MW-H24A Zone 3	19-Oct-2012	CCR Site	Hasler	38.4	54.6	16.2	9.0E-07
MW-H24A Zone 4		CCR Site	Hasler	54.3	67.1	12.8	4.0E-06
MW-H25A Zone 1	31-Oct-2012	CCR Site	Hasler	58.5	69.2	10.7	4.0E-07
MW-H25A Zone 2		CCR Site	Hasler	69.2	79.9	10.7	1.0E-08
MW-H26A Zone 1	26-Oct-2012	CCR Site	Hasler	34.1	48.5	14.4	7.0E-08
MW-H26A Zone 2	27-Oct-2012	CCR Site	Hasler	49.7	64.3	14.6	7.0E-07
MW-H27 Zone 1	23-Jul-2013	CCR Site	Hasler	32.8	39.2	6.4	2.0E-07
MW-H28 Zone 1	24-Jul-2013	CCR Site	Hasler	13.3	18.6	5.3	3.0E-06
MW-H28 Zone 2	24-Jul-2013	CCR Site	Hasler	19.1	26.8	7.7	2.0E-08
MW-H28 Zone 3	25-Jul-2013	CCR Site	Hasler	27.3	41.8	14.5	6.0E-09
MW-H28 Zone 4	26-Jul-2013	CCR Site	Hasler	42.2	56.7	14.5	9.0E-08
MW-H28 Zone 5	26-Jul-2013	CCR Site	Hasler	57.5	76.5	19.0	6.0E-08
MW-H28 Zone 6	27-Jul-2013	CCR Site	Hasler	77.3	93.3	16.0	4.0E-09
MW-H29 Zone 1	28-Jul-2013	CCR Site	Hasler	5.8	8.8	3.0	7.0E-07
MW-H29 Zone 2	28-Jul-2013	CCR Site	Hasler	9.6	24.4	14.8	3.0E-07
MW-H29 Zone 3	28-Jul-2013	CCR Site	Hasler	25.1	39.6	14.5	9.0E-09
MW-H29 Zone 4	29-Jul-2013	CCR Site	Hasler	40.4	59.4	19.0	2.0E-09
MW-H29 Zone 5	29-Jul-2013	CCR Site	Hasler	58.7	77.7	19.0	9.0E-10
MW-H29 Zone 6	30-Jul-2013	CCR Site	Hasler	78.5	98.5	20.0	2.0E-09
MW-H30 Zone 1	22-Jul-2013	CCR Site	Hasler	19.1	22.9	3.8	2.0E-08

Hole #: MW- H2A
Test #: 2

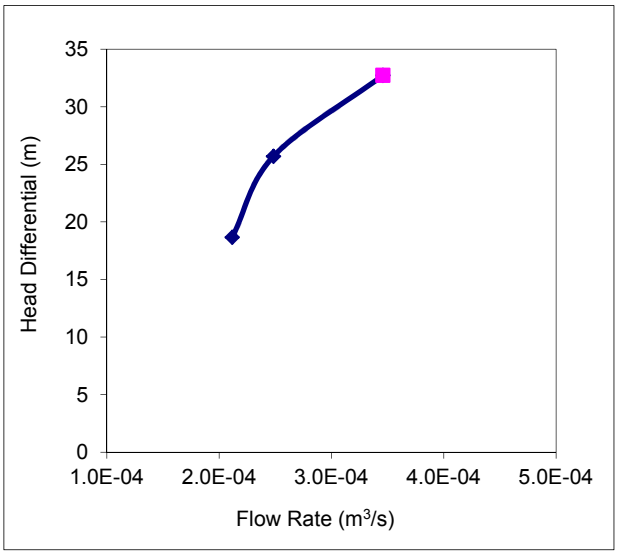
Input Parameters

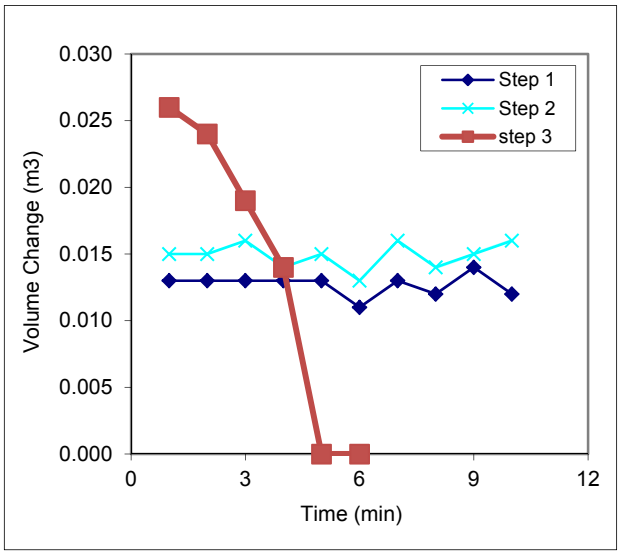
Top of Packer Test Interval (mah):	30.0
Bottom of Packer Test Interval (mah):	91.0
L: Length of Test Interval (mah)	61.0
Test Interval Midpoint (mah):	61
Stickup Height (mah):	1.40
Pressure Gauge Height (m above ground):	1.40
Depth to Water Table (mah):	4.60
Borehole Diameter (mm):	96.0
r: Borehole Radius (m):	0.048
A: Angle From Horizontal (deg):	90

* mah indicates "meters along hole"

$$K = \frac{Q \ln\left(\frac{L \sin(A)}{r}\right)}{2\pi L dH \sin(A)}$$

Pressure (psi)	Q: Flowrate (m^3/s):	Pressure (m of water)	dH: Head Differential (m)	K: Hydraulic Conductivity (m/s)
20.0	2.1E-04	14.1	18.7	2.1E-07
30.0	2.5E-04	21.1	25.7	1.8E-07
40.0	3.5E-04	28.1	32.7	2.0E-07
			Geo Mean K:	**2.E-07**





Remarks: Test aborted during third step due to depletion of water reserves.

Hole #: **MW- 2HA**
Test #: **1**

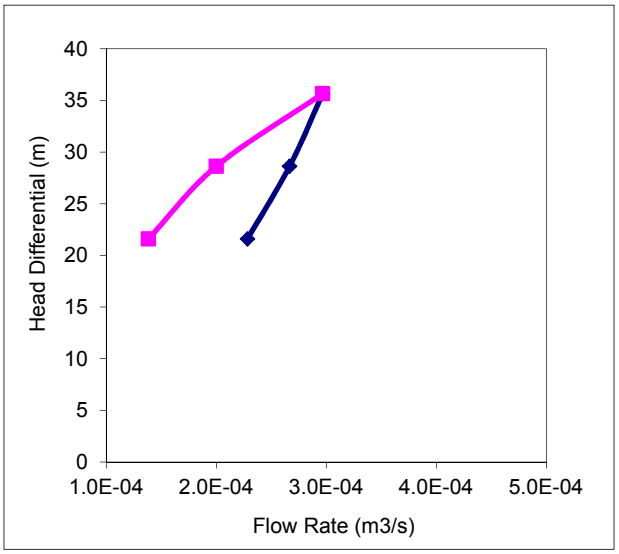
Input Parameters

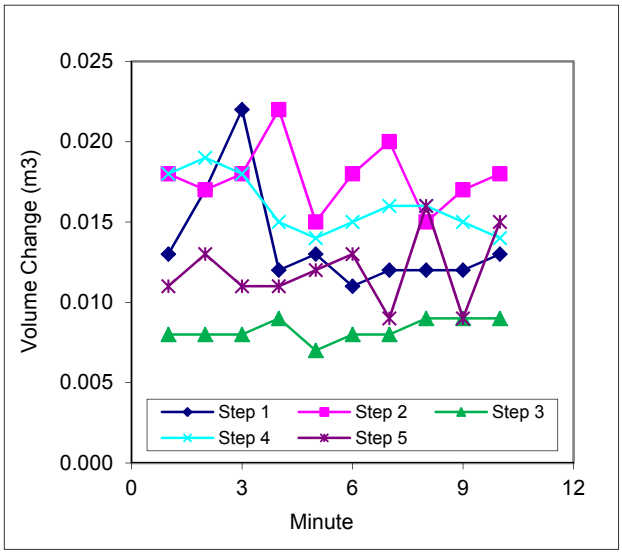
Top of Packer Test Interval (mah):	45.0
Bottom of Packer Test Interval (mah):	91.0
L: Length of Test Interval (mah)	46.0
Test Interval Midpoint (mah):	68
Stickup Height (mah):	1.40
Pressure Gauge Height (m above ground):	1.40
Depth to Water Table (mah):	7.53
Borehole Diameter (mm):	96.0
r: Borehole Radius (m):	0.048
A: Angle From Horizontal (deg):	90

* mah indicates "meters along hole"

$$K = \frac{Q \ln\left(\frac{L \sin(A)}{r}\right)}{2\pi L dH \sin(A)}$$

Pressure (psi)	Q: Flowrate (m^3/s):	Pressure (m of water)	dH: Head Differential (m)	K: Hydraulic Conductivity (m/s)
20.0	2.3E-04	14.1	21.6	2.5E-07
30.0	2.7E-04	21.1	28.6	2.2E-07
40.0	3.0E-04	28.1	35.7	2.0E-07
30.0	2.0E-04	21.1	28.6	1.7E-07
20.0	1.4E-04	14.1	21.6	1.5E-07
			Geo Mean	**1.9.E-07**

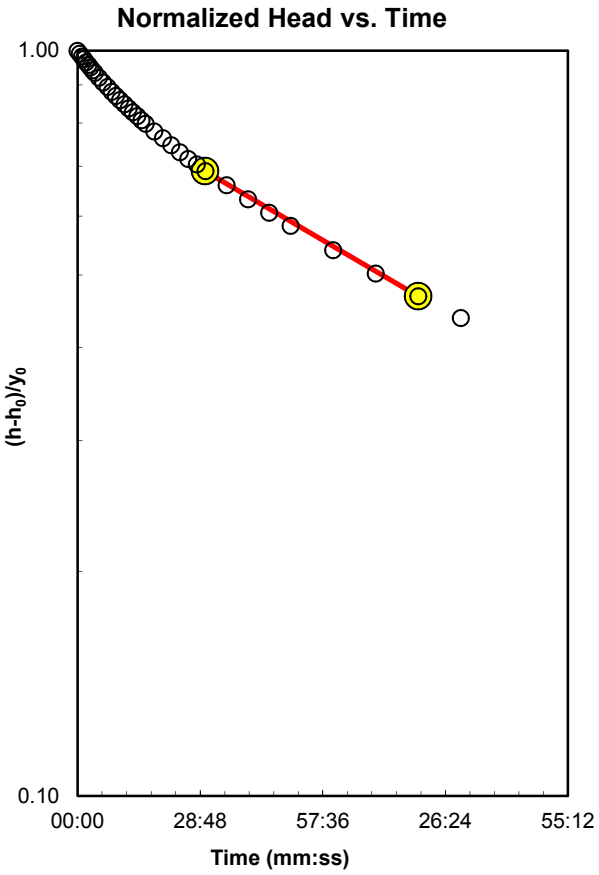




Remarks: Test completed normally. Some difficulty maintaining injection pressures.

MW-H20 **Double Packer - Falling Head Test** **Date: 5/21/2011**	
Static Water Level (mbgs):	53.4
Initial displacement (y0):	16.05
Initial Water Level (h0):	37.35
Hole elevation (masl):	948
Top of packer interval (mbgs):	72.63
Bottom of packer interval (mbgs):	100.67
Volume hole flushed (L):	1900
Duration of flush (hrs.):	1.1

Time Elapsed (s)	Water Level (h)	Normalized Head (m/m)
0	37.35	1
30	37.5	0.991
60	37.64	0.982
90	37.77	0.974
120	37.91	0.965
150	38.04	0.957
180	38.16	0.950
210	38.29	0.941
240	38.41	0.934
300	38.63	0.920
360	38.85	0.907
420	39.05	0.894
480	39.26	0.881
540	39.44	0.870
600	39.62	0.859
660	39.8	0.847
720	39.97	0.837
780	40.13	0.827
840	40.29	0.817
900	40.45	0.807
960	40.59	0.798
1080	40.89	0.779
1200	41.15	0.763
1320	41.41	0.747
1440	41.67	0.731
1560	41.91	0.716
1680	42.11	0.703
1800	42.34	0.689
2100	42.81	0.660
2400	43.26	0.632
2700	43.67	0.606
3000	44.06	0.582
3600	44.73	0.540
4200	45.34	0.502
4800	45.88	0.469
5400	46.37	0.438
K (m/s)		**4.E-08**
Analysis Method		Bouwer & Rice



Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H17 (Rising Head Slug Test)
Date: 08/14/13
Time: 09:07:31

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 22 August 2012
Test Well: MW-H17

AQUIFER DATA

Saturated Thickness: 20. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H17

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.15 m
Static Water Column Height: 3.608 m
Casing Radius: 0.0255 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 3.608 m

No. of Observations: 24

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.	360.	0.0174
30.	0.0891	390.	0.016
60.	0.0504	420.	0.0145
90.	0.0435	450.	0.0129
120.	0.0386	480.	0.0101
150.	0.0349	510.	0.0103
180.	0.0312	540.	0.0087
210.	0.029	570.	0.0072
240.	0.0267	600.	0.0051
270.	0.0238	630.	0.0045
300.	0.022	660.	0.0022
330.	0.0194	690.	0.001

SOLUTION

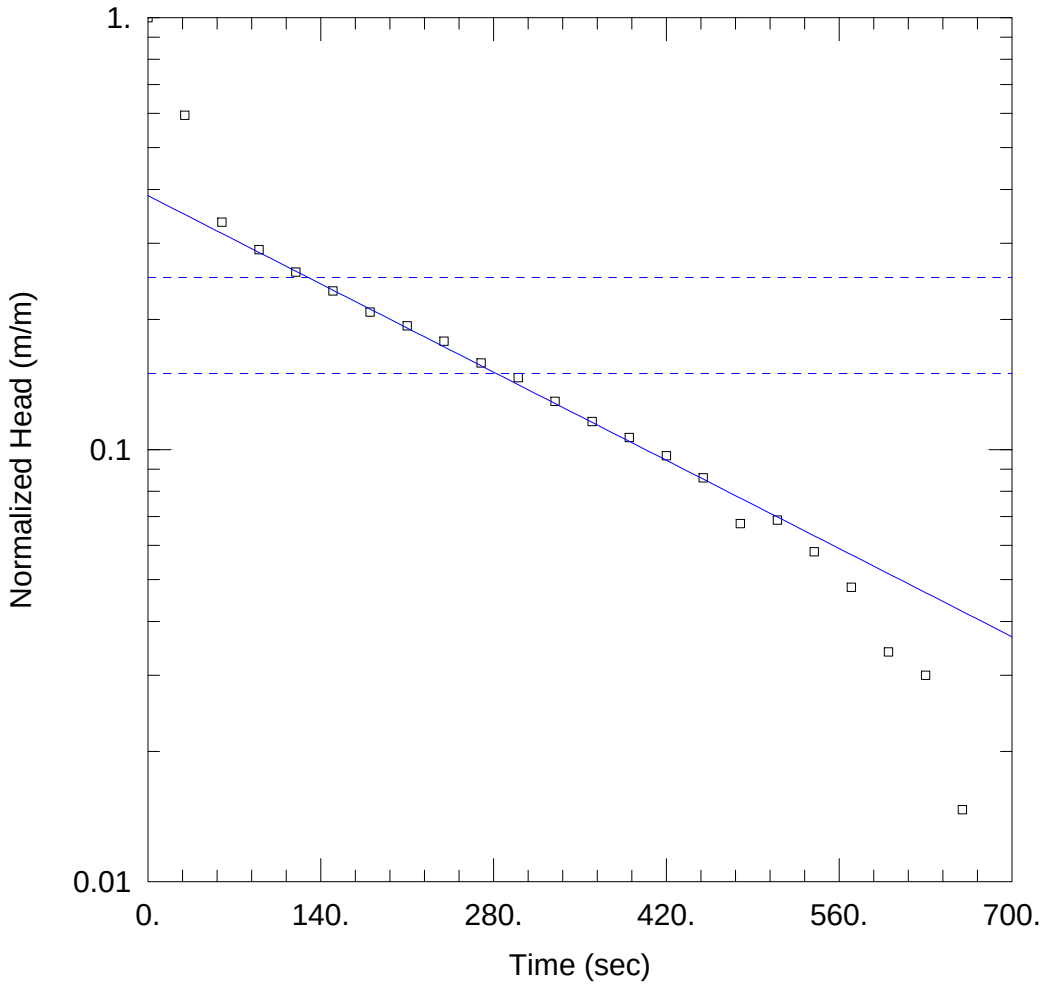
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.2462

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.454E-6	m/sec
y0	0.05803	m

K = 0.0001454 cm/sec
T = K*b = 2.908E-5 m²/sec (0.2908 sq. cm/sec)



MW-H17 (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H17
Test Date: 22 August 2012

AQUIFER DATA

Saturated Thickness: 20. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H17)

Initial Displacement: 0.15 m
Total Well Penetration Depth: 3.608 m
Casing Radius: 0.0255 m
Static Water Column Height: 3.608 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

SOLUTION

Aquifer Model: Unconfined
K = 1.454E-6 m/sec
Solution Method: Hvorslev
y0 = 0.05803 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H18 (Rising Head Slug Test)
Date: 08/14/13
Time: 11:43:12

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 25 August 2012
Test Well: MW-H18

AQUIFER DATA

Saturated Thickness: 20. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H18

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.3 m
Static Water Column Height: 2.573 m
Casing Radius: 0.0255 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 2.573 m
Total Well Penetration Depth: 2.573 m
Corrected Casing Radius (Butler Method): 0.03701 m
Expected Initial Displacement: 1. m

No. of Observations: 38

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.3	570.	0.1183
30.	0.2844	600.	0.1116
60.	0.2734	630.	0.1047
90.	0.2622	660.	0.0985
120.	0.2499	690.	0.0921
150.	0.2405	720.	0.0853
180.	0.2306	750.	0.0806
210.	0.2205	780.	0.0752
240.	0.2109	810.	0.0689
270.	0.201	840.	0.0626
300.	0.1912	870.	0.0558
330.	0.1826	900.	0.0504
360.	0.1736	930.	0.0454
390.	0.1641	960.	0.0404
420.	0.1565	990.	0.0357
450.	0.1491	1020.	0.0317
480.	0.141	1050.	0.0257
510.	0.1348	1080.	0.0225
540.	0.1263	1110.	0.0171

SOLUTION

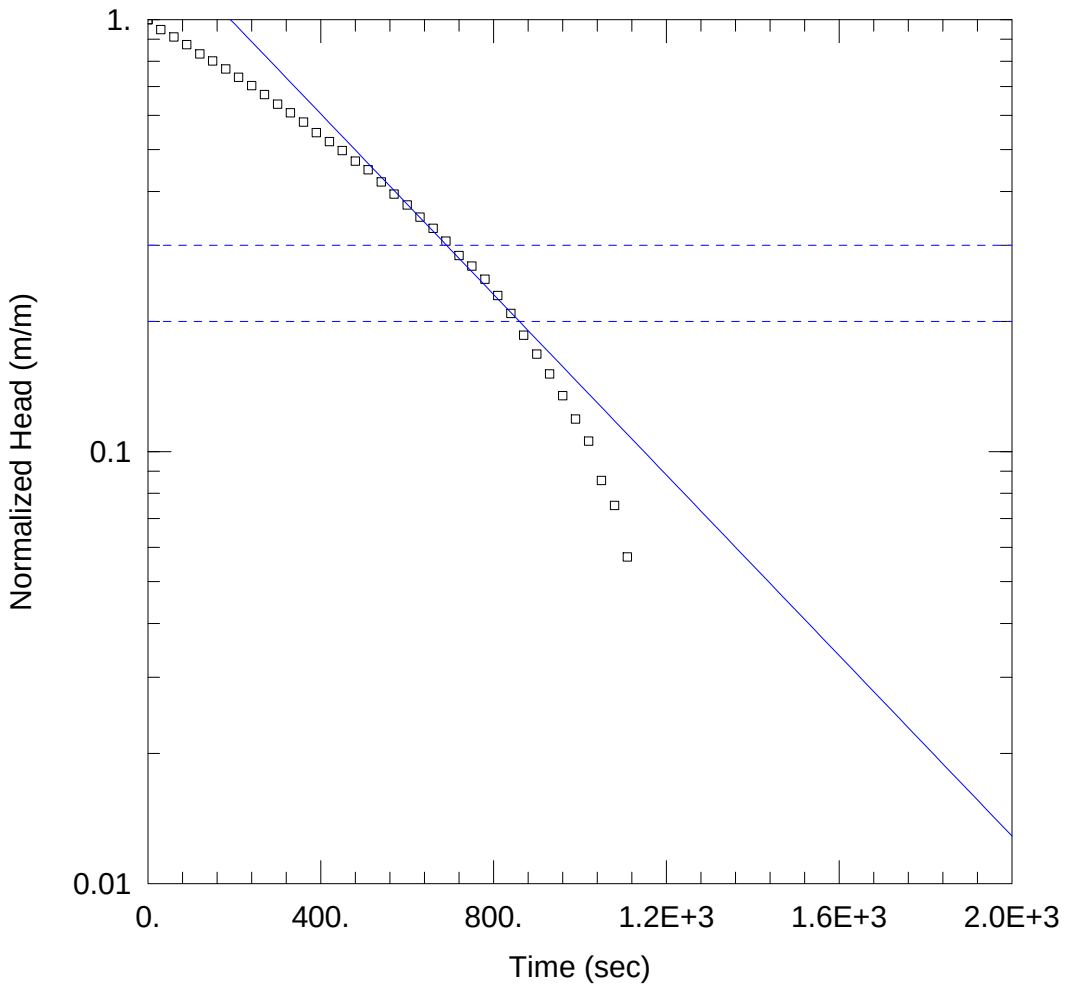
Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 2.483

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.59E-6	m/sec
y0	0.4748	m

K = 0.000159 cm/sec
T = K*b = 3.179E-5 m²/sec (0.3179 sq. cm/sec)



MW-H18 (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H18
Test Date: 25 August 2012

AQUIFER DATA

Saturated Thickness: 20. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H18)

Initial Displacement: 0.3 m
Total Well Penetration Depth: 2.573 m
Casing Radius: 0.0255 m
Static Water Column Height: 2.573 m
Screen Length: 2.573 m
Well Radius: 0.0525 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.59E-6 m/sec
y0 = 0.4748 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H19 (Rising Head Slug Test)
Date: 08/14/13
Time: 09:15:30

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 25 August 2012
Test Well: MW-H19

AQUIFER DATA

Saturated Thickness: 20. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H19

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.5 m
Static Water Column Height: 5.336 m
Casing Radius: 0.0225 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 5.336 m

No. of Observations: 201

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.	3030.	0.3001
30.	0.3526	3060.	0.2996
60.	0.3342	3090.	0.3001
90.	0.3291	3120.	0.2997
120.	0.3243	3150.	0.3002
150.	0.3218	3180.	0.3002
180.	0.3221	3210.	0.2998
210.	0.3196	3240.	0.2986
240.	0.3196	3270.	0.2983
270.	0.3188	3300.	0.2974
300.	0.3186	3330.	0.2995
330.	0.3166	3360.	0.2968
360.	0.3172	3390.	0.2977
390.	0.3163	3420.	0.2965
420.	0.3166	3450.	0.2984
450.	0.3145	3480.	0.2984
480.	0.3154	3510.	0.2976
510.	0.3138	3540.	0.2985
540.	0.3141	3570.	0.2965
570.	0.3136	3600.	0.2976
600.	0.3137	3630.	0.2967
630.	0.3147	3660.	0.2976
660.	0.3131	3690.	0.2972
690.	0.3121	3720.	0.2978
720.	0.3119	3750.	0.2973
750.	0.3096	3780.	0.2963
780.	0.3123	3810.	0.2959
810.	0.3112	3840.	0.2964
840.	0.312	3870.	0.2966
870.	0.3113	3900.	0.2956

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	0.3111	3930.	0.2941
930.	0.3117	3960.	0.2951
960.	0.3093	3990.	0.2966
990.	0.3105	4020.	0.2954
1020.	0.3102	4050.	0.2947
1050.	0.3109	4080.	0.2955
1080.	0.3113	4110.	0.2944
1110.	0.3092	4140.	0.2947
1140.	0.31	4170.	0.2958
1170.	0.3098	4200.	0.2956
1200.	0.3102	4230.	0.2941
1230.	0.3102	4260.	0.2938
1260.	0.3107	4290.	0.2939
1290.	0.31	4320.	0.2946
1320.	0.3092	4350.	0.2938
1350.	0.3101	4380.	0.2933
1380.	0.3084	4410.	0.2956
1410.	0.3093	4440.	0.2934
1440.	0.3096	4470.	0.2932
1470.	0.3097	4500.	0.2934
1500.	0.3087	4530.	0.2922
1530.	0.3081	4560.	0.2936
1560.	0.3091	4590.	0.2931
1590.	0.3069	4620.	0.2935
1620.	0.3071	4650.	0.2925
1650.	0.3073	4680.	0.2936
1680.	0.3084	4710.	0.2934
1710.	0.3079	4740.	0.2925
1740.	0.3068	4770.	0.2921
1770.	0.3063	4800.	0.2932
1800.	0.3065	4830.	0.2944
1830.	0.3064	4860.	0.2926
1860.	0.3059	4890.	0.2933
1890.	0.3044	4920.	0.2931
1920.	0.3049	4950.	0.2924
1950.	0.3046	4980.	0.2937
1980.	0.3057	5010.	0.2916
2010.	0.3065	5040.	0.2925
2040.	0.3057	5070.	0.2918
2070.	0.3055	5100.	0.2921
2100.	0.3057	5130.	0.2921
2130.	0.3055	5160.	0.2938
2160.	0.305	5190.	0.2911
2190.	0.305	5220.	0.2934
2220.	0.3051	5250.	0.2925
2250.	0.3044	5280.	0.2928
2280.	0.3049	5310.	0.2919
2310.	0.304	5340.	0.2921
2340.	0.3051	5370.	0.292
2370.	0.3028	5400.	0.2911
2400.	0.3036	5430.	0.291
2430.	0.3031	5460.	0.292
2460.	0.303	5490.	0.2916
2490.	0.3035	5520.	0.2915
2520.	0.3025	5550.	0.291
2550.	0.303	5580.	0.2922
2580.	0.3041	5610.	0.2908
2610.	0.3014	5640.	0.2915
2640.	0.3016	5670.	0.2919
2670.	0.3027	5700.	0.2913
2700.	0.302	5730.	0.2909
2730.	0.3002	5760.	0.2916
2760.	0.3018	5790.	0.291
2790.	0.3016	5820.	0.2902
2820.	0.301	5850.	0.2909
2850.	0.3014	5880.	0.2896
2880.	0.2991	5910.	0.2896

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
2910.	0.3009	5940.	0.2906
2940.	0.3016	5970.	0.2898
2970.	0.3006	6000.	0.2908
3000.	0.2996		

SOLUTION

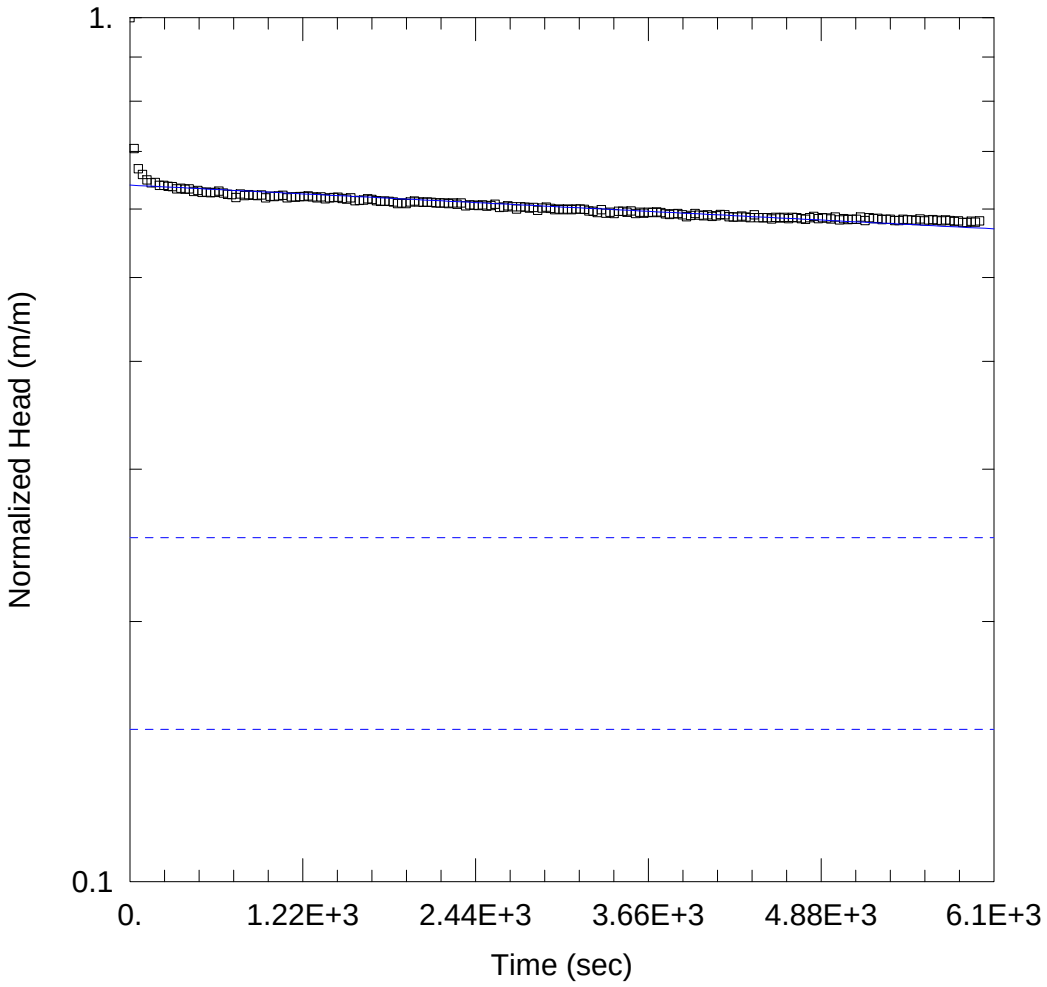
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.2462

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	6.433E-9	m/sec
y0	0.3199	m

K = 6.433E-7 cm/sec
T = K*b = 1.287E-7 m²/sec (0.001287 sq. cm/sec)



MW-H19 (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H19
Test Date: 25 August 2012

AQUIFER DATA

Saturated Thickness: 20. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H19)

Initial Displacement: 0.5 m
Total Well Penetration Depth: 5.336 m
Casing Radius: 0.0225 m
Static Water Column Height: 5.336 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

SOLUTION

Aquifer Model: Unconfined
K = 6.433E-9 m/sec
Solution Method: Hvorslev
y0 = 0.3199 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H22 (Rising Head Slug Test)
Date: 08/14/13
Time: 11:35:46

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 21 August 2012
Test Well: MW-H22

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H22

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.3 m
Static Water Column Height: 5.41 m
Casing Radius: 0.0255 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 5.41 m

No. of Observations: 37

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.3	570.	0.0427
30.	0.1859	600.	0.0399
60.	0.1342	630.	0.038
90.	0.1077	660.	0.0373
120.	0.0926	690.	0.0348
150.	0.0844	720.	0.0338
180.	0.0781	750.	0.0321
210.	0.0726	780.	0.0309
240.	0.0692	810.	0.0284
270.	0.0659	840.	0.0274
300.	0.0633	870.	0.0262
330.	0.0611	900.	0.0234
360.	0.0577	930.	0.0233
390.	0.0551	960.	0.0218
420.	0.0538	990.	0.0214
450.	0.0512	1020.	0.0196
480.	0.0488	1050.	0.0185
510.	0.0469	1080.	0.018
540.	0.0439		

SOLUTION

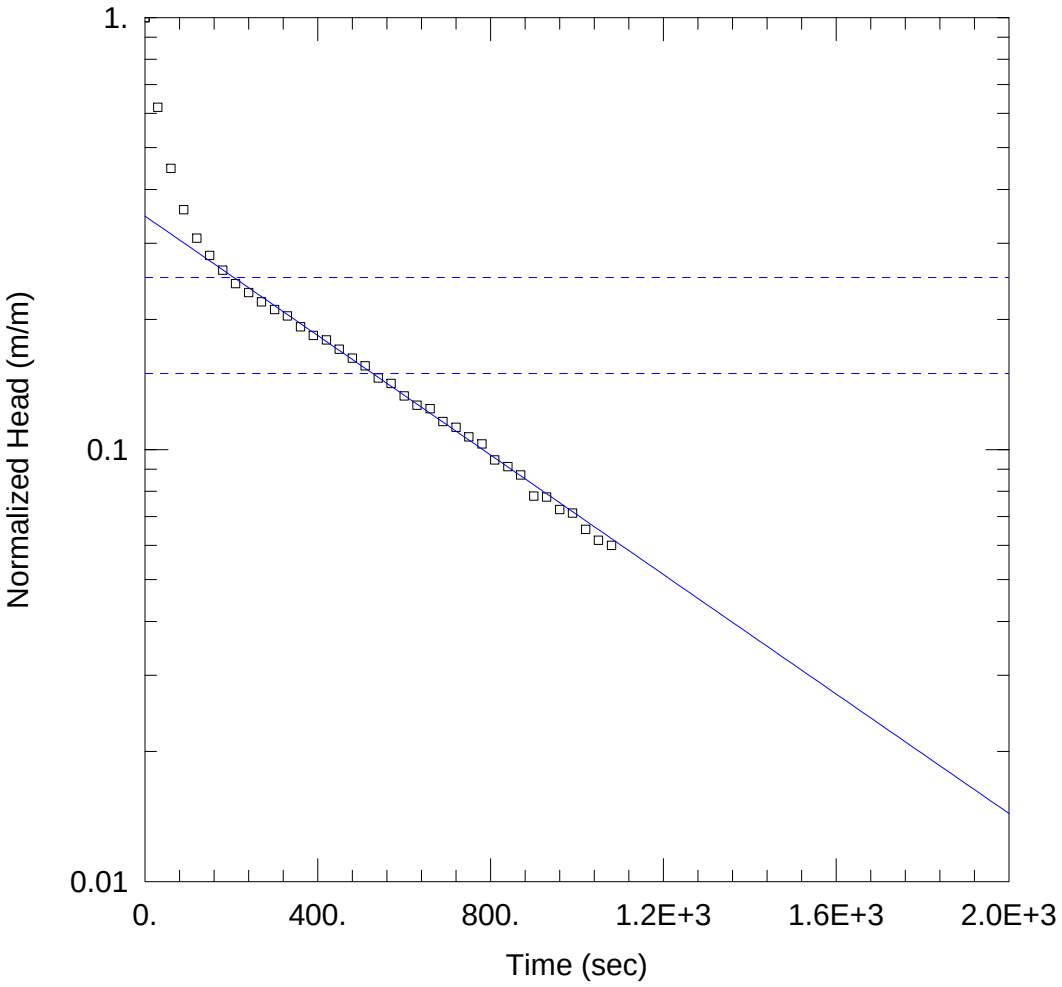
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.2462

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	6.895E-7	m/sec
y0	0.1041	m

K = 6.895E-5 cm/sec
T = K*b = 3.448E-5 m²/sec (0.3448 sq. cm/sec)



MW-H22 (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H22
Test Date: 21 August 2012

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H22)

Initial Displacement: 0.3 m
Total Well Penetration Depth: 5.41 m
Casing Radius: 0.0255 m
Static Water Column Height: 5.41 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

SOLUTION

Aquifer Model: Unconfined
K = 6.895E-7 m/sec
Solution Method: Hvorslev
y0 = 0.1041 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H23 (Risign Head Slug Test)
Date: 08/14/13
Time: 09:40:51

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 21 July 2013
Test Well: MW-H23

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H23

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.5 m
Static Water Column Height: 3.62 m
Casing Radius: 0.0255 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 3.62 m

No. of Observations: 9

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
4.5	0.1143	7.	0.0107
5.	0.0635	7.5	0.0092
5.5	0.04	8.	0.0087
6.	0.031	8.5	0.
6.5	0.0161		

SOLUTION

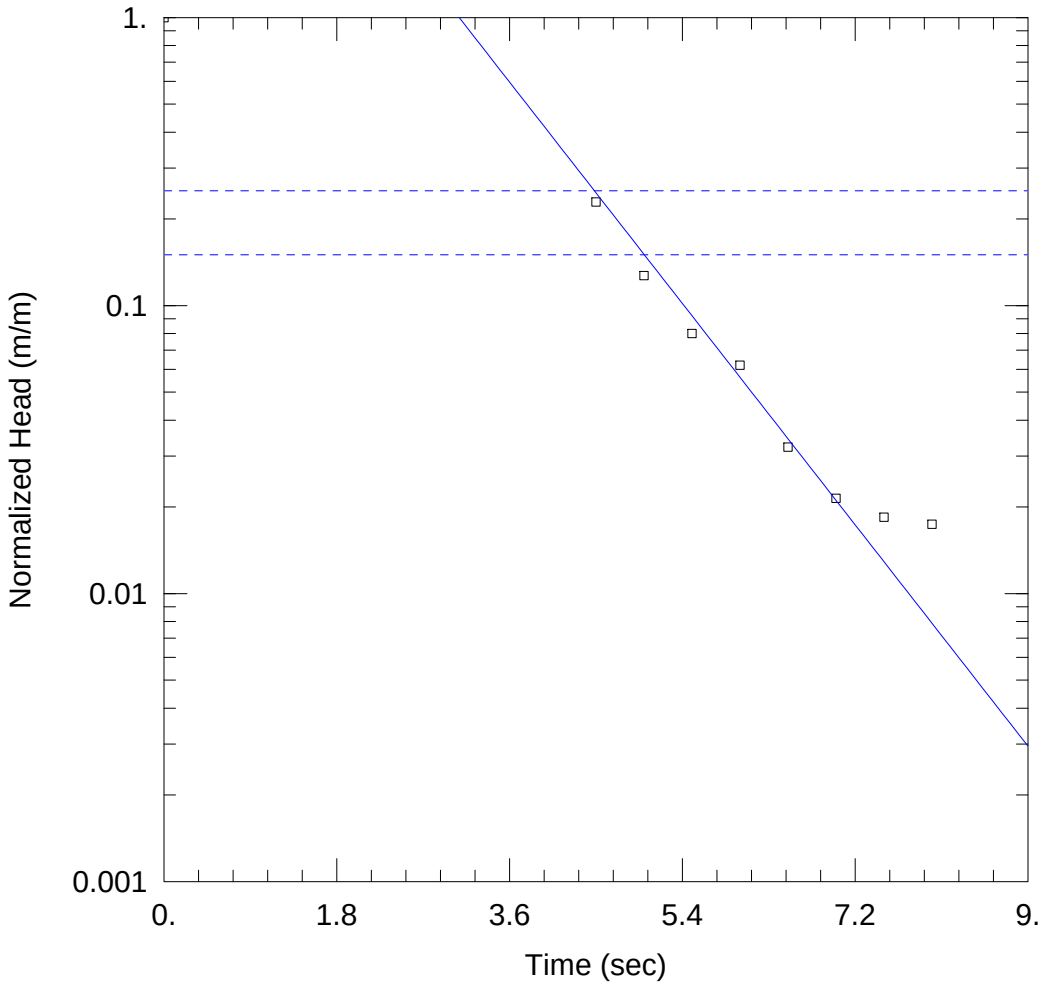
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.2462

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.0004258	m/sec
y0	10.31	m

K = 0.04258 cm/sec
T = K*b = 0.02129 m²/sec (212.9 sq. cm/sec)



MW-H23 (RISIGN HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H23
Test Date: 21 July 2013

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H23)

Initial Displacement: 0.5 m
Total Well Penetration Depth: 3.62 m
Casing Radius: 0.0255 m
Static Water Column Height: 3.62 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

SOLUTION

Aquifer Model: Unconfined
K = 0.0004258 m/sec
Solution Method: Hvorslev
y0 = 10.31 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24A (Rising Head Slug Test)
Date: 08/14/13
Time: 12:02:49

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 19 December 2012
Test Well: MW-H24A

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H24A

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.2 m
Static Water Column Height: 32. m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 32. m

No. of Observations: 25

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.2	7800.	0.512
600.	1.09	8400.	0.4821
1200.	1.009	9000.	0.4435
1800.	0.9431	9600.	0.4051
2400.	0.883	1.02E+4	0.3654
3000.	0.8302	1.08E+4	0.3299
3600.	0.7813	1.14E+4	0.2976
4200.	0.7409	1.2E+4	0.2614
4800.	0.694	1.26E+4	0.2264
5400.	0.6579	1.32E+4	0.1909
6000.	0.6192	1.38E+4	0.1578
6600.	0.5783	1.44E+4	0.1223
7200.	0.5437		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.511E-8	m/sec
y0	4.896	m

K = 4.511E-6 cm/sec

T = K*b = 4.511E-6 m²/sec (0.04511 sq. cm/sec)

NOTES

Well may not be sufficiently developed due to a slow recovery.

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24A Zone 1 (Falling Head Packer Test, vertical interval 9.8-25 m)
Date: 08/14/13
Time: 12:55:16

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 15 October 2012
Test Well: MW-H24A Zone 1

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H24A Zone 1

X Location: 0. m
Y Location: 0. m

Initial Displacement: 4.81 m
Static Water Column Height: 20.21 m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 15.25 m
Total Well Penetration Depth: 20.21 m

No. of Observations: 26

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	4.81	390.	1.299
30.	4.191	420.	1.177
60.	3.736	450.	1.062
90.	3.355	480.	0.9551
120.	3.029	510.	0.8545
150.	2.747	540.	0.7591
180.	2.501	570.	0.6696
210.	2.276	600.	0.5859
240.	2.075	630.	0.5064
270.	1.893	660.	0.4335
300.	1.727	690.	0.3636
330.	1.581	720.	0.2988
360.	1.431	750.	0.2367

SOLUTION

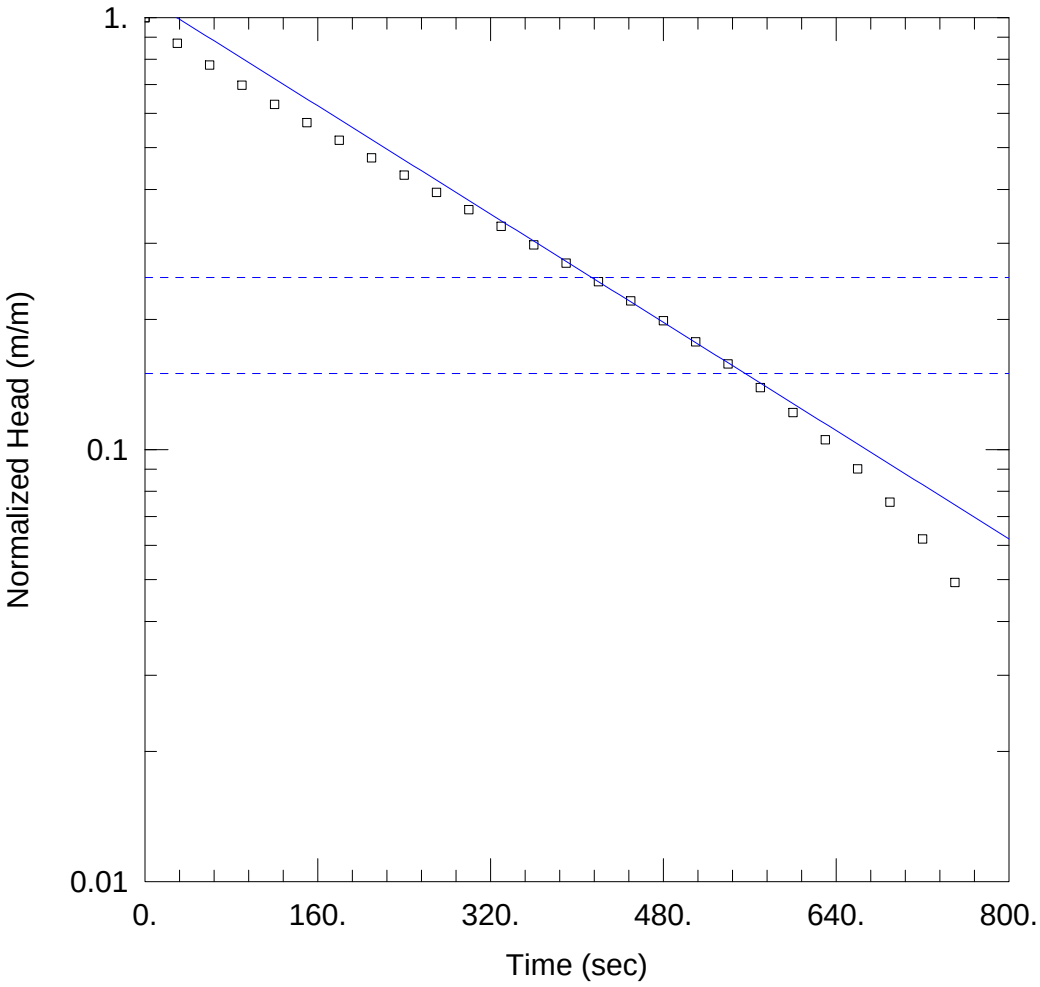
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1668

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.024E-6	m/sec
y0	5.35	m

K = 0.0001024 cm/sec



MW-H24A ZONE 1 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 9.8-25 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24A Zone 1
Test Date: 15 October 2012

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 1.024E-6 m/sec
y0 = 5.35 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24A Zone 2 (Falling Head Packer Test, vertical interval 25.3-38.4 m)
Date: 08/14/13
Time: 12:57:13

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 19 October 2012
Test Well: MW-H24 Zone 2

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H24A Zone 2

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.91 m
Static Water Column Height: 38.1 m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 11.9 m
Total Well Penetration Depth: 38.1 m

No. of Observations: 132

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.91	1980.	1.495
30.	1.896	2010.	1.491
60.	1.89	2040.	1.485
90.	1.881	2070.	1.48
120.	1.872	2100.	1.473
150.	1.863	2130.	1.469
180.	1.854	2160.	1.464
210.	1.847	2190.	1.458
240.	1.838	2220.	1.454
270.	1.832	2250.	1.448
300.	1.824	2280.	1.443
330.	1.817	2310.	1.439
360.	1.812	2340.	1.432
390.	1.803	2370.	1.429
420.	1.796	2400.	1.425
450.	1.789	2430.	1.42
480.	1.783	2460.	1.416
510.	1.776	2490.	1.411
540.	1.771	2520.	1.404
570.	1.765	2550.	1.4
600.	1.757	2580.	1.395
630.	1.75	2610.	1.388
660.	1.746	2640.	1.385
690.	1.739	2670.	1.38
720.	1.732	2700.	1.375
750.	1.726	2730.	1.37
780.	1.72	2760.	1.365
810.	1.714	2790.	1.359
840.	1.706	2820.	1.356
870.	1.7	2850.	1.351

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	1.695	2880.	1.345
930.	1.689	2910.	1.341
960.	1.683	2940.	1.335
990.	1.678	2970.	1.331
1020.	1.672	3000.	1.326
1050.	1.665	3030.	1.321
1080.	1.66	3060.	1.316
1110.	1.654	3090.	1.311
1140.	1.649	3120.	1.307
1170.	1.642	3150.	1.301
1200.	1.638	3180.	1.298
1230.	1.632	3210.	1.292
1260.	1.626	3240.	1.287
1290.	1.62	3270.	1.283
1320.	1.615	3300.	1.278
1350.	1.609	3330.	1.274
1380.	1.604	3360.	1.268
1410.	1.598	3390.	1.263
1440.	1.593	3420.	1.259
1470.	1.587	3450.	1.254
1500.	1.581	3480.	1.249
1530.	1.575	3510.	1.245
1560.	1.57	3540.	1.24
1590.	1.564	3570.	1.236
1620.	1.559	3600.	1.23
1650.	1.555	3630.	1.225
1680.	1.549	3660.	1.221
1710.	1.544	3690.	1.22
1740.	1.538	3720.	1.213
1770.	1.533	3750.	1.208
1800.	1.527	3780.	1.203
1830.	1.522	3810.	1.199
1860.	1.517	3840.	1.195
1890.	1.511	3870.	1.19
1920.	1.507	3900.	1.186
1950.	1.502	3930.	1.179

SOLUTION

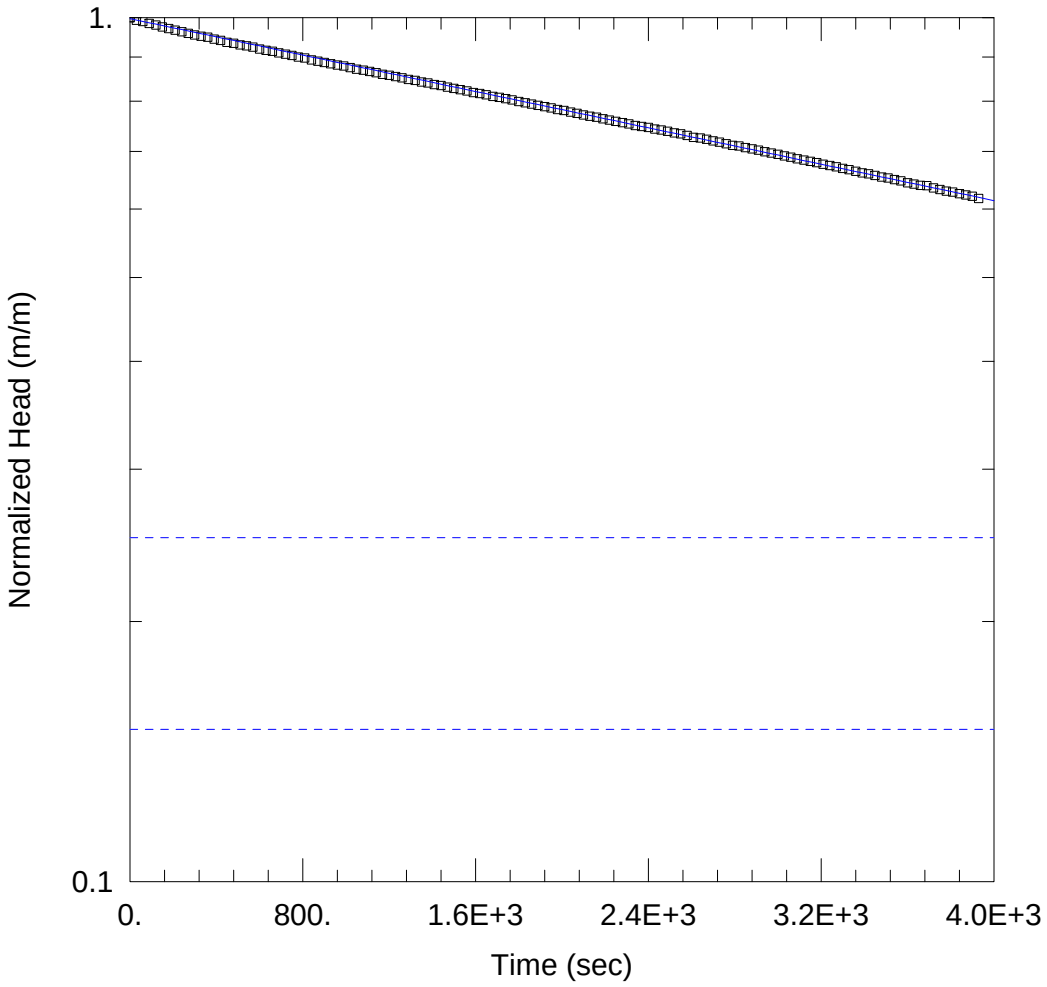
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.174

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.224E-8	m/sec
y0	1.904	m

K = 4.224E-6 cm/sec
T = K*b = 4.224E-6 m²/sec (0.04224 sq. cm/sec)



MW-H24A ZONE 2 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 25.3-38.4 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24 Zone 2
Test Date: 19 October 2012

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 4.224E-8 m/sec
y0 = 1.904 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24A Zone 3 (Falling Head Packer Test, vertical interval 38.4-54.6 m)
Date: 08/14/13
Time: 13:01:09

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 19 October 2012
Test Well: MW-H24A Zone 3

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H24A Zone 3

X Location: 0. m
Y Location: 0. m

Initial Displacement: 4.04 m
Static Water Column Height: 48.44 m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 12.2 m
Total Well Penetration Depth: 48.44 m

No. of Observations: 33

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	4.04	510.	1.359
30.	3.851	540.	1.27
60.	3.59	570.	1.184
90.	3.35	600.	1.105
120.	3.134	630.	1.029
150.	2.928	660.	0.9565
180.	2.739	690.	0.8866
210.	2.566	720.	0.8205
240.	2.406	750.	0.7576
270.	2.256	780.	0.6946
300.	2.116	810.	0.6341
330.	1.982	840.	0.5748
360.	1.86	870.	0.5172
390.	1.752	900.	0.4609
420.	1.648	930.	0.4046
450.	1.549	960.	0.3516
480.	1.453		

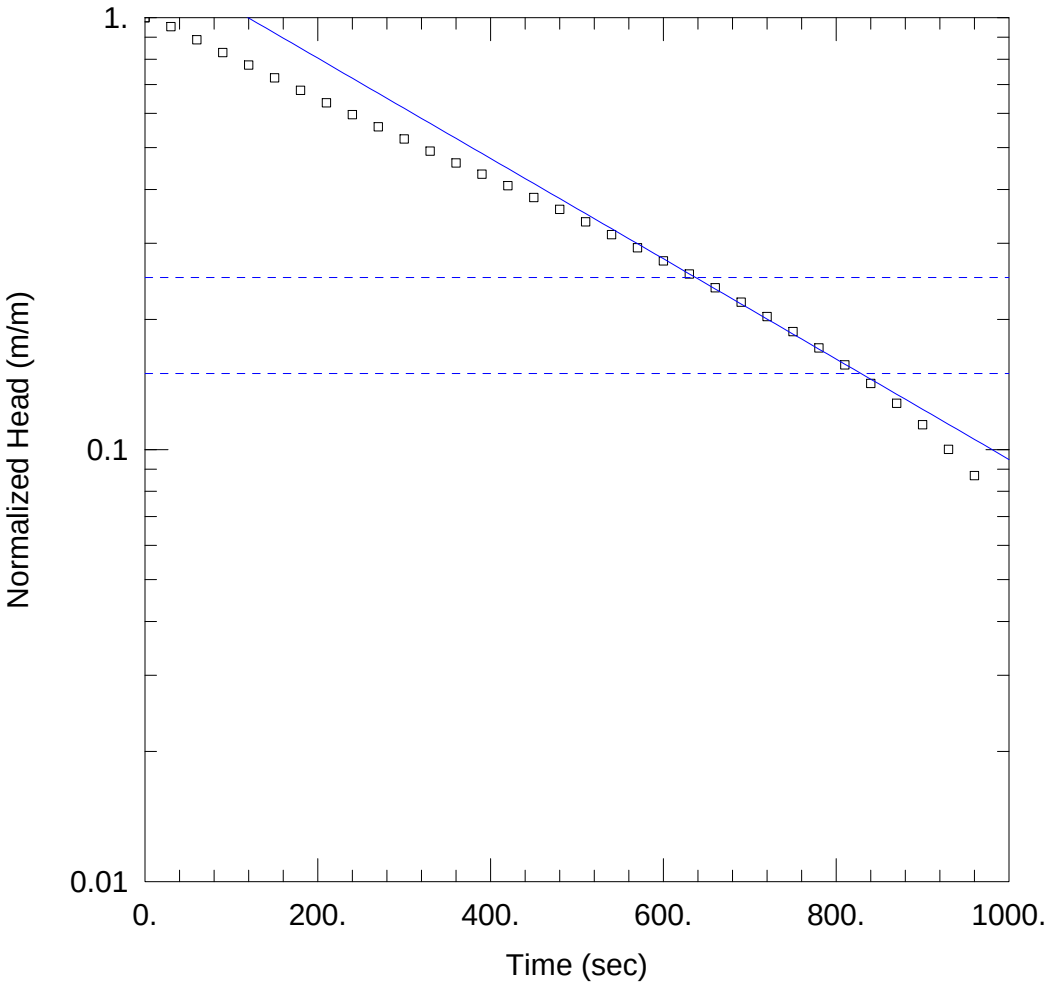
SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1733

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate



MW-H24A ZONE 3 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 38.4-54.6 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24A Zone 3
Test Date: 19 October 2012

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 9.132E-7 m/sec
y0 = 5.553 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24A Zone 4 (Falling Head Packer Test, vertical interval 54.3-67.1 m)
Date: 08/15/13
Time: 13:34:38

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24A Zone 4

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H24A Zone 4

X Location: 0. m
Y Location: 0. m

Initial Displacement: 5.01 m
Static Water Column Height: 63. m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 11.8 m
Total Well Penetration Depth: 63. m

No. of Observations: 20

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	5.01	300.	2.34
30.	4.65	330.	2.185
60.	4.44	360.	1.94
90.	3.97	390.	1.62
120.	3.66	420.	1.195
150.	3.28	450.	0.86
180.	3.07	480.	0.6
210.	2.85	510.	0.39
240.	2.67	540.	0.215
270.	2.51	570.	0.08

SOLUTION

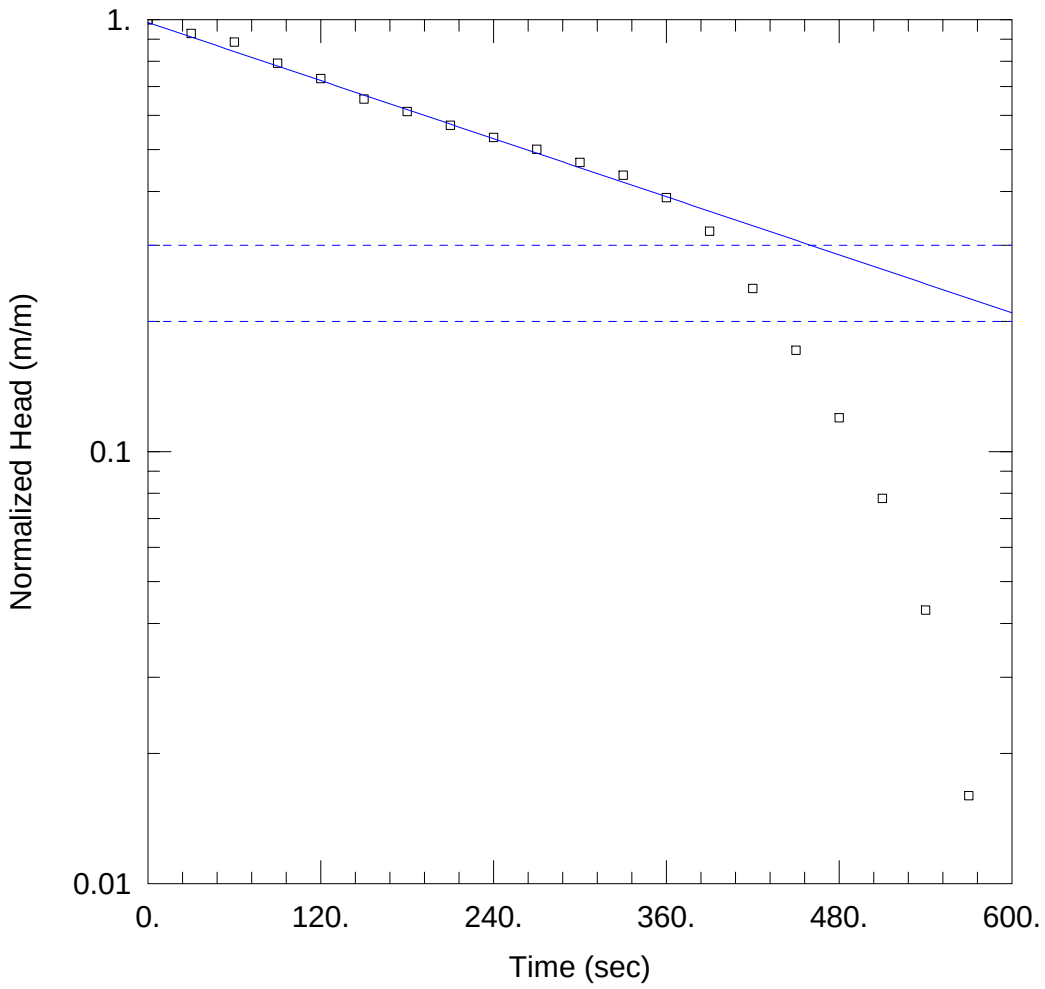
Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 4.956

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	7.823E-7	m/sec
y0	4.931	m

K = 7.823E-5 cm/sec
T = K*b = 7.823E-5 m²/sec (0.7823 sq. cm/sec)



MW-H24A ZONE 4 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 54.3-67.1 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24A Zone 4

AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

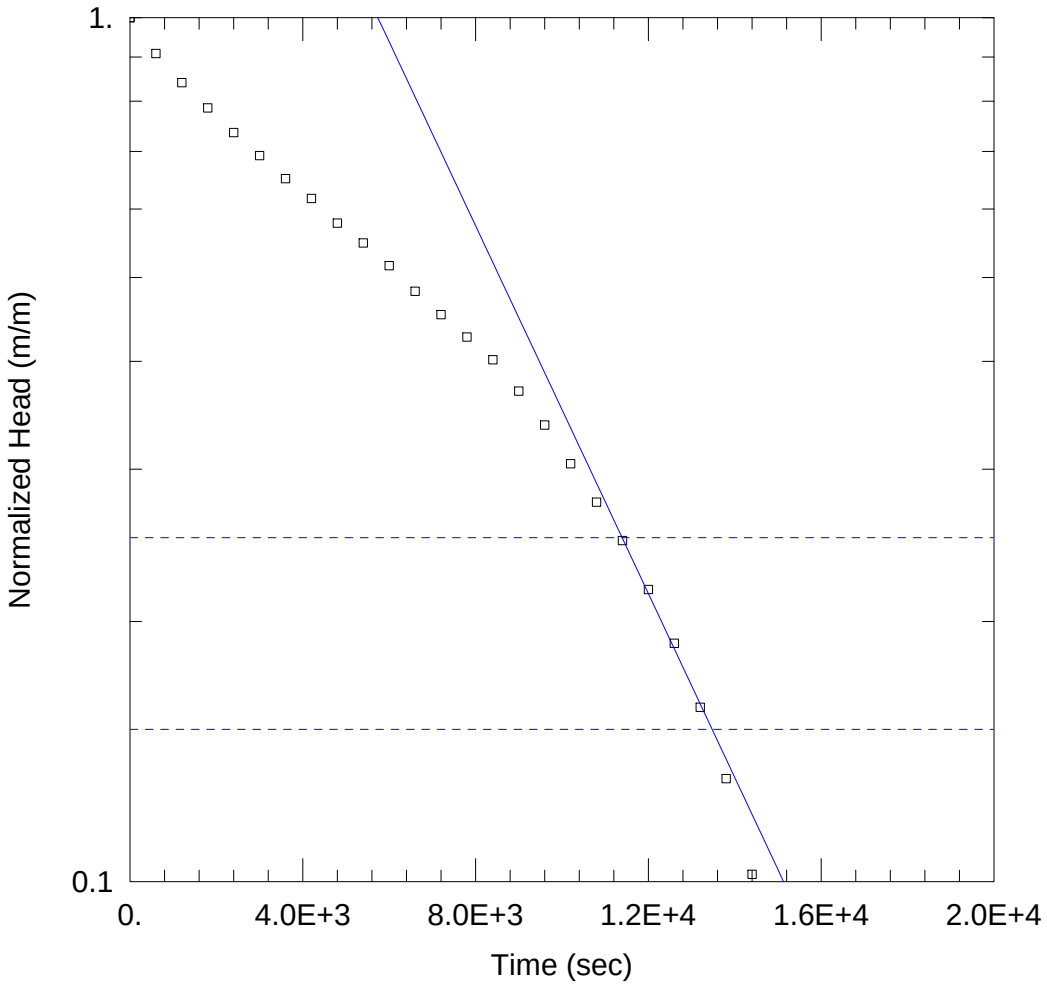
SOLUTION

Aquifer Model: Confined

Solution Method: Bouwer-Rice

K = 7.823E-7 m/sec

y0 = 4.931 m



MW-H24A (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24A
Test Date: 19 December 2012

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H24A)

Initial Displacement: 1.2 m
Total Well Penetration Depth: 32. m
Casing Radius: 0.016 m
Static Water Column Height: 32. m
Screen Length: 3.05 m
Well Radius: 0.038 m

SOLUTION

Aquifer Model: Confined
K = 4.511E-8 m/sec
Solution Method: Hvorslev
y0 = 4.896 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24B (Rising Head Slug Test)
Date: 08/14/13
Time: 10:19:25

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 24 October 2012
Test Well: MW-H24B

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H24B

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.141 m
Static Water Column Height: 4.64 m
Casing Radius: 0.016 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 4.64 m

No. of Observations: 47

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.141	360.	0.0053
15.	0.0519	375.	0.0048
30.	0.0374	390.	0.0045
45.	0.0288	405.	0.0045
60.	0.0263	420.	0.0037
75.	0.0239	435.	0.0035
90.	0.0205	450.	0.0033
105.	0.0187	465.	0.0038
120.	0.0172	480.	0.0027
135.	0.0151	495.	0.0021
150.	0.0145	510.	0.0032
165.	0.0126	525.	0.0026
180.	0.0119	540.	0.003
195.	0.0114	555.	0.0021
210.	0.0098	570.	0.0021
225.	0.0094	585.	0.0024
240.	0.0091	600.	0.002
255.	0.0082	615.	0.0019
270.	0.0071	630.	0.0016
285.	0.0067	645.	0.0012
300.	0.0065	660.	0.0018
315.	0.0061	675.	0.0013
330.	0.0059	690.	0.0013
345.	0.0057		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev

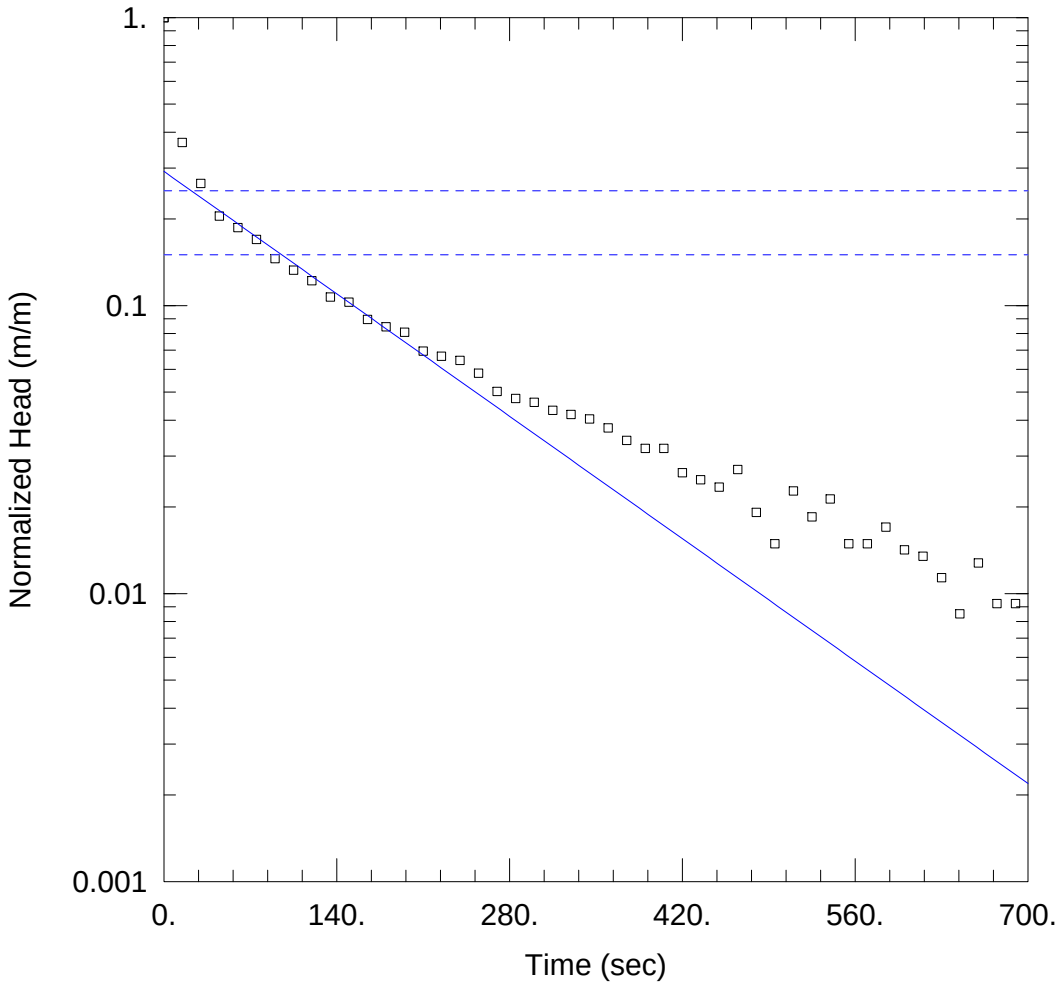
Log Factor: 0.2462

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.192E-6	m/sec
y0	0.0412	m

K = 0.0001192 cm/sec
T = K*b = 5.96E-5 m^2/sec (0.596 sq. cm/sec)



MW-H24B (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H24B
Test Date: 24 October 2012

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H24B)

Initial Displacement: 0.141 m
Total Well Penetration Depth: 4.64 m
Casing Radius: 0.016 m
Static Water Column Height: 4.64 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

SOLUTION

Aquifer Model: Unconfined
K = 1.192E-6 m/sec
Solution Method: Hvorslev
y0 = 0.0412 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H24C (Rising Head Slug Test)
Date: 08/14/13
Time: 10:22:31

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 21 July 2013
Test Well: MW-H24C

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H24C

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.5 m
Static Water Column Height: 10.47 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 10.47 m

No. of Observations: 256

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.5	309.	0.0767
1.	0.4905	324.	0.0711
2.	0.4836	339.	0.0661
3.	0.4777	354.	0.0619
4.	0.4733	369.	0.0577
5.	0.4685	384.	0.0532
6.	0.464	399.	0.0502
7.	0.4606	414.	0.0469
8.	0.457	429.	0.0442
9.	0.4527	444.	0.0415
10.	0.4494	459.	0.0388
11.	0.4464	474.	0.0368
12.	0.4429	489.	0.0344
13.	0.4398	504.	0.0324
14.	0.4363	519.	0.0298
15.	0.4331	534.	0.0275
16.	0.4304	549.	0.0255
17.	0.4281	564.	0.0247
18.	0.424	579.	0.0231
19.	0.4216	594.	0.0216
20.	0.4191	609.	0.0205
21.	0.4151	624.	0.0196
22.	0.4127	639.	0.0174
23.	0.4106	654.	0.0167
24.	0.4079	669.	0.0164
25.	0.4052	684.	0.0154
26.	0.403	699.	0.0152
27.	0.3997	714.	0.0143
28.	0.3969	729.	0.0136
29.	0.3944	744.	0.013

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
30.	0.3917	759.	0.0126
31.	0.3895	774.	0.0117
32.	0.3863	789.	0.0116
33.	0.384	804.	0.0113
34.	0.3817	819.	0.0107
35.	0.379	834.	0.01
36.	0.3772	849.	0.0093
37.	0.3748	864.	0.0076
38.	0.3725	879.	0.0086
39.	0.3699	894.	0.0093
40.	0.3674	909.	0.0085
41.	0.3645	924.	0.0079
42.	0.3626	939.	0.0077
43.	0.3602	954.	0.0077
44.	0.3584	969.	0.007
45.	0.3559	984.	0.0074
46.	0.3538	999.	0.0072
47.	0.3517	1014.	0.0069
48.	0.3496	1029.	0.0064
49.	0.3472	1044.	0.0065
50.	0.3448	1059.	0.0068
51.	0.3431	1074.	0.0063
52.	0.3403	1089.	0.0058
53.	0.3385	1104.	0.0061
54.	0.3357	1119.	0.0061
55.	0.3343	1134.	0.0062
56.	0.3324	1149.	0.0058
57.	0.3306	1164.	0.0058
58.	0.3289	1179.	0.0062
59.	0.3266	1194.	0.0065
60.	0.3244	1209.	0.0057
61.	0.3233	1224.	0.0053
62.	0.3199	1239.	0.0051
63.	0.3177	1254.	0.005
64.	0.3156	1269.	0.0055
65.	0.314	1284.	0.0043
66.	0.3119	1299.	0.0049
67.	0.31	1314.	0.0055
68.	0.3085	1329.	0.0045
69.	0.3061	1344.	0.0048
70.	0.3044	1359.	0.0044
71.	0.3024	1374.	0.0043
72.	0.3016	1389.	0.0041
73.	0.2991	1404.	0.0046
74.	0.2978	1419.	0.0043
75.	0.2952	1434.	0.0039
76.	0.2937	1449.	0.0039
77.	0.2918	1464.	0.0044
78.	0.2902	1479.	0.0042
79.	0.2886	1494.	0.0044
80.	0.2865	1509.	0.0042
81.	0.2856	1524.	0.0044
82.	0.2832	1539.	0.0041
83.	0.2822	1554.	0.0038
84.	0.2801	1569.	0.0035
85.	0.2793	1584.	0.0035
86.	0.2765	1599.	0.0036
87.	0.2743	1614.	0.0041
88.	0.2736	1629.	0.0043
89.	0.2713	1644.	0.0045
90.	0.2687	1659.	0.0037
91.	0.2688	1674.	0.0047
92.	0.2666	1689.	0.0035
93.	0.2649	1704.	0.0033
94.	0.2632	1719.	0.0034
95.	0.2611	1734.	0.0042
96.	0.2595	1749.	0.0038

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
97.	0.2586	1764.	0.0049
98.	0.2566	1779.	0.0038
99.	0.255	1794.	0.0034
100.	0.2536	1809.	0.003
101.	0.2519	1824.	0.0036
102.	0.2504	1839.	0.0038
103.	0.2489	1854.	0.0038
104.	0.2472	1869.	0.0034
105.	0.2464	1884.	0.0032
106.	0.2444	1899.	0.0033
107.	0.2435	1914.	0.0028
108.	0.2424	1929.	0.0037
109.	0.241	1944.	0.0035
110.	0.2395	1959.	0.0027
111.	0.2379	1974.	0.0029
112.	0.2362	1989.	0.0033
113.	0.2352	2004.	0.0025
114.	0.2334	2019.	0.0036
115.	0.2139	2034.	0.0021
129.	0.1955	2049.	0.0032
144.	0.1801	2064.	0.003
159.	0.1659	2079.	0.0035
174.	0.1542	2094.	0.0033
189.	0.1411	2109.	0.0027
204.	0.1305	2124.	0.0026
219.	0.1205	2139.	0.0037
234.	0.1111	2154.	0.0028
249.	0.103	2169.	0.003
264.	0.0954	2184.	0.0049
279.	0.0883	2199.	0.0022
294.	0.0827	2214.	0.0027

SOLUTION

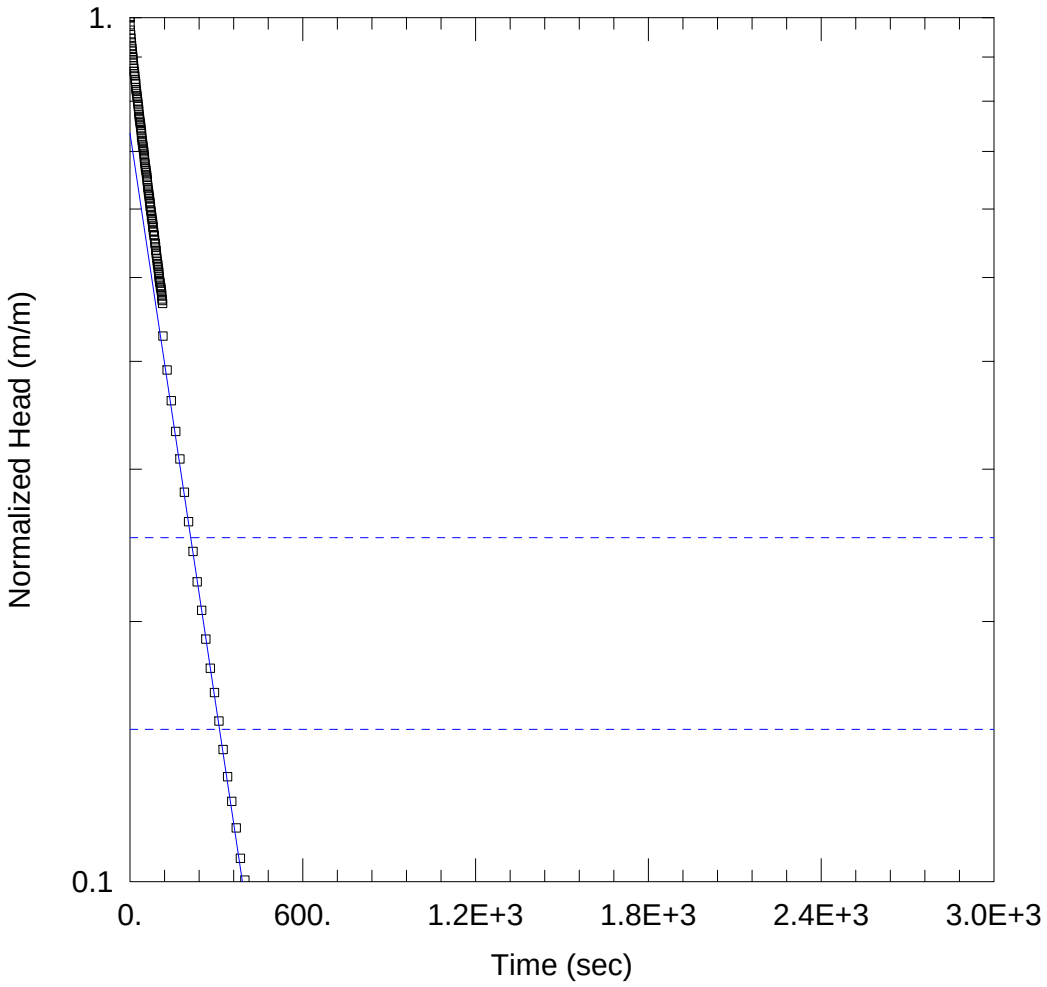
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.228

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	9.404E-7	m/sec
y0	0.3672	m

K = 9.404E-5 cm/sec
T = K*b = 4.702E-5 m²/sec (0.4702 sq. cm/sec)



MW-H24C (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H24C
Test Date: 21 July 2013

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H24C)

Initial Displacement: 0.5 m
Total Well Penetration Depth: 10.47 m
Casing Radius: 0.016 m
Static Water Column Height: 10.47 m
Screen Length: 3.05 m
Well Radius: 0.038 m

SOLUTION

Aquifer Model: Unconfined
K = 9.404E-7 m/sec
Solution Method: Hvorslev
y0 = 0.3672 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H25A (Rising Head Slug Test)
Date: 08/14/13
Time: 10:39:14

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 21 July 2013
Test Well: MW-H25A

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H25A

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.35 m
Static Water Column Height: 59.92 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 59.92 m

No. of Observations: 197

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.35	99.	0.0848
1.	0.3359	100.	0.0843
2.	0.3216	101.	0.0838
3.	0.3104	102.	0.0829
4.	0.2994	103.	0.0823
5.	0.2896	104.	0.0819
6.	0.2818	105.	0.0819
7.	0.2733	106.	0.0805
8.	0.2659	107.	0.0741
9.	0.2586	108.	0.0681
10.	0.2522	123.	0.0632
11.	0.2457	138.	0.0596
12.	0.24	153.	0.0555
13.	0.2342	168.	0.0522
14.	0.2288	183.	0.0492
15.	0.224	198.	0.0471
16.	0.2191	213.	0.045
17.	0.2145	228.	0.0421
18.	0.2099	243.	0.0405
19.	0.206	258.	0.0387
20.	0.2017	273.	0.0369
21.	0.1985	288.	0.036
22.	0.1946	303.	0.0335
23.	0.1914	318.	0.0327
24.	0.1878	333.	0.0314
25.	0.1841	348.	0.0302
26.	0.1814	363.	0.0293
27.	0.1785	378.	0.0282
28.	0.1759	393.	0.0269
29.	0.1728	408.	0.0263

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
30.	0.1698	423.	0.0258
31.	0.1679	438.	0.0247
32.	0.1649	453.	0.0243
33.	0.1624	468.	0.0227
34.	0.1598	483.	0.0224
35.	0.1576	498.	0.0214
36.	0.1551	513.	0.0209
37.	0.1531	528.	0.0204
38.	0.1511	543.	0.0203
39.	0.1488	558.	0.0193
40.	0.1473	573.	0.0185
41.	0.145	588.	0.0176
42.	0.1427	603.	0.018
43.	0.1409	618.	0.0169
44.	0.1394	633.	0.0167
45.	0.1371	648.	0.0153
46.	0.1356	663.	0.0156
47.	0.1343	678.	0.0148
48.	0.1325	693.	0.0147
49.	0.1313	708.	0.0136
50.	0.1294	723.	0.0133
51.	0.1282	738.	0.0129
52.	0.1271	753.	0.0125
53.	0.1254	768.	0.012
54.	0.1241	783.	0.0115
55.	0.1225	798.	0.0111
56.	0.1217	813.	0.0108
57.	0.1203	828.	0.0108
58.	0.1187	843.	0.0105
59.	0.1176	858.	0.0101
60.	0.1165	873.	0.0098
61.	0.1154	888.	0.0097
62.	0.1139	903.	0.0097
63.	0.1126	918.	0.0088
64.	0.1118	933.	0.008
65.	0.1106	948.	0.0082
66.	0.1101	963.	0.0087
67.	0.1091	978.	0.0078
68.	0.1077	993.	0.0073
69.	0.1073	1008.	0.0068
70.	0.1056	1023.	0.0064
71.	0.1049	1038.	0.0064
72.	0.1043	1053.	0.0065
73.	0.1033	1068.	0.0059
74.	0.1027	1083.	0.0063
75.	0.1016	1098.	0.0057
76.	0.1004	1113.	0.0059
77.	0.0999	1128.	0.0054
78.	0.0994	1143.	0.0054
79.	0.098	1158.	0.0049
80.	0.0973	1173.	0.0045
81.	0.0962	1188.	0.0041
82.	0.096	1203.	0.0045
83.	0.0947	1218.	0.0042
84.	0.0946	1233.	0.0041
85.	0.0936	1248.	0.0039
86.	0.093	1263.	0.0039
87.	0.092	1278.	0.0038
88.	0.0915	1293.	0.0039
89.	0.0905	1308.	0.0035
90.	0.0903	1323.	0.0029
91.	0.0897	1338.	0.0029
92.	0.0884	1353.	0.003
93.	0.0884	1368.	0.0032
94.	0.0879	1383.	0.0031
95.	0.0862	1398.	0.0022
96.	0.0867	1413.	0.0024

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
97.	0.0863	1428.	0.0024
98.	0.0849		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	4.258E-7	m/sec
y0	0.07041	m

K = 4.258E-5 cm/sec
T = K*b = 4.258E-5 m²/sec (0.4258 sq. cm/sec)

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H25A Zone 1 (Falling Head Packer Test, vertical interval 58.5-69.2 m)
Date: 08/15/13
Time: 13:38:12

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 31 October 2012
Test Well: MW-H25A Zone 1

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H25A Zone 1

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.5 m
Static Water Column Height: 68.3 m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 10.7 m
Total Well Penetration Depth: 68.3 m

No. of Observations: 93

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.5	1410.	0.1645
30.	1.197	1440.	0.1616
60.	1.011	1470.	0.1583
90.	0.8819	1500.	0.155
120.	0.7867	1530.	0.1522
150.	0.7108	1560.	0.1494
180.	0.6526	1590.	0.1448
210.	0.6039	1620.	0.1431
240.	0.5638	1650.	0.1393
270.	0.5301	1680.	0.1368
300.	0.5007	1710.	0.1349
330.	0.4752	1740.	0.1325
360.	0.4501	1770.	0.1298
390.	0.4298	1800.	0.1269
420.	0.4111	1830.	0.1253
450.	0.395	1860.	0.1219
480.	0.38	1890.	0.1196
510.	0.3661	1920.	0.1173
540.	0.3531	1950.	0.1147
570.	0.3402	1980.	0.1131
600.	0.3284	2010.	0.1103
630.	0.3182	2040.	0.1093
660.	0.3076	2070.	0.1069
690.	0.2983	2100.	0.1052
720.	0.2896	2130.	0.1025
750.	0.2809	2160.	0.1011
780.	0.2726	2190.	0.0986
810.	0.2639	2220.	0.0972
840.	0.2572	2250.	0.0954
870.	0.2501	2280.	0.0947

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	0.2435	2310.	0.0926
930.	0.2374	2340.	0.0918
960.	0.2317	2370.	0.0894
990.	0.2258	2400.	0.0884
1020.	0.2203	2430.	0.086
1050.	0.2149	2460.	0.0841
1080.	0.21	2490.	0.082
1110.	0.2047	2520.	0.0803
1140.	0.2002	2550.	0.0788
1170.	0.1957	2580.	0.0778
1200.	0.1921	2610.	0.0759
1230.	0.1874	2640.	0.0729
1260.	0.1826	2670.	0.0712
1290.	0.1789	2700.	0.0698
1320.	0.1735	2730.	0.0688
1350.	0.1712	2760.	0.0666
1380.	0.1677		

SOLUTION

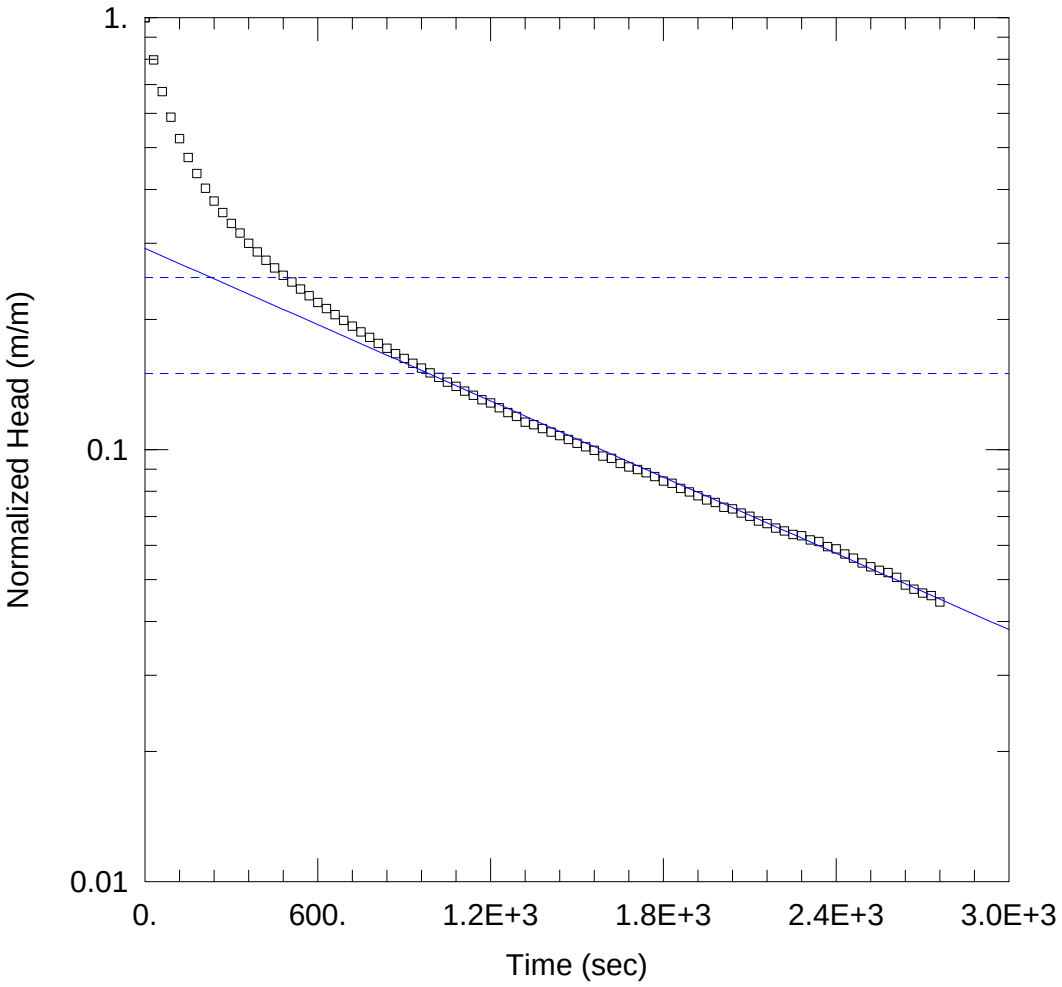
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1773

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	2.578E-7	m/sec
y0	0.4382	m

K = 2.578E-5 cm/sec
T = K*b = 2.578E-5 m²/sec (0.2578 sq. cm/sec)



MW-H25A ZONE 1 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 58.5-69.2 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H25A Zone 1
Test Date: 31 October 2012

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 2.578E-7 m/sec
y0 = 0.4382 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H25A Zone 2 (Falling Head Packer Test, vertical interval 69.2-79.9 m)
Date: 08/14/13
Time: 14:22:50

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 31 October 2012
Test Well: MW-H25A Zone 2

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H25A Zone 2

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.8 m
Static Water Column Height: 77.63 m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 10.7 m
Total Well Penetration Depth: 77.63 m

No. of Observations: 124

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	2.8	1860.	2.6
30.	2.787	1890.	2.598
60.	2.778	1920.	2.596
90.	2.771	1950.	2.593
120.	2.765	1980.	2.591
150.	2.76	2010.	2.59
180.	2.754	2040.	2.588
210.	2.749	2070.	2.585
240.	2.745	2100.	2.583
270.	2.74	2130.	2.581
300.	2.737	2160.	2.579
330.	2.733	2190.	2.577
360.	2.729	2220.	2.575
390.	2.726	2250.	2.573
420.	2.722	2280.	2.571
450.	2.719	2310.	2.569
480.	2.715	2340.	2.567
510.	2.712	2370.	2.565
540.	2.71	2400.	2.563
570.	2.706	2430.	2.561
600.	2.704	2460.	2.559
630.	2.7	2490.	2.556
660.	2.698	2520.	2.555
690.	2.695	2550.	2.552
720.	2.692	2580.	2.551
750.	2.689	2610.	2.549
780.	2.686	2640.	2.547
810.	2.684	2670.	2.546
840.	2.681	2700.	2.544
870.	2.678	2730.	2.542

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	2.676	2760.	2.54
930.	2.675	2790.	2.539
960.	2.671	2820.	2.536
990.	2.668	2850.	2.535
1020.	2.665	2880.	2.533
1050.	2.663	2910.	2.53
1080.	2.66	2940.	2.529
1110.	2.658	2970.	2.528
1140.	2.655	3000.	2.526
1170.	2.652	3030.	2.524
1200.	2.65	3060.	2.522
1230.	2.649	3090.	2.52
1260.	2.646	3120.	2.518
1290.	2.644	3150.	2.515
1320.	2.641	3180.	2.513
1350.	2.639	3210.	2.512
1380.	2.636	3240.	2.511
1410.	2.634	3270.	2.509
1440.	2.632	3300.	2.507
1470.	2.629	3330.	2.504
1500.	2.627	3360.	2.503
1530.	2.624	3390.	2.5
1560.	2.622	3420.	2.499
1590.	2.621	3450.	2.498
1620.	2.618	3480.	2.496
1650.	2.616	3510.	2.494
1680.	2.614	3540.	2.491
1710.	2.612	3570.	2.49
1740.	2.61	3600.	2.489
1770.	2.607	3630.	2.487
1800.	2.606	3660.	2.486
1830.	2.603	3690.	2.478

SOLUTION

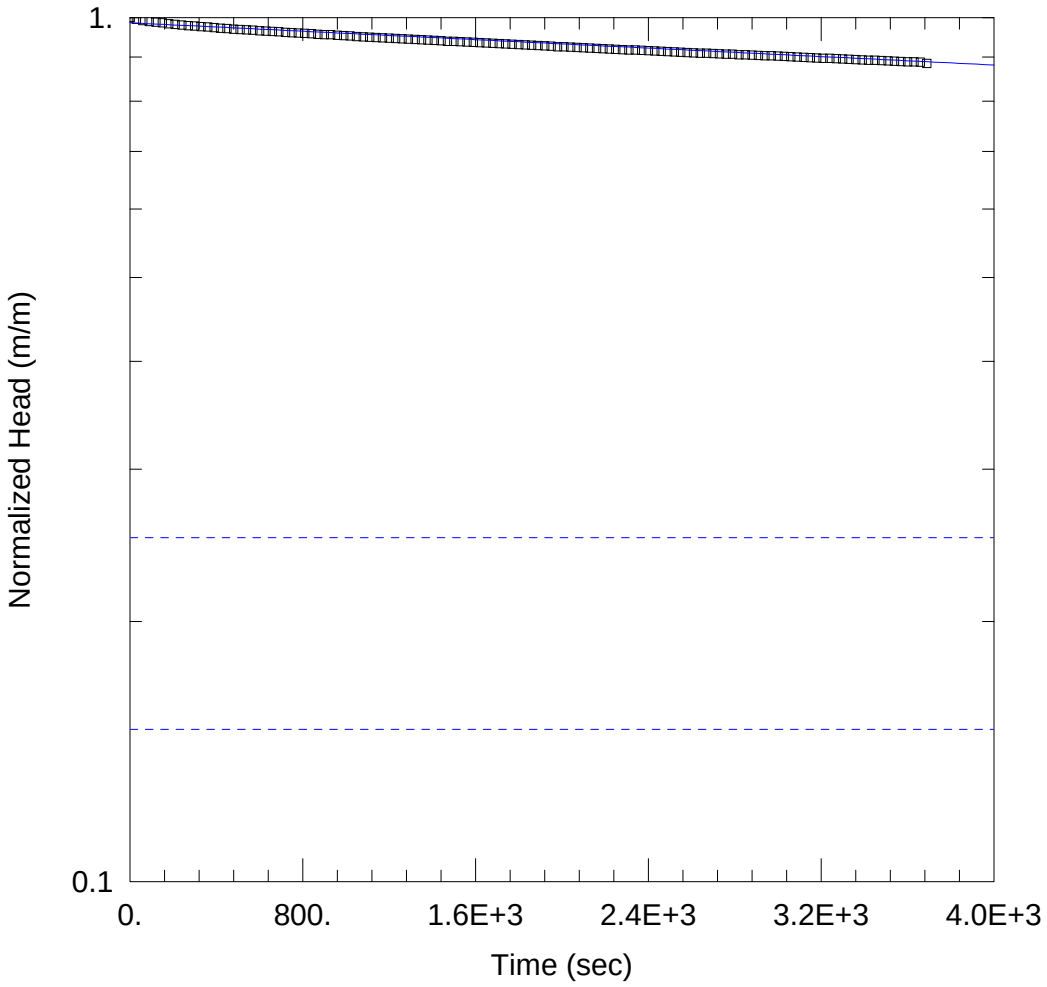
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1773

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.071E-8	m/sec
y0	2.761	m

K = 1.071E-6 cm/sec
T = K*b = 1.071E-6 m²/sec (0.01071 sq. cm/sec)



MW-H25A ZONE 2 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 69.2-79.9 M)

PROJECT INFORMATION

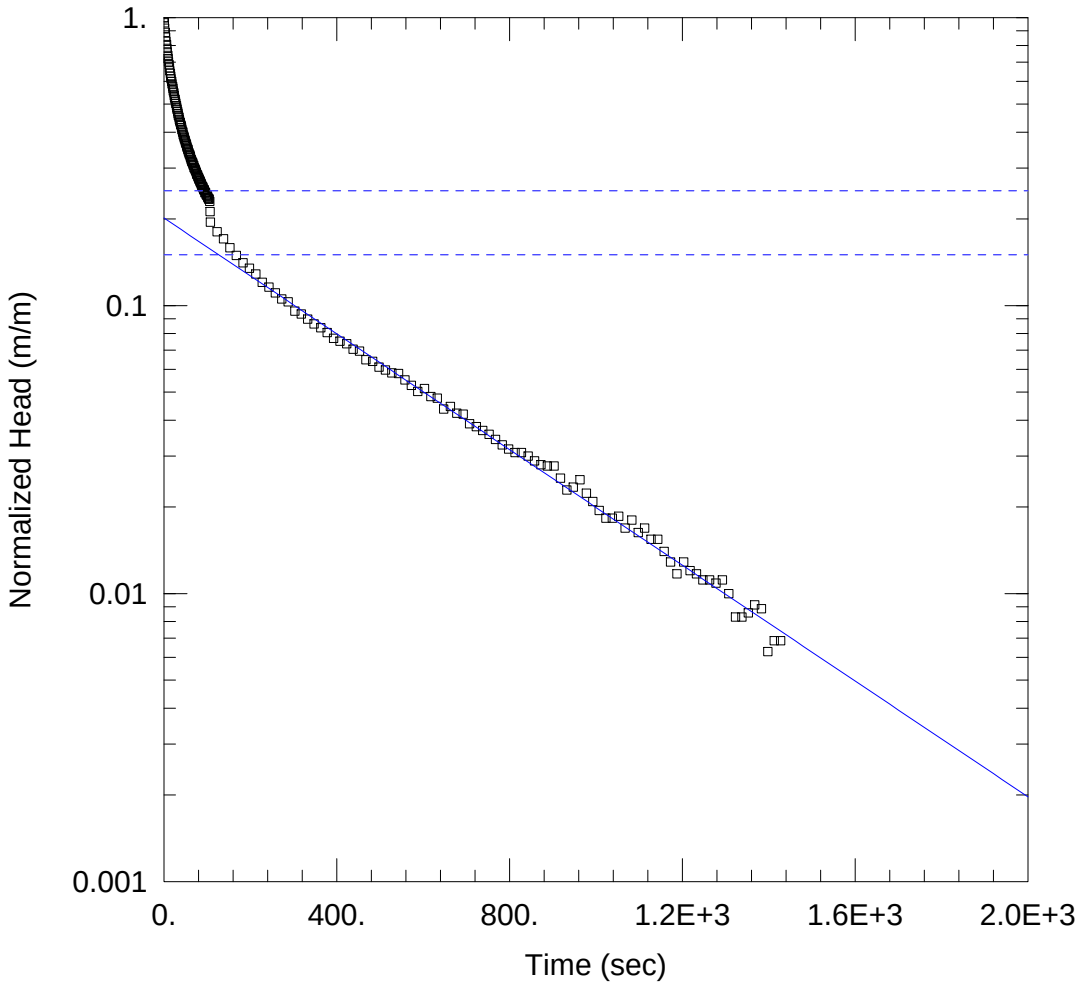
Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H25A Zone 2
Test Date: 31 October 2012

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 1.071E-8 m/sec
y0 = 2.761 m



MW-H25A (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H25A
Test Date: 21 July 2013

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H25A)

Initial Displacement: 0.35 m
Total Well Penetration Depth: 59.92 m
Casing Radius: 0.016 m
Static Water Column Height: 59.92 m
Screen Length: 3.05 m
Well Radius: 0.038 m

SOLUTION

Aquifer Model: Confined
K = 4.258E-7 m/sec
Solution Method: Hvorslev
y0 = 0.07041 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H25B (Rising Head Slug Test)
Date: 08/14/13
Time: 10:57:20

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 24 October 2012
Test Well: MW-H25B

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H25B

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.13 m
Static Water Column Height: 4.068 m
Casing Radius: 0.016 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 4.113 m

No. of Observations: 101

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.13	255.	0.0327
5.	0.1159	260.	0.0322
10.	0.1097	265.	0.0311
15.	0.1043	270.	0.0306
20.	0.1012	275.	0.0299
25.	0.0983	280.	0.0296
30.	0.0944	285.	0.0299
35.	0.0915	290.	0.0283
40.	0.0874	295.	0.0273
45.	0.0858	300.	0.0272
50.	0.0828	305.	0.0266
55.	0.0807	310.	0.0256
60.	0.079	315.	0.025
65.	0.0768	320.	0.0251
70.	0.0742	325.	0.0243
75.	0.0721	330.	0.025
80.	0.0716	335.	0.0245
85.	0.0695	340.	0.0228
90.	0.0683	345.	0.0228
95.	0.0656	350.	0.0236
100.	0.0641	355.	0.0221
105.	0.0624	360.	0.0215
110.	0.0605	365.	0.0213
115.	0.0593	370.	0.0209
120.	0.0583	375.	0.0198
125.	0.0573	380.	0.0193
130.	0.0554	385.	0.0193
135.	0.055	390.	0.0202
140.	0.0526	395.	0.0183
145.	0.0516	400.	0.0188

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
150.	0.0513	405.	0.0184
155.	0.0488	410.	0.0184
160.	0.0483	415.	0.0171
165.	0.0482	420.	0.0177
170.	0.0462	425.	0.0167
175.	0.0456	430.	0.0161
180.	0.0432	435.	0.0161
185.	0.0434	440.	0.0151
190.	0.0426	445.	0.0157
195.	0.041	450.	0.0154
200.	0.0411	455.	0.0147
205.	0.0399	460.	0.0152
210.	0.039	465.	0.0144
215.	0.0374	470.	0.0141
220.	0.0375	475.	0.0133
225.	0.0368	480.	0.0134
230.	0.0365	485.	0.0131
235.	0.0353	490.	0.0127
240.	0.0346	495.	0.0122
245.	0.034	500.	0.0119
250.	0.0331		

SOLUTION

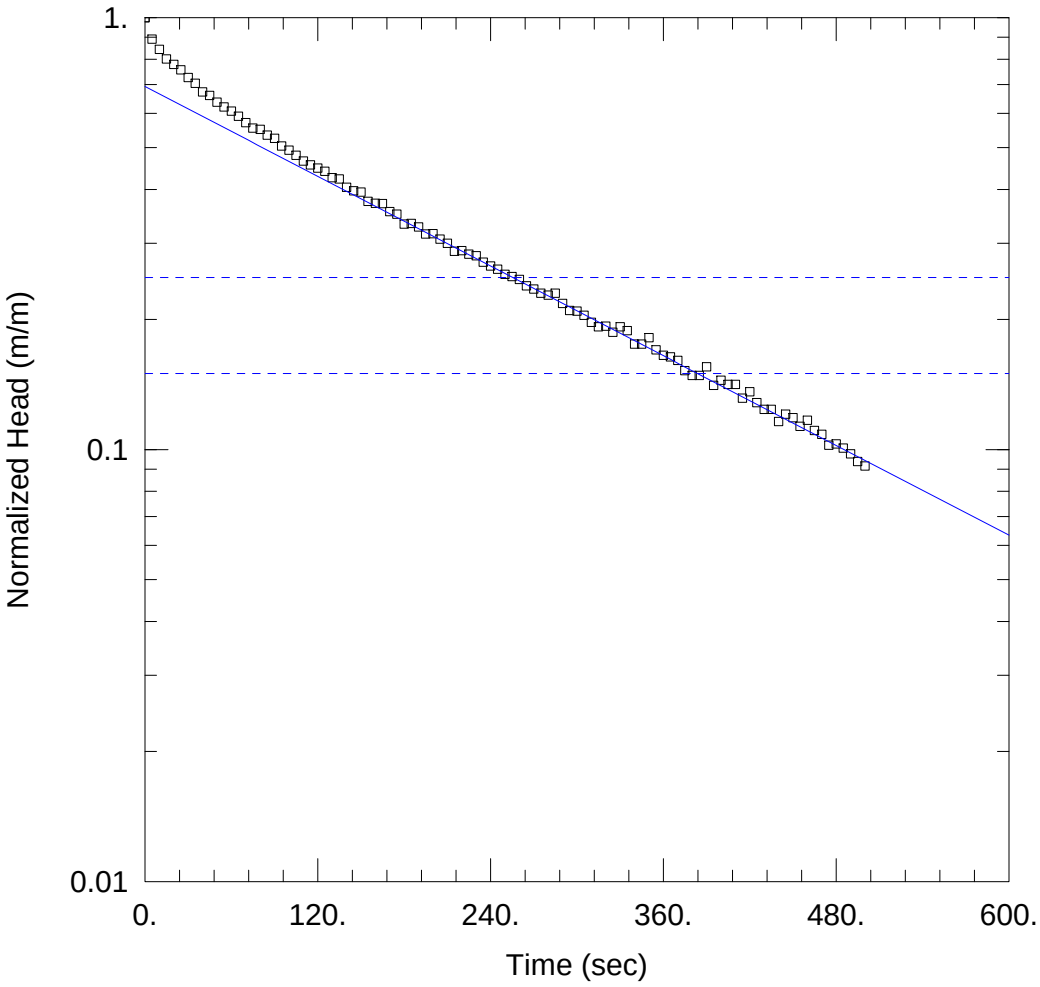
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.2462

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	6.795E-7	m/sec
y0	0.08998	m

K = 6.795E-5 cm/sec
T = K*b = 3.397E-5 m²/sec (0.3397 sq. cm/sec)



MW-H25B (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H25B
Test Date: 24 October 2012

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H25B)

Initial Displacement: 0.13 m
Total Well Penetration Depth: 4.113 m
Casing Radius: 0.016 m
Static Water Column Height: 4.068 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

SOLUTION

Aquifer Model: Unconfined
K = 6.795E-7 m/sec
Solution Method: Hvorslev
y0 = 0.08998 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H26A (Rising Head Slug Test)
Date: 08/14/13
Time: 10:59:00

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 21 July 2013
Test Well: MW-H26A

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H26A

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.4 m
Static Water Column Height: 32.45 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 32.45 m

No. of Observations: 55

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.4	420.	0.0081
15.	0.3446	435.	0.0068
30.	0.2984	450.	0.0057
45.	0.2583	465.	0.005
60.	0.2232	480.	0.004
75.	0.1926	495.	0.0038
90.	0.1664	510.	0.0034
105.	0.145	525.	0.0029
120.	0.1249	540.	0.0018
135.	0.1078	555.	0.0026
150.	0.0938	570.	0.0019
165.	0.0808	585.	0.0017
180.	0.0705	600.	0.0012
195.	0.0611	615.	0.0014
210.	0.0526	630.	0.0017
225.	0.0459	645.	0.0016
240.	0.0398	660.	0.0013
255.	0.0343	675.	0.0015
270.	0.0299	690.	0.0011
285.	0.0256	705.	0.0016
300.	0.0223	720.	0.0011
315.	0.0198	735.	0.0008
330.	0.0174	750.	0.0009
345.	0.0152	765.	0.0009
360.	0.0134	780.	0.0008
375.	0.0115	795.	0.0006
390.	0.01	810.	0.0012
405.	0.009		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.746E-6	m/sec
y0	0.3936	m

K = 0.0001746 cm/sec
T = K*b = 0.0001746 m²/sec (1.746 sq. cm/sec)

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H26A Zone 1 (Falling Head Packer Test, vertical interval 34.1-48.5 m)
Date: 08/14/13
Time: 14:20:48

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ldt.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 26 October 2012
Test Well: MW-H26A Zone 1

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H26A Zone 1

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.3 m
Static Water Column Height: 48.9 m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 14.4 m
Total Well Penetration Depth: 48.9 m

No. of Observations: 92

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.3	1380.	0.1643
30.	0.2688	1410.	0.1684
60.	0.2548	1440.	0.1632
90.	0.2397	1470.	0.1647
120.	0.2328	1500.	0.1607
150.	0.2248	1530.	0.162
180.	0.2235	1560.	0.1613
210.	0.2183	1590.	0.1571
240.	0.2165	1620.	0.1592
270.	0.2128	1650.	0.1534
300.	0.2114	1680.	0.1578
330.	0.2141	1710.	0.151
360.	0.2104	1740.	0.151
390.	0.2093	1770.	0.1519
420.	0.2072	1800.	0.1477
450.	0.2045	1830.	0.1497
480.	0.2053	1860.	0.1438
510.	0.2022	1890.	0.1475
540.	0.2014	1920.	0.1455
570.	0.199	1950.	0.1403
600.	0.1972	1980.	0.1444
630.	0.197	2010.	0.139
660.	0.1925	2040.	0.1414
690.	0.195	2070.	0.1383
720.	0.1917	2100.	0.136
750.	0.1902	2130.	0.1389
780.	0.1902	2160.	0.1314
810.	0.1877	2190.	0.1351
840.	0.1882	2220.	0.133
870.	0.1842	2250.	0.1302

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	0.1844	2280.	0.1317
930.	0.1832	2310.	0.1254
960.	0.18	2340.	0.1302
990.	0.1822	2370.	0.1247
1020.	0.1777	2400.	0.1257
1050.	0.1796	2430.	0.1262
1080.	0.1764	2460.	0.1214
1110.	0.1761	2490.	0.1258
1140.	0.1749	2520.	0.1183
1170.	0.1726	2550.	0.1221
1200.	0.1743	2580.	0.1204
1230.	0.1709	2610.	0.114
1260.	0.1727	2640.	0.1205
1290.	0.1682	2670.	0.114
1320.	0.1677	2700.	0.1154
1350.	0.1688	2730.	0.1132

SOLUTION

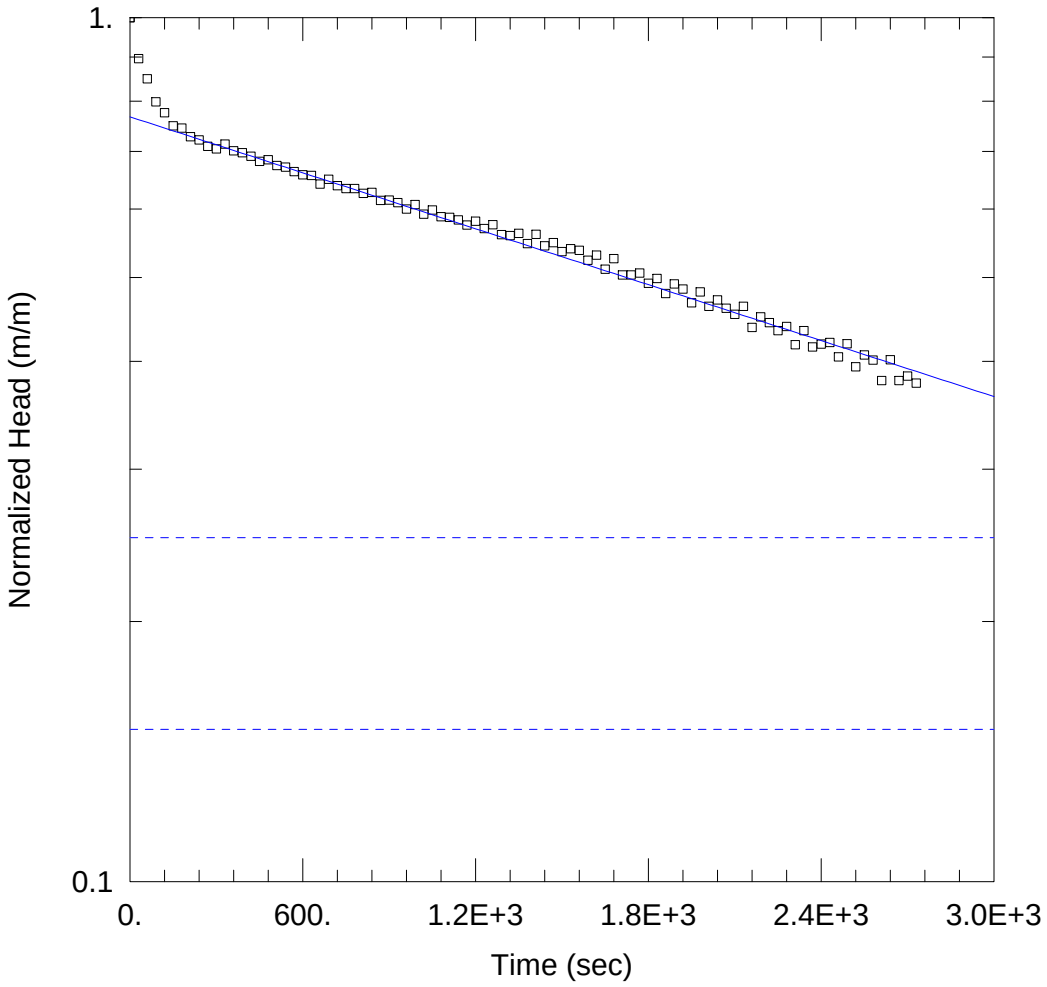
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1684

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	7.396E-8	m/sec
y0	0.2302	m

K = 7.396E-6 cm/sec
T = K*b = 7.396E-6 m²/sec (0.07396 sq. cm/sec)



MW-H26A ZONE 1 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 34.1-48.5 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ldt.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H26A Zone 1
Test Date: 26 October 2012

AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 7.396E-8 m/sec

y0 = 0.2302 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H26A Zone 2 (Falling Head Packer Test, vertical interval 49.7-64.3 m)
Date: 08/14/13
Time: 14:31:53

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 27 October 2012
Test Well: MW-H26A Zone 2

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H26A Zone 2

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.45 m
Static Water Column Height: 65. m
Casing Radius: 0.038 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 14.6 m
Total Well Penetration Depth: 65. m

No. of Observations: 44

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.45	660.	0.6905
30.	1.396	690.	0.6632
60.	1.346	720.	0.6369
90.	1.304	750.	0.6113
120.	1.261	780.	0.585
150.	1.222	810.	0.5598
180.	1.184	840.	0.5341
210.	1.149	870.	0.51
240.	1.111	900.	0.4838
270.	1.08	930.	0.4599
300.	1.044	960.	0.4346
330.	1.013	990.	0.4158
360.	0.9773	1020.	0.3905
390.	0.9488	1050.	0.3672
420.	0.9213	1080.	0.3475
450.	0.8895	1110.	0.3227
480.	0.8549	1140.	0.299
510.	0.827	1170.	0.2777
540.	0.8016	1200.	0.2592
570.	0.7734	1230.	0.2363
600.	0.743	1260.	0.2151
630.	0.7176	1290.	0.1962

SOLUTION

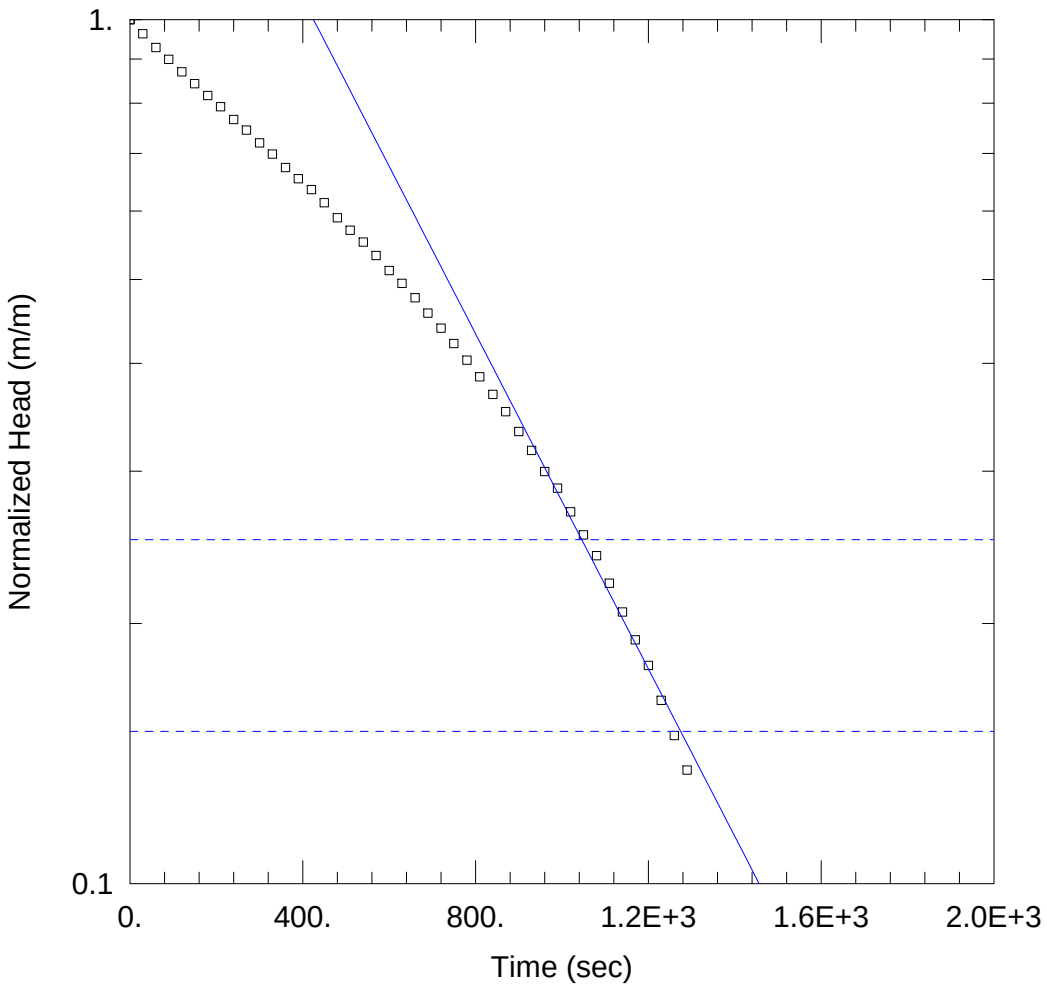
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.168

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	6.569E-7	m/sec
y0	3.742	m

K = 6.569E-5 cm/sec
T = K*b = 6.569E-5 m²/sec (0.6569 sq. cm/sec)



MW-H26A ZONE 2 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 49.7-64.3 M)

PROJECT INFORMATION

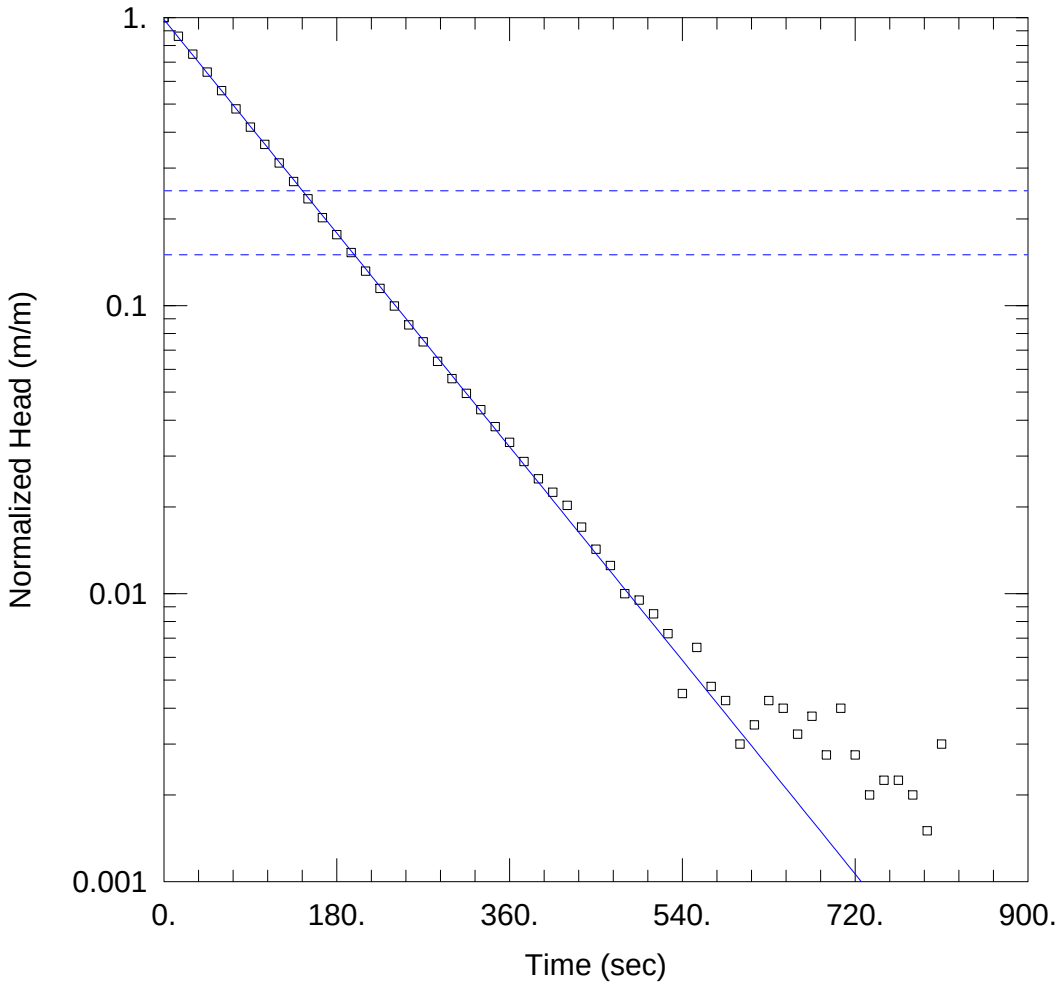
Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-H26A Zone 2
Test Date: 27 October 2012

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 6.569E-7 m/sec
y0 = 3.742 m



MW-H26A (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H26A
Test Date: 21 July 2013

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H26A)

Initial Displacement: 0.4 m
Total Well Penetration Depth: 32.45 m
Casing Radius: 0.016 m
Static Water Column Height: 32.45 m
Screen Length: 3.05 m
Well Radius: 0.038 m

SOLUTION

Aquifer Model: Confined
K = 1.746E-6 m/sec
Solution Method: Hvorslev
y0 = 0.3936 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H26B (Rising Head Slug Test)
Date: 08/14/13
Time: 11:09:31

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Date: 31 October 2012
Test Well: MW-26B

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H26B

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.3 m
Static Water Column Height: 3.6 m
Casing Radius: 0.016 m
Well Radius: 0.0525 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 3.6 m

No. of Observations: 898

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.3	2.694E+4	0.1567
60.	0.2985	2.7E+4	0.1558
120.	0.2989	2.706E+4	0.1559
180.	0.2981	2.712E+4	0.1553
240.	0.2966	2.718E+4	0.1551
300.	0.2963	2.724E+4	0.1552
360.	0.2951	2.73E+4	0.1547
420.	0.295	2.736E+4	0.154
480.	0.2951	2.742E+4	0.1532
540.	0.296	2.748E+4	0.1534
600.	0.2956	2.754E+4	0.1532
660.	0.2938	2.76E+4	0.1527
720.	0.2931	2.766E+4	0.1533
780.	0.2929	2.772E+4	0.1524
840.	0.2944	2.778E+4	0.1512
900.	0.2935	2.784E+4	0.151
960.	0.2932	2.79E+4	0.1508
1020.	0.2918	2.796E+4	0.1503
1080.	0.2922	2.802E+4	0.1508
1140.	0.2914	2.808E+4	0.1496
1200.	0.2917	2.814E+4	0.1496
1260.	0.2906	2.82E+4	0.149
1320.	0.2902	2.826E+4	0.1494
1380.	0.2899	2.832E+4	0.1483
1440.	0.2891	2.838E+4	0.1485
1500.	0.2892	2.844E+4	0.1487
1560.	0.2883	2.85E+4	0.1478
1620.	0.2886	2.856E+4	0.1476
1680.	0.2879	2.862E+4	0.1468
1740.	0.2867	2.868E+4	0.1462

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1800.	0.287	2.874E+4	0.1457
1860.	0.2871	2.88E+4	0.1458
1920.	0.2858	2.886E+4	0.1448
1980.	0.2858	2.892E+4	0.1455
2040.	0.2855	2.898E+4	0.1439
2100.	0.2851	2.904E+4	0.1444
2160.	0.2842	2.91E+4	0.1442
2220.	0.2842	2.916E+4	0.1438
2280.	0.2839	2.922E+4	0.1425
2340.	0.2824	2.928E+4	0.1423
2400.	0.2826	2.934E+4	0.1423
2460.	0.2822	2.94E+4	0.1422
2520.	0.2812	2.946E+4	0.1425
2580.	0.2802	2.952E+4	0.1412
2640.	0.2797	2.958E+4	0.1414
2700.	0.2794	2.964E+4	0.1405
2760.	0.2795	2.97E+4	0.1405
2820.	0.2793	2.976E+4	0.1402
2880.	0.2792	2.982E+4	0.1398
2940.	0.2778	2.988E+4	0.1397
3000.	0.2775	2.994E+4	0.1398
3060.	0.2767	3.0E+4	0.1391
3120.	0.2772	3.006E+4	0.1399
3180.	0.2764	3.012E+4	0.1399
3240.	0.2763	3.018E+4	0.1388
3300.	0.2756	3.024E+4	0.1379
3360.	0.274	3.03E+4	0.1387
3420.	0.2746	3.036E+4	0.1391
3480.	0.2735	3.042E+4	0.1388
3540.	0.2732	3.048E+4	0.1383
3600.	0.273	3.054E+4	0.1367
3660.	0.2726	3.06E+4	0.1379
3720.	0.2716	3.066E+4	0.1374
3780.	0.2707	3.072E+4	0.1374
3840.	0.2711	3.078E+4	0.1373
3900.	0.2702	3.084E+4	0.1366
3960.	0.2701	3.09E+4	0.1361
4020.	0.2696	3.096E+4	0.1352
4080.	0.2699	3.102E+4	0.1352
4140.	0.2688	3.108E+4	0.1351
4200.	0.2692	3.114E+4	0.136
4260.	0.2674	3.12E+4	0.1349
4320.	0.2671	3.126E+4	0.1346
4380.	0.2659	3.132E+4	0.1346
4440.	0.2659	3.138E+4	0.1339
4500.	0.2659	3.144E+4	0.1337
4560.	0.2656	3.15E+4	0.1333
4620.	0.2647	3.156E+4	0.1329
4680.	0.2639	3.162E+4	0.1331
4740.	0.2633	3.168E+4	0.1317
4800.	0.2629	3.174E+4	0.132
4860.	0.2619	3.18E+4	0.1315
4920.	0.2614	3.186E+4	0.1313
4980.	0.2616	3.192E+4	0.1308
5040.	0.2611	3.198E+4	0.1309
5100.	0.2607	3.204E+4	0.1302
5160.	0.2591	3.21E+4	0.1301
5220.	0.2596	3.216E+4	0.1304
5280.	0.2589	3.222E+4	0.1298
5340.	0.2568	3.228E+4	0.1281
5400.	0.2574	3.234E+4	0.1286
5460.	0.2568	3.24E+4	0.1289
5520.	0.2557	3.246E+4	0.1272
5580.	0.2556	3.252E+4	0.1276
5640.	0.2549	3.258E+4	0.1276
5700.	0.2555	3.264E+4	0.1279
5760.	0.2545	3.27E+4	0.1263

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
5820.	0.2545	3.276E+4	0.1263
5880.	0.253	3.282E+4	0.1259
5940.	0.2535	3.288E+4	0.1261
6000.	0.2526	3.294E+4	0.1253
6060.	0.2524	3.3E+4	0.1257
6120.	0.2512	3.306E+4	0.1246
6180.	0.2514	3.312E+4	0.1245
6240.	0.251	3.318E+4	0.1244
6300.	0.2506	3.324E+4	0.1238
6360.	0.2502	3.33E+4	0.1238
6420.	0.2498	3.336E+4	0.1238
6480.	0.2487	3.342E+4	0.1237
6540.	0.2483	3.348E+4	0.1226
6600.	0.2469	3.354E+4	0.1217
6660.	0.2468	3.36E+4	0.1222
6720.	0.2478	3.366E+4	0.123
6780.	0.2474	3.372E+4	0.1223
6840.	0.2473	3.378E+4	0.1215
6900.	0.2475	3.384E+4	0.1224
6960.	0.247	3.39E+4	0.1213
7020.	0.2467	3.396E+4	0.1218
7080.	0.2452	3.402E+4	0.1205
7140.	0.245	3.408E+4	0.1208
7200.	0.2449	3.414E+4	0.1205
7260.	0.2448	3.42E+4	0.1197
7320.	0.2454	3.426E+4	0.1201
7380.	0.2448	3.432E+4	0.1195
7440.	0.2449	3.438E+4	0.1189
7500.	0.2447	3.444E+4	0.1193
7560.	0.2442	3.45E+4	0.1187
7620.	0.2429	3.456E+4	0.1191
7680.	0.2433	3.462E+4	0.1174
7740.	0.2435	3.468E+4	0.1184
7800.	0.2421	3.474E+4	0.1172
7860.	0.2432	3.48E+4	0.1178
7920.	0.2426	3.486E+4	0.1167
7980.	0.2425	3.492E+4	0.1165
8040.	0.2431	3.498E+4	0.1167
8100.	0.2421	3.504E+4	0.1162
8160.	0.2416	3.51E+4	0.1161
8220.	0.242	3.516E+4	0.1156
8280.	0.2413	3.522E+4	0.1149
8340.	0.242	3.528E+4	0.1149
8400.	0.2412	3.534E+4	0.1154
8460.	0.2401	3.54E+4	0.1153
8520.	0.2404	3.546E+4	0.1144
8580.	0.2398	3.552E+4	0.1141
8640.	0.2397	3.558E+4	0.1145
8700.	0.2398	3.564E+4	0.1136
8760.	0.2401	3.57E+4	0.1135
8820.	0.2387	3.576E+4	0.113
8880.	0.2389	3.582E+4	0.1116
8940.	0.2379	3.588E+4	0.1116
9000.	0.2378	3.594E+4	0.1116
9060.	0.2383	3.6E+4	0.1117
9120.	0.2384	3.606E+4	0.1113
9180.	0.2372	3.612E+4	0.1111
9240.	0.2379	3.618E+4	0.1112
9300.	0.2363	3.624E+4	0.1111
9360.	0.2363	3.63E+4	0.1103
9420.	0.2354	3.636E+4	0.11
9480.	0.2351	3.642E+4	0.1102
9540.	0.2348	3.648E+4	0.1093
9600.	0.2347	3.654E+4	0.1097
9660.	0.2342	3.66E+4	0.1088
9720.	0.2349	3.666E+4	0.1091
9780.	0.2342	3.672E+4	0.109

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
9840.	0.2348	3.678E+4	0.1088
9900.	0.2342	3.684E+4	0.1073
9960.	0.235	3.69E+4	0.1074
1.002E+4	0.2339	3.696E+4	0.1074
1.008E+4	0.2337	3.702E+4	0.1062
1.014E+4	0.2334	3.708E+4	0.1071
1.02E+4	0.2331	3.714E+4	0.1069
1.026E+4	0.2333	3.72E+4	0.1055
1.032E+4	0.2326	3.726E+4	0.1057
1.038E+4	0.233	3.732E+4	0.1056
1.044E+4	0.2321	3.738E+4	0.1056
1.05E+4	0.2321	3.744E+4	0.1053
1.056E+4	0.2313	3.75E+4	0.1046
1.062E+4	0.2305	3.756E+4	0.1037
1.068E+4	0.2307	3.762E+4	0.1036
1.074E+4	0.2309	3.768E+4	0.1041
1.08E+4	0.2304	3.774E+4	0.1037
1.086E+4	0.2297	3.78E+4	0.1035
1.092E+4	0.2299	3.786E+4	0.1031
1.098E+4	0.2287	3.792E+4	0.1023
1.104E+4	0.2294	3.798E+4	0.1023
1.11E+4	0.2291	3.804E+4	0.1026
1.116E+4	0.2282	3.81E+4	0.102
1.122E+4	0.2283	3.816E+4	0.102
1.128E+4	0.2275	3.822E+4	0.1015
1.134E+4	0.2268	3.828E+4	0.1023
1.14E+4	0.227	3.834E+4	0.1002
1.146E+4	0.2265	3.84E+4	0.1008
1.152E+4	0.2269	3.846E+4	0.1001
1.158E+4	0.2268	3.852E+4	0.1005
1.164E+4	0.2258	3.858E+4	0.0994
1.17E+4	0.2259	3.864E+4	0.0995
1.176E+4	0.2251	3.87E+4	0.0995
1.182E+4	0.2244	3.876E+4	0.0991
1.188E+4	0.2251	3.882E+4	0.0977
1.194E+4	0.2244	3.888E+4	0.0987
1.2E+4	0.2245	3.894E+4	0.0988
1.206E+4	0.224	3.9E+4	0.0981
1.212E+4	0.2231	3.906E+4	0.0979
1.218E+4	0.2231	3.912E+4	0.0973
1.224E+4	0.2227	3.918E+4	0.0974
1.23E+4	0.2226	3.924E+4	0.0968
1.236E+4	0.222	3.93E+4	0.0964
1.242E+4	0.2231	3.936E+4	0.096
1.248E+4	0.2219	3.942E+4	0.0965
1.254E+4	0.2215	3.948E+4	0.0956
1.26E+4	0.2213	3.954E+4	0.0952
1.266E+4	0.2212	3.96E+4	0.0962
1.272E+4	0.2206	3.966E+4	0.0954
1.278E+4	0.2215	3.972E+4	0.0945
1.284E+4	0.2211	3.978E+4	0.0949
1.29E+4	0.2212	3.984E+4	0.0946
1.296E+4	0.2203	3.99E+4	0.093
1.302E+4	0.2195	3.996E+4	0.0945
1.308E+4	0.2194	4.002E+4	0.0929
1.314E+4	0.218	4.008E+4	0.0937
1.32E+4	0.2183	4.014E+4	0.0924
1.326E+4	0.2185	4.02E+4	0.0917
1.332E+4	0.2181	4.026E+4	0.0918
1.338E+4	0.2175	4.032E+4	0.0918
1.344E+4	0.2164	4.038E+4	0.0911
1.35E+4	0.2159	4.044E+4	0.0905
1.356E+4	0.2165	4.05E+4	0.0905
1.362E+4	0.216	4.056E+4	0.09
1.368E+4	0.2159	4.062E+4	0.0901
1.374E+4	0.2155	4.068E+4	0.0894
1.38E+4	0.2155	4.074E+4	0.0895

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.386E+4	0.2144	4.08E+4	0.0888
1.392E+4	0.2149	4.086E+4	0.0886
1.398E+4	0.2142	4.092E+4	0.0881
1.404E+4	0.2138	4.098E+4	0.088
1.41E+4	0.2137	4.104E+4	0.0872
1.416E+4	0.2135	4.11E+4	0.0877
1.422E+4	0.2141	4.116E+4	0.087
1.428E+4	0.2129	4.122E+4	0.0859
1.434E+4	0.2133	4.128E+4	0.0863
1.44E+4	0.213	4.134E+4	0.0867
1.446E+4	0.2127	4.14E+4	0.0856
1.452E+4	0.2115	4.146E+4	0.0851
1.458E+4	0.2116	4.152E+4	0.0858
1.464E+4	0.2122	4.158E+4	0.0861
1.47E+4	0.2112	4.164E+4	0.085
1.476E+4	0.2115	4.17E+4	0.0839
1.482E+4	0.2107	4.176E+4	0.0838
1.488E+4	0.2095	4.182E+4	0.0835
1.494E+4	0.2101	4.188E+4	0.0828
1.5E+4	0.21	4.194E+4	0.0825
1.506E+4	0.2099	4.2E+4	0.0828
1.512E+4	0.2092	4.206E+4	0.0815
1.518E+4	0.2084	4.212E+4	0.0824
1.524E+4	0.2087	4.218E+4	0.0818
1.53E+4	0.2082	4.224E+4	0.0813
1.536E+4	0.2084	4.23E+4	0.0812
1.542E+4	0.2089	4.236E+4	0.0799
1.548E+4	0.2075	4.242E+4	0.0804
1.554E+4	0.2084	4.248E+4	0.0805
1.56E+4	0.2077	4.254E+4	0.0792
1.566E+4	0.2065	4.26E+4	0.0794
1.572E+4	0.2072	4.266E+4	0.0792
1.578E+4	0.2064	4.272E+4	0.0782
1.584E+4	0.2069	4.278E+4	0.0787
1.59E+4	0.2063	4.284E+4	0.0788
1.596E+4	0.2051	4.29E+4	0.0778
1.602E+4	0.2061	4.296E+4	0.0782
1.608E+4	0.2056	4.302E+4	0.0767
1.614E+4	0.2056	4.308E+4	0.077
1.62E+4	0.2061	4.314E+4	0.077
1.626E+4	0.205	4.32E+4	0.0769
1.632E+4	0.2055	4.326E+4	0.076
1.638E+4	0.2051	4.332E+4	0.0766
1.644E+4	0.2047	4.338E+4	0.0753
1.65E+4	0.2047	4.344E+4	0.0749
1.656E+4	0.2035	4.35E+4	0.0748
1.662E+4	0.2047	4.356E+4	0.0755
1.668E+4	0.2041	4.362E+4	0.0744
1.674E+4	0.2034	4.368E+4	0.0748
1.68E+4	0.2029	4.374E+4	0.0739
1.686E+4	0.2023	4.38E+4	0.0735
1.692E+4	0.2022	4.386E+4	0.0737
1.698E+4	0.2013	4.392E+4	0.0738
1.704E+4	0.2013	4.398E+4	0.0736
1.71E+4	0.2009	4.404E+4	0.0733
1.716E+4	0.2009	4.41E+4	0.0731
1.722E+4	0.1999	4.416E+4	0.073
1.728E+4	0.2009	4.422E+4	0.0726
1.734E+4	0.1997	4.428E+4	0.073
1.74E+4	0.2	4.434E+4	0.072
1.746E+4	0.2004	4.44E+4	0.0714
1.752E+4	0.1993	4.446E+4	0.0708
1.758E+4	0.1989	4.452E+4	0.0712
1.764E+4	0.1993	4.458E+4	0.0713
1.77E+4	0.1986	4.464E+4	0.0702
1.776E+4	0.1978	4.47E+4	0.072
1.782E+4	0.1977	4.476E+4	0.0706

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.788E+4	0.1981	4.482E+4	0.0706
1.794E+4	0.1978	4.488E+4	0.0709
1.8E+4	0.1971	4.494E+4	0.0701
1.806E+4	0.1966	4.5E+4	0.0711
1.812E+4	0.1959	4.506E+4	0.0699
1.818E+4	0.1956	4.512E+4	0.0694
1.824E+4	0.1952	4.518E+4	0.0701
1.83E+4	0.1953	4.524E+4	0.0693
1.836E+4	0.1955	4.53E+4	0.0691
1.842E+4	0.1949	4.536E+4	0.0688
1.848E+4	0.1952	4.542E+4	0.0685
1.854E+4	0.1939	4.548E+4	0.0684
1.86E+4	0.1931	4.554E+4	0.0678
1.866E+4	0.1932	4.56E+4	0.0688
1.872E+4	0.193	4.566E+4	0.068
1.878E+4	0.1929	4.572E+4	0.0672
1.884E+4	0.1919	4.578E+4	0.0673
1.89E+4	0.1924	4.584E+4	0.0665
1.896E+4	0.1922	4.59E+4	0.067
1.902E+4	0.1913	4.596E+4	0.0668
1.908E+4	0.1911	4.602E+4	0.0653
1.914E+4	0.1911	4.608E+4	0.0667
1.92E+4	0.1912	4.614E+4	0.0659
1.926E+4	0.1918	4.62E+4	0.0654
1.932E+4	0.1901	4.626E+4	0.0654
1.938E+4	0.1906	4.632E+4	0.0647
1.944E+4	0.1905	4.638E+4	0.0649
1.95E+4	0.1892	4.644E+4	0.0644
1.956E+4	0.1896	4.65E+4	0.0648
1.962E+4	0.1888	4.656E+4	0.0635
1.968E+4	0.1885	4.662E+4	0.0633
1.974E+4	0.1888	4.668E+4	0.063
1.98E+4	0.1881	4.674E+4	0.0636
1.986E+4	0.1876	4.68E+4	0.0624
1.992E+4	0.1879	4.686E+4	0.0628
1.998E+4	0.1874	4.692E+4	0.0627
2.004E+4	0.188	4.698E+4	0.0621
2.01E+4	0.1864	4.704E+4	0.0626
2.016E+4	0.1853	4.71E+4	0.0617
2.022E+4	0.1857	4.716E+4	0.0617
2.028E+4	0.1854	4.722E+4	0.0614
2.034E+4	0.1853	4.728E+4	0.0613
2.04E+4	0.1851	4.734E+4	0.061
2.046E+4	0.1844	4.74E+4	0.0594
2.052E+4	0.1854	4.746E+4	0.0598
2.058E+4	0.1844	4.752E+4	0.0602
2.064E+4	0.1829	4.758E+4	0.0587
2.07E+4	0.1844	4.764E+4	0.0594
2.076E+4	0.1839	4.77E+4	0.0596
2.082E+4	0.1826	4.776E+4	0.0583
2.088E+4	0.183	4.782E+4	0.0585
2.094E+4	0.1829	4.788E+4	0.0588
2.1E+4	0.1821	4.794E+4	0.0586
2.106E+4	0.1825	4.8E+4	0.0579
2.112E+4	0.1818	4.806E+4	0.0581
2.118E+4	0.1806	4.812E+4	0.0575
2.124E+4	0.1814	4.818E+4	0.0572
2.13E+4	0.1814	4.824E+4	0.0573
2.136E+4	0.181	4.83E+4	0.0569
2.142E+4	0.1799	4.836E+4	0.0575
2.148E+4	0.1799	4.842E+4	0.0565
2.154E+4	0.1791	4.848E+4	0.0564
2.16E+4	0.1796	4.854E+4	0.0561
2.166E+4	0.1787	4.86E+4	0.0551
2.172E+4	0.179	4.866E+4	0.056
2.178E+4	0.1783	4.872E+4	0.0549
2.184E+4	0.1777	4.878E+4	0.0549

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
2.19E+4	0.1772	4.884E+4	0.0544
2.196E+4	0.1768	4.89E+4	0.0535
2.202E+4	0.1772	4.896E+4	0.0545
2.208E+4	0.1771	4.902E+4	0.055
2.214E+4	0.1767	4.908E+4	0.0541
2.22E+4	0.1763	4.914E+4	0.0531
2.226E+4	0.1764	4.92E+4	0.0531
2.232E+4	0.176	4.926E+4	0.0527
2.238E+4	0.1753	4.932E+4	0.0526
2.244E+4	0.1762	4.938E+4	0.0522
2.25E+4	0.1746	4.944E+4	0.0523
2.256E+4	0.1742	4.95E+4	0.0521
2.262E+4	0.1744	4.956E+4	0.051
2.268E+4	0.1747	4.962E+4	0.0505
2.274E+4	0.1741	4.968E+4	0.0507
2.28E+4	0.1741	4.974E+4	0.0501
2.286E+4	0.1735	4.98E+4	0.0507
2.292E+4	0.1728	4.986E+4	0.0499
2.298E+4	0.1736	4.992E+4	0.049
2.304E+4	0.1721	4.998E+4	0.0492
2.31E+4	0.1719	5.004E+4	0.0488
2.316E+4	0.1715	5.01E+4	0.0483
2.322E+4	0.1719	5.016E+4	0.0475
2.328E+4	0.1716	5.022E+4	0.0477
2.334E+4	0.1712	5.028E+4	0.0466
2.34E+4	0.1705	5.034E+4	0.0468
2.346E+4	0.1702	5.04E+4	0.0468
2.352E+4	0.1694	5.046E+4	0.0469
2.358E+4	0.1696	5.052E+4	0.0455
2.364E+4	0.169	5.058E+4	0.0452
2.37E+4	0.1682	5.064E+4	0.0445
2.376E+4	0.168	5.07E+4	0.0449
2.382E+4	0.1681	5.076E+4	0.045
2.388E+4	0.1679	5.082E+4	0.0444
2.394E+4	0.1673	5.088E+4	0.0439
2.4E+4	0.1669	5.094E+4	0.0436
2.406E+4	0.1678	5.1E+4	0.0437
2.412E+4	0.166	5.106E+4	0.0427
2.418E+4	0.1674	5.112E+4	0.0424
2.424E+4	0.167	5.118E+4	0.0419
2.43E+4	0.1656	5.124E+4	0.0422
2.436E+4	0.1657	5.13E+4	0.0414
2.442E+4	0.166	5.136E+4	0.0408
2.448E+4	0.1662	5.142E+4	0.0414
2.454E+4	0.1654	5.148E+4	0.0406
2.46E+4	0.1657	5.154E+4	0.0406
2.466E+4	0.1654	5.16E+4	0.0405
2.472E+4	0.1638	5.166E+4	0.0402
2.478E+4	0.1653	5.172E+4	0.0407
2.484E+4	0.1646	5.178E+4	0.0403
2.49E+4	0.1654	5.184E+4	0.0397
2.496E+4	0.1647	5.19E+4	0.0397
2.502E+4	0.1638	5.196E+4	0.0389
2.508E+4	0.164	5.202E+4	0.0395
2.514E+4	0.1638	5.208E+4	0.0384
2.52E+4	0.1635	5.214E+4	0.0378
2.526E+4	0.1635	5.22E+4	0.0376
2.532E+4	0.1629	5.226E+4	0.0355
2.538E+4	0.1631	5.232E+4	0.0362
2.544E+4	0.1617	5.238E+4	0.0359
2.55E+4	0.1615	5.244E+4	0.036
2.556E+4	0.1609	5.25E+4	0.0353
2.562E+4	0.1604	5.256E+4	0.035
2.568E+4	0.1607	5.262E+4	0.0348
2.574E+4	0.1598	5.268E+4	0.0346
2.58E+4	0.1601	5.274E+4	0.0338
2.586E+4	0.1605	5.28E+4	0.0337

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
2.592E+4	0.1602	5.286E+4	0.0339
2.598E+4	0.1598	5.292E+4	0.0333
2.604E+4	0.1599	5.298E+4	0.033
2.61E+4	0.1594	5.304E+4	0.0321
2.616E+4	0.1589	5.31E+4	0.0323
2.622E+4	0.1588	5.316E+4	0.0315
2.628E+4	0.1581	5.322E+4	0.0324
2.634E+4	0.1576	5.328E+4	0.0308
2.64E+4	0.158	5.334E+4	0.0311
2.646E+4	0.157	5.34E+4	0.0311
2.652E+4	0.1562	5.346E+4	0.0307
2.658E+4	0.1573	5.352E+4	0.0302
2.664E+4	0.156	5.358E+4	0.0294
2.67E+4	0.1557	5.364E+4	0.03
2.676E+4	0.1559	5.37E+4	0.0294
2.682E+4	0.1556	5.376E+4	0.0283
2.688E+4	0.1558	5.382E+4	0.0282

