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ASSESSMENT REPORT TITLE PAGE AND SUMMARY

TITLE OF REPORT: Quintette 2013 Exploration Assessment Report

TOTAL COST: $4,168,876

AUTHOR(S): Kevin Sharman, P.Geo.
SIGNATURE(S): 2015/07/14

NOTICE OF WORK PERMIT NUMBER(S)/DATE(S): 0900001-2013-01, July 12, 2013 (work covered by MAPA C-156, amended June 21, 2013)
STATEMENT OF WORK EVENT NUMBER(S)/DATE(S): N/A

YEAR OF WORK: 2013

PROPERTY NAME: Quintette

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

Coal Leases #389287, #418129

COMMODITIES SOUGHT: Coal

MINERAL INVENTORY MINFILE NUMBER(S),IF KNOWN:

MINING DIVISION: Liard
NTS / BCGS: 093 I/13
LATITUDE: _____° _____' _____"
LONGITUDE: _____° _____' _____" (at centre of work)
UTM Zone: 10N EASTING: 628290 NORTHING: 6089300

OWNER(S):

Teck Coal Ltd.

MAILING ADDRESS:
Box 1500 Tumbler Ridge, BC
V0C 2W0

OPERATOR(S) [who paid for the work]: N/A

MAILING ADDRESS:

REPORT KEYWORDS (lithology, age, stratigraphy, structure, alteration, mineralization, size and attitude. **Do not use abbreviations or codes**)

Quintette, Babcock, Coal, Exploration, Gates, Cretaceous, Tumbler Ridge, Northeast.

REFERENCES TO PREVIOUS ASSESSMENT WORK AND ASSESSMENT REPORT NUMBERS:

N/A

TYPE OF WORK IN THIS REPORT	EXTENT OF WORK (in metric units)	ON WHICH CLAIMS	PROJECT COSTS APPORTIONED (incl. support)
GEOLOGICAL (scale, area)			
Ground, mapping	N/A		
Photo interpretation			
GEOPHYSICAL			
Ground	N/A		
Magnetic			
Electromagnetic			
Induced Polarization			
Radiometric			
Seismic			
Other (well logging)	58 holes, 12,211 m	Coal Lease #389287, #418129	$226,465
Airborne	N/A		
GEOCHEMICAL (number of samples analysed for ...)			
Soil	N/A		
Silt	N/A		
Rock	N/A		
Other	N/A		
DRILLING (total metres, number of holes, size, storage location)			
Core	1000 m HQ in 4 holes	Coal Lease #389287, #418129	$291,163
Non-core	12,039 m in 78 holes	Coal Lease #389287, #418129	$2,284,549
RELATED TECHNICAL			
Sampling / Assaying	2917 samples	Coal Lease #389287, #418129	$283,733
Petrographic	N/A		
Mineralographic	N/A		
Metallurgic	N/A		
PROSPECTING (scale/area)	N/A		
PREPARATORY / PHYSICAL			
Line/grid (km)	N/A		
Topo/Photogrammetric (scale, area)			
Legal Surveys (scale, area)	N/A		
Road, local access (km)/trail	7.2 km	Coal Lease #389287, #418129	$1,082,966
Trench (number/metres)	N/A		
Underground development (metres)	N/A		
Other	N/A		
		TOTAL COST	$4,168,876

Table 3, Table 4, and Appendix C remain confidential under the terms of the Coal Act Regulation, and have been removed from the public version.

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

Quintette Coal Operations

Assessment Report

2013 Exploration Program

Teck

Statement of Author's Academic and Professional Qualifications

CERTIFICATE OF QUALIFIED PERSON

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I am employed as Senior Geologist Supervisor for Teck Coal Limited ("Teck").

I graduated with a Bachelor of Science degree in Geology from the University of Calgary in 1980. I am a member of the Association of Professional Engineers and Geoscientists of the Province of British Columbia, Canada (# 20014).

Since 1980, I have worked in coal exploration and coal mine geology at a number of properties in southeastern and northeastern BC. I am currently working on-site at Quintette.

Kevin Sharman, P.Geo.

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1. Project Description and Land Tenure

The Quintette Project is located in northeastern BC, 20 km south of the town of Tumbler Ridge. It is accessed by travelling south of Tumbler Ridge on provincial Highway 52 and the Murray River Forest Service Road. Figure 1 is a location map.

The property is in the Peace River Coalfield, a belt of coal-bearing strata extending across northeastern British Columbia in a northwest-southeast trend. The stratigraphic succession exposed at the Quintette property ranges from Upper Jurassic to Lower Cretaceous and consists of interbedded shales and sandstones of both marine and continental origin. Most of the coal-bearing strata were deposited in a deltaic environment. Formation names from oldest to youngest that are present in the Babcock area include the Gates, Hulcross and Boulder Creek Formations. Bedrock on the property is faulted and folded due to post-depositional tectonic activity. Folds in the area tend to be broad and open.

The majority of the property is located on Crown Land. The Babcock mine area (Figure 2) is covered by Coal Leases #389287 and #418129 (Mines Act), authorizing development of coal reserves. Table 1 lists the coal tenure (leases and licences). There is a General Surface Lease (Land Act), which provides further rights to the land. Other existing Surface Leases are:

Lower Mtn: Lease #813850 – Expiry date: July 31, 2018
Mine: Lease #813851 – Expiry date: July 31, 2018
Tailings: Lease #800477 – Expiry date: July 31, 2018

In addition, Quintette has a private land holding at the Quintette Plant – PID #010602003, District Lot 3198, Peace River Regional District. Figure 2 shows the project area and tenure.

Figure 1 – Location Map

Code	Name	Parties	Jurisdiction	Type	Status	Grant Date	Official Area Value	Official Area Unit	Project
389287	COAL LEASE No. 06	TECK COAL LIMITED (100.0000%)	British Columbia	CLE (BC)	Active	7/7/1982	3,871.00	Ha	Quintette Mine Site, BC
418129	Lease 418129 (Quintette)	TECK COAL LIMITED (100.0000%)	British Columbia	CLE (BC)	Active	6/21/2013	3,799.00	Ha	Quintette Mine Site, BC
327337	CLIC-327337	TECK COAL LIMITED (100.0000%)	British Columbia	CLI (BC)	Active	1/15/1986	149	Ha	Quintette Mine Site, BC
327341	CLIC-327341	TECK COAL LIMITED (100.0000%)	British Columbia	CLI (BC)	Active	1/15/1986	149	Ha	Quintette Mine Site, BC
327359	CLIC-327359	TECK COAL LIMITED (100.0000%)	British Columbia	CLI (BC)	Active	4/29/1986	297	Ha	Quintette Mine Site, BC
327360	CLIC-327360	TECK COAL LIMITED (100.0000%)	British Columbia	CLI (BC)	Active	4/29/1986	149	Ha	Quintette Mine Site, BC
327590	CLIC-327590	TECK COAL LIMITED (100.0000%)	British Columbia	CLI (BC)	Active	10/16/1986	223	Ha	Quintette Mine Site, BC
327601	CLIC-327601	TECK COAL LIMITED (100.0000%)	British Columbia	CLI (BC)	Active	10/16/1986	149	Ha	Quintette Mine Site, BC
383407	CLIC-383407	TECK COAL LIMITED (100.0000%)	British Columbia	CLI (BC)	Active	1/16/2001	293	Ha	Quintette Mine Site, BC

Table 1 – Quintette Coal Tenure

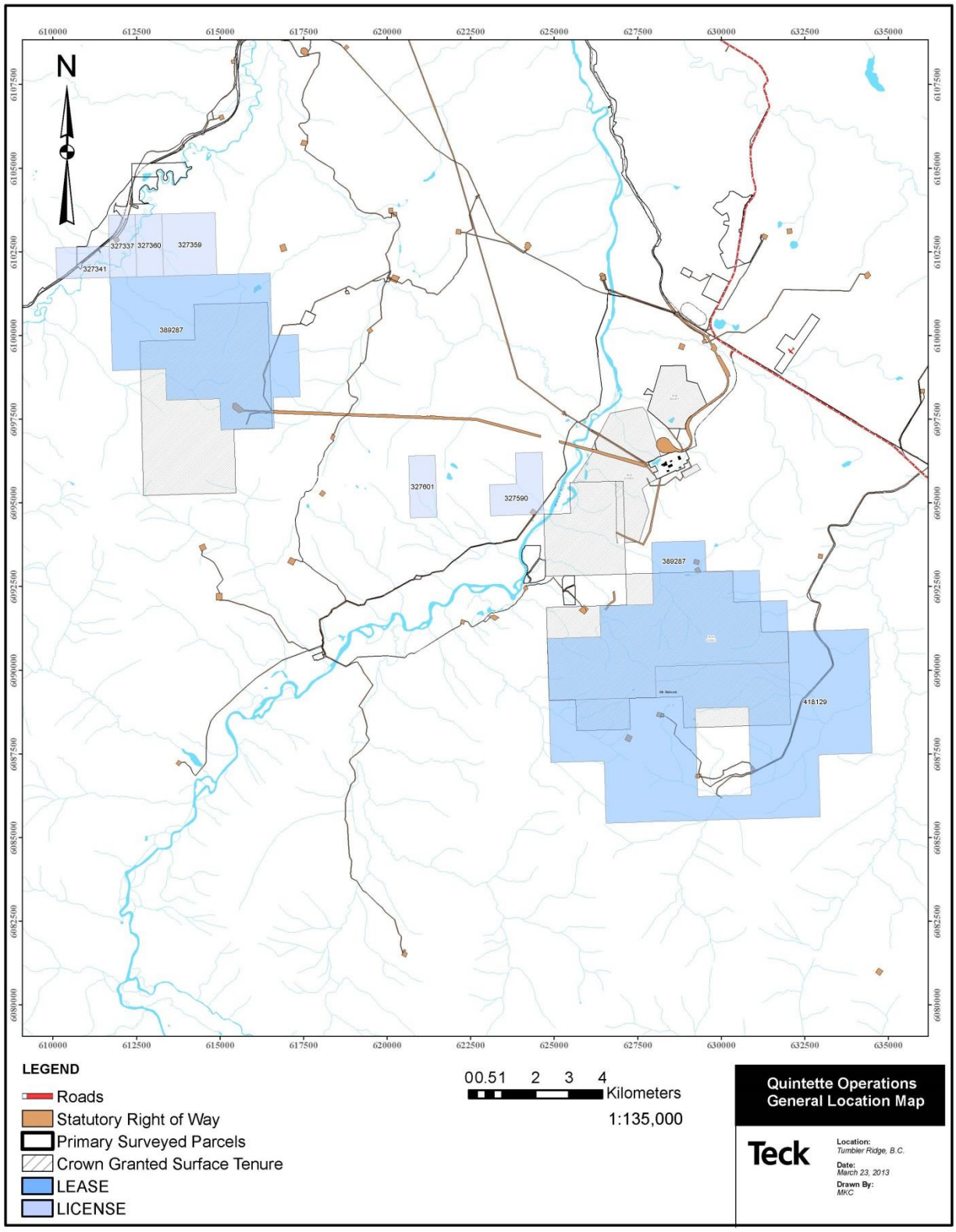


Figure 2 – Coal and Surface Tenure

2. Geology

2.1 Stratigraphy

The general stratigraphy at Quintette is summarized in Figure 3 below.

The Quintette project is located in the Peace River Coal Field, a belt of coal-bearing strata extending across northeastern British Columbia in a northwest-southeast trend. The stratigraphic succession exposed at the Quintette property ranges from Upper Jurassic to Lower Cretaceous in age and consists of inter-bedded shales and sandstones of both marine and continental origin.

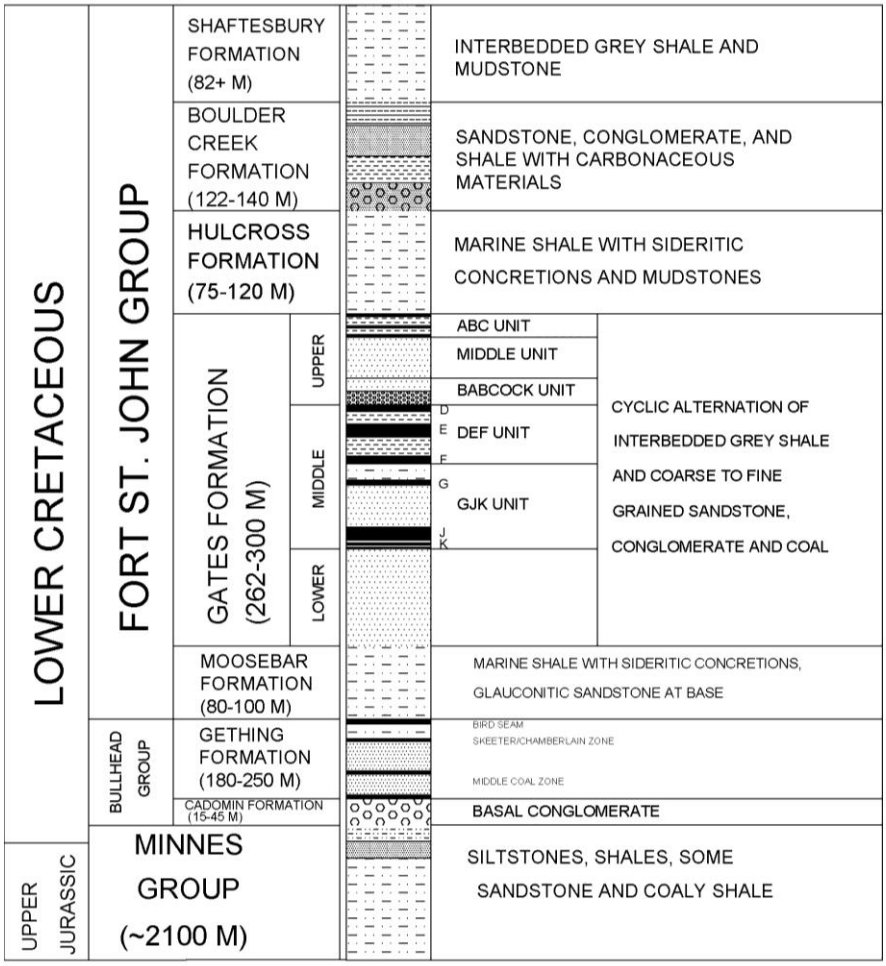


Figure 3 - Regional Stratigraphic Section

The Gates Formation is the coal-bearing formation in the area. It consists of strong sandstones, minor pebble conglomerates, some mudstones or shales, and coal seams. The rock in the upper part of the formation tends to be finer bedded, less massive and less competent than the rock (especially the sandstones) in the lower part of the formation. The Gates Formation consists of three members: Upper Gates, Middle Gates and Lower Gates. Figure 4 below is a stratigraphic section of the Middle Gates Formation which shows the mineable seams.

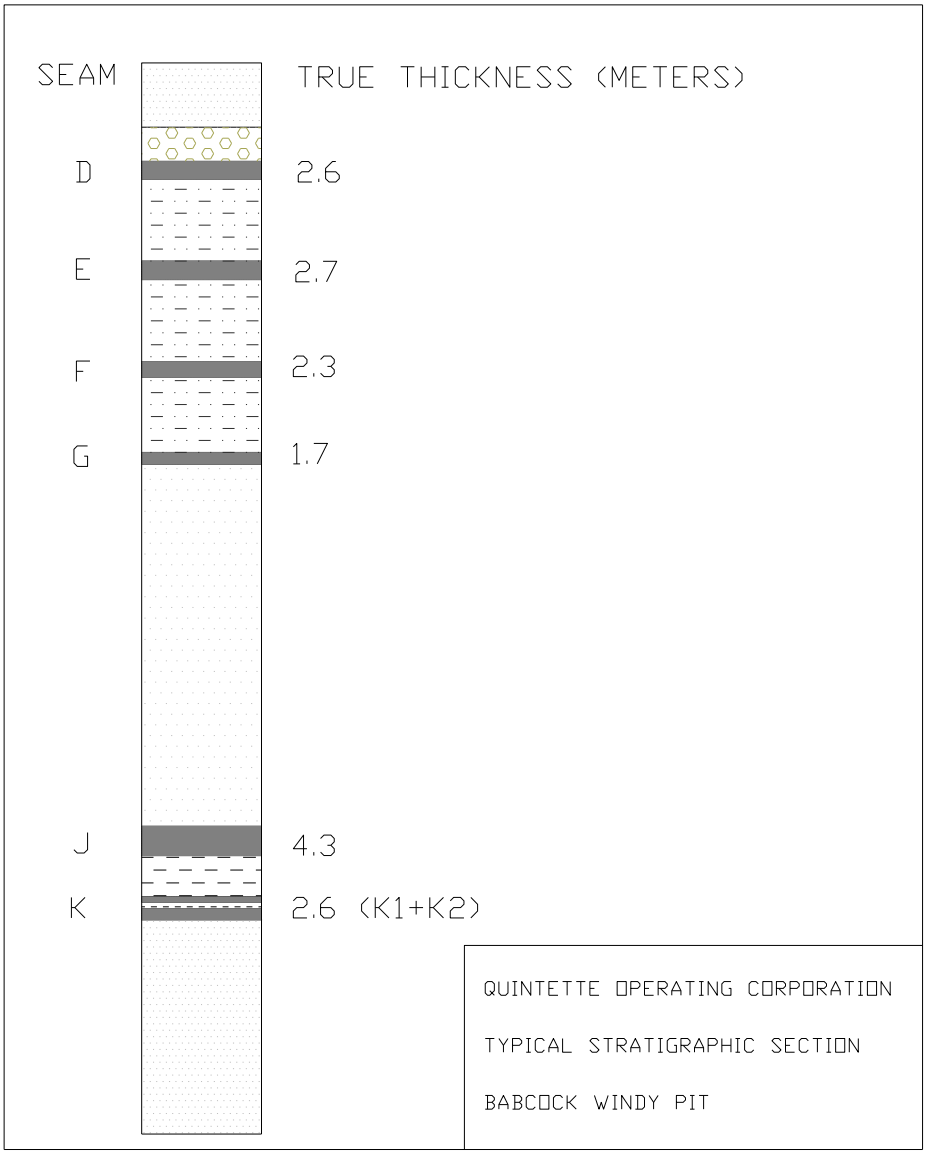


Figure 4 – Babcock Stratigraphic Section

The Lower Gates Member consists of massive, light-grey, medium-grained sandstones, with minor carbonaceous and conglomeratic horizons. The Middle Gates Member, which overlies

the Lower Gates Member, contains several sequences of coal seams in a 100 m to 110 m thick stratigraphic section. These seams have been named D, E, F, G, J and K, from youngest to oldest. The Upper Gates Member, which overlies the Middle Gates Member, consists of several distinct units. One of these, the Babcock Member, directly overlies the economic coal zone and is comprised of sandstones and conglomerates. The remainder of the Upper Gates Member is predominantly mudstone with some sandstone and poorly developed coal seams. These thin, high ash coal seams have been named A, B and C seams.

2.2 Structure

The Gates Formation outcrops on the northwest side of the mountain. The primary structure is a broad, box-like anticline that plunges to the southeast at 5° to 10°. The bulk of the mineable coal occurs in the gently dipping, unfaulted area between the bounding anticlines of the box fold. The southwestern limb steepens on the southwest side of the anticline, with dips reaching near-vertical. This steeply dipping section is not within the pit limits.

There are several fault systems in the area. These fault systems strike NW-SE and dip to the southwest. The faults have reverse displacement and repeat the seams and surrounding strata. The most prominent of these is the Northeast fault system. To the southwest of this, bedding dips are gentle (up to 10^0). Between the splays of the fault system and northeast of it, bedding dips are steeper (up to ~50^0). Other faults in the deposit occur on the southwest limb of the broad anticline and do not have significant dip changes associated with them. The area immediately on either side of the faults can be a zone of fractured rock and minor folding. Faulting on the northeast side of the mountain forms the northeast mining limit and the increasing depth of cover near the top of the mountain forms the southwest mining limit.

GSC Paper 88-21[1] lists four categories of geology type, which are intended to "address differences in the complexity of seam geometry within deposits." In order of increasing complexity, these include Low, Moderate, Complex and Severe. Deposits of geology type Complex "have been subjected to relatively high levels of tectonic deformation. Tight folds, some with steep inclinations or overturned limbs, may be present, and offsets by faults are

[1] Geological Survey of Canada Paper 88-21, a Standardized Coal Resource/Reserve Reporting System for Canada.

common." Fault plates generally retain normal stratigraphic sequences and seam thicknesses are rarely modified.

Based on the geologic and structural characteristics in the area, Teck Coal geologists have determined that the coal deposits of the Quintette area are geology type Complex.

3. 2013 Exploration Project

3.1 Goals/ Objectives

The objective of the 2013 reverse circulation exploration program was to upgrade the coal reserve classification in the planned pit areas. A core drilling program was designed to obtain rock strength information for wall design, and delineate faults that may impact the pit walls. Geotechnical drilling in the foundations of the proposed water management structures gave design information, and groundwater wells were installed downgradient of the proposed mining area to monitor water quality.

The approximate centre of the 2013 work is located at 629340E, 6089450N (WGS84, UTM Zone 10), latitude 54.9350^0, longitude -120.9810^0.

3.2 Summary of Work Done

3.2.1 Drilling

Drilling in 2013 was comprised of the following:

- Forty one reverse circulation drillholes in the Window pit areas for a total of 8,867 m
- Thirteen reverse circulation drillholes in the Windy pit areas for a total of 2,344 m
- Four core drillholes in the Window and Windy pit areas for a total of 1,000 m
- Twenty four geotechnical and groundwater drillholes for foundation studies in the areas of proposed water management structures and for groundwater sampling, for a total of 828 m

The total drilling at Quintette in 2013 was 13,039 m in 82 holes, comprised of 11,211 m of reverse circulation drilling, 1,000 m of HQ wireline coring, and 828 m of mud rotary/spot coring. Table 2 has drillhole locations by tenure area. Appendix A has a list of drillhole collar locations, orientations, and depths.

Existing exploration trails were used to access the drill pads as much as possible. New access trail and drill site construction accounted for 7.4 ha of new disturbance.

Reverse circulation rotary drilling was performed by Foraco Canada Ltd. with a truck mounted Foremost DR24 rig and a GEFCO 22-30K-DH rig. Diamond drilling services were provided by Orofino Drilling Ltd. with a Zinex A5 diamond drill. Geotechnical drilling was performed by Geotech Drilling Ltd. with a Fraste MDXL drill.

Geophysical logging was performed by Century Wireline Services. Gamma, neutron, open-hole density, slim-line density and borehole deviation were logged on all drillholes except the geotechnical holes. In addition dipmeter analysis was performed on select drillholes.

Vibrating wire piezometers were installed in the 4 core holes in the Window and Windy pit areas. Selected geotechnical drillholes were completed as groundwater monitoring wells and had standpipes installed for sampling and water level measurement.

Core was geotechnically logged by consultants from Piteau Engineering. Quintette personnel logged and sampled the coal sections. Core is stored at the Teck Coal Limited core storage facility at the Quintette minesite.

The following table shows borehole locations with respect to Coal Lease boundaries.

Tenure	Drillholes
Coal Lease #389287	BG13-09, BG13-010, BG13-011, BG13-014, BG13-015 BD13-002, BD13-004 BR13-020 TO BR13-026 BR13-051 TO BR13-056
Coal Lease #418129	BR13-001 TO BR13-019, BR13-027 TO BR13-045
OFF TENURE	BG13-001 TO BG13-008, BG13-012, BG13-013, BG13-016, BG13-017 TO BG13-024

Table 2 – Quintette 2013 Borehole locations

3.2.2 Test Pits

A total of 27 test pits were completed for foundation investigations. These were 4 m X 4 m excavations in the right of way of the exploration trails. Overburden materials encountered in the test pits were logged by consultants from Klohn Crippen Berger Ltd.

3.2.3 Coal Quality

Coal seams intersected in reverse circulation drillholes were sampled at half meter intervals called plies and sent to a contract lab (Loring Laboratories Ltd). Raw ash, FSI and moisture analysis were performed on ply samples. Ply samples were grouped together to create composite samples to most accurately reflect seam quality data. Past and proposed mining practices, geophysical log signatures and ply sample analyses were the main pieces of information used to generate composite samples from plys and determine core sample intervals.

For the RC samples, lab analysis determined raw proximate values of the composite samples, as well as phosphorous and sulphur. The composite samples were washed at specific gravities of 1.5, 1.6, and 1.76. Ash, residual moisture, and free swelling index were determined on the float products. A clean coal composite was prepared from the float product that was closest in ash to the 8% target, and proximate analysis, sulphur, phosphorous, calorific value and mineral ash analysis was performed as well.