SOLUTION

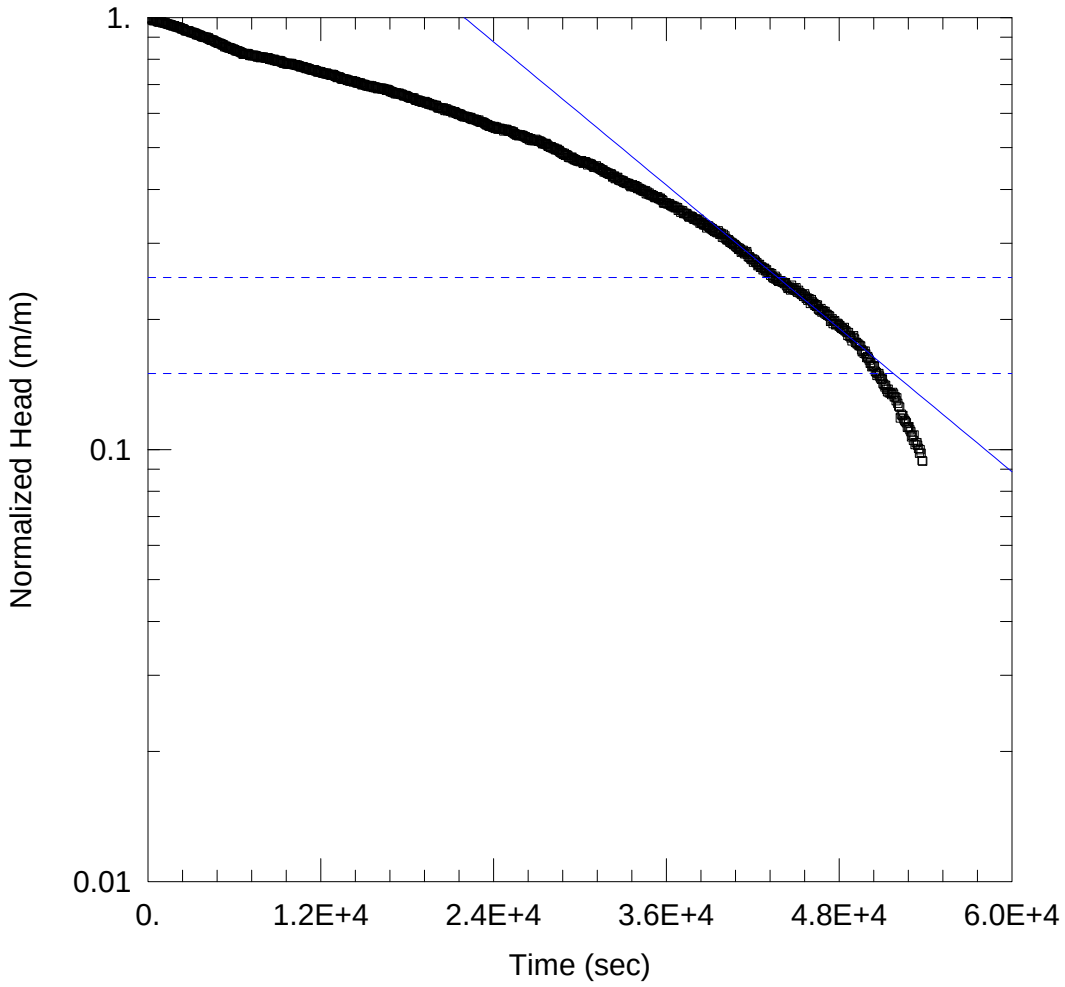
Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.2462

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.085E-8	m/sec
y0	1.214	m

K = 1.085E-6 cm/sec
T = K*b = 5.426E-7 m²/sec (0.005426 sq. cm/sec)



MW-H26B (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0791-25-22
Location: Tumbler Ridge, BC
Test Well: MW-26B
Test Date: 31 October 2012

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H26B)

Initial Displacement: 0.3 m
Total Well Penetration Depth: 3.6 m
Casing Radius: 0.016 m
Static Water Column Height: 3.6 m
Screen Length: 3.05 m
Well Radius: 0.0525 m

SOLUTION

Aquifer Model: Unconfined
K = 1.085E-8 m/sec
Solution Method: Hvorslev
y0 = 1.214 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H27 (Rising Head Slug Test)
Date: 08/14/13
Time: 11:29:30

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 28 July 2013
Test Well: MW-H27

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H27

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.4 m
Static Water Column Height: 27.6 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 27.6 m

No. of Observations: 387

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.4	454.	0.1642
1.	0.4085	484.	0.1569
2.	0.4153	514.	0.1504
3.	0.4028	544.	0.144
4.	0.4079	574.	0.1381
5.	0.4009	604.	0.1325
6.	0.3993	634.	0.1275
7.	0.3942	664.	0.1225
8.	0.3892	694.	0.1181
9.	0.3878	724.	0.1148
10.	0.3869	754.	0.1104
11.	0.3853	784.	0.1062
12.	0.3853	814.	0.1027
13.	0.3834	844.	0.0994
14.	0.3832	874.	0.0964
15.	0.3817	904.	0.0924
16.	0.3802	934.	0.0892
17.	0.3796	964.	0.0865
18.	0.3786	994.	0.0832
19.	0.3775	1024.	0.0808
20.	0.3766	1054.	0.0785
21.	0.3753	1084.	0.0756
22.	0.3747	1114.	0.0739
23.	0.3735	1144.	0.0717
24.	0.3728	1174.	0.0688
25.	0.3717	1204.	0.0668
26.	0.3706	1234.	0.0651
27.	0.3696	1264.	0.064
28.	0.3687	1294.	0.0613
29.	0.368	1324.	0.0599

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
30.	0.3672	1354.	0.0582
31.	0.3659	1384.	0.0565
32.	0.3656	1414.	0.0557
33.	0.3642	1444.	0.0547
34.	0.3636	1474.	0.0525
35.	0.3627	1504.	0.0514
36.	0.3615	1534.	0.0501
37.	0.3605	1564.	0.049
38.	0.3601	1594.	0.0477
39.	0.3593	1624.	0.0466
40.	0.3584	1654.	0.0456
41.	0.3577	1684.	0.0447
42.	0.3563	1714.	0.0439
43.	0.3557	1744.	0.0425
44.	0.3549	1774.	0.0425
45.	0.3538	1804.	0.0413
46.	0.3532	1834.	0.0404
47.	0.3524	1864.	0.0398
48.	0.3516	1894.	0.0389
49.	0.3509	1924.	0.038
50.	0.3501	1954.	0.0373
51.	0.3493	1984.	0.0362
52.	0.3486	2014.	0.0354
53.	0.3473	2044.	0.0349
54.	0.3469	2074.	0.0342
55.	0.3463	2104.	0.0333
56.	0.3458	2134.	0.0323
57.	0.3444	2164.	0.0317
58.	0.3441	2194.	0.0321
59.	0.3438	2224.	0.0308
60.	0.3428	2254.	0.03
61.	0.3414	2284.	0.0294
62.	0.3409	2314.	0.0289
63.	0.3401	2344.	0.0286
64.	0.3392	2374.	0.0278
65.	0.3385	2404.	0.0267
66.	0.3378	2434.	0.0272
67.	0.337	2464.	0.0266
68.	0.3364	2494.	0.0256
69.	0.3362	2524.	0.025
70.	0.3352	2554.	0.025
71.	0.3343	2584.	0.0241
72.	0.3336	2614.	0.0239
73.	0.3328	2644.	0.023
74.	0.332	2674.	0.0235
75.	0.3316	2704.	0.0231
76.	0.3313	2734.	0.0221
77.	0.33	2764.	0.0223
78.	0.3301	2794.	0.0217
79.	0.3297	2824.	0.0214
80.	0.3288	2854.	0.0208
81.	0.3274	2884.	0.0212
82.	0.3269	2914.	0.0195
83.	0.3263	2944.	0.0193
84.	0.3254	2974.	0.0192
85.	0.3247	3004.	0.0194
86.	0.3243	3034.	0.0192
87.	0.3236	3064.	0.0176
88.	0.3228	3094.	0.0177
89.	0.3225	3124.	0.0174
90.	0.3214	3154.	0.0168
91.	0.3206	3184.	0.0167
92.	0.3195	3214.	0.017
93.	0.3197	3244.	0.0164
94.	0.3186	3274.	0.0168
95.	0.3185	3304.	0.0155
96.	0.318	3334.	0.0152

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
97.	0.3171	3364.	0.0149
98.	0.3161	3394.	0.0147
99.	0.3155	3424.	0.0148
100.	0.315	3454.	0.0149
101.	0.3144	3484.	0.0145
102.	0.3136	3514.	0.0134
103.	0.313	3544.	0.0133
104.	0.3125	3574.	0.0129
105.	0.3114	3604.	0.0125
106.	0.3112	3634.	0.0126
107.	0.3107	3664.	0.0122
108.	0.31	3694.	0.0125
109.	0.3098	3724.	0.0118
110.	0.3088	3754.	0.0116
111.	0.3083	3784.	0.012
112.	0.308	3814.	0.0114
113.	0.3062	3844.	0.011
114.	0.3062	3874.	0.0112
115.	0.3062	3904.	0.0111
116.	0.3058	3934.	0.0103
117.	0.3045	3964.	0.0102
118.	0.3039	3994.	0.0107
119.	0.3031	4024.	0.0098
120.	0.3034	4054.	0.0098
121.	0.3026	4084.	0.0095
122.	0.3018	4114.	0.0097
123.	0.3012	4144.	0.0091
124.	0.3003	4174.	0.0083
125.	0.3001	4204.	0.0083
126.	0.2992	4234.	0.0079
127.	0.2987	4264.	0.0084
128.	0.2979	4294.	0.0079
129.	0.2974	4324.	0.0078
130.	0.2975	4354.	0.0079
131.	0.2964	4384.	0.0076
132.	0.2962	4414.	0.0073
133.	0.2952	4444.	0.0079
134.	0.2965	4474.	0.0069
135.	0.2934	4504.	0.0069
136.	0.2931	4534.	0.0071
137.	0.2934	4564.	0.0065
138.	0.2917	4594.	0.0065
139.	0.2919	4624.	0.0064
140.	0.2914	4654.	0.0067
141.	0.291	4684.	0.0063
142.	0.2901	4714.	0.0056
143.	0.2897	4744.	0.0062
144.	0.2892	4774.	0.0052
145.	0.2885	4804.	0.006
146.	0.2884	4834.	0.0054
147.	0.2879	4864.	0.0051
148.	0.286	4894.	0.005
149.	0.2863	4924.	0.0047
150.	0.2863	4954.	0.0049
151.	0.2855	4984.	0.0045
152.	0.2844	5014.	0.0042
153.	0.2844	5044.	0.0042
154.	0.2839	5074.	0.0042
155.	0.283	5104.	0.0046
156.	0.283	5134.	0.0044
157.	0.282	5164.	0.0038
158.	0.2818	5194.	0.0039
159.	0.2815	5224.	0.0036
160.	0.2808	5254.	0.0036
161.	0.2802	5284.	0.0032
162.	0.2797	5314.	0.0035
163.	0.2792	5344.	0.0036

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
164.	0.2783	5374.	0.0033
165.	0.2774	5404.	0.0026
166.	0.2775	5434.	0.003
167.	0.2765	5464.	0.003
168.	0.2763	5494.	0.0028
169.	0.2758	5524.	0.0023
170.	0.2754	5554.	0.0027
171.	0.2751	5584.	0.0026
172.	0.2743	5614.	0.0015
173.	0.2741	5644.	0.0022
174.	0.2735	5674.	0.0022
175.	0.2727	5704.	0.0025
176.	0.2726	5734.	0.0024
177.	0.2717	5764.	0.0024
178.	0.2715	5794.	0.0025
179.	0.2705	5824.	0.0021
180.	0.2707	5854.	0.002
181.	0.2695	5884.	0.0021
182.	0.2687	5914.	0.0021
183.	0.2687	5944.	0.0016
184.	0.2683	5974.	0.001
185.	0.2546	6004.	0.0011
214.	0.2419	6034.	0.0013
244.	0.2297	6064.	0.001
274.	0.2189	6094.	0.0011
304.	0.208	6124.	0.0004
334.	0.1983	6154.	0.0009
364.	0.1888	6184.	0.0005
394.	0.18	6214.	0.
424.	0.1719		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.907E-7	m/sec
y0	0.237	m

K = 1.907E-5 cm/sec
T = K*b = 9.537E-6 m²/sec (0.09537 sq. cm/sec)

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H27 (Falling Head Packer Test, vertical interval 32.77 - 39.17 m)
Date: 08/14/13
Time: 14:35:44

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 23 July 2013
Test Well: MW-H27

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H27

X Location: 0. m
Y Location: 0. m

Initial Displacement: 5.066 m
Static Water Column Height: 34.1 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 6.4 m
Total Well Penetration Depth: 34.1 m

No. of Observations: 228

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	5.066	1710.	3.457
15.	5.046	1725.	3.444
30.	5.029	1740.	3.432
45.	5.011	1755.	3.419
60.	4.995	1770.	3.406
75.	4.979	1785.	3.393
90.	4.963	1800.	3.381
105.	4.946	1815.	3.368
120.	4.93	1830.	3.356
135.	4.914	1845.	3.344
150.	4.899	1860.	3.331
165.	4.884	1875.	3.318
180.	4.868	1890.	3.306
195.	4.853	1905.	3.294
210.	4.838	1920.	3.281
225.	4.824	1935.	3.269
240.	4.809	1950.	3.257
255.	4.795	1965.	3.244
270.	4.78	1980.	3.232
285.	4.765	1995.	3.22
300.	4.751	2010.	3.208
315.	4.737	2025.	3.196
330.	4.737	2040.	3.184
345.	4.708	2055.	3.171
360.	4.694	2070.	3.159
375.	4.679	2085.	3.147
390.	4.665	2100.	3.134
405.	4.651	2115.	3.122
420.	4.637	2130.	3.11
435.	4.622	2145.	3.098

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
450.	4.608	2160.	3.087
465.	4.594	2175.	3.075
480.	4.579	2190.	3.062
495.	4.565	2205.	3.05
510.	4.551	2220.	3.039
525.	4.536	2235.	3.027
540.	4.522	2250.	3.018
555.	4.508	2265.	3.007
570.	4.493	2280.	2.994
585.	4.478	2295.	2.983
600.	4.464	2310.	2.972
615.	4.45	2325.	2.96
630.	4.436	2340.	2.948
645.	4.421	2355.	2.937
660.	4.407	2370.	2.925
675.	4.393	2385.	2.914
690.	4.379	2400.	2.902
705.	4.365	2415.	2.89
720.	4.35	2430.	2.878
735.	4.336	2445.	2.866
750.	4.322	2460.	2.855
765.	4.308	2475.	2.843
780.	4.293	2490.	2.832
795.	4.28	2505.	2.821
810.	4.266	2520.	2.809
825.	4.252	2535.	2.797
840.	4.238	2550.	2.786
855.	4.224	2565.	2.774
870.	4.21	2580.	2.763
885.	4.196	2595.	2.752
900.	4.181	2610.	2.739
915.	4.168	2625.	2.729
930.	4.154	2640.	2.717
945.	4.14	2655.	2.706
960.	4.127	2670.	2.695
975.	4.113	2685.	2.683
990.	4.099	2700.	2.669
1005.	4.086	2715.	2.657
1020.	4.072	2730.	2.645
1035.	4.058	2745.	2.636
1050.	4.045	2760.	2.624
1065.	4.03	2775.	2.612
1080.	4.016	2790.	2.602
1095.	4.002	2805.	2.59
1110.	3.989	2820.	2.579
1125.	3.976	2835.	2.568
1140.	3.962	2850.	2.556
1155.	3.948	2865.	2.545
1170.	3.935	2880.	2.535
1185.	3.921	2895.	2.524
1200.	3.908	2910.	2.512
1215.	3.895	2925.	2.5
1230.	3.882	2940.	2.489
1245.	3.867	2955.	2.477
1260.	3.854	2970.	2.466
1275.	3.841	2985.	2.451
1290.	3.827	3000.	2.44
1305.	3.813	3015.	2.43
1320.	3.8	3030.	2.419
1335.	3.787	3045.	2.409
1350.	3.774	3060.	2.398
1365.	3.76	3075.	2.387
1380.	3.747	3090.	2.377
1395.	3.734	3105.	2.366
1410.	3.72	3120.	2.355
1425.	3.707	3135.	2.344
1440.	3.693	3150.	2.333

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1455.	3.681	3165.	2.321
1470.	3.667	3180.	2.31
1485.	3.654	3195.	2.298
1500.	3.64	3210.	2.287
1515.	3.628	3225.	2.277
1530.	3.614	3240.	2.265
1545.	3.601	3255.	2.253
1560.	3.588	3270.	2.242
1575.	3.574	3285.	2.228
1590.	3.561	3300.	2.218
1605.	3.548	3315.	2.209
1620.	3.535	3330.	2.198
1635.	3.522	3345.	2.183
1650.	3.509	3360.	2.172
1665.	3.496	3375.	2.161
1680.	3.484	3390.	2.15
1695.	3.47	3405.	2.138

SOLUTION

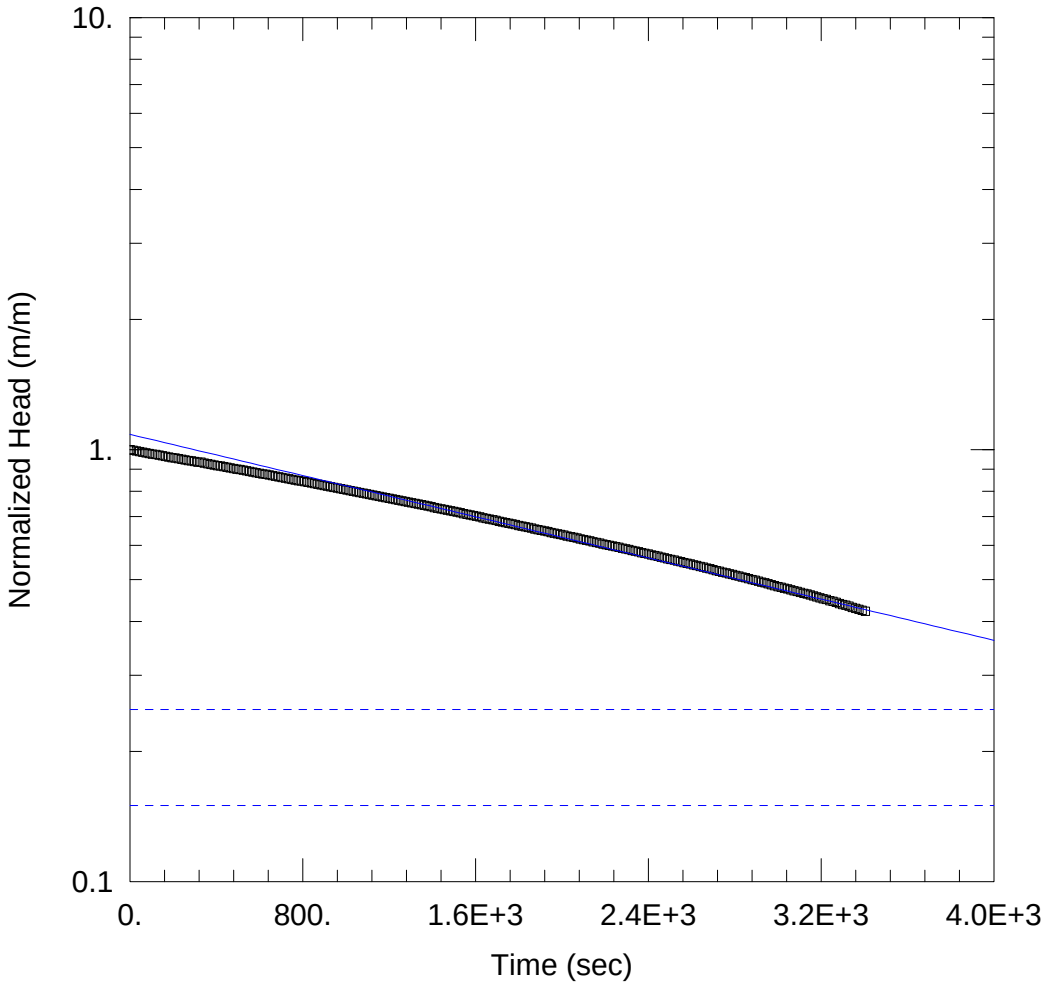
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.2044

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	2.417E-7	m/sec
y0	5.492	m

K = 2.417E-5 cm/sec
T = K*b = 1.209E-5 m²/sec (0.1209 sq. cm/sec)



MW-H27 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 32.77 - 39.17 M)

PROJECT INFORMATION

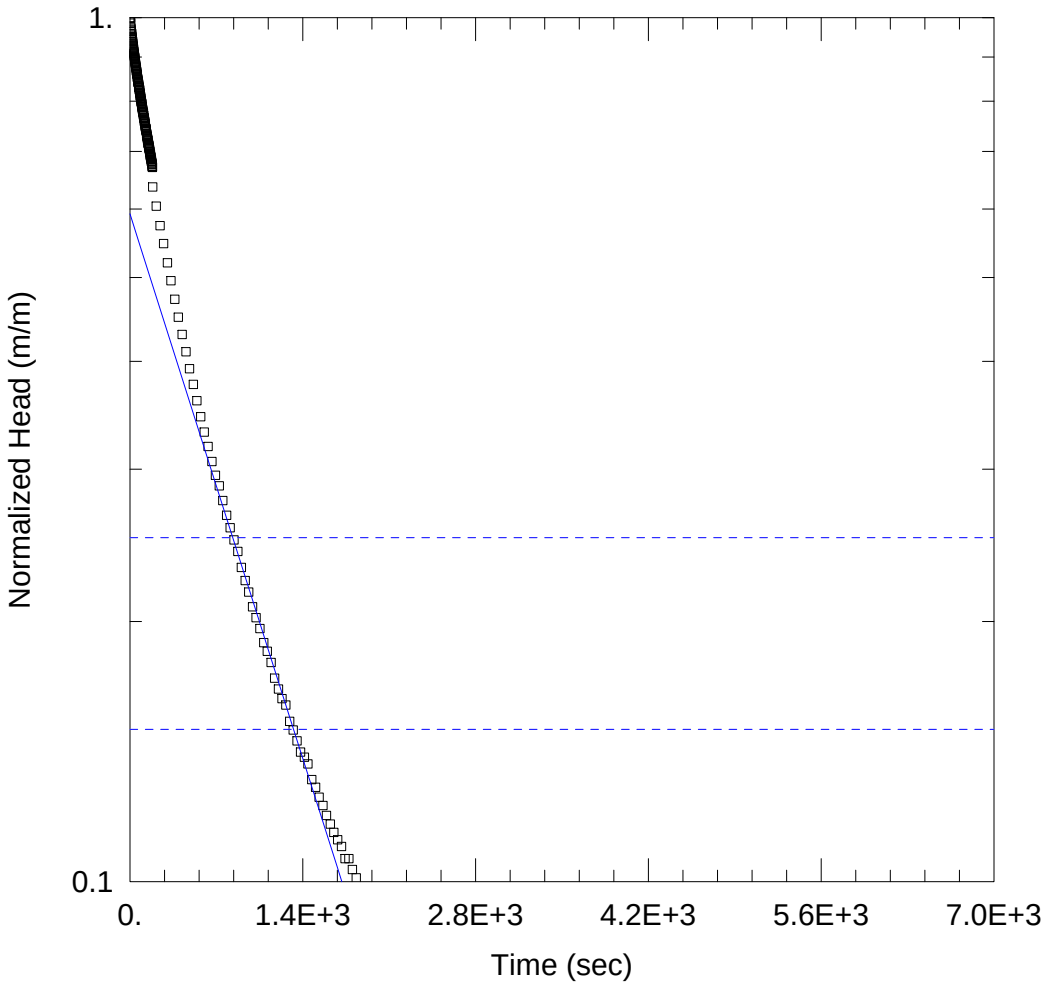
Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H27
Test Date: 23 July 2013

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 2.417E-7 m/sec
y0 = 5.492 m



MW-H27 (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H27
Test Date: 28 July 2013

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H27)

Initial Displacement: 0.4 m
Total Well Penetration Depth: 27.6 m
Casing Radius: 0.016 m
Static Water Column Height: 27.6 m
Screen Length: 3.05 m
Well Radius: 0.038 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 1.907E-7 m/sec
y0 = 0.237 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 (Rising Head Slug Test)
Date: 08/14/13
Time: 12:01:57

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 1 August 2013
Test Well: MW-H28

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.1 m
Static Water Column Height: 5.079 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 5.079 m

No. of Observations: 195

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.1	2940.	0.0549
30.	0.0997	2970.	0.0552
60.	0.1002	3000.	0.0546
90.	0.1	3030.	0.0526
120.	0.0996	3060.	0.0535
150.	0.1005	3090.	0.0529
180.	0.1	3120.	0.0532
210.	0.0986	3150.	0.0518
240.	0.0988	3180.	0.0512
270.	0.0989	3210.	0.0508
300.	0.0986	3240.	0.0511
330.	0.099	3270.	0.0499
360.	0.0982	3300.	0.0501
390.	0.0995	3330.	0.0501
420.	0.0978	3360.	0.0484
450.	0.0974	3390.	0.0482
480.	0.0976	3420.	0.0487
510.	0.0982	3450.	0.0479
540.	0.0975	3480.	0.0477
570.	0.0978	3510.	0.047
600.	0.0968	3540.	0.0469
630.	0.0953	3570.	0.0457
660.	0.0964	3600.	0.0456
690.	0.097	3630.	0.046
720.	0.0963	3660.	0.0446
750.	0.0954	3690.	0.0451
780.	0.0957	3720.	0.044
810.	0.0948	3750.	0.0449
840.	0.0949	3780.	0.0428
870.	0.0944	3810.	0.0434

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	0.0927	3840.	0.0436
930.	0.0926	3870.	0.0429
960.	0.0923	3900.	0.0414
990.	0.0928	3930.	0.0413
1020.	0.0923	3960.	0.0415
1050.	0.0903	3990.	0.0407
1080.	0.0911	4020.	0.0403
1110.	0.0902	4050.	0.0388
1140.	0.09	4080.	0.0379
1170.	0.0895	4110.	0.0381
1200.	0.0882	4140.	0.0383
1230.	0.088	4170.	0.0379
1260.	0.0869	4200.	0.0364
1290.	0.0857	4230.	0.0372
1320.	0.0857	4260.	0.0365
1350.	0.0857	4290.	0.0365
1380.	0.0858	4320.	0.0357
1410.	0.0847	4350.	0.0343
1440.	0.0833	4380.	0.0335
1470.	0.0831	4410.	0.0337
1500.	0.0826	4440.	0.0344
1530.	0.0824	4470.	0.0334
1560.	0.0827	4500.	0.033
1590.	0.0797	4530.	0.0326
1620.	0.0794	4560.	0.0313
1650.	0.0792	4590.	0.0308
1680.	0.079	4620.	0.0315
1710.	0.078	4650.	0.0305
1740.	0.0769	4680.	0.0302
1770.	0.0767	4710.	0.0296
1800.	0.0759	4740.	0.028
1830.	0.0749	4770.	0.0289
1860.	0.0746	4800.	0.0283
1890.	0.0748	4830.	0.0277
1920.	0.0738	4860.	0.0264
1950.	0.072	4890.	0.0267
1980.	0.0715	4920.	0.0266
2010.	0.0707	4950.	0.0258
2040.	0.0696	4980.	0.0256
2070.	0.0683	5010.	0.0256
2100.	0.0682	5040.	0.0253
2130.	0.0676	5070.	0.0246
2160.	0.0674	5100.	0.0234
2190.	0.0658	5130.	0.0231
2220.	0.0648	5160.	0.0226
2250.	0.0651	5190.	0.0218
2280.	0.0647	5220.	0.0214
2310.	0.0639	5250.	0.0212
2340.	0.0624	5280.	0.0205
2370.	0.0625	5310.	0.021
2400.	0.0615	5340.	0.0205
2430.	0.061	5370.	0.0204
2460.	0.0604	5400.	0.019
2490.	0.0603	5430.	0.0193
2520.	0.0602	5460.	0.0174
2550.	0.0603	5490.	0.0186
2580.	0.0587	5520.	0.0184
2610.	0.059	5550.	0.0164
2640.	0.059	5580.	0.0167
2670.	0.0594	5610.	0.0158
2700.	0.0576	5640.	0.0156
2730.	0.0579	5670.	0.0157
2760.	0.0582	5700.	0.0139
2790.	0.0568	5730.	0.0137
2820.	0.0565	5760.	0.0136
2850.	0.056	5790.	0.0132
2880.	0.0563	5820.	0.0126

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
2910.	0.0549		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.199E-7	m/sec
y0	0.6461	m

K = 1.199E-5 cm/sec
T = K*b = 1.199E-5 m²/sec (0.1199 sq. cm/sec)

NOTES

Well may not be sufficiently developed due to a slow recovery.

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 Zone 1 (Falling Head Packer Test, vertical interval 13.26 - 18.59 m)
Date: 08/14/13
Time: 14:46:11

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 24 July 2013
Test Well: MW-H28 Zone 1

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.35 m
Static Water Column Height: 17.61 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 5.334 m
Total Well Penetration Depth: 17.61 m

No. of Observations: 252

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.35	630.	0.5988
5.	1.311	635.	0.5929
10.	1.303	640.	0.588
15.	1.296	645.	0.582
20.	1.289	650.	0.5765
25.	1.282	655.	0.5712
30.	1.275	660.	0.5658
35.	1.269	665.	0.5606
40.	1.262	670.	0.5554
45.	1.255	675.	0.5499
50.	1.248	680.	0.545
55.	1.243	685.	0.5397
60.	1.236	690.	0.5344
65.	1.231	695.	0.5286
70.	1.225	700.	0.5236
75.	1.219	705.	0.5191
80.	1.212	710.	0.5131
85.	1.207	715.	0.5086
90.	1.201	720.	0.5034
95.	1.195	725.	0.4978
100.	1.19	730.	0.4928
105.	1.184	735.	0.4872
110.	1.179	740.	0.4822
115.	1.173	745.	0.4773
120.	1.167	750.	0.4725
125.	1.162	755.	0.4675
130.	1.156	760.	0.4621
135.	1.15	765.	0.4571
140.	1.145	770.	0.4527
145.	1.14	775.	0.4478

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
150.	1.134	780.	0.4426
155.	1.128	785.	0.4373
160.	1.123	790.	0.4323
165.	1.117	795.	0.4279
170.	1.112	800.	0.4234
175.	1.107	805.	0.4181
180.	1.101	810.	0.4125
185.	1.096	815.	0.4079
190.	1.09	820.	0.404
195.	1.086	825.	0.3991
200.	1.08	830.	0.3949
205.	1.075	835.	0.39
210.	1.069	840.	0.3854
215.	1.065	845.	0.3808
220.	1.06	850.	0.3766
225.	1.055	855.	0.3719
230.	1.05	860.	0.3678
235.	1.045	865.	0.363
240.	1.039	870.	0.3582
245.	1.034	875.	0.3538
250.	1.029	880.	0.3494
255.	1.023	885.	0.3455
260.	1.018	890.	0.341
265.	1.012	895.	0.3361
270.	1.007	900.	0.3315
275.	1.002	905.	0.3272
280.	0.9969	910.	0.3227
285.	0.9918	915.	0.3182
290.	0.9865	920.	0.3141
295.	0.9807	925.	0.3094
300.	0.9753	930.	0.3056
305.	0.9703	935.	0.3006
310.	0.9657	940.	0.2957
315.	0.9604	945.	0.2916
320.	0.9555	950.	0.2875
325.	0.9502	955.	0.2831
330.	0.9443	960.	0.2781
335.	0.9382	965.	0.2738
340.	0.933	970.	0.2698
345.	0.9272	975.	0.265
350.	0.9216	980.	0.2607
355.	0.9155	985.	0.2565
360.	0.9095	990.	0.2516
365.	0.904	995.	0.2478
370.	0.8984	1000.	0.2429
375.	0.8926	1005.	0.2393
380.	0.8863	1010.	0.2347
385.	0.8808	1015.	0.2303
390.	0.8747	1020.	0.2259
395.	0.8689	1025.	0.2217
400.	0.8636	1030.	0.2174
405.	0.8571	1035.	0.213
410.	0.8511	1040.	0.2085
415.	0.8464	1045.	0.2045
420.	0.84	1050.	0.2005
425.	0.8341	1055.	0.1961
430.	0.8279	1060.	0.1914
435.	0.8223	1065.	0.1875
440.	0.8166	1070.	0.1836
445.	0.811	1075.	0.1791
450.	0.805	1080.	0.1748
455.	0.7997	1085.	0.1709
460.	0.7934	1090.	0.1661
465.	0.7875	1095.	0.1625
470.	0.7814	1100.	0.1581
475.	0.7761	1105.	0.1537
480.	0.7698	1110.	0.1497

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
485.	0.7643	1115.	0.1461
490.	0.7589	1120.	0.1421
495.	0.7526	1125.	0.138
500.	0.7477	1130.	0.1339
505.	0.7415	1135.	0.1299
510.	0.7359	1140.	0.1256
515.	0.7302	1145.	0.1218
520.	0.7244	1150.	0.118
525.	0.7185	1155.	0.1134
530.	0.713	1160.	0.1094
535.	0.7066	1165.	0.106
540.	0.7009	1170.	0.1015
545.	0.6954	1175.	0.0973
550.	0.6895	1180.	0.0934
555.	0.6839	1185.	0.0898
560.	0.6783	1190.	0.0859
565.	0.6722	1195.	0.0818
570.	0.6669	1200.	0.0779
575.	0.661	1205.	0.0736
580.	0.6552	1210.	0.0699
585.	0.6493	1215.	0.0656
590.	0.6437	1220.	0.0617
595.	0.6379	1225.	0.0577
600.	0.6324	1230.	0.0534
605.	0.6267	1235.	0.0494
610.	0.6207	1240.	0.0457
615.	0.6151	1245.	0.0411
620.	0.6097	1250.	0.0374
625.	0.6044	1255.	0.0337

SOLUTION

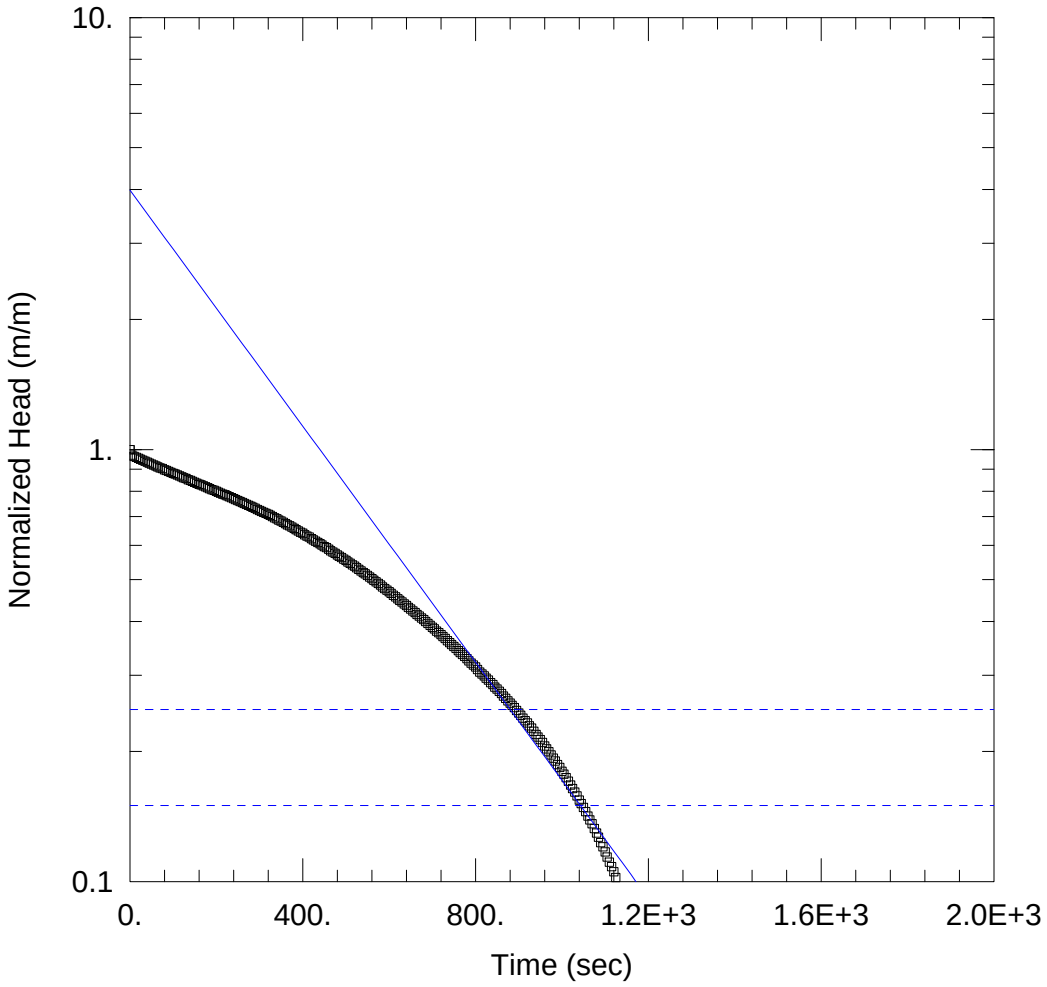
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.2123

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	3.2E-6	m/sec
y0	5.379	m

K = 0.00032 cm/sec
T = K*b = 0.00032 m²/sec (3.2 sq. cm/sec)



MW-H28 ZONE 1 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 13.26 - 18.59 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28 Zone 1
Test Date: 24 July 2013

AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 3.2E-6 m/sec

y0 = 5.379 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 Zone 2 (Falling Head Packer Test, vertical interval 19.05 - 26.82 m)
Date: 08/14/13
Time: 14:55:36

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 24 July 2013
Test Well: MW-H28 Zone 2

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.3 m
Static Water Column Height: 26.54 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: .1 m
Screen Length: 7.7 m
Total Well Penetration Depth: 26.54 m

No. of Observations: 722

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.3	1805.	1.198
5.	1.3	1810.	1.198
10.	1.299	1815.	1.196
15.	1.297	1820.	1.198
20.	1.296	1825.	1.198
25.	1.295	1830.	1.197
30.	1.295	1835.	1.197
35.	1.293	1840.	1.197
40.	1.293	1845.	1.196
45.	1.292	1850.	1.196
50.	1.29	1855.	1.196
55.	1.29	1860.	1.196
60.	1.289	1865.	1.195
65.	1.288	1870.	1.195
70.	1.288	1875.	1.195
75.	1.287	1880.	1.195
80.	1.286	1885.	1.195
85.	1.285	1890.	1.194
90.	1.285	1895.	1.194
95.	1.284	1900.	1.193
100.	1.283	1905.	1.193
105.	1.282	1910.	1.193
110.	1.281	1915.	1.193
115.	1.282	1920.	1.193
120.	1.281	1925.	1.193
125.	1.28	1930.	1.192
130.	1.279	1935.	1.192
135.	1.279	1940.	1.192
140.	1.279	1945.	1.192
145.	1.278	1950.	1.192

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
150.	1.278	1955.	1.191
155.	1.277	1960.	1.191
160.	1.277	1965.	1.191
165.	1.277	1970.	1.19
170.	1.276	1975.	1.19
175.	1.275	1980.	1.19
180.	1.275	1985.	1.19
185.	1.275	1990.	1.19
190.	1.274	1995.	1.19
195.	1.274	2000.	1.189
200.	1.274	2005.	1.189
205.	1.273	2010.	1.188
210.	1.273	2015.	1.188
215.	1.272	2020.	1.188
220.	1.272	2025.	1.188
225.	1.272	2030.	1.189
230.	1.271	2035.	1.187
235.	1.271	2040.	1.188
240.	1.271	2045.	1.187
245.	1.271	2050.	1.187
250.	1.27	2055.	1.187
255.	1.27	2060.	1.187
260.	1.269	2065.	1.186
265.	1.269	2070.	1.187
270.	1.269	2075.	1.186
275.	1.268	2080.	1.186
280.	1.268	2085.	1.185
285.	1.267	2090.	1.185
290.	1.267	2095.	1.186
295.	1.267	2100.	1.185
300.	1.266	2105.	1.185
305.	1.266	2110.	1.184
310.	1.266	2115.	1.184
315.	1.266	2120.	1.183
320.	1.265	2125.	1.183
325.	1.265	2130.	1.183
330.	1.264	2135.	1.183
335.	1.264	2140.	1.183
340.	1.264	2145.	1.183
345.	1.263	2150.	1.183
350.	1.263	2155.	1.182
355.	1.262	2160.	1.183
360.	1.262	2165.	1.182
365.	1.262	2170.	1.182
370.	1.262	2175.	1.182
375.	1.261	2180.	1.181
380.	1.261	2185.	1.181
385.	1.261	2190.	1.18
390.	1.261	2195.	1.18
395.	1.26	2200.	1.18
400.	1.26	2205.	1.18
405.	1.26	2210.	1.179
410.	1.26	2215.	1.18
415.	1.259	2220.	1.179
420.	1.258	2225.	1.179
425.	1.258	2230.	1.178
430.	1.258	2235.	1.178
435.	1.258	2240.	1.178
440.	1.257	2245.	1.177
445.	1.257	2250.	1.177
450.	1.257	2255.	1.177
455.	1.256	2260.	1.177
460.	1.256	2265.	1.177
465.	1.256	2270.	1.177
470.	1.256	2275.	1.176
475.	1.255	2280.	1.176
480.	1.255	2285.	1.176

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
485.	1.254	2290.	1.175
490.	1.254	2295.	1.176
495.	1.254	2300.	1.175
500.	1.254	2305.	1.174
505.	1.254	2310.	1.174
510.	1.254	2315.	1.174
515.	1.253	2320.	1.174
520.	1.253	2325.	1.173
525.	1.253	2330.	1.173
530.	1.252	2335.	1.172
535.	1.252	2340.	1.173
540.	1.252	2345.	1.172
545.	1.252	2350.	1.172
550.	1.251	2355.	1.172
555.	1.251	2360.	1.172
560.	1.251	2365.	1.171
565.	1.251	2370.	1.171
570.	1.25	2375.	1.171
575.	1.25	2380.	1.171
580.	1.249	2385.	1.17
585.	1.249	2390.	1.17
590.	1.249	2395.	1.169
595.	1.249	2400.	1.169
600.	1.249	2405.	1.169
605.	1.249	2410.	1.169
610.	1.248	2415.	1.168
615.	1.248	2420.	1.168
620.	1.248	2425.	1.168
625.	1.247	2430.	1.168
630.	1.247	2435.	1.168
635.	1.247	2440.	1.167
640.	1.247	2445.	1.167
645.	1.246	2450.	1.166
650.	1.246	2455.	1.166
655.	1.246	2460.	1.166
660.	1.246	2465.	1.166
665.	1.246	2470.	1.165
670.	1.246	2475.	1.165
675.	1.245	2480.	1.165
680.	1.245	2485.	1.165
685.	1.245	2490.	1.164
690.	1.245	2495.	1.163
695.	1.245	2500.	1.163
700.	1.244	2505.	1.163
705.	1.244	2510.	1.162
710.	1.244	2515.	1.162
715.	1.244	2520.	1.162
720.	1.244	2525.	1.161
725.	1.244	2530.	1.161
730.	1.244	2535.	1.161
735.	1.243	2540.	1.16
740.	1.243	2545.	1.16
745.	1.243	2550.	1.159
750.	1.243	2555.	1.159
755.	1.242	2560.	1.158
760.	1.242	2565.	1.158
765.	1.242	2570.	1.158
770.	1.242	2575.	1.157
775.	1.242	2580.	1.157
780.	1.241	2585.	1.157
785.	1.241	2590.	1.157
790.	1.241	2595.	1.156
795.	1.241	2600.	1.156
800.	1.24	2605.	1.155
805.	1.24	2610.	1.154
810.	1.24	2615.	1.155
815.	1.24	2620.	1.154

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
820.	1.239	2625.	1.154
825.	1.239	2630.	1.154
830.	1.239	2635.	1.154
835.	1.239	2640.	1.153
840.	1.238	2645.	1.152
845.	1.239	2650.	1.152
850.	1.238	2655.	1.152
855.	1.238	2660.	1.12
860.	1.238	2665.	1.154
865.	1.238	2670.	1.153
870.	1.238	2675.	1.15
875.	1.238	2680.	1.15
880.	1.237	2685.	1.149
885.	1.237	2690.	1.149
890.	1.236	2695.	1.149
895.	1.236	2700.	1.149
900.	1.236	2705.	1.148
905.	1.236	2710.	1.148
910.	1.236	2715.	1.148
915.	1.236	2720.	1.148
920.	1.236	2725.	1.148
925.	1.235	2730.	1.147
930.	1.235	2735.	1.147
935.	1.235	2740.	1.146
940.	1.235	2745.	1.146
945.	1.235	2750.	1.146
950.	1.234	2755.	1.145
955.	1.234	2760.	1.145
960.	1.234	2765.	1.145
965.	1.234	2770.	1.144
970.	1.234	2775.	1.144
975.	1.234	2780.	1.144
980.	1.233	2785.	1.143
985.	1.233	2790.	1.143
990.	1.233	2795.	1.143
995.	1.233	2800.	1.143
1000.	1.232	2805.	1.143
1005.	1.233	2810.	1.142
1010.	1.232	2815.	1.142
1015.	1.232	2820.	1.143
1020.	1.232	2825.	1.142
1025.	1.232	2830.	1.142
1030.	1.232	2835.	1.141
1035.	1.231	2840.	1.141
1040.	1.231	2845.	1.14
1045.	1.231	2850.	1.14
1050.	1.231	2855.	1.14
1055.	1.231	2860.	1.14
1060.	1.23	2865.	1.14
1065.	1.231	2870.	1.139
1070.	1.23	2875.	1.139
1075.	1.23	2880.	1.139
1080.	1.23	2885.	1.139
1085.	1.23	2890.	1.139
1090.	1.23	2895.	1.138
1095.	1.229	2900.	1.138
1100.	1.229	2905.	1.138
1105.	1.228	2910.	1.138
1110.	1.229	2915.	1.137
1115.	1.228	2920.	1.137
1120.	1.228	2925.	1.137
1125.	1.228	2930.	1.137
1130.	1.228	2935.	1.136
1135.	1.228	2940.	1.136
1140.	1.227	2945.	1.134
1145.	1.227	2950.	1.136
1150.	1.227	2955.	1.135

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1155.	1.226	2960.	1.134
1160.	1.226	2965.	1.135
1165.	1.227	2970.	1.135
1170.	1.226	2975.	1.134
1175.	1.226	2980.	1.134
1180.	1.226	2985.	1.134
1185.	1.226	2990.	1.133
1190.	1.226	2995.	1.133
1195.	1.225	3000.	1.133
1200.	1.225	3005.	1.133
1205.	1.225	3010.	1.133
1210.	1.224	3015.	1.132
1215.	1.224	3020.	1.132
1220.	1.224	3025.	1.132
1225.	1.224	3030.	1.132
1230.	1.224	3035.	1.131
1235.	1.224	3040.	1.131
1240.	1.223	3045.	1.131
1245.	1.223	3050.	1.131
1250.	1.223	3055.	1.13
1255.	1.223	3060.	1.13
1260.	1.222	3065.	1.13
1265.	1.222	3070.	1.129
1270.	1.222	3075.	1.129
1275.	1.222	3080.	1.129
1280.	1.221	3085.	1.129
1285.	1.221	3090.	1.129
1290.	1.221	3095.	1.128
1295.	1.221	3100.	1.128
1300.	1.222	3105.	1.127
1305.	1.221	3110.	1.128
1310.	1.221	3115.	1.127
1315.	1.22	3120.	1.127
1320.	1.22	3125.	1.127
1325.	1.22	3130.	1.126
1330.	1.22	3135.	1.126
1335.	1.219	3140.	1.126
1340.	1.22	3145.	1.126
1345.	1.218	3150.	1.125
1350.	1.219	3155.	1.125
1355.	1.219	3160.	1.125
1360.	1.218	3165.	1.125
1365.	1.218	3170.	1.124
1370.	1.218	3175.	1.124
1375.	1.218	3180.	1.124
1380.	1.217	3185.	1.123
1385.	1.217	3190.	1.123
1390.	1.217	3195.	1.123
1395.	1.217	3200.	1.122
1400.	1.216	3205.	1.122
1405.	1.216	3210.	1.122
1410.	1.215	3215.	1.122
1415.	1.215	3220.	1.122
1420.	1.215	3225.	1.121
1425.	1.215	3230.	1.121
1430.	1.215	3235.	1.12
1435.	1.215	3240.	1.12
1440.	1.214	3245.	1.12
1445.	1.214	3250.	1.119
1450.	1.214	3255.	1.119
1455.	1.214	3260.	1.119
1460.	1.213	3265.	1.119
1465.	1.213	3270.	1.118
1470.	1.213	3275.	1.118
1475.	1.213	3280.	1.118
1480.	1.213	3285.	1.118
1485.	1.212	3290.	1.117

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1490.	1.212	3295.	1.117
1495.	1.212	3300.	1.117
1500.	1.212	3305.	1.117
1505.	1.212	3310.	1.117
1510.	1.212	3315.	1.116
1515.	1.211	3320.	1.116
1520.	1.21	3325.	1.115
1525.	1.211	3330.	1.115
1530.	1.211	3335.	1.115
1535.	1.21	3340.	1.115
1540.	1.21	3345.	1.115
1545.	1.21	3350.	1.114
1550.	1.21	3355.	1.114
1555.	1.21	3360.	1.114
1560.	1.21	3365.	1.113
1565.	1.21	3370.	1.113
1570.	1.209	3375.	1.113
1575.	1.209	3380.	1.112
1580.	1.209	3385.	1.113
1585.	1.209	3390.	1.112
1590.	1.208	3395.	1.112
1595.	1.208	3400.	1.112
1600.	1.208	3405.	1.111
1605.	1.208	3410.	1.111
1610.	1.208	3415.	1.11
1615.	1.207	3420.	1.11
1620.	1.207	3425.	1.11
1625.	1.207	3430.	1.11
1630.	1.206	3435.	1.109
1635.	1.207	3440.	1.109
1640.	1.206	3445.	1.109
1645.	1.206	3450.	1.109
1650.	1.206	3455.	1.108
1655.	1.206	3460.	1.109
1660.	1.205	3465.	1.108
1665.	1.206	3470.	1.108
1670.	1.205	3475.	1.108
1675.	1.204	3480.	1.108
1680.	1.204	3485.	1.107
1685.	1.204	3490.	1.107
1690.	1.204	3495.	1.107
1695.	1.204	3500.	1.107
1700.	1.204	3505.	1.106
1705.	1.203	3510.	1.106
1710.	1.203	3515.	1.106
1715.	1.204	3520.	1.105
1720.	1.203	3525.	1.107
1725.	1.202	3530.	1.106
1730.	1.202	3535.	1.105
1735.	1.202	3540.	1.104
1740.	1.202	3545.	1.104
1745.	1.202	3550.	1.104
1750.	1.201	3555.	1.103
1755.	1.201	3560.	1.103
1760.	1.2	3565.	1.103
1765.	1.2	3570.	1.102
1770.	1.2	3575.	1.101
1775.	1.199	3580.	1.101
1780.	1.2	3585.	1.101
1785.	1.199	3590.	1.101
1790.	1.199	3595.	1.1
1795.	1.199	3600.	1.099
1800.	1.198	3605.	1.099

SOLUTION

Slug Test

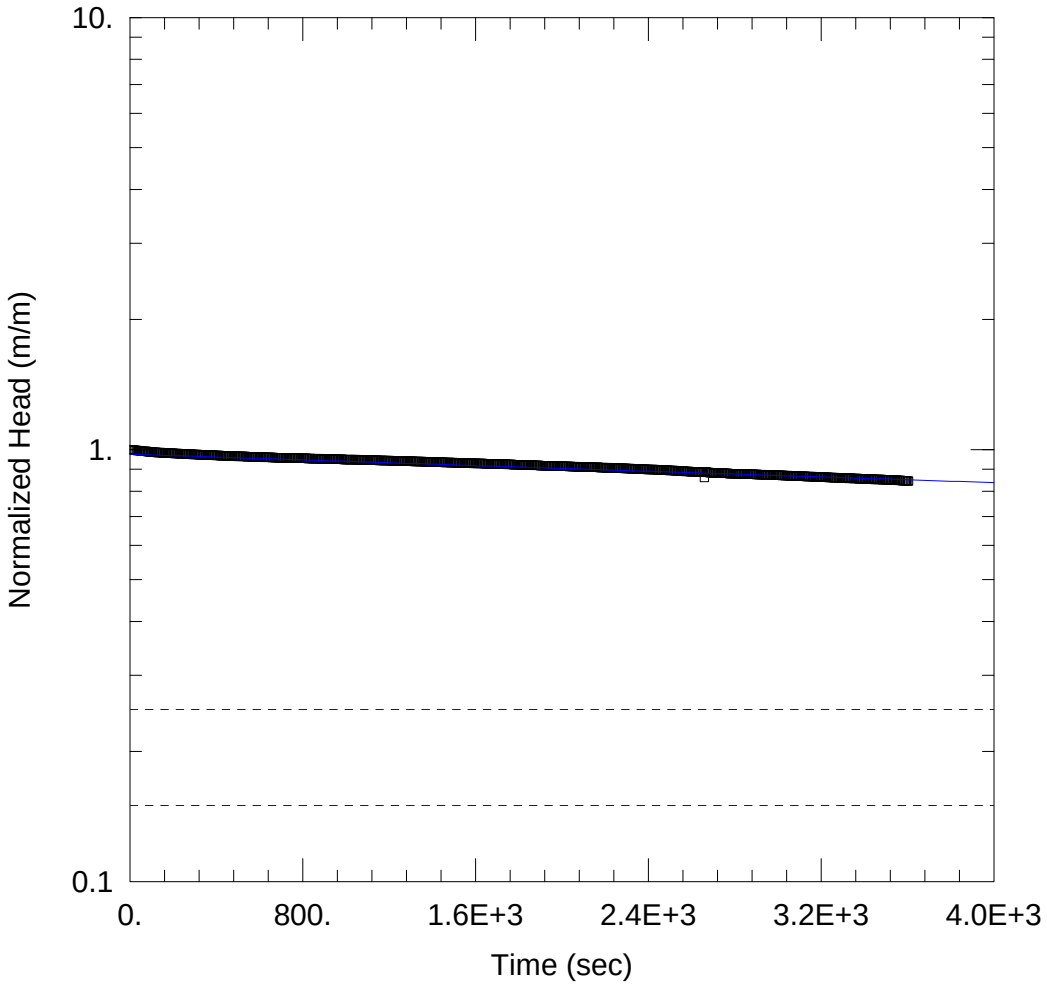
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1969

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	2.876E-8	m/sec
y0	1.268	m

K = 2.876E-6 cm/sec
T = K*b = 2.876E-6 m²/sec (0.02876 sq. cm/sec)



MW-H28 ZONE 2 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 19.05 - 26.82 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28 Zone 2
Test Date: 24 July 2013

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 2.876E-8 m/sec
y0 = 1.268 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 Zone 3 (Falling Head Packer Test, vertical interval 27.28 - 41.76 m)
Date: 08/14/13
Time: 15:01:00

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 25 July 2013
Test Well: MW-H28 Zone 3

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.5 m
Static Water Column Height: 41.13 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 14.48 m
Total Well Penetration Depth: 41.13 m

No. of Observations: 94

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.5	1410.	1.467
30.	1.495	1440.	1.467
60.	1.492	1470.	1.467
90.	1.489	1500.	1.466
120.	1.487	1530.	1.466
150.	1.485	1560.	1.466
180.	1.484	1590.	1.465
210.	1.483	1620.	1.465
240.	1.482	1650.	1.465
270.	1.482	1680.	1.464
300.	1.481	1710.	1.465
330.	1.48	1740.	1.464
360.	1.48	1770.	1.463
390.	1.479	1800.	1.463
420.	1.478	1830.	1.463
450.	1.478	1860.	1.463
480.	1.477	1890.	1.462
510.	1.477	1920.	1.462
540.	1.476	1950.	1.462
570.	1.476	1980.	1.461
600.	1.476	2010.	1.461
630.	1.476	2040.	1.461
660.	1.475	2070.	1.461
690.	1.475	2100.	1.46
720.	1.474	2130.	1.46
750.	1.474	2160.	1.46
780.	1.473	2190.	1.459
810.	1.473	2220.	1.459
840.	1.473	2250.	1.459
870.	1.473	2280.	1.459

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	1.472	2310.	1.458
930.	1.471	2340.	1.458
960.	1.472	2370.	1.458
990.	1.471	2400.	1.459
1020.	1.471	2430.	1.458
1050.	1.471	2460.	1.458
1080.	1.47	2490.	1.458
1110.	1.47	2520.	1.457
1140.	1.469	2550.	1.456
1170.	1.47	2580.	1.456
1200.	1.468	2610.	1.456
1230.	1.468	2640.	1.455
1260.	1.468	2670.	1.456
1290.	1.468	2700.	1.463
1320.	1.468	2730.	1.456
1350.	1.468	2760.	1.453
1380.	1.467	2790.	1.441

SOLUTION

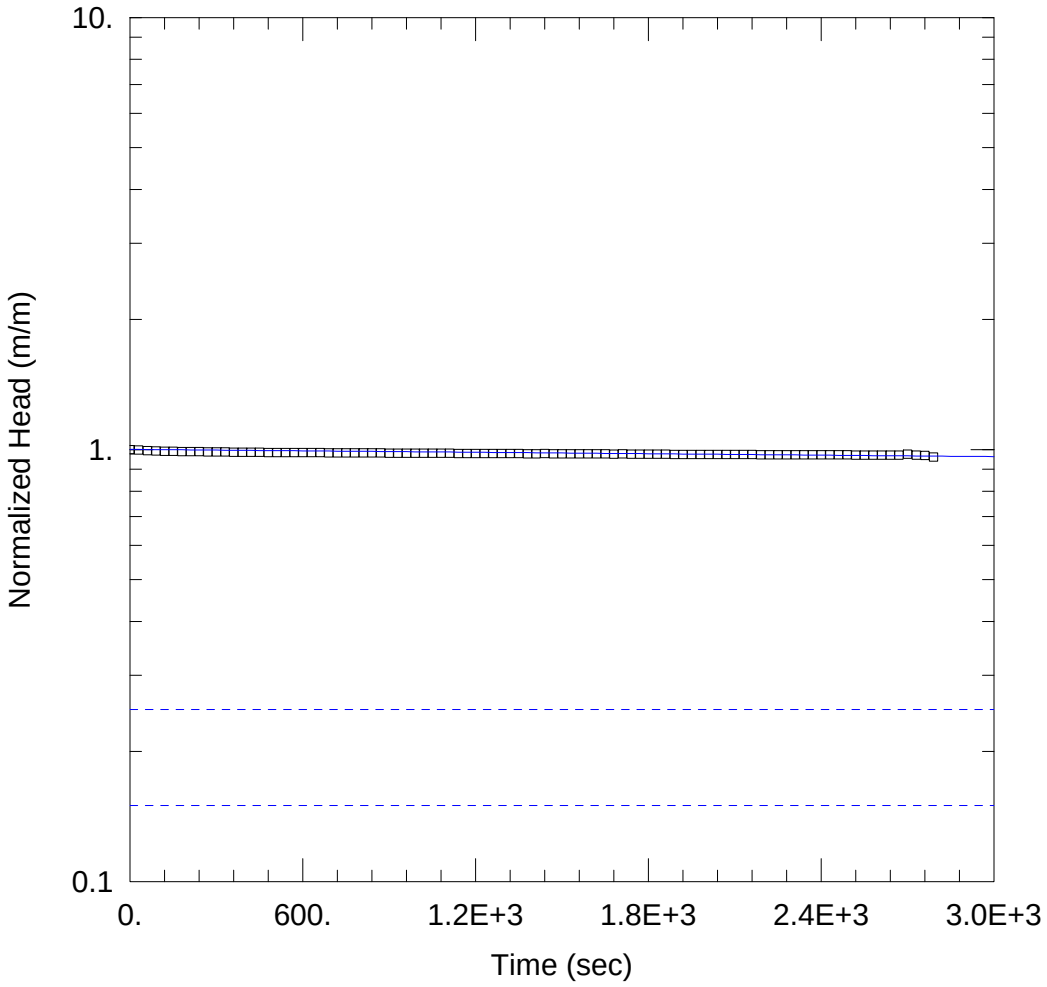
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1752

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	5.821E-9	m/sec
y0	1.501	m

K = 5.821E-7 cm/sec
T = K*b = 5.821E-7 m²/sec (0.005821 sq. cm/sec)



MW-H28 ZONE 3 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 27.28 - 41.76 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28 Zone 3
Test Date: 25 July 2013

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 5.821E-9 m/sec
y0 = 1.501 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 Zone 4 (Falling Head Packer Test, vertical interval 42.22 - 56.69 m)
Date: 08/14/13
Time: 15:06:17

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 26 July 2013
Test Well: MW-H28 Zone 4

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.3 m
Static Water Column Height: 44.93 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 14.48 m
Total Well Penetration Depth: 44.93 m

No. of Observations: 90

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.3	1350.	1.043
30.	1.29	1380.	1.037
60.	1.282	1410.	1.032
90.	1.274	1440.	1.027
120.	1.267	1470.	1.022
150.	1.26	1500.	1.016
180.	1.254	1530.	1.011
210.	1.248	1560.	1.006
240.	1.242	1590.	1.
270.	1.236	1620.	0.9953
300.	1.231	1650.	0.9897
330.	1.225	1680.	0.9845
360.	1.22	1710.	0.9797
390.	1.214	1740.	0.9741
420.	1.208	1770.	0.9682
450.	1.203	1800.	0.963
480.	1.197	1830.	0.958
510.	1.192	1860.	0.9527
540.	1.186	1890.	0.9469
570.	1.181	1920.	0.9417
600.	1.176	1950.	0.9368
630.	1.171	1980.	0.9314
660.	1.165	2010.	0.9264
690.	1.16	2040.	0.921
720.	1.154	2070.	0.9156
750.	1.149	2100.	0.9103
780.	1.143	2130.	0.9048
810.	1.138	2160.	0.9001
840.	1.133	2190.	0.8944
870.	1.128	2220.	0.8889

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	1.122	2250.	0.8839
930.	1.116	2280.	0.8786
960.	1.111	2310.	0.8734
990.	1.106	2340.	0.8684
1020.	1.101	2370.	0.8633
1050.	1.096	2400.	0.8586
1080.	1.09	2430.	0.8535
1110.	1.085	2460.	0.848
1140.	1.079	2490.	0.8428
1170.	1.075	2520.	0.8368
1200.	1.069	2550.	0.8314
1230.	1.063	2580.	0.8258
1260.	1.058	2610.	0.8205
1290.	1.053	2640.	0.8148
1320.	1.048	2670.	0.8106

SOLUTION

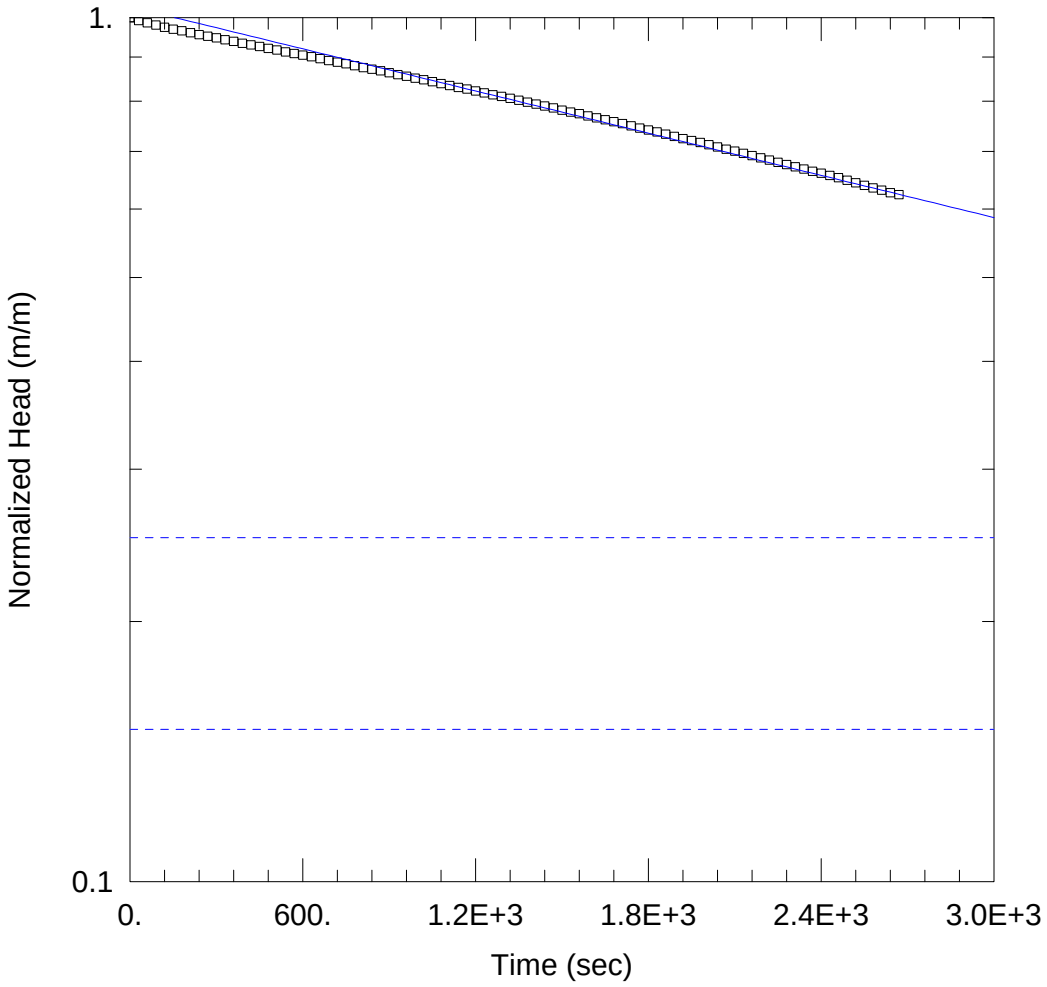
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1752

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	8.509E-8	m/sec
y0	1.338	m

K = 8.509E-6 cm/sec
T = K*b = 8.509E-6 m²/sec (0.08509 sq. cm/sec)



MW-H28 ZONE 4 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 42.22 - 56.69 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28 Zone 4
Test Date: 26 July 2013

AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 8.509E-8 m/sec

y0 = 1.338 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 Zone 5 (Falling Head Packer Test, vertical interval 57.45 - 76.51 m)
Date: 08/14/13
Time: 15:14:28

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 26 July 2013
Test Well: MW-H28 Zone 5

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 6.7 m
Static Water Column Height: 68.94 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 19.05 m
Total Well Penetration Depth: 68.94 m

No. of Observations: 79

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	6.7	1200.	5.445
30.	6.658	1230.	5.416
60.	6.625	1260.	5.387
90.	6.592	1290.	5.356
120.	6.554	1320.	5.329
150.	6.521	1350.	5.3
180.	6.486	1380.	5.272
210.	6.453	1410.	5.243
240.	6.419	1440.	5.214
270.	6.386	1470.	5.185
300.	6.354	1500.	5.157
330.	6.32	1530.	5.129
360.	6.29	1560.	5.101
390.	6.257	1590.	5.072
420.	6.226	1620.	5.045
450.	6.195	1650.	5.018
480.	6.165	1680.	4.99
510.	6.13	1710.	4.961
540.	6.102	1740.	4.933
570.	6.072	1770.	4.904
600.	6.04	1800.	4.877
630.	6.01	1830.	4.85
660.	5.979	1860.	4.822
690.	5.949	1890.	4.795
720.	5.918	1920.	4.767
750.	5.888	1950.	4.74
780.	5.859	1980.	4.713
810.	5.828	2010.	4.685
840.	5.8	2040.	4.657
870.	5.769	2070.	4.63

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	5.739	2100.	4.603
930.	5.708	2130.	4.575
960.	5.679	2160.	4.548
990.	5.648	2190.	4.522
1020.	5.62	2220.	4.495
1050.	5.591	2250.	4.467
1080.	5.561	2280.	4.44
1110.	5.532	2310.	4.411
1140.	5.503	2340.	4.34
1170.	5.473		

SOLUTION

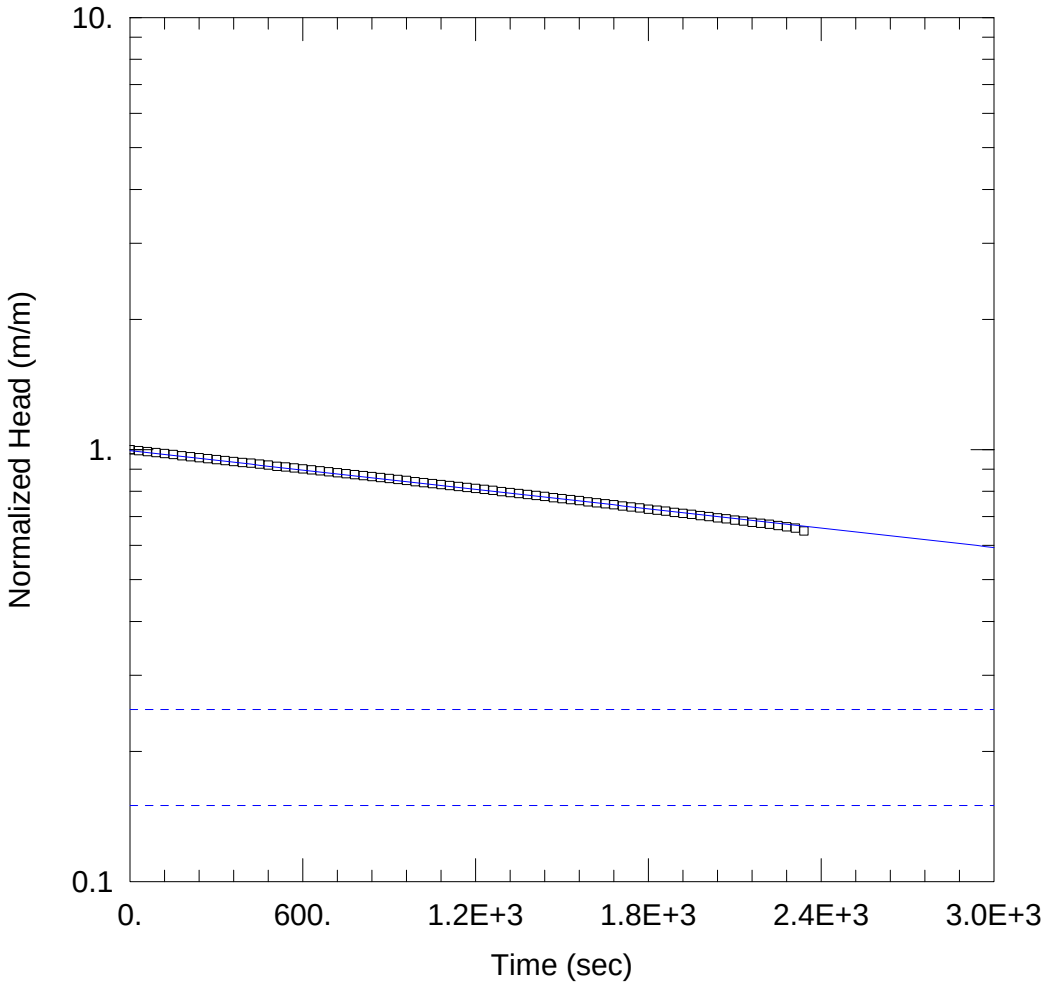
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1671

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	6.219E-8	m/sec
y0	6.658	m

K = 6.219E-6 cm/sec
T = K*b = 6.219E-6 m²/sec (0.06219 sq. cm/sec)



MW-H28 ZONE 5 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 57.45 - 76.51 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28 Zone 5
Test Date: 26 July 2013

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 6.219E-8 m/sec
y0 = 6.658 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H28 Zone 6 (Falling Head Packer Test, vertical interval 77.27 - 93.27 m)
Date: 08/14/13
Time: 15:17:04

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 27 July 2013
Test Well: MW-H28 Zone 6

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H28

X Location: 0. m
Y Location: 0. m

Initial Displacement: 4.99 m
Static Water Column Height: 88.28 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 16. m
Total Well Penetration Depth: 88.28 m

No. of Observations: 17

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	4.99	750.	4.781
30.	4.82	900.	4.779
60.	4.805	1200.	4.769
120.	4.798	1500.	4.759
180.	4.795	1800.	4.754
240.	4.794	2100.	4.746
300.	4.792	2400.	4.74
450.	4.789	2700.	4.735
600.	4.784		

SOLUTION

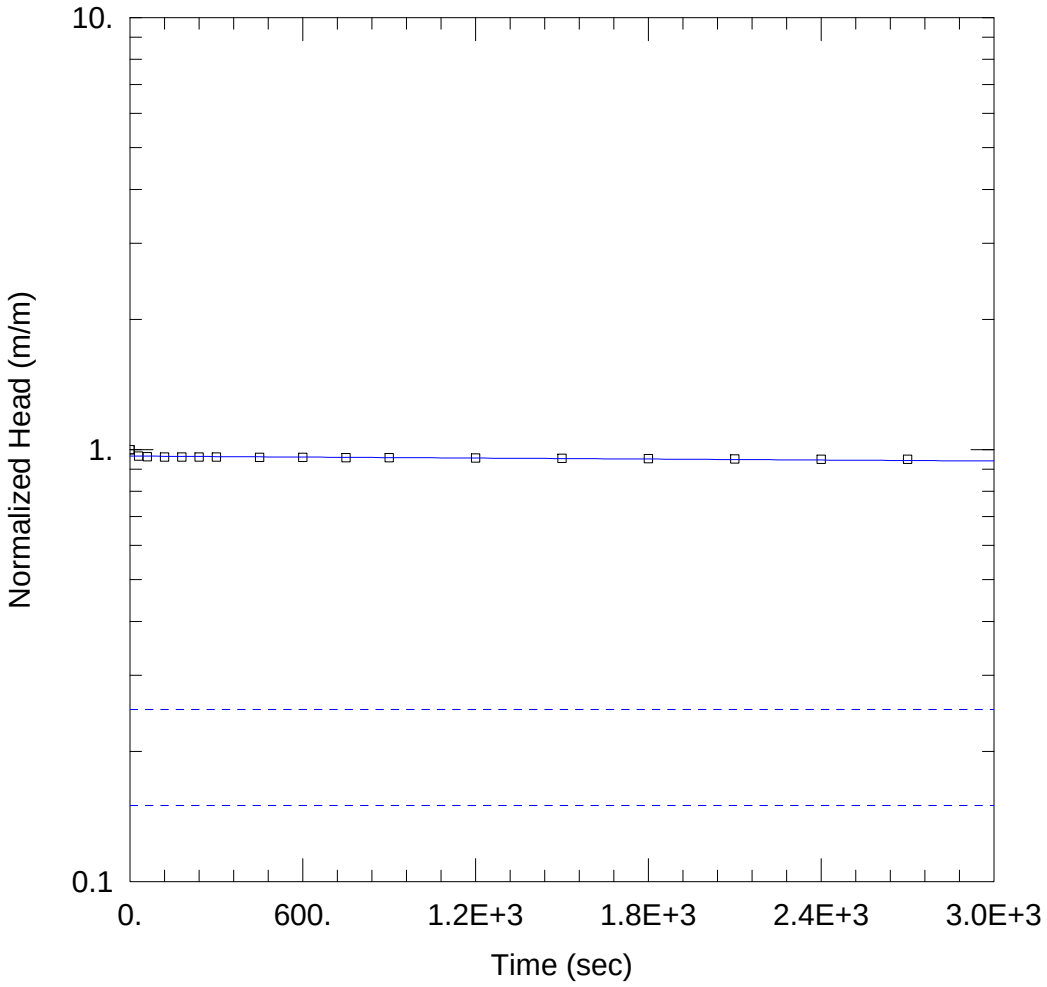
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1721

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	3.668E-9	m/sec
y0	4.818	m

K = 3.668E-7 cm/sec
T = K*b = 3.668E-7 m²/sec (0.003668 sq. cm/sec)



MW-H28 ZONE 6 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 77.27 - 93.27 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28 Zone 6
Test Date: 27 July 2013

AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

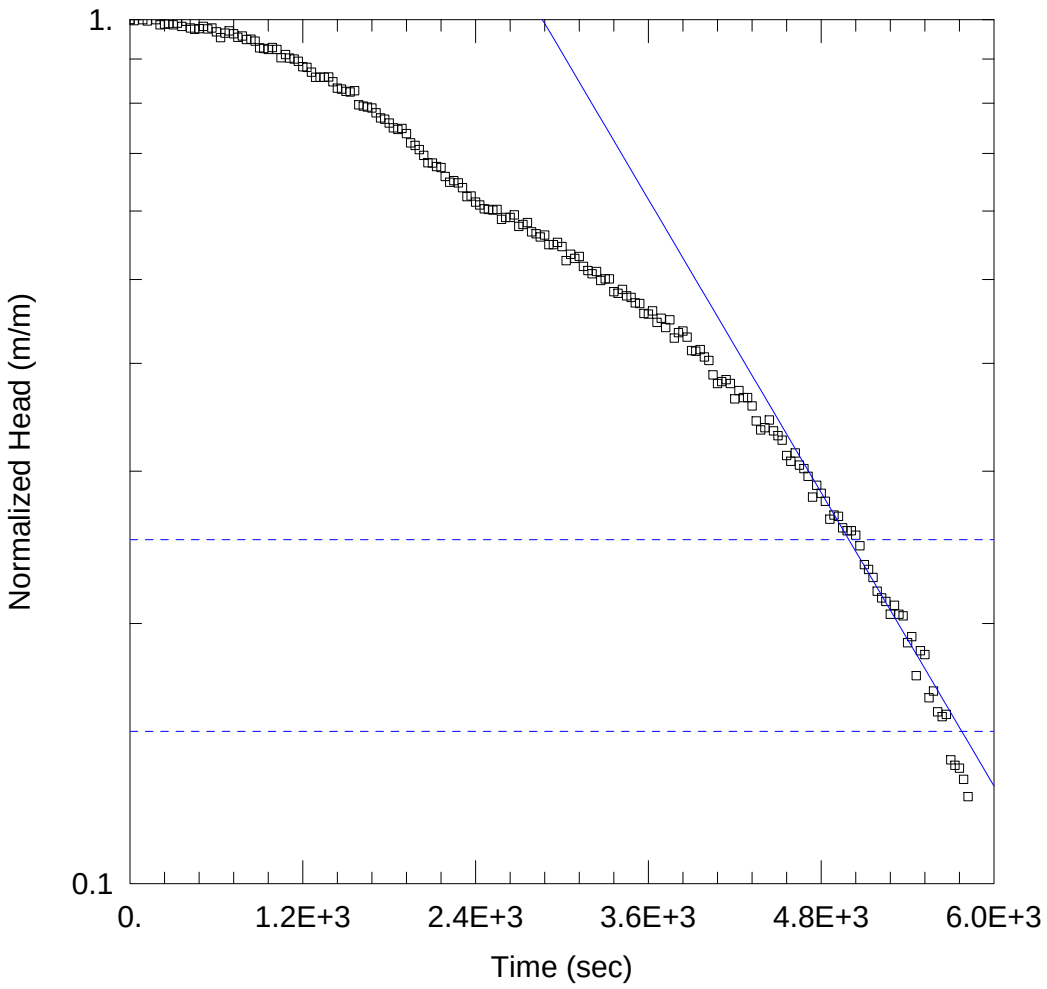
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 3.668E-9 m/sec

y0 = 4.818 m



MW-H28 (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H28
Test Date: 1 August 2013

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H28)

Initial Displacement: 0.1 m
Total Well Penetration Depth: 5.079 m
Casing Radius: 0.016 m
Static Water Column Height: 5.079 m
Screen Length: 3.05 m
Well Radius: 0.038 m

SOLUTION

Aquifer Model: Confined
K = 1.199E-7 m/sec
Solution Method: Hvorslev
y0 = 0.6461 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 (Rising Head Slug Test)
Date: 08/14/13
Time: 11:57:27

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 1 August 2013
Test Well: MW-H29

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.95 m
Static Water Column Height: 6.61 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 6.61 m

No. of Observations: 232

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.95	3480.	0.2804
30.	0.9498	3510.	0.2768
60.	0.9474	3540.	0.2736
90.	0.9418	3570.	0.2696
120.	0.9363	3600.	0.2663
150.	0.9294	3630.	0.2626
180.	0.9216	3660.	0.2596
210.	0.9145	3690.	0.2564
240.	0.9069	3720.	0.2522
270.	0.8991	3750.	0.2487
300.	0.8911	3780.	0.2454
330.	0.8834	3810.	0.2425
360.	0.8746	3840.	0.2394
390.	0.8669	3870.	0.2366
420.	0.8593	3900.	0.2331
450.	0.8511	3930.	0.23
480.	0.843	3960.	0.227
510.	0.8349	3990.	0.2232
540.	0.8268	4020.	0.2201
570.	0.8192	4050.	0.217
600.	0.8108	4080.	0.2137
630.	0.8034	4110.	0.2114
660.	0.7961	4140.	0.209
690.	0.788	4170.	0.2058
720.	0.7808	4200.	0.2029
750.	0.7724	4230.	0.2
780.	0.7644	4260.	0.1968
810.	0.7573	4290.	0.1942
840.	0.7493	4320.	0.191
870.	0.7423	4350.	0.1883

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	0.7349	4380.	0.1855
930.	0.7276	4410.	0.1827
960.	0.7202	4440.	0.1796
990.	0.7129	4470.	0.1766
1020.	0.7057	4500.	0.1744
1050.	0.6985	4530.	0.1717
1080.	0.691	4560.	0.1686
1110.	0.6839	4590.	0.1658
1140.	0.6776	4620.	0.1633
1170.	0.6705	4650.	0.1621
1200.	0.6647	4680.	0.1589
1230.	0.6572	4710.	0.1566
1260.	0.6509	4740.	0.1542
1290.	0.6444	4770.	0.1517
1320.	0.6376	4800.	0.1488
1350.	0.6313	4830.	0.1462
1380.	0.6251	4860.	0.1442
1410.	0.618	4890.	0.1416
1440.	0.6125	4920.	0.1386
1470.	0.6065	4950.	0.1361
1500.	0.5991	4980.	0.134
1530.	0.593	5010.	0.1315
1560.	0.5871	5040.	0.1288
1590.	0.5813	5070.	0.1277
1620.	0.5749	5100.	0.125
1650.	0.5688	5130.	0.1226
1680.	0.5627	5160.	0.1202
1710.	0.556	5190.	0.1182
1740.	0.551	5220.	0.1156
1770.	0.5445	5250.	0.1135
1800.	0.5388	5280.	0.1114
1830.	0.5324	5310.	0.1092
1860.	0.5264	5340.	0.1065
1890.	0.522	5370.	0.1059
1920.	0.516	5400.	0.1031
1950.	0.5106	5430.	0.1009
1980.	0.505	5460.	0.0989
2010.	0.4993	5490.	0.0969
2040.	0.4938	5520.	0.0949
2070.	0.4887	5550.	0.0931
2100.	0.483	5580.	0.0907
2130.	0.4778	5610.	0.0888
2160.	0.4722	5640.	0.0866
2190.	0.4671	5670.	0.0851
2220.	0.4625	5700.	0.0826
2250.	0.4565	5730.	0.0807
2280.	0.452	5760.	0.0787
2310.	0.4463	5790.	0.0768
2340.	0.4417	5820.	0.0754
2370.	0.4372	5850.	0.0733
2400.	0.4318	5880.	0.0708
2430.	0.4267	5910.	0.0693
2460.	0.4213	5940.	0.0685
2490.	0.4172	5970.	0.0664
2520.	0.4119	6000.	0.065
2550.	0.4073	6030.	0.0633
2580.	0.4036	6060.	0.0614
2610.	0.3988	6090.	0.0598
2640.	0.3944	6120.	0.0577
2670.	0.3894	6150.	0.0562
2700.	0.3848	6180.	0.0543
2730.	0.3807	6210.	0.0529
2760.	0.3756	6240.	0.0514
2790.	0.3717	6270.	0.0499
2820.	0.3668	6300.	0.0482
2850.	0.3631	6330.	0.0467
2880.	0.3587	6360.	0.0453

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
2910.	0.3539	6390.	0.0436
2940.	0.3503	6420.	0.0416
2970.	0.3458	6450.	0.041
3000.	0.3417	6480.	0.0389
3030.	0.3376	6510.	0.0371
3060.	0.3333	6540.	0.0355
3090.	0.3288	6570.	0.0339
3120.	0.325	6600.	0.0331
3150.	0.3208	6630.	0.0316
3180.	0.3177	6660.	0.0296
3210.	0.3138	6690.	0.0284
3240.	0.3096	6720.	0.0273
3270.	0.3056	6750.	0.0254
3300.	0.3021	6780.	0.0239
3330.	0.2979	6810.	0.0226
3360.	0.2947	6840.	0.0209
3390.	0.2906	6870.	0.0197
3420.	0.2882	6900.	0.0185
3450.	0.2847	6930.	0.0176

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	9.196E-8	m/sec
y0	1.643	m

K = 9.196E-6 cm/sec
T = K*b = 9.196E-6 m²/sec (0.09196 sq. cm/sec)

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 Zone 1 (Falling Head Packer Test, vertical interval 5.79 - 8.84 m)
Date: 08/14/13
Time: 15:29:16

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 28 July 2013
Test Well: MW-H29 Zone 1

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.75 m
Static Water Column Height: 8.459 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 3.048 m
Total Well Penetration Depth: 8.459 m

No. of Observations: 486

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.75	1215.	0.4707
5.	0.7497	1220.	0.4694
10.	0.7787	1225.	0.4686
15.	0.7762	1230.	0.4672
20.	0.7737	1235.	0.4659
25.	0.7704	1240.	0.465
30.	0.7672	1245.	0.4629
35.	0.7646	1250.	0.4625
40.	0.7631	1255.	0.4625
45.	0.763	1260.	0.4601
50.	0.7621	1265.	0.4593
55.	0.7607	1270.	0.4586
60.	0.758	1275.	0.4577
65.	0.755	1280.	0.4554
70.	0.7516	1285.	0.455
75.	0.7503	1290.	0.4539
80.	0.7507	1295.	0.4527
85.	0.7501	1300.	0.4513
90.	0.749	1305.	0.4502
95.	0.7459	1310.	0.4499
100.	0.7423	1315.	0.4479
105.	0.7403	1320.	0.447
110.	0.7396	1325.	0.4458
115.	0.7406	1330.	0.4448
120.	0.7393	1335.	0.4439
125.	0.7369	1340.	0.443
130.	0.7339	1345.	0.4415
135.	0.7309	1350.	0.4407
140.	0.7303	1355.	0.4395
145.	0.7306	1360.	0.4383

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
150.	0.7308	1365.	0.4371
155.	0.7283	1370.	0.4364
160.	0.7252	1375.	0.4351
165.	0.722	1380.	0.434
170.	0.7213	1385.	0.433
175.	0.7217	1390.	0.4319
180.	0.722	1395.	0.4311
185.	0.721	1400.	0.43
190.	0.718	1405.	0.4289
195.	0.7143	1410.	0.4276
200.	0.7129	1415.	0.4263
205.	0.7136	1420.	0.425
210.	0.7135	1425.	0.4246
215.	0.7122	1430.	0.4228
220.	0.7089	1435.	0.4217
225.	0.7057	1440.	0.4205
230.	0.7046	1445.	0.4198
235.	0.7058	1450.	0.4184
240.	0.7052	1455.	0.4169
245.	0.7039	1460.	0.4161
250.	0.7004	1465.	0.415
255.	0.6974	1470.	0.4133
260.	0.6966	1475.	0.412
265.	0.6971	1480.	0.411
270.	0.6971	1485.	0.4089
275.	0.6952	1490.	0.4083
280.	0.6924	1495.	0.4069
285.	0.6887	1500.	0.4053
290.	0.6883	1505.	0.4044
295.	0.6878	1510.	0.4029
300.	0.6893	1515.	0.4019
305.	0.6877	1520.	0.4007
310.	0.6848	1525.	0.3994
315.	0.6815	1530.	0.3983
320.	0.6792	1535.	0.3967
325.	0.6796	1540.	0.3955
330.	0.6808	1545.	0.3945
335.	0.6794	1550.	0.3932
340.	0.6777	1555.	0.3917
345.	0.6752	1560.	0.3898
350.	0.6721	1565.	0.3894
355.	0.6716	1570.	0.3877
360.	0.6715	1575.	0.3876
365.	0.6699	1580.	0.3854
370.	0.669	1585.	0.384
375.	0.6672	1590.	0.3832
380.	0.6665	1595.	0.3813
385.	0.6652	1600.	0.3805
390.	0.6638	1605.	0.3791
395.	0.6627	1610.	0.3777
400.	0.6615	1615.	0.3764
405.	0.6597	1620.	0.3753
410.	0.6594	1625.	0.3734
415.	0.6583	1630.	0.3732
420.	0.6565	1635.	0.3714
425.	0.6559	1640.	0.3701
430.	0.6543	1645.	0.3693
435.	0.6531	1650.	0.3679
440.	0.6524	1655.	0.3665
445.	0.6505	1660.	0.3654
450.	0.6497	1665.	0.3645
455.	0.6485	1670.	0.3626
460.	0.647	1675.	0.362
465.	0.6453	1680.	0.3603
470.	0.6446	1685.	0.3591
475.	0.6429	1690.	0.3577
480.	0.6425	1695.	0.3568

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
485.	0.641	1700.	0.3557
490.	0.6399	1705.	0.3542
495.	0.6385	1710.	0.3528
500.	0.6375	1715.	0.3519
505.	0.6366	1720.	0.3502
510.	0.6352	1725.	0.3493
515.	0.6335	1730.	0.3482
520.	0.6329	1735.	0.347
525.	0.6315	1740.	0.3459
530.	0.6308	1745.	0.3441
535.	0.6292	1750.	0.3428
540.	0.6275	1755.	0.3419
545.	0.6267	1760.	0.3408
550.	0.6258	1765.	0.3393
555.	0.6244	1770.	0.3377
560.	0.6227	1775.	0.3372
565.	0.6217	1780.	0.3353
570.	0.6213	1785.	0.3338
575.	0.6193	1790.	0.3333
580.	0.6187	1795.	0.3319
585.	0.6171	1800.	0.331
590.	0.6157	1805.	0.3293
595.	0.6144	1810.	0.3281
600.	0.6131	1815.	0.3267
605.	0.6118	1820.	0.3253
610.	0.6108	1825.	0.324
615.	0.6097	1830.	0.3225
620.	0.6082	1835.	0.322
625.	0.6073	1840.	0.3201
630.	0.6063	1845.	0.3198
635.	0.6052	1850.	0.3179
640.	0.6042	1855.	0.3164
645.	0.6029	1860.	0.3154
650.	0.6014	1865.	0.3141
655.	0.6003	1870.	0.3127
660.	0.5994	1875.	0.312
665.	0.5981	1880.	0.3098
670.	0.5972	1885.	0.3092
675.	0.5957	1890.	0.3079
680.	0.5919	1895.	0.3067
685.	0.5939	1900.	0.3058
690.	0.5926	1905.	0.3048
695.	0.5913	1910.	0.3027
700.	0.5896	1915.	0.3019
705.	0.5893	1920.	0.3005
710.	0.588	1925.	0.2995
715.	0.5864	1930.	0.2986
720.	0.5856	1935.	0.2937
725.	0.5848	1940.	0.2962
730.	0.5834	1945.	0.2943
735.	0.5817	1950.	0.2932
740.	0.5805	1955.	0.2922
745.	0.5797	1960.	0.2906
750.	0.5787	1965.	0.292
755.	0.5776	1970.	0.2888
760.	0.5762	1975.	0.2874
765.	0.5751	1980.	0.286
770.	0.5783	1985.	0.2848
775.	0.572	1990.	0.2838
780.	0.5708	1995.	0.2822
785.	0.5701	2000.	0.2807
790.	0.5683	2005.	0.2799
795.	0.5674	2010.	0.279
800.	0.5662	2015.	0.2776
805.	0.5651	2020.	0.2764
810.	0.5643	2025.	0.2746
815.	0.5629	2030.	0.2735

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
820.	0.5621	2035.	0.2726
825.	0.5611	2040.	0.2715
830.	0.56	2045.	0.2697
835.	0.5587	2050.	0.2694
840.	0.558	2055.	0.2676
845.	0.5565	2060.	0.2666
850.	0.5562	2065.	0.266
855.	0.5548	2070.	0.2648
860.	0.553	2075.	0.263
865.	0.5518	2080.	0.2618
870.	0.5507	2085.	0.2611
875.	0.5497	2090.	0.2595
880.	0.5483	2095.	0.2588
885.	0.5473	2100.	0.2576
890.	0.5462	2105.	0.256
895.	0.5445	2110.	0.2551
900.	0.5442	2115.	0.2538
905.	0.5428	2120.	0.2524
910.	0.5415	2125.	0.251
915.	0.5399	2130.	0.2501
920.	0.5394	2135.	0.2485
925.	0.5382	2140.	0.248
930.	0.5373	2145.	0.2465
935.	0.5358	2150.	0.2456
940.	0.535	2155.	0.2443
945.	0.5333	2160.	0.2429
950.	0.5327	2165.	0.2421
955.	0.5312	2170.	0.2406
960.	0.5299	2175.	0.2395
965.	0.5293	2180.	0.2382
970.	0.5277	2185.	0.2376
975.	0.5269	2190.	0.2362
980.	0.5251	2195.	0.2348
985.	0.524	2200.	0.2331
990.	0.523	2205.	0.2324
995.	0.522	2210.	0.2304
1000.	0.5202	2215.	0.2299
1005.	0.5192	2220.	0.2279
1010.	0.5184	2225.	0.2275
1015.	0.517	2230.	0.2261
1020.	0.516	2235.	0.2248
1025.	0.5148	2240.	0.2236
1030.	0.5137	2245.	0.2223
1035.	0.5127	2250.	0.2213
1040.	0.5119	2255.	0.2201
1045.	0.5099	2260.	0.2187
1050.	0.5089	2265.	0.2177
1055.	0.5081	2270.	0.2168
1060.	0.5065	2275.	0.215
1065.	0.5061	2280.	0.2137
1070.	0.5045	2285.	0.2126
1075.	0.5047	2290.	0.2119
1080.	0.5043	2295.	0.2105
1085.	0.4995	2300.	0.2093
1090.	0.5	2305.	0.208
1095.	0.4981	2310.	0.2063
1100.	0.4967	2315.	0.2053
1105.	0.4953	2320.	0.2039
1110.	0.494	2325.	0.203
1115.	0.4936	2330.	0.2015
1120.	0.4911	2335.	0.1999
1125.	0.4904	2340.	0.1988
1130.	0.4895	2345.	0.1977
1135.	0.4863	2350.	0.1967
1140.	0.4935	2355.	0.1948
1145.	0.487	2360.	0.1945
1150.	0.4856	2365.	0.1932

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1155.	0.4822	2370.	0.192
1160.	0.4832	2375.	0.1907
1165.	0.4822	2380.	0.1892
1170.	0.4809	2385.	0.1886
1175.	0.4796	2390.	0.1874
1180.	0.4779	2395.	0.1857
1185.	0.4777	2400.	0.1855
1190.	0.4763	2405.	0.1829
1195.	0.4752	2410.	0.1826
1200.	0.4742	2415.	0.1808
1205.	0.4725	2420.	0.1791
1210.	0.4715	2425.	0.1786

SOLUTION

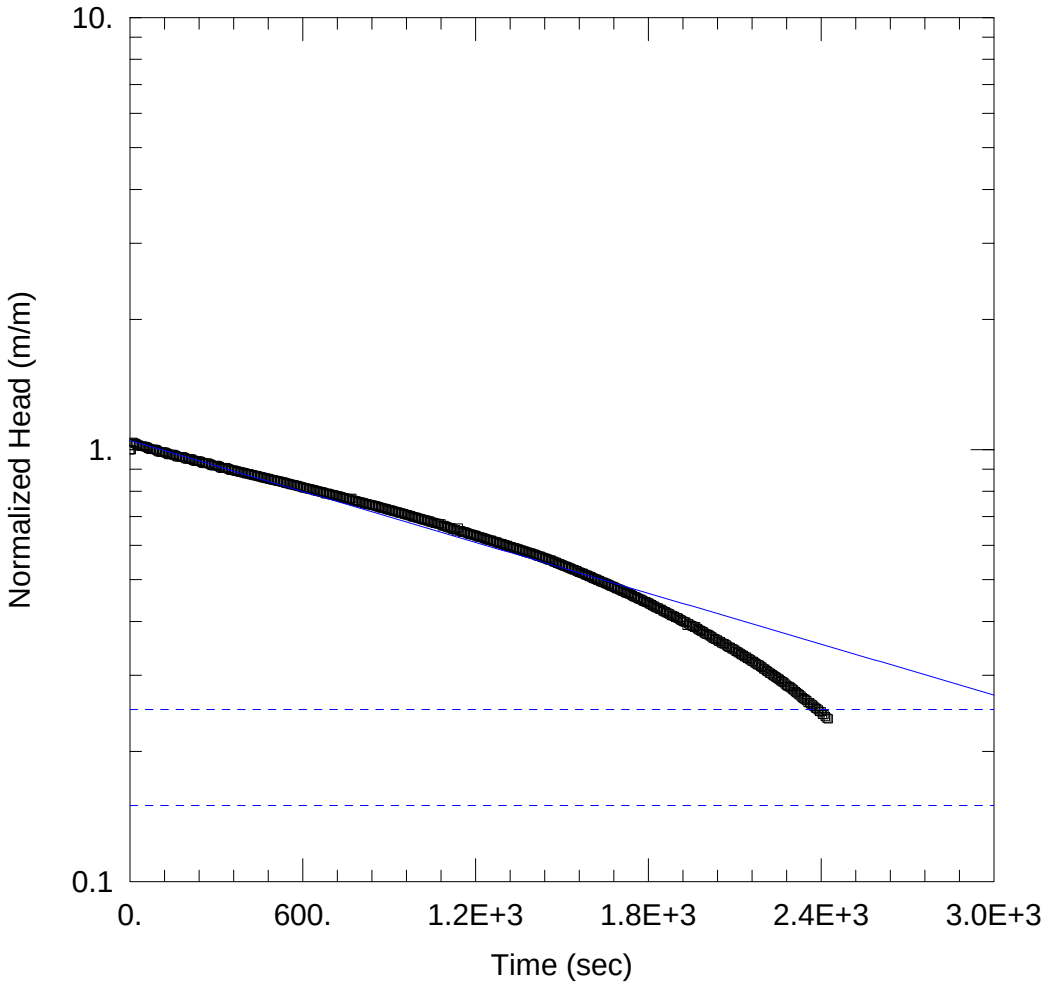
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.2409

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	7.095E-7	m/sec
y0	0.7867	m

K = 7.095E-5 cm/sec
T = K*b = 7.095E-5 m²/sec (0.7095 sq. cm/sec)



MW-H29 ZONE 1 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 5.79 - 8.84 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29 Zone 1
Test Date: 28 July 2013

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 7.095E-7 m/sec
y0 = 0.7867 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 Zone 2 (Falling Head Packer Test, vertical interval 9.60- 24.38 m)
Date: 08/14/13
Time: 15:31:55

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 28 July 2013
Test Well: MW-H29 Zone 2

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 6. m
Static Water Column Height: 20. m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 14.78 m
Total Well Penetration Depth: 20. m

No. of Observations: 79

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	6.	1200.	2.116
30.	5.671	1230.	2.072
60.	5.308	1260.	2.029
90.	5.037	1290.	1.987
120.	4.827	1320.	1.945
150.	4.653	1350.	1.904
180.	4.503	1380.	1.864
210.	4.372	1410.	1.825
240.	4.253	1440.	1.786
270.	4.142	1470.	1.748
300.	4.037	1500.	1.71
330.	3.939	1530.	1.675
360.	3.845	1560.	1.638
390.	3.757	1590.	1.602
420.	3.671	1620.	1.567
450.	3.59	1650.	1.535
480.	3.511	1680.	1.5
510.	3.435	1710.	1.467
540.	3.361	1740.	1.435
570.	3.29	1770.	1.403
600.	3.22	1800.	1.372
630.	3.152	1830.	1.341
660.	3.085	1860.	1.31
690.	3.02	1890.	1.28
720.	2.958	1920.	1.251
750.	2.898	1950.	1.222
780.	2.836	1980.	1.194
810.	2.777	2010.	1.167
840.	2.72	2040.	1.139
870.	2.663	2070.	1.111

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	2.608	2100.	1.085
930.	2.555	2130.	1.059
960.	2.501	2160.	1.033
990.	2.45	2190.	1.008
1020.	2.399	2220.	0.9828
1050.	2.35	2250.	0.9584
1080.	2.301	2280.	0.9338
1110.	2.253	2310.	0.9101
1140.	2.207	2340.	0.8843
1170.	2.161		

SOLUTION

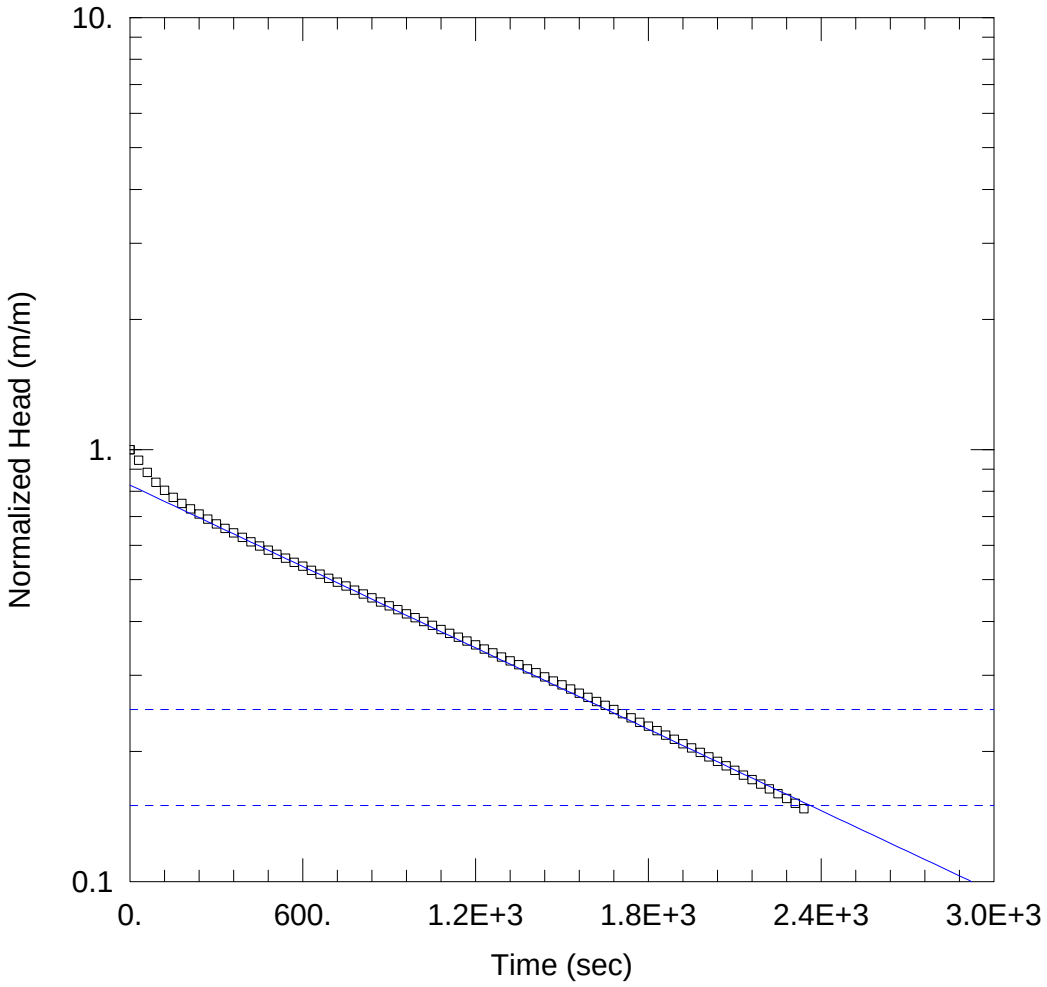
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1745

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	3.229E-7	m/sec
y0	4.963	m

K = 3.229E-5 cm/sec
T = K*b = 3.229E-5 m²/sec (0.3229 sq. cm/sec)



MW-H29 ZONE 2 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 9.60- 24.38 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29 Zone 2
Test Date: 28 July 2013

AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 3.229E-7 m/sec

y0 = 4.963 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 Zone 3 (Falling Head Packer Test, vertical interval 25.15 - 39.62 m)
Date: 08/14/13
Time: 15:35:35

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 28 July 2013
Test Well: MW-H29 Zone 3

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 3.08 m
Static Water Column Height: 36.54 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 14.48 m
Total Well Penetration Depth: 36.54 m

No. of Observations: 86

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	4.15	1290.	4.047
30.	4.135	1320.	4.045
60.	4.129	1350.	4.045
90.	4.124	1380.	4.043
120.	4.12	1410.	4.042
150.	4.116	1440.	4.04
180.	4.113	1470.	4.039
210.	4.11	1500.	4.038
240.	4.107	1530.	4.036
270.	4.105	1560.	4.035
300.	4.102	1590.	4.034
330.	4.099	1620.	4.032
360.	4.097	1650.	4.032
390.	4.095	1680.	4.03
420.	4.093	1710.	4.028
450.	4.092	1740.	4.027
480.	4.089	1770.	4.026
510.	4.088	1800.	4.024
540.	4.087	1830.	4.023
570.	4.085	1860.	4.021
600.	4.083	1890.	4.021
630.	4.082	1920.	4.019
660.	4.08	1950.	4.019
690.	4.078	1980.	4.018
720.	4.076	2010.	4.016
750.	4.074	2040.	4.015
780.	4.073	2070.	4.014
810.	4.071	2100.	4.013
840.	4.069	2130.	4.011
870.	4.068	2160.	4.01

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	4.066	2190.	4.009
930.	4.064	2220.	4.007
960.	4.063	2250.	4.006
990.	4.061	2280.	4.005
1020.	4.059	2310.	4.004
1050.	4.058	2340.	4.002
1080.	4.056	2370.	4.001
1110.	4.055	2400.	3.999
1140.	4.053	2430.	3.997
1170.	4.051	2460.	3.995
1200.	4.051	2490.	3.994
1230.	4.05	2520.	3.993
1260.	4.048	2550.	3.991

SOLUTION

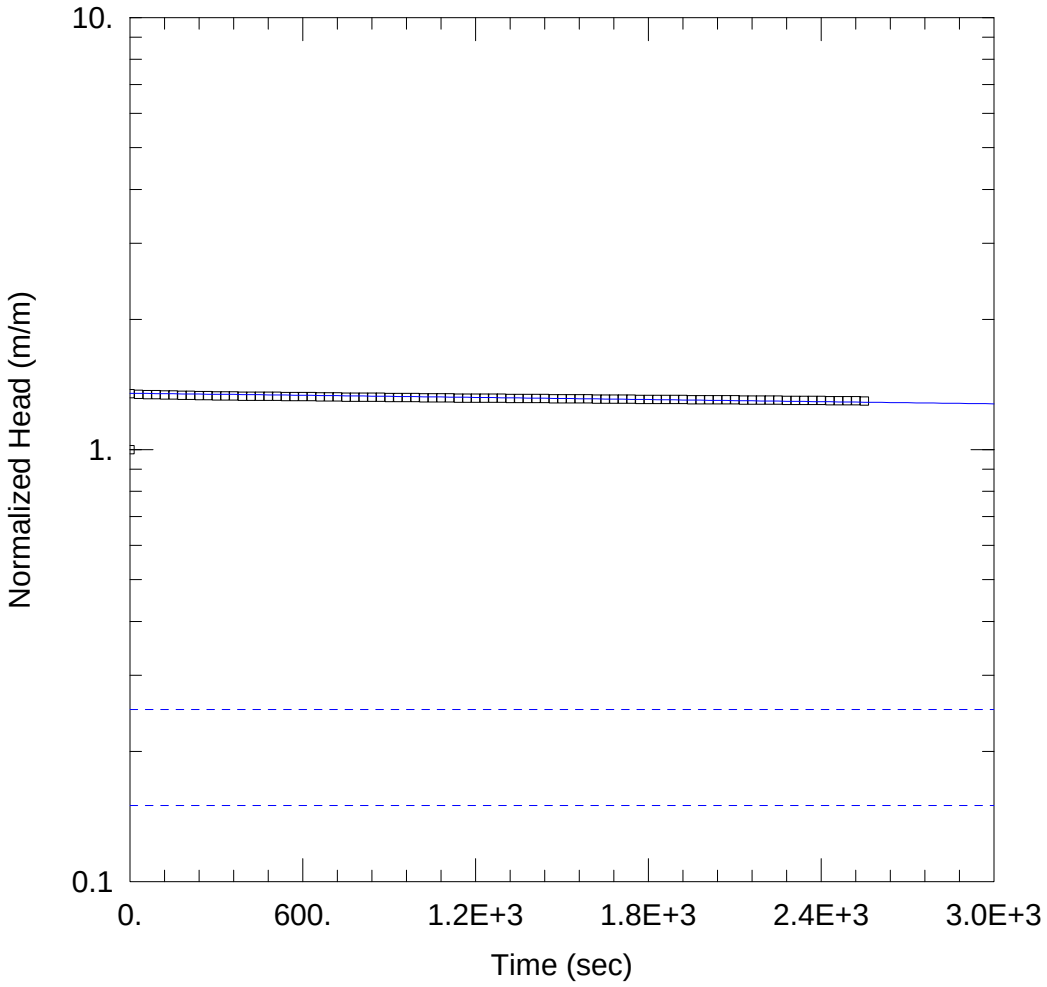
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1752

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	8.535E-9	m/sec
y0	4.158	m

K = 8.535E-7 cm/sec
T = K*b = 8.535E-7 m²/sec (0.008535 sq. cm/sec)



MW-H29 ZONE 3 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 25.15 - 39.62 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29 Zone 3
Test Date: 28 July 2013

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 8.535E-9 m/sec
y0 = 4.158 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 Zone 4 (Falling Head Packer Test, vertical interval 40.39 - 59.44 m)
Date: 08/14/13
Time: 15:41:52

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 29 July 2013
Test Well: MW-H29 Zone 4

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 1.05 m
Static Water Column Height: 59.34 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 19.05 m
Total Well Penetration Depth: 59.34 m

No. of Observations: 92

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	1.05	1380.	1.032
30.	1.049	1410.	1.031
60.	1.048	1440.	1.031
90.	1.046	1470.	1.031
120.	1.046	1500.	1.031
150.	1.045	1530.	1.03
180.	1.045	1560.	1.03
210.	1.044	1590.	1.03
240.	1.044	1620.	1.03
270.	1.043	1650.	1.029
300.	1.042	1680.	1.029
330.	1.042	1710.	1.029
360.	1.042	1740.	1.028
390.	1.042	1770.	1.028
420.	1.041	1800.	1.028
450.	1.041	1830.	1.028
480.	1.04	1860.	1.027
510.	1.04	1890.	1.028
540.	1.04	1920.	1.027
570.	1.039	1950.	1.027
600.	1.039	1980.	1.027
630.	1.039	2010.	1.027
660.	1.038	2040.	1.026
690.	1.038	2070.	1.027
720.	1.038	2100.	1.026
750.	1.037	2130.	1.026
780.	1.038	2160.	1.026
810.	1.037	2190.	1.025
840.	1.037	2220.	1.025
870.	1.036	2250.	1.025

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	1.036	2280.	1.025
930.	1.036	2310.	1.024
960.	1.036	2340.	1.024
990.	1.036	2370.	1.024
1020.	1.035	2400.	1.024
1050.	1.034	2430.	1.023
1080.	1.035	2460.	1.023
1110.	1.034	2490.	1.024
1140.	1.034	2520.	1.023
1170.	1.033	2550.	1.022
1200.	1.034	2580.	1.023
1230.	1.033	2610.	1.022
1260.	1.033	2640.	1.022
1290.	1.032	2670.	1.021
1320.	1.032	2700.	1.022
1350.	1.032	2730.	1.021

SOLUTION

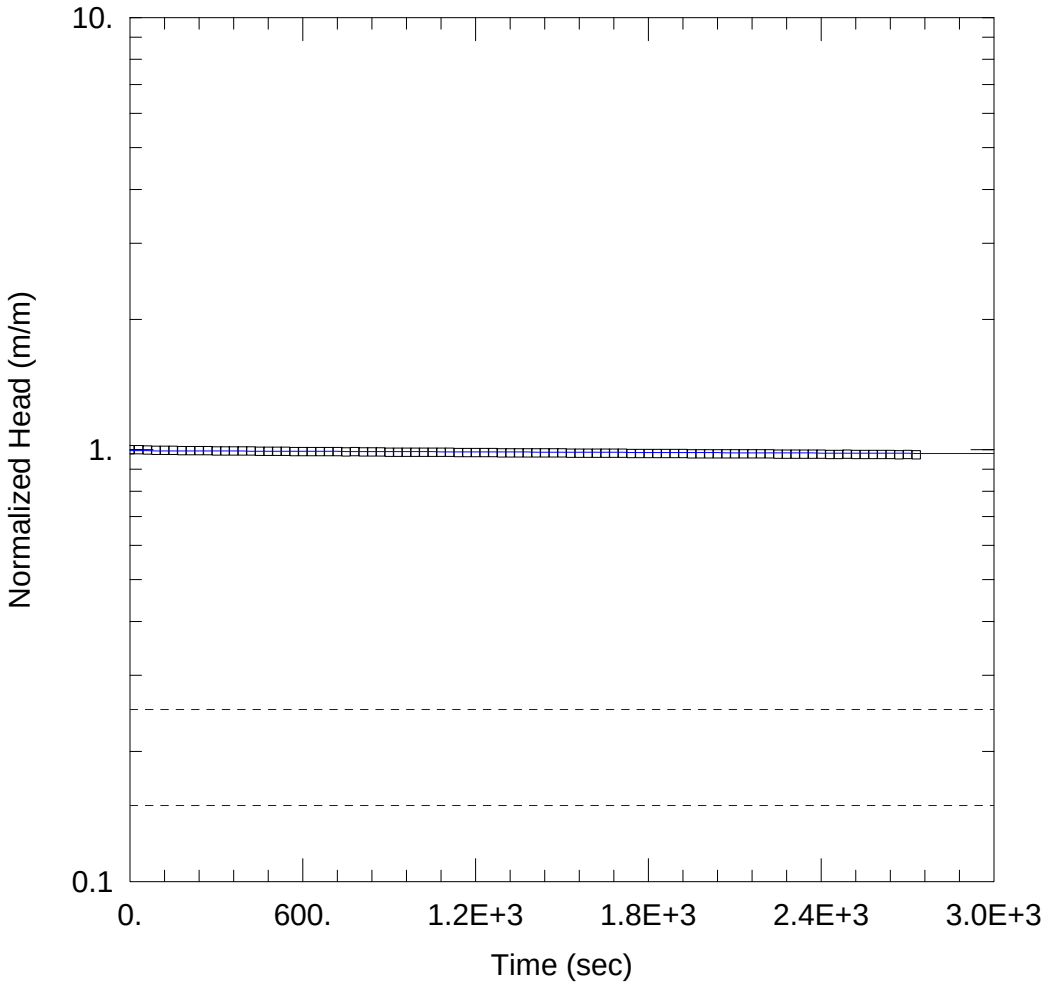
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1671

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.877E-9	m/sec
y0	1.043	m

K = 1.877E-7 cm/sec
T = K*b = 1.877E-7 m²/sec (0.001877 sq. cm/sec)



MW-H29 ZONE 4 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 40.39 - 59.44 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29 Zone 4
Test Date: 29 July 2013

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 1.877E-9 m/sec
y0 = 1.043 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 Zone 5 (Falling Head Packer Test, vertical interval 58.67 - 77.72 m)
Date: 08/14/13
Time: 15:46:40

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 29 July 2013
Test Well: MW-H29 Zone 5

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 2.1 m
Static Water Column Height: 75.8 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 19.05 m
Total Well Penetration Depth: 75.8 m

No. of Observations: 93

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	2.1	1410.	2.081
30.	2.099	1440.	2.081
60.	2.098	1470.	2.081
90.	2.096	1500.	2.081
120.	2.096	1530.	2.08
150.	2.095	1560.	2.08
180.	2.095	1590.	2.08
210.	2.094	1620.	2.08
240.	2.094	1650.	2.079
270.	2.093	1680.	2.079
300.	2.092	1710.	2.079
330.	2.092	1740.	2.078
360.	2.092	1770.	2.078
390.	2.092	1800.	2.078
420.	2.091	1830.	2.078
450.	2.091	1860.	2.077
480.	2.09	1890.	2.078
510.	2.09	1920.	2.077
540.	2.09	1950.	2.077
570.	2.089	1980.	2.077
600.	2.089	2010.	2.077
630.	2.089	2040.	2.076
660.	2.088	2070.	2.077
690.	2.088	2100.	2.076
720.	2.088	2130.	2.076
750.	2.087	2160.	2.076
780.	2.088	2190.	2.075
810.	2.087	2220.	2.075
840.	2.087	2250.	2.075
870.	2.086	2280.	2.075

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
900.	2.086	2310.	2.074
930.	2.086	2340.	2.074
960.	2.086	2370.	2.074
990.	2.086	2400.	2.074
1020.	2.084	2430.	2.073
1050.	2.084	2460.	2.073
1080.	2.085	2490.	2.074
1110.	2.084	2520.	2.073
1140.	2.084	2550.	2.072
1170.	2.083	2580.	2.073
1200.	2.084	2610.	2.072
1230.	2.083	2640.	2.072
1260.	2.083	2670.	2.071
1290.	2.082	2700.	2.072
1320.	2.082	2730.	2.071
1350.	2.082	2760.	2.074
1380.	2.082		

SOLUTION

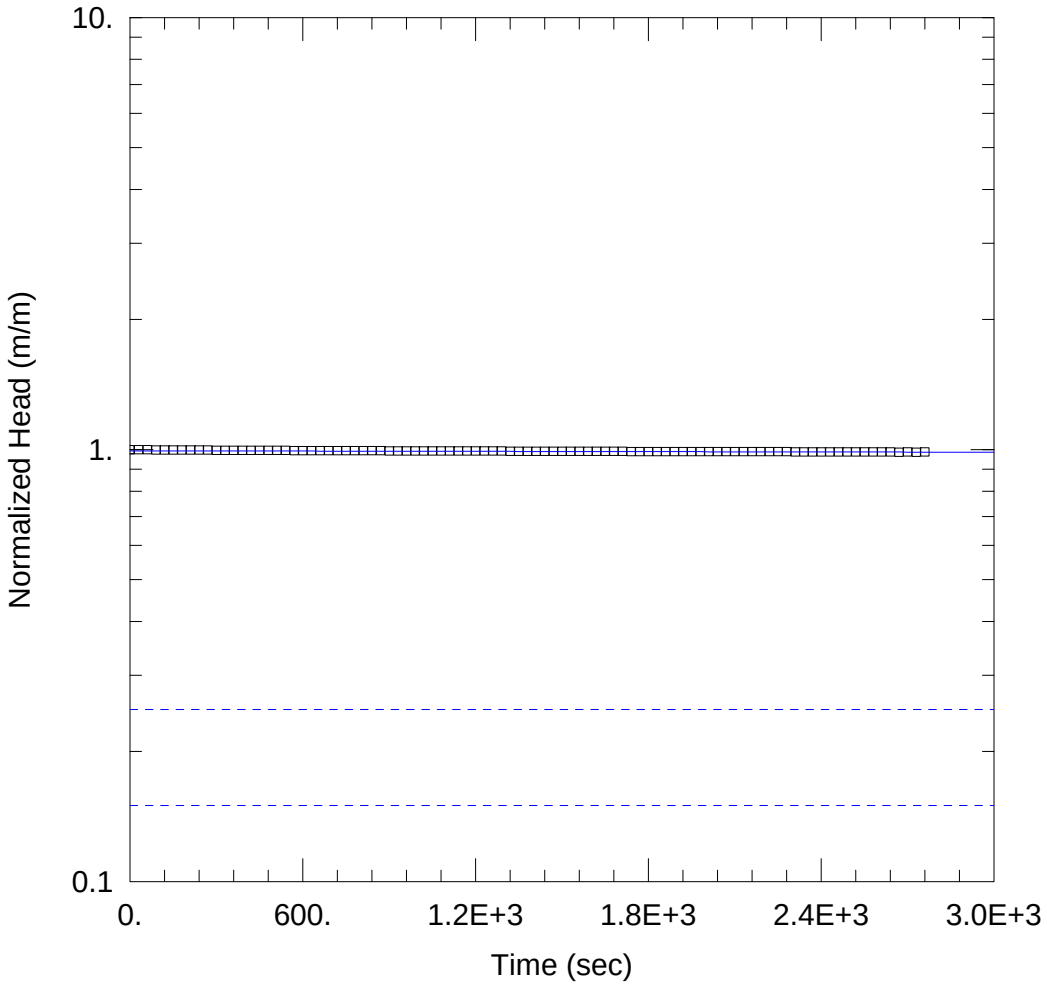
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.1671

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	9.152E-10	m/sec
y0	2.086	m

K = 9.152E-8 cm/sec
T = K*b = 9.152E-8 m²/sec (0.0009152 sq. cm/sec)



MW-H29 ZONE 5 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 58.67 - 77.72 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29 Zone 5
Test Date: 29 July 2013

AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 9.152E-10 m/sec

y0 = 2.086 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H29 Zone 6 (Falling Head Packer Test, vertical interval 78.49 - 98.45 m)
Date: 08/14/13
Time: 15:50:53

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 30 July 2013
Test Well: MW-H29 Zone 6

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H29

X Location: 0. m
Y Location: 0. m

Initial Displacement: 6.2 m
Static Water Column Height: 98.33 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 19.96 m
Total Well Penetration Depth: 98.33 m

No. of Observations: 49

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	6.2	1500.	6.146
60.	6.187	1560.	6.146
120.	6.18	1620.	6.144
180.	6.174	1680.	6.144
240.	6.17	1740.	6.143
300.	6.166	1800.	6.143
360.	6.164	1860.	6.142
420.	6.162	1920.	6.141
480.	6.16	1980.	6.14
540.	6.16	2040.	6.14
600.	6.158	2100.	6.14
660.	6.157	2160.	6.139
720.	6.156	2220.	6.138
780.	6.155	2280.	6.137
840.	6.154	2340.	6.137
900.	6.154	2400.	6.136
960.	6.152	2460.	6.137
1020.	6.152	2520.	6.136
1080.	6.151	2580.	6.135
1140.	6.15	2640.	6.135
1200.	6.149	2700.	6.133
1260.	6.148	2760.	6.134
1320.	6.148	2820.	6.133
1380.	6.147	2880.	6.133
1440.	6.146		

SOLUTION

Slug Test
Aquifer Model: Confined

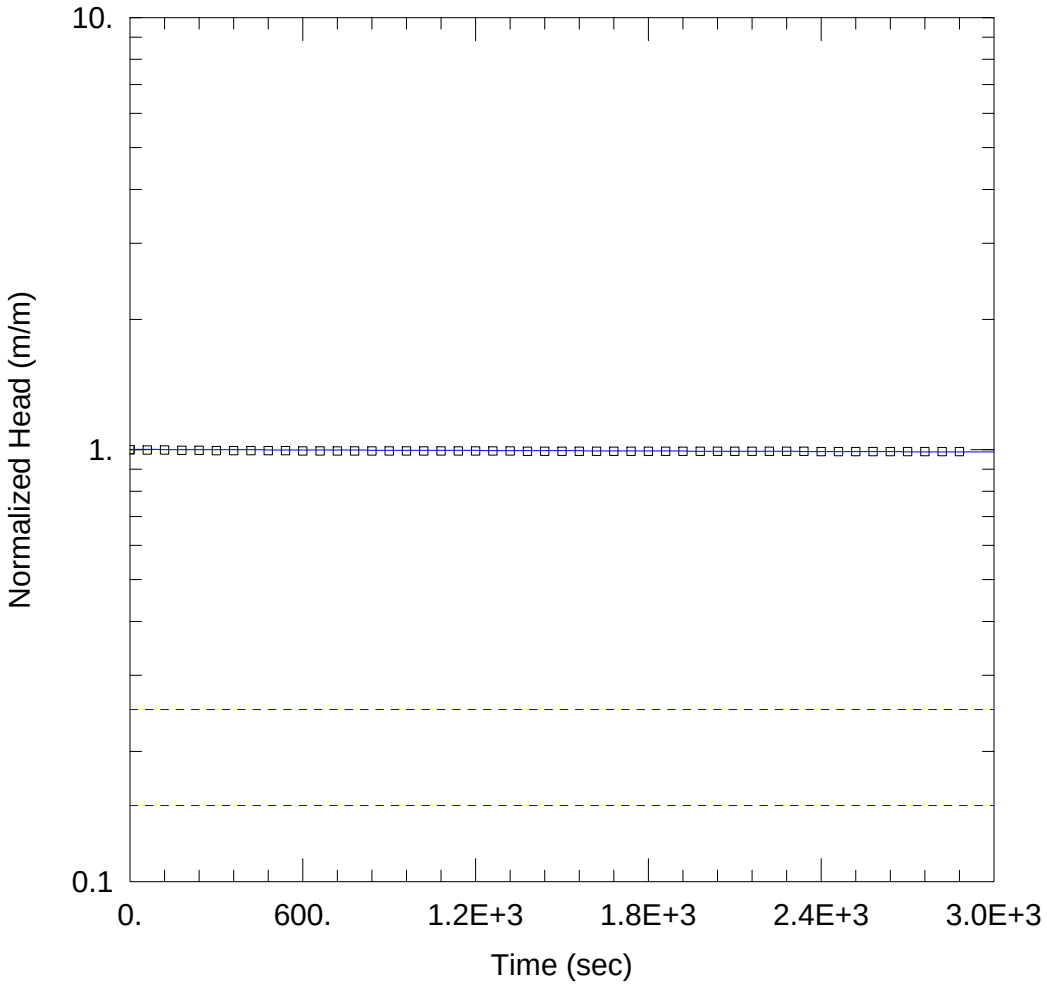
Solution Method: Hvorslev
Log Factor: 0.1658

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.606E-9	m/sec
y0	6.203	m

K = 1.606E-7 cm/sec
T = K*b = 1.606E-7 m²/sec (0.001606 sq. cm/sec)



MW-H29 ZONE 6 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 78.49 - 98.45 M)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29 Zone 6
Test Date: 30 July 2013

AQUIFER DATA

Saturated Thickness: 100. m

Anisotropy Ratio (Kz/Kr): 1.

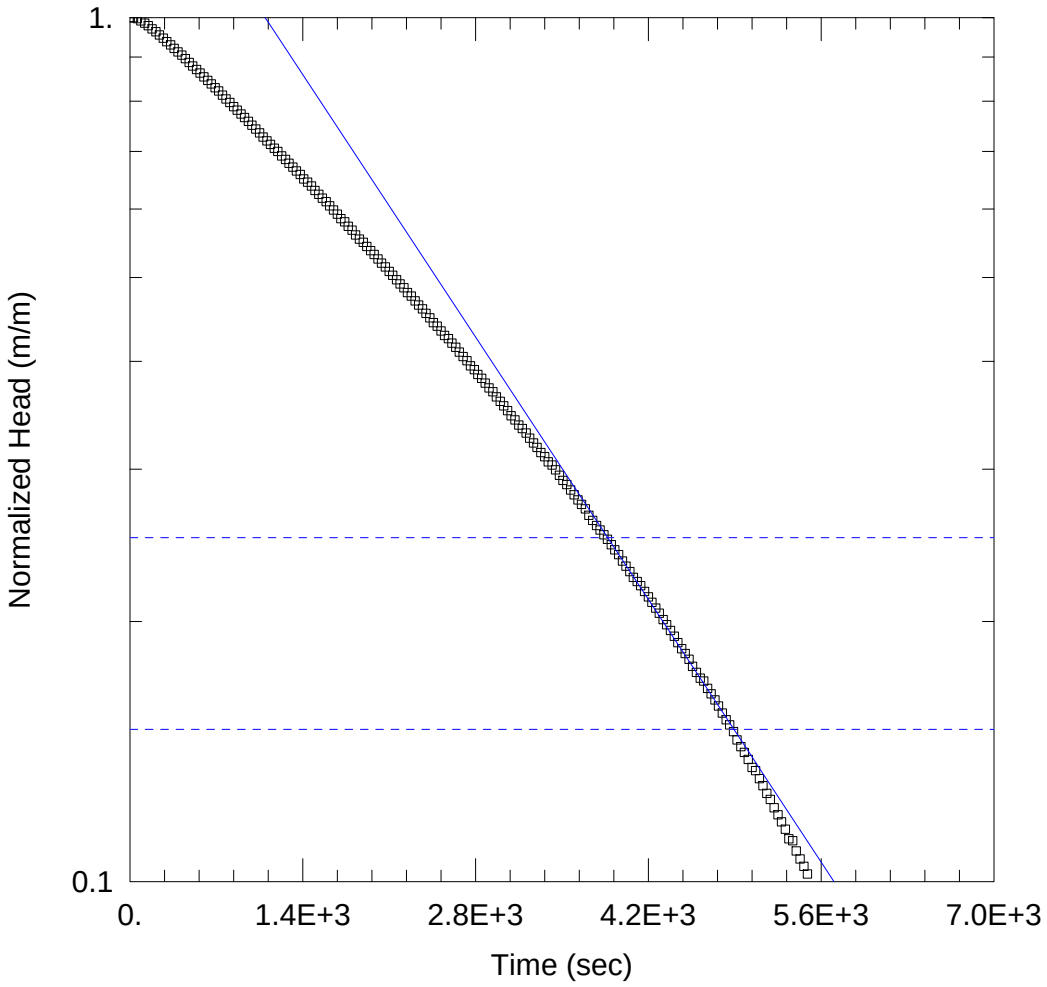
SOLUTION

Aquifer Model: Confined

Solution Method: Hvorslev

K = 1.606E-9 m/sec

y0 = 6.203 m



MW-H29 (RISING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H29
Test Date: 1 August 2013

AQUIFER DATA

Saturated Thickness: 100. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H29)

Initial Displacement: 0.95 m
Total Well Penetration Depth: 6.61 m
Casing Radius: 0.016 m
Static Water Column Height: 6.61 m
Screen Length: 3.05 m
Well Radius: 0.038 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 9.196E-8 m/sec
y0 = 1.643 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H30 (Falling Head Slug Test)
Date: 08/14/13
Time: 12:09:05

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 24 July 2013
Test Well: MW-H30

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H30

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.25 m
Static Water Column Height: 2.772 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 2.772 m
Total Well Penetration Depth: 2.772 m
Corrected Casing Radius (Bouwer-Rice Method): 0.016 m
Gravel Pack Porosity: 0.

No. of Observations: 1479

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.25	2.22E+4	0.1495
30.	0.2524	2.223E+4	0.15
60.	0.252	2.226E+4	0.1496
90.	0.2515	2.229E+4	0.1496
120.	0.2508	2.232E+4	0.1487
150.	0.2508	2.235E+4	0.149
180.	0.2503	2.238E+4	0.1491
210.	0.2496	2.241E+4	0.1486
240.	0.2493	2.244E+4	0.1485
270.	0.2487	2.247E+4	0.1484
300.	0.2484	2.25E+4	0.1487
330.	0.2477	2.253E+4	0.1482
360.	0.2472	2.256E+4	0.1482
390.	0.2466	2.259E+4	0.1475
420.	0.2519	2.262E+4	0.1474
450.	0.252	2.265E+4	0.148
480.	0.2509	2.268E+4	0.1469
510.	0.2516	2.271E+4	0.1473
540.	0.2509	2.274E+4	0.1469
570.	0.2505	2.277E+4	0.1472
600.	0.2498	2.28E+4	0.147
630.	0.2491	2.283E+4	0.1463
660.	0.2487	2.286E+4	0.1469
690.	0.2482	2.289E+4	0.147
720.	0.248	2.292E+4	0.1469
750.	0.2476	2.295E+4	0.1467
780.	0.2466	2.298E+4	0.1468
810.	0.2463	2.301E+4	0.1464

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
840.	0.2481	2.304E+4	0.1463
870.	0.251	2.307E+4	0.1462
900.	0.2511	2.31E+4	0.1467
930.	0.2506	2.313E+4	0.1458
960.	0.2499	2.316E+4	0.1456
990.	0.2496	2.319E+4	0.1455
1020.	0.249	2.322E+4	0.1457
1050.	0.2488	2.325E+4	0.1457
1080.	0.2483	2.328E+4	0.1454
1110.	0.2478	2.331E+4	0.1455
1140.	0.2476	2.334E+4	0.1456
1170.	0.2468	2.337E+4	0.1456
1200.	0.2466	2.34E+4	0.1449
1230.	0.2461	2.343E+4	0.1454
1260.	0.2495	2.346E+4	0.1449
1290.	0.25	2.349E+4	0.1451
1320.	0.2503	2.352E+4	0.1449
1350.	0.2502	2.355E+4	0.1446
1380.	0.2497	2.358E+4	0.1444
1410.	0.2497	2.361E+4	0.1445
1440.	0.2496	2.364E+4	0.1444
1470.	0.2497	2.367E+4	0.1442
1500.	0.2497	2.37E+4	0.1445
1530.	0.249	2.373E+4	0.1444
1560.	0.2494	2.376E+4	0.1439
1590.	0.249	2.379E+4	0.1443
1620.	0.2493	2.382E+4	0.1441
1650.	0.2486	2.385E+4	0.1442
1680.	0.2489	2.388E+4	0.1439
1710.	0.2488	2.391E+4	0.1439
1740.	0.2482	2.394E+4	0.1438
1770.	0.2481	2.397E+4	0.144
1800.	0.2479	2.4E+4	0.1442
1830.	0.248	2.403E+4	0.1434
1860.	0.2475	2.406E+4	0.1435
1890.	0.2478	2.409E+4	0.1436
1920.	0.2474	2.412E+4	0.1435
1950.	0.2469	2.415E+4	0.1432
1980.	0.247	2.418E+4	0.143
2010.	0.2471	2.421E+4	0.143
2040.	0.247	2.424E+4	0.1425
2070.	0.2467	2.427E+4	0.1426
2100.	0.247	2.43E+4	0.1427
2130.	0.2466	2.433E+4	0.1425
2160.	0.2465	2.436E+4	0.1425
2190.	0.2466	2.439E+4	0.1419
2220.	0.2459	2.442E+4	0.1416
2250.	0.2463	2.445E+4	0.1419
2280.	0.2459	2.448E+4	0.1414
2310.	0.2462	2.451E+4	0.1414
2340.	0.2459	2.454E+4	0.1417
2370.	0.2454	2.457E+4	0.1409
2400.	0.2452	2.46E+4	0.1407
2430.	0.2454	2.463E+4	0.141
2460.	0.2455	2.466E+4	0.1405
2490.	0.2449	2.469E+4	0.1403
2520.	0.2448	2.472E+4	0.1403
2550.	0.2445	2.475E+4	0.1402
2580.	0.2449	2.478E+4	0.1399
2610.	0.2445	2.481E+4	0.1398
2640.	0.2444	2.484E+4	0.1396
2670.	0.2445	2.487E+4	0.1391
2700.	0.2444	2.49E+4	0.1393
2730.	0.2437	2.493E+4	0.1395
2760.	0.2434	2.496E+4	0.1392
2790.	0.2435	2.499E+4	0.1389
2820.	0.2435	2.502E+4	0.1386

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
2850.	0.2436	2.505E+4	0.1386
2880.	0.2432	2.508E+4	0.1387
2910.	0.2435	2.511E+4	0.1387
2940.	0.2431	2.514E+4	0.139
2970.	0.2431	2.517E+4	0.1385
3000.	0.243	2.52E+4	0.138
3030.	0.2423	2.523E+4	0.1383
3060.	0.2429	2.526E+4	0.1384
3090.	0.2421	2.529E+4	0.1381
3120.	0.2421	2.532E+4	0.1382
3150.	0.2421	2.535E+4	0.1379
3180.	0.2421	2.538E+4	0.1377
3210.	0.2421	2.541E+4	0.1375
3240.	0.242	2.544E+4	0.1371
3270.	0.2419	2.547E+4	0.1372
3300.	0.2418	2.55E+4	0.137
3330.	0.2417	2.553E+4	0.1372
3360.	0.2416	2.556E+4	0.1373
3390.	0.2419	2.559E+4	0.1371
3420.	0.2418	2.562E+4	0.1372
3450.	0.2419	2.565E+4	0.1368
3480.	0.2413	2.568E+4	0.1372
3510.	0.2413	2.571E+4	0.1369
3540.	0.2413	2.574E+4	0.1367
3570.	0.2412	2.577E+4	0.1365
3600.	0.241	2.58E+4	0.1366
3630.	0.2408	2.583E+4	0.1364
3660.	0.2405	2.586E+4	0.1365
3690.	0.2408	2.589E+4	0.1358
3720.	0.2406	2.592E+4	0.1359
3750.	0.2403	2.595E+4	0.1359
3780.	0.2404	2.598E+4	0.136
3810.	0.2403	2.601E+4	0.1351
3840.	0.2401	2.604E+4	0.1344
3870.	0.2401	2.607E+4	0.1346
3900.	0.24	2.61E+4	0.1348
3930.	0.2399	2.613E+4	0.1343
3960.	0.2399	2.616E+4	0.1338
3990.	0.2399	2.619E+4	0.1334
4020.	0.239	2.622E+4	0.1334
4050.	0.2393	2.625E+4	0.1334
4080.	0.2387	2.628E+4	0.1331
4110.	0.2388	2.631E+4	0.1332
4140.	0.2387	2.634E+4	0.1329
4170.	0.2385	2.637E+4	0.133
4200.	0.2383	2.64E+4	0.1328
4230.	0.239	2.643E+4	0.1322
4260.	0.2378	2.646E+4	0.1323
4290.	0.2382	2.649E+4	0.1321
4320.	0.2383	2.652E+4	0.1317
4350.	0.238	2.655E+4	0.1315
4380.	0.238	2.658E+4	0.1315
4410.	0.238	2.661E+4	0.1317
4440.	0.2377	2.664E+4	0.1314
4470.	0.2376	2.667E+4	0.1312
4500.	0.2378	2.67E+4	0.1313
4530.	0.2372	2.673E+4	0.1312
4560.	0.2369	2.676E+4	0.1306
4590.	0.2376	2.679E+4	0.1304
4620.	0.2371	2.682E+4	0.1305
4650.	0.2368	2.685E+4	0.1302
4680.	0.2364	2.688E+4	0.1302
4710.	0.2368	2.691E+4	0.1304
4740.	0.2363	2.694E+4	0.1303
4770.	0.2371	2.697E+4	0.1303
4800.	0.2358	2.7E+4	0.1296
4830.	0.2359	2.703E+4	0.13

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
4860.	0.2359	2.706E+4	0.1295
4890.	0.2357	2.709E+4	0.1299
4920.	0.2358	2.712E+4	0.1297
4950.	0.2356	2.715E+4	0.1295
4980.	0.2354	2.718E+4	0.1298
5010.	0.2354	2.721E+4	0.1293
5040.	0.2349	2.724E+4	0.1289
5070.	0.2346	2.727E+4	0.129
5100.	0.2346	2.73E+4	0.1293
5130.	0.2355	2.733E+4	0.1289
5160.	0.2342	2.736E+4	0.1291
5190.	0.2344	2.739E+4	0.1286
5220.	0.2348	2.742E+4	0.1288
5250.	0.234	2.745E+4	0.1285
5280.	0.2341	2.748E+4	0.1288
5310.	0.2343	2.751E+4	0.1285
5340.	0.2338	2.754E+4	0.1279
5370.	0.2337	2.757E+4	0.1277
5400.	0.2336	2.76E+4	0.1278
5430.	0.2337	2.763E+4	0.1276
5460.	0.2336	2.766E+4	0.1273
5490.	0.2333	2.769E+4	0.1273
5520.	0.2334	2.772E+4	0.127
5550.	0.2333	2.775E+4	0.1268
5580.	0.2337	2.778E+4	0.1269
5610.	0.2329	2.781E+4	0.1266
5640.	0.2325	2.784E+4	0.1269
5670.	0.2325	2.787E+4	0.1268
5700.	0.2325	2.79E+4	0.127
5730.	0.2319	2.793E+4	0.1265
5760.	0.2322	2.796E+4	0.1262
5790.	0.2325	2.799E+4	0.1263
5820.	0.232	2.802E+4	0.1261
5850.	0.2316	2.805E+4	0.1262
5880.	0.2311	2.808E+4	0.126
5910.	0.2314	2.811E+4	0.1258
5940.	0.2317	2.814E+4	0.1256
5970.	0.2308	2.817E+4	0.1258
6000.	0.2307	2.82E+4	0.1257
6030.	0.2305	2.823E+4	0.1258
6060.	0.2306	2.826E+4	0.1257
6090.	0.2306	2.829E+4	0.1257
6120.	0.2304	2.832E+4	0.1252
6150.	0.2303	2.835E+4	0.1252
6180.	0.23	2.838E+4	0.1247
6210.	0.2298	2.841E+4	0.1242
6240.	0.23	2.844E+4	0.1251
6270.	0.2301	2.847E+4	0.1242
6300.	0.23	2.85E+4	0.1237
6330.	0.2296	2.853E+4	0.1237
6360.	0.2294	2.856E+4	0.1238
6390.	0.2298	2.859E+4	0.124
6420.	0.2293	2.862E+4	0.124
6450.	0.229	2.865E+4	0.1241
6480.	0.2286	2.868E+4	0.1235
6510.	0.2293	2.871E+4	0.1234
6540.	0.2289	2.874E+4	0.1241
6570.	0.2286	2.877E+4	0.1235
6600.	0.2284	2.88E+4	0.1232
6630.	0.2285	2.883E+4	0.1236
6660.	0.228	2.886E+4	0.1231
6690.	0.228	2.889E+4	0.1233
6720.	0.2276	2.892E+4	0.1233
6750.	0.2271	2.895E+4	0.1233
6780.	0.2269	2.898E+4	0.123
6810.	0.2272	2.901E+4	0.1228
6840.	0.2265	2.904E+4	0.1229

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
6870.	0.2267	2.907E+4	0.1226
6900.	0.2267	2.91E+4	0.1227
6930.	0.2265	2.913E+4	0.1221
6960.	0.2268	2.916E+4	0.1227
6990.	0.2263	2.919E+4	0.1222
7020.	0.226	2.922E+4	0.1218
7050.	0.2263	2.925E+4	0.1221
7080.	0.226	2.928E+4	0.1217
7110.	0.2262	2.931E+4	0.1218
7140.	0.2256	2.934E+4	0.1217
7170.	0.2255	2.937E+4	0.1225
7200.	0.2252	2.94E+4	0.1222
7230.	0.2256	2.943E+4	0.1219
7260.	0.2249	2.946E+4	0.1219
7290.	0.2245	2.949E+4	0.1219
7320.	0.2247	2.952E+4	0.1217
7350.	0.2241	2.955E+4	0.1216
7380.	0.2244	2.958E+4	0.1219
7410.	0.2239	2.961E+4	0.1215
7440.	0.224	2.964E+4	0.1211
7470.	0.2241	2.967E+4	0.1217
7500.	0.2237	2.97E+4	0.1211
7530.	0.2234	2.973E+4	0.1209
7560.	0.2238	2.976E+4	0.1207
7590.	0.2234	2.979E+4	0.1208
7620.	0.2234	2.982E+4	0.1205
7650.	0.2231	2.985E+4	0.1206
7680.	0.223	2.988E+4	0.1203
7710.	0.223	2.991E+4	0.1203
7740.	0.223	2.994E+4	0.1201
7770.	0.2232	2.997E+4	0.12
7800.	0.2227	3.0E+4	0.12
7830.	0.2221	3.003E+4	0.1203
7860.	0.2223	3.006E+4	0.1197
7890.	0.2227	3.009E+4	0.119
7920.	0.2219	3.012E+4	0.1188
7950.	0.2226	3.015E+4	0.1193
7980.	0.2219	3.018E+4	0.1192
8010.	0.2216	3.021E+4	0.1191
8040.	0.2213	3.024E+4	0.1187
8070.	0.2215	3.027E+4	0.1187
8100.	0.2215	3.03E+4	0.1184
8130.	0.2212	3.033E+4	0.1184
8160.	0.2212	3.036E+4	0.1183
8190.	0.2209	3.039E+4	0.1182
8220.	0.2211	3.042E+4	0.1183
8250.	0.2208	3.045E+4	0.1175
8280.	0.2203	3.048E+4	0.1174
8310.	0.2208	3.051E+4	0.1174
8340.	0.22	3.054E+4	0.1178
8370.	0.2208	3.057E+4	0.1172
8400.	0.2203	3.06E+4	0.1169
8430.	0.2198	3.063E+4	0.117
8460.	0.2197	3.066E+4	0.1171
8490.	0.2204	3.069E+4	0.1164
8520.	0.2202	3.072E+4	0.1168
8550.	0.2203	3.075E+4	0.1162
8580.	0.2195	3.078E+4	0.1163
8610.	0.2193	3.081E+4	0.1167
8640.	0.2193	3.084E+4	0.1158
8670.	0.2194	3.087E+4	0.1159
8700.	0.2186	3.09E+4	0.1157
8730.	0.2189	3.093E+4	0.1156
8760.	0.2185	3.096E+4	0.1157
8790.	0.2184	3.099E+4	0.1157
8820.	0.2181	3.102E+4	0.115
8850.	0.2181	3.105E+4	0.1153

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
8880.	0.2182	3.108E+4	0.1153
8910.	0.2178	3.111E+4	0.115
8940.	0.2152	3.114E+4	0.1141
8970.	0.215	3.117E+4	0.1143
9000.	0.2147	3.12E+4	0.1145
9030.	0.2145	3.123E+4	0.114
9060.	0.2146	3.126E+4	0.1142
9090.	0.2147	3.129E+4	0.1143
9120.	0.2147	3.132E+4	0.1137
9150.	0.2142	3.135E+4	0.1137
9180.	0.2142	3.138E+4	0.1138
9210.	0.2137	3.141E+4	0.1136
9240.	0.214	3.144E+4	0.1131
9270.	0.2136	3.147E+4	0.1132
9300.	0.2131	3.15E+4	0.1134
9330.	0.2132	3.153E+4	0.1131
9360.	0.2127	3.156E+4	0.1128
9390.	0.2129	3.159E+4	0.1125
9420.	0.2125	3.162E+4	0.1122
9450.	0.2124	3.165E+4	0.1124
9480.	0.2122	3.168E+4	0.1121
9510.	0.2122	3.171E+4	0.1118
9540.	0.2118	3.174E+4	0.1114
9570.	0.2115	3.177E+4	0.1118
9600.	0.2108	3.18E+4	0.1112
9630.	0.2107	3.183E+4	0.1112
9660.	0.2106	3.186E+4	0.1113
9690.	0.2099	3.189E+4	0.1107
9720.	0.2098	3.192E+4	0.111
9750.	0.2096	3.195E+4	0.1104
9780.	0.2101	3.198E+4	0.11
9810.	0.2097	3.201E+4	0.1101
9840.	0.2094	3.204E+4	0.1104
9870.	0.2094	3.207E+4	0.1103
9900.	0.2086	3.21E+4	0.1099
9930.	0.2083	3.213E+4	0.1104
9960.	0.2084	3.216E+4	0.1091
9990.	0.2085	3.219E+4	0.1095
1.002E+4	0.2081	3.222E+4	0.1096
1.005E+4	0.2078	3.225E+4	0.1095
1.008E+4	0.2077	3.228E+4	0.1093
1.011E+4	0.2075	3.231E+4	0.1094
1.014E+4	0.2072	3.234E+4	0.1089
1.017E+4	0.2068	3.237E+4	0.1092
1.02E+4	0.2071	3.24E+4	0.1092
1.023E+4	0.207	3.243E+4	0.1087
1.026E+4	0.2066	3.246E+4	0.1091
1.029E+4	0.2064	3.249E+4	0.1086
1.032E+4	0.2067	3.252E+4	0.1088
1.035E+4	0.2067	3.255E+4	0.1089
1.038E+4	0.206	3.258E+4	0.1083
1.041E+4	0.2063	3.261E+4	0.1082
1.044E+4	0.2063	3.264E+4	0.1084
1.047E+4	0.206	3.267E+4	0.1083
1.05E+4	0.2057	3.27E+4	0.108
1.053E+4	0.2055	3.273E+4	0.1083
1.056E+4	0.2055	3.276E+4	0.1082
1.059E+4	0.2051	3.279E+4	0.108
1.062E+4	0.2047	3.282E+4	0.1077
1.065E+4	0.205	3.285E+4	0.1081
1.068E+4	0.2041	3.288E+4	0.1078
1.071E+4	0.2044	3.291E+4	0.1081
1.074E+4	0.2042	3.294E+4	0.1077
1.077E+4	0.2038	3.297E+4	0.1076
1.08E+4	0.2033	3.3E+4	0.1078
1.083E+4	0.2033	3.303E+4	0.1069
1.086E+4	0.2034	3.306E+4	0.1073

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.089E+4	0.2027	3.309E+4	0.1072
1.092E+4	0.2026	3.312E+4	0.1068
1.095E+4	0.2028	3.315E+4	0.1065
1.098E+4	0.2025	3.318E+4	0.1065
1.101E+4	0.2028	3.321E+4	0.1067
1.104E+4	0.2024	3.324E+4	0.1062
1.107E+4	0.2023	3.327E+4	0.1061
1.11E+4	0.2019	3.33E+4	0.1057
1.113E+4	0.2015	3.333E+4	0.1057
1.116E+4	0.2022	3.336E+4	0.1055
1.119E+4	0.2016	3.339E+4	0.1052
1.122E+4	0.2011	3.342E+4	0.1055
1.125E+4	0.2014	3.345E+4	0.1052
1.128E+4	0.2013	3.348E+4	0.1051
1.131E+4	0.201	3.351E+4	0.1052
1.134E+4	0.201	3.354E+4	0.1049
1.137E+4	0.2009	3.357E+4	0.1046
1.14E+4	0.2004	3.36E+4	0.1048
1.143E+4	0.2002	3.363E+4	0.1046
1.146E+4	0.2002	3.366E+4	0.1043
1.149E+4	0.2002	3.369E+4	0.1043
1.152E+4	0.1997	3.372E+4	0.1039
1.155E+4	0.1999	3.375E+4	0.104
1.158E+4	0.1997	3.378E+4	0.104
1.161E+4	0.1994	3.381E+4	0.1033
1.164E+4	0.1988	3.384E+4	0.1032
1.167E+4	0.1988	3.387E+4	0.1036
1.17E+4	0.1991	3.39E+4	0.1028
1.173E+4	0.199	3.393E+4	0.1027
1.176E+4	0.1985	3.396E+4	0.103
1.179E+4	0.1985	3.399E+4	0.103
1.182E+4	0.1986	3.402E+4	0.1028
1.185E+4	0.1982	3.405E+4	0.1025
1.188E+4	0.1981	3.408E+4	0.1026
1.191E+4	0.1982	3.411E+4	0.1026
1.194E+4	0.1978	3.414E+4	0.1027
1.197E+4	0.1977	3.417E+4	0.1027
1.2E+4	0.1975	3.42E+4	0.1017
1.203E+4	0.1976	3.423E+4	0.1017
1.206E+4	0.1972	3.426E+4	0.1016
1.209E+4	0.1972	3.429E+4	0.1011
1.212E+4	0.1967	3.432E+4	0.1013
1.215E+4	0.197	3.435E+4	0.1008
1.218E+4	0.1967	3.438E+4	0.1008
1.221E+4	0.1964	3.441E+4	0.1005
1.224E+4	0.1962	3.444E+4	0.1003
1.227E+4	0.1967	3.447E+4	0.1003
1.23E+4	0.1962	3.45E+4	0.0997
1.233E+4	0.196	3.453E+4	0.1003
1.236E+4	0.1958	3.456E+4	0.0999
1.239E+4	0.196	3.459E+4	0.0996
1.242E+4	0.1956	3.462E+4	0.0997
1.245E+4	0.1954	3.465E+4	0.0995
1.248E+4	0.1955	3.468E+4	0.0992
1.251E+4	0.1955	3.471E+4	0.099
1.254E+4	0.1949	3.474E+4	0.0989
1.257E+4	0.1946	3.477E+4	0.0991
1.26E+4	0.1946	3.48E+4	0.0993
1.263E+4	0.1952	3.483E+4	0.0991
1.266E+4	0.1947	3.486E+4	0.0991
1.269E+4	0.1947	3.489E+4	0.0992
1.272E+4	0.1941	3.492E+4	0.0989
1.275E+4	0.1943	3.495E+4	0.0992
1.278E+4	0.1943	3.498E+4	0.0988
1.281E+4	0.1939	3.501E+4	0.0986
1.284E+4	0.1938	3.504E+4	0.0986
1.287E+4	0.1934	3.507E+4	0.099

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.29E+4	0.1934	3.51E+4	0.0986
1.293E+4	0.1936	3.513E+4	0.099
1.296E+4	0.1933	3.516E+4	0.0989
1.299E+4	0.1932	3.519E+4	0.0984
1.302E+4	0.1926	3.522E+4	0.0979
1.305E+4	0.1929	3.525E+4	0.0983
1.308E+4	0.1921	3.528E+4	0.0983
1.311E+4	0.1923	3.531E+4	0.0975
1.314E+4	0.1921	3.534E+4	0.0973
1.317E+4	0.1918	3.537E+4	0.0977
1.32E+4	0.1922	3.54E+4	0.0973
1.323E+4	0.192	3.543E+4	0.0976
1.326E+4	0.1918	3.546E+4	0.0974
1.329E+4	0.1913	3.549E+4	0.0968
1.332E+4	0.1912	3.552E+4	0.0967
1.335E+4	0.1912	3.555E+4	0.0969
1.338E+4	0.1911	3.558E+4	0.0968
1.341E+4	0.1908	3.561E+4	0.0968
1.344E+4	0.1907	3.564E+4	0.0964
1.347E+4	0.1905	3.567E+4	0.0968
1.35E+4	0.1905	3.57E+4	0.0962
1.353E+4	0.1904	3.573E+4	0.0963
1.356E+4	0.1903	3.576E+4	0.0967
1.359E+4	0.1903	3.579E+4	0.0961
1.362E+4	0.19	3.582E+4	0.0961
1.365E+4	0.1898	3.585E+4	0.0959
1.368E+4	0.1895	3.588E+4	0.0954
1.371E+4	0.1894	3.591E+4	0.095
1.374E+4	0.1888	3.594E+4	0.0951
1.377E+4	0.1891	3.597E+4	0.0955
1.38E+4	0.1889	3.6E+4	0.0952
1.383E+4	0.1883	3.603E+4	0.0946
1.386E+4	0.1884	3.606E+4	0.0949
1.389E+4	0.1881	3.609E+4	0.0948
1.392E+4	0.1878	3.612E+4	0.0946
1.395E+4	0.1879	3.615E+4	0.0946
1.398E+4	0.1876	3.618E+4	0.0942
1.401E+4	0.1869	3.621E+4	0.0941
1.404E+4	0.1865	3.624E+4	0.0937
1.407E+4	0.1869	3.627E+4	0.0939
1.41E+4	0.1863	3.63E+4	0.0933
1.413E+4	0.1856	3.633E+4	0.094
1.416E+4	0.1853	3.636E+4	0.0931
1.419E+4	0.1853	3.639E+4	0.0934
1.422E+4	0.1858	3.642E+4	0.0933
1.425E+4	0.185	3.645E+4	0.0933
1.428E+4	0.1849	3.648E+4	0.0931
1.431E+4	0.1844	3.651E+4	0.0929
1.434E+4	0.1843	3.654E+4	0.093
1.437E+4	0.1843	3.657E+4	0.0928
1.44E+4	0.184	3.66E+4	0.0929
1.443E+4	0.1832	3.663E+4	0.0925
1.446E+4	0.1837	3.666E+4	0.0929
1.449E+4	0.1834	3.669E+4	0.0925
1.452E+4	0.1827	3.672E+4	0.0927
1.455E+4	0.183	3.675E+4	0.092
1.458E+4	0.1831	3.678E+4	0.0915
1.461E+4	0.1826	3.681E+4	0.0915
1.464E+4	0.1826	3.684E+4	0.092
1.467E+4	0.1823	3.687E+4	0.0913
1.47E+4	0.1823	3.69E+4	0.0917
1.473E+4	0.182	3.693E+4	0.0911
1.476E+4	0.1821	3.696E+4	0.091
1.479E+4	0.1816	3.699E+4	0.0903
1.482E+4	0.1816	3.702E+4	0.0902
1.485E+4	0.1813	3.705E+4	0.0903
1.488E+4	0.1811	3.708E+4	0.0902

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.491E+4	0.1814	3.711E+4	0.0898
1.494E+4	0.1812	3.714E+4	0.0901
1.497E+4	0.1813	3.717E+4	0.0897
1.5E+4	0.1812	3.72E+4	0.0896
1.503E+4	0.1807	3.723E+4	0.089
1.506E+4	0.1804	3.726E+4	0.0892
1.509E+4	0.1802	3.729E+4	0.0892
1.512E+4	0.18	3.732E+4	0.089
1.515E+4	0.1798	3.735E+4	0.0889
1.518E+4	0.1798	3.738E+4	0.0887
1.521E+4	0.18	3.741E+4	0.0888
1.524E+4	0.1798	3.744E+4	0.0882
1.527E+4	0.1793	3.747E+4	0.0887
1.53E+4	0.18	3.75E+4	0.0879
1.533E+4	0.1798	3.753E+4	0.0875
1.536E+4	0.1796	3.756E+4	0.0879
1.539E+4	0.1795	3.759E+4	0.088
1.542E+4	0.1796	3.762E+4	0.0879
1.545E+4	0.1794	3.765E+4	0.0873
1.548E+4	0.1792	3.768E+4	0.0872
1.551E+4	0.1785	3.771E+4	0.0869
1.554E+4	0.179	3.774E+4	0.087
1.557E+4	0.1786	3.777E+4	0.0863
1.56E+4	0.1781	3.78E+4	0.0859
1.563E+4	0.1785	3.783E+4	0.0862
1.566E+4	0.1782	3.786E+4	0.0858
1.569E+4	0.1785	3.789E+4	0.0864
1.572E+4	0.1779	3.792E+4	0.0858
1.575E+4	0.1776	3.795E+4	0.0856
1.578E+4	0.1772	3.798E+4	0.0856
1.581E+4	0.1774	3.801E+4	0.0853
1.584E+4	0.1773	3.804E+4	0.0851
1.587E+4	0.1762	3.807E+4	0.085
1.59E+4	0.1767	3.81E+4	0.085
1.593E+4	0.1764	3.813E+4	0.0848
1.596E+4	0.1762	3.816E+4	0.0845
1.599E+4	0.1757	3.819E+4	0.0849
1.602E+4	0.176	3.822E+4	0.0845
1.605E+4	0.176	3.825E+4	0.0845
1.608E+4	0.1757	3.828E+4	0.0838
1.611E+4	0.1754	3.831E+4	0.0845
1.614E+4	0.1754	3.834E+4	0.0837
1.617E+4	0.1747	3.837E+4	0.0839
1.62E+4	0.175	3.84E+4	0.0836
1.623E+4	0.1744	3.843E+4	0.0834
1.626E+4	0.1746	3.846E+4	0.0832
1.629E+4	0.1742	3.849E+4	0.0833
1.632E+4	0.1745	3.852E+4	0.0827
1.635E+4	0.1739	3.855E+4	0.0825
1.638E+4	0.1742	3.858E+4	0.0828
1.641E+4	0.1744	3.861E+4	0.0827
1.644E+4	0.1743	3.864E+4	0.0822
1.647E+4	0.1738	3.867E+4	0.0822
1.65E+4	0.1738	3.87E+4	0.0823
1.653E+4	0.1736	3.873E+4	0.0819
1.656E+4	0.1733	3.876E+4	0.082
1.659E+4	0.1732	3.879E+4	0.0817
1.662E+4	0.174	3.882E+4	0.0814
1.665E+4	0.1736	3.885E+4	0.0815
1.668E+4	0.1731	3.888E+4	0.0817
1.671E+4	0.173	3.891E+4	0.0809
1.674E+4	0.1728	3.894E+4	0.0811
1.677E+4	0.1727	3.897E+4	0.0809
1.68E+4	0.1719	3.9E+4	0.0806
1.683E+4	0.1721	3.903E+4	0.0806
1.686E+4	0.1722	3.906E+4	0.0802
1.689E+4	0.1719	3.909E+4	0.0801

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.692E+4	0.1711	3.912E+4	0.0799
1.695E+4	0.1713	3.915E+4	0.0796
1.698E+4	0.1708	3.918E+4	0.0793
1.701E+4	0.1714	3.921E+4	0.0789
1.704E+4	0.1708	3.924E+4	0.0792
1.707E+4	0.1704	3.927E+4	0.0791
1.71E+4	0.1703	3.93E+4	0.0795
1.713E+4	0.1702	3.933E+4	0.0791
1.716E+4	0.1705	3.936E+4	0.0785
1.719E+4	0.1701	3.939E+4	0.0788
1.722E+4	0.17	3.942E+4	0.0788
1.725E+4	0.1699	3.945E+4	0.079
1.728E+4	0.1695	3.948E+4	0.0785
1.731E+4	0.1694	3.951E+4	0.0781
1.734E+4	0.1694	3.954E+4	0.0781
1.737E+4	0.169	3.957E+4	0.0779
1.74E+4	0.1691	3.96E+4	0.0773
1.743E+4	0.1694	3.963E+4	0.0775
1.746E+4	0.1692	3.966E+4	0.0775
1.749E+4	0.1688	3.969E+4	0.0776
1.752E+4	0.1689	3.972E+4	0.0775
1.755E+4	0.1687	3.975E+4	0.0777
1.758E+4	0.169	3.978E+4	0.0773
1.761E+4	0.1683	3.981E+4	0.0771
1.764E+4	0.1681	3.984E+4	0.0763
1.767E+4	0.1685	3.987E+4	0.0771
1.77E+4	0.1678	3.99E+4	0.0767
1.773E+4	0.1677	3.993E+4	0.0763
1.776E+4	0.1679	3.996E+4	0.0761
1.779E+4	0.168	3.999E+4	0.0759
1.782E+4	0.1679	4.002E+4	0.0762
1.785E+4	0.1676	4.005E+4	0.0764
1.788E+4	0.1673	4.008E+4	0.0759
1.791E+4	0.1674	4.011E+4	0.0758
1.794E+4	0.1676	4.014E+4	0.0754
1.797E+4	0.1672	4.017E+4	0.0753
1.8E+4	0.1668	4.02E+4	0.0749
1.803E+4	0.1677	4.023E+4	0.0751
1.806E+4	0.1666	4.026E+4	0.0748
1.809E+4	0.1668	4.029E+4	0.0747
1.812E+4	0.1663	4.032E+4	0.0744
1.815E+4	0.1665	4.035E+4	0.0743
1.818E+4	0.1665	4.038E+4	0.0742
1.821E+4	0.1663	4.041E+4	0.0743
1.824E+4	0.1662	4.044E+4	0.0741
1.827E+4	0.166	4.047E+4	0.0737
1.83E+4	0.1664	4.05E+4	0.0738
1.833E+4	0.1655	4.053E+4	0.074
1.836E+4	0.1657	4.056E+4	0.0735
1.839E+4	0.1655	4.059E+4	0.073
1.842E+4	0.1647	4.062E+4	0.0735
1.845E+4	0.1648	4.065E+4	0.0732
1.848E+4	0.1643	4.068E+4	0.0731
1.851E+4	0.1644	4.071E+4	0.0727
1.854E+4	0.1646	4.074E+4	0.0727
1.857E+4	0.1637	4.077E+4	0.0725
1.86E+4	0.1637	4.08E+4	0.0721
1.863E+4	0.1639	4.083E+4	0.0723
1.866E+4	0.1631	4.086E+4	0.0723
1.869E+4	0.1638	4.089E+4	0.0722
1.872E+4	0.1633	4.092E+4	0.0719
1.875E+4	0.163	4.095E+4	0.0711
1.878E+4	0.1632	4.098E+4	0.0717
1.881E+4	0.1627	4.101E+4	0.0712
1.884E+4	0.1628	4.104E+4	0.0713
1.887E+4	0.163	4.107E+4	0.0712
1.89E+4	0.1632	4.11E+4	0.0708

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.893E+4	0.1632	4.113E+4	0.0709
1.896E+4	0.1626	4.116E+4	0.0702
1.899E+4	0.1623	4.119E+4	0.0705
1.902E+4	0.1628	4.122E+4	0.0704
1.905E+4	0.1621	4.125E+4	0.0701
1.908E+4	0.1623	4.128E+4	0.0697
1.911E+4	0.1616	4.131E+4	0.0693
1.914E+4	0.162	4.134E+4	0.0697
1.917E+4	0.1622	4.137E+4	0.0697
1.92E+4	0.1616	4.14E+4	0.0696
1.923E+4	0.1617	4.143E+4	0.0686
1.926E+4	0.1618	4.146E+4	0.0688
1.929E+4	0.1614	4.149E+4	0.0682
1.932E+4	0.1607	4.152E+4	0.0684
1.935E+4	0.1613	4.155E+4	0.0685
1.938E+4	0.1611	4.158E+4	0.0678
1.941E+4	0.1608	4.161E+4	0.0677
1.944E+4	0.1605	4.164E+4	0.0678
1.947E+4	0.1609	4.167E+4	0.0677
1.95E+4	0.1599	4.17E+4	0.0678
1.953E+4	0.1597	4.173E+4	0.0673
1.956E+4	0.1596	4.176E+4	0.0672
1.959E+4	0.1594	4.179E+4	0.0669
1.962E+4	0.1589	4.182E+4	0.0668
1.965E+4	0.159	4.185E+4	0.0665
1.968E+4	0.159	4.188E+4	0.0667
1.971E+4	0.1593	4.191E+4	0.0666
1.974E+4	0.1586	4.194E+4	0.0662
1.977E+4	0.1588	4.197E+4	0.0661
1.98E+4	0.1582	4.2E+4	0.0659
1.983E+4	0.1587	4.203E+4	0.0653
1.986E+4	0.1588	4.206E+4	0.0657
1.989E+4	0.1584	4.209E+4	0.0658
1.992E+4	0.1586	4.212E+4	0.0653
1.995E+4	0.1589	4.215E+4	0.0654
1.998E+4	0.1581	4.218E+4	0.0647
2.001E+4	0.1578	4.221E+4	0.0648
2.004E+4	0.1579	4.224E+4	0.0647
2.007E+4	0.158	4.227E+4	0.0646
2.01E+4	0.1582	4.23E+4	0.0644
2.013E+4	0.1577	4.233E+4	0.0647
2.016E+4	0.1581	4.236E+4	0.0644
2.019E+4	0.1574	4.239E+4	0.0638
2.022E+4	0.1572	4.242E+4	0.0636
2.025E+4	0.1574	4.245E+4	0.0632
2.028E+4	0.1573	4.248E+4	0.0633
2.031E+4	0.1571	4.251E+4	0.0634
2.034E+4	0.1572	4.254E+4	0.063
2.037E+4	0.1571	4.257E+4	0.063
2.04E+4	0.1571	4.26E+4	0.0626
2.043E+4	0.1568	4.263E+4	0.0627
2.046E+4	0.1565	4.266E+4	0.0621
2.049E+4	0.1567	4.269E+4	0.0617
2.052E+4	0.1562	4.272E+4	0.0615
2.055E+4	0.1561	4.275E+4	0.0619
2.058E+4	0.1559	4.278E+4	0.0614
2.061E+4	0.1554	4.281E+4	0.0616
2.064E+4	0.1554	4.284E+4	0.0609
2.067E+4	0.1558	4.287E+4	0.0608
2.07E+4	0.1556	4.29E+4	0.0607
2.073E+4	0.1554	4.293E+4	0.0608
2.076E+4	0.155	4.296E+4	0.0603
2.079E+4	0.1557	4.299E+4	0.0599
2.082E+4	0.1554	4.302E+4	0.0602
2.085E+4	0.1555	4.305E+4	0.06
2.088E+4	0.1549	4.308E+4	0.0606
2.091E+4	0.155	4.311E+4	0.0603

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
2.094E+4	0.1553	4.314E+4	0.0598
2.097E+4	0.1554	4.317E+4	0.0596
2.1E+4	0.1547	4.32E+4	0.0592
2.103E+4	0.1544	4.323E+4	0.0595
2.106E+4	0.1546	4.326E+4	0.0592
2.109E+4	0.1543	4.329E+4	0.0588
2.112E+4	0.1542	4.332E+4	0.0589
2.115E+4	0.1536	4.335E+4	0.0584
2.118E+4	0.1543	4.338E+4	0.0588
2.121E+4	0.1537	4.341E+4	0.0582
2.124E+4	0.1532	4.344E+4	0.0581
2.127E+4	0.1536	4.347E+4	0.0581
2.13E+4	0.1531	4.35E+4	0.0575
2.133E+4	0.1529	4.353E+4	0.0576
2.136E+4	0.1526	4.356E+4	0.0571
2.139E+4	0.1528	4.359E+4	0.0573
2.142E+4	0.1529	4.362E+4	0.0566
2.145E+4	0.1524	4.365E+4	0.0564
2.148E+4	0.1525	4.368E+4	0.0563
2.151E+4	0.152	4.371E+4	0.0559
2.154E+4	0.1529	4.374E+4	0.056
2.157E+4	0.1523	4.377E+4	0.0556
2.16E+4	0.1522	4.38E+4	0.0552
2.163E+4	0.1517	4.383E+4	0.0552
2.166E+4	0.152	4.386E+4	0.0542
2.169E+4	0.1518	4.389E+4	0.0546
2.172E+4	0.1517	4.392E+4	0.0549
2.175E+4	0.1512	4.395E+4	0.0544
2.178E+4	0.1514	4.398E+4	0.0546
2.181E+4	0.1511	4.401E+4	0.0539
2.184E+4	0.1512	4.404E+4	0.0537
2.187E+4	0.1511	4.407E+4	0.0537
2.19E+4	0.1511	4.41E+4	0.0538
2.193E+4	0.1509	4.413E+4	0.0531
2.196E+4	0.1505	4.416E+4	0.0531
2.199E+4	0.1504	4.419E+4	0.0528
2.202E+4	0.1507	4.422E+4	0.053
2.205E+4	0.15	4.425E+4	0.0529
2.208E+4	0.1502	4.428E+4	0.0525
2.211E+4	0.1504	4.431E+4	0.052
2.214E+4	0.1502	4.434E+4	0.0519
2.217E+4	0.1498		

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Bouwer-Rice
ln(Re/rw): 2.802

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	3.653E-9	m/sec
y0	0.278	m

K = 3.653E-7 cm/sec
T = K*b = 1.826E-7 m²/sec (0.001826 sq. cm/sec)

NOTES

Well may not be sufficiently developed due to a slow recovery.

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H30 Zone 1 (Falling Head Packer Test, vertical interval 19.05 - 22.86 m)
Date: 08/14/13
Time: 15:56:25

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 22 July 2013
Test Well: MW-H30

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H30

X Location: 0. m
Y Location: 0. m

Initial Displacement: 8.05 m
Static Water Column Height: 14.75 m
Casing Radius: 0.048 m
Well Radius: 0.048 m
Well Skin Radius: 1. m
Screen Length: 3.81 m
Total Well Penetration Depth: 14.75 m

No. of Observations: 59

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	8.05	1800.	7.934
60.	8.045	1860.	7.934
120.	8.048	1920.	7.931
180.	8.044	1980.	7.927
240.	8.041	2040.	7.92
300.	8.041	2100.	7.92
360.	8.033	2160.	7.916
420.	8.028	2220.	7.908
480.	8.02	2280.	7.908
540.	8.02	2340.	7.904
600.	8.017	2400.	7.9
660.	8.014	2460.	7.895
720.	8.009	2520.	7.892
780.	8.005	2580.	7.888
840.	8.001	2640.	7.884
900.	7.997	2700.	7.878
960.	7.992	2760.	7.877
1020.	7.99	2820.	7.873
1080.	7.984	2880.	7.867
1140.	7.981	2940.	7.865
1200.	7.976	3000.	7.861
1260.	7.973	3060.	7.855
1320.	7.97	3120.	7.85
1380.	7.965	3180.	7.85
1440.	7.96	3240.	7.845
1500.	7.958	3300.	7.841
1560.	7.953	3360.	7.838
1620.	7.946	3420.	7.834
1680.	7.945	3480.	7.826
1740.	7.939		

SOLUTION

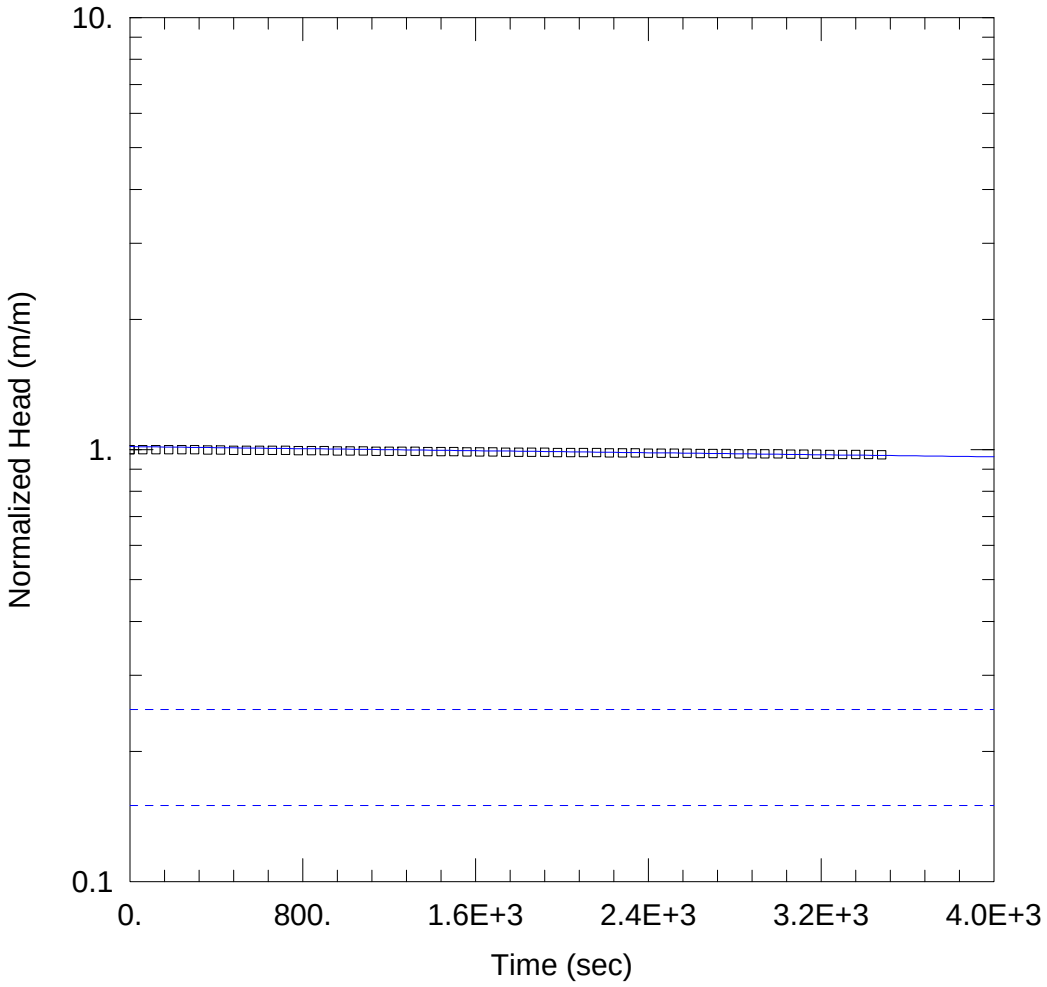
Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.2286

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	1.792E-8	m/sec
y0	8.175	m

K = 1.792E-6 cm/sec
T = K*b = 8.959E-7 m²/sec (0.008959 sq. cm/sec)



MW-H30 ZONE 1 (FALLING HEAD PACKER TEST, VERTICAL INTERVAL 19.05 - 22.86 M)

PROJECT INFORMATION

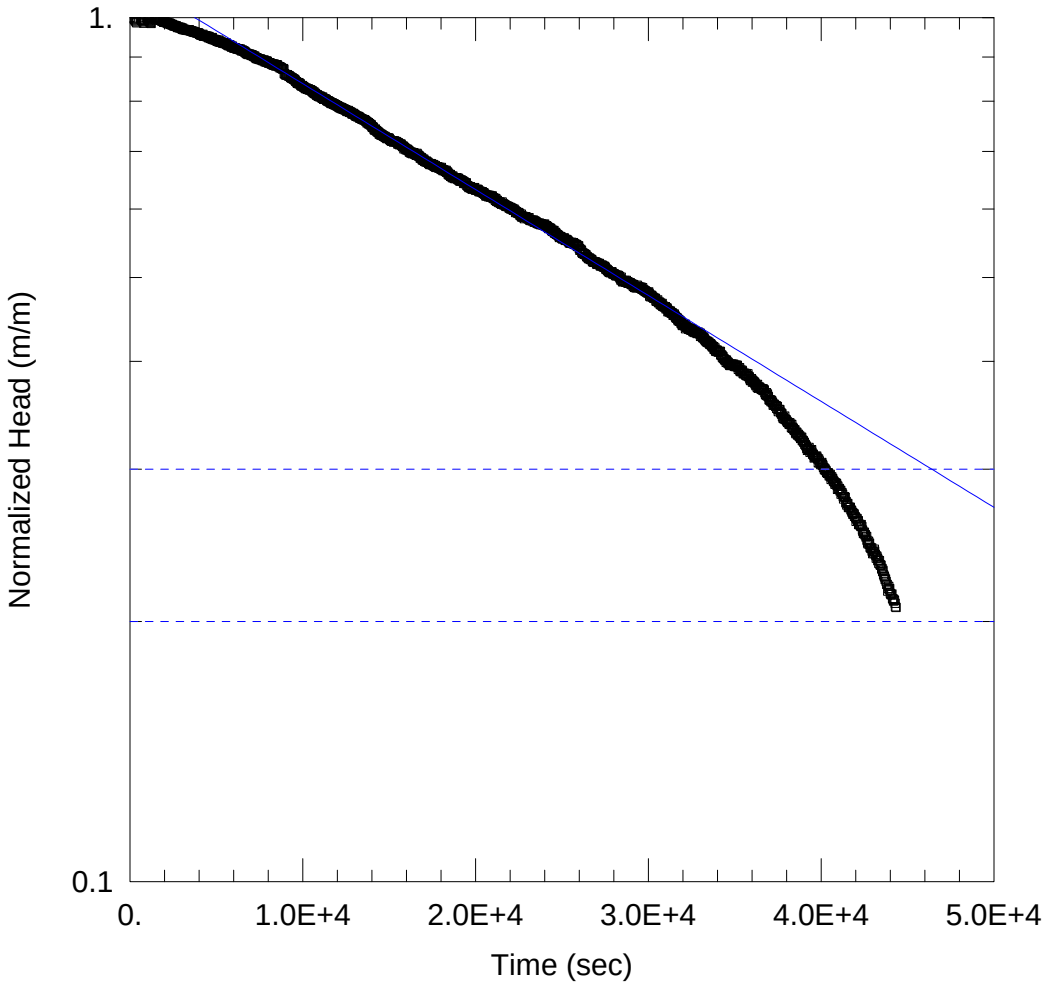
Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H30
Test Date: 22 July 2013

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 1.792E-8 m/sec
y0 = 8.175 m



MW-H30 (FALLING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H30
Test Date: 24 July 2013

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H30)

Initial Displacement: 0.25 m
Total Well Penetration Depth: 2.772 m
Casing Radius: 0.016 m
Static Water Column Height: 2.772 m
Screen Length: 2.772 m
Well Radius: 0.038 m
Gravel Pack Porosity: 0.

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice
K = 3.653E-9 m/sec
y0 = 0.278 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H31 (Falling Head Slug Test)
Date: 08/14/13
Time: 12:15:45

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 21 July 2013
Test Well: MW-H31

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H31

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.75 m
Static Water Column Height: 21.91 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 21.91 m

No. of Observations: 2480

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.75	1.686E+4	0.3689
1.	0.7115	1.688E+4	0.3696
2.	0.7329	1.689E+4	0.3692
3.	0.7253	1.691E+4	0.3675
4.	0.7332	1.692E+4	0.3686
5.	0.7296	1.694E+4	0.3682
6.	0.73	1.695E+4	0.3668
7.	0.7321	1.697E+4	0.3675
8.	0.7317	1.698E+4	0.3669
9.	0.7313	1.7E+4	0.3667
10.	0.7322	1.701E+4	0.3665
11.	0.7322	1.703E+4	0.3649
12.	0.7325	1.704E+4	0.3658
13.	0.7336	1.706E+4	0.3643
14.	0.7334	1.707E+4	0.3654
15.	0.734	1.709E+4	0.3638
16.	0.7331	1.71E+4	0.3648
17.	0.7343	1.712E+4	0.3654
18.	0.7322	1.713E+4	0.3643
19.	0.7318	1.715E+4	0.3643
20.	0.7336	1.716E+4	0.3641
21.	0.7334	1.718E+4	0.363
22.	0.7331	1.719E+4	0.3632
23.	0.7336	1.721E+4	0.3636
24.	0.734	1.722E+4	0.3624
25.	0.7334	1.724E+4	0.3624
26.	0.7329	1.725E+4	0.3621
27.	0.7354	1.727E+4	0.3617
28.	0.7346	1.728E+4	0.361
29.	0.7348	1.73E+4	0.361

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
30.	0.7342	1.731E+4	0.3597
31.	0.7347	1.733E+4	0.361
32.	0.7344	1.734E+4	0.3601
33.	0.7344	1.736E+4	0.3594
34.	0.7344	1.737E+4	0.3599
35.	0.7346	1.739E+4	0.3583
36.	0.7347	1.74E+4	0.3595
37.	0.7344	1.742E+4	0.3583
38.	0.7349	1.743E+4	0.358
39.	0.7334	1.745E+4	0.3576
40.	0.7348	1.746E+4	0.3572
41.	0.7341	1.748E+4	0.3578
42.	0.7334	1.749E+4	0.3566
43.	0.7345	1.751E+4	0.3561
44.	0.7348	1.752E+4	0.3558
45.	0.7345	1.754E+4	0.3561
46.	0.7348	1.755E+4	0.3552
47.	0.735	1.757E+4	0.3557
48.	0.7342	1.758E+4	0.3556
49.	0.7347	1.76E+4	0.3545
50.	0.7336	1.761E+4	0.3555
51.	0.7334	1.763E+4	0.3542
52.	0.7344	1.764E+4	0.3538
53.	0.7336	1.766E+4	0.3533
54.	0.735	1.767E+4	0.3514
55.	0.7339	1.769E+4	0.3534
56.	0.7349	1.77E+4	0.3536
57.	0.7343	1.772E+4	0.3525
58.	0.7345	1.773E+4	0.3522
59.	0.7333	1.775E+4	0.3509
60.	0.7351	1.776E+4	0.3521
61.	0.7331	1.778E+4	0.3514
62.	0.7341	1.779E+4	0.3499
63.	0.7333	1.781E+4	0.3505
64.	0.734	1.782E+4	0.3491
65.	0.7339	1.784E+4	0.3499
66.	0.7333	1.785E+4	0.3499
67.	0.7343	1.787E+4	0.3483
68.	0.7334	1.788E+4	0.3485
69.	0.7339	1.79E+4	0.348
70.	0.7339	1.791E+4	0.35
71.	0.7337	1.793E+4	0.3479
72.	0.7336	1.794E+4	0.3478
73.	0.7344	1.796E+4	0.3473
74.	0.7346	1.797E+4	0.3484
75.	0.7338	1.799E+4	0.3472
76.	0.7327	1.8E+4	0.3476
77.	0.7333	1.802E+4	0.3456
78.	0.7336	1.803E+4	0.3459
79.	0.734	1.805E+4	0.3459
80.	0.7334	1.806E+4	0.3441
81.	0.7337	1.808E+4	0.3446
82.	0.7343	1.809E+4	0.3448
83.	0.7324	1.811E+4	0.3442
84.	0.7332	1.812E+4	0.3443
85.	0.7346	1.814E+4	0.3434
86.	0.7333	1.815E+4	0.3431
87.	0.7336	1.817E+4	0.3429
88.	0.7335	1.818E+4	0.3436
89.	0.7327	1.82E+4	0.3431
90.	0.7339	1.821E+4	0.3421
91.	0.7328	1.823E+4	0.342
92.	0.7337	1.824E+4	0.3407
93.	0.733	1.826E+4	0.3417
94.	0.7329	1.827E+4	0.34
95.	0.7336	1.829E+4	0.3413
96.	0.7335	1.83E+4	0.3399

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
97.	0.7334	1.832E+4	0.3402
98.	0.7338	1.833E+4	0.3393
99.	0.7329	1.835E+4	0.339
100.	0.7334	1.836E+4	0.3391
101.	0.7333	1.838E+4	0.3387
102.	0.7336	1.839E+4	0.3379
103.	0.7344	1.841E+4	0.3385
104.	0.7336	1.842E+4	0.3379
105.	0.7331	1.844E+4	0.3357
106.	0.7334	1.845E+4	0.3379
107.	0.7336	1.847E+4	0.3364
108.	0.733	1.848E+4	0.3376
109.	0.7337	1.85E+4	0.3371
110.	0.733	1.851E+4	0.3362
111.	0.7333	1.853E+4	0.3364
112.	0.7324	1.854E+4	0.3361
113.	0.7322	1.856E+4	0.3346
114.	0.7328	1.857E+4	0.3359
115.	0.7326	1.859E+4	0.3343
116.	0.7335	1.86E+4	0.3347
117.	0.7335	1.862E+4	0.3336
118.	0.7323	1.863E+4	0.3333
119.	0.7343	1.865E+4	0.3337
120.	0.7329	1.866E+4	0.3336
121.	0.7328	1.868E+4	0.3338
122.	0.7336	1.869E+4	0.3328
123.	0.7329	1.871E+4	0.3328
124.	0.7314	1.872E+4	0.3325
138.	0.7311	1.874E+4	0.3338
153.	0.7298	1.875E+4	0.3308
168.	0.7299	1.877E+4	0.3322
183.	0.729	1.878E+4	0.3314
198.	0.7285	1.88E+4	0.3317
213.	0.7286	1.881E+4	0.3317
228.	0.7283	1.883E+4	0.3312
243.	0.7273	1.884E+4	0.3315
258.	0.7274	1.886E+4	0.331
273.	0.7281	1.887E+4	0.3286
288.	0.7276	1.889E+4	0.3284
303.	0.7273	1.89E+4	0.329
318.	0.7267	1.892E+4	0.3293
333.	0.7253	1.893E+4	0.3285
348.	0.725	1.895E+4	0.3276
363.	0.7256	1.896E+4	0.3274
378.	0.7249	1.898E+4	0.3275
393.	0.7253	1.899E+4	0.3262
408.	0.7259	1.901E+4	0.3267
423.	0.7233	1.902E+4	0.3276
438.	0.7241	1.904E+4	0.3263
453.	0.7236	1.905E+4	0.3261
468.	0.722	1.907E+4	0.3245
483.	0.7234	1.908E+4	0.3248
498.	0.7223	1.91E+4	0.325
513.	0.7212	1.911E+4	0.3247
528.	0.7198	1.913E+4	0.3241
543.	0.7213	1.914E+4	0.3244
558.	0.7205	1.916E+4	0.3241
573.	0.7208	1.917E+4	0.3235
588.	0.72	1.919E+4	0.3233
603.	0.7197	1.92E+4	0.322
618.	0.7178	1.922E+4	0.3235
633.	0.7179	1.923E+4	0.3224
648.	0.7182	1.925E+4	0.322
663.	0.7174	1.926E+4	0.3216
678.	0.7176	1.928E+4	0.3217
693.	0.718	1.929E+4	0.322
708.	0.7174	1.931E+4	0.3208

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
723.	0.7163	1.932E+4	0.3201
738.	0.7161	1.934E+4	0.3199
753.	0.7159	1.935E+4	0.3199
768.	0.7153	1.937E+4	0.3197
783.	0.715	1.938E+4	0.318
798.	0.7138	1.94E+4	0.3191
813.	0.7143	1.941E+4	0.3185
828.	0.7134	1.943E+4	0.3176
843.	0.7123	1.944E+4	0.318
858.	0.7131	1.946E+4	0.3179
873.	0.7125	1.947E+4	0.318
888.	0.7111	1.949E+4	0.3175
903.	0.7109	1.95E+4	0.3179
918.	0.712	1.952E+4	0.3169
933.	0.7108	1.953E+4	0.3169
948.	0.7103	1.955E+4	0.3167
963.	0.7115	1.956E+4	0.3163
978.	0.7096	1.958E+4	0.3146
993.	0.7092	1.959E+4	0.3154
1008.	0.7093	1.961E+4	0.3147
1023.	0.7085	1.962E+4	0.3145
1038.	0.7092	1.964E+4	0.3143
1053.	0.7078	1.965E+4	0.3141
1068.	0.7076	1.967E+4	0.3141
1083.	0.7073	1.968E+4	0.3139
1098.	0.7065	1.97E+4	0.3134
1113.	0.7058	1.971E+4	0.3138
1128.	0.7064	1.973E+4	0.3137
1143.	0.7064	1.974E+4	0.3134
1158.	0.7058	1.976E+4	0.3131
1173.	0.7057	1.977E+4	0.3118
1188.	0.7058	1.979E+4	0.3123
1203.	0.7047	1.98E+4	0.3114
1218.	0.7042	1.982E+4	0.3103
1233.	0.7045	1.983E+4	0.3109
1248.	0.7034	1.985E+4	0.3102
1263.	0.7038	1.986E+4	0.3096
1278.	0.7033	1.988E+4	0.3096
1293.	0.7027	1.989E+4	0.3097
1308.	0.7028	1.991E+4	0.3089
1323.	0.7018	1.992E+4	0.3084
1338.	0.7021	1.994E+4	0.3079
1353.	0.7018	1.995E+4	0.3096
1368.	0.7004	1.997E+4	0.3072
1383.	0.7002	1.998E+4	0.3081
1398.	0.7009	2.0E+4	0.307
1413.	0.7013	2.001E+4	0.3074
1428.	0.6995	2.003E+4	0.3062
1443.	0.6995	2.004E+4	0.3068
1458.	0.7	2.006E+4	0.3058
1473.	0.6986	2.007E+4	0.3053
1488.	0.6992	2.009E+4	0.3049
1503.	0.6986	2.01E+4	0.3049
1518.	0.6973	2.012E+4	0.3049
1533.	0.6976	2.013E+4	0.304
1548.	0.6973	2.015E+4	0.3048
1563.	0.6965	2.016E+4	0.3045
1578.	0.6979	2.018E+4	0.3027
1593.	0.6968	2.019E+4	0.303
1608.	0.6953	2.021E+4	0.3025
1623.	0.6962	2.022E+4	0.3022
1638.	0.6954	2.024E+4	0.302
1653.	0.6944	2.025E+4	0.3018
1668.	0.6947	2.027E+4	0.3019
1683.	0.6944	2.028E+4	0.302
1698.	0.695	2.03E+4	0.3005
1713.	0.6939	2.031E+4	0.3005

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1728.	0.6938	2.033E+4	0.3004
1743.	0.693	2.034E+4	0.2997
1758.	0.6921	2.036E+4	0.3003
1773.	0.692	2.037E+4	0.3001
1788.	0.6927	2.039E+4	0.299
1803.	0.6927	2.04E+4	0.2994
1818.	0.6912	2.042E+4	0.2986
1833.	0.6912	2.043E+4	0.2988
1848.	0.6907	2.045E+4	0.2989
1863.	0.6901	2.046E+4	0.2983
1878.	0.6898	2.048E+4	0.2977
1893.	0.6895	2.049E+4	0.2967
1908.	0.6894	2.051E+4	0.2969
1923.	0.6904	2.052E+4	0.2959
1938.	0.6889	2.054E+4	0.296
1953.	0.6887	2.055E+4	0.2954
1968.	0.688	2.057E+4	0.2954
1983.	0.6869	2.058E+4	0.2953
1998.	0.6881	2.06E+4	0.2943
2013.	0.6877	2.061E+4	0.2936
2028.	0.6867	2.063E+4	0.2938
2043.	0.6864	2.064E+4	0.295
2058.	0.6865	2.066E+4	0.2931
2073.	0.686	2.067E+4	0.2935
2088.	0.6859	2.069E+4	0.2919
2103.	0.6863	2.07E+4	0.2921
2118.	0.6847	2.072E+4	0.2913
2133.	0.6846	2.073E+4	0.2913
2148.	0.6843	2.075E+4	0.2915
2163.	0.6833	2.076E+4	0.2908
2178.	0.6832	2.078E+4	0.2915
2193.	0.6834	2.079E+4	0.2905
2208.	0.6821	2.081E+4	0.2893
2223.	0.6824	2.082E+4	0.2902
2238.	0.6817	2.084E+4	0.2891
2253.	0.6811	2.085E+4	0.2892
2268.	0.682	2.087E+4	0.2889
2283.	0.6808	2.088E+4	0.2893
2298.	0.6808	2.09E+4	0.2888
2313.	0.6802	2.091E+4	0.2879
2328.	0.6803	2.093E+4	0.2869
2343.	0.6788	2.094E+4	0.288
2358.	0.6794	2.096E+4	0.2884
2373.	0.6793	2.097E+4	0.288
2388.	0.6783	2.099E+4	0.2868
2403.	0.6776	2.1E+4	0.2873
2418.	0.6774	2.102E+4	0.2857
2433.	0.6773	2.103E+4	0.2862
2448.	0.677	2.105E+4	0.286
2463.	0.6772	2.106E+4	0.2852
2478.	0.6763	2.108E+4	0.2849
2493.	0.6757	2.109E+4	0.2848
2508.	0.6754	2.111E+4	0.285
2523.	0.6751	2.112E+4	0.2841
2538.	0.6746	2.114E+4	0.2838
2553.	0.6749	2.115E+4	0.2851
2568.	0.6743	2.117E+4	0.2826
2583.	0.675	2.118E+4	0.2828
2598.	0.6736	2.12E+4	0.2825
2613.	0.6741	2.121E+4	0.2809
2628.	0.6732	2.123E+4	0.2819
2643.	0.673	2.124E+4	0.2817
2658.	0.6728	2.126E+4	0.2819
2673.	0.6719	2.127E+4	0.2809
2688.	0.673	2.129E+4	0.2812
2703.	0.6719	2.13E+4	0.2792
2718.	0.6707	2.132E+4	0.2804

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
2733.	0.6703	2.133E+4	0.2794
2748.	0.6709	2.135E+4	0.2799
2763.	0.6706	2.136E+4	0.2798
2778.	0.6717	2.138E+4	0.2787
2793.	0.67	2.139E+4	0.2789
2808.	0.6701	2.141E+4	0.2786
2823.	0.6701	2.142E+4	0.2768
2838.	0.6697	2.144E+4	0.2775
2853.	0.6686	2.145E+4	0.2764
2868.	0.6684	2.147E+4	0.2763
2883.	0.6678	2.148E+4	0.277
2898.	0.6683	2.15E+4	0.2751
2913.	0.6673	2.151E+4	0.2757
2928.	0.6678	2.153E+4	0.2757
2943.	0.6664	2.154E+4	0.2768
2958.	0.6662	2.156E+4	0.2749
2973.	0.6662	2.157E+4	0.2754
2988.	0.6659	2.159E+4	0.2751
3003.	0.665	2.16E+4	0.2753
3018.	0.6644	2.162E+4	0.2748
3033.	0.6649	2.163E+4	0.2743
3048.	0.6643	2.165E+4	0.273
3063.	0.664	2.166E+4	0.2738
3078.	0.6634	2.168E+4	0.2718
3093.	0.6626	2.169E+4	0.2719
3108.	0.6635	2.171E+4	0.2724
3123.	0.6623	2.172E+4	0.2727
3138.	0.6623	2.174E+4	0.2721
3153.	0.6619	2.175E+4	0.2715
3168.	0.662	2.177E+4	0.2711
3183.	0.6619	2.178E+4	0.2711
3198.	0.6608	2.18E+4	0.2711
3213.	0.6602	2.181E+4	0.2709
3228.	0.6602	2.183E+4	0.2695
3243.	0.6604	2.184E+4	0.2696
3258.	0.6597	2.186E+4	0.269
3273.	0.6588	2.187E+4	0.2698
3288.	0.6588	2.189E+4	0.2685
3303.	0.6578	2.19E+4	0.2681
3318.	0.6581	2.192E+4	0.2683
3333.	0.6578	2.193E+4	0.268
3348.	0.6582	2.195E+4	0.2668
3363.	0.6567	2.196E+4	0.2683
3378.	0.6568	2.198E+4	0.2671
3393.	0.6561	2.199E+4	0.2673
3408.	0.6561	2.201E+4	0.2662
3423.	0.6565	2.202E+4	0.2662
3438.	0.6556	2.204E+4	0.2659
3453.	0.6547	2.205E+4	0.2662
3468.	0.655	2.207E+4	0.2654
3483.	0.6547	2.208E+4	0.2655
3498.	0.6534	2.21E+4	0.2651
3513.	0.653	2.211E+4	0.2641
3528.	0.653	2.213E+4	0.264
3543.	0.6531	2.214E+4	0.2634
3558.	0.6532	2.216E+4	0.263
3573.	0.6521	2.217E+4	0.2638
3588.	0.6523	2.219E+4	0.2619
3603.	0.6508	2.22E+4	0.2618
3618.	0.6513	2.222E+4	0.2632
3633.	0.6509	2.223E+4	0.2612
3648.	0.6506	2.225E+4	0.2613
3663.	0.6501	2.226E+4	0.2618
3678.	0.6487	2.228E+4	0.2615
3693.	0.6498	2.229E+4	0.2609
3708.	0.6493	2.231E+4	0.2595
3723.	0.6486	2.232E+4	0.2589

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
3738.	0.6492	2.234E+4	0.2594
3753.	0.6483	2.235E+4	0.2591
3768.	0.6484	2.237E+4	0.2587
3783.	0.6479	2.238E+4	0.2587
3798.	0.6471	2.24E+4	0.2586
3813.	0.6479	2.241E+4	0.2583
3828.	0.6464	2.243E+4	0.2578
3843.	0.6455	2.244E+4	0.258
3858.	0.646	2.246E+4	0.258
3873.	0.646	2.247E+4	0.257
3888.	0.6458	2.249E+4	0.2562
3903.	0.6459	2.25E+4	0.2569
3918.	0.6447	2.252E+4	0.2567
3933.	0.6449	2.253E+4	0.256
3948.	0.6438	2.255E+4	0.2565
3963.	0.6444	2.256E+4	0.2554
3978.	0.6439	2.258E+4	0.2557
3993.	0.6436	2.259E+4	0.2547
4008.	0.6435	2.261E+4	0.2545
4023.	0.6431	2.262E+4	0.2538
4038.	0.6422	2.264E+4	0.254
4053.	0.6417	2.265E+4	0.2535
4068.	0.6414	2.267E+4	0.2543
4083.	0.6409	2.268E+4	0.253
4098.	0.6405	2.27E+4	0.2529
4113.	0.6393	2.271E+4	0.2523
4128.	0.6397	2.273E+4	0.2528
4143.	0.6392	2.274E+4	0.2516
4158.	0.6395	2.276E+4	0.2518
4173.	0.638	2.277E+4	0.2512
4188.	0.6388	2.279E+4	0.2502
4203.	0.6384	2.28E+4	0.2508
4218.	0.6378	2.282E+4	0.249
4233.	0.638	2.283E+4	0.2499
4248.	0.6374	2.285E+4	0.2499
4263.	0.6368	2.286E+4	0.2488
4278.	0.6365	2.288E+4	0.2489
4293.	0.6371	2.289E+4	0.2497
4308.	0.636	2.291E+4	0.2485
4323.	0.6358	2.292E+4	0.2474
4338.	0.6356	2.294E+4	0.2487
4353.	0.6352	2.295E+4	0.2474
4368.	0.6346	2.297E+4	0.2467
4383.	0.634	2.298E+4	0.2469
4398.	0.6335	2.3E+4	0.2466
4413.	0.6339	2.301E+4	0.2457
4428.	0.6342	2.303E+4	0.2467
4443.	0.6337	2.304E+4	0.2458
4458.	0.633	2.306E+4	0.2455
4473.	0.6318	2.307E+4	0.2449
4488.	0.632	2.309E+4	0.2461
4503.	0.6317	2.31E+4	0.2453
4518.	0.6322	2.312E+4	0.2435
4533.	0.6312	2.313E+4	0.2439
4548.	0.6305	2.315E+4	0.244
4563.	0.6302	2.316E+4	0.2442
4578.	0.6298	2.318E+4	0.2441
4593.	0.6305	2.319E+4	0.2433
4608.	0.6298	2.321E+4	0.2426
4623.	0.6289	2.322E+4	0.2429
4638.	0.6294	2.324E+4	0.2379
4653.	0.629	2.325E+4	0.242
4668.	0.6289	2.327E+4	0.2431
4683.	0.6274	2.328E+4	0.2423
4698.	0.6272	2.33E+4	0.2406
4713.	0.6277	2.331E+4	0.2417
4728.	0.6277	2.333E+4	0.2401

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
4743.	0.6275	2.334E+4	0.24
4758.	0.6261	2.336E+4	0.2404
4773.	0.6267	2.337E+4	0.2405
4788.	0.6263	2.339E+4	0.2404
4803.	0.6251	2.34E+4	0.2394
4818.	0.6253	2.342E+4	0.2393
4833.	0.6238	2.343E+4	0.2389
4848.	0.6245	2.345E+4	0.2391
4863.	0.6239	2.346E+4	0.2384
4878.	0.6234	2.348E+4	0.2382
4893.	0.6238	2.349E+4	0.2378
4908.	0.6233	2.351E+4	0.2368
4923.	0.6224	2.352E+4	0.2375
4938.	0.6231	2.354E+4	0.237
4953.	0.6228	2.355E+4	0.2372
4968.	0.6226	2.357E+4	0.2356
4983.	0.621	2.358E+4	0.2364
4998.	0.6221	2.36E+4	0.2352
5013.	0.6205	2.361E+4	0.2363
5028.	0.6208	2.363E+4	0.234
5043.	0.621	2.364E+4	0.2346
5058.	0.6207	2.366E+4	0.235
5073.	0.6197	2.367E+4	0.2339
5088.	0.6188	2.369E+4	0.2336
5103.	0.6181	2.37E+4	0.2338
5118.	0.6185	2.372E+4	0.2331
5133.	0.6178	2.373E+4	0.2327
5148.	0.6178	2.375E+4	0.2331
5163.	0.6173	2.376E+4	0.2329
5178.	0.6171	2.378E+4	0.2315
5193.	0.6169	2.379E+4	0.2308
5208.	0.6167	2.381E+4	0.2312
5223.	0.6159	2.382E+4	0.2322
5238.	0.6159	2.384E+4	0.2305
5253.	0.6152	2.385E+4	0.2312
5268.	0.6151	2.387E+4	0.2297
5283.	0.6141	2.388E+4	0.2298
5298.	0.614	2.39E+4	0.2308
5313.	0.614	2.391E+4	0.2291
5328.	0.6143	2.393E+4	0.2287
5343.	0.614	2.394E+4	0.2287
5358.	0.6129	2.396E+4	0.2292
5373.	0.6121	2.397E+4	0.2293
5388.	0.6123	2.399E+4	0.2272
5403.	0.6115	2.4E+4	0.2276
5418.	0.6109	2.402E+4	0.2283
5433.	0.6107	2.403E+4	0.2268
5448.	0.6114	2.405E+4	0.2267
5463.	0.6104	2.406E+4	0.2255
5478.	0.6109	2.408E+4	0.2239
5493.	0.6109	2.409E+4	0.2251
5508.	0.61	2.411E+4	0.2245
5523.	0.6106	2.412E+4	0.2249
5538.	0.6086	2.414E+4	0.2244
5553.	0.6081	2.415E+4	0.2239
5568.	0.6087	2.417E+4	0.2241
5583.	0.6072	2.418E+4	0.2237
5598.	0.6075	2.42E+4	0.2237
5613.	0.6072	2.421E+4	0.2217
5628.	0.607	2.423E+4	0.2226
5643.	0.6071	2.424E+4	0.2237
5658.	0.606	2.426E+4	0.2224
5673.	0.6054	2.427E+4	0.2219
5688.	0.6047	2.429E+4	0.2216
5703.	0.6047	2.43E+4	0.2213
5718.	0.6049	2.432E+4	0.2219
5733.	0.6056	2.433E+4	0.2204

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
5748.	0.6047	2.435E+4	0.2204
5763.	0.604	2.436E+4	0.2199
5778.	0.6033	2.438E+4	0.2197
5793.	0.6037	2.439E+4	0.2182
5808.	0.6031	2.441E+4	0.2197
5823.	0.6026	2.442E+4	0.2188
5838.	0.6022	2.444E+4	0.2194
5853.	0.6018	2.445E+4	0.2184
5868.	0.6022	2.447E+4	0.2183
5883.	0.6011	2.448E+4	0.2183
5898.	0.6014	2.45E+4	0.2179
5913.	0.5997	2.451E+4	0.2178
5928.	0.6017	2.453E+4	0.2175
5943.	0.6004	2.454E+4	0.2158
5958.	0.5994	2.456E+4	0.2178
5973.	0.5993	2.457E+4	0.2156
5988.	0.5992	2.459E+4	0.2159
6003.	0.5986	2.46E+4	0.2153
6018.	0.5983	2.462E+4	0.2144
6033.	0.5987	2.463E+4	0.2153
6048.	0.598	2.465E+4	0.2139
6063.	0.5981	2.466E+4	0.2139
6078.	0.5966	2.468E+4	0.2137
6093.	0.5966	2.469E+4	0.2129
6108.	0.5964	2.471E+4	0.2133
6123.	0.5969	2.472E+4	0.2123
6138.	0.5961	2.474E+4	0.2128
6153.	0.5951	2.475E+4	0.2112
6168.	0.5951	2.477E+4	0.2121
6183.	0.595	2.478E+4	0.2116
6198.	0.595	2.48E+4	0.2123
6213.	0.5945	2.481E+4	0.2123
6228.	0.5937	2.483E+4	0.2114
6243.	0.5936	2.484E+4	0.2104
6258.	0.5928	2.486E+4	0.2103
6273.	0.5937	2.487E+4	0.2097
6288.	0.5909	2.489E+4	0.2099
6303.	0.5919	2.49E+4	0.2092
6318.	0.5923	2.492E+4	0.2083
6333.	0.5915	2.493E+4	0.2084
6348.	0.5907	2.495E+4	0.2074
6363.	0.5903	2.496E+4	0.2075
6378.	0.5907	2.498E+4	0.2082
6393.	0.5898	2.499E+4	0.2085
6408.	0.5903	2.501E+4	0.208
6423.	0.5896	2.502E+4	0.2071
6438.	0.589	2.504E+4	0.2074
6453.	0.5883	2.505E+4	0.2066
6468.	0.5889	2.507E+4	0.2067
6483.	0.5877	2.508E+4	0.2062
6498.	0.5874	2.51E+4	0.2057
6513.	0.5875	2.511E+4	0.2055
6528.	0.5869	2.513E+4	0.2057
6543.	0.5859	2.514E+4	0.2052
6558.	0.5865	2.516E+4	0.2059
6573.	0.5854	2.517E+4	0.2043
6588.	0.5855	2.519E+4	0.2046
6603.	0.5854	2.52E+4	0.2038
6618.	0.5843	2.522E+4	0.2027
6633.	0.5835	2.523E+4	0.2027
6648.	0.5842	2.525E+4	0.203
6663.	0.5841	2.526E+4	0.2033
6678.	0.5841	2.528E+4	0.2033
6693.	0.5828	2.529E+4	0.2029
6708.	0.5835	2.531E+4	0.2031
6723.	0.5822	2.532E+4	0.2021
6738.	0.5825	2.534E+4	0.2019

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
6753.	0.5813	2.535E+4	0.2005
6768.	0.5817	2.537E+4	0.2006
6783.	0.5812	2.538E+4	0.2001
6798.	0.5808	2.54E+4	0.2006
6813.	0.5808	2.541E+4	0.1997
6828.	0.5794	2.543E+4	0.1999
6843.	0.5795	2.544E+4	0.1995
6858.	0.5798	2.546E+4	0.1985
6873.	0.5797	2.547E+4	0.1989
6888.	0.5789	2.549E+4	0.1986
6903.	0.5789	2.55E+4	0.1987
6918.	0.5792	2.552E+4	0.1985
6933.	0.5779	2.553E+4	0.1979
6948.	0.5774	2.555E+4	0.1969
6963.	0.5777	2.556E+4	0.1977
6978.	0.5773	2.558E+4	0.1964
6993.	0.5771	2.559E+4	0.1965
7008.	0.5763	2.561E+4	0.1957
7023.	0.5759	2.562E+4	0.1956
7038.	0.5757	2.564E+4	0.1966
7053.	0.5751	2.565E+4	0.1941
7068.	0.5746	2.567E+4	0.1942
7083.	0.5745	2.568E+4	0.1953
7098.	0.5742	2.57E+4	0.1935
7113.	0.5744	2.571E+4	0.1935
7128.	0.5729	2.573E+4	0.1941
7143.	0.5733	2.574E+4	0.1939
7158.	0.5729	2.576E+4	0.1923
7173.	0.5727	2.577E+4	0.193
7188.	0.5714	2.579E+4	0.1923
7203.	0.5729	2.58E+4	0.1919
7218.	0.5721	2.582E+4	0.1912
7233.	0.5718	2.583E+4	0.1915
7248.	0.5707	2.585E+4	0.1902
7263.	0.5709	2.586E+4	0.1905
7278.	0.5688	2.588E+4	0.1909
7293.	0.5697	2.589E+4	0.1905
7308.	0.5692	2.591E+4	0.1897
7323.	0.5683	2.592E+4	0.1896
7338.	0.5693	2.594E+4	0.1878
7353.	0.5686	2.595E+4	0.1893
7368.	0.568	2.597E+4	0.1881
7383.	0.5673	2.598E+4	0.1881
7398.	0.5663	2.6E+4	0.1862
7413.	0.5669	2.601E+4	0.1874
7428.	0.5667	2.603E+4	0.1878
7443.	0.5659	2.604E+4	0.1865
7458.	0.5659	2.606E+4	0.1884
7473.	0.5658	2.607E+4	0.1869
7488.	0.5651	2.609E+4	0.1863
7503.	0.5646	2.61E+4	0.1852
7518.	0.5651	2.612E+4	0.185
7533.	0.5633	2.613E+4	0.1862
7548.	0.563	2.615E+4	0.1849
7563.	0.5629	2.616E+4	0.1855
7578.	0.5632	2.618E+4	0.1862
7593.	0.563	2.619E+4	0.1849
7608.	0.562	2.621E+4	0.185
7623.	0.5615	2.622E+4	0.1831
7638.	0.563	2.624E+4	0.1838
7653.	0.5618	2.625E+4	0.1833
7668.	0.561	2.627E+4	0.1834
7683.	0.5606	2.628E+4	0.1825
7698.	0.5597	2.63E+4	0.1817
7713.	0.5597	2.631E+4	0.182
7728.	0.5589	2.633E+4	0.1816
7743.	0.5594	2.634E+4	0.1817

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
7758.	0.5595	2.636E+4	0.1817
7773.	0.5586	2.637E+4	0.1803
7788.	0.5588	2.639E+4	0.1813
7803.	0.5575	2.64E+4	0.1801
7818.	0.557	2.642E+4	0.1787
7833.	0.5569	2.643E+4	0.1784
7848.	0.5576	2.645E+4	0.1784
7863.	0.5574	2.646E+4	0.1791
7878.	0.5561	2.648E+4	0.1782
7893.	0.5559	2.649E+4	0.1795
7908.	0.556	2.651E+4	0.177
7923.	0.5557	2.652E+4	0.1763
7938.	0.5561	2.654E+4	0.1767
7953.	0.5542	2.655E+4	0.1764
7968.	0.5543	2.657E+4	0.1749
7983.	0.5538	2.658E+4	0.1756
7998.	0.5537	2.66E+4	0.1768
8013.	0.5538	2.661E+4	0.1751
8028.	0.5526	2.663E+4	0.1755
8043.	0.5527	2.664E+4	0.1748
8058.	0.5522	2.666E+4	0.1747
8073.	0.5513	2.667E+4	0.1738
8088.	0.5525	2.669E+4	0.174
8103.	0.5515	2.67E+4	0.1726
8118.	0.5515	2.672E+4	0.1723
8133.	0.5507	2.673E+4	0.1723
8148.	0.5516	2.675E+4	0.1715
8163.	0.5499	2.676E+4	0.1717
8178.	0.5492	2.678E+4	0.1709
8193.	0.5503	2.679E+4	0.1707
8208.	0.5494	2.681E+4	0.1711
8223.	0.5487	2.682E+4	0.1715
8238.	0.549	2.684E+4	0.1703
8253.	0.5473	2.685E+4	0.1711
8268.	0.5481	2.687E+4	0.1695
8283.	0.5477	2.688E+4	0.1684
8298.	0.547	2.69E+4	0.1695
8313.	0.5469	2.691E+4	0.1691
8328.	0.5467	2.693E+4	0.1682
8343.	0.5472	2.694E+4	0.1679
8358.	0.5463	2.696E+4	0.1684
8373.	0.5455	2.697E+4	0.1679
8388.	0.547	2.699E+4	0.1667
8403.	0.5449	2.7E+4	0.1685
8418.	0.5446	2.702E+4	0.1662
8433.	0.5439	2.703E+4	0.1666
8448.	0.5442	2.705E+4	0.1667
8463.	0.5433	2.706E+4	0.1664
8478.	0.5428	2.708E+4	0.1657
8493.	0.5428	2.709E+4	0.1649
8508.	0.5419	2.711E+4	0.1656
8523.	0.5416	2.712E+4	0.1655
8538.	0.5428	2.714E+4	0.1645
8553.	0.5418	2.715E+4	0.1643
8568.	0.5424	2.717E+4	0.1644
8583.	0.5405	2.718E+4	0.1638
8598.	0.54	2.72E+4	0.1625
8613.	0.5412	2.721E+4	0.1626
8628.	0.5397	2.723E+4	0.1622
8643.	0.5392	2.724E+4	0.1621
8658.	0.5395	2.726E+4	0.1623
8673.	0.5381	2.727E+4	0.1621
8688.	0.5385	2.729E+4	0.1619
8703.	0.5377	2.73E+4	0.162
8718.	0.5374	2.732E+4	0.1604
8733.	0.5367	2.733E+4	0.1604
8748.	0.5374	2.735E+4	0.1606

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
8763.	0.5373	2.736E+4	0.1599
8778.	0.5366	2.738E+4	0.1607
8793.	0.5367	2.739E+4	0.1593
8808.	0.5354	2.741E+4	0.1596
8823.	0.5364	2.742E+4	0.1585
8838.	0.5353	2.744E+4	0.1597
8853.	0.5355	2.745E+4	0.158
8868.	0.5352	2.747E+4	0.1593
8883.	0.5337	2.748E+4	0.1581
8898.	0.5346	2.75E+4	0.1575
8913.	0.5339	2.751E+4	0.1578
8928.	0.5333	2.753E+4	0.1575
8943.	0.5333	2.754E+4	0.1557
8958.	0.5329	2.756E+4	0.1556
8973.	0.5329	2.757E+4	0.1562
8988.	0.5325	2.759E+4	0.1554
9003.	0.5329	2.76E+4	0.1561
9018.	0.5327	2.762E+4	0.1552
9033.	0.5323	2.763E+4	0.1546
9048.	0.5313	2.765E+4	0.1545
9063.	0.5297	2.766E+4	0.1533
9078.	0.5294	2.768E+4	0.1547
9093.	0.5296	2.769E+4	0.1543
9108.	0.5303	2.771E+4	0.1549
9123.	0.5294	2.772E+4	0.153
9138.	0.5295	2.774E+4	0.1532
9153.	0.5288	2.775E+4	0.153
9168.	0.5281	2.777E+4	0.1535
9183.	0.5282	2.778E+4	0.1521
9198.	0.5296	2.78E+4	0.1518
9213.	0.5271	2.781E+4	0.1519
9228.	0.5265	2.783E+4	0.151
9243.	0.527	2.784E+4	0.1509
9258.	0.5278	2.786E+4	0.15
9273.	0.526	2.787E+4	0.1502
9288.	0.5253	2.789E+4	0.1504
9303.	0.5254	2.79E+4	0.1518
9318.	0.5245	2.792E+4	0.15
9333.	0.5239	2.793E+4	0.1496
9348.	0.524	2.795E+4	0.1478
9363.	0.5237	2.796E+4	0.149
9378.	0.5241	2.798E+4	0.1489
9393.	0.5238	2.799E+4	0.1482
9408.	0.5225	2.801E+4	0.1489
9423.	0.5223	2.802E+4	0.1478
9438.	0.5223	2.804E+4	0.1484
9453.	0.5222	2.805E+4	0.1475
9468.	0.522	2.807E+4	0.1458
9483.	0.5223	2.808E+4	0.1466
9498.	0.5208	2.81E+4	0.1462
9513.	0.5225	2.811E+4	0.1456
9528.	0.5204	2.813E+4	0.1456
9543.	0.5211	2.814E+4	0.1469
9558.	0.52	2.816E+4	0.1446
9573.	0.5197	2.817E+4	0.1447
9588.	0.5197	2.819E+4	0.1449
9603.	0.5185	2.82E+4	0.1433
9618.	0.5174	2.822E+4	0.1448
9633.	0.5185	2.823E+4	0.1446
9648.	0.5174	2.825E+4	0.1429
9663.	0.5178	2.826E+4	0.1429
9678.	0.517	2.828E+4	0.1421
9693.	0.5166	2.829E+4	0.1416
9708.	0.5171	2.831E+4	0.1411
9723.	0.5162	2.832E+4	0.1426
9738.	0.5165	2.834E+4	0.142
9753.	0.5149	2.835E+4	0.1412

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
9768.	0.5153	2.837E+4	0.1408
9783.	0.5157	2.838E+4	0.1413
9798.	0.5145	2.84E+4	0.1409
9813.	0.514	2.841E+4	0.1405
9828.	0.5136	2.843E+4	0.1405
9843.	0.5147	2.844E+4	0.1388
9858.	0.5137	2.846E+4	0.1399
9873.	0.5143	2.847E+4	0.14
9888.	0.5123	2.849E+4	0.1393
9903.	0.5129	2.85E+4	0.1381
9918.	0.5123	2.852E+4	0.137
9933.	0.5117	2.853E+4	0.1383
9948.	0.5117	2.855E+4	0.1378
9963.	0.5128	2.856E+4	0.1379
9978.	0.5113	2.858E+4	0.1378
9993.	0.5109	2.859E+4	0.1365
1.001E+4	0.5116	2.861E+4	0.1372
1.002E+4	0.5102	2.862E+4	0.1364
1.004E+4	0.5103	2.864E+4	0.1361
1.005E+4	0.5106	2.865E+4	0.1349
1.007E+4	0.5099	2.867E+4	0.1353
1.008E+4	0.5089	2.868E+4	0.1343
1.01E+4	0.5097	2.87E+4	0.1353
1.011E+4	0.5085	2.871E+4	0.1354
1.013E+4	0.509	2.873E+4	0.1348
1.014E+4	0.5078	2.874E+4	0.1343
1.016E+4	0.5071	2.876E+4	0.1338
1.017E+4	0.5085	2.877E+4	0.1341
1.019E+4	0.5058	2.879E+4	0.1332
1.02E+4	0.5063	2.88E+4	0.1343
1.022E+4	0.5051	2.882E+4	0.1337
1.023E+4	0.5057	2.883E+4	0.133
1.025E+4	0.5063	2.885E+4	0.1322
1.026E+4	0.5046	2.886E+4	0.1323
1.028E+4	0.5049	2.888E+4	0.1313
1.029E+4	0.5051	2.889E+4	0.1318
1.031E+4	0.5043	2.891E+4	0.1323
1.032E+4	0.5029	2.892E+4	0.1314
1.034E+4	0.5036	2.894E+4	0.1314
1.035E+4	0.5037	2.895E+4	0.1303
1.037E+4	0.5031	2.897E+4	0.1307
1.038E+4	0.5036	2.898E+4	0.1305
1.04E+4	0.502	2.9E+4	0.1293
1.041E+4	0.5017	2.901E+4	0.1294
1.043E+4	0.5012	2.903E+4	0.1295
1.044E+4	0.5023	2.904E+4	0.1294
1.046E+4	0.502	2.906E+4	0.129
1.047E+4	0.5012	2.907E+4	0.1282
1.049E+4	0.501	2.909E+4	0.1277
1.05E+4	0.4993	2.91E+4	0.1277
1.052E+4	0.4994	2.912E+4	0.1286
1.053E+4	0.4984	2.913E+4	0.1279
1.055E+4	0.4999	2.915E+4	0.128
1.056E+4	0.4994	2.916E+4	0.1271
1.058E+4	0.4973	2.918E+4	0.1266
1.059E+4	0.4979	2.919E+4	0.1267
1.061E+4	0.4985	2.921E+4	0.126
1.062E+4	0.4974	2.922E+4	0.1266
1.064E+4	0.4975	2.924E+4	0.1256
1.065E+4	0.4973	2.925E+4	0.125
1.067E+4	0.4976	2.927E+4	0.1244
1.068E+4	0.4967	2.928E+4	0.1243
1.07E+4	0.4953	2.93E+4	0.1236
1.071E+4	0.4962	2.931E+4	0.1243
1.073E+4	0.4965	2.933E+4	0.124
1.074E+4	0.4954	2.934E+4	0.1234
1.076E+4	0.4956	2.936E+4	0.1239

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.077E+4	0.4955	2.937E+4	0.123
1.079E+4	0.494	2.939E+4	0.1234
1.08E+4	0.4944	2.94E+4	0.1225
1.082E+4	0.4934	2.942E+4	0.1219
1.083E+4	0.4939	2.943E+4	0.1233
1.085E+4	0.4925	2.945E+4	0.1214
1.086E+4	0.4929	2.946E+4	0.1212
1.088E+4	0.4921	2.948E+4	0.1214
1.089E+4	0.4925	2.949E+4	0.1204
1.091E+4	0.4918	2.951E+4	0.1204
1.092E+4	0.4911	2.952E+4	0.1203
1.094E+4	0.4915	2.954E+4	0.1198
1.095E+4	0.4909	2.955E+4	0.1206
1.097E+4	0.4904	2.957E+4	0.1198
1.098E+4	0.4896	2.958E+4	0.1189
1.1E+4	0.4893	2.96E+4	0.1194
1.101E+4	0.4891	2.961E+4	0.1182
1.103E+4	0.4888	2.963E+4	0.1185
1.104E+4	0.4886	2.964E+4	0.1178
1.106E+4	0.4884	2.966E+4	0.1174
1.107E+4	0.4891	2.967E+4	0.1158
1.109E+4	0.4883	2.969E+4	0.117
1.11E+4	0.4879	2.97E+4	0.117
1.112E+4	0.4879	2.972E+4	0.1167
1.113E+4	0.4872	2.973E+4	0.1162
1.115E+4	0.4871	2.975E+4	0.116
1.116E+4	0.4868	2.976E+4	0.1151
1.118E+4	0.486	2.978E+4	0.1148
1.119E+4	0.4849	2.979E+4	0.1145
1.121E+4	0.4858	2.981E+4	0.1147
1.122E+4	0.4848	2.982E+4	0.1142
1.124E+4	0.4853	2.984E+4	0.1135
1.125E+4	0.4846	2.985E+4	0.1136
1.127E+4	0.4831	2.987E+4	0.1132
1.128E+4	0.484	2.988E+4	0.1138
1.13E+4	0.4817	2.99E+4	0.1129
1.131E+4	0.4829	2.991E+4	0.1132
1.133E+4	0.4838	2.993E+4	0.1126
1.134E+4	0.482	2.994E+4	0.1113
1.136E+4	0.4826	2.996E+4	0.1114
1.137E+4	0.4829	2.997E+4	0.1108
1.139E+4	0.4827	2.999E+4	0.111
1.14E+4	0.4814	3.0E+4	0.1109
1.142E+4	0.4821	3.002E+4	0.1113
1.143E+4	0.4804	3.003E+4	0.1089
1.145E+4	0.4805	3.005E+4	0.1095
1.146E+4	0.4803	3.006E+4	0.1092
1.148E+4	0.4813	3.008E+4	0.1093
1.149E+4	0.48	3.009E+4	0.1088
1.151E+4	0.4806	3.011E+4	0.1094
1.152E+4	0.4804	3.012E+4	0.1088
1.154E+4	0.4795	3.014E+4	0.1079
1.155E+4	0.477	3.015E+4	0.1072
1.157E+4	0.4783	3.017E+4	0.1084
1.158E+4	0.4762	3.018E+4	0.1074
1.16E+4	0.4773	3.02E+4	0.1072
1.161E+4	0.4766	3.021E+4	0.107
1.163E+4	0.4778	3.023E+4	0.1065
1.164E+4	0.4757	3.024E+4	0.1065
1.166E+4	0.4769	3.026E+4	0.1061
1.167E+4	0.4754	3.027E+4	0.1063
1.169E+4	0.4756	3.029E+4	0.1049
1.17E+4	0.4754	3.03E+4	0.1055
1.172E+4	0.4765	3.032E+4	0.1036
1.173E+4	0.4746	3.033E+4	0.1041
1.175E+4	0.4735	3.035E+4	0.1039
1.176E+4	0.4741	3.036E+4	0.103

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.178E+4	0.4725	3.038E+4	0.104
1.179E+4	0.474	3.039E+4	0.1033
1.181E+4	0.4733	3.041E+4	0.1031
1.182E+4	0.472	3.042E+4	0.1022
1.184E+4	0.4728	3.044E+4	0.1018
1.185E+4	0.4722	3.045E+4	0.1013
1.187E+4	0.4718	3.047E+4	0.1006
1.188E+4	0.4703	3.048E+4	0.1005
1.19E+4	0.4721	3.05E+4	0.1004
1.191E+4	0.4699	3.051E+4	0.1001
1.193E+4	0.4714	3.053E+4	0.1004
1.194E+4	0.4704	3.054E+4	0.0998
1.196E+4	0.467	3.056E+4	0.1002
1.197E+4	0.4688	3.057E+4	0.1001
1.199E+4	0.4685	3.059E+4	0.0996
1.2E+4	0.4689	3.06E+4	0.0985
1.202E+4	0.4684	3.062E+4	0.098
1.203E+4	0.4685	3.063E+4	0.0978
1.205E+4	0.4677	3.065E+4	0.098
1.206E+4	0.4679	3.066E+4	0.0969
1.208E+4	0.4671	3.068E+4	0.0967
1.209E+4	0.4669	3.069E+4	0.0974
1.211E+4	0.466	3.071E+4	0.0971
1.212E+4	0.4663	3.072E+4	0.0968
1.214E+4	0.4653	3.074E+4	0.0954
1.215E+4	0.4664	3.075E+4	0.0962
1.217E+4	0.4657	3.077E+4	0.0949
1.218E+4	0.4655	3.078E+4	0.0949
1.22E+4	0.4651	3.08E+4	0.0949
1.221E+4	0.4644	3.081E+4	0.0943
1.223E+4	0.4637	3.083E+4	0.0949
1.224E+4	0.4633	3.084E+4	0.0942
1.226E+4	0.4642	3.086E+4	0.094
1.227E+4	0.4642	3.087E+4	0.0937
1.229E+4	0.4627	3.089E+4	0.0937
1.23E+4	0.4622	3.09E+4	0.0921
1.232E+4	0.4621	3.092E+4	0.0922
1.233E+4	0.4616	3.093E+4	0.0924
1.235E+4	0.463	3.095E+4	0.0911
1.236E+4	0.46	3.096E+4	0.0914
1.238E+4	0.4632	3.098E+4	0.0919
1.239E+4	0.4589	3.099E+4	0.0924
1.241E+4	0.4602	3.101E+4	0.0914
1.242E+4	0.4599	3.102E+4	0.0914
1.244E+4	0.459	3.104E+4	0.091
1.245E+4	0.4589	3.105E+4	0.0899
1.247E+4	0.4576	3.107E+4	0.09
1.248E+4	0.4576	3.108E+4	0.0902
1.25E+4	0.458	3.11E+4	0.0885
1.251E+4	0.4569	3.111E+4	0.0894
1.253E+4	0.458	3.113E+4	0.0894
1.254E+4	0.4562	3.114E+4	0.0882
1.256E+4	0.4571	3.116E+4	0.0881
1.257E+4	0.4565	3.117E+4	0.0879
1.259E+4	0.457	3.119E+4	0.0875
1.26E+4	0.4549	3.12E+4	0.0871
1.262E+4	0.4542	3.122E+4	0.0864
1.263E+4	0.4545	3.123E+4	0.0871
1.265E+4	0.4549	3.125E+4	0.0871
1.266E+4	0.454	3.126E+4	0.0866
1.268E+4	0.4548	3.128E+4	0.0863
1.269E+4	0.4542	3.129E+4	0.0845
1.271E+4	0.4539	3.131E+4	0.0848
1.272E+4	0.4547	3.132E+4	0.0854
1.274E+4	0.4529	3.134E+4	0.0848
1.275E+4	0.4527	3.135E+4	0.0842
1.277E+4	0.4516	3.137E+4	0.0839

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.278E+4	0.4507	3.138E+4	0.0834
1.28E+4	0.452	3.14E+4	0.0833
1.281E+4	0.4501	3.141E+4	0.0833
1.283E+4	0.45	3.143E+4	0.0823
1.284E+4	0.4499	3.144E+4	0.0824
1.286E+4	0.4516	3.146E+4	0.082
1.287E+4	0.451	3.147E+4	0.0824
1.289E+4	0.4506	3.149E+4	0.0817
1.29E+4	0.4502	3.15E+4	0.0814
1.292E+4	0.4494	3.152E+4	0.0805
1.293E+4	0.4503	3.153E+4	0.0812
1.295E+4	0.4484	3.155E+4	0.0803
1.296E+4	0.4477	3.156E+4	0.0803
1.298E+4	0.4481	3.158E+4	0.0806
1.299E+4	0.4475	3.159E+4	0.0795
1.301E+4	0.4461	3.161E+4	0.0792
1.302E+4	0.4475	3.162E+4	0.0784
1.304E+4	0.4472	3.164E+4	0.0795
1.305E+4	0.4458	3.165E+4	0.0783
1.307E+4	0.4467	3.167E+4	0.0776
1.308E+4	0.4458	3.168E+4	0.0772
1.31E+4	0.4459	3.17E+4	0.078
1.311E+4	0.4443	3.171E+4	0.0772
1.313E+4	0.4448	3.173E+4	0.0771
1.314E+4	0.444	3.174E+4	0.077
1.316E+4	0.4438	3.176E+4	0.077
1.317E+4	0.4439	3.177E+4	0.0763
1.319E+4	0.4431	3.179E+4	0.0759
1.32E+4	0.4423	3.18E+4	0.0762
1.322E+4	0.4434	3.182E+4	0.0744
1.323E+4	0.4425	3.183E+4	0.0752
1.325E+4	0.4428	3.185E+4	0.0751
1.326E+4	0.442	3.186E+4	0.0744
1.328E+4	0.4415	3.188E+4	0.0752
1.329E+4	0.4419	3.189E+4	0.0738
1.331E+4	0.4395	3.191E+4	0.0738
1.332E+4	0.4406	3.192E+4	0.0729
1.334E+4	0.441	3.194E+4	0.0728
1.335E+4	0.4392	3.195E+4	0.0732
1.337E+4	0.4403	3.197E+4	0.0725
1.338E+4	0.4395	3.198E+4	0.0722
1.34E+4	0.4383	3.2E+4	0.0721
1.341E+4	0.437	3.201E+4	0.072
1.343E+4	0.4383	3.203E+4	0.0725
1.344E+4	0.4371	3.204E+4	0.0715
1.346E+4	0.4376	3.206E+4	0.0705
1.347E+4	0.4374	3.207E+4	0.0707
1.349E+4	0.435	3.209E+4	0.0706
1.35E+4	0.4367	3.21E+4	0.0705
1.352E+4	0.4374	3.212E+4	0.0702
1.353E+4	0.4358	3.213E+4	0.0694
1.355E+4	0.436	3.215E+4	0.0691
1.356E+4	0.4337	3.216E+4	0.07
1.358E+4	0.4353	3.218E+4	0.0683
1.359E+4	0.4341	3.219E+4	0.0679
1.361E+4	0.4352	3.221E+4	0.0676
1.362E+4	0.4346	3.222E+4	0.0682
1.364E+4	0.4335	3.224E+4	0.0672
1.365E+4	0.4325	3.225E+4	0.0666
1.367E+4	0.4333	3.227E+4	0.0673
1.368E+4	0.4326	3.228E+4	0.0675
1.37E+4	0.4318	3.23E+4	0.067
1.371E+4	0.4318	3.231E+4	0.0673
1.373E+4	0.431	3.233E+4	0.065
1.374E+4	0.4305	3.234E+4	0.0662
1.376E+4	0.4301	3.236E+4	0.0658
1.377E+4	0.431	3.237E+4	0.0654

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.379E+4	0.4309	3.239E+4	0.0654
1.38E+4	0.4307	3.24E+4	0.0654
1.382E+4	0.4299	3.242E+4	0.0647
1.383E+4	0.4274	3.243E+4	0.0655
1.385E+4	0.4285	3.245E+4	0.0654
1.386E+4	0.4288	3.246E+4	0.0653
1.388E+4	0.4284	3.248E+4	0.0644
1.389E+4	0.4288	3.249E+4	0.0636
1.391E+4	0.4282	3.251E+4	0.0632
1.392E+4	0.4283	3.252E+4	0.0635
1.394E+4	0.4265	3.254E+4	0.0627
1.395E+4	0.4261	3.255E+4	0.0629
1.397E+4	0.4268	3.257E+4	0.0622
1.398E+4	0.4259	3.258E+4	0.0622
1.4E+4	0.4271	3.26E+4	0.063
1.401E+4	0.4253	3.261E+4	0.0619
1.403E+4	0.4258	3.263E+4	0.0619
1.404E+4	0.4256	3.264E+4	0.0616
1.406E+4	0.4244	3.266E+4	0.0608
1.407E+4	0.4246	3.267E+4	0.0604
1.409E+4	0.4237	3.269E+4	0.0611
1.41E+4	0.4243	3.27E+4	0.0609
1.412E+4	0.4239	3.272E+4	0.0599
1.413E+4	0.4239	3.273E+4	0.0599
1.415E+4	0.4232	3.275E+4	0.0589
1.416E+4	0.4234	3.276E+4	0.0591
1.418E+4	0.4233	3.278E+4	0.0591
1.419E+4	0.4226	3.279E+4	0.0591
1.421E+4	0.4225	3.281E+4	0.0586
1.422E+4	0.4219	3.282E+4	0.0582
1.424E+4	0.4212	3.284E+4	0.0582
1.425E+4	0.4214	3.285E+4	0.0572
1.427E+4	0.4216	3.287E+4	0.0578
1.428E+4	0.4215	3.288E+4	0.0574
1.43E+4	0.4209	3.29E+4	0.0571
1.431E+4	0.4204	3.291E+4	0.0563
1.433E+4	0.4202	3.293E+4	0.0562
1.434E+4	0.419	3.294E+4	0.0563
1.436E+4	0.4193	3.296E+4	0.0561
1.437E+4	0.4193	3.297E+4	0.0559
1.439E+4	0.4187	3.299E+4	0.0552
1.44E+4	0.4201	3.3E+4	0.0547
1.442E+4	0.4177	3.302E+4	0.0543
1.443E+4	0.4183	3.303E+4	0.0549
1.445E+4	0.4169	3.305E+4	0.0547
1.446E+4	0.4163	3.306E+4	0.0534
1.448E+4	0.4174	3.308E+4	0.0541
1.449E+4	0.4168	3.309E+4	0.0541
1.451E+4	0.4159	3.311E+4	0.0534
1.452E+4	0.417	3.312E+4	0.0534
1.454E+4	0.4157	3.314E+4	0.0521
1.455E+4	0.4156	3.315E+4	0.0518
1.457E+4	0.4153	3.317E+4	0.0525
1.458E+4	0.4135	3.318E+4	0.0516
1.46E+4	0.4137	3.32E+4	0.0513
1.461E+4	0.4151	3.321E+4	0.0517
1.463E+4	0.4133	3.323E+4	0.0522
1.464E+4	0.4131	3.324E+4	0.0514
1.466E+4	0.4134	3.326E+4	0.0503
1.467E+4	0.4142	3.327E+4	0.0495
1.469E+4	0.4132	3.329E+4	0.0493
1.47E+4	0.413	3.33E+4	0.0493
1.472E+4	0.4133	3.332E+4	0.0492
1.473E+4	0.4126	3.333E+4	0.0487
1.475E+4	0.4108	3.335E+4	0.0484
1.476E+4	0.4116	3.336E+4	0.0484
1.478E+4	0.4105	3.338E+4	0.0484

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.479E+4	0.4103	3.339E+4	0.0471
1.481E+4	0.4104	3.341E+4	0.0473
1.482E+4	0.4104	3.342E+4	0.047
1.484E+4	0.4103	3.344E+4	0.0469
1.485E+4	0.4102	3.345E+4	0.0462
1.487E+4	0.4092	3.347E+4	0.0466
1.488E+4	0.4089	3.348E+4	0.0467
1.49E+4	0.4086	3.35E+4	0.0459
1.491E+4	0.4088	3.351E+4	0.045
1.493E+4	0.4072	3.353E+4	0.0461
1.494E+4	0.4085	3.354E+4	0.0448
1.496E+4	0.4078	3.356E+4	0.0456
1.497E+4	0.407	3.357E+4	0.0444
1.499E+4	0.4069	3.359E+4	0.045
1.5E+4	0.4064	3.36E+4	0.0445
1.502E+4	0.4063	3.362E+4	0.0434
1.503E+4	0.4064	3.363E+4	0.0438
1.505E+4	0.4065	3.365E+4	0.0437
1.506E+4	0.405	3.366E+4	0.0431
1.508E+4	0.4053	3.368E+4	0.0425
1.509E+4	0.4045	3.369E+4	0.0426
1.511E+4	0.4047	3.371E+4	0.0409
1.512E+4	0.4028	3.372E+4	0.0414
1.514E+4	0.4034	3.374E+4	0.0423
1.515E+4	0.4038	3.375E+4	0.0415
1.517E+4	0.4027	3.377E+4	0.0407
1.518E+4	0.4037	3.378E+4	0.0405
1.52E+4	0.4036	3.38E+4	0.0417
1.521E+4	0.4019	3.381E+4	0.0404
1.523E+4	0.4011	3.383E+4	0.0407
1.524E+4	0.4012	3.384E+4	0.0391
1.526E+4	0.4025	3.386E+4	0.0401
1.527E+4	0.4011	3.387E+4	0.0391
1.529E+4	0.4011	3.389E+4	0.0398
1.53E+4	0.4013	3.39E+4	0.038
1.532E+4	0.4016	3.392E+4	0.0384
1.533E+4	0.4007	3.393E+4	0.0376
1.535E+4	0.3985	3.395E+4	0.037
1.536E+4	0.3993	3.396E+4	0.0369
1.538E+4	0.3993	3.398E+4	0.0372
1.539E+4	0.3998	3.399E+4	0.0376
1.541E+4	0.3986	3.401E+4	0.0362
1.542E+4	0.3988	3.402E+4	0.0367
1.544E+4	0.3981	3.404E+4	0.0357
1.545E+4	0.3983	3.405E+4	0.0356
1.547E+4	0.3976	3.407E+4	0.0364
1.548E+4	0.3983	3.408E+4	0.0354
1.55E+4	0.3968	3.41E+4	0.0354
1.551E+4	0.3971	3.411E+4	0.0353
1.553E+4	0.3953	3.413E+4	0.0348
1.554E+4	0.396	3.414E+4	0.0341
1.556E+4	0.3954	3.416E+4	0.0342
1.557E+4	0.3943	3.417E+4	0.0338
1.559E+4	0.395	3.419E+4	0.0335
1.56E+4	0.3954	3.42E+4	0.0326
1.562E+4	0.3937	3.422E+4	0.0327
1.563E+4	0.3941	3.423E+4	0.0326
1.565E+4	0.3938	3.425E+4	0.0314
1.566E+4	0.3936	3.426E+4	0.0322
1.568E+4	0.3937	3.428E+4	0.0316
1.569E+4	0.393	3.429E+4	0.0309
1.571E+4	0.3928	3.431E+4	0.0308
1.572E+4	0.3925	3.432E+4	0.0306
1.574E+4	0.3916	3.434E+4	0.0306
1.575E+4	0.3911	3.435E+4	0.0305
1.577E+4	0.3911	3.437E+4	0.0296
1.578E+4	0.3897	3.438E+4	0.0302

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.58E+4	0.3905	3.44E+4	0.0286
1.581E+4	0.3905	3.441E+4	0.0292
1.583E+4	0.3903	3.443E+4	0.0285
1.584E+4	0.3898	3.444E+4	0.029
1.586E+4	0.3902	3.446E+4	0.0283
1.587E+4	0.3883	3.447E+4	0.0281
1.589E+4	0.3896	3.449E+4	0.0273
1.59E+4	0.389	3.45E+4	0.0281
1.592E+4	0.3886	3.452E+4	0.0276
1.593E+4	0.3888	3.453E+4	0.0262
1.595E+4	0.3889	3.455E+4	0.0261
1.596E+4	0.3883	3.456E+4	0.0263
1.598E+4	0.3874	3.458E+4	0.0262
1.599E+4	0.387	3.459E+4	0.0264
1.601E+4	0.3873	3.461E+4	0.0258
1.602E+4	0.3853	3.462E+4	0.0254
1.604E+4	0.3848	3.464E+4	0.025
1.605E+4	0.3855	3.465E+4	0.0257
1.607E+4	0.3853	3.467E+4	0.0244
1.608E+4	0.3853	3.468E+4	0.0248
1.61E+4	0.3846	3.47E+4	0.0236
1.611E+4	0.385	3.471E+4	0.023
1.613E+4	0.3833	3.473E+4	0.0235
1.614E+4	0.3839	3.474E+4	0.0227
1.616E+4	0.3836	3.476E+4	0.0232
1.617E+4	0.3822	3.477E+4	0.0219
1.619E+4	0.3828	3.479E+4	0.0228
1.62E+4	0.3825	3.48E+4	0.0225
1.622E+4	0.3822	3.482E+4	0.0219
1.623E+4	0.3821	3.483E+4	0.0207
1.625E+4	0.3815	3.485E+4	0.0204
1.626E+4	0.3814	3.486E+4	0.022
1.628E+4	0.3813	3.488E+4	0.0213
1.629E+4	0.3815	3.489E+4	0.021
1.631E+4	0.3796	3.491E+4	0.0201
1.632E+4	0.3803	3.492E+4	0.0191
1.634E+4	0.3796	3.494E+4	0.0202
1.635E+4	0.3798	3.495E+4	0.0189
1.637E+4	0.38	3.497E+4	0.0189
1.638E+4	0.3788	3.498E+4	0.0196
1.64E+4	0.3794	3.5E+4	0.0195
1.641E+4	0.3793	3.501E+4	0.0191
1.643E+4	0.3771	3.503E+4	0.0183
1.644E+4	0.3773	3.504E+4	0.017
1.646E+4	0.3769	3.506E+4	0.0183
1.647E+4	0.3771	3.507E+4	0.0176
1.649E+4	0.3771	3.509E+4	0.0171
1.65E+4	0.3777	3.51E+4	0.0177
1.652E+4	0.3761	3.512E+4	0.0168
1.653E+4	0.3773	3.513E+4	0.0167
1.655E+4	0.3752	3.515E+4	0.0167
1.656E+4	0.3755	3.516E+4	0.0157
1.658E+4	0.3748	3.518E+4	0.0147
1.659E+4	0.3752	3.519E+4	0.0162
1.661E+4	0.3744	3.521E+4	0.0157
1.662E+4	0.3745	3.522E+4	0.0153
1.664E+4	0.3734	3.524E+4	0.0153
1.665E+4	0.3735	3.525E+4	0.014
1.667E+4	0.3731	3.527E+4	0.0143
1.668E+4	0.3733	3.528E+4	0.0134
1.67E+4	0.3731	3.53E+4	0.0143
1.671E+4	0.3727	3.531E+4	0.0145
1.673E+4	0.3736	3.533E+4	0.0129
1.674E+4	0.3714	3.534E+4	0.0123
1.676E+4	0.3713	3.536E+4	0.0125
1.677E+4	0.371	3.537E+4	0.0122
1.679E+4	0.371	3.539E+4	0.0113

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1.68E+4	0.3698	3.54E+4	0.0113
1.682E+4	0.3701	3.542E+4	0.0108
1.683E+4	0.3693	3.543E+4	0.0104
1.685E+4	0.3698	3.545E+4	0.0104

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Hvorslev
Log Factor: 0.228

VISUAL ESTIMATION RESULTS

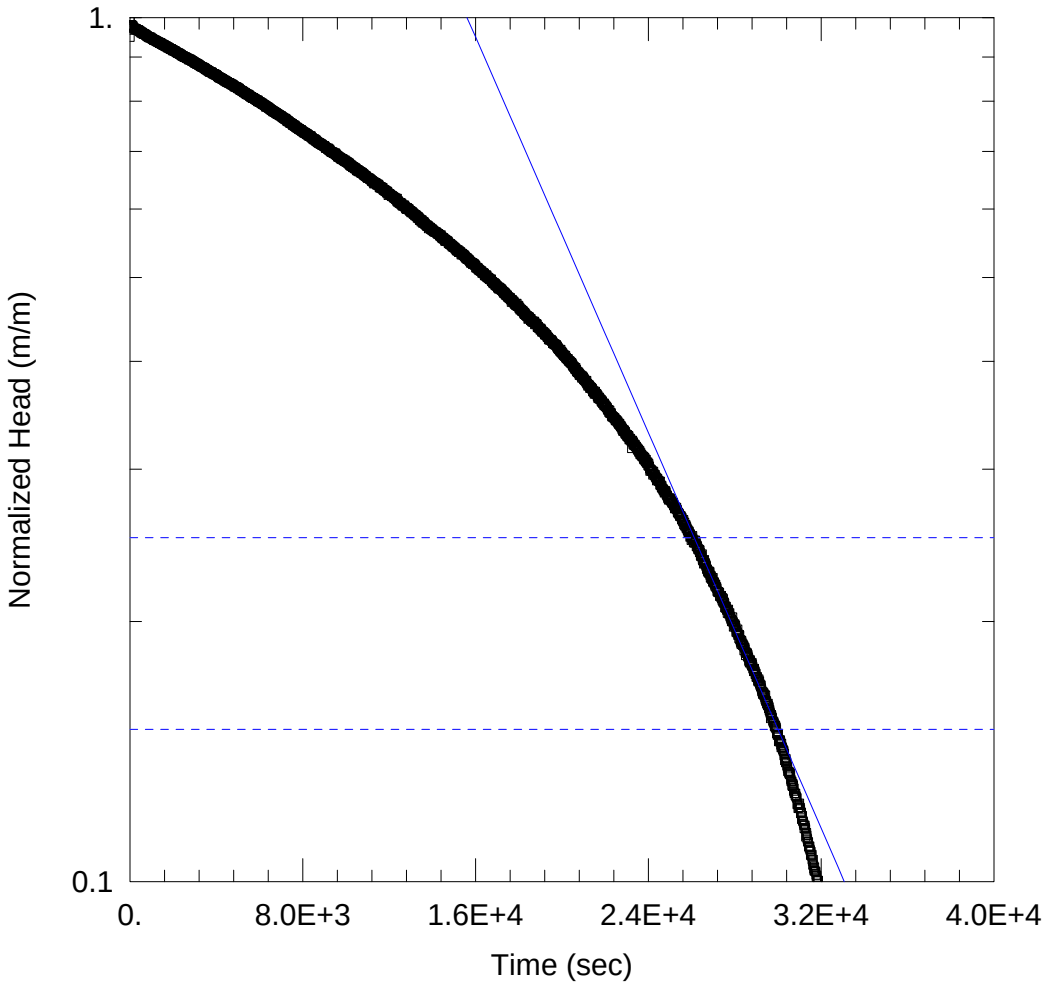
Estimated Parameters

Parameter	Estimate	
K	2.426E-8	m/sec
y0	5.866	m

K = 2.426E-6 cm/sec
T = K*b = 1.213E-6 m²/sec (0.01213 sq. cm/sec)

NOTES

Well may not be sufficiently developed due to a slow recovery.



MW-H31 (FALLING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H31
Test Date: 21 July 2013

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H31)

Initial Displacement: 0.75 m
Total Well Penetration Depth: 21.91 m
Casing Radius: 0.016 m
Static Water Column Height: 21.91 m
Screen Length: 3.05 m
Well Radius: 0.038 m

SOLUTION

Aquifer Model: Unconfined
K = 2.426E-8 m/sec
Solution Method: Hvorslev
y0 = 5.866 m

Data Set: N:\791 Canadian Dehua Int'l\791-002 Murray River Coal Project\Phase 03 - Baseline and EA 2011_2012\
Title: MW-H32 (Fallling Head Slug Test)
Date: 08/14/13
Time: 12:23:38

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Date: 22 July 2013
Test Well: MW-H32

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-H32

X Location: 0. m
Y Location: 0. m

Initial Displacement: 0.1 m
Static Water Column Height: 21.28 m
Casing Radius: 0.016 m
Well Radius: 0.038 m
Well Skin Radius: 1. m
Screen Length: 3.05 m
Total Well Penetration Depth: 21.28 m

No. of Observations: 1234

Observation Data

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
0.	0.1	9255.	0.0886
15.	0.0994	9270.	0.0882
30.	0.0998	9285.	0.0883
45.	0.1002	9300.	0.0883
60.	0.1003	9315.	0.0885
75.	0.1	9330.	0.0876
90.	0.1006	9345.	0.0878
105.	0.0999	9360.	0.0884
120.	0.1	9375.	0.0883
135.	0.1001	9390.	0.0879
150.	0.1005	9405.	0.088
165.	0.1004	9420.	0.088
180.	0.1001	9435.	0.0882
195.	0.1003	9450.	0.0882
210.	0.1003	9465.	0.0881
225.	0.0999	9480.	0.0869
240.	0.1004	9495.	0.0877
255.	0.1002	9510.	0.0874
270.	0.0995	9525.	0.0877
285.	0.1002	9540.	0.0875
300.	0.0998	9555.	0.0883
315.	0.0997	9570.	0.0882
330.	0.0997	9585.	0.0882
345.	0.1002	9600.	0.0883
360.	0.0997	9615.	0.0883
375.	0.1005	9630.	0.0876
390.	0.0996	9645.	0.0876
405.	0.0997	9660.	0.0885
420.	0.0998	9675.	0.0875
435.	0.0999	9690.	0.0888

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
450.	0.1001	9705.	0.0897
465.	0.0997	9720.	0.0872
480.	0.0996	9735.	0.0875
495.	0.0996	9750.	0.0885
510.	0.0992	9765.	0.0872
525.	0.0995	9780.	0.0876
540.	0.0986	9795.	0.0873
555.	0.0993	9810.	0.0878
570.	0.0996	9825.	0.0872
585.	0.0988	9840.	0.0878
600.	0.0994	9855.	0.0879
615.	0.099	9870.	0.0875
630.	0.0984	9885.	0.0884
645.	0.0988	9900.	0.0881
660.	0.0992	9915.	0.0876
675.	0.0986	9930.	0.0879
690.	0.0988	9945.	0.0877
705.	0.099	9960.	0.0879
720.	0.0991	9975.	0.0881
735.	0.099	9990.	0.0878
750.	0.0986	1.001E+4	0.0879
765.	0.0986	1.002E+4	0.0875
780.	0.0982	1.004E+4	0.0877
795.	0.0993	1.005E+4	0.088
810.	0.0994	1.007E+4	0.088
825.	0.0992	1.008E+4	0.0871
840.	0.099	1.01E+4	0.0877
855.	0.0987	1.011E+4	0.0874
870.	0.0987	1.013E+4	0.0865
885.	0.0989	1.014E+4	0.0872
900.	0.0985	1.016E+4	0.0876
915.	0.0985	1.017E+4	0.0884
930.	0.0989	1.019E+4	0.0883
945.	0.0987	1.02E+4	0.0881
960.	0.0987	1.022E+4	0.0879
975.	0.0989	1.023E+4	0.0887
990.	0.0988	1.025E+4	0.0877
1005.	0.0983	1.026E+4	0.0881
1020.	0.0984	1.028E+4	0.0878
1035.	0.0987	1.029E+4	0.088
1050.	0.0984	1.031E+4	0.0877
1065.	0.099	1.032E+4	0.0884
1080.	0.0989	1.034E+4	0.0882
1095.	0.0982	1.035E+4	0.0882
1110.	0.0981	1.037E+4	0.0881
1125.	0.0978	1.038E+4	0.0882
1140.	0.0978	1.04E+4	0.0881
1155.	0.0975	1.041E+4	0.0878
1170.	0.0977	1.043E+4	0.088
1185.	0.0985	1.044E+4	0.0874
1200.	0.0981	1.046E+4	0.0875
1215.	0.0971	1.047E+4	0.0879
1230.	0.0969	1.049E+4	0.0881
1245.	0.0974	1.05E+4	0.0881
1260.	0.0969	1.052E+4	0.0878
1275.	0.0967	1.053E+4	0.088
1290.	0.0969	1.055E+4	0.0883
1305.	0.0972	1.056E+4	0.0874
1320.	0.0969	1.058E+4	0.0879
1335.	0.0964	1.059E+4	0.0875
1350.	0.0969	1.061E+4	0.0874
1365.	0.0969	1.062E+4	0.0874
1380.	0.097	1.064E+4	0.088
1395.	0.0976	1.065E+4	0.088
1410.	0.0974	1.067E+4	0.0873
1425.	0.0977	1.068E+4	0.0878
1440.	0.0968	1.07E+4	0.0877

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
1455.	0.0969	1.071E+4	0.0878
1470.	0.0976	1.073E+4	0.0878
1485.	0.0975	1.074E+4	0.0877
1500.	0.0973	1.076E+4	0.0879
1515.	0.0974	1.077E+4	0.0879
1530.	0.0968	1.079E+4	0.0873
1545.	0.0953	1.08E+4	0.087
1560.	0.097	1.082E+4	0.0877
1575.	0.0963	1.083E+4	0.0877
1590.	0.0963	1.085E+4	0.0877
1605.	0.0972	1.086E+4	0.0875
1620.	0.0971	1.088E+4	0.0874
1635.	0.0967	1.089E+4	0.0873
1650.	0.0958	1.091E+4	0.0867
1665.	0.0961	1.092E+4	0.0873
1680.	0.0963	1.094E+4	0.0874
1695.	0.096	1.095E+4	0.0872
1710.	0.0969	1.097E+4	0.0873
1725.	0.0964	1.098E+4	0.0874
1740.	0.0974	1.1E+4	0.0872
1755.	0.0935	1.101E+4	0.0878
1770.	0.0964	1.103E+4	0.0874
1785.	0.0962	1.104E+4	0.0872
1800.	0.0958	1.106E+4	0.0867
1815.	0.0971	1.107E+4	0.0878
1830.	0.0949	1.109E+4	0.0875
1845.	0.0967	1.11E+4	0.0875
1860.	0.0966	1.112E+4	0.0874
1875.	0.097	1.113E+4	0.0882
1890.	0.0966	1.115E+4	0.0866
1905.	0.0959	1.116E+4	0.0876
1920.	0.0966	1.118E+4	0.0881
1935.	0.0967	1.119E+4	0.0876
1950.	0.0965	1.121E+4	0.0877
1965.	0.0963	1.122E+4	0.0876
1980.	0.0963	1.124E+4	0.0873
1995.	0.0956	1.125E+4	0.0875
2010.	0.0938	1.127E+4	0.0871
2025.	0.096	1.128E+4	0.0876
2040.	0.0967	1.13E+4	0.088
2055.	0.0953	1.131E+4	0.0877
2070.	0.0945	1.133E+4	0.0874
2085.	0.0955	1.134E+4	0.0875
2100.	0.0959	1.136E+4	0.0878
2115.	0.0958	1.137E+4	0.0874
2130.	0.0955	1.139E+4	0.0887
2145.	0.0951	1.14E+4	0.0881
2160.	0.0953	1.142E+4	0.0878
2175.	0.0958	1.143E+4	0.0878
2190.	0.0958	1.145E+4	0.0886
2205.	0.0959	1.146E+4	0.0886
2220.	0.0953	1.148E+4	0.0885
2235.	0.0964	1.149E+4	0.0882
2250.	0.0961	1.151E+4	0.0886
2265.	0.0968	1.152E+4	0.088
2280.	0.0952	1.154E+4	0.0876
2295.	0.0957	1.155E+4	0.0882
2310.	0.096	1.157E+4	0.0881
2325.	0.0965	1.158E+4	0.088
2340.	0.0959	1.16E+4	0.0877
2355.	0.0957	1.161E+4	0.0879
2370.	0.0957	1.163E+4	0.0877
2385.	0.096	1.164E+4	0.0877
2400.	0.0965	1.166E+4	0.0879
2415.	0.0962	1.167E+4	0.0877
2430.	0.0963	1.169E+4	0.0881
2445.	0.0966	1.17E+4	0.0882

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
2460.	0.0962	1.172E+4	0.0883
2475.	0.0964	1.173E+4	0.0879
2490.	0.097	1.175E+4	0.0884
2505.	0.0968	1.176E+4	0.0883
2520.	0.0963	1.178E+4	0.0878
2535.	0.097	1.179E+4	0.0876
2550.	0.0963	1.181E+4	0.0877
2565.	0.0969	1.182E+4	0.088
2580.	0.0961	1.184E+4	0.0875
2595.	0.0963	1.185E+4	0.0878
2610.	0.0962	1.187E+4	0.0868
2625.	0.0956	1.188E+4	0.0877
2640.	0.0959	1.19E+4	0.0868
2655.	0.0958	1.191E+4	0.0872
2670.	0.0958	1.193E+4	0.0877
2685.	0.0964	1.194E+4	0.087
2700.	0.0961	1.196E+4	0.0866
2715.	0.0959	1.197E+4	0.0872
2730.	0.0956	1.199E+4	0.0859
2745.	0.0962	1.2E+4	0.0869
2760.	0.0957	1.202E+4	0.0872
2775.	0.0957	1.203E+4	0.0872
2790.	0.0959	1.205E+4	0.0871
2805.	0.0958	1.206E+4	0.0871
2820.	0.0959	1.208E+4	0.087
2835.	0.0964	1.209E+4	0.0875
2850.	0.096	1.211E+4	0.0876
2865.	0.0953	1.212E+4	0.0874
2880.	0.095	1.214E+4	0.0873
2895.	0.0949	1.215E+4	0.0871
2910.	0.0957	1.217E+4	0.0873
2925.	0.0948	1.218E+4	0.0873
2940.	0.0955	1.22E+4	0.0873
2955.	0.0954	1.221E+4	0.0872
2970.	0.0958	1.223E+4	0.0868
2985.	0.0959	1.224E+4	0.0871
3000.	0.0952	1.226E+4	0.0868
3015.	0.0958	1.227E+4	0.0871
3030.	0.0961	1.229E+4	0.0874
3045.	0.0965	1.23E+4	0.0867
3060.	0.0963	1.232E+4	0.0864
3075.	0.0966	1.233E+4	0.0871
3090.	0.0969	1.235E+4	0.0865
3105.	0.0957	1.236E+4	0.0871
3120.	0.0963	1.238E+4	0.0872
3135.	0.0959	1.239E+4	0.0866
3150.	0.0963	1.241E+4	0.0864
3165.	0.0959	1.242E+4	0.0868
3180.	0.0963	1.244E+4	0.0864
3195.	0.0962	1.245E+4	0.0865
3210.	0.0964	1.247E+4	0.0865
3225.	0.0959	1.248E+4	0.0868
3240.	0.0952	1.25E+4	0.0868
3255.	0.0951	1.251E+4	0.0865
3270.	0.0959	1.253E+4	0.0868
3285.	0.0959	1.254E+4	0.0865
3300.	0.0954	1.256E+4	0.0864
3315.	0.0956	1.257E+4	0.0865
3330.	0.0951	1.259E+4	0.0863
3345.	0.0952	1.26E+4	0.0862
3360.	0.095	1.262E+4	0.0866
3375.	0.0951	1.263E+4	0.0867
3390.	0.0955	1.265E+4	0.0867
3405.	0.0955	1.266E+4	0.0862
3420.	0.0958	1.268E+4	0.0868
3435.	0.0954	1.269E+4	0.0866
3450.	0.0954	1.271E+4	0.0866

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
3465.	0.0956	1.272E+4	0.0865
3480.	0.0952	1.274E+4	0.0869
3495.	0.095	1.275E+4	0.0865
3510.	0.0954	1.277E+4	0.0871
3525.	0.0952	1.278E+4	0.087
3540.	0.095	1.28E+4	0.0872
3555.	0.0954	1.281E+4	0.0855
3570.	0.0952	1.283E+4	0.0873
3585.	0.0956	1.284E+4	0.0863
3600.	0.0953	1.286E+4	0.0873
3615.	0.0958	1.287E+4	0.0873
3630.	0.0955	1.289E+4	0.0874
3645.	0.0958	1.29E+4	0.087
3660.	0.0948	1.292E+4	0.0874
3675.	0.095	1.293E+4	0.0866
3690.	0.0948	1.295E+4	0.087
3705.	0.0946	1.296E+4	0.0872
3720.	0.0948	1.298E+4	0.0878
3735.	0.0942	1.299E+4	0.0877
3750.	0.0949	1.301E+4	0.0871
3765.	0.0956	1.302E+4	0.0871
3780.	0.0949	1.304E+4	0.0866
3795.	0.0956	1.305E+4	0.0869
3810.	0.0951	1.307E+4	0.0868
3825.	0.095	1.308E+4	0.0866
3840.	0.0953	1.31E+4	0.0866
3855.	0.095	1.311E+4	0.0871
3870.	0.0947	1.313E+4	0.0874
3885.	0.0942	1.314E+4	0.0869
3900.	0.0944	1.316E+4	0.0868
3915.	0.0951	1.317E+4	0.0874
3930.	0.0943	1.319E+4	0.0867
3945.	0.0949	1.32E+4	0.0868
3960.	0.0941	1.322E+4	0.087
3975.	0.0945	1.323E+4	0.0868
3990.	0.0947	1.325E+4	0.0865
4005.	0.0944	1.326E+4	0.0872
4020.	0.0935	1.328E+4	0.0866
4035.	0.0941	1.329E+4	0.087
4050.	0.0936	1.331E+4	0.087
4065.	0.0944	1.332E+4	0.0867
4080.	0.0943	1.334E+4	0.0868
4095.	0.0943	1.335E+4	0.0865
4110.	0.0936	1.337E+4	0.0869
4125.	0.094	1.338E+4	0.0871
4140.	0.0937	1.34E+4	0.0872
4155.	0.0931	1.341E+4	0.0866
4170.	0.0937	1.343E+4	0.0874
4185.	0.0938	1.344E+4	0.0874
4200.	0.0938	1.346E+4	0.0872
4215.	0.0942	1.347E+4	0.0875
4230.	0.0935	1.349E+4	0.0866
4245.	0.0945	1.35E+4	0.0866
4260.	0.0941	1.352E+4	0.0879
4275.	0.0941	1.353E+4	0.0873
4290.	0.0941	1.355E+4	0.0875
4305.	0.0947	1.356E+4	0.0877
4320.	0.0943	1.358E+4	0.087
4335.	0.0947	1.359E+4	0.0872
4350.	0.0942	1.361E+4	0.087
4365.	0.0944	1.362E+4	0.0876
4380.	0.0937	1.364E+4	0.0875
4395.	0.0947	1.365E+4	0.0874
4410.	0.0946	1.367E+4	0.0873
4425.	0.0943	1.368E+4	0.0873
4440.	0.0941	1.37E+4	0.0873
4455.	0.0943	1.371E+4	0.0872

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
4470.	0.094	1.373E+4	0.0876
4485.	0.0939	1.374E+4	0.0869
4500.	0.0937	1.376E+4	0.0862
4515.	0.0942	1.377E+4	0.0865
4530.	0.0938	1.379E+4	0.0872
4545.	0.0937	1.38E+4	0.0872
4560.	0.0936	1.382E+4	0.0876
4575.	0.0935	1.383E+4	0.0878
4590.	0.0941	1.385E+4	0.0873
4605.	0.0939	1.386E+4	0.0878
4620.	0.0941	1.388E+4	0.0879
4635.	0.094	1.389E+4	0.0878
4650.	0.0938	1.391E+4	0.0873
4665.	0.0938	1.392E+4	0.0879
4680.	0.0932	1.394E+4	0.0875
4695.	0.0935	1.395E+4	0.0877
4710.	0.0938	1.397E+4	0.0883
4725.	0.0938	1.398E+4	0.0873
4740.	0.0931	1.4E+4	0.0877
4755.	0.0929	1.401E+4	0.087
4770.	0.0935	1.403E+4	0.0873
4785.	0.0934	1.404E+4	0.087
4800.	0.093	1.406E+4	0.0875
4815.	0.0933	1.407E+4	0.0875
4830.	0.0941	1.409E+4	0.0879
4845.	0.0936	1.41E+4	0.0877
4860.	0.0937	1.412E+4	0.0878
4875.	0.0937	1.413E+4	0.0872
4890.	0.0938	1.415E+4	0.0876
4905.	0.0935	1.416E+4	0.0873
4920.	0.0931	1.418E+4	0.0874
4935.	0.0935	1.419E+4	0.0874
4950.	0.0933	1.421E+4	0.0877
4965.	0.093	1.422E+4	0.0877
4980.	0.0922	1.424E+4	0.0874
4995.	0.0928	1.425E+4	0.0872
5010.	0.0925	1.427E+4	0.0877
5025.	0.0928	1.428E+4	0.0875
5040.	0.0931	1.43E+4	0.0866
5055.	0.0926	1.431E+4	0.0873
5070.	0.0928	1.433E+4	0.0873
5085.	0.0926	1.434E+4	0.0873
5100.	0.0924	1.436E+4	0.0876
5115.	0.0932	1.437E+4	0.0874
5130.	0.092	1.439E+4	0.0872
5145.	0.0925	1.44E+4	0.0879
5160.	0.0933	1.442E+4	0.0871
5175.	0.093	1.443E+4	0.0865
5190.	0.093	1.445E+4	0.0872
5205.	0.0927	1.446E+4	0.0862
5220.	0.0925	1.448E+4	0.087
5235.	0.0925	1.449E+4	0.0869
5250.	0.0925	1.451E+4	0.087
5265.	0.0927	1.452E+4	0.0869
5280.	0.0929	1.454E+4	0.0868
5295.	0.093	1.455E+4	0.0869
5310.	0.0919	1.457E+4	0.087
5325.	0.0927	1.458E+4	0.0866
5340.	0.0922	1.46E+4	0.0872
5355.	0.092	1.461E+4	0.0865
5370.	0.0929	1.463E+4	0.0864
5385.	0.0926	1.464E+4	0.0868
5400.	0.0922	1.466E+4	0.0871
5415.	0.0926	1.467E+4	0.0865
5430.	0.0922	1.469E+4	0.0868
5445.	0.0929	1.47E+4	0.087
5460.	0.0919	1.472E+4	0.0872

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
5475.	0.0928	1.473E+4	0.0864
5490.	0.092	1.475E+4	0.0869
5505.	0.0926	1.476E+4	0.0872
5520.	0.0924	1.478E+4	0.086
5535.	0.092	1.479E+4	0.0868
5550.	0.092	1.481E+4	0.087
5565.	0.0919	1.482E+4	0.087
5580.	0.0923	1.484E+4	0.0865
5595.	0.0919	1.485E+4	0.0874
5610.	0.0924	1.487E+4	0.0873
5625.	0.0918	1.488E+4	0.0875
5640.	0.0917	1.49E+4	0.0875
5655.	0.0914	1.491E+4	0.0876
5670.	0.0917	1.493E+4	0.0871
5685.	0.0923	1.494E+4	0.0876
5700.	0.0923	1.496E+4	0.0881
5715.	0.0911	1.497E+4	0.0876
5730.	0.091	1.499E+4	0.088
5745.	0.0916	1.5E+4	0.0877
5760.	0.092	1.502E+4	0.0877
5775.	0.0919	1.503E+4	0.0871
5790.	0.0914	1.505E+4	0.0873
5805.	0.091	1.506E+4	0.0876
5820.	0.0916	1.508E+4	0.0876
5835.	0.0914	1.509E+4	0.0872
5850.	0.0921	1.511E+4	0.087
5865.	0.0913	1.512E+4	0.0876
5880.	0.0913	1.514E+4	0.0862
5895.	0.0908	1.515E+4	0.087
5910.	0.0901	1.517E+4	0.0877
5925.	0.091	1.518E+4	0.0873
5940.	0.0918	1.52E+4	0.0879
5955.	0.0909	1.521E+4	0.0874
5970.	0.0909	1.523E+4	0.0861
5985.	0.0904	1.524E+4	0.0864
6000.	0.0916	1.526E+4	0.0867
6015.	0.0903	1.527E+4	0.0863
6030.	0.0908	1.529E+4	0.0869
6045.	0.0909	1.53E+4	0.087
6060.	0.0907	1.532E+4	0.0871
6075.	0.0902	1.533E+4	0.0871
6090.	0.0909	1.535E+4	0.0868
6105.	0.0913	1.536E+4	0.0865
6120.	0.0911	1.538E+4	0.0867
6135.	0.0908	1.539E+4	0.086
6150.	0.0915	1.541E+4	0.0869
6165.	0.091	1.542E+4	0.0862
6180.	0.0908	1.544E+4	0.0863
6195.	0.0906	1.545E+4	0.0867
6210.	0.0912	1.547E+4	0.0868
6225.	0.0911	1.548E+4	0.0865
6240.	0.0916	1.55E+4	0.0867
6255.	0.091	1.551E+4	0.0864
6270.	0.0906	1.553E+4	0.0864
6285.	0.0908	1.554E+4	0.0866
6300.	0.0911	1.556E+4	0.0867
6315.	0.0912	1.557E+4	0.0865
6330.	0.0901	1.559E+4	0.0867
6345.	0.0905	1.56E+4	0.0863
6360.	0.0912	1.562E+4	0.0856
6375.	0.0908	1.563E+4	0.0864
6390.	0.091	1.565E+4	0.0866
6405.	0.0905	1.566E+4	0.0867
6420.	0.091	1.568E+4	0.0862
6435.	0.0909	1.569E+4	0.0869
6450.	0.0914	1.571E+4	0.0864
6465.	0.0913	1.572E+4	0.0864

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
6480.	0.0906	1.574E+4	0.0854
6495.	0.0917	1.575E+4	0.0861
6510.	0.0898	1.577E+4	0.0862
6525.	0.0908	1.578E+4	0.0862
6540.	0.0904	1.58E+4	0.0868
6555.	0.0904	1.581E+4	0.0862
6570.	0.0902	1.583E+4	0.0867
6585.	0.0898	1.584E+4	0.0861
6600.	0.0902	1.586E+4	0.0859
6615.	0.0906	1.587E+4	0.0865
6630.	0.0907	1.589E+4	0.0864
6645.	0.0906	1.59E+4	0.0861
6660.	0.0901	1.592E+4	0.086
6675.	0.0902	1.593E+4	0.0861
6690.	0.0912	1.595E+4	0.0862
6705.	0.0893	1.596E+4	0.0863
6720.	0.0899	1.598E+4	0.0863
6735.	0.0897	1.599E+4	0.0863
6750.	0.0892	1.601E+4	0.0863
6765.	0.0876	1.602E+4	0.086
6780.	0.0903	1.604E+4	0.0857
6795.	0.0905	1.605E+4	0.0856
6810.	0.091	1.607E+4	0.0859
6825.	0.091	1.608E+4	0.086
6840.	0.0906	1.61E+4	0.0862
6855.	0.0912	1.611E+4	0.086
6870.	0.0912	1.613E+4	0.0858
6885.	0.0908	1.614E+4	0.0862
6900.	0.0909	1.616E+4	0.0861
6915.	0.0909	1.617E+4	0.0862
6930.	0.091	1.619E+4	0.0861
6945.	0.0909	1.62E+4	0.0856
6960.	0.0909	1.622E+4	0.0868
6975.	0.0908	1.623E+4	0.0862
6990.	0.0909	1.625E+4	0.0855
7005.	0.0901	1.626E+4	0.0863
7020.	0.091	1.628E+4	0.0864
7035.	0.0914	1.629E+4	0.086
7050.	0.0913	1.631E+4	0.086
7065.	0.0903	1.632E+4	0.0856
7080.	0.0908	1.634E+4	0.0861
7095.	0.0908	1.635E+4	0.0854
7110.	0.0914	1.637E+4	0.0861
7125.	0.0919	1.638E+4	0.0857
7140.	0.0911	1.64E+4	0.0861
7155.	0.0902	1.641E+4	0.0858
7170.	0.0908	1.643E+4	0.0855
7185.	0.091	1.644E+4	0.0856
7200.	0.0912	1.646E+4	0.0855
7215.	0.091	1.647E+4	0.0858
7230.	0.0909	1.649E+4	0.0855
7245.	0.0909	1.65E+4	0.0849
7260.	0.0909	1.652E+4	0.0853
7275.	0.0906	1.653E+4	0.0854
7290.	0.0908	1.655E+4	0.0855
7305.	0.0911	1.656E+4	0.085
7320.	0.0912	1.658E+4	0.0855
7335.	0.0916	1.659E+4	0.0851
7350.	0.0913	1.661E+4	0.0853
7365.	0.0911	1.662E+4	0.0853
7380.	0.0903	1.664E+4	0.085
7395.	0.0907	1.665E+4	0.0849
7410.	0.0906	1.667E+4	0.0846
7425.	0.0904	1.668E+4	0.0853
7440.	0.0893	1.67E+4	0.0844
7455.	0.0902	1.671E+4	0.0845
7470.	0.0896	1.673E+4	0.085

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
7485.	0.0898	1.674E+4	0.0846
7500.	0.0898	1.676E+4	0.0857
7515.	0.0899	1.677E+4	0.0855
7530.	0.0897	1.679E+4	0.0858
7545.	0.0891	1.68E+4	0.0857
7560.	0.0898	1.682E+4	0.0853
7575.	0.0905	1.683E+4	0.0854
7590.	0.0896	1.685E+4	0.0853
7605.	0.0897	1.686E+4	0.0852
7620.	0.0895	1.688E+4	0.0848
7635.	0.0899	1.689E+4	0.0851
7650.	0.0894	1.691E+4	0.0855
7665.	0.0895	1.692E+4	0.0852
7680.	0.0899	1.694E+4	0.0846
7695.	0.0895	1.695E+4	0.0851
7710.	0.0897	1.697E+4	0.0856
7725.	0.0885	1.698E+4	0.0857
7740.	0.0891	1.7E+4	0.0852
7755.	0.0901	1.701E+4	0.0854
7770.	0.0894	1.703E+4	0.0857
7785.	0.0898	1.704E+4	0.085
7800.	0.0897	1.706E+4	0.0857
7815.	0.0892	1.707E+4	0.086
7830.	0.0894	1.709E+4	0.0855
7845.	0.0894	1.71E+4	0.0854
7860.	0.0894	1.712E+4	0.0853
7875.	0.0901	1.713E+4	0.0852
7890.	0.0896	1.715E+4	0.0854
7905.	0.0897	1.716E+4	0.0852
7920.	0.0893	1.718E+4	0.0857
7935.	0.0892	1.719E+4	0.0858
7950.	0.0891	1.721E+4	0.0858
7965.	0.0881	1.722E+4	0.0852
7980.	0.0877	1.724E+4	0.0853
7995.	0.0885	1.725E+4	0.0857
8010.	0.0881	1.727E+4	0.0854
8025.	0.0889	1.728E+4	0.0857
8040.	0.089	1.73E+4	0.0852
8055.	0.0882	1.731E+4	0.0853
8070.	0.089	1.733E+4	0.0854
8085.	0.0888	1.734E+4	0.085
8100.	0.089	1.736E+4	0.0855
8115.	0.0889	1.737E+4	0.0853
8130.	0.088	1.739E+4	0.0855
8145.	0.0886	1.74E+4	0.0854
8160.	0.0888	1.742E+4	0.0851
8175.	0.0893	1.743E+4	0.0856
8190.	0.0888	1.745E+4	0.0852
8205.	0.0891	1.746E+4	0.0852
8220.	0.0893	1.748E+4	0.0855
8235.	0.0895	1.749E+4	0.0858
8250.	0.0883	1.751E+4	0.0857
8265.	0.0889	1.752E+4	0.0856
8280.	0.0888	1.754E+4	0.0859
8295.	0.089	1.755E+4	0.0857
8310.	0.0891	1.757E+4	0.0861
8325.	0.0883	1.758E+4	0.0857
8340.	0.0894	1.76E+4	0.0853
8355.	0.0894	1.761E+4	0.0857
8370.	0.0887	1.763E+4	0.0853
8385.	0.0881	1.764E+4	0.0859
8400.	0.0889	1.766E+4	0.0857
8415.	0.0888	1.767E+4	0.0856
8430.	0.0884	1.769E+4	0.0859
8445.	0.0885	1.77E+4	0.0859
8460.	0.0884	1.772E+4	0.0854
8475.	0.0886	1.773E+4	0.0853

Time (sec)	Displacement (m)	Time (sec)	Displacement (m)
8490.	0.0875	1.775E+4	0.0856
8505.	0.0879	1.776E+4	0.0863
8520.	0.0878	1.778E+4	0.0856
8535.	0.0884	1.779E+4	0.0859
8550.	0.088	1.781E+4	0.0852
8565.	0.0878	1.782E+4	0.0861
8580.	0.088	1.784E+4	0.0858
8595.	0.0878	1.785E+4	0.0855
8610.	0.0888	1.787E+4	0.0854
8625.	0.0886	1.788E+4	0.0858
8640.	0.088	1.79E+4	0.0861
8655.	0.0882	1.791E+4	0.0856
8670.	0.0883	1.793E+4	0.0858
8685.	0.0883	1.794E+4	0.0857
8700.	0.0891	1.796E+4	0.0855
8715.	0.0891	1.797E+4	0.0854
8730.	0.0896	1.799E+4	0.0855
8745.	0.0893	1.8E+4	0.0857
8760.	0.0884	1.802E+4	0.0856
8775.	0.0883	1.803E+4	0.0855
8790.	0.0892	1.805E+4	0.0852
8805.	0.0885	1.806E+4	0.0858
8820.	0.0882	1.808E+4	0.0856
8835.	0.0889	1.809E+4	0.0854
8850.	0.088	1.811E+4	0.0852
8865.	0.088	1.812E+4	0.0858
8880.	0.0896	1.814E+4	0.0852
8895.	0.0882	1.815E+4	0.0854
8910.	0.0889	1.817E+4	0.0856
8925.	0.0884	1.818E+4	0.0854
8940.	0.0883	1.82E+4	0.0853
8955.	0.0885	1.821E+4	0.0853
8970.	0.0884	1.823E+4	0.0855
8985.	0.0884	1.824E+4	0.0857
9000.	0.0879	1.826E+4	0.0858
9015.	0.0877	1.827E+4	0.0855
9030.	0.0878	1.829E+4	0.0858
9045.	0.0881	1.83E+4	0.0858
9060.	0.0884	1.832E+4	0.0854
9075.	0.0885	1.833E+4	0.0849
9090.	0.0884	1.835E+4	0.0862
9105.	0.0883	1.836E+4	0.0858
9120.	0.0886	1.838E+4	0.0856
9135.	0.0876	1.839E+4	0.0859
9150.	0.0884	1.841E+4	0.0857
9165.	0.0882	1.842E+4	0.0861
9180.	0.0878	1.844E+4	0.0862
9195.	0.088	1.845E+4	0.0855
9210.	0.0881	1.847E+4	0.086
9225.	0.0881	1.848E+4	0.0851
9240.	0.0882	1.85E+4	0.0854

SOLUTION

Slug Test
Aquifer Model: Confined
Solution Method: Hvorslev
Log Factor: 0.228

VISUAL ESTIMATION RESULTS

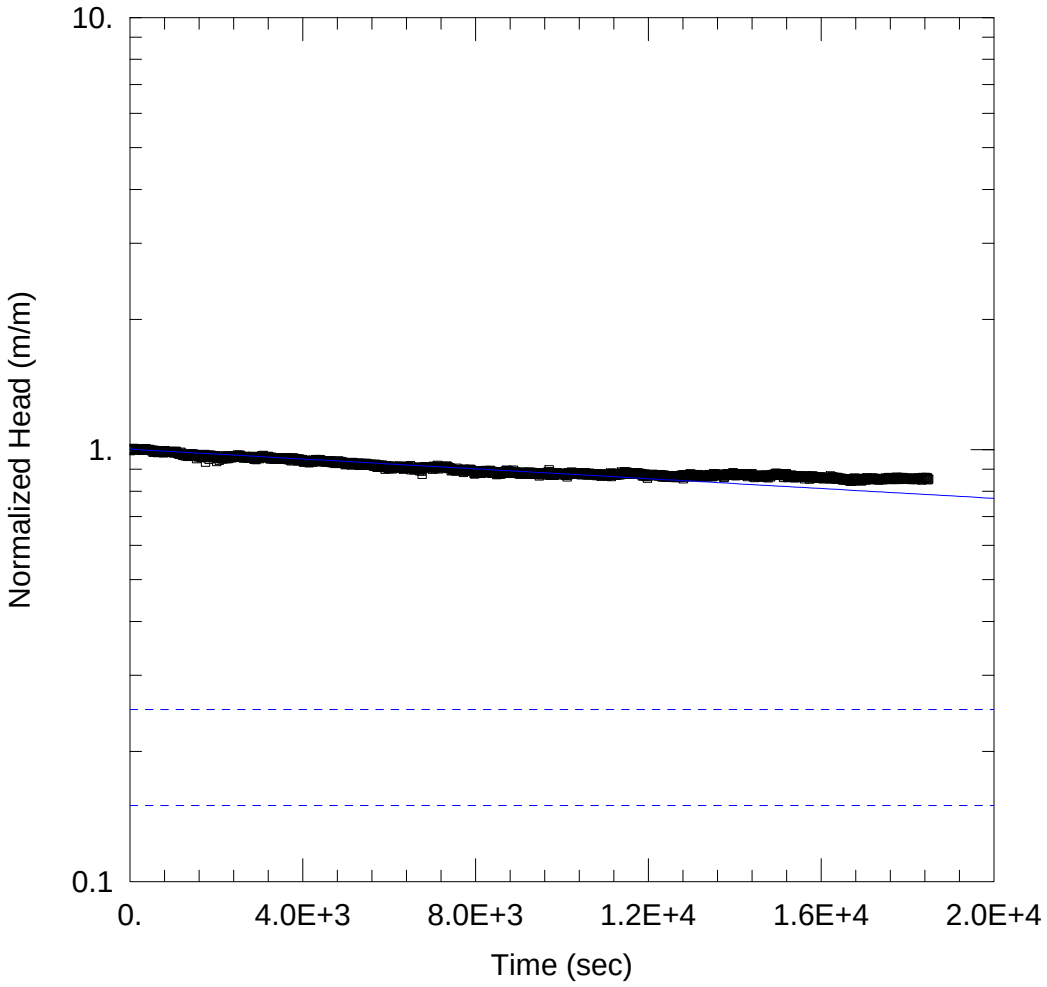
Estimated Parameters

Parameter	Estimate	
K	2.411E-9	m/sec
y0	0.1002	m

K = 2.411E-7 cm/sec
T = K*b = 1.206E-7 m²/sec (0.001206 sq. cm/sec)

NOTES

Well may not be sufficiently developed due to a slow recovery.



MW-H32 (FALLLING HEAD SLUG TEST)

PROJECT INFORMATION

Company: Rescan Environmental Services
Client: HD Mining International Ltd.
Project: 0194106-0002-0005
Location: Tumbler Ridge, BC
Test Well: MW-H32
Test Date: 22 July 2013

AQUIFER DATA

Saturated Thickness: 50. m
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-H32)

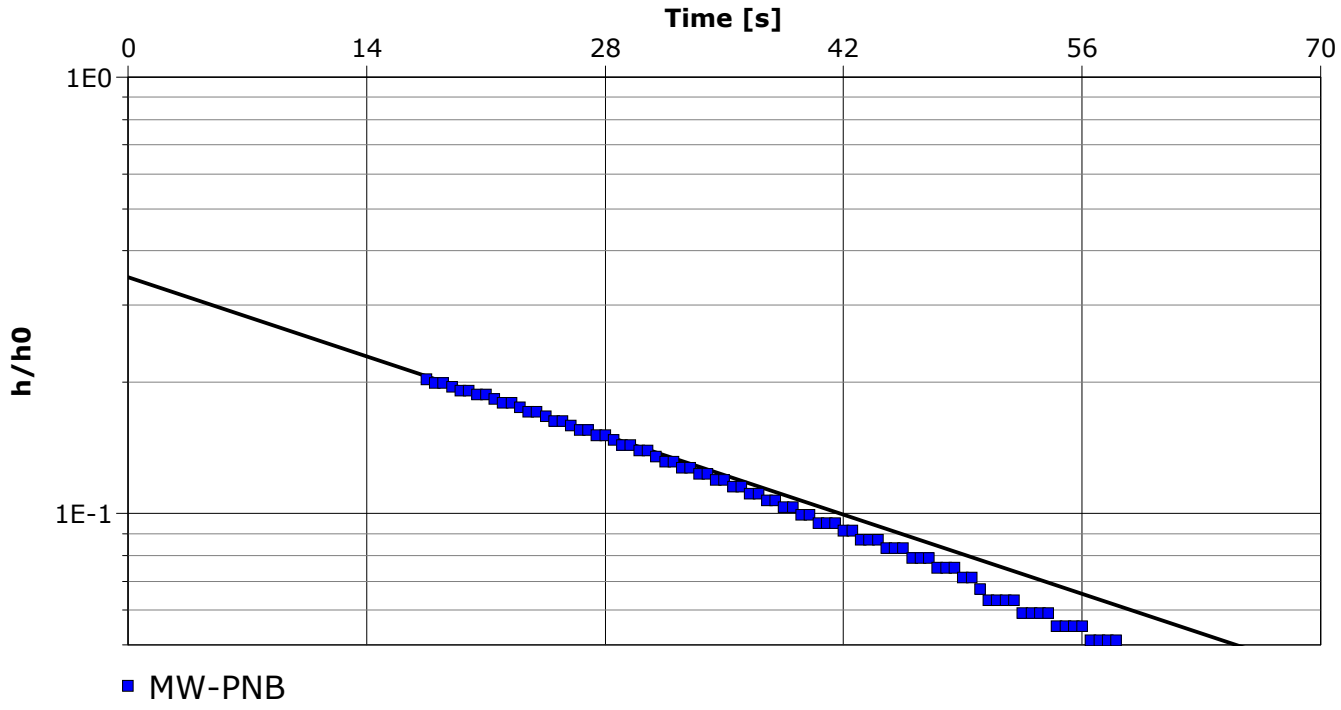
Initial Displacement: 0.1 m
Total Well Penetration Depth: 21.28 m
Casing Radius: 0.016 m
Static Water Column Height: 21.28 m
Screen Length: 3.05 m
Well Radius: 0.038 m

SOLUTION

Aquifer Model: Confined
K = 2.411E-9 m/sec
Solution Method: Hvorslev
y0 = 0.1002 m

ERM Rescan 1111 W. Hastings St. Vancouver, BC, V6E 2J3	**Slug Test Analysis Report**	
	Project: Murray River Coal	
	Number: 0194106-0002-0005	
	Client: HD Mining	

Location:	Slug Test: MW-PNB-Scenario2	Test Well: MW-PNB
Test Conducted by: Tyler Gale		Test Date: 11/6/2013
Analysis Performed by: Tyler Gale	MW-PNB-Scenario2-Hv	Analysis Date: 11/18/2013
Aquifer Thickness: 40.00 m		



Calculation using Hvorslev

Observation Well	Hydraulic Conductivity [m/s]	
MW-PNB	1.36×10^{-5}	

Appendix D
Groundwater Level Records

ERM

Appendix D. Records of Manual Groundwater Level Measurements in Standpipe and Vibrating Wire Piezometers

Well ID	Coordinates Northing (m) Zone 10U (NAD83)	Coordinates Easting (m) Zone 10U (NAD83)	Top of Casing Elev. (masl)	Stick-up Height (m)	Top of Casing Elevation (masl)	Screen Interval Top (mbg)	Screen Interval Bottom (mbg)	Date	Time	Water Level mbsu	Water Level mbg	Water Level masl	Annual Mean	Remarks
MW-H2A	6,101,837	620,575	1,104.341	0.76	1,104.341	83.00	88.00	10-Jul-11	na	9.350	8.590	1,094.991		
MW-H2A	6,101,837	620,575	1,104.341	0.76	1,104.341	83.00	88.00	18-Oct-11	na	9.640	8.880	1,094.701		
MW-H2A	6,101,837	620,575	1,104.341	1.19	1,104.341	83.00	88.00	13-May-12	na	10.818	9.628	1,093.523		
MW-H2A	6,101,837	620,575	1,104.341	1.19	1,104.341	83.00	88.00	23-Aug-12	na	10.695	9.505	1,093.646		
MW-H2A	6,101,837	620,575	1,104.341	1.19	1,104.341	83.00	88.00	6-Nov-13	10:00	10.877	9.687	1,093.464	1,093.957	Pressure transducer installed November 2013
MW-H2B	6,101,831	620,567	1,103.370	0.35	1,103.370	9.90	12.90	10-Jul-11	na	5.770	5.420	1,097.600		
MW-H2B	6,101,831	620,567	1,103.370	0.35	1,103.370	9.90	12.90	18-Oct-11	na	7.690	7.340	1,095.680		
MW-H2B	6,101,831	620,567	1,103.370	0.47	1,103.370	9.90	12.90	13-May-12	na	6.192	5.722	1,097.178		
MW-H2B	6,101,831	620,567	1,103.370	0.47	1,103.370	9.90	12.90	23-Aug-12	na	7.140	6.670	1,096.230		
MW-H2B	6,101,831	620,567	1,103.370	0.47	1,103.370	9.90	12.90	6-Nov-13	10:00	7.225	6.755	1,096.145	1,096.363	
MW-H3A	6,102,191	621,818	1,215.710	0.45	1,215.700	183.00	193.00	7-Jul-11	na	26.700	26.250	1,189.000	1,189.000	difficult/unsafe site access during trip after this date
MW-H3B	6,102,191	621,821	1,215.700	0.45	1,215.700	4.50	8.80	7-Jul-11	na	1.830	1.380	1,213.870	1,213.870	difficult/unsafe site access during trip after this date
MW-H5	6,100,571	620,658	1,102.530	0.68	1,102.500	27.50	30.50	9-Jul-11	na	na	na	na		
MW-H5	6,100,571	620,658	1,102.530	0.68	1,102.500	27.50	30.50	18-Oct-11	na	na	na	na		
MW-H5	6,100,571	620,658	1,102.530	0.68	1,102.500	27.50	30.50	12-May-12	na	na	na	na		
MW-H5	6,100,571	620,658	1,102.530	0.68	1,102.500	27.50	30.50	22-Aug-12	na	na	na	na		
MW-H5	6,100,571	620,658	1,102.530	0.83	1,102.650	27.50	30.50	6-Nov-13	11:30	-2.1	-2.930	1,104.750	1,104.750	flowing artesian, pressure gauge reads 3.0 psi
MW-H13	6,098,569	626,086	821.580	1.27	822.070	66.00	69.00	14-Oct-11	na	52.710	51.440	769.360		
MW-H13	6,098,569	626,086	821.580	1.27	822.070	66.00	69.00	11-May-12	na	54.950	53.680	767.120		
MW-H13	6,098,569	626,086	821.580	0.78	821.580	66.00	69.00	22-Aug-12	na	54.688	53.908	766.892	767.791	
MW-H15	6,098,253	624,907	854.397	1.17	854.347	94.00	100.00	13-Oct-11	na	52.630	51.460	801.717		
MW-H15	6,098,253	624,907	854.397	1.17	854.347	94.00	100.00	14-May-12	na	55.992	54.822	798.355		
MW-H15	6,098,253	624,907	854.397	1.22	854.397	94.00	100.00	23-Aug-12	na	55.214	53.994	799.183		
MW-H15	6,098,253	624,907	854.397	1.22	854.397	94.00	100.00	25-Oct-12	na	55.488	54.268	798.909		
MW-H15	6,098,253	624,907	854.397	1.22	854.397	94.00	100.00	19-Dec-12	na	54.880	53.660	799.517		
MW-H15	6,098,253	624,907	854.397	1.22	854.397	94.00	100.00	23-Jul-13	na	53.745	52.525	800.652		
MW-H15	6,098,253	624,907	854.397	1.22	854.397	94.00	100.00	11-Nov-13	9:30	48.885	47.665	805.512	799.722	
MW-H15	6,098,253	624,907	854.397	1.22	854.397	94.00	100.00	9-Feb-14	8:30	50.805	49.585	803.592		
MW-H16	6,097,821	624,891	839.467	0.86	839.467	67.50	70.50	14-May-12	na	61.748	60.888	777.719		
MW-H16	6,097,821	624,891	839.467	0.86	839.467	67.50	70.50	21-Aug-12	na	61.580	60.720	777.887	777.803	
MW-H16	6,097,821	624,891	839.467	0.86	839.467	67.50	70.50	8-Feb-14	16:30	> 60.58	-	-		
MW-H17	6,097,925	625,520	829.960	0.66	829.960	5.50	8.50	10-May-12	na	5.528	4.868	824.432		
MW-H17	6,097,925	625,520	829.960	0.66	829.960	5.50	8.50	22-Aug-12	na	5.552	4.892	824.408		
MW-H17	6,097,925	625,520	829.960	0.66	829.960	5.50	8.50	25-Oct-12	na	5.740	5.080	824.220		
MW-H17	6,097,925	625,520	829.960	0.66	829.960	5.50	8.50	20-Dec-12	na	5.852	5.192	824.108		
MW-H17	6,097,925	625,520	829.960	0.66	829.960	5.50	8.50	23-Jul-13	na	5.706	5.046	824.254		
MW-H17	6,097,925	625,520	829.960	0.66	829.960	5.50	8.50	11-Nov-13	10:00	5.905	5.245	824.055	824.284	
MW-H17	6,097,925	625,520	829.960	0.66	829.960	5.50	8.50	9-Feb-14	13:00	5.630	4.970	824.330		Pressure Transducer records available from July 2013
MW-H18	6,097,953	625,740	831.697	0.82	831.697	10.50	13.50	10-May-12	na	11.956	11.136	819.741		
MW-H18	6,097,953	625,740	831.697	0.82	831.697	10.50	13.50	22-Aug-12	na	11.747	10.927	819.950		
MW-H18	6,097,953	625,740	831.697	0.82	831.697	10.50	13.50	25-Oct-12	na	11.828	11.008	819.869		
MW-H18	6,097,953	625,740	831.697	0.82	831.697	10.50	13.50	20-Dec-12	na	11.821	11.001	819.876		
MW-H18	6,097,953	625,740	831.697	0.82	831.697	10.50	13.50	23-Jul-13	na	11.707	10.887	819.990		
MW-H18	6,097,953	625,740	831.697	0.82	831.697	10.50	13.50	11-Nov-13	10:25	11.720	10.900	819.977	819.885	
MW-H18	6,097,953	625,740	831.697	0.82	831.697	10.50	13.50	9-Feb-14	13:45	10.595	9.775	821.102		
MW-H19	6,098,131	625,663	833.344	0.77	833.344	5.70	8.70	10-May-12	na	4.420	3.650	828.924		
MW-H19	6,098,131	625,663	833.344	0.77	833.344	5.70	8.70	22-Aug-12	na	4.134	3.364	829.210		
MW-H19	6,098,131	625,663	833.344	0.77	833.344	5.70	8.70	25-Oct-12	na	4.366	3.596	828.978		
MW-H19	6,098,131	625,663	833.344	0.77	833.344	5.70	8.70	20-Dec-12	na	4.511	3.741	828.833		
MW-H19	6,098,131	625,663	833.344	0.77	833.344	5.70	8.70	23-Jul-13	na	4.090	3.320	829.254		
MW-H19	6,098,131	625,663	833.344	0.77	833.344	5.70	8.70	11-Nov-13	10:15	4.428	3.658	828.916	829.040	
MW-H19	6,098,131	625,663	833.344	0.77	833.344	5.70	8.70	9-Feb-14	13:50	4.290	3.520	829.054		
MW-H20	6,099,766	624,397	954.200	0.67	954.075	37.80	40.80	14-Oct-11	na	25.980	25.310	928.095		
MW-H20	6,099,766	624,397	954.200	0.67	954.075	37.80	40.80	11-May-12	na	26.638	25.968	927.437		
MW-H20	6,099,766	624,397	954.200	0.80	954.200	37.80	40.80	22-Aug-12	na	26.740	25.945	927.460	927.664	

na indicates record not available or not applicable.