Coal seams intersected in core holes were sampled at variable intervals called plies and sent to a contract lab (Loring Laboratories Ltd). Raw ash, FSI and moisture analysis were performed on ply samples. Ply samples were grouped together to create composite samples to most accurately reflect seam quality data. Past and proposed mining practices, geophysical log signatures and ply sample analyses were the main pieces of information used to generate composite samples from plies and determine core sample intervals.

For the core samples, lab analysis determined raw proximate values of the composite samples, as well as phosphorous and sulphur. The composite samples were screened into three size fractions (+1.0 mm, 1.0 mm X 0.25 mm, and -0.25 mm). The two coarse size fractions were washed at a series of specific gravities ranging from 1.30 to 1.90. The -0.25 mm size fraction underwent froth flotation. Ash, residual moisture, and free swelling index were determined on the float products. A clean coal composite was prepared from the combination of float products that was closest in ash to the 8% target, and proximate analysis, sulphur, phosphorous, calorific value and mineral ash analysis was performed on it.

All coal quality information in is Appendix C.

3.2.4 Access Construction and Surveys

Access to drill site and road locations was laid out by Quintette personnel. Timber removal, drill site and road construction was completed by Duz Cho Construction Ltd. (McLeod Lake, BC). Quintette surveyors provided collar surveys for all drillholes.

3.2.5 Reclamation

New drill sites and exploration trails were reclaimed to the end land use of wildlife habitat. At the drill sites, the sumps were backfilled and the casing was removed unless there was a monitoring well installation. Sites and trails were recontoured as necessary (fill was pulled back, surface was roughened) using an excavator. An appropriate seed mix was applied to provide erosion control, inhibit the growth of noxious weeds, and establish a vegetative cover. Access trails that were planned to be used in the following year were temporarily deactivated (culverts were removed, cross ditches and water bars were installed at an appropriate spacing for the grade).

All existing trails that were reopened for 2013 access were deactivated unless needed for the next year's planned program. Culverts were removed, cross ditches and water bars were installed, and an appropriate seed mix was applied to provide erosion control, inhibit the growth of noxious weeds, and establish a vegetative cover.

3.2.7 Costs

Total costs for the 2013 program were $4,168,876.47. Detailed costs are found in Appendix D.

3.2.6 Results

A reinterpretation of the geological model was done in April 2014, using the structural information from the 2013 drilling. Quality information from the 2013 drilling has not been added to the geological model yet. The 2013 drilling program increased the proportion of the reserves classified as proven, due to increased data point density. Both the reverse circulation and core holes provided better structural definition, especially in the Northeast fault system area.

Cross sections through the deposit and a plan map showing the location of the cross sections are in Appendix E.

The geotechnical foundation drilling program was successful in gathering additional information on the foundations of the proposed water management structures, and the groundwater well installations will provide important water quality information for permit sampling and water quality predictions.

Tables 3 and 4 show reserves and resources as of December 31st, 2014.

4. Conclusions

The 2013 exploration program has successfully increased borehole density in the Window and Windy pit areas, defined the faulting better, and confirmed foundation conditions in the area of the water management structures. Further drilling is recommended prior to the mine restart to further increase drillhole density in the Window pit area.

Appendix A - Drillhole Collar Locations

HOLE ID	TYPE	EAST	NORTH	ELEVATION	AZIMUTH	DIP	DEPTH	START DATE	END DATE	CASING DEPTH
BR13-001	REV CIRC	629327.33	6089828.03	1638.86	0	-90	181.56	26-Jul-13	28-Jul-13	18
BR13-002	REV CIRC	629259.90	6089418.83	1665.31	0	-90	201.57	28-Jul-13	30-Jul-13	14.7
BR13-003	REV CIRC	629299.47	6089547.75	1658.09	0	-90	236.60	30-Jul-13	1-Aug-13	23.7
BR13-004	REV CIRC	629453.98	6089621.91	1631.50	0	-90	181.76	1-Aug-13	3-Aug-13	20.8
BR13-005	REV CIRC	629751.42	6089439.53	1614.47	0	-90	158.61	3-Aug-13	4-Aug-13	20.6
BR13-006	REV CIRC	629808.89	6089716.69	1595.08	0	-90	285.11	4-Aug-13	7-Aug-13	16.7
BR13-007	REV CIRC	630100.37	6089484.75	1557.57	0	-90	309.66	7-Aug-13	10-Aug-13	14.5
BR13-008	REV CIRC	630004.32	6089572.70	1574.99	0	-90	249.01	10-Aug-13	12-Aug-13	8.5
BR13-009	REV CIRC	629978.91	6089621.62	1580.38	0	-90	273.34	12-Aug-13	14-Aug-13	10.2
BR13-010	REV CIRC	629569.24	6089920.41	1590.64	0	-90	279.13	14-Aug-13	16-Aug-13	11.7
BR13-011	REV CIRC	629504.52	6089825.78	1609.85	0	-90	266.83	16-Aug-13	18-Aug-13	11.3
BR13-012	REV CIRC	629485.19	6089888.99	1605.38	0	-90	207.75	18-Aug-13	20-Aug-13	11.3
BR13-013	REV CIRC	629422.10	6089960.76	1606.41	0	-90	206.79	20-Aug-13	21-Aug-13	14.7
BR13-014	REV CIRC	628959.10	6089752.80	1727.10	0	-90	203.58	21-Aug-13	22-Aug-13	8.4
BR13-015	REV CIRC	628997.78	6089909.16	1701.61	0	-90	192.97	22-Aug-13	24-Aug-13	11.7
BR13-016	REV CIRC	629141.54	6089955.12	1662.39	0	-90	183.40	24-Aug-13	25-Aug-13	8.8
BR13-017	REV CIRC	629671.86	6089792.35	1596.31	0	-90	255.26	25-Aug-13	27-Aug-13	5.0
BR13-018	REV CIRC	629767.32	6089753.09	1593.22	0	-90	334.39	27-Aug-13	29-Aug-13	6.0
BR13-019	REV CIRC	630185.10	6089491.59	1543.00	0	-90	316.04	29-Aug-13	1-Sep-13	32.7
BR13-020	REV CIRC	626306.26	6089434.92	1608.61	0	-90	134.35	1-Sep-13	2-Sep-13	8.3
BR13-021	REV CIRC	626500.63	6089200.02	1662.26	0	-90	195.34	2-Sep-13	3-Sep-13	8.8
BR13-022	REV CIRC	626405.49	6089166.82	1621.14	0	-90	152.68	3-Sep-13	4-Sep-13	8.5
BR13-023	REV CIRC	626368.11	6089201.14	1613.03	0	-90	140.49	4-Sep-13	5-Sep-13	4.2
BR13-024	REV CIRC	626314.71	6089291.51	1613.36	0	-90	134.51	5-Sep-13	6-Sep-13	2.6
BR13-025	REV CIRC	628288.88	6090793.65	1583.74	0	-90	254.90	6-Sep-13	8-Sep-13	13.2
BR13-026	REV CIRC	628330.16	6090838.94	1583.61	0	-90	170.84	8-Sep-13	9-Sep-13	23.6
BR13-027	REV CIRC	630128.76	6089245.90	1537.20	0	-90	104.10	9-Sep-13	10-Sep-13	8.8
BR13-028	REV CIRC	630016.52	6089011.12	1552.49	0	-90	128.35	10-Sep-13	11-Sep-13	8.5
BR13-029	REV CIRC	630221.99	6088782.01	1539.60	0	-90	145.07	11-Sep-13	12-Sep-13	11.5
BR13-030	REV CIRC	630143.33	6088878.80	1545.89	0	-90	136.92	12-Sep-13	13-Sep-13	11.1
BR13-031	REV CIRC	630196.63	6089149.28	1522.72	0	-90	91.49	13-Sep-13	14-Sep-13	17.6
BR13-032	REV CIRC	630265.62	6089331.94	1518.35	0	-90	200.07	14-Sep-13	15-Sep-13	23.3
BR13-033	REV CIRC	630325.34	6089431.88	1510.51	0	-90	297.93	15-Sep-13	18-Sep-13	14.6
BR13-034	REV CIRC	630393.87	6089255.38	1497.12	0	-90	199.59	18-Sep-13	20-Sep-13	32.7
BR13-035	REV CIRC	630462.63	6089364.94	1491.56	0	-90	327.74	20-Sep-13	22-Sep-13	33.6
BR13-036	REV CIRC	629810.06	6088718.02	1592.59	0	-90	230.34	22-Sep-13	24-Sep-13	20.7
BR13-037	REV CIRC	630069.62	6088580.20	1582.42	0	-90	248.71	24-Sep-13	26-Sep-13	17.6
BR13-038	REV CIRC	630819.43	6088510.42	1512.19	0	-90	212.43	26-Sep-13	28-Sep-13	26.6
BR13-039	REV CIRC	630637.33	6088762.98	1514.58	0	-90	146.99	28-Sep-13	29-Sep-13	35.6
BR13-040	REV CIRC	629794.15	6089120.47	1601.29	0	-90	164.14	26-Sep-13	1-Oct-13	11.6
BR13-041	REV CIRC	630010.24	6089253.76	1569.07	0	-90	122.28	1-Oct-13	2-Oct-13	14.7
BR13-042	REV CIRC	629606.98	6089338.89	1632.09	0	-90	182.00	2-Oct-13	4-Oct-13	16.0
BR13-043	REV CIRC	629619.63	6089495.49	1624.29	0	-90	158.99	4-Oct-13	5-Oct-13	11.6
BR13-044	REV CIRC	629286.28	6089362.72	1657.70	0	-90	184.00	5-Oct-13	6-Oct-13	11.6
BR13-045	REV CIRC	629201.11	6090085.86	1639.60	0	-90	225.57	8-Oct-13	10-Oct-13	16.7
BR13-051	REV CIRC	627829.25	6091168.19	1465.95	217	-70	217.89	19-Sep-13	22-Sep-13	5.6
BR13-052	REV CIRC	627728.43	6091214.30	1457.89	217	-70	193.27	22-Sep-13	23-Sep-13	8.7
BR13-053	REV CIRC	627965.03	6091108.85	1466.68	217	-70	163.08	23-Sep-13	25-Sep-13	8.8
BR13-054	REV CIRC	627664.47	6091127.08	1500.41	217	-70	254.50	25-Sep-13	27-Sep-13	5.9
BR13-055	REV CIRC	627761.60	6091090.70	1497.21	217	-70	132.76	27-Sep-13	28-Sep-13	5.9
BR13-056	REV CIRC	628187.37	6090918.05	1501.61	217	-70	199.50	29-Sep-13	30-Sep-13	8.9
BR13-057	REV CIRC	629793.07	6089833.84	1579.71	217	-70	266.87	30-Sep-13	2-Oct-13	5.9
BR13-058	REV CIRC	629574.28	6090011.04	1580.14	217	-70	248.20	2-Oct-13	5-Oct-13	31.8
BR13-059	REV CIRC	630580.16	6089244.17	1484.33	0	-90	321.49	7-Oct-13	9-Oct-13	52.7
BD13-001	CORE	629647.61	6089850.35	1594.75	0	-90	316.37	27-Jul-13	30-Jul-13	10.5
BD13-002	CORE	629259.70	6090209.22	1620.11	37	-60	160.69	1-Aug-13	4-Aug-13	33.2
BD13-003	CORE	629234.08	6090087.67	1629.13	0	-90	334.95	13-Aug-13	17-Aug-13	15.1
BD13-004	CORE	628125.99	6090918.79	1504.05	217	-60	188.07	23-Aug-13	27-Aug-13	20.6

HOLE ID	TYPE	EAST	NORTH	ELEVATION	AZIMUTH	DIP	DEPTH	START DATE	END DATE	CASING DEPTH
BG13-01	PIEZOMETER	627659.68	6093459.92	1016.82	0	-90	33.00		20-Jul-13	31.9
BG13-02	PIEZOMETER	627760.34	6093268.48	1036.76	0	-90	25.10		22-Jul-13	14.3
BG13-03	PIEZOMETER	625609.03	6094673.32	799.42	0	-90	50.30		24-Jul-13	1.5
BG13-04	PIEZOMETER	626031.46	6096113.87	763.59	0	-90	25.60		27-Jul-13	25.6
BG13-05	PIEZOMETER	632330.48	6088465.44	1296.95	0	-90	101.30		8-Apr-13	17.5
BG13-06	PIEZOMETER	632300.41	6088082.69	1295.21	0	-90	25.20		8-Jul-13	12.8
BG13-07	PIEZOMETER	632352.73	6088274.98	1298.45	0	-90	30.90		8-Oct-13	4.1
BG13-08	PIEZOMETER	632636.53	6092264.44	1159.36	0	-90	60.60		14-Aug-13	39.0
BG13-09	PIEZOMETER	631618.21	6091697.24	1251.73	0	-90	32.50		18-Aug-13	30.0
BG13-10	PIEZOMETER	631321.39	6091915.02	1255.08	0	-90	30.60		21-Aug-13	5.8
BG13-11	PIEZOMETER	631851.08	6091508.33	1246.87	0	-90	37.40		24-Aug-13	33.8
BG13-12	PIEZOMETER	626988.06	6092576.85	1117.58	0	-90	25.00		27-Aug-13	7.6
BG13-13	PIEZOMETER	626942.29	6092448.33	1133.80	0	-90	29.70		29-Aug-13	4.6
BG13-14	PIEZOMETER	626505.17	6091806.73	1120.17	0	-90	50.60		9-Jan-13	7.9
BG13-15	PIEZOMETER	626464.96	6091782.26	1121.44	0	-90	31.10		9-Mar-13	11.4
BG13-16	PIEZOMETER	626824.93	6092428.29	1125.64	0	-90	25.00		9-Jun-13	4.3
BG13-17	PIEZOMETER	626763.58	6096715.02	845.81	0	-90	22.30		9-Jul-13	2.4
BG13-18	PIEZOMETER	627071.19	6096529.62	855.27	0	-90	19.00		9-Sep-13	2.3
BG13-19	PIEZOMETER	626983.84	6096463.50	854.76	0	-90	20.20		9-Nov-13	2.1
BG13-20	PIEZOMETER	626875.98	6096592.52	853.57	0	-90	23.50		9-Dec-13	1.0
BG13-21	PIEZOMETER	626614.13	6096567.00	842.71	0	-90	20.32		13-Sep-13	1.8
BG13-22	PIEZOMETER	621348.93	6091100.22	776.18	0	-90	57.60		15-Sep-13	57.6
BG13-23	PIEZOMETER	625926.00	6097320.00	763.00	0	-90	39.30		16-Sep-13	39.3
BG13-24	PIEZOMETER	625936.00	6097321.00	763.50	0	-90	11.90		17-Sep-13	11.9

Appendix B – Geophysical Logs

(see separate folder of logs for each RC and core hole)

Appendix D – Exploration Costs

(See separate Excel file Quintette 2013 Exploration Cost Statement.xls)

Exploration Work type	Comment	Days			Totals
Personnel (Name)* / Position	**Field Days (list actual days)**	**Days**	**Rate**	**Subtotal***	
			$0.00	$0.00	
			$0.00	$0.00	
				$0.00	**$0.00**
Office Studies	**List Personnel (note - Office only, do not include field days**				
Literature search			$0.00	$0.00	
Database compilation			$0.00	$0.00	
Computer modelling			$0.00	$0.00	
Reprocessing of data			$0.00	$0.00	
General research			$0.00	$0.00	
Report preparation			$0.00	$0.00	
Other (specify)				$0.00	
				$0.00	**$0.00**
Airborne Exploration Surveys	**Line Kilometres / Enter total invoiced amount**				
Aeromagnetics			$0.00	$0.00	
Radiometrics			$0.00	$0.00	
Electromagnetics			$0.00	$0.00	
Gravity			$0.00	$0.00	
Digital terrain modelling			$0.00	$0.00	
Other (specify)			$0.00	$0.00	
				$0.00	**$0.00**
Remote Sensing	**Area in Hectares / Enter total invoiced amount or list personnel**				
Aerial photography			$0.00	$0.00	
LANDSAT			$0.00	$0.00	
Other (specify)			$0.00	$0.00	
				$0.00	**$0.00**
Ground Exploration Surveys	**Area in Hectares/List Personnel**				
Geological mapping					
Regional		*note: expenditures here*			
Reconnaissance		*should be captured in Personnel*			
Prospect		*field expenditures above*			
Underground	Define by length and width				
Trenches	Define by length and width			$0.00	**$0.00**
Ground geophysics	**Line Kilometres / Enter total amount invoiced list personnel**				
Radiometrics					
Magnetics					
Gravity					
Digital terrain modelling					
Electromagnetics	*note: expenditures for your crew in the field*				
SP/AP/EP	*should be captured above in Personnel*				
IP	*field expenditures above*				
AMT/CSAMT					
Resistivity					
Complex resistivity					
Seismic reflection					
Seismic refraction					
Well logging	58 holes for 12,211 m			$ 226,465.26	
Geophysical interpretation					
Petrophysics					
Other (specify)					
				$226,465.26	**$226,465.26**

Exploration Work type	Comment	Days			Totals
Geochemical Surveying	**Number of Samples**	**No.**	**Rate**	**Subtotal**	
Drill (cuttings, core, etc.)			$0.00	$0.00	
Stream sediment			$0.00	$0.00	
Soil	*note: This is for assays or*		$0.00	$0.00	
Rock	*laboratory costs*		$0.00	$0.00	
Water			$0.00	$0.00	
Biogeochemistry			$0.00	$0.00	
Whole rock			$0.00	$0.00	
Petrology			$0.00	$0.00	
Other (specify)	Coal lab analysis		$0.00	$283,732.98	
				$283,732.98	**$283,732.98**
Drilling	**No. of Holes, Size of Core and Metres**	**No.**	**Rate**	**Subtotal**	
Diamond	4 holes, HQ, 1000 m		$0.00	$279,728.84	
Reverse circulation (RC)	54 holes, 5 1/2", 11,211 m		$0.00	$1,729,532.77	
Rotary air blast (RAB)			$0.00	$0.00	
Other (mud rotary)	24 holes, 5", 828 m		$0.00	$555,016.52	
				$2,564,278.13	**$2,564,278.13**
Other Operations	**Clarify**	**No.**	**Rate**	**Subtotal**	
Trenching			$0.00	$0.00	
Bulk sampling			$0.00	$0.00	
Underground development			$0.00	$0.00	
Other (specify)	drill access trails and sites		$0.00	$1,082,966.41	
Contract first aid				$ 61,564.5	
				$1,082,966.41	**$1,082,966.41**
Reclamation	**Clarify**	**No.**	**Rate**	**Subtotal**	
After drilling	included in drill access (line 81)		$0.00	$0.00	
Monitoring			$0.00	$0.00	
Other (specify)			$0.00	$0.00	
Transportation		**No.**	**Rate**	**Subtotal**	
Airfare			$0.00	$0.00	
Taxi			$0.00	$0.00	
truck rental			$0.00	$0.00	
kilometers			$0.00	$0.00	
ATV			$0.00	$0.00	
fuel			$0.00	$0.00	
Helicopter (hours)			$0.00	$0.00	
Fuel (litres/hour)			$0.00	$0.00	
				$0.00	**$0.00**
Accommodation & Food	**Rates per day**				
Hotel			$0.00	$0.00	
Camp			$0.00	$0.00	
Meals	day rate or actual costs-specify		$0.00	$0.00	
				$0.00	**$0.00**
Miscellaneous					
Telephone			$0.00	$0.00	
Other (Specify)	water tank rental for core drill			$11,433.70	
				$11,433.70	**$11,433.70**
Equipment Rentals					
Field Gear (Specify)			$0.00	$0.00	
Other (Specify)					
				$0.00	**$0.00**
Freight, rock samples					
			$0.00	$0.00	
				$0.00	**$0.00**
TOTAL Expenditures					**$4,168,876.47**

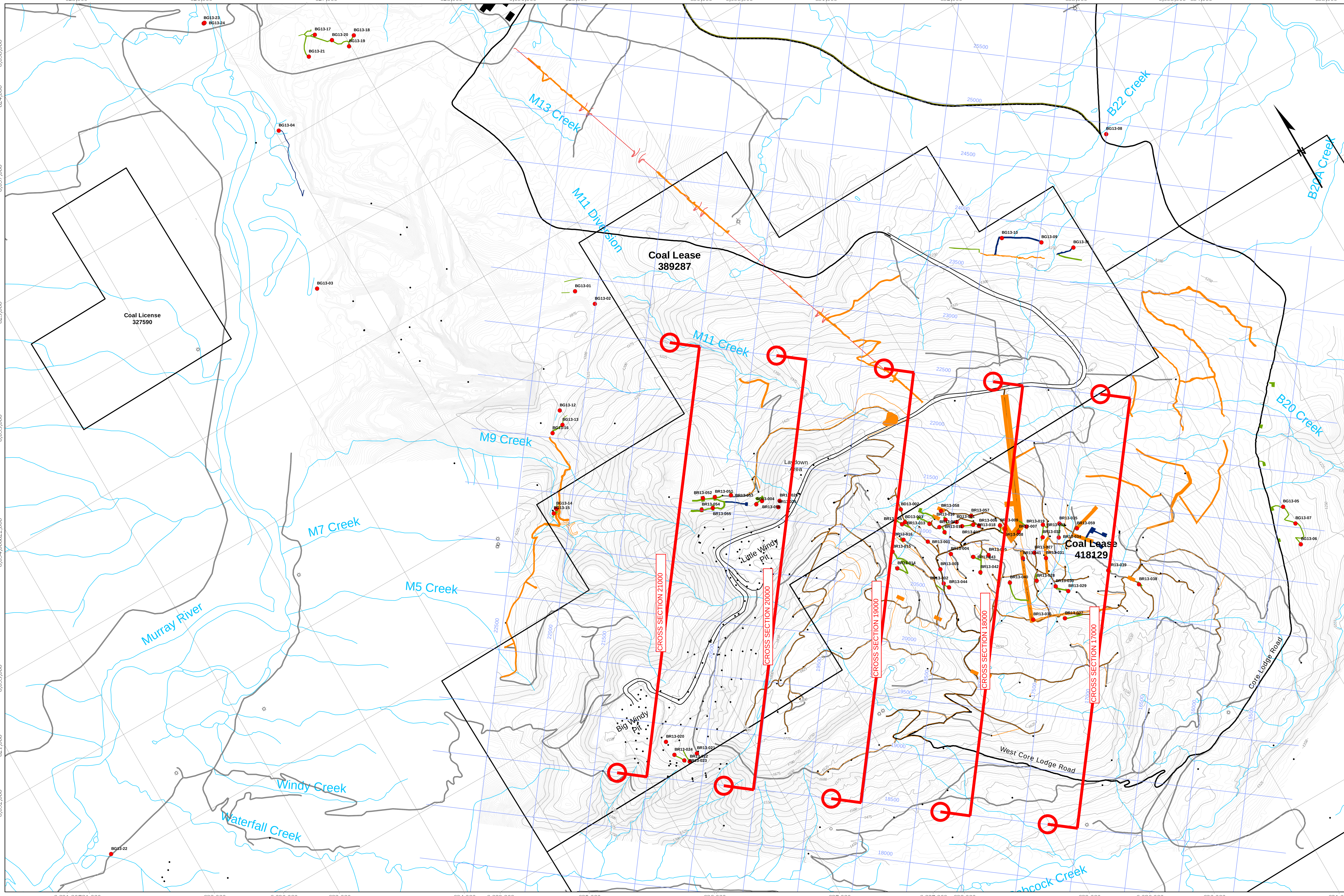
Appendix E – Cross Sections and Drillhole Map

Cross sections

(see separate file Cross Sections.pdf)

Drillhole Map

(see separate pdf file 2013 Summary of Work map.pdf)



Legend

•	Existing Drillholes		Proposed Conveyor Route	☼	Gas Wells
●	2013 Completed Drillholes		Main Access		Mine Gridset
🟩	2013 New Disturbance-Reclaimed		Trend Bypass Road	■	Quintette Plant Buildings
■	2013 New Disturbance-Not Reclaimed		Trails - Asbuilt		
🟧	Pre 2013 Disturbance areas				