Appendix D. Records of Manual Groundwater Level Measurements in Standpipe and Vibrating Wire Piezometers

Well ID	Coordinates Northing (m) Zone 10U (NAD83)	Coordinates Easting (m) Zone 10U (NAD83)	Top of Casing Elev. (masl)	Stick-up Height (m)	Top of Casing Elevation (masl)	Screen Interval Top (mbg)	Screen Interval Bottom (mbg)	Date	Time	Water Level mbsu	Water Level mbg	Water Level masl	Annual Mean	Remarks
MW-H21	6,100,259	625,390	917.000	1.30	915.700	50.70	53.70	8-Jul-11	na	25.830	24.530	889.870		
MW-H21	6,100,259	625,390	917.000	0	917.000	50.70	53.70	14-Oct-11	na	25.310	25.310	891.690		
MW-H21	6,100,259	625,390	917.000	0	917.000	50.70	53.70	11-May-12	na	26.638	26.638	890.362		
MW-H21	6,100,259	625,390	917.000	0	917.000	50.70	53.70	22-Aug-12	na	26.020	26.020	890.980	25.989	
MW-H22	6,096,815	624,960	784.422	0.85	784.422	22.10	25.10	11-May-12	na	19.558	18.708	764.864		
MW-H22	6,096,815	624,960	784.422	0.85	784.422	22.10	25.10	21-Aug-12	na	20.540	19.690	763.882		
MW-H22	6,096,815	624,960	784.422	0.85	784.422	22.10	25.10	28-Oct-12	na	21.730	20.880	762.692		
MW-H22	6,096,815	624,960	784.422	0.85	784.422	22.10	25.10	19-Dec-12	na	22.022	21.172	762.400		
MW-H22	6,096,815	624,960	784.422	0.85	784.422	22.10	25.10	21-Jul-13	na	19.680	18.830	764.742		
MW-H22	6,096,815	624,960	784.422	0.85	784.422	22.10	25.10	6-Nov-13	15:50	21.510	20.660	762.912	763.460	
MW-H22	6,096,815	624,960	784.422	0.85	784.422	22.10	25.10	8-Feb-14	12:30	21.715	20.865	762.707		
MW-H23	6,096,618	624,942	785.698	0.78	785.698	22.10	25.10	11-May-12	na	20.937	20.157	764.761		
MW-H23	6,096,618	624,942	785.698	0.78	785.698	22.10	25.10	21-Aug-12	na	22.361	21.581	763.337		
MW-H23	6,096,618	624,942	785.698	0.78	785.698	22.10	25.10	28-Oct-12	na	23.496	22.716	762.202		
MW-H23	6,096,618	624,942	785.698	0.78	785.698	22.10	25.10	19-Dec-12	na	23.773	22.993	761.925		
MW-H23	6,096,618	624,942	785.698	0.78	785.698	22.10	25.10	21-Jul-13	na	21.480	20.700	764.218		
MW-H23	6,096,618	624,942	785.698	0.78	785.698	22.10	25.10	6-Nov-13	15:40	23.294	22.514	762.404	763.056	
MW-H23	6,096,618	624,942	785.698	0.78	785.698	22.10	25.10	8-Feb-14	9:00	23.440	22.660	762.258		Pressure Transducer records available from July 2013
MW-H24A	6,099,756	628,116	832.000	0.90	832.000	44.85	47.90	1-Nov-12	na	19.720	18.820	812.280		
MW-H24A	6,099,756	628,116	832.000	0.90	832.000	44.85	47.90	18-Dec-12	na	16.025	15.125	815.975		
MW-H24A	6,099,756	628,116	832.000	0.90	832.000	44.85	47.90	7-May-13	na	16.462	15.562	815.538		
MW-H24A	6,099,756	628,116	832.000	0.90	832.000	44.85	47.90	31-Jul-13	na	16.200	15.300	815.800		
MW-H24A	6,099,756	628,116	832.000	0.90	832.000	44.85	47.90	7-Nov-13	8:55	16.345	15.445	815.655	815.771	
MW-H24B	6,099,756	628,119	832.000	0.40	832.000	5.55	8.60	1-Nov-12	na	5.956	5.556	826.044		
MW-H24B	6,099,756	628,119	832.000	0.40	832.000	5.55	8.60	18-Dec-12	na	5.973	5.573	826.027		
MW-H24B	6,099,756	628,119	832.000	0.40	832.000	5.55	8.60	7-May-13	na	2.842	2.442	829.158		
MW-H24B	6,099,756	628,119	832.000	0.40	832.000	5.55	8.60	31-Jul-13	na	4.860	4.460	827.140		
MW-H24B	6,099,756	628,119	832.000	0.40	832.000	5.55	8.60	7-Nov-13	8:55	5.898	5.498	826.102	827.442	
MW-H24B	6,099,756	628,119	832.000	0.40	832.000	5.55	8.60	10-Feb-14	15:45	4.800	4.400	827.200		
MW-H24C	6,099,625	627,954	825.000	0.92	825.000	9.23	12.28	31-Jul-13	na	2.515	1.595	822.485		
MW-H24C	6,099,625	627,954	825.000	0.92	825.000	9.23	12.28	10-Nov-13	9:15	3.415	2.495	821.585		
MW-H24C	6,099,625	627,954	825.000	0.92	825.000	9.23	12.28	13-Feb-14	12:45	3.200	2.280	821.800	821.957	
MW-H25A	6,099,615	627,334	766.000	0.70	766.000	58.95	62.00	1-Nov-12	na	1.315	0.615	764.685		
MW-H25A	6,099,615	627,334	766.000	0.70	766.000	58.95	62.00	18-Dec-12	na	0.700	0.000	765.300		
MW-H25A	6,099,615	627,334	766.000	0.70	766.000	58.95	62.00	7-May-13	na	0.890	0.190	765.110		
MW-H25A	6,099,615	627,334	766.000	0.70	766.000	58.95	62.00	31-Jul-13	na	2.744	2.044	763.256		
MW-H25A	6,099,615	627,334	766.000	0.70	766.000	58.95	62.00	5-Nov-13	10:00	2.765	2.065	763.235	764.555	
MW-H25A	6,099,615	627,334	766.000	0.70	766.000	58.95	62.00	13-Feb-14	9:15	2.570	1.870	763.430		MW-H25B purged/sampled previous day (2 m away)
MW-H25B	6,099,615	627,332	766.000	0.70	766.000	1.55	4.60	1-Nov-12	na	0.840	0.140	765.160		
MW-H25B	6,099,615	627,332	766.000	0.70	766.000	1.55	4.60	18-Dec-12	na	0.790	0.090	765.210		
MW-H25B	6,099,615	627,332	766.000	0.70	766.000	1.55	4.60	7-May-13	na	0.842	0.142	765.158		
MW-H25B	6,099,615	627,332	766.000	0.70	766.000	1.55	4.60	31-Jul-13	na	0.776	0.076	765.224		
MW-H25B	6,099,615	627,332	766.000	0.70	766.000	1.55	4.60	8-Nov-13	14:00	0.840	0.140	765.160	765.197	
MW-H25B	6,099,615	627,332	766.000	0.70	766.000	1.55	4.60	12-Feb-14	14:00	0.670	-0.030	765.330		ice at indicated water level, approx. 10 cm thick
MW-H26A	6,098,990	627,478	792.000	0.78	792.000	29.84	32.89	29-Oct-12	na	0.822	0.042	791.178		
MW-H26A	6,098,990	627,478	792.000	0.78	792.000	29.84	32.89	18-Dec-12	na	0.800	0.020	791.200		
MW-H26A	6,098,990	627,478	792.000	0.78	792.000	29.84	32.89	7-May-13	na	1.265	0.485	790.735		
MW-H26A	6,098,990	627,478	792.000	0.78	792.000	29.84	32.89	31-Jul-13	na	1.175	0.395	790.825		
MW-H26A	6,098,990	627,478	792.000	0.78	792.000	29.84	32.89	7-Nov-13	10:30	1.367	0.587	790.633	790.920	
MW-H26A	6,098,990	627,478	792.000	0.78	792.000	29.84	32.89	10-Feb-14	11:10	1.490	0.710	790.510		Pressure Transducer records available from July 2013
MW-H26B	6,098,987	627,485	792.000	0.65	792.000	1.55	4.60	1-Nov-12	na	2.258	1.608	789.742		
MW-H26B	6,098,987	627,485	792.000	0.65	792.000	1.55	4.60	18-Dec-12	na	1.810	1.160	790.190		
MW-H26B	6,098,987	627,485	792.000	0.65	792.000	1.55	4.60	7-May-13	na	1.307	0.657	790.693		
MW-H26B	6,098,987	627,485	792.000	0.65	792.000	1.55	4.60	31-Jul-13	na	1.476	0.826	790.524		
MW-H26B	6,098,987	627,485	792.000	0.65	792.000	1.55	4.60	7-Nov-13	10:30	1.935	1.285	790.065	790.469	
MW-H26B	6,098,987	627,485	792.000	0.65	792.000	1.55	4.60	11-Feb-14	11:15	1.705	1.055	790.295		Pressure Transducer records available from July 2013

na indicates record not available or not applicable.

Appendix D. Records of Manual Groundwater Level Measurements in Standpipe and Vibrating Wire Piezometers

Well ID	Coordinates Northing (m) Zone 10U (NAD83)	Coordinates Easting (m) Zone 10U (NAD83)	Top of Casing Elev. (masl)	Stick-up Height (m)	Top of Casing Elevation (masl)	Screen Interval Top (mbg)	Screen Interval Bottom (mbg)	Date	Time	Water Level mbsu	Water Level mbg	Water Level masl	Annual Mean	Remarks
MW-H27	6,098,578	627,607	810	0.47	810	34.58	37.63	31-Jul-13	na	10.365	9.895	799.635		
MW-H27	6,098,578	627,607	810	0.47	810	34.58	37.63	8-Nov-13	12:15	10.436	9.966	799.564		
MW-H27	6,098,578	627,607	810	0.47	810	34.58	37.63	10-Feb-14	9:15	10.510	10.040	799.490	799.563	
MW-H28	6,098,772	627,715	819	0.70	819	13.92	16.97	31-Jul-13	na	12.591	11.891	806.409		
MW-H28	6,098,772	627,715	819	0.70	819	13.92	16.97	8-Nov-13	16:15	12.798	12.098	806.202		
MW-H28	6,098,772	627,715	819	0.70	819	13.92	16.97	12-Feb-14	10:10	11.520	10.820	807.480	806.697	
MW-H29	6,099,198	627,938	826	0.70	826	8.26	11.31	31-Jul-13	na	5.578	4.878	820.422		
MW-H29	6,099,198	627,938	826	0.70	826	8.26	11.31	9-Nov-13	na	5.788	5.088	820.212	820.317	
MW-H29	6,099,198	627,938	826	0.70	826	8.26	11.31	10-Feb-14	10:00	5.260	4.560	820.740		
MW-H30	6,098,501	627,372	793	0.73	793	11.46	14.51	31-Jul-13	na	13.644	12.914	779.356		
MW-H30	6,098,501	627,372	793	0.73	793	11.46	14.51	8-Nov-13	13:20	10.140	9.410	782.860		
MW-H30	6,098,501	627,372	793	0.73	793	11.46	14.51	11-Feb-14	11:25	9.160	8.430	783.840	782.019	
MW-H31	6,099,893	627,456	798	0.68	798	27.37	30.42	31-Jul-13	na	15.703	15.023	782.297		
MW-H31	6,099,893	627,456	798	0.68	798	27.37	30.42	9-Nov-13	17:00	16.738	16.058	781.262	781.780	
MW-H32	6,099,810	628,333	840	0.37	840	27.08	30.13	31-Jul-13	na	10.771	10.401	829.229		
MW-H32	6,099,810	628,333	840	0.37	840	27.08	30.13	10-Nov-13	16:10	11.195	10.825	828.805		
MW-H32	6,099,810	628,333	840	0.37	840	27.08	30.13	13-Feb-14	10:45	9.270	8.900	830.730	829.588	
MW-PNB	6,097,114	625,101	778.853	1.27	778.983	45.50	48.50	6-Jul-11	na	13.050	11.780	765.933		
MW-PNB	6,097,114	625,101	778.853	1.27	778.983	45.50	48.50	15-Oct-11	na	13.070	11.800	765.913		
MW-PNB	6,097,114	625,101	778.853	1.14	778.853	45.50	48.50	11-May-12	na	14.820	13.680	764.033		
MW-PNB	6,097,114	625,101	778.853	1.14	778.853	45.50	48.50	21-Aug-12	na	14.057	12.917	764.796		
MW-PNB	6,097,114	625,101	778.853	1.14	778.853	45.50	48.50	19-Dec-12	na	15.206	14.066	763.647		
MW-PNB	6,097,114	625,101	778.853	1.14	778.853	45.50	48.50	7-May-13	na	14.102	12.962	764.751		
MW-PNB	6,097,114	625,101	778.853	1.14	778.853	45.50	48.50	21-Jul-13	na	13.575	12.435	765.278		
MW-PNB	6,097,114	625,101	778.853	1.14	778.853	45.50	48.50	6-Nov-13	16:00	14.678	13.538	764.175	764.846	
MW-PNB	6,097,114	625,101	778.853	1.14	778.853	45.50	48.50	8-Feb-14	14:45	14.615	13.475	764.238		
MW-Shaft	6,098,150	625,176	846.032	0.90	846.032	2.10	5.10	9-Jul-11	na	3.275	2.375	842.757		
MW-Shaft	6,098,150	625,176	846.032	0.90	846.032	2.10	5.10	22-Aug-12	na	4.445	3.545	841.587		
MW-Shaft	6,098,150	625,176	846.032	0.90	846.032	2.10	5.10	25-Oct-12	na	4.785	3.885	841.247		
MW-Shaft	6,098,150	625,176	846.032	0.90	846.032	2.10	5.10	20-Dec-12	na	3.985	3.085	842.047		
MW-Shaft	6,098,150	625,176	846.032	0.90	846.032	2.10	5.10	23-Jul-13	na	4.235	3.335	841.797		
MW-Shaft	6,098,150	625,176	846.032	0.90	846.032	2.10	5.10	11-Nov-13	9:45	4.330	3.430	841.702	841.697	
MW-Shaft	6,098,150	625,176	846.032	0.90	846.032	2.10	5.10	9-Feb-14	11:00	3.815	2.915	842.217		
VWP-H7-1MPa	6,100,872	622,015	1,131.500	na	na	92.50		4-Apr-11	na	na	-11.099	1142.60		
	6,100,872	622,015	1,131.500	na	na	92.50		13-May-12	na	na	-0.292	1131.79		
	6,100,872	622,015	1,131.500	na	na	92.50		24-Aug-12	na	na	2.880	1128.62		
VWP-H7-2MPa	6,100,872	622,015	1,131.500	na	na	207.50		4-Apr-11	na	na	-0.740	1132.24		
	6,100,872	622,015	1,131.500	na	na	207.50		13-May-12	na	na	4.076	1127.42		
	6,100,872	622,015	1,131.500	na	na	207.50		24-Aug-12	na	na	6.640	1124.86		
VWP-H12-1MPa	6,100,659	624,446	1,120.800	na	na	116.00		4-Apr-11	na	na	15.609	1105.19		
	6,100,659	624,446	1,120.800	na	na	116.00		24-Aug-12	na	na	24.190	1096.61		
VWP-H12-2MPa	6,100,659	624,446	1,120.800	na	na	210.00		4-Apr-11	na	na	78.288	1042.51		
	6,100,659	624,446	1,120.800	na	na	210.00		24-Aug-12	na	na	81.660	1039.14		
TH12-03*	6,096,785	624,886	783.804	0.79	783.804	na	na	25-Aug-12	na	20.018	19.228	763.786	763.786	

na indicates record not available or not applicable.

Appendix E

Supplemental Groundwater Quality Inforation

ERM

Appendix E1. Water Quality Results and Guideline Exceedances for Well Installed in the Camp Creek Basin: Physical Parameters, Anions, Nutrients, and Aggregate Organics

Well ID				MW-H2A				MW-H2B					MW-H5					MW-20			
Date Sampled				10-JUL-11	18-OCT-11	13-MAY-12	23-AUG-12	10-JUL-11	18-OCT-11	13-MAY-12	23-AUG-12	13-MAY-14	09-JUL-11	18-OCT-11	12-MAY-12	22-AUG-12	08-MAY-14	08-JUL-11	17-OCT-11	14-MAY-12	22-AUG-12
Time Sampled		BC MOE FWAL	DW	00:00	12:00	00:00	00:00	00:00	12:00	00:00	00:00	14:00	00:00	12:00	00:00	00:00	16:00	00:00	12:00	00:00	00:00
ALS Sample ID	Units	Gudielines [A]	Guidelines [A]	L1031047-6	L1074937-1	L1147583-5	L1201463-3	L1031047-1	L1074937-2	L1147583-6	L1201463-4	L1455515-3	L1031047-3	L1074937-3	L1147583-9	L1201465-2	L1453879-1	L1031047-2	L1074937-6	L1147583-2	L1201465-6
Field Measurements																					
pH	-	6.5-9.0 [D, G]	6.5-8.5	-	8.85	8.57	8.71	-	8.26	8.31	7.87	7.5	-	7.9	7.48	6.87	-	-	9.0	8.57	8.63
Oxidation-Reduction Potential	mV	ng		-	-	-	-20	-	-	-	190	50	-	-	-	50	-	-	-	-	-30
Specific Conductance	µS/cm	ng		-	1578	1596	1584	-	345	435	271	322	-	622	648	699	-	-	1373	1458	1401
Turbidity	NTU	na		-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-
Temperature	°C	na		-	4.8	5.8	5.1	-	3.9	9.0	6.1	6.1	-	4.8	6.1	8.0	-	-	5.6	7.4	9.4
Physical Tests (Laboratory)																					
Colour, True		na [D]		6.9	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	15.0	10.7
Conductivity	µS/cm	ng		1200	1540	1580	1510	279	332	280	262	326	587	598	570	548	564	655	1340	1350	1320
Hardness (as $CaCO_3$)	mg/L	ng		27.4	29.5	32.1	28.7	134	145	151	140	160	295	293	312	309	309	146	7.49	8.89	7.32
pH		6.5-9.0 [D, G]		8.48	8.69	8.71	8.64	7.97	8.27	8.24	8.25	8.21	7.87	8.14	8.12	8.17	7.99	8.30	8.75	8.65	8.63
Total Suspended Solids	mg/L	ng		6000	89.3	49.0	10.8	282	4.0	745	548	<3.0	178	10.7	19.7	3.1	5.7	554	256	33.0	12.1
Total Dissolved Solids	mg/L	ng		-	-	1220	-	-	-	162	-	200	-	-	316	-	324	-	-	888	-
Turbidity	NTU	na		>4000	712	161	43.0	314	4.27	76.9	105	0.53	376	11.6	6.78	7.09	19.4	561	612	38.8	19.8
Anions and Nutrients																					
Acidity (as $CaCO_3$)	mg/L	ng		<1.0	<1.0	<1.0	<1.0	2.8	1.3	1.8	<1.0	<1.0	4.0	4.1	5.0	2.4	5.1	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	ng		622	804	887	839	134	160	135	134	158	327	320	316	331	319	383	659	724	717
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	ng		38	72.3	58.0	44.4	<1.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	2.3	58.5	65.6	48.2
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	ng		<10	<1.0	<1.0	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	ng		660	877	937	883	134	160	135	134	158	327	320	316	331	319	385	717	773	765
Ammonia, Total (as N)	mg/L	0.45 to 29 [H]		0.123	-	<0.0050	0.548	0.0195	-	<0.0050	0.0063	<0.0050	0.180	-	0.158	0.175	0.167	0.722	-	0.0170	0.366
Bromide (Br)	mg/L	ng		<0.50	<0.50	<0.50	<1.0	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.50	<0.50	<0.050
Chloride (Cl)	mg/L	150 [C]	250	10.4	9.1	10.6	13	5.67	7.90	8.31	4.81	9.65	5.35	0.78	<0.50	<0.50	<0.50	2.99	<5.0	<5.0	<0.50
Fluoride (F)	mg/L	K	1 [C]	1.60	1.43	1.68	1.49	0.099	0.110	0.091	0.084	0.076	0.154	0.150	0.146	0.147	0.150	0.879	1.97	2.07	0.226
Nitrate (as N)	mg/L	3 [C]	10 [L]	<0.050	<0.050	<0.050	<0.10	<0.0050	0.0116	0.0722	0.0775	0.407	<0.0050	0.0103	<0.0050	<0.0050	<0.0050	<0.0050	<0.050	<0.050	<0.0050
Nitrite (as N)	mg/L	0.02 [C]	1	<0.010	<0.010	<0.010	<0.020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.010	<0.010	<0.0010
Total Kjeldahl Nitrogen	mg/L	ng		1.02	-	0.973	0.729	0.603	-	0.615	0.272	<0.081	0.473	-	0.238	0.250	0.172	1.41	-	0.791	0.550
Total Nitrogen	mg/L	ng		1.02	-	0.973	0.73	0.603	-	0.688	0.350	0.406	0.473	-	0.238	0.250	0.172	1.41	-	0.791	0.550
Orthophosphate-Dissolved (as P)	mg/L	ng		0.0947	0.222	0.186	0.158	0.0249	0.0014	0.0015	0.0024	0.0025	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.108	0.352	0.430
Phosphorus (P)-Total Dissolved	mg/L	between 0.005 and 0.015 [B, E]		0.131	0.220	0.0996	0.167	0.348	<0.0020	0.0022	0.0029	0.0026	0.301	<0.0020	<0.0020	<0.0020	<0.0020	0.00990	0.120	0.331	0.442
Phosphorus (P)-Total	mg/L	refer to dissolved component	0.01 [E]	6.45	0.567	0.376	0.261	0.379	0.0089	0.582	0.147	0.0029	0.364	0.0287	0.0302	0.0119	0.0057	0.255	0.487	0.475	0.518
Sulfate (SO_4)	mg/L	128 to 429 [F]	500	11.9	<5.0	<5.0	<10	11.7	7.51	4.34	4.09	4.15	12.8	12.6	12.2	12.1	12.8	5.02	29.0	9.9	<0.50
Organic / Inorganic Carbon																					
Total Organic Carbon	mg/L	na [D]	4 [M]	227	-	9.6	2.52	19.9	-	5.42	4.61	0.75	5.65	-	0.83	1.03	0.83	24.9	-	10.0	6.29
Aggregate Organics																					
COD	mg/L			442		47		117		59			33		<20			60		47	

ng = no approved water quality guideline.

na = not applicable.

Shaded values indicate guideline exceedances.

Underlined values indicate not-detection exceeds guideline.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014)*

[M] *Applicable for treatment with chlorination.*

Appendix E2. Water Quality Results and Guideline Exceedances for Well Installed at the Mine Sites: Physical Parameters, Anions, Nutrients, and Aggregate Organics

Well ID				MW-H15			MW-H16		MW-H17						MW-H18				MW-H19			
Date Sampled				19-OCT-11	14-MAY-12	23-AUG-12	16-OCT-11	14-MAY-12	10-MAY-12	22-AUG-12	25-OCT-12	20-DEC-12	09-FEB-14	11-MAY-14	10-MAY-12	22-AUG-12	25-OCT-12	20-DEC-12	10-MAY-12	22-AUG-12	25-OCT-12	20-DEC-12
Time Sampled		BC FWAL	DW	12:00	00:00	00:00	12:00	00:00	00:00	00:00	00:00	00:00	14:20	14:30	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID	Units	Gudielines [A]	Guidelines [A]	L1074937-4	L1147583-3	L1201463-2	L1074937-5	L1147583-4	L1147583-16	L1201465-7	L1230640-5	L1252558-1	L1422942-1	L1453879-8	L1147583-15	L1201465-3	L1230640-3	L1252558-2	L1147583-14	L1201465-4	L1230640-4	L1252558-3
Field Measurements																						
pH	-	6.5-9.0 [D, G]	6.5-8.5	8.8	8.82	-	9.1	-	7.58	7.5	7.21	-	7.59	7.25	7.65	7.19	7.32	-	-	7.0	7.36	-
Oxidation-Reduction Potential	mV	ng		-	-	-	-	-	-	190	10	-	0	-30	-	180	20	-	-	50	40	-
Specific Conductance	µS/cm	ng		1028	1956	-	1137	-	570	560	420	-	456	526	566	510	480	-	-	651	339	-
Temperature	°C	na		6.5	7.7	-	5.2	-	5.8	15.2	6.1	-	4.0	6.1	7.0	16.4	6.1	-	-	14.9	6.7	-
Physical Tests (Laboratory)																						
Colour, True		na [D]		38.8	25.5	24.0	14.4	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	17.7	7.2	<5.0	<5.0
Conductivity	µS/cm	ng		1800	1870	1830	1090	-	529	505	561	548	517	522	494	466	494	503	540	529	500	494
Hardness (as $CaCO_3$)	mg/L	ng		33.7	17.7	18.5	12.1	128	267	261	211	227	266	283	188	259	262	264	35.0	123	127	136
pH		6.5-9.0 [D, G]		8.41	8.78	8.51	8.35	-	8.25	8.10	8.19	8.13	8.23	8.03	8.22	7.94	8.02	8.00	8.24	8.10	8.09	8.27
Total Suspended Solids	mg/L	ng		1060	122	75.8	5220	-	312	36.9	86.7	66.7	<3.0	<3.0	2930	85.7	30.1	151	794	402	13.5	<3.0
Total Dissolved Solids	mg/L	ng		-	1250	-	-	-	329	-	-	-	-	313	313	-	-	-	678	-	-	-
Turbidity	NTU	na		1730	97.2	40.4	>4000	-	104	59.6	84.2	107	2.17	2.54	1310	26.0	17.2	40.1	743	401	7.23	5.86
Anions and Nutrients																						
Acidity (as $CaCO_3$)	mg/L	ng		<1.0	<1.0	<1.0	<50	-	1.2	3.8	2.6	3.9	1.5	3.6	2.0	122	5.4	6.6	1.2	3.3	3.8	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	ng		514	577	566	615	-	278	278	295	282	277	291	260	267	273	266	188	297	284	287
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	ng		<1.0	61.9	21.4	21.6	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	ng		<1.0	<1.0	<1.0	<1.0	-	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	ng		514	631	588	636	-	278	278	295	282	277	291	260	267	273	266	188	297	284	287
Ammonia, Total (as N)	mg/L	0.45 to 29 [H]		-	0.206	0.814	-	-	0.045	0.0704	0.0576	0.0206	0.047	0.054	<0.0050	0.0608	0.0417	0.0299	0.040	0.426	0.304	0.384
Bromide (Br)	mg/L	ng		1.3	<1.0	1.4	<0.50	-	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chloride (Cl)	mg/L	150 [C]	250	167	205	205	10.4	-	<0.50	<0.50	<0.50	0.52	<0.50	<0.50	0.51	0.60	0.58	0.52	2.24	0.79	0.70	0.69
Fluoride (F)	mg/L	K	1 [C]	0.69	0.70	0.86	0.84	-	0.124	0.134	0.177	0.155	0.121	0.116	0.255	0.202	0.214	0.210	0.742	0.298	0.269	0.250
Nitrate (as N)	mg/L	3 [C]	10 [L]	<0.10	<0.10	<0.10	<0.050	-	0.0601	<0.0050	0.0492	0.113	0.0209	0.0179	0.0350	0.0840	0.125	0.215	0.0644	<0.0050	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.02 [C]	1	0.033	<0.020	0.024	<0.010	-	<0.0010	<0.0010	0.0033	<0.0010	0.0083	0.0047	<0.0010	0.0021	0.0011	0.0026	0.0039	<0.0010	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	ng		-	1.37	1.41	-	-	0.308	0.180	0.227	0.166	0.069	0.054	4.01	0.264	0.054	<0.051	2.37	0.500	0.340	0.626
Total Nitrogen	mg/L	ng		-	1.37	1.43	-	-	0.368	0.180	0.280	0.279	0.098	0.077	4.05	0.350	0.180	0.254	2.44	0.500	0.340	0.626
Orthophosphate-Dissolved (as P)	mg/L	ng		0.0157	0.185	0.0257	0.141	-	0.0053	0.0061	0.0022	0.0053	0.0044	0.0039	0.0043	<0.0010	<0.0010	0.0040	0.0095	0.0124	<0.0010	0.0067
Phosphorus (P)-Total Dissolved	mg/L	between 0.005 and 0.015 [B, E]		0.100	0.093	0.0482	0.155	-	0.0048	0.0068	0.0035	0.0058	0.0057	0.0053	0.0058	<0.0020	<0.0020	0.0041	0.0191	0.0153	0.0028	0.0086
Phosphorus (P)-Total	mg/L	refer to dissolved component	0.01 [E]	1.14	0.332	0.280	7.60	-	0.258	0.0773	0.123	0.137	0.0126	0.0109	1.99	0.0796	0.0390	0.125	0.826	0.555	0.0640	0.0240
Sulfate (SO_4)	mg/L	128 to 429 [F]	500	174	80	75	24.8	-	24.7	21.3	49.3	35.1	11.2	11.0	17.4	12.2	19.3	24.2	44.2	15.8	14.5	13.6
Organic / Inorganic Carbon																						
Total Organic Carbon	mg/L	na [D]	4 [M]	-	24.5	19.1	-	-	5.02	2.63	6.09	3.87	1.33	1.06	48.5	4.12	2.44	1.66	12.3	11.4	4.98	2.84
Aggregate Organics																						
COD	mg/L				90			-	32			<20			231			<20	95			<20

ng = no approved water quality guideline.

na = not applicable.

Shaded values indicate guideline exceedances.

Underlined values indicate not-detection exceeds guideline.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 log_{10}(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

[M] *Applicable for treatment with chlorination.*

Appendix E2. Water Quality Results and Guideline Exceedances for Well Installed at the Mine Sites: Physical Parameters, Anions, Nutrients, and Aggregate Organics

Well ID				MW-PNB				MW-H22						MW-H23						MW-SHAFT
Date Sampled				07-JUL-11	15-OCT-11	11-MAY-12	21-AUG-12	11-MAY-12	21-AUG-12	28-OCT-12	19-DEC-12	08-FEB-14	17-APR-14	11-MAY-12	21-AUG-12	28-OCT-12	19-DEC-12	08-FEB-14	17-APR-14	09-FEB-14
Time Sampled		BC FWAL	DW	00:00	12:00	00:00	00:00	00:00	00:00	00:00	00:00	15:30	14:00	00:00	00:00	00:00	00:00	12:00	17:00	12:00
ALS Sample ID	Units	Gudielines [A]	Guidelines [A]	L1031047-4	L1074937-7	L1147583-11	L1201465-5	L1147583-13	L1201465-8	L1230640-7	L1252558-5	L1422942-2	L1445192-1	L1147583-12	L1201465-1	L1230640-6	L1252558-6	L1422942-4	L1445192-2	L1422942-3
Field Measurements																				
pH	-	6.5-9.0 [D, G]	6.5-8.5	-	8.0	8.06	-	8.05	7.46	7.21	7.02	7.49	7.46	8.08	7.39	7.02	7.51	7.61	7.56	7.1
Oxidation-Reduction Potential	mV	ng		-	-	-	-	-	240	140	60	230	80	-	250	170	130	220	100	120
Specific Conductance	µS/cm	ng		-	431	629	-	502	564	348	330	524	601	442	446	261	247	403	468	1180
Temperature	°C	na		-	4.8	6.1	-	7.2	9.3	3.4	2.1	5.2	4.0	6.4	10.7	3.4	2.0	4.9	3.5	1.2
Physical Tests (Laboratory)																				
Colour, True		na [D]		<5.0	<5.0	5.2	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	ng		401	413	549	519	456	543	576	544	573	586	429	428	430	434	436	452	1330
Hardness (as $CaCO_3$)	mg/L	ng		215	220	194	194	284	322	336	339	340	340	247	252	230	248	234	253	650
pH		6.5-9.0 [D, G]		8.17	8.23	8.20	8.23	8.08	8.11	8.03	8.10	8.07	7.99	8.21	8.20	8.11	8.12	8.10	8.08	7.87
Total Suspended Solids	mg/L	ng		<3.0	<3.0	17.0	17.7	1570	10600	847	108	40.3	29.6	91.7	33.9	48.8	247	405	19.9	9.1
Total Dissolved Solids	mg/L	ng		-	-	340	-	288	-	-	-	-	340	251	-	-	-	-	261	-
Turbidity	NTU	na		2.81	4.47	14.9	12.4	333	>4000	82.2	61.0	28.3	13.2	78.4	25.3	27.6	161	354	14.5	7.85
Anions and Nutrients																				
Acidity (as $CaCO_3$)	mg/L	ng		1.3	1.9	2.9	1.6	4.8	4.2	5.9	5.3	4.1	5.7	2.4	2.2	5.0	4.2	2.2	2.9	11.7
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	ng		215	214	251	251	263	308	301	343	344	329	241	247	247	255	247	257	372
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	ng		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	ng		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	ng		215	214	251	251	263	308	301	343	344	329	241	247	247	255	247	257	372
Ammonia, Total (as N)	mg/L	0.45 to 29 [H]		0.0161	-	<0.0050	0.0096	<0.0050	0.0340	<0.0050	<0.0050	0.0071	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.017	<0.0050	<0.0050
Bromide (Br)	mg/L	ng		<0.050	<0.050	<0.050	0.132	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.50
Chloride (Cl)	mg/L	150 [C]	250	<0.50	<0.50	3.91	3.25	0.74	<0.50	<0.50	<0.50	1.64	1.29	<0.50	<0.50	<0.50	<0.50	0.56	<0.50	219
Fluoride (F)	mg/L	K	1 [C]	0.058	0.058	0.210	0.189	0.066	0.061	0.049	0.052	0.047	0.045	0.075	0.079	0.081	0.076	0.079	0.075	<0.20
Nitrate (as N)	mg/L	3 [C]	10 [L]	0.394	0.260	0.0124	<0.0050	0.120	0.145	0.415	0.489	0.465	0.476	0.202	0.149	0.177	0.245	0.237	0.289	<0.050
Nitrite (as N)	mg/L	0.02 [C]	1	<0.0010	<0.0010	0.0152	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0023	<0.0010	<0.0010	<0.010
Total Kjeldahl Nitrogen	mg/L	ng		0.098	-	0.222	0.200	0.837	2.60	<0.084	<0.093	<0.11	<0.094	0.180	0.161	0.083	0.110	0.232	<0.069	0.189
Total Nitrogen	mg/L	ng		0.492	-	0.250	0.200	0.957	2.74	0.420	0.464	0.554	0.470	0.382	0.310	0.260	0.357	0.469	0.343	0.189
Orthophosphate-Dissolved (as P)	mg/L	ng		<0.0010	<0.0010	0.0024	0.0017	<0.0010	<0.0010	<0.0010	<0.0010	0.0049	<0.0010	0.0015	<0.0010	0.0014	<0.0010	0.0019	<0.0010	0.0024
Phosphorus (P)-Total Dissolved	mg/L	between 0.005 and 0.015 [B, E]		<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0062	-	<0.0020	<0.0020	<0.0020	<0.0020	0.0045	-	0.0054
Phosphorus (P)-Total	mg/L	refer to dissolved component	0.01 [E]	0.0030	0.0046	0.0714	0.0567	0.942	3.23	0.111	0.0911	0.0579	0.0234	0.0886	0.0380	0.0563	0.198	0.388	0.0163	0.0226
Sulfate (SO_4)	mg/L	128 to 429 [F]	500	16.0	15.3	55.1	44.9	15.3	8.46	6.00	5.44	5.14	5.28	6.36	6.28	6.89	6.82	6.98	7.03	5.4
Organic / Inorganic Carbon																				
Total Organic Carbon	mg/L	na [D]	4 [M]	1.41	-	5.19	10.2	25.5	59.7	2.99	0.90	2.03	0.64	3.87	3.32	2.46	3.56	7.2	1.14	6.43
Aggregate Organics																				
COD	mg/L			<20		32		81			<20			23			<20			

ng = no approved water quality guideline.

na = not applicable.

Shaded values indicate guideline exceedances.

Underlined values indicate not-detection exceeds guideline.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 log_{10}(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

[M] *Applicable for treatment with chlorination.*

Appendix E3. Water Quality Results and Guideline Exceedances for Well Installed at the Coarse Coal Reject Site: Physical Parameters, Anions, Nutrients, and Aggregate Organics

Well ID				MW-H24A				MW-H24B						MW-H24C				MW-H25A		
Date Sampled				29-OCT-12	20-DEC-12	09-MAY-13	08-NOV-13	22-OCT-12	19-DEC-12	07-MAY-13	23-JUL-13	08-NOV-13	10-FEB-14	23-JUL-13	08-NOV-13	13-FEB-14	09-MAY-14	01-NOV-12	09-MAY-13	28-JUL-13
Time Sampled		BC MOE FWAL	DW	00:00	00:00	00:00	12:00	00:00	00:00	00:00	00:00	12:00	16:15	00:00	12:00	14:00	14:00	00:00	00:00	00:00
ALS Sample ID	Units	Gudielines [A]	Guidelines [A]	L1233652-2	L1252558-4	L1300522-5	L1390394-1	L1230640-1	L1252558-7	L1300522-6	L1337870-1	L1390394-2	L1422942-5	L1337870-2	L1390394-3	L1422938-5	L1453879-2	L1233652-4	L1300522-3	L1340620-1
Field Measurements																				
pH	-	6.5-9.0 [D, G]	6.5-8.5	11.92	-	12.7	13.06	7.36	7.51	7.6	7.57	7.58	7.45	7.9	7.64	7.75	7.37	11.9	8.7	-
Oxidation-Reduction Potential	mV	ng		-60	-	-30	-120	80	0	20	-50	0	60	30	-110	-150	-130	-40	80	-
Specific Conductance	µS/cm	ng		881	-	4900	9760	267	310	338	360	458	389	605	522	507	537	1087	714	-
Temperature	°C	na		3.8	-	5.0	3.1	1.0	3.1	5.1	12.5	4.6	2.2	7.3	3.8	4.9	5.7	5.2	8.0	-
Physical Tests (Laboratory)																				
Colour, True		na [D]		8.5	9.6	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	9.8	<5.0	<5.0	<5.0	7.6	<5.0	<5.0
Conductivity	µS/cm	ng		15300	11500	5760	8760	471	459	518	447	472	449	585	527	515	528	1430	1050	1080
Hardness (as $CaCO_3$)	mg/L	ng		1750	1220	577	1050	247	248	248	224	239	239	262	267	272	293	592	16.2	18.1
pH		6.5-9.0 [D, G]		12.88	12.63	12.30	12.57	8.08	8.10	8.21	8.04	8.14	8.24	8.02	8.11	8.08	8.05	11.62	8.72	8.47
Total Suspended Solids	mg/L	ng		123	205	52.7	56.9	141	594	45.3	5.1	8.5	<3.0	28.6	10.5	<3.0	7.2	129	577	28.7
Total Dissolved Solids	mg/L	ng		-	-	-	-	-	-	-	-	-	-	-	-	-	305	-	-	-
Turbidity	NTU	na		64.0	171	36.8	34.6	68.2	168	33.1	3.56	4.37	1.11	16.4	20.3	13.0	13.3	18.4	2030	857
Anions and Nutrients																				
Acidity (as $CaCO_3$)	mg/L	ng		<1.0	<1.0	<1.0	<1.0	6.3	4.6	3.3	5.6	2.4	<1.0	6.4	3.4	3.5	3.5	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	ng		<5.0	<13	<1.0	<1.0	276	277	283	243	270	261	299	311	314	319	<1.0	600	598
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	ng		208	1410	95.4	113	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<1.0	<2.0	<2.0	43.5	18.9	21.7
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	ng		3960	1710	1550	1750	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	<1.0	<2.0	<2.0	164	<1.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	ng		4170	3120	1650	1870	276	277	283	243	270	261	299	311	314	319	208	619	619
Ammonia, Total (as N)	mg/L	0.45 to 29 [H]		3.96	6.24	3.86	4.75	0.0452	0.0071	0.0227	0.0234	0.0173	0.021	0.188	0.180	0.204	0.248	0.0451	0.452	0.262
Bromide (Br)	mg/L	ng		<5.0	<2.5	<2.5	<2.5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<1.0	<0.50	<0.50
Chloride (Cl)	mg/L	150 [C]	250	<50	<25	<25	<25	<0.50	<0.50	2.12	<0.50	<0.50	<0.50	1.00	<0.50	<0.50	<0.50	<10	<5.0	<5.0
Fluoride (F)	mg/L	K	1 [C]	<2.0	<1.0	1.1	<1.0	0.113	0.094	0.122	0.106	0.107	0.112	0.169	0.114	0.113	0.111	0.41	0.76	0.84
Nitrate (as N)	mg/L	3 [C]	10 [L]	<0.50	0.42	<0.25	<0.25	0.0435	0.0051	0.0850	0.0503	0.0542	0.0821	0.0075	<0.0050	<0.0050	<0.0050	0.10	<0.050	<0.050
Nitrite (as N)	mg/L	0.02 [C]	1	<0.10	<0.050	<0.050	<0.050	<0.0010	0.0072	0.0023	0.0070	<0.0010	<0.0010	0.0037	<0.0010	<0.0010	<0.0010	<0.020	0.012	<0.010
Total Kjeldahl Nitrogen	mg/L	ng		4.87	94.0	4.65	5.85	0.086	0.232	0.251	0.082	0.079	0.068	5.38	0.441	0.246	0.236	0.359	0.664	0.75
Total Nitrogen	mg/L	ng		4.87	94.4	4.65	5.85	0.130	0.244	0.338	0.139	0.133	0.150	5.39	0.441	0.246	0.236	0.460	0.676	0.75
Orthophosphate-Dissolved (as P)	mg/L	ng		0.0012	<0.10	<0.0010	<0.0010	0.0015	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0080	<0.0010	<0.0010	<0.0010	<0.0010	0.0209	<0.0010
Phosphorus (P)-Total Dissolved	mg/L	between 0.005 and 0.015 [B, E]		0.0038	0.0058	0.0038	0.0043	0.0035	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0141	<0.0020	<0.0020	<0.0020	0.0027	0.0321	0.0032
Phosphorus (P)-Total	mg/L	refer to dissolved component	0.01 [E]	0.0347	0.0326	0.0234	0.0353	0.104	0.327	0.0286	0.0123	0.0112	0.0055	0.0516	0.125	0.0669	0.0531	0.0198	1.00	0.566
Sulfate (SO_4)	mg/L	128 to 429 [F]	500	<50	<25	<25	<25	5.46	4.44	21.0	5.38	3.76	4.63	34.7	1.01	1.43	2.36	390	<5.0	<5.0
Organic / Inorganic Carbon																				
Total Organic Carbon	mg/L	na [D]	4 [M]	21.0	25.7	12.6	25.2	3.22	2.08	5.71	2.22	1.82	1.17	23.2	2.29	1.13	1.04	7.01	37.5	12.0
Aggregate Organics																				
COD	mg/L				110	42	79		46	<20	<20	<20		69	<20				144	43

ng = no approved water quality guideline.

na = not applicable.

Shaded values indicate guideline exceedances.

Underlined values indicate not-detection exceeds guideline.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

[M] *Applicable for treatment with chlorination.*

Appendix E3. Water Quality Results and Guideline Exceedances for Well Installed at the Coarse Coal Reject Site: Physical Parameters, Anions, Nutrients, and Aggregate Organics

Well ID				MW-H25A *(cont'd)*			MW-H25B							MW-H26A					
Date Sampled				08-NOV-13	13-FEB-14	09-MAY-14	22-OCT-12	19-DEC-12	07-MAY-13	23-JUL-13	08-NOV-13	12-FEB-14	11-MAY-14	30-OCT-12	09-MAY-13	28-JUL-13	08-NOV-13	12-FEB-14	10-MAY-14
Time Sampled		BC MOE FWAL	DW	12:00	18:45	14:30	00:00	00:00	00:00	00:00	12:00	15:00	11:00	00:00	00:00	00:00	12:00	15:30	15:00
ALS Sample ID	**Units**	**Guidelines [A]**	**Guidelines [A]**	L1390394-4	L1422945-2	L1453879-3	L1230640-2	L1252558-8	L1300522-4	L1337870-4	L1390394-5	L1422938-4	L1453879-7	L1233652-1	L1300522-1	L1340620-3	L1390524-1	L1422938-3	L1453879-4
Field Measurements																			
pH	-	6.5-9.0 [D, G]	6.5-8.5	8.62	-	8.48	7.04	7.89	7.25	7.46	7.29	7.13	7.02	12.1	9.0	8.83	9.21	8.97	8.92
Oxidation-Reduction Potential	mV	ng		-100	-	-10	100	120	140	30	-60	-80	-56	-60	90	80	-30	-50	30
Specific Conductance	µS/cm	ng		970	-	992	440	519	386	661	632	616	670	1683	721	762	985	960	1068
Temperature	°C	na		4.5	-	9.5	1.1	3.1	4.0	13.1	7.3	4.7	4.2	4.6	8.2	7.8	4.4	4.8	9.0
Physical Tests (Laboratory)																			
Colour, True		na [D]		<5.0	<5.0	<5.0	7.7	<5.0	<5.0	5.5	<5.0	<5.0	<5.0	12.4	<5.0	<5.0	<5.0	<5.0	<5.0
Conductivity	µS/cm	ng		1010	1020	1010	764	612	621	672	653	643	659	2350	1090	1100	1030	1050	1050
Hardness (as $CaCO_3$)	mg/L	ng		15.3	14.1	15.5	406	345	345	346	360	363	379	358	22.1	18.6	18.6	18.9	20.7
pH		6.5-9.0 [D, G]		8.57	8.72	8.63	7.81	8.12	8.16	7.90	8.03	7.93	7.86	12.09	8.93	8.81	9.06	8.91	8.89
Total Suspended Solids	mg/L	ng		7.5	<3.0	<3.0	1530	36.0	341	<3.0	3.3	10.6	12.9	157	830	37.4	7.2	<3.0	<3.0
Total Dissolved Solids	mg/L	ng		-	-	642	-	-	-	-	-	-	387	-	-	-	-	-	682
Turbidity	NTU	na		15.2	6.92	3.19	1920	132	288	2.07	3.85	10.8	8.71	60.7	595	285	15.2	1.12	0.53
Anions and Nutrients																			
Acidity (as $CaCO_3$)	mg/L	ng		<1.0	<1.0	<1.0	14.6	5.8	7.5	12.8	8.0	9.3	9.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	ng		570	494	509	436	363	369	382	383	392	397	<1.0	565	591	497	472	531
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	ng		31.6	37.3	51.4	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	76.8	122	64.6	100	73.8	83.1
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	ng		<1.0	<1.0	<1.0	<2.0	<2.0	<2.0	<2.0	<1.0	<2.0	<2.0	401	<1.0	<1.0	<1.0	<1.0	<1.0
Alkalinity, Total (as $CaCO_3$)	mg/L	ng		602	531	561	436	363	369	382	383	392	397	478	688	656	597	546	615
Ammonia, Total (as N)	mg/L	0.45 to 29 [H]		0.396	0.405	0.470	0.207	0.0780	0.0689	0.0701	0.0575	0.073	0.106	1.38	0.388	0.415	0.384	0.375	0.428
Bromide (Br)	mg/L	ng		<0.50	<0.50	<0.50	<0.50	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<1.0	<0.50	<0.50	<0.50	<0.50	<0.50
Chloride (Cl)	mg/L	150 [C]	250	<5.0	<2.5	<5.0	<5.0	2.47	2.08	1.43	1.30	1.26	1.28	<10	<5.0	<5.0	<5.0	<5.0	<5.0
Fluoride (F)	mg/L	K	1 [C]	0.72	0.78	0.75	<0.20	0.188	0.175	0.189	0.182	0.175	0.171	0.45	0.90	0.68	0.68	0.67	0.67
Nitrate (as N)	mg/L	3 [C]	10 [L]	<0.050	<0.025	<0.050	<0.050	0.0098	0.0081	<0.0050	<0.0050	<0.0050	<0.0050	<0.10	<0.050	<0.050	<0.050	<0.050	<0.050
Nitrite (as N)	mg/L	0.02 [C]	1	<0.010	<0.0050	<0.010	<0.010	0.0012	<0.0010	<0.0010	0.0013	<0.0010	<0.0010	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010
Total Kjeldahl Nitrogen	mg/L	ng		0.450	0.450	0.462	0.790	0.250	0.477	0.170	0.139	0.204	0.201	1.59	0.581	0.63	0.460	0.489	0.485
Total Nitrogen	mg/L	ng		0.450	0.450	0.462	0.790	0.261	0.485	0.170	0.140	0.204	0.201	1.59	0.581	0.63	0.460	0.489	0.485
Orthophosphate-Dissolved (as P)	mg/L	ng		0.0046	0.0365	0.0268	0.0052	<0.0010	<0.0010	<0.0010	<0.0010	0.0012	0.0021	<0.0010	0.0622	0.0593	0.0781	0.0710	0.0570
Phosphorus (P)-Total Dissolved	mg/L	between 0.005 and 0.015 [B, E]		0.0122	0.0437	0.0267	0.0098	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0099	0.0669	0.0666	0.0861	0.0802	0.0532
Phosphorus (P)-Total	mg/L	refer to dissolved component	0.01 [E]	0.0311	0.0520	0.0330	1.27	0.080	0.315	0.0080	0.0091	0.0216	0.0293	0.0798	0.932	0.355	0.128	0.0824	0.0743
Sulfate (SO_4)	mg/L	128 to 429 [F]	500	<5.0	<2.5	<5.0	29.2	8.02	8.17	6.03	5.85	6.06	6.12	179	<5.0	<5.0	5.3	<5.0	<5.0
Organic / Inorganic Carbon																			
Total Organic Carbon	mg/L	na [D]	4 [M]	1.74	1.88	1.37	11.4	4.01	11.0	4.14	2.86	4.05	3.63	14.5	10.8	8.6	2.66	3.04	2.34
Aggregate Organics																			
COD	mg/L			<20				22	36	24	<20				47	27	<20		

ng = no approved water quality guideline.

na = not applicable.

Shaded values indicate guideline exceedances.

Underlined values indicate not-detection exceeds guideline.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 log_{10}(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

[M] *Applicable for treatment with chlorination.*

Appendix E3. Water Quality Results and Guideline Exceedances for Well Installed at the Coarse Coal Reject Site: Physical Parameters, Anions, Nutrients, and Aggregate Organics

Well ID				MW-H26B						MW-H27				MW-H28				MW-H29			
Date Sampled				30-OCT-12	19-DEC-12	08-MAY-13	23-JUL-13	08-NOV-13	11-FEB-14	28-JUL-13	08-NOV-13	10-FEB-14	10-MAY-14	31-JUL-13	08-NOV-13	13-FEB-14	13-MAY-14	01-AUG-13	08-NOV-13	11-FEB-14	10-MAY-14
Time Sampled		BC MOE FWAL	DW	00:00	00:00	00:00	00:00	12:00	14:30	00:00	12:00	17:30	16:00	00:00	12:00	15:00	00:00	00:00	12:00	15:30	14:00
ALS Sample ID	Units	Gudielines [A]	Guidelines [A]	L1233652-3	L1252558-9	L1300522-2	L1337870-3	L1390524-2	L1422938-1	L1340620-2	L1390524-4	L1422942-6	L1453879-5	L1343263-1	L1390524-5	L1422945-1	L1455515-2	L1343263-2	L1390524-6	L1422938-2	L1453879-6
Field Measurements																					
pH	-	6.5-9.0 [D, G]	6.5-8.5	6.61	7.26	7.4	7.2	7.24	7.39	8.85	8.85	8.79	8.78	8.69	8.27	8.4	8.09	8.09	8.31	7.8	7.76
Oxidation-Reduction Potential	mV	ng		150	60	140	10	20	100	100	100	20	48	80	-120	80	-120	100	60	-60	-88
Specific Conductance	µS/cm	ng		806	552	435	819	687	648	935	630	1192	1269	902	1098	1400	1896	493	614	623	668
Temperature	°C	na		6.1	1.1	3.8	14.2	6.8	0.5	11.2	3.5	13.3	16.4	9.6	1.8	7.3	6.4	7.5	0.0	1.4	9
Physical Tests (Laboratory)																					
Colour, True		na [D]		8.9	12.8	<5.0	8.0	6.0	<5.0	<5.0	<5.0	<5.0	<5.0	5.1	15.7	23.0	28.6	8.2	<5.0	<5.0	<5.0
Conductivity	µS/cm	ng		760	982	681	847	722	720	1090	1260	1260	1250	1320	1160	1350	1820	699	689	665	658
Hardness (as $CaCO_3$)	mg/L	ng		393	378	351	377	386	353	20.1	14.6	12.5	13.2	16.2	42.5	55.3	72.8	26.5	8.47	8.37	8.53
pH		6.5-9.0 [D, G]		7.95	8.05	8.11	7.88	8.00	8.30	8.65	8.72	8.79	8.77	8.62	8.40	8.55	8.47	8.20	8.34	8.57	8.23
Total Suspended Solids	mg/L	ng		164	810	106	43.1	5.4	24.5	204	476	<3.0	<3.0	80.8	270	9.8	6.2	17.6	7.4	<3.0	<3.0
Total Dissolved Solids	mg/L	ng		-	-	-	-	-	-	-	-	-	812	-	-	-	1290	-	-	-	433
Turbidity	NTU	na		115	347	46.6	33.2	5.91	15.7	203	818	1.15	0.86	213	206	9.28	3.76	282	32.7	4.92	3.70
Anions and Nutrients																					
Acidity (as $CaCO_3$)	mg/L	ng		8.2	6.4	4.9	12.2	6.7	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.3	<1.0	<1.0	<1.0
Alkalinity, Bicarbonate (as $CaCO_3$)	mg/L	ng		331	343	355	349	351	345	572	676	627	664	692	528	503	264	357	376	344	383
Alkalinity, Carbonate (as $CaCO_3$)	mg/L	ng		<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	45.4	61.5	62.2	91.1	47.7	14.6	12.6	<1.0	<2.0	5.6	14.2	<2.0
Alkalinity, Hydroxide (as $CaCO_3$)	mg/L	ng		<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<2.0
Alkalinity, Total (as $CaCO_3$)	mg/L	ng		331	343	355	349	351	345	618	738	689	755	739	542	516	264	357	382	358	383
Ammonia, Total (as N)	mg/L	0.45 to 29 [H]		0.167	0.0946	0.0492	0.176	0.0894	0.165	0.434	0.370	0.420	0.498	0.393	0.446	0.451	0.514	0.293	0.201	0.189	0.227
Bromide (Br)	mg/L	ng		<0.50	<0.50	<0.050	<0.50	<0.25	<0.050	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.52	2.1	<0.50	<0.25	<0.050	<0.050
Chloride (Cl)	mg/L	150 [C]	250	<5.0	9.3	1.67	<5.0	<2.5	1.32	<5.0	6.7	6.9	5.4	5.7	7.9	14.1	30	<5.0	3.9	2.35	2.33
Fluoride (F)	mg/L	K	1 [C]	0.28	<0.20	0.126	0.32	0.13	0.133	0.84	0.93	0.98	0.95	1.13	0.53	0.68	0.72	0.63	0.35	0.381	0.351
Nitrate (as N)	mg/L	3 [C]	10 [L]	0.371	<0.050	0.119	<0.050	<0.025	0.0183	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.10	<0.050	<0.025	<0.0050	<0.0050
Nitrite (as N)	mg/L	0.02 [C]	1	<0.010	0.013	0.0035	<0.010	0.0068	0.0064	<0.010	0.014	<0.010	<0.010	<0.010	0.011	<0.010	<0.020	<0.010	<0.0050	<0.0010	<0.0010
Total Kjeldahl Nitrogen	mg/L	ng		0.56	0.737	0.414	0.535	0.276	0.404	0.56	0.69	0.777	0.486	0.622	1.46	1.01	1.16	0.628	0.279	0.286	0.248
Total Nitrogen	mg/L	ng		0.930	0.751	0.536	0.535	0.283	0.429	0.56	0.70	0.777	0.486	0.622	1.48	1.01	1.16	0.628	0.279	0.286	0.248
Orthophosphate-Dissolved (as P)	mg/L	ng		<0.0010	0.0182	0.0019	0.0037	0.0146	0.0064	0.0533	0.0072	0.0858	0.0758	0.0255	0.0025	0.0977	0.380	<0.0010	0.0687	0.0646	0.0429
Phosphorus (P)-Total Dissolved	mg/L	between 0.005 and 0.015 [B, E]		0.0053	0.0259	0.0036	0.0046	0.0138	0.0057	0.0603	0.0460	0.0900	0.0815	0.0449	0.0150	0.125	0.389	0.0078	0.0755	0.0651	0.0392
Phosphorus (P)-Total	mg/L	refer to dissolved component	0.01 [E]	0.191	0.610	0.099	0.0913	0.0368	0.0707	0.289	0.745	0.121	0.0848	0.224	0.523	0.422	0.618	0.287	0.142	0.0857	0.0660
Sulfate (SO_4)	mg/L	128 to 429 [F]	500	125	223	59.7	128	73.1	79.9	17.1	<5.0	<5.0	<5.0	20.7	107	195	410	44.7	9.9	6.31	6.95
Organic / Inorganic Carbon																					
Total Organic Carbon	mg/L	na [D]	4 [M]	6.16	9.25	4.99	6.85	3.48	5.69	10.3	11.8	3.57	2.03	17.2	27.7	28.9	48.1	12.4	3.03	3.05	2.39
Aggregate Organics																					
COD	mg/L				41	<20	32	<20		85	86			111	67			44	<20		

ng = no approved water quality guideline.

na = not applicable.

Shaded values indicate guideline exceedances.

Underlined values indicate not-detection exceeds guideline.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *P guideline applicable to lake water only.*

[F] *Range defined for sulphate guidelines based on ahrdness classification: very soft (128 mg/L), soft (218 mg/L), moderately soft to hard (309 mg/L), very hard (429 mg/L).*

[G] *Unresitrcted pH change permitted within 6.5 - 9.0 range. No statistically significant deviations further from this range if basline pH is outside this range. Guideline screening applied here flags groundwater outside this range.*

[H] *Ammonia guidelines temperature and pH dependent.*

[K] *Fl guideline hardness-dependent: guideline = 0.01 x [-51.73 + 92.57 $\log_{10}$(Hardness)].*

[L] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

[M] *Applicable for treatment with chlorination.*

Appendix E4. Water Quality Results and Guideline Exceedances for Well Installed in the Camp Creek Basin: Dissolved Metals

Well ID				MW-H2A				MW-H2B					MW-H5					MW-20			
Date Sampled				10-JUL-11	18-OCT-11	13-MAY-12	23-AUG-12	10-JUL-11	18-OCT-11	13-MAY-12	23-AUG-12	13-MAY-14	09-JUL-11	18-OCT-11	12-MAY-12	22-AUG-12	08-MAY-14	08-JUL-11	17-OCT-11	14-MAY-12	22-AUG-12
Time Sampled		BC MOE FWAL	DW	00:00	12:00	00:00	00:00	00:00	12:00	00:00	00:00	14:00	00:00	12:00	00:00	00:00	16:00	00:00	12:00	00:00	00:00
ALS Sample ID	Units	Gudielines [A]	Guidelines [A]	L1031047-6	L1074937-1	L1147583-5	L1201463-3	L1031047-1	L1074937-2	L1147583-6	L1201463-4	L1455515-3	L1031047-3	L1074937-3	L1147583-9	L1201465-2	L1453879-1	L1031047-2	L1074937-6	L1147583-2	L1201465-6
Dissolved Metals																					
Dissolved Metals Filtration Location	mg/L					FIELD	FIELD			FIELD	FIELD				FIELD	FIELD				FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	0.05 [B,E]	0.2	4.96	0.0996	0.0094	0.0078	0.0086	<0.0030	0.0043	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0065	2.00	0.0249	0.0185
Antimony (Sb)-Dissolved	mg/L	0.02 [B, R]	0.06 [B, T]	0.00246	0.00035	<0.00020	<0.00020	0.00027	0.00012	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00166	0.00768	0.00091	<0.00010
Arsenic (As)-Dissolved	mg/L	0.005 [B]	0.025 [B]	0.00308	0.00083	0.00039	<0.00020	0.00062	0.00027	0.00021	0.00012	<0.00010	0.00244	0.00270	0.00272	0.00270	0.00228	0.00085	0.00598	0.00240	0.00152
Barium (Ba)-Dissolved	mg/L	1 [B, C, R]	1 [B, T]	1.20	1.59	1.51	1.47	0.259	0.421	0.204	0.184	0.286	0.136	0.117	0.116	0.115	0.116	2.67	0.732	0.386	0.437
Beryllium (Be)-Dissolved	mg/L	0.0053 [B, C, R]		<0.00020	<0.00020	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00010
Bismuth (Bi)-Dissolved	mg/L	ng		<0.0010	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050
Boron (B)-Dissolved	mg/L	1.2 [B]	5 [B]	0.173	0.196	0.193	0.192	0.013	0.016	<0.010	<0.010	<0.010	0.026	0.026	0.029	0.028	0.029	0.144	0.200	0.185	0.180
Cadmium (Cd)-Dissolved	mg/L	B, R, N	0.005 [B, T]	0.000060	0.000029	<0.000020	<0.000020	<0.000010	0.000011	0.000017	<0.000010	<0.000010	<0.000010	0.000010	<0.000010	0.000016	<0.000010	0.000029	<0.000020	<0.000020	<0.000010
Calcium (Ca)-Dissolved	mg/L	na		6.31	6.61	6.98	6.29	38.2	42.0	43.2	39.7	46.2	73.5	74.3	78.8	78.3	78.3	29.2	1.86	2.35	1.91
Chromium (Cr)-Dissolved	mg/L	0.0089 [B, P]	0.05 [B, T]	0.00225	<0.00020	<0.00020	<0.00020	<0.00010	<0.00010	0.00013	<0.00010	0.00015	<0.00010	0.00012	<0.00010	<0.00010	<0.00010	0.00022	0.00096	<0.00020	0.00012
Cobalt (Co)-Dissolved	mg/L	4 [B, C]		0.00087	0.00027	<0.00020	<0.00020	0.00084	0.00029	0.00024	<0.00010	<0.00010	0.00028	0.00026	0.00027	0.00025	0.00025	0.00023	0.00030	0.00026	0.00012
Copper (Cu)-Dissolved	mg/L	0.0004 to 0.002 [B, C, F]	0.5 [B]	0.0050	<0.0010	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0937	0.0013	0.0030	<0.00050
Iron (Fe)-Dissolved	mg/L	0.35	0.3 [B, T]	1.13	<0.030	0.041	0.046	<0.030	0.076	<0.030	<0.030	<0.030	0.173	0.538	0.843	0.854	0.919	<0.030	0.526	0.067	0.164
Lead (Pb)-Dissolved	mg/L	B, C, H	0.05 [B]	0.00103	0.00014	<0.00010	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000100	0.00071	0.00021	0.000061
Lithium (Li)-Dissolved	mg/L	0.096 [R]		0.825	1.25	1.20	1.32	0.00400	0.0203	0.00203	0.00293	0.00242	0.00486	0.00528	0.00578	0.00603	0.00572	0.263	1.11	0.949	1.11
Magnesium (Mg)-Dissolved	mg/L	ng		2.83	3.17	3.56	3.16	9.30	9.82	10.4	9.83	10.9	27.0	26.2	27.9	27.5	27.5	17.7	0.690	0.74	0.618
Manganese (Mn)-Dissolved	mg/L	B, C, J	0.05 [B, T]	0.0516	0.0367	0.0329	0.0197	0.253	0.0962	0.244	0.0292	0.00166	0.634	0.534	0.574	0.567	0.608	0.0691	0.0122	0.159	0.168
Mercury (Hg)-Dissolved	mg/L	0.0000125 to 0.0002 [B, C, K]	0.001 [B]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	1 [B, C]	0.25 [B]	0.00940	0.00207	0.00159	0.00047	0.00135	0.000721	0.000455	0.000336	0.000248	0.00125	0.00137	0.00139	0.00136	0.00123	0.0252	0.0120	0.0105	0.00625
Nickel (Ni)-Dissolved	mg/L	0.025 to 0.15 [B, C, R, Q]		0.0042	0.0013	0.00159	<0.0010	0.00285	0.00087	<0.00050	<0.00050	<0.00050	0.00061	<0.00050	<0.00050	<0.00050	<0.00050	0.00102	0.0020	0.0018	0.00065
Phosphorus (P)-Dissolved	mg/L	---- refer to anions and nutrients ----		<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	0.42	0.50
Potassium (K)-Dissolved	mg/L	195 [R]		1.48	0.94	0.88	0.76	0.649	0.472	0.537	0.496	0.623	1.04	0.987	0.990	0.931	0.943	2.48	0.71	0.82	0.646
Selenium (Se)-Dissolved	mg/L	0.002 [B]	0.01 [B]	0.00066	<0.00020	<0.00020	<0.00020	0.00043	0.00018	0.00027	0.00025	0.00019	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00015	0.00081	<0.00020	0.00014
Silicon (Si)-Dissolved	mg/L	ng		12.4	3.02	2.85	2.91	2.61	2.41	2.60	2.62	2.78	6.32	5.85	6.05	6.06	5.68	3.63	5.37	2.89	2.74
Silver (Ag)-Dissolved	mg/L	0.0005 to 0.0015 [B, C, L]		0.000028	<0.000020	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000020	<0.000010
Sodium (Na)-Dissolved	mg/L	ng	200 [B, T]	304	390	368	387	9.3	10.3	1.21	<2.0	<2.0	16.1	15.1	14.1	13.8	10.3	113	347	326	339
Strontium (Sr)-Dissolved	mg/L	ng		0.169	0.229	0.237	0.229	0.0766	0.0844	0.0705	0.0655	0.0727	0.310	0.313	0.304	0.338	0.314	0.644	0.0869	0.0833	0.0849
Thallium (Tl)-Dissolved	mg/L	0.0003 [B, R]		0.000042	<0.000020	<0.000020	<0.000020	0.000018	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000011	<0.000020	<0.000020	<0.000010
Tin (Sn)-Dissolved	mg/L	ng		<0.00020	<0.00020	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00083	0.00021	<0.00010
Titanium (Ti)-Dissolved	mg/L	2 [B, R]		0.155	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.039	<0.010	<0.010
Uranium (U)-Dissolved	mg/L	0.3 [B, R]	0.02 [B, T]	0.0101	0.00286	0.000991	0.000781	0.000439	0.000179	0.000142	0.000121	0.000139	0.00126	0.00119	0.00135	0.00122	0.00114	0.000725	0.0103	0.00757	0.00449
Vanadium (V)-Dissolved	mg/L	0.006 [B, R]		0.0219	0.0045	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0081	0.0023	0.0014
Zinc (Zn)-Dissolved	mg/L	B, C, M	5 [B]	0.0127	<0.0060	<0.0060	<0.0060	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0056	<0.0030	<0.0030	<0.0030	0.124	0.0213	<0.0060	<0.0030

ng = no approved water quality guideline.

na = not applicable.

Shaded values indicate guideline exceedances.

Underlined values indicate not-detection exceeds guideline.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$\log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent.*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

Appendix E5. Water Quality Results and Guideline Exceedances for Well Installed at the Mine Sites: Dissolved Metals

Well ID				MW-H15			MW-H16		MW-H17						MW-H18				MW-H19			
Date Sampled				19-OCT-11	14-MAY-12	23-AUG-12	16-OCT-11	14-MAY-12	10-MAY-12	22-AUG-12	25-OCT-12	20-DEC-12	09-FEB-14	11-MAY-14	10-MAY-12	22-AUG-12	25-OCT-12	20-DEC-12	10-MAY-12	22-AUG-12	25-OCT-12	20-DEC-12
Time Sampled				12:00	00:00	00:00	12:00	00:00	00:00	00:00	00:00	00:00	14:20	14:30	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		BC MOE FWAL	DW	L1074937-4	L1147583-3	L1201463-2	L1074937-5	L1147583-4	L1147583-16	L1201465-7	L1230640-5	L1252558-1	L1422942-1	L1453879-8	L1147583-15	L1201465-3	L1230640-3	L1252558-2	L1147583-14	L1201465-4	L1230640-4	L1252558-3
Matrix	Units	Gudielines [A]	Guidelines [A]	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Dissolved Metals																						
Dissolved Metals Filtration Location	mg/L				FIELD	FIELD		-	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	0.05 [B,E]	0.2	0.130	0.0167	0.0272	0.383	-	0.0072	0.0040	0.0034	<0.0030	<0.0030	<0.0030	0.0053	0.0092	<0.0030	<0.0030	0.0268	0.0080	0.0042	<0.0030
Antimony (Sb)-Dissolved	mg/L	0.02 [B, R]	0.06 [B, T]	0.00149	0.00021	0.00025	0.0047	-	0.00098	0.00012	0.00069	0.00050	<0.00010	<0.00010	0.00120	0.00015	0.00017	0.00015	0.00687	0.00091	0.00107	0.00078
Arsenic (As)-Dissolved	mg/L	0.005 [B]	0.025 [B]	0.00335	0.00241	0.00267	0.0046	-	0.00049	0.00109	0.00305	0.00183	0.00061	0.00055	0.00044	0.00020	0.00019	0.00012	0.00117	0.00172	0.00120	0.00126
Barium (Ba)-Dissolved	mg/L	1 [B, C, R]	1 [B, T]	0.247	0.624	0.614	0.273	-	0.214	0.307	0.163	0.184	0.329	0.329	1.16	0.477	1.06	0.920	0.193	0.940	1.46	1.56
Beryllium (Be)-Dissolved	mg/L	0.0053 [B, C, R]		<0.00020	<0.00020	<0.00020	<0.0010	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L	ng		<0.0010	<0.0010	<0.0010	<0.0050	-	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Dissolved	mg/L	1.2 [B]	5 [B]	0.140	0.156	0.142	0.25	-	0.016	0.016	0.018	0.013	0.015	0.017	0.056	0.023	0.018	0.020	0.143	0.216	0.253	0.241
Cadmium (Cd)-Dissolved	mg/L	B, R, N	0.005 [B, T]	0.000020	0.000028	0.000028	<0.00010	-	0.000032	0.000024	0.000017	0.000028	0.000011	0.000019	0.000025	0.000136	0.000021	0.000023	0.000033	0.000013	0.000022	0.000018
Calcium (Ca)-Dissolved	mg/L	na		9.21	4.92	5.19	2.74	-	75.4	72.7	60.7	65.1	74.2	80.0	50.3	71.4	72.1	71.7	10.0	29.9	31.4	32.9
Chromium (Cr)-Dissolved	mg/L	0.0089 [B, P]	0.05 [B, T]	0.00048	<0.00020	0.00038	<0.0010	-	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00026	<0.00010	0.00011	0.00012
Cobalt (Co)-Dissolved	mg/L	4 [B, C]		0.00133	0.00034	0.00032	<0.0010	-	0.00078	0.00075	0.00061	0.00026	0.00021	0.00021	0.00074	0.00041	0.00024	0.00021	0.00090	0.00145	0.00177	0.00184
Copper (Cu)-Dissolved	mg/L	0.0004 to 0.002 [B, C, F]	0.5 [B]	0.0013	<0.0010	<0.0010	<0.0050	-	<0.00050	<0.00050	<0.00050	0.00086	<0.00050	0.00053	<0.00050	0.00071	<0.00050	0.00065	0.00289	<0.00050	0.00065	0.00093
Iron (Fe)-Dissolved	mg/L	0.35	0.3 [B, T]	0.118	0.079	0.098	0.087	-	<0.030	<0.030	<0.030	<0.030	0.036	0.048	<0.030	<0.030	<0.030	<0.030	0.048	0.057	<0.030	<0.030
Lead (Pb)-Dissolved	mg/L	B, C, H	0.05 [B]	0.00026	<0.00010	<0.00010	<0.00050	-	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000083	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	0.096 [R]		0.703	0.868	0.884	0.469	-	0.0156	0.0159	0.0217	0.0147	0.0148	0.0155	0.0656	0.0209	0.0147	0.0129	0.101	0.111	0.120	0.118
Magnesium (Mg)-Dissolved	mg/L	ng		2.60	1.32	1.34	1.28	-	19.2	19.3	14.5	15.7	19.5	20.1	15.1	19.7	20.0	20.6	2.42	11.8	11.8	13.2
Manganese (Mn)-Dissolved	mg/L	B, C, J	0.05 [B, T]	0.337	0.205	0.205	0.0625	-	0.0725	0.119	0.145	0.0665	0.0468	0.0397	0.0429	0.0431	0.0157	0.00796	0.0656	0.310	0.344	0.364
Mercury (Hg)-Dissolved	mg/L	0.0000125 to 0.0002 [B, C, K]	0.001 [B]	<0.000010	<0.000010	<0.000010	<0.000010	-	<0.000050	<0.000010	<0.000010	<0.000010	0.000017	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	1 [B, C]	0.25 [B]	0.0529	0.0267	0.0280	0.0657	-	0.00706	0.00241	0.00646	0.00379	0.000707	0.000666	0.00136	0.000745	0.000704	0.000699	0.0165	0.00537	0.00392	0.00381
Nickel (Ni)-Dissolved	mg/L	0.025 to 0.15 [B, C, R, Q]		0.0069	0.0012	0.0018	0.0065	-	0.00205	0.00162	0.00286	0.00266	0.00091	0.00092	0.00298	0.00166	0.00171	0.00176	0.00797	0.00499	0.00534	0.00538
Phosphorus (P)-Dissolved	mg/L	---- refer to anions and nutrients ----		<0.30	<0.30	<0.30	<0.30	-	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved	mg/L	195 [R]		1.33	1.11	1.13	2.21	-	1.29	1.11	1.68	1.44	1.08	1.05	1.44	0.953	0.860	0.837	2.73	1.67	1.61	1.73
Selenium (Se)-Dissolved	mg/L	0.002 [B]	0.01 [B]	0.00059	<0.00020	0.00031	0.0016	-	0.00245	<0.00010	0.00028	0.00026	<0.00010	<0.00010	0.00114	0.00047	0.00061	0.00066	0.00258	0.00028	0.00060	0.00022
Silicon (Si)-Dissolved	mg/L	ng		3.80	3.36	3.48	4.00	-	3.85	4.18	4.84	4.34	4.26	4.11	3.43	3.24	3.26	3.14	4.16	4.69	4.44	4.37
Silver (Ag)-Dissolved	mg/L	0.0005 to 0.0015 [B, C, L]		<0.000020	<0.000020	<0.000020	<0.00010	-	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	ng	200 [B, T]	404	391	440	289	-	17.6	17.0	52.9	32.2	11.2	10.6	40.6	11.3	6.5	5.3	115	83.9	73.3	70.0
Strontium (Sr)-Dissolved	mg/L	ng		0.156	0.200	0.204	0.0984	-	0.208	0.219	0.144	0.139	0.214	0.229	0.488	0.388	0.480	0.435	0.0875	0.795	0.931	0.943
Thallium (Tl)-Dissolved	mg/L	0.0003 [B, R]		0.000056	<0.000020	<0.000020	<0.00010	-	0.000014	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000018	<0.000010	<0.000010	<0.000010	0.000024	<0.000010	0.000041	0.000024
Tin (Sn)-Dissolved	mg/L	ng		<0.00020	0.00057	0.00054	<0.0010	-	<0.00010	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00016	<0.00010	0.00018	0.00019	0.00197	0.00056
Titanium (Ti)-Dissolved	mg/L	2 [B, R]		<0.010	<0.010	<0.010	<0.010	-	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Dissolved	mg/L	0.3 [B, R]	0.02 [B, T]	0.00276	0.00105	0.00109	0.00734	-	0.00316	0.00241	0.00794	0.00509	0.00117	0.00113	0.000716	0.000598	0.000711	0.000599	0.00277	0.00253	0.00176	0.00167
Vanadium (V)-Dissolved	mg/L	0.006 [B, R]		0.0021	<0.0020	<0.0020	0.010	-	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)-Dissolved	mg/L	B, C, M	5 [B]	<0.0060	<0.0060	<0.0060	<0.030	-	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0050	0.0032	<0.0030	<0.0030	<0.0030	0.0033	0.0059

ng = no approved water quality guideline.

na = not applicable.

Shaded values indicate guideline exceedances.

Underlined values indicate not-detection exceeds guideline.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercury (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$\log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent.*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

Appendix E5. Water Quality Results and Guideline Exceedances for Well Installed at the Mine Sites: Dissolved Metals

Well ID				MW-PNB				MW-H22						MW-H23						MW-SHAFT
Date Sampled				07-JUL-11	15-OCT-11	11-MAY-12	21-AUG-12	11-MAY-12	21-AUG-12	28-OCT-12	19-DEC-12	08-FEB-14	17-APR-14	11-MAY-12	21-AUG-12	28-OCT-12	19-DEC-12	08-FEB-14	17-APR-14	09-FEB-14
Time Sampled				00:00	12:00	00:00	00:00	00:00	00:00	00:00	00:00	15:30	14:00	00:00	00:00	00:00	00:00	12:00	17:00	12:00
ALS Sample ID				L1031047-4	L1074937-7	L1147583-11	L1201465-5	L1147583-13	L1201465-8	L1230640-7	L1252558-5	L1422942-2	L1445192-1	L1147583-12	L1201465-1	L1230640-6	L1252558-6	L1422942-4	L1445192-2	L1422942-3
Matrix	Units	BC MOE FWAL Gudielines [A]	DW Guidelines [A]	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Dissolved Metals																				
Dissolved Metals Filtration Location	mg/L					FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	0.05 [B,E]	0.2	0.0034	0.0032	<0.0030	<0.0030	<0.0060	0.0074	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0031
Antimony (Sb)-Dissolved	mg/L	0.02 [B, R]	0.06 [B, T]	0.00015	0.00010	0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.005 [B]	0.025 [B]	<0.00010	<0.00010	0.00107	0.00094	<0.00020	0.00012	0.00012	0.00015	0.00015	<0.00010	<0.00010	<0.00010	<0.00010	0.00012	0.00015	<0.00010	0.00022
Barium (Ba)-Dissolved	mg/L	1 [B, C, R]	1 [B, T]	0.204	0.195	0.113	0.126	0.246	0.341	0.315	0.310	0.252	0.257	0.206	0.228	0.249	0.253	0.245	0.252	0.717
Beryllium (Be)-Dissolved	mg/L	0.0053 [B, C, R]		<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L	ng		<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Dissolved	mg/L	1.2 [B]	5 [B]	<0.010	<0.010	0.014	0.012	<0.020	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium (Cd)-Dissolved	mg/L	B, R, N	0.005 [B, T]	0.000024	0.000012	<0.000010	<0.000010	<0.000020	0.000021	0.000015	0.000014	0.000061	<0.000010	0.000015	0.000029	<0.000010	0.000016	0.000021	<0.000010	0.000146
Calcium (Ca)-Dissolved	mg/L	na		58.8	61.1	54.3	52.8	79.6	89.3	97.4	95.6	99.1	98.3	71.1	72.3	66.3	69.1	67.1	71.3	192
Chromium (Cr)-Dissolved	mg/L	0.0089 [B, P]	0.05 [B, T]	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	0.00028	0.00057	0.00065	0.00067	0.00076	0.00013	<0.00010	0.00013	0.00015	0.00010	0.00011	<0.00010
Cobalt (Co)-Dissolved	mg/L	4 [B, C]		0.00025	0.00015	0.00039	0.00080	0.00027	0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00013	<0.00010	<0.00010	0.00022	<0.00010	<0.00010	0.00094
Copper (Cu)-Dissolved	mg/L	0.0004 to 0.002 [B, C, F]	0.5 [B]	0.00056	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	0.00064	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00052	0.00061	<0.00050	0.00141
Iron (Fe)-Dissolved	mg/L	0.35	0.3 [B, T]	0.188	0.203	0.654	0.967	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	<0.030	0.041
Lead (Pb)-Dissolved	mg/L	B, C, H	0.05 [B]	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	0.096 [R]		0.00355	0.00372	0.00309	0.00310	0.0043	0.00467	0.00394	0.00414	0.00334	0.00339	0.00317	0.00421	0.00328	0.00349	0.00314	0.00336	0.00453
Magnesium (Mg)-Dissolved	mg/L	ng		16.5	16.3	14.3	15.0	20.7	24.0	22.4	24.4	22.6	22.9	16.9	17.4	15.5	18.4	16.1	18.2	41.4
Manganese (Mn)-Dissolved	mg/L	B, C, J	0.05 [B, T]	0.0547	0.0381	1.12	1.13	0.0277	0.0268	0.00327	0.00393	0.00405	0.00737	0.00796	0.00349	0.00324	0.0254	0.000660	0.00169	0.0507
Mercury (Hg)-Dissolved	mg/L	0.0000125 to 0.0002 [B, C, K]	0.001 [B]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	1 [B, C]	0.25 [B]	0.000606	0.000528	0.00354	0.00269	0.00172	0.00138	0.000813	0.000778	0.000435	0.000423	0.000431	0.000440	0.000417	0.000686	0.000448	0.000375	0.000251
Nickel (Ni)-Dissolved	mg/L	0.025 to 0.15 [B, C, R, Q]		0.00135	0.00091	0.00152	0.00113	<0.0010	0.00072	0.00056	0.00057	<0.00050	<0.00050	0.00069	<0.00050	<0.00050	0.00062	0.00055	<0.00050	0.00527
Phosphorus (P)-Dissolved	mg/L	---- refer to anions and nutrients ----		<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved	mg/L	195 [R]		0.588	0.552	0.964	0.854	0.80	0.805	0.908	1.00	1.56	0.951	0.640	0.637	0.618	0.747	1.02	0.649	1.09
Selenium (Se)-Dissolved	mg/L	0.002 [B]	0.01 [B]	0.00063	0.00066	0.00027	0.00037	<0.00020	0.00034	0.00046	0.00052	0.00073	0.00066	0.00042	0.00044	0.00043	0.00058	0.00053	0.00056	<0.00010
Silicon (Si)-Dissolved	mg/L	ng		2.50	2.34	2.65	2.63	3.18	3.69	3.85	3.74	3.80	3.84	2.85	2.91	2.87	2.81	2.93	2.97	4.01
Silver (Ag)-Dissolved	mg/L	0.0005 to 0.0015 [B, C, L]		<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	ng	200 [B, T]	2.4	2.4	50.7	40.9	2.20	<2.0	<2.0	<2.0	<2.0	<2.0	2.36	2.2	2.2	2.5	2.3	2.4	24.9
Strontium (Sr)-Dissolved	mg/L	ng		0.111	0.110	0.116	0.129	0.110	0.141	0.139	0.133	0.139	0.137	0.108	0.115	0.109	0.106	0.112	0.118	0.255
Thallium (Tl)-Dissolved	mg/L	0.0003 [B, R]		0.000011	0.000011	<0.000010	<0.000010	<0.000020	0.000013	0.000013	0.000015	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000010	<0.000010	<0.000010	0.000012
Tin (Sn)-Dissolved	mg/L	ng		<0.00010	<0.00010	<0.00010	0.00017	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	2 [B, R]		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.018	<0.010	<0.010	<0.010	<0.010	<0.010	0.015	0.011
Uranium (U)-Dissolved	mg/L	0.3 [B, R]	0.02 [B, T]	0.000282	0.000247	0.00110	0.000931	0.000577	0.000492	0.000480	0.000506	0.000440	0.000433	0.000265	0.000245	0.000235	0.000303	0.000247	0.000245	0.000658
Vanadium (V)-Dissolved	mg/L	0.006 [B, R]		<0.0010	<0.0010	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)-Dissolved	mg/L	B, C, M	5 [B]	<0.0030	0.0042	<0.0030	<0.0030	<0.0060	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	0.0049

ng = no approved water quality guideline.

na = not applicable.

Shaded values indicate guideline exceedances.

Underlined values indicate not-detection exceeds guideline.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$\log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent.*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

Appendix E6. Water Quality Results and Guideline Exceedances for Well Installed at the Coarse Coal Reject Site: Dissolved Metals

Well ID				MW-H24A				MW-H24B						MW-H24C				MW-H25A		
Date Sampled				29-OCT-12	20-DEC-12	09-MAY-13	08-NOV-13	22-OCT-12	19-DEC-12	07-MAY-13	23-JUL-13	08-NOV-13	10-FEB-14	23-JUL-13	08-NOV-13	13-FEB-14	09-MAY-14	01-NOV-12	09-MAY-13	28-JUL-13
Time Sampled				00:00	00:00	00:00	12:00	00:00	00:00	00:00	00:00	12:00	16:15	00:00	12:00	14:00	14:00	00:00	00:00	00:00
ALS Sample ID		BC MOE FWAL	DW	L1233652-2	L1252558-4	L1300522-5	L1390394-1	L1230640-1	L1252558-7	L1300522-6	L1337870-1	L1390394-2	L1422942-5	L1337870-2	L1390394-3	L1422938-5	L1453879-2	L1233652-4	L1300522-3	L1340620-1
Matrix	Units	Gudielines [A]	Guidelines [A]	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Dissolved Metals																				
Dissolved Metals Filtration Location	mg/L			LAB	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD		FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved	mg/L	0.05 [B,E]	0.2	0.054	0.025	0.123	0.0590	<0.0030	0.0048	<0.0030	0.0050	<0.0030	<0.0030	0.0075	0.0043	0.0042	0.0047	0.0166	0.0042	0.0089
Antimony (Sb)-Dissolved	mg/L	0.02 [B, R]	0.06 [B, T]	<0.00050	<0.00050	0.00051	0.00027	0.00095	0.00014	0.00072	0.00028	0.00025	0.00029	0.00096	<0.00010	<0.00010	<0.00010	0.00176	0.00076	0.00170
Arsenic (As)-Dissolved	mg/L	0.005 [B]	0.025 [B]	<0.00050	<0.00050	<0.00020	0.00023	0.00024	0.00028	0.00124	0.00086	0.00021	0.00037	0.0409	0.00124	0.00051	0.00070	0.00276	0.00111	0.00206
Barium (Ba)-Dissolved	mg/L	1 [B, C, R]	1 [B, T]	6.91	6.96	3.60	3.67	1.08	0.699	0.615	0.810	0.904	0.859	0.296	1.05	1.03	1.11	0.392	1.27	1.37
Beryllium (Be)-Dissolved	mg/L	0.0053 [B, C, R]		<0.00050	<0.00050	<0.00020	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L	ng		<0.0025	<0.0025	<0.0010	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050
Boron (B)-Dissolved	mg/L	1.2 [B]	5 [B]	<0.050	<0.050	<0.020	<0.020	0.013	0.011	0.014	<0.010	0.012	0.011	0.024	0.025	0.023	0.023	<0.020	0.193	0.202
Cadmium (Cd)-Dissolved	mg/L	B, R, N	0.005 [B, T]	<0.000050	<0.000050	<0.000020	<0.000020	0.000027	0.000045	0.000018	<0.000010	0.000038	0.000034	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010	0.000054
Calcium (Ca)-Dissolved	mg/L	na		701	490	231	420	69.8	69.5	71.2	63.4	67.4	67.5	69.3	71.1	72.9	77.2	237	3.83	4.06
Chromium (Cr)-Dissolved	mg/L	0.0089 [B, P]	0.05 [B, T]	0.0470	0.0352	0.0206	0.0186	<0.00010	0.00032	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.0649	<0.00010	<0.00010
Cobalt (Co)-Dissolved	mg/L	4 [B, C]		0.00058	<0.00050	<0.00020	0.00025	0.00077	0.00055	0.00164	0.00180	0.00082	0.00075	0.00072	<0.00010	<0.00010	<0.00010	<0.00020	0.00011	0.00054
Copper (Cu)-Dissolved	mg/L	0.0004 to 0.002 [B, C, F]	0.5 [B]	0.0047	0.0050	0.00459	0.00632	<0.00050	0.00104	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0025	<0.00050	0.00142
Iron (Fe)-Dissolved	mg/L	0.35	0.3 [B, T]	<0.030	<0.030	<0.030	<0.030	<0.030	0.043	<0.030	0.488	0.047	0.169	0.863	3.65	2.15	1.82	<0.030	<0.030	<0.030
Lead (Pb)-Dissolved	mg/L	B, C, H	0.05 [B]	0.00156	0.00127	0.00064	0.00098	<0.000050	0.000052	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.00010	0.000076	0.000061
Lithium (Li)-Dissolved	mg/L	0.096 [R]		0.244	0.215	0.143	0.100	0.00178	0.00143	0.00328	0.00118	0.00153	0.00141	0.0157	0.0169	0.0165	0.0156	0.0157	0.531	0.505
Magnesium (Mg)-Dissolved	mg/L	ng		0.040	0.032	0.036	0.043	17.8	18.2	17.0	16.0	17.3	17.2	21.6	21.8	22.0	24.3	0.225	1.62	1.92
Manganese (Mn)-Dissolved	mg/L	B, C, J	0.05 [B, T]	<0.00025	<0.00025	<0.00010	0.00010	0.0546	0.0596	0.371	0.344	0.0408	0.0469	0.212	0.327	0.105	0.0912	0.00027	0.00616	0.00939
Mercury (Hg)-Dissolved	mg/L	0.0000125 to 0.0002 [B, C, K]	0.001 [B]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	1 [B, C]	0.25 [B]	0.0242	0.0214	0.0120	0.0101	0.000933	0.000610	0.00158	0.00121	0.000667	0.000726	0.00650	0.00258	0.00159	0.00174	0.0172	0.00622	0.00725
Nickel (Ni)-Dissolved	mg/L	0.025 to 0.15 [B, C, R, Q]		<0.0025	<0.0025	<0.0010	0.0013	0.00166	0.00099	0.00485	0.00191	0.00099	0.00111	0.00171	<0.00050	<0.00050	<0.00050	0.0013	0.00110	0.00422
Phosphorus (P)-Dissolved	mg/L	---- refer to anions and nutrients ----		<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved	mg/L	195 [R]		101	72.5	18.7	11.3	0.858	1.06	1.19	0.815	0.835	0.834	2.37	0.969	0.826	0.873	6.70	0.725	1.48
Selenium (Se)-Dissolved	mg/L	0.002 [B]	0.01 [B]	0.00063	0.00060	0.00048	0.00040	0.00083	<0.00010	0.00079	0.00028	0.00028	0.00027	0.00016	<0.00010	<0.00010	0.00022	0.00125	0.00010	0.00112
Silicon (Si)-Dissolved	mg/L	ng		0.132	0.254	0.668	0.325	2.68	2.80	2.84	2.65	2.86	2.74	5.47	6.66	6.59	6.22	40.1	3.19	2.74
Silver (Ag)-Dissolved	mg/L	0.0005 to 0.0015 [B, C, L]		<0.000050	<0.000050	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	ng	200 [B, T]	898	883	528	567	8.0	6.5	24.3	6.2	11.7	10.1	22.4	15.0	13.3	10.0	32.6	290	248
Strontium (Sr)-Dissolved	mg/L	ng		26.3	22.3	8.17	6.67	0.237	0.180	0.307	0.186	0.188	0.191	0.381	0.523	0.483	0.506	0.842	0.139	0.144
Thallium (Tl)-Dissolved	mg/L	0.0003 [B, R]		<0.000050	<0.000050	<0.000020	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000010	0.000021
Tin (Sn)-Dissolved	mg/L	ng		0.00095	0.00383	0.00037	0.00096	<0.00010	0.00013	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00052	<0.00010	0.00024
Titanium (Ti)-Dissolved	mg/L	2 [B, R]		<0.010	0.016	0.011	0.016	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Dissolved	mg/L	0.3 [B, R]	0.02 [B, T]	<0.000050	<0.000050	<0.000020	<0.000020	0.000413	0.000519	0.00465	0.000698	0.000469	0.000456	0.00130	0.000147	0.000091	0.000084	<0.000020	0.000555	0.00176
Vanadium (V)-Dissolved	mg/L	0.006 [B, R]		<0.0050	<0.0050	<0.0020	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0258	0.0021	0.0037
Zinc (Zn)-Dissolved	mg/L	B, C, M	5 [B]	0.016	<0.015	0.0143	0.0173	<0.0030	0.0077	0.0034	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030	<0.0060	<0.0030	<0.0030

ng = no approved water quality guideline.

na = not applicable.

Shaded values indicate guideline exceedances.

Underlined values indicate not-detection exceeds guideline.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$\log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent.*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

Appendix E6. Water Quality Results and Guideline Exceedances for Well Installed at the Coarse Coal Reject Site: Dissolved Metals

Well ID				MW-H25A *(cont'd)*			MW-H25B							MW-H26A					
Date Sampled				08-NOV-13	13-FEB-14	09-MAY-14	22-OCT-12	19-DEC-12	07-MAY-13	23-JUL-13	08-NOV-13	12-FEB-14	11-MAY-14	30-OCT-12	09-MAY-13	28-JUL-13	08-NOV-13	12-FEB-14	10-MAY-14
Time Sampled				12:00	18:45	14:30	00:00	00:00	00:00	00:00	12:00	15:00	11:00	00:00	00:00	00:00	12:00	15:30	15:00
ALS Sample ID		BC MOE FWAL	DW	L1390394-4	L1422945-2	L1453879-3	L1230640-2	L1252558-8	L1300522-4	L1337870-4	L1390394-5	L1422938-4	L1453879-7	L1233652-1	L1300522-1	L1340620-3	L1390524-1	L1422938-3	L1453879-4
Matrix	Units	Gudielines [A]	Guidelines [A]	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Dissolved Metals																			
Dissolved Metals Filtration Location	mg/L			FIELD	FIELD		FIELD	FIELD	FIELD	FIELD	FIELD	FIELD		FIELD	FIELD	FIELD	FIELD	FIELD	
Aluminum (Al)-Dissolved	mg/L	0.05 [B,E]	0.2	0.0050	0.0061	0.0049	0.0131	<0.0030	<0.0030	0.0033	<0.0030	<0.0030	<0.0030	0.0573	0.111	0.0595	0.127	0.112	0.112
Antimony (Sb)-Dissolved	mg/L	0.02 [B, R]	0.06 [B, T]	<0.00010	<0.00010	<0.00010	0.00028	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00119	0.00104	0.00073	0.00098	0.00045	0.00038
Arsenic (As)-Dissolved	mg/L	0.005 [B]	0.025 [B]	<0.00010	<0.00010	<0.00010	0.00131	0.00130	0.00125	0.00160	0.00166	0.00147	0.00146	0.00211	0.00133	0.00169	0.00087	0.00043	0.00050
Barium (Ba)-Dissolved	mg/L	1 [B, C, R]	1 [B, T]	1.13	1.14	1.18	0.291	0.220	0.211	0.274	0.287	0.267	0.273	0.473	0.844	0.795	0.547	0.626	0.647
Beryllium (Be)-Dissolved	mg/L	0.0053 [B, C, R]		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L	ng		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Dissolved	mg/L	1.2 [B]	5 [B]	0.200	0.193	0.213	0.014	0.017	0.012	0.011	0.013	0.010	0.010	0.037	0.183	0.185	0.197	0.191	0.207
Cadmium (Cd)-Dissolved	mg/L	B, R, N	0.005 [B, T]	<0.000010	<0.000010	<0.000010	0.000142	0.000029	0.000017	<0.000010	<0.000010	<0.000010	<0.000010	<0.000050	<0.000010	0.000105	<0.000010	<0.000010	<0.000010
Calcium (Ca)-Dissolved	mg/L	na		3.57	3.19	3.44	109	89.3	90.0	91.7	95.3	96.2	99.1	143	5.52	4.12	4.86	4.49	4.69
Chromium (Cr)-Dissolved	mg/L	0.0089 [B, P]	0.05 [B, T]	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.0764	0.00019	0.00107	0.00023	0.00015	0.00017
Cobalt (Co)-Dissolved	mg/L	4 [B, C]		<0.00010	<0.00010	<0.00010	0.00731	0.00204	0.00166	0.00146	0.00128	0.00120	0.00118	0.00012	<0.00010	0.00061	<0.00010	<0.00010	<0.00010
Copper (Cu)-Dissolved	mg/L	0.0004 to 0.002 [B, C, F]	0.5 [B]	<0.00050	<0.00050	<0.00050	0.00082	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.00708	0.00111	0.00189	<0.00050	<0.00050	<0.00050
Iron (Fe)-Dissolved	mg/L	0.35	0.3 [B, T]	0.062	0.070	0.061	0.047	<0.030	0.094	0.372	0.367	0.526	0.525	0.034	0.066	<0.030	0.054	0.048	0.044
Lead (Pb)-Dissolved	mg/L	B, C, H	0.05 [B]	<0.000050	<0.000050	<0.000050	0.000071	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000099	0.000578	0.000635	0.000159	0.000107	0.000099
Lithium (Li)-Dissolved	mg/L	0.096 [R]		0.567	0.473	0.576	0.00757	0.00713	0.00655	0.00631	0.00724	0.00664	0.00702	0.185	0.571	0.497	0.521	0.500	0.567
Magnesium (Mg)-Dissolved	mg/L	ng		1.56	1.49	1.68	32.7	29.5	29.3	28.3	29.7	29.8	32.0	0.123	2.01	2.08	1.58	1.87	2.17
Manganese (Mn)-Dissolved	mg/L	B, C, J	0.05 [B, T]	0.0226	0.0206	0.0195	0.549	0.805	0.782	0.700	0.710	0.673	0.705	0.00123	0.00460	0.00506	0.00676	0.00818	0.00998
Mercury (Hg)-Dissolved	mg/L	0.0000125 to 0.0002 [B, C, K]	0.001 [B]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	1 [B, C]	0.25 [B]	0.000707	0.000580	0.000583	0.00274	0.00317	0.00250	0.00218	0.00218	0.00195	0.00190	0.156	0.00791	0.00570	0.00899	0.00626	0.00554
Nickel (Ni)-Dissolved	mg/L	0.025 to 0.15 [B, C, R, Q]		<0.00050	<0.00050	<0.00050	0.0204	0.00408	0.00399	0.00372	0.00341	0.00278	0.00272	0.00090	0.00096	0.00188	<0.00050	<0.00050	<0.00050
Phosphorus (P)-Dissolved	mg/L	---- refer to anions and nutrients ----		<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved	mg/L	195 [R]		0.560	0.546	0.593	1.57	1.00	0.766	0.585	0.592	0.533	0.520	9.44	0.601	0.773	0.687	0.664	0.663
Selenium (Se)-Dissolved	mg/L	0.002 [B]	0.01 [B]	<0.00010	<0.00010	<0.00010	0.00138	0.00012	<0.00010	<0.00010	0.00011	<0.00010	0.00025	0.00238	<0.00010	0.00018	<0.00010	<0.00010	<0.00010
Silicon (Si)-Dissolved	mg/L	ng		3.15	3.19	3.08	5.99	5.49	5.29	5.53	5.90	5.37	5.13	17.6	4.38	3.89	4.80	4.60	4.52
Silver (Ag)-Dissolved	mg/L	0.0005 to 0.0015 [B, C, L]		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000048	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	ng	200 [B, T]	275	285	277	12.2	11.5	10.2	8.5	9.2	8.3	8.1	156	293	259	277	276	285
Strontium (Sr)-Dissolved	mg/L	ng		0.139	0.124	0.136	0.271	0.274	0.264	0.251	0.262	0.256	0.258	0.708	0.139	0.132	0.134	0.134	0.140
Thallium (Tl)-Dissolved	mg/L	0.0003 [B, R]		<0.000010	<0.000010	<0.000010	0.000026	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000103	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved	mg/L	ng		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00067	0.00012	0.00055	0.00019	0.00014	0.00014
Titanium (Ti)-Dissolved	mg/L	2 [B, R]		<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	<0.010	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Dissolved	mg/L	0.3 [B, R]	0.02 [B, T]	0.000020	0.000016	0.000014	0.00435	0.00267	0.00181	0.00142	0.00140	0.00130	0.00130	<0.000010	0.000318	0.000512	0.000508	0.000357	0.000327
Vanadium (V)-Dissolved	mg/L	0.006 [B, R]		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0158	0.0011	0.0042	<0.0010	<0.0010	<0.0010
Zinc (Zn)-Dissolved	mg/L	B, C, M	5 [B]	<0.0030	<0.0030	<0.0030	0.0033	<0.0030	0.0122	<0.0030	<0.0030	<0.0030	<0.0030	0.0031	0.0033	<0.0030	0.0037	<0.0030	<0.0030

ng = no approved water quality guideline.

na = not applicable.

Shaded values indicate guideline exceedances.

Underlined values indicate not-detection exceeds guideline.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$\log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent.*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

Appendix E6. Water Quality Results and Guideline Exceedances for Well Installed at the Coarse Coal Reject Site: Dissolved Metals

Well ID				MW-H26B						MW-H27				MW-H28				MW-H29			
Date Sampled				30-OCT-12	19-DEC-12	08-MAY-13	23-JUL-13	08-NOV-13	11-FEB-14	28-JUL-13	08-NOV-13	10-FEB-14	10-MAY-14	31-JUL-13	08-NOV-13	13-FEB-14	13-MAY-14	01-AUG-13	08-NOV-13	11-FEB-14	10-MAY-14
Time Sampled				00:00	00:00	00:00	00:00	12:00	14:30	00:00	12:00	17:30	16:00	00:00	12:00	15:00	00:00	00:00	12:00	15:30	14:00
ALS Sample ID		BC MOE FWAL	DW	L1233652-3	L1252558-9	L1300522-2	L1337870-3	L1390524-2	L1422938-1	L1340620-2	L1390524-4	L1422942-6	L1453879-5	L1343263-1	L1390524-5	L1422945-1	L1455515-2	L1343263-2	L1390524-6	L1422938-2	L1453879-6
Matrix	Units	Gudielines [A]	Guidelines [A]	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Dissolved Metals																					
Dissolved Metals Filtration Location	mg/L			FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD	FIELD		FIELD	FIELD	FIELD		FIELD	FIELD	FIELD	
Aluminum (Al)-Dissolved	mg/L	0.05 [B,E]	0.2	0.0118	0.0066	0.0032	0.0050	0.0043	<0.0030	0.0178	0.0076	0.0101	0.0075	0.0259	0.0142	0.0112	0.0073	0.0434	0.0064	0.0044	0.0032
Antimony (Sb)-Dissolved	mg/L	0.02 [B, R]	0.06 [B, T]	0.00072	0.00098	0.00016	0.00037	<0.00010	<0.00010	0.00041	0.00036	<0.00010	<0.00020	0.00087	0.00024	0.00014	<0.00020	0.00033	<0.00010	<0.00010	<0.00010
Arsenic (As)-Dissolved	mg/L	0.005 [B]	0.025 [B]	0.00096	0.00117	0.00096	0.00290	0.00223	0.00154	0.00071	0.00058	0.00021	0.00021	0.00183	0.00482	0.00330	0.00570	0.00044	0.00118	0.00103	0.00067
Barium (Ba)-Dissolved	mg/L	1 [B, C, R]	1 [B, T]	0.0947	0.0759	0.0641	0.0729	0.0790	0.0732	0.810	0.988	1.24	1.27	0.697	0.0491	0.179	0.160	0.114	0.0657	0.0428	0.0906
Beryllium (Be)-Dissolved	mg/L	0.0053 [B, C, R]		<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00010	<0.00020	<0.00020	<0.00010	<0.00010	<0.00020	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved	mg/L	ng		<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010	<0.0010	<0.00050	<0.0010	<0.0010	<0.00050	<0.00050	<0.0010	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Dissolved	mg/L	1.2 [B]	5 [B]	0.069	0.070	0.027	0.052	0.048	0.044	0.203	0.221	0.153	0.222	0.199	0.192	0.196	0.154	0.160	0.177	0.169	0.170
Cadmium (Cd)-Dissolved	mg/L	B, R, N	0.005 [B, T]	0.000236	0.000071	0.000083	0.000045	0.000029	0.000038	<0.000020	0.000033	<0.000010	<0.000020	0.000098	0.000020	<0.000010	<0.000020	0.000038	<0.000010	<0.000010	<0.000010
Calcium (Ca)-Dissolved	mg/L	na		107	97.6	85.3	92.9	94.4	85.0	3.30	3.90	2.85	3.27	4.25	10.3	13.7	17.3	7.81	2.72	2.84	2.88
Chromium (Cr)-Dissolved	mg/L	0.0089 [B, P]	0.05 [B, T]	0.00101	0.00017	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020	<0.00020	<0.00010	<0.00020	0.00023	0.00021	0.00022	<0.00020	0.00015	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved	mg/L	4 [B, C]		0.0123	0.00554	0.00222	0.00341	0.00258	0.00220	<0.00020	0.00024	0.00011	<0.00020	0.00054	0.00166	0.00087	0.00032	0.00096	0.00036	0.00023	0.00018
Copper (Cu)-Dissolved	mg/L	0.0004 to 0.002 [B, C, F]	0.5 [B]	0.00645	0.00239	0.00082	<0.00050	<0.00050	<0.00050	<0.00050	0.00146	0.00099	<0.00050	0.00176	<0.00050	0.00066	<0.00050	0.00136	<0.00050	<0.00050	<0.00050
Iron (Fe)-Dissolved	mg/L	0.35	0.3 [B, T]	<0.030	<0.030	0.036	1.13	0.287	0.182	<0.030	<0.030	<0.030	<0.030	<0.030	0.396	0.090	0.305	<0.030	0.148	0.135	0.117
Lead (Pb)-Dissolved	mg/L	B, C, H	0.05 [B]	0.000077	0.000104	<0.000050	<0.000050	<0.000050	<0.000050	0.00010	0.00013	0.000063	<0.00010	0.00018	0.000052	0.000061	<0.00010	<0.000050	<0.000050	<0.000050	<0.000050
Lithium (Li)-Dissolved	mg/L	0.096 [R]		0.0133	0.00925	0.00759	0.00531	0.00571	0.00414	0.645	0.764	0.505	0.756	0.710	0.232	0.263	0.219	0.161	0.173	0.155	0.175
Magnesium (Mg)-Dissolved	mg/L	ng		30.5	32.7	33.5	35.1	36.5	34.1	2.89	1.18	1.30	1.23	1.35	4.11	5.11	7.19	1.71	0.406	0.312	0.322
Manganese (Mn)-Dissolved	mg/L	B, C, J	0.05 [B, T]	0.892	1.02	0.670	1.47	1.17	0.978	0.00567	0.0102	0.0175	0.0175	0.00674	0.520	0.638	0.730	0.0999	0.121	0.0971	0.0757
Mercury (Hg)-Dissolved	mg/L	0.0000125 to 0.0002 [B, C, K]	0.001 [B]	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	0.000012	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved	mg/L	1 [B, C]	0.25 [B]	0.00438	0.00676	0.00237	0.00338	0.00291	0.00268	0.0110	0.0138	0.00942	0.0102	0.0139	0.0225	0.0204	0.0191	0.00696	0.000566	0.000269	0.000156
Nickel (Ni)-Dissolved	mg/L	0.025 to 0.15 [B, C, R, Q]		0.0388	0.0152	0.00524	0.00905	0.00621	0.00612	<0.0010	0.0025	<0.00050	<0.0010	0.0060	0.00946	0.00531	0.0023	0.00574	0.00156	0.00098	0.00095
Phosphorus (P)-Dissolved	mg/L	---- refer to anions and nutrients ----		<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	<0.30	0.57	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved	mg/L	195 [R]		5.25	3.83	1.86	2.50	2.32	2.30	0.68	0.66	1.24	0.51	0.91	1.35	1.70	1.59	1.47	0.498	0.401	0.296
Selenium (Se)-Dissolved	mg/L	0.002 [B]	0.01 [B]	0.00404	0.00061	0.00027	0.00026	0.00021	0.00011	0.00209	<0.00020	<0.00010	<0.00020	0.00042	0.00030	0.00019	<0.00020	0.00014	<0.00010	<0.00010	<0.00010
Silicon (Si)-Dissolved	mg/L	ng		5.88	6.76	4.64	6.03	6.35	5.68	2.83	2.95	2.86	2.91	2.67	4.04	4.56	4.30	3.55	4.25	4.14	3.91
Silver (Ag)-Dissolved	mg/L	0.0005 to 0.0015 [B, C, L]		<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020	<0.000020	<0.000010	<0.000020	<0.000020	<0.000010	<0.000010	<0.000020	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved	mg/L	ng	200 [B, T]	49.9	86.3	22.6	34.3	23.5	19.2	306	352	339	347	323	295	354	361	173	185	173	175
Strontium (Sr)-Dissolved	mg/L	ng		0.332	0.329	0.279	0.336	0.316	0.341	0.118	0.150	0.120	0.151	0.116	0.127	0.201	0.326	0.0573	0.0286	0.0243	0.0375
Thallium (Tl)-Dissolved	mg/L	0.0003 [B, R]		0.000046	0.000011	0.000023	0.000020	0.000014	0.000013	<0.000020	<0.000020	<0.000010	<0.000020	<0.000020	<0.000010	<0.000010	<0.000020	0.000022	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved	mg/L	ng		0.0114	0.00027	<0.00010	0.00014	<0.00010	<0.00010	<0.00020	0.00076	<0.00010	<0.00020	0.00042	0.00020	<0.00010	<0.00020	0.00022	<0.00010	<0.00010	<0.00010
Titanium (Ti)-Dissolved	mg/L	2 [B, R]		<0.010	0.010	<0.010	<0.010	0.012	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Dissolved	mg/L	0.3 [B, R]	0.02 [B, T]	0.00543	0.0117	0.00478	0.00761	0.00650	0.00554	0.000684	0.000574	0.000080	0.000080	0.00262	0.00294	0.00256	0.00290	0.000925	0.000539	0.000415	0.000257
Vanadium (V)-Dissolved	mg/L	0.006 [B, R]		<0.0010	<0.0010	<0.0010	0.0017	<0.0010	<0.0010	<0.0020	<0.0020	<0.0010	<0.0020	<0.0020	<0.0010	<0.0010	<0.0020	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)-Dissolved	mg/L	B, C, M	5 [B]	0.0194	0.0099	0.0069	<0.0030	0.0033	<0.0030	0.0031	0.0038	0.0041	<0.0030	<0.0030	0.0032	0.0042	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

ng = no approved water quality guideline.

na = not applicable.

Shaded values indicate guideline exceedances.

Underlined values indicate not-detection exceeds guideline.

[A] *Reference: British Columbia Approved Water Quality Guidelines (BC MOE 2014a), unless indicated otherwise.*

[B] *Dissolved component of analyte in groundwater screened against guideline for total concentration.*

[C] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[D] *Guideline intended for future comparison with baseline conditions.*

[E] *Al guideline is pH-dependent for pH < 6.5.*

[F] *Cu guideline hardness-dependent: Cu < 2 µg/L for Hardness < 50 mg/L as $CaCO_3$; Cu < 0.04 µg/L for Hardness > 50 mg/L.*

[H] *Pb guideline hardness-dependent: guideline = 3.31 + exp[1.273 Ln (hardness) - 4.704] in µg/L.*

[J] *Mn guideline hardness-dependent: guideline = 0.0044 x hardness + 0.605 in mg/L.*

[K] *Hg guideline dependent on proportion of methyl-mercurcy (meHg).*

[L] *Ag guideline hardness-dependent: 0.05 µg/L for hardness < 100 mg/L; 1.5 µg/L for hardness > 100 mg/L.*

[M] *Zinc guideline hardness-dependent: guideline = 7.5 x 0.75 x (hardness - 90) in µg/L.*

[N] *Cd working guideline hardness-dependent: guideline = 10 x exp{0.86[$\log_{10}$(hardness)]-3.2} in µg/L.*

[P] *Cr guideline valence-dependent: Cr(VI) < 1.0 µg/L, Cr (III) < 8.9 µg/L.*

[Q] *Ni working guideline hardness-dependent.*

[R] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[S] *Values reported as below detection limit were included in statistical calculations as half the reported detection limit.*

[T] *Reference: Health Canada Guidelines for Drinking Water Quality (Health Canada 2014).*

Appendix E7. Water Quality Results and Guideline Exceedances for Polycyclic Aromatic Hydrocarbons (All Samples)

Well ID				MW-H17	MW-H18	MW-H19	MW-H22	MW-H23	MW-H24A	MW-H24B	MW-H24C	MW-H25A	MW-H25B	MW-H26A	MW-H26B	MW-H27	MW-H28	MW-H29
Date Sampled				20-DEC-12	20-DEC-12	20-DEC-12	19-DEC-12	19-DEC-12	20-DEC-12	19-DEC-12	23-JUL-13	28-JUL-13	19-DEC-12	28-JUL-13	19-DEC-12	28-JUL-13	31-JUL-13	01-AUG-13
Time Sampled				00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID		**FWAL**	**DW**	L1252558-1	L1252558-2	L1252558-3	L1252558-5	L1252558-6	L1252558-4	L1252558-7	L1337870-2	L1340620-1	L1252558-8	L1340620-3	L1252558-9	L1340620-2	L1343263-1	L1343263-2
Matrix	**Units**	**Gudielines [A]**	**Gudielines [E]**	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Aggregate Organics																		
Phenols (4AAP)	mg/L	0.0045 to 0.05 [C]		<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0040	<0.0010	0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Polycyclic Aromatic Hydrocarbons																		
Acenaphthene	mg/L	0.006 [B]	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acenaphthylene	mg/L	ng	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Acridine	mg/L	0.003 [B]	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Anthracene	mg/L	0.004 [B]	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benz(a)anthracene	mg/L	0.0001 [B]	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(a)pyrene	mg/L	0.00001 [B]	0.00001	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Benzo(b)fluoranthene	mg/L	ng	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(g,h,i)perylene	mg/L	ng	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Benzo(k)fluoranthene	mg/L	ng	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Chrysene	mg/L	ng	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Dibenz(a,h)anthracene	mg/L	ng	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluoranthene	mg/L	0.004 [B]	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Fluorene	mg/L	0.012 [B]	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000085
Indeno(1,2,3-c,d)pyrene	mg/L	ng	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Naphthalene	mg/L	0.001 [B]	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000415	<0.000050	0.000346	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000057	0.000412
Phenanthrene	mg/L	0.0003 [B]	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	0.000080
Pyrene	mg/L	0.02 [B]	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
Quinoline	mg/L	0.0034 [D]	ng	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000090	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

ng = no approved water quality guideline.

Shaded values indicate guideline exceedances.

[A] *Reference: Approved Water Quality Guidelines for the protection of freshwater aquatic life (BC MOE 2014a), unless indicated otherwise.*

[B] *Analyte concentration screened against 30-day mean (chronic) guideline.*

[C] *Guidelines prescribed for specific phenol compounds range from 4.5 µg/L to 50 µg/L.*

[D] *Reference: Compendium of Working Water Quality Guidelines for British Columbia (BC MOE 2014b).*

[E] *Reference: BC Contaminated Sites Regulation Schedule 6 (BC MOE 2014c).*

RESCAN ENVIRONMENTAL SERVICES
ATTN: G. Papini
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 13-JUL-11
Report Date: 25-JUL-11 14:20 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1031047
Project P.O. #: NOT SUBMITTED
Job Reference: 0791-002-03-05 MURRAY RIVER
Legal Site Desc:
C of C Numbers: 10-175011

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1031047-1	L1031047-2	L1031047-3	L1031047-4	L1031047-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	10-JUL-11	08-JUL-11	09-JUL-11	07-JUL-11	07-JUL-11
	Sampled Time					
	Client ID	MW-2B	MW-20	MW-5	MW-PNB	MW-PNC
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0	<5.0	16.1
	Conductivity (uS/cm)	279	655	587	401	400
	Hardness (as CaCO3) (mg/L)	134	146	295	215	212
	pH (pH)	7.97	8.30	7.87	8.17	8.21
	Total Suspended Solids (mg/L)	282	554	178	<3.0	<3.0
	Turbidity (NTU)	314	561	376	2.81	1.68
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	2.8	<1.0	4.0	1.3	1.3
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	134	383	327	215	213
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	2.3	<1.0	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	134	385	327	215	213
	Ammonia (as N) (mg/L)	0.0195	0.722	0.180	0.0161	0.0152
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	5.67	2.99	5.35	<0.50	<0.50
	Fluoride (F) (mg/L)	0.099	0.879	0.154	0.058	0.057
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.0050	0.394	0.394
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.603	1.41	0.473	0.098	0.129
	Total Nitrogen (mg/L)	0.603	1.41	0.473	0.492	0.523
	Orthophosphate-Dissolved (as P) (mg/L)	0.0249	<0.0010	0.0015	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.348	0.00990	0.301	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.379	0.255	0.364	0.0030	0.0020
	Sulfate (SO4) (mg/L)	11.7	5.02	12.8	16.0	15.9
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	19.9	24.9	5.65	1.41	1.41
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.0086	0.0065	<0.0030	0.0034	0.0033
	Antimony (Sb)-Dissolved (mg/L)	0.00027	0.00166	<0.00010	0.00015	0.00015
	Arsenic (As)-Dissolved (mg/L)	0.00062	0.00085	0.00244	<0.00010	<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.259	2.67	0.136	0.204	0.208
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	0.013	0.144	0.026	<0.010	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010	0.000029	<0.000010	0.000024	0.000024
	Calcium (Ca)-Dissolved (mg/L)	38.2	29.2	73.5	58.8	57.9
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00022	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00084	0.00023	0.00028	0.00025	0.00023
	Copper (Cu)-Dissolved (mg/L)	<0.00050	0.0937	<0.00050	0.00056	<0.00050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1031047-6	L1031047-7			
	Description	WATER	WATER			
	Sampled Date	10-JUL-11				
	Sampled Time					
	Client ID	MW-2A	FIELD BLANK			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	6.9	<5.0			
	Conductivity (uS/cm)	1200	<2.0			
	Hardness (as CaCO3) (mg/L)	27.4	<0.50			
	pH (pH)	8.48	5.99			
	Total Suspended Solids (mg/L)	6000	<3.0			
	Turbidity (NTU)	>4000	<0.10			
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	2.8			
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	622	<2.0			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	38	<2.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<10	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)	660	<2.0			
	Ammonia (as N) (mg/L)	0.123	<0.0050			
	Bromide (Br) (mg/L)	<0.50	<0.050			
	Chloride (Cl) (mg/L)	10.4	<0.50			
	Fluoride (F) (mg/L)	1.60	<0.020			
	Nitrate (as N) (mg/L)	<0.050	<0.0050			
	Nitrite (as N) (mg/L)	<0.010	<0.0010			
	Total Kjeldahl Nitrogen (mg/L)	1.02	<0.050			
	Total Nitrogen (mg/L)	1.02	<0.0025			
	Orthophosphate-Dissolved (as P) (mg/L)	0.0947	<0.0010			
	Phosphorus (P)-Total Dissolved (mg/L)	0.131	<0.0020			
	Phosphorus (P)-Total (mg/L)	6.45	<0.0020			
	Sulfate (SO4) (mg/L)	11.9	<0.50			
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	227	<0.50			
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	4.96	<0.0030			
	Antimony (Sb)-Dissolved (mg/L)	0.00246	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	0.00308	<0.00010			
	Barium (Ba)-Dissolved (mg/L)	1.20	<0.000050			
	Beryllium (Be)-Dissolved (mg/L)	<0.00020 DLA	<0.00010			
	Bismuth (Bi)-Dissolved (mg/L)	<0.0010 DLA	<0.00050			
	Boron (B)-Dissolved (mg/L)	0.173	<0.010			
	Cadmium (Cd)-Dissolved (mg/L)	0.000060	<0.000010			
	Calcium (Ca)-Dissolved (mg/L)	6.31	<0.020			
	Chromium (Cr)-Dissolved (mg/L)	0.00225	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	0.00087	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	0.0050	<0.00050			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1031047-1 WATER 10-JUL-11 MW-2B	L1031047-2 WATER 08-JUL-11 MW-20	L1031047-3 WATER 09-JUL-11 MW-5	L1031047-4 WATER 07-JUL-11 MW-PNB	L1031047-5 WATER 07-JUL-11 MW-PNC
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
WATER						
Dissolved Metals	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	0.173	0.188	0.209
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000100	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.00400	0.263	0.00486	0.00355	0.00354
	Magnesium (Mg)-Dissolved (mg/L)	9.30	17.7	27.0	16.5	16.4
	Manganese (Mn)-Dissolved (mg/L)	0.253	0.0691	0.634	0.0547	0.0518
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.00135	0.0252	0.00125	0.000606	0.000596
	Nickel (Ni)-Dissolved (mg/L)	0.00285	0.00102	0.00061	0.00135	0.00124
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	0.649	2.48	1.04	0.588	0.588
	Selenium (Se)-Dissolved (mg/L)	0.00043	0.00015	<0.00010	0.00063	0.00066
	Silicon (Si)-Dissolved (mg/L)	2.61	3.63	6.32	2.50	2.48
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	9.3	113	16.1	2.4	2.3
	Strontium (Sr)-Dissolved (mg/L)	0.0766	0.644	0.310	0.111	0.110
	Thallium (Tl)-Dissolved (mg/L)	0.000018	0.000011	<0.000010	0.000011	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.000439	0.000725	0.00126	0.000282	0.000283
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	0.124	<0.0030	<0.0030	<0.0030
Aggregate Organics	COD (mg/L)	117	60	33	<20	<20

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1031047-6	L1031047-7			
	Description	WATER	WATER			
	Sampled Date	10-JUL-11				
	Sampled Time					
	Client ID	MW-2A	FIELD BLANK			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Iron (Fe)-Dissolved (mg/L)	1.13	<0.030			
	Lead (Pb)-Dissolved (mg/L)	0.00103	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.825	<0.00050			
	Magnesium (Mg)-Dissolved (mg/L)	2.83	<0.0050			
	Manganese (Mn)-Dissolved (mg/L)	0.0516	<0.000050			
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00940	<0.000050			
	Nickel (Ni)-Dissolved (mg/L)	0.0042	<0.00050			
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30			
	Potassium (K)-Dissolved (mg/L)	1.48	<0.050			
	Selenium (Se)-Dissolved (mg/L)	0.00066	<0.00010			
	Silicon (Si)-Dissolved (mg/L)	12.4	<0.050			
	Silver (Ag)-Dissolved (mg/L)	0.000028	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	304	<2.0			
	Strontium (Sr)-Dissolved (mg/L)	0.169	<0.00010			
	Thallium (Tl)-Dissolved (mg/L)	0.000042	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00020 DLA	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	0.155	<0.010			
	Uranium (U)-Dissolved (mg/L)	0.0101	<0.000010			
	Vanadium (V)-Dissolved (mg/L)	0.0219	<0.0010			
	Zinc (Zn)-Dissolved (mg/L)	0.0127	<0.0030			
Aggregate Organics	COD (mg/L)	442	<20			

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

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
SPL	Sample was Preserved at the laboratory - sample # 6 - Total Metals

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"
This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.			
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity
This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.			
ALK-MAN-VA	Water	Alkalinity (Species) by Manual Titration	APHA 2320 "Alkalinity"
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-MAN-VA	Water	Alkalinity (Species) by Manual Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320
This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method. OR This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

Reference Information

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

COLOUR-TRUE-VA Water Colour (True) by Spectrometer APHA 2120 "Color"

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

COLOUR-TRUE-VA Water Colour (True) by Spectrometer APHA 2120 Color

This analysis is carried out using procedures adapted from APHA Method 2120 "Color". Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-MAN-VA Water Conductivity (Manual) APHA 2510 "Conductivity"

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-MAN-VA Water Conductivity (Manual) APHA 2510 Conductivity

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-MAN-VA Water pH by Manual Meter APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-MAN-VA Water pH by Manual Meter APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH

Reference Information

electrode.

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-SIE-VA Water TKN in Water by SIE APHA 4500-NORG (TKN)

This analysis is carried out using procedures adapted from APHA Method 4500-Norg "Nitrogen (Organic)". Total Kjeldahl Nitrogen is determined using an ammonia selective electrode.

TN-CALC-VA Water Total Nitrogen (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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, BC, CANADA

Chain of Custody Numbers:

10-175011

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.

Short Holding Time

Rush Processing

10-175011

ytical Request Form
1 800 668 9878
bal.com

Page 1 of 1

Report To		Report Format / Distribution		Service Request (Rush subject to availability - Contact ALS to confirm TAT)	
Company:	RESCAN	Standard: ✓	Other (specify):	X	Regular (Standard Turnaround Times - Business Days)
Contact:		Select: PDF	Excel ✓ Digital ✓ Fax		Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	1111 WEST HASTINGS VANCOUVER	Email 1:	gpapini@rescan.com		Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
		Email 2:			Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	604 687-4277 Fax:			Analysis Request	
Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information		(Indicate Filtered or Preserved, F/P)	
	Copy of Invoice with Report? (circle) Yes or No	Job #:			
Company:		PO / AFE:			
Contact:		LSD:			
Address:					
Phone:	Fax:	Quote #:			
Lab Work Order # (lab use only)	L1031047	ALS Contact:	Ms Springer	Sampler:	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General BC	Metals BC	CaD/NH3/TKN	Number of Containers
	MW-2B	10-07-11	—	water	✓	✓	✓	
	MW-20	08-07-11	—	"	✓	✓	✓	
	MW-5	09-07-11	—	"	✓	✓	✓	
	MW-PNB	07-07-11	—	"	✓	✓	✓	
	MW-PNC	07-07-11	—	"	✓	✓	✓	
	MW-2A (very dirty - please do clean up)	10-07-11	—	"	✓	✓	✓	
	2 x 1 L bottles provided							
	Field Blank				✓	✓	✓	

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Please call me about sample MW-2A. No need to analyse trip blank.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Adrian Ang	07/13/11	2:15	WATER	July 12/11	15:30	13.4 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Max Taylor
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 20-OCT-11
Report Date: 02-NOV-11 14:04 (MT)
Version: FINAL

Client Phone: 867-920-2090

Certificate of Analysis

Lab Work Order #: L1074937

Project P.O. #: NOT SUBMITTED
Job Reference: 791-002-03-05
C of C Numbers: 10-140547
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1074937-1 WATER 18-OCT-11 12:00 MURRAY RIVER H2A	L1074937-2 WATER 18-OCT-11 12:00 MURRAY RIVER H2B	L1074937-3 WATER 18-OCT-11 12:00 MURRAY RIVER H5	L1074937-4 WATER 19-OCT-11 12:00 MURRAY RIVER H15	L1074937-5 WATER 16-OCT-11 12:00 MURRAY RIVER H16
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0	38.8	14.4
	Conductivity (uS/cm)	1540	332	598	1800	1090
	Hardness (as CaCO3) (mg/L)	29.5	145	293	33.7	12.1
	pH (pH)	8.69	8.27	8.14	8.41	8.35
	Total Suspended Solids (mg/L)	89.3	4.0	10.7	1060	5220
	Turbidity (NTU)	712	4.27	11.6	1730	>4000
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	1.3	4.1	<1.0	<50
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	804	160	320	514	615
	Alkalinity, Carbonate (as CaCO3) (mg/L)	72.3	<2.0	<2.0	<1.0	21.6
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<2.0	<2.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	877	160	320	514	636
	Bromide (Br) (mg/L)	<0.50	<0.050	<0.050	1.3	<0.50 DLM
	Chloride (Cl) (mg/L)	9.1	7.90	0.78	167	10.4
	Fluoride (F) (mg/L)	1.43	0.110	0.150	0.69	0.84
	Nitrate (as N) (mg/L)	<0.050	0.0116	0.0103	<0.10	<0.050
	Nitrite (as N) (mg/L)	<0.010	<0.0010	<0.0010	0.033	<0.010
	Orthophosphate-Dissolved (as P) (mg/L)	0.222	0.0014	<0.0010	0.0157	0.141
	Phosphorus (P)-Total Dissolved (mg/L)	0.220	<0.0020	<0.0020	0.100	0.155
	Phosphorus (P)-Total (mg/L)	0.567	0.0089	0.0287	1.14	7.60
	Sulfate (SO4) (mg/L)	<5.0	7.51	12.6	174	24.8
Total Metals	Aluminum (Al)-Total (mg/L)	42.5	0.143	0.325	26.5	178
	Antimony (Sb)-Total (mg/L)	0.00024	0.00011	<0.00010	0.00180	<0.0010 DLA
	Arsenic (As)-Total (mg/L)	0.00165	0.00034	0.00317	0.0195	0.0672
	Barium (Ba)-Total (mg/L)	2.67	0.405	0.127	1.79	12.3
	Beryllium (Be)-Total (mg/L)	0.00097	<0.00010	<0.00010	0.00150	0.0159
	Bismuth (Bi)-Total (mg/L)	<0.0010 DLA	<0.00050	<0.00050	<0.0010 DLA	<0.0050 DLA
	Boron (B)-Total (mg/L)	0.218	0.018	0.027	0.141	0.51
	Cadmium (Cd)-Total (mg/L)	0.000386	0.000021	0.000026	0.00135	0.00345
	Calcium (Ca)-Total (mg/L)	9.49	41.8	74.2	29.9	45.3
	Chromium (Cr)-Total (mg/L)	0.0229	0.00058	0.00110	0.0426	0.272
	Cobalt (Co)-Total (mg/L)	0.00437	0.00039	0.00042	0.0182	0.110
	Copper (Cu)-Total (mg/L)	0.0195	<0.00050	0.00116	0.0492	0.313
	Iron (Fe)-Total (mg/L)	8.50	0.299	1.61	41.4	177
	Lead (Pb)-Total (mg/L)	0.00682	0.000137	0.00138	0.0453	0.140
	Lithium (Li)-Total (mg/L)	1.26	0.0196	0.00518	0.689	0.839
	Magnesium (Mg)-Total (mg/L)	6.35	9.83	26.1	11.4	56.0
	Manganese (Mn)-Total (mg/L)	0.115	0.106	0.558	1.11	2.16

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1074937-6	L1074937-7	L1074937-8		
	Description	WATER	WATER	WATER		
	Sampled Date	17-OCT-11	15-OCT-11	15-OCT-11		
	Sampled Time	12:00	12:00	12:00		
	Client ID	MURRAY RIVER H20	MURRAY RIVER HPNB	MURRAY RIVER HPNC		
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0		
	Conductivity (uS/cm)	1340	413	414		
	Hardness (as CaCO3) (mg/L)	7.49	220	220		
	pH (pH)	8.75	8.23	8.27		
	Total Suspended Solids (mg/L)	256	<3.0	5.3		
	Turbidity (NTU)	612	4.47	6.28		
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	1.9	1.3		
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	659	214	214		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	58.5	<2.0	<2.0		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<2.0	<2.0		
	Alkalinity, Total (as CaCO3) (mg/L)	717	214	214		
	Bromide (Br) (mg/L)	<0.50 DLM	<0.050	<0.050		
	Chloride (Cl) (mg/L)	<5.0	<0.50	<0.50		
	Fluoride (F) (mg/L)	1.97	0.058	0.058		
	Nitrate (as N) (mg/L)	<0.050	0.260	0.258		
	Nitrite (as N) (mg/L)	<0.010	<0.0010	<0.0010		
	Orthophosphate-Dissolved (as P) (mg/L)	0.108	<0.0010	<0.0010		
	Phosphorus (P)-Total Dissolved (mg/L)	0.120	<0.0020	<0.0020		
	Phosphorus (P)-Total (mg/L)	0.487	0.0046	0.0063		
	Sulfate (SO4) (mg/L)	29.0	15.3	15.3		
Total Metals	Aluminum (Al)-Total (mg/L)	20.0	0.0627	0.0870		
	Antimony (Sb)-Total (mg/L)	0.00538	0.00010	0.00012		
	Arsenic (As)-Total (mg/L)	0.00902	0.00014	0.00016		
	Barium (Ba)-Total (mg/L)	4.84	0.188	0.190		
	Beryllium (Be)-Total (mg/L)	0.00078	<0.00010	<0.00010		
	Bismuth (Bi)-Total (mg/L)	<0.0010 DLA	<0.00050	<0.00050		
	Boron (B)-Total (mg/L)	0.222	<0.010	<0.010		
	Cadmium (Cd)-Total (mg/L)	0.000187	0.000022	0.000026		
	Calcium (Ca)-Total (mg/L)	2.84	59.3	61.2		
	Chromium (Cr)-Total (mg/L)	0.0176	0.00073	0.00111		
	Cobalt (Co)-Total (mg/L)	0.00461	0.00025	0.00032		
	Copper (Cu)-Total (mg/L)	0.0255	0.00089	0.00120		
	Iron (Fe)-Total (mg/L)	16.6	0.471	0.685		
	Lead (Pb)-Total (mg/L)	0.0106	0.000059	0.000083		
	Lithium (Li)-Total (mg/L)	1.11	0.00323	0.00332		
	Magnesium (Mg)-Total (mg/L)	2.89	15.9	16.2		
	Manganese (Mn)-Total (mg/L)	0.0751	0.0503	0.0603		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1074937-1	L1074937-2	L1074937-3	L1074937-4	L1074937-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	18-OCT-11	18-OCT-11	18-OCT-11	19-OCT-11	16-OCT-11
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	MURRAY RIVER H2A	MURRAY RIVER H2B	MURRAY RIVER H5	MURRAY RIVER H15	MURRAY RIVER H16
Grouping	**Analyte**					
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.00010	<0.000010	<0.000010	0.00015	<0.00010
	Molybdenum (Mo)-Total (mg/L)	0.00220	0.000790	0.00144	0.0487	0.0661
	Nickel (Ni)-Total (mg/L)	0.0187	0.00145	0.00100	0.0552	0.332
	Phosphorus (P)-Total (mg/L)	0.59	<0.30	<0.30	1.30	7.97
	Potassium (K)-Total (mg/L)	5.48	0.531	1.02	5.83	46.0
	Selenium (Se)-Total (mg/L)	0.00034	0.00019	<0.00010	0.00142	0.0097
	Silicon (Si)-Total (mg/L)	34.8	2.61	6.27	47.0	203
	Silver (Ag)-Total (mg/L)	0.000137	<0.000010	0.000011	0.000837	0.00252
	Sodium (Na)-Total (mg/L)	345	9.85	13.6	357	299
	Strontium (Sr)-Total (mg/L)	0.275	0.0847	0.314	0.272	0.963
	Thallium (Tl)-Total (mg/L)	0.000326	<0.000010	0.000014	0.000718	0.00303
	Tin (Sn)-Total (mg/L)	<0.00020 DLA	<0.00010	<0.00010	0.00277	0.0037
	Titanium (Ti)-Total (mg/L)	0.272	<0.010	0.012	0.216	0.203
	Uranium (U)-Total (mg/L)	0.00322	0.000180	0.00116	0.00386	0.0224
	Vanadium (V)-Total (mg/L)	0.0534	<0.0010	0.0011	0.0813	0.494
	Zinc (Zn)-Total (mg/L)	0.0774	<0.0030	0.0647	0.284	0.948
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	0.0996	<0.0030	<0.0030	0.130	0.383
	Antimony (Sb)-Dissolved (mg/L)	0.00035	0.00012	<0.00010	0.00149	0.0047
	Arsenic (As)-Dissolved (mg/L)	0.00083	0.00027	0.00270	0.00335	0.0046
	Barium (Ba)-Dissolved (mg/L)	1.59	0.421	0.117	0.247	0.273
	Beryllium (Be)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00020 DLA	<0.0010 DLA
	Bismuth (Bi)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	<0.00050	<0.0010 DLA	<0.0050 DLA
	Boron (B)-Dissolved (mg/L)	0.196	0.016	0.026	0.140	0.25
	Cadmium (Cd)-Dissolved (mg/L)	0.000029	0.000011	0.000010	0.000020	<0.00010 DLA
	Calcium (Ca)-Dissolved (mg/L)	6.61	42.0	74.3	9.21	2.74
	Chromium (Cr)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	0.00012	0.00048	<0.0010 DLA
	Cobalt (Co)-Dissolved (mg/L)	0.00027	0.00029	0.00026	0.00133	<0.0010 DLA
	Copper (Cu)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	<0.00050	0.0013	<0.0050 DLA
	Iron (Fe)-Dissolved (mg/L)	<0.030	0.076	0.538	0.118	0.087
	Lead (Pb)-Dissolved (mg/L)	0.00014	<0.000050	<0.000050	0.00026	<0.00050 DLA
	Lithium (Li)-Dissolved (mg/L)	1.25	0.0203	0.00528	0.703	0.469
	Magnesium (Mg)-Dissolved (mg/L)	3.17	9.82	26.2	2.60	1.28
	Manganese (Mn)-Dissolved (mg/L)	0.0367	0.0962	0.534	0.337	0.0625
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.00207	0.000721	0.00137	0.0529	0.0657
	Nickel (Ni)-Dissolved (mg/L)	0.0013	0.00087	<0.00050	0.0069	0.0065
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1074937-6 WATER 17-OCT-11 12:00 MURRAY RIVER H20	L1074937-7 WATER 15-OCT-11 12:00 MURRAY RIVER HPNB	L1074937-8 WATER 15-OCT-11 12:00 MURRAY RIVER HPNC		
WATER						
Total Metals	Mercury (Hg)-Total (mg/L)	<0.00010	<0.000010	<0.000010		
	Molybdenum (Mo)-Total (mg/L)	0.0128	0.000591	0.000728		
	Nickel (Ni)-Total (mg/L)	0.0156	0.00135	0.00172		
	Phosphorus (P)-Total (mg/L)	0.54	<0.30	<0.30		
	Potassium (K)-Total (mg/L)	4.42	0.558	0.561		
	Selenium (Se)-Total (mg/L)	0.00121	0.00060	0.00063		
	Silicon (Si)-Total (mg/L)	26.9	2.37	2.44		
	Silver (Ag)-Total (mg/L)	0.000147	<0.000010	<0.000010		
	Sodium (Na)-Total (mg/L)	318	2.31	2.35		
	Strontium (Sr)-Total (mg/L)	0.196	0.110	0.112		
	Thallium (Tl)-Total (mg/L)	0.000250	0.000014	0.000019		
	Tin (Sn)-Total (mg/L)	<0.00020 DLA	<0.00010	0.00012		
	Titanium (Ti)-Total (mg/L)	0.196	<0.010	<0.010		
	Uranium (U)-Total (mg/L)	0.0106	0.000266	0.000293		
	Vanadium (V)-Total (mg/L)	0.0461	<0.0010	<0.0010		
	Zinc (Zn)-Total (mg/L)	0.0593	<0.0030	<0.0030		
Dissolved Metals	Aluminum (Al)-Dissolved (mg/L)	2.00	0.0032	<0.0030		
	Antimony (Sb)-Dissolved (mg/L)	0.00768	0.00010	0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00598	<0.00010	<0.00010		
	Barium (Ba)-Dissolved (mg/L)	0.732	0.195	0.197		
	Beryllium (Be)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010		
	Bismuth (Bi)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	<0.00050		
	Boron (B)-Dissolved (mg/L)	0.200	<0.010	<0.010		
	Cadmium (Cd)-Dissolved (mg/L)	<0.000020 DLA	0.000012	0.000012		
	Calcium (Ca)-Dissolved (mg/L)	1.86	61.1	61.4		
	Chromium (Cr)-Dissolved (mg/L)	0.00096	<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	0.00030	0.00015	0.00014		
	Copper (Cu)-Dissolved (mg/L)	0.0013	<0.00050	<0.00050		
	Iron (Fe)-Dissolved (mg/L)	0.526	0.203	0.197		
	Lead (Pb)-Dissolved (mg/L)	0.00071	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	1.11	0.00372	0.00329		
	Magnesium (Mg)-Dissolved (mg/L)	0.690	16.3	16.3		
	Manganese (Mn)-Dissolved (mg/L)	0.0122	0.0381	0.0339		
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Dissolved (mg/L)	0.0120	0.000528	0.000524		
	Nickel (Ni)-Dissolved (mg/L)	0.0020	0.00091	0.00096		
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1074937-1 WATER 18-OCT-11 12:00 MURRAY RIVER H2A	L1074937-2 WATER 18-OCT-11 12:00 MURRAY RIVER H2B	L1074937-3 WATER 18-OCT-11 12:00 MURRAY RIVER H5	L1074937-4 WATER 19-OCT-11 12:00 MURRAY RIVER H15	L1074937-5 WATER 16-OCT-11 12:00 MURRAY RIVER H16
WATER						
Dissolved Metals	Potassium (K)-Dissolved (mg/L)	0.94	0.472	0.987	1.33	2.21
	Selenium (Se)-Dissolved (mg/L)	<0.00020 DLA	0.00018	<0.00010	0.00059	0.0016
	Silicon (Si)-Dissolved (mg/L)	3.02	2.41	5.85	3.80	4.00
	Silver (Ag)-Dissolved (mg/L)	<0.000020 DLA	<0.000010	<0.000010	<0.000020 DLA	<0.00010 DLA
	Sodium (Na)-Dissolved (mg/L)	390	10.3	15.1	404	289
	Strontium (Sr)-Dissolved (mg/L)	0.229	0.0844	0.313	0.156	0.0984
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 DLA	<0.000010	<0.000010	0.000056	<0.00010 DLA
	Tin (Sn)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00020 DLA	<0.0010 DLA
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00286	0.000179	0.00119	0.00276	0.00734
	Vanadium (V)-Dissolved (mg/L)	0.0045	<0.0010	<0.0010	0.0021	0.010
	Zinc (Zn)-Dissolved (mg/L)	<0.0060 DLA	<0.0030	0.0056	<0.0060 DLA	<0.030 DLA

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1074937-6	L1074937-7	L1074937-8		
	Description	WATER	WATER	WATER		
	Sampled Date	17-OCT-11	15-OCT-11	15-OCT-11		
	Sampled Time	12:00	12:00	12:00		
	Client ID	MURRAY RIVER H20	MURRAY RIVER HPNB	MURRAY RIVER HPNC		
Grouping	**Analyte**					
WATER						
Dissolved Metals	Potassium (K)-Dissolved (mg/L)	0.71	0.552	0.547		
	Selenium (Se)-Dissolved (mg/L)	0.00081	0.00066	0.00071		
	Silicon (Si)-Dissolved (mg/L)	5.37	2.34	2.34		
	Silver (Ag)-Dissolved (mg/L)	<0.000020 DLA	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	347	2.4	2.4		
	Strontium (Sr)-Dissolved (mg/L)	0.0869	0.110	0.110		
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 DLA	0.000011	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	0.00083	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	0.039	<0.010	<0.010		
	Uranium (U)-Dissolved (mg/L)	0.0103	0.000247	0.000255		
	Vanadium (V)-Dissolved (mg/L)	0.0081	<0.0010	<0.0010		
	Zinc (Zn)-Dissolved (mg/L)	0.0213	0.0042	<0.0030		

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

Reference Information

Qualifiers for Sample Submission Listed:

Qualifier	Description
SPL	Sample was Preserved at the laboratory - sample # 1 - Total Metals

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Matrix Spike	Nitrate (as N)	MS-B	L1074937-1, -3, -4, -5, -6, -7, -8
Matrix Spike	Fluoride (F)	MS-B	L1074937-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sulfate (SO4)	MS-B	L1074937-1, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
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**
ACY-MAN-VA	Water	Acidity by Manual Titration	APHA - ACIDITY (2310)

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-MAN-VA	Water	Alkalinity (Species) by Manual Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-MAN-VA	Water	Alkalinity (Species) by Manual Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

Reference Information

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-MAN-VA	Water	Conductivity (Manual)	APHA 2510 "Conductivity"

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-MAN-VA	Water	Conductivity (Manual)	APHA 2510 Conductivity

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA	Water	Total Mercury in Water by CVAFS(Low)	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

Reference Information

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-MAN-VA	Water	pH by Manual Meter	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-MAN-VA	Water	pH by Manual Meter	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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, BC, CANADA

Chain of Custody Numbers:

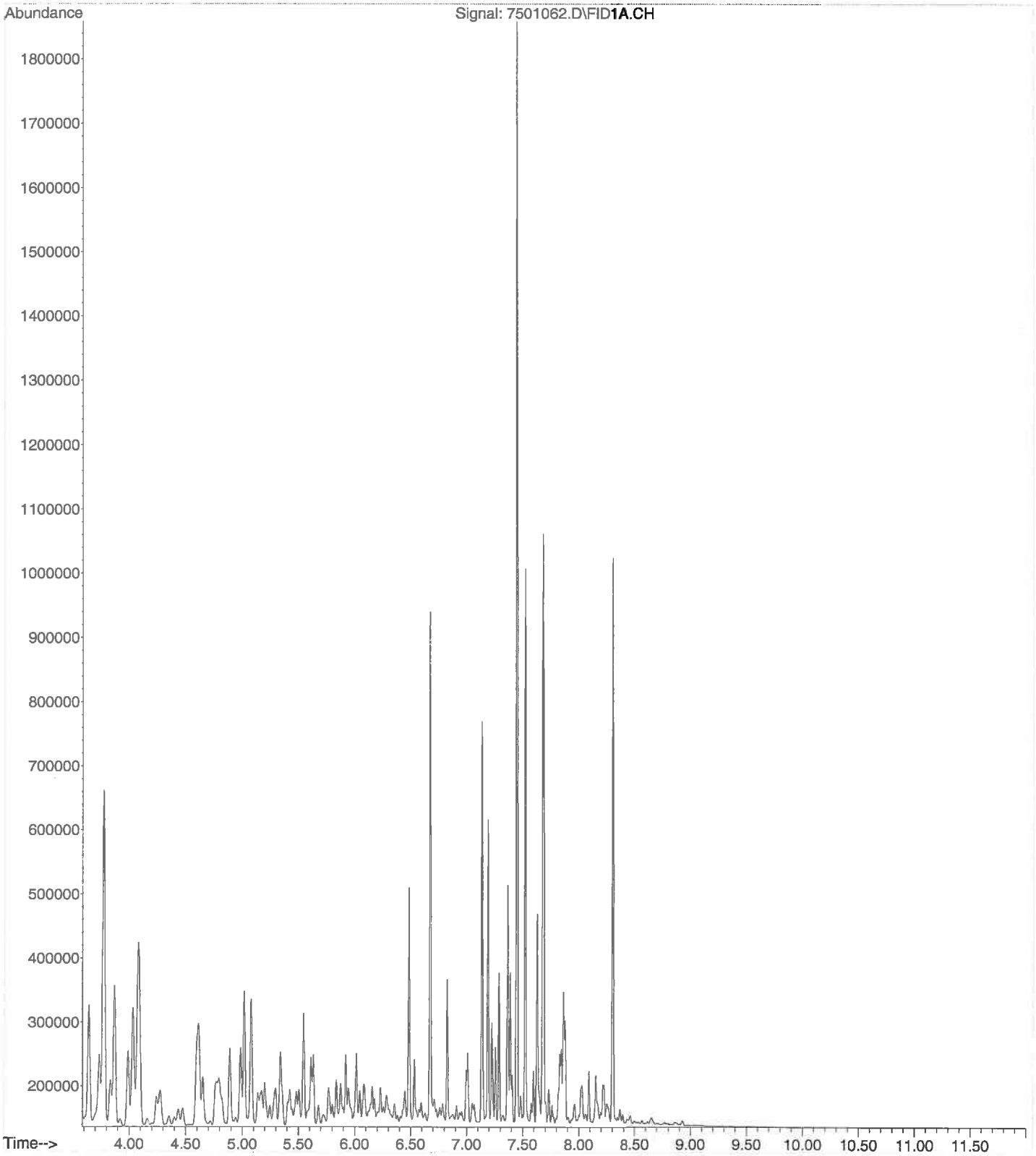
10-140547

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.

File :C:\MSDCHEM\1\DATA\111025\7501062.D
Operator : vt
Acquired : 26 Oct 2011 7:42 using AcqMethod CCME-SIM.M
Instrument : VOC #4
Sample Name: L1074934-14
Misc Info : WG1375418
Vial Number: 75



10-140547

ALS | *L1074937-COFC*

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

L1074937

Page ____ of ____

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan Environmental	Standard: ✓ Other (specify):	✓ Regular (Standard Turnaround Times - Business Days)
Contact: Max Taylor	Select: PDF ✓ Excel ✓ Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver	Email 1: gpapini@rescan.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2: mtaylor@rescan.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: 604-689-9460 Fax:		**Analysis Request**
Invoice To Same as Report ? (circle) (Yes) or No (if No, provide details)	**Client / Project Information**	(Indicate Filtered or Preserved, F/P)
Copy of Invoice with Report? (circle) (Yes) or No	Job #: 791-002-103-05	
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only)	**ALS Contact:** Sampler: MT/CH	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem.	Dissolved Metals	Number of Containers
H2A	Murray River H2A	18-Oct	12:00	Water	✓	✓	2
H2B	" H2B	18-Oct			✓	✓	2
H5	" H5	18-Oct			✓	✓	2
H15	" H15	19-Oct			✓	✓	2
H16	" H16	16-Oct			✓	✓	2
H20	" H20	17-Oct			✓	✓	2
HPNB	" HPNB	15-Oct			✓	✓	2
HPNC	" HPNC	15-Oct			✓	✓	2

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Max Taylor	20-Oct	19:00	MT	20-Oct-11	19:00	-2 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

BP Oct.22 9:53 6°C

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 15-MAY-12
Report Date: 07-NOV-12 15:53 (MT)
Version: FINAL REV. 3

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1147583

Project P.O. #: NOT SUBMITTED
Job Reference: 0791-002-03
C of C Numbers: 10-173783, 10-173784
Legal Site Desc:

Comments: 04-JUN-12: Additional analysis has been added.

07-NOV-12: File reissued.

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1147583-1	L1147583-2	L1147583-3	L1147583-4	L1147583-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	14-MAY-12	14-MAY-12	14-MAY-12	14-MAY-12	13-MAY-12
	Sampled Time					
	Client ID	HASLER	MW-H20	MW-H15	MW-H16	MW-H2A
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	9.0	15.0	25.5		<5.0
	Conductivity (uS/cm)	71.1	1350	1870		1580
	Hardness (as CaCO3) (mg/L)	15.5	8.89	17.7	128	32.1
	pH (pH)	8.03	8.65	8.78		8.71
	Total Suspended Solids (mg/L)	69.0	33.0	122		49.0
	Total Dissolved Solids (mg/L)	312	888	1250		1220
	Turbidity (NTU)	280	38.8	97.2		161
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	3.3	<1.0	<1.0		<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	32.9	724	577		887
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	65.6	61.9		58.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	34.0	773	631		937
	Ammonia, Total (as N) (mg/L)	0.108 PEHT	0.0170 PEHT	0.206 PEHT		<0.0050 PEHT
	Bromide (Br) (mg/L)	<0.050	<0.50 DLM	<1.0 DLM		<0.50 DLM
	Chloride (Cl) (mg/L)	2.07	<5.0 DLM	205		10.6
	Fluoride (F) (mg/L)	0.314	2.07	0.70		1.68
	Nitrate (as N) (mg/L)	0.359	<0.050 DLM	<0.10 DLM		<0.050 DLM
	Nitrite (as N) (mg/L)	0.0040	<0.010 DLM	<0.020 DLM		<0.010 DLM
	Total Kjeldahl Nitrogen (mg/L)	1.17	0.791	1.37		0.973
	Total Nitrogen (mg/L)	1.53	0.791	1.37		0.973
	Orthophosphate-Dissolved (as P) (mg/L)	0.0277	0.352	0.185		0.186
	Phosphorus (P)-Total Dissolved (mg/L)	0.0267	0.331	0.093		0.0996
	Phosphorus (P)-Total (mg/L)	0.403	0.475	0.332		0.376
	Sulfate (SO4) (mg/L)	4.11	9.9	80		<5.0 DLM
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)	4.71	10.0	24.5		9.6
Total Metals	Aluminum (Al)-Total (mg/L)	7.02	2.28	1.23	0.516	8.39
	Antimony (Sb)-Total (mg/L)	0.00067	0.00118	0.00031	0.00013	<0.00020 DLA
	Arsenic (As)-Total (mg/L)	0.00249	0.00274	0.00321	0.00118	0.00085
	Barium (Ba)-Total (mg/L)	0.814	0.501	0.766	1.03	1.82
	Beryllium (Be)-Total (mg/L)	0.00041	<0.00020 DLA	<0.00020 DLA	<0.00010	0.00029
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.0010 DLA	<0.0010 DLA	<0.00050	<0.0010 DLA
	Boron (B)-Total (mg/L)	0.031	0.187	0.163	0.204	0.215
	Cadmium (Cd)-Total (mg/L)	0.000090	0.000119	0.000114	0.000063	0.000107
	Calcium (Ca)-Total (mg/L)	6.66	2.76	7.40	24.7	7.67
	Chromium (Cr)-Total (mg/L)	0.0108	0.00331	0.00245	0.00095	0.00783

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1147583-6 WATER 13-MAY-12 MW-H2B	L1147583-7 WATER 13-MAY-12 X2	L1147583-9 WATER 12-MAY-12 MW-H5	L1147583-10 WATER 11-MAY-12 X1	L1147583-11 WATER 11-MAY-12 MW-PNB
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0	5.2	5.2
	Conductivity (uS/cm)	280	1580	570	540	549
	Hardness (as CaCO3) (mg/L)	151	32.3	312	193	194
	pH (pH)	8.24	8.71	8.12	8.03	8.20
	Total Suspended Solids (mg/L)	745	27.7	19.7	16.3	17.0
	Total Dissolved Solids (mg/L)	162	1050	316	340	340
	Turbidity (NTU)	76.9	159	6.78	14.8	14.9
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	1.8	<1.0	5.0	5.5	2.9
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	135	864	316	245	251
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	94.6	<2.0	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<1.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	135	934	316	245	251
	Ammonia, Total (as N) (mg/L)	<0.0050 PEHT	0.0053 PEHT	0.158 PEHT	<0.0050 PEHT	<0.0050 PEHT
	Bromide (Br) (mg/L)	<0.050	<0.50 DLM	<0.050	0.313	<0.050
	Chloride (Cl) (mg/L)	8.31	10.7	<0.50	3.88	3.91
	Fluoride (F) (mg/L)	0.091	1.61	0.146	0.208	0.210
	Nitrate (as N) (mg/L)	0.0722	<0.050 DLM	<0.0050	0.0124	0.0124
	Nitrite (as N) (mg/L)	<0.0010	<0.010 DLM	<0.0010	0.0150	0.0152
	Total Kjeldahl Nitrogen (mg/L)	0.615	1.00	0.238	0.232	0.222
	Total Nitrogen (mg/L)	0.688	1.00	0.238	0.260	0.250
	Orthophosphate-Dissolved (as P) (mg/L)	0.0015	0.174	<0.0010	0.0014	0.0024
	Phosphorus (P)-Total Dissolved (mg/L)	0.0022	0.095	<0.0020	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.582	0.388	0.0302	0.0722	0.0714
	Sulfate (SO4) (mg/L)	4.34	<5.0 DLM	12.2	54.8	55.1
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)	5.42	9.8	0.83	5.57	5.19
Total Metals	Aluminum (Al)-Total (mg/L)	4.98	4.70	0.0041	0.0527	0.0554
	Antimony (Sb)-Total (mg/L)	0.00040	<0.00020 DLA	<0.00010	0.00017	0.00018
	Arsenic (As)-Total (mg/L)	0.00563	0.00083	0.00408	0.00025	0.00025
	Barium (Ba)-Total (mg/L)	0.420	1.85	0.126	0.150	0.147
	Beryllium (Be)-Total (mg/L)	0.00036	0.00026	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.0010 DLA	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	0.020	0.203	0.034	0.013	0.012
	Cadmium (Cd)-Total (mg/L)	0.000573	0.000100	<0.000010	0.000074	0.000077
	Calcium (Ca)-Total (mg/L)	64.0	7.86	79.5	64.0	63.2
	Chromium (Cr)-Total (mg/L)	0.00893	0.00732	0.00059	0.00026	0.00023

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1147583-12 WATER 11-MAY-12 MW-H23	L1147583-13 WATER 11-MAY-12 MW-H22	L1147583-14 WATER 10-MAY-12 MW-H19	L1147583-15 WATER 10-MAY-12 MW-H18	L1147583-16 WATER 10-MAY-12 MW-H17
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	17.7	<5.0	<5.0
	Conductivity (uS/cm)	429	456	540	494	529
	Hardness (as CaCO3) (mg/L)	247	284	35.0	188	267
	pH (pH)	8.21	8.08	8.24	8.22	8.25
	Total Suspended Solids (mg/L)	91.7	1570	794	2930	312
	Total Dissolved Solids (mg/L)	251	288	678	313	329
	Turbidity (NTU)	78.4	333	743	1310	104
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	2.4	4.8	1.2	2.0	1.2
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	241	263	188	260	278
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<1.0	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<1.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	241	263	188	260	278
	Ammonia, Total (as N) (mg/L)	<0.0050 PEHT	<0.0050 PEHT	0.040 PEHT	<0.0050 PEHT	0.045 PEHT
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	0.74	2.24	0.51	<0.50
	Fluoride (F) (mg/L)	0.075	0.066	0.742	0.255	0.124
	Nitrate (as N) (mg/L)	0.202	0.120	0.0644	0.0350	0.0601
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.0039	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.180	0.837	2.37	4.01	0.308
	Total Nitrogen (mg/L)	0.382	0.957	2.44	4.05	0.368
	Orthophosphate-Dissolved (as P) (mg/L)	0.0015	<0.0010	0.0095	0.0043	0.0053
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	0.0191	0.0058	0.0048
	Phosphorus (P)-Total (mg/L)	0.0886	0.942	0.826	1.99	0.258
	Sulfate (SO4) (mg/L)	6.36	15.3	44.2	17.4	24.7
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)					
	Total Organic Carbon (mg/L)	3.87	25.5	12.3	48.5	5.02
Total Metals	Aluminum (Al)-Total (mg/L)	2.77	9.75	7.67	6.35	2.36
	Antimony (Sb)-Total (mg/L)	0.00054	0.00107	0.00462	0.00108	0.00107
	Arsenic (As)-Total (mg/L)	0.00252	0.0121	0.00426	0.00588	0.00236
	Barium (Ba)-Total (mg/L)	0.255	0.548	0.526	1.83	0.341
	Beryllium (Be)-Total (mg/L)	0.00013	0.00066	0.00040	0.00047	0.00012
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.0010 DLA	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	0.015	0.021	0.158	0.069	0.022
	Cadmium (Cd)-Total (mg/L)	0.000773	0.00356	0.000150	0.000247	0.000212
	Calcium (Ca)-Total (mg/L)	81.1	411	10.7	55.0	89.5
	Chromium (Cr)-Total (mg/L)	0.00491	0.0281	0.0127	0.0118	0.00438

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1147583-21				
		Description	WATER				
		Sampled Date					
		Sampled Time					
		Client ID	TRIP BLANK				
Grouping	**Analyte**						
WATER							
Physical Tests	Colour, True (CU)		<5.0				
	Conductivity (uS/cm)		<2.0				
	Hardness (as CaCO3) (mg/L)						
	pH (pH)		5.86				
	Total Suspended Solids (mg/L)		<3.0				
	Total Dissolved Solids (mg/L)		<10				
	Turbidity (NTU)		<0.10				
Anions and Nutrients	Acidity (as CaCO3) (mg/L)		1.4				
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)		<2.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)		<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)		<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)		<2.0				
	Ammonia, Total (as N) (mg/L)		<0.0050 PEHT				
	Bromide (Br) (mg/L)		<0.050				
	Chloride (Cl) (mg/L)		<0.50				
	Fluoride (F) (mg/L)		<0.020				
	Nitrate (as N) (mg/L)		<0.0050				
	Nitrite (as N) (mg/L)		<0.0010				
	Total Kjeldahl Nitrogen (mg/L)		<0.050				
	Total Nitrogen (mg/L)		<0.0025				
	Orthophosphate-Dissolved (as P) (mg/L)		<0.0010				
	Phosphorus (P)-Total Dissolved (mg/L)		<0.0020				
	Phosphorus (P)-Total (mg/L)		<0.0020				
	Sulfate (SO4) (mg/L)		<0.50				
Organic / Inorganic Carbon	Dissolved Organic Carbon (mg/L)		<0.50				
	Total Organic Carbon (mg/L)						
Total Metals	Aluminum (Al)-Total (mg/L)		<0.0030				
	Antimony (Sb)-Total (mg/L)		<0.00010				
	Arsenic (As)-Total (mg/L)		<0.00010				
	Barium (Ba)-Total (mg/L)		<0.000050				
	Beryllium (Be)-Total (mg/L)		<0.00010				
	Bismuth (Bi)-Total (mg/L)		<0.00050				
	Boron (B)-Total (mg/L)		<0.010				
	Cadmium (Cd)-Total (mg/L)		<0.000010				
	Calcium (Ca)-Total (mg/L)		<0.050				
	Chromium (Cr)-Total (mg/L)		<0.00010				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

		Sample ID	L1147583-1	L1147583-2	L1147583-3	L1147583-4	L1147583-5
		Description	WATER	WATER	WATER	WATER	WATER
		Sampled Date	14-MAY-12	14-MAY-12	14-MAY-12	14-MAY-12	13-MAY-12
		Sampled Time					
		Client ID	HASLER	MW-H20	MW-H15	MW-H16	MW-H2A
Grouping	**Analyte**						
WATER							
Total Metals	Cobalt (Co)-Total (mg/L)		0.00370	0.00069	0.00124	0.00034	0.00130
	Copper (Cu)-Total (mg/L)		0.00851	0.0141	0.0050	0.00231	0.0063
	Iron (Fe)-Total (mg/L)		5.19	1.16	2.23	0.692	3.05
	Lead (Pb)-Total (mg/L)		0.00370	0.00217	0.00224	0.000307	0.00220
	Lithium (Li)-Total (mg/L)		0.0152	0.933	0.872	0.268	1.27
	Magnesium (Mg)-Total (mg/L)		1.57	1.05	1.93	16.1	4.75
	Manganese (Mn)-Total (mg/L)		0.0669	0.185	0.271	0.162	0.0526
	Mercury (Hg)-Total (mg/L)		<0.000050 DLM	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)		0.00351	0.0105	0.0256	0.00465	0.00171
	Nickel (Ni)-Total (mg/L)		0.0110	0.0033	0.0041	0.00096	0.0050
	Phosphorus (P)-Total (mg/L)		<0.30	0.47	<0.30	<0.30	0.38
	Potassium (K)-Total (mg/L)		2.64	1.46	1.31	1.73	2.34
	Selenium (Se)-Total (mg/L)		0.00206	0.00023	0.00027	<0.00010	<0.00020 DLA
	Silicon (Si)-Total (mg/L)		24.3	7.10	5.02	5.47	22.5
	Silver (Ag)-Total (mg/L)		0.000031	<0.000020 DLA	0.000028	<0.000010	0.000047
	Sodium (Na)-Total (mg/L)		5.35	326	389	145	360
	Strontium (Sr)-Total (mg/L)		0.0404	0.0890	0.213	0.639	0.265
	Thallium (Tl)-Total (mg/L)		0.000172	0.000040	0.000024	<0.000010	0.000098
	Tin (Sn)-Total (mg/L)		0.00427	0.00064	0.00283	0.00024	<0.00020 DLA
	Titanium (Ti)-Total (mg/L)		0.195	0.048	0.014	0.018	0.289
	Uranium (U)-Total (mg/L)		0.000445	0.00761	0.00113	0.000217	0.00142
	Vanadium (V)-Total (mg/L)		0.0233	0.0090	0.0051	0.0022	0.0172
	Zinc (Zn)-Total (mg/L)		0.174	0.0164	0.0196	0.0165	0.0271
Dissolved Metals	Dissolved Metals Filtration Location		LAB	FIELD	FIELD		FIELD
	Aluminum (Al)-Dissolved (mg/L)		0.229	0.0249	0.0167		0.0094
	Antimony (Sb)-Dissolved (mg/L)		0.00067	0.00091	0.00021		<0.00020 DLA
	Arsenic (As)-Dissolved (mg/L)		0.00093	0.00240	0.00241		0.00039
	Barium (Ba)-Dissolved (mg/L)		0.258	0.386	0.624		1.51
	Beryllium (Be)-Dissolved (mg/L)		<0.00010	<0.00020 DLA	<0.00020 DLA		<0.00020 DLA
	Bismuth (Bi)-Dissolved (mg/L)		<0.00050	<0.0010 DLA	<0.0010 DLA		<0.0010 DLA
	Boron (B)-Dissolved (mg/L)		0.014	0.185	0.156		0.193
	Cadmium (Cd)-Dissolved (mg/L)		0.000010	<0.000020 DLA	0.000028		<0.000020 DLA
	Calcium (Ca)-Dissolved (mg/L)		5.73	2.35	4.92		6.98
	Chromium (Cr)-Dissolved (mg/L)		0.00040	<0.00020 DLA	<0.00020 DLA		<0.00020 DLA
	Cobalt (Co)-Dissolved (mg/L)		0.00012	0.00026	0.00034		<0.00020 DLA
	Copper (Cu)-Dissolved (mg/L)		0.00087	0.0030	<0.0010 DLA		<0.0010 DLA
	Iron (Fe)-Dissolved (mg/L)		0.074	0.067	0.079		0.041

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1147583-6	L1147583-7	L1147583-9	L1147583-10	L1147583-11
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	13-MAY-12	13-MAY-12	12-MAY-12	11-MAY-12	11-MAY-12
	Sampled Time					
	Client ID	MW-H2B	X2	MW-H5	X1	MW-PNB
Grouping	**Analyte**					
WATER						
Total Metals	Cobalt (Co)-Total (mg/L)	0.00577	0.00128	0.00027	0.00035	0.00034
	Copper (Cu)-Total (mg/L)	0.0153	0.0059	0.00125	0.00131	0.00130
	Iron (Fe)-Total (mg/L)	15.0	3.09	2.42	0.165 DTC	0.173 DTC
	Lead (Pb)-Total (mg/L)	0.00762	0.00205	<0.000050	0.000074	0.000094
	Lithium (Li)-Total (mg/L)	0.00829	1.25	0.00648	0.00423	0.00397
	Magnesium (Mg)-Total (mg/L)	17.2	4.82	28.4	16.7	16.7
	Manganese (Mn)-Total (mg/L)	0.752	0.0522	0.589	0.484	0.488
	Mercury (Hg)-Total (mg/L)	0.000065	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.00104	0.00159	0.00159	0.00178	0.00164
	Nickel (Ni)-Total (mg/L)	0.0168	0.0053	<0.00050	0.00217	0.00221
	Phosphorus (P)-Total (mg/L)	0.63	0.39	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	2.05	2.17	0.922	0.735	0.723
	Selenium (Se)-Total (mg/L)	0.00142	<0.00020 DLA	<0.00010	0.00055	0.00054
	Silicon (Si)-Total (mg/L)	13.4	20.7	6.22	2.58	2.62
	Silver (Ag)-Total (mg/L)	0.000179	0.000062	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	1.36	369	13.8	14.0	13.7
	Strontium (Sr)-Total (mg/L)	0.0998	0.247	0.315	0.121	0.119
	Thallium (Tl)-Total (mg/L)	0.000215	0.000085	0.000016	0.000015	0.000018
	Tin (Sn)-Total (mg/L)	0.00022	<0.00020 DLA	<0.00010	0.00026	0.00035
	Titanium (Ti)-Total (mg/L)	0.134	0.257	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.000570	0.00129	0.00142	0.000723	0.000721
	Vanadium (V)-Total (mg/L)	0.0191	0.0164	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Total (mg/L)	0.0698	0.0256	0.0032	0.0077	0.0064
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0043	0.0170	<0.0030	0.0058	<0.0030
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00010	<0.00010	0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00021	0.00037	0.00272	0.00107 DTC	0.00107 DTC
	Barium (Ba)-Dissolved (mg/L)	0.204	1.53	0.116	0.112	0.113
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.0010 DLA	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	<0.010	0.201	0.029	0.015	0.014
	Cadmium (Cd)-Dissolved (mg/L)	0.000017	<0.000020 DLA	<0.000010	0.000012	<0.000010
	Calcium (Ca)-Dissolved (mg/L)	43.2	7.07	78.8	53.7	54.3
	Chromium (Cr)-Dissolved (mg/L)	0.00013	<0.00020 DLA	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00024	<0.00020 DLA	0.00027	0.00040	0.00039
	Copper (Cu)-Dissolved (mg/L)	<0.00050	0.0314 DTC	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	<0.030	0.047	0.843	0.651 DTC	0.654 DTC

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1147583-12	L1147583-13	L1147583-14	L1147583-15	L1147583-16
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	11-MAY-12	11-MAY-12	10-MAY-12	10-MAY-12	10-MAY-12
	Sampled Time					
	Client ID	MW-H23	MW-H22	MW-H19	MW-H18	MW-H17
Grouping	**Analyte**					
WATER						
Total Metals	Cobalt (Co)-Total (mg/L)	0.00303	0.0127	0.00397	0.00497	0.00246
	Copper (Cu)-Total (mg/L)	0.00587	0.0302	0.0122	0.0139	0.00508
	Iron (Fe)-Total (mg/L)	4.39	26.1	6.78	11.4	4.31
	Lead (Pb)-Total (mg/L)	0.00263	0.0146	0.00424	0.00724	0.00236
	Lithium (Li)-Total (mg/L)	0.00581	0.0202	0.110	0.0725	0.0186
	Magnesium (Mg)-Total (mg/L)	19.4	65.0	3.49	18.3	23.3
	Manganese (Mn)-Total (mg/L)	0.114	0.888	0.0979	0.116	0.127
	Mercury (Hg)-Total (mg/L)	<0.000050 DLM	0.000072	0.000033	<0.000050 DLM	<0.000050 DLM
	Molybdenum (Mo)-Total (mg/L)	0.00107	0.00551	0.0165	0.00208	0.00717
	Nickel (Ni)-Total (mg/L)	0.0107	0.0430	0.0183	0.0164	0.00809
	Phosphorus (P)-Total (mg/L)	<0.30	1.15	0.32	0.48	<0.30
	Potassium (K)-Total (mg/L)	1.59	3.29	4.84	3.26	1.95
	Selenium (Se)-Total (mg/L)	0.00085	0.00072	0.00302	0.00163	0.00269
	Silicon (Si)-Total (mg/L)	10.8	21.2	18.8	17.2	8.40
	Silver (Ag)-Total (mg/L)	0.000026	0.000229	0.000159	0.000157	0.000037
	Sodium (Na)-Total (mg/L)	2.44	2.61	111	40.7	17.3
	Strontium (Sr)-Total (mg/L)	0.124	0.493	0.107	0.528	0.226
	Thallium (Tl)-Total (mg/L)	0.000240	0.000787	0.000184	0.000200	0.000098
	Tin (Sn)-Total (mg/L)	0.00017	0.00039	0.00041	0.00030	0.00036
	Titanium (Ti)-Total (mg/L)	0.141	0.195	0.134	0.128	0.071
	Uranium (U)-Total (mg/L)	0.000425	0.00202	0.00332	0.00155	0.00344
	Vanadium (V)-Total (mg/L)	0.0124	0.0532	0.0252	0.0214	0.0088
	Zinc (Zn)-Total (mg/L)	0.0319	0.151	0.0366	0.0530	0.0239
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	<0.0060 DLA	0.0268	0.0053	0.0072
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	0.00687 DTC	0.00120	0.00098
	Arsenic (As)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	0.00117	0.00044	0.00049
	Barium (Ba)-Dissolved (mg/L)	0.206	0.246	0.193	1.16	0.214
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.0010 DLA	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	<0.010	<0.020 DLA	0.143	0.056	0.016
	Cadmium (Cd)-Dissolved (mg/L)	0.000015	<0.000020 DLA	0.000033	0.000025	0.000032
	Calcium (Ca)-Dissolved (mg/L)	71.1	79.6	10.0	50.3	75.4
	Chromium (Cr)-Dissolved (mg/L)	0.00013	<0.00020 DLA	0.00026	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00013	0.00027	0.00090	0.00074	0.00078
	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.0010 DLA	0.00289	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	0.048	<0.030	<0.030

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1147583-21				
	Description	WATER				
	Sampled Date					
	Sampled Time					
	Client ID	TRIP BLANK				
Grouping	**Analyte**					
WATER						
Total Metals	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	<0.00050				
	Iron (Fe)-Total (mg/L)	<0.030				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.00050				
	Magnesium (Mg)-Total (mg/L)	<0.10				
	Manganese (Mn)-Total (mg/L)	<0.000050				
	Mercury (Hg)-Total (mg/L)	<0.000010				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Phosphorus (P)-Total (mg/L)	<0.30				
	Potassium (K)-Total (mg/L)	<0.050				
	Selenium (Se)-Total (mg/L)	<0.00010				
	Silicon (Si)-Total (mg/L)	<0.050				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	<0.050				
	Strontium (Sr)-Total (mg/L)	<0.00010				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.010				
	Uranium (U)-Total (mg/L)	<0.000010				
	Vanadium (V)-Total (mg/L)	<0.0010				
	Zinc (Zn)-Total (mg/L)	<0.0030				
Dissolved Metals	Dissolved Metals Filtration Location					
	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Bismuth (Bi)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L1147583-1 Description: WATER Sampled Date: 14-MAY-12 Sampled Time: Client ID: HASLER	L1147583-2 WATER 14-MAY-12 MW-H20	L1147583-3 WATER 14-MAY-12 MW-H15	L1147583-4 WATER 14-MAY-12 MW-H16	L1147583-5 WATER 13-MAY-12 MW-H2A
WATER						
Dissolved Metals	Lead (Pb)-Dissolved (mg/L)	0.000061	0.00021	DLA <0.00010		DLA <0.00010
	Lithium (Li)-Dissolved (mg/L)	0.00900	0.949	0.868		1.20
	Magnesium (Mg)-Dissolved (mg/L)	0.28	0.74	1.32		3.56
	Manganese (Mn)-Dissolved (mg/L)	0.00572	0.159	0.205		0.0329
	Mercury (Hg)-Dissolved (mg/L)	DLM <0.000050	<0.000010	<0.000010		<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.00369	0.0105	0.0267		0.00159
	Nickel (Ni)-Dissolved (mg/L)	0.00062	0.0018	0.0012		DLA <0.0010
	Phosphorus (P)-Dissolved (mg/L)	<0.30	0.42	<0.30		<0.30
	Potassium (K)-Dissolved (mg/L)	0.440	0.82	1.11		0.88
	Selenium (Se)-Dissolved (mg/L)	0.00192	DLA <0.00020	DLA <0.00020		DLA <0.00020
	Silicon (Si)-Dissolved (mg/L)	1.20	2.89	3.36		2.85
	Silver (Ag)-Dissolved (mg/L)	<0.000010	DLA <0.000020	DLA <0.000020		DLA <0.000020
	Sodium (Na)-Dissolved (mg/L)	5.24	326	391		368
	Strontium (Sr)-Dissolved (mg/L)	0.0315	0.0833	0.200		0.237
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	DLA <0.000020	DLA <0.000020		DLA <0.000020
	Tin (Sn)-Dissolved (mg/L)	0.00110	0.00021	0.00057		DLA <0.00020
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010		<0.010
	Uranium (U)-Dissolved (mg/L)	0.000174	0.00757	0.00105		0.000991
	Vanadium (V)-Dissolved (mg/L)	0.0012	0.0023	DLA <0.0020		DLA <0.0020
	Zinc (Zn)-Dissolved (mg/L)	0.0045	DLA <0.0060	DLA <0.0060		DLA <0.0060
Aggregate Organics	COD (mg/L)	SP 31	SP 47	SP 90		SP 47

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1147583-6 WATER 13-MAY-12 MW-H2B	L1147583-7 WATER 13-MAY-12 X2	L1147583-9 WATER 12-MAY-12 MW-H5	L1147583-10 WATER 11-MAY-12 X1	L1147583-11 WATER 11-MAY-12 MW-PNB
WATER						
Dissolved Metals	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.00018	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.00203	1.31	0.00578	0.00315	0.00309
	Magnesium (Mg)-Dissolved (mg/L)	10.4	3.56	27.9	14.2 DTC	14.3 DTC
	Manganese (Mn)-Dissolved (mg/L)	0.244	0.0324	0.574	1.12	1.12
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.000455	0.00147	0.00139	0.00350	0.00354 DTC
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.0010 DLA	<0.00050	0.00156	0.00152
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	0.537	0.86	0.990	0.969 DTC	0.964 DTC
	Selenium (Se)-Dissolved (mg/L)	0.00027	<0.00020 DLA	<0.00010	0.00029	0.00027
	Silicon (Si)-Dissolved (mg/L)	2.60	2.86	6.05	2.65	2.65
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000020 DLA	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	1.21	377	14.1	51.1 DTC	50.7 DTC
	Strontium (Sr)-Dissolved (mg/L)	0.0705	0.234	0.304	0.119	0.116
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 DLA	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.000142	0.000950	0.00135	0.00113 DTC	0.00110 DTC
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0020 DLA	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0060 DLA	<0.0030	<0.0030	<0.0030
Aggregate Organics	COD (mg/L)	59 SP	43 SP	<20 SP	32 SP	32 SP

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1147583-12 WATER 11-MAY-12 MW-H23	L1147583-13 WATER 11-MAY-12 MW-H22	L1147583-14 WATER 10-MAY-12 MW-H19	L1147583-15 WATER 10-MAY-12 MW-H18	L1147583-16 WATER 10-MAY-12 MW-H17
WATER						
Dissolved Metals	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.00010 DLA	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.00317	0.0043	0.101	0.0656	0.0156
	Magnesium (Mg)-Dissolved (mg/L)	16.9	20.7	2.42	15.1	19.2
	Manganese (Mn)-Dissolved (mg/L)	0.00796	0.0277	0.0656	0.0429	0.0725
	Mercury (Hg)-Dissolved (mg/L)	<0.000050 DLM	<0.000010	<0.000010	<0.000050 DLM	<0.000050 DLM
	Molybdenum (Mo)-Dissolved (mg/L)	0.000431	0.00172	0.0165	0.00136	0.00706
	Nickel (Ni)-Dissolved (mg/L)	0.00069	<0.0010 DLA	0.00797	0.00298	0.00205
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	0.640	0.80	2.73	1.44	1.29
	Selenium (Se)-Dissolved (mg/L)	0.00042	<0.00020 DLA	0.00258	0.00114	0.00245
	Silicon (Si)-Dissolved (mg/L)	2.85	3.18	4.16	3.43	3.85
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000020 DLA	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	2.36	2.20	115	40.6	17.6
	Strontium (Sr)-Dissolved (mg/L)	0.108	0.110	0.0875	0.488	0.208
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000020 DLA	0.000024	0.000018	0.000014
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	0.00018	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.000265	0.000577	0.00277	0.000716	0.00316
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0020 DLA	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0060 DLA	<0.0030	<0.0030	<0.0030
Aggregate Organics	COD (mg/L)	23 SP	81 SP	95 SP	231 SP	32 SP

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1147583-21				
	Description	WATER				
	Sampled Date					
	Sampled Time					
	Client ID	TRIP BLANK				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Lead (Pb)-Dissolved (mg/L)					
	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Phosphorus (P)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					
	Silicon (Si)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Strontium (Sr)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					
Aggregate Organics	COD (mg/L)	<20 SP				

* 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)
Duplicate	Iron (Fe)-Dissolved	DLA	L1147583-1
Duplicate	Phosphorus (P)-Dissolved	DLA	L1147583-1
Duplicate	Titanium (Ti)-Dissolved	DLA	L1147583-1
Duplicate	Aluminum (Al)-Dissolved	DLA	L1147583-1
Duplicate	Antimony (Sb)-Dissolved	DLA	L1147583-1
Duplicate	Arsenic (As)-Dissolved	DLA	L1147583-1
Duplicate	Beryllium (Be)-Dissolved	DLA	L1147583-1
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1147583-1
Duplicate	Chromium (Cr)-Dissolved	DLA	L1147583-1
Duplicate	Cobalt (Co)-Dissolved	DLA	L1147583-1
Duplicate	Lead (Pb)-Dissolved	DLA	L1147583-1
Duplicate	Nickel (Ni)-Dissolved	DLA	L1147583-1
Duplicate	Selenium (Se)-Dissolved	DLA	L1147583-1
Duplicate	Silver (Ag)-Dissolved	DLA	L1147583-1
Duplicate	Thallium (Tl)-Dissolved	DLA	L1147583-1
Duplicate	Tin (Sn)-Dissolved	DLA	L1147583-1
Duplicate	Vanadium (V)-Dissolved	DLA	L1147583-1
Method Blank	Chromium (Cr)-Total	MB-LOR	L1147583-1
Matrix Spike	Chloride (Cl)	MS-B	L1147583-1, -10, -11, -12, -13, -14, -15, -16, -2, -21, -3, -5, -6, -7, -9
Matrix Spike	Bromide (Br)	MS-B	L1147583-1, -10, -11, -12, -13, -14, -15, -16, -2, -21, -3, -5, -6, -7, -9
Matrix Spike	Sulfate (SO4)	MS-B	L1147583-1, -10, -11, -12, -13, -14, -15, -16, -2, -21, -3, -5, -6, -7, -9
Matrix Spike	Dissolved Organic Carbon	MS-B	L1147583-21
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1147583-1
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1147583-1
Matrix Spike	Nickel (Ni)-Dissolved	MS-B	L1147583-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1147583-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1147583-1
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1147583-1
Matrix Spike	Total Organic Carbon	MS-B	L1147583-10, -12, -16, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1147583-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1147583-1
Matrix Spike	Barium (Ba)-Total	MS-B	L1147583-1
Matrix Spike	Boron (B)-Total	MS-B	L1147583-1
Matrix Spike	Lithium (Li)-Total	MS-B	L1147583-1
Matrix Spike	Manganese (Mn)-Total	MS-B	L1147583-1
Matrix Spike	Potassium (K)-Total	MS-B	L1147583-1
Matrix Spike	Sodium (Na)-Total	MS-B	L1147583-1
Matrix Spike	Strontium (Sr)-Total	MS-B	L1147583-1
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1147583-1
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1147583-1
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1147583-1
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1147583-1

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MB-LOR	Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required.
	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.

Reference Information

MS-B	
PEHT	Parameter Exceeded Recommended Holding Time Prior to Analysis
SP	Sample was Preserved at the laboratory

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"
This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.			
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity
This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.			
ALK-COL-VA	Water	Alkalinity by Colourimetric (Automated)	EPA 310.2
This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.			
ALK-MAN-VA	Water	Alkalinity (Species) by Manual Titration	APHA 2320 "Alkalinity"
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-MAN-VA	Water	Alkalinity (Species) by Manual Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320
This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method. OR This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
CARBONS-DOC-VA	Water	Dissolved organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)". Dissolved carbon (DOC) fractions are determined by filtering the sample through a 0.45 micron membrane filter prior to analysis.			
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)

Reference Information

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COD-COL-VA Water Chemical Oxygen Demand by Colorimetric APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

COLOUR-TRUE-VA Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

Reference Information

PH-MAN-VA	Water	pH by Manual Meter	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-MAN-VA	Water	pH by Manual Meter	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode.

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TN-CALC-VA	Water	Total Nitrogen (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:

10-173783 10-173784

Reference Information

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.

10-173783

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

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Report To		Report Format / Distribution		Service Request: (Rush subject to availability - Contact ALS to confirm TAT)	
Company:	Rescan Environmental Services Ltd	Standard: ✓ Other (specify):		✓	Regular (Standard Turnaround Times - Business Days)
Contact:	Rusto Martinka	Select: PDF ✓ Excel ✓ Digital Fax			Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	1111 W Hastings St, Vancouver, BC V6E 2J3	Email 1:	rmartinka@rescan.com		Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone:	(604) 689-9460 Fax: (604) 687-4277	Email 2:			Same Day or Weekend Emergency - Contact ALS to confirm TAT
Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**		**Analysis Request**	
	Copy of Invoice with Report? (circle) Yes or No	Job #:	791-002-03	(Indicate Filtered or Preserved, F/P)	
Company:		PO / AFE:			
Contact:		LSD:			
Address:					
Phone:	Fax:	Quote #:			
Lab Work Order # (lab use only)		**ALS Contact:**	Amber	**Sampler:**	RM/JB

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Physical	Total Metals	Dissolved Metals	TOC	Total Metals	Dissolved Metals	Ammonia	Number of Containers
	HASLER	14/05/12		grab	✓			✓	✓	✓	✓	4
	MW-H20				✓	✓	✓	✓				4
	MW-H15				✓	✓	✓	✓				4
	MW-H16					✓						1
	MW-H2A	13/05/12			✓	✓	✓	✓				4
	MW-H2B				✓	✓	✓	✓				4
	X2				✓	✓	✓	✓				4
	SHAFT	12/05/12			✓	✓	✓	✓				4
	MW-H5				✓	✓	✓	✓				4
	X1	11/05/12			✓	✓	✓	✓				4
	MW-PNB				✓	✓	✓	✓				4
	MW-H23				✓	✓	✓	✓				4

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Hasler sample - total and dissolved metals in one bottle. Not preserved or filtered.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Rusto	Date: 15 May 12	Time: 12:00	Received by:	Date: 15 May 12	Time: 11:50	Temperature: 8 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

10-173784

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

L1147583

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Report To		**Report Format / Distribution**		**Service Request:** (Rush subject to availability - Contact ALS to confirm TAT)
Company:	Rescan Environmental Services Ltd	Standard: ✓	Other (specify):	✓ Regular (Standard Turnaround Times - Business Days)
Contact:	Rusto Martinka	Select: PDF ✓	Excel ✓ Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	1111 W. Hastings St., Vancouver, BC V6E 2J3	Email 1:	rmartinka@rescan.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone:	(604) 689-9460 Fax: (604) 687-4277	Email 2:		Same Day or Weekend Emergency - Contact ALS to confirm TAT
Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**		**Analysis Request**
	Copy of Invoice with Report? (circle) Yes or No	Job #:	791-002-03	(Indicate Filtered or Preserved, F/P)
Company:		PO / AFE:		
Contact:		LSD:		
Address:				
Phone:	Fax:	Quote #:		
Lab Work Order # (lab use only)		**ALS Contact:**	**Sampler:** RM/JB	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Physical	Total Metals	Dissolved Metals	TOC	Number of Containers
	MW-H22	11/05/12		grab	✓	✓	✓	✓	4
	MW-H19				✓				1
	MW-H19 (same)	10/05/12				✓	✓	✓	3
	MW-H18				✓	✓	✓	✓	4
	MW-H17				✓	✓	✓	✓	4

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Rusto	15 May 12	1200	HB	15-May-12	11:30	8 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 29-AUG-12
Report Date: 07-NOV-12 15:53 (MT)
Version: FINAL REV. 2

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1201463

Project P.O. #: NOT SUBMITTED
Job Reference: 0791-007-24-12
C of C Numbers: 10-240018
Legal Site Desc:

Comments: 07-NOV-12: File re-issued.

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1201463-2	L1201463-3	L1201463-4	L1201463-5	L1201463-6
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	23-AUG-12	23-AUG-12	23-AUG-12	23-AUG-12	23-AUG-12
	Sampled Time					
	Client ID	MW-H15	MW-H2A	MW-H2B	X2	FIELD BLANKS
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	24.0	<5.0	<5.0	<5.0	<5.0
	Conductivity (uS/cm)	1830	1510	262	1510	<2.0
	Hardness (as CaCO3) (mg/L)	18.5	28.7	140	28.9	<0.50
	pH (pH)	8.51	8.64	8.25	8.65	6.06
	Total Suspended Solids (mg/L)	75.8	10.8	548	10.5	<3.0
	Turbidity (NTU)	40.4	43.0	105	41.2	<0.10
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	1.9
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	566	839	134	845	<2.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	21.4	44.4	<2.0	49.4	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<2.0	<1.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	588	883	134	894	<2.0
	Ammonia, Total (as N) (mg/L)	0.814	0.548	0.0063	0.525	<0.0050
	Bromide (Br) (mg/L)	1.4	<1.0 DLM	<0.050	<1.0 DLM	<0.050
	Chloride (Cl) (mg/L)	205	13	4.81	11	<0.50
	Fluoride (F) (mg/L)	0.86	1.49	0.084	1.42	<0.020
	Nitrate (as N) (mg/L)	<0.10 DLM	<0.10 DLM	0.0775	<0.10 DLM	<0.0050
	Nitrite (as N) (mg/L)	0.024	<0.020 DLM	<0.0010	<0.020 DLM	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	1.41	0.729	0.272	0.650	<0.050
	Total Nitrogen (mg/L)	1.43	0.73	0.350	0.650	<0.050
	Orthophosphate-Dissolved (as P) (mg/L)	0.0257	0.158	0.0024	0.163	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0482	0.167	0.0029	0.172	<0.0020
	Phosphorus (P)-Total (mg/L)	0.280	0.261	0.147	0.265	<0.0020
	Sulfate (SO4) (mg/L)	75	<10 DLM	4.09	<10 DLM	<0.50
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	19.1	2.52	4.61	3.97	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.669	1.73	2.37	1.78	<0.0030
	Antimony (Sb)-Total (mg/L)	0.00040	<0.00020 DLA	0.00023	<0.00020 DLA	<0.00010
	Arsenic (As)-Total (mg/L)	0.00293	0.00033	0.00288	0.00034	<0.00010
	Barium (Ba)-Total (mg/L)	0.659	1.53	0.348	1.55	<0.000050
	Beryllium (Be)-Total (mg/L)	<0.00020 DLA	<0.00020 DLA	0.00019	<0.00020 DLA	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.00050	<0.0010 DLA	<0.00050
	Boron (B)-Total (mg/L)	0.140	0.192	0.013	0.192	<0.010
	Cadmium (Cd)-Total (mg/L)	0.000088	0.000026	0.000361	0.000029	<0.000010
	Calcium (Ca)-Total (mg/L)	6.54	6.43	79.6	6.36	<0.020
	Chromium (Cr)-Total (mg/L)	0.00292	0.00282	0.00491	0.00301	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00075	0.00035	0.00276	0.00034	<0.00010
	Copper (Cu)-Total (mg/L)	0.0031	0.0018	0.00824	0.0017	<0.00050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1201463-2	L1201463-3	L1201463-4	L1201463-5	L1201463-6
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	23-AUG-12	23-AUG-12	23-AUG-12	23-AUG-12	23-AUG-12
	Sampled Time					
	Client ID	MW-H15	MW-H2A	MW-H2B	X2	FIELD BLANKS
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	1.20	0.774	6.91	0.803	<0.030
	Lead (Pb)-Total (mg/L)	0.00145	0.00057	0.00351	0.00055	<0.000050
	Lithium (Li)-Total (mg/L)	0.841	1.25	0.00889	1.25	<0.00050
	Magnesium (Mg)-Total (mg/L)	1.75	3.39	19.5	3.48	<0.0050
	Manganese (Mn)-Total (mg/L)	0.239	0.0257	0.547	0.0258	<0.000050
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.0283	0.00052	0.000638	0.00058	<0.000050
	Nickel (Ni)-Total (mg/L)	0.0046	0.0013	0.00795	0.0013	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	0.47	<0.30	<0.30
	Potassium (K)-Total (mg/L)	1.21	1.27	1.31	1.34	<0.050
	Selenium (Se)-Total (mg/L)	0.00028	<0.00020 DLA	0.00064	<0.00020 DLA	<0.00010
	Silicon (Si)-Total (mg/L)	4.47	6.84	8.76	7.14	<0.050
	Silver (Ag)-Total (mg/L)	0.000025	<0.000020 DLA	0.000082	0.000020	<0.000010
	Sodium (Na)-Total (mg/L)	415	367	<2.0	387	<2.0
	Strontium (Sr)-Total (mg/L)	0.208	0.229	0.107	0.238	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000020 DLA	0.000030	0.000099	0.000033	<0.000010
	Tin (Sn)-Total (mg/L)	0.00138	<0.00020 DLA	0.00020	<0.00020 DLA	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.010	0.056	0.097	0.063	<0.010
	Uranium (U)-Total (mg/L)	0.00112	0.000877	0.000458	0.000898	<0.000010
	Vanadium (V)-Total (mg/L)	0.0036	0.0063	0.0097	0.0064	<0.0010
	Zinc (Zn)-Total (mg/L)	0.0119	0.0077	0.0324	0.0074	<0.0030
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0272	0.0078	<0.0030	<0.0060 DLA	
	Antimony (Sb)-Dissolved (mg/L)	0.00025	<0.00020 DLA	<0.00010	<0.00020 DLA	
	Arsenic (As)-Dissolved (mg/L)	0.00267	<0.00020 DLA	0.00012	<0.00020 DLA	
	Barium (Ba)-Dissolved (mg/L)	0.614	1.47	0.184	1.47	
	Beryllium (Be)-Dissolved (mg/L)	<0.00020 DLA	<0.00020 DLA	<0.00010	<0.00020 DLA	
	Bismuth (Bi)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.00050	<0.0010 DLA	
	Boron (B)-Dissolved (mg/L)	0.142	0.192	<0.010	0.191	
	Cadmium (Cd)-Dissolved (mg/L)	0.000028	<0.000020 DLA	<0.000010	<0.000020 DLA	
	Calcium (Ca)-Dissolved (mg/L)	5.19	6.29	39.7	6.24	
	Chromium (Cr)-Dissolved (mg/L)	0.00038	<0.00020 DLA	<0.00010	<0.00020 DLA	
	Cobalt (Co)-Dissolved (mg/L)	0.00032	<0.00020 DLA	<0.00010	<0.00020 DLA	
	Copper (Cu)-Dissolved (mg/L)	<0.0010 DLA	<0.0010 DLA	<0.00050	<0.0010 DLA	
	Iron (Fe)-Dissolved (mg/L)	0.098	0.046	<0.030	0.045	
	Lead (Pb)-Dissolved (mg/L)	<0.00010 DLA	<0.00010 DLA	<0.000050	<0.00010 DLA	
	Lithium (Li)-Dissolved (mg/L)	0.884	1.32	0.00293	1.31	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1201463-2 WATER 23-AUG-12 MW-H15	L1201463-3 WATER 23-AUG-12 MW-H2A	L1201463-4 WATER 23-AUG-12 MW-H2B	L1201463-5 WATER 23-AUG-12 X2	L1201463-6 WATER 23-AUG-12 FIELD BLANKS
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	1.34	3.16	9.83	3.22	
	Manganese (Mn)-Dissolved (mg/L)	0.205	0.0197	0.0292	0.0197	
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Dissolved (mg/L)	0.0280	0.00047	0.000336	0.00050	
	Nickel (Ni)-Dissolved (mg/L)	0.0018	<0.0010 DLA	<0.00050	<0.0010 DLA	
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	
	Potassium (K)-Dissolved (mg/L)	1.13	0.76	0.496	0.77	
	Selenium (Se)-Dissolved (mg/L)	0.00031	<0.00020 DLA	0.00025	<0.00020 DLA	
	Silicon (Si)-Dissolved (mg/L)	3.48	2.91	2.62	2.91	
	Silver (Ag)-Dissolved (mg/L)	<0.000020 DLA	<0.000020 DLA	<0.000010	<0.000020 DLA	
	Sodium (Na)-Dissolved (mg/L)	440	387	<2.0	389	
	Strontium (Sr)-Dissolved (mg/L)	0.204	0.229	0.0655	0.228	
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 DLA	<0.000020 DLA	<0.000010	<0.000020 DLA	
	Tin (Sn)-Dissolved (mg/L)	0.00054	<0.00020 DLA	<0.00010	<0.00020 DLA	
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Uranium (U)-Dissolved (mg/L)	0.00109	0.000781	0.000121	0.000792	
	Vanadium (V)-Dissolved (mg/L)	<0.0020 DLA	<0.0020 DLA	<0.0010	<0.0020 DLA	
	Zinc (Zn)-Dissolved (mg/L)	<0.0060 DLA	<0.0060 DLA	<0.0030	<0.0060 DLA	

* 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)
Duplicate	Phosphorus (P)-Total	DLA	L1201463-2
Method Blank	Manganese (Mn)-Total	MB-LOR	L1201463-2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Arsenic (As)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Silver (Ag)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1201463-2, -3, -4, -5
Matrix Spike	Barium (Ba)-Total	MS-B	L1201463-3, -4, -5
Matrix Spike	Calcium (Ca)-Total	MS-B	L1201463-3, -4, -5
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1201463-3, -4, -5
Matrix Spike	Manganese (Mn)-Total	MS-B	L1201463-3, -4, -5
Matrix Spike	Strontium (Sr)-Total	MS-B	L1201463-3, -4, -5
Matrix Spike	Sodium (Na)-Total	MS-B	L1201463-2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
MB-LOR	Method Blank exceeds ALS DQO. LORs adjusted for samples with positive hits below 5 times blank level. Please contact ALS if re-analysis is required.
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"
This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.			
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity
This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.			
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320
This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method. OR This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA Water Chloride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA Water Fluoride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA Water Nitrite in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA Water Nitrate in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA Water Total organic carbon by combustion APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COLOUR-TRUE-VA Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Reference Information

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-TOT-COMBUST-VA	Water	Total Nitrogen in Water by Combustion	BC: TN by Combustion/Chemiluminescence

This analysis is carried out, on hydrochloric acid preserved samples, following Method BC MOE "Total and Dissolved Nitrogen (TN) by Combustion with Chemiluminescence Detection". Total Nitrogen is determined directly by pyrolysis with chemiluminescence detection using automated instrumentation.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA	Water	TKN in Water (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TKN-F-VA	Water	TKN in Water by Fluorescence	APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TN-CALC-VA	Water	Total Nitrogen (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Nitrogen is a calculated parameter. Total Nitrogen = Total Kjeldahl Nitrogen + [Nitrate and Nitrite (as N)]

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:

Reference Information

10-240018

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.

10-240018

ALS Environmental

Page 1 of 1

Report To		Report Format / Distribution		Service Request: (Rush subject to availability - Contact ALS to confirm TAT)	
Company:	Rescan Environmental	Standard or other (specify):		X	Regular (Standard Turnaround Times - Business Days)
Contact:	Rusto Martinka	Select: PDF X Excel X Digital	Fax		Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	1111 W. Hasting St Vancouver BC	Email 1:	rmartinka@rescan.com		Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
		Email 2:			Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	Fax:			Analysis Request	
Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information		(Indicate Filtered or Preserved, F/P)	
	Copy of Invoice with Report? (circle) Yes or No	Job #:	0791-007-24-12		
Company:		PO / AFE:			
Contact:		LSD:			
Address:					
Phone:	Fax:	Quote #:			
Lab Work Order # (lab use only)	L1201463	ALS Contact:	Amber	Sampler:	Rusto

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem.	Nutrients	TOC	Total Metals	Diss. Metals								Number of Containers
					F/P	F/P	F/P	F/P	F/P								
	SHAFT	23-08-12		water	X	X	X	X	X								5
	MW-H15				X	X	X	X	X								5
	MW-H2A				X	X	X	X	X								5
	MW-H2B				X	X	X	X	X								5
	X2				X	X	X	X	X								5
	Field Blanks	23-08-12		water	X	X	X	X									4

Short Holding Time

Rush Processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Rusto Martinka	27-08-12	11:00		Aug 29	9:15	11.3 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 29-AUG-12
Report Date: 10-SEP-12 13:19 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1201465

Project P.O. #: NOT SUBMITTED
Job Reference: 0791-007-24-12
C of C Numbers: 10-240019, 10-240021
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1201465-1	L1201465-2	L1201465-3	L1201465-4	L1201465-5
Description	WATER	WATER	WATER	WATER	WATER
Sampled Date	21-AUG-12	22-AUG-12	22-AUG-12	22-AUG-12	21-AUG-12
Sampled Time					
Client ID	MW-H23	MW-H5	MW-H18	MW-H19	MW-PNB
Grouping / **Analyte**					
WATER					
Physical Tests Colour, True (CU)	<5.0	<5.0	<5.0	7.2	<5.0
Conductivity (uS/cm)	428	548	466	529	519
Hardness (as CaCO3) (mg/L)	252	309	259	123	194
pH (pH)	8.20	8.17	7.94	8.10	8.23
Total Suspended Solids (mg/L)	33.9	3.1	85.7	402	17.7
Turbidity (NTU)	25.3	7.09	26.0	401	12.4
Anions and Nutrients Acidity (as CaCO3) (mg/L)	2.2	2.4	122	3.3	1.6
Alkalinity, Bicarbonate (as CaCO3) (mg/L)	247	331	267	297	251
Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<1.0	<2.0
Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<1.0	<2.0
Alkalinity, Total (as CaCO3) (mg/L)	247	331	267	297	251
Ammonia, Total (as N) (mg/L)	<0.0050	0.175	0.0608	0.426	0.0096
Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	0.132
Chloride (Cl) (mg/L)	<0.50	<0.50	0.60	0.79	3.25
Fluoride (F) (mg/L)	0.079	0.147	0.202	0.298	0.189
Nitrate (as N) (mg/L)	0.149	<0.0050	0.0840	<0.0050	<0.0050
Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.0021	<0.0010	<0.0010
Total Kjeldahl Nitrogen (mg/L)	0.161	0.250	0.264	0.500	0.200
Total Nitrogen (mg/L)	0.310	0.250	0.350	0.500	0.200
Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	0.0124	0.0017
Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	0.0153	<0.0020
Phosphorus (P)-Total (mg/L)	0.0380	0.0119	0.0796	0.555	0.0567
Sulfate (SO4) (mg/L)	6.28	12.1	12.2	15.8	44.9
Organic / Inorganic Carbon Total Organic Carbon (mg/L)	3.32	1.03	4.12	11.4	10.2
Total Metals Aluminum (Al)-Total (mg/L)	0.477	<0.0030	0.662	6.39	0.204
Antimony (Sb)-Total (mg/L)	0.00016	<0.00010	0.00019	0.00118	<0.00010
Arsenic (As)-Total (mg/L)	0.00068	0.00276	0.00061	0.00635	0.00123
Barium (Ba)-Total (mg/L)	0.233	0.116	0.491	1.10	0.121
Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00042	<0.00010
Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Total (mg/L)	0.012	0.031	0.024	0.212	0.016
Cadmium (Cd)-Total (mg/L)	0.000262	<0.000010	0.000075	0.000344	0.000048
Calcium (Ca)-Total (mg/L)	73.1	77.8	70.5	25.2	50.3
Chromium (Cr)-Total (mg/L)	0.00108	0.00014	0.00137	0.0125	0.00084
Cobalt (Co)-Total (mg/L)	0.00091	0.00029	0.00092	0.00584	0.00097
Copper (Cu)-Total (mg/L)	0.00198	<0.00050	0.00193	0.0159	0.00136

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1201465-6	L1201465-7	L1201465-8	L1201465-9	
Description	WATER	WATER	WATER	WATER	
Sampled Date	22-AUG-12	22-AUG-12	21-AUG-12	21-AUG-12	
Sampled Time					
Client ID	MW-H20	MW-H17	MW-H22	X1	
Grouping	**Analyte**				
WATER					
Physical Tests	Colour, True (CU)	10.7	<5.0	<5.0	<5.0	
	Conductivity (uS/cm)	1320	505	543	524	
	Hardness (as CaCO3) (mg/L)	7.32	261	322	196	
	pH (pH)	8.63	8.10	8.11	8.26	
	Total Suspended Solids (mg/L)	12.1	36.9	10600	16.5	
	Turbidity (NTU)	19.8	59.6	>4000 TMV	13.0	
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	3.8	4.2	<1.0	
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	717	278	308	243	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	48.2	<2.0	<2.0	<2.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<2.0	<2.0	<2.0	
	Alkalinity, Total (as CaCO3) (mg/L)	765	278	308	243	
	Ammonia, Total (as N) (mg/L)	0.366	0.0704	0.0340	0.0122	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	0.148	
	Chloride (Cl) (mg/L)	<0.50	<0.50	<0.50	3.33	
	Fluoride (F) (mg/L)	0.226	0.134	0.061	0.195	
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	0.145	<0.0050	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Total Kjeldahl Nitrogen (mg/L)	0.550	0.180	2.60	0.150	
	Total Nitrogen (mg/L)	0.550	0.180	2.74	0.150	
	Orthophosphate-Dissolved (as P) (mg/L)	0.430	0.0061	<0.0010	0.0023	
	Phosphorus (P)-Total Dissolved (mg/L)	0.442	0.0068	<0.0020	<0.0020	
	Phosphorus (P)-Total (mg/L)	0.518	0.0773	3.23	0.0667	
	Sulfate (SO4) (mg/L)	<0.50	21.3	8.46	45.6	
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	6.29	2.63	59.7	10.2	
Total Metals	Aluminum (Al)-Total (mg/L)	1.12	2.07	2.34	0.336	
	Antimony (Sb)-Total (mg/L)	0.00031	0.00022	0.00027	0.00011	
	Arsenic (As)-Total (mg/L)	0.00166	0.00316	0.00184	0.00132	
	Barium (Ba)-Total (mg/L)	0.579	0.422	0.369	0.126	
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	0.00011	<0.00010	
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	0.185	0.021	0.012	0.014	
	Cadmium (Cd)-Total (mg/L)	0.000078	0.000096	0.000255	0.000033	
	Calcium (Ca)-Total (mg/L)	2.02	71.0	90.8	53.8	
	Chromium (Cr)-Total (mg/L)	0.00177	0.00314	0.00533	0.00075	
	Cobalt (Co)-Total (mg/L)	0.00045	0.00171	0.00154	0.00102	
	Copper (Cu)-Total (mg/L)	0.00631	0.00352	0.00508	0.00128	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1201465-1	L1201465-2	L1201465-3	L1201465-4	L1201465-5
Description	WATER	WATER	WATER	WATER	WATER
Sampled Date	21-AUG-12	22-AUG-12	22-AUG-12	22-AUG-12	21-AUG-12
Sampled Time					
Client ID	MW-H23	MW-H5	MW-H18	MW-H19	MW-PNB
Grouping / **Analyte**					
WATER					
Total Metals Iron (Fe)-Total (mg/L)	1.06	0.835	0.857	9.10	1.50
Lead (Pb)-Total (mg/L)	0.000723	<0.000050	0.000694	0.00628	0.000341
Lithium (Li)-Total (mg/L)	0.00666	0.00774	0.0187	0.153	0.00358
Magnesium (Mg)-Total (mg/L)	17.8	27.5	19.6	9.54	14.7
Manganese (Mn)-Total (mg/L)	0.0330	0.606	0.0499	0.343	1.16
Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Total (mg/L)	0.000581	0.00145	0.000799	0.00808	0.00271
Nickel (Ni)-Total (mg/L)	0.00295	<0.00050	0.00284	0.0203	0.00171
Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	0.55	<0.30
Potassium (K)-Total (mg/L)	0.791	0.944	1.06	3.10	0.891
Selenium (Se)-Total (mg/L)	0.00047	<0.00010	0.00049	0.00066	0.00026
Silicon (Si)-Total (mg/L)	3.75	5.91	4.44	26.8	2.90
Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000018	0.000207	<0.000010
Sodium (Na)-Total (mg/L)	2.2	13.6	9.5	110	37.5
Strontium (Sr)-Total (mg/L)	0.114	0.317	0.376	0.532	0.124
Thallium (Tl)-Total (mg/L)	0.000055	<0.000010	0.000033	0.000188	<0.000010
Tin (Sn)-Total (mg/L)	0.00019	<0.00010	0.00026	0.00073	0.00090
Titanium (Ti)-Total (mg/L)	0.018	<0.010	0.025	0.299	<0.010
Uranium (U)-Total (mg/L)	0.000268	0.00120	0.000676	0.00387	0.000978
Vanadium (V)-Total (mg/L)	0.0027	<0.0010	0.0025	0.0211	<0.0010
Zinc (Zn)-Total (mg/L)	0.0080	<0.0030	0.0078	0.0492	0.0068
Dissolved Metals Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
Aluminum (Al)-Dissolved (mg/L)	<0.0030	<0.0030	0.0092	0.0080	<0.0030
Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00015	0.00091	<0.00010
Arsenic (As)-Dissolved (mg/L)	<0.00010	0.00270	0.00020	0.00172	0.00094
Barium (Ba)-Dissolved (mg/L)	0.228	0.115	0.477	0.940	0.126
Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Boron (B)-Dissolved (mg/L)	<0.010	0.028	0.023	0.216	0.012
Cadmium (Cd)-Dissolved (mg/L)	0.000029	0.000016	0.000136 DTC	0.000013	<0.000010
Calcium (Ca)-Dissolved (mg/L)	72.3	78.3	71.4	29.9	52.8
Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00025	0.00041	0.00145	0.00080
Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050	0.00071	<0.00050	<0.00050
Iron (Fe)-Dissolved (mg/L)	<0.030	0.854	<0.030	0.057	0.967
Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000083	<0.000050	<0.000050
Lithium (Li)-Dissolved (mg/L)	0.00421	0.00603	0.0209	0.111	0.00310

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1201465-6	L1201465-7	L1201465-8	L1201465-9	
Description	WATER	WATER	WATER	WATER	
Sampled Date	22-AUG-12	22-AUG-12	21-AUG-12	21-AUG-12	
Sampled Time					
Client ID	MW-H20	MW-H17	MW-H22	X1	
Grouping	**Analyte**				
WATER					
Total Metals	Iron (Fe)-Total (mg/L)	0.842	2.05	3.66	1.63	
	Lead (Pb)-Total (mg/L)	0.00126	0.00101	0.00188	0.000343	
	Lithium (Li)-Total (mg/L)	0.952	0.0186	0.00720	0.00401	
	Magnesium (Mg)-Total (mg/L)	0.706	23.2	24.3	15.2	
	Manganese (Mn)-Total (mg/L)	0.157	0.165	0.0735	1.21	
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	0.000015	<0.000010	
	Molybdenum (Mo)-Total (mg/L)	0.00609	0.00258	0.00183	0.00292	
	Nickel (Ni)-Total (mg/L)	0.00167	0.00574	0.00640	0.00174	
	Phosphorus (P)-Total (mg/L)	0.49	<0.30	<0.30	<0.30	
	Potassium (K)-Total (mg/L)	0.913	1.93	1.59	0.938	
	Selenium (Se)-Total (mg/L)	0.00012	0.00030	0.00041	0.00029	
	Silicon (Si)-Total (mg/L)	5.11	7.32	11.7	3.85	
	Silver (Ag)-Total (mg/L)	0.000019	0.000020	0.000049	<0.000010	
	Sodium (Na)-Total (mg/L)	316	17.8	<2.0	42.7	
	Strontium (Sr)-Total (mg/L)	0.0877	0.209	0.142	0.134	
	Thallium (Tl)-Total (mg/L)	0.000019	0.000059	0.000156	<0.000010	
	Tin (Sn)-Total (mg/L)	0.00026	0.00025	0.00017	0.00099	
	Titanium (Ti)-Total (mg/L)	0.030	0.042	0.148	0.019	
	Uranium (U)-Total (mg/L)	0.00443	0.00260	0.000617	0.00100	
	Vanadium (V)-Total (mg/L)	0.0050	0.0080	0.0108	<0.0010	
	Zinc (Zn)-Total (mg/L)	0.0072	0.0145	0.0224	0.0067	
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0185	0.0040	0.0074	<0.0030	
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00012	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)	0.00152	0.00109	0.00012	0.00094	
	Barium (Ba)-Dissolved (mg/L)	0.437	0.307	0.341	0.125	
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Dissolved (mg/L)	0.180	0.016	<0.010	0.012	
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010	0.000024	0.000021	<0.000010	
	Calcium (Ca)-Dissolved (mg/L)	1.91	72.7	89.3	53.2	
	Chromium (Cr)-Dissolved (mg/L)	0.00012	<0.00010	0.00028	<0.00010	
	Cobalt (Co)-Dissolved (mg/L)	0.00012	0.00075	0.00010	0.00082	
	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Dissolved (mg/L)	0.164	<0.030	<0.030	0.958	
	Lead (Pb)-Dissolved (mg/L)	0.000061	<0.000050	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)	1.11	0.0159	0.00467	0.00327	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1201465-1	L1201465-2	L1201465-3	L1201465-4	L1201465-5
Description	WATER	WATER	WATER	WATER	WATER
Sampled Date	21-AUG-12	22-AUG-12	22-AUG-12	22-AUG-12	21-AUG-12
Sampled Time					
Client ID	MW-H23	MW-H5	MW-H18	MW-H19	MW-PNB
Grouping / **Analyte**					
WATER					
Dissolved Metals Magnesium (Mg)-Dissolved (mg/L)	17.4	27.5	19.7	11.8 DTC	15.0
Manganese (Mn)-Dissolved (mg/L)	0.00349	0.567	0.0431	0.310	1.13
Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Molybdenum (Mo)-Dissolved (mg/L)	0.000440	0.00136	0.000745	0.00537	0.00269
Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	0.00166	0.00499	0.00113
Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
Potassium (K)-Dissolved (mg/L)	0.637	0.931	0.953	1.67	0.854
Selenium (Se)-Dissolved (mg/L)	0.00044	<0.00010	0.00047	0.00028	0.00037
Silicon (Si)-Dissolved (mg/L)	2.91	6.06	3.24	4.69	2.63
Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Sodium (Na)-Dissolved (mg/L)	2.2	13.8	11.3	83.9	40.9
Strontium (Sr)-Dissolved (mg/L)	0.115	0.338	0.388	0.795 DTC	0.129
Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00019	0.00017
Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
Uranium (U)-Dissolved (mg/L)	0.000245	0.00122	0.000598	0.00253	0.000931
Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0030	0.0050	<0.0030	<0.0030

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1201465-6 WATER 22-AUG-12 MW-H20	L1201465-7 WATER 22-AUG-12 MW-H17	L1201465-8 WATER 21-AUG-12 MW-H22	L1201465-9 WATER 21-AUG-12 X1	
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	0.618	19.3	24.0	15.2	
	Manganese (Mn)-Dissolved (mg/L)	0.168	0.119	0.0268	1.12	
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Dissolved (mg/L)	0.00625	0.00241	0.00138	0.00269	
	Nickel (Ni)-Dissolved (mg/L)	0.00065	0.00162	0.00072	0.00107	
	Phosphorus (P)-Dissolved (mg/L)	0.50	<0.30	<0.30	<0.30	
	Potassium (K)-Dissolved (mg/L)	0.646	1.11	0.805	0.856	
	Selenium (Se)-Dissolved (mg/L)	0.00014	<0.00010	0.00034	0.00023	
	Silicon (Si)-Dissolved (mg/L)	2.74	4.18	3.69	2.60	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)	339	17.0	<2.0	40.1	
	Strontium (Sr)-Dissolved (mg/L)	0.0849	0.219	0.141	0.129	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	0.000013	<0.000010	
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00020	
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Uranium (U)-Dissolved (mg/L)	0.00449	0.00241	0.000492	0.000940	
	Vanadium (V)-Dissolved (mg/L)	0.0014	<0.0010	<0.0010	<0.0010	
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	

* 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	Barium (Ba)-Total	MS-B	L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Total	MS-B	L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Total	MS-B	L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Total	MS-B	L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1201465-1, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
TMV	Turbidity exceeded upper limit of the nephelometric method. Minimum value reported.

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"
This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.			
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity
This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.			
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320
This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method. OR This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.			
ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.			
ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0
This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.			
ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.
This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".			
CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)
This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".			
COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

Reference Information

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-TOT-COMBUST-VA Water Total Nitrogen in Water by Combustion BC: TN by Combustion/Chemiluminescence

This analysis is carried out, on hydrochloric acid preserved samples, following Method BC MOE "Total and Dissolved Nitrogen (TN) by Combustion with Chemiluminescence Detection". Total Nitrogen is determined directly by pyrolysis with chemiluminescence detection using automated instrumentation.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA	Water	TKN in Water (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:

10-240019 10-240021

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.

10-240019

ALS Environmental

L1201465-COFC

Page 1 of 1

Report To		Service Request (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan	Standard: Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Rusto Martinka	Select: PDF X Excel X Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W Hastings St Vancouver	Email 1: rmartinka@rescan.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2:	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: Fax:		Analysis Request
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information	(Indicate Filtered or Preserved, F/P)
Copy of Invoice with Report? (circle) Yes or No	Job #: 0791-007-24-12	
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only): L1201465	ALS Contact: Amber	Sampler: Rusto

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Cyanide Chem. F	Total Metals F	Diss. Metals F	TOC F	Nutrients F								Number of Containers
	MW-H23	21-08-12		water	X	X	X	X	X								5
	MW-H5	22-08-12			X	X	X	X	X								5
	MW-H18	22-08-12			X			X									2
	MW-H19	22-08-12			X			X									2
	MW-PN3	21-08-12			X	X	X	X	X								5
	MW-H20	22-08-12			X	X		X	X								4
	MW-H17	22-08-12			X	X											2
	MW-H22	21-08-12			X	X	X	X	X								5
	X1	21-08-12		water	X	X	X	X	X								5

Rush Processing

Short Holding Time

Special Instructions / Regula... ... land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Rusto Martinka	Date: 23-Aug-12	Time: 11:30	Received by: Britt	Date: Aug 29	Time: 9:15	Temperature: 11.3 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

10-240021

ALS Environmental

L12014 65-COFC

cal Request Form
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Page 1 of 1

Report To		Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan	Standard: Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Rusto Martinka	Select: PDF X Excel X Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W Hastings St. Vancouver	Email 1: rmartinka@rescan.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2:	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: Fax:		

Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information
	Copy of Invoice with Report? (circle) Yes or No	Job #: 0791-007-24-12
Company:		PO / AFE:
Contact:		LSD:
Address:		
Phone:	Fax:	Quote #:

Lab Work Order # (lab use only): L12014 65 **ALS Contact:** Amber **Sampler:** Rusto

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	F/P Diss. Metals	F/P Tot. Metals	F/P Nutrients	F/P TPC	Number of Containers
	MW-H20	22-08-12		Water	X				1
	MW-H19	"		"	X	X	X		3
	MW-H17	"		"	X		X	X	3
	MW-H18	22-08-11		Water	X	X	X		3

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Rusto Martinka	Date: 23-Aug-12	Time: 11:30	Received by: Britt	Date: Aug 29	Time: 9:25	Temperature: 12.4 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 30-OCT-12
Report Date: 08-NOV-12 10:44 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1230640

Project P.O. #: NOT SUBMITTED
Job Reference: 0791-007-24-13
C of C Numbers: 10-274123
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1230640-1	L1230640-2	L1230640-3	L1230640-4	L1230640-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	22-OCT-12	22-OCT-12	25-OCT-12	25-OCT-12	25-OCT-12
	Sampled Time					
	Client ID	MW-H24B	MW-H25B	MW-H18	MW-H19	MW-H17
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	7.7	<5.0	<5.0	<5.0
	Conductivity (uS/cm)	471	764	494	500	561
	Hardness (as CaCO3) (mg/L)	247	406	262	127	211
	pH (pH)	8.08	7.81	8.02	8.09	8.19
	Total Suspended Solids (mg/L)	141	1530	30.1	13.5	86.7
	Turbidity (NTU)	68.2	1920	17.2	7.23	84.2
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	6.3	14.6	5.4	3.8	2.6
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	276	436	273	284	295
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	276	436	273	284	295
	Ammonia, Total (as N) (mg/L)	0.0452	0.207	0.0417	0.304	0.0576
	Bromide (Br) (mg/L)	<0.050	<0.50 DLM	<0.050	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	<5.0 DLM	0.58	0.70	<0.50
	Fluoride (F) (mg/L)	0.113	<0.20 DLM	0.214	0.269	0.177
	Nitrate (as N) (mg/L)	0.0435	<0.050 DLM	0.125	<0.0050	0.0492
	Nitrite (as N) (mg/L)	<0.0010	<0.010 DLM	0.0011	<0.0010	0.0033
	Total Kjeldahl Nitrogen (mg/L)	0.086	0.790	0.054	0.340	0.227
	Total Nitrogen (mg/L)	0.130	0.790	0.180	0.340	0.280
	Orthophosphate-Dissolved (as P) (mg/L)	0.0015	0.0052	<0.0010	<0.0010	0.0022
	Phosphorus (P)-Total Dissolved (mg/L)	0.0035	0.0098	<0.0020	0.0028	0.0035
	Phosphorus (P)-Total (mg/L)	0.104	1.27	0.0390	0.0640	0.123
	Sulfate (SO4) (mg/L)	5.46	29.2	19.3	14.5	49.3
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	3.22	11.4	2.44	4.98	6.09
Total Metals	Aluminum (Al)-Total (mg/L)	1.67	20.4	0.192	0.0807	1.43
	Antimony (Sb)-Total (mg/L)	0.00096	0.00091	0.00022	0.00135	0.00107
	Arsenic (As)-Total (mg/L)	0.00072	0.0126	0.00029	0.00116	0.00583
	Barium (Ba)-Total (mg/L)	1.56	0.635	1.12	1.42	0.241
	Beryllium (Be)-Total (mg/L)	0.00011	0.00123	<0.00010	<0.00010	0.00010
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	0.015	0.032	0.020	0.256	0.022
	Cadmium (Cd)-Total (mg/L)	0.000156	0.00193	0.000029	0.000086	0.000085
	Calcium (Ca)-Total (mg/L)	78.1	170	71.2	32.3	61.7
	Chromium (Cr)-Total (mg/L)	0.00278	0.0327	0.00048	0.00047	0.00233
	Cobalt (Co)-Total (mg/L)	0.00237	0.0265	0.00039	0.00182	0.00156
	Copper (Cu)-Total (mg/L)	0.00299	0.0487	0.00101	0.00258	0.00436

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1230640-6	L1230640-7			
	Description	WATER	WATER			
	Sampled Date	28-OCT-12	28-OCT-12			
	Sampled Time					
	Client ID	MW-H23	MW-H22			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0			
	Conductivity (uS/cm)	430	576			
	Hardness (as CaCO3) (mg/L)	230	336			
	pH (pH)	8.11	8.03			
	Total Suspended Solids (mg/L)	48.8	847			
	Turbidity (NTU)	27.6	82.2			
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	5.0	5.9			
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	247	301			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)	247	301			
	Ammonia, Total (as N) (mg/L)	<0.0050	<0.0050			
	Bromide (Br) (mg/L)	<0.050	<0.050			
	Chloride (Cl) (mg/L)	<0.50	<0.50			
	Fluoride (F) (mg/L)	0.081	0.049			
	Nitrate (as N) (mg/L)	0.177	0.415			
	Nitrite (as N) (mg/L)	<0.0010	<0.0010			
	Total Kjeldahl Nitrogen (mg/L)	0.083	<0.084			
	Total Nitrogen (mg/L)	0.260	0.420			
	Orthophosphate-Dissolved (as P) (mg/L)	0.0014	<0.0010			
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020			
	Phosphorus (P)-Total (mg/L)	0.0563	0.111			
	Sulfate (SO4) (mg/L)	6.89	6.00			
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	2.46	2.99			
Total Metals	Aluminum (Al)-Total (mg/L)	0.636	2.58			
	Antimony (Sb)-Total (mg/L)	0.00020	0.00034			
	Arsenic (As)-Total (mg/L)	0.00083	0.00290			
	Barium (Ba)-Total (mg/L)	0.260	0.388			
	Beryllium (Be)-Total (mg/L)	<0.00010	0.00022			
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050			
	Boron (B)-Total (mg/L)	<0.010	0.012			
	Cadmium (Cd)-Total (mg/L)	0.000247	0.000699			
	Calcium (Ca)-Total (mg/L)	70.3	194			
	Chromium (Cr)-Total (mg/L)	0.00143	0.00760			
	Cobalt (Co)-Total (mg/L)	0.00105	0.00269			
	Copper (Cu)-Total (mg/L)	0.00211	0.00705			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1230640-1	L1230640-2	L1230640-3	L1230640-4	L1230640-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	22-OCT-12	22-OCT-12	25-OCT-12	25-OCT-12	25-OCT-12
	Sampled Time					
	Client ID	MW-H24B	MW-H25B	MW-H18	MW-H19	MW-H17
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	2.59	37.9	0.233	0.142	2.57
	Lead (Pb)-Total (mg/L)	0.00182	0.0190	0.000180	0.000208	0.00172
	Lithium (Li)-Total (mg/L)	0.00394	0.0357	0.0148	0.121	0.0235
	Magnesium (Mg)-Total (mg/L)	20.6	47.8	19.8	12.1	14.8
	Manganese (Mn)-Total (mg/L)	0.101	1.12	0.0213	0.346	0.167
	Mercury (Hg)-Total (mg/L)	<0.000010	0.000053	<0.000010	<0.000010	0.000011
	Molybdenum (Mo)-Total (mg/L)	0.00110	0.00457	0.000771	0.00398	0.00652
	Nickel (Ni)-Total (mg/L)	0.00606	0.0850	0.00202	0.00575	0.00749
	Phosphorus (P)-Total (mg/L)	<0.30	0.99	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	1.37	5.33	0.882	1.58	2.02
	Selenium (Se)-Total (mg/L)	0.00098	0.00212	0.00060	0.00064	0.00045
	Silicon (Si)-Total (mg/L)	6.45	66.7	3.88	4.54	7.12
	Silver (Ag)-Total (mg/L)	0.000046	0.000361	<0.000010	<0.000010	0.000029
	Sodium (Na)-Total (mg/L)	7.9	12.2	6.4	71.2	50.8
	Strontium (Sr)-Total (mg/L)	0.280	0.345	0.492	0.943	0.149
	Thallium (Tl)-Total (mg/L)	0.000061	0.000684	0.000012	0.000043	0.000070
	Tin (Sn)-Total (mg/L)	0.00018	0.00032	0.00029	0.00215	0.00050
	Titanium (Ti)-Total (mg/L)	0.059	0.887	0.017	<0.010	0.022
	Uranium (U)-Total (mg/L)	0.000587	0.00543	0.000728	0.00177	0.00841
	Vanadium (V)-Total (mg/L)	0.0062	0.0721	<0.0010	<0.0010	0.0068
	Zinc (Zn)-Total (mg/L)	0.0136	0.165	0.0051	0.0057	0.0162
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	0.0131	<0.0030	0.0042	0.0034
	Antimony (Sb)-Dissolved (mg/L)	0.00095	0.00028	0.00017	0.00107	0.00069
	Arsenic (As)-Dissolved (mg/L)	0.00024	0.00131	0.00019	0.00120	0.00305
	Barium (Ba)-Dissolved (mg/L)	1.08	0.291	1.06	1.46	0.163
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	0.013	0.014	0.018	0.253	0.018
	Cadmium (Cd)-Dissolved (mg/L)	0.000027	0.000142	0.000021	0.000022	0.000017
	Calcium (Ca)-Dissolved (mg/L)	69.8	109	72.1	31.4	60.7
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00011	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00077	0.00731	0.00024	0.00177	0.00061
	Copper (Cu)-Dissolved (mg/L)	<0.00050	0.00082	<0.00050	0.00065	<0.00050
	Iron (Fe)-Dissolved (mg/L)	<0.030	0.047	<0.030	<0.030	<0.030
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000071	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.00178	0.00757	0.0147	0.120	0.0217

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1230640-6	L1230640-7			
	Description	WATER	WATER			
	Sampled Date	28-OCT-12	28-OCT-12			
	Sampled Time					
	Client ID	MW-H23	MW-H22			
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	1.28	6.06			
	Lead (Pb)-Total (mg/L)	0.000890	0.00353			
	Lithium (Li)-Total (mg/L)	0.00398	0.00791			
	Magnesium (Mg)-Total (mg/L)	16.8	46.3			
	Manganese (Mn)-Total (mg/L)	0.0355	0.217			
	Mercury (Hg)-Total (mg/L)	<0.000010	0.000013			
	Molybdenum (Mo)-Total (mg/L)	0.000622	0.00171			
	Nickel (Ni)-Total (mg/L)	0.00338	0.0111			
	Phosphorus (P)-Total (mg/L)	<0.30	0.76			
	Potassium (K)-Total (mg/L)	0.847	1.68			
	Selenium (Se)-Total (mg/L)	0.00048	0.00059			
	Silicon (Si)-Total (mg/L)	4.12	8.31			
	Silver (Ag)-Total (mg/L)	0.000014	0.000052			
	Sodium (Na)-Total (mg/L)	2.2	<2.0			
	Strontium (Sr)-Total (mg/L)	0.116	0.240			
	Thallium (Tl)-Total (mg/L)	0.000067	0.000173			
	Tin (Sn)-Total (mg/L)	0.00014	0.00051			
	Titanium (Ti)-Total (mg/L)	0.026	0.062			
	Uranium (U)-Total (mg/L)	0.000304	0.00111			
	Vanadium (V)-Total (mg/L)	0.0032	0.0162			
	Zinc (Zn)-Total (mg/L)	0.0100	0.0331			
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	<0.0030			
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Dissolved (mg/L)	<0.00010	0.00012			
	Barium (Ba)-Dissolved (mg/L)	0.249	0.315			
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010			
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050			
	Boron (B)-Dissolved (mg/L)	<0.010	<0.010			
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010	0.000015			
	Calcium (Ca)-Dissolved (mg/L)	66.3	97.4			
	Chromium (Cr)-Dissolved (mg/L)	0.00013	0.00057			
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	<0.00010			
	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050			
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.00328	0.00394			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1230640-1 WATER 22-OCT-12 MW-H24B	L1230640-2 WATER 22-OCT-12 MW-H25B	L1230640-3 WATER 25-OCT-12 MW-H18	L1230640-4 WATER 25-OCT-12 MW-H19	L1230640-5 WATER 25-OCT-12 MW-H17
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	17.8	32.7	20.0	11.8	14.5
	Manganese (Mn)-Dissolved (mg/L)	0.0546	0.549	0.0157	0.344	0.145
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.000933	0.00274	0.000704	0.00392	0.00646
	Nickel (Ni)-Dissolved (mg/L)	0.00166	0.0204	0.00171	0.00534	0.00286
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	0.858	1.57	0.860	1.61	1.68
	Selenium (Se)-Dissolved (mg/L)	0.00083	0.00138	0.00061	0.00060	0.00028
	Silicon (Si)-Dissolved (mg/L)	2.68	5.99	3.26	4.44	4.84
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	8.0	12.2	6.5	73.3	52.9
	Strontium (Sr)-Dissolved (mg/L)	0.237	0.271	0.480	0.931	0.144
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000026	<0.000010	0.000041	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	0.00016	0.00197	0.00013
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.000413	0.00435	0.000711	0.00176	0.00794
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	0.0033	0.0032	0.0033	<0.0030

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1230640-6	L1230640-7			
	Description	WATER	WATER			
	Sampled Date	28-OCT-12	28-OCT-12			
	Sampled Time					
	Client ID	MW-H23	MW-H22			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	15.5	22.4			
	Manganese (Mn)-Dissolved (mg/L)	0.00324	0.00327			
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)	0.000417	0.000813			
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00056			
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30			
	Potassium (K)-Dissolved (mg/L)	0.618	0.908			
	Selenium (Se)-Dissolved (mg/L)	0.00043	0.00046			
	Silicon (Si)-Dissolved (mg/L)	2.87	3.85			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	2.2	<2.0			
	Strontium (Sr)-Dissolved (mg/L)	0.109	0.139			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000013			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010			
	Uranium (U)-Dissolved (mg/L)	0.000235	0.000480			
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010			
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0030			

* 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)
Duplicate	Bromide (Br)	DLM	L1230640-1, -2, -3, -4, -5, -6, -7
Duplicate	Chloride (Cl)	DLM	L1230640-1, -2, -3, -4, -5, -6, -7
Duplicate	Fluoride (F)	DLM	L1230640-1, -2, -3, -4, -5, -6, -7
Duplicate	Nitrate (as N)	DLM	L1230640-1, -2, -3, -4, -5, -6, -7
Duplicate	Bromide (Br)	DLM	L1230640-1, -2, -3, -4, -5, -6, -7
Duplicate	Chloride (Cl)	DLM	L1230640-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Nitrate (as N)	MS-B	L1230640-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1230640-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1230640-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1230640-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1230640-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1230640-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Mercury (Hg)-Total	MS-B	L1230640-1, -2, -3, -4, -5, -6, -7

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted For Sample Matrix Effects
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

Reference Information

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-TOT-COMBUST-VA Water Total Nitrogen in Water by Combustion BC: TN by Combustion/Chemiluminescence

This analysis is carried out, on hydrochloric acid preserved samples, following Method BC MOE "Total and Dissolved Nitrogen (TN) by Combustion with Chemiluminescence Detection". Total Nitrogen is determined directly by pyrolysis with chemiluminescence detection using automated instrumentation.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA	Water	TKN in Water (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:

10-274123

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.

10-274123

ALS Environmental

L1230640-COFC

Form

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan Environmental	Standard: X Other (specify):	X (Regular) Standard Turnaround Times - Business Days)
Contact: Rusto Martinka	Select: PDF X Excel X Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 111 W Hastings St Vancouver BC	Email 1: rmartinka@rescan.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2:	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: Fax:		Analysis Request
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information	(Indicate Filtered or Preserved, F/P)
Copy of Invoice with Report? (circle) Yes or No	Job #: 0791-007-24-13	
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only): L1230640	ALS Contact: Amber	Sampler: Rusto

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Short Holding Time	Number of Containers
~~MW-H24~~	MW-H24B	22-Oct-12		Water	X X X X X	5
	MW-H25B	22-Oct-12			X X X X X	5
	MW-H18	25-Oct-12			X X X X X	5
	MW-H19	25-Oct-12			X X X X X	5
	MW-H17	25-Oct-12			X X X X X	5
	MW-H23	28-Oct-12			X X X X X	5
	MW-H22	28-Oct-12		Water	X X X X X	5

Rush Processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Rusto Martinka	Date: 29-Oct-12	Time: 11:00	Received by: Brittany	Date: Oct. 30	Time: 8:25	Temperature: 2.5 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 06-NOV-12
Report Date: 16-NOV-12 16:06 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1233652

Project P.O. #: NOT SUBMITTED
Job Reference: 0791-007-24-13
C of C Numbers: 10-274122
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1233652-1	L1233652-2	L1233652-3	L1233652-4	L1233652-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	30-OCT-12	29-OCT-12	30-OCT-12	01-NOV-12	01-NOV-12
	Sampled Time					
	Client ID	MW-H26A	MW-H24A	MW-H26B	MW-H25A	X1
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	12.4	8.5	8.9	7.6	7.7
	Conductivity (uS/cm)	2350	15300	760	1430	1420
	Hardness (as CaCO3) (mg/L)	358	1750	393	592	623
	pH (pH)	12.09	12.88	7.95	11.62	11.61
	Total Suspended Solids (mg/L)	157	123	164	129	155
	Turbidity (NTU)	60.7	64.0	115	18.4	24.5
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	<1.0	8.2	<1.0	<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<1.0	<5.0	331	<1.0	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	76.8	208	<2.0	43.5	56.7
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	401	3960	<2.0	164	146
	Alkalinity, Total (as CaCO3) (mg/L)	478	4170	331	208	203
	Ammonia, Total (as N) (mg/L)	1.38	3.96	0.167	0.0451	
	Bromide (Br) (mg/L)	<1.0 DLM	<5.0 DLM	<0.50 DLM	<1.0 DLM	<1.0 DLM
	Chloride (Cl) (mg/L)	<10 DLM	<50 DLM	<5.0 DLM	<10 DLM	<10 DLM
	Fluoride (F) (mg/L)	0.45	<2.0 DLM	0.28	0.41	0.41
	Nitrate (as N) (mg/L)	<0.10 DLM	<0.50 DLM	0.371	0.10	0.12
	Nitrite (as N) (mg/L)	<0.020 DLM	<0.10 DLM	<0.010 DLM	<0.020 DLM	<0.020 DLM
	Total Kjeldahl Nitrogen (mg/L)	1.59	4.87	0.56	0.359	
	Total Nitrogen (mg/L)	1.59	4.87	0.930	0.460	0.500
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	0.0012	<0.0010	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0099	0.0038	0.0053	0.0027	0.0028
	Phosphorus (P)-Total (mg/L)	0.0798	0.0347	0.191	0.0198	0.0293
	Sulfate (SO4) (mg/L)	179	<50 DLM	125	390	393
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	14.5	21.0	6.16	7.01	8.17
Total Metals	Aluminum (Al)-Total (mg/L)	1.41	1.85	3.01	1.03	1.26
	Antimony (Sb)-Total (mg/L)	0.00211	0.00178	0.00104	0.00268	0.00281
	Arsenic (As)-Total (mg/L)	0.00348	0.00198	0.00384	0.00331	0.00381
	Barium (Ba)-Total (mg/L)	0.531	6.94	0.174	0.350	0.410
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00050 DLA	0.00019	<0.00020 DLA	<0.00020 DLA
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.0025 DLA	<0.00050	<0.0010 DLA	<0.0010 DLA
	Boron (B)-Total (mg/L)	0.042	<0.050 DLA	0.081	<0.020 DLA	<0.020 DLA
	Cadmium (Cd)-Total (mg/L)	<0.00013 DLM	0.000061	0.000409	0.000072	0.000083
	Calcium (Ca)-Total (mg/L)	149	711	112	246	247
	Chromium (Cr)-Total (mg/L)	0.0756	0.0521	0.00830	0.0619	0.0696
	Cobalt (Co)-Total (mg/L)	0.00118	0.00187	0.0145	0.00083	0.00101
	Copper (Cu)-Total (mg/L)	0.0573	0.0200	0.0273	0.0424	0.0526

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1233652-1	L1233652-2	L1233652-3	L1233652-4	L1233652-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	30-OCT-12	29-OCT-12	30-OCT-12	01-NOV-12	01-NOV-12
	Sampled Time					
	Client ID	MW-H26A	MW-H24A	MW-H26B	MW-H25A	X1
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	2.26	1.51	6.39	1.83	2.07
	Lead (Pb)-Total (mg/L)	0.00251	0.00313	0.00434	0.00256	0.00355
	Lithium (Li)-Total (mg/L)	0.182	0.238	0.0160	0.0159	0.0160
	Magnesium (Mg)-Total (mg/L)	1.23	0.569	30.7	0.976	1.18
	Manganese (Mn)-Total (mg/L)	0.0529	0.0484	0.938	0.0555	0.0679
	Mercury (Hg)-Total (mg/L)	0.000010	<0.000010	0.000013	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.153	0.0253	0.00512	0.0181	0.0183
	Nickel (Ni)-Total (mg/L)	0.00354	<0.0025 DLA	0.0443	0.0030	0.0037
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	8.93	100	5.72	5.72	6.49
	Selenium (Se)-Total (mg/L)	0.00230	0.00073	0.00394	0.00130	0.00131
	Silicon (Si)-Total (mg/L)	23.9	7.48	12.5	40.9	43.1
	Silver (Ag)-Total (mg/L)	0.000088	0.000120	0.000102	0.000106	0.000147
	Sodium (Na)-Total (mg/L)	152	899	47.3	30.4	32.0
	Strontium (Sr)-Total (mg/L)	0.711	27.2	0.331	0.846	0.885
	Thallium (Tl)-Total (mg/L)	0.000020	<0.000050 DLA	0.000129	<0.000020 DLA	<0.000020 DLA
	Tin (Sn)-Total (mg/L)	0.00343	0.00443	0.0163	0.00320	0.00404
	Titanium (Ti)-Total (mg/L)	0.077	0.075	0.121	0.050	0.051
	Uranium (U)-Total (mg/L)	0.000252	0.000246	0.00564	0.000269	0.000289
	Vanadium (V)-Total (mg/L)	0.0196	<0.0050 DLA	0.0096	0.0244	0.0276
	Zinc (Zn)-Total (mg/L)	0.0569	0.068	0.0669	0.0968	0.121
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	LAB	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)	0.0573	0.054	0.0118	0.0166	
	Antimony (Sb)-Dissolved (mg/L)	0.00119	<0.00050 DLA	0.00072	0.00176	
	Arsenic (As)-Dissolved (mg/L)	0.00211	<0.00050 DLA	0.00096	0.00276	
	Barium (Ba)-Dissolved (mg/L)	0.473	6.91	0.0947	0.392	
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00050 DLA	<0.00010	<0.00020 DLA	
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.0025 DLA	<0.00050	<0.0010 DLA	
	Boron (B)-Dissolved (mg/L)	0.037	<0.050 DLA	0.069	<0.020 DLA	
	Cadmium (Cd)-Dissolved (mg/L)	<0.000050 DLM	<0.000050 DLA	0.000236	<0.000020 DLA	
	Calcium (Ca)-Dissolved (mg/L)	143	701	107	237	
	Chromium (Cr)-Dissolved (mg/L)	0.0764	0.0470	0.00101	0.0649	
	Cobalt (Co)-Dissolved (mg/L)	0.00012	0.00058	0.0123	<0.00020 DLA	
	Copper (Cu)-Dissolved (mg/L)	0.00708	0.0047	0.00645	0.0025	
	Iron (Fe)-Dissolved (mg/L)	0.034	<0.030	<0.030	<0.030	
	Lead (Pb)-Dissolved (mg/L)	0.000099	0.00156	0.000077	<0.00010 DLA	
	Lithium (Li)-Dissolved (mg/L)	0.185	0.244	0.0133	0.0157	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1233652-1	L1233652-2	L1233652-3	L1233652-4	L1233652-5
	Description	WATER	WATER	WATER	WATER	WATER
	Sampled Date	30-OCT-12	29-OCT-12	30-OCT-12	01-NOV-12	01-NOV-12
	Sampled Time					
	Client ID	MW-H26A	MW-H24A	MW-H26B	MW-H25A	X1
Grouping	**Analyte**					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	0.123	0.040	30.5	0.225	
	Manganese (Mn)-Dissolved (mg/L)	0.00123	<0.00025 DLA	0.892	0.00027	
	Mercury (Hg)-Dissolved (mg/L)	0.000010	<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Dissolved (mg/L)	0.156	0.0242	0.00438	0.0172	
	Nickel (Ni)-Dissolved (mg/L)	0.00090	<0.0025 DLA	0.0388	0.0013	
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	
	Potassium (K)-Dissolved (mg/L)	9.44	101	5.25	6.70	
	Selenium (Se)-Dissolved (mg/L)	0.00238	0.00063	0.00404	0.00125	
	Silicon (Si)-Dissolved (mg/L)	17.6	0.132	5.88	40.1	
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000050 DLA	<0.000010	<0.000020 DLA	
	Sodium (Na)-Dissolved (mg/L)	156	898	49.9	32.6	
	Strontium (Sr)-Dissolved (mg/L)	0.708	26.3	0.332	0.842	
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000050 DLA	0.000046	<0.000020 DLA	
	Tin (Sn)-Dissolved (mg/L)	0.00067	0.00095	0.0114	0.00052	
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	
	Uranium (U)-Dissolved (mg/L)	<0.000010	<0.000050 DLA	0.00543	<0.000020 DLA	
	Vanadium (V)-Dissolved (mg/L)	0.0158	<0.0050 DLA	<0.0010	0.0258	
	Zinc (Zn)-Dissolved (mg/L)	0.0031	0.016	0.0194	<0.0060 DLA	

* 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)
Duplicate	Bromide (Br)	DLM	L1233652-1, -2, -3, -4, -5
Duplicate	Bromide (Br)	DLM	L1233652-1, -2, -3, -4, -5
Duplicate	Nitrate (as N)	DLM	L1233652-1, -2, -3, -4, -5
Duplicate	Bromide (Br)	DLM	L1233652-1, -2, -3, -4, -5
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1233652-1, -2, -3, -4, -5
Matrix Spike	Phosphorus (P)-Total	MS-B	L1233652-1, -2, -3, -4, -5
Matrix Spike	Phosphorus (P)-Total Dissolved	MS-B	L1233652-1, -2, -3, -4, -5
Matrix Spike	Phosphorus (P)-Total	MS-B	L1233652-1, -2, -3, -4, -5
Matrix Spike	Phosphorus (P)-Total Dissolved	MS-B	L1233652-1, -2, -3, -4, -5
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1233652-1, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1233652-2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1233652-2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1233652-2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1233652-2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1233652-2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1233652-2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1233652-2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1233652-2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-MAN-VA	Water	Alkalinity (Species) by Manual Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-MAN-VA	Water	Alkalinity (Species) by Manual Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA	Water	Total Mercury in Water by CVAFS(Low)	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United

Reference Information

States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-TOT-COMBUST-VA Water Total Nitrogen in Water by Combustion BC: TN by Combustion/Chemiluminescence

This analysis is carried out, on hydrochloric acid preserved samples, following Method BC MOE "Total and Dissolved Nitrogen (TN) by Combustion with Chemiluminescence Detection". Total Nitrogen is determined directly by pyrolysis with chemiluminescence detection using automated instrumentation.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:

10-274122

Reference Information

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.

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 22-DEC-12
Report Date: 08-JAN-13 12:57 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1252558

Project P.O. #: NOT SUBMITTED
Job Reference: 0791-24-14
C of C Numbers: 10-033695
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1252558-1 water 20-DEC-12 MW-H17	L1252558-2 water 20-DEC-12 MW-H18	L1252558-3 water 20-DEC-12 MW-H19	L1252558-4 water 20-DEC-12 MW-H24A	L1252558-5 water 19-DEC-12 MW-H22
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0	9.6	<5.0
	Conductivity (uS/cm)	548	503	494	11500	544
	Hardness (as CaCO3) (mg/L)	227	264	136	1220	339
	pH (pH)	8.13	8.00	8.27	12.63	8.10
	Total Suspended Solids (mg/L)	66.7	151	<3.0	205	108
	Turbidity (NTU)	107	40.1	5.86	171	61.0
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	3.9	6.6	<1.0	<1.0	5.3
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	282	266	287	<13	343
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	1410	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	1710	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	282	266	287	3120	343
	Ammonia, Total (as N) (mg/L)	0.0206	0.0299	0.384	6.24	<0.0050
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<2.5 DLM	<0.050
	Chloride (Cl) (mg/L)	0.52	0.52	0.69	<25 DLM	<0.50
	Fluoride (F) (mg/L)	0.155	0.210	0.250	<1.0 DLM	0.052
	Nitrate (as N) (mg/L)	0.113	0.215	<0.0050	0.42	0.489
	Nitrite (as N) (mg/L)	<0.0010	0.0026	<0.0010	<0.050 DLM	0.0012
	Total Kjeldahl Nitrogen (mg/L)	0.166	<0.051	0.626	94.0	<0.093
	Total Nitrogen (mg/L)	0.279	0.254	0.626	94.4	0.464
	Orthophosphate-Dissolved (as P) (mg/L)	0.0053	0.0040	0.0067	<0.10 DLM	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0058	0.0041	0.0086	0.0058	<0.0020
	Phosphorus (P)-Total (mg/L)	0.137	0.125	0.0240	0.0326	0.0911
	Sulfate (SO4) (mg/L)	35.1	24.2	13.6	<25 DLM	5.44
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	3.87	1.66	2.84	25.7	0.90
Total Metals	Aluminum (Al)-Total (mg/L)	0.734	0.0567	0.0341	0.999	0.434
	Antimony (Sb)-Total (mg/L)	0.00065	0.00015	0.00087	0.00126	0.00011
	Arsenic (As)-Total (mg/L)	0.00361	0.00015	0.00136	0.00123	0.00053
	Barium (Ba)-Total (mg/L)	0.204	0.898	1.53	6.76	0.294
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00050 DLA	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.0025 DLA	<0.00050
	Boron (B)-Total (mg/L)	0.012	0.017	0.228	<0.050 DLA	<0.010
	Cadmium (Cd)-Total (mg/L)	0.000071	0.000026	0.000030	0.000064	0.000069
	Calcium (Ca)-Total (mg/L)	62.2	70.9	32.9	492	96.4
	Chromium (Cr)-Total (mg/L)	0.00148	0.00019	0.00022	0.0363	0.00221
	Cobalt (Co)-Total (mg/L)	0.00144	0.00029	0.00193	0.00099	0.00035
	Copper (Cu)-Total (mg/L)	0.00427	0.00169	0.00151	0.0176	0.00226

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1252558-6 water 19-DEC-12 MW-H23	L1252558-7 water 19-DEC-12 MW-H24B	L1252558-8 water 19-DEC-12 MW-H25B	L1252558-9 water 19-DEC-12 MW-H26B	L1252558-10 water 20-DEC-12 X1
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0	12.8	<5.0
	Conductivity (uS/cm)	434	459	612	982	554
	Hardness (as CaCO3) (mg/L)	248	248	345	378	230
	pH (pH)	8.12	8.10	8.12	8.05	8.23
	Total Suspended Solids (mg/L)	247	594	36.0	810	78.0
	Turbidity (NTU)	161	168	132	347	124
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	4.2	4.6	5.8	6.4	2.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	255	277	363	343	290
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	255	277	363	343	290
	Ammonia, Total (as N) (mg/L)	<0.0050	0.0071	0.0780	0.0946	0.0211
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.50 DLM	<0.050
	Chloride (Cl) (mg/L)	<0.50	<0.50	2.47	9.3	<0.50
	Fluoride (F) (mg/L)	0.076	0.094	0.188	<0.20 DLM	0.155
	Nitrate (as N) (mg/L)	0.245	0.0051	0.0098	<0.050 DLM	0.112
	Nitrite (as N) (mg/L)	0.0023	0.0072	0.0012	0.013	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.110	0.232	0.250	0.737	0.202
	Total Nitrogen (mg/L)	0.357	0.244	0.261	0.751	0.315
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	0.0182	0.0051
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	<0.0020	0.0259	0.0051
	Phosphorus (P)-Total (mg/L)	0.198	0.327	0.080	0.610	0.124
	Sulfate (SO4) (mg/L)	6.82	4.44	8.02	223	35.5
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	3.56	2.08	4.01	9.25	3.45
Total Metals	Aluminum (Al)-Total (mg/L)	2.60	2.03	2.11	3.06	0.880
	Antimony (Sb)-Total (mg/L)	0.00069	0.00040	0.00028	0.00115	0.00067
	Arsenic (As)-Total (mg/L)	0.00443	0.00117	0.00224	0.00321	0.00366
	Barium (Ba)-Total (mg/L)	0.332	1.34	0.244	0.131	0.208
	Beryllium (Be)-Total (mg/L)	0.00017	0.00014	0.00012	0.00030	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	0.011	0.012	0.018	0.069	0.014
	Cadmium (Cd)-Total (mg/L)	0.00126	0.000346	0.000151	0.000358	0.000071
	Calcium (Ca)-Total (mg/L)	87.9	80.7	89.3	102	67.1
	Chromium (Cr)-Total (mg/L)	0.00645	0.00542	0.00325	0.00402	0.00158
	Cobalt (Co)-Total (mg/L)	0.00505	0.00260	0.00320	0.00814	0.00146
	Copper (Cu)-Total (mg/L)	0.00957	0.0215	0.00415	0.0208	0.00404

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1252558-1 water 20-DEC-12 MW-H17	L1252558-2 water 20-DEC-12 MW-H18	L1252558-3 water 20-DEC-12 MW-H19	L1252558-4 water 20-DEC-12 MW-H24A	L1252558-5 water 19-DEC-12 MW-H22
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	1.36	0.068	0.052	0.726	0.896
	Lead (Pb)-Total (mg/L)	0.00105	0.000073	0.000073	0.00242	0.000490
	Lithium (Li)-Total (mg/L)	0.0143	0.0123	0.114	0.203	0.00473
	Magnesium (Mg)-Total (mg/L)	16.0	20.6	13.0	0.286	22.7
	Manganese (Mn)-Total (mg/L)	0.222	0.00961	0.358	0.0251	0.0183
	Mercury (Hg)-Total (mg/L)	0.000013	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.00384	0.000695	0.00396	0.0210	0.000834
	Nickel (Ni)-Total (mg/L)	0.00598	0.00198	0.00550	<0.0025 DLA	0.00171
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	1.60	0.836	1.67	69.3	1.11
	Selenium (Se)-Total (mg/L)	0.00041	0.00063	0.00029	0.00063	0.00049
	Silicon (Si)-Total (mg/L)	5.57	3.28	4.51	3.27	4.44
	Silver (Ag)-Total (mg/L)	0.000030	<0.000010	<0.000010	0.000075	0.000011
	Sodium (Na)-Total (mg/L)	32.9	5.4	71.7	800	<2.0
	Strontium (Sr)-Total (mg/L)	0.139	0.442	0.980	21.9	0.137
	Thallium (Tl)-Total (mg/L)	0.000040	<0.000010	0.000025	<0.000050 DLA	0.000035
	Tin (Sn)-Total (mg/L)	0.00041	<0.00010	0.00112	0.00628	0.00040
	Titanium (Ti)-Total (mg/L)	0.016	0.010	<0.010	0.049	0.025
	Uranium (U)-Total (mg/L)	0.00494	0.000561	0.00172	0.000114	0.000498
	Vanadium (V)-Total (mg/L)	0.0043	<0.0010	<0.0010	<0.0050 DLA	0.0022
	Zinc (Zn)-Total (mg/L)	0.0158	0.0053	0.0079	0.041	0.0081
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	<0.0030	<0.0030	0.025	<0.0030
	Antimony (Sb)-Dissolved (mg/L)	0.00050	0.00015	0.00078	<0.00050 DLA	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00183	0.00012	0.00126	<0.00050 DLA	0.00015
	Barium (Ba)-Dissolved (mg/L)	0.184	0.920	1.56	6.96	0.310
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00050 DLA	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.0025 DLA	<0.00050
	Boron (B)-Dissolved (mg/L)	0.013	0.020	0.241	<0.050 DLA	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	0.000028	0.000023	0.000018	<0.000050 DLA	0.000014
	Calcium (Ca)-Dissolved (mg/L)	65.1	71.7	32.9	490	95.6
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00012	0.0352	0.00065
	Cobalt (Co)-Dissolved (mg/L)	0.00026	0.00021	0.00184	<0.00050 DLA	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00086	0.00065	0.00093	0.0050	0.00064
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.030	<0.030	<0.030
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	0.00127	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.0147	0.0129	0.118	0.215	0.00414

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ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1252558-6	L1252558-7	L1252558-8	L1252558-9	L1252558-10
	Description	water	water	water	water	water
	Sampled Date	19-DEC-12	19-DEC-12	19-DEC-12	19-DEC-12	20-DEC-12
	Sampled Time					
	Client ID	MW-H23	MW-H24B	MW-H25B	MW-H26B	X1
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	6.35	3.74	2.75	4.22	1.33
	Lead (Pb)-Total (mg/L)	0.00435	0.00346	0.00139	0.00389	0.00109
	Lithium (Li)-Total (mg/L)	0.00637	0.00391	0.00889	0.0111	0.0154
	Magnesium (Mg)-Total (mg/L)	22.9	21.2	31.1	34.9	16.2
	Manganese (Mn)-Total (mg/L)	0.166	0.116	0.823	1.12	0.221
	Mercury (Hg)-Total (mg/L)	0.000022	0.000016	<0.000010	0.000015	0.000014
	Molybdenum (Mo)-Total (mg/L)	0.00183	0.00113	0.00341	0.00721	0.00401
	Nickel (Ni)-Total (mg/L)	0.0147	0.00827	0.00851	0.0223	0.00606
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	1.60	1.58	1.66	4.29	1.67
	Selenium (Se)-Total (mg/L)	0.00098	0.00036	0.00021	0.00083	0.00040
	Silicon (Si)-Total (mg/L)	8.20	5.72	13.7	14.0	6.00
	Silver (Ag)-Total (mg/L)	0.000066	0.000077	0.000029	0.000065	0.000032
	Sodium (Na)-Total (mg/L)	2.6	6.6	11.6	83.4	33.8
	Strontium (Sr)-Total (mg/L)	0.125	0.216	0.270	0.345	0.143
	Thallium (Tl)-Total (mg/L)	0.000314	0.000086	0.000074	0.000091	0.000042
	Tin (Sn)-Total (mg/L)	0.00055	0.00119	<0.00010	0.00155	0.00047
	Titanium (Ti)-Total (mg/L)	0.081	0.044	0.143	0.099	0.023
	Uranium (U)-Total (mg/L)	0.000516	0.000663	0.00286	0.0129	0.00511
	Vanadium (V)-Total (mg/L)	0.0146	0.0071	0.0081	0.0053	0.0045
	Zinc (Zn)-Total (mg/L)	0.0493	0.0571	0.0159	0.0458	0.0161
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	0.0048	<0.0030	0.0066	<0.0030
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	0.00014	0.00017	0.00098	0.00048
	Arsenic (As)-Dissolved (mg/L)	0.00012	0.00028	0.00130	0.00117	0.00196
	Barium (Ba)-Dissolved (mg/L)	0.253	0.699	0.220	0.0759	0.189
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	<0.010	0.011	0.017	0.070	0.014
	Cadmium (Cd)-Dissolved (mg/L)	0.000016	0.000045	0.000029	0.000071	0.000027
	Calcium (Ca)-Dissolved (mg/L)	69.1	69.5	89.3	97.6	65.0
	Chromium (Cr)-Dissolved (mg/L)	0.00015	0.00032	<0.00010	0.00017	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00022	0.00055	0.00204	0.00554	0.00026
	Copper (Cu)-Dissolved (mg/L)	0.00052	0.00104	<0.00050	0.00239	0.00074
	Iron (Fe)-Dissolved (mg/L)	<0.030	0.043	<0.030	<0.030	<0.030
	Lead (Pb)-Dissolved (mg/L)	<0.000050	0.000052	<0.000050	0.000104	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.00349	0.00143	0.00713	0.00925	0.0149

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1252558-1 water 20-DEC-12 MW-H17	L1252558-2 water 20-DEC-12 MW-H18	L1252558-3 water 20-DEC-12 MW-H19	L1252558-4 water 20-DEC-12 MW-H24A	L1252558-5 water 19-DEC-12 MW-H22
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	15.7	20.6	13.2	0.032 DLA	24.4
	Manganese (Mn)-Dissolved (mg/L)	0.0665	0.00796	0.364	<0.00025 DLA	0.00393
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.00379	0.000699	0.00381	0.0214	0.000778
	Nickel (Ni)-Dissolved (mg/L)	0.00266	0.00176	0.00538	<0.0025 DLA	0.00057
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	1.44	0.837	1.73	72.5	1.00
	Selenium (Se)-Dissolved (mg/L)	0.00026	0.00066	0.00022	0.00060	0.00052
	Silicon (Si)-Dissolved (mg/L)	4.34	3.14	4.37	0.254	3.74
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000050 DLA	<0.000010
	Sodium (Na)-Dissolved (mg/L)	32.2	5.3	70.0	883	<2.0
	Strontium (Sr)-Dissolved (mg/L)	0.139	0.435	0.943	22.3	0.133
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	0.000024	<0.000050 DLA	0.000015
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	0.00056	0.00383	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.016	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00509	0.000599	0.00167	<0.000050 DLA	0.000506
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0050 DLA	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0030	0.0059	<0.015 DLA	<0.0030
Aggregate Organics	COD (mg/L)	<20	<20	<20	110	<20
	Phenols (4AAP) (mg/L)	<0.0010	<0.0010	<0.0010	0.0040	<0.0010
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluorene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	0.000415	<0.000050
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1252558-6 water 19-DEC-12 MW-H23	L1252558-7 water 19-DEC-12 MW-H24B	L1252558-8 water 19-DEC-12 MW-H25B	L1252558-9 water 19-DEC-12 MW-H26B	L1252558-10 water 20-DEC-12 X1
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	18.4	18.2	29.5	32.7	16.5
	Manganese (Mn)-Dissolved (mg/L)	0.0254	0.0596	0.805	1.02	0.0678
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.000686	0.000610	0.00317	0.00676	0.00377
	Nickel (Ni)-Dissolved (mg/L)	0.00062	0.00099	0.00408	0.0152	0.00282
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	0.747	1.06	1.00	3.83	1.50
	Selenium (Se)-Dissolved (mg/L)	0.00058	<0.00010	0.00012	0.00061	0.00025
	Silicon (Si)-Dissolved (mg/L)	2.81	2.80	5.49	6.76	4.38
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	2.5	6.5	11.5	86.3	33.7
	Strontium (Sr)-Dissolved (mg/L)	0.106	0.180	0.274	0.329	0.144
	Thallium (Tl)-Dissolved (mg/L)	0.000010	<0.000010	<0.000010	0.000011	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	0.00013	<0.00010	0.00027	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.000303	0.000519	0.00267	0.0117	0.00497
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	0.0077	<0.0030	0.0099	<0.0030
Aggregate Organics	COD (mg/L)	<20	46	22	41	<20
	Phenols (4AAP) (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Fluorene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1252558-1	L1252558-2	L1252558-3	L1252558-4	L1252558-5
	Description	water	water	water	water	water
	Sampled Date	20-DEC-12	20-DEC-12	20-DEC-12	20-DEC-12	19-DEC-12
	Sampled Time					
	Client ID	MW-H17	MW-H18	MW-H19	MW-H24A	MW-H22
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acenaphthene d10 (%)	95.3	91.3	87.1	90.6	93.0
	Surrogate: Acridine d9 (%)	94.9	89.3	88.8	89.4	86.9
	Surrogate: Chrysene d12 (%)	97.2	92.7	91.6	95.2	93.8
	Surrogate: Naphthalene d8 (%)	95.2	90.7	84.9	94.0	93.3
	Surrogate: Phenanthrene d10 (%)	101.8	97.2	93.9	97.5	98.4

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1252558-6	L1252558-7	L1252558-8	L1252558-9	L1252558-10
	Description	water	water	water	water	water
	Sampled Date	19-DEC-12	19-DEC-12	19-DEC-12	19-DEC-12	20-DEC-12
	Sampled Time					
	Client ID	MW-H23	MW-H24B	MW-H25B	MW-H26B	X1
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Surrogate: Acenaphthene d10 (%)	92.1	101.2	94.3	89.5	95.9
	Surrogate: Acridine d9 (%)	91.0	92.0	94.3	90.1	95.0
	Surrogate: Chrysene d12 (%)	93.4	93.5	96.7	92.7	96.2
	Surrogate: Naphthalene d8 (%)	93.7	92.5	94.4	90.5	95.3
	Surrogate: Phenanthrene d10 (%)	98.4	101.5	101.4	97.5	102.8

* 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)
Duplicate	Bromide (Br)	DLM	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Chloride (Cl)	DLM	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Fluoride (F)	DLM	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrite (as N)	DLM	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Bromide (Br)	DLM	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Chloride (Cl)	DLM	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Fluoride (F)	DLM	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrite (as N)	DLM	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Nitrate (as N)	MS-B	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Sulfate (SO4)	MS-B	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Nitrate (as N)	MS-B	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Phosphorus (P)-Total	MS-B	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1252558-1, -10, -2, -3, -4, -5, -6, -7, -8, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-MAN-VA	Water	Alkalinity (Species) by Manual Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-MAN-VA	Water	Alkalinity (Species) by Manual Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

Reference Information

ANIONS-NO2-IC-VA Water Nitrite in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA Water Nitrate in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA Water Total organic carbon by combustion APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COD-COL-VA Water Chemical Oxygen Demand by Colorimetric APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

COLOUR-TRUE-VA Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

Reference Information

N-T-COL-VA	Water	Total Nitrogen in water by Colour	USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PAH-SF-MS-VA	Water	PAH in Water by GCMS	EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-SURR-MS-VA	Water	PAH Surrogates for Waters	EPA 3510, 8270

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PHENOLS-4AAP-WT	Water	Phenol (4AAP)	EPA 9066

An automated method is used to distill the sample. The distillate is then buffered to pH 9.4 which reacts with 4AAP and potassium ferricyanide to form a red complex which is measured colorimetrically.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA	Water	TKN in Water (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

10-033695

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.

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

10-033695

Page 1 of 1

Report To	Report Format / Distribution	Service Requested: (Rush subject to availability)
Company: Rescan Environmental	Standard: X Other (specify):	X (Regular) (Standard Turnaround Times))
Contact: Rusto Martinkus	Select: PDF X Excel X Digital Fax	Priority, Date Req'd: _____ (Surcharges apply)
Address: 1144 W Hasting St Unit Bc	Email 1: rmartinkus@rescan.com	Emergency (1 Business Day) - 100% Surcharge
	Email 2:	For Emergency < 1 Day, ASAP or Weekend - Contact ALS
Phone: Fax:		**Analysis Request**
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	(Indicate Filtered or Preserved, F/P)
Copy of Invoice with Report? (circle) Yes or No	Job #: 0791-007-25-22	
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone:	Quote #:	
Lab Work Order # (lab use only):	ALS Contact: Amber	Sampler: Rusto

Short Holding Time
Rush Processing

Sample # (lab use only)	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	F/P Physical	F/P TOC	F/P Nutrients COD Phenols	F/P Total Metals	F/P Diss. Metals	F/P Anions	F/P BTEX	Number of Containers
	MW-H17	20-12-12		Water	X	X	X	X	X	X	X	6
	MW-H18	↓			X	X	X	X	X	X	X	6
	MW-H19				X	X	X	X	X	X	X	6
	MW-H24A *	20-12-12			X	X	X	X	X	X	X	6
	MW-H22	19-12-12			X	X	X	X	X	X	X	6
	MW-H23				X	X	X	X	X	X	X	6
	MW-H24B				X	X	X	X	X	X	X	6
	MW-H25B	↓			X	X	X	X	X	X	X	6
	MW-H26B	19-12-12		↓	X	X	X	X	X	X	X	6
	X1	20-12-12		Water	X	X	X	X	X	X	X	6

Special Instructions / Regulations / Hazardous Details

* Insufficient sample volume (MW-H24A)

L1252558-COFC

Failure to complete all portions of this form may delay analysis. Please fill in this

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - repor...

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
R. Martinkus	21-12-12	10:00	TN	Dec 22	11:05	-0.5°C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 11-MAY-13
Report Date: 27-MAY-13 10:44 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1300522

Project P.O. #:	NOT SUBMITTED
Job Reference:	0194106-0002-0005
C of C Numbers:	10-294658
Legal Site Desc:	

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1300522-7	L1300522-8			
	Description	soil	soil			
	Sampled Date	07-MAY-13	07-MAY-13			
	Sampled Time					
	Client ID	S-MW-H25A	S-MW-H26A			
Grouping	**Analyte**					
SOIL						
Particle Size	% Gravel (>2mm) (%)	<0.10	<0.10			
	% Sand (2.0mm - 0.063mm) (%)	1.71	1.88			
	% Silt (0.063mm - 4um) (%)	43.8	40.3			
	% Clay (<4um) (%)	54.5	57.8			
	Texture	Silty clay	Silty clay			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1300522-1	L1300522-2	L1300522-3	L1300522-4	L1300522-5
	Description	water	water	water	water	water
	Sampled Date	09-MAY-13	08-MAY-13	09-MAY-13	07-MAY-13	09-MAY-13
	Sampled Time					
	Client ID	MW-H26A	MW-H26B	MW-H25A	MW-H25B	MW-H24A
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0	<5.0	<5.0
	Conductivity (uS/cm)	1090	681	1050	621	5760
	Hardness (as CaCO3) (mg/L)	22.1	351	16.2	345	577
	pH (pH)	8.93	8.11	8.72	8.16	12.30
	Total Suspended Solids (mg/L)	830	106	577	341	52.7
	Turbidity (NTU)	595	46.6	2030	288	36.8
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	4.9	<1.0	7.5	<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	565	355	600	369	<1.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	122	<2.0	18.9	<2.0	95.4
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<2.0	<1.0	<2.0	1550
	Alkalinity, Total (as CaCO3) (mg/L)	688	355	619	369	1650
	Ammonia, Total (as N) (mg/L)	0.388	0.0492	0.452	0.0689	3.86
	Bromide (Br) (mg/L)	<0.50 DLM	<0.050	<0.50 DLM	<0.050	<2.5 DLM
	Chloride (Cl) (mg/L)	<5.0 DLM	1.67	<5.0 DLM	2.08	<25 DLM
	Fluoride (F) (mg/L)	0.90	0.126	0.76	0.175	1.1
	Nitrate (as N) (mg/L)	<0.050 DLM	0.119	<0.050 DLM	0.0081	<0.25 DLM
	Nitrite (as N) (mg/L)	<0.010 DLM	0.0035	0.012	<0.0010	<0.050 DLM
	Total Kjeldahl Nitrogen (mg/L)	0.581	0.414	0.664	0.477	4.65
	Total Nitrogen (mg/L)	0.581	0.536	0.676	0.485	4.65
	Orthophosphate-Dissolved (as P) (mg/L)	0.0622	0.0019	0.0209	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0669	0.0036	0.0321	<0.0020	0.0038
	Phosphorus (P)-Total (mg/L)	0.932	0.099	1.00	0.315	0.0234
	Sulfate (SO4) (mg/L)	<5.0 DLM	59.7	<5.0 DLM	8.17	<25 DLM
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	10.8	4.99	37.5	11.0	12.6
Total Metals	Aluminum (Al)-Total (mg/L)	7.09	0.852	14.9	4.97	0.402
	Antimony (Sb)-Total (mg/L)	0.00146	0.00025	0.00087	0.00025	0.00064
	Arsenic (As)-Total (mg/L)	0.00584	0.00130	0.0101	0.00281	0.00043
	Barium (Ba)-Total (mg/L)	1.20	0.0732	2.19	0.260	3.55
	Beryllium (Be)-Total (mg/L)	0.00039	<0.00010	0.00153	0.00024	<0.00020 DLA
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010 DLA
	Boron (B)-Total (mg/L)	0.200	0.027	0.300	0.019	<0.020 DLA
	Cadmium (Cd)-Total (mg/L)	0.000461	0.000166	0.000812	0.000301	0.000026
	Calcium (Ca)-Total (mg/L)	34.5	81.2	14.0	93.4	231
	Chromium (Cr)-Total (mg/L)	0.0120	0.00095	0.0230	0.00736	0.0212
	Cobalt (Co)-Total (mg/L)	0.00454	0.00286	0.0113	0.00400	0.00038
	Copper (Cu)-Total (mg/L)	0.0193	0.00372	0.0466	0.00823	0.0080

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1300522-6	L1300522-9			
	Description	water	water			
	Sampled Date	07-MAY-13	07-MAY-13			
	Sampled Time					
	Client ID	MW-H24B	X1			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0			
	Conductivity (uS/cm)	518	515			
	Hardness (as CaCO3) (mg/L)	248	239			
	pH (pH)	8.21	8.24			
	Total Suspended Solids (mg/L)	45.3	49.3			
	Turbidity (NTU)	33.1	32.1			
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	3.3	1.5			
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	283	280			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)	283	280			
	Ammonia, Total (as N) (mg/L)	0.0227	0.0210			
	Bromide (Br) (mg/L)	<0.050	<0.050			
	Chloride (Cl) (mg/L)	2.12	2.13			
	Fluoride (F) (mg/L)	0.122	0.121			
	Nitrate (as N) (mg/L)	0.0850	0.0857			
	Nitrite (as N) (mg/L)	0.0023	0.0024			
	Total Kjeldahl Nitrogen (mg/L)	0.251	0.269			
	Total Nitrogen (mg/L)	0.338	0.358			
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010			
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020			
	Phosphorus (P)-Total (mg/L)	0.0286	0.0308			
	Sulfate (SO4) (mg/L)	21.0	20.9			
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	5.71	5.24			
Total Metals	Aluminum (Al)-Total (mg/L)	1.54	1.23			
	Antimony (Sb)-Total (mg/L)	0.00068	0.00072			
	Arsenic (As)-Total (mg/L)	0.00144	0.00141			
	Barium (Ba)-Total (mg/L)	0.639	0.638			
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010			
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050			
	Boron (B)-Total (mg/L)	0.016	0.016			
	Cadmium (Cd)-Total (mg/L)	0.000056	0.000064			
	Calcium (Ca)-Total (mg/L)	68.1	70.8			
	Chromium (Cr)-Total (mg/L)	0.00177	0.00149			
	Cobalt (Co)-Total (mg/L)	0.00202	0.00195			
	Copper (Cu)-Total (mg/L)	0.00191	0.00220			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1300522-1	L1300522-2	L1300522-3	L1300522-4	L1300522-5
	Description	water	water	water	water	water
	Sampled Date	09-MAY-13	08-MAY-13	09-MAY-13	07-MAY-13	09-MAY-13
	Sampled Time					
	Client ID	MW-H26A	MW-H26B	MW-H25A	MW-H25B	MW-H24A
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	9.77	0.888	24.8	5.35	0.316
	Lead (Pb)-Total (mg/L)	0.00824	0.000662	0.0185	0.00255	0.00098
	Lithium (Li)-Total (mg/L)	0.549	0.00763	0.709	0.0113	0.146
	Magnesium (Mg)-Total (mg/L)	10.4	33.8	9.51	29.9	0.221
	Manganese (Mn)-Total (mg/L)	0.138	0.734	0.140	0.827	0.00654
	Mercury (Hg)-Total (mg/L)	<0.000050 DLM	<0.000010	<0.000050 DLM	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.00966	0.00244	0.0101	0.00295	0.0119
	Nickel (Ni)-Total (mg/L)	0.0157	0.00672	0.0415	0.0124	0.0012
	Phosphorus (P)-Total (mg/L)	0.66	<0.30	1.09	<0.30	<0.30
	Potassium (K)-Total (mg/L)	2.72	2.01	4.81	2.42	17.6
	Selenium (Se)-Total (mg/L)	0.00068	0.00026	0.00135	0.00020	0.00051
	Silicon (Si)-Total (mg/L)	18.0	7.50	171	17.1	1.54
	Silver (Ag)-Total (mg/L)	0.000227	0.000020	0.000490	0.000051	<0.000020 DLA
	Sodium (Na)-Total (mg/L)	286	22.8	262	10.0	497
	Strontium (Sr)-Total (mg/L)	0.194	0.278	0.201	0.263	8.04
	Thallium (Tl)-Total (mg/L)	0.000178	0.000041	0.000362	0.000140	<0.000020 DLA
	Tin (Sn)-Total (mg/L)	0.00093	0.00040	0.00046	0.00025	0.00065
	Titanium (Ti)-Total (mg/L)	0.163	0.036	3.76	0.203	0.021
	Uranium (U)-Total (mg/L)	0.00116	0.00480	0.00254	0.00201	0.000049
	Vanadium (V)-Total (mg/L)	0.0237	0.0022	0.0526	0.0174	<0.0020 DLA
	Zinc (Zn)-Total (mg/L)	0.0820	0.0130	0.121	0.0436	0.0242
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.111	0.0032	0.0042	<0.0030	0.123
	Antimony (Sb)-Dissolved (mg/L)	0.00104	0.00016	0.00076	<0.00010	0.00051
	Arsenic (As)-Dissolved (mg/L)	0.00133	0.00096	0.00111	0.00125	<0.00020 DLA
	Barium (Ba)-Dissolved (mg/L)	0.844	0.0641	1.27	0.211	3.60
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 DLA
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010 DLA
	Boron (B)-Dissolved (mg/L)	0.183	0.027	0.193	0.012	<0.020 DLA
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010	0.000083	<0.000010	0.000017	<0.000020 DLA
	Calcium (Ca)-Dissolved (mg/L)	5.52	85.3	3.83	90.0	231
	Chromium (Cr)-Dissolved (mg/L)	0.00019	<0.00010	<0.00010	<0.00010	0.0206
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00222	0.00011	0.00166	<0.00020 DLA
	Copper (Cu)-Dissolved (mg/L)	0.00111	0.00082	<0.00050	<0.00050	0.00459
	Iron (Fe)-Dissolved (mg/L)	0.066	0.036	<0.030	0.094	<0.030
	Lead (Pb)-Dissolved (mg/L)	0.000578	<0.000050	0.000076	<0.000050	0.00064
	Lithium (Li)-Dissolved (mg/L)	0.571	0.00759	0.531	0.00655	0.143

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1300522-6	L1300522-9			
	Description	water	water			
	Sampled Date	07-MAY-13	07-MAY-13			
	Sampled Time					
	Client ID	MW-H24B	X1			
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	0.914	0.840			
	Lead (Pb)-Total (mg/L)	0.000681	0.000641			
	Lithium (Li)-Total (mg/L)	0.00409	0.00401			
	Magnesium (Mg)-Total (mg/L)	17.4	16.9			
	Manganese (Mn)-Total (mg/L)	0.395	0.382			
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Total (mg/L)	0.00160	0.00164			
	Nickel (Ni)-Total (mg/L)	0.00614	0.00604			
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30			
	Potassium (K)-Total (mg/L)	1.47	1.40			
	Selenium (Se)-Total (mg/L)	0.00076	0.00072			
	Silicon (Si)-Total (mg/L)	8.09	6.36			
	Silver (Ag)-Total (mg/L)	0.000019	0.000019			
	Sodium (Na)-Total (mg/L)	24.2	23.7			
	Strontium (Sr)-Total (mg/L)	0.305	0.319			
	Thallium (Tl)-Total (mg/L)	0.000022	0.000020			
	Tin (Sn)-Total (mg/L)	0.00040	0.00037			
	Titanium (Ti)-Total (mg/L)	0.070	0.047			
	Uranium (U)-Total (mg/L)	0.00456	0.00468			
	Vanadium (V)-Total (mg/L)	0.0036	0.0031			
	Zinc (Zn)-Total (mg/L)	0.0083	0.0084			
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	<0.0030			
	Antimony (Sb)-Dissolved (mg/L)	0.00072	0.00074			
	Arsenic (As)-Dissolved (mg/L)	0.00124	0.00124			
	Barium (Ba)-Dissolved (mg/L)	0.615	0.660			
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010			
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050			
	Boron (B)-Dissolved (mg/L)	0.014	0.014			
	Cadmium (Cd)-Dissolved (mg/L)	0.000018	0.000020			
	Calcium (Ca)-Dissolved (mg/L)	71.2	68.3			
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010			
	Cobalt (Co)-Dissolved (mg/L)	0.00164	0.00162			
	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050			
	Iron (Fe)-Dissolved (mg/L)	<0.030	0.031			
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.00328	0.00322			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1300522-1	L1300522-2	L1300522-3	L1300522-4	L1300522-5
	Description	water	water	water	water	water
	Sampled Date	09-MAY-13	08-MAY-13	09-MAY-13	07-MAY-13	09-MAY-13
	Sampled Time					
	Client ID	MW-H26A	MW-H26B	MW-H25A	MW-H25B	MW-H24A
Grouping	**Analyte**					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	2.01	33.5	1.62	29.3	0.036
	Manganese (Mn)-Dissolved (mg/L)	0.00460	0.670	0.00616	0.782	<0.00010 DLA
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.00791	0.00237	0.00622	0.00250	0.0120
	Nickel (Ni)-Dissolved (mg/L)	0.00096	0.00524	0.00110	0.00399	<0.0010 DLA
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	0.601	1.86	0.725	0.766	18.7
	Selenium (Se)-Dissolved (mg/L)	<0.00010	0.00027	0.00010	<0.00010	0.00048
	Silicon (Si)-Dissolved (mg/L)	4.38	4.64	3.19	5.29	0.668
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 DLA
	Sodium (Na)-Dissolved (mg/L)	293	22.6	290	10.2	528
	Strontium (Sr)-Dissolved (mg/L)	0.139	0.279	0.139	0.264	8.17
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000023	<0.000010	<0.000010	<0.000020 DLA
	Tin (Sn)-Dissolved (mg/L)	0.00012	<0.00010	<0.00010	<0.00010	0.00037
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	0.011
	Uranium (U)-Dissolved (mg/L)	0.000318	0.00478	0.000555	0.00181	<0.000020 DLA
	Vanadium (V)-Dissolved (mg/L)	0.0011	<0.0010	0.0021	<0.0010	<0.0020 DLA
	Zinc (Zn)-Dissolved (mg/L)	0.0033	0.0069	<0.0030	0.0122	0.0143
Aggregate Organics	COD (mg/L)	47	<20	144	36	42

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1300522-6	L1300522-9			
	Description	water	water			
	Sampled Date	07-MAY-13	07-MAY-13			
	Sampled Time					
	Client ID	MW-H24B	X1			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	17.0	16.8			
	Manganese (Mn)-Dissolved (mg/L)	0.371	0.364			
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)	0.00158	0.00153			
	Nickel (Ni)-Dissolved (mg/L)	0.00485	0.00479			
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30			
	Potassium (K)-Dissolved (mg/L)	1.19	1.20			
	Selenium (Se)-Dissolved (mg/L)	0.00079	0.00075			
	Silicon (Si)-Dissolved (mg/L)	2.84	2.88			
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	24.3	24.5			
	Strontium (Sr)-Dissolved (mg/L)	0.307	0.301			
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010			
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010			
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010			
	Uranium (U)-Dissolved (mg/L)	0.00465	0.00474			
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010			
	Zinc (Zn)-Dissolved (mg/L)	0.0034	0.0038			
Aggregate Organics	COD (mg/L)	<20	<20			

* 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	Sulfate (SO4)	MS-B	L1300522-1, -2, -3, -4, -5, -6, -9
Matrix Spike	Total Nitrogen	MS-B	L1300522-1, -2, -3, -4, -6, -9
Matrix Spike	Total Nitrogen	MS-B	L1300522-1, -2, -3, -4, -6, -9
Matrix Spike	Total Nitrogen	MS-B	L1300522-1, -2, -3, -4, -6, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

Reference Information

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA	Water	Total Mercury in Water by CVAFS(Low)	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-T-COL-VA	Water	Total Nitrogen in water by Colour	USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PSA-PIPET+GRAVEL-SK Soil Particle size - Sieve and Pipette SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

TKN-CALC-VA Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-294658

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.

10- 294658

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To		Report Format / Distribution		Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company:	Rescan Environmental	Standard:	Other (specify):	Regular (Standard Turnaround Times - Business Days)
Contact:	Rusto Martinka	Select: PDF X	Excel X Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	111 W Hastings	Email 1:	rmartinka@rescan.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Van BC	Email 2:	Rusto.Martinka@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	Fax:			

Invoice To	Same as Report ? (circle) Yes or No (if No, provide details)	Client / Project Information	Analysis Request (Indicate Filtered or Preserved, F/P)
	Copy of Invoice with Report? (circle) Yes or No	Job #:	
Company:			
Contact:			
Address:			
Phone:			
Lab Work Orde		Sampler:	

Short Holding

Rush Process

L1300522-COFC

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem	P Total Metals	P Diss. Metals	P TOC	P COD	P Nutrients		Sieve Analysis					Number of Containers
	MW-H26A		9May13	water	X	X	X	X	X	X							4
	MW-H26B		8May13		X	X	X	X	X	X							4
	MW-H25A		9May13		X	X	X	X	X	X							4
	MW-H25B		7May13		X	X	X	X	X	X							4
	MW-H24A *		9May13		X	X	X	X	X	X							4
	MW-H24B		7May13	water	X	X	X	X	X	X							4
	S-MW-H25A		7May13	soil								X					1
	S-MW-H26A		7May13	soil								X					1
	X1		7May13	water	X	X	X	X	X	X							4

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

* High pH

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Rusto Martinka	Date: 10 May 13	Time: 11:00	Received by: TN	Date: May 11	Time: 10:05	Temperature: 9 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 25-JUL-13
Report Date: 07-AUG-13 13:00 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1337870

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-283720
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1337870-1 Water 23-JUL-13 MW-H24B	L1337870-2 Water 23-JUL-13 MW-H24C	L1337870-3 Water 23-JUL-13 MW-H26B	L1337870-4 Water 23-JUL-13 MW-H25B	L1337870-5 Water 23-JUL-13 X1
WATER						
Physical Tests	Colour, True (CU)	<5.0	9.8	8.0	5.5	5.4
	Conductivity (uS/cm)	447	585	847	672	671
	Hardness (as CaCO3) (mg/L)	224	262	377	346	357
	pH (pH)	8.04	8.02	7.88	7.90	7.91
	Total Suspended Solids (mg/L)	5.1	28.6	43.1	<3.0	<3.0
	Turbidity (NTU)	3.56	16.4	33.2	2.07	1.95
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	5.6	6.4	12.2	12.8	12.5
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	243	299	349	382	383
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	243	299	349	382	383
	Ammonia, Total (as N) (mg/L)	0.0234	0.188	0.176	0.0701	0.0725
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.50 DLM	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	1.00	<5.0 DLM	1.43	1.43
	Fluoride (F) (mg/L)	0.106	0.169	0.32	0.189	0.188
	Nitrate (as N) (mg/L)	0.0503	0.0075	<0.050 DLM	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	0.0070	0.0037	<0.010 DLM	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.082	5.38	0.535	0.170	0.171
	Total Nitrogen (mg/L)	0.139	5.39	0.535	0.170	0.171
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	0.0080	0.0037	<0.0010	0.0017
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	0.0141	0.0046	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0123	0.0516	0.0913	0.0080	0.0097
	Sulfate (SO4) (mg/L)	5.38	34.7	128	6.03	6.02
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	2.22	23.2	6.85	4.14	4.01
Total Metals	Aluminum (Al)-Total (mg/L)	0.0457	0.219	3.00	0.0170	0.0183
	Antimony (Sb)-Total (mg/L)	0.00031	0.00098	0.00048	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00094	0.0420	0.00561	0.00168	0.00154
	Barium (Ba)-Total (mg/L)	0.873	0.290	0.126	0.292	0.265
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	0.00019	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	0.011	0.025	0.062	0.013	0.012
	Cadmium (Cd)-Total (mg/L)	0.000023	0.000015	0.000726	<0.000010	<0.000010
	Calcium (Ca)-Total (mg/L)	65.2	73.0	99.1	103	97.8
	Chromium (Cr)-Total (mg/L)	0.00017	0.00050	0.00382	<0.00010	0.00011
	Cobalt (Co)-Total (mg/L)	0.00188	0.00089	0.00687	0.00154	0.00145
	Copper (Cu)-Total (mg/L)	<0.00050	0.00106	0.0112	<0.00050	<0.00050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1337870-1 Water 23-JUL-13 MW-H24B	L1337870-2 Water 23-JUL-13 MW-H24C	L1337870-3 Water 23-JUL-13 MW-H26B	L1337870-4 Water 23-JUL-13 MW-H25B	L1337870-5 Water 23-JUL-13 X1
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	0.603	1.29	6.33	0.396	0.397
	Lead (Pb)-Total (mg/L)	0.000095	0.000228	0.00308	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.00153	0.0168	0.00715	0.00754	0.00685
	Magnesium (Mg)-Total (mg/L)	16.1	21.5	38.6	30.9	29.5
	Manganese (Mn)-Total (mg/L)	0.349	0.217	1.73	0.745	0.724
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	0.000019	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.00128	0.00682	0.00379	0.00251	0.00230
	Nickel (Ni)-Total (mg/L)	0.00202	0.00213	0.0187	0.00370	0.00354
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	0.833	2.37	3.23	0.598	0.566
	Selenium (Se)-Total (mg/L)	0.00031	0.00018	0.00055	<0.00010	<0.00010
	Silicon (Si)-Total (mg/L)	2.84	5.91	13.0	5.76	5.29
	Silver (Ag)-Total (mg/L)	0.000010	<0.000010	0.000087	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	6.6	25.3	38.8	9.1	8.3
	Strontium (Sr)-Total (mg/L)	0.197	0.410	0.369	0.285	0.266
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	0.000172	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	0.00085	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.010	0.010	0.097	0.010	<0.010
	Uranium (U)-Total (mg/L)	0.000745	0.00142	0.00860	0.00155	0.00147
	Vanadium (V)-Total (mg/L)	<0.0010	0.0010	0.0076	<0.0010	<0.0010
	Zinc (Zn)-Total (mg/L)	0.0031	0.0034	0.0206	<0.0030	<0.0030
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0050	0.0075	0.0050	0.0033	<0.0030
	Antimony (Sb)-Dissolved (mg/L)	0.00028	0.00096	0.00037	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00086	0.0409	0.00290	0.00160	0.00157
	Barium (Ba)-Dissolved (mg/L)	0.810	0.296	0.0729	0.274	0.275
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	<0.010	0.024	0.052	0.011	0.011
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010	<0.000010	0.000045	<0.000010	<0.000010
	Calcium (Ca)-Dissolved (mg/L)	63.4	69.3	92.9	91.7	96.2
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00180	0.00072	0.00341	0.00146	0.00146
	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	0.488	0.863	1.13	0.372	0.373
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050
	Lithium (Li)-Dissolved (mg/L)	0.00118	0.0157	0.00531	0.00631	0.00682

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1337870-1 Water 23-JUL-13 MW-H24B	L1337870-2 Water 23-JUL-13 MW-H24C	L1337870-3 Water 23-JUL-13 MW-H26B	L1337870-4 Water 23-JUL-13 MW-H25B	L1337870-5 Water 23-JUL-13 X1
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	16.0	21.6	35.1	28.3	28.4
	Manganese (Mn)-Dissolved (mg/L)	0.344	0.212	1.47	0.700	0.675
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.00121	0.00650	0.00338	0.00218	0.00227
	Nickel (Ni)-Dissolved (mg/L)	0.00191	0.00171	0.00905	0.00372	0.00369
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	0.815	2.37	2.50	0.585	0.582
	Selenium (Se)-Dissolved (mg/L)	0.00028	0.00016	0.00026	<0.00010	<0.00010
	Silicon (Si)-Dissolved (mg/L)	2.65	5.47	6.03	5.53	5.28
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	6.2	22.4	34.3	8.5	8.0
	Strontium (Sr)-Dissolved (mg/L)	0.186	0.381	0.336	0.251	0.265
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	0.000020	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	0.00014	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.000698	0.00130	0.00761	0.00142	0.00144
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	0.0017	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Aggregate Organics	COD (mg/L)	<20	69	32	24	<20
	Phenols (4AAP) (mg/L)		0.0010			
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)		<0.000050			
	Acenaphthylene (mg/L)		<0.000050			
	Acridine (mg/L)		<0.000050			
	Anthracene (mg/L)		<0.000050			
	Benz(a)anthracene (mg/L)		<0.000050			
	Benzo(a)pyrene (mg/L)		<0.000010			
	Benzo(b)fluoranthene (mg/L)		<0.000050			
	Benzo(g,h,i)perylene (mg/L)		<0.000050			
	Benzo(k)fluoranthene (mg/L)		<0.000050			
	Chrysene (mg/L)		<0.000050			
	Dibenz(a,h)anthracene (mg/L)		<0.000050			
	Fluoranthene (mg/L)		<0.000050			
	Fluorene (mg/L)		<0.000050			
	Indeno(1,2,3-c,d)pyrene (mg/L)		<0.000050			
	Naphthalene (mg/L)		0.000346			
	Phenanthrene (mg/L)		<0.000050			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1337870-1	L1337870-2	L1337870-3	L1337870-4	L1337870-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	23-JUL-13	23-JUL-13	23-JUL-13	23-JUL-13	23-JUL-13
	Sampled Time					
	Client ID	MW-H24B	MW-H24C	MW-H26B	MW-H25B	X1
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Pyrene (mg/L)		<0.000050			
	Quinoline (mg/L)		<0.000090 DLM			
	Surrogate: Acenaphthene d10 (%)		97.0			
	Surrogate: Acridine d9 (%)		101.8			
	Surrogate: Chrysene d12 (%)		87.3			
	Surrogate: Naphthalene d8 (%)		92.5			
	Surrogate: Phenanthrene d10 (%)		95.1			

* 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)
Duplicate	Bromide (Br)	DLM	L1337870-1, -2, -3, -4, -5
Duplicate	Chloride (Cl)	DLM	L1337870-1, -2, -3, -4, -5
Duplicate	Nitrite (as N)	DLM	L1337870-1, -2, -3, -4, -5
Duplicate	Nitrate (as N)	DLM	L1337870-1, -2, -3, -4, -5
Duplicate	Bromide (Br)	DLM	L1337870-1, -2, -3, -4, -5
Duplicate	Nitrite (as N)	DLM	L1337870-1, -2, -3, -4, -5
Matrix Spike	Total Organic Carbon	MS-B	L1337870-2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1337870-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1337870-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1337870-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1337870-1, -2, -3, -4, -5
Matrix Spike	Arsenic (As)-Dissolved	MS-B	L1337870-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1337870-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1337870-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1337870-1, -2, -3, -4, -5
Matrix Spike	Total Nitrogen	MS-B	L1337870-1, -3, -4, -5
Matrix Spike	Total Nitrogen	MS-B	L1337870-1, -3, -4, -5
Matrix Spike	Total Nitrogen	MS-B	L1337870-2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted For Sample Matrix Effects
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA Water Total organic carbon by combustion APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COD-COL-VA Water Chemical Oxygen Demand by Colorimetric APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

COLOUR-TRUE-VA Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-T-COL-VA Water Total Nitrogen in water by Colour USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

Reference Information

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PAH-SF-MS-VA Water PAH in Water by GCMS EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-SURR-MS-VA Water PAH Surrogates for Waters EPA 3510, 8270

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PHENOLS-4AAP-ED Water Phenols (4AAP) AB ENV.06537-COLORIMETRIC

This analysis is carried out using procedures adapted from ENVIRODAT VMV 06537 689, Method Code 154, in "Methods Manual for Chemical Analysis of Water and Wastes" published by the Alberta Environmental Centre. This automated method is based on the distillation of phenol and subsequent reaction of the distillate with alkaline ferricyanide and 4-aminoantipyrine to form a red complex which is measured at 505 nm.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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
ED	ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-283720

Reference Information

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.