0 0.75 1.5 2.25 3

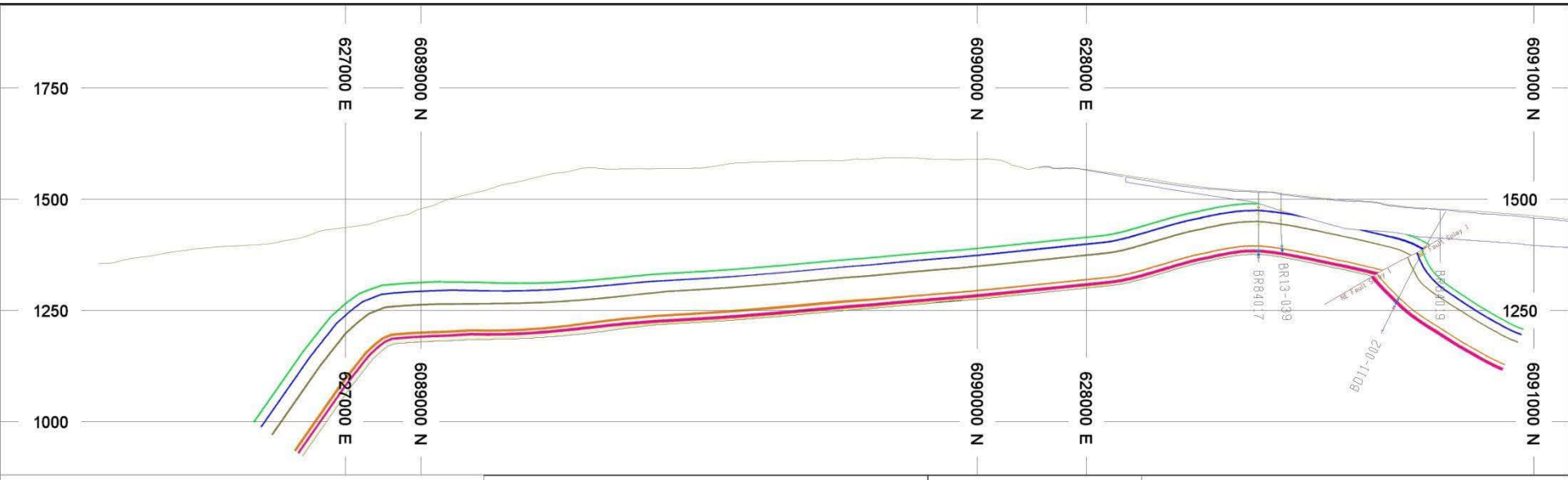
Kilometers

Projection: Universal Transverse Mercator Zone 10N
Datum: NAD 83

Note: Contour Interval 5 m

Teck

TITLE: 2013 Summary of Work		
DRAWN BY: DJG	DATE: 3/13/2014	PROJECT: Quintette 2013 Exploration
SCALE: 1:15,000	REV DATE:	FILE NAME: 2013 Summary of Work.pdf



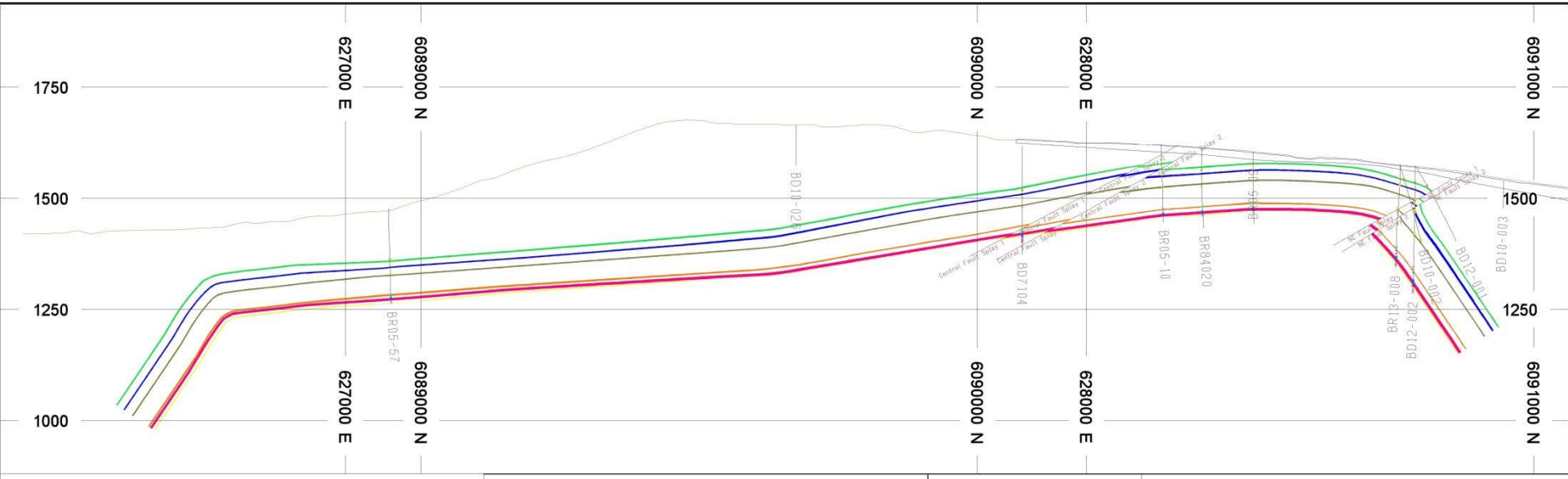
LEGEND

- D SEAM
- E SEAM
- F SEAM
- G SEAM
- J SEAM
- K1 SEAM
- K2 SEAM

1 : 5000

0 50 100 150 200 250 300 350 400 450 500 550

TITLE:	Babcock Cross Section
DATE:	2015/07/14
SCALE:	1:5000
AUTHOR:	Kevin Sharman
SECTION:	17000



LEGEND

- D SEAM
- E SEAM
- F SEAM
- G SEAM
- J SEAM
- K1 SEAM
- K2 SEAM

1 : 5000

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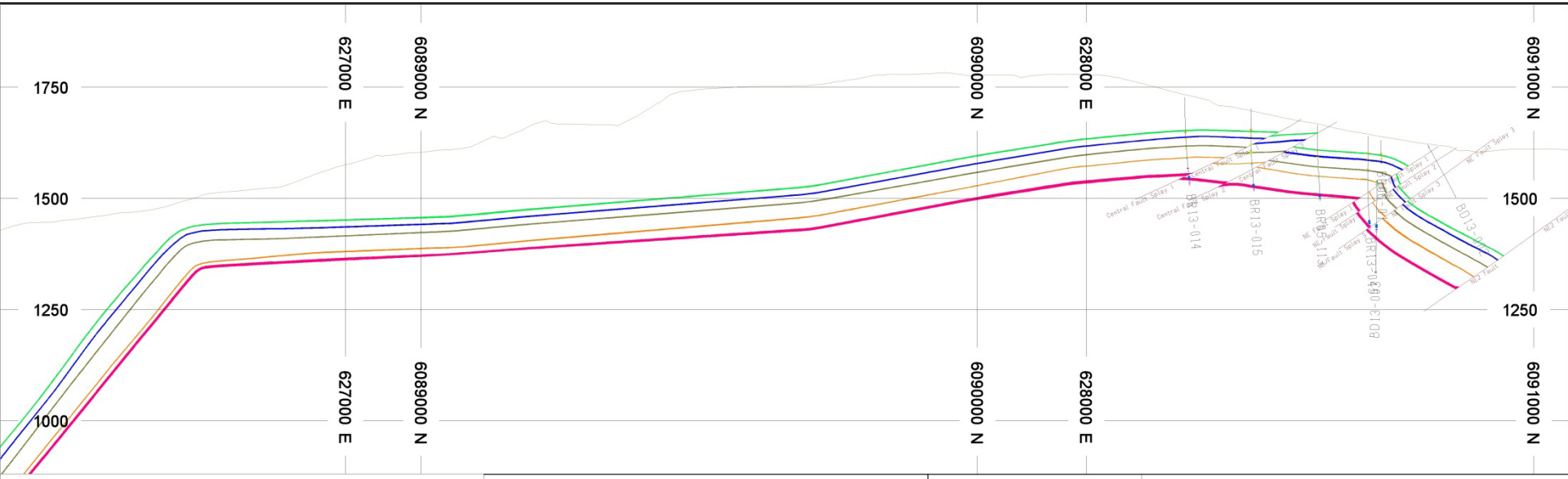
TITLE:	Babcock Cross Section
DATE:	2015/07/14
SCALE:	1:5000
AUTHOR:	Kevin Sharman
SECTION:	18000



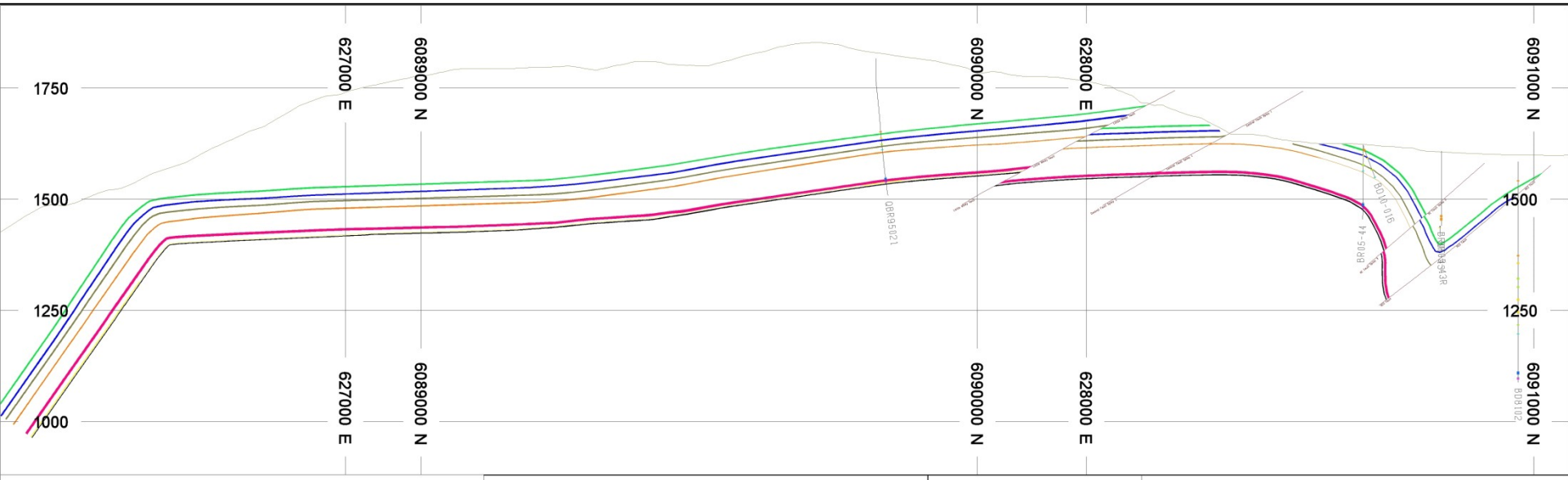
LEGEND

- D SEAM
- E SEAM
- F SEAM
- G SEAM
- J SEAM
- K1 SEAM
- K2 SEAM

1 : 5000

0 50 100 150 200 250 300 350 400 450 500 550

TITLE:	Babcock Cross Section
DATE:	2015/07/14
SCALE:	1:5000
AUTHOR:	Kevin Sharman
SECTION:	19000



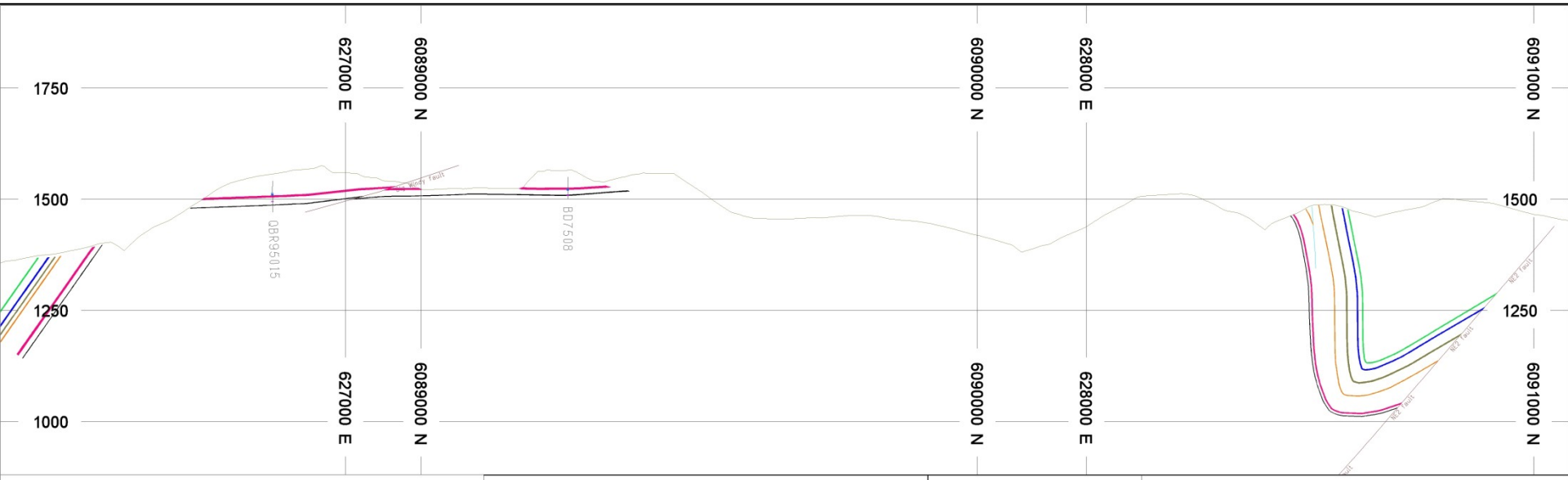
LEGEND

- D SEAM
- E SEAM
- F SEAM
- G SEAM
- J SEAM
- K1 SEAM
- K2 SEAM

1 : 5000

0 50 100 150 200 250 300 350 400 450 500 550

TITLE:	Babcock Cross Section
DATE:	2015/07/14
SCALE:	1:5000
AUTHOR:	Kevin Sharman
SECTION:	20000



LEGEND

- D SEAM
- E SEAM
- F SEAM
- G SEAM
- J SEAM
- K1 SEAM
- K2 SEAM

1 : 5000

0 50 100 150 200 250 300 350 400 450 500 550

TITLE:	Babcock Cross Section
DATE:	2015/07/14
SCALE:	1:5000
AUTHOR:	Kevin Sharman
SECTION:	21000

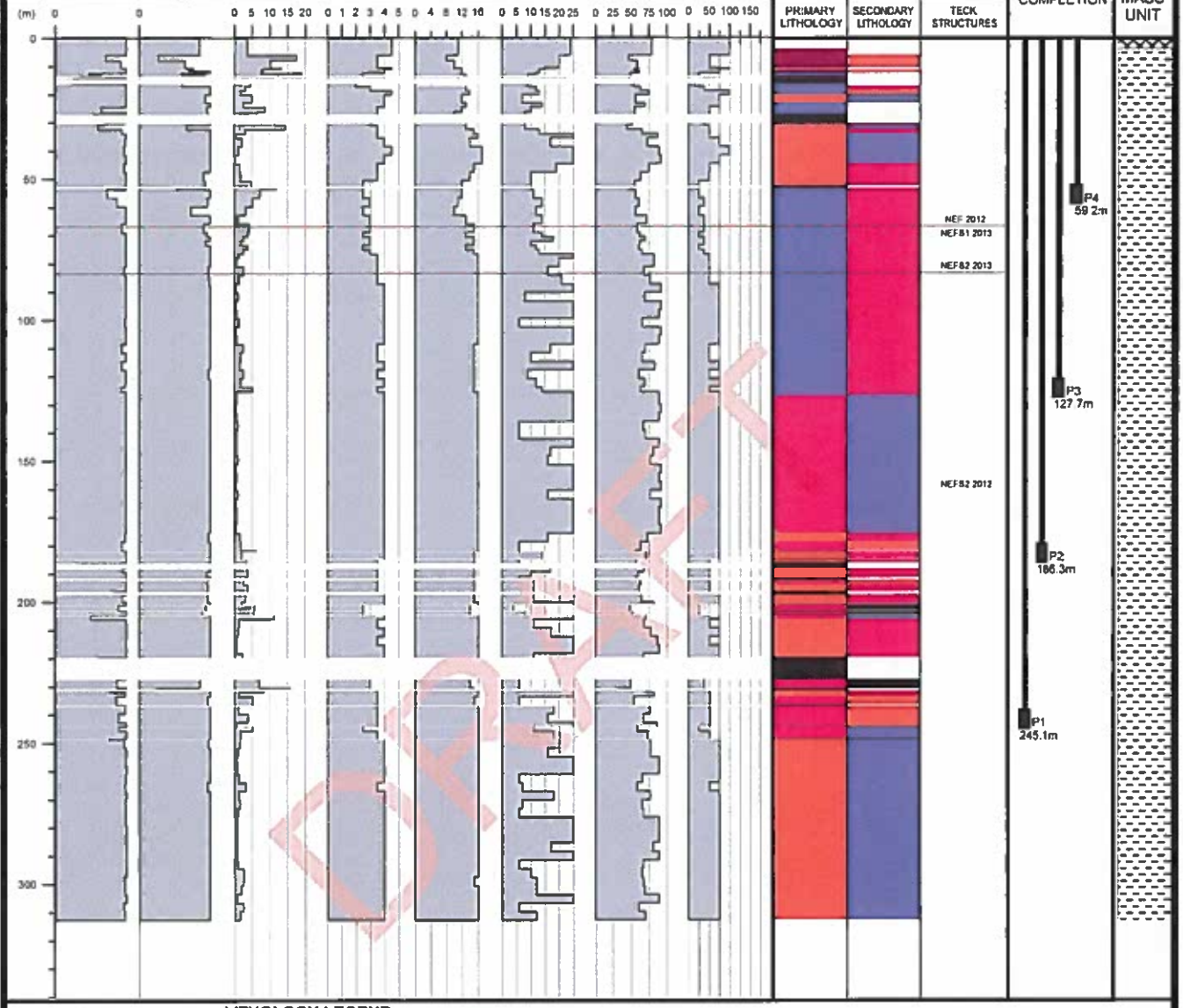
Appendix F – Core Logs and Geotechnical Hole Logs

(see separate pdf files 2013 Core Logs.pdf and 2013 Geotechnical Hole Logs.pdf)

H:/Project/3159/Quintette/2013/Geomech/Geomech_Log/BD13-001.grf

GEOMECHANICAL LOG: BD13-001

Coordinates: N 6089867 E 629625 Collar Elevation: 1591.68m Depth: 312.72m Azimuth: — Dip: -90°



EOH 312.72m

LITHOLOGY LEGEND

- MUDSTONE
- SANDSTONE
- SHALE
- SILTSTONE
- CONGLOMERATE
- CLAY
- COAL
- GOUGE
- GRAVEL
- CARBONACEOUS MUDSTONE
- CARBONACEOUS SANDSTONE
- CARBONACEOUS SHALE

ROCK MASS UNITS

- OVERBURDEN
- HULCROSS MEMBER
- GATES MEMBER

- TECK FAULTS 2013
- KCB PROPOSED FAULTS 2012

TECK COAL LTD.
QUINTETTE OPERATIONS
FEASIBILITY OPEN PIT DESIGN STUDY

PITEAU ASSOCIATES
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS

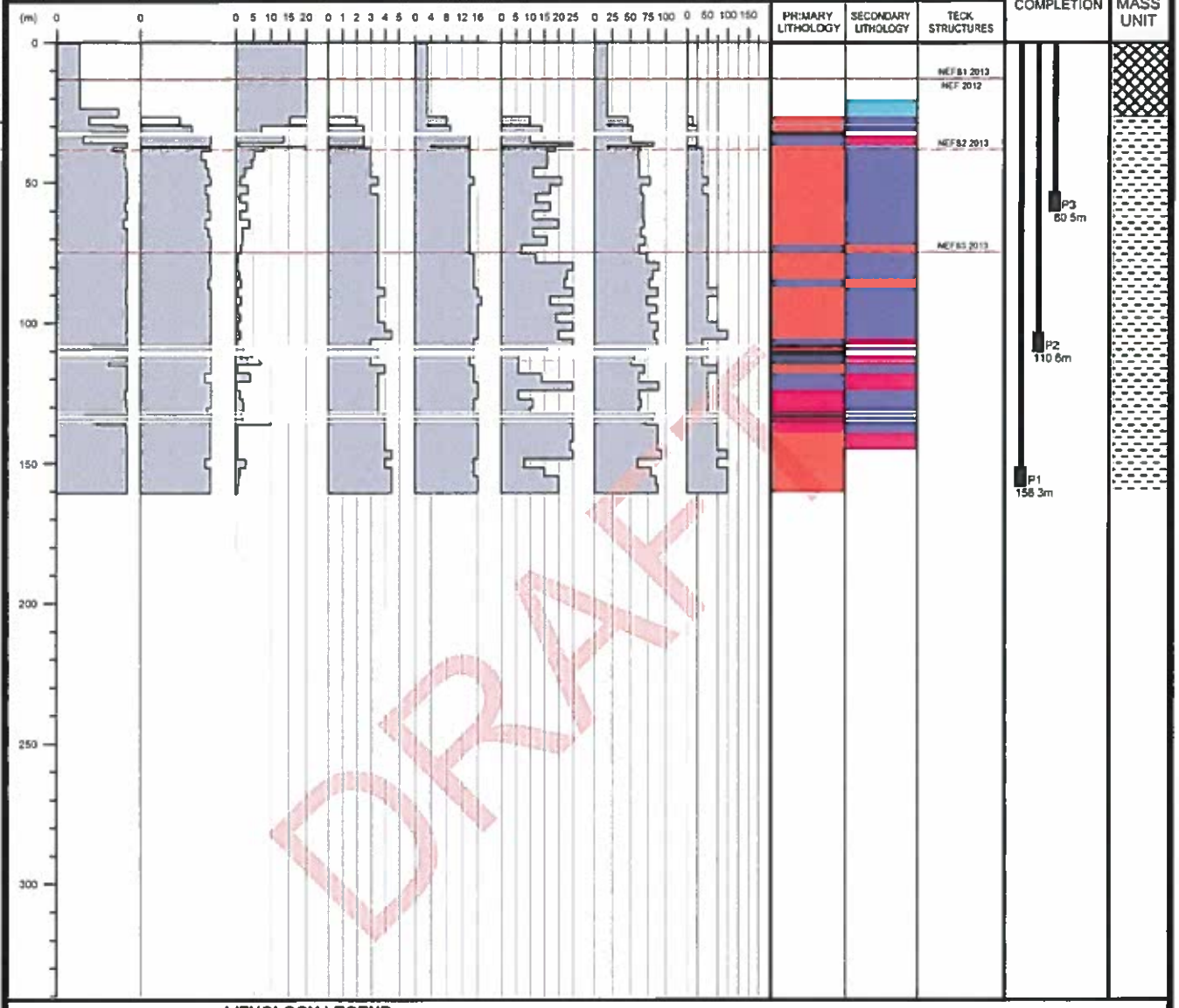
GEOMECHANICAL LOG
BD13-001

BY:	DATE:
SJ	DEC 13
APPROVED:	FIG: B9

H:/Project/3159/Quintette/Geomech_log/BD13-002.grf

GEOMECHANICAL LOG: BD13-002

Coordinates: N 6090209 E 629260 Collar Elevation: 1620.11m Depth: 160.63m Azimuth: 037° Dip: -60°



EOH 160.63m

LITHOLOGY LEGEND

- MUDSTONE
- SANDSTONE
- SHALE
- SILTSTONE
- CONGLOMERATE
- CLAY
- COAL
- GOUGE
- GRAVEL
- CARBONACEOUS MUDSTONE
- CARBONACEOUS SANDSTONE
- CARBONACEOUS SHALE

ROCK MASS UNITS

- OVERBURDEN
- HULCROSS MEMBER
- GATES MEMBER

- TECK FAULTS 2013
- KCB PROPOSED FAULTS 2012

TECK COAL LTD.
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PITEAU ASSOCIATES
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS

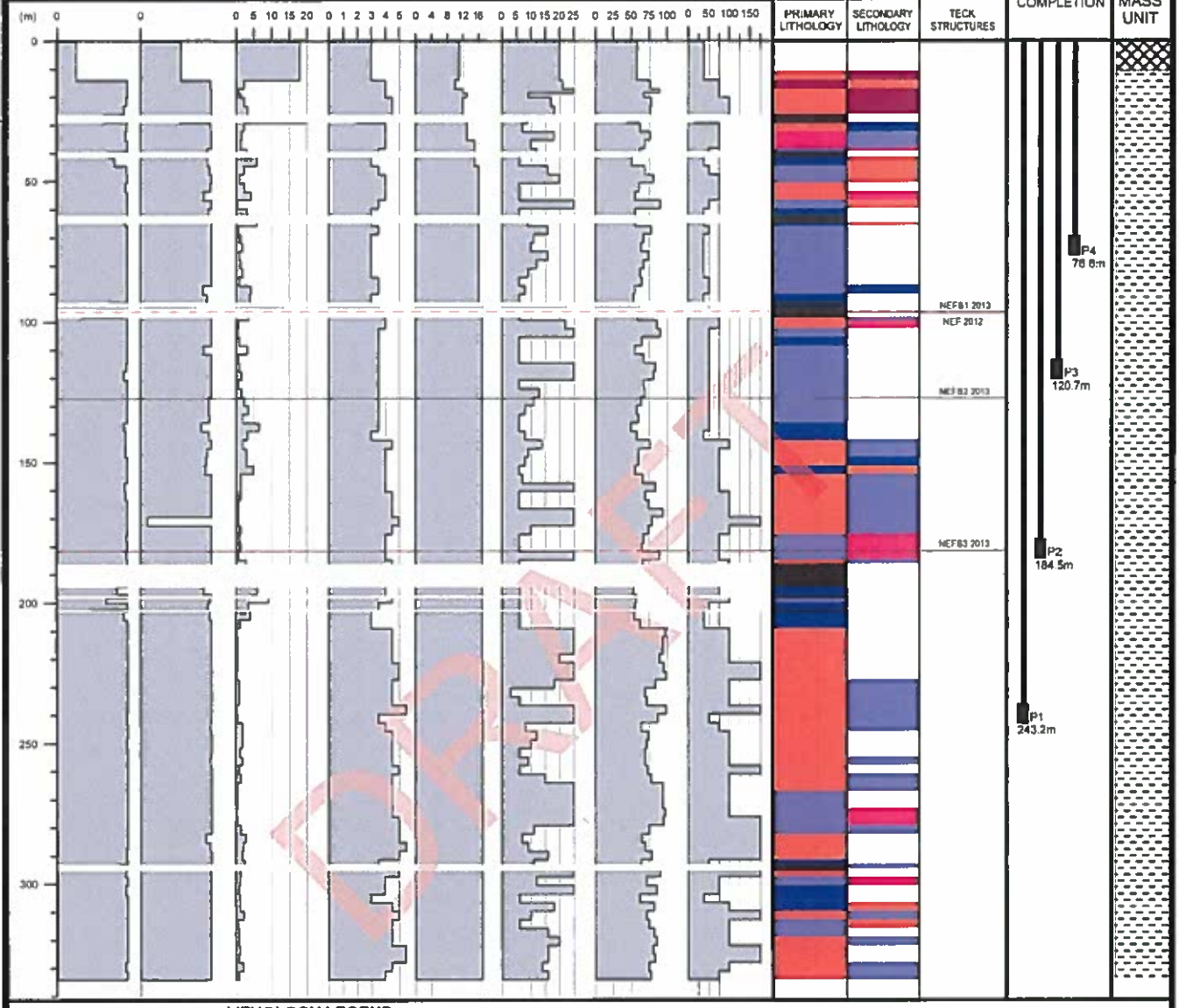
GEOMECHANICAL LOG
BD13-002

BY:	DATE:
SJ	DEC 13
APPROVED:	FIG:
	B10

H:/Project/3159/Quintette/Geomech_log/BD13-003.grf

GEOMECHANICAL LOG: BD13-003

Coordinates: N 609088 E 629234 Collar Elevation: 1629.13m Depth: 334.06m Azimuth: --- Dip: -90°



EOH 334.06m

LITHOLOGY LEGEND

- MUDSTONE
- SANDSTONE
- SHALE
- SILTSTONE
- CONGLOMERATE
- CLAY
- COAL
- GOUGE
- GRAVEL
- CARBONACEOUS MUDSTONE
- CARBONACEOUS SANDSTONE
- CARBONACEOUS SHALE

ROCK MASS UNITS

- OVERBURDEN
- HULCROSS MEMBER
- GATES MEMBER

- TECK FAULTS 2013
- KCB PROPOSED FAULTS 2012

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GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS

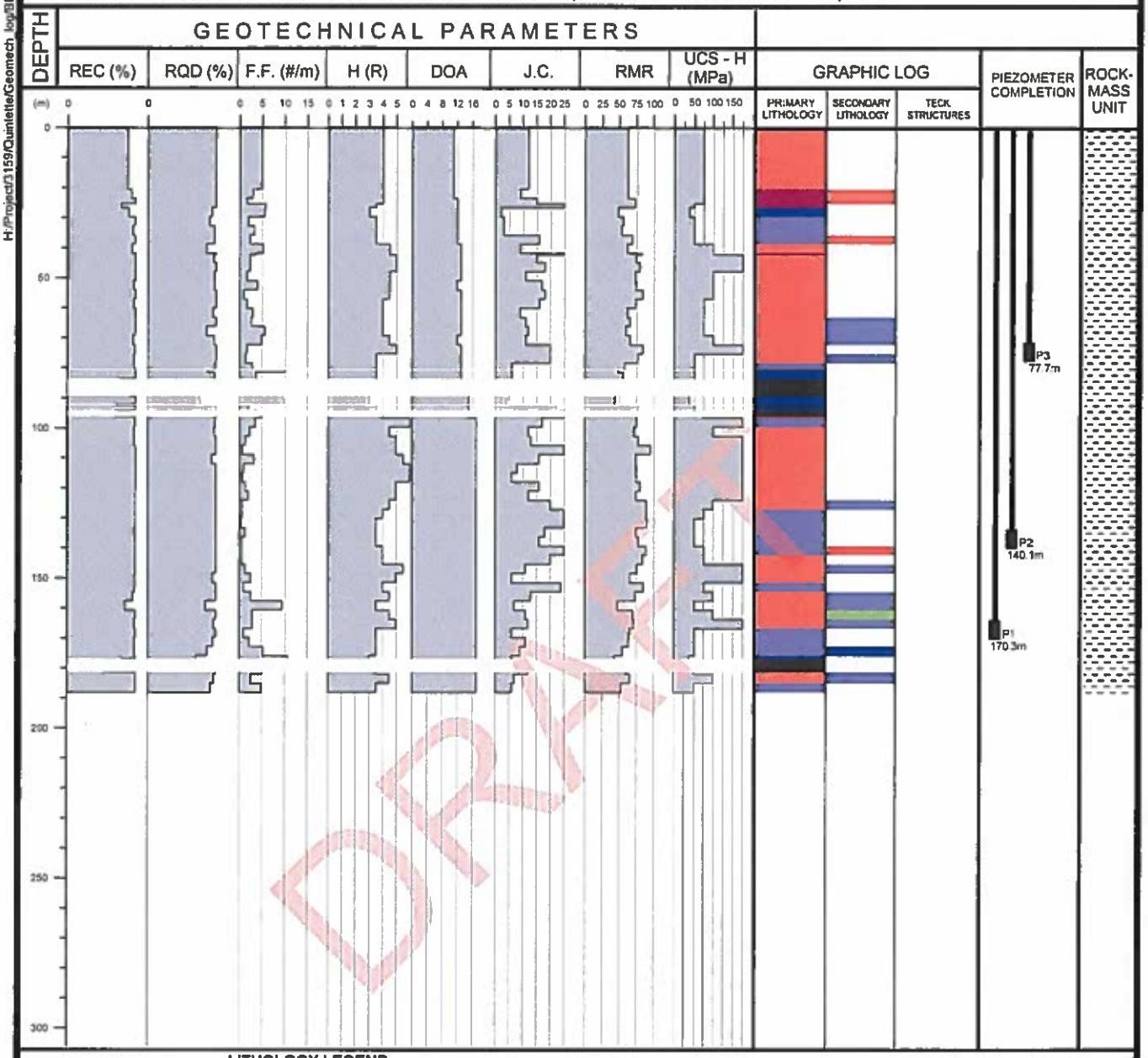
GEOMECHANICAL LOG
BD13-003

BY:	DATE:
SJ	DEC 13
APPROVED:	FIG:
	B11

H:/Project/3159/Quintette/Geomech_log/BD13-004.grf

GEOMECHANICAL LOG: BD13-004

Coordinates: N 6090919 E 628126 Collar Elevation: 1504.05m Depth: 188.06m Azimuth: 217° Dip: -60°



EOH 188.06m

LITHOLOGY LEGEND

- MUDSTONE
- SANDSTONE
- SHALE
- SILTSTONE
- CONGLOMERATE
- CLAY
- COAL
- GOUGE
- GRAVEL
- CARBONACEOUS MUDSTONE
- CARBONACEOUS SANDSTONE
- CARBONACEOUS SHALE

ROCK MASS UNITS

- OVERBURDEN
- HULCROSS MEMBER
- GATES MEMBER

- TECK FAULTS 2013
- KCB PROPOSED FAULTS 2012

TECK COAL LTD.
QUINTETTE OPERATIONS
FEASIBILITY OPEN PIT DESIGN STUDY

PITEAU ASSOCIATES
GEOTECHNICAL AND HYDROGEOLOGICAL CONSULTANTS

GEOMECHANICAL LOG
BD13-004

BY:	DATE:
SJ	DEC 13
APPROVED:	FIG: B12

OVERBURDEN DRILLHOLE LOG BG13-01

STARTED: July 18, 2013 **FINISHED:** July 20, 2013
DRILL METHOD: 4.5 ODEX
GROUND ELEV. (m): 1016.8
COORDINATES (m): N 6093460 E 627660

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS
0					SILT (ML), some clay, some gravel, some sand, trace coal, low plasticity, stiff, dry, dark brown, gravel is silty sandy shale, coarse, flat, subangular, trace oxidation. [Waste dump fill]
	27 20 21	01-SPT-1 (K-1)	43%		
3	12 54	01-SPT-2 (K-2)	30%		@ 3.0 m: Becomes wet.
4.6	4 10 42	01-SPT-3 (K-3)	35%		@ 4.6m: Becomes gravelly, trace clay, trace sand, medium to low plasticity, gravel is fine sandstone with ~60% quartz.
7.6	12 11 11	01-LPT-5 (K-4)	52%		@ 7.6m: With some gravel, trace sand, trace coal, low plasticity, soft, moist, dark brown, coal odour, gravel is shale, blocky, subangular-angular, slightly weathered.
9.1	5 5 9 7	01-SPT-6 (K-5)			@ 9.1 m: Becomes gravelly, coarse grained with some cobbles, fresh, medium to low plasticity.
10					Continued Next Page

INSTRUMENT DETAILS

Su - kPa
25 75 125 175 225
UC/2 P.PEN/2
WATER1 WATER2 WATER3
% FINES SPT N LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B3.2 Pond
LOGGED BY: ES **CHECKED BY: RP**
SHEET 1 **OF** 4 **HOLE NO.:** BG13-01

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-01

STARTED: July 18, 2013 **FINISHED:** July 20, 2013
DRILL METHOD: 4.5 ODEX
GROUND ELEV. (m): 1016.8
COORDINATES (m): N 6093460 E 627660

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
					10.7 1006.1 GRAVEL (GM), fine to coarse, some sand, some silt, well graded, loose, wet, gravel is blocky, angular, strong, fines are low plasticity. [Waste dump fill]	
11	36 40 29 13	01-LPT-7 (K-6)				
12	12 8 14 17	01-LPT-8 (K-7)	53%		12.2 1004.6 SILT (ML), gravelly, sandy, trace coal, medium to low plasticity, firm, wet, dark brown, coal odour, gravel is well graded, blocky and subangular, shale and fine sandstone, slightly oxidized. [Waste dump fill]	
13						
14	11 15 16 21	01-LPT-9 (K-8)	45%		@ 13.7 m: Pocket penetrometer readings = 1.0 to 1.5 kg/cm^2.	
15						
	13 8 11 11	01-LPT-10 (K-9)	50%		15.3 1001.5 SAND AND GRAVEL (SM), fine to coarse grained, silty, well graded, loose, blocky, subangular, abundant coal, dark brown, fines are low plasticity, pocket penetrometer reading = 1.0 to 1.5 kg/cm^2. [Waste dump fill]	
16						
17	10 8 18 10	01-LPT-11 (K-10)	55%		16.8 1000.0 GRAVEL (GM), sandy, some silt, some cobbles, gravel and cobbles are sandstone (50% quartz), strong, blocky, subangular, sand is fine to coarse grained, dark brown. [Waste dump fill]	
18						
	14 11 18 15	01-LPT-12 (K-11)				
19						
20		01-LPT-13 (K-12)	53%		20.0	

Continued Next Page

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B3.2 Pond
LOGGED BY: ES **CHECKED BY:** RP
SHEET 2 **OF** 4 **HOLE NO.:** BG13-01

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-01

STARTED: July 18, 2013 **FINISHED:** July 20, 2013
DRILL METHOD: 4.5 ODEX
GROUND ELEV. (m): 1016.8
COORDINATES (m): N 6093460 E 627660

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
	10 16 10 17				996.8 SAND (SM), fine to coarse grained, gravelly, silty, some coal, trace cobbles, loose, moist, max. size 100 mm, dark brown, coal odour, gravel is sandstone with traces of shale, sand is fine to coarse grained with fine sand size dominant. [Waste dump fill]	
21					21.3 995.5 SAND AND GRAVEL (SW), trace silt, fine to coarse grained sand with coarse dominant, gravel is fine grained, well graded, rounded, heterolithic, orange-red, fines are non-plastic. [Waste dump fill]	
22						
23					23.0 993.9 @ 22.9m: 50 mm zone of SILT (ML), some gravel, some clay, trace fine grained sand, medium plasticity, brown, wet. SILT (ML), gravelly, trace cobbles, trace fine grained sand, gap graded, low plasticity, compact, moist, gravel is grey siltstone, weak, subangular, silt is blocky, brittle chunks. [Waste dump fill] @ 23.7m: 50 mm coal horizon.	
24					24.4 992.4 GRAVEL (GP), some sand, trace silt, trace coal, gap graded, compact, moist, gravel is medium strong siltstone and sandstone, angular to subangular, sand is fine grained. [Waste dump fill]	
	7 15 12 11	01-LPT-15 (K-13)	73%			
25						
26	9 7 13 20	01-LPT-16 (K-14)	63%		25.9 990.9 GRAVEL (GW), some sand, trace silt, trace coal, well graded, compact, moist, gravel is medium strong siltstone and sandstone, angular to subangular. [Waste dump fill]	
27					Vibrating Wire Piezometer installed at 27.0 m depth (VW25861) - Grouted Installation	
	8 12 12 11	01-LPT-17 (K-15)	57%			
28						
29	R	01-LPT-18 (K-16)			29.0 987.8 SAND AND GRAVEL (SP), medium to coarse grained, trace silt, gap graded, loose, moist, angular to subangular, dark brown to black. [Waste dump fill] 29.6 987.2 SAND (SM), fine to coarse grained, some silt, trace gravel, well graded, compact, dry, rounded to subangular.	
30					Continued Next Page	

Su - kPa
25 75 125 175 225
UC/2 P.PEN/2
WATER1 WATER2 WATER3
% FINES SPT N LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B3.2 Pond
LOGGED BY: ES **CHECKED BY: RP**
SHEET 3 **OF** 4 **HOLE NO.:** BG13-01

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-01

STARTED: July 18, 2013 **FINISHED:** July 20, 2013

DRILL METHOD: 4.5 ODEX

GROUND ELEV. (m): 1016.8

COORDINATES (m): N 6093460 E 627660

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
			33%		yellowish brown, some organics (wood stocks ~ 50 mm long). [ALLUVIUM]	
	R	01-LPT-19 (K-17)			30.5 / 986.3 @ 30.4 m: 100 mm zone of CLAY (CL), sandy, medium plasticity, firm, brown, sand is fine to coarse grained.	
31					SILT AND GRAVEL (GM), fine to coarse grained, gap graded, compact, moist, yellowish grey, gravel is moderately weathered and subangular to subrounded, silt is firm. [ALLUVIUM] 31.1 / 985.7	
					SAND (SM), fine to coarse grained, silty, some clay, trace gravel, well graded, medium plasticity, rounded, orange, moist. [ALLUVIUM]	
32	8 27 32 27	01-LPT-20 (K-18)	90%		32.0 / 984.8 WEATHERED ROCK, highly weathered, centre of rock pieces are grey and show some of original texture, likely siltstone or shale, crumbles in fingers, weathered material, orange, clay, blocky, medium plasticity, cohesive material, can only see separate pieces of original rock when the sample is broken open with hands.	
	24 38 53	01-LPT-21 (K-20)	78%			
33					33.0 / 983.8 Bedrock Contact and End of Hole @ 33.0 m	
34						
35						
36						
37						
38						
39						
40						

Su - kPa

25 75 125 175 225

UC/2 P.PEN/2

WATER1 WATER2 WATER3

★ % FINES ■ SPT N □ LPT N

W_P% W% W_L%

20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05

PROJECT: Quintette 2013 Site Investigation

LOCATION: B3.2 Pond

LOGGED BY: ES **CHECKED BY: RP**

SHEET 4 **OF** 4 **HOLE NO.:** BG13-01

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-02

STARTED: July 20, 2013 **FINISHED:** July 22, 2013
DRILL METHOD: 4.5 ODEX
GROUND ELEV. (m): 1036.8
COORDINATES (m): N 6093268 E 627760

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
					No Recovery.	
1.5						
1035.3					GRAVEL (GM), some silt, trace sand; gravel: grey, angular, strong, siltstone, fresh, blocky; sand is coarse; silt: black, low plasticity. [Waste dump fill]	
3.0						
1033.8	R	02-LPT-1	33%		SILT and GRAVEL (ML), some sand; gravel: fine to coarse, up to 60 mm, flat or blocky; sand: fine to medium, clasts are subangular to angular, poorly graded, light brown to black. Pocket penetrometer = 0. [Waste dump fill]	
4.6						
1032.2	4 7 10 12	02-LPT-2	50%		SAND and GRAVEL(GP-GM), some silt, gravel: fine to coarse, up to 60 mm, flat or blocky; sand is fine to medium, clasts are subangular-angular, fresh to slightly weathered, poorly graded light brown to black. Pocket penetrometer = 0. [Waste dump fill]	
6.1						
1030.7	6 7 12 13	02-LPT-3			CLAY and SILT (CI), trace sand, intermediate plasticity, slow dilatancy, brown. [GLACIAL TILL]	
6.7						
1030.1					SILT (ML), some gravel, trace fine to medium grained sand; gravel: fine to coarse, max size 70 mm, rounded, elongate or flat, shale and sandstone, gap-graded, low plasticity, brown, organic smell, stiff, intermediate plasticity. [GLACIAL TILL]	
7.6						▽
1029.2	3 5 7 6	02-LPT-4	40%		SAND and GRAVEL (SW-SM), trace fines, sand fine to coarse; gravel: fine, rounded-subrounded, well graded, well sorted, heterolithic, brown. [GLACIAL TILL]	
8.2						
1028.6					SAND (SM-SC), some coarse gravel, some clay/silt, sand fine to medium, rounded, uniformly graded, brown to light brown; gravel is sandstone. [GLACIAL TILL]	
9.1						
1027.7	11 10 9 10	02-LPT-5	80%		SAND (SM-SC), fine with trace medium and coarse particles, gravelly , some clay/silt, trace cobbles up to 100 mm; gravel is fine to coarse, subangular, slightly oxidized, sandstone and trace shale, shale is moderately weathered and orange-red surfaces, gap-graded, dark brown fines, medium plasticity. [GLACIAL TILL]	

Continued Next Page

Su - kPa
25 75 125 175 225
UC/2 P.PEN/2
WATER1 WATER2 WATER3
% FINES SPT N LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B3.2 Pond
LOGGED BY: ES **CHECKED BY: RP**
SHEET 1 **OF** 4 **HOLE NO.:** BG13-02

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-02

STARTED: July 20, 2013 **FINISHED:** July 22, 2013
DRILL METHOD: 4.5 ODEX
GROUND ELEV. (m): 1036.8
COORDINATES (m): N 6093268 E 627760

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
11					@10.1 m: Boulder (33-37.5 ft); grey fine sandstone.	
12					@11.4 m: Boulder; grey fine sandstone.	
	11 12 22	02-LPT-6	70%		Vibrating Wire Piezometer installed at 12.2 m depth (VW25859) - Grouted Installation	
13						
			20%		@13.7 m: Silty clay (CL) layer, with trace fine sand.	
14	R	02-LPT-7			14.3 1022.5	
15					Bedrock Contact @ 14.3 m, See Rock Log	
					End of Overburden Drill Log at 14.3 m.	
16						
17						
18						
19						
20						

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
× – – – – ▲ – – – – ×
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B3.2 Pond
LOGGED BY: ES **CHECKED BY:** RP
SHEET 2 **OF** 4 **HOLE NO.:** BG13-02

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-02

Klohn Crippen Berger

DATE STARTED: July 20, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: 4" ODEX	SHEET 3 OF 4
DATE FINISHED: July 22, 2013	LOGGED BY: ES	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 1036.759
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 25.1	COORDINATES (m): E 627760.335 N 6093268.477
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 14.3	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Norm Dillabough	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
15											Drilled open hole with hammer bit to confirm bedrock, then switched to HQ3 core.												
											15.60 1021.16					15.6							
	1	1		0.3	100	39	82	R2			SILTSTONE, dark grey, weak-peeled with knife, slightly weathered, discolouration on some surfaces and joints, mm scale laminations are light grey and perpendicular to core axis. Horizontal bioturbation.			3		15.72	J	80	>3	N	5		
																15.78	J	45	>3	NC	1		
16														2		15.84	T	60	<0.2	N	1		
																15.92	S	90	<1	NC	1		
	2	1		1.5	97	86	97				@16.57 m: bioturbation decreased below 16.57 m depth.			1		16	J	45	>3	NC	5		
																16.23	J		>3	Cl	5		
17														1		17.1	J	70	>3	Cl/NC	6		
														1		17.19	J	80	>3	Cl/NC	6		
																17.44	J	80	>3	Cl/NC	1,3		
														2		17.7	J	50	>3	FeOx/C	6		
														3		17.74	J	60	>3	FeOx/C	6		
18																17.91	J	90	>3	Cl	1,3		
	3	1		1.5	100	76	79				@18.1 m: siltstone has laminations at 85 deg, with 10 cm layer of clay on top of run, clay is dark brown, high plasticity, firm.			4		17.94	J	80	>3	N	5		
																18.1	S	60	>3	Cl	1		
														4		18.15	T	60	>3	NC	Closed		
																18.18	J	90	>3	NC	5		
														4		18.35	J	90	>3	NC	5		
																18.42	T	0	>3	NC	Closed		
19																18.53	J	80	>3	N	5		
														2		18.56	J	90	>3	NC	Closed		
																18.62	J	90	>3	N	5		
														3		18.64	J	90	>3	N	5		
	4	2		1.5	100	83	75				@19.1 m: bioturbation is horizontal again.			4		18.68	J	90	>3	FeOx	5		
																19.03	J	90	>3	Cl	6		
																19.19	J	5	>3	Cl	6		
20														5		19.24	J	30	>3	N	1		
																19.42	J	90	>3	N	5		
														6		19.45	J	90	>3	N	6		
																19.6	J	90	>3	N	6		
																19.64	J	90	<1	N	6		
																19.76	T	90	<1	FeOx	Closed		
																19.79	J	55	<1	FeOx	6		
21														1		19.94	J	45		NC	6		
																20.05	J	90		NC	1,3		
	5	2		1.5	100	994	91				@20.5 m: no bioturbation.			2		20.08	J	40		NC	13		
																20.12	J	30		Qtz	4		
																20.14	J	90		Cl	5		
																20.82	S	90		NC	1		
														4		21.17	J	90		Cl	1		
22																21.18	J	80		Cl	5		
														1		21.79	J	90		Cl	5		
																21.81	J	85		Cl	1		

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-02

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
23	6	2		1.5	95	77	90				@22.6 m: 1cm pyrite nodule.			3 1		21.85 22.13 22.4	J J J	30 30 25		Cl Cl Cl/P	1 1 1		
														1		22.46 22.5 22.8	J J J	80 0 0		Cl/P Cl/P Cl	1 1 1		
24	7	3		1.5	100	56	62				@23.5 m: no bioturbation.			3 1 3		22.93 23.36 23.42	J S J	0 0 0		Cl Cl Cl	6 1 1		
														1		23.48 23.65 23.93	J J S	0 0 0		Cl Cl/P Qtz	1 1 1		
25											25.10 1011.66 End of Hole at: 25.1 m			6 1 6		24.06 24.07 24.55	S S S J	0 90 90 90 90		Cl P P	1 1 1/3 5 1		
26																							
27																							
28																							
29																							
30																							
31																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