10-283720

ALS Environment

L1337870-COFC

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To	**Report Format / Distribution**	**Service Request:** (Rush subject to availability - Contact ALS to confirm TAT)
Company: Rescan	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Rusto Martinka	Select: PDF X Excel X Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: Vancouver BC	Email 1: rusto.martinka@rescan.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2:	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: Fax:		**Analysis Request**
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	(Indicate Filtered or Preserved, F/P)
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194106-0002-0005	
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only) L1337870	**ALS Contact:** Amber **Sampler:** Rusto	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem	Diss. Metals	Total Metals	Nutrients	Major Ions	TOC	COD	Phenols	PAH				Number of Containers
	MW-H24B	23-07-13		water	X	X	X	X	X	X	X						4
	MW-H24C	"		"	X	X	X	X	X	X	X	X	X				5
	MW-H26B	"		"	X	X	X	X	X	X	X						4
	MW-H25B	"		"	X	X	X	X	X	X	X						4
	X1	"		"	X	X	X	X	X	X	X						4

Short Holding Time

Rush Processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

MW-H24C → Diss. metals small ~~bottle~~ volume

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Rusto	Date: 24-07-13	Time: 11:00	Received by: Brit	Date: July 25	Time: 9:30	Temperature: 9.6 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 31-JUL-13
Report Date: 15-AUG-13 13:04 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1340620

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-283719
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1340620-1	L1340620-2	L1340620-3	L1340620-4	
	Description	water	water	water	water	
	Sampled Date	28-JUL-13	28-JUL-13	28-JUL-13	23-JUL-13	
	Sampled Time					
	Client ID	MW-H25A	MW-H27	MW-H26A	MW-H26B	
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0		
	Conductivity (uS/cm)	1080	1090	1100		
	Hardness (as CaCO3) (mg/L)	18.1	20.1	18.6		
	pH (pH)	8.47	8.65	8.81		
	Total Suspended Solids (mg/L)	28.7	204	37.4		
	Turbidity (NTU)	857	203	285		
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	598	572	591		
	Alkalinity, Carbonate (as CaCO3) (mg/L)	21.7	45.4	64.6		
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0		
	Alkalinity, Total (as CaCO3) (mg/L)	619	618	656		
	Ammonia, Total (as N) (mg/L)	0.262	0.434	0.415	0.163	
	Bromide (Br) (mg/L)	<0.50 DLM	<0.50 DLM	<0.50 DLM		
	Chloride (Cl) (mg/L)	<5.0 DLM	<5.0 DLM	<5.0 DLM		
	Fluoride (F) (mg/L)	0.84	0.84	0.68		
	Nitrate (as N) (mg/L)	<0.050 DLM	<0.050 DLM	<0.050 DLM		
	Nitrite (as N) (mg/L)	<0.010 DLM	<0.010 DLM	<0.010 DLM		
	Total Kjeldahl Nitrogen (mg/L)	0.75	0.56	0.63	0.550	
	Total Nitrogen (mg/L)	0.75 DLA	0.56 DLA	0.63 DLA	0.50 DLA	
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	0.0533	0.0593		
	Phosphorus (P)-Total Dissolved (mg/L)	0.0032	0.0603	0.0666		
	Phosphorus (P)-Total (mg/L)	0.566	0.289	0.355		
	Sulfate (SO4) (mg/L)	<5.0 DLM	17.1	<5.0 DLM		
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	12.0	10.3	8.6	6.51	
Total Metals	Aluminum (Al)-Total (mg/L)	1.36	0.485	5.02		
	Antimony (Sb)-Total (mg/L)	0.00130	0.00044	0.00074		
	Arsenic (As)-Total (mg/L)	0.00355	0.00108	0.00167		
	Barium (Ba)-Total (mg/L)	2.26	1.13	0.970		
	Beryllium (Be)-Total (mg/L)	0.00041	<0.00020 DLA	0.00028		
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.0010 DLA	<0.00050		
	Boron (B)-Total (mg/L)	0.208	0.206	0.201		
	Cadmium (Cd)-Total (mg/L)	0.000485	0.000121	0.000166		
	Calcium (Ca)-Total (mg/L)	8.35	9.49	11.9		
	Chromium (Cr)-Total (mg/L)	0.00198	0.00110	0.00858		
	Cobalt (Co)-Total (mg/L)	0.00455	0.00082	0.00174		
	Copper (Cu)-Total (mg/L)	0.0143	0.0030	0.0102		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1340620-1	L1340620-2	L1340620-3	L1340620-4	
	Description	water	water	water	water	
	Sampled Date	28-JUL-13	28-JUL-13	28-JUL-13	23-JUL-13	
	Sampled Time					
	Client ID	MW-H25A	MW-H27	MW-H26A	MW-H26B	
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	2.41	3.25	3.64		
	Lead (Pb)-Total (mg/L)	0.00807	0.00347	0.00258		
	Lithium (Li)-Total (mg/L)	0.502	0.652	0.493		
	Magnesium (Mg)-Total (mg/L)	3.43	5.27	3.96		
	Manganese (Mn)-Total (mg/L)	0.0434	0.0501	0.0617		
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Total (mg/L)	0.00558	0.0101	0.00491		
	Nickel (Ni)-Total (mg/L)	0.0174	0.0040	0.00777		
	Phosphorus (P)-Total (mg/L)	0.56	0.57	<0.30		
	Potassium (K)-Total (mg/L)	1.80	0.76	2.27		
	Selenium (Se)-Total (mg/L)	0.00105	0.00214	0.00023		
	Silicon (Si)-Total (mg/L)	4.99	3.90	17.4		
	Silver (Ag)-Total (mg/L)	0.000017	<0.000020 DLA	0.000056		
	Sodium (Na)-Total (mg/L)	256	307	253		
	Strontium (Sr)-Total (mg/L)	0.186	0.147	0.155		
	Thallium (Tl)-Total (mg/L)	0.000056	0.000021	0.000113		
	Tin (Sn)-Total (mg/L)	0.00054	0.00047	0.00058		
	Titanium (Ti)-Total (mg/L)	0.019	0.018	0.213		
	Uranium (U)-Total (mg/L)	0.00257	0.00147	0.000705		
	Vanadium (V)-Total (mg/L)	0.0115	0.0036	0.0200		
	Zinc (Zn)-Total (mg/L)	0.0459	0.0376	0.0240		
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0089	0.0178	0.0595		
	Antimony (Sb)-Dissolved (mg/L)	0.00170 DTC	0.00041	0.00073		
	Arsenic (As)-Dissolved (mg/L)	0.00206	0.00071	0.00169		
	Barium (Ba)-Dissolved (mg/L)	1.37	0.810	0.795		
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	<0.00010		
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.0010 DLA	<0.00050		
	Boron (B)-Dissolved (mg/L)	0.202	0.203	0.185		
	Cadmium (Cd)-Dissolved (mg/L)	0.000054	<0.000020 DLA	0.000105		
	Calcium (Ca)-Dissolved (mg/L)	4.06	3.30	4.12		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00020 DLA	0.00107		
	Cobalt (Co)-Dissolved (mg/L)	0.00054	<0.00020 DLA	0.00061		
	Copper (Cu)-Dissolved (mg/L)	0.00142	<0.00050 DLA	0.00189		
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030	<0.030		
	Lead (Pb)-Dissolved (mg/L)	0.000061	0.00010	0.000635		
	Lithium (Li)-Dissolved (mg/L)	0.505	0.645	0.497		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1340620-1	L1340620-2	L1340620-3	L1340620-4	
	Description	water	water	water	water	
	Sampled Date	28-JUL-13	28-JUL-13	28-JUL-13	23-JUL-13	
	Sampled Time					
	Client ID	MW-H25A	MW-H27	MW-H26A	MW-H26B	
Grouping	**Analyte**					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	1.92	2.89	2.08		
	Manganese (Mn)-Dissolved (mg/L)	0.00939	0.00567	0.00506		
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Dissolved (mg/L)	0.00725 DTC	0.0110	0.00570		
	Nickel (Ni)-Dissolved (mg/L)	0.00422	<0.0010 DLA	0.00188		
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30		
	Potassium (K)-Dissolved (mg/L)	1.48	0.68	0.773		
	Selenium (Se)-Dissolved (mg/L)	0.00112	0.00209	0.00018		
	Silicon (Si)-Dissolved (mg/L)	2.74	2.83	3.89		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000020 DLA	0.000048		
	Sodium (Na)-Dissolved (mg/L)	248	306	259		
	Strontium (Sr)-Dissolved (mg/L)	0.144	0.118	0.132		
	Thallium (Tl)-Dissolved (mg/L)	0.000021	<0.000020 DLA	0.000103		
	Tin (Sn)-Dissolved (mg/L)	0.00024	<0.00020 DLA	0.00055		
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010		
	Uranium (U)-Dissolved (mg/L)	0.00176	0.000684	0.000512		
	Vanadium (V)-Dissolved (mg/L)	0.0037	<0.0020 DLA	0.0042		
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	0.0031	<0.0030		
Aggregate Organics	COD (mg/L)	43	85	27	<20	
	Phenols (4AAP) (mg/L)	<0.0010	<0.0010	<0.0010		
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Acenaphthylene (mg/L)	<0.000050	<0.000050	<0.000050		
	Acridine (mg/L)	<0.000050	<0.000050	<0.000050		
	Anthracene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010	<0.000010		
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050	<0.000050		
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Chrysene (mg/L)	<0.000050	<0.000050	<0.000050		
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050	<0.000050		
	Fluoranthene (mg/L)	<0.000050	<0.000050	<0.000050		
	Fluorene (mg/L)	<0.000050	<0.000050	<0.000050		
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050	<0.000050		
	Naphthalene (mg/L)	<0.000050	<0.000050	<0.000050		
	Phenanthrene (mg/L)	<0.000050	<0.000050	<0.000050		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1340620-1	L1340620-2	L1340620-3	L1340620-4	
	Description	water	water	water	water	
	Sampled Date	28-JUL-13	28-JUL-13	28-JUL-13	23-JUL-13	
	Sampled Time					
	Client ID	MW-H25A	MW-H27	MW-H26A	MW-H26B	
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Pyrene (mg/L)	<0.000050	<0.000050	<0.000050		
	Quinoline (mg/L)	<0.000050	<0.000050	<0.000050		
	Surrogate: Acenaphthene d10 (%)	87.7	95.9	89.8		
	Surrogate: Acridine d9 (%)	94.4	104.7	95.8		
	Surrogate: Chrysene d12 (%)	83.8	89.4	83.1		
	Surrogate: Naphthalene d8 (%)	90.5	98.2	93.1		
	Surrogate: Phenanthrene d10 (%)	91.8	99.7	92.7		

* 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)
Duplicate	Total Nitrogen	DLA	L1340620-1, -2, -3, -4
Duplicate	Bromide (Br)	DLM	L1340620-1, -2, -3
Duplicate	Chloride (Cl)	DLM	L1340620-1, -2, -3
Duplicate	Nitrite (as N)	DLM	L1340620-1, -2, -3
Duplicate	Nitrate (as N)	DLM	L1340620-1, -2, -3
Duplicate	Sulfate (SO4)	DLM	L1340620-1, -2, -3
Matrix Spike	Nitrite (as N)	MS-B	L1340620-1, -2, -3
Matrix Spike	Total Nitrogen	MS-B	L1340620-1, -2, -3, -4
Matrix Spike	Total Nitrogen	MS-B	L1340620-1, -2, -3, -4
Matrix Spike	Ammonia, Total (as N)	MS-B	L1340620-1, -2, -3, -4
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L1340620-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1340620-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1340620-1, -2, -3
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1340620-1, -2, -3
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1340620-1, -2, -3
Matrix Spike	Aluminum (Al)-Dissolved	MS-B	L1340620-1, -2, -3
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1340620-1, -2, -3
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1340620-1, -2, -3
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1340620-1, -2, -3
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1340620-1, -2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

Reference Information

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA	Water	Total Mercury in Water by CVAFS(Low)	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-T-COL-VA	Water	Total Nitrogen in water by Colour	USGS - 03 - 4174 / NEMI 5735

Reference Information

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PAH-SF-MS-VA Water PAH in Water by GCMS EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-SURR-MS-VA Water PAH Surrogates for Waters EPA 3510, 8270

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PHENOLS-4AAP-ED Water Phenols (4AAP) AB ENV.06537-COLORIMETRIC

This analysis is carried out using procedures adapted from ENVIRODAT VMV 06537 689, Method Code 154, in "Methods Manual for Chemical Analysis of Water and Wastes" published by the Alberta Environmental Centre. This automated method is based on the distillation of phenol and subsequent reaction of the distillate with alkaline ferricyanide and 4-aminoantipyrine to form a red complex which is measured at 505 nm.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TKN-F-VA Water TKN in Water by Fluorescence APHA 4500-NORG D.

This analysis is carried out using procedures adapted from APHA Method 4500-Norg D. "Block Digestion and Flow Injection Analysis". Total Kjeldahl Nitrogen is determined using block digestion followed by Flow-injection analysis with fluorescence detection.

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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
ED	ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA

Reference Information

VA ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

10-283719

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.

ALS Environmental

L1340620-COFC

10-283719

Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: Descan	Standard: Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Rusto Martinka	Select: PDF Excel Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: Vancouver, BC	Email 1: rusto.martinka@esm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2:	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: Fax:		

Invoice To	Client / Project Information
Same as Report ? (circle) Yes or No (if No, provide details)	Job #: 0194106-0002-0005
Copy of Invoice with Report? (circle) Yes or No	PO / AFE:
Company:	LSD:
Contact:	
Address:	Quote #:
Phone: Fax:	

Lab Work Order # (lab use only): L1340620 | **ALS Contact:** Amber | **Sampler:** Rusto

Analysis Request (Indicate Filtered or Preserved, F/P)

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General	Total metals	Dis. metals	Nutrients	TOC	COD	Phenols	PAH	Number of Containers
	MW-H25A	28-07-13		Water	X	X	X	X	X	X	X	X	5
	MW-H27	"		Water	X	X	X	X	X	X	X	X	5
	MW-H26A	"		"	X	X	X	X	X	X	X	X	5
	MW-H26B	23-07-13		"				X	X	X			1

Short Holding Time

Rush Processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by: Rusto	Date: 30-07-13	Time: 9:30	Received by: Brit	Date: July 31	Time: 9:40	Temperature: 8.4 °C	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION | WHITE - LABORATORY COPY | YELLOW - CLIENT COPY | GENF 18.01 Front

RESCAN ENVIRONMENTAL SERVICES
ATTN: Rusto Martinka
Sixth Floor
1111 West Hastings Street
Vancouver BC V6E 2J3

Date Received: 06-AUG-13
Report Date: 22-AUG-13 16:40 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1343263

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-002-005
C of C Numbers:
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1343263-1	L1343263-2			
	Description	water	water			
	Sampled Date	31-JUL-13	01-AUG-13			
	Sampled Time					
	Client ID	MW-H28	MW-H29			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	5.1	8.2			
	Conductivity (uS/cm)	1320	699			
	Hardness (as CaCO3) (mg/L)	16.2	26.5			
	pH (pH)	8.62	8.20			
	Total Suspended Solids (mg/L)	80.8	17.6			
	Turbidity (NTU)	213	282			
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	1.3			
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	692	357			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	47.7	<2.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<2.0			
	Alkalinity, Total (as CaCO3) (mg/L)	739	357			
	Ammonia, Total (as N) (mg/L)	0.393	0.293			
	Bromide (Br) (mg/L)	<0.50 DLM	<0.50 DLM			
	Chloride (Cl) (mg/L)	5.7	<5.0 DLM			
	Fluoride (F) (mg/L)	1.13	0.63			
	Nitrate (as N) (mg/L)	<0.050 DLM	<0.050 DLM			
	Nitrite (as N) (mg/L)	<0.010 DLM	<0.010 DLM			
	Total Kjeldahl Nitrogen (mg/L)	0.622	0.628			
	Total Nitrogen (mg/L)	0.622	0.628			
	Orthophosphate-Dissolved (as P) (mg/L)	0.0255	<0.0010			
	Phosphorus (P)-Total Dissolved (mg/L)	0.0449	0.0078			
	Phosphorus (P)-Total (mg/L)	0.224	0.287			
	Sulfate (SO4) (mg/L)	20.7	44.7			
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	17.2	12.4			
Total Metals	Aluminum (Al)-Total (mg/L)	2.39	2.57			
	Antimony (Sb)-Total (mg/L)	0.00090	0.00030			
	Arsenic (As)-Total (mg/L)	0.00290	0.00095			
	Barium (Ba)-Total (mg/L)	0.962	0.424			
	Beryllium (Be)-Total (mg/L)	0.00026	0.00032			
	Bismuth (Bi)-Total (mg/L)	<0.0010 DLA	<0.00050			
	Boron (B)-Total (mg/L)	0.186	0.160			
	Cadmium (Cd)-Total (mg/L)	0.000391	0.000196			
	Calcium (Ca)-Total (mg/L)	10.9	9.69			
	Chromium (Cr)-Total (mg/L)	0.00413	0.00406			
	Cobalt (Co)-Total (mg/L)	0.00240	0.00263			
	Copper (Cu)-Total (mg/L)	0.0093	0.00503			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1343263-1	L1343263-2			
	Description	water	water			
	Sampled Date	31-JUL-13	01-AUG-13			
	Sampled Time					
	Client ID	MW-H28	MW-H29			
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	6.18	1.71			
	Lead (Pb)-Total (mg/L)	0.00568	0.00120			
	Lithium (Li)-Total (mg/L)	0.641	0.150			
	Magnesium (Mg)-Total (mg/L)	4.11	2.34			
	Manganese (Mn)-Total (mg/L)	0.0729	0.147			
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Total (mg/L)	0.0121	0.00587			
	Nickel (Ni)-Total (mg/L)	0.0118	0.00877			
	Phosphorus (P)-Total (mg/L)	0.70	<0.30			
	Potassium (K)-Total (mg/L)	1.59	2.31			
	Selenium (Se)-Total (mg/L)	0.00050	0.00013			
	Silicon (Si)-Total (mg/L)	12.5	7.41			
	Silver (Ag)-Total (mg/L)	0.000039	<0.000010			
	Sodium (Na)-Total (mg/L)	317	172			
	Strontium (Sr)-Total (mg/L)	0.139	0.0674			
	Thallium (Tl)-Total (mg/L)	0.000064	0.000072			
	Tin (Sn)-Total (mg/L)	0.00122	0.00075			
	Titanium (Ti)-Total (mg/L)	0.165	0.039			
	Uranium (U)-Total (mg/L)	0.00329	0.00116			
	Vanadium (V)-Total (mg/L)	0.0097	0.0076			
	Zinc (Zn)-Total (mg/L)	0.0339	0.0185			
Dissolved Metals	Dissolved Metals Filtration Location	FIELD	FIELD			
	Aluminum (Al)-Dissolved (mg/L)	0.0259	0.0434			
	Antimony (Sb)-Dissolved (mg/L)	0.00087	0.00033			
	Arsenic (As)-Dissolved (mg/L)	0.00183	0.00044			
	Barium (Ba)-Dissolved (mg/L)	0.697	0.114			
	Beryllium (Be)-Dissolved (mg/L)	<0.00020 DLA	<0.00010			
	Bismuth (Bi)-Dissolved (mg/L)	<0.0010 DLA	<0.00050			
	Boron (B)-Dissolved (mg/L)	0.199	0.160			
	Cadmium (Cd)-Dissolved (mg/L)	0.000098	0.000038			
	Calcium (Ca)-Dissolved (mg/L)	4.25	7.81			
	Chromium (Cr)-Dissolved (mg/L)	0.00023	0.00015			
	Cobalt (Co)-Dissolved (mg/L)	0.00054	0.00096			
	Copper (Cu)-Dissolved (mg/L)	0.00176	0.00136			
	Iron (Fe)-Dissolved (mg/L)	<0.030	<0.030			
	Lead (Pb)-Dissolved (mg/L)	0.00018	<0.000050			
	Lithium (Li)-Dissolved (mg/L)	0.710	0.161			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1343263-1	L1343263-2			
	Description	water	water			
	Sampled Date	31-JUL-13	01-AUG-13			
	Sampled Time					
	Client ID	MW-H28	MW-H29			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Magnesium (Mg)-Dissolved (mg/L)	1.35	1.71			
	Manganese (Mn)-Dissolved (mg/L)	0.00674	0.0999			
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010			
	Molybdenum (Mo)-Dissolved (mg/L)	0.0139	0.00696			
	Nickel (Ni)-Dissolved (mg/L)	0.0060	0.00574			
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30			
	Potassium (K)-Dissolved (mg/L)	0.91	1.47			
	Selenium (Se)-Dissolved (mg/L)	0.00042	0.00014			
	Silicon (Si)-Dissolved (mg/L)	2.67	3.55			
	Silver (Ag)-Dissolved (mg/L)	<0.000020 DLA	<0.000010			
	Sodium (Na)-Dissolved (mg/L)	323	173			
	Strontium (Sr)-Dissolved (mg/L)	0.116	0.0573			
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 DLA	0.000022			
	Tin (Sn)-Dissolved (mg/L)	0.00042	0.00022			
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010			
	Uranium (U)-Dissolved (mg/L)	0.00262	0.000925			
	Vanadium (V)-Dissolved (mg/L)	<0.0020 DLA	<0.0010			
	Zinc (Zn)-Dissolved (mg/L)	<0.0030 DLA	<0.0030			
Aggregate Organics	COD (mg/L)	111	44			
	Phenols (4AAP) (mg/L)	<0.0010	<0.0010			
Polycyclic Aromatic Hydrocarbons	Acenaphthene (mg/L)	<0.000050	<0.000050			
	Acenaphthylene (mg/L)	<0.000050	<0.000050			
	Acridine (mg/L)	<0.000050	<0.000050			
	Anthracene (mg/L)	<0.000050	<0.000050			
	Benz(a)anthracene (mg/L)	<0.000050	<0.000050			
	Benzo(a)pyrene (mg/L)	<0.000010	<0.000010			
	Benzo(b)fluoranthene (mg/L)	<0.000050	<0.000050			
	Benzo(g,h,i)perylene (mg/L)	<0.000050	<0.000050			
	Benzo(k)fluoranthene (mg/L)	<0.000050	<0.000050			
	Chrysene (mg/L)	<0.000050	<0.000050			
	Dibenz(a,h)anthracene (mg/L)	<0.000050	<0.000050			
	Fluoranthene (mg/L)	<0.000050	<0.000050			
	Fluorene (mg/L)	<0.000050	0.000085			
	Indeno(1,2,3-c,d)pyrene (mg/L)	<0.000050	<0.000050			
	Naphthalene (mg/L)	0.000057	0.000412			
	Phenanthrene (mg/L)	<0.000050	0.000080			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1343263-1	L1343263-2			
	Description	water	water			
	Sampled Date	31-JUL-13	01-AUG-13			
	Sampled Time					
	Client ID	MW-H28	MW-H29			
Grouping	**Analyte**					
WATER						
Polycyclic Aromatic Hydrocarbons	Pyrene (mg/L)	<0.000050	<0.000050			
	Quinoline (mg/L)	<0.000050	<0.000050			
	Surrogate: Acenaphthene d10 (%)	91.2	89.7			
	Surrogate: Acridine d9 (%)	99.6	94.7			
	Surrogate: Chrysene d12 (%)	90.6	89.4			
	Surrogate: Naphthalene d8 (%)	88.3	88.0			
	Surrogate: Phenanthrene d10 (%)	94.8	91.9			

* 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)
Duplicate	Nitrite (as N)	DLM	L1343263-1, -2
Matrix Spike	Mercury (Hg)-Total	MS-B	L1343263-1, -2
Matrix Spike	Phosphorus (P)-Total	MS-B	L1343263-1, -2
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1343263-1, -2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1343263-1, -2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1343263-1, -2
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1343263-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1343263-1, -2
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1343263-1, -2
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1343263-1, -2
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1343263-1, -2

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted For Sample Matrix Effects
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COD-COL-VA	Water	Chemical Oxygen Demand by Colorimetric	APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA	Water	Total Mercury in Water by CVAFS(Low)	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-T-COL-VA	Water	Total Nitrogen in water by Colour	USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

Reference Information

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PAH-SF-MS-VA	Water	PAH in Water by GCMS	EPA 3510, 8270

The entire water sample is extracted with dichloromethane, prior to analysis by gas chromatography with mass spectrometric detection (GC/MS). Because the two isomers cannot be readily chromatographically separated, benzo(j)fluoranthene is reported as part of the benzo(b)fluoranthene parameter.

PAH-SURR-MS-VA	Water	PAH Surrogates for Waters	EPA 3510, 8270

Analysed as per the corresponding PAH test method. Known quantities of surrogate compounds are added prior to analysis to each sample to demonstrate analytical accuracy.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PHENOLS-4AAP-ED	Water	Phenols (4AAP)	AB ENV.06537-COLORIMETRIC

This analysis is carried out using procedures adapted from ENVIRODAT VMV 06537 689, Method Code 154, in "Methods Manual for Chemical Analysis of Water and Wastes" published by the Alberta Environmental Centre. This automated method is based on the distillation of phenol and subsequent reaction of the distillate with alkaline ferricyanide and 4-aminoantipyrine to form a red complex which is measured at 505 nm.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA	Water	TKN in Water (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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
ED	ALS ENVIRONMENTAL - EDMONTON, ALBERTA, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

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.

Chain of Custody

Short Holding Time

Rush Processing

L1343263

L1343263-COFC

Rescan Environmental, Vancouver, BC

Rusto Martinka to Amber Springer

Job # 0194106-002-0005 rusto.martinka@erm.com

MW-428	water	31-July-13	5 bottles
MW-429	water	1-Aug-13	5 bottles

Analysis Request:

General Chem, Total Metals, Diss. Metals, Nutrients, Ions + Majors, TOC, COD

Phenols and PAH ⇒ Regular service request

As per all other water samples submitted for this project number. (Murray River, Tumbler Ridge, BC)

Rusto Martinka 2-Aug-13

Recd by Brittany, Aug 6, 13:20, 5.8°C

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
6/Floor
Vancouver BC V6E 2J3

Date Received: 12-NOV-13
Report Date: 26-NOV-13 12:36 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1390394

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-339044
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1390394-1	L1390394-2	L1390394-3	L1390394-4	L1390394-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	08-NOV-13	08-NOV-13	08-NOV-13	08-NOV-13	08-NOV-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	MW-H24A	MW-H24B	MW-H24C	MW-H25A	MW-H25B
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0	<5.0	<5.0
	Conductivity (uS/cm)	8760	472	527	1010	653
	Hardness (as CaCO3) (mg/L)	1050	239	267	15.3	360
	pH (pH)	12.57	8.14	8.11	8.57	8.03
	Total Suspended Solids (mg/L)	56.9	8.5	10.5	7.5	3.3
	Turbidity (NTU)	34.6	4.37	20.3	15.2	3.85
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	2.4	3.4	<1.0	8.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<1.0	270	311	570	383
	Alkalinity, Carbonate (as CaCO3) (mg/L)	113	<1.0	<1.0	31.6	<1.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	1750	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	1870	270	311	602	383
	Ammonia, Total (as N) (mg/L)	4.75	0.0173	0.180	0.396	0.0575
	Bromide (Br) (mg/L)	<2.5 DLM	<0.050	<0.050	<0.50 DLM	<0.050
	Chloride (Cl) (mg/L)	<25 DLM	<0.50	<0.50	<5.0 DLM	1.30
	Fluoride (F) (mg/L)	<1.0 DLM	0.107	0.114	0.72	0.182
	Nitrate (as N) (mg/L)	<0.25 DLM	0.0542	<0.0050	<0.050 DLM	<0.0050
	Nitrite (as N) (mg/L)	<0.050 DLM	<0.0010	<0.0010	<0.010 DLM	0.0013
	Total Kjeldahl Nitrogen (mg/L)	5.85	0.079	0.441	0.450	0.139
	Total Nitrogen (mg/L)	5.85	0.133	0.441	0.450	0.140
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010	<0.0010	0.0046	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0043	<0.0020	<0.0020	0.0122	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0353	0.0112	0.125	0.0311	0.0091
	Sulfate (SO4) (mg/L)	<25 DLM	3.76	1.01	<5.0 DLM	5.85
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	25.2	1.82	2.29	1.74	2.86
Total Metals	Aluminum (Al)-Total (mg/L)	1.48	0.0932	0.0059	0.927	0.0515
	Antimony (Sb)-Total (mg/L)	0.00213	0.00029	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00195	0.00027	0.00132	0.00037	0.00161
	Barium (Ba)-Total (mg/L)	3.81	0.893	1.07	1.18	0.303
	Beryllium (Be)-Total (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.0010 DLA	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	<0.020 DLA	0.015	0.029	0.202	0.014
	Cadmium (Cd)-Total (mg/L)	0.000562	0.000067	<0.000010	0.000030	0.000030
	Calcium (Ca)-Total (mg/L)	455	73.4	73.5	3.66	97.2
	Chromium (Cr)-Total (mg/L)	0.0267	0.00028	0.00133	0.00152	0.00020
	Cobalt (Co)-Total (mg/L)	0.00137	0.00096	<0.00010	0.00037	0.00136
	Copper (Cu)-Total (mg/L)	0.0288	0.00145	<0.00050	0.00132	<0.00050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1390394-6				
	Description	Water				
	Sampled Date	08-NOV-13				
	Sampled Time	12:00				
	Client ID	MW-H25C				
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0				
	Conductivity (uS/cm)	523				
	Hardness (as CaCO3) (mg/L)	266				
	pH (pH)	8.11				
	Total Suspended Solids (mg/L)	8.7				
	Turbidity (NTU)	22.4				
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	3.3				
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	311				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Total (as CaCO3) (mg/L)	311				
	Ammonia, Total (as N) (mg/L)	0.184				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	0.56				
	Fluoride (F) (mg/L)	0.115				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	0.256				
	Total Nitrogen (mg/L)	0.256				
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010				
	Phosphorus (P)-Total Dissolved (mg/L)	0.0020				
	Phosphorus (P)-Total (mg/L)	0.0986				
	Sulfate (SO4) (mg/L)	0.98				
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	2.29				
Total Metals	Aluminum (Al)-Total (mg/L)	0.0054				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	0.00127				
	Barium (Ba)-Total (mg/L)	1.09				
	Beryllium (Be)-Total (mg/L)	<0.00010				
	Bismuth (Bi)-Total (mg/L)	<0.00050				
	Boron (B)-Total (mg/L)	0.028				
	Cadmium (Cd)-Total (mg/L)	<0.000010				
	Calcium (Ca)-Total (mg/L)	75.5				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	<0.00050				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1390394-1	L1390394-2	L1390394-3	L1390394-4	L1390394-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	08-NOV-13	08-NOV-13	08-NOV-13	08-NOV-13	08-NOV-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	MW-H24A	MW-H24B	MW-H24C	MW-H25A	MW-H25B
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	1.94	0.181	3.95	0.873	0.388
	Lead (Pb)-Total (mg/L)	0.00434	0.000121	<0.000050	0.000643	0.000056
	Lithium (Li)-Total (mg/L)	0.0953	0.00184	0.0170	0.523	0.00708
	Magnesium (Mg)-Total (mg/L)	0.571	18.9	23.1	1.90	32.9
	Manganese (Mn)-Total (mg/L)	0.0458	0.0474	0.334	0.0277	0.765
	Mercury (Hg)-Total (mg/L)	0.000023	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.0111	0.000769	0.00285	0.000812	0.00230
	Nickel (Ni)-Total (mg/L)	0.0047	0.00125	<0.00050	0.00138	0.00346
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	10.5	0.889	0.974	0.878	0.622
	Selenium (Se)-Total (mg/L)	0.00040	0.00028	<0.00010	<0.00010	0.00010
	Silicon (Si)-Total (mg/L)	6.86	3.11	6.86	6.32	6.02
	Silver (Ag)-Total (mg/L)	0.000306	<0.000010	<0.000010	0.000016	<0.000010
	Sodium (Na)-Total (mg/L)	514	10.5	14.4	265	8.6
	Strontium (Sr)-Total (mg/L)	7.05	0.207	0.551	0.134	0.273
	Thallium (Tl)-Total (mg/L)	<0.000020 DLA	<0.000010	<0.000010	0.000019	0.000014
	Tin (Sn)-Total (mg/L)	0.00742	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.073	0.012	0.010	0.049	0.014
	Uranium (U)-Total (mg/L)	0.000191	0.000502	0.000152	0.000098	0.00154
	Vanadium (V)-Total (mg/L)	0.0039	<0.0010	<0.0010	0.0033	<0.0010
	Zinc (Zn)-Total (mg/L)	0.157	0.0033	<0.0030	0.0070	<0.0030
Dissolved Metals	Dissolved Mercury Filtration Location	LAB	LAB	LAB	LAB	LAB
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0590	<0.0030	0.0043	0.0050	<0.0030
	Antimony (Sb)-Dissolved (mg/L)	0.00027	0.00025	<0.00010	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00023	0.00021	0.00124	<0.00010	0.00166
	Barium (Ba)-Dissolved (mg/L)	3.67	0.904	1.05	1.13	0.287
	Beryllium (Be)-Dissolved (mg/L)	<0.00020 DLA	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.0010 DLA	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	<0.020 DLA	0.012	0.025	0.200	0.013
	Cadmium (Cd)-Dissolved (mg/L)	<0.000020 DLA	0.000038	<0.000010	<0.000010	<0.000010
	Calcium (Ca)-Dissolved (mg/L)	420	67.4	71.1	3.57	95.3
	Chromium (Cr)-Dissolved (mg/L)	0.0186	<0.00010	<0.00010	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00025	0.00082	<0.00010	<0.00010	0.00128
	Copper (Cu)-Dissolved (mg/L)	0.00632	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	<0.030	0.047	3.65	0.062	0.367
	Lead (Pb)-Dissolved (mg/L)	0.00098	<0.000050	<0.000050	<0.000050	<0.000050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1390394-6				
	Description	Water				
	Sampled Date	08-NOV-13				
	Sampled Time	12:00				
	Client ID	MW-H25C				
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	3.98				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	0.0166				
	Magnesium (Mg)-Total (mg/L)	23.6				
	Manganese (Mn)-Total (mg/L)	0.342				
	Mercury (Hg)-Total (mg/L)	<0.000010				
	Molybdenum (Mo)-Total (mg/L)	0.00283				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Phosphorus (P)-Total (mg/L)	<0.30				
	Potassium (K)-Total (mg/L)	0.975				
	Selenium (Se)-Total (mg/L)	<0.00010				
	Silicon (Si)-Total (mg/L)	7.01				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	14.5				
	Strontium (Sr)-Total (mg/L)	0.562				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	0.010				
	Uranium (U)-Total (mg/L)	0.000150				
	Vanadium (V)-Total (mg/L)	<0.0010				
	Zinc (Zn)-Total (mg/L)	<0.0030				
Dissolved Metals	Dissolved Mercury Filtration Location	LAB				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0040				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00130				
	Barium (Ba)-Dissolved (mg/L)	1.02				
	Beryllium (Be)-Dissolved (mg/L)	<0.00010				
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050				
	Boron (B)-Dissolved (mg/L)	0.025				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010				
	Calcium (Ca)-Dissolved (mg/L)	70.2				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	<0.00010				
	Copper (Cu)-Dissolved (mg/L)	<0.00050				
	Iron (Fe)-Dissolved (mg/L)	3.70				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1390394-1	L1390394-2	L1390394-3	L1390394-4	L1390394-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	08-NOV-13	08-NOV-13	08-NOV-13	08-NOV-13	08-NOV-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	MW-H24A	MW-H24B	MW-H24C	MW-H25A	MW-H25B
Grouping	**Analyte**					
WATER						
Dissolved Metals	Lithium (Li)-Dissolved (mg/L)	0.100	0.00153	0.0169	0.567	0.00724
	Magnesium (Mg)-Dissolved (mg/L)	0.043	17.3	21.8	1.56	29.7
	Manganese (Mn)-Dissolved (mg/L)	0.00010	0.0408	0.327	0.0226	0.710
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.0101	0.000667	0.00258	0.000707	0.00218
	Nickel (Ni)-Dissolved (mg/L)	0.0013	0.00099	<0.00050	<0.00050	0.00341
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	11.3	0.835	0.969	0.560	0.592
	Selenium (Se)-Dissolved (mg/L)	0.00040	0.00028	<0.00010	<0.00010	0.00011
	Silicon (Si)-Dissolved (mg/L)	0.325	2.86	6.66	3.15	5.90
	Silver (Ag)-Dissolved (mg/L)	<0.000020 DLA	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	567	11.7	15.0	275	9.2
	Strontium (Sr)-Dissolved (mg/L)	6.67	0.188	0.523	0.139	0.262
	Thallium (Tl)-Dissolved (mg/L)	<0.000020 DLA	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00096	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	0.016	<0.010	<0.010	<0.010	0.011
	Uranium (U)-Dissolved (mg/L)	<0.000020 DLA	0.000469	0.000147	0.000020	0.00140
	Vanadium (V)-Dissolved (mg/L)	<0.0020 DLA	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	0.0173	<0.0030	<0.0030	<0.0030	<0.0030
Aggregate Organics	COD (mg/L)	79	<20	<20	<20	<20

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1390394-6				
	Description	Water				
	Sampled Date	08-NOV-13				
	Sampled Time	12:00				
	Client ID	MW-H25C				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Lithium (Li)-Dissolved (mg/L)	0.0172				
	Magnesium (Mg)-Dissolved (mg/L)	22.1				
	Manganese (Mn)-Dissolved (mg/L)	0.318				
	Mercury (Hg)-Dissolved (mg/L)	<0.000010				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00260				
	Nickel (Ni)-Dissolved (mg/L)	<0.00050				
	Phosphorus (P)-Dissolved (mg/L)	<0.30				
	Potassium (K)-Dissolved (mg/L)	0.956				
	Selenium (Se)-Dissolved (mg/L)	<0.00010				
	Silicon (Si)-Dissolved (mg/L)	6.63				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	14.8				
	Strontium (Sr)-Dissolved (mg/L)	0.536				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	0.000140				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0030				
Aggregate Organics	COD (mg/L)	<20				

* 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	Barium (Ba)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Total Nitrogen	MS-B	L1390394-2, -4, -5, -6
Matrix Spike	Antimony (Sb)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Arsenic (As)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Total Organic Carbon	MS-B	L1390394-1
Matrix Spike	Ammonia, Total (as N)	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Total	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1390394-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects.
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA Water Alkalinity by Auto. Titration APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-SCR-VA Water Alkalinity by colour or titration EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA Water Bromide by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA Water Chloride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA Water Fluoride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA Water Nitrite in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA Water Nitrate in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA Water Total organic carbon by combustion APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COD-COL-VA Water Chemical Oxygen Demand by Colorimetric APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

COLOUR-TRUE-VA Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

Reference Information

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-T-COL-VA Water Total Nitrogen in water by Colour USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:

10-339044

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.

10- 339044

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

L1390394

Page 1 of 1

Report To		Report Format / Distribution		Service Request: (Rush subject to availability - Contact ALS to confirm TAT)	
Company:	Rescan-ERM	Standard: X	Other (specify):	X	Regular (Standard Turnaround Times - Business Days)
Contact:	Tyler Gale	Select: PDF X	Excel X Digital Fax		Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address:	1111 W. Hastings St. Vancouver BC	Email 1:	Tyler.Gale@erm.com		Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
		Email 2:	Yaming.Chen@erm.com		Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone:	604-689-9460 Fax:			Analysis Request	
Invoice To	Same as Report ? (circle) (Yes) or No (if No, provide details)	Client / Project Information		(Indicate Filtered or Preserved, F/P)	
	Copy of Invoice with Report? (circle) Yes or No	Job #:	0194106-0000-0005		
Company:		PO / AFE:			
Contact:		LSD:			
Address:					
Phone:	Fax:	Quote #:			
Lab Work Order # (lab use only)		ALS Contact:	Sampler:		

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chemistry	Nutrients /Toc	Total Metals	Dissolved Metals	Total Hg	Dissolved Hg	Number of Containers
	MW-H24A			Water							6
	MW-H24B			"							6
	MW-H24C			"							6
	MW-H25A			"							6
	MW-H25B			"							6
	MW-H25C			"							6

Short Holding Time

Rush Processing

L1390394-COFC

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Field pH for MW-H24A was 13.1

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Tyler Gale	Nov. 11/13	Noon	HB	NOV 12-13	8:55 AM Drop Box	1 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY

YELLOW - CLIENT COPY

GENF 18.01 Front

Brit Nov. 13 8:50 3.0

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
6/Floor
Vancouver BC V6E 2J3

Date Received: 12-NOV-13
Report Date: 25-NOV-13 16:59 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1390524

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-339045
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1390524-1	L1390524-2	L1390524-3	L1390524-4	L1390524-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	08-NOV-13	08-NOV-13	08-NOV-13	08-NOV-13	08-NOV-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	MW-26A	MW-26B	MW-26C	MW-27	MW-28
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	6.0	<5.0	<5.0	15.7
	Conductivity (uS/cm)	1030	722	474	1260	1160
	Hardness (as CaCO3) (mg/L)	18.6	386	249	14.6	42.5
	pH (pH)	9.06	8.00	8.13	8.72	8.40
	Total Suspended Solids (mg/L)	7.2	5.4	3.1	476	270
	Turbidity (NTU)	15.2	5.91	2.82	818	206
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	6.7	2.6	<1.0	<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	497	351	272	676	528
	Alkalinity, Carbonate (as CaCO3) (mg/L)	100	<1.0	<1.0	61.5	14.6
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	597	351	272	738	542
	Ammonia, Total (as N) (mg/L)	0.384	0.0894	0.0166	0.370	0.446
	Bromide (Br) (mg/L)	<0.50 DLM	<0.25 DLM	<0.050	<0.50 DLM	<0.50 DLM
	Chloride (Cl) (mg/L)	<5.0 DLM	<2.5 DLM	<0.50	6.7	7.9
	Fluoride (F) (mg/L)	0.68	0.13	0.106	0.93	0.53
	Nitrate (as N) (mg/L)	<0.050 DLM	<0.025 DLM	0.0525	<0.050 DLM	<0.050 DLM
	Nitrite (as N) (mg/L)	<0.010 DLM	0.0068	0.0015	0.014	0.011
	Total Kjeldahl Nitrogen (mg/L)	0.460	0.276	0.065	0.69	1.46
	Total Nitrogen (mg/L)	0.460	0.283	0.119	0.70 DLA	1.48
	Orthophosphate-Dissolved (as P) (mg/L)	0.0781	0.0146	<0.0010	0.0072	0.0025
	Phosphorus (P)-Total Dissolved (mg/L)	0.0861	0.0138	<0.0020	0.0460	0.0150
	Phosphorus (P)-Total (mg/L)	0.128	0.0368	0.0072	0.745	0.523
	Sulfate (SO4) (mg/L)	5.3	73.1	3.72	<5.0 DLM	107
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	2.66	3.48	1.52	11.8	27.7
Total Metals	Aluminum (Al)-Total (mg/L)	1.07	0.107	0.0979	10.2	4.54
	Antimony (Sb)-Total (mg/L)	0.00101	0.00013	0.00028	0.00095	0.00035
	Arsenic (As)-Total (mg/L)	0.00101	0.00211	0.00031	0.0108	0.00636
	Barium (Ba)-Total (mg/L)	0.581	0.0844	0.864	1.63	0.669
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00082	0.00032
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.0010	<0.00050
	Boron (B)-Total (mg/L)	0.229	0.056	0.014	0.231	0.200
	Cadmium (Cd)-Total (mg/L)	0.000068	0.000095	0.000058	0.000597	0.000626
	Calcium (Ca)-Total (mg/L)	5.55	91.9	73.5	15.0	14.4
	Chromium (Cr)-Total (mg/L)	0.00193	0.00026	0.00022	0.0137	0.00986
	Cobalt (Co)-Total (mg/L)	0.00024	0.00257	0.00097	0.00835	0.00367
	Copper (Cu)-Total (mg/L)	0.00112	0.00065	<0.00050	0.0273	0.00907

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1390524-6	L1390524-7			
	Description	Water	Water			
	Sampled Date	08-NOV-13	08-NOV-13			
	Sampled Time	12:00	12:00			
	Client ID	MW-29	ALS TRAVEL BLANK			
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0			
	Conductivity (uS/cm)	689	<2.0			
	Hardness (as CaCO3) (mg/L)	8.47	<0.50			
	pH (pH)	8.34	5.68			
	Total Suspended Solids (mg/L)	7.4	<3.0			
	Turbidity (NTU)	32.7	<0.10			
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	1.4			
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	376	<1.0			
	Alkalinity, Carbonate (as CaCO3) (mg/L)	5.6	<1.0			
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0			
	Alkalinity, Total (as CaCO3) (mg/L)	382	<1.0			
	Ammonia, Total (as N) (mg/L)	0.201	<0.0050			
	Bromide (Br) (mg/L)	<0.25 DLM	<0.050			
	Chloride (Cl) (mg/L)	3.9	<0.50			
	Fluoride (F) (mg/L)	0.35	<0.020			
	Nitrate (as N) (mg/L)	<0.025 DLM	<0.0050			
	Nitrite (as N) (mg/L)	<0.0050 DLM	<0.0010			
	Total Kjeldahl Nitrogen (mg/L)	0.279	<0.050			
	Total Nitrogen (mg/L)	0.279	<0.050			
	Orthophosphate-Dissolved (as P) (mg/L)	0.0687	<0.0010			
	Phosphorus (P)-Total Dissolved (mg/L)	0.0755	<0.0020			
	Phosphorus (P)-Total (mg/L)	0.142	<0.0020			
	Sulfate (SO4) (mg/L)	9.9	<0.50			
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	3.03	<0.50			
Total Metals	Aluminum (Al)-Total (mg/L)	1.25	<0.0030			
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010			
	Arsenic (As)-Total (mg/L)	0.00147	<0.00010			
	Barium (Ba)-Total (mg/L)	0.103	<0.000050			
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010			
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050			
	Boron (B)-Total (mg/L)	0.186	<0.010			
	Cadmium (Cd)-Total (mg/L)	0.000070	<0.000010			
	Calcium (Ca)-Total (mg/L)	2.83	<0.020			
	Chromium (Cr)-Total (mg/L)	0.00226	<0.00010			
	Cobalt (Co)-Total (mg/L)	0.00076	<0.00010			
	Copper (Cu)-Total (mg/L)	0.00176	<0.00050			

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1390524-1	L1390524-2	L1390524-3	L1390524-4	L1390524-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	08-NOV-13	08-NOV-13	08-NOV-13	08-NOV-13	08-NOV-13
	Sampled Time	12:00	12:00	12:00	12:00	12:00
	Client ID	MW-26A	MW-26B	MW-26C	MW-27	MW-28
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	0.432	0.313	0.185	20.4	4.97
	Lead (Pb)-Total (mg/L)	0.000356	0.000125	0.000114	0.0173	0.00391
	Lithium (Li)-Total (mg/L)	0.608	0.00657	0.00224	0.726	0.244
	Magnesium (Mg)-Total (mg/L)	1.93	36.7	17.9	8.06	5.49
	Manganese (Mn)-Total (mg/L)	0.0121	1.17	0.0486	0.124	0.567
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000050 DLM	<0.000050 DLM
	Molybdenum (Mo)-Total (mg/L)	0.00992	0.00346	0.000780	0.0149	0.0201
	Nickel (Ni)-Total (mg/L)	0.00104	0.00722	0.00121	0.0304	0.0155
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	0.89	0.38
	Potassium (K)-Total (mg/L)	0.996	2.51	0.881	2.63	2.48
	Selenium (Se)-Total (mg/L)	<0.00010	0.00033	0.00030	0.00175	0.00038
	Silicon (Si)-Total (mg/L)	6.95	6.92	3.14	98.5	15.4
	Silver (Ag)-Total (mg/L)	0.000011	0.000013	<0.000010	0.000454	0.000102
	Sodium (Na)-Total (mg/L)	277	21.7	10.5	333	278
	Strontium (Sr)-Total (mg/L)	0.141	0.327	0.209	0.215	0.187
	Thallium (Tl)-Total (mg/L)	0.000016	0.000030	<0.000010	0.000276	0.000135
	Tin (Sn)-Total (mg/L)	0.00030	<0.00010	<0.00010	0.00212	0.00290
	Titanium (Ti)-Total (mg/L)	0.032	0.017	0.012	2.01	0.085
	Uranium (U)-Total (mg/L)	0.000614	0.00682	0.000542	0.00249	0.00395
	Vanadium (V)-Total (mg/L)	0.0040	<0.0010	<0.0010	0.0234	0.0097
	Zinc (Zn)-Total (mg/L)	0.0057	<0.0030	<0.0030	0.132	0.0393
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.127	0.0043	<0.0030	0.0076	0.0142
	Antimony (Sb)-Dissolved (mg/L)	0.00098	<0.00010	0.00026	0.00036	0.00024
	Arsenic (As)-Dissolved (mg/L)	0.00087	0.00223	0.00022	0.00058	0.00482
	Barium (Ba)-Dissolved (mg/L)	0.547	0.0790	0.861	0.988	0.0491
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00020 DLA	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.0010 DLA	<0.00050
	Boron (B)-Dissolved (mg/L)	0.197	0.048	0.012	0.221	0.192
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010	0.000029	0.000036	0.000033	0.000020
	Calcium (Ca)-Dissolved (mg/L)	4.86	94.4	71.7	3.90	10.3
	Chromium (Cr)-Dissolved (mg/L)	0.00023	<0.00010	<0.00010	<0.00020 DLA	0.00021
	Cobalt (Co)-Dissolved (mg/L)	<0.00010	0.00258	0.00082	0.00024	0.00166
	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	0.00146	<0.00050
	Iron (Fe)-Dissolved (mg/L)	0.054	0.287	0.049	<0.030	0.396
	Lead (Pb)-Dissolved (mg/L)	0.000159	<0.000050	<0.000050	0.00013	0.000052

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1390524-6	L1390524-7			
	Description	Water	Water			
	Sampled Date	08-NOV-13	08-NOV-13			
	Sampled Time	12:00	12:00			
	Client ID	MW-29	ALS TRAVEL BLANK			
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	0.937	<0.030			
	Lead (Pb)-Total (mg/L)	0.000476	<0.000050			
	Lithium (Li)-Total (mg/L)	0.169	<0.00050			
	Magnesium (Mg)-Total (mg/L)	0.579	<0.0050			
	Manganese (Mn)-Total (mg/L)	0.132	<0.000050			
	Mercury (Hg)-Total (mg/L)	<0.000050 DLM	<0.000010			
	Molybdenum (Mo)-Total (mg/L)	0.000857	<0.000050			
	Nickel (Ni)-Total (mg/L)	0.00271	<0.00050			
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30			
	Potassium (K)-Total (mg/L)	0.893	<0.050			
	Selenium (Se)-Total (mg/L)	<0.00010	<0.00010			
	Silicon (Si)-Total (mg/L)	8.23	<0.050			
	Silver (Ag)-Total (mg/L)	0.000012	<0.000010			
	Sodium (Na)-Total (mg/L)	176	<2.0			
	Strontium (Sr)-Total (mg/L)	0.0297	<0.00020			
	Thallium (Tl)-Total (mg/L)	0.000048	<0.000010			
	Tin (Sn)-Total (mg/L)	0.00012	<0.00010			
	Titanium (Ti)-Total (mg/L)	0.058	<0.010			
	Uranium (U)-Total (mg/L)	0.000635	<0.000010			
	Vanadium (V)-Total (mg/L)	0.0041	<0.0010			
	Zinc (Zn)-Total (mg/L)	0.0041	<0.0030			
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0064				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00118				
	Barium (Ba)-Dissolved (mg/L)	0.0657				
	Beryllium (Be)-Dissolved (mg/L)	<0.00010				
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050				
	Boron (B)-Dissolved (mg/L)	0.177				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010				
	Calcium (Ca)-Dissolved (mg/L)	2.72				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	0.00036				
	Copper (Cu)-Dissolved (mg/L)	<0.00050				
	Iron (Fe)-Dissolved (mg/L)	0.148				
	Lead (Pb)-Dissolved (mg/L)	<0.000050				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1390524-1 Water 08-NOV-13 12:00 MW-26A	L1390524-2 Water 08-NOV-13 12:00 MW-26B	L1390524-3 Water 08-NOV-13 12:00 MW-26C	L1390524-4 Water 08-NOV-13 12:00 MW-27	L1390524-5 Water 08-NOV-13 12:00 MW-28
WATER						
Dissolved Metals	Lithium (Li)-Dissolved (mg/L)	0.521	0.00571	0.00221	0.764	0.232
	Magnesium (Mg)-Dissolved (mg/L)	1.58	36.5	17.0	1.18	4.11
	Manganese (Mn)-Dissolved (mg/L)	0.00676	1.17	0.0413	0.0102	0.520
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.00899	0.00291	0.000716	0.0138	0.0225
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	0.00621	0.00105	0.0025	0.00946
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	0.687	2.32	0.828	0.66	1.35
	Selenium (Se)-Dissolved (mg/L)	<0.00010	0.00021	0.00032	<0.00020 DLA	0.00030
	Silicon (Si)-Dissolved (mg/L)	4.80	6.35	2.81	2.95	4.04
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000020 DLA	<0.000010
	Sodium (Na)-Dissolved (mg/L)	277	23.5	10.4	352	295
	Strontium (Sr)-Dissolved (mg/L)	0.134	0.316	0.204	0.150	0.127
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	0.000014	0.000011	<0.000020 DLA	<0.000010
	Tin (Sn)-Dissolved (mg/L)	0.00019	<0.00010	<0.00010	0.00076	0.00020
	Titanium (Ti)-Dissolved (mg/L)	<0.010	0.012	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.000508	0.00650	0.000465	0.000574	0.00294
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0020 DLA	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	0.0037	0.0033	<0.0030	0.0038	0.0032
Aggregate Organics	COD (mg/L)	<20	<20	<20	86	67

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1390524-6	L1390524-7			
	Description	Water	Water			
	Sampled Date	08-NOV-13	08-NOV-13			
	Sampled Time	12:00	12:00			
	Client ID	MW-29	ALS TRAVEL BLANK			
Grouping	**Analyte**					
WATER						
Dissolved Metals	Lithium (Li)-Dissolved (mg/L)	0.173				
	Magnesium (Mg)-Dissolved (mg/L)	0.406				
	Manganese (Mn)-Dissolved (mg/L)	0.121				
	Mercury (Hg)-Dissolved (mg/L)	<0.000010				
	Molybdenum (Mo)-Dissolved (mg/L)	0.000566				
	Nickel (Ni)-Dissolved (mg/L)	0.00156				
	Phosphorus (P)-Dissolved (mg/L)	<0.30				
	Potassium (K)-Dissolved (mg/L)	0.498				
	Selenium (Se)-Dissolved (mg/L)	<0.00010				
	Silicon (Si)-Dissolved (mg/L)	4.25				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	185				
	Strontium (Sr)-Dissolved (mg/L)	0.0286				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	0.000539				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	<0.0030				
Aggregate Organics	COD (mg/L)	<20	<20			

* 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	Total Nitrogen	MS-B	L1390524-1, -2, -3, -4, -5, -6, -7
Matrix Spike	Total Organic Carbon	MS-B	L1390524-5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Boron (B)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Lithium (Li)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Total	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Total	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Total	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Total	MS-B	L1390524-7
Matrix Spike	Calcium (Ca)-Total	MS-B	L1390524-7
Matrix Spike	Copper (Cu)-Total	MS-B	L1390524-7
Matrix Spike	Magnesium (Mg)-Total	MS-B	L1390524-7
Matrix Spike	Strontium (Sr)-Total	MS-B	L1390524-7
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Cobalt (Co)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Boron (B)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1390524-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit Adjusted For required dilution
DLM	Detection Limit Adjusted due to sample matrix effects.
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-PCT-VA Water Alkalinity by Auto. Titration APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA Water Alkalinity by Auto. Titration APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-SCR-VA Water Alkalinity by colour or titration EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA Water Bromide by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA Water Chloride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA Water Fluoride by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA Water Nitrite in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA Water Nitrate in Water by Ion Chromatography EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA Water Total organic carbon by combustion APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COD-COL-VA Water Chemical Oxygen Demand by Colorimetric APHA 5220 D. CHEMICAL OXYGEN DEMAND

This analysis is carried out using procedures adapted from APHA Method 5220 "Chemical Oxygen Demand (COD)". Chemical oxygen demand is determined using the closed reflux colourimetric method.

COLOUR-TRUE-VA Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the

Reference Information

American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-T-COL-VA Water Total Nitrogen in water by Colour USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

Reference Information

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:

10-339045

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.

10- 339045

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

L1390524 Page 1 of 1

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: ERM-Rescan	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
	Email 2: Yaming.Chen@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Phone: 604-689-9460 Fax:		
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194106-0002-0005	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only)	**ALS Contact:** **Sampler:**	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chemistry	Nutrients	Total Metals	Dissolved Metals	Total Hg	Dissolved Hg	Number of Containers
	MW-26A			Water	P	P	F P	P	F P		6
	MW-26B			"							6
	MW-26C			"							6
	MW-27			"							6
	MW-28			"							6
	MW-29			"							6
	ALS Travel Blank			"				HM		HM	4

Short Holding Time

Rush Processing

L1390524-COFC

Special Instructions / Regulation with water or land use (CCME- Fre ...atural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Tyler Gale	Nov. 11 2013	Noon	HB	Nov 12-13	9:09 DROP Box	5 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

Brit Nov. 13 8:50 2.1

WHITE - LABORATORY COPY YELLOW - CLIENT COPY GENF 18.01 Front

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
15th Floor
Vancouver BC V6E 2J3

Date Received: 15-FEB-14
Report Date: 26-FEB-14 15:28 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1422938

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-143968
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1422938-1	L1422938-2	L1422938-3	L1422938-4	L1422938-5
	Description	water	water	water	water	water
	Sampled Date	11-FEB-14	11-FEB-14	12-FEB-14	12-FEB-14	13-FEB-14
	Sampled Time	14:30	15:30	15:30	15:00	14:00
	Client ID	MW-H26B	MW-H29	MW-H26A	MW-H25B	MW-H24C
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0	<5.0	<5.0
	Conductivity (uS/cm)	720	665	1050	643	515
	Hardness (as CaCO3) (mg/L)	353	8.37	18.9	363	272
	pH (pH)	8.30	8.57	8.91	7.93	8.08
	Total Suspended Solids (mg/L)	24.5	<3.0	<3.0	10.6	<3.0
	Turbidity (NTU)	15.7	4.92	1.12	10.8	13.0
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	9.3	3.5
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	345	344	472	392	314
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<1.0	14.2	73.8	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	345	358	546	392	314
	Ammonia, Total (as N) (mg/L)	0.165	0.189	0.375	0.073	0.204
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.50 DLM	<0.050	<0.050
	Chloride (Cl) (mg/L)	1.32	2.35	<5.0 DLM	1.26	<0.50
	Fluoride (F) (mg/L)	0.133	0.381	0.67	0.175	0.113
	Nitrate (as N) (mg/L)	0.0183	<0.0050	<0.050 DLM	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	0.0064	<0.0010	<0.010 DLM	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.404	0.286	0.489	0.204	0.246
	Total Nitrogen (mg/L)	0.429	0.286	0.489	0.204	0.246
	Orthophosphate-Dissolved (as P) (mg/L)	0.0064	0.0646	0.0710	0.0012	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0057	0.0651	0.0802	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0707	0.0857	0.0824	0.0216	0.0669
	Sulfate (SO4) (mg/L)	79.9	6.31	<5.0 DLM	6.06	1.43
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	5.69	3.05	3.04	4.05	1.13
Total Metals	Aluminum (Al)-Total (mg/L)	0.367	0.236	0.130	0.223	0.0053
	Antimony (Sb)-Total (mg/L)	0.00014	<0.00010	0.00044	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00160	0.00081	0.00042	0.00159	0.00054
	Barium (Ba)-Total (mg/L)	0.0752	0.0843	0.616	0.276	0.999
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	0.045	0.173	0.178	0.013	0.023
	Cadmium (Cd)-Total (mg/L)	0.000085	0.000030	0.000012	0.000025	<0.000010
	Calcium (Ca)-Total (mg/L)	79.6	2.60	4.26	99.7	66.6
	Chromium (Cr)-Total (mg/L)	0.00069	0.00058	0.00027	0.00040	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00242	0.00028	<0.00010	0.00139	<0.00010
	Copper (Cu)-Total (mg/L)	0.00250	0.00060	<0.00050	0.00054	<0.00050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1422938-1 water 11-FEB-14 14:30 MW-H26B	L1422938-2 water 11-FEB-14 15:30 MW-H29	L1422938-3 water 12-FEB-14 15:30 MW-H26A	L1422938-4 water 12-FEB-14 15:00 MW-H25B	L1422938-5 water 13-FEB-14 14:00 MW-H24C
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	0.778	0.318	0.071	0.840	2.15
	Lead (Pb)-Total (mg/L)	0.000465	0.000310	0.000129	0.000187	<0.000050
	Lithium (Li)-Total (mg/L)	0.00430	0.154	0.457	0.00739	0.0144
	Magnesium (Mg)-Total (mg/L)	32.6	0.349	1.86	30.8	22.5
	Manganese (Mn)-Total (mg/L)	0.900	0.0829	0.00885	0.699	0.107
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.00280	0.000274	0.00637	0.00203	0.00156
	Nickel (Ni)-Total (mg/L)	0.00699	0.00126	<0.00050	0.00340	<0.00050
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	2.22	0.384	0.655	0.617	0.827
	Selenium (Se)-Total (mg/L)	0.00017	<0.00010	<0.00010	<0.00010	<0.00010
	Silicon (Si)-Total (mg/L)	6.48	4.64	4.77	5.89	6.62
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	18.6	165	277	8.1	13.1
	Strontium (Sr)-Total (mg/L)	0.326	0.0308	0.127	0.264	0.442
	Thallium (Tl)-Total (mg/L)	0.000026	0.000013	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	0.00018	0.00021	0.00017	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	0.020	<0.010	<0.010	0.015	<0.010
	Uranium (U)-Total (mg/L)	0.00565	0.000356	0.000346	0.00132	0.000098
	Vanadium (V)-Total (mg/L)	0.0011	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Total (mg/L)	0.0037	<0.0030	<0.0030	0.0034	<0.0030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	0.0044	0.112	<0.0030	0.0042
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	0.00045	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00154	0.00103 DTC	0.00043	0.00147	0.00051
	Barium (Ba)-Dissolved (mg/L)	0.0732	0.0428	0.626	0.267	1.03
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	0.044	0.169	0.191	0.010	0.023
	Cadmium (Cd)-Dissolved (mg/L)	0.000038	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)-Dissolved (mg/L)	85.0	2.84	4.49	96.2	72.9
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	0.00015	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00220	0.00023	<0.00010	0.00120	<0.00010
	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	0.182	0.135	0.048	0.526	2.15
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	0.000107	<0.000050	<0.000050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1422938-1 water 11-FEB-14 14:30 MW-H26B	L1422938-2 water 11-FEB-14 15:30 MW-H29	L1422938-3 water 12-FEB-14 15:30 MW-H26A	L1422938-4 water 12-FEB-14 15:00 MW-H25B	L1422938-5 water 13-FEB-14 14:00 MW-H24C
WATER						
Dissolved Metals	Lithium (Li)-Dissolved (mg/L)	0.00414	0.155	0.500	0.00664	0.0165
	Magnesium (Mg)-Dissolved (mg/L)	34.1	0.312	1.87	29.8	22.0
	Manganese (Mn)-Dissolved (mg/L)	0.978	0.0971	0.00818	0.673	0.105
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.00268	0.000269	0.00626	0.00195	0.00159
	Nickel (Ni)-Dissolved (mg/L)	0.00612	0.00098	<0.00050	0.00278	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	2.30	0.401	0.664	0.533	0.826
	Selenium (Se)-Dissolved (mg/L)	0.00011	<0.00010	<0.00010	<0.00010	<0.00010
	Silicon (Si)-Dissolved (mg/L)	5.68	4.14	4.60	5.37	6.59
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	19.2	173	276	8.3	13.3
	Strontium (Sr)-Dissolved (mg/L)	0.341	0.0243	0.134	0.256	0.483
	Thallium (Tl)-Dissolved (mg/L)	0.000013	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	0.00014	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00554	0.000415	0.000357	0.00130	0.000091
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

* 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)
Duplicate	Bromide (Br)	DLM	L1422938-1, -2, -3, -4, -5
Duplicate	Fluoride (F)	DLM	L1422938-1, -2, -3, -4, -5
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1422938-2, -3, -4, -5
Matrix Spike	Sulfate (SO4)	MS-B	L1422938-1, -2, -3, -4, -5
Matrix Spike	Total Nitrogen	MS-B	L1422938-1, -2, -3, -4, -5
Matrix Spike	Total Nitrogen	MS-B	L1422938-1, -2, -3, -4, -5
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1422938-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1422938-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1422938-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1422938-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects.
DTC	Dissolved concentration exceeds total. Results were confirmed by re-analysis.
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

Reference Information

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA	Water	Total Mercury in Water by CVAFS(Low)	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-T-COL-VA	Water	Total Nitrogen in water by Colour	USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

Reference Information

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA	Water	TKN in Water (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:

10-143968

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.

10-143968

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page ____ of ____

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: ERM-Rescan	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 15th Floor 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone: 604 689 9460 Fax:	Email 2: Yaming.Chen@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT

Invoice To	Client / Project Information
Same as Report ? (circle) (Yes) or No (if No, provide details)	Job #: 0194106-0002-0005
Copy of Invoice with Report? (circle) Yes or No	PO / AFE:
Company:	LSD:
Contact:	
Address:	Quote #:
Phone:	ALS Contact: Sampler:

Lab Work Order # (L1422938-COFC

Analysis Request
(Indicate Filtered or Preserved, F/P)

Sample #	(This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem.	Nutrients P	Total Metals P	Total Hg P	Dissolved Metals F/P	Dissolved Hg F/P	Number of Containers
	~~MW-H26B~~ MW-H26B	11-Feb-14	14:30	Water	—	—	—	—	—	—	6
	MW-H29	11-Feb-14	15:30	Water	—	—	—	—	—	—	6
	MW-H26A	12-Feb-14	15:30	Water	—	—	—	—	—	—	6
	MW-H25B	12-Feb-14	15:00	Water	—	—	—	—	—	—	6
	MW-H24C	13-Feb-14	14:00	Water	—	—	—	—	—	—	6

Short Holding Time

Rush Processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Tyler Gale	14-Feb-14	Afternoon	SAIK	14-Feb-14	15:45	4 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

PR 15FEB 12:30 6 °C

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
15th Floor
Vancouver BC V6E 2J3

Date Received: 15-FEB-14
Report Date: 28-FEB-14 12:48 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1422942

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-143967
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1422942-1	L1422942-2	L1422942-3	L1422942-4	L1422942-5
	Description	water	water	water	water	water
	Sampled Date	09-FEB-14	08-FEB-14	09-FEB-14	08-FEB-14	10-FEB-14
	Sampled Time	14:20	15:30	12:00	12:00	16:15
	Client ID	MW-H17	MW-H22	MW-SHAFT	MW-H23	MW-H24B
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0	<5.0	<5.0
	Conductivity (uS/cm)	517	573	1330	436	449
	Hardness (as CaCO3) (mg/L)	266	340	650	234	239
	pH (pH)	8.23	8.07	7.87	8.10	8.24
	Total Suspended Solids (mg/L)	<3.0	40.3	9.1	405	<3.0
	Turbidity (NTU)	2.17	28.3	7.85	354	1.11
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	1.5	4.1	11.7	2.2	<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	277	344	372	247	261
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	277	344	372	247	261
	Ammonia, Total (as N) (mg/L)	0.047	0.0071	<0.0050	0.017	0.021
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.50 DLM	<0.050	<0.050
	Chloride (Cl) (mg/L)	<0.50	1.64	219	0.56	<0.50
	Fluoride (F) (mg/L)	0.121	0.047	<0.20 DLM	0.079	0.112
	Nitrate (as N) (mg/L)	0.0209	0.465	<0.050 DLM	0.237	0.0821
	Nitrite (as N) (mg/L)	0.0083	<0.0010	<0.010 DLM	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	0.069	<0.11	0.189	0.232	0.068
	Total Nitrogen (mg/L)	0.098	0.554	0.189	0.469	0.150
	Orthophosphate-Dissolved (as P) (mg/L)	0.0044	0.0049	0.0024	0.0019	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.0057	0.0062	0.0054	0.0045	<0.0020
	Phosphorus (P)-Total (mg/L)	0.0126	0.0579	0.0226	0.388	0.0055
	Sulfate (SO4) (mg/L)	11.2	5.14	5.4	6.98	4.63
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	1.33	2.03	6.43	7.2	1.17
Total Metals	Aluminum (Al)-Total (mg/L)	0.147	0.400	0.188	5.45	0.0109
	Antimony (Sb)-Total (mg/L)	<0.00010	0.00011	<0.00010	0.00109	0.00027
	Arsenic (As)-Total (mg/L)	0.00089	0.00057	0.00038	0.00762	0.00035
	Barium (Ba)-Total (mg/L)	0.327	0.247	0.713	0.387	0.850
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00033	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	0.017	<0.010	<0.010	0.018	0.011
	Cadmium (Cd)-Total (mg/L)	0.000018	0.000173	0.000165	0.00242	0.000042
	Calcium (Ca)-Total (mg/L)	78.9	98.1	188	99.0	67.9
	Chromium (Cr)-Total (mg/L)	0.00025	0.00245	0.00034	0.0115	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00055	0.00033	0.00132	0.0104	0.00074
	Copper (Cu)-Total (mg/L)	<0.00050	0.00154	0.00133	0.0168	0.00062

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1422942-6
	Description	water
	Sampled Date	10-FEB-14
	Sampled Time	17:30
	Client ID	MW-H27
Grouping	**Analyte**	
WATER		
Physical Tests	Colour, True (CU)	<5.0
	Conductivity (uS/cm)	1260
	Hardness (as CaCO3) (mg/L)	12.5
	pH (pH)	8.79
	Total Suspended Solids (mg/L)	<3.0
	Turbidity (NTU)	1.15
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	627
	Alkalinity, Carbonate (as CaCO3) (mg/L)	62.2
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	689
	Ammonia, Total (as N) (mg/L)	0.420
	Bromide (Br) (mg/L)	<0.50 DLM
	Chloride (Cl) (mg/L)	6.9
	Fluoride (F) (mg/L)	0.98
	Nitrate (as N) (mg/L)	<0.050 DLM
	Nitrite (as N) (mg/L)	<0.010 DLM
	Total Kjeldahl Nitrogen (mg/L)	0.777
	Total Nitrogen (mg/L)	0.777
	Orthophosphate-Dissolved (as P) (mg/L)	0.0858
	Phosphorus (P)-Total Dissolved (mg/L)	0.0900
	Phosphorus (P)-Total (mg/L)	0.121
	Sulfate (SO4) (mg/L)	<5.0 DLM
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	3.57
Total Metals	Aluminum (Al)-Total (mg/L)	0.0435
	Antimony (Sb)-Total (mg/L)	<0.00010
	Arsenic (As)-Total (mg/L)	0.00033
	Barium (Ba)-Total (mg/L)	1.24
	Beryllium (Be)-Total (mg/L)	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.00050
	Boron (B)-Total (mg/L)	0.199
	Cadmium (Cd)-Total (mg/L)	0.000038
	Calcium (Ca)-Total (mg/L)	3.39
	Chromium (Cr)-Total (mg/L)	0.00018
	Cobalt (Co)-Total (mg/L)	0.00011
	Copper (Cu)-Total (mg/L)	0.00119

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1422942-1 water 09-FEB-14 14:20 MW-H17	L1422942-2 water 08-FEB-14 15:30 MW-H22	L1422942-3 water 09-FEB-14 12:00 MW-SHAFT	L1422942-4 water 08-FEB-14 12:00 MW-H23	L1422942-5 water 10-FEB-14 16:15 MW-H24B
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	0.222	0.940	0.322	12.7	0.180
	Lead (Pb)-Total (mg/L)	0.000124	0.000491	0.000148	0.00823	<0.000050
	Lithium (Li)-Total (mg/L)	0.0155	0.00417	0.00504	0.00919	0.00157
	Magnesium (Mg)-Total (mg/L)	20.0	23.2	42.3	24.0	17.1
	Manganese (Mn)-Total (mg/L)	0.0890	0.0170	0.0633	0.471	0.0452
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.000753	0.000613	0.000331	0.00226	0.000751
	Nickel (Ni)-Total (mg/L)	0.00156	0.00172	0.00584	0.0301	0.00103
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	0.37	<0.30
	Potassium (K)-Total (mg/L)	1.15	1.67	1.15	2.81	0.811
	Selenium (Se)-Total (mg/L)	<0.00010	0.00067	<0.00010	0.00140	0.00026
	Silicon (Si)-Total (mg/L)	4.51	4.62	4.47	15.7	2.75
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	0.000102	0.000104	<0.000010
	Sodium (Na)-Total (mg/L)	10.7	<2.0	24.5	2.5	9.6
	Strontium (Sr)-Total (mg/L)	0.226	0.142	0.260	0.144	0.197
	Thallium (Tl)-Total (mg/L)	0.000014	0.000031	0.000020	0.000593	<0.000010
	Tin (Sn)-Total (mg/L)	<0.00010	0.00010	<0.00010	0.00035	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.010	0.021	0.016	0.204	<0.010
	Uranium (U)-Total (mg/L)	0.00132	0.000475	0.000694	0.000659	0.000475
	Vanadium (V)-Total (mg/L)	<0.0010	0.0022	<0.0010	0.0275	<0.0010
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0069	0.0036	0.0911	<0.0030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	<0.0030	0.0031	<0.0030	<0.0030
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	0.00029
	Arsenic (As)-Dissolved (mg/L)	0.00061	0.00015	0.00022	0.00015	0.00037
	Barium (Ba)-Dissolved (mg/L)	0.329	0.252	0.717	0.245	0.859
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	0.015	<0.010	<0.010	<0.010	0.011
	Cadmium (Cd)-Dissolved (mg/L)	0.000011	0.000061	0.000146	0.000021	0.000034
	Calcium (Ca)-Dissolved (mg/L)	74.2	99.1	192	67.1	67.5
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	0.00067	<0.00010	0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00021	<0.00010	0.00094	<0.00010	0.00075
	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050	0.00141	0.00061	<0.00050
	Iron (Fe)-Dissolved (mg/L)	0.036	<0.030	0.041	<0.030	0.169
	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	<0.000050	<0.000050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1422942-6				
	Description	water				
	Sampled Date	10-FEB-14				
	Sampled Time	17:30				
	Client ID	MW-H27				
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	0.086				
	Lead (Pb)-Total (mg/L)	0.000408				
	Lithium (Li)-Total (mg/L)	0.658				
	Magnesium (Mg)-Total (mg/L)	1.33				
	Manganese (Mn)-Total (mg/L)	0.0183				
	Mercury (Hg)-Total (mg/L)	<0.000010				
	Molybdenum (Mo)-Total (mg/L)	0.0121				
	Nickel (Ni)-Total (mg/L)	0.00062				
	Phosphorus (P)-Total (mg/L)	<0.30				
	Potassium (K)-Total (mg/L)	1.20				
	Selenium (Se)-Total (mg/L)	<0.00010				
	Silicon (Si)-Total (mg/L)	2.97				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	334				
	Strontium (Sr)-Total (mg/L)	0.151				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.010				
	Uranium (U)-Total (mg/L)	0.000104				
	Vanadium (V)-Total (mg/L)	<0.0010				
	Zinc (Zn)-Total (mg/L)	0.0038				
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD				
	Dissolved Metals Filtration Location	FIELD				
	Aluminum (Al)-Dissolved (mg/L)	0.0101				
	Antimony (Sb)-Dissolved (mg/L)	<0.00010				
	Arsenic (As)-Dissolved (mg/L)	0.00021				
	Barium (Ba)-Dissolved (mg/L)	1.24				
	Beryllium (Be)-Dissolved (mg/L)	<0.00010				
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050				
	Boron (B)-Dissolved (mg/L)	0.153				
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010				
	Calcium (Ca)-Dissolved (mg/L)	2.85				
	Chromium (Cr)-Dissolved (mg/L)	<0.00010				
	Cobalt (Co)-Dissolved (mg/L)	0.00011				
	Copper (Cu)-Dissolved (mg/L)	0.00099				
	Iron (Fe)-Dissolved (mg/L)	<0.030				
	Lead (Pb)-Dissolved (mg/L)	0.000063				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1422942-1 water 09-FEB-14 14:20 MW-H17	L1422942-2 water 08-FEB-14 15:30 MW-H22	L1422942-3 water 09-FEB-14 12:00 MW-SHAFT	L1422942-4 water 08-FEB-14 12:00 MW-H23	L1422942-5 water 10-FEB-14 16:15 MW-H24B
WATER						
Dissolved Metals	Lithium (Li)-Dissolved (mg/L)	0.0148	0.00334	0.00453	0.00314	0.00141
	Magnesium (Mg)-Dissolved (mg/L)	19.5	22.6	41.4	16.1	17.2
	Manganese (Mn)-Dissolved (mg/L)	0.0468	0.00405	0.0507	0.000660	0.0469
	Mercury (Hg)-Dissolved (mg/L)	0.000017	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.000707	0.000435	0.000251	0.000448	0.000726
	Nickel (Ni)-Dissolved (mg/L)	0.00091	<0.00050	0.00527	0.00055	0.00111
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	1.08	1.56	1.09	1.02	0.834
	Selenium (Se)-Dissolved (mg/L)	<0.00010	0.00073	<0.00010	0.00053	0.00027
	Silicon (Si)-Dissolved (mg/L)	4.26	3.80	4.01	2.93	2.74
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	11.2	<2.0	24.9	2.3	10.1
	Strontium (Sr)-Dissolved (mg/L)	0.214	0.139	0.255	0.112	0.191
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	0.000012	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	0.011	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00117	0.000440	0.000658	0.000247	0.000456
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0030	0.0049	<0.0030	<0.0030

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1422942-6				
	Description	water				
	Sampled Date	10-FEB-14				
	Sampled Time	17:30				
	Client ID	MW-H27				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Lithium (Li)-Dissolved (mg/L)	0.505				
	Magnesium (Mg)-Dissolved (mg/L)	1.30				
	Manganese (Mn)-Dissolved (mg/L)	0.0175				
	Mercury (Hg)-Dissolved (mg/L)	0.000012				
	Molybdenum (Mo)-Dissolved (mg/L)	0.00942				
	Nickel (Ni)-Dissolved (mg/L)	<0.00050				
	Phosphorus (P)-Dissolved (mg/L)	<0.30				
	Potassium (K)-Dissolved (mg/L)	1.24				
	Selenium (Se)-Dissolved (mg/L)	<0.00010				
	Silicon (Si)-Dissolved (mg/L)	2.86				
	Silver (Ag)-Dissolved (mg/L)	<0.000010				
	Sodium (Na)-Dissolved (mg/L)	339				
	Strontium (Sr)-Dissolved (mg/L)	0.120				
	Thallium (Tl)-Dissolved (mg/L)	<0.000010				
	Tin (Sn)-Dissolved (mg/L)	<0.00010				
	Titanium (Ti)-Dissolved (mg/L)	<0.010				
	Uranium (U)-Dissolved (mg/L)	0.000080				
	Vanadium (V)-Dissolved (mg/L)	<0.0010				
	Zinc (Zn)-Dissolved (mg/L)	0.0041				

* 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)
Duplicate	Bromide (Br)	DLM	L1422942-1, -2, -3, -4, -5, -6
Duplicate	Nitrite (as N)	DLM	L1422942-1, -2, -3, -4, -5, -6
Method Blank	Manganese (Mn)-Total	MB-LOR	L1422942-1, -2, -3, -4, -5, -6
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1422942-1, -2, -3, -4, -5, -6
Matrix Spike	Total Nitrogen	MS-B	L1422942-1, -2, -3, -4, -5, -6
Matrix Spike	Total Nitrogen	MS-B	L1422942-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1422942-1, -2, -3, -4, -5, -6
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1422942-1, -2, -3, -4, -5, -6
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1422942-1, -2, -3, -4, -5, -6
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1422942-1, -2, -3, -4, -5, -6

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

Reference Information

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA	Water	Total Mercury in Water by CVAFS(Low)	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA	Water	Dissolved Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA	Water	Dissolved Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA	Water	Total Metals in Water by CRC ICPMS	APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA	Water	Total Metals in Water by ICPOES	EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-T-COL-VA	Water	Total Nitrogen in water by Colour	USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

NH3-F-VA	Water	Ammonia in Water by Fluorescence	J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA	Water	Total P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

Reference Information

P-TD-COL-VA	Water	Total Dissolved P in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA	Water	pH by Meter (Automated)	APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA	Water	Diss. Orthophosphate in Water by Colour	APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA	Water	TKN in Water (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:

10-143967

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.

10- 143967

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page ____ of ____

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: ERM - Rescan	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St., 15th Floor Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone: (604 689 9460 Fax:	Email 2: Yaming.Chen@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194106-0002-0005	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone:	Quote #:	
Lab Work Order # L1422942-COFC	**ALS Contact:**	**Sampler:**

Sample # (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem.	F/P Nutrients	F/P Total Metals	F/P Total Hg	F/P Dissolved Metals	F/P Dissolved Hg	Number of Containers
MW-H17	09-Feb-14	14:20	Water	—	—	—	—	—	—	6
MW-H22	08-Feb-14	15:30	Water	—	—	—	—	—	—	6
MW-Shaft	09-Feb-14	12:00	Water	—	—	—	—	—	—	6
MW-H23	08-Feb-14	12:00	Water	—	—	—	—	—	—	6
MW-H24B	10-Feb-14	16:15	Water	—	—	—	—	—	—	6
[redacted] MW-H27	10-Feb-14	17:30	Water	—	—	—	—	—	—	6

Short Holding Time

Rush Processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Tyler Gale	14-Feb-14	Afternoon	PR	15 FEB	12:30	5 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
15th Floor
Vancouver BC V6E 2J3

Date Received: 15-FEB-14
Report Date: 26-FEB-14 17:13 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1422945

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-143969
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1422945-1	L1422945-2	L1422945-3	L1422945-4	L1422945-5
	Description	water	water	water	water	water
	Sampled Date	13-FEB-14	13-FEB-14	12-FEB-14	13-FEB-14	14-FEB-14
	Sampled Time	15:00	18:45	11:00	10:30	09:30
	Client ID	MW-H28	MW-H25A	MW-H33	MW-H34	MW-H32A
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	23.0	<5.0	<5.0	<5.0	<5.0
	Conductivity (uS/cm)	1350	1020	1050	526	<2.0
	Hardness (as CaCO3) (mg/L)	55.3	14.1	19.0	264	<0.50
	pH (pH)	8.55	8.72	8.92	8.32	6.39
	Total Suspended Solids (mg/L)	9.8	<3.0	<3.0	4.9	<3.0
	Turbidity (NTU)	9.28	6.92	0.81	12.8	<0.10
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	503	494	461	299	<2.0
	Alkalinity, Carbonate (as CaCO3) (mg/L)	12.6	37.3	70.9	<1.0	<2.0
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<1.0	<1.0	<1.0	<1.0	<2.0
	Alkalinity, Total (as CaCO3) (mg/L)	516	531	532	299	<2.0
	Ammonia, Total (as N) (mg/L)	0.451	0.405	0.380	0.202	<0.0050
	Bromide (Br) (mg/L)	0.52	<0.50 DLM	<0.50 DLM	<0.050	<0.050
	Chloride (Cl) (mg/L)	14.1	<2.5 DLM	<5.0 DLM	0.51	<0.50
	Fluoride (F) (mg/L)	0.68	0.78	0.70	0.118	<0.020
	Nitrate (as N) (mg/L)	<0.050 DLM	<0.025 DLM	<0.050 DLM	<0.0050	<0.0050
	Nitrite (as N) (mg/L)	<0.010 DLM	<0.0050 DLM	0.012	<0.0010	<0.0010
	Total Kjeldahl Nitrogen (mg/L)	1.01	0.450	0.475	0.254	<0.050
	Total Nitrogen (mg/L)	1.01	0.450	0.487	0.254	<0.050
	Orthophosphate-Dissolved (as P) (mg/L)	0.0977	0.0365	0.0727	<0.0010	<0.0010
	Phosphorus (P)-Total Dissolved (mg/L)	0.125	0.0437	0.0790	<0.0020	<0.0020
	Phosphorus (P)-Total (mg/L)	0.422	0.0520	0.0852	0.0518	<0.0020
	Sulfate (SO4) (mg/L)	195	<2.5 DLM	<5.0 DLM	1.45	<0.50
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	28.9	1.88	2.89	1.29	<0.50
Total Metals	Aluminum (Al)-Total (mg/L)	0.192	0.241	0.117	0.0048	<0.0030
	Antimony (Sb)-Total (mg/L)	0.00015	<0.00010	0.00051	<0.00010	<0.00010
	Arsenic (As)-Total (mg/L)	0.00371	0.00012	0.00043	0.00054	<0.00010
	Barium (Ba)-Total (mg/L)	0.210	1.10	0.620	0.999	<0.000050
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Total (mg/L)	0.201	0.201	0.192	0.024	<0.010
	Cadmium (Cd)-Total (mg/L)	0.000030	<0.000010	0.000015	<0.000010	<0.000010
	Calcium (Ca)-Total (mg/L)	13.9	3.27	4.50	64.5	<0.020
	Chromium (Cr)-Total (mg/L)	0.00071	0.00044	0.00026	<0.00010	<0.00010
	Cobalt (Co)-Total (mg/L)	0.00093	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Total (mg/L)	0.00066	<0.00050	<0.00050	<0.00050	<0.00050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1422945-6				
	Description	water				
	Sampled Date	14-FEB-14				
	Sampled Time	10:00				
	Client ID	MW-H32B				
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0				
	Conductivity (uS/cm)	<2.0				
	Hardness (as CaCO3) (mg/L)	<0.50				
	pH (pH)	5.91				
	Total Suspended Solids (mg/L)	<3.0				
	Turbidity (NTU)	<0.10				
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0				
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0				
	Alkalinity, Total (as CaCO3) (mg/L)	<2.0				
	Ammonia, Total (as N) (mg/L)	<0.0050				
	Bromide (Br) (mg/L)	<0.050				
	Chloride (Cl) (mg/L)	<0.50				
	Fluoride (F) (mg/L)	<0.020				
	Nitrate (as N) (mg/L)	<0.0050				
	Nitrite (as N) (mg/L)	<0.0010				
	Total Kjeldahl Nitrogen (mg/L)	<0.050				
	Total Nitrogen (mg/L)	<0.050				
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010				
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020				
	Phosphorus (P)-Total (mg/L)	<0.0020				
	Sulfate (SO4) (mg/L)	<0.50				
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	<0.50				
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030				
	Antimony (Sb)-Total (mg/L)	<0.00010				
	Arsenic (As)-Total (mg/L)	<0.00010				
	Barium (Ba)-Total (mg/L)	0.000638 RRV				
	Beryllium (Be)-Total (mg/L)	<0.00010				
	Bismuth (Bi)-Total (mg/L)	<0.00050				
	Boron (B)-Total (mg/L)	<0.010				
	Cadmium (Cd)-Total (mg/L)	<0.000010				
	Calcium (Ca)-Total (mg/L)	<0.020				
	Chromium (Cr)-Total (mg/L)	<0.00010				
	Cobalt (Co)-Total (mg/L)	<0.00010				
	Copper (Cu)-Total (mg/L)	<0.00050				

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1422945-1	L1422945-2	L1422945-3	L1422945-4	L1422945-5
	Description	water	water	water	water	water
	Sampled Date	13-FEB-14	13-FEB-14	12-FEB-14	13-FEB-14	14-FEB-14
	Sampled Time	15:00	18:45	11:00	10:30	09:30
	Client ID	MW-H28	MW-H25A	MW-H33	MW-H34	MW-H32A
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	1.26	0.252	0.073	2.08	<0.030
	Lead (Pb)-Total (mg/L)	0.000248	0.000138	0.000160	<0.000050	<0.000050
	Lithium (Li)-Total (mg/L)	0.259	0.471	0.472	0.0146	<0.00050
	Magnesium (Mg)-Total (mg/L)	5.20	1.52	1.83	22.3	<0.0050
	Manganese (Mn)-Total (mg/L)	0.666	0.0226	0.00849	0.102	<0.000050
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.0208	0.000727	0.00671	0.00153	<0.000050
	Nickel (Ni)-Total (mg/L)	0.00566	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Total (mg/L)	0.41	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	1.67	0.610	0.616	0.784	<0.050
	Selenium (Se)-Total (mg/L)	0.00019	<0.00010	<0.00010	<0.00010	<0.00010
	Silicon (Si)-Total (mg/L)	4.79	3.96	4.82	6.50	<0.050
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Total (mg/L)	336	276	293	13.6	<2.0
	Strontium (Sr)-Total (mg/L)	0.215	0.129	0.131	0.424	<0.00020
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Total (mg/L)	0.00017	<0.00010	0.00018	<0.00010	<0.00010
	Titanium (Ti)-Total (mg/L)	<0.010	0.013	<0.010	<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.00252	0.000047	0.000392	0.000092	<0.000010
	Vanadium (V)-Total (mg/L)	0.0016	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	0.0112	0.0061	0.107	0.0030	<0.0030
	Antimony (Sb)-Dissolved (mg/L)	0.00014	<0.00010	0.00047	<0.00010	<0.00010
	Arsenic (As)-Dissolved (mg/L)	0.00330	<0.00010	0.00042	0.00051	<0.00010
	Barium (Ba)-Dissolved (mg/L)	0.179	1.14	0.594	1.01	<0.000050
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Boron (B)-Dissolved (mg/L)	0.196	0.193	0.204	0.024	<0.010
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Calcium (Ca)-Dissolved (mg/L)	13.7	3.19	4.57	70.9	<0.020
	Chromium (Cr)-Dissolved (mg/L)	0.00022	<0.00010	0.00017	<0.00010	<0.00010
	Cobalt (Co)-Dissolved (mg/L)	0.00087	<0.00010	<0.00010	<0.00010	<0.00010
	Copper (Cu)-Dissolved (mg/L)	0.00066	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	0.090	0.070	0.046	2.24	<0.030
	Lead (Pb)-Dissolved (mg/L)	0.000061	<0.000050	0.000121	<0.000050	<0.000050

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1422945-6				
	Description	water				
	Sampled Date	14-FEB-14				
	Sampled Time	10:00				
	Client ID	MW-H32B				
Grouping	**Analyte**					
WATER						
Total Metals	Iron (Fe)-Total (mg/L)	<0.030				
	Lead (Pb)-Total (mg/L)	<0.000050				
	Lithium (Li)-Total (mg/L)	<0.00050				
	Magnesium (Mg)-Total (mg/L)	<0.0050				
	Manganese (Mn)-Total (mg/L)	0.000083 RRV				
	Mercury (Hg)-Total (mg/L)	<0.000010				
	Molybdenum (Mo)-Total (mg/L)	<0.000050				
	Nickel (Ni)-Total (mg/L)	<0.00050				
	Phosphorus (P)-Total (mg/L)	<0.30				
	Potassium (K)-Total (mg/L)	<0.050				
	Selenium (Se)-Total (mg/L)	<0.00010				
	Silicon (Si)-Total (mg/L)	<0.050				
	Silver (Ag)-Total (mg/L)	<0.000010				
	Sodium (Na)-Total (mg/L)	<2.0				
	Strontium (Sr)-Total (mg/L)	<0.00020				
	Thallium (Tl)-Total (mg/L)	<0.000010				
	Tin (Sn)-Total (mg/L)	<0.00010				
	Titanium (Ti)-Total (mg/L)	<0.010				
	Uranium (U)-Total (mg/L)	<0.000010				
	Vanadium (V)-Total (mg/L)	<0.0010				
	Zinc (Zn)-Total (mg/L)	<0.0030				
Dissolved Metals	Dissolved Mercury Filtration Location					
	Dissolved Metals Filtration Location					
	Aluminum (Al)-Dissolved (mg/L)					
	Antimony (Sb)-Dissolved (mg/L)					
	Arsenic (As)-Dissolved (mg/L)					
	Barium (Ba)-Dissolved (mg/L)					
	Beryllium (Be)-Dissolved (mg/L)					
	Bismuth (Bi)-Dissolved (mg/L)					
	Boron (B)-Dissolved (mg/L)					
	Cadmium (Cd)-Dissolved (mg/L)					
	Calcium (Ca)-Dissolved (mg/L)					
	Chromium (Cr)-Dissolved (mg/L)					
	Cobalt (Co)-Dissolved (mg/L)					
	Copper (Cu)-Dissolved (mg/L)					
	Iron (Fe)-Dissolved (mg/L)					
	Lead (Pb)-Dissolved (mg/L)					

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1422945-1 water 13-FEB-14 15:00 MW-H28	L1422945-2 water 13-FEB-14 18:45 MW-H25A	L1422945-3 water 12-FEB-14 11:00 MW-H33	L1422945-4 water 13-FEB-14 10:30 MW-H34	L1422945-5 water 14-FEB-14 09:30 MW-H32A
WATER						
Dissolved Metals	Lithium (Li)-Dissolved (mg/L)	0.263	0.473	0.503	0.0153	<0.00050
	Magnesium (Mg)-Dissolved (mg/L)	5.11	1.49	1.84	21.1	<0.0050
	Manganese (Mn)-Dissolved (mg/L)	0.638	0.0206	0.00807	0.101	<0.000050
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.0204	0.000580	0.00656	0.00159	<0.000050
	Nickel (Ni)-Dissolved (mg/L)	0.00531	<0.00050	<0.00050	<0.00050	<0.00050
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	1.70	0.546	0.631	0.784	<0.050
	Selenium (Se)-Dissolved (mg/L)	0.00019	<0.00010	<0.00010	<0.00010	<0.00010
	Silicon (Si)-Dissolved (mg/L)	4.56	3.19	4.61	6.73	<0.050
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Sodium (Na)-Dissolved (mg/L)	354	285	289	13.9	<2.0
	Strontium (Sr)-Dissolved (mg/L)	0.201	0.124	0.137	0.476	<0.00020
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000010
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	0.00017	<0.00010	<0.00010
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00256	0.000016	0.000373	0.000090	<0.000010
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
	Zinc (Zn)-Dissolved (mg/L)	0.0042	<0.0030	<0.0030	<0.0030	<0.0030

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1422945-6				
	Description	water				
	Sampled Date	14-FEB-14				
	Sampled Time	10:00				
	Client ID	MW-H32B				
Grouping	**Analyte**					
WATER						
Dissolved Metals	Lithium (Li)-Dissolved (mg/L)					
	Magnesium (Mg)-Dissolved (mg/L)					
	Manganese (Mn)-Dissolved (mg/L)					
	Mercury (Hg)-Dissolved (mg/L)					
	Molybdenum (Mo)-Dissolved (mg/L)					
	Nickel (Ni)-Dissolved (mg/L)					
	Phosphorus (P)-Dissolved (mg/L)					
	Potassium (K)-Dissolved (mg/L)					
	Selenium (Se)-Dissolved (mg/L)					
	Silicon (Si)-Dissolved (mg/L)					
	Silver (Ag)-Dissolved (mg/L)					
	Sodium (Na)-Dissolved (mg/L)					
	Strontium (Sr)-Dissolved (mg/L)					
	Thallium (Tl)-Dissolved (mg/L)					
	Tin (Sn)-Dissolved (mg/L)					
	Titanium (Ti)-Dissolved (mg/L)					
	Uranium (U)-Dissolved (mg/L)					
	Vanadium (V)-Dissolved (mg/L)					
	Zinc (Zn)-Dissolved (mg/L)					

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

Reference Information

Qualifiers for Individual Samples Listed:

Sample Number	Client Sample ID	Qualifier	Description
L1422945-2	MW-H25A	WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Bromide (Br)	DLM	L1422945-1, -2, -3, -4, -5, -6
Duplicate	Nitrite (as N)	DLM	L1422945-1, -2, -3, -4, -5, -6
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1422945-1, -2, -3, -4, -5, -6
Matrix Spike	Total Nitrogen	MS-B	L1422945-1, -2, -3, -4, -5, -6
Matrix Spike	Total Nitrogen	MS-B	L1422945-1, -2, -3, -4, -5, -6
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1422945-1, -2, -3, -4, -5
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1422945-1, -2, -3, -4, -5
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1422945-1, -2, -3, -4, -5
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1422945-1, -2, -3, -4, -5

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLM	Detection Limit Adjusted due to sample matrix effects.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
RRV	Reported Result Verified By Repeat Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is

Reference Information

detected by UV absorbance.

ANIONS-SO4-IC-VA Water Sulfate by Ion Chromatography APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA Water Total organic carbon by combustion APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COLOUR-TRUE-VA Water Colour (True) by Spectrometer BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA Water Conductivity (Automated) APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA Water Hardness APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-T-COL-VA Water Total Nitrogen in water by Colour USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

Reference Information

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorous is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorous is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TKN-CALC-VA Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA Water Turbidity by Meter APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:

10-143969

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.

10- 143969

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page ___ of ___

Report To	Report Format / Distribution	Service Request: (Rush subject to availability - Contact ALS to confirm TAT)
Company: ERM-Rescan	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 15th Floor 1111 W. Hastings St. Vancouver BC	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone: 604 689 9460 Fax:	Email 2: Yaming.chen@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT

Invoice To	Client / Project Information
Same as Report ? (circle) Yes or No (if No, provide details)	Job #: 0194106-0002-0005
Copy of Invoice with Report? (circle) Yes or No	PO / AFE:
Company:	LSD:
Contact:	
Address:	Quote #:
Phone:	ALS Contact: Sampler:
Lab Work Order # L1422945-COFC	

Analysis Request
(Indicate Filtered or Preserved, F/P)

Sample #	(This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	General Chem.	Nutrients (P)	Total Metals (P)	Total Hg (P)	Dissolved Metals (F/P)	Dissolved Hg (F/P)	Number of Containers
	MW-H28	13-Feb-14	15:00	Water	—	—	—	—	—	—	6
	MW-H25A	13-Feb-14	18:45	Water	—	—	—	—	—	—	6
	MW-H33	12-Feb-14	11:00	Water	—	—	—	—	—	—	6
	MW-H34	13-Feb-14	10:30	Water	—	—	—	—	—	—	6
	MW-H32A	14-Feb-14	09:30	Water	—	—	—	—	—	—	6
	MW-H32B	14-Feb-14	10:00	Water	—	—	—	—	—	—	6

Short Holding Time

Rush Processing

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Tyler Gale	14-Feb-14	Afternoon	PR	15FEB	12:30	5 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
15th Floor
Vancouver BC V6E 2J3

Date Received: 12-MAY-14
Report Date: 22-MAY-14 15:50 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1453879

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-202028
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1453879-1	L1453879-2	L1453879-3	L1453879-4	L1453879-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	08-MAY-14	09-MAY-14	09-MAY-14	10-MAY-14	10-MAY-14
	Sampled Time	16:00	14:00	14:30	15:00	16:00
	Client ID	MW-H5	MW-H24C	MW-H25A	MW-H26A	MW-H27
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0	<5.0	<5.0
	Conductivity (uS/cm)	564	528	1010	1050	1250
	Hardness (as CaCO3) (mg/L)	309	293	15.5	20.7	13.2
	pH (pH)	7.99	8.05	8.63	8.89	8.77
	Total Suspended Solids (mg/L)	5.7	7.2	<3.0	<3.0	<3.0
	Total Dissolved Solids (mg/L)	324	305	642	682	812
	Turbidity (NTU)	19.4	13.3	3.19	0.53	0.86
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	5.1	3.5	<1.0	<1.0	<1.0
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	319	319	509	531	664
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	51.4	83.1	91.1
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<1.0	<1.0	<1.0
	Alkalinity, Total (as CaCO3) (mg/L)	319	319	561	615	755
	Ammonia, Total (as N) (mg/L)	0.167	0.248	0.470	0.428	0.498
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.50 DLM	<0.50 DLM	<0.50 DLM
	Chloride (Cl) (mg/L)	<0.50	<0.50	<5.0 DLM	<5.0 DLM	5.4
	Fluoride (F) (mg/L)	0.150	0.111	0.75	0.67	0.95
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	<0.050 DLM	<0.050 DLM	<0.050 DLM
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	<0.010 DLM	<0.010 DLM	<0.010 DLM
	Total Kjeldahl Nitrogen (mg/L)	0.172	0.236	0.462	0.485	0.486
	Total Nitrogen (mg/L)	0.172	0.236	0.462	0.485	0.486
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	<0.0010 PEHT	0.0268 PEHT	0.0570 PEHT	0.0758 PEHT
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	<0.0020	0.0267	0.0532	0.0815
	Phosphorus (P)-Total (mg/L)	0.0057	0.0531	0.0330	0.0743	0.0848
	Sulfate (SO4) (mg/L)	12.8	2.36	<5.0 DLM	<5.0 DLM	<5.0 DLM
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	0.83	1.04	1.37	2.34	2.03
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030	0.0049	0.220	0.136	0.0247
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00040	<0.00020 DLA
	Arsenic (As)-Total (mg/L)	0.00236	0.00066	<0.00010	0.00051	<0.00020 DLA
	Barium (Ba)-Total (mg/L)	0.114	1.07	1.12	0.631	1.28
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 DLA
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010 DLA
	Boron (B)-Total (mg/L)	0.029	0.023	0.199	0.201	0.219
	Cadmium (Cd)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 DLA
	Calcium (Ca)-Total (mg/L)	76.3	75.1	3.66	4.71	3.30
	Chromium (Cr)-Total (mg/L)	<0.00010	<0.00010	0.00039	0.00026	<0.00020 DLA
	Cobalt (Co)-Total (mg/L)	0.00027	<0.00010	<0.00010	<0.00010	<0.00020 DLA

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1453879-6	L1453879-7	L1453879-8	L1453879-9	
	Description	Water	Water	Water	Water	
	Sampled Date	10-MAY-14	11-MAY-14	11-MAY-14		
	Sampled Time	14:00	11:00	14:30		
	Client ID	MW-H29	MW-H25B	MW-H17	ALS TRAVEL BLANK	
Grouping	**Analyte**					
WATER						
Physical Tests	Colour, True (CU)	<5.0	<5.0	<5.0	<5.0	
	Conductivity (uS/cm)	658	659	522	<2.0	
	Hardness (as CaCO3) (mg/L)	8.53	379	283	<0.50	
	pH (pH)	8.23	7.86	8.03	5.65	
	Total Suspended Solids (mg/L)	<3.0	12.9	<3.0	<3.0	
	Total Dissolved Solids (mg/L)	433	387	313	<10	
	Turbidity (NTU)	3.70	8.71	2.54	<0.10	
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	<1.0	9.2	3.6	1.0	
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	383	397	291	<2.0	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<2.0	<2.0	<2.0	
	Alkalinity, Total (as CaCO3) (mg/L)	383	397	291	<2.0	
	Ammonia, Total (as N) (mg/L)	0.227	0.106	0.054	<0.0050	
	Bromide (Br) (mg/L)	<0.050	<0.050	<0.050	<0.050	
	Chloride (Cl) (mg/L)	2.33	1.28	<0.50	<0.50	
	Fluoride (F) (mg/L)	0.351	0.171	0.116	<0.020	
	Nitrate (as N) (mg/L)	<0.0050	<0.0050	0.0179	<0.0050	
	Nitrite (as N) (mg/L)	<0.0010	<0.0010	0.0047	<0.0010	
	Total Kjeldahl Nitrogen (mg/L)	0.248	0.201	0.054	<0.050	
	Total Nitrogen (mg/L)	0.248	0.201	0.077	<0.050	
	Orthophosphate-Dissolved (as P) (mg/L)	0.0429 PEHT	0.0021	0.0039	<0.0010	
	Phosphorus (P)-Total Dissolved (mg/L)	0.0392	<0.0020	0.0053	<0.0020	
	Phosphorus (P)-Total (mg/L)	0.0660	0.0293	0.0109	<0.0020	
	Sulfate (SO4) (mg/L)	6.95	6.12	11.0	<0.50	
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	2.39	3.63	1.06	<0.50	
Total Metals	Aluminum (Al)-Total (mg/L)	0.269	0.123	0.0643	<0.0030	
	Antimony (Sb)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Arsenic (As)-Total (mg/L)	0.00061	0.00135	0.00054	<0.00010	
	Barium (Ba)-Total (mg/L)	0.0966	0.272	0.322	<0.000050	
	Beryllium (Be)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Bismuth (Bi)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	0.173	0.013	0.017	<0.010	
	Cadmium (Cd)-Total (mg/L)	0.000011	0.000017	0.000023	<0.000010	
	Calcium (Ca)-Total (mg/L)	2.81	100	79.2	<0.020	
	Chromium (Cr)-Total (mg/L)	0.00044	0.00025	0.00011	<0.00010	
	Cobalt (Co)-Total (mg/L)	0.00023	0.00136	0.00036	<0.00010	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1453879-1	L1453879-2	L1453879-3	L1453879-4	L1453879-5
	Description	Water	Water	Water	Water	Water
	Sampled Date	08-MAY-14	09-MAY-14	09-MAY-14	10-MAY-14	10-MAY-14
	Sampled Time	16:00	14:00	14:30	15:00	16:00
	Client ID	MW-H5	MW-H24C	MW-H25A	MW-H26A	MW-H27
Grouping	**Analyte**					
WATER						
Total Metals	Copper (Cu)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010 DLA
	Iron (Fe)-Total (mg/L)	1.38	1.87	0.158	0.060	0.032
	Lead (Pb)-Total (mg/L)	<0.000050	<0.000050	0.000068	0.000123	<0.00010 DLA
	Lithium (Li)-Total (mg/L)	0.00495	0.0139	0.514	0.529	0.711
	Magnesium (Mg)-Total (mg/L)	26.9	23.8	1.76	2.12	1.23
	Manganese (Mn)-Total (mg/L)	0.605	0.0909	0.0222	0.0102	0.0183
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010		<0.000010
	Molybdenum (Mo)-Total (mg/L)	0.00126	0.00186	0.000648	0.00609	0.0111
	Nickel (Ni)-Total (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010 DLA
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Total (mg/L)	0.928	0.835	0.643	0.664	0.52
	Selenium (Se)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 DLA
	Silicon (Si)-Total (mg/L)	5.67	6.21	3.59	4.62	2.99
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 DLA
	Sodium (Na)-Total (mg/L)	10.5	10.3	272	289	350
	Strontium (Sr)-Total (mg/L)	0.321	0.514	0.138	0.144	0.156
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 DLA
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	0.00019	<0.00020 DLA
	Titanium (Ti)-Total (mg/L)	0.010	0.010	0.011	<0.010	<0.010
	Uranium (U)-Total (mg/L)	0.00115	0.000088	0.000032	0.000358	0.000088
	Vanadium (V)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020 DLA
	Zinc (Zn)-Total (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0060 DLA
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD	FIELD	FIELD	FIELD
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD	FIELD	FIELD
	Aluminum (Al)-Dissolved (mg/L)	<0.0030	0.0047	0.0049	0.112	0.0075
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00038	<0.00020 DLA
	Arsenic (As)-Dissolved (mg/L)	0.00228	0.00070	<0.00010	0.00050	0.00021
	Barium (Ba)-Dissolved (mg/L)	0.116	1.11	1.18	0.647	1.27
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	<0.00020 DLA
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010 DLA
	Boron (B)-Dissolved (mg/L)	0.029	0.023	0.213	0.207	0.222
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 DLA
	Calcium (Ca)-Dissolved (mg/L)	78.3	77.2	3.44	4.69	3.27
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00017	<0.00020 DLA
	Cobalt (Co)-Dissolved (mg/L)	0.00025	<0.00010	<0.00010	<0.00010	<0.00020 DLA
	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
	Iron (Fe)-Dissolved (mg/L)	0.919	1.82	0.061	0.044	<0.030

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1453879-6 Water 10-MAY-14 14:00 MW-H29	L1453879-7 Water 11-MAY-14 11:00 MW-H25B	L1453879-8 Water 11-MAY-14 14:30 MW-H17	L1453879-9 Water ALS TRAVEL BLANK	
WATER						
Total Metals	Copper (Cu)-Total (mg/L)	<0.00050	0.00074	<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	0.262	0.734	0.130	<0.030	
	Lead (Pb)-Total (mg/L)	0.000113	0.000119	0.000057	<0.000050	
	Lithium (Li)-Total (mg/L)	0.169	0.00759	0.0148	<0.00050	
	Magnesium (Mg)-Total (mg/L)	0.342	32.1	19.8	<0.0050	
	Manganese (Mn)-Total (mg/L)	0.0763	0.723	0.0610	<0.000050	
	Mercury (Hg)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Total (mg/L)	0.000251	0.00201	0.000724	<0.000050	
	Nickel (Ni)-Total (mg/L)	0.00107	0.00316	0.00102	<0.00050	
	Phosphorus (P)-Total (mg/L)	<0.30	<0.30	<0.30	<0.30	
	Potassium (K)-Total (mg/L)	0.367	0.577	1.05	<0.050	
	Selenium (Se)-Total (mg/L)	0.00019	0.00011	<0.00010	<0.00010	
	Silicon (Si)-Total (mg/L)	4.62	5.35	4.10	<0.050	
	Silver (Ag)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	175	8.2	10.4	<2.0	
	Strontium (Sr)-Total (mg/L)	0.0381	0.272	0.235	<0.00020	
	Thallium (Tl)-Total (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010	<0.00010	<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.010	0.017	0.012	<0.010	
	Uranium (U)-Total (mg/L)	0.000270	0.00134	0.00115	<0.000010	
	Vanadium (V)-Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	
	Zinc (Zn)-Total (mg/L)	<0.0030	0.0034	<0.0030	<0.0030	
Dissolved Metals	Dissolved Mercury Filtration Location	FIELD	FIELD	FIELD		
	Dissolved Metals Filtration Location	FIELD	FIELD	FIELD		
	Aluminum (Al)-Dissolved (mg/L)	0.0032	<0.0030	<0.0030		
	Antimony (Sb)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Arsenic (As)-Dissolved (mg/L)	0.00067	0.00146	0.00055		
	Barium (Ba)-Dissolved (mg/L)	0.0906	0.273	0.329		
	Beryllium (Be)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Bismuth (Bi)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050		
	Boron (B)-Dissolved (mg/L)	0.170	0.010	0.017		
	Cadmium (Cd)-Dissolved (mg/L)	<0.000010	<0.000010	0.000019		
	Calcium (Ca)-Dissolved (mg/L)	2.88	99.1	80.0		
	Chromium (Cr)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Cobalt (Co)-Dissolved (mg/L)	0.00018	0.00118	0.00021		
	Copper (Cu)-Dissolved (mg/L)	<0.00050	<0.00050	0.00053		
	Iron (Fe)-Dissolved (mg/L)	0.117	0.525	0.048		

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1453879-1 Water 08-MAY-14 16:00 MW-H5	L1453879-2 Water 09-MAY-14 14:00 MW-H24C	L1453879-3 Water 09-MAY-14 14:30 MW-H25A	L1453879-4 Water 10-MAY-14 15:00 MW-H26A	L1453879-5 Water 10-MAY-14 16:00 MW-H27
WATER						
Dissolved Metals	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050	0.000099	<0.00010 DLA
	Lithium (Li)-Dissolved (mg/L)	0.00572	0.0156	0.576	0.567	0.756
	Magnesium (Mg)-Dissolved (mg/L)	27.5	24.3	1.68	2.17	1.23
	Manganese (Mn)-Dissolved (mg/L)	0.608	0.0912	0.0195	0.00998	0.0175
	Mercury (Hg)-Dissolved (mg/L)		<0.000010	<0.000010	<0.000010	<0.000010
	Molybdenum (Mo)-Dissolved (mg/L)	0.00123	0.00174	0.000583	0.00554	0.0102
	Nickel (Ni)-Dissolved (mg/L)	<0.00050	<0.00050	<0.00050	<0.00050	<0.0010 DLA
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30	<0.30	<0.30
	Potassium (K)-Dissolved (mg/L)	0.943	0.873	0.593	0.663	0.51
	Selenium (Se)-Dissolved (mg/L)	<0.00010	0.00022	<0.00010	<0.00010	<0.00020 DLA
	Silicon (Si)-Dissolved (mg/L)	5.68	6.22	3.08	4.52	2.91
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 DLA
	Sodium (Na)-Dissolved (mg/L)	10.3	10.0	277	285	347
	Strontium (Sr)-Dissolved (mg/L)	0.314	0.506	0.136	0.140	0.151
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010	<0.000010	<0.000020 DLA
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010	0.00014	<0.00020 DLA
	Titanium (Ti)-Dissolved (mg/L)	<0.010	<0.010	<0.010	<0.010	<0.010
	Uranium (U)-Dissolved (mg/L)	0.00114	0.000084	0.000014	0.000327	0.000080
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0020 DLA
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0030	<0.0030	<0.0030	<0.0030

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1453879-6	L1453879-7	L1453879-8	L1453879-9	
	Description	Water	Water	Water	Water	
	Sampled Date	10-MAY-14	11-MAY-14	11-MAY-14		
	Sampled Time	14:00	11:00	14:30		
	Client ID	MW-H29	MW-H25B	MW-H17	ALS TRAVEL BLANK	
Grouping	**Analyte**					
WATER						
Dissolved Metals	Lead (Pb)-Dissolved (mg/L)	<0.000050	<0.000050	<0.000050		
	Lithium (Li)-Dissolved (mg/L)	0.175	0.00702	0.0155		
	Magnesium (Mg)-Dissolved (mg/L)	0.322	32.0	20.1		
	Manganese (Mn)-Dissolved (mg/L)	0.0757	0.705	0.0397		
	Mercury (Hg)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Molybdenum (Mo)-Dissolved (mg/L)	0.000156	0.00190	0.000666		
	Nickel (Ni)-Dissolved (mg/L)	0.00095	0.00272	0.00092		
	Phosphorus (P)-Dissolved (mg/L)	<0.30	<0.30	<0.30		
	Potassium (K)-Dissolved (mg/L)	0.296	0.520	1.05		
	Selenium (Se)-Dissolved (mg/L)	<0.00010	0.00025	<0.00010		
	Silicon (Si)-Dissolved (mg/L)	3.91	5.13	4.11		
	Silver (Ag)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Sodium (Na)-Dissolved (mg/L)	175	8.1	10.6		
	Strontium (Sr)-Dissolved (mg/L)	0.0375	0.258	0.229		
	Thallium (Tl)-Dissolved (mg/L)	<0.000010	<0.000010	<0.000010		
	Tin (Sn)-Dissolved (mg/L)	<0.00010	<0.00010	<0.00010		
	Titanium (Ti)-Dissolved (mg/L)	<0.010	0.011	0.011		
	Uranium (U)-Dissolved (mg/L)	0.000257	0.00130	0.00113		
	Vanadium (V)-Dissolved (mg/L)	<0.0010	<0.0010	<0.0010		
	Zinc (Zn)-Dissolved (mg/L)	<0.0030	<0.0030	<0.0030		

* 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)
Duplicate	Bismuth (Bi)-Dissolved	DLA	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Duplicate	Chromium (Cr)-Dissolved	DLA	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Duplicate	Molybdenum (Mo)-Dissolved	DLA	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Duplicate	Silver (Ag)-Dissolved	DLA	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Duplicate	Tin (Sn)-Dissolved	DLA	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Duplicate	Vanadium (V)-Dissolved	DLA	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Duplicate	Bromide (Br)	DLM	L1453879-1, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Fluoride (F)	DLM	L1453879-1, -2, -3, -4, -5, -6, -7, -8, -9
Duplicate	Nitrate (as N)	DLM	L1453879-1, -2, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Arsenic (As)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Copper (Cu)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Antimony (Sb)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Arsenic (As)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Phosphorus (P)-Total	MS-B	L1453879-1, -3, -4, -5, -6, -7, -8, -9
Matrix Spike	Selenium (Se)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Silicon (Si)-Total	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Silicon (Si)-Total	MS-B	L1453879-9
Matrix Spike	Arsenic (As)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8
Matrix Spike	Sodium (Na)-Dissolved	MS-B	L1453879-1, -2, -3, -4, -5, -6, -7, -8

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects.
MS-B	Matrix Spike recovery could not be accurately calculated due to high analyte background in sample.
PEHT	Parameter Exceeded Recommended Holding Time Prior to Analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

Reference Information

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

HG-DIS-LOW-CVAFS-VA	Water	Dissolved Mercury in Water by CVAFS(Low)	EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA	Water	Total Mercury in Water by CVAFS(Low)	EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption

Reference Information

spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-T-COL-VA Water Total Nitrogen in water by Colour USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TDS-VA Water Total Dissolved Solids by Gravimetric APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-CALC-VA Water TKN in Water (Calculation) BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA Water Total Suspended Solids by Gravimetric APHA 2540 D - GRAVIMETRIC

Reference Information

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:

10-202028

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.

L1453879-COFC

10-202028

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page ____ of ____

Report To	**Report Format / Distribution**	**Service Request:** (Rush subject to availability - Contact ALS to confirm TAT)
Company: ERM-Rescan	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority(2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. (15th Floor) Vancouver BC V6E 2J3	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone: 604-689-9460 Fax:	Email 2: Yaming.Chen@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Invoice To Same as Report ? (circle) Yes or No (if No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194106-0002-0005	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only) L1453879	**ALS Contact:** Amber Springer **Sampler:**	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Gen. Chem.	Nutrients	Total Metals	Dissolved Metals	Total Hg	Dissolved Hg	Number of Containers
	MW-H5	08-May-14	16:00	Water	X	X	X	X	X		5
	MW-H24C	09-May-14	14 00	"	—	—	—	—	—	—	6
	MW-H25A	09-May-14	14 30	"	—	—	—	—	—	—	6
	MW-H26A	10-May-14	15:00	"	—	—	—	—		X	5
	MW-H27	10-May-14	16:00	"	—	—	—	—	—	—	6
	MW-H29	10-May-14	14:00	"	—	—	—	—	—	X	6
	MW-H25B	11-May-14	11:00	"	—	—	—	—	—	—	6
	MW-H17	11-May-14	14:30	"	—	—	—	—	—	—	6
	ALS Travel Blank				X	X	X		X		4

Special Instructions / Regulation with water or land use (CCME-Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SF
Tyler Gale			Geoff	May 12	9am (drop box)	6/9 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION — WHITE - LABORATORY COPY — YELLOW - CLIENT COPY — GENF 18.01 Front

ERM Consultants Canada Ltd.
ATTN: Tyler Gale
1111 West Hastings Street
15th Floor
Vancouver BC V6E 2J3

Date Received: 14-MAY-14
Report Date: 27-MAY-14 11:16 (MT)
Version: FINAL

Client Phone: 604-689-9460

Certificate of Analysis

Lab Work Order #: L1455515

Project P.O. #: NOT SUBMITTED
Job Reference: 0194106-0002-0005
C of C Numbers: 10-147364
Legal Site Desc:

Amber Springer
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1455515-1 Water 13-MAY-14 08:30 ALS FIELD BLANK	L1455515-2 Water 13-MAY-14 MW-H28	L1455515-3 Water 13-MAY-14 14:00 MW-H2B	L1455515-4 Water 13-MAY-14 11:00 MW-H25C	
Sample ID		L1455515-1	L1455515-2	L1455515-3	L1455515-4	
Description		Water	Water	Water	Water	
Sampled Date		13-MAY-14	13-MAY-14	13-MAY-14	13-MAY-14	
Sampled Time		08:30		14:00	11:00	
Client ID		ALS FIELD BLANK	MW-H28	MW-H2B	MW-H25C	
WATER						
Physical Tests	Colour, True (CU)	<5.0	28.6	<5.0	<5.0	
	Conductivity (uS/cm)	<2.0	1820	326	325	
	Hardness (as CaCO3) (mg/L)	<0.50	72.8	160	155	
	pH (pH)	6.39	8.47	8.21	8.22	
	Total Suspended Solids (mg/L)	<3.0	6.2	<3.0	<3.0	
	Total Dissolved Solids (mg/L)	<10	1290	200	189	
	Turbidity (NTU)	<0.10	3.76	0.53	0.49	
Anions and Nutrients	Acidity (as CaCO3) (mg/L)	1.0	<1.0	<1.0	<1.0	
	Alkalinity, Bicarbonate (as CaCO3) (mg/L)	<2.0	264	158	157	
	Alkalinity, Carbonate (as CaCO3) (mg/L)	<2.0	<1.0	<2.0	<2.0	
	Alkalinity, Hydroxide (as CaCO3) (mg/L)	<2.0	<1.0	<2.0	<2.0	
	Alkalinity, Total (as CaCO3) (mg/L)	<2.0	264	158	157	
	Ammonia, Total (as N) (mg/L)	<0.0050	0.514	<0.0050	<0.0050	
	Bromide (Br) (mg/L)	<0.050	2.1	<0.050	<0.050	
	Chloride (Cl) (mg/L)	<0.50	30	9.65	9.75	
	Fluoride (F) (mg/L)	<0.020	0.72	0.076	0.077	
	Nitrate (as N) (mg/L)	<0.0050	<0.10 DLM	0.407	0.412	
	Nitrite (as N) (mg/L)	<0.0010	<0.020 DLM	<0.0010	<0.0010	
	Total Kjeldahl Nitrogen (mg/L)	<0.050	1.16	<0.081	<0.082	
	Total Nitrogen (mg/L)	<0.050	1.16	0.406	0.408	
	Orthophosphate-Dissolved (as P) (mg/L)	<0.0010	0.380	0.0025	0.0024	
	Phosphorus (P)-Total Dissolved (mg/L)	<0.0020	0.389	0.0026	0.0029	
	Phosphorus (P)-Total (mg/L)	<0.0020	0.618	0.0029	0.0035	
	Sulfate (SO4) (mg/L)	<0.50	410	4.15	4.19	
Organic / Inorganic Carbon	Total Organic Carbon (mg/L)	<0.50	48.1	0.75	1.22	
Total Metals	Aluminum (Al)-Total (mg/L)	<0.0030		0.0097	0.0113	
	Antimony (Sb)-Total (mg/L)	<0.00010		<0.00010	<0.00010	
	Arsenic (As)-Total (mg/L)	<0.00010		<0.00010	<0.00010	
	Barium (Ba)-Total (mg/L)	<0.000050		0.284	0.281	
	Beryllium (Be)-Total (mg/L)	<0.00010		<0.00010	<0.00010	
	Bismuth (Bi)-Total (mg/L)	<0.00050		<0.00050	<0.00050	
	Boron (B)-Total (mg/L)	<0.010		<0.010	<0.010	
	Cadmium (Cd)-Total (mg/L)	<0.000010		0.000022	0.000067	
	Calcium (Ca)-Total (mg/L)	<0.020		47.1	45.5	
	Chromium (Cr)-Total (mg/L)	<0.00010		0.00021	0.00022	
	Cobalt (Co)-Total (mg/L)	<0.00010		<0.00010	<0.00010	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1455515-1	L1455515-2	L1455515-3	L1455515-4	
	Description	Water	Water	Water	Water	
	Sampled Date	13-MAY-14	13-MAY-14	13-MAY-14	13-MAY-14	
	Sampled Time	08:30		14:00	11:00	
	Client ID	ALS FIELD BLANK	MW-H28	MW-H2B	MW-H25C	
Grouping	**Analyte**					
WATER						
Total Metals	Copper (Cu)-Total (mg/L)	<0.00050		<0.00050	<0.00050	
	Iron (Fe)-Total (mg/L)	<0.030		<0.030	<0.030	
	Lead (Pb)-Total (mg/L)	<0.000050		<0.000050	<0.000050	
	Lithium (Li)-Total (mg/L)	<0.00050		0.00272	0.00256	
	Magnesium (Mg)-Total (mg/L)	<0.0050		10.2	10.5	
	Manganese (Mn)-Total (mg/L)	<0.000050		0.00249	0.00242	
	Mercury (Hg)-Total (mg/L)	<0.000010		<0.000010	<0.000010	
	Molybdenum (Mo)-Total (mg/L)	<0.000050		0.000263	0.000266	
	Nickel (Ni)-Total (mg/L)	<0.00050		<0.00050	<0.00050	
	Phosphorus (P)-Total (mg/L)	<0.30		<0.30	<0.30	
	Potassium (K)-Total (mg/L)	<0.050		0.615	0.622	
	Selenium (Se)-Total (mg/L)	<0.00010		0.00017	0.00023	
	Silicon (Si)-Total (mg/L)	<0.050		2.80	2.82	
	Silver (Ag)-Total (mg/L)	<0.000010		<0.000010	<0.000010	
	Sodium (Na)-Total (mg/L)	<2.0		2.2	<2.0	
	Strontium (Sr)-Total (mg/L)	<0.00020		0.0757	0.0734	
	Thallium (Tl)-Total (mg/L)	<0.000010		<0.000010	<0.000010	
	Tin (Sn)-Total (mg/L)	<0.00010		<0.00010	<0.00010	
	Titanium (Ti)-Total (mg/L)	<0.010		<0.010	<0.010	
	Uranium (U)-Total (mg/L)	<0.000010		0.000142	0.000142	
	Vanadium (V)-Total (mg/L)	<0.0010		<0.0010	<0.0010	
	Zinc (Zn)-Total (mg/L)	<0.0030		<0.0030	<0.0030	
Dissolved Metals	Dissolved Mercury Filtration Location		FIELD	FIELD	FIELD	
	Dissolved Metals Filtration Location		FIELD	FIELD	FIELD	
	Aluminum (Al)-Dissolved (mg/L)		0.0073	<0.0030	<0.0030	
	Antimony (Sb)-Dissolved (mg/L)		<0.00020 DLA	<0.00010	<0.00010	
	Arsenic (As)-Dissolved (mg/L)		0.00570	<0.00010	<0.00010	
	Barium (Ba)-Dissolved (mg/L)		0.160	0.286	0.284	
	Beryllium (Be)-Dissolved (mg/L)		<0.00020 DLA	<0.00010	<0.00010	
	Bismuth (Bi)-Dissolved (mg/L)		<0.0010 DLA	<0.00050	<0.00050	
	Boron (B)-Dissolved (mg/L)		0.154	<0.010	<0.010	
	Cadmium (Cd)-Dissolved (mg/L)		<0.000020 DLA	<0.000010	<0.000010	
	Calcium (Ca)-Dissolved (mg/L)		17.3	46.2	45.1	
	Chromium (Cr)-Dissolved (mg/L)		<0.00020 DLA	0.00015	0.00026	
	Cobalt (Co)-Dissolved (mg/L)		0.00032	<0.00010	<0.00010	
	Copper (Cu)-Dissolved (mg/L)		<0.00050	<0.00050	<0.00050	
	Iron (Fe)-Dissolved (mg/L)		0.305	<0.030	<0.030	

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

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1455515-1	L1455515-2	L1455515-3	L1455515-4	
	Description	Water	Water	Water	Water	
	Sampled Date	13-MAY-14	13-MAY-14	13-MAY-14	13-MAY-14	
	Sampled Time	08:30		14:00	11:00	
	Client ID	ALS FIELD BLANK	MW-H28	MW-H2B	MW-H25C	
Grouping	**Analyte**					
WATER						
Dissolved Metals	Lead (Pb)-Dissolved (mg/L)		<0.00010 DLA	<0.000050	<0.000050	
	Lithium (Li)-Dissolved (mg/L)		0.219	0.00242	0.00233	
	Magnesium (Mg)-Dissolved (mg/L)		7.19	10.9	10.3	
	Manganese (Mn)-Dissolved (mg/L)		0.730	0.00166	0.00166	
	Mercury (Hg)-Dissolved (mg/L)		<0.000010	<0.000010	<0.000010	
	Molybdenum (Mo)-Dissolved (mg/L)		0.0191	0.000248	0.000252	
	Nickel (Ni)-Dissolved (mg/L)		0.0023	<0.00050	<0.00050	
	Phosphorus (P)-Dissolved (mg/L)		0.57	<0.30	<0.30	
	Potassium (K)-Dissolved (mg/L)		1.59	0.623	0.607	
	Selenium (Se)-Dissolved (mg/L)		<0.00020 DLA	0.00019	0.00019	
	Silicon (Si)-Dissolved (mg/L)		4.30	2.78	2.83	
	Silver (Ag)-Dissolved (mg/L)		<0.000020 DLA	<0.000010	<0.000010	
	Sodium (Na)-Dissolved (mg/L)		361	<2.0	<2.0	
	Strontium (Sr)-Dissolved (mg/L)		0.326	0.0727	0.0724	
	Thallium (Tl)-Dissolved (mg/L)		<0.000020 DLA	<0.000010	<0.000010	
	Tin (Sn)-Dissolved (mg/L)		<0.00020 DLA	<0.00010	<0.00010	
	Titanium (Ti)-Dissolved (mg/L)		<0.010	<0.010	<0.010	
	Uranium (U)-Dissolved (mg/L)		0.00290	0.000139	0.000138	
	Vanadium (V)-Dissolved (mg/L)		<0.0020 DLA	<0.0010	<0.0010	
	Zinc (Zn)-Dissolved (mg/L)		<0.0030	<0.0030	<0.0030	

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

Reference Information

Qualifiers for Individual Samples Listed:

Sample Number	Client Sample ID	Qualifier	Description
L1455515-2	MW-H28	WSMD	Water sample(s) for dissolved mercury analysis was not submitted in glass container with HCl preservative. Results may be biased low.

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Bromide (Br)	DLM	L1455515-1, -2, -3, -4
Duplicate	Nitrite (as N)	DLM	L1455515-1, -2, -3, -4
Duplicate	Bromide (Br)	DLM	L1455515-1, -2, -3, -4
Duplicate	Fluoride (F)	DLM	L1455515-1, -2, -3, -4
Duplicate	Nitrite (as N)	DLM	L1455515-1, -2, -3, -4
Duplicate	Nitrate (as N)	DLM	L1455515-1, -2, -3, -4
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Orthophosphate-Dissolved (as P)	MS-B	L1455515-1, -2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Antimony (Sb)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Arsenic (As)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Boron (B)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Manganese (Mn)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Molybdenum (Mo)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Uranium (U)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Total Nitrogen	MS-B	L1455515-1, -2, -3, -4
Matrix Spike	Total Nitrogen	MS-B	L1455515-1, -2, -3, -4
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Silicon (Si)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Barium (Ba)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Calcium (Ca)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Magnesium (Mg)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Potassium (K)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Strontium (Sr)-Dissolved	MS-B	L1455515-2, -3, -4
Matrix Spike	Total Organic Carbon	MS-B	L1455515-2, -3
Matrix Spike	Total Organic Carbon	MS-B	L1455515-2, -3

Qualifiers for Individual Parameters Listed:

Qualifier	Description

Reference Information

DLA	Detection Limit adjusted for required dilution
DLM	Detection Limit Adjusted due to sample matrix effects.
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**
ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 "Acidity"

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ACY-PCT-VA	Water	Acidity by Automatic Titration	APHA 2310 Acidity

This analysis is carried out using procedures adapted from APHA Method 2310 "Acidity". Acidity is determined by potentiometric titration to a specified endpoint.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 "Alkalinity"

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-PCT-VA	Water	Alkalinity by Auto. Titration	APHA 2320 Alkalinity

This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ALK-SCR-VA	Water	Alkalinity by colour or titration	EPA 310.2 OR APHA 2320

This analysis is carried out using procedures adapted from EPA Method 310.2 "Alkalinity". Total Alkalinity is determined using the methyl orange colourimetric method.
OR
This analysis is carried out using procedures adapted from APHA Method 2320 "Alkalinity". Total alkalinity is determined by potentiometric titration to a pH 4.5 endpoint. Bicarbonate, carbonate and hydroxide alkalinity are calculated from phenolphthalein alkalinity and total alkalinity values.

ANIONS-BR-IC-VA	Water	Bromide by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-CL-IC-VA	Water	Chloride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-F-IC-VA	Water	Fluoride by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

ANIONS-NO2-IC-VA	Water	Nitrite in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrite is detected by UV absorbance.

ANIONS-NO3-IC-VA	Water	Nitrate in Water by Ion Chromatography	EPA 300.0

This analysis is carried out using procedures adapted from EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography". Nitrate is detected by UV absorbance.

ANIONS-SO4-IC-VA	Water	Sulfate by Ion Chromatography	APHA 4110 B.

This analysis is carried out using procedures adapted from APHA Method 4110 B. "Ion Chromatography with Chemical Suppression of Eluent Conductivity" and EPA Method 300.0 "Determination of Inorganic Anions by Ion Chromatography".

CARBONS-TOC-VA	Water	Total organic carbon by combustion	APHA 5310 TOTAL ORGANIC CARBON (TOC)

This analysis is carried out using procedures adapted from APHA Method 5310 "Total Organic Carbon (TOC)".

COLOUR-TRUE-VA	Water	Colour (True) by Spectrometer	BCMOE Colour Single Wavelength

This analysis is carried out using procedures adapted from British Columbia Environmental Manual "Colour- Single Wavelength." Colour (True Colour) is determined by filtering a sample through a 0.45 micron membrane filter followed by analysis of the filtrate using the platinum-cobalt colourimetric method. Aparent Colour is determined without prior sample filtration. Colour is pH dependent. Unless otherwise indicated, reported colour results pertain to the pH of the sample as received, to within +/- 1 pH unit.

EC-PCT-VA	Water	Conductivity (Automated)	APHA 2510 Auto. Conduc.

This analysis is carried out using procedures adapted from APHA Method 2510 "Conductivity". Conductivity is determined using a conductivity electrode.

HARDNESS-CALC-VA	Water	Hardness	APHA 2340B

Hardness (also known as Total Hardness) is calculated from the sum of Calcium and Magnesium concentrations, expressed in CaCO3 equivalents. Dissolved Calcium and Magnesium concentrations are preferentially used for the hardness calculation.

Reference Information

HG-DIS-LOW-CVAFS-VA Water Dissolved Mercury in Water by CVAFS(Low) EPA SW-846 3005A & EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by filtration (EPA Method 3005A) and involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

HG-TOT-LOW-CVAFS-VA Water Total Mercury in Water by CVAFS(Low) EPA 245.7

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride. Instrumental analysis is by cold vapour atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

MET-D-CCMS-VA Water Dissolved Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-DIS-ICP-VA Water Dissolved Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedure involves filtration (EPA Method 3005A) and analysis by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

MET-T-CCMS-VA Water Total Metals in Water by CRC ICPMS APHA 3030 B&E / EPA SW-846 6020A

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using hotblock, or filtration (APHA 3030B&E). Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

MET-TOT-ICP-VA Water Total Metals in Water by ICPOES EPA SW-846 3005A/6010B

This analysis is carried out using procedures adapted from "Standard Methods for the Examination of Water and Wastewater" published by the American Public Health Association, and with procedures adapted from "Test Methods for Evaluating Solid Waste" SW-846 published by the United States Environmental Protection Agency (EPA). The procedures may involve preliminary sample treatment by acid digestion, using either hotblock or microwave oven (EPA Method 3005A). Instrumental analysis is by inductively coupled plasma - optical emission spectrophotometry (EPA Method 6010B).

N-T-COL-VA Water Total Nitrogen in water by Colour USGS - 03 - 4174 / NEMI 5735

This analysis is carried out using procedures adapted from the US Geological Survey (USGS) Method 03-4174 " Evaluation of Alkaline persulfate digestion as an alternative to kjeldahl digestion for determination of total and dissolved nitrogen and phosphorus in water." and National Environmental Methods Index Nemi method 5735. Nitrate via manual vanadium (III) reduction.

NH3-F-VA Water Ammonia in Water by Fluorescence J. ENVIRON. MONIT., 2005, 7, 37-42, RSC

This analysis is carried out, on sulfuric acid preserved samples, using procedures modified from J. Environ. Monit., 2005, 7, 37 - 42, The Royal Society of Chemistry, "Flow-injection analysis with fluorescence detection for the determination of trace levels of ammonium in seawater", Roslyn J. Waston et al.

P-T-COL-VA Water Total P in Water by Colour APHA 4500-P Phosphorus

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Phosphorus is determined colourimetrically after persulphate digestion of the sample.

P-TD-COL-VA Water Total Dissolved P in Water by Colour APHA 4500-P Phosphorous

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Total Dissolved Phosphorus is determined colourimetrically after persulphate digestion of a sample that has been lab or field filtered through a 0.45 micron membrane filter.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H "pH Value"

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PH-PCT-VA Water pH by Meter (Automated) APHA 4500-H pH Value

This analysis is carried out using procedures adapted from APHA Method 4500-H "pH Value". The pH is determined in the laboratory using a pH electrode

It is recommended that this analysis be conducted in the field.

PO4-DO-COL-VA Water Diss. Orthophosphate in Water by Colour APHA 4500-P Phosphorus

Reference Information

This analysis is carried out using procedures adapted from APHA Method 4500-P "Phosphorus". Dissolved Orthophosphate is determined colourimetrically on a sample that has been lab or field filtered through a 0.45 micron membrane filter.

TDS-VA	Water	Total Dissolved Solids by Gravimetric	APHA 2540 C - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Dissolved Solids (TDS) are determined by filtering a sample through a glass fibre filter, TDS is determined by evaporating the filtrate to dryness at 180 degrees celsius.

TKN-CALC-VA	Water	TKN in Water (Calculation)	BC MOE LABORATORY MANUAL (2005)

Total Kjeldahl Nitrogen is a calculated parameter. Total Kjeldahl Nitrogen (calc) = Total Nitrogen - [Nitrite (as N) + Nitrate (as N)].

TSS-VA	Water	Total Suspended Solids by Gravimetric	APHA 2540 D - GRAVIMETRIC

This analysis is carried out using procedures adapted from APHA Method 2540 "Solids". Solids are determined gravimetrically. Total Suspended Solids (TSS) are determined by filtering a sample through a glass fibre filter, TSS is determined by drying the filter at 104 degrees celsius.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 "Turbidity"

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

TURBIDITY-VA	Water	Turbidity by Meter	APHA 2130 Turbidity

This analysis is carried out using procedures adapted from APHA Method 2130 "Turbidity". Turbidity is determined by the nephelometric method.

** 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:

10-147364

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.

L1455515-COFC

10-147364

ALS Environmental

Chain of Custody / Analytical Request Form
Canada Toll Free: 1 800 668 9878
www.alsglobal.com

Page 1 of 1

Report To	**Report Format / Distribution**	**Service Request:** (Rush subject to availability - Contact ALS to confirm TAT)
Company: ERM - Rescan	Standard: X Other (specify):	X Regular (Standard Turnaround Times - Business Days)
Contact: Tyler Gale	Select: PDF X Excel X Digital Fax	Priority (2-4 Business Days)-50% surcharge - Contact ALS to confirm TAT
Address: 1111 W. Hastings St. Vancouver BC V6E 2J3	Email 1: Tyler.Gale@erm.com	Emergency (1-2 Business Days)-100% Surcharge - Contact ALS to confirm TAT
Phone: 604-689-9460 Fax:	Email 2: Yaming.Chen@erm.com	Same Day or Weekend Emergency - Contact ALS to confirm TAT
Invoice To Same as Report ? (circle) (Yes) or No (if No, provide details)	**Client / Project Information**	**Analysis Request**
Copy of Invoice with Report? (circle) Yes or No	Job #: 0194106-0002-0005	(Indicate Filtered or Preserved, F/P)
Company:	PO / AFE:	
Contact:	LSD:	
Address:		
Phone: Fax:	Quote #:	
Lab Work Order # (lab use only) L1455515	**ALS Contact:** Amber Springer **Sampler:** Tyler Gale	

Sample #	Sample Identification (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	Routine	Nutrients	Total Metals	Dissolved Metals	Total Hg	Dissolved Hg	Number of Containers
	ALS Field Blank preserved →	13-May-14	08:30	Water	X	X	X		X		4
	MW-H28	13-May-14		"	X	X		X		X	4
	MW-H2B	13-May-14	14:00	"	—	—	—	—	—	—	6
	MW-H25C	13-May-14	11:00	"	—	—	—	—	—	—	6

Special Instructions / Regulation with water or land use (CCME- Freshwater Aquatic Life/BC CSR-Commercial/AB Tier 1-Natural/ETC) / Hazardous Details

MW-H28: in Routine bottle please prioritize anions, hardness, turbidity, TDS.

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY.

By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

SHIPMENT RELEASE (client use)			SHIPMENT RECEPTION (lab use only)				SHIPMENT VERIFICATION (lab use only)			
Released by:	Date:	Time:	Received by:	Date:	Time:	Temperature:	Verified by:	Date:	Time:	Observations: Yes / No ? If Yes add SIF
Tyler Gale	14-May-14		Geoff	May 14	15:45	9 °C				

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

GENF 18.01 Front

Appendix F

Murray River Coal Project Geologic Model

ERM

Memorandum

Refer to File No.: \\server04\publishing\Murray River\2014 Geology Model Memo\0.3 MUR_GC_Geology Model.docx

Date: June 04, 2014

To: Piotr Rzepecki

From: Mark Nelson

Cc: Kelsey Norlund, Jason Rempel

Subject: **Memorandum: Murray River Geological Model**

A three dimensional (3D) geology model of the stratigraphy above and hosting the coal seams at the Murray River Project was not available to provide cross sections incorporating hydrogeology data. Seismic interpretations were matched to and modified by down hole geology to generate a 3D geology model that can be cut to produce various visualizations of the data.

This 3D geology model was generated to allow for visualization of overall structure within the Murray River Project area. The model is not detailed enough to act aid in any resource or reserve estimation as the error on faults and lithological contacts exceeds ±10m.

1. METHODOLOGY

The geology model was generated by blending seismic interpreted cross sections generated by HD Mining (No. 173 Prospecting Party of China National Administration of Coal Geology 2011) with stratigraphic interpretations presented in exploration drill logs.

1.1 Limitations

The stratigraphic interpretations do not differentiate between units above the Boulder Creek Formation. All material above Boulder Creek Formation is logged as Hasler Formation. The thickness of the material indicates that some of the material should belong to overlying units (Dunvagen, Cruiser, or Goodrich Formations).

The complexity of the shape of the overlying, undifferentiated material and its uncertain origin made modelling the material difficult and resulted in its exclusion from the final 3D model.

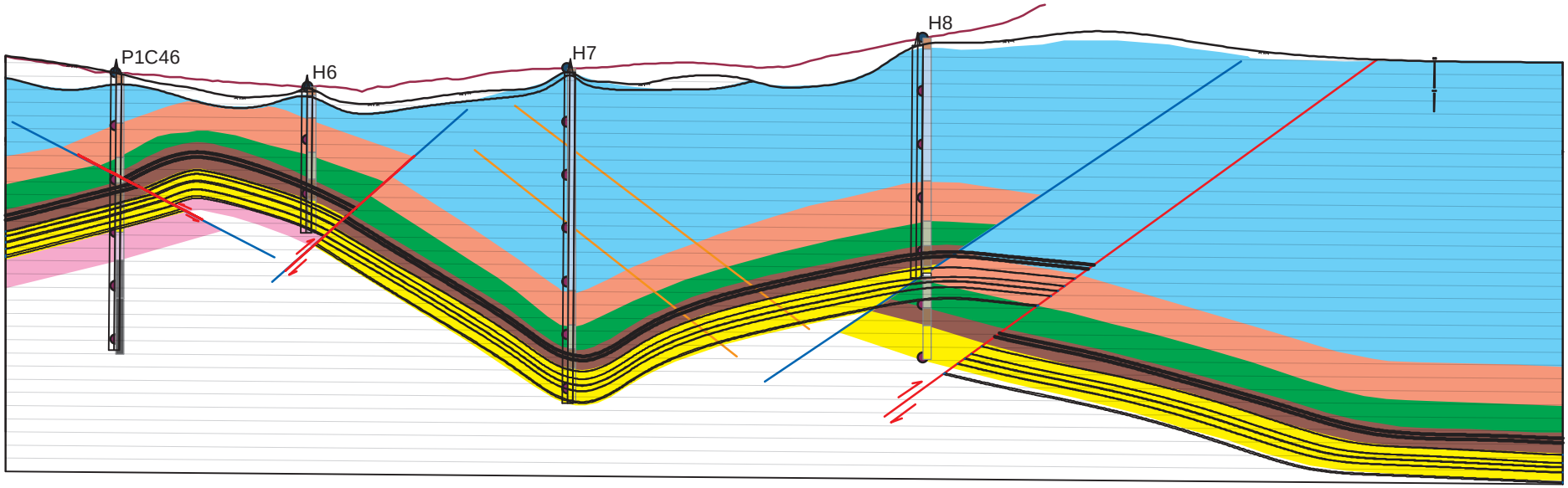
Faults interpreted from the seismic survey did not always match the exploration drill logs. Additionally not all faults were presented in all the HD Mining cross sections. It was assumed that faults interpreted from the seismic survey were large or persistent enough that they should appear in all cross sections. When faults were inferred between sections they were labelled as inferred. An example of this reinterpretation is presented in Figure 1.1-1.

Deep drill holes or seismic survey results do not extend under the proposed Coarse Coal Reject site to the west of the Murray River. Consequently the geological model does not cover that region.

Appendix A contains notes made during the interpretation process.

Figure 1.1-1

Comparison Between Seismic and Exploration Interpreted Geology



1.2 Process

A summary of the process is listed below:

1. Import location and down hole stratigraphy information of exploration and hydrogeology drill holes.
2. Choose eight cross section locations that closely match the seismic interpreted sections and plot preliminary cross sections displaying topography, drill hole trace, and down hole stratigraphy.
3. Import the eight seismic interpreted cross sections generated by HD Mining (No. 173 Prospecting Party of China National Administration of Coal Geology 2011).
4. Georeference the eight seismic interpreted cross sections in the preliminary drill hole cross sections so that they are hanging in 3D space correctly.
5. Compare the seismic interpreted stratigraphy and the down hole stratigraphy sections to determine discrepancies between interpreted and logged coal seams and faults.
6. Adjust seismic interpreted faults to account for potential faults in the exploration drill logs. Add new interpreted faults not present in the seismic interpretations. The new interpreted faults were added to the geology model to help the software interpolate between sections.
7. Digitize geology in each section using the shape of the seismic interpreted coal seams as a guide for the form of the stratigraphic contacts.
8. When each section was complete the geology was interpolated between sections to create volumes.

2. RESULTS

The primary result of the modelling exercise was the generation of a 3D geology model. The extent of three cross sections through the model are presented in Figure 2-1. Three cross sections are presented in Figures 2-2 to 2-4 and a 3D perspective of the geologic cross sections used to generate the 3D model are presented in Figure 2-5.

Figure 2-1

Plan Map Illustrating Extents of Cross Sections

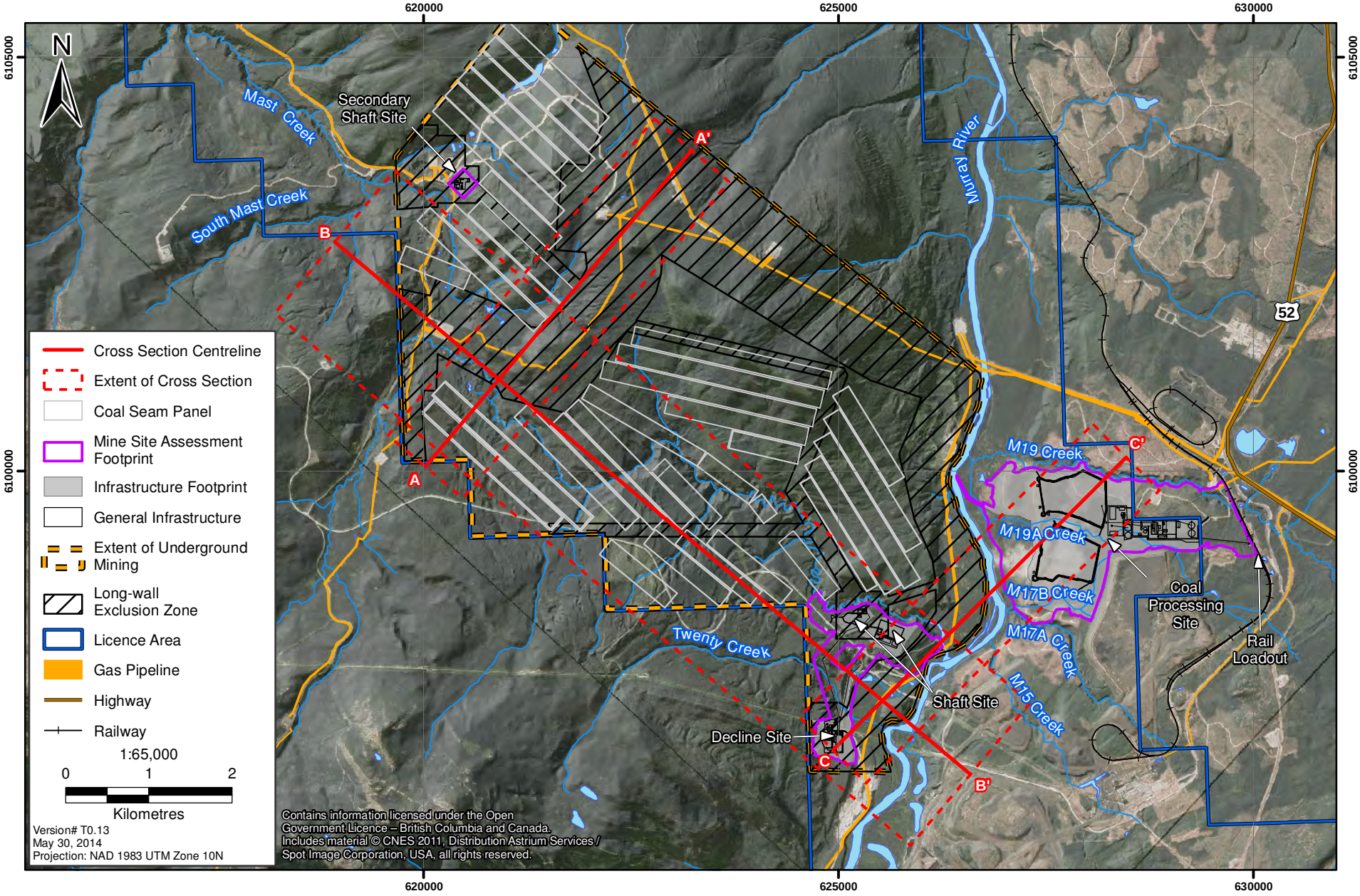
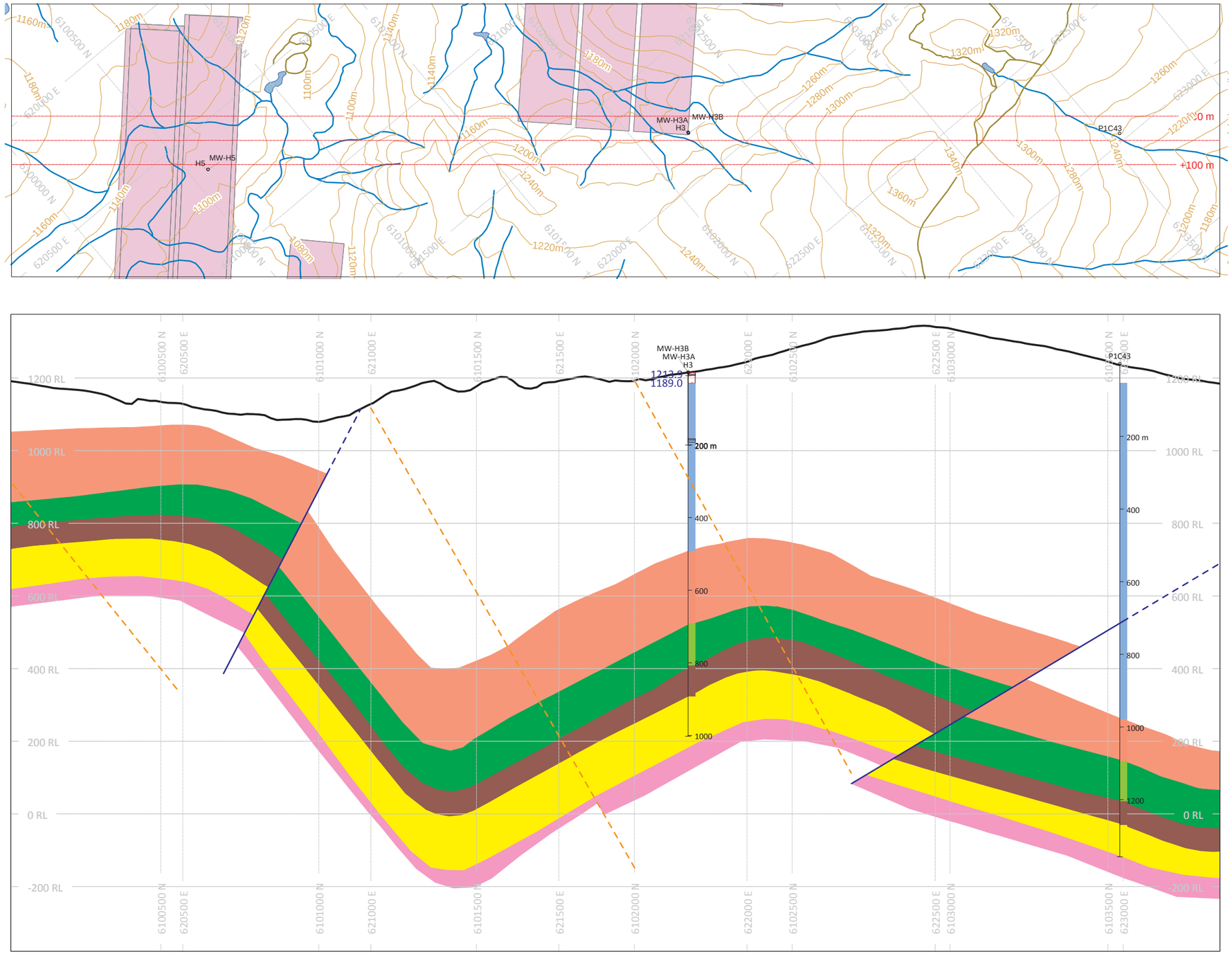


Figure 2-2
Cross Section A-A'



HOLES PLOTTED

TOTAL 4

H3 MW-H3A MW-H3B P1C43

- Contours
- Transportation
- Stream
- Coal Seam Panel
- Water Wetlands
- Powerline
- Conveyor
- Structure
- Concrete Paving
- Coarse Coal Reject Pile
- Pad
- Pond
- Collection Pipe
- Diversion Channel

- Topography
- Overburden
- Hasler and undifferentiated
- Boulder Creek
- Hulcross
- Upper Gates
- Middle Gates
- Lower Gates
- Hydrogeology Well
- 777.8 Water Table
- Fault, Interpretted from Geophysics
- Fault, Inferred

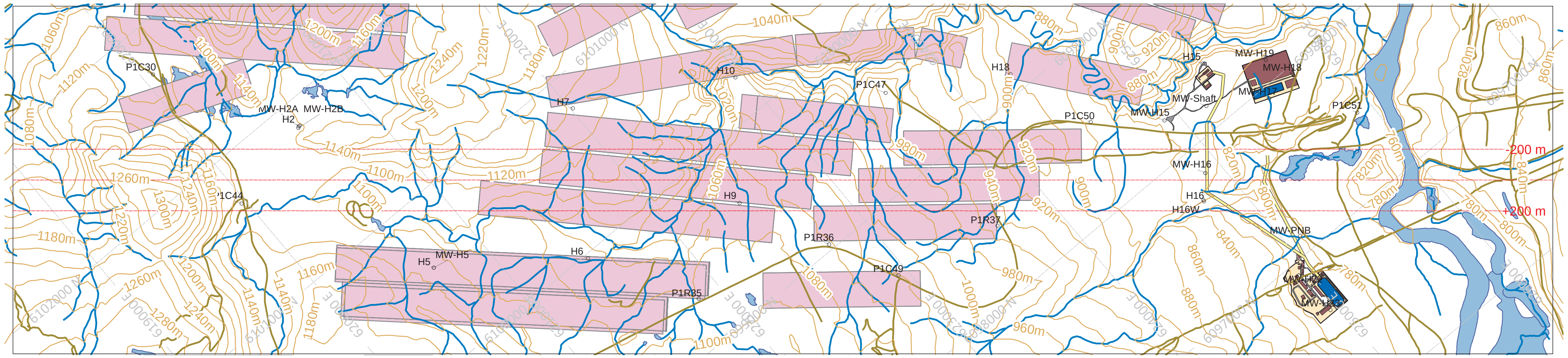
SECTION SPECS:

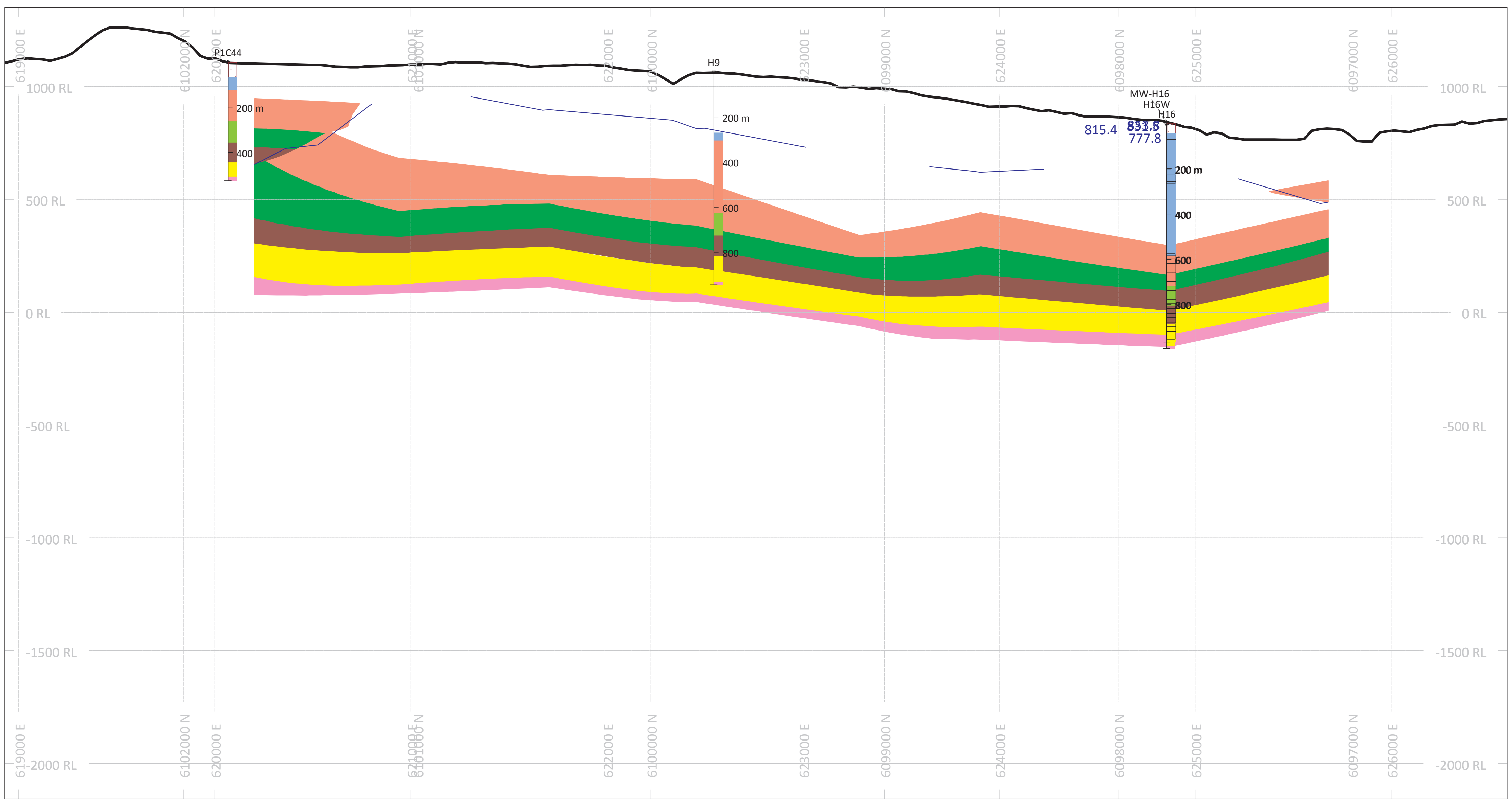
REF. PT. E, N	621650 m	6101940 m
EXTENTS	5000 m	1754 m
SECTION TOP, BOT	1375 m	-378.5 m
TOLERANCE +/-	100 m	
VERTICAL EXAG.	1.5 m	

SCALE
(m)
-100 0 100 200 300 400 500
NAD83 / UTM zone 10

AZIMUTH = 45°
N
W E
S

Figure 2-3
Cross Section B-B'





HOLES PLOTTED

TOTAL 5

H16 H16W H9 MW-H16
P1C44

- Contours
- Transportation
- Stream
- Coal Seam Panel
- Water Wetlands
- Powerline
- Conveyor
- Structure
- Concrete Paving
- Coarse Coal Reject Pile
- Pad
- Pond
- Collection Pipe
- Diversion Channel

- Topography
- Overburden
- Hasler and undifferentiated
- Boulder Creek
- Hulcross
- Upper Gates
- Middle Gates
- Lower Gates
- Hydrogeology Well
- 777.8 Water Table
- Fault, Interpretted from Geophysics
- Fault, Inferred

SECTION SPECS:

REF. PT. E, N	622760 m	6099550 m
EXTENTS	10000 m	3508 m
SECTION TOP, BOT	1351 m	-2157 m
TOLERANCE +/-	200 m	
VERTICAL EXAG.	1.5 m	

SCALE

(m)

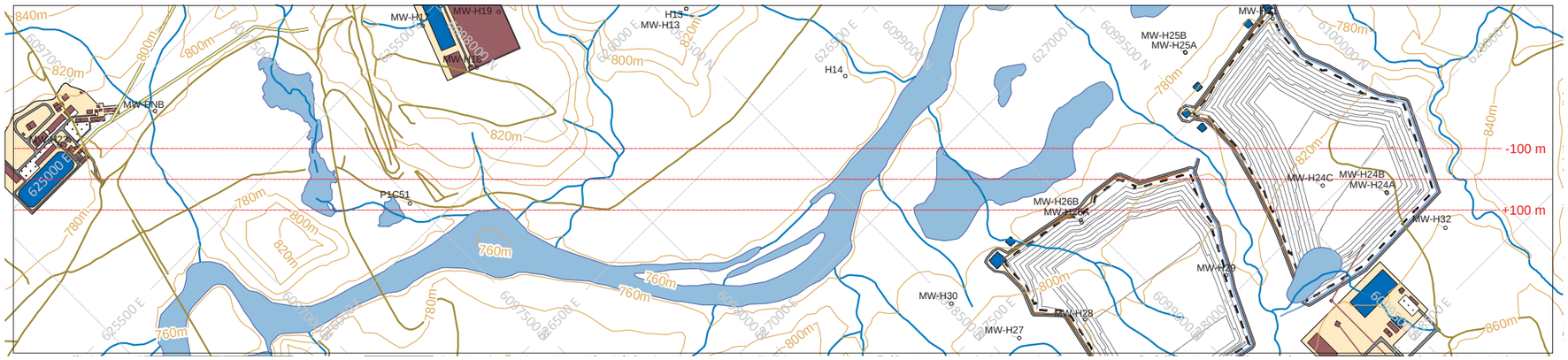
-200 0 200 400 600 800 1000

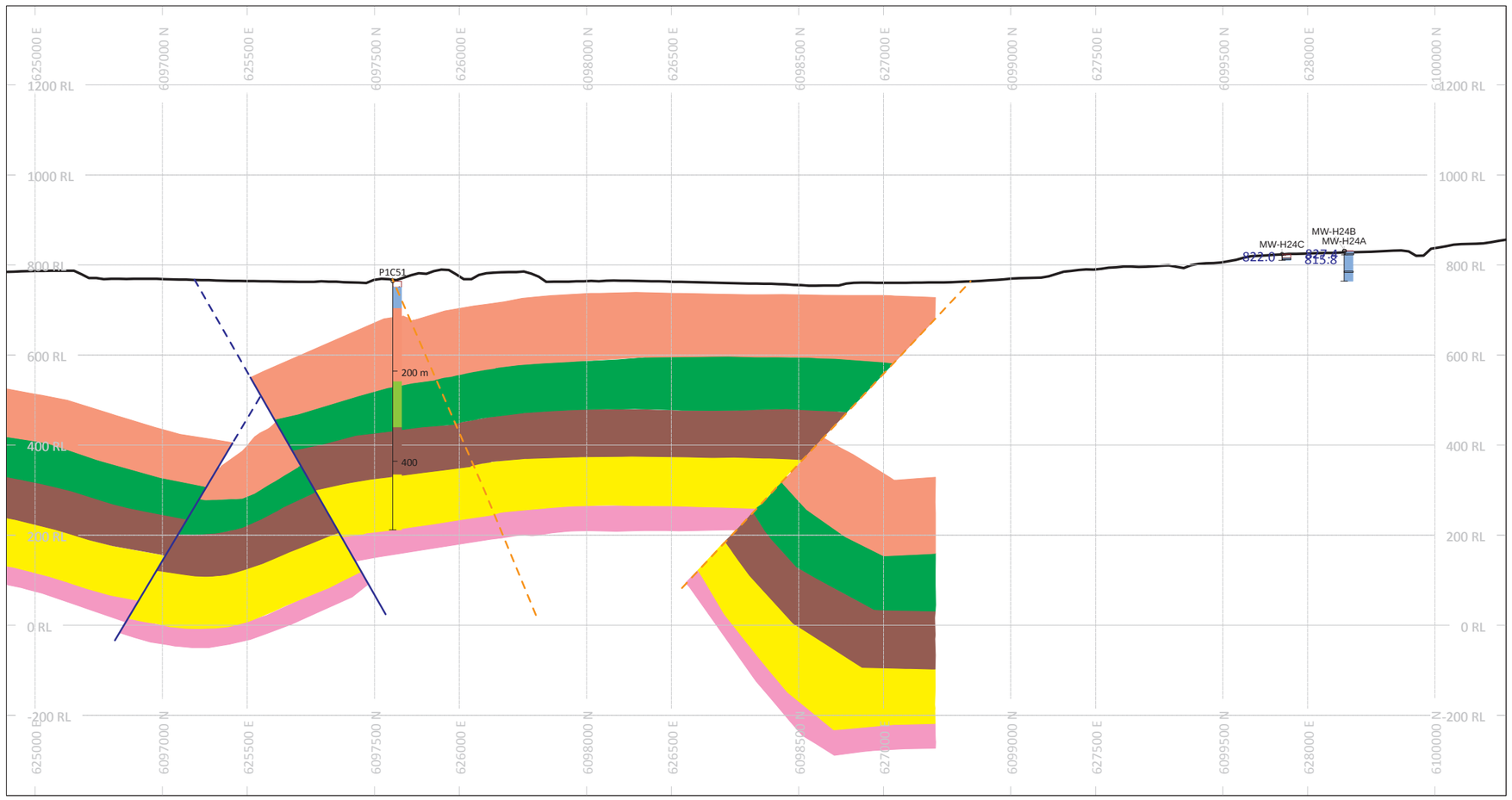
NAD83 / UTM zone 10

AZIMUTH = 130°

N W E S

Figure 2-4
Cross Section C-C'





HOLES PLOTTED

TOTAL 4

MW-H24A MW-H24B MW-H24C P1C51

- Contours
- Transportation
- Stream
- Coal Seam Panel
- Water Wetlands
- Powerline
- Conveyor
- Structure
- Concrete Paving
- Coarse Coal Reject Pile
- Pad
- Pond
- Collection Pipe
- Diversion Channel

- Topography
- Overburden
- Hasler and undifferentiated
- Boulder Creek
- Hulcross
- Upper Gates
- Middle Gates
- Lower Gates
- Hydrogeology Well
- 777.8 Water Table
- Fault, Interpretted from Geophysics
- Fault, Inferred

SECTION SPECS:

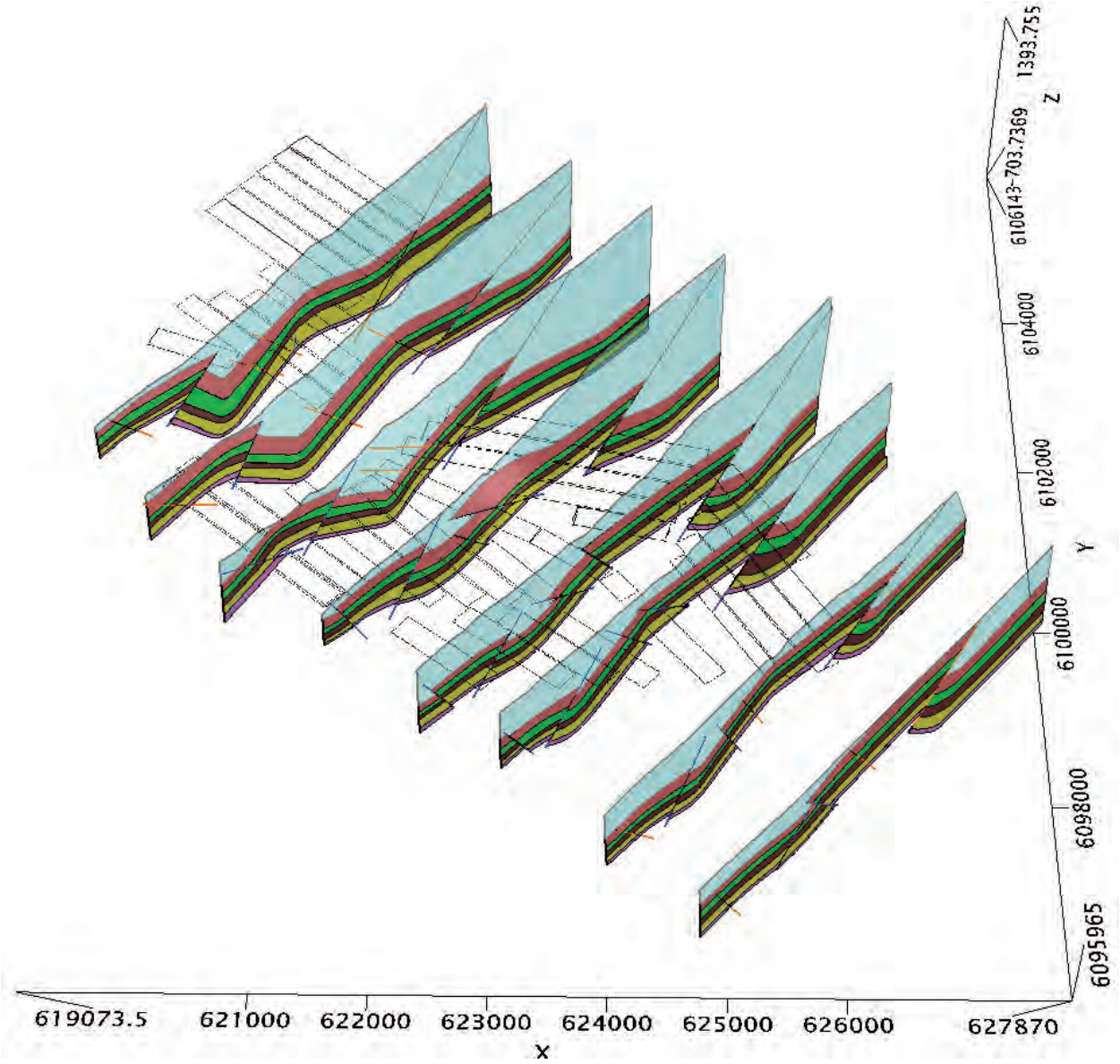
REF. PT. E, N	626700 m	6098400 m
EXTENTS	5000 m	1754 m
SECTION TOP, BOT	1375 m	-378.5 m
TOLERANCE +/-	100 m	
VERTICAL EXAG.	1.5 m	

SCALE
(m)
-100 0 100 200 300 400 500
NAD83 / UTM zone 10

AZIMUTH = 45°
N
W E
S

Figure 2-5

3D Perspective View of Geologic Cross Sections



Prepared By:

Mark Nelson M.Sc. P.Geo., Consultant
ERM Rescan

REFERENCES

No. 173 Prospecting Party of China National Administration of Coal Geology. 2011. *Coal Exploration Report for the First Prospecting Area of the Murray River Coal Property in Northeastern British Columbia, Canada*. Compiled for Huiyong Holding Group Co., Ltd. by No. 173 Prospecting Party of China National Administration of Coal Geology July 2011:

APPENDIX A

— Notes —

- **Section 09**: no fault adjustments
- **Section 08**: near PIC48 – fault moved down due to repeating lithology in exploration drill logs AND slickenlines mentioned. No breccia/slickenlines mentioned at location of HD interpreted fault location
- **Section 07**: near PIR37 – moved fault up as thickened Boulder Creek and exploration logs indicate polished bedding plane and fractures ~600m down hole
  - near H21 – moved fault down as exploration log indicated bedding plane changes and broken rock at ~740m (Middle Gates)
- **Section 06**: no adjustments
- **Section 05**: near H9 – moved fault down from ~336 to ~420m because thickening of Boulder Creek and exploration logs indicate slickenlines between 426 and 460m. Fractures noted at ~330m
  - near H10 (middle) – moved fault up ~100m as thickened Boulder Creek and exploration log indicates bedding faults at ~480m and no fault fracture info at ~600m
- **Section 04**: not provided
- **Section 03**: near H8 – moved fault up ~450m because exploration log indicated fault unit at ~880m
  - did not modify (add) extra faults on H8 to account for thickening of Hasler Formation. I expect thick Hasler is due to incorrect core logging and should be Dunvegan or other overlying stratigraphy.
  - near H7 – added fault to intersect at ~300m based on exploration log broken core at ~300m and thickened Hasler and evidence of fault in Section 04
- **Section 02**: near PIC43 – moved fault down ~470m, thickening of Hasler with slickenlines mentioned in exploration logs between 680-740m and not in top 100m
  - no additional fractures added to PIC43 because probably incorrect stratigraphy, however broken core is noted in H3 between 200-290m so there is potential, although nothing noted in Section 03
  - near H3 – added fault, thickened Hasler and exploration log with broken core at ~200m and also present in Section 03 and 05. The fault seems out of sequence spatially with Section 03 and 05.
- **Section 01**: near H2 – fault adjusted/extended to account for slickenlines at ~100m. Hasler is still very thickened. Compressional fault noted in exploration log at 425m so a new fault added en echelon to existing

APPENDIX 2

"Geotechnical Data Report for Portal Cut, Murray River Coal Project Tumbler Ridge BC", submitted to HD Mining International Ltd. by Golder Associates Ltd. (Report Number: 1214940127) dated September 13, 2012.

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September 13, 2012

GEOTECHNICAL DATA REPORT FOR PORTAL CUT

MURRAY RIVER COAL PROJECT, TUMBLER RIDGE, BC

Submitted to:
Mr. Lingyun Zuo
HD Mining International Mining Ltd.
Suite 433, Three Bentall Centre
595 Burrard Street
Vancouver, BC
V7X 1J1

REPORT

Report Number: 1214940127-R-Rev0-4000-4600

Distribution:

HD Mining International Mining Ltd. - 3 Copies

Golder Associates Ltd. - 2 Copies

Golder Associates

Table of Contents

1.0 INTRODUCTION

As requested and authorized by HD Mining International Mining Ltd. (HD Mining), Golder Associates Ltd. (Golder) has completed a geotechnical investigation program in support of portal cut design and portal structure development for the proposed Murray River Coal Project near Tumbler Ridge, BC. This geotechnical data report provides factual information gathered during the geotechnical investigation and laboratory testing program.

It should be noted that this data report is limited to the geotechnical aspects in support of the proposed development noted above and does not include any investigations, analytical testing or assessments of possible soil and groundwater contamination, biological or archaeological considerations or sediment control measures.

The reader is referred to the section entitled “Important Information and Limitations of this Report” which follows the text but forms an integral part of this document and affects the proper use and interpretation of this report.

This report has been prepared for the exclusive use of HD Mining and their consultants in support of the proposed Murray River Coal Project, noted above. Reliance on the material by any party other than HD Mining, or for any other purpose other than the proposed development at the above-noted project site is strictly forbidden. Permission is hereby granted to the BC Ministry of Energy and Mines to use this report for permitting approval associated with the intended use of the subject property discussed herein.

2.0 SITE DESCRIPTION

The proposed development site of the Murray River Coal Project is located approximately 15 km southwest of Tumbler Ridge. Access to the project site is off of the Murray River Forest Service Road, which intersects the Heritage Highway (Hwy 52), approximately 13 km southeast of Tumbler Ridge, BC. The proposed development site is located on the west and opposite side of Murray River from the Teck Coal Inc. Quintette Coal operation. The field investigation was carried out under an access agreement between HD Mining International Ltd. and Teck Coal Inc.

Temporary access roads and drilling work areas were arranged by HD Mining to be cleared and prepared in advance of the field investigation program.

3.0 FIELD INVESTIGATION

The field investigation consisted of drilling five boreholes (BH12-01 to BH12-05) and excavating five test pits (TP12-01 to TP12-05) at locations shown in Figure 1. The locations of boreholes and test pits were selected based on discussions between Golder and HD Mining in order to have a good coverage of the area to be considered as the portal location. BC-One-Call ticket was initiated prior to the field investigation. Once the field program is complete, the locations and ground elevations of the boreholes and test pits were surveyed at the arrangement by HD Mining.

N:\bur-graphics\Projects\2012\1494\12-1494-0127\Drafting\4000\4500\Drafting\Figures\1214940127-4000-4500-01.dwg | Layout: SITE PLAN - BOREHOLE LOCATIONS AND TUNNEL ALIGNMENT | Modified: EAbella 09/06/2012 11:29 AM | Plotted: EAbella 09/06/2012

624 500 E
625 000 E
625 500 E
6 098 500 N
6 098 000 N
6 097 500 N
6 097 000 N

END OF TUNNEL
EASTING=625196.63
NORTHING=6098382.37
ELEVATION=350.00

TH12
TH07
TH06
SHAFT
TH05
TH08
TH09
TH04
TUNNEL DESIGN BY OTHERS
TUNNEL ENTRANCE
EASTING=624890.98
NORTHING=6096943.72
INVERT ELEVATION=771.73
START OF PORTAL EXCAVATION DECLINE
EASTING=624880.65
NORTHING=6096895.10
ELEVATION=785.98
AZIMUTH=192.0°
BH12-01
BH12-02
BH12-03
BH12-04
BH12-05
TH01
TH02
TH03
TH10
TH11
TP1
TP2
TP3
TP4
TP5
E
E'
F
F'
8
9

LEGEND

- BOREHOLE
- BOREHOLE WITH TELEVIEWER DATA
- TEST PIT
- BULK SAMPLE SURFACE FACILITIES BOUNDARY
- COAL CONVEYOR BELT
- 230KV POWERLINE
- RIVER OR CREEK
- EXISTING ROADS
- FOREST ROADS
- WETLAND
- CONTOUR (12.5m)
- CONTOUR (2.5m)
- AREA OF INDUSTRIAL SITE BOUNDARY
- TUNNEL ALIGNMENT

NOTES

1. ALL DIMENSIONS AND ELEVATIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. THE PORTAL LOCATION IS SELECTED BASED ON GROUND CONDITIONS OBTAINED FROM BOREHOLES AND TEST PITS AT THE SELECTED PORTAL LOCATION, LIMITED GEOTECHNICAL INFORMATION IN THE TH04 AREA, THE BOTTOM ELEVATION OF THE F COAL SEAM AT THE END OF TUNNEL, AND HD MINING PREFERRED TUNNEL INCLINATION ANGLE OF 16°. VERIFYING BEDROCK PROFILE ALONG THE TUNNEL ALIGNMENT WILL BE DONE BY OTHERS OR DURING TUNNELING PROCESS IF DEEMED NECESSARY.
3. DURING PORTAL EXCAVATION, SOIL AND BEDROCK CONDITIONS, GROUNDWATER SEEPAGE OR FLOW CONDITIONS SHOULD BE INSPECTED FULL-TIME BY QUALIFIED GEOTECHNICAL PERSONNEL(S), IN ORDER TO CONFIRM GEOTECHNICAL INFORMATION USED FOR THE PORTAL EXCAVATION DESIGN. IF ACTUAL GROUND CONDITIONS ARE DIFFERENT FROM THOSE USED FOR THE DESIGN, REVISION TO THE PORTAL EXCAVATION DESIGN OR CONSTRUCTION PROCEDURES MAY HAVE TO BE MADE IF DEEMED NECESSARY.

REFERENCES

1. BASE PLAN PROVIDED BY "SINO-COAL INTERNATIONAL ENGINEERING GROUP SHENYANG DESIGN AND RESEARCH INSTITUTE", CAD FILE : DY1452-2-1.dwg DATED APRIL 2012.
2. END OF TUNNEL POSITION AND ELEVATION BASED ON LEVEL OF SEAM F FROM "SINO-COAL INTERNATIONAL ENGINEERING GROUP SHENYANG DESIGN AND RESEARCH INSTITUTE", CAD FILE : DY1452-2-2.dwg.

0 100 200 300m
SCALE IN METRES

PROJECT
MURRAY RIVER COAL PROJECT
TUMBLER RIDGE, B.C.

TITLE
SITE PLAN - BOREHOLE LOCATIONS AND PORTAL ALIGNMENT

Golder Associates

PROJECT No.		12-1494-0127	FILE No. 1214940127-4000-4500-01
DESIGN	DC	24AUG12	SCALE AS SHOWN
CADD	EA	27AUG12	
CHECK	BRL	29AUG12	
REVIEW	BD	30AUG12	

FIGURE 1

The drilling portion of the field investigation was conducted from July 31 to August 7, 2012, with a truck mounted Mobile 53 drill rig supplied and operated by Sea to Sky Drilling of Coquitlam, British Columbia. The drilling program included five boreholes advanced to depths ranging between 26.55 m and 33.83 m below existing ground surface (mbgs). Standard Penetration Tests (SPTs) were conducted at selected depths using a 51 mm diameter drive-open split spoon sampler, to obtain soil samples and provide an index measure of relative density and/or consistency of the soil. The SPTs were driven using an automatic trip hammer, which used a 63.5 kg weight dropped from a height of 762 mm. For details of SPT sample depths and uncorrected field SPT N-values in each borehole, refer to the individual Record of Borehole sheets in Appendix A.

Boreholes BH12-01, BH12-02, BH12-04, and BH12-05 were advanced into bedrock using HQ3 diamond coring equipment with HW steel casing advanced through the overburden and weathered rock profiles. Where bedrock was cored using HQ3 coring methods, each run was logged with respect to general rock type, recovery, rock quality (RQD), structure, strength, weathering and colour. Individual discontinuities were logged with respect to their depth, type, alpha angle (angle of the discontinuity relative to the axis of the core), shape, surface roughness, and infill characteristics. With the exception of the core samples selected for laboratory testing, the cores recovered from the boreholes were left in their core boxes and stacked neatly on site adjacent to each borehole location as directed by HD Mining. The geotechnical information logged from the cores is summarized in the corehole logs presented in Appendix B. Photographs of the recovered core are presented in Appendix D.

The boreholes were closed in accordance with the BC Groundwater Protection Regulation, which entailed backfilling the holes with a cement-bentonite grout or bentonite chips for the shallower holes.

The test pits were excavated with a Komatsu PC3000LC excavator supplied and operated with the arrangement of HD Mining. The test pits were excavated on August 10 to 11, 2012 to depths ranging from 6.0 m to 9.8 m where it is deemed not safe to continue the excavation. Record of Test pit Sheets are included in Appendix C.

Standpipe piezometers were installed in three of the five boreholes advanced. The installations were generally backfilled with sand in the screened sections, followed by drill cuttings above the sand in the solid section, and finally by a nominal 0.6 m thickness bentonite seal at the ground surface. Details for each standpipe installation are provided in the Record of Borehole sheets in Appendix A.

The field investigation program was carried out under the full-time supervision of member(s) of Golder's Kamloops geotechnical staff, who recorded the soil and rock conditions encountered, observed groundwater conditions during drilling, and collected soil and rock samples for review and subsequent laboratory testing.

Groundwater levels were measured in the standpipe Piezometers on August 7, 9 ,and 11, 2012. The most recent readings obtained on August 11, 2012 were noted in the Record of Borehole sheets in Appendix A.

Table 1 below provides a summary of the completion results of the boreholes and test pits in the field investigation program.

Table 1: Borehole and Test Pit Depth Summary

Borehole ID	Depth (m)	Overburden Thickness Encountered (m)	Bedrock Thickness Encountered (m)	Standpipe Piezometers
BH12-01	26.55	10.53	16.02	Two standpipe piezometers were installed
BH12-02	31.38	9.30	22.08	
BH12-03	33.83	33.83	n/a	One standpipe piezometer was installed
BH12-04	28.04	18.02	10.02	One standpipe piezometer was installed
BH12-05	29.90	19.16	10.74	
TP12-01	6.0	5.5	0.5	
TP12-02	8.5	4.7	3.8	
TP12-03	9.8	9.8	n/a	
TP12-04	9.3	9.3	n/a	
TP12-05	5.5	4.4	1.1	

4.0 LABORATORY TESTING

4.1 Soils

Soil samples collected during the field investigation were transported back to Golder's Laboratory in Burnaby, BC. Laboratory testing on soil samples was not carried out.

4.2 Rock Cores

Rock core samples collected during the field investigation were transported back to Golder's laboratory in Burnaby, BC. Select samples were tested for Uniaxial Compressive Strength (UCS; ASTM D7012-07). Results from the laboratory testing of rock cores are provided in Appendix E.

5.0 CLOSURE

We trust this data report provides the information for your reference. If you have any questions or concerns, please contact the undersigned at your convenience.

GOLDER ASSOCIATES LTD.

ORIGINAL SIGNED

Bingsheng Liu, Ph.D, P.Eng.
Senior Geotechnical Engineer

ORIGINAL SIGNED

Bruce Downing, P.Eng.
Principal, Senior Geotechnical Engineer

BRL/BD/ap

n:\active\2012\1494 geotechnical\12-1494-0127 hd mining murray river geotechnical design\07 deliverables\task 4600 additional drilling for portal cut\1214940127-r-rev0-4000-4600 geotech data report 13sep_12.docx

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

APPENDIX A

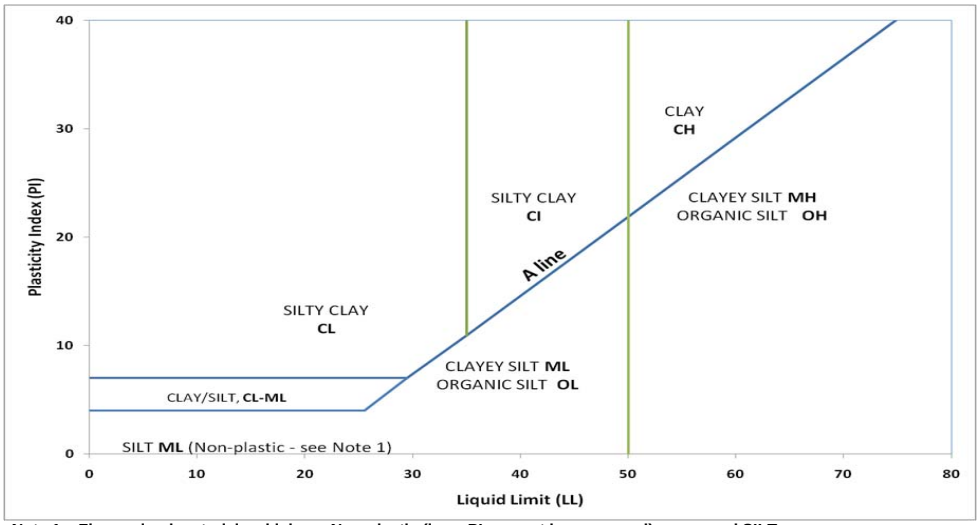
Record of Borehole Sheets

METHOD OF SOIL CLASSIFICATION

Organic or Inorganic	Soil Group	Type of Soil		Gradation or Plasticity	$Cu = \frac{D_{60}}{D_{10}}$	$Cc = \frac{D_{30}^2}{D_{10} x D_{60}}$	Organic Content	USCS Group Symbol	Group Name
INORGANIC (Organic Content <30% by mass)	COARSE GRAINED SOILS (>50% by mass is larger than 0.075 mm)	GRAVELS (>50% by mass is larger than 4.75 mm)	Gravels with <12% fines (by mass)	Poorly Graded	<4	≤1 or ≥3	<30%	GP	GRAVEL
				Well Graded	≥4	1 to 3		GW	GRAVEL
			Gravels with >12% fines (by mass)	Below A Line	n/a			GM	SILTY GRAVEL
				Above A Line	n/a			GC	CLAYEY GRAVEL
		SANDS (>50% by mass is smaller than 4.75 mm)	Sands with <12% fines (by mass)	Poorly Graded	<6	≤1 or ≥3		SP	SAND
				Well Graded	≥6	1 to 3		SW	SAND
			Sands with >12% fines (by mass)	Below A Line	n/a			SM	SILTY SAND
				Above A Line	n/a			SC	CLAYEY SAND

Organic or Inorganic	Soil Group	Type of Soil		Laboratory Tests	Field Indicators				Organic Content	USCS Group Symbol	Group Name
					Dilatancy	Dry Strength	Thread Diameter	Toughness (of 3 mm thread)			
INORGANIC (Organic Content <30% by mass)	FINE GRAINED SOILS (>50% by mass is smaller than 0.075 mm)	SILTS (PI and LL plot below A-Line on Plasticity Chart)		Liquid Limit <50	Rapid	None	>6 mm	N/A (can't roll 3 mm thread)	<5%	ML	SILT
					Slow	None to Low	3mm to 6 mm	None to low	<5%	ML	CLAYEY SILT
					Slow to very slow	Low to medium	3mm to 6 mm	Low	5% to 30%	OL	ORGANIC SILT
				Liquid Limit >50	Slow to very slow	Low to medium	3mm to 6 mm	Low to medium	<5%	MH	CLAYEY SILT
					None	Medium to High	1 mm to 3 mm	Medium to High	5% to 30%	OH	ORGANIC SILT
		CLAYS (PI and LL plot above A-Line on Plasticity Chart)		Liquid Limit <35	None	Low to medium	~ 3 mm	Low to medium	0% to 30%	CL	SILTY CLAY
				Liquid Limit 35 to 50	None	Medium to High	1 mm to 3 mm	Medium		CI	SILTY CLAY
				Liquid Limit >50	None	High	<1 mm	High		CH	CLAY
HIGHLY ORGANIC SOILS (Organic Content >30% by mass)		Peat and mineral soil mixtures							30% to 75%	PT	SILTY PEAT, SANDY PEAT
		Predominantly peat, may contain some mineral soil, fibrous or amorphous peat							>75%		PEAT

PLASTICITY CHART



Note 1 – Fine grained materials which are Non-plastic (i.e. a PL cannot be measured) are named SILT.

Dual Symbol — A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC, CL-ML used when the soil has between 5 and 12% fines (*i.e.* between "clean" sand and "dirty" sand) or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

Borderline Symbol — A borderline symbol is two symbols separated by a slash, for example, CL/CI, GM/SM, CL/ML.

SYMBOLS AND TERMS USED ON RECORDS OF BOREHOLES AND TEST PITS

PARTICLE SIZES OF CONSTITUENTS

Soil Constituent	Particle Size Description	Millimetres	Inches (US Std. Sieve Size)
BOULDERS	Not Applicable	>300	>12
COBBLES	Not Applicable	75 to 300	3 to 12
GRAVEL	Coarse Fine	19 to 75 4.75 to 19	0.75 to 3 (4) to 0.75
SAND	Coarse Medium Fine	2.00 to 4.75 0.425 to 2.00 0.075 to 0.425	(10) to (4) (40) to (10) (200) to (40)
SILT/CLAY	Classified by plasticity	<0.075	< (200)

MODIFIERS FOR SECONDARY AND MINOR CONSTITUENTS

Percentage by Mass	Modifier
≤ 5	trace
5 to 12	some
12 to 35	Primary soil name prefixed with "gravelly, sandy, SILTY, CLAYEY" as applicable
>35	Use 'and' to combine major constituents (*i.e.,* SAND and GRAVEL, SAND and CLAY)

PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open sampler for a distance of 300 mm (12 in.).

Piezo-Cone Penetration Test (CPT)

An electronic cone penetrometer with a 60° conical tip and a project end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (q_t), porewater pressure (u) and sleeve frictions are recorded electronically at 25 mm penetration intervals.

Dynamic Cone Penetration Resistance; N_d:

The number of blows by a 63.5 kg (140 lb) hammer dropped 760 mm (30 in.) to drive uncased a 50 mm (2 in.) diameter, 60° cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

SAMPLES

AS	Auger sample
BS	Block sample
CS	Chunk sample
SS	Split-spoon
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample

SOIL TESTS

w	water content
PL	plastic limit
LL	liquid limit
C	consolidation (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, Gs)
DS	direct shear test
GS	specific gravity
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	Modified Proctor compaction test
SPC	Standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V (FV)	field vane (LV-laboratory vane test)
γ	unit weight

Note: [1] Tests which are anisotropically consolidated prior to shear are shown as CAD, CAU.

NON-COHESIVE (COHESIONLESS) SOILS

Compactness

Term	SPT 'N' (blows/0.3m) *
Very Loose	0 - 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	>50

1. SPT 'N' in accordance with ASTM D 1586, uncorrected for overburden pressure effects or energy transfer.
2. Definition of compactness descriptions based on SPT 'N' ranges from Terzaghi and Peck (1967) and correspond to typical average N_{60} values.

Field Moisture Condition

Term	Description
Dry	Soil flows freely through fingers.
Moist	Soils are darker than in the dry condition and may feel cool.
Wet	As moist, but with free water forming on hands when handled.

COHESIVE SOILS

Consistency

Term	Undrained Shear Strength (kPa)	SPT 'N' (blows/0.3m)
Very Soft	<12	0 to 2
Soft	12 to 25	2 to 4
Firm	25 to 50	4 to 8
Stiff	50 to 100	8 to 15
Very Stiff	100 to 200	15 to 30
Hard	>200	>30

1. SPT 'N' in accordance with ASTM D 1586, uncorrected for overburden pressure effects or energy transfer.

Water Content

Term	Description
w < PL	Material is estimated to be drier than the Plastic Limit.
w ~ PL	Material is estimated to be close to the Plastic Limit.
w > PL	Material is estimated to be wetter than the Plastic Limit.

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-01

SHEET 1 OF 3

LOCATION: North of Old Conveyor Belt Alignment, near toe of slope
N: 6096943.72 E: 624890.98 NAD 83
Survey Provided by: McElhanney Consulting Services Ltd.

DRILLING DATE: July 31, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
		cleared drill pad		790.22							
0	Mobile B-53 / 75 mm Hollow Carbide Bit			0.00							Concrete plug to set stick-up casing.
1		(ML) SILT, some sand, trace fine rounded gravel, non-cohesive, brown, wet, compact.			1	SS	33				
2				787.47							Backfill with Cuttings
3		(SM) SILTY SAND, some fine rounded gravel, grey-brown, non-cohesive, wet, very loose.		2.74	2	SS	4				
4				785.80							Bentonite Chips
5	Mobile B-53 / 75 mm Tricone	(SM) SILTY SAND, some gravel, grey-brown, non-cohesive, wet, very dense. [TILL]		4.42	3	SS	87				
6	Mobile B-53 / 75 mm Hollow Carbide Bit	(Cl) SILTY CLAY, low to medium plasticity, grey and brown mottled, containing lake organics, cohesive, w~PL, stiff. [TILL]		784.43	4	SS	14				
7				5.79							Sand
8		(Cl) SILTY CLAY, medium plasticity, dary grey, containing mottled sand seams, cohesive, w~PL, hard. [TILLto fully weathered bedrock]		782.90	5	SS	39				
9	Mobile B-53 / 75 mm Tricone	(GC) CLAYEY GRAVEL, containing cobbles, dary grey, hard. [WEATHERED BEDROCK]		7.32	6	SS	100				8/11/2012 BH12-01S ▽ 25 mm Diameter
10		*CONTINUED NEXT PAGE*		781.23 8.99							

DEPTH SCALE
1 : 50

LOGGED: SNC
CHECKED: BRL

Golder Associates

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-01

SHEET 2 OF 3

LOCATION: North of Old Conveyor Belt Alignment, near toe of slope
N: 6096943.72 E: 624890.98 NAD 83
Survey Provided by: McElhanney Consulting Services Ltd.

DRILLING DATE: July 31, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
10	Mobile B-53	(GC) CLAYEY GRAVEL, containing cobbles, dary grey, hard. [WEATHERED BEDROCK] *(continued)*		779.70 / 10.52							Sand
11											
12											8/11/2012 BH12-01D ▽ 25 mm Diameter
13											
14											Bentonite Pellets
15	Mobile B-53 / HQ Coring	Refer to core hole log for continuation of rock description									
16											
17											
18											Sand
19											
20		*CONTINUED NEXT PAGE*									

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SNC
CHECKED: BRL

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-01

SHEET 3 OF 3

LOCATION: North of Old Conveyor Belt Alignment, near toe of slope
N: 6096943.72 E: 624890.98 NAD 83
Survey Provided by: McElhanney Consulting Services Ltd.

DATUM: Ground Surface

DRILLING DATE: July 31, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
20											
21											
22											
23	Mobile B-53 HQ Coring	Refer to core hole log for continuation of rock description *(continued)*									Sand
24											
25											3.05 m slotted 25 mm diameter PVC pipe
26				763.67							
		End of Borehole.		26.55							Slough Aug 7/12 GW levels: BH12-01S = 9.39 mbgs; BH12-01D = 12.13 mbgs.
27											
28											
29											
30											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SNC
CHECKED: BRL

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-02

SHEET 1 OF 4

LOCATION: Upslope, along old alignment
N: 6096932.69 E: 624789.17 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 2, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
		cleared drill pad		809.66							
0				0.00							
1		(ML) SILT, some sand, low plasticity, brown, cohesive, w>PL, stiff			1	SS	10				
2											
				806.91							
		(SM) SILTY SAND, fine to medium grained, brown, non-cohesive, wet, compact		2.74							
3					2	SS	11				
				806.46							
				3.20							
4											
					3	SS	44				
5	Mobile B-53										
	75mm Hollow Carbide Bit										
6		(Cl) SILTY CLAY, medium plasticity, grey, homogeneous, cohesive, w~PL, hard [TILL to fully weathered bedrock]			4	SS	40				
7											
					5	SS	43				
8											
					6	SS	50				
				800.36							
9				9.30							
		Please refer to core hole log for continuation of rock description									
10											
		CONTINUED NEXT PAGE									

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SNC
CHECKED: BRL

File:N:\ACTIVE\2012\1494-0127 HD MINING MURRAY RIVER GEOTECHNICAL DESIGN\06 DATA\2012 DRILLING PROGRAM\12-1494-0127 2012 DRILLING BH LOGS.GPJ Output Form:BC_BOREHOLE (AUTO) Template:BC REGION TEMPLATE BETA 1.GDT Library:BC REGION LIBRARY.GLB BLoehr 9/6/12

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-02

SHEET 2 OF 4

LOCATION: Upslope, along old alignment
N: 6096932.69 E: 624789.17 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 2, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
10	Mobile B-53 75mm Hollow Carbide Bit	Please refer to core hole log for continuation of rock description *(continued)*									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20		*CONTINUED NEXT PAGE*									

DEPTH SCALE
1 : 50

LOGGED: SNC
CHECKED: BRL

Golder Associates

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-02

SHEET 3 OF 4

LOCATION: Upslope, along old alignment
N: 6096932.69 E: 624789.17 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 2, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
20	Mobile B-53 75mm Hollow Carbide Bit	Please refer to core hole log for continuation of rock description *(continued)*									
21											
22											
23											
24											
25											
26											
27											
28											
29											
30		*CONTINUED NEXT PAGE*									

DEPTH SCALE
1 : 50

LOGGED: SNC
CHECKED: BRL

Golder Associates

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-02

SHEET 4 OF 4

LOCATION: Upslope, along old alignment
N: 6096932.69 E: 624789.17 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 2, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
30	Mobile B-53 75mm Hollow Carbide Bit	Please refer to core hole log for continuation of rock description *(continued)*									
31				778.28							
		End of Borehole.		31.38							
32											
33											
34											
35											
36											
37											
38											
39											
40											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SNC
CHECKED: BRL

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-03

SHEET 1 OF 4

LOCATION: North West corner of cleared area
N: 6096785.376 E: 624885.79 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 3, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
0		cleared drill pad		782.79							
				0.00							Concrete plug to set stick-up casing.
1											
					1	SS	33				
2		(SW/GW) SAND and GRAVEL, well graded, trace fines, non-cohesive, moist to wet, dense, containing cobbles									
					2	SS	36				Cuttings backfill / concrete for casing
3											
				778.83							
4				3.96							
					3	SS	17				
5	Mobile B-53										Bentonite Chips
	75 mm hollow Carbide Bit										
6					4	SS	11				
		(SW) SAND, trace fines, well graded, brown, non-cohesive, wet, compact, containing seams of SILT (ml), brown non-cohesive, wet, compact									
7											
					5	SS	10				Granular slough
8											
9				773.65	6	SS	11				
				9.14							
		(ML), CLAYEY SILT, low plasticity, brown, cohesive, w>PL, stiff									Bentonite Chips
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SNC
CHECKED: BRL

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-03

SHEET 2 OF 4

LOCATION: North West corner of cleared area
N: 6096785.376 E: 624885.79 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 3, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
10		(ML), CLAYEY SILT, low plasticity, brown, cohesive, w>PL, stiff *(continued)*									Bentonite Chips
				772.12 / 10.67	7	SS	24				
11											
12					8	SS	26				
13											
14											
15	Mobile B-53 / 75 mm hollow Carbide Bit	(SW) SAND, fine to medium grained, brown, non-cohesive, wet, compact to dense, containing seams of (ml) CLAYEY SILT, low plasticity, brown, cohesive, w>PL, stiff to very stiff			9	SS	33				Sand Backfill
16											
17											
18					10	SS	31				
19											8/11/2012 BH12-03 ▽ 25 mm Diameter
20		*CONTINUED NEXT PAGE*									

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SNC
CHECKED: BRL

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-03

SHEET 3 OF 4

LOCATION: North West corner of cleared area
N: 6096785.376 E: 624885.79 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 3, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
20											
21	Mobile B-53 75 mm hollow Carbide Bit	(SW) SAND, fine to medium grained, brown, non-cohesive, wet, compact to dense, containing seams of (ml) CLAYEY SILT, low plasticity, brown, cohesive, w>PL, stiff to very stiff *(continued)*			11	SS	44				
22											
23											
24					12	SS	41				Sand Backfill
25				757.34 / 25.45							
26		(SW/GW) SAND and GRAVEL, some fines, grey-brown, non-cohesive, wet, dense [TILL]									
27					13	SS	48				
28				754.75 / 28.04							Sandy slough
29		(SW) SAND, some fines, trace of gravel, well graded, grey-brown, non-cohesive, wet, dense (TILL)									Sand
30		*CONTINUED NEXT PAGE*									

DEPTH SCALE
1 : 50

LOGGED: SNC
CHECKED: BRL

Golder Associates

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-03

SHEET 4 OF 4

LOCATION: North West corner of cleared area
N: 6096785.376 E: 624885.79 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 3, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
30											
31	Mobile B-53 75 mm hollow Carbide Bit	(SW) SAND, some fines, trace of gravel, well graded, grey-brown, non-cohesive, wet, dense (TILL) *(continued)*			14	SS	47				Sand 3.05 m slotted 25 mm diameter PVC pipe
32				750.02 32.77							
33		(SW) gravelly SAND, some fines, brown, non-cohesive, wet, very dense (TILL)			15	SS	58				
34		End of Borehole.		748.96 33.83							Aug 7/12 GW Level: BH12-03 = 18.88 mbgs.
35											
36											
37											
38											
39											
40											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SNC
CHECKED: BRL

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-04

SHEET 1 OF 3

LOCATION: East of BH12-01
N: 6096922.89 E: 624953.47 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 4, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
		cleared drill pad		780.98							
0				0.00							Concrete plug to set stick-up casing.
1	Mobile B-53 0.2 m³ Bucket	(ML) SILT, some sand, trace gravel, non-cohesive, moist, dense, containing cobbles			1	SS	39				
2				778.54							
		(SW) gravelly SAND, trace of fines, grey-brown, non-cohesive, moist, compact		2.44	2	SS	26				
3				777.32							
4		(SW) SAND, some rounded gravel, fine to medium grained sand, trace of fines, brown, non-cohesive, moist, compact		3.66	3	SS	19				
5				775.19							Slough and Backfill with Cuttings
6		(ML) CLAYEY SILT, some sand, some subrounded gravel, cohesive, w>PL, very stiff (TILL)		5.79	4	SS	18				
7				773.66							
8		(SW/GW) SAND and GRAVEL, trace of fines, brown, non-cohesive, moist, compact, cobble at 47.5 ft (TILL)		7.32	5	SS	18				
9					6	SS	16				
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE
1 : 50

LOGGED: SNC
CHECKED: BRL

Golder Associates

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-04

SHEET 2 OF 3

LOCATION: East of BH12-01
N: 6096922.89 E: 624953.47 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 4, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp, W, Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
10											
11					7	SS					
12		(SW/GW) SAND and GRAVEL, trace of fines, brown, non-cohesive, moist, compact, cobble at 47.5 ft (TILL) *(continued)*			8	SS	25				
13											Slough and Backfill with Cuttings
14					9	SS	21				8/11/2012 ▽
15	Mobile B-53 0.2 m^3 Bucket			766.04							
		(SW/SP) SAND, fine to medium grained banded with medium to coarse grained, brown, non-cohesive, wet, compact (TILL)		14.94	10	SS	26				
16											Bentonite Pellets
17					11	SS	12				
				763.61							
		(GM) SILTY GRAVEL, trace sand, angular, dark grey with orange mottling, non-cohesive, dry to moist, very dense (WEATHERED BEDROCK)		17.37	12	SS	100				
18				763.00							Sand
				17.98							
19		Please refer to core hole log for continuation of rock description									
20											Slough
		CONTINUED NEXT PAGE									

DEPTH SCALE
1 : 50

LOGGED: SNC
CHECKED: BRL

Golder Associates

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-04

SHEET 3 OF 3

LOCATION: East of BH12-01
N: 6096922.89 E: 624953.47 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 4, 2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
20											Slough
21											
22											
23											
24	Mobile B-53 0.2 m^3 Bucket	Please refer to core hole log for continuation of rock description *(continued)*									Sand
25											
26											
27											3.05 m slotted 25 mm diameter PVC pipe
28				752.94 28.04							
		End of Borehole.									Aug 7/12 GW Level: BH12-04 = 15.40 mbgs.
29											
30											

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SNC
CHECKED: BRL

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-05

SHEET 1 OF 3

LOCATION: South of BH12-01, North of BH12-03
N: 6096869.87 E: 624885.463 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 6,2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (nat V. + Q - ● / rem V. ⊕ U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (Wp — W — Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
		cleared drill pad		783.79							
0	Mobile B-53 75 mm Hollow Carbide Bit	(SM/GM) SILTY SAND and GRAVEL, orange-white, non-cohesive, dry, compact		0.00							
1				782.57							
		(SW/GW) SAND and GRAVEL, trace fines, subrounded to rounded, orange-white becoming grey, non-cohesive, wet, compact to dense		1.22	1	SS	33				
2											
3					2	SS	47				
4											
					3	SS	35				
5											
6					4	SS	24				
7				776.63							
		(SM) SILTY SAND, very fine to fine grained, brown, non-cohesive, wet, compact		7.16	5	SS	28				
8											
				775.26							
		(SP) SAND, trace fines, very fine to fine, brown, non-cohesive, wet, compact, containing seams of (cl) SILTY CLAY, low pasticity, brown, cohesive, w>PL, very stiff		8.53							
9					6	SS	18				
10		*CONTINUED NEXT PAGE*									

DEPTH SCALE
1 : 50

Golder Associates

LOGGED: SNC
CHECKED: BRL

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-05

SHEET 2 OF 3

LOCATION: South of BH12-01, North of BH12-03
N: 6096869.87 E: 624885.463 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 6,2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa (nat V. +, rem V. ⊕, Q - ●, U - ○) (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}); WATER CONTENT PERCENT (Wp, W, Wl, NP - Non-Plastic) (10 20 30 40)	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
10	Mobile B-53 75 mm Hollow Carbide Bit	(SP) SAND, trace fines, very fine to fine, brown, non-cohesive, wet, compact, containing seams of (cl) SILTY CLAY, low pasticity, brown, cohesive, w>PL, very stiff *(continued)*									
11					7	SS	29				
12					8	SS	34				
13											
14											
15				768.79 15.00	9	SS	100				
16		(GM/GC) SILTY GRAVEL TO CLAYEY GRAVEL, some sand, dark grey, cohesive, w>PL, very dense, (TILL) or (HIGHLY WEATHERED BEDROCK)									
17											
18					10	SS	100				
19		Please refer to core hole log for continuation of rock description		765.20 18.59							
20		*CONTINUED NEXT PAGE*									

DEPTH SCALE
1 : 50

LOGGED: SNC
CHECKED: BRL

Golder Associates

PROJECT No.: 12-1494-0127

RECORD OF BOREHOLE: BH12-05

SHEET 3 OF 3

LOCATION: South of BH12-01, North of BH12-03
N: 6096869.87 E: 624885.463 NAD 83
Survey Provided by: McElhanney

DRILLING DATE: August 6,2012
DRILLING CONTRACTOR: Sea to Sky Drilling Ltd.

DATUM: Ground Surface

SAMPLER HAMMER, 64kg; DROP, 762mm

INCLINATION: -90°

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. / DEPTH (m)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80) / SHEAR STRENGTH Cu, kPa (20 40 60 80) nat V. + Q - ● rem V. ⊕ U - ○	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-6} 10^{-5} 10^{-4} 10^{-3}) / WATER CONTENT PERCENT (10 20 30 40) Wp W Wl NP - Non-Plastic	ADDITIONAL LAB. TESTING	PIEZOMETER, STANDPIPE OR THERMISTOR INSTALLATION
20	Mobile B-53 75 mm Hollow Carbide Bit	Please refer to core hole log for continuation of rock description *(continued)*									
21											
22											
23											
24											
25											
26											
27											
28											
29											
30				753.89 29.90							
		End of Borehole.									

DEPTH SCALE
1 : 50

LOGGED: SNC
CHECKED: BRL

Golder Associates

APPENDIX B

Core Logs

LITHOLOGICAL AND GEOTECHNICAL DESCRIPTION OF ROCK

CORE LOG DEFINITIONS:

Recovery (%): Records the total cumulative length of all core recovered in the core tube, and expressed as a percentage of the total length drilled.

RQD Rock Quality Designation (RQD): The total cumulative length of sound core recovered in lengths greater than 10 cm, as measured along the centreline axis of the core. The 10 cm index length is independent of core size, and is applicable to BQ, NQ, HQ, PQ, 4-inch, and 6-inch core sizes.

Fracture Frequency per Run: Number of natural discontinuities per geotechnical interval. Where a zone of broken core or rubble is encountered, and the number of discontinuities within that zone is unknown, it has been assumed that there is a fracture spacing of five (5) to two (2) centimetres for the length of the zone of broken core or rubble respectively.

Alpha Angle: The maximum angle of dip measured between the discontinuity plane and the core axis (0° = parallel to core axis; 90° = perpendicular to core axis)

Beta Angle: The linear angle between the orientation reference line, which is a straight line along the core and parallel to the core axis, and the lowest point of the ellipse of the discontinuity, measured clockwise, looking down the axis of the core.

Shape: Planarity (or shape) of the discontinuity surface at the scale of the cored rock.

Roughness: Small scale roughness or “feel” of the discontinuity surface at the scale of the cored rock.

Infill Character: Information regarding the character of the discontinuity, indicating whether the discontinuity is clean, stained, altered, coated or infilled.

Infill Type: Mineral or soil composition of the stain, alteration, coating or infilling.

Infill Thickness: Apparent aperture of the discontinuity or thickness of the coating or infilling material. If televiewer imaging is available aperture can be measured directly from the images.

Jn NGI: Joint set number.

Ja NGI: Joint alteration number.

Jr NGI: Joint roughness number.

Jcon CSIR: Joint condition rating.

Microfracture: A healed discontinuity in the rock.

SEQUENCE OF TERMS FOR ROCK DESCRIPTION:

A complete rock description includes the following:

A)	**Weathered State**	**E)**	**Porosity**
B)	**Structure**	**F)**	**Strength**
C)	**Color**	**G)**	**Rock Type**
D)	**Grain or Crystal Size**	**H)**	**Geologic Unit and / or Formation Name**

Example:
"Slightly weathered, thin to medium bedded, grey, fine grained, moderately porous, strong, DOLOMITE (Lockport Formation)"
NOTE: When known, the geologic name of the unit and/or formation is given.

DESCRIPTION OF WEATHERED / ALTERED STATE:

(Reference: Rock Characterization Testing and Monitoring: ISRM Suggested Methods, 1981)

Term	Symbol	Description	Discoloration Extent	Fracture Condition	Surface Character
Fresh	W1/A1	No visible sign of rock material weathering or alteration.	None	Closed or Discoloured	Unchanged
Slightly Weathered or Altered	W2/A2	Discoloration indicates weathering of rock material on discontinuity surfaces. Less than 5% of rock mass altered.	<20% of fracture spacing on both sides of fracture	Discoloured, may contain thin filling	Partial discoloration
Moderately Weathered or Altered	W3/A3	Less than 50% of the rock material is decomposed and/or disintegrated to a soil or is altered. Fresh or discoloured rock is present either as a discontinuous framework or as corestones.	>20% of fracture spacing on both sides of fracture	Discoloured, may contain thick filling	Partial to complete discoloration, not friable except poorly cemented rocks
Highly Weathered or Altered	W4/A4	More than 50% of the rock material is decomposed and/or disintegrated to a soil or is altered. Fresh or discoloured rock is present either as a discontinuous framework or as core stones.	Throughout	Filled with alteration minerals	Friable and possibly pitted
Completely Weathered or Altered	W5/A5	100% of rock material is decomposed and/or disintegrated to soil or 100% of the minerals have been replaced with alteration minerals. The original mass structure is still largely intact.	Throughout	Filled with alteration minerals	Resembles soil
Residual Soil (applies to weathering only)	W6	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.	Throughout	N/A	Resembles soil

DESCRIPTION OF ROCK STRENGTH:

(Reference: Rock Characterization Testing and Monitoring: ISRM Suggested Methods, 1981)

Grade	Description	Field Identification	Approx. Range of Uniaxial Compressive Strength (MPa)
R0	Extremely weak	Indented by thumbnail.	0.25 – 1.0 (>2.5 on Pocket Penetrometer)
R1	Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife.	1.0 - 5.0 (Maximum reading exceeded for Pocket Penetrometer)
R2	Weak	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.	5.0 – 25
R3	Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer.	25 – 50
R4	Strong	Specimen requires more than one blow of geological hammer to fracture it.	50 – 100
R5	Very strong	Specimen requires many blows of geological hammer to fracture it.	100 – 250
R6	Extremely strong	Specimen can only be chipped with geological hammer.	>250

NOTE: Materials having a uniaxial compressive strength of less than about 0.5 MPa and cohesionless materials should be classified using soil classification systems. (1 MPa = 145 psi)

DESCRIPTION OF STRUCTURE:

(Reference: Rock Characterization Testing and Monitoring: ISRM Suggested Methods, 1981)

BEDDING THICKNESS

Term	Thickness
Very Thickly Bedded	> 2 m
Thickly Bedded	0.6 m - 2 m
Medium Bedded	0.2 m - 0.6 m
Thinly Bedded	60 mm - 0.2 m
Very Thinly Bedded	20 mm - 60 mm
Laminated	6 mm - 20 mm
Thinly Laminated	< 6 mm

DISCONTINUITY SPACING

Term	Spacing
Extremely Close	<20 mm
Very Close	20 mm - 60 mm
Close	60 mm - 0.2 m
Moderate	0.2 m - 0.6 m
Wide	0.6 m - 2 m
Very Wide	2 m - 6 m
Extremely Wide	> 6 m

APERTURE OPENING

Term	Aperture	General Terminology
Very Tight	<0.1 mm	"Closed" Features
Tight	0.1 - 0.25 mm	
Partly Open	0.25 - 0.5 mm	
Open	0.5 - 2.5 mm	"Gapped" Features
Moderately Wide	2.5 - 10 mm	
Wide	>10 mm	
Very Wide	1 - 10 cm	"Open" Features
Extremely Wide	10 - 100 cm	
Cavernous	>1 m	

ABBREVIATIONS FOR THE DESCRIPTION OF DISCONTINUITIES:

Shape:	Roughness:	Infilling / Coating Type:			
		Phyllosilicates	**Mineral Precipitate/Cement**		**Physical**
Pl: Planar	K: Slickensided	Bt: Biotite	Ca: Calcite	Si: Silt	Clean: Clean
Cu: Curved	Po: Polished	Pg: Phlogopite	Ep: Epidote	Su: Sulphide	St: Staining
Un: Undulating	Sm: Smooth	Ch: Chlorite	Fe: Iron	He: Hematite	Go: Gouge
St: Stepped	Ro: Rough	Cl: Clay	Mn: Manganese	Qz: Quartz	Br: Broken Rock
Ir: Irregular	Vr: Very Rough	Sr: Sericite	Gr: Graphite	Qfsp: Quartz Feldspar	Sa: Sand
		Oth: Other	Gy: Gypsum	Tc: Talc	Gv: Gravel

Type:			
Fracture	Fr	Bedding	Bd
Joint	Jn	Foliation	Fo
Fault	Flt	Cleavage	Cl
Vein	Vn	Broken Core	Bc
Open Vein	Vno	Contact	Con
		Open Contact	Cono

Joint Roughness (Jr):	
Discontinuous	4.0
Wavy and Rough	3.0
Wavy and Smooth	2.0
Planar/Rough or Wavy/Slickensided	1.5
Planar/Smooth or Filled	1.0
Planar/Slickensided	0.5

Joint Alteration (Ja):				
Unfilled or Coated:		**Filled:**		
Healed Fractures	0.75	Sand/Crushed Rock < 5mm		4
Staining only	1	Sand/Crushed Rock > 5mm		5
Slightly altered walls	2	Cement/Non-softening	< 5 mm	6
Silty/Sandy (Decomposing)	3	Soft Clays/Low friction	< 5 mm	8
Clay (Disintegrating)	4	Hydrating Clays/Chlorite	< 5 mm	12
		Cement/Non-softening	> 5 mm	10
		Soft Clays/Low friction	> 5 mm	15
		Hydrating Clays/Chlorite	> 5 mm	20

Joint Number (Jn):	
Massive	0.5
Occas. Random	1
One set	2
One plus random	3
Two sets	4
Two plus random	6
Three sets	9
Three plus random	12
Four or more sets	15
Crushed rock	20

Joint Condition (Jcon):	Value
Very rough surfaces, no separation, hard joint wall rock.	25
Rough to very rough surfaces, separation < 1mm, hard rock, clean or stained surfaces.	22
Slightly rough surfaces, separation < 1mm, hard joint wall rock.	20
Smooth or slightly rough and planar surfaces, or smooth and undulating surfaces, separation < 1mm, stained or slightly altered or partially coated surfaces.	16
Slightly rough surfaces, separation < 1mm, soft joint wall rock.	12
Joints open 1-5 mm, or gouge < 5mm, or slickensided or polished surfaces.	6
Soft gouge > 5 mm thick, or separation > 5 mm.	0

GEOTECHNICAL DATA COLLECTION AND ROCK MASS CHARACTERIZATION:

The standards used by Golder Associates Ltd for the collection of geotechnical data conform to the following rock mass characterization systems:

1. Norwegian Geotechnical Institute (NGI) Tunneling Quality Index, Q (Barton, 1974)
2. Council for Scientific and Industrial Research (CSIR) Rock Mass Rating System (Bieniawski, 1976)

RECORD OF DRILLHOLE: BH12-01

HD Mining International Ltd
Murray River Coal project
Tumbler Ridge, BC

Completion Date: 8/1/2012
Drill Contractor: Sea to Sky Drilling
Checked by: R. Preston

North: 6096943.72
East: 624890.98
UTM NAD83N Zone 10
Elevation: 790.22
Depth: 26.54 m
Azimuth: N/A
Dip: -90 degrees

Geotechnical Interval								Description/Comments	Discontinuities						Zones			UCS Strength (MPa)
From (m)	To (m)	Rock Type	ISRM Strength Rating	Weathering / Alteration Index	Recovery (%)	RQD (%)	Fracture Frequency (Fractures per Interval)		Depth	Type	Alpha Angle	Shape	Roughness	Infill	LC	BC	FZ	
10.53	11.25	SLT	R4	W1	100	93	5	Fresh siltstone with slight weathering along fracture surfaces.	10.73	JN	60	CU	Ro					
									10.74	JN	78	CU	Ro	Si				
									10.85	JN	55	CU	Ro	Fbx				
									11.05	JN	55	CU	Ro	Ca				
									11.09	JN	68	UN	Ro	Ca				
11.25	12.84	SLT	R3	W1	100	82	10	Fresh siltstone, containing thin coarser grained sand seams.	11.34	JN								
									11.43	JN				Si				
									11.61	JN				Si				
									11.79	JN				Si				
									12	BD								
									12.18	JN				Ca				
									12.3	JN								
									12.37	JN				Sa				
									12.38	JN				Si				
									12.47	BD				Ca				
									12.5	JN								
12.84	14.27	SLT	R3	W1	100	92	12	Fresh siltstone, containing thin coarser grained sand seams, slight weathering along fracture surfaces.	12.94	JN								
									13.15	JN								
									13.21	JN				Si				
									13.36	JN								
									13.37	JN								
									13.69	JN								
									13.91	JN								
									14.02	FLT				Fbx				
									14.26	JN								30.6
14.27	15.81	SLT	R3	W1	100	98	8	Fresh siltstone, slight weathering along fracture surfaces.	14.57	JN				Br				
									14.74	JN				Si				
									14.96	JN								
									15.13	JN				Br				
									15.31	JN				Br				
									15.57	JN								
15.81	17.34	SLT	R3	W1	100	95	9	Fresh siltstone, containing thin coarser grained sand seams.	15.87	JN								
									15.99	JN								
									16.06	JN								
									16.32	JN								
									16.47	JN								
									16.58	BD								
									16.74	JN				Oth				
									16.92	JN				Si				
									17.05	JN				Si				
									17.18	JN				Si				
17.34	17.92	SLT	R3	W1	100	55	8	Fresh siltstone, slight weathering along fracture surfaces.	17.4	JN								
									17.46	JN								
									17.5	BD								

Length of data per page: 7 m

RECORD OF DRILLHOLE: BH12-01

HD Mining International Ltd
Murray River Coal project
Tumbler Ridge, BC

Completion Date: 8/1/2012
Drill Contractor: Sea to Sky Drilling
Checked by: R. Preston

North: 6096943.72
East: 624890.98
UTM NAD83N Zone 10
Elevation: 790.22
Depth: 26.54 m
Azimuth: N/A
Dip: -90 degrees

Geotechnical Interval								Description/Comments	Discontinuities						Zones			UCS Strength (MPa)
From (m)	To (m)	Rock Type	ISRM Strength Rating	Weathering / Alteration Index	Recovery (%)	RQD (%)	Fracture Frequency (Fractures per Interval)		Depth	Type	Alpha Angle	Shape	Roughness	Infill	LC	BC	FZ	
17.34	17.92	SLT	R3	W1	100	55	8	Fresh siltstone, slight weathering along fracture surfaces.	17.62 17.67 17.72 17.82 17.92	JN JN JN JN JN								
17.92	18.88	SLT	R3	W1	100	100	3	Fresh siltstone.	18.18 18.36 18.78	JN JN JN								
18.88	20.43	SLT	R3	W1	100	92	11	Fresh siltstone.	19.06 19.07 19.2 19.23 19.26 19.58 19.85 20.01 20.16 20.25 20.31	JN JN JN JN JN JN JN JN JN JN JN				Su Si Fbx				30.4
20.43	21.96	SLT	R3	W1	100	87	11	Fresh Siltstone, containing thin finer grained seams.	20.59 20.86 20.95 21.23 21.45 21.66 21.76 21.87 21.9 21.96	JN JN JN JN JN JN JN JN JN JN				Br Fbx Br Si				
21.96	23.55	SLT	R3	W1	100	96	8	Fresh Siltstone, containing thin finer grained seams.	22.19 22.4 22.81 22.92 22.99 23 23.15 23.21 23.31 23.59 23.63 23.69 23.73 23.83	JN JN JN CON JN BD JN JN JN JN JN JN JN JN				Oth Br				
23.55	25.01	MST	R3	W1	100	89	12	Fresh mudstone.	24.03 24.23 24.4 24.42	JN JN JN JN				Br				

Length of data per page: 7 m

Golder Associates

RECORD OF DRILLHOLE: BH12-01

HD Mining International Ltd
Murray River Coal project
Tumbler Ridge, BC

Completion Date: 8/1/2012
Drill Contractor: Sea to Sky Drilling
Checked by: R. Preston

North: 6096943.72
East: 624890.98
UTM NAD83N Zone 10
Elevation: 790.22
Depth: 26.54 m
Azimuth: N/A
Dip: -90 degrees

Geotechnical Interval								Description/Comments	Discontinuities						Zones			UCS Strength (MPa)
Depth From (m)	To (m)	Rock Type	ISRM Strength Rating	Weathering / Alteration Index	Recovery (%)	RQD (%)	Fracture Frequency (Fractures per Interval)		Depth	Type	Alpha Angle	Shape	Roughness	Infill	LC	BC	FZ	
			1 2 3 4 5	1 2 3 4 5	25 50 75 100	25 50 75 100	10 20 30 40 50											24 48 72
23.55	25.01	MST	R3	W1	100	89	12	Fresh mudstone.	24.58	JN								17.1
									24.75	JN				Si				
									24.96	JN				Si				
25.01	26.54	SLT	R3	W1	100	80	14	Fresh Siltstone, containing thin finer grained seams.	25.28	JN								
									25.39	BD				Si				
									25.41	BD								
									25.55	BD								
									25.57	BD								
									25.59	JN								
									25.81	BD				Si				
									25.88	BD								
									25.98	BD								
									26.09	BD								
									26.16	BD								
									26.26	BD				Br				
									26.5	BD								

Length of data per page: 7 m

Golder Associates

RECORD OF DRILLHOLE: BH12-02

HD Mining International Ltd
Murray River Coal project
Tumbler Ridge, BC

Completion Date: 8/3/2012
Drill Contractor: Sea to Sky Drilling
Checked by: R. Preston

North: 6096932.69
East: 624789.17
UTM NAD83N Zone 10
Elevation: 809.66
Depth: 31.38 m
Azimuth: N/A
Dip: -90 degrees

Depth	Geotechnical Interval								Description/Comments	Discontinuities						Zones			UCS Strength (MPa)
	From (m)	To (m)	Rock Type	ISRM Strength Rating	Weathering / Alteration Index	Recovery (%)	RQD (%)	Fracture Frequency (Fractures per Interval)		Depth	Type	Alpha Angle	Shape	Roughness	Infill	LC	BC	FZ	
				1 2 3 4 5	1 2 3 4 5	25 50 75 100	25 50 75 100	10 20 30 40 50											24 48 72
10	9.30	9.60	MST	R2	W3	100	0	14	Fractured and moderately weathered mudstone, return is grey-brown.	9.3 9.36 9.47 9.58	CONO JN RUB JN	90 73 40 85	ST UN PL UN	Ro Ro Ro SM	Cl Oth Br Ca				
	9.60	9.90	MST	R2	W3	100	0	30	Highly fractured and moderately weathered mudstone, rubble consists of fine to medium sized rock pieces.	9.75 9.9	RUB LC	60	IR	Ro	Br				
	9.90	10.30	MST	R2	W2	100	0	30	Slightly weathered mudstone, recovered in Run #2.	10.11 10.16 10.19 10.25	JN JN JN JN	15 54 40 44	CU CU CU CU	Ro SM SM Ro	Si Ca Si Ca				
	10.30	10.64	MST	R0	W3	100	0	21	Fault consists of rare core stones with rubble consisting of sand and gravel sized rock pieces with silt.	10.31 10.32 10.4 10.45 10.59	FLT FLT FLT FLT FLT	34 86 43 40 75			Fbx Go Fbx Fbx Br			■	
	10.64	10.83								10.735	LC					■			
11	10.83	11.46	SLT	R2	W3	100	57	7	Moderately weathered siltstone.	10.93 11.08 11.16 11.22 11.33 11.38 11.45	JN JN JN JN JN JN JN	65 60 33 58 80 80 45	UN PL PL UN UN UN UN	SM Ro Ro SM Ro SM Ro	Si Si Cl Ca Si Cl Si				
	11.46	11.74								11.6	LC					■			
12	11.74	13.07	SLT	R2	W1	100	79	11	Fresh siltstone, broken core at top of run likely slough from lost core zones above.	11.81 12.14 12.23 12.26 12.3 12.37 12.69	RUB JN BD JN JN JN JN	45 73 32 43 90 67 63	UN UN CU CU CU CU CU	SM SM Ro SM SM SM Ro	Br Si Br Br Si				12.4
13	13.07	14.08	SLT	R2	W1	100	100	1	Fresh siltstone, containing thin coarser grained sand seams.	13.85	JN	75	UN	SM					
14	14.08	14.44	SLT	R0	W2	100	0	20	Fault consists of rare core stones with rubble consisting of sand and gravel sized rock pieces with silt.	14.1 14.16 14.22 14.37	FLT FLT FLT FLT	82 55 55 75	UN CU	SM SM	Br Go Br Fbx			■	
	14.44	14.59								14.59	LC					■			
15	14.59	16.10	SLT	R2		93	47	47	Slightly weathered siltstone.	14.74 14.85 14.91 14.99 15.05 15.15 15.66	RUB JN JN JN BC BC FLT	73 50 38 73 20 52 35	CU CU CU UN CU UN CU	SM SM Ro SM Ro Ro SM	Br Si Si Si Fbx Fbx Go				
16	16.10	17.53	SLT	R3	W1	100	88	7	Fresh, relatively intact siltstone.	16.04 16.16 16.21	RUB BD JN	90 30 68	UN PL ST	Ro SM SM	Br Si Ca				

Length of data per page: 7 m

RECORD OF DRILLHOLE: BH12-02

HD Mining International Ltd
Murray River Coal project
Tumbler Ridge, BC

Completion Date: 8/3/2012
Drill Contractor: Sea to Sky Drilling
Checked by: R. Preston

North: 6096932.69
East: 624789.17
UTM NAD83N Zone 10
Elevation: 809.66
Depth: 31.38 m
Azimuth: N/A
Dip: -90 degrees

Depth	Geotechnical Interval								Description/Comments	Discontinuities						Zones			UCS Strength (MPa)
	From (m)	To (m)	Rock Type	ISRM Strength Rating	Weathering / Alteration Index	Recovery (%)	RQD (%)	Fracture Frequency (Fractures per Interval)		Depth	Type	Alpha Angle	Shape	Roughness	Infill	LC	BC	FZ	
				1 2 3 4 5	1 2 3 4 5	25 50 75 100	25 50 75 100	10 20 30 40 50											24 48 72
17	16.10	17.53	**SLT**	**R3**	**W1**	**100**	**88**	**7**	Fresh, relatively intact siltstone.	16.79 16.83 16.87 16.91 17.1	FLT BD JN JN JN	68 28 45 65 63	CU CU CU PL PL	SM SM Ro SM SM	Fbx Si Si Si Si				
18	17.53	19.09	**SLT**	**R3**	**W1**	**100**	**98**	**2**	Fresh, intact siltstone, containing thin coarser grained seams.	18.55 18.58	JN JN	27 68	UN PL	Ro SM	 Si				27.9
19	19.09	20.62	**SST**	**R3**	**W1**	**100**	**100**	**3**	Fresh, intact sandstone.	19.09 19.56	BD JN	40 68	UN CU	SM Ro	Si Si				69.7
20										20.43	JN	73	CU	Ro					
21	20.62	22.17	**SST**	**R3**	**W1**	**100**	**98**	**4**	Fresh, intact sandstone.	20.83 21.18 21.21 21.89	JN JN JN JN	68 75 78 64	CU UN UN CU	Ro Ro Ro Ro	Su Su Su Si				
22	22.17	23.74	**SST**	**R3**	**W1**	**100**	**100**	**3**	Fresh, intact sandstone.	22.37 22.63	JN JN	74 72	PL CU	Ro Ro	Su Su				
23																			

Length of data per page: 7 m

RECORD OF DRILLHOLE: BH12-04

HD Mining International Ltd
Murray River Coal project
Tumbler Ridge, BC

Completion Date: 8/6/2012
Drill Contractor: Sea to Sky Drilling
Checked by: R. Preston

North: 6096922.89
East: 624953.47
UTM NAD83N Zone 10
Elevation: 780.98
Depth: 28.05 m
Azimuth: N/A
Dip: -90 degrees

Depth	Geotechnical Interval								Description/Comments	Discontinuities						Zones			UCS Strength (MPa)
	From (m)	To (m)	Rock Type	ISRM Strength Rating	Weathering / Alteration Index	Recovery (%)	RQD (%)	Fracture Frequency (Fractures per Interval)		Depth	Type	Alpha Angle	Shape	Roughness	Infill	LC	BC	FZ	
				1 2 3 4 5	1 2 3 4 5	25 50 75 100	25 50 75 100	10 20 30 40 50											24 48 72
	17.33	17.83	OB	R0	W6	100	0	25	Overburden slough.	17.58	RUB	90	CU	SM	Oth				
	17.83	18.02								17.925	LC								
18	18.02	18.42	SLT	R0	W3	100	0	20	Periodic loss of return during drilling, recovered material is likely slough and rubble zones with sand washed away.	18.12	RUB	90	CU	SM	Oth				
										18.32	RUB	90	CU	Ro	Br				
	18.42	18.79								18.605	LC								
	18.79	18.91	SLT	R0	W3	100	0	6	Broken rock likely due to slough from lost core zone.	18.85	RUB	90	CU	SM	Br				
19	18.91	19.29	SLT	R0	W3	100	0	38	Rubble consists of fine to medium gravel sized rock pieces with sand and silt.	18.94	JN	10	UN	Ro	Br				
										19.01	JN	45	PL	Ro	Fe				
										19.1	RUB	90	CU	Ro	Br				
										19.19	JN	25	PL	Ro	Br				
	19.29	19.46	SLT	R2	W3	100	0	8	Broken rock likely due to slough and washed material from above rubble zone.	19.39	RUB	63	PL	Ro	Br				
	19.46	20.21	SLT	R2	W2	100	39	14	Slightly weathered siltstone, with sand and fine grained rock pieces infilling some of the fractures.	19.56	JN	68	IR	Ro	Fe				
										19.64	JN	68	CU	Ro	Fe				
										19.69	JN	72	CU	Ro	Br				
										19.71	JN	75	PL	Ro	Fe				
										19.9	JN	37	CU	Ro	Si				
										19.96	JN	40	CU	Ro	Fbx				
20										20	JN	43	CU	Ro	Fbx				
										20.05	JN	25	PL	Ro	Fbx				
										20.07	JN	75	CU	Ro	Go				
										20.15	JN	33	UN	Ro	Fe				
										20.19	RUB	81	CU	Ro	Go				
	20.21	20.55	SLT	R3	W1	100	100	0	Fresh, intact siltstone.										
	20.55	22.08	SLT	R3	W2	100	48	18	Slightly fractured siltstone with iron coatings on most fracture surfaces.	20.84	JN	68	CU	Ro	Si				
										20.88	JN	66	UN	Ro	Si				
										20.9	JN	50	CU	Ro	Fe				
21										21.14	JN	65	CU	Ro	Fe				
										21.23	JN	74	CU	Ro	Br				
										21.25	JN	45	CU	Ro	Cl				
										21.34	JN	76	UN	Ro	Fe				
										21.44	JN	30	UN	Ro	Go				
										21.47	JN	74	IR	Ro	Fe				
										21.52	JN	52	CU	Ro	Fe				
										21.58	JN	55	IR	Ro	Fe				
										21.67	JN	40	UN	Ro	Fe				
										21.69	JN	51	PL	Ro	Fe				
										21.73	JN	37	PL	Ro	Si				
22										21.9	JN	36	CU	Ro	Fe				
										21.96	JN	38	CU	Ro	Si				
										22.01	JN	20	CU	Ro	Fe				
										22.07	JN	63	PL	Ro	Si				
										22.11	JN	58	PL	Ro	Fe				
										22.13	JN	18	CU	Ro	Si				
	22.08	23.03	SLT	R2	W2	100	26	20	Fractured siltstone with iron coatings on most fracture surfaces, broken rock infill consists of fine to medium sized gravel rock pieces.	22.16	JN	65	CU	Ro	Cl				
										22.27	JN	43	CU	Ro					
										22.35	JN	43	PL	Ro	Fe				
										22.39	JN	38	CU	Ro	Fe				
										22.46	JN	70	CU	SM	Cl				
										22.48	JN	35	CU	Ro	Oth				
23										22.5	JN	28	CU	Ro	Oth				
										22.54	RUB	88	CU	Ro	Oth				
										22.6	JN	48	CU	Ro	Br				
										22.63	JN	53	CU	Ro	Fe				
										22.65	JN	72	UN	Ro	Fe				
										22.68	JN	62	CU	Ro	Fe				
										22.69	JN	0	CU	Ro	Fbx				
										22.78	JN	53	CU	Ro	Si				
										22.91	JN	59	CU	Ro	Fbx				
										23.19	JN	60	CU	SM	Si				
	23.03	23.71	SLT	R3	W1	100	90	4	Slightly fractured, fresh siltstone.	23.37	BD	45	CU	Ro	Si				26.4
										23.44	JN	57	CU	SM	Si				
										23.69	JN	48	CU	SM					
24	23.71	25.11	SLT	R3	W1	100	94	8	Slightly fractured, fresh siltstone.	23.99	JN	57	CU	SM	Si				
										24.1	BD	40	CU	K					

Length of data per page: 7 m

RECORD OF DRILLHOLE: BH12-04

HD Mining International Ltd
Murray River Coal project
Tumbler Ridge, BC

Completion Date: 8/6/2012
Drill Contractor: Sea to Sky Drilling
Checked by: R. Preston

North: 6096922.89
East: 624953.47
UTM NAD83N Zone 10
Elevation: 780.98
Depth: 28.05 m
Azimuth: N/A
Dip: -90 degrees

Depth	Geotechnical Interval								Description/Comments	Discontinuities						Zones			UCS Strength (MPa)
	From (m)	To (m)	Rock Type	ISRM Strength Rating	Weathering / Alteration Index	Recovery (%)	RQD (%)	Fracture Frequency (Fractures per Interval)		Depth	Type	Alpha Angle	Shape	Roughness	Infill	LC	BC	FZ	
				1 2 3 4 5	1 2 3 4 5	25 50 75 100	25 50 75 100	10 20 30 40 50											24 48 72
25	23.71	25.11	SLT	R3	W1	100	94	8	Slightly fractured, fresh siltstone.	24.39	JN	53	CU	Ro	Ca				
										24.47	JN	55	CU	SM	Si				
										24.66	JN	57	PL	SM	Si				
										24.83	JN	60	CU	Ro	Si				
										24.93	JN	55	CU	Ro	Si				
										25.01	JN	50	CU	SM	Si				
	25.11	26.67	SLT	R3	W1	100	94	11	Slightly fractured, fresh siltstone.	25.15	JN	52	PL	SM	Cl				
										25.32	JN	54	CU	SM	Si				
										25.48	JN	44	CU	SM	Si				
26										25.67	JN	53	CU	SM	Ca				
										25.81	JN	50	CU	Ro	Si				
										26.03	JN	50	UN	Ro	Ca				
										26.19	JN	57	CU	Ro	Cl				
										26.26	JN	50	CU	SM	Ca				
										26.29	BD	45	CU	Ro	Ca				
										26.47	JN	48	CU	SM					
										26.6	JN	54	CU	SM	Si				
										26.8	JN	40	CU	SM	Ca				
										26.84	JN	44	CU	Ro	Ca				
										26.88	BD	40	UN	K	Si				
27										26.89	JN	48	CU	Ro					
																			34.9
	26.67	28.05	SLT	R3	W1	100	90	9	Slightly fractured, fresh siltstone.	27.35	JN	48	CU	SM	Si				
										27.4	JN	45	CU	Ro	Si				
										27.58	JN	48	CU	Ro	Si				
										27.71	JN	5	UN	Ro	Cl				
										27.84	JN	40	UN	Ro	Si				
28																			
29																			
30																			
31																			

Length of data per page: 7 m

RECORD OF DRILLHOLE: BH12-05

HD Mining International Ltd
Murray River Coal project
Tumbler Ridge, BC

Completion Date: 8/7/2012
Drill Contractor: Sea to Sky Drilling
Checked by: R. Preston

North: 6096869.87
East: 624885.46
UTM NAD83N Zone 10
Elevation: 783.79
Depth: 29.9 m
Azimuth: N/A
Dip: -90 degrees

Depth	Geotechnical Interval								Description/Comments	Discontinuities						Zones			UCS Strength (MPa)
	From (m)	To (m)	Rock Type	ISRM Strength Rating	Weathering / Alteration Index	Recovery (%)	RQD (%)	Fracture Frequency (Fractures per Interval)		Depth	Type	Alpha Angle	Shape	Roughness	Infill	LC	BC	FZ	
				1 2 3 4 5	1 2 3 4 5	25 50 75 100	25 50 75 100	10 20 30 40 50											24 48 72
18	17.25	18.70								17.975	LC								
19	18.70	19.16	OB	R0	W1	100	0	12	Overburden slough.	18.89	RUB	90	CU	SM	Br				
20	19.16	20.70	SLT	R3	W1	100	90	11	Fresh, slightly fractured siltstone, containing coarser grained sand seams.	19.21 19.32 19.4 19.51 19.7 19.82 19.99 20.05 20.37 20.39 20.56	JN BD BD BD JN JN JN JN JN JN BD	40 35 33 35 65 22 25 66 63 32 28	CU UN PL CU CU UN CU PL CU CU CU	Ro K SM SM SM Ro Ro SM SM SM K	Br Si Cl Cl Si Cl Si Si Sa				
21	20.70	21.45	SLT	R2	W3	100	33	36	Moderately weathered siltstone, infill of fractures consists of fine to medium sized gravel rock pieces with sand and silt.	20.9 21 21.03 21.04 21.1 21.25 21.37	FLT JN BD JN RUB RUB FLT	67 48 30 50 55 45 38	CU CU CU CU CU CU CU	Ro Ro Ro Ro Ro SM Ro	Fbx Br Br Fbx				
22	21.45	22.20								21.825	LC								
	22.20	22.50								22.35	LC								
23	22.50	23.09	SLT	R2	W2	100	63	9	Fractured, slightly weathered siltstone.	22.54 22.61 22.75 22.78 22.83 22.96 23.01 23.06 23.09	BD BD BD JN FLT BD BD BD JN	53 36 38 48 38 33 45 35 70	CU PL CU CU CU UN CU CU CU	SM SM SM Ro Ro Ro K Ro Ro	Cl Si Ca Cl Br Sa				
	23.09	23.82	SST	R3	W1	100	100	0	Fresh, intact sandstone.										
24	23.82	25.24	SST	R3	W1	100	100	1	Fresh, intact sandstone.	24.15	JN	57	UN	Ro	Si				63.8

Length of data per page: 7 m

Golder Associates

RECORD OF DRILLHOLE: BH12-05

HD Mining International Ltd
Murray River Coal project
Tumbler Ridge, BC

Completion Date: 8/7/2012
Drill Contractor: Sea to Sky Drilling
Checked by: R. Preston

North: 6096869.87
East: 624885.46
UTM NAD83N Zone 10
Elevation: 783.79
Depth: 29.9 m
Azimuth: N/A
Dip: -90 degrees

Depth	Geotechnical Interval								Description/Comments	Discontinuities						Zones			UCS Strength (MPa)
	From (m)	To (m)	Rock Type	ISRM Strength Rating	Weathering / Alteration Index	Recovery (%)	RQD (%)	Fracture Frequency (Fractures per Interval)		Depth	Type	Alpha Angle	Shape	Roughness	Infill	LC	BC	FZ	
				1 2 3 4 5	1 2 3 4 5	25 50 75 100	25 50 75 100	10 20 30 40 50											24 48 72
25	23.82	25.24	SST	R3	W1	100	100	1	Fresh, intact sandstone.	25.24	JN	70	CU	VR	Si				
26	25.24	26.82	SST	R3	W1	100	100	2	Fresh, intact sandstone.	26.02	JN	65	CU	Ro	Si				
27	26.82	28.34	SST	R3	W1	100	100	1	Fresh, intact sandstone.	27.67	JN	73	CU	Ro					
28	28.34	29.90	SST	R3	W1	100	100	3	Fresh, intact sandstone.	28.87	BD	35	CU	K					
29										29.13	BD	38	CU	K					36.1
30										29.74	BD	48	CU	Ro					
31																			

Length of data per page: 7 m

APPENDIX C

Record of Test Pit Sheets

Record of Test Pit Sheets

Test Pit No.	Depth (m)	Description	Sample / Depth
TP12-01	Northing: 6096881.861; Easting: 624794.269 (NAD83); Ground Elevation: **794.484** m Survey Provided by: McElhanney Consulting Services Ltd.		
	0 – 1.1	(SM) SILTY SAND, light brown, moist	SA1 (0.6 m)
	1.1 – 3.0	(SP) SAND, fine to medium grained, some coarse sand, grey, moist	SA2 (1.5 m)
	3.0 – 4.0	(ML) SILT, low plasticity, brown, w~PL	SA3 (3.0 m)
	4.0 – 5.5	(ML) SILT, low plasticity, dark grey, w~PL [TILL to Fully Weathered Bedrock]	
	5.5 – 6.0	SHALE, broken, weathered, grey	
		Slow seepage was oberserved at 4.0 mbgs. Test pit was terminated due to bucket refusal.	

TP12-01 Photo 1

Record of Test Pit Sheets

TP12-01 Photo 2

Record of Test Pit Sheets

Test Pit No.	Depth (m)	Description	Sample / Depth
TP12-02	Northing: 6096888.678; Easting: 624816.248 (NAD 83) Ground Elevation **792.357** m Survey Provided by: McElhanney Consulting Services Ltd.		
	0 – 1.6	(ML) SILT, some cobbles, some sand, brown, non-cohesive, moist	
	1.6 – 3.4	(SP) SAND, fine to medium grained, trace cobbles and gravel, trace silt, grey-light brown, moist	SA1 (2.5 m)
	3.4 – 4.7	(ML) CLAYEY SILT, low plasticity, dark grey, w~PL [Till to Fully Weathered Bedrock]	
	4.7 – 8.5	BEDROCK, broken [Highly Weathered Bedrock], depth of broken bedrock becomes deeper from north to south	
		Slow seepage was oberserved at 4.7 mbgs. Test pit was terminated due to reaching machine limit and close to bucket refusal.	

TP12-02 Photo 1

Record of Test Pit Sheets

TP12-02 Photo 2

Record of Test Pit Sheets

Test Pit No.	Depth (m)	Description	Sample / Depth
TP12-03	Northing: 6096854.031; Easting: 624792.283 (NAD 83) Ground Elevation **791.915** m Survey Provided by: McElhanney Consulting Services Ltd.		
	0 – 2.1	(SM) SILTY SAND/SANDY SILT, trace rootlets, fine grained, light brown, non-cohesive, moist	
	2.1 – 9.8	(SP) SAND, fine to medium grained, some seams of coarse sand, trace silt, grey, moist	
		No seepage was oberserved. Test pit was terminated since too deep to be excavated safely.	

TP12-0 3 Photo 1

Record of Test Pit Sheets

TP12-0 3 Photo 2

Record of Test Pit Sheets

Test Pit No.	Depth (m)	Description	Sample / Depth
TP12-04	Northing: 6096743.726; Easting: 624787.417 (NAD 83) Ground Elevation **791.463** m Survey Provided by: McElhanney Consulting Services Ltd.		
	0 – 3.0	(SM/ML) SILTY SAND/SANDY SILT, trace rootlets, fine grained, brown to grey, non-cohesive, moist	SA1 (2.9 m)
	3.0 – 9.3	(GP/SP) GRAVEL and SAND, fine to medium grained sand, coarse grained gravel, some cobbles, moist. Sloping down eastwards; keep caving	
		No seepage was oberserved. Test pit was terminated due to caving condition.	

TP12-04 Photo 1

Record of Test Pit Sheets

TP12-04 Photo 2

Record of Test Pit Sheets

Test Pit No.	Depth (m)	Description	Sample / Depth
TP12-05	Northing: 6096631.304; Easting: 624833.477 (NAD 83) Ground Elevation **787.100** m Survey Provided by: McElhanney Consulting Services Ltd.		
	0 – 1.8	(GP/SP) GRAVEL and SAND, some broken rock pieces, generally angular, some rounded boulders and cobbles, trace roots, brown, moist, [COLLUVIUM]	
	1.8 – 4.4	(SP) SAND, fine to medium grained, some silt, trace angular gravel, rounded cobbles and boulders, very dense	
	4.4 – 5.5	Possible BEDROCK, broken, siltstone to fine grained sandstone East side wall: N36°E<60° West side wall: N25°E<71°	
		No seepage was oberserved. Test pit was terminated due to bucket refusal. Sandstone outcrop at south end: N28°E<65°	

TP12-05 Photo 1

Record of Test Pit Sheets

TP12-05 Photo 2 (Looking south)

Record of Test Pit Sheets

Panorama View of the Testpitting Area

APPENDIX D

Photography of Soil and Cores

N:\Active\2012\1494 Geotechnical\12-1494-0127 HD Mining Murray River Geotechnical Design\07 Deliverables\Task 4600 Additional Drilling for Portal Cut

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-01 SS#1 1.22m to 1.83m**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

N:\Active\2012\1494 Geotechnical\12-1494-0127 HD Mining Murray River Geotechnical Design\07 Deliverables\Task 4600 Additional Drilling for Portal Cut

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-01 SS#3 (4.27m to 4.72m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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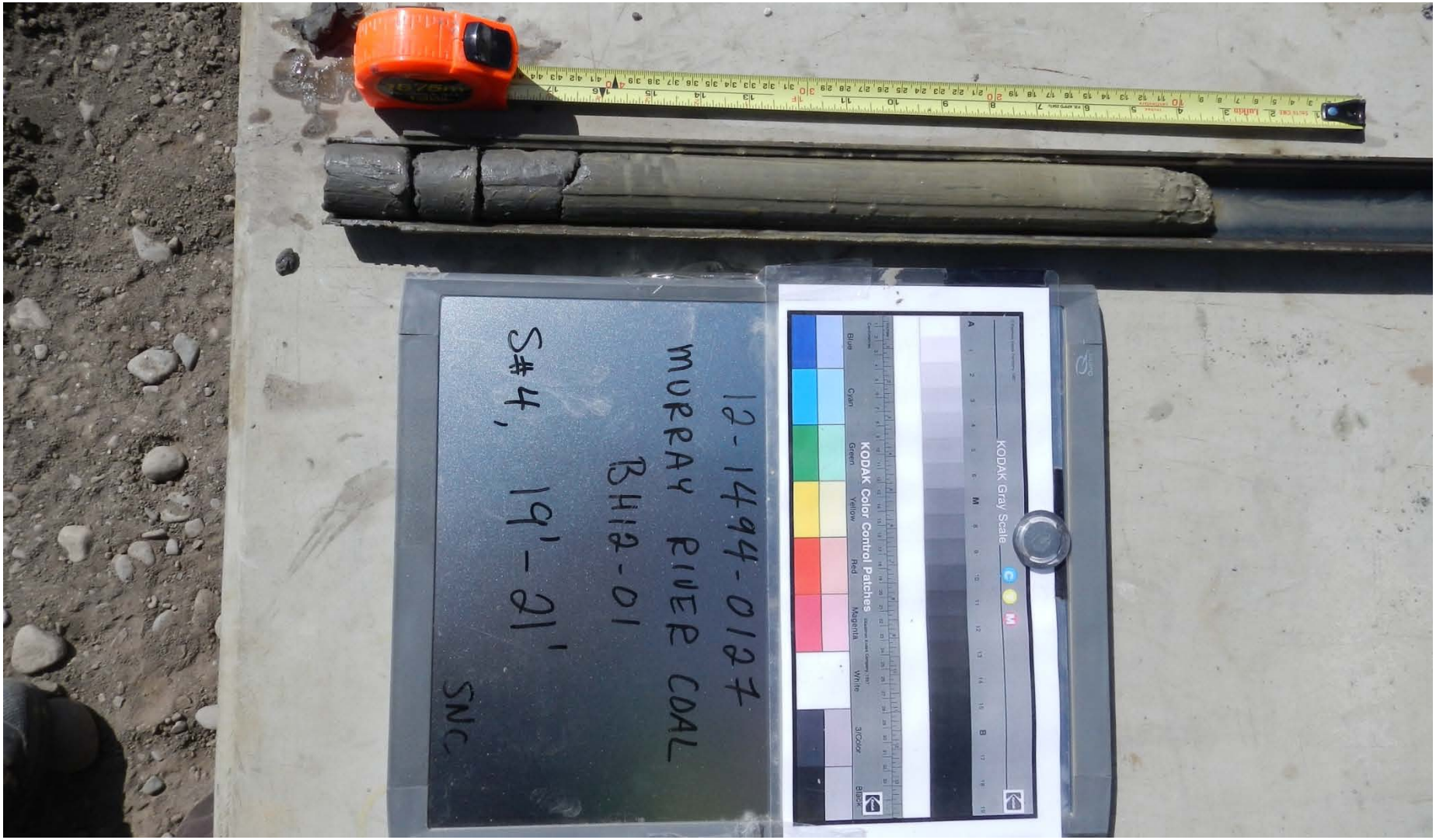

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-01 SS#4 (5.79m to 6.40m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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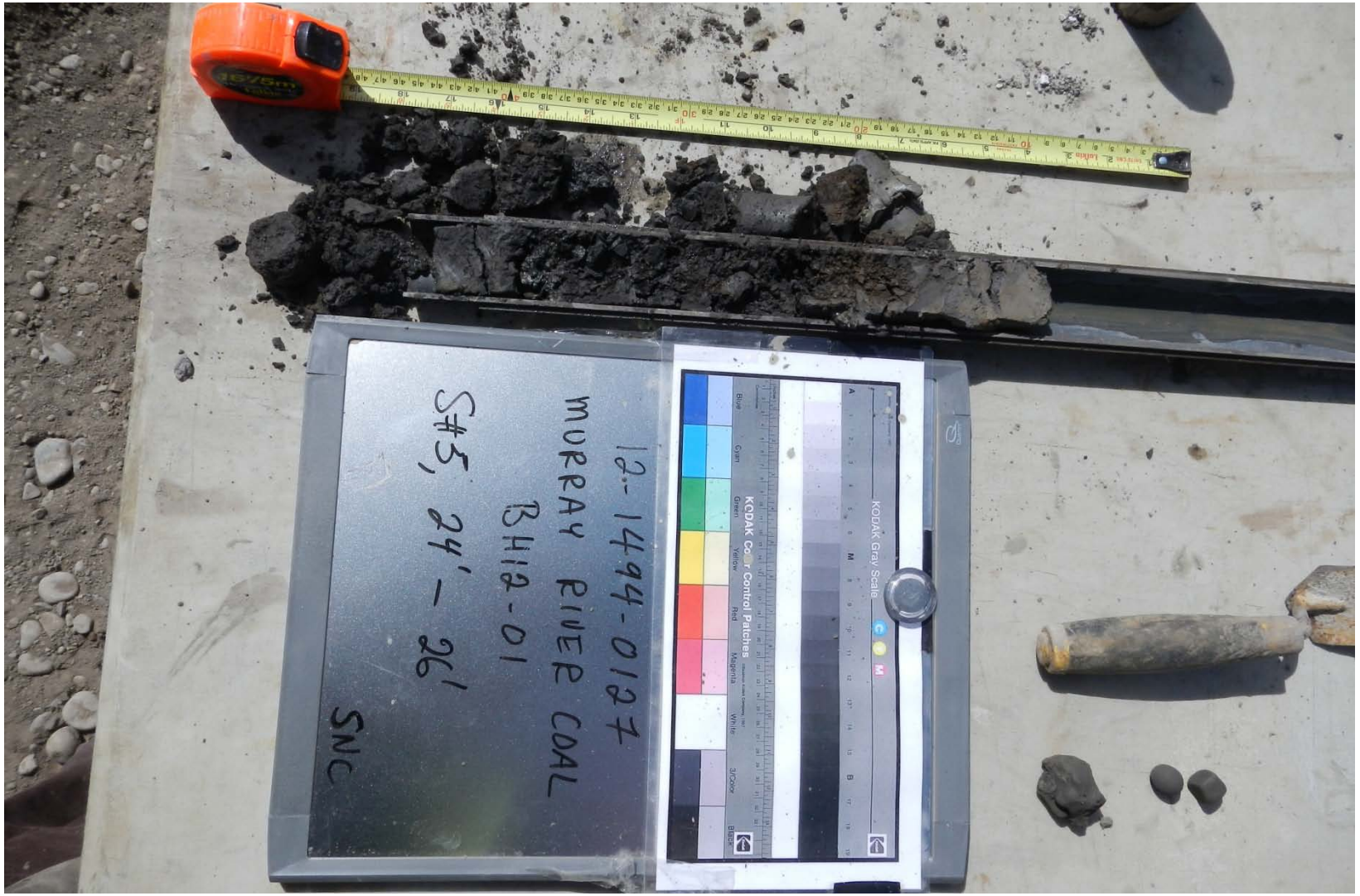

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 SS#5 (7.32 m to 7.92 m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-01 SS#6 (8.84 m to 8.99 m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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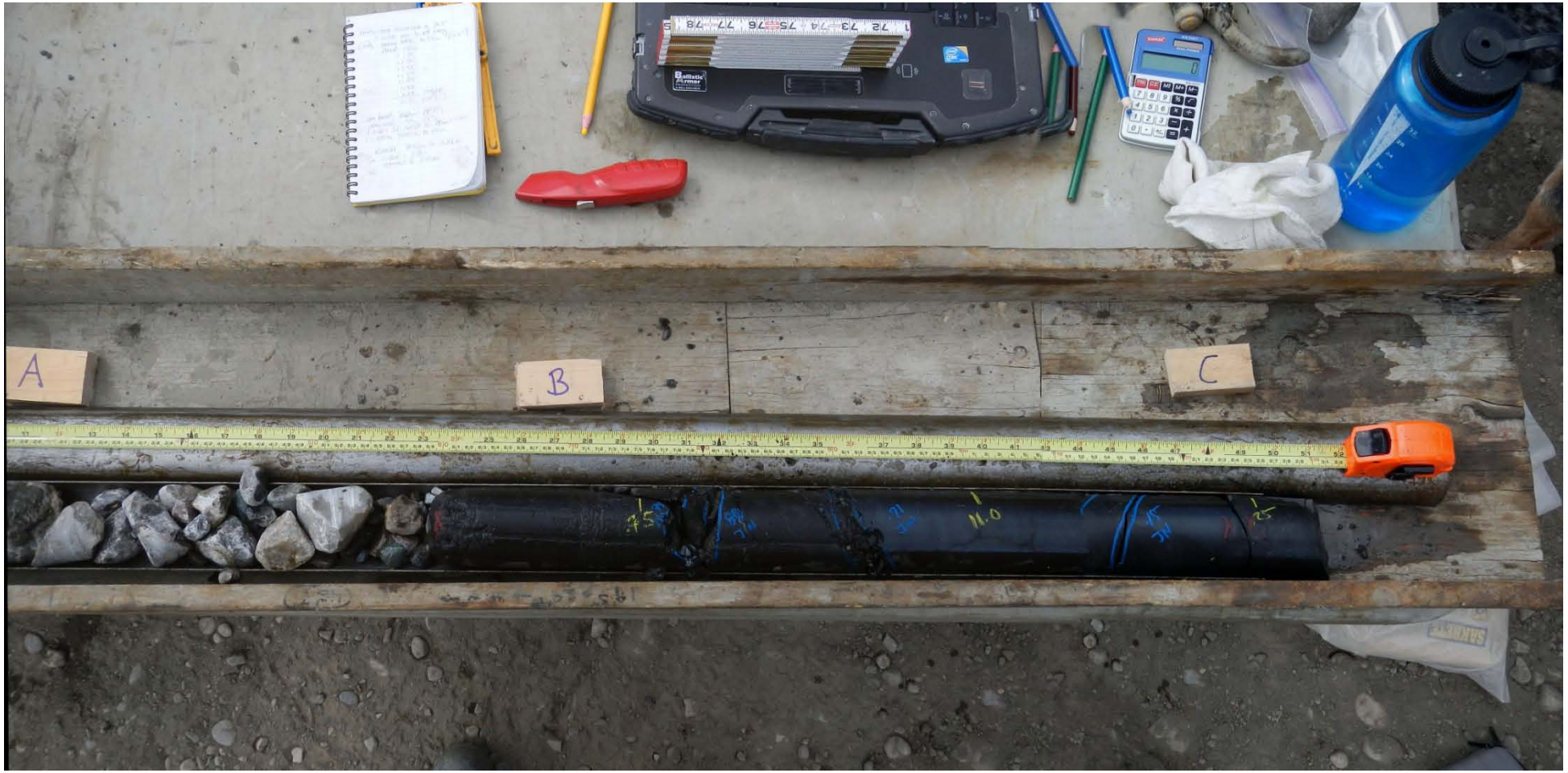

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (10.53m to 11.25m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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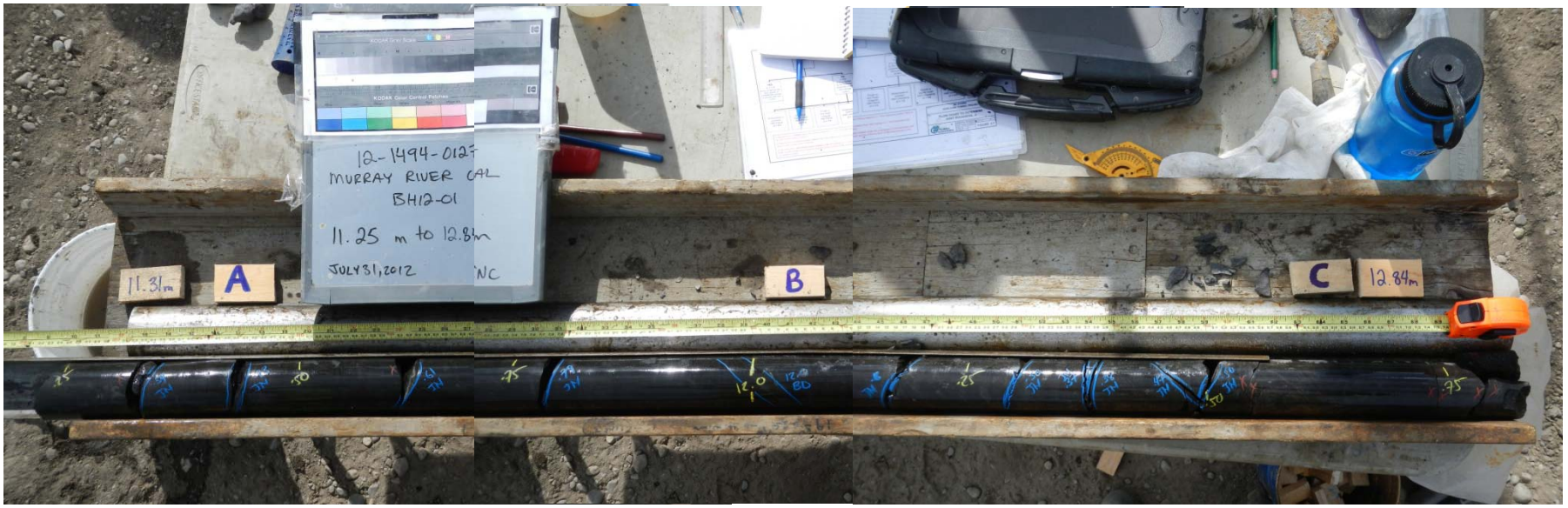

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (11.25m to 12.84m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (12.84m to 14.27m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (12.84m to 14.27m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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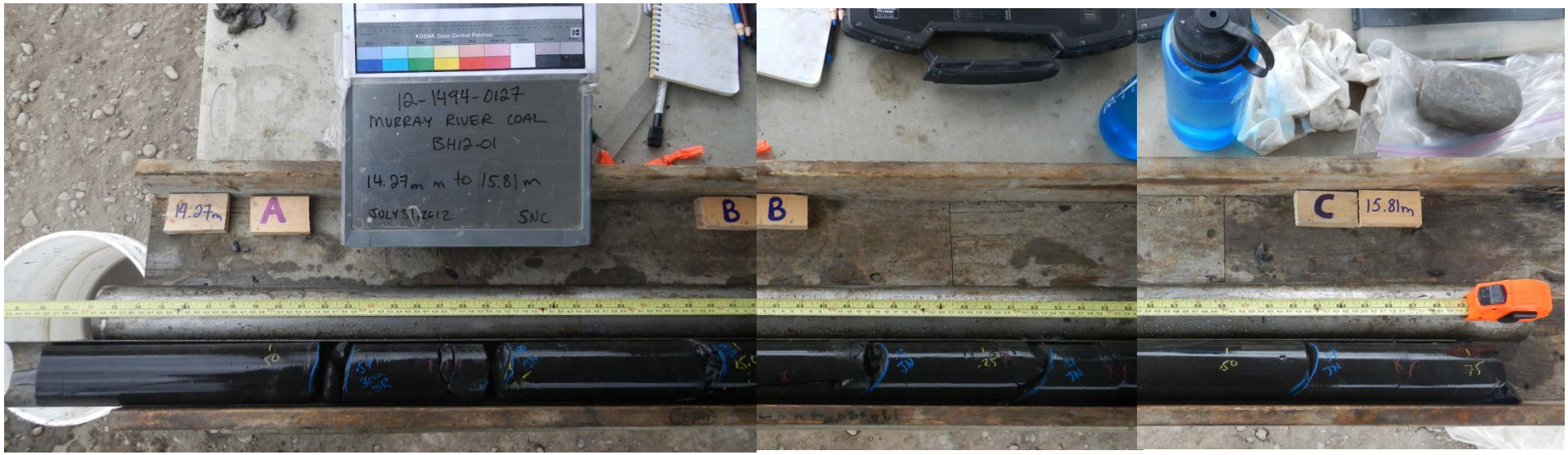

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (14.27m to 15.81m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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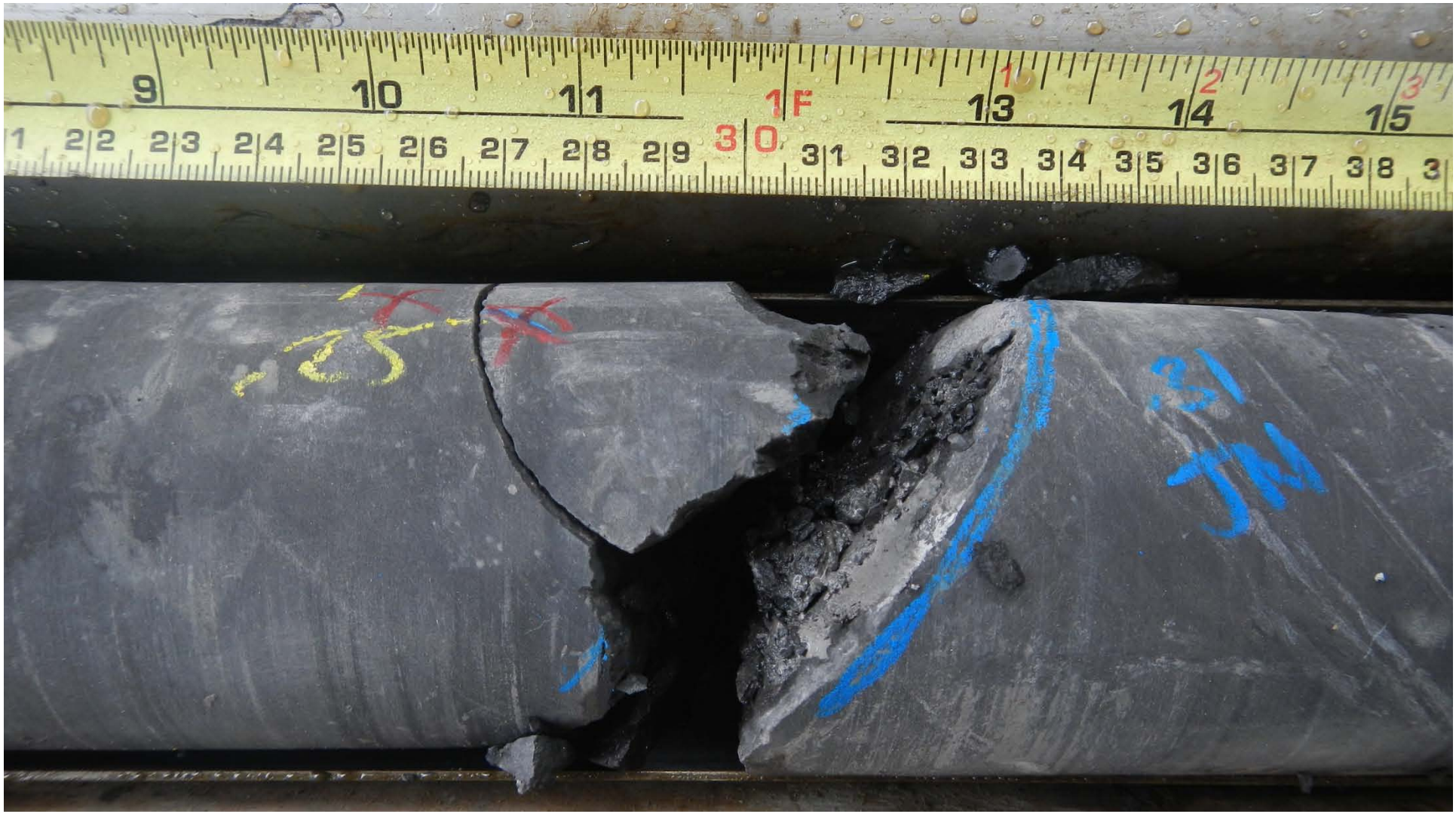

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (14.27m to 15.81m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-01 (15.81m to 17.34 m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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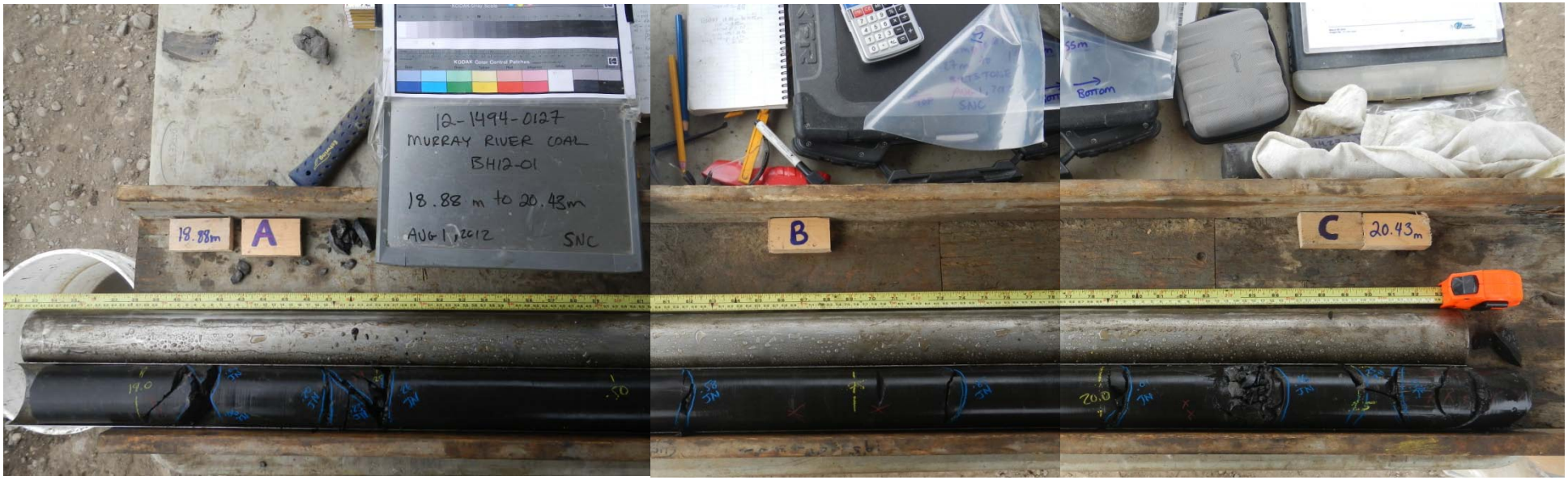

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (18.88m to 20.43m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (18.88m to 20.43m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (18.88m to 20.43m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (18.88m to 20.43m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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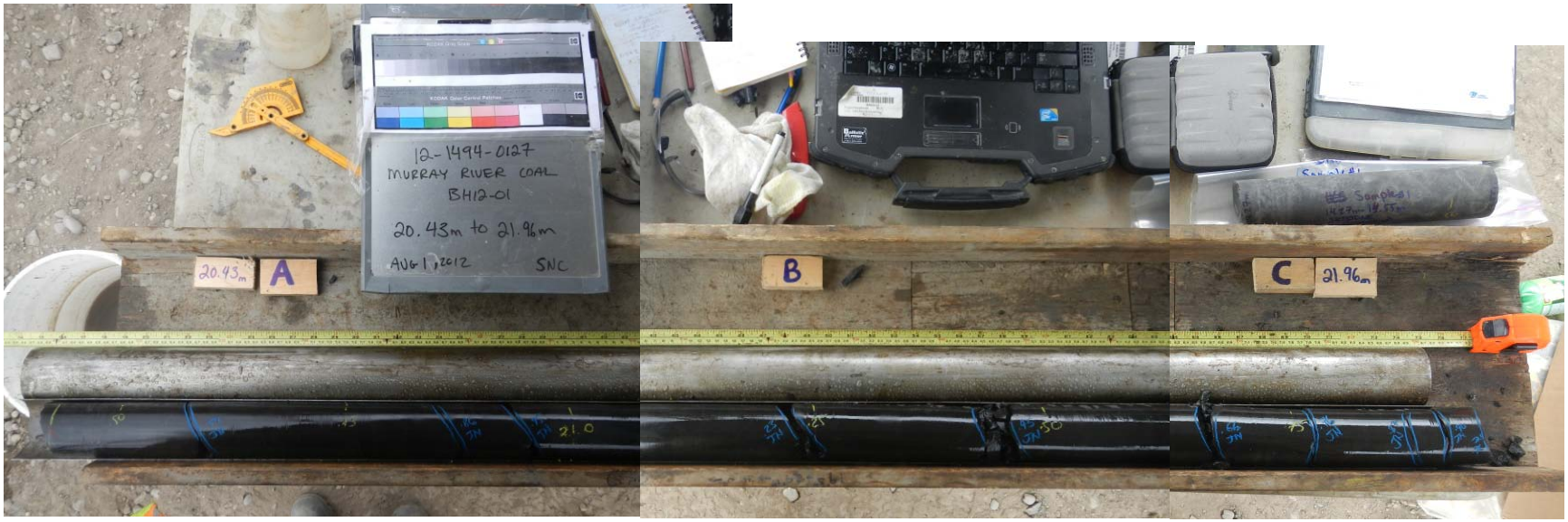

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (20.45m to 21.96m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (20.45m to 21.96m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (20.45m to 21.96m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (21.96m to 23.55m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (21.96m to 23.55m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (21.96m to 23.55m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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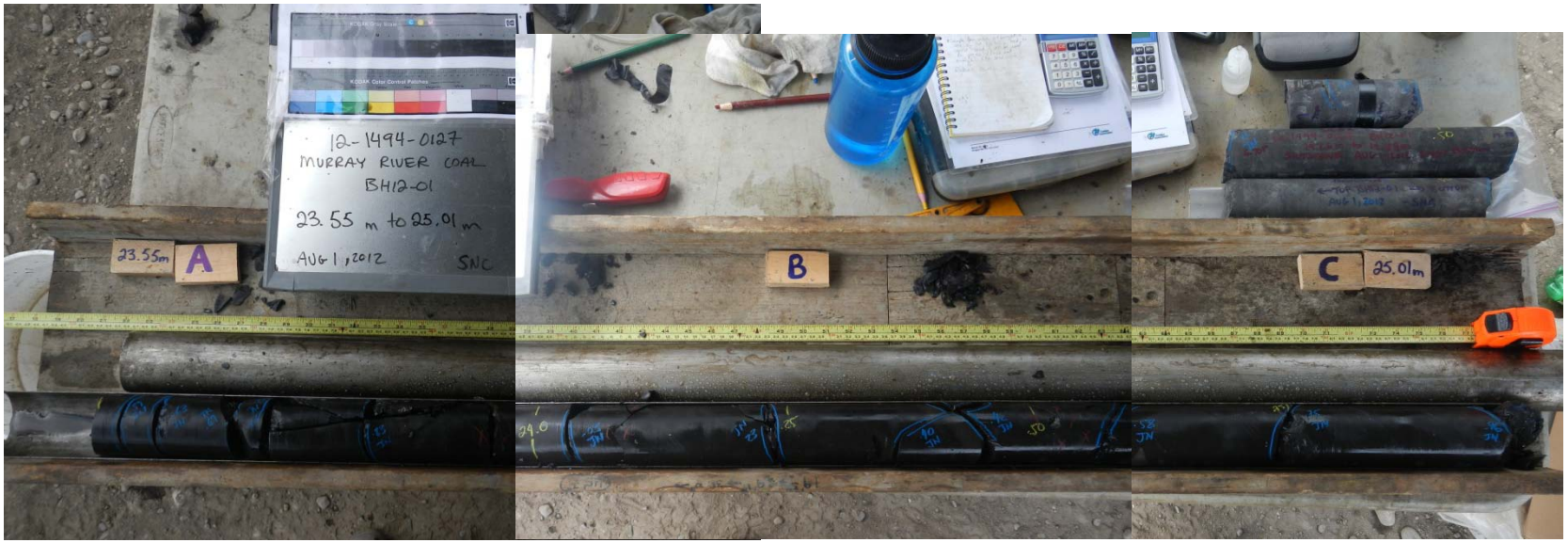

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (23.55m to 25.01m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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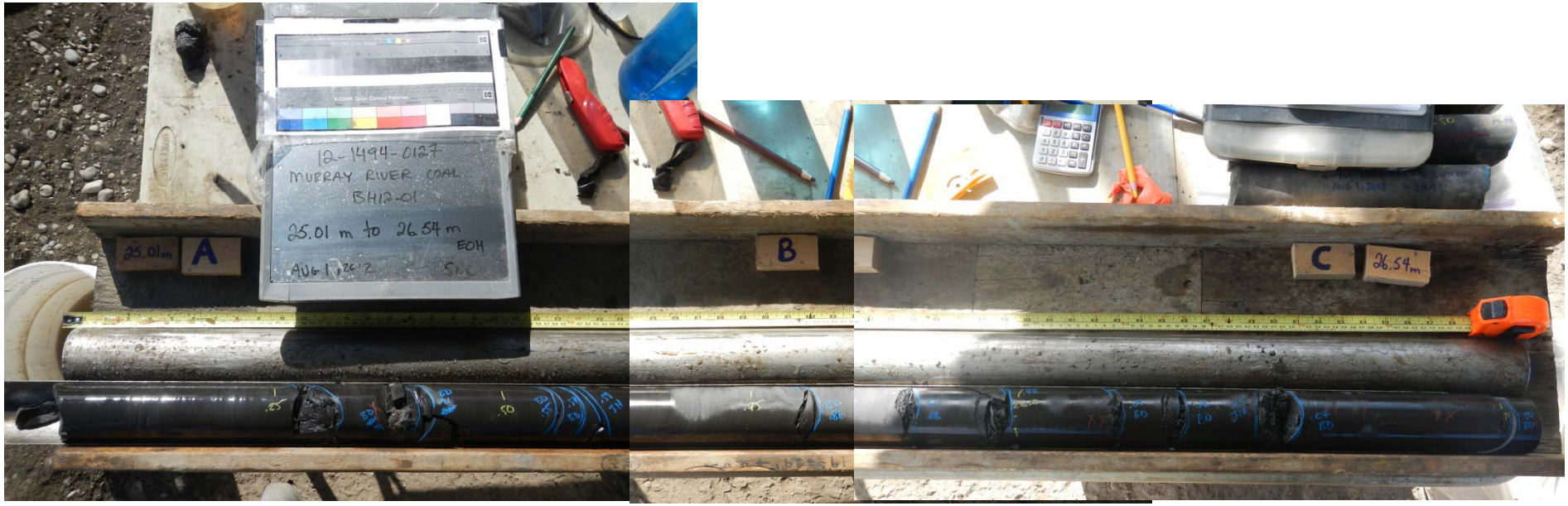

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 (25.01m to 26.54m)

Golder Associates

PROJECT No.		12-1494-0127	PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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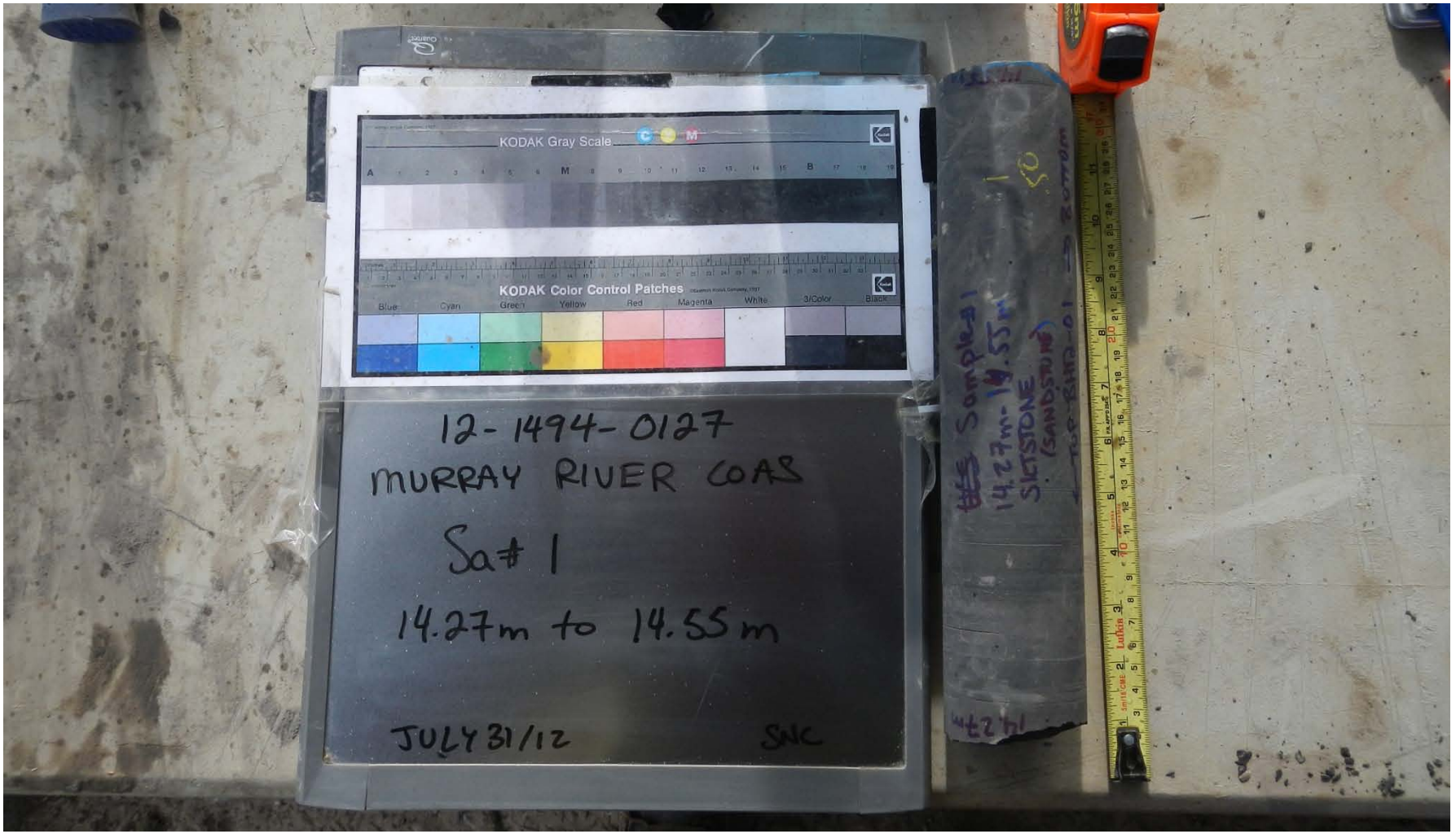

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-01 Sa#1 - Dry (14.27m to 14.55m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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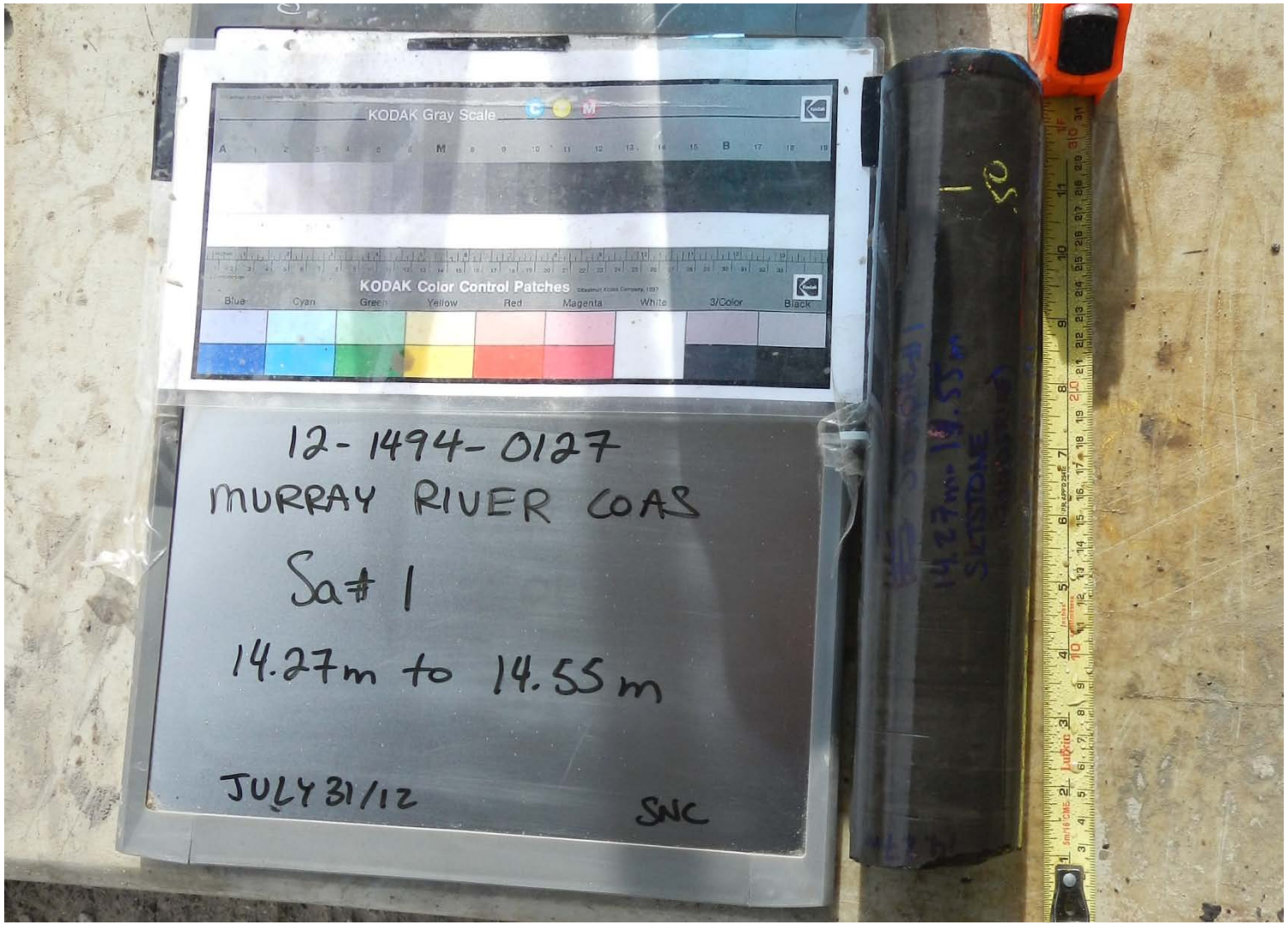

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-01 Sa#1 - Wet (14.27m to 14.55m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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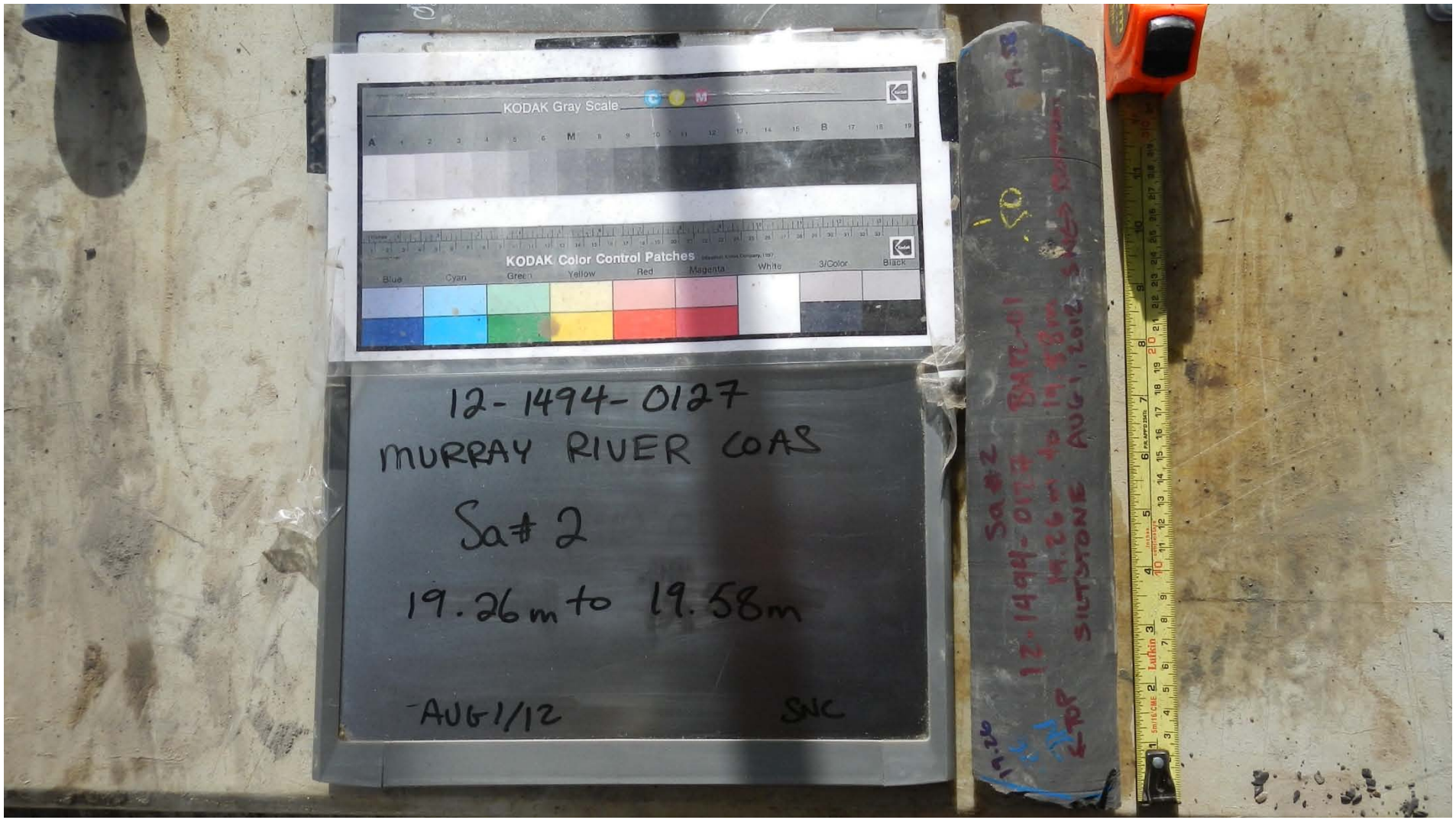

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-01 Sa#2 - Dry (19.26m to 19.58m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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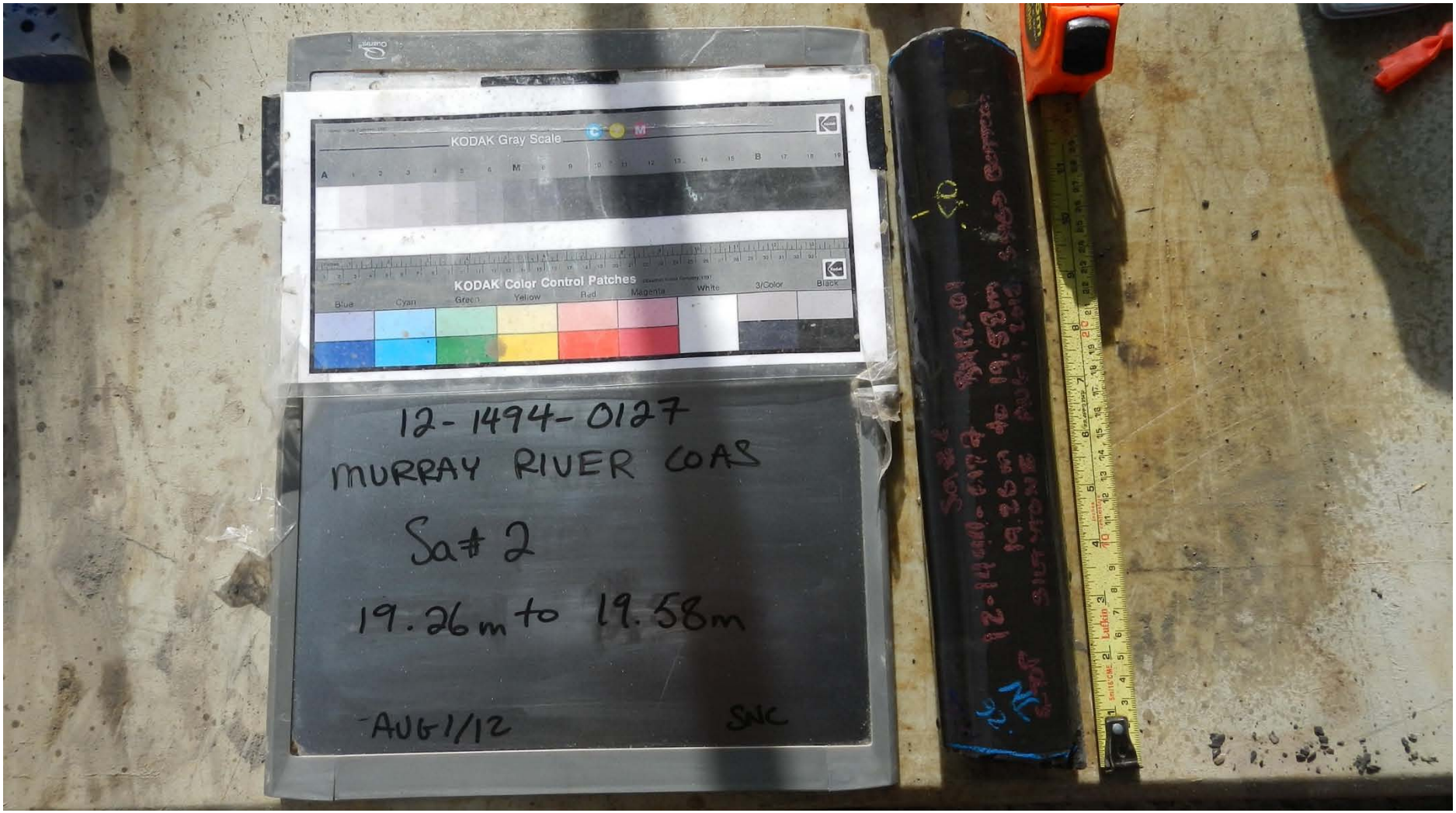