DRAFT

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

OVERBURDEN DRILLHOLE LOG BG13-05

STARTED: July 29, 2013 **FINISHED:** Aug 4, 2013
DRILL METHOD: 4.5 ODEX/ HQ3 Diamond Bit
GROUND ELEV. (m): 1297.0
COORDINATES (m): N 6088465 E 632330

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
0					CLAY (Cl), silty, trace sand, some gravel; gravel is rounded and moderately weathered, medium plasticity, firm, dark brown, mc above PL, homogeneous, no dilatancy, high dry strength. [GLACIAL TILL]	
1						
2		05-SPT-1	34%			
3		05-SPT-2	40%		@3.04 m: clay is stiffer with mc below PL.	
4						
5	7 12 17	05-SPT-3			@4.56 m: clay is stiff with mc below PL.	
6		05-SPT-4	53%		@6.01 m: clay is stiff with mc below PL.	
7			13%		7.7 1289.3 @7.6-7.7 m: clay is stiff with mc below PL.	
8		05-SPT-5-1 05-SPT-5-2	50%		CLAY (CL), sandy, some gravel, low plasticity, very stiff, mc below PL, brown, homogeneous, slow dilatancy, high dry strength. [GLACIAL TILL] 8.1 1288.9	
9		05-Core-1	100%		SAND (SM), fine-grained, silty, some gravel, some boulder/cobble fragments, poorly graded, very loose, gravel is subrounded, brown, very wet. [GLACIAL TILL] 9.0 1288.0	
10		05-Core-2	38% 19%		CLAY (CL), sandy, some gravel, low plasticity, very stiff, mc below PL, brown, homogeneous, slow dilatancy, high dry strength. [GLACIAL TILL] 9.5	
		05-Core-3	6% 31%		@9.3-9.45 m: clay has brown/orange mottling. 9.8 1287.5 SILT (ML), sandy, low plasticity, black, dry, homogeneous, dry strength, rapid dilatancy. [GLACIAL TILL] 1287.2	
		05-Core-4 05-Core-5	6%		Continued Next Page	

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: Augmentation Reservoir
LOGGED BY: MC **CHECKED BY:** RP
SHEET 1 **OF** 12 **HOLE NO.:** BG13-05

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-05

STARTED: July 29, 2013 **FINISHED:** Aug 4, 2013
DRILL METHOD: 4.5 ODEX/ HQ3 Diamond Bit
GROUND ELEV. (m): 1297.0
COORDINATES (m): N 6088465 E 632330

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
	5 9 8	05-Core-6 05-SPT-6	21%		CLAY (CL), sandy, some gravel, low plasticity, very stiff, mc below PL, brown, homogeneous, slow dilatancy, high dry strength, gravel is subangular. [GLACIAL TILL]	
			23%		10.6 1286.4 SILT (ML), sandy, low plasticity, black, mc below PL, homogeneous, dry strength, rapid dilatancy. [GLACIAL TILL] @9.8-10.3 m: 2 mm lens of brown silty clay in silt.	
11		05-Core-7 05-Core-8	77%		CLAY (CL), sandy, some gravel, low plasticity, very stiff, mc below PL, brown, homogeneous, slow dilatancy, high dry strength, gravel is subangular; laminated with 5 mm beds of low plasticity silt (ML), some angular to subangular gravel with iron oxide staining. [GLACIAL TILL]	
	11 17 22 24 30 R	05-SPT-7	36%		11.4 1285.6	
12		05-Core-9	100%		CLAY and SILT (CL), sandy, low plasticity, very stiff, stratified grey clay and orangish brown silt, beds are 10-50 mm thick, mc below PL. [GLACIAL TILL] @12.2-12.3 m: grey silty sand.	
		05-Core-10	20%		12.3 1284.7 SILTSTONE (ML), fine-grained, dark grey, completely weathered, crumbles under finger pressure, rock pieces are angular, highly fractured, iron oxide stains on joints. [WEATHERED ROCK]	
13		05-Core-11	13% 100%		13.0 1284.0	
	13 27 R @ 50mm	05-SPT-8 05-Core-12	100%		13.2 1283.8 SAND (SM), some clay, poorly graded, medium-grained, silty, loose, wet, dark brown. [WEATHERED ROCK]	
		05-Core-13	100%		13.6 1283.4 CLAY (CI), silty, some sand, medium plasticity, firm, dark brown, homogeneous, MC above PL, very high dry strength, no dilatancy. [WEATHERED ROCK] @13.45 m: becomes very stiff.	
14					14.1 1282.9 SAND (SM), some clay, poorly graded, medium grained, silty, loose, wet, dark brown. [WEATHERED ROCK]	
			6%		14.4 1282.6 @13.7 m: angular rock fragments similar to siltstone above, clay infill around rock pieces.	
	33 R @50mm	05-SPT-9			14.5 1282.5 CLAY (CI), gravelly, some sand, medium plasticity, firm, dark brown, homogeneous, MC above PL, very high dry strength, no dilatancy. [WEATHERED ROCK]	
15					SAND and CLAY (SC), fine-grained, poorly graded, firm, low plasticity, dark brown, MC below PL, very high dry strength, slow dilatancy. [WEATHERED ROCK]	
					End of Overburden Drill Log at 14.5 m. Bedrock Contact @ 14.45 m, See Rock Log	
16						
17						
18						
19						
20						

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: Augmentation Reservoir
LOGGED BY: MC **CHECKED BY: RP**
SHEET 2 **OF** 12 **HOLE NO.:** BG13-05

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-05

Klohn Crippen Berger

DATE STARTED: July 29, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 3 OF 12
DATE FINISHED: August 4, 2013	LOGGED BY: MC	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 1296.952
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 101.3	COORDINATES (m): E 632330.478 N 6088465.439
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 14.45	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Norm Dillabough	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	DISCONTINUITY DATA: FRACTURE ZONE	DISCONTINUITY DATA: DISCONT. DEPTH (m)	DISCONTINUITY DATA: DISCONT. TYPE	DISCONTINUITY DATA: ANGLE (From Core Axis)	DISCONTINUITY DATA: APERTURE (<1,1-3,>3mm)	DISCONTINUITY DATA: INFILL TYPE	DISCONTINUITY DATA: JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
15	6	1		1.52	97	0	8				@15.4-15.95 m: fractured zone, gravel pieces with clay infill.			6									05-SPT-9
16											@16.2-16.55 m: siltstone is moderately weathered.			6									
	7	1		1.52	86	8	21				@16.55-17.25 m: fractured zone, gravel pieces with clay infill.			3		16.35	J	80	1-3	N	5		
17														6		16.4	J	50	1-3	CL	3		
														6		16.46	J	50	1-3	CL	5		
											17.25 / 1279.70 / 17.48 / 1279.47 No recovery.			6									
								R1	HW		SILTSTONE, fine-grained, dark grey, highly weathered, weak, joints are typically planar and rough, iron oxide, gravel and clay infill between joints, bedding faintly visible at 15.4-15.95m fractured zone, gravel pieces with clay infill.			6									
18	8	2		1.52	93	33	39				@17.48-17.83 m: fractured zone in siltstone, gravel pieces with clay infill.			2		18.08	J	30	1-4	N	3		
														6		18.13	J	30	1-5	N	3		
											18.68 / 1278.27 / 18.90 / 1278.05 @18.1-18.68 m: fractured zone in siltstone with some joints at 30 and 50 deg TCA.			6									
								R1	SW					1		18.9	J	30	1-6	N	3		
19								R1	SW		1277.95 Siltstone, fine-grained, dark grey, slightly weathered, weak, joints are typically planar and rough, gravel and clay infill between joints, gravel pieces with clay infill.			6									
	9	2		1.52	87	0	17							6									
20											No recovery.			6									
											SILTSTONE, fine-grained, dark grey, slightly weathered, weak, joints are typically planar and rough, gravel and clay infill between joints, gravel pieces with clay infill.			6									
								R1-R2	SW		20.52 / 1276.43 @19.22-20.52 m: fractured zone in siltstone, gravel fragments with clay infill, some iron oxide stain.			6									
21														2		20.99	J	60	1-3	N	1,3		
	10	3		1.52	86	12	26							6		21.1	J	80	1-3	N	6		
											SILTSTONE, fine-grained, dark grey, slightly weathered, weak, joints are typically planar and rough, gravel and clay infill between joints, gravel pieces with clay infill.			6									
											21.82 / 1275.13 @20.52-20.8 m: fractured zone with no clay infill.			6									
22											22.05 / 1274.90 @21.1-21.72 m: fractured zone with no clay infill, bedding faintly visible at 25 deg TCA.			6									
								R2	SW					6									

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-05

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m) (5 10 15)	RUN LENGTH (m)	TCR (%) (25 50 75)	RQD (%) (25 50 75)	SCR (%) (25 50 75)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS
23	11	3		1.52	99	48	50				(continued from previous page) @21.72-21.82 m: traces of coal. No recovery. SILTSTONE, fine-grained, dark grey, slightly weathered, weak, fractures along bedding are typically planar and smooth, gravel and clay infill between joints, bedding at 20 deg TCA, coal laminations 5-10 mm thick, gravel pieces with clay infill.		
24	12	3		1.52	81	27	46				@23.95-24.77 m: coal, black, fine-grained, friable, fresh, extremely weak.		
25								R0-R1	HW		24.77 1272.18 No recovery. 25.10 1271.85 SHALE, dark grey, very fine-grained, fresh, highly fractured, friable, extremely weak.		
26	13	4		1.52	75	19	19	R1	SW		25.70 1271.25 SILTSTONE, fine-grained, dark grey, slightly weathered, weak, fractures along bedding are typically planar and smooth, gravel and clay infill between joints, bedding at 20 deg TCA, coal laminations 5-10 mm thick, gravel pieces with clay infill.		
27	14	4		1.52	100	53	63	R1	SW		26.24 1270.71 26.62 1270.33 @25.95-26.24 m: coal, black, fine-grained, friable, fresh, extremely weak. No recovery. SILTSTONE, fine-grained, dark grey, slightly weathered, weak, fractures along bedding are typically planar and smooth, gravel and clay infill between joints, bedding at 20 deg TCA, coal laminations 5-10 mm thick, gravel pieces with clay infill. @27.9-28.1 m: highly fractured, weak, friable zone. @28.1 m: very hard drilling.	@ 28.1 m: Switched to an Open-hole-hammer bit. Cutting were logged from 28.1 m to 101.3 m (End of Hole).	
28													
29													
30													
31											@31.2 m: very hard drilling.		

DISCONTINUITY DATA

FRACTURE FREQ. (No. Per 30 cm) (2 4)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
6									
1		22.9	J	20	1-3	N	1,3		
2		23.09	J	35	1-3	N	1,3		
		23.11	J	60	1-3	N	1		
4		23.28	J	70	1-3	N	1		
		23.32	J	15	1-3	N	1,3		
6		23.38	J	60	1-3	N	6		
		23.52	J	30	1-3	N	1,3		
6									
		24.17	B	20	1-3	N	1		
3		24.19	J	70	1-3	N	6		
		24.28	J	25	1-3	N	1		
3		24.63	B	30	1-3	N	1		
		24.68	J	60	1-3	N	1		
		24.77	B	20	1-3	N	1		
6									
6									
		25.71	B	25	1-3	N	1		
2		25.95	B	25	1-3	N	1		
6									
		26.7	J	20	<1	CL	1,3		
4		26.77	J	90	<1	CL	5		
		26.89	J	60	1-3	N	1		
		26.92	J	60	1-3	N	1		
1		27.44	J	20	1-3	N	3		
		27.56	J	60	1-3	N	1		
3		27.61	J	20	1-3	N	3		
		27.76	J	40	1-3	N	3		
6									

DRAFT

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DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

Klohn Crippen Berger

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-05

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	DISCONTINUITY DATA: FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	DISCONT. DATA: ANGLE (From Core Axis)	DISCONT. DATA: APERTURE (<1,1-3,>3mm)	DISCONT. DATA: INFILL TYPE	DISCONT. DATA: JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
33											SILTSTONE, fine-grained, dark grey, fresh, hard drilling.												
34								R1	SW		34.24 1262.71 SHALE: black, fine-grained, friable, can be broken with fingers; and sandstone: light grey, fine-grained, can be broken with fingers.												
35																							
36																							
37																							
38																							
39																							
40											@40.34 m: predominantly shale.												
41																							

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DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese
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			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
42											SHALE: black, fine-grained, friable, can be broken with fingers; and sandstone: light grey, fine-grained, can be broken with fingers. @41.9 m: predominantly shale.												
43																							
44											@43.38 m: predominantly shale, bedding visible.												
45																							
46																							
47																							
48																							
49																							
50																							
51								R1	SW		51.00 1245.95 SANDSTONE: light grey, fine-grained, can be broken												

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			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
52											with fingers; and shale: black, fine-grained, friable, can be broken with fingers. Predominantly sandstone.												
53																							
54																							
55																							
56											SANDSTONE: light grey, fine-grained, can be broken with fingers; and shale: black, fine-grained, friable, can be broken with fingers. Predominantly sandstone.												
57																							
58																							
59																							
60																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

DRAFT

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			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
61											SANDSTONE: light grey, fine-grained, can be broken with fingers; and shale: black, fine-grained, friable, can be broken with fingers. Predominantly sandstone.												
62																							
63																							
64																							
65																							
66																							
67																							
68																							
69																							
70																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

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			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
71											SANDSTONE: light grey, fine-grained, can be broken with fingers; and shale: black, fine-grained, friable, can be broken with fingers. Predominantly sandstone.												
72																							
73																							
74																							
75											@ ~75 m: driller noted soft layer approximately 100 mm thick, may be coal.												
76																							
77																							
78																							
79																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

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			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
80											SANDSTONE: light grey, fine-grained, can be broken with fingers; and shale: black, fine-grained, friable, can be broken with fingers. Predominantly sandstone.												
81											@81.48-83.01 m: some siltstone, dark grey, cannot be broken in fingers.												
82																							
83																							
84																							
85																							
86																							
87											@87.58-89.1 m: some shale in sandstone.												
88																							
89											@89.1-90.63 m: sandstone and shale present in equal quantities.												

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GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-05

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DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	DISCONTINUITY DATA: FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	DISCONT. DATA: ANGLE (From Core Axis)	DISCONT. DATA: APERTURE (<1,1-3,>3mm)	DISCONT. DATA: INFILL TYPE	DISCONT. DATA: JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
90																							
											90.63 1206.32 SILTSTONE, grey, fine-grained, trace calcite, hard drilling.												
91																							
92											@92.15-92.68 m: some shale.												
93																							
94																							
95																							
96																							
97											@ 96.7 m: start to see very fine grained greenish grey mixed with the dark grey sandstone, some sandstone.												05-Cuttings-X
98																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

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Klohn Crippen Berger

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-05

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	DISCONTINUITY DATA: FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	DISCONT. ANGLE (From Core Axis)	DISCONT. APERTURE (<1,1-3,>3mm)	DISCONT. INFILL TYPE	DISCONT. JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
100											SILTSTONE, fine-grained, dark grey, some very fine-grained greenish-grey, some sandstone.	Vibrating Wire Piezometer installed at 99.6 m depth (VW25858) - Grouted installation											
101											101.30 1195.65 End of Hole at: 101.3 m												
102																							
103																							
104																							
105																							
106																							
107																							
108																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

DRAFT

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese
WEATHERING: F: Fresh SW: Slightly MW: Moderately HW: Highly CW: Completely RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

OVERBURDEN DRILLHOLE LOG BG13-06

STARTED: Aug 5, 2013 **FINISHED:** Aug 7, 2013
DRILL METHOD: 4.5 ODEX/ HQ3 Diamond Bit
GROUND ELEV. (m): 1295.2
COORDINATES (m): N 6088083 E 632300

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT	DETAILS
0					CLAY (CL), silty, some sand, some gravel, low plasticity, stiff, dark brown, mc below PL, homogeneous, high dry strength, no dilatancy [GLACIAL TILL]		
1							
2	6 11 10 9	06-SPT-01	80%		@ 1.9m: 200 mm of SAND (SM), fine grained, some gravel, some silt, poorly graded, compact, dry, light brown		
3	6 14 16 16	06-SPT-02	35%		@ 3.6m: Start to see some cobbles and boulders		
4					@ 4.2m: Started seeing water coming into hole		
5							
6							
7							
8							
9							
10					Continued Next Page		

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
× – – – – ▲ – – – – ×
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: Augmentation Reservoir
LOGGED BY: MC **CHECKED BY:** RP
SHEET 1 **OF** 4 **HOLE NO.:** BG13-06

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-06

STARTED: Aug 5, 2013 **FINISHED:** Aug 7, 2013
DRILL METHOD: 4.5 ODEX/ HQ3 Diamond Bit
GROUND ELEV. (m): 1295.2
COORDINATES (m): N 6088083 E 632300

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
11		06-Core-01	66%		@ 9.9m: Becomes very stiff clay and gravel Vibrating Wire Piezometer Installed at 10.7 m depth (VWP25851)	
	14 26 39	06-SPT-03	49%			
12		06-Core-02	104%			
					12.8 1282.4	
13					Bedrock Contact @ 12.8 m, See Rock Log	
14					End of Overburden Drill Log at 12.8 m.	
15						
16						
17						
18						
19						
20						

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: Augmentation Reservoir
LOGGED BY: MC **CHECKED BY: RP**
SHEET 2 **OF** 4 **HOLE NO.:** BG13-06

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-06

Klohn Crippen Berger

DATE STARTED: August 5, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 3 OF 4
DATE FINISHED: August 7, 2013	LOGGED BY: MC	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 1295.213
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 25.2	COORDINATES (m): E 632300.409 N 6088082.687
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 12.8	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Norm Dillabough	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
13								R2	SW		SANDSTONE, fine-grained, grey, medium strength, slightly weathered, laminated with 1 mm beds of shale, bedding is warty and at 50 deg TCA, iron oxide stain on most fractures.					13.05	J	80	1-3	FeOx	1		
																	13.17	J	70	1-3	FeOx	1,3		
																	13.21	J	60	1-3	FeOx	3		
	5	1		1.52	95	47	62										13.31	B	60	1-3	FeOx	1		
14											From 13.7 m to 14.3 m: highly weathered shale and sandstone, highly fractured with clay infill between fractures, clay infill up to 30 mm thick, rock is weak and friable.						13.83	J	30	<1	Cl	0		
																	13.89	S	70	1-3	Cl	0		
								R0-R1	MW		14.30 1281.91													
								R0-R1	MW		14.82 1280.73 SHALE, dark grey, very fine-grained, extremely weak, moderately weathered.													
											No recovery.						14.86	J	80	1-3	Cl	5		
15																	14.95	J	40	<1	Cl	1,3		
																	15.03	J	70	1-3	Cl	5		
	6	1		1.52	100	26	60										15.07	J	70	1-3	Cl	5		
											15.35 1279.86						15.23	B	60	1-3	N	3		
								R0-R1	MW		15.73 1279.48 SHALE, dark grey, very fine-grained, extremely weak, moderately weathered, 200 mm bed of sandstone, coal seams up to 50 mm thick, bedding at 60 deg TCA.						15.35	J	80	1-3	Cl-FeOx	0		
16											SANDSTONE, highly weathered, fine-grained, friable.													
											SHALE, dark grey, very fine-grained, extremely weak, moderately weathered, 200 mm bed of sandstone, coal seams up to 50 mm thick, bedding at 60 deg TCA, fractured.													
											16.60 1278.61													
	7	2		1.52	100	64	64	R1	HW		From 16.0 m to 16.6 m: highly fractured shale and sandstone with clay infill up to 30 mm thick between fractures, clay ranges from soft to firm, slightly weathered.					17.33	B	90	<1	FeOx	3		
17											SANDSTONE, highly weathered, fine-grained, friable, bedding at 90 deg TCA.													
																	18.06	J	60	1-3	FeOx	3		
																	18.12	B	90	1-3	Cl-FeOx	0		
																	18.33	J	45	1-3	FeOx	3		
18	8	2		1.52	100	68	92										18.38	B	70	1-3	FeOx	5		
											18.37 1276.84													
									MW		SANDSTONE, fine-grained, friable, laminated with shale beds less than 1 mm thick spaced at 10 mm, bedding at 70 deg TCA, some joints infilled with firm clay and iron oxide, moderately weathered, fractures preferentially along bedding.						18.76	J	5	<1	Cl-FeOx	0		
19																	18.8	J	5	<1	Cl-FeOx	0		
																	18.85	B	70	1-3	FeOx	6		
																	19.18	J	60	1-3	FeOx	5		
																	19.24	J	80	1-3	FeOx	3		
																	19.25	J	60	1-3	FeOx	5		
	9	3		1.52	100	24	61										19.27	J	80	1-3	FeOx	3		
											19.85 1275.36													
20									HW		SANDSTONE, fine-grained, friable, laminated with shale beds less than 1 mm thick spaced at 10 mm, bedding at 70 deg TCA, some joints infilled with clay and crushed rock, highly weathered, fractures preferentially along bedding.						20.04	J	90	1-3	FeOx	3		
																	20.05	J	90	1-3	FeOx	3		
											20.35 1274.86						20.12	J	30	1-3	Cl	0		
									MW		20.57 1274.64						20.17	J	30	1-3	Cl	0		
									MW								20.28	J	50	1-3	FeOx	5		
																	20.45	J	80	1-3	FeOx	3		

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CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese
WEATHERING: F: Fresh SW: Slightly MW: Moderately HW: Highly CW: Completely RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-06

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	DISCONTINUITY DATA: FRACTURE ZONE	DISCONTINUITY DATA: DISCONT. DEPTH (m)	DISCONTINUITY DATA: DISCONT. TYPE	DISCONTINUITY DATA: ANGLE (From Core Axis)	DISCONTINUITY DATA: APERTURE (<1,1-3,>3mm)	DISCONTINUITY DATA: INFILL TYPE	DISCONTINUITY DATA: JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
21											SANDSTONE, fine-grained, friable, laminated with shale beds less than 1 mm thick spaced at 10 mm, bedding at 70 deg TCA, some joints infilled with firm clay and iron oxide, moderately weathered, fractures preferentially along bedding.			2		20.48	J	80	1-3	FeOx	3		
																20.85	B	70	1-3	FeOx	3		
	10	3		1.52	100	20	73							6		21.01	B	70	1-3	FeOx	3		
														6									
22											SANDSTONE, fine-grained, friable, laminated with shale beds less than 1 mm thick spaced at 10 mm, bedding at 70 deg TCA, some joints infilled with firm clay and iron oxide, moderately weathered, nearly all fractures along bedding.					21.77	B	70	1-3	FeOx	3		
														4		21.82	B	70	1-3	FeOx	3		
																21.93	B	70	1-3	FeOx	3		
														6		22.03	B	70	1-3	FeOx	3		
	11	3		1.52	98	38	68				@22.03 m: 70 mm zone of clay.			2		22.58	B	70	1-3	FeOx	3		
23											@22.62-23.62 m: spacing between laminations up to 100 mm, sandstone becomes fine to medium-grained.			3		22.61	B	70	>3	FeOx-Cl	0		
																22.73	J	50	1-3	Coal	1,3		
														3		22.87	B	70	<1	FeOx	0		
																22.98	B	70	1-3	Cl	0		
														3		23.06	B	70	1-3	Cl	3		
																23.23	B	70	1-3	FeOx	3		
											@23.62-25.15 m: bedding planes become oriented at 70 deg TCA.			3		23.27	S	50	>3	FeOx	0		
																23.33	S	50	>3	FeOx	0		
														2		23.42	B	80	1-3	Cl	3		
24																23.53	J	50	1-3	FeOx	3		
														3		23.77	B	70	1-3	Cl	3		
	12	4		1.52	99	69	85									23.91	J	50	>3	FeOx	0		
														5		23.95	J	80	1-3	FeOx	3		
																24.02	J	80	1-3	Cl	5		
25																24.09	B	70	1-3	FeOx	5		
																24.31	B	70	1-3	FeOx	3		
																24.35	B	70	1-3	FeOx-Cl	3		
																24.41	J	50	1-3	FeOx	6		
																24.48	J	70	1-3	FeOx	5		
																24.52	J	70	1-3	FeOx	6		
																				FeOx			
																				FeOx			
																				FeOx			
																				FeOx			
																				FeOx			
26											25.20 1270.01 @25 m: becomes coarse-grained, slightly weathered. End of Hole at: 25.2 m												
27																							
28																							
29																							
30																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

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CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

OVERBURDEN DRILLHOLE LOG BG13-07

STARTED: Aug 7, 2013 **FINISHED:** Aug 10, 2013
DRILL METHOD: 4.5 ODEX
GROUND ELEV. (m): 1298.5
COORDINATES (m): N 6088275 E 632353

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
					No Recovery.	
1.5 / 1296.9		07-SPT-1	83%		CLAY (CL), gravelly, some sand, low plasticity, firm to stiff, dark brown, mc above PL, homogeneous, no dilatancy, high dry strength.	
2.1 / 1296.3					Bedrock Contact @ 2.13 m, See Rock Log	
					End of Overburden Drill Log at 2.1 m.	