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-01 Sa#2 - Wet (19.26m to 19.58m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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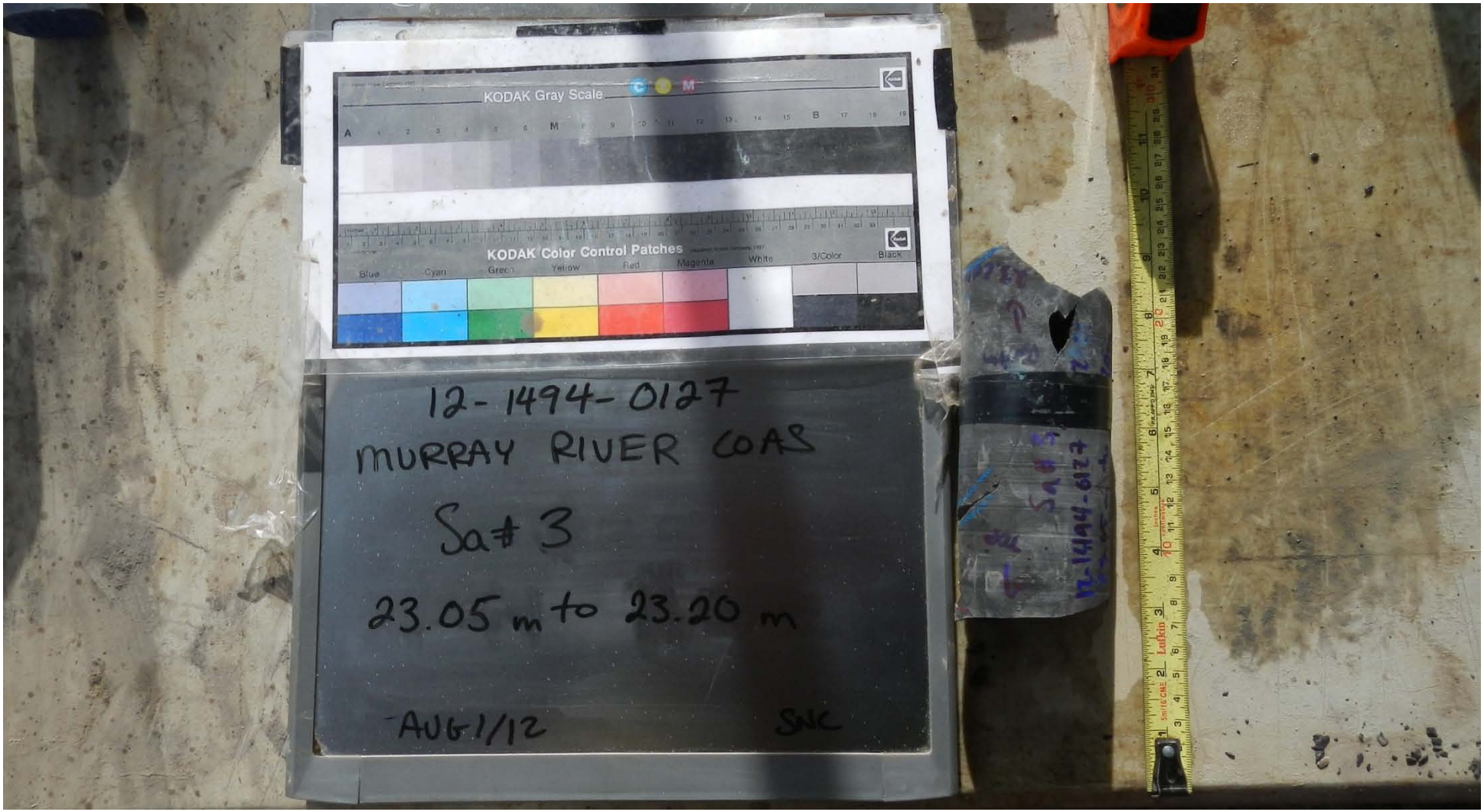

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-01 Sa#3 - Dry (23.05m to 23.20m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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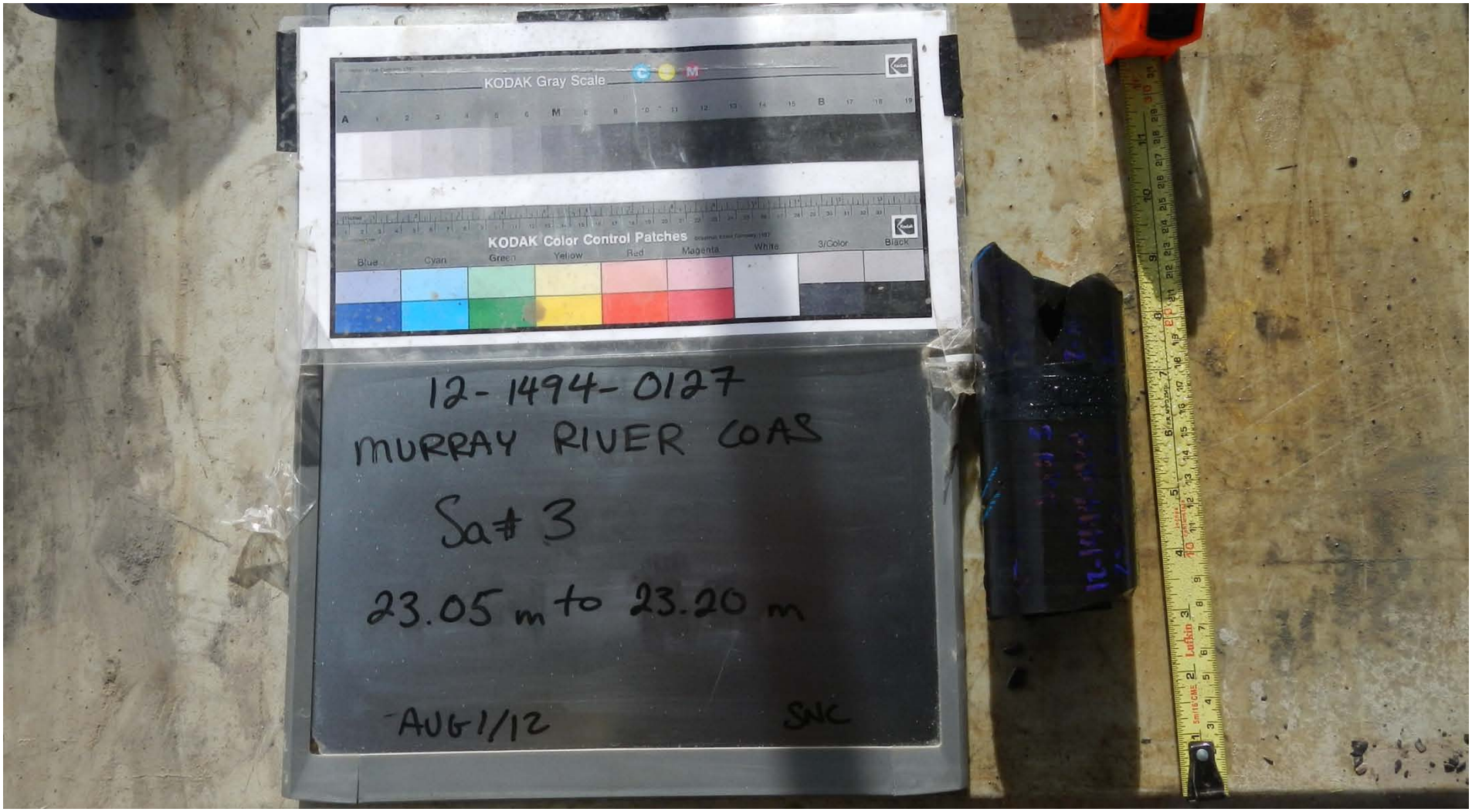

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-01 Sa#3 - Wet (23.05m to 23.20m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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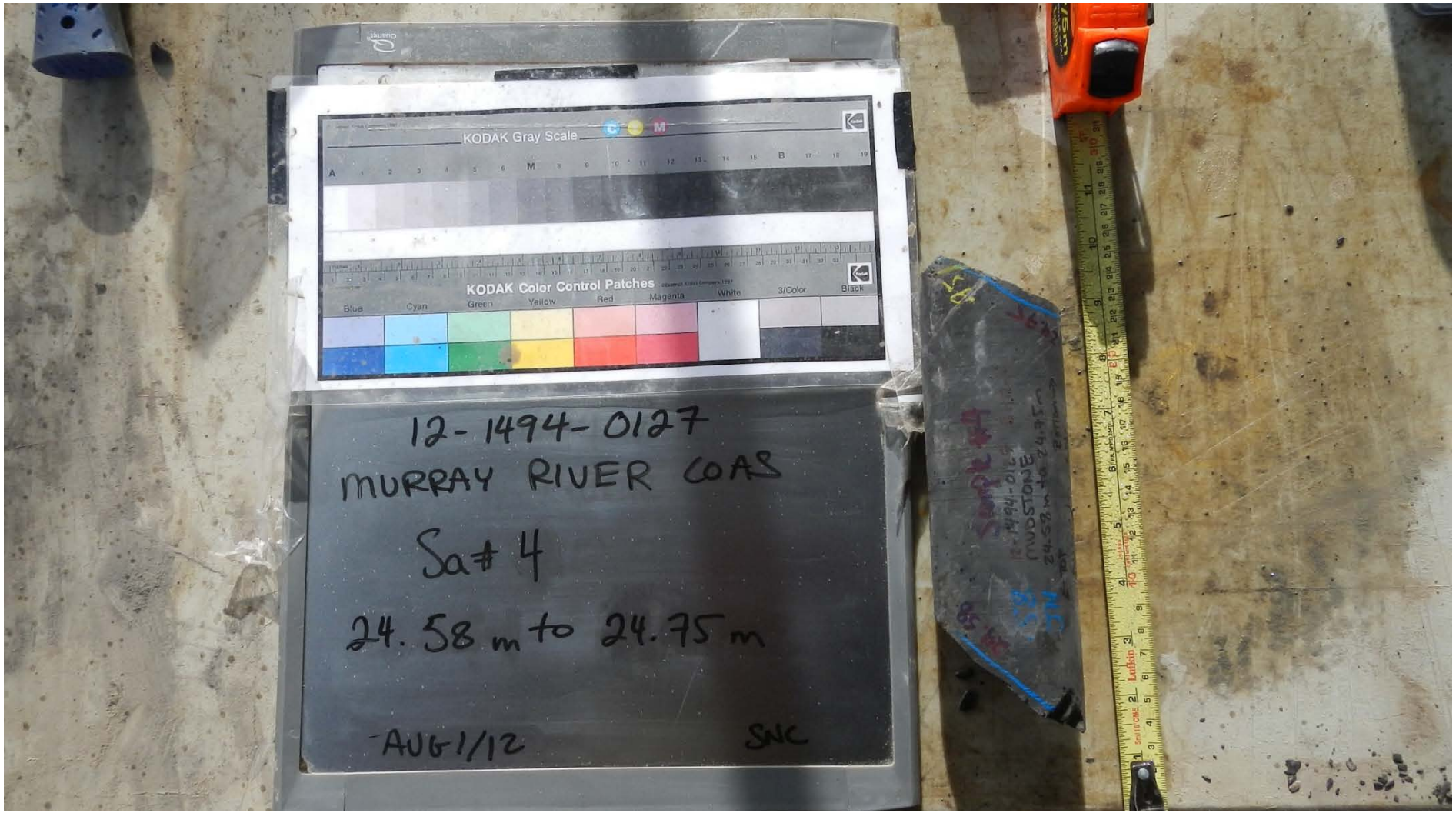

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-01 Sa#4 - Dry (24.58m to 24.75m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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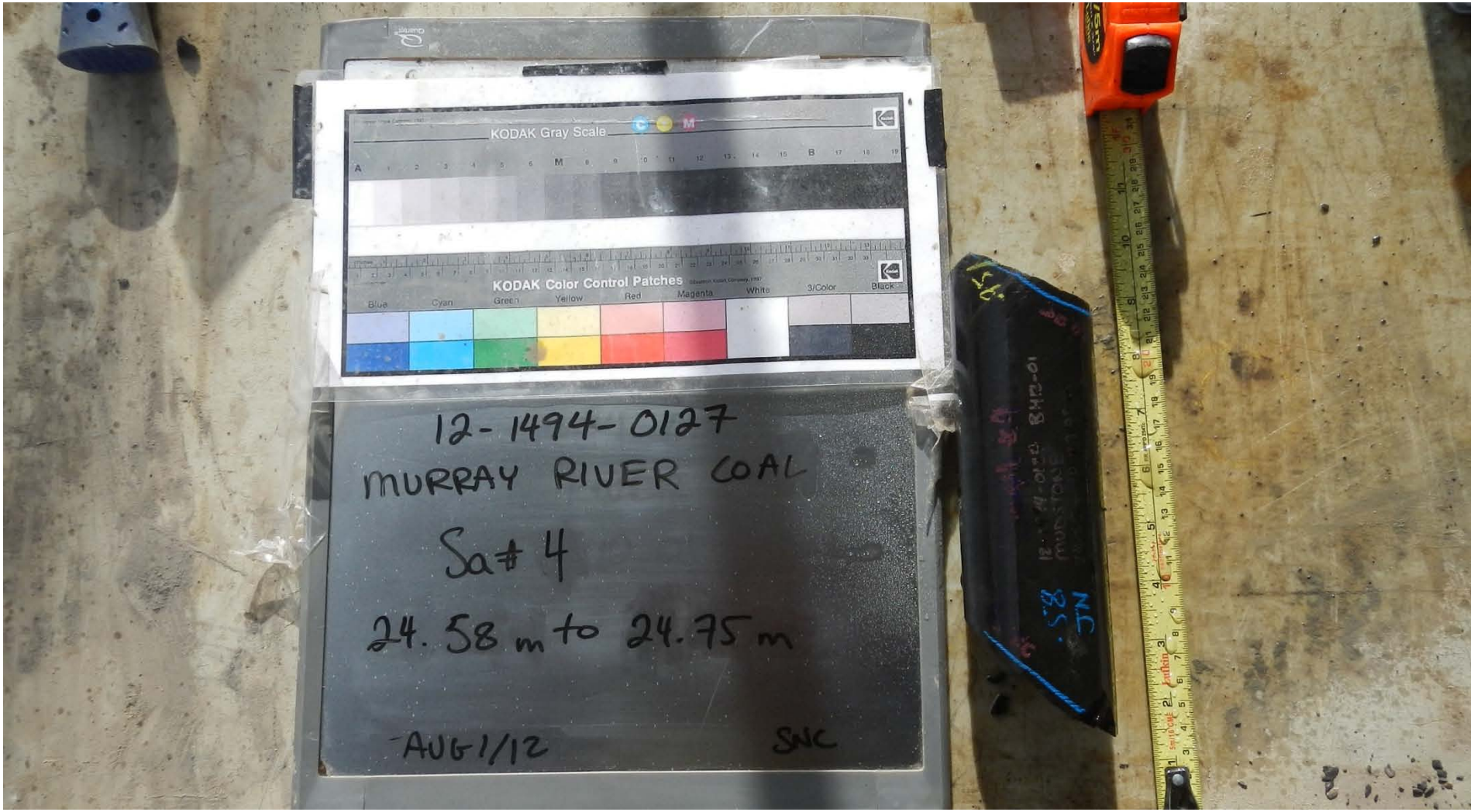

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-01 Sa#4 - Wet (24.58m to 24.75m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

N:\Active\2012\1494 Geotechnical\12-1494-0127 HD Mining Murray River Geotechnical Design\07 Deliverables\Task 4600 Additional Drilling for Portal Cut

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 Sa#1 (1.22m to 1.83m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 SS#1 (1.22m to 1.83m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 SS#2 (2.74m to 3.35m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 SS#2 (2.74m to 3.35m)

Golder Associates

PROJECT No.		12-1494-0127	PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 SS#3 (4.27m to 4.72m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 SS#3 (4.27m to 4.72m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 SS#4 (5.79m to 6.31m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 SS#4 (5.79m to 6.31m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 SS#5 (7.32m to 7.92m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 SS#5 (7.32m to 7.92m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 SS#6 (8.84m to 9.30m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 SS#6 (8.84m to 9.30m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (9.30m to 9.90m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (9.30m to 9.90m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (9.90m to 10.64m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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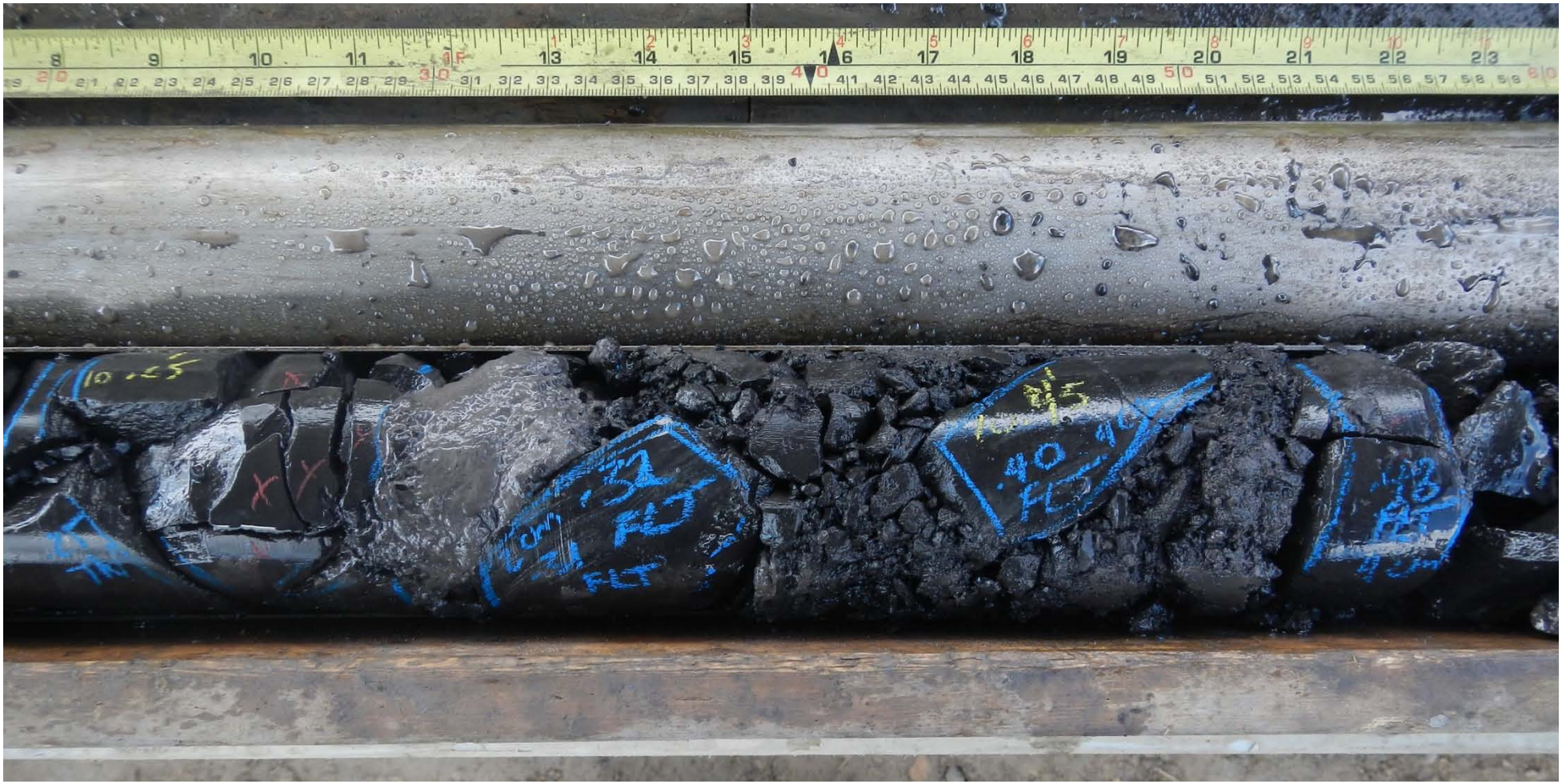

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (9.90m to 10.64m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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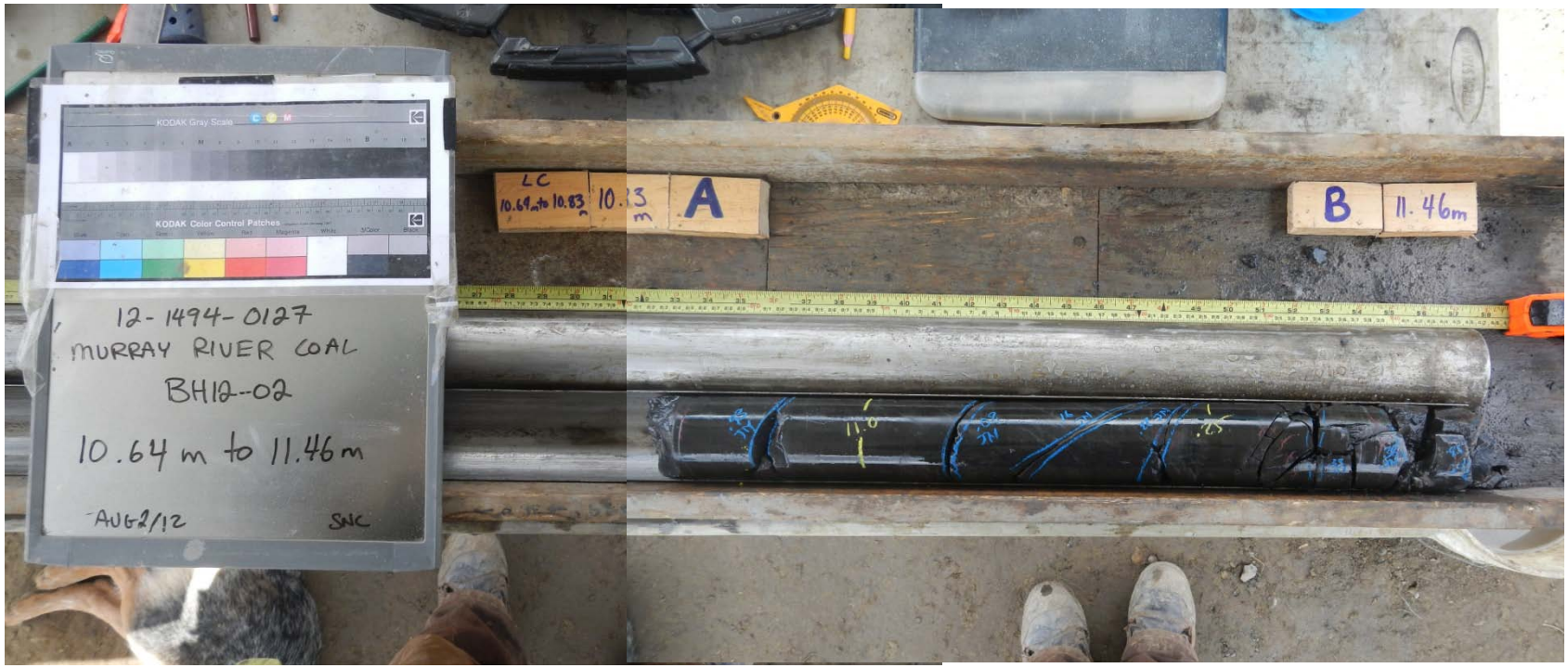

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**				
TITLE	**BH12-02 (10.64m to 11.46m)**				
Golder Associates	PROJECT No. 12-1494-0127			PHASE No. 4000	
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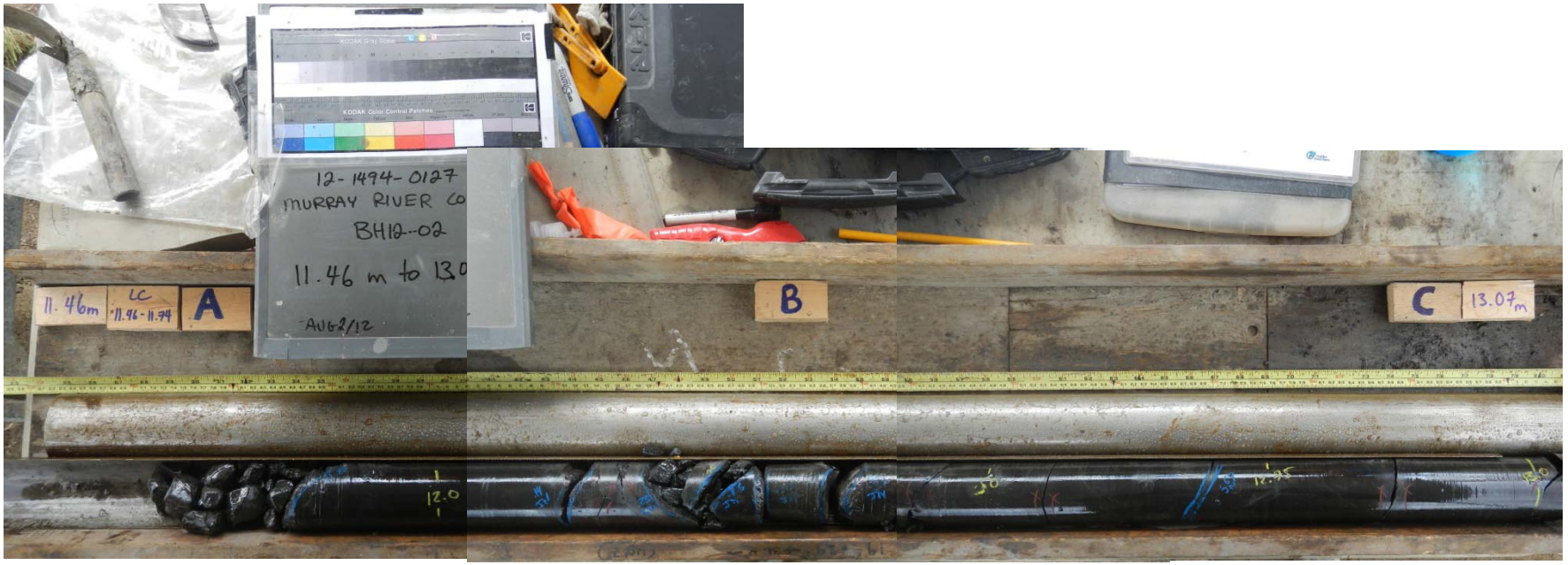

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (11.46m to 13.07m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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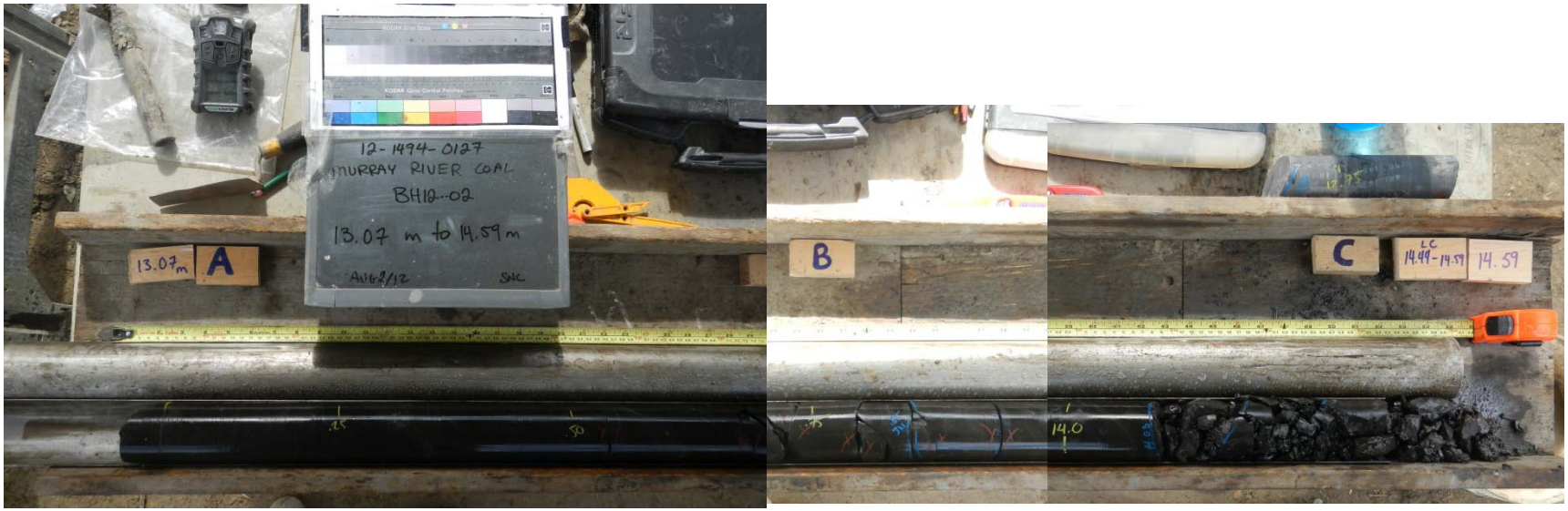

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (13.07m to 14.59m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (14.59m to 16.10m)

Golder Associates

PROJECT No.		12-1494-0127	PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (14.59m to 16.10m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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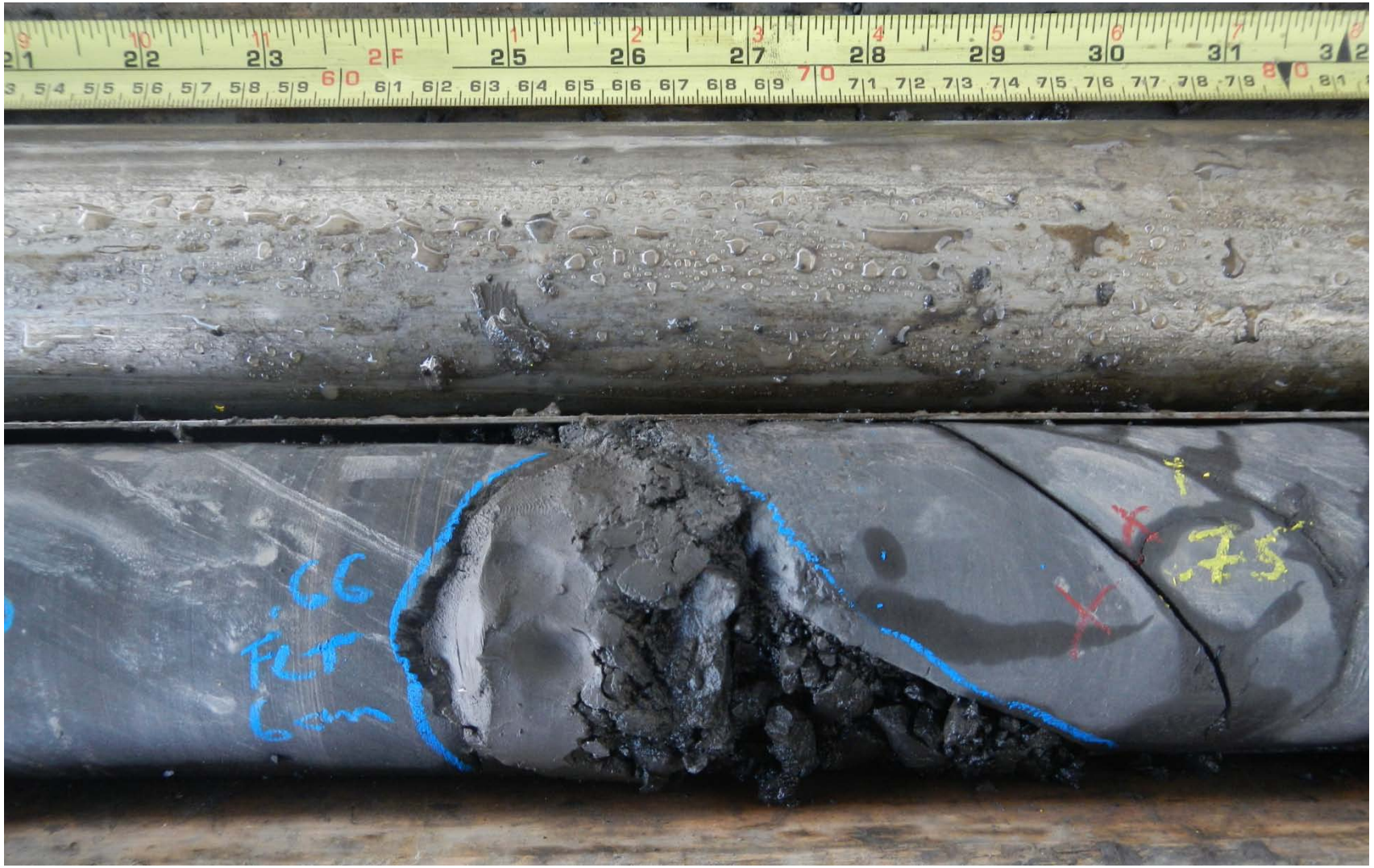

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (14.59m to 16.10m)

Golder Associates

PROJECT No.		12-1494-0127	PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (14.59m to 16.10m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-02 (16.10m to 17.53m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (17.53m to 19.09m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (19.09m to 20.62m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (20.62m to 22.17m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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CADD				
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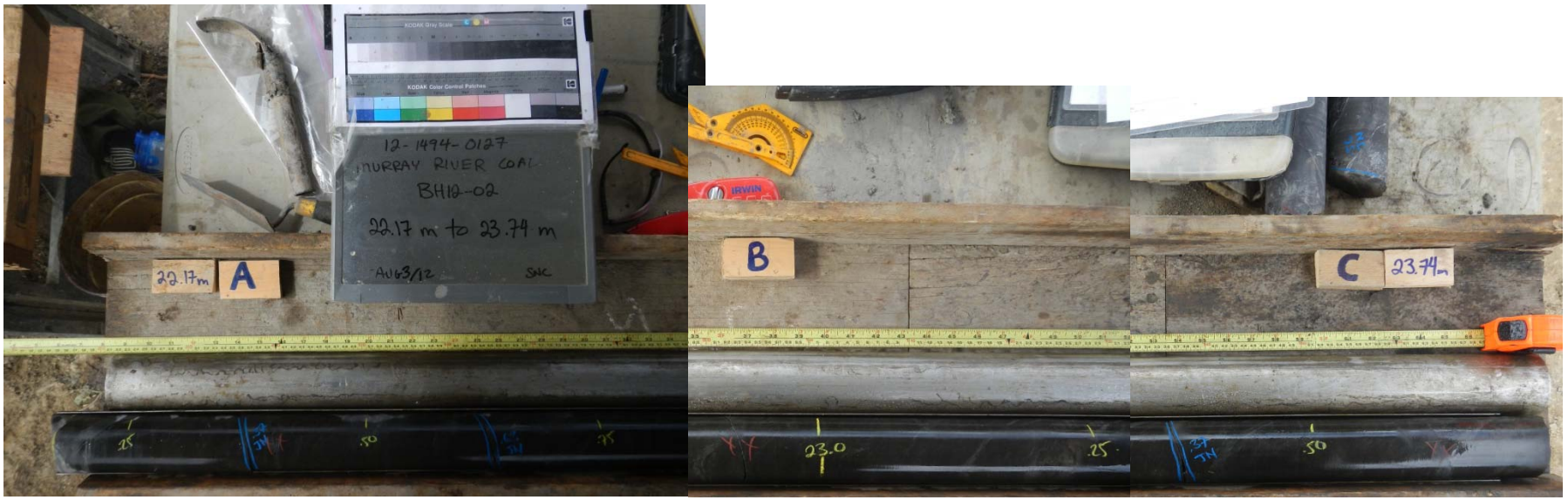

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**				
TITLE	**BH12-02 (22.17m to 23.74m)**				
Golder Associates	PROJECT No. 12-1494-0127			PHASE No. 4000	
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	CADD				
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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**				
TITLE	**BH12-02 (23.74m to 25.29m)**				
Golder Associates	PROJECT No. 12-1494-0127			PHASE No. 4000	
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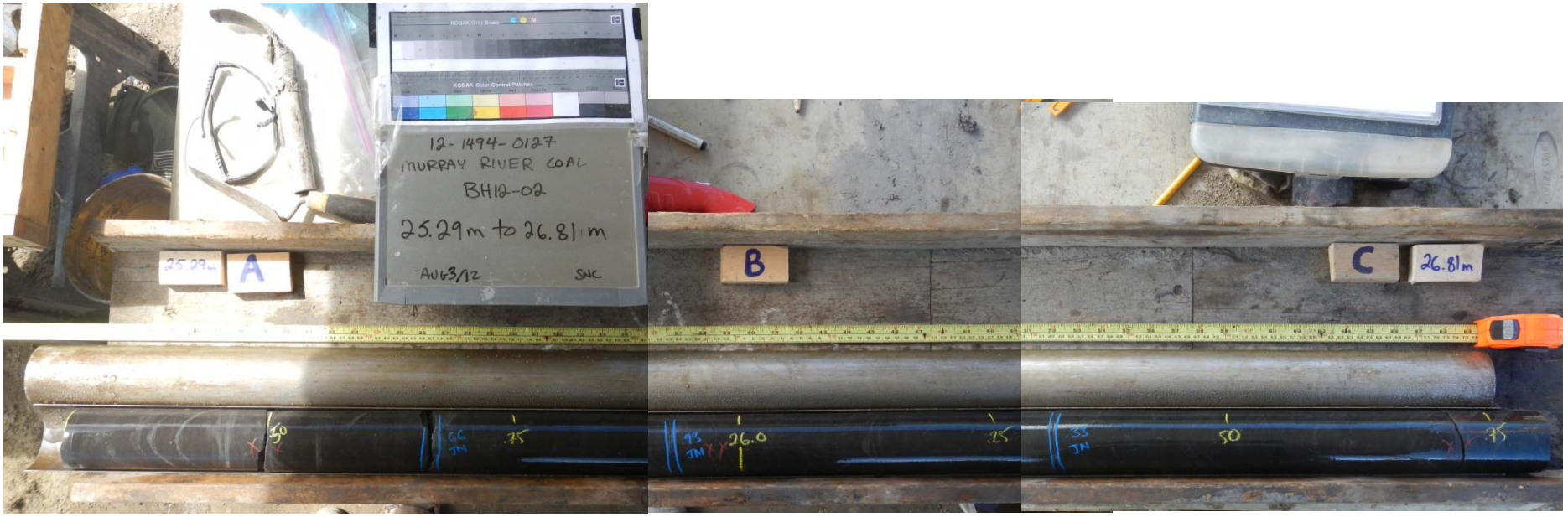

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (25.29m to 26.81m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (26.81m to 28.32m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 (28.32m to 29.87m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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PROJECT	**HD Mining Murray River Coal Project TUMBLER Ridge, BC**				
TITLE	**BH12-02 (29.87m to 31.38m)**				
Golder Associates	PROJECT No. 12-1494-0127			PHASE No. 4000	
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	CADD				
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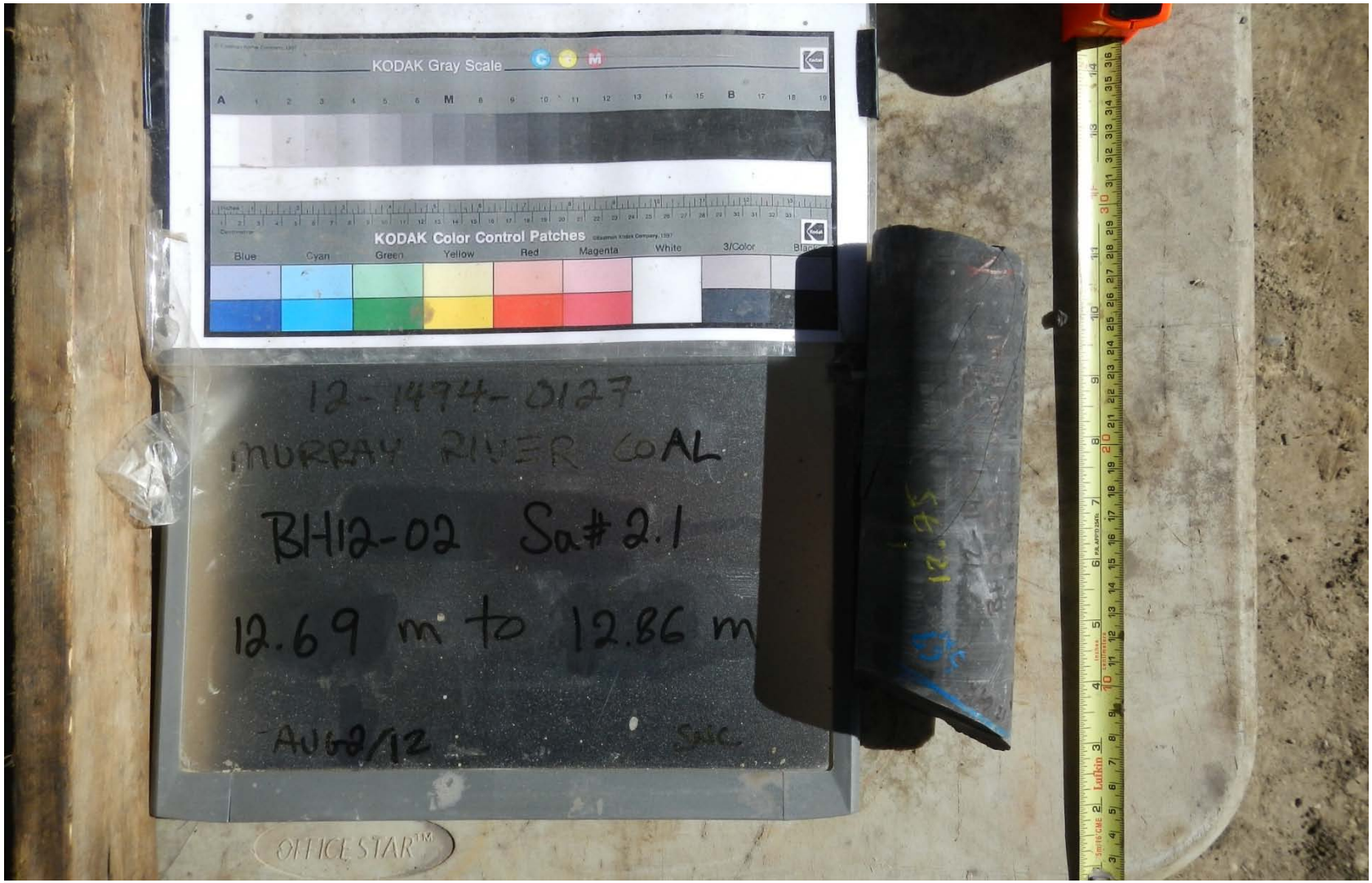

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-02 S#2.1 - Dry (12.69m to 12.86m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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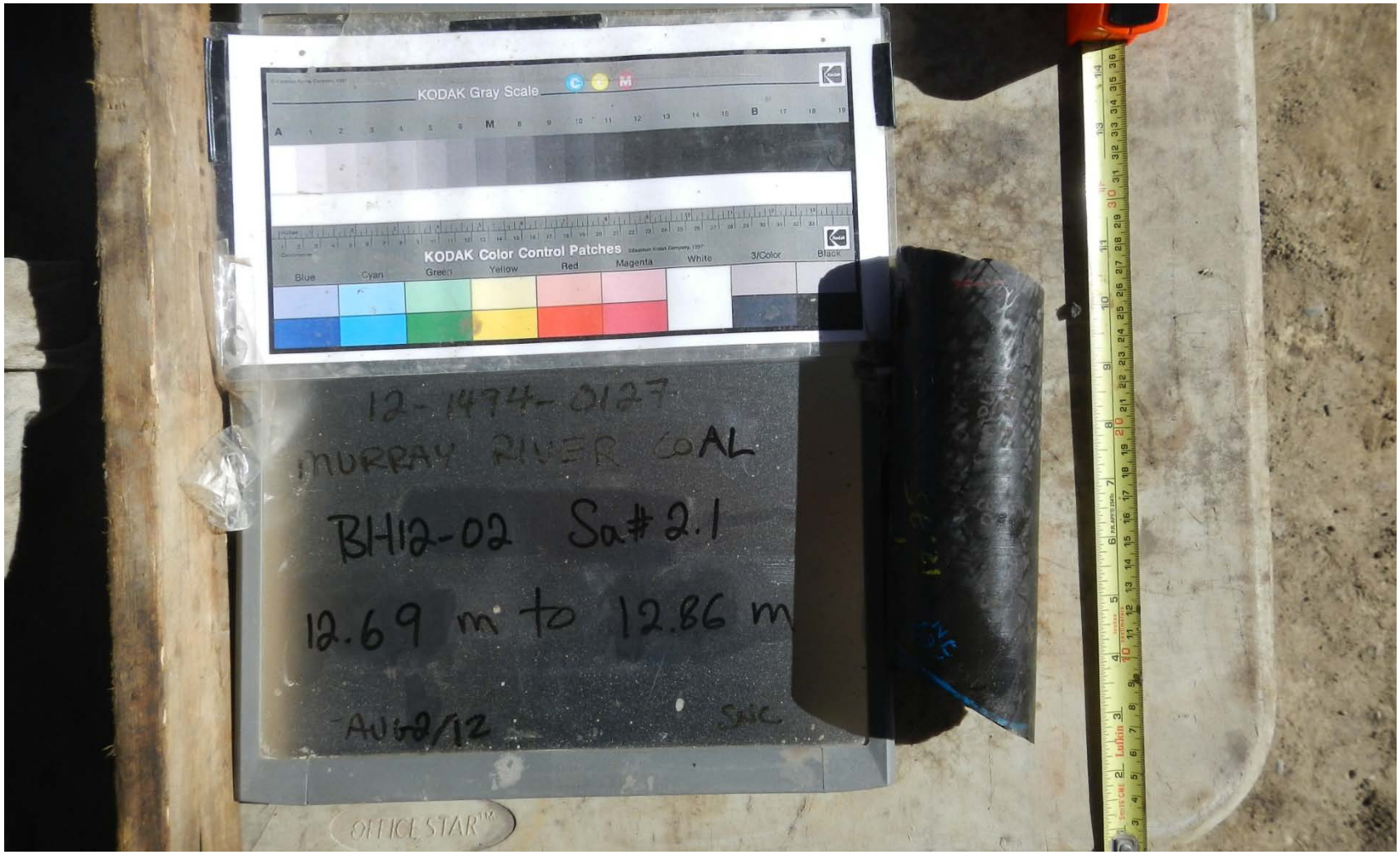

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-02 S#2.1 - Wet (12.69m to 12.86m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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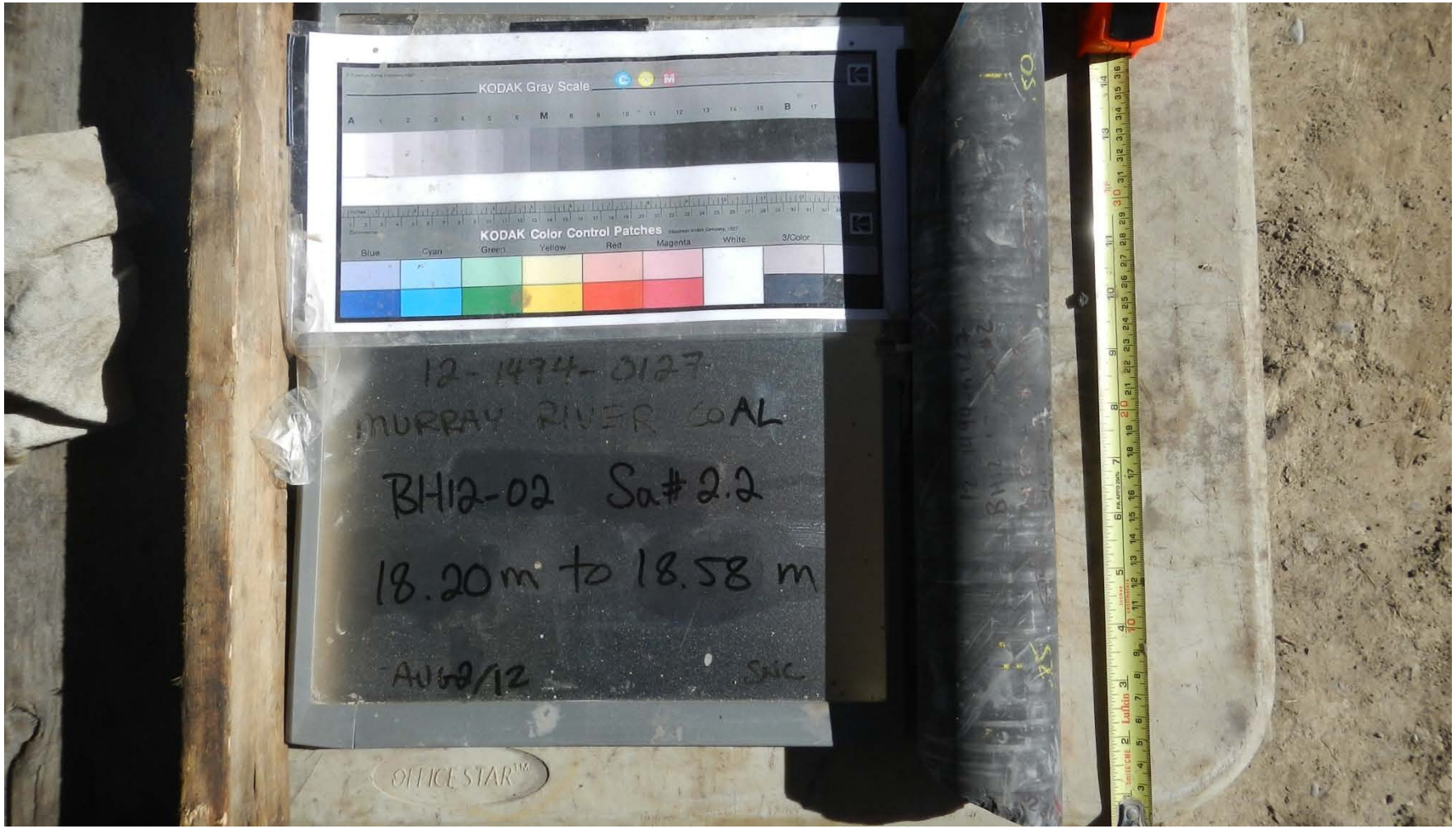

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-02 S#2.2 - Dry (18.20m to 18.58m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-02 S#2.2 - Wet (18.20m to 18.58m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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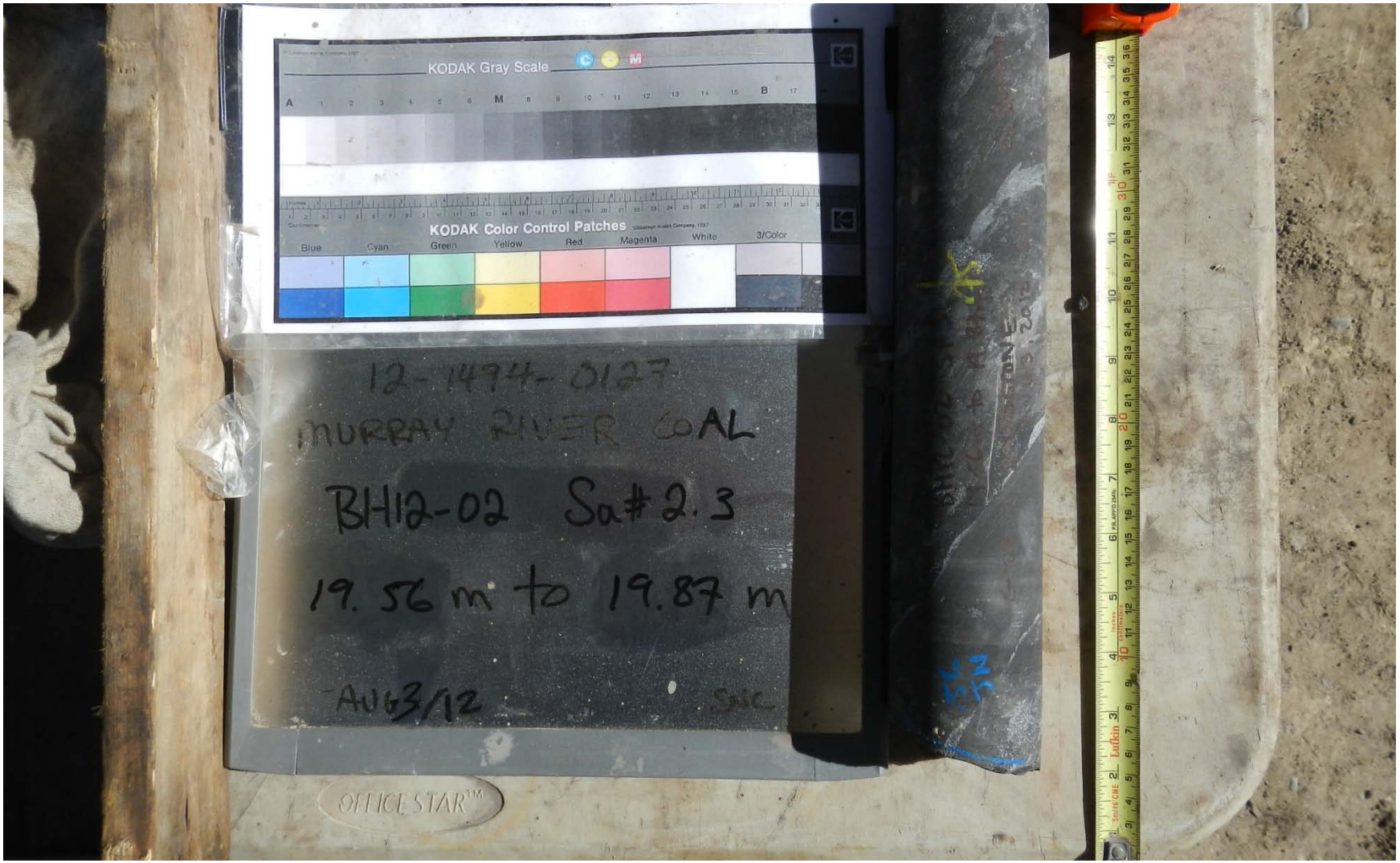

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-02 S#2.3 - Dry (19.56m to 19.87m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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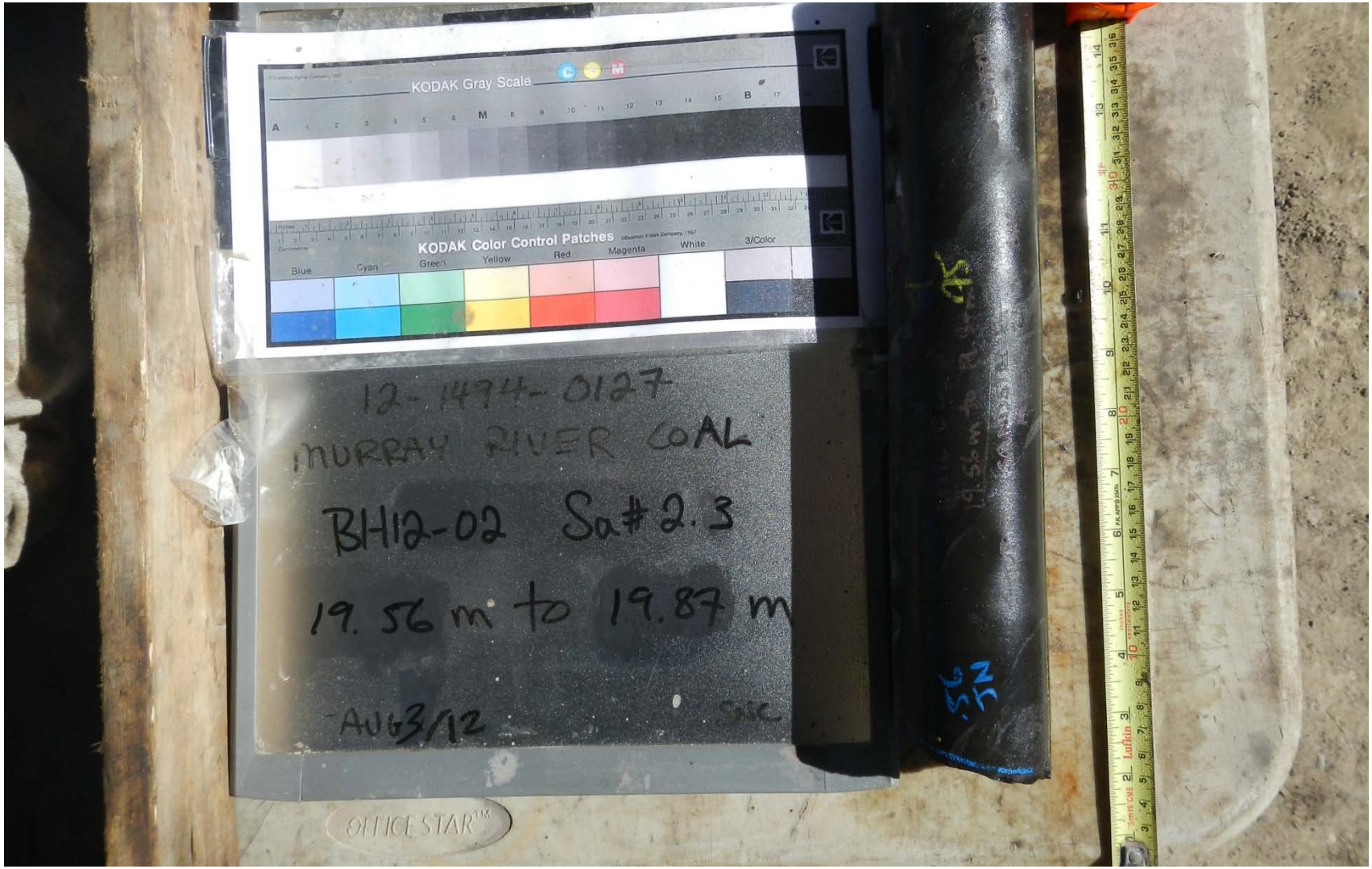

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-02 S#2.3 - Wet (19.56m to 19.87m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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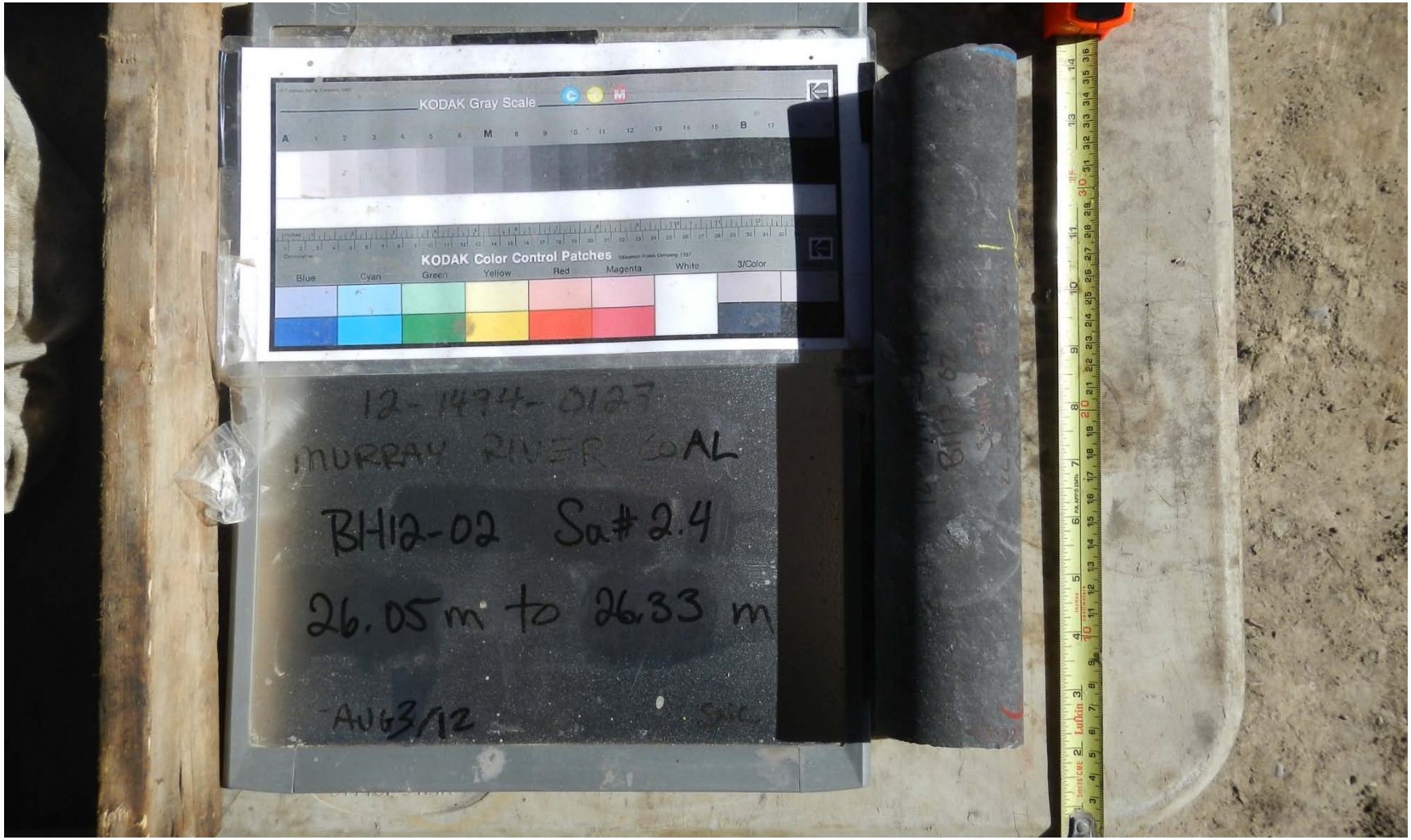

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-02 S#2.4 - Dry (26.05m to 26.33m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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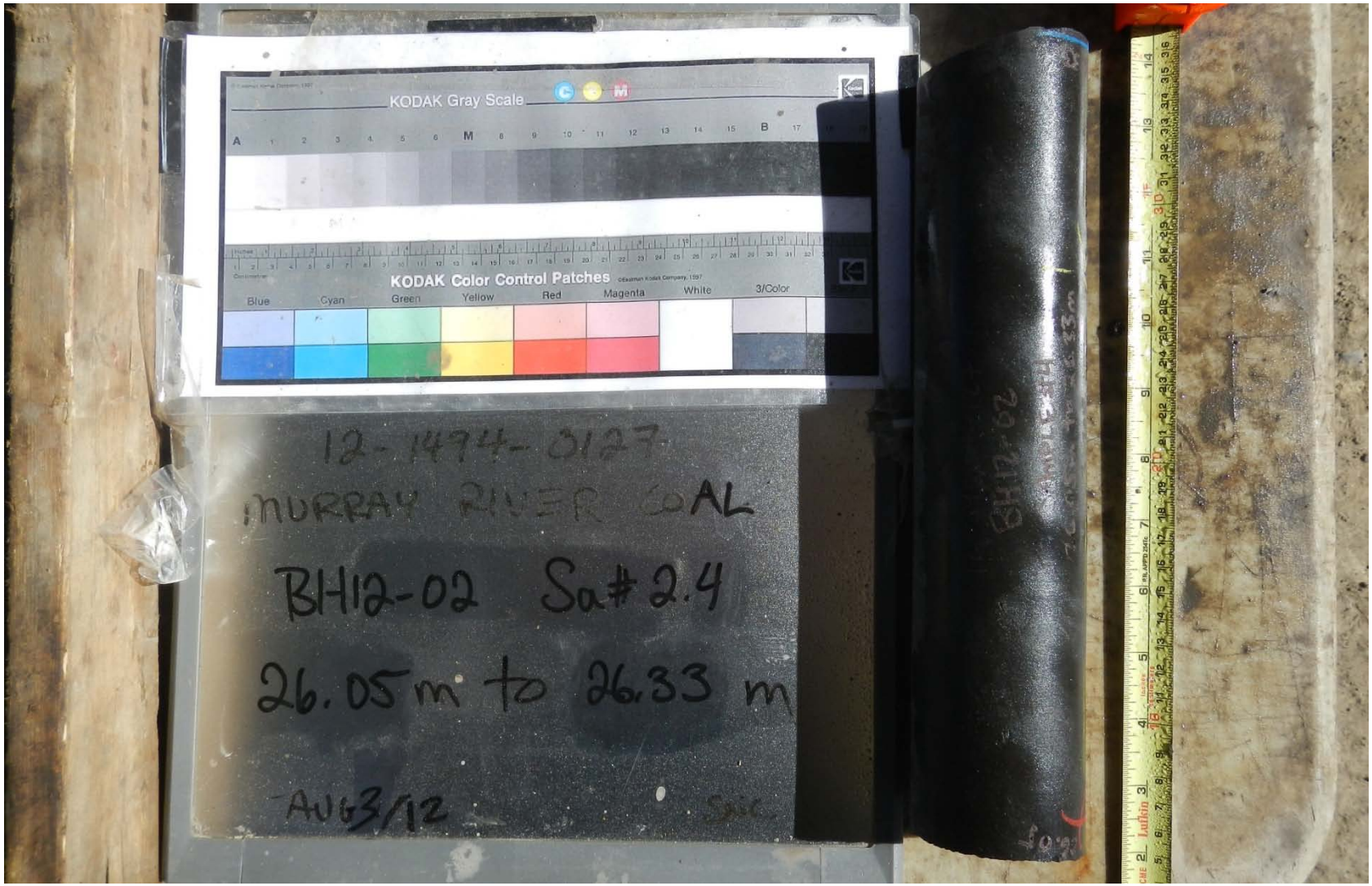

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-02 S#2.4 - Wet (26.05m to 26.33m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#1 (1.22m to 1.83m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#2 (2.74m to 3.35m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-03 SS#3 (4.27m to 4.88m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#3 (4.27m to 4.88m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#4 (5.79m to 6.40m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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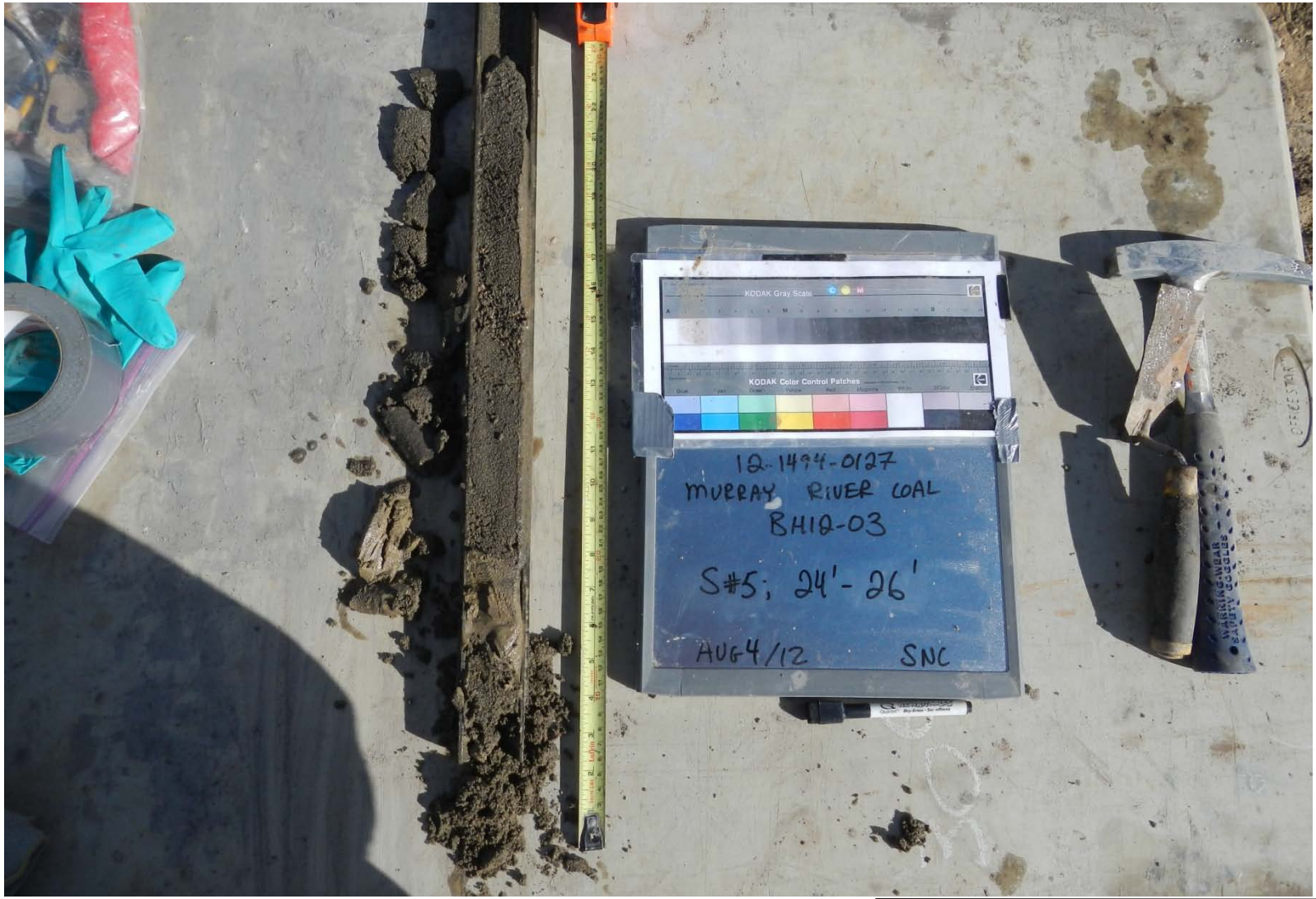

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#5 (7.32m to 7.92m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#5 (7.32m to 7.92m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#6 (8.84m to 9.45m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#6 (8.84m to 9.45m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#7 (10.36m to 10.97m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#7 (10.36m to 10.97m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#8 (11.89m to 12.50m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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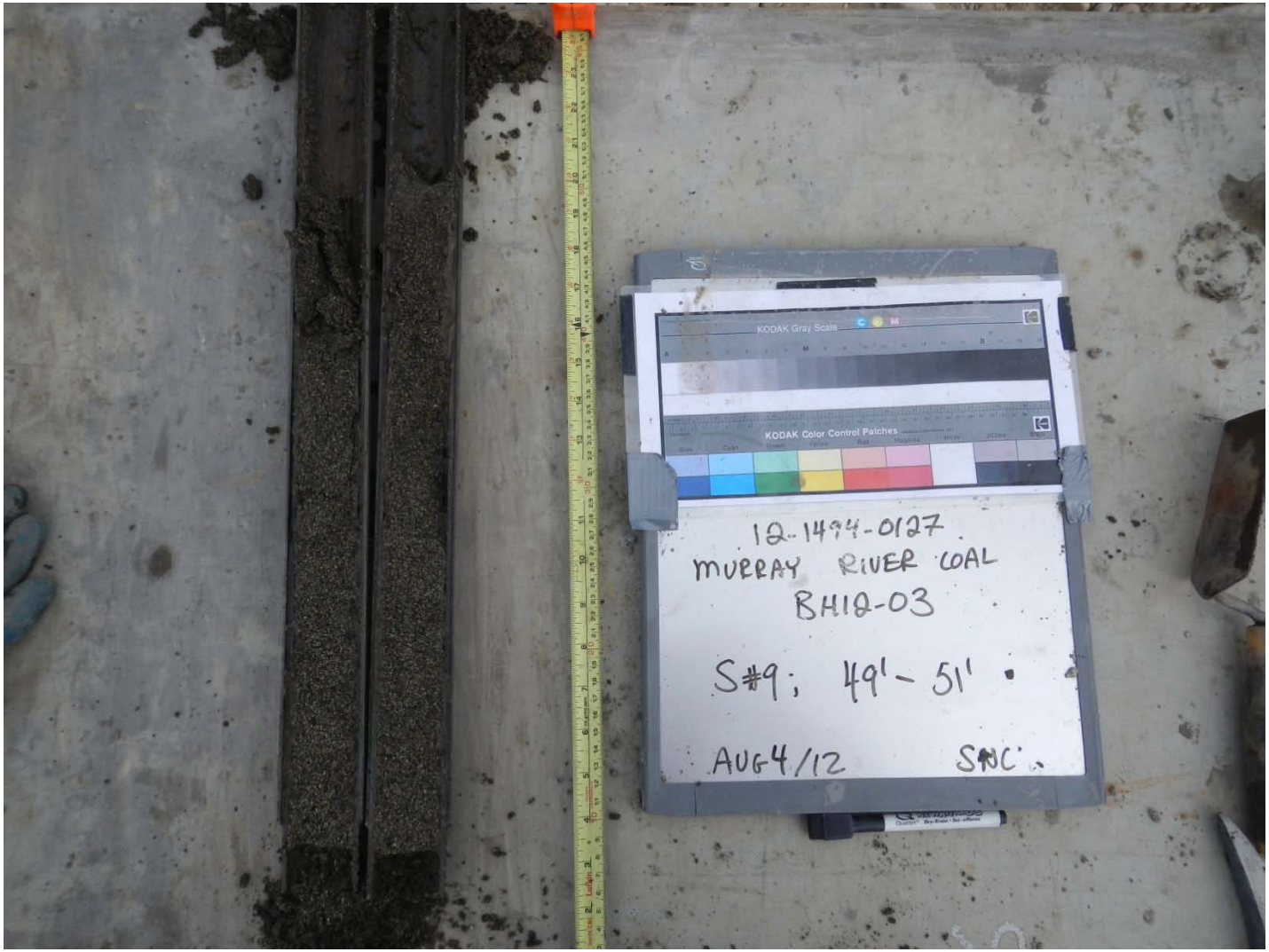

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#9 (14.94m to 15.54m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#10 (17.98m to 18.59m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#11 (21.03m to 21.64m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#11 (21.03m to 21.64m)

Golder Associates

PROJECT No.		12-1494-0127	PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#13 (24.08m to 24.69m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#13 (24.08m to 24.69m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#14 (30.18m to 30.79m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#14 (30.18m to 30.79m)

Golder Associates

PROJECT No.		12-1494-0127	PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#15 (33.22m to 33.83m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-03 SS#15 (33.22m to 33.83m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 SS#1 (1.22m to 1.83m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 SS#1 (1.22m to 1.83m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-04 SS#3 (4.27m to 4.88m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 SS#3 (4.27m to 4.88m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 SS#4 (5.79m to 6.40m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 SS#4 (5.79m to 6.40m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 SS#5 (7.32m to 7.92m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 SS#5 (7.32m to 7.92m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 SS#6 (8.84m to 9.45m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 SS#6 (8.84m to 9.45m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-04 SS#7 (10.36m to 10.97m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-04 SS#8 (11.88m to 12.50m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 SS#9 (13.41m to 14.02m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 SS#9 (13.41m to 14.02m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 S#11 (16.46m to 17.07m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 S#11 (16.46m to 17.07m)

Golder Associates

PROJECT No.		12-1494-0127	PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**				
TITLE	**BH12-04 SS#12 (17.53m to 17.83m)**				
Golder Associates	PROJECT No. 12-1494-0127			PHASE No. 4000	
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	CADD				
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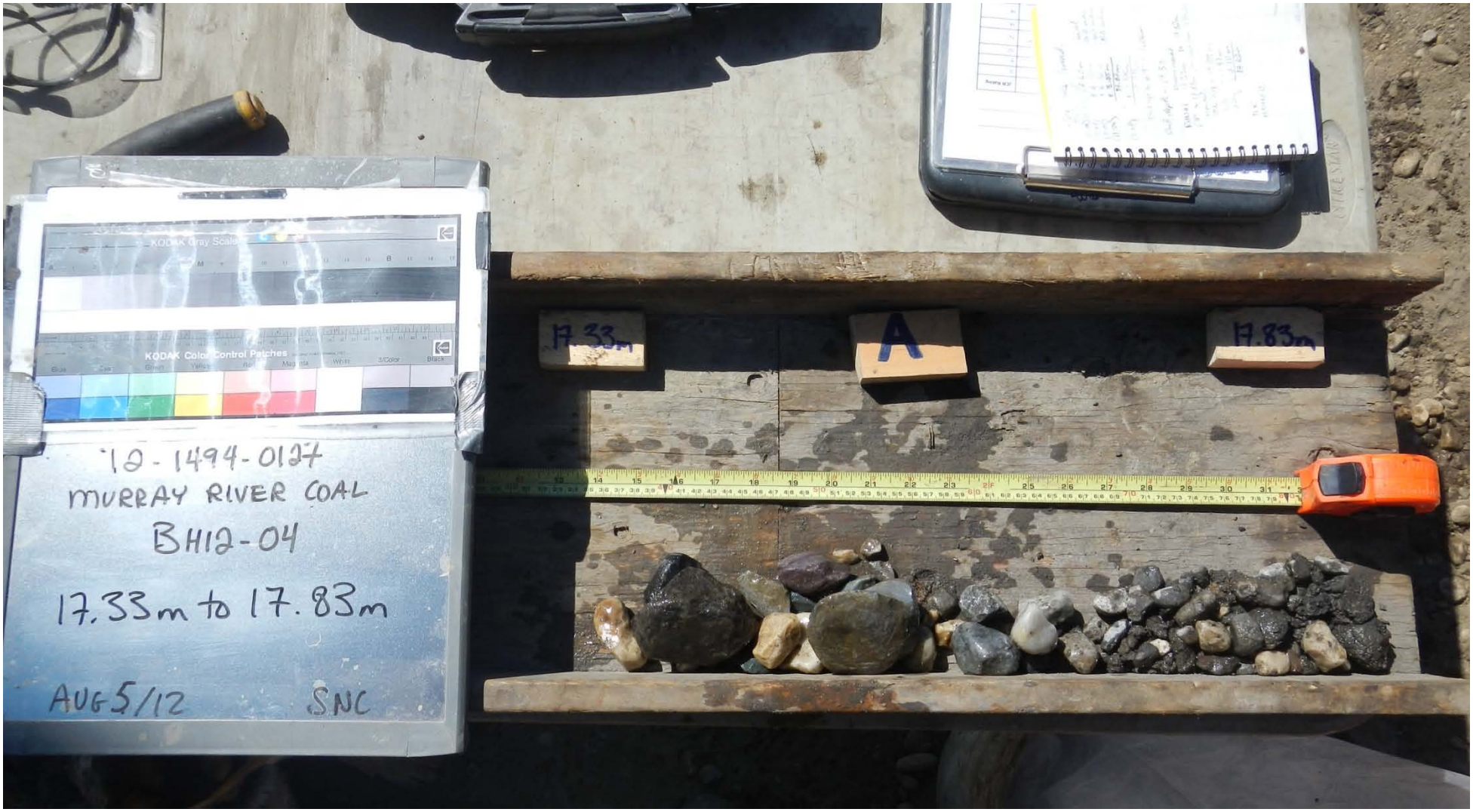

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (17.33m to 17.83m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 SS#12 (17.83m to 18.42m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-04 (18.42m to 19.29m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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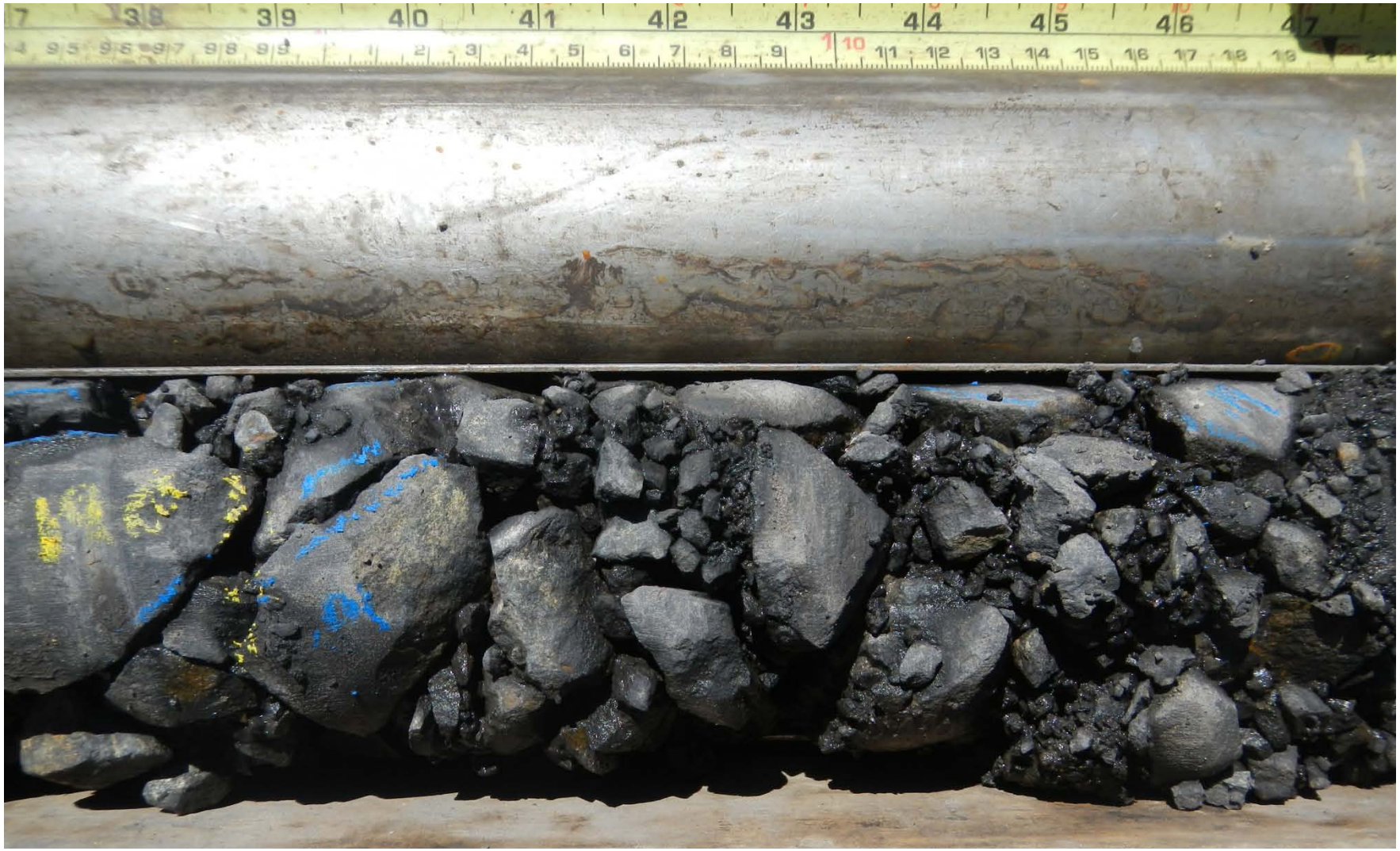

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (18.42m to 19.29m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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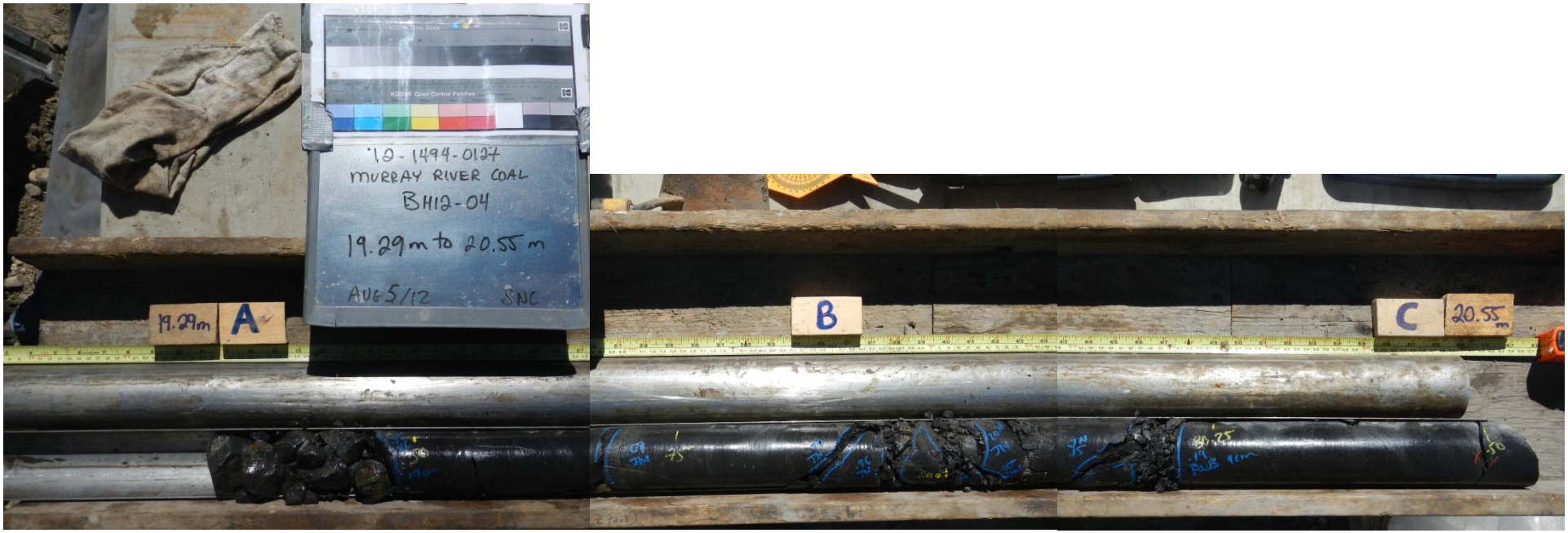

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (19.29m to 20.55m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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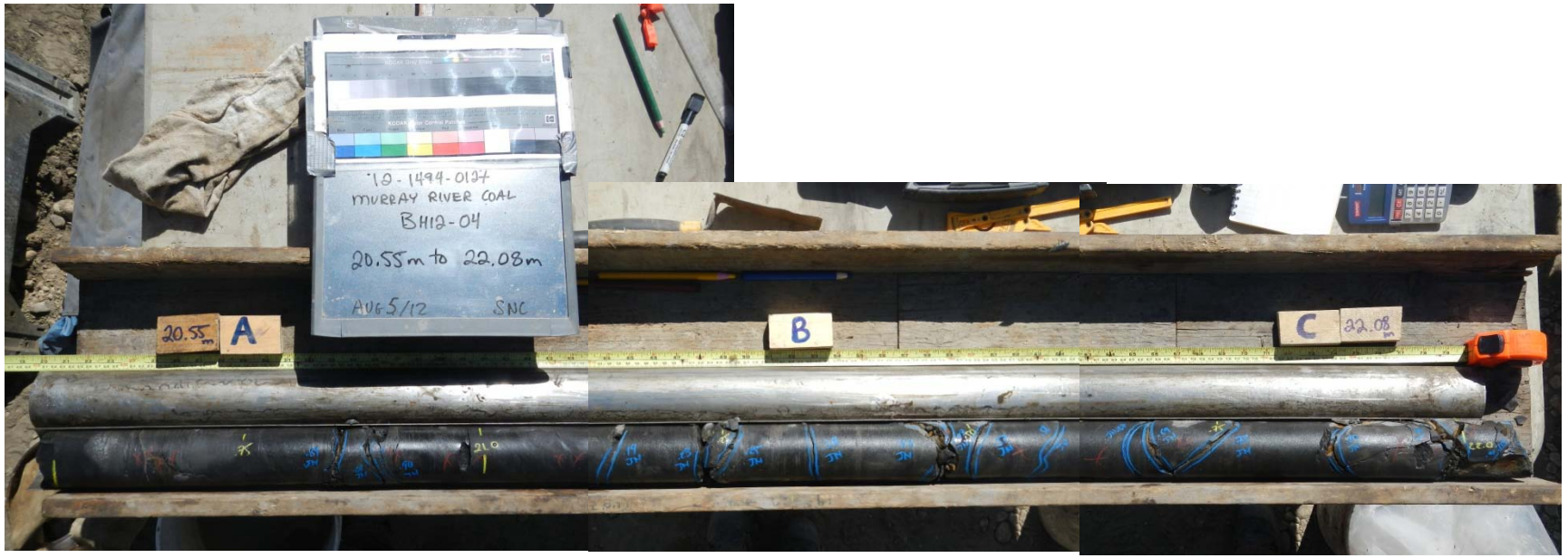

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (20.55m to 22.08m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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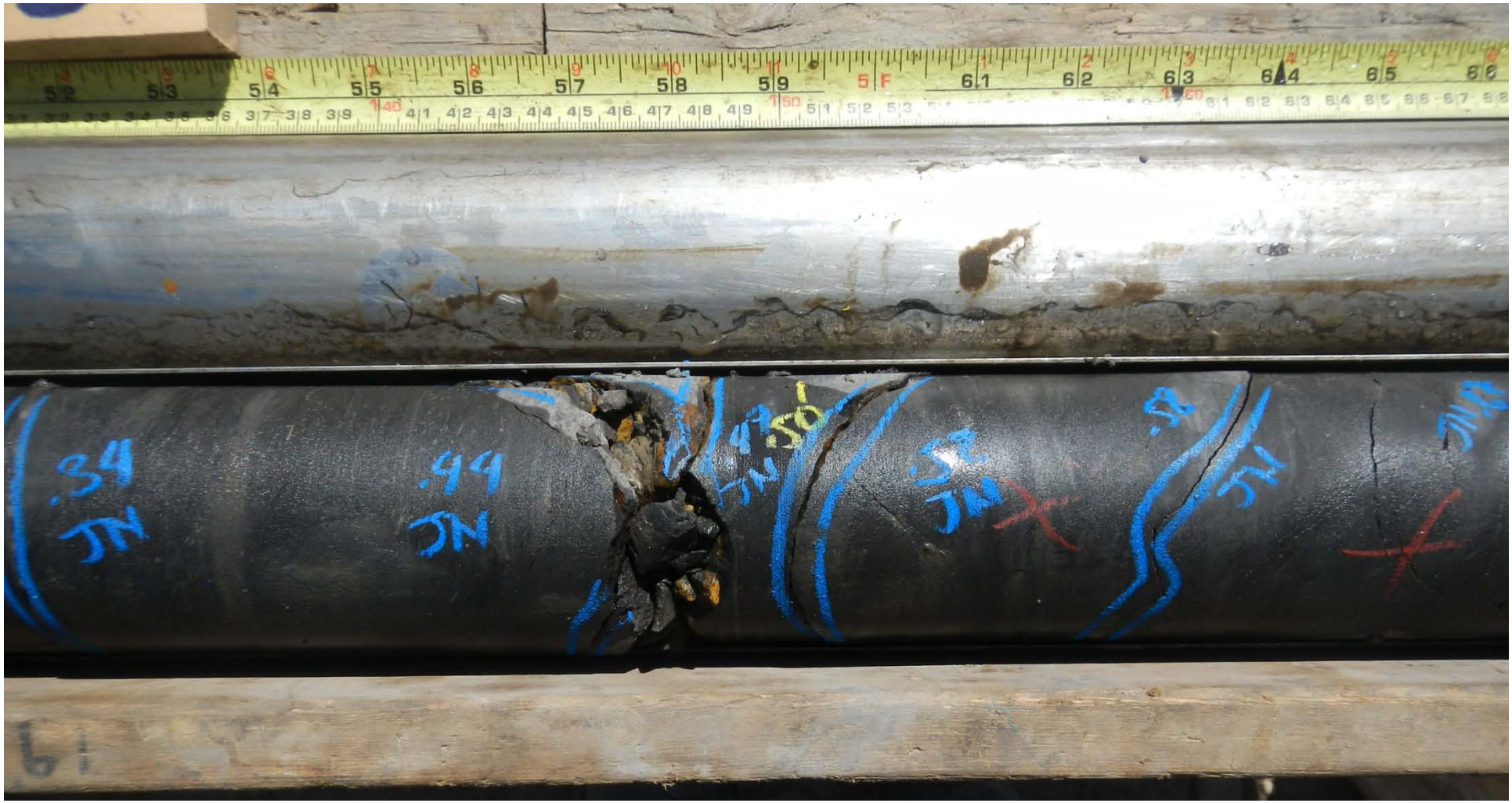

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (20.55m to 22.08m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (20.55m to 22.08m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (22.08m to 23.03m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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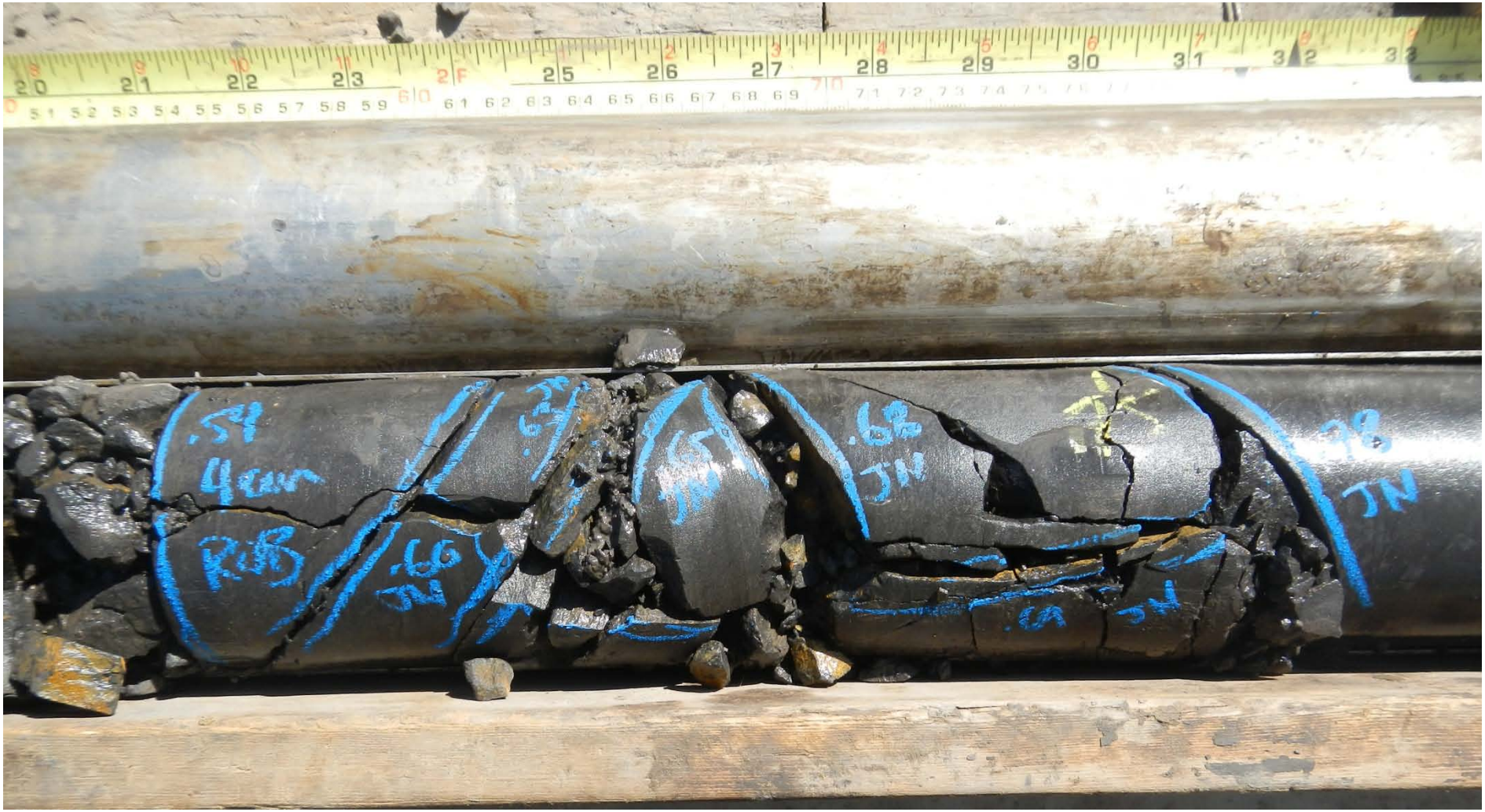

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (22.08m to 23.03m)

Golder Associates

PROJECT No.		12-1494-0127	PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (22.08m to 23.03m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (23.03m to 23.71m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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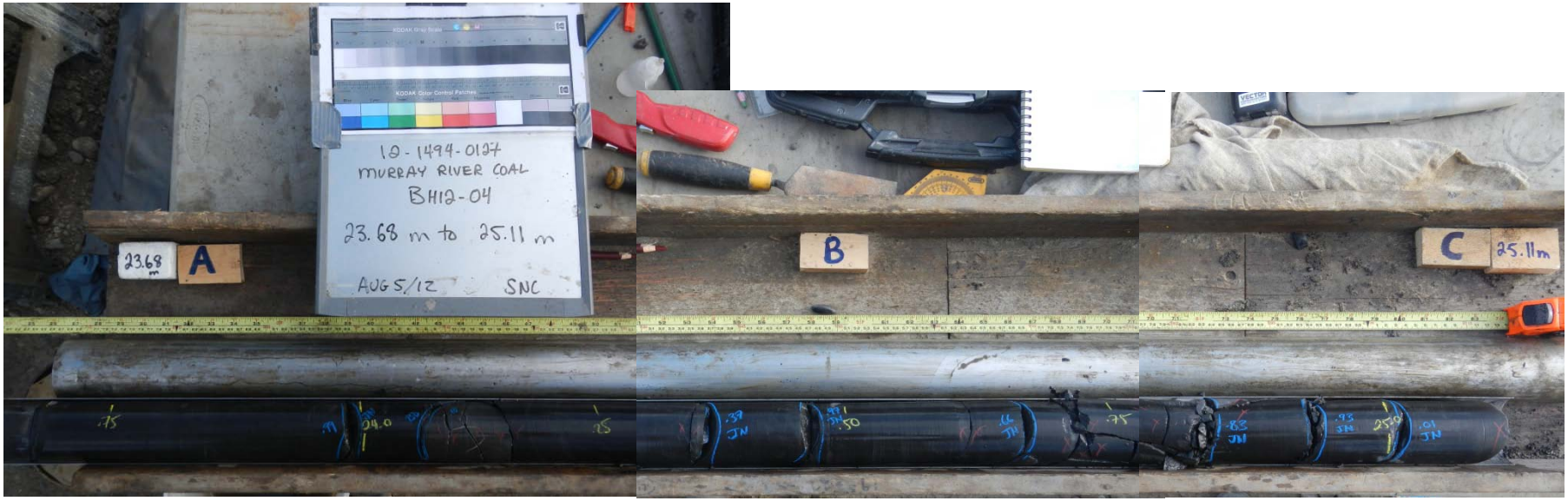

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (23.68m to 25.11m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (25.11m to 26.67m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (25.11m to 26.67m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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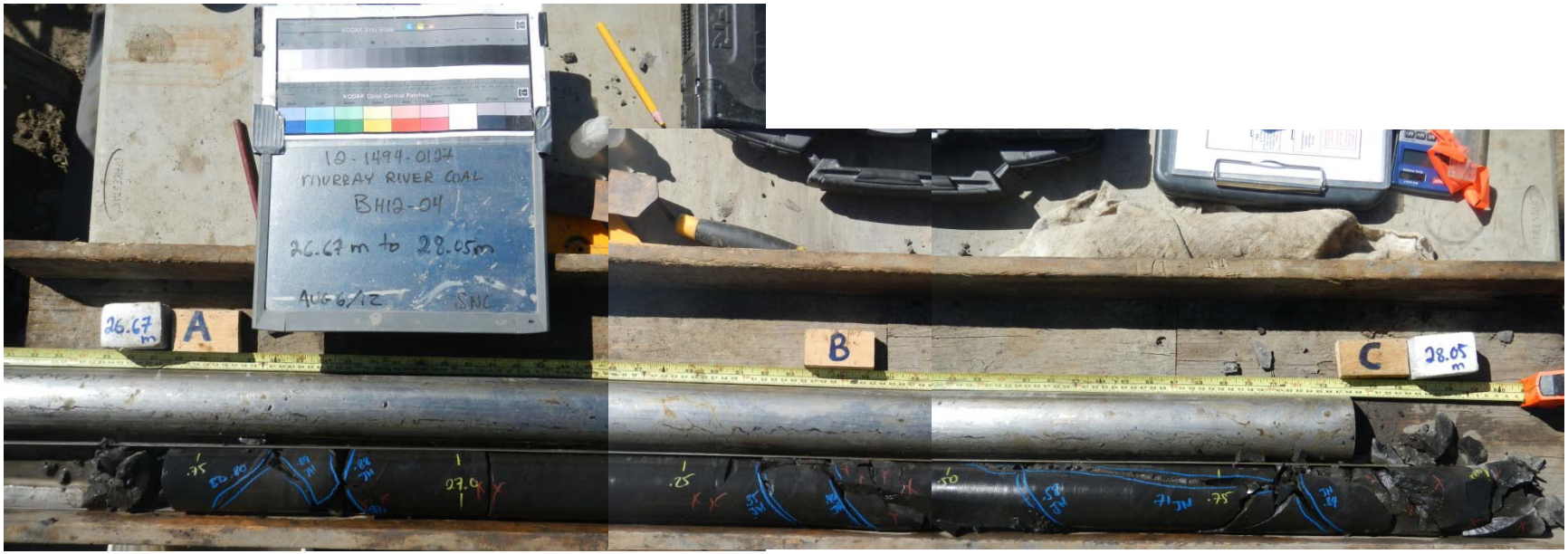

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (26.67m to 28.05m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 (26.67m to 28.05m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 S#4.1 - Dry (23.41m to 23.66m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 S#4.1 – Wet (23.41m to 23.66m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 S#4.2 – Dry (27.02m to 27.25m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-04 S#4.2 – Wet (27.02m to 27.25m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-05 SS#1 (1.22m to 1.83m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#1 (1.22m to 1.83m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#2 (2.74m to 3.35m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-05 SS#3 (4.27m to 4.88m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#3 (4.27m to 4.88m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-05 SS#4 (5.79m to 6.40m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#4 (5.79m to 6.40m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#5 (7.32m to 7.92m)

Golder Associates

PROJECT No. 12-1494-0127			PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

N:\Active\2012\1494 Geotechnical\12-1494-0127 HD Mining Murray River Geotechnical Design\07 Deliverables\Task 4600 Additional Drilling for Portal Cut

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#5 (7.32m to 7.92m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#6 (8.84m to 9.45m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#6 (8.84m to 9.45m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-05 SS#7 (10.36m to 10.97m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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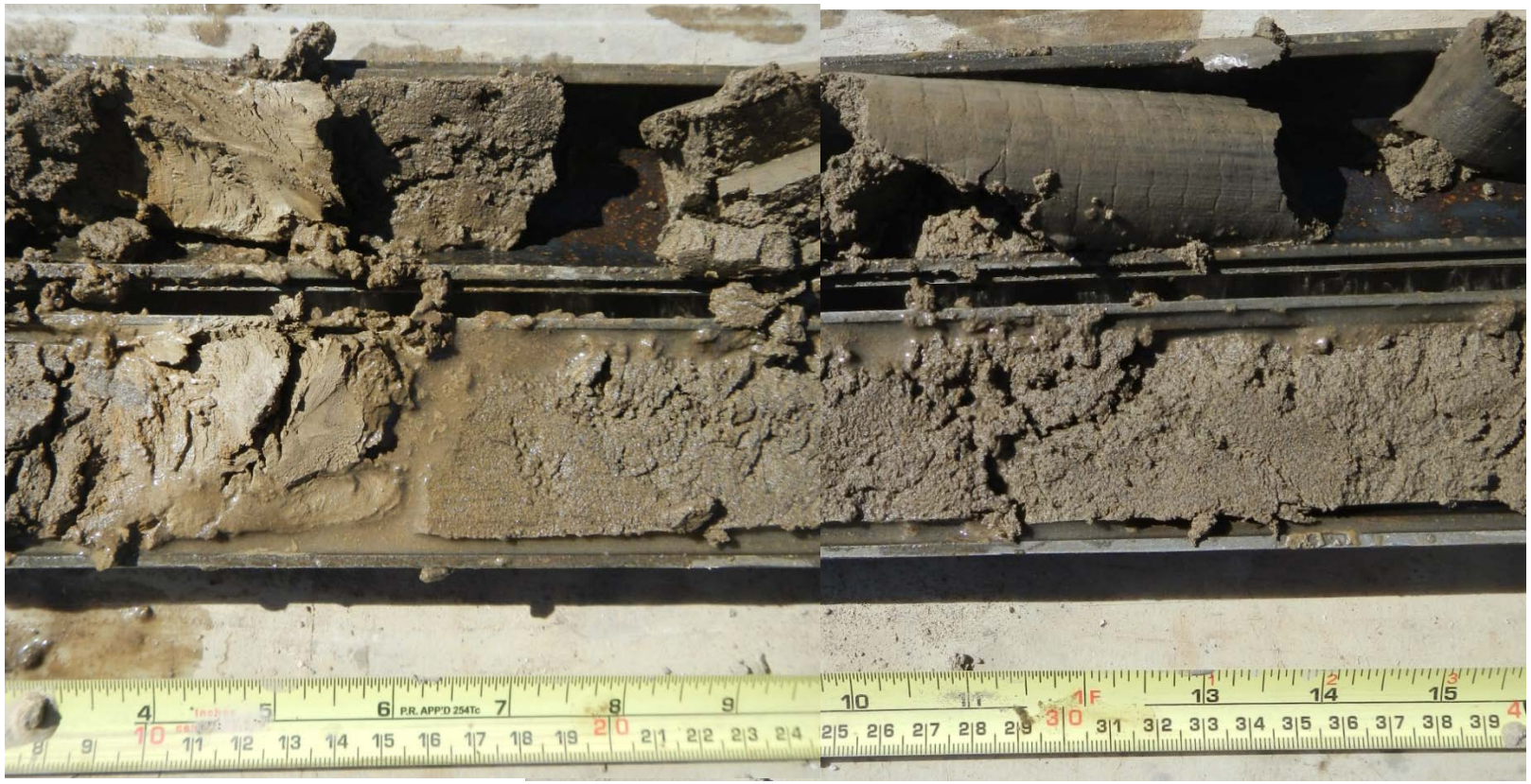

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#7 (10.36m to 10.97m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#8 (11.89m to 12.50m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#8 (11.89m to 12.50m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#9 (14.94m to 15.24m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#9 (14.94m to 15.24m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#10 (17.53m to 17.68m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 SS#10 (17.53m to 17.68m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
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REVIEW	BD	13SEP12		

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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-05 SS#10 (17.25m to 19.08m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
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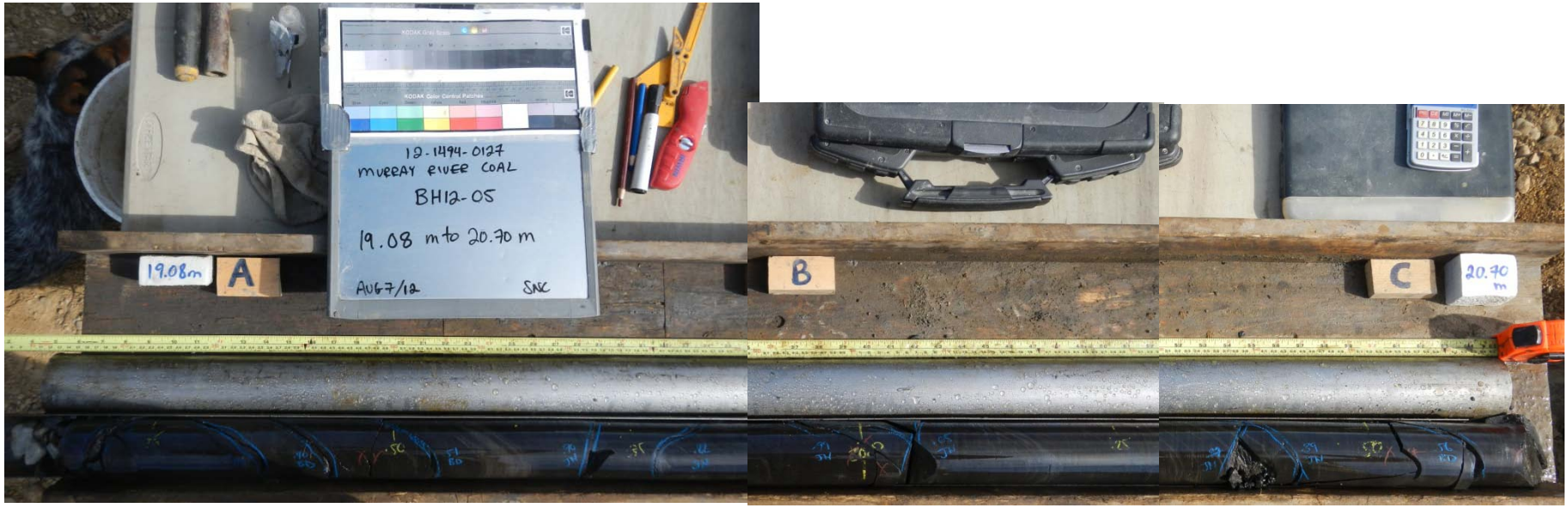

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 (19.08m to 20.70m)

Golder Associates

PROJECT No. 12-1494-0127			PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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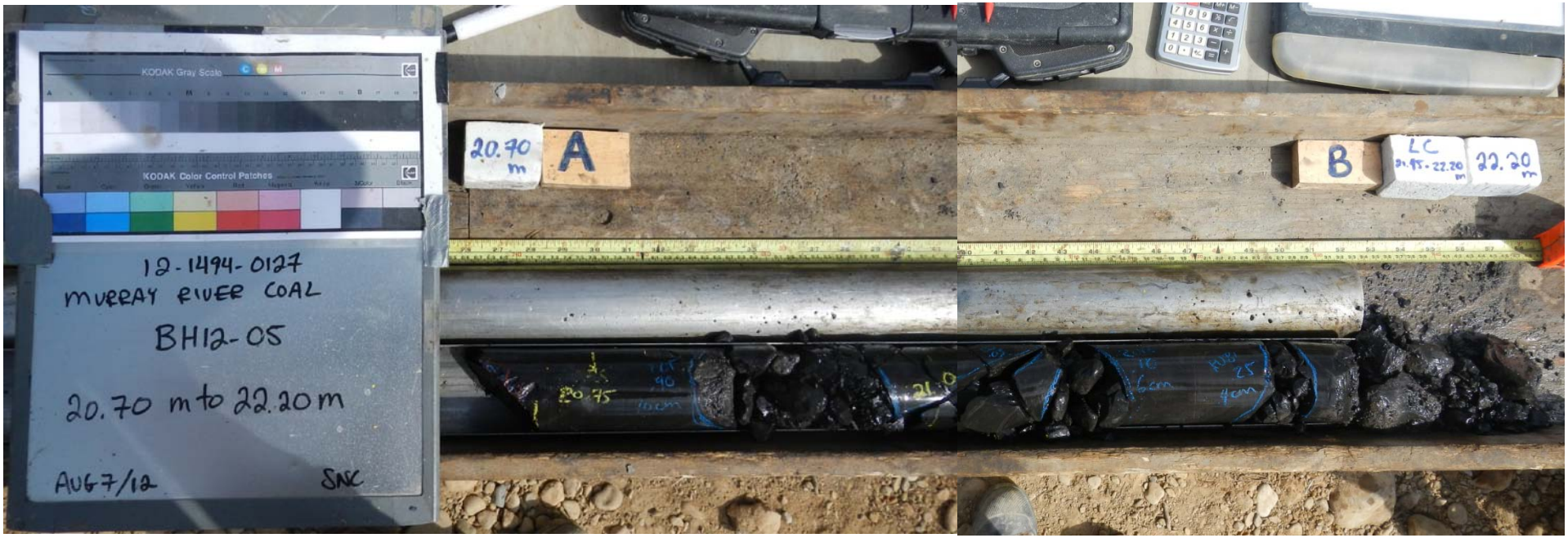

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 (20.70m to 22.20m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
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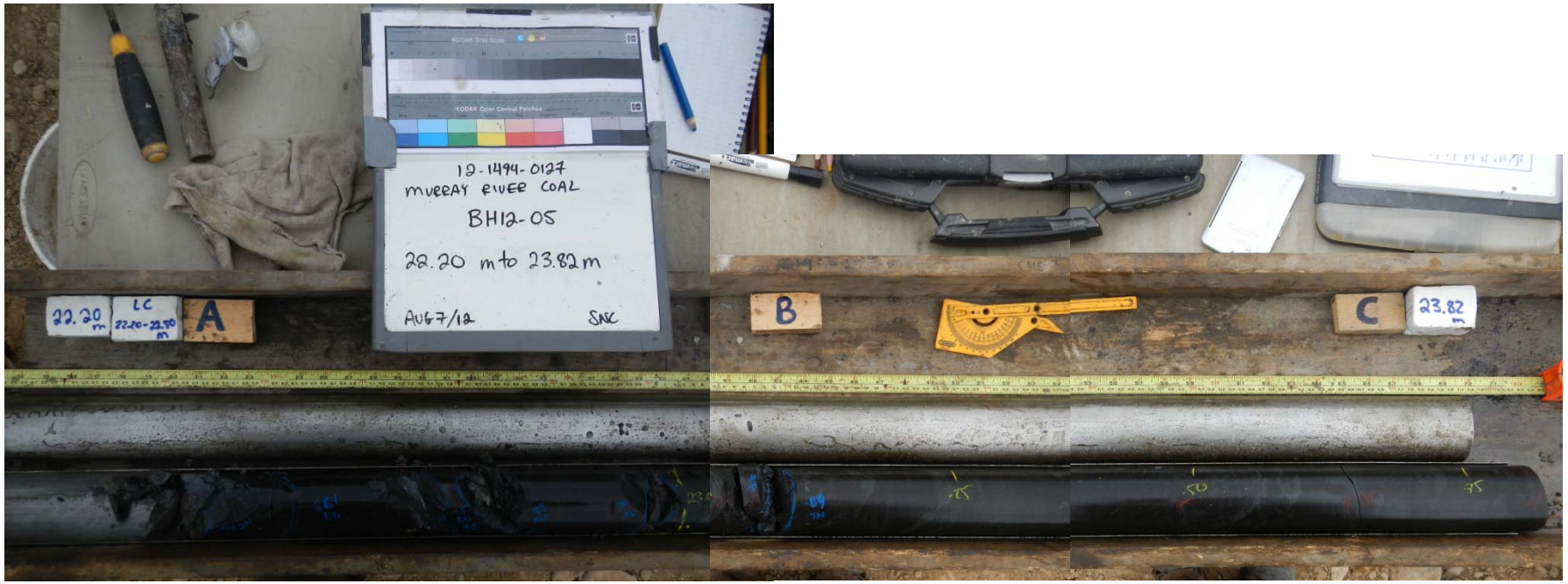

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 (22.20m to 23.82m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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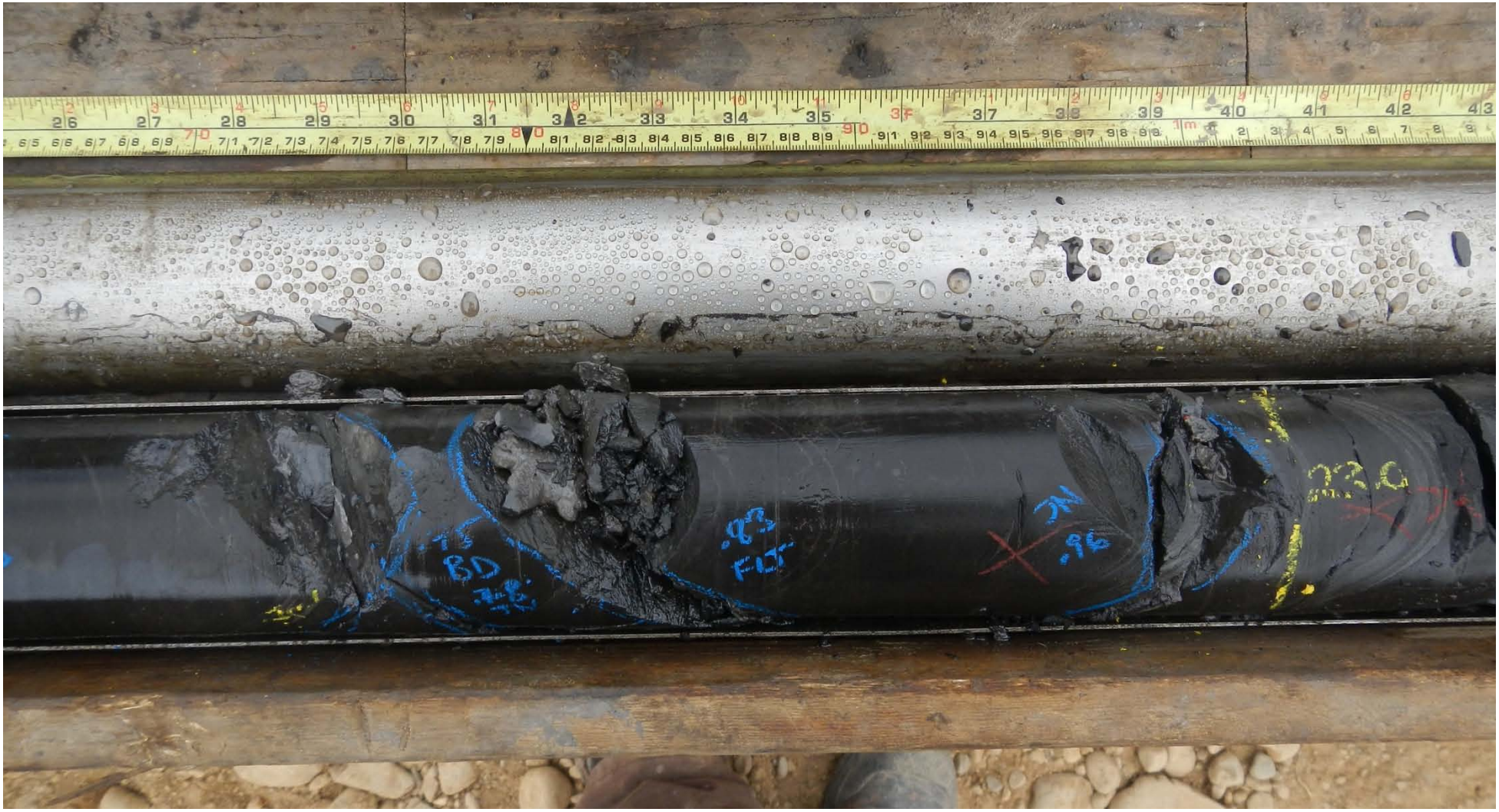

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 (22.20m to 23.82m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
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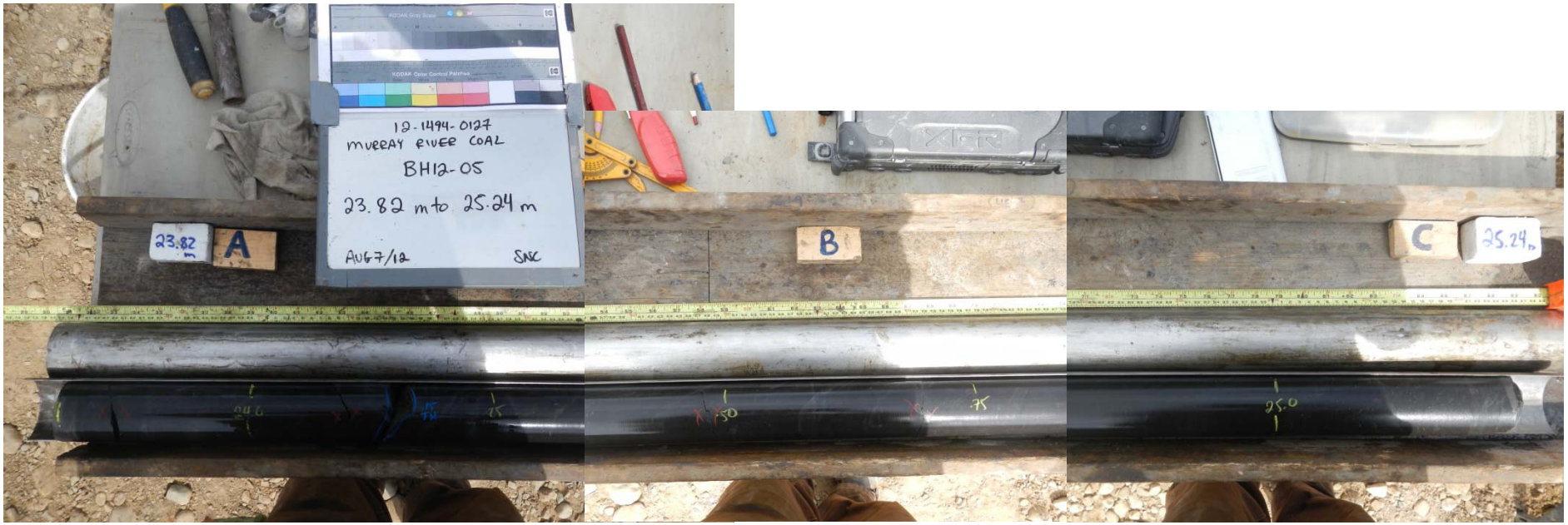

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 (23.82m to 25.24m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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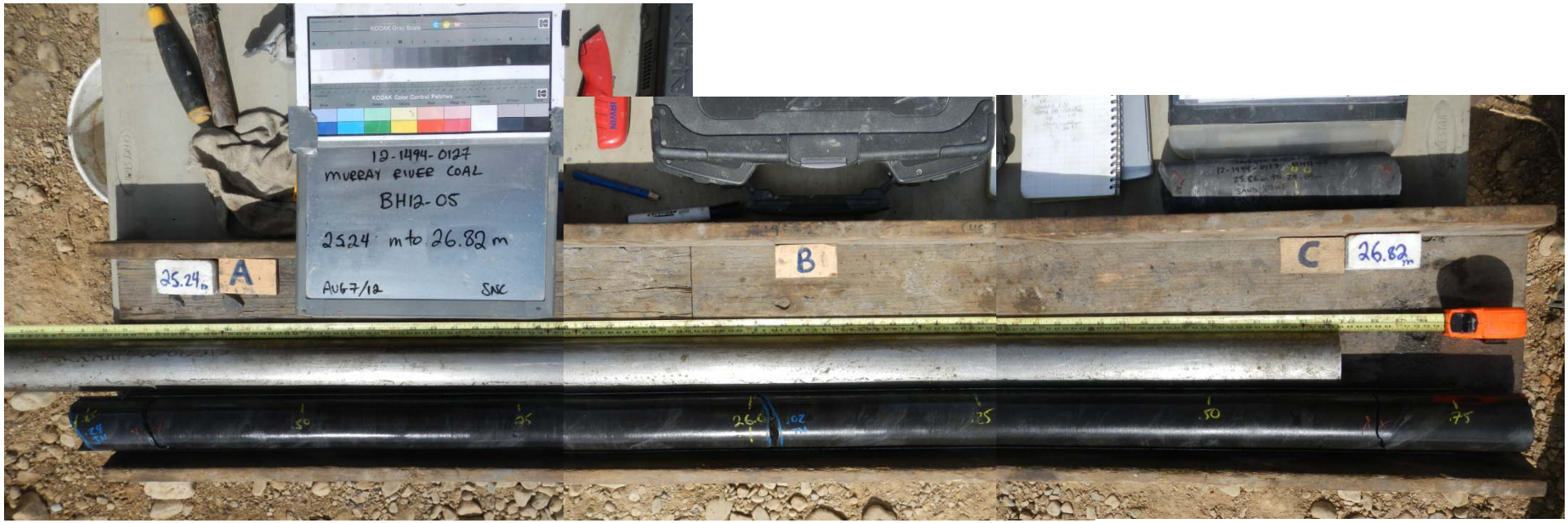
REVIEW	BD	13SEP12		



PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 (25.24m to 26.82m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
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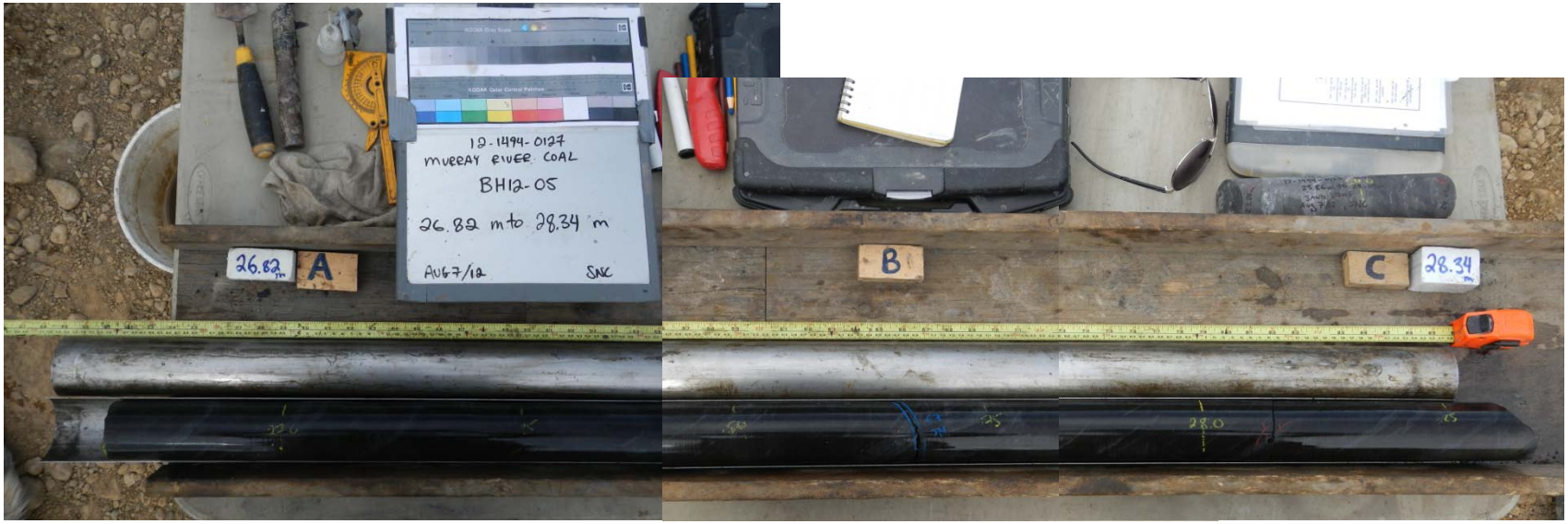


PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 (26.82m to 28.34m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

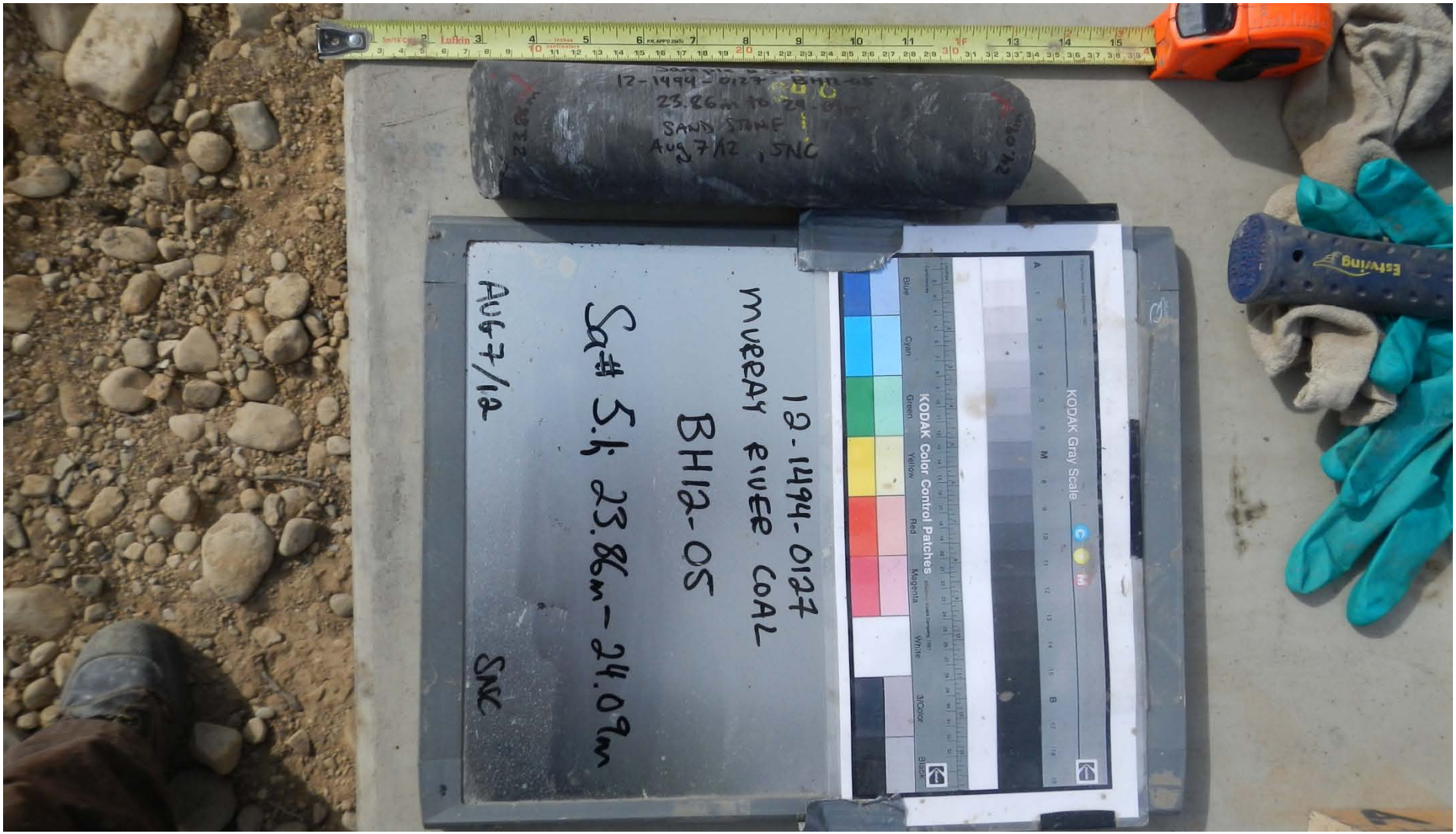
TITLE

BH12-05 (28.34m to 29.90m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No.	4000
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

N:\Active\2012\1494 Geotechnical\12-1494-0127 HD Mining Murray River Geotechnical Design\07 Deliverables\Task 4600 Additional Drilling for Portal Cut



PROJECT	HD Mining Murray River Coal Project TUMBLER Ridge, BC				
TITLE	BH12-05 S#5.1 - Dry (23.86m to 24.09m)				
Golder Associates	PROJECT No. 12-1494-0127			PHASE No. 4000	
	DESIGN	CR	24AUG12	SCALE	REV.
	CADD				
	CHECK	BRL	24AUG12		
	REVIEW	BD	13SEP12		

N:\Active\2012\1494 Geotechnical\12-1494-0127 HD Mining Murray River Geotechnical Design\07 Deliverables\Task 4600 Additional Drilling for Portal Cut

PROJECT

HD Mining
Murray River Coal Project
TUMBLER Ridge, BC

TITLE

BH12-05 S#5.1 - Wet (23.86m to 24.09m)

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

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PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**				
TITLE	**BH12-05 S#5.2 - Dry (29.27m to 29.55m)**				
Golder Associates	PROJECT No.	12-1494-0127	PHASE No.	4000	
	DESIGN	CR	24AUG12	SCALE	REV.
	CADD				
	CHECK	BRL	24AUG12		
	REVIEW	BD	13SEP12		

N:\Active\2012\1494 Geotechnical\12-1494-0127 HD Mining Murray River Geotechnical Design\07 Deliverables\Task 4600 Additional Drilling for Portal Cut

PROJECT	**HD Mining** **Murray River Coal Project** **TUMBLER Ridge, BC**
TITLE	**BH12-05 S#5.2 - Wet (29.27m to 29.55m)**

Golder Associates

PROJECT No.	12-1494-0127		PHASE No. 4000	
DESIGN	CR	24AUG12	SCALE	REV.
CADD				
CHECK	BRL	24AUG12		
REVIEW	BD	13SEP12		

APPENDIX E

Rock Core Laboratory Testing Results

Golder Associates Ltd. - Burnaby Laboratory
4280 Still Creek Drive
Burnaby, B.C. Canada V5C 6C8

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	12-1494-0127/4000/4600
Project:	Murray River Coal
Client:	HD Mining International Ltd.
Location:	Tumbler Ridge, BC
Lab ID	163

Failure Mode

(1) Diagonal shear plane(s) (5) Conical
(2) Vertical fracture(s) (6) Spalling
(3) Vertical splitting (7) Other
(4) Shear along foliation / discontinuity Note: (deg) measured from core axis

									Wet		Dry	Maximum	Stress			
No.	**Borehole**	**Sample**	**Depth**	**Dia**	**Ht**	**A**	**V**	**Mass**	**Density**	**W**	**Density**	**Load**	**σ**	**Rock Type**	**Failure Mode**	
	#	#	(m)	(mm)	(mm)	(cm^2)	(cm^3)	(g)	(Kg/m^3)	(%)	(Kg/m^3)	(kN)	(MPa)		Type	(deg)
1	BH12-01	1	14.2714.55	60.26	129.83	28.52	370.27	965.90	2609	1.43	2572	87.40	30.6	Siltstone	4	25
2	BH12-01	2	19.26-19.58	60.43	129.83	28.68	372.37	971.60	2609	1.25	2577	87.30	30.4	Siltstone	2	N/A
3	BH12-01	3	23.05-23.2	Sample Received Broken - Unable to Test												
4	BH12-01	4	24.58-24.75	60.46	132.78	28.71	381.21	993.00	2605	1.70	2561	49.20	17.1	Siltstone	2/4	39
5	BH12-02	2.1	12.69-12.86	60.61	129.76	28.85	374.39	975.40	2605	1.96	2555	35.70	12.4	Siltstone	4	27
6	BH12-02	2.2	18.20-18.58	60.52	129.65	28.77	372.96	981.50	2632	1.14	2602	80.20	27.9	Sandstone	4/2	27
7	BH12-02	2.3	19.56-19.87	60.45	128.56	28.70	368.97	979.00	2653	0.72	2634	200.10	69.7	Sandstone	2/4	28
8	BH12-02	2.4	26.05-26.33	60.52	129.44	28.77	372.35	982.10	2638	0.91	2614	177.00	61.5	Sandstone	4	22
9	BH12-04	4.1	23.41-23.66	60.59	125.24	28.83	361.11	942.50	2610	1.92	2561	76.20	26.4	Siltstone	4	38
10	BH12-04	4.2	27.02-27.25	60.74	125.91	28.98	364.84	957.40	2624	1.86	2576	101.00	34.9	Siltstone	1/4	28
11	BH12-05	5.1	23.86-24.09	60.83	126.39	29.06	367.31	973.00	2649	1.20	2618	185.30	63.8	Sandstone	4	24
12	BH12-05	5.2	29.27-29.55	60.83	126.52	29.06	367.69	967.10	2630	1.11	2601	104.80	36.1	Sandstone	4	35

G. Patton	August 27, 2012	E. Kostyukov	August 28, 2012
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Lab
4280 Still Creek Drive
Burnaby, B.C. Canada V5C 6C6

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	12-1494-0127/4000/4600	**Borehole:**	**BH12-01**
Project:	Murray River Coal	**Sample Number:**	1
Location:	Tumbler Ridge, BC	**Depth (m):**	14.2714.55
Client:	HD Mining International Ltd.	**Lab ID No:**	163

Testing Results

Max Load (kN)	**87.40**
Stress σ (MPa)	**30.6**
Pace Rate (kN/s)	0.50
Lithology	Siltstone

Sample Measurements

Diameter (mm)	60.26
Height (mm)	129.83
Area (cm^2)	28.52
Volume (cm^3)	370.27
Mass (g)	965.90
Moisture Content (%)	1.43
Wet Density (Kg/m^3)	2608.61
Dry Density (Kg/m^3)	2571.80

Failure Mode

Type: **4**

Degrees:* **25**

* Degrees measured with respect to core axis.

Notes

- Water content as received

Mode:

(1) Diagonal shear plane(s)
(2) Vertical fracture(s)
(3) Vertical splitting
(4) Shear along foliation /discontinuity
(5) Conical
(6) Spalling
(7) Other

Comments

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BEFORE TEST

AFTER TEST

G. Patton	August 27, 2012	E. Kostyukov	August 28, 2012
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Lab
4280 Still Creek Drive
Burnaby, B.C. Canada V5C 6C6

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	12-1494-0127/4000/4600	**Borehole:**	**BH12-01**
Project:	Murray River Coal	**Sample Number:**	2
Location:	Tumbler Ridge, BC	**Depth (m):**	19.26-19.58
Client:	HD Mining International Ltd.	**Lab ID No:**	163

Testing Results

Max Load (kN)	**87.30**
Stress σ (MPa)	**30.4**
Pace Rate (kN/s)	0.50
Lithology	Siltstone

Sample Measurements

Diameter (mm)	60.43
Height (mm)	129.83
Area (cm^2)	28.68
Volume (cm^3)	372.37
Mass (g)	971.60
Moisture Content (%)	1.25
Wet Density (Kg/m^3)	2609.26
Dry Density (Kg/m^3)	2577.00

Failure Mode

Type: **2**

Degrees:* **N/A**

* Degrees measured with respect to core axis.

Notes

- Water content as received

Mode:

(1) Diagonal shear plane(s)
(2) Vertical fracture(s)
(3) Vertical splitting
(4) Shear along foliation /discontinuity
(5) Conical
(6) Spalling
(7) Other

Comments

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BEFORE TEST

AFTER TEST

G. Patton	August 27, 2012	E. Kostyukov	August 28, 2012
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Lab
4280 Still Creek Drive
Burnaby, B.C. Canada V5C 6C6

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	12-1494-0127/4000/4600	**Borehole:**	**BH12-01**
Project:	Murray River Coal	**Sample Number:**	4
Location:	Tumbler Ridge, BC	**Depth (m):**	24.58-24.75
Client:	HD Mining International Ltd.	**Lab ID No:**	163

Testing Results

Max Load (kN)	**49.20**
Stress σ (MPa)	**17.1**
Pace Rate (kN/s)	0.50
Lithology	Siltstone

Sample Measurements

Diameter (mm)	60.46
Height (mm)	132.78
Area (cm^2)	28.71
Volume (cm^3)	381.21
Mass (g)	993.00
Moisture Content (%)	1.70
Wet Density (Kg/m^3)	2604.90
Dry Density (Kg/m^3)	2561.27

Failure Mode

Type: **2/4**

Degrees:* **39**

* Degrees measured with respect to core axis.

Notes

- Water content as received

Mode:

(1) Diagonal shear plane(s)
(2) Vertical fracture(s)
(3) Vertical splitting
(4) Shear along foliation /discontinuity
(5) Conical
(6) Spalling
(7) Other

Comments

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BEFORE TEST

AFTER TEST

G. Patton	August 27, 2012	E. Kostyukov	August 28, 2012
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Lab
4280 Still Creek Drive
Burnaby, B.C. Canada V5C 6C6

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	12-1494-0127/4000/4600	**Borehole:**	**BH12-02**
Project:	Murray River Coal	**Sample Number:**	2.1
Location:	Tumbler Ridge, BC	**Depth (m):**	12.69-12.86
Client:	HD Mining International Ltd.	**Lab ID No:**	163

Testing Results		Sample Measurements	
Max Load (kN)	**35.70**	Diameter (mm)	60.61
		Height (mm)	129.76
Stress σ (MPa)	**12.4**	Area (cm^2)	28.85
		Volume (cm^3)	374.39
Pace Rate (kN/s)	0.50	Mass (g)	975.40
		Moisture Content (%)	1.96
Lithology	Siltstone	Wet Density (Kg/m^3)	2605.33
		Dry Density (Kg/m^3)	2555.31

Failure Mode		Notes
		- Water content as received
Type:	**4**	**Mode:**
		(1) Diagonal shear plane(s)
Degrees:*	**27**	(2) Vertical fracture(s)
		(3) Vertical splitting
		(4) Shear along foliation /discontinuity
		(5) Conical
* Degrees measured with respect to core axis.		(6) Spalling
		(7) Other

Comments

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BEFORE TEST

AFTER TEST

G. Patton	August 25, 2012	E. Kostyukov	August 28, 2012
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Lab
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Burnaby, B.C. Canada V5C 6C6

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	12-1494-0127/4000/4600	**Borehole:**	**BH12-02**
Project:	Murray River Coal	**Sample Number:**	2.2
Location:	Tumbler Ridge, BC	**Depth (m):**	18.20-18.58
Client:	HD Mining International Ltd.	**Lab ID No:**	163

Testing Results		Sample Measurements	
Max Load (kN)	**80.20**	Diameter (mm)	60.52
		Height (mm)	129.65
Stress σ (MPa)	**27.9**	Area (cm^2)	28.77
		Volume (cm^3)	372.96
Pace Rate (kN/s)	0.50	Mass (g)	981.50
		Moisture Content (%)	1.14
Lithology	Sandstone	Wet Density (Kg/m^3)	2631.66
		Dry Density (Kg/m^3)	2602.12

Failure Mode		Notes
		- Water content as received
Type:	**4/2**	**Mode:**
		(1) Diagonal shear plane(s)
Degrees:*	**27**	(2) Vertical fracture(s)
		(3) Vertical splitting
		(4) Shear along foliation /discontinuity
		(5) Conical
* Degrees measured with respect to core axis.		(6) Spalling
		(7) Other

Comments

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BEFORE TEST

AFTER TEST

G. Patton	August 27, 2012	E. Kostyukov	August 28, 2012
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Lab
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Burnaby, B.C. Canada V5C 6C6

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	12-1494-0127/4000/4600	**Borehole:**	**BH12-02**
Project:	Murray River Coal	**Sample Number:**	2.3
Location:	Tumbler Ridge, BC	**Depth (m):**	19.56-19.87
Client:	HD Mining International Ltd.	**Lab ID No:**	163

Testing Results

Max Load (kN)	**200.10**
Stress σ (MPa)	**69.7**
Pace Rate (kN/s)	0.50
Lithology	Sandstone

Sample Measurements

Diameter (mm)	60.45
Height (mm)	128.56
Area (cm^2)	28.70
Volume (cm^3)	368.97
Mass (g)	979.00
Moisture Content (%)	0.72
Wet Density (Kg/m^3)	2653.35
Dry Density (Kg/m^3)	2634.42

Failure Mode

Type: **2/4**

Degrees:* **28**

* Degrees measured with respect to core axis.

Notes

- Water content as received

Mode:

(1) Diagonal shear plane(s)
(2) Vertical fracture(s)
(3) Vertical splitting
(4) Shear along foliation /discontinuity
(5) Conical
(6) Spalling
(7) Other

Comments

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BEFORE TEST

AFTER TEST

G. Patton	August 27, 2012	E. Kostyukov	August 28, 2012
TESTED BY	DATE	CHECKED BY	DATE

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Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	12-1494-0127/4000/4600	**Borehole:**	**BH12-02**
Project:	Murray River Coal	**Sample Number:**	2.4
Location:	Tumbler Ridge, BC	**Depth (m):**	26.05-26.33
Client:	HD Mining International Ltd.	**Lab ID No:**	163

Testing Results

Max Load (kN)	**177.00**
Stress σ (MPa)	**61.5**
Pace Rate (kN/s)	0.50
Lithology	Sandstone

Sample Measurements

Diameter (mm)	60.52
Height (mm)	129.44
Area (cm^2)	28.77
Volume (cm^3)	372.35
Mass (g)	982.10
Moisture Content (%)	0.91
Wet Density (Kg/m^3)	2637.54
Dry Density (Kg/m^3)	2613.80

Failure Mode

Type: **4**

Degrees:* **22**

* Degrees measured with respect to core axis.

Notes

- Water content as received

Mode:

(1) Diagonal shear plane(s)
(2) Vertical fracture(s)
(3) Vertical splitting
(4) Shear along foliation /discontinuity
(5) Conical
(6) Spalling
(7) Other

Comments

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BEFORE TEST

AFTER TEST

G. Patton	August 27, 2012	E. Kostyukov	August 28, 2012
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Lab
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Burnaby, B.C. Canada V5C 6C6

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	12-1494-0127/4000/4600	**Borehole:**	**BH12-04**
Project:	Murray River Coal	**Sample Number:**	4.1
Location:	Tumbler Ridge, BC	**Depth (m):**	23.41-23.66
Client:	HD Mining International Ltd.	**Lab ID No:**	163

Testing Results		Sample Measurements	
Max Load (kN)	**76.20**	Diameter (mm)	60.59
		Height (mm)	125.24
Stress σ (MPa)	**26.4**	Area (cm^2)	28.83
		Volume (cm^3)	361.11
Pace Rate (kN/s)	0.50	Mass (g)	942.50
		Moisture Content (%)	1.92
Lithology	Siltstone	Wet Density (Kg/m^3)	2610.04
		Dry Density (Kg/m^3)	2560.78

Failure Mode		Notes
		- Water content as received
Type:	**4**	**Mode:**
		(1) Diagonal shear plane(s)
Degrees:*	**38**	(2) Vertical fracture(s)
		(3) Vertical splitting
		(4) Shear along foliation /discontinuity
		(5) Conical
* Degrees measured with respect to core axis.		(6) Spalling
		(7) Other

Comments

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BEFORE TEST

AFTER TEST

G. Patton	August 25, 2012	E. Kostyukov	August 28, 2012
TESTED BY	DATE	CHECKED BY	DATE

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Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	12-1494-0127/4000/4600	**Borehole:**	**BH12-04**
Project:	Murray River Coal	**Sample Number:**	4.2
Location:	Tumbler Ridge, BC	**Depth (m):**	27.02-27.25
Client:	HD Mining International Ltd.	**Lab ID No:**	163

Testing Results		Sample Measurements	
Max Load (kN)	**101.00**	Diameter (mm)	60.74
		Height (mm)	125.91
Stress σ (MPa)	**34.9**	Area (cm^2)	28.98
		Volume (cm^3)	364.84
Pace Rate (kN/s)	0.50	Mass (g)	957.40
		Moisture Content (%)	1.86
Lithology	Siltstone	Wet Density (Kg/m^3)	2624.18
		Dry Density (Kg/m^3)	2576.17

Failure Mode		Notes
		- Water content as received
Type:	**1/4**	**Mode:**
		(1) Diagonal shear plane(s)
Degrees:*	**28**	(2) Vertical fracture(s)
		(3) Vertical splitting
		(4) Shear along foliation /discontinuity
		(5) Conical
* Degrees measured with respect to core axis.		(6) Spalling
		(7) Other

Comments

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BEFORE TEST

AFTER TEST

G. Patton	August 25, 2012	E. Kostyukov	August 28, 2012
TESTED BY	DATE	CHECKED BY	DATE

Golder Associates Ltd. - Burnaby Lab
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Burnaby, B.C. Canada V5C 6C6

Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	12-1494-0127/4000/4600	**Borehole:**	**BH12-05**
Project:	Murray River Coal	**Sample Number:**	5.1
Location:	Tumbler Ridge, BC	**Depth (m):**	23.86-24.09
Client:	HD Mining International Ltd.	**Lab ID No:**	163

Testing Results

Max Load (kN)	**185.30**
Stress σ (MPa)	**63.8**
Pace Rate (kN/s)	0.50
Lithology	Sandstone

Sample Measurements

Diameter (mm)	60.83
Height (mm)	126.39
Area (cm^2)	29.06
Volume (cm^3)	367.31
Mass (g)	973.00
Moisture Content (%)	1.20
Wet Density (Kg/m^3)	2648.96
Dry Density (Kg/m^3)	2617.50

Failure Mode

Type: **4**

Degrees:* **24**

* Degrees measured with respect to core axis.

Notes

- Water content as received

Mode:

(1) Diagonal shear plane(s)
(2) Vertical fracture(s)
(3) Vertical splitting
(4) Shear along foliation /discontinuity
(5) Conical
(6) Spalling
(7) Other

Comments

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BEFORE TEST

AFTER TEST

G. Patton	August 25, 2012	E. Kostyukov	August 28, 2012
TESTED BY	DATE	CHECKED BY	DATE

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Unconfined Compressive Strength of Intact Rock Core Specimens

Reference
ASTM D7012-10 Method C

Project No.:	12-1494-0127/4000/4600	**Borehole:**	**BH12-05**
Project:	Murray River Coal	**Sample Number:**	5.2
Location:	Tumbler Ridge, BC	**Depth (m):**	29.27-29.55
Client:	HD Mining International Ltd.	**Lab ID No:**	163

Testing Results		Sample Measurements	
Max Load (kN)	**104.80**	Diameter (mm)	60.83
		Height (mm)	126.52
Stress σ (MPa)	**36.1**	Area (cm^2)	29.06
		Volume (cm^3)	367.69
Pace Rate (kN/s)	0.50	Mass (g)	967.10
		Moisture Content (%)	1.11
Lithology	Sandstone	Wet Density (Kg/m^3)	2630.19
		Dry Density (Kg/m^3)	2601.32

Failure Mode		Notes
		- Water content as received
Type:	**4**	**Mode:**
		(1) Diagonal shear plane(s)
Degrees:*	**35**	(2) Vertical fracture(s)
		(3) Vertical splitting
		(4) Shear along foliation /discontinuity
		(5) Conical
* Degrees measured with respect to core axis.		(6) Spalling
		(7) Other

Comments

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BEFORE TEST

AFTER TEST

G. Patton	August 25, 2012	E. Kostyukov	August 28, 2012
TESTED BY	DATE	CHECKED BY	DATE

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.

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South America	+ 55 21 3095 9500

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