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: Augmentation Reservoir
LOGGED BY: MC **CHECKED BY:** RP
SHEET 1 **OF** 5 **HOLE NO.:** BG13-07

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-07

Klohn Crippen Berger

DATE STARTED: August 7, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 2 OF 5
DATE FINISHED: August 10, 2013	LOGGED BY: MC	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 1298.452
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 30.89	COORDINATES (m): E 632352.725 N 6088274.975
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 2.13	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Norm Dillabough/John Rudolf	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
3								R2	MW		SANDSTONE, fine-grained, grey, moderately weathered, medium strength, bedding at 20 deg TCA, highly fractured, iron oxide on fracture surfaces, bedding fractures are typically smooth and planar, laminated with shale beds 1 mm thick.												
4												Began coring				4.06							
	1	1		0.91	77	0	0							6									
5											@4.98 m: shale becomes thicker (up to 30 mm), highly weathered, friable, black clay and crushed rock on fractures.			6									
	2	1		1.52	70	0	0							6									
6											6.05 1292.40 No recovery.			6									
											6.50 1291.95												
								R2	MW		SANDSTONE, fine-grained, grey, moderately weathered, medium strength, bedding at 20 deg TCA, highly fractured, iron oxide on fracture surfaces, bedding fractures are typically smooth and planar, laminated with shale beds 1 mm thick, trace coal in some fractures.			6									
7														3		6.86	J	80	1-3	FeOx	3		
																6.98	B	20	<1	FeOc	1		
																7.04	J	80	>3	Cl	3		
	3	1		1.52	100	24	44							5		7.15	J	70	1-3	FeOx	3		
																7.17	B	20	1-3	FeOx	3		
														6		7.29	J	70	1-3	FeOx	3		
																7.32	J	20	1-3	FeOx	1,3		
														6		7.42	B	20	1-3	FeOx	3		
8																8.03	B	20	1-3	FeOx FeOx	1		
									SW		@8.03 m: becomes unfriable, stronger, bedding at 20-30 deg TCA, slightly weathered.			2		8.29	J	60	1-3	FeOx	1,3		
														1		8.58	B	30	1-3	N	1		
	4	2		1.52	78	55	61		MW		@ 8.66 m: Fractured zone, shale with some coal, black, very fine-grained, moderately weathered, friable, some clay infill between fractures. No recovery.			6									
9											9.55 1288.90 @ 9.55 m: Fractured zone, shale with some coal and some fin-grained sandstone, black, very fine-grained, moderately weathered, friable, some clay infill between			6									
											10.04	Vibrating Wire		6									
10																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-07

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
11	5	2		1.52	82	36	47	R1-R2	MW		1288.41 fractures. SANDSTONE, fine-grained, grey, moderately weathered, medium strength, bedding at 20 deg TCA, highly fractured, iron oxide on fracture surfaces, bedding fractures are typically smooth and planar, laminated with shale beds 1 mm thick, trace coal in some fractures. @ 10.64: Fractured zone, shale with some coal and some fin-grained sandstone, black, very fine-grained, moderately weathered, friable, some clay infill between fractures. No recovery. 11.07 1287.38	Piezometer installed at 9.8 m depth (VW25853) - Grouted installation		4 6		10.48 10.58 10.62 10.64	B B B B	20 20 20 20	1-3 1-3 1-3 1-3	FeOx Cl FeOx Cl FeOx Cl FeOx Cl	3 3 3 3		
12	6	2		1.52	100	0	9				@ 11.07 m: Fractured zone, fine-grained sandstone interbedded with very fine-grained shale, bedding at 30 deg TCA, fractures infilled with crushed rock and clay and iron oxide. 12.84 1285.61			6 6 6 6 6 6 6								
13	7	3		1.52	100	25	50		SW		Interbedded SILTSTONE and SANDSTONE, sandstone as above (10.04-10.64 m), siltstone is dark grey, very fine-grained, medium strength, slightly weathered, bedding at 20 deg TCA, mm scale shale laminations.			3 6		12.94 13.04 13.18	J J J	60 5 50	<1 1-3 1-3 <1	Py Ca FeOX N	3 1 6		
14	8	3		1.52	97	62	69				@14.12-15.65m: bedding at 20 deg TCA. @14.83 m: grains become massive.			3 6 6 6		13.63 13.71 13.75 14.81	B B J J	10 10 80 70	>3 >3 >3 1-3	Cl R FeOx Cl R FeOx Cl R FeOx Cl FeOx	1,3 1,3 1,3		
15											15.65			1 1		15.28 15.35 15.38	B B J	20 20 90	1-3 1-3 1-3	Cl FeOx Cl			
16	9	3		1.52	100	72	83	R1-R2	SW		1282.80 SILTSTONE, very fine-grained, medium strength, dark grey, slightly weathered, bedding at 20 deg TCA.			3 1 2 2		15.56 15.75 15.77 15.93 16.09 16.36 16.55 16.58 16.8	J J B J B J J B J	80 70 20 50 20 50 70 20 50	1-3 >3 1-3 1-3 1-3 1-3 >3 1-3 1-3	FeOx N FeOx N FeOx FeOx FeOx Cl N Cl	5 1,3 1 1,3 3 5 1 3		
17											17.17			2		17.12	J	70	1-3	FeOx	3		
18	10	4		1.52	100	31	63	R1-R2	SW		1281.28 SILTSTONE, dark grey, very fine-grained, medium strength, slightly weathered, interbedded with mudstone, bedding at 30 deg TCA, mudstone beds are typically less than 20 mm thick.			6 3 6 4		17.19 17.88 17.89 18.04 18.13 18.19 18.33 18.36 18.45 18.48 18.54 18.64 19.17 19.24	J B B J J B J B J B J B J J	70 30 30 70 70 30 50 30 30 30 50 30 70 70	1-3 1-3 1-3 1-3 >3 1-3 1-3 1-3 1-3 1-3 1-3 1-3 >3 1-3	Cl N N FeOx FeOx FeOx N FeOx FeOx N N N FeOx N	5 3 3 3 3 1,3 3 3 5 3 1 1,3 3 3		
19	11	4		1.52	0	0	0							2 3									

DRAFT

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-07

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
20														3		19.36	B	30	>3	N	1		
																19.42	J	45	1-3	N	3		
														4		19.44	B	30	1-3	Ca	3		
																19.72	B	30	<1	Ca	1		
														6		19.81	J	60	1-3	N	3		
																19.83	J	60	1-3	N	3		
														2		20.04	J	70	<1	N	3		
																20.08	J	70	<1	N	3		
21	12	4		1.52	100	53	86							4		20.09	J	70	<1	N	3		
																20.16	B	30	1-3	N	3		
																20.78	B	30	<1	Ca	3		
														1		20.82	B	30	<1	Ca	3		
																20.84	B	30	<1	Ca	3		
														1		20.91	J	50	<1	N	3		
											@21.74-23.27 m: mudstone beds are up to 30 mm thick.					20.97	J	50	<1	N	6		
22														1		21.02	J	70	<1	N	5		
																21.28	J	70	1-3	Cl	1,3		
														4		21.61	J	70	1-3	Cl	3		
																22	J	50	1-3	N	5		
	13	5		1.52	92	57	81							2		22.18	J	70	<1	N	6		
																22.24	J	70	<1	N	3		
														2		22.34	B	30	<1	Ca	3		
23																22.4	B	30	<1	N	3		
														1		22.47	B	30	>3	Cl	0		
																22.8	J	70	1-3	N	3		
																22.86	B	30	<1	Ca	3		
														3		23.05	J	70	1-3	N	6		
																23.32	J	70	1-3	N	3		
														5		23.34	J	90	>3	Cl	3		
24	14	5		1.52	100	34	58									23.46	J	90	1-3	Cl	1,3		
														3		23.61	J	70	1-3	N	1,3		
																23.63	J	70	<1	N	1		
														6		23.69	J	80	1-3	N	3		
																23.72	J	80	1-3	Cl	1,3		
														6		23.88	J	70	<1	N	1		
											@24.79-26.31 m: predominantly mudstone.					23.93	B	30	<1	N	3		
25														6		24.12	J	60	<1	N	1		
																24.17	B	30	<1	Cl	1		
																25.15	B	30	1-3	N	3		
	15	5		1.52	100	53	70							2		25.17	J	70	<1	N	3		
																	J	80		N			
														1									
26																25.98	J	50	1-3	N	6		
														6									
														1		26.5	B	30	<1	Py	1		
																26.78	B	30	<1	Py	1		
														3		26.82	J	80	1-3	N	1		
27	16	6		1.52	100	66	72									26.83	J	80	1-3	N	1		
														6									
																27.63	J	70	1-3	N	5		
														3		27.82	J	70	1-3	N	5		
28											@27.84-29.36 m: fractures along siltstone bedding are slickensided, fractures preferentially along bedding.					27.84	B	30	<1	Cl	1		
														1		28.13	B	30	1-3	N	0		
														6									
	17	6		1.52	100	55	64							6									
																28.87	J	80	1-3	N	6		
29														1		29.05	B	30	1-3	N	0		
														2		29.15	J	80	1-3	N	6		

CODES: DISCONT. TYPE: J: Joint, S: Shear, B: Bedding, Fol: Foliation

DISCONT. INFILL: N: None, Cl: Clay, Qtz: Quartz, FeOx: Iron, Ca: Calcite, MnOx: Manganese

WEATHERING: F: Fresh, SW: Slightly, MW: Moderately, HW: Highly, CW: Completely, RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled, 1: Smooth, Planar, 3: Slightly Rough, Undulating, 5: Rough Undulating, Stepped, 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1), R1: Very Weak (1-5), R2: Weak (5-25), R3: Medium Strong (25-30), R4: Strong (50-100), R5: Very Strong (100-250), R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-07

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
30	18	6		1.52	93	34	55				@29.36-30.89 m: similar to above, trace pyrite on fracture surfaces, bedding at 30 deg TCA.			6 6 2 6		30.03 30.21	J B	60 30	1-3 <1	Py Py	3 0		
											30.89 1267.56 End of Hole at: 30.9 m			1		30.72	B	30	<1	Py	0		
31																							
32																							
33																							
34																							
35																							
36																							
37																							
38																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

DRAFT

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese
WEATHERING: F: Fresh SW: Slightly MW: Moderately HW: Highly CW: Completely RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

OVERBURDEN DRILLHOLE LOG BG13-09

STARTED: Aug 15, 2013 **FINISHED:** Aug 18, 2013
DRILL METHOD: ODEX/HQ3 Coring
GROUND ELEV. (m): 1251.7
COORDINATES (m): N 6091697 E 631618

Su - kPa: 25 75 125 175 225 | UC/2 P.PEN/2 | WATER1 WATER2 WATER3 | % FINES SPT N LPT N | W_P% W% W_L%: 20 40 60 80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
0					CLAY (CI/CL), silty, some sand, intermediate to low plasticity, brown to dark brown, mc below PL, homogeneous, weak, glacial till matrix. [GLACIAL TILL]	
1	6 6 7 5 6 R	09-SPT-01				
2	10 12 17 20	09-SPT-02			@1.98-2.58 m: Same as previous, with trace-some fine gravel, max size 19mm, subrounded, dark brown.	
		09-Core-01	44%		@2.58 m: coarser gravel, max size 60mm, subrounded-subangular, well graded.	
3					3.0 / 1248.7 GRAVEL (GW-GC), coarse, max size 75 mm, clayey, some sand, some silt, trace cobbles, max size 800 mm, well-graded, subangular to angular, moist, moderate cementation. [GLACIAL TILL]	
		09-Core-02				
4					4.6 / 1247.2 CLAY (CI-CL), silty, some sand, some gravel (fine, max size 11 mm, subangular), intermediate plasticity, dark brown, mc below PL, glacial till matrix. [GLACIAL TILL]	
	7 15 14 13 9	09-SPT-04	100%		@4.9-6.42 m:some fine cobbles, max size 90 mm.	
5		09-Core-03				
6					6.6 / 1245.1 CLAY (CI) and GRAVEL (GC), coarse, subangular, max size 75 mm, some silt, some sand, trace cobbles, intermediate plasticity, dark brown, gravel and cobbles range in colour grey to dark grey to light brown, mc below PL. [GLACIAL TILL]	
7		09-Core-04				
8		09-Core-05				
9					@9.1 m: less gravel, darker in colour, increase in moisture content, increase in clay content.	
					9.6 / 1242.1 CLAY (CL), gravelly, silty, trace sand, intermediate plasticity, well graded gravel, max size 60 mm.	
10					Continued Next Page	

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B4 Pond
LOGGED BY: BO **CHECKED BY:** RP
SHEET 1 **OF** 5 **HOLE NO.:** BG13-09

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-09

STARTED: Aug 15, 2013 **FINISHED:** Aug 18, 2013
DRILL METHOD: ODEX/HQ3 Coring
GROUND ELEV. (m): 1251.7
COORDINATES (m): N 6091697 E 631618

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
× – – – – ▲ – – – – ×
20 40 60 80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT	DETAILS
					subangular, brown to dark brown, grey, orange, mc below PL, very stiff to hard, some iron oxide staining, glacial till matrix.[GLACIAL TILL]		
11					@11.2-12.7 m: higher plasticity clay, larger cobbles, grey to orange in colour.		
12		09-Core-06					
		09-Core-07			@12.7-14.2 m: large cobbles, max size 140 mm.		
13							
14		09-Core-08			@14.3-14.8 m: large boulder, 400 mm diameter, subangular.		
15					@14.8-15.6 m: large boulders and clay layers interbedded, mc below PL, probable sandstone and conglomerate.		
16		09-Core-09					
17		09-Core-10			@17.3-18.3 m: gravel size decreases (<60 mm), trace cobbles, no boulders.		
18							
19		09-Core-11			@18.8-21.8 m: some cobbles, max size 140 mm.		
20					Continued Next Page		

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B4 Pond
LOGGED BY: BO **CHECKED BY:** RP
SHEET 2 **OF** 5 **HOLE NO.:** BG13-09

OVERBURDEN DRILLHOLE LOG BG13-09

STARTED: Aug 15, 2013 **FINISHED:** Aug 18, 2013
DRILL METHOD: ODEX/HQ3 Coring
GROUND ELEV. (m): 1251.7
COORDINATES (m): N 6091697 E 631618

Su - kPa: 25 75 125 175 225 — UC/2 — P.PEN/2
WATER1 WATER2 WATER3
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%: 20 40 60 80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT	DETAILS
21							
22		09-Core-12			@21.8-23.36 m: increase in gravel content, no cobbles or boulders.		
23					@23.4-24.9 m: trace cobbles, max size 90 mm.		
24							
25		09-Core-13					
26					@26.4-27.9 m: increased gravel content, angular, max size 75 mm, well graded.		
27							
28		09-Core-14	32%		Vibrating Wire Piezometer installed at 27.5 m depth (VW25847) - Grouted installation		
29							
30					30.0		

Continued Next Page

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B4 Pond
LOGGED BY: BO **CHECKED BY:** RP
SHEET 3 **OF** 5 **HOLE NO.:** BG13-09

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-09

STARTED: Aug 15, 2013 **FINISHED:** Aug 18, 2013
DRILL METHOD: ODEX/HQ3 Coring
GROUND ELEV. (m): 1251.7
COORDINATES (m): N 6091697 E 631618

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
× – – – – ▲ – – – – ×
20 40 60 80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
					1221.7	
					Bedrock Contact @ 30.0 m, See Rock Log	
31					End of Overburden Drill Log at 30.0 m.	
32						
33						
34						
35						
36						
37						
38						
39						
40						

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B4 Pond
LOGGED BY: BO **CHECKED BY:** RP
SHEET 4 **OF** 5 **HOLE NO.:** BG13-09

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-09

Klohn Crippen Berger

DATE STARTED: August 15, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 5 OF 5
DATE FINISHED: August 18, 2013	LOGGED BY: BO	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 1251.726
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 32.5	COORDINATES (m): E 631618.206 N 6091697.241
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 30	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Ryan Frisk	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	DISCONTINUITY DATA: FRACTURE ZONE	DISCONTINUITY DATA: DISCONT. DEPTH (m)	DISCONTINUITY DATA: DISCONT. TYPE	DISCONTINUITY DATA: ANGLE (From Core Axis)	DISCONTINUITY DATA: APERTURE (<1,1-3,>3mm)	DISCONTINUITY DATA: INFILL TYPE	DISCONTINUITY DATA: JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
31	1	1	20	1	97	0	37	R1	SW		SHALE, some coarse gravel, some coarse sand, black to light grey/brown, FeOx staining, slightly weathered, R1-R2, bedding visible, fractures along bedding planes, planar fractures at end of run disturbed when removed from tube, fine-grained, highly fractured with contact zone 5 cm width.			6		30	B/J	70-90	<1	FeOx			
														6									
														6									
														6									
	2	1	20	1.52	93	0	18							6		31	B/J	70-90	<1	FeOx			
32														6									
								R1-R2	SW		@32 m: some clay infill in joints.			6									
														6									
											32.50 1219.23 End of Hole at: 32.5 m												
33																							
34																							
35																							
36																							
37																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

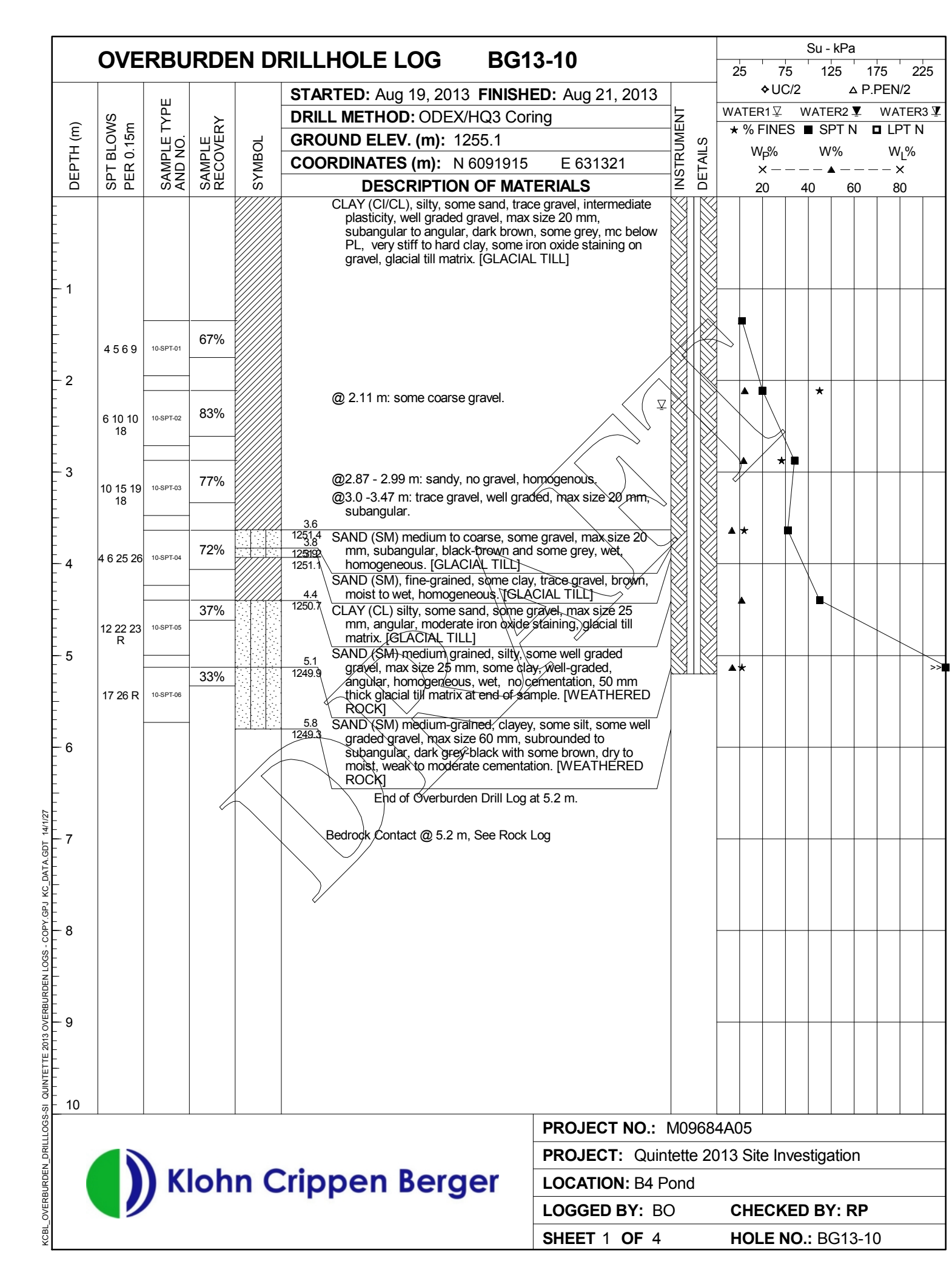
CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 5: Rough Undulating, Stepped 3: Slightly Rough, Undulating 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

OVERBURDEN DRILLHOLE LOG BG13-10

STARTED: Aug 19, 2013 **FINISHED:** Aug 21, 2013
DRILL METHOD: ODEX/HQ3 Coring
GROUND ELEV. (m): 1255.1
COORDINATES (m): N 6091915 E 631321

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
0					CLAY (CI/CL), silty, some sand, trace gravel, intermediate plasticity, well graded gravel, max size 20 mm, subangular to angular, dark brown, some grey, mc below PL, very stiff to hard clay, some iron oxide staining on gravel, glacial till matrix. [GLACIAL TILL]	
1	4 5 6 9	10-SPT-01	67%			
2	6 10 10 18	10-SPT-02	83%		@ 2.11 m: some coarse gravel.	
3	10 15 19 18	10-SPT-03	77%		@2.87 - 2.99 m: sandy, no gravel, homogenous. @3.0 -3.47 m: trace gravel, well graded, max size 20 mm, subangular.	
3.6 (1251.4)					SAND (SM) medium to coarse, some gravel, max size 20 mm, subangular, black-brown and some grey, wet, homogeneous. [GLACIAL TILL]	
3.8 (1251.2)						
4	4 6 25 26	10-SPT-04	72%			
4.1 (1251.1)					SAND (SM), fine-grained, some clay, trace gravel, brown, moist to wet, homogeneous. [GLACIAL TILL]	
4.4 (1250.7)					CLAY (CL) silty, some sand, some gravel, max size 25 mm, angular, moderate iron oxide staining, glacial till matrix. [GLACIAL TILL]	
5	12 22 23 R	10-SPT-05	37%		SAND (SM) medium grained, silty, some well graded gravel, max size 25 mm, some clay, well-graded, angular, homogeneous, wet, no cementation, 50 mm thick glacial till matrix at end of sample. [WEATHERED ROCK]	
5.1 (1249.9)						
5.8 (1249.3)	17 26 R	10-SPT-06	33%		SAND (SM) medium-grained, clayey, some silt, some well graded gravel, max size 60 mm, subrounded to subangular, dark grey-black with some brown, dry to moist, weak to moderate cementation. [WEATHERED ROCK]	
6					End of Overburden Drill Log at 5.2 m.	
7					Bedrock Contact @ 5.2 m, See Rock Log	
8						
9						
10						

Su - kPa
25 75 125 175 225
UC/2 P.PEN/2
WATER1 WATER2 WATER3
% FINES SPT N LPT N
W_P% W% W_L%
20 40 60 80



Klohn Crippen Berger

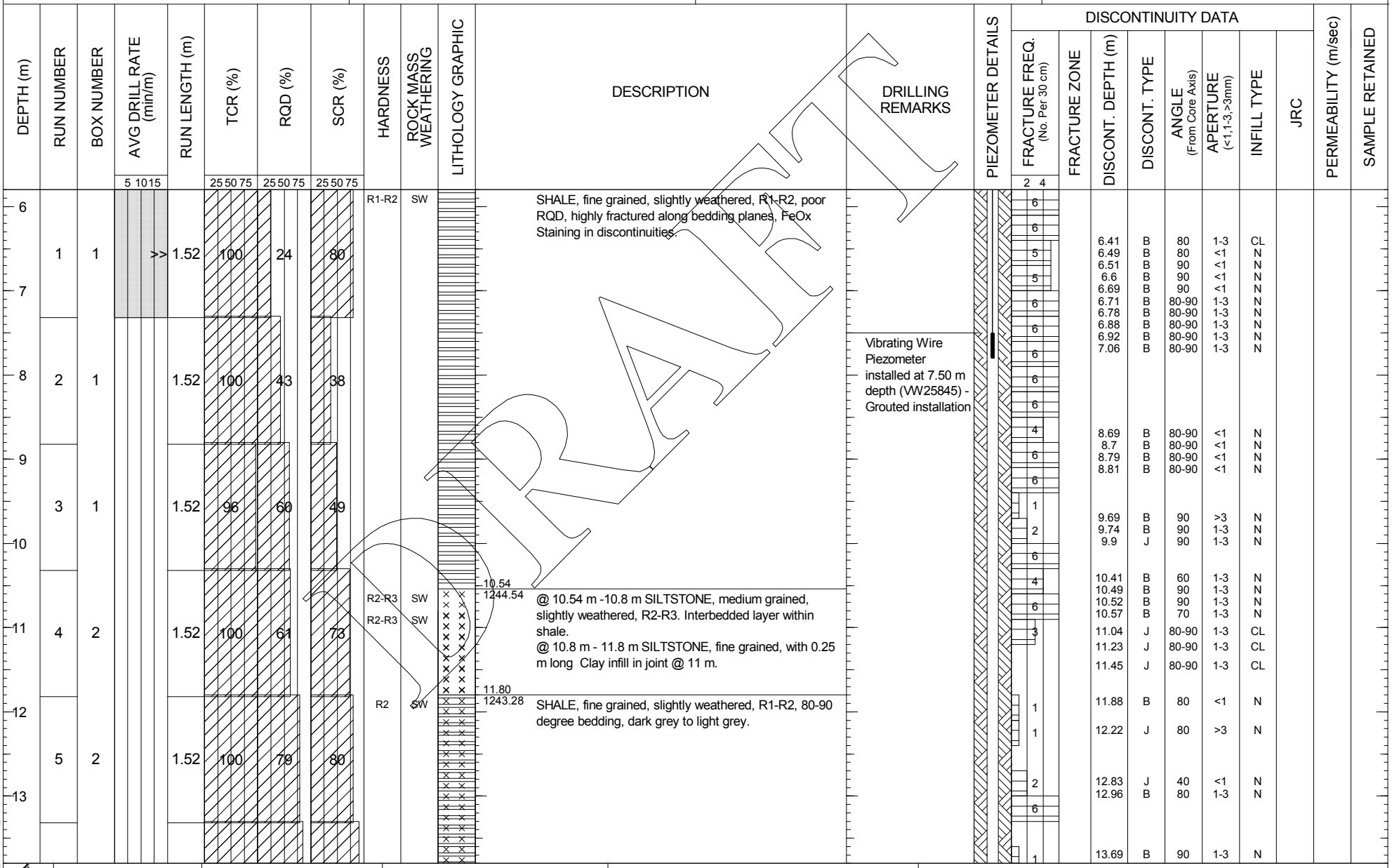
PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B4 Pond
LOGGED BY: BO **CHECKED BY:** RP
SHEET 1 **OF** 4 **HOLE NO.:** BG13-10

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-10

Klohn Crippen Berger

DATE STARTED: August 19, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 2 OF 4
DATE FINISHED: August 21, 2013	LOGGED BY: BO	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 1255.078
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 30.6	COORDINATES (m): E 631321.39 N 6091915.02
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 5.8	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Ryan Frisk	AZIMUTH/ANGLE FROM VERT.: N/A	



KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES: DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation

DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese

WEATHERING: F: Fresh SW: Slightly MW: Moderately HW: Highly CW: Completely RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-10

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m) 5 10 15	RUN LENGTH (m)	TCR (%) 25 50 75	RQD (%) 25 50 75	SCR (%) 25 50 75	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm) 2 4	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
14	6	3		1.52	100	85	91				(continued from previous page)			1		14.04	B	90	1-3	FeOx			
														1		14.26	J	90	1-3	FeOx			
15														3		14.68	J	90	1-3	FeOx			
																14.69	J	90	1-3	FeOx			
	7	3		1.52	100	91	93							2		14.76	J	90	1-3	Ca			
														1		15	B	80	1-3	N			
16																15.39	B	80	1-3	N			
								R2-R3	F-SW		@ 16.3 Fresh, intact rock, R2-R3.			2		15.81	B	80	>3	N			
																15.82	B	80	>3	N			
														2		15.86	B	90	1-3	N			
	8	3		1.52	100	90	97									16.16	B	80	>3	N			
																16.18	B	80	>3	N			
17														1		16.32	B	90	>3	N			
														1		17.2	B	80	<1	N			
																17.4	B	80	<1	N			
18														6									
														6									
														6									
	9	4		1.52	100	35	38							4		18.44	B	80	1-3	N			
																18.46	B	80	>3	N			
																18.48	B	80	>3	N			
19														3		18.54	B	60	1-3	N			
																18.71	J	70	>3	FeOx			
														6		18.77	B	90	>3	FeOx			
																18.93	J	20	>3	FeOx			
								R2-R3			19.30 1235.78 SILTSTONE, fine grained, Fresh-Slightly Weathered, R2-R3, Calcite in discontinuities.			2		19.34	B	90	>3	Ca			
																19.55	B	60	>3	Ca			
														2		19.66	B	90	>3	Ca			
20	10	4		1.52	96	52	60									19.67	B	90	>3	Ca			
																19.93	B	90	>3	N			
														2		19.94	B	90	>3	N			
																20.22	B	90	>3	N			
														4		20.23	B	60	>3	N			
																20.41	B	70	>3	N			
21																20.82	B	90	>3	N			
														3		20.83	B	90	>3	N			
																21.19	B	90	1-3	CL			
														2		21.3	B	90	1-3	CL			
	11	4		1.52	100	60	61									21.52	J	60	1-3	Ca			
														3		21.56	J	80	1-3	Ca			
																21.65	B	90	1-3	Ca			
22														1		21.9	J	70	>3	N			
														1		22.2	J	70	>3	N			
																22.35	B	90	>3	Ca			
														3		22.39	B	80	>3	Ca			
																22.6	B	80	1-3	Ca			
														2		22.71	B	90	1-3	FeOx			
23	12	5		1.52	100	60	70									22.76	B	90	1-3	FeOx			
														2		23.04	B	70	1-3	N			
																23.13	B	70	1-3	N			

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese
WEATHERING: F: Fresh SW: Slightly MW: Moderately HW: Highly CW: Completely RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-10

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
24														6									
														6									
														1		23.99	B	90	1-3	N			
														1		24.3	B	90	>3	CL			
	13	5		1.52	100	86	90							1		24.51	B	80	>3	N			
25														1		24.78	B/J	60	1-3	N			
														3		25.02	B	70	>3	FeOx			
																25.08	B	70	>3	FeOx			
																25.17	B	80	>3	FeOx			
26																							
														2		26.21	B	80	>3	N			
																26.39	B	80	>3	N			
														3		26.47	B	80	>3	CL			
																26.49	J	40	>3	CL			
27	14	5		1.52	100	58	69							3		26.59	B	90	1-3	CL			
																26.86	B	80	1-3	N			
																26.94	B	80	1-3	N			
														2		27	B	80	>3	N			
																27.18	B	80	1-3	N			
								R3			27.60 @ 27.4 m, highly fractured zone.			6		27.3	B	80	1-3	N			
								R3			1227.48 SHALE, fine grained, fresh, highly fractured along												
28											bedding planes, fragmented rock within discontinuities.			6									
														6									
	15	6		1.52	99	16	20							6									
														6									
29														1									
																29.14	B	90	1-3	N			
														4		29.25	B	80	1-3	N			
																29.35	B	70	1-3	N			
														2		29.4	J	40	1-3	N			
																29.52	J	40	1-3	N			
30	16	6		1.52	100	89	85									29.56	J	40	1-3	CL			
																30.03	B	90	>3	N			
														3		30.06	B	90	>3	N			
											30.60 1224.48 End of Hole at: 30.6 m													
31																							
32																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

OVERBURDEN DRILLHOLE LOG BG13-11

STARTED: Aug 22, 2013 **FINISHED:** Aug 24, 2013
DRILL METHOD: ODEX/HQ3 Coring
GROUND ELEV. (m): 1246.9
COORDINATES (m): N 6091508 E 631851

Su - kPa: 25 75 125 175 225 | UC/2 P.PEN/2 | WATER1 WATER2 WATER3 | % FINES SPT N LPT N | W_P% W% W_L% | 20 40 60 80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
			25%		Drill pad, clay and silt, some sand, dark brown, dry to moist, homogeneous.	
	R	11-SPT-01				
					0.8 / 1246.1 CLAY (CI), silty, some sand, some gap graded gravel, max size 30 mm, angular, intermediate plasticity, mc below PL, glacial till matrix. [GLACIAL TILL]	
1	5 6 9 R	11-SPT-02	67%			
			47%		@1.52 -2.1 m: gravel, max size 30 mm, well-graded, subangular to angular, minor iron oxide staining.	
	8 9 18 13	11-SPT-03				
2						
3					3.0 / 1243.8 CLAY (CI), silty, gravelly, well graded, max size 45 mm, subrounded to subangular, grey-light grey, dry, weak, glacial till matrix. [GLACIAL TILL]	
	9 13 17 15	11-SPT-04	63%			
			72%		@3.75-4.35 m: increased silt and some sand.	
4	10 19 17 21	11-SPT-05				
					4.6 / 1242.3 CLAY (CI), silty, gravelly, max size 40 mm, sandy (coarse, wet, angular to subangular), intermediate to high plasticity, moist to wet. Refusal on SPT's due to high gravel content. [GLACIAL TILL]	
			38%		Switch to soil coring at 4.6 m	
	17 38 R	11-SPT-06				
5		11-Core-01			5.4 / 1241.4 Slough from hole, saturated clay, silt and sand.	
		11-Core-02			@ 5.43 m: increased gravel content and some smaller cobbles, max size 75mm, subangular.	
6						
					7.0 / 1239.9 SAND (SM) medium to coarse, some silt, some clay, trace to no gravel (max size 5mm), poorly graded, subangular, dark brown and black, wet, homogenous. [GLACIAL TILL]	
7		11-Core-03				
		11-Core-04				
8						
					8.5 / 1238.4 SAND and SILT (SM), fine grained, poorly graded, dark brown, saturated, homogeneous, weak cementation, coal present. Sand Layer	
		11-Core-05A			8.9 / 1238.0 SAND (SM) medium to coarse, some silt, some clay, trace to no gravel (max size 5mm), poorly graded, subangular, dark brown and black, wet, homogenous. [GLACIAL TILL]	
9		11-Core-05B				
10					10.0 Continued Next Page	

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B4 Pond
LOGGED BY: BO **CHECKED BY: RP**
SHEET 1 **OF** 5 **HOLE NO.:** BG13-11

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-11

STARTED: Aug 22, 2013 **FINISHED:** Aug 24, 2013
DRILL METHOD: ODEX/HQ3 Coring
GROUND ELEV. (m): 1246.9
COORDINATES (m): N 6091508 E 631851

Su - kPa: 25 75 125 175 225 | UC/2 P.PEN/2 | WATER1 WATER2 WATER3 | % FINES SPT N LPT N | W_P% W% W_L% | 20 40 60 80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
		11-Core-06			1236.9 SAND and SILT (SM), fine grained, poorly graded, dark brown, saturated, homogeneous, weak cementation, coal present. Sand Layer	
					10.3 1236.6 @10.3 Large boulder, 160 mm. CLAY (CI/CL) and SAND (SM), silty, gravelly, some cobbles, low to intermediate plasticity clay, dark brown, mc below PL, homogenous sand, glacial till matrix. [GLACIAL TILL]	
11		11-Core-07				
12						
13		11-Core-08			@13.0 m: increasing sand content.	
14						
15		11-Core-09			@14.67-14.77 m Coarse sand layer, poorly graded, wet, trace to no cementation	
16					16.1 1230.8 SAND(SM), medium to coarse grained, well graded, some clay some silt, trace to no gravel, brown to dark brown, some grey and black, subangular.	
		11-Core-10A			16.6 1230.3 CLAY (CI/CL) and SAND (SM), silty, gravelly, some cobbles, low to intermediate plasticity clay, dark brown, mc below PL, homogenous sand, glacial till matrix. [GLACIAL TILL]	
17		11-Core-10B				
		11-Core-11A			17.6 1229.3 SAND (SM), fine to medium grained, poorly graded, wet, no cementation.	
18		11-Core-11B			17.9 1229.0 CLAY (CI/CL) and SAND (SM), silty, gravelly, some cobbles, low to intermediate plasticity clay, dark brown, mc below PL, homogenous sand, glacial till matrix. [GLACIAL TILL] @ 18 m: increasing sand content.	
19		11-Core-12				
20					Continued Next Page	

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B4 Pond
LOGGED BY: BO **CHECKED BY:** RP
SHEET 2 **OF** 5 **HOLE NO.:** BG13-11

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-11

STARTED: Aug 22, 2013 **FINISHED:** Aug 24, 2013
DRILL METHOD: ODEX/HQ3 Coring
GROUND ELEV. (m): 1246.9
COORDINATES (m): N 6091508 E 631851

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
× — — — ▲ — — — ×
20 40 60 80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT	DETAILS
21		11-Core-13			20.8 1226.1 SAND (SM), fine to medium grained, poorly graded, wet, no cementation. 1225.9 CLAY (CI/CL) and SAND (SM), silty, gravelly, coarse grained, some cobbles, max size 300 mm, low to intermediate plasticity clay, dark brown, mc below PL, homogenous sand, glacial till matrix. [GLACIAL TILL]		
22							
23		11-Core-14					
24							
25					@22.2 -25.5 m Gravel (washed clean), 40 mm, subangular.		
26							
27		11-Core-16					
28							
29							
30					Continued Next Page		

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B4 Pond
LOGGED BY: BO **CHECKED BY: RP**
SHEET 3 **OF** 5 **HOLE NO.:** BG13-11

OVERBURDEN DRILLHOLE LOG BG13-11

STARTED: Aug 22, 2013 **FINISHED:** Aug 24, 2013
DRILL METHOD: ODEX/HQ3 Coring
GROUND ELEV. (m): 1246.9
COORDINATES (m): N 6091508 E 631851

Su - kPa: 25 75 125 175 225 — UC/2 — P.PEN/2
WATER1 WATER2 WATER3
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
20 40 60 80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
31					Vibrating Wire Piezometer installed at 30.75 m depth (VW25844) - Grouted installation	
					31.3 / 1215.6	
		11-Core-17			SAND (SM), coarse, poorly graded, dark brown, with black, grey and orange, wet, no cementation.	
					31.5 / 1215.4	
32					CLAY (CI/CL) and SAND (SM), silty, gravelly, coarse grained, some cobbles, low to intermediate plasticity clay, dark brown, mc below PL, homogenous sand, glacial till matrix. [GLACIAL TILL]	
33						
					33.8 / 1213.1	
34					Bedrock Contact @ 33.75 m, See Rock Log	
35					End of Overburden Drill Log at 33.8 m.	
36						
37						
38						
39						
40						

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B4 Pond
LOGGED BY: BO **CHECKED BY:** RP
SHEET 4 **OF** 5 **HOLE NO.:** BG13-11

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-11

Klohn Crippen Berger

DATE STARTED: August 22, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 5 OF 5
DATE FINISHED: August 24, 2013	LOGGED BY: BO	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 1246.869
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 37.4	COORDINATES (m): E 631851.08 N 6091508.33
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 33.75	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Ryan Frisk	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
34	1	1		0.65	100	17	78	R0-R1	MW		SHALE, very fine grained, slightly-moderately weathered, R0-R1, dark grey to black, 80-90 degree bedding planes. Significant FeOx staining in discontinuities.			6		34.13	B	80-90	1-3	FeOx			
														4		34.27	B	80-90	1-3	FeOx			
35	2	1		1.52	100	0	39							6		34.33	B	80-90	<1	FeOx			
								R1-R2	SW		@35.5 m: R1-R2. Increase in rock strength near end of run.			6		34.34	B	80-90	1-3	FeOx			
36														6									
	3	1		1.52	100	0	26							6									
37														6									
											37.40 / 1209.47 End of Hole at: 37.4 m			6									
38																							
39																							
40																							
41																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

OVERBURDEN DRILLHOLE LOG BG13-12

STARTED: Aug 25, 2013 **FINISHED:** Aug 27, 2013
DRILL METHOD: 4.5 ODEX
GROUND ELEV. (m): 1117.6
COORDINATES (m): N 6092577 E 626988

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	DESCRIPTION OF MATERIALS
	4 3 11 11	12-SPT-01	67%	SILT and CLAY (ML - CL), some sand, fine grained, non-plastic, light brown, dry to moist, weak cementation, homogenous.
0.8 / 1116.8				
1	9 8 9 9	12-SPT-02	53%	SILT and CLAY (ML - CL), some sand, some well graded gravel, max size 40mm, subrounded to subangular, dry.
				@1.52 increasing clay content.
	7 7 5 6	12-SPT-03	43%	
2				
2.3 / 1115.3				
	12 8 11 18	12-SPT-04	58%	CLAY (CI), silty, some sand, some gravel, intermediate to low plasticity, light brown, dark grey and black, mc below PL, clay matrix. [GLACIAL TILL]
2.5 / 1115.2				
3				CLAY and SILT (CL) gravelly, coarse grained, well graded, max size 40mm, some sand, light grey, black, dry, iron oxide staining, no cementation. [GLACIAL TILL]
3.1 / 1114.5	8 19 33 8	12-SPT-05	42%	CLAY (CI), gravelly, coarse, well graded, max size 40 mm, subangular, some sand, dark brown to light grey, no cementation, moist to wet, iron oxide staining, glacial till matrix. [GLACIAL TILL]
4	14 36 R	12-SPT-06	90%	
4.6 / 1113.0				
5	25 38 32 R	12-SPT-07	80%	CLAY (CI), sandy, some gravel, fine grained, intermediate plasticity, dark brown and grey, mc below PL, very stiff to hard, moderate cementation, some iron oxide staining. [GLACIAL TILL]
				@5.0 - 5.2 m saturated soil from aquifer
6	9 12 20 23	12-Spt-08	75%	
6.7 / 1110.9				
7		12-Odex-01		SILT and SAND (ML), some gravel, well graded, max size 15 mm, subrounded, some clay, grey to light grey, dry, no cementation, no structure. [WEATHERED BEDROCK]
7.5 / 1110.1				
8				Bedrock Contact @ 7.5 m, See Rock Log
9				End of Overburden Drill Log at 7.5 m.
10				

INSTRUMENT DETAILS

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

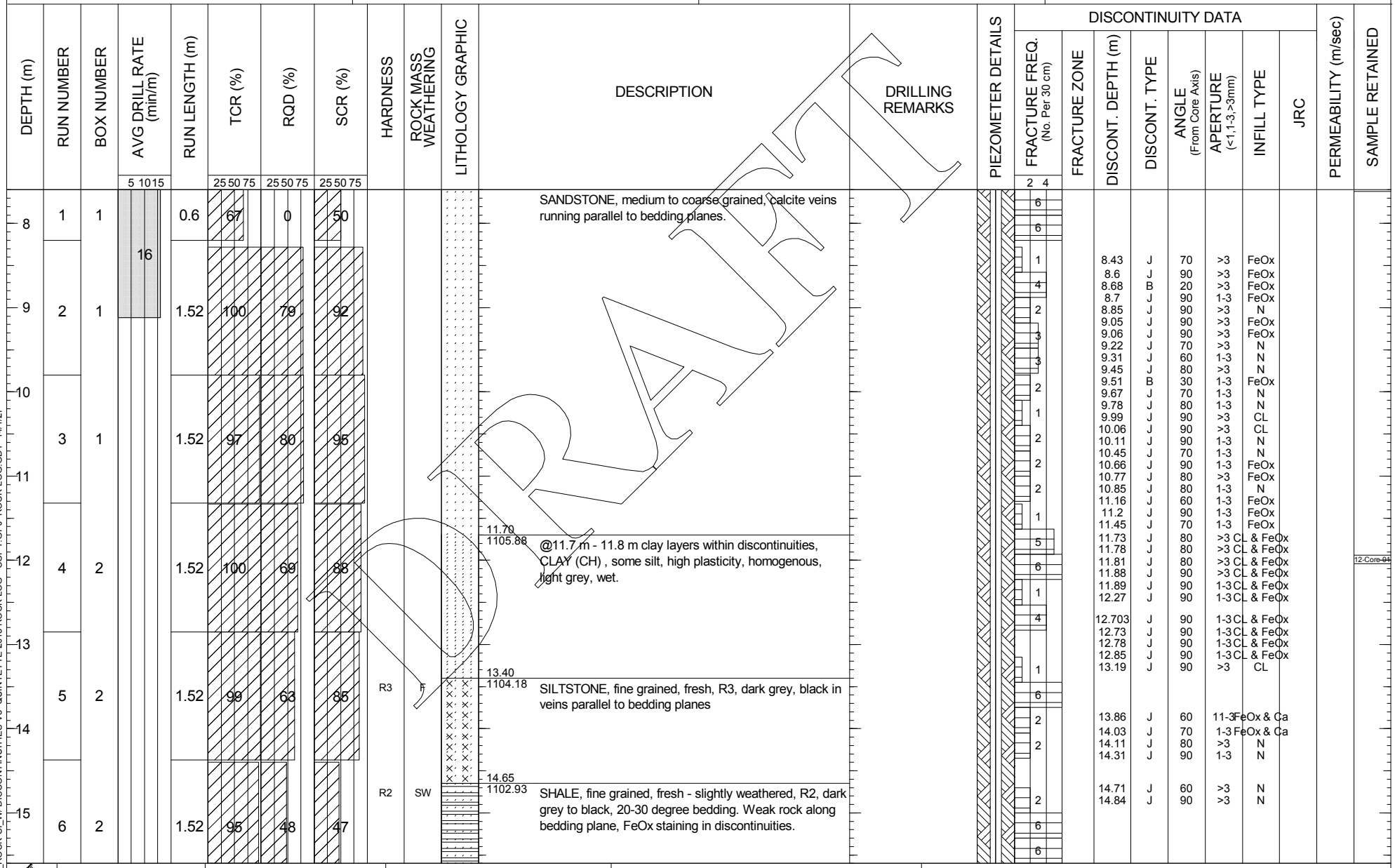
PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B3.1 Pipeline
LOGGED BY: BO **CHECKED BY: RP**
SHEET 1 **OF** 4 **HOLE NO.:** BG13-12

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-12

Klohn Crippen Berger

DATE STARTED: August 25, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 2 OF 4
DATE FINISHED: August 27, 2013	LOGGED BY: BO	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 1117.582
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 25.1	COORDINATES (m): E 626988.06 N 6092576.851
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 7.6	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Norm Dillabough	AZIMUTH/ANGLE FROM VERT.: N/A	



KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES: DRAFT

DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation

DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese

WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-12

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
16														6									
														6									
														6									
	7	3		1.52	98	54	75				@16.5 m clay layer is fracture. CLAY (CH) some silt, high plasticity, homogeneous, dark brown to black, wet.			2		16.51	J	80	1-3	CL			
																16.73	J	70	1-3	CL			
17														6									
														6									
																17.43	J	70	>3	Ca			
														4		17.44	J	70	>3	Ca			
																17.58	J	70	1-3	Ca			
																17.68	J	70	1-3	Ca			
18																18.05	B	30	1-3	Weathered rock			
	8	3		1.52	100	93	83				@18 -18.6 m, Transition zone of alternating layers of interbedded shale and sandstone.			3		18.25	J	70	1-3	Weathered rock			
																18.27	J	70	1-3	Weathered rock			
											18.60			6									
								R3-R4	F		1098.98 SANDSTONE, fine to medium grained, slightly weathered, R3-R4, light grey, 30 degree bedding.			2		18.77	J	70	<1	Ca			
																18.87	J	60	<1	Ca			
19																18.92	B	30	>3	Ca			
	9	3		1.52	86	35	38				@19.15 m finer grained sandstone. Interbedded with shale layers and white Calcite veins.			6									
											@19.7 m highly fractured zone, with clay in fractures.			6									
														6									
20														3		19.91	B	20	>3	CL			
																20.07	B	20	>3	CL			
												Vibrating Wire Piezometer installed at 20.0 m depth (VW25860)				20.15	B	20	>3	CL			
											20.47					20.47	J	80	<1	N			
								R4	F		1097.11 SANDSTONE, fine to medium grained, fresh, R4, light grey and white, 20-30 degree bedding planes, calcite veins.			1									
21																21.03	J	80	<1	N			
	10	4		1.52	100	82	91							3		21.33	J	80	1-3	N			
																21.34	B	80	<1	N			
														2		21.57	B	30	<1	Ca			
																21.58	B	30	1-3	Ca			
22														3		21.79	J	80	1-3	Ca			
																21.85	J	60	1-3	Ca			
									SW		@22.15 m - 22. 30 clay layer. CLAY (CH) , some silt, high plasticity, homogenous, light grey, wet.			6		21.89	J	60	>3	Ca			
																22.35	J	80	1-3	CL & Ca			
	11	4		1.52	100	61	68							5		22.43	J	90	>3	CL & Ca			
																22.45	B	20	>3	CL & Ca			
																22.51	B	30	1-3	CL & Ca			
23														2		23.1	B	30	<1	CL & Ca			
																23.17	J	60	>3	CL & Ca			
								R0-R1	HW		23.40 @23.2 moderately to highly weathered section (R0-R1). Very fine sand in fractures.			6									
								R2-R3	SW		1094.18 @23.5 R2-R3 to end of hole.												
24														3		24.06	J	80	<1	FeOx & Ca			
														1		24.08	J	80	<1	FeOx & Ca			
	12	5		1.52	100	97	95									24.1	J	80	<1	FeOx & Ca			
														2		24.22	B	60	1-3	FeOx			
																24.42	B	50	>3	CL			
														1		24.54	B	30	>3	CL			
25																24.87	B	50	1-3	FeOx			
								R3-R4	SW		25.00 1092.58 SANDSTONE, fine grained, slightly weathered, R3-R4,												

DRAFT

CODES:
DISCONT. TYPE: J: Joint, B: Bedding, S: Shear, Fol: Foliation
DISCONT. INFILL: N: None, Cl: Clay, Qtz: Quartz, FeOx: Iron, Ca: Calcite, MnOx: Manganese
WEATHERING: F: Fresh, SW: Slightly, MW: Moderately, HW: Highly, CW: Completely, RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled, 1: Smooth, Planar, 3: Slightly Rough, Undulating, 5: Rough Undulating, Stepped, 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1), R1: Very Weak (1-5), R2: Weak (5-25), R3: Medium Strong (25-30), R4: Strong (50-100), R5: Very Strong (100-250), R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

Klohn Crippen Berger

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-12

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	DISCONTINUITY DATA: FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	DISCONT. ANGLE (From Core Axis)	DISCONT. APERTURE (<1,1-3,>3mm)	DISCONT. INFILL TYPE	DISCONT. JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
											light grey, 30 degree bedding, some FeOx staining in discontinuities												
											End of Hole at: 25.1 m												
26																							
27																							
28																							
29																							
30																							
31																							
32																							
33																							
34																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

OVERBURDEN DRILLHOLE LOG BG13-13

STARTED: Aug 28, 2013 **FINISHED:** Aug 29, 2013
DRILL METHOD: 4.5 ODEX
GROUND ELEV. (m): 1133.8
COORDINATES (m): N 6092448 E 626942

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
0	5 4 6 4	13-SPT-01	50%		CLAY and SILT (CI), some sand, some gravel, well graded, max size 20 mm, subangular, low plasticity, light brown to dark brown, black and orange staining, mc below PL, very soft. [GLACIAL TILL]	
1.5 (1132.3)	3 3 3 4	13-SPT-02	55%		CLAY (CI/CL) and silt, sandy, some gravel well graded, max size 40 mm, subrounded-subangular), intermediate plasticity, brown, black and orange, mc below PL, moderate cementation. [GLACIAL TILL]	
3.0 (1130.8)	20 R	13-SPT-03	67%		GRAVEL (GW), silty, some clay, trace sand, well graded, max size 40 mm, angular, bedding structure, completely weathered rock. [Weathered Bedrock]	
4.6 (1129.2)	R	13-SPT-04	8%		Bedrock Contact @ 4.57 m, See Rock Log End of Overburden Drill Log at 4.6 m.	

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B3.1 Pipeline
LOGGED BY: JW **CHECKED BY:** RP
SHEET 1 **OF** 4 **HOLE NO.:** BG13-13

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-13

Klohn Crippen Berger

DATE STARTED: August 28, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 2 OF 4
DATE FINISHED: August 29, 2013	LOGGED BY: JW	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 1133.799
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 29.7	COORDINATES (m): E 626942.29 N 6092448.329
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 4.57	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Norm Dillabough	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
5	1	1		0.7	100	20	29	R0-R1	MW		SHALE, fine grained, SW-MW, R0-R1, very weak, highly fractured along 50 degree bedding planes. Clay and FeOx staining in discontinuities.			6									13-SPT-04
								R1	SW		@5.3 m slightly weathered.			6		5.33	B	50	>3	FeOx			
														4		5.42	J	70	1-3	FeOx			
																5.48	J	80	1-3	FeOx			
6	2	1		1.52	100	35	75							3		5.51	B	50	<1	CL			
																5.7	J	90	>3	CL			
														2		5.85	J	90	>3	CL			
																5.88	B	50	>3	CL			
														2		6.1	B	50	1-3	CL			
																6.17	B	50	1-3	CL			
																6.26	B	50	<1	CL			
								R1-R2	SW		6.80			6		6.44	B	50	<1	CL			
								R1-R2	F		1127.00 @6.7 m interbedded sandstone w/ calcite veins.												
7											SANDSTONE, fine grained, slightly weathered to fresh, R1-R2, bedding at 50-60 degrees, calcite veins perpendicular to bedding.			6									
														6									
	3	1		1.52	100	59	67							2		7.53	B	60	<1	CL			
																7.66	B	60	<1	CL			
8																							
														4		8.13	J	60	>3	CL			
																8.14	B	70	>3	CL			
																8.15	J	20	>3	CL	0		
											@ 8.5 - 8.6 m Clay infill (CLAY (CH), high plasticity, mc at PL).			3		8.3	B	50	>3	CL	0		13-Core-01
																8.46	B	70	>3	CL	0		
														4		8.52	J	90	1-3	CL	3		
9																8.64	J	90	1-3	CL	3		
	4	2		1.52	100	70	79									8.73	B	70	1-3	FeOx	3		
																8.81	B	70	<1	FeOx	3		
																8.89	J	90	>3	FeOx			
																8.96	J	90	1-3	FeOx			
10																							
																9.92	J	80	1-3	FeOx	3		
														4		10.1	B	60	>3	Ca	6		
																10.16	B	60	>3	Ca	6		
														4		10.18	B	60	>3	Ca	6		
																10.25	J	80	>3	Ca	6		
	5	2		1.52	100	48	80							2		10.32	J	80	1-3	Ca	6		
																10.37	B	60	<1	Ca	6		
11											@ 10.66 m Slickensided Joint.			6		10.47	B	60	<1	Ca	6		
											@ 11.06 m Slickensided Joint.					10.66	B	70	1-3	Ca	3		
														6		10.72	B	70	<1	Ca	0		
														1		11.51	B	70	>3	N	0		
																11.7	B	70	>3	Ca	3		
12														2		11.88	J	70	<1	Ca	3		
	6	2		1.52	100	91	82							2		12.18	B	80	1-3	Ca	3		
																12.2	J	70	<1	Ca	3		
								R3	F		12.30 1121.50 SHALE, fresh, R3, Dark Grey, interbedded with			3		12.4	B	60	1-3	CL	3		

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-13

Klohn Crippen Berger

(continued from previous page)

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
13											Sandstone, medium grey. Trace Calcite in Joints.					12.42	B	60	1-3	CL	3		
														1		12.57	B	60	1-3	N	0		
																12.83	J	60	1-3	CL	0		
														2		12.95	B	90	>3	CL	0		
																13.04	B	60	>3	CL	6		
														2		13.24	B	60	<1	N	0		
																13.27	B	60	1-3	N	0		
	7	3		1.52	100	76	93	R3-R4	F		@ 13.5 m - 13.9 m: Clay infill (CLAY (CH), high plasticity, brownish grey, Mc~PL).			3		13.53	B	60	1-3	N	0		13-Core-02
																13.62	B	60	<1	N	0		
14														2		13.76	B	60	<1	N	0		
																13.88	B	60	<1	N	3		
																14	B	60	<1	N	1		
														6									
									F		@ 14.46 m - 14.64 m highly fractured zone.			6									
15														6									
	8	3		1.52	100	52	65							6									
														5		15.45	J	80-90	1-3	N	0		
																15.46	B	60	1-3	N	0		
														6		15.51	B	60	1-3	N	0		
																15.56	B	60	1-3	N	0		
16																15.63	B	60	1-3	N	0		
														2		16.09	B	75	1-3	N	1		
																16.21	B	70	>3	N	1		
														2		16.35	B	70	1-3	N	0		
																16.42	B	70	1-3	N	0		
	9	3		1.52	100	66	84							3		16.6	B	70	<1	N	0		
																16.7	B	70	<1	N	0		
17														4		16.86	B	70	<1	N	0		
																16.94	B	70	<1	N	0		
														6		16.99	B	70	<1	N	0		
																17.04	B	70	<1	N	0		
									SW		@ 17.5 m Slightly weathered.					17.12	J	90	<1	Ca	3		
														2		17.71	B	70	>3	FeOx	3		
18														6		17.76	B	70	1-3	FeOx & Ca	3		
																18.2	B	50	1-3	FeOx	6		
														2		18.21	J	30	>3	FeOx	6		
																18.5	B	60	1-3	FeOx	3		
	10	4		1.52	100	61	54							3		18.52	J	80	>3	Ca	1		
																18.63	B	60	<1	N	3		
19														5		18.7	B	60	1-3	N	1		
																18.8	B	60	<1	Ca	1		
														4		18.86	B	60	<1	Ca	1		
																18.91	J	80	>3	Ca	3		
														4		19.1	J	80-90	>3	N	3		
	11	4		1.52	100	45	71									19.13	B	60	1-3	N	1		
														6		19.18	B	60	1-3	CL	3		
20																19.25	J	60	1-3	Ca	3		
														2		19.36	B	60	>3	FeOx	3		
																19.46	J	20	>3	N	1		
														6		19.51	B	60	1-3	FeOx	6		
																19.57	B	60	>3	FeOx	3		
																19.96	B	60	<1	FeOx	0		
														2		20.03	J	60	<1	FeOx	0		
21																20.7	J	90	<1	FeOx	0		
														1		20.86	B	70	1-3	N	3		
	12	4		1.52	100	55	78				@ 21 m: Calcite Veins.					21.03	B	70	<1	N	1		
														4		21.2	B	60	1-3	N	1		
																21.31	B	60	1-3	N	3		
														5		21.32	B	60	1-3	N	3		
																21.39	B	60	<1	Ca	3		
22														6		21.47	B	65	<1	N	0		
																21.5	B	65	<1	N	0		

CODES: DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation

DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese

WEATHERING: F: Fresh SW: Slightly MW: Moderately HW: Highly CW: Completely RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-13

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	DISCONTINUITY DATA: FRACTURE ZONE	DISCONTINUITY DATA: DISCONT. DEPTH (m)	DISCONTINUITY DATA: DISCONT. TYPE	DISCONTINUITY DATA: ANGLE (From Core Axis)	DISCONTINUITY DATA: APERTURE (<1,1-3,>3mm)	DISCONTINUITY DATA: INFILL TYPE	DISCONTINUITY DATA: JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
23	13	5		1.52	100	51	69							3		21.61	B	65	<1	N	0		
														2		21.68	B	65	<1	N	0		
														3		21.74	B	65	<1	Ca	1		
														5		22.13	B	60	1-3	N	0		
														6		22.21	B	60	1-3	N	1		
														1		22.27	B	60	1-3	N	1		
24	14	5		1.52	100	70	86							6		22.43	B	60	<1	N	1		
														6		22.65	B	60	<1	N	3		
														2		22.85	B	60	<1	N	3		
														3		22.93	B	60	<1	N	1		
25	15	6		1.52	98	46	66							6		22.97	B	60	<1	N	1		
														4		22.99	B	60	<1	N	1		
														2		23.05	B	60	<1	N	1		
														6		23.1	B	60	<1	N	1		
26	16	6		1.52	100	42	56							6		23.12	B	60	<1	N	1		
														4		23.27	B	60	<1	N	1		
														3		23.85	B	65	1-3	N	1		
														1		23.92	J	80	1-3	N	3		
27														6		24	B	60	1-3	N	1		
														6		24.08	B	60	1-3	N	1		
														6		24.14	B	60	1-3	N	1		
														6		24.15	B	60	1-3	N	1		
														3		24.57	B	60	1-3	N	1		
														3		24.7	B	60	1-3	N	3		
														4		24.86	B	60	1-3	N	3		
														4		25	B	60	1-3	N	3		
														4		25.07	J	80	>3	N	3		
														4		25.74	B	60	1-3	Fe	6		
														4		25.77	B	60	1-3	Ca	3		
														4		25.94	J	60	>3	CL	3		
														4		26.01	B	85	>3	CL	3		
														4		26.06	J	85	>3	CL	6		
														4		26.12	B	60	<1	CL	6		
														4		26.76	B	60	>3	CL	1		
														4		26.8	B	60	1-3	N	1		
														4		26.84	B	60	1-3	N	1		
														4		26.98	B	60	1-3	N	1		
														4		27.06	J	80	1-3	N	1		
														4		27.08	B	60	>3	N	6		
														4		27.36	J	85	1-3	N	3		
														4						N	6		
28														4						FeOx			
												Vibrating Wire Piezometer installed at 28.0 m depth (VW25863) - Grouted installation		4									
														4									
														4									
														4		28.52	B	60	>3	FeOx	3		
														4		28.68	B	60	1-3	FeOx	3		
														4		28.75	B	60	1-3	FeOx	3		
29	17	7		1.52	100	43	61							4		28.87	B	60	1-3	FeOx	3		
														4		28.95	B	60	1-3	FeOx	3		
														4		28.98	B	60	1-3	FeOx	3		
														4		29.04	B	60	1-3	FeOx	3		
														4		29.11	J	70	>3	Ca	6		
											29.70			4		29.26	B	60	>3	Ca	6		
											1104.10 End of Hole at: 29.7 m					29.36	J	70	1-3	Ca	6		
30																29.47	B	60	>3	Ca	6		
																29.54	B	70	1-3	Ca	6		
																29.58	B	70	1-3	Ca	6		
31																29.68	B	70	1-3	Ca	6		

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-14

STARTED: Aug 30, 2013 **FINISHED:** Sept 01, 2013
DRILL METHOD: ODEX/HQ3 Coring
GROUND ELEV. (m): 1120.2
COORDINATES (m): N 6091807 E 626505

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
					Fill/disturbed drill pad material	
					0.3	
	4 5 6	14-SPT-01	73%		1119.9 CLAY (CI), gravelly, max size 40 mm, subrounded to subangular, brown, trace sand, intermediate plasticity, firm to stiff, grey to brown, mc below PL, glacial till matrix, Iron Oxide present on gravel. [GLACIAL TILL]	
					1.8	
	2 4 8	14-SPT-02	82%		1118.3 CLAY (CI), some silt, intermediate plasticity, grey-brown, Mc<Pl, firm, homogeneous. [GLACIAL TILL]	
					3.4	
	17 23 R	14-LPT-02	78%		1116.8 CLAY (CI), gravelly, some sand, intermediate to high plasticity, stiff, grey to brown, mc below PL, glacial till matrix. [GLACIAL TILL]	
					4.9	
	8 9 14 28	14-SPT-03	32%		1115.3 CLAY (CI), gravelly, fine to coarse, max size 30 mm, angular to subangular, some silt, trace fine grained sand, dark grey to brown, glacial till matrix. [GLACIAL TILL]	
					6.4	
					1113.8 CLAY (CI), gravelly, fine to coarse grained, max size 20mm, subangular, some medium grained sand, intermediate plasticity, grey, mc at PL, glacial till matrix. [GLACIAL TILL] Vibrating Wire Piezometer installed at 6.9 m depth (VW25857) - Grouted installation	
		14-Core-01			7.9	
					1112.2 @ 7.93 m: GRAVEL (GP), fine to coarse grained, mixed lithology, oxide staining. [Weathered bedrock].	
					Bedrock Contact @ 7.93 m, See Rock Log	
					End of Overburden Drill Log at 7.9 m.	

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B3.1 Pond
LOGGED BY: JW **CHECKED BY: RP**
SHEET 1 **OF** 6 **HOLE NO.:** BG13-14

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-14

Klohn Crippen Berger

DATE STARTED: August 30, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 2 OF 6
DATE FINISHED: September 01, 2013	LOGGED BY: JW	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 1120.174
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 50.63	COORDINATES (m): E 626505.174 N 6091806.73
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 7.93	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Norm Dillabough	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
8								R1	HW		CONGLOMERATE (CG) sandstone matrix, highly weathered and fractured, light to dark grey, R1, FeOx staining in joints, no bedding apparent.			6									
9	2	1		1.52	54	0	0				@ 8.59 m : Coal Seam, friable, black. @ 8.75 - 9.45 m : Core Loss.			6									
											@ 9.15 m - 9.40 m: Rubble Zone.			6									
10	3	1		1.52	99	49	43				@ 9.67 -10.67 m: 10mm Coal Seam. @ 10.19 m: Sandstone Matrix, Bedding at 20 degrees TCA. @ 10.55 m : Coal Seam, fractured along bedding.			6 3 6 1 1		9.78 9.91 9.95 10.59 10.85	J B B J B	90 70 70 90 20	>3 >3 1-3 >3 >3	Fe Ca Fe Ca Fe Ca FeOx FeOx	6 6 6 6 3		
11								R3			@ 10.97 m: Coarser grained, R3.			4		11.01 11.02	J J	0 60	>3 >3	FeOx FeOx	6 6		
12	4	2		1.52	100	53	59							2 3 2		11.12 11.25 11.34 11.48 11.58 11.74 12.1 12.13	B J J J S J B B	50 90 85 85 90 80 70 70	>3 >3 >3 >3 >3 1-3 >3 >3	FeOx Fe Ca Fe Ca Fe Ca FeOx	6 6 6 3 3 3 1 3		
13	5	2		1.52	97	57	47				@12.50 m - 14.02 m : Calcite Veins/Healed fractures (1-2 mm thick).			2 3 5 5		12.62 12.69 12.87 13.05 13.08 13.18 13.2 13.24	J J B B B J J B	85 90 70 70 70 80 90 70	>3 1-3 >3 >3 >3 >3 1-3 >3	Fe Ca Ca FeOx FeOx N Fe Ca Fe	3 3 3 6 6 6 6 6		
14											@ 13.5 m: Near Vertical Coal Seam, friable, slickensides present.			6		13.29 13.4	J J	90 0	>3 1-3	Ca Fe	6 3		
	6	2		1.52	93	92	72							1 1 1 3 1 6		13.5 13.55 13.56 13.58 13.6 14.31 14.45 14.67 15.06 15.12 15.15 15.27	J J B B J J J J J J J J	90 90 60 60 0 80 70 20 90 85 40 90	1-3 1-3 1-3 1-3 1-3 >3 >3 >3 >3 >3 <1 >3	Ca Fe Ca Fe Ca Fe Ca Fe Ca Fe Ca Coal Coal Coal	6 1 1 1 3 3 3 3 6 3		
15									MW		15.05 1105.12 SANDSTONE, medium grained sandstone matrix, grey, R2-R3, FeOx in joints, no bedding, fractures along 80 degrees TCA.												

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

DRAFT

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-14

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
16														6						Coal			
																				Coal			
	7	3		1.52	100	59	53							6						Fe			
																16.46	J	0	1-3	Ca	6		
														3		16.55	B	60	>3	FeOx	3		
																16.72	J	80	>3	FeOx	3		
17											17.06			1		16.78	J	80	1-3	FeOx	3		
											1103.11									N			
								R3	MW		SANDSTONE, fine grained, moderately weathered, R3, Grey to brown calcite healed fractures, some FeOx staining in joints.					17.14	J	85	>3	N	3		
														2		17.26	B	70	>3	N	3		
																17.44	J	85	>3	FeOx	6		
	8	3		1.52	100	63	57							2		17.64	J	85	>3	FeOx	3		
																				FeOx			
18														1		17.95	B	75	<1	FeOx	3		
																				CL			
																18.28	B	80	<1	FeOX	3		
																18.33	B	80	<1	FeOX	3		
														4		18.39	J	25	>3	N	6		
																18.56	B	65	1-3	Fe	3		
																18.7	B	75	1-3	Ca	3		
														1		18.96	J	30	1-3	Fe	3		
19																19.01	J	90	1-3	Ca	3		
														3		19.09	B	70	1-3	FeOx	3		
	9	4		1.52	100	77	76				19.38					19.25	J	70	>3	FeOx	3		
								R2	F		1100.79			3		19.45	B	80	1-3	FeOx	3		
											SANDSTONE and interbedded SHALE, Fresh, R2, light to dark grey, fractures along 70 degree bedding planes.					19.5	B	80	1-3	FeOx	3		
														1		19.8	B	70	1-3	FeOx	3		
20											20.13									FeOx			
											1100.04									FeOx			
								R2	F		SHALE interbedded sandstone (fine grained), fresh, R2, dark grey to grey, bedding at 15 degrees TCA. 0.40 /m of slickensided fractures along bedding planes. @ 21.60 - 22.0 m slickensided bedding fracture.			1						FeOx			
																				FeOx			
																20.53	B	15	<1	FeOx	0		
																				N			
	10	4		1.52	100	100	79							2		20.83	J	85	1-3	FeOx	3		
																20.87	J	85	1-3	FeOx	3		
21														1		21.1	B	30	1-3	FeOx	3		
																21.66	B	15	<1	N	0		
														3		21.74	J	80	1-3	CL	1		
																21.91	J	80	>3	FeOx	3		
22														1		21.99	J	80	1-3	Ca	0		
																22.27	J	80	1-3	Ca	0		
	11	4		1.52	100	95	61							2		22.37	J	80	<1	FeOx	3		
																22.6	J	80	>3	FeOx	3		
														2		22.76	J	60	>3	FeOx	3		
23											23.18												
								R2	F		1096.99												
											SANDSTONE, fine grained, fresh, R2, bedding at 60 degree TCA, mm scale healed joints and bedding fractures.			2		23.36	B	60	<1	FeOx	3		
																23.41	B	60	<1	FeOx	3		
														1		23.54	B	60	<1	FeOx	3		
	12	5		1.52	90	95	61							1		23.85	B	60	>3	FeOx	6		
24																							
											0.30 m of Core Loss.												
														2		24.84	B	30	1-3	FeOx	3		
																24.95	J	85	>3	Fe	6		
25														2		25.11	J	70	<1	Ca	3		
																25.13	B	20	>3	FeOx	6		
																25.33	B	60	1-3	FeOx	3		

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-14

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
26	13	5		1.52	100	86	66							3		25.49	B	70	1-3	FeOx	6		
														1		25.52	B	60	1-3	FeOx	3		
																25.77	B	60	>3	FeOx	3		
														1						FeOx			
																26.17	J	90	>3	N	3		
														1		26.38	B	70					
																26.56	B	60					
27	14	5		1.52	100	76	53							2		26.76	J	80					
																27.22	B	80					
														2		27.42	J	85					
								R1	SW		From 27.53 m to 27.73 m: Rubble zone of sandstone with FeOx stain.			6									
28														3		27.86	J	90	1-3	FeOx	3		
																27.98	J	90	<1	FeOx	3		
									HW		@ 28.1 m - 28. 6 m highly fractured zone, with significant FeOx staining.					28.04	B	60	<1	FeOx	3		
														3		28.14	J	80	>3	FeOx	6		
	15	6		1.52	100	55	53									28.24	J	80	>3	FeOx	6		
														3		28.33	J	80	>3	FeOx	6		
																28.39	J	85	>3	FeOx	6		
														1		28.52	B	60	>3	FeOx	6		
29																28.6	B	60	>3	FeOx	6		
														1		28.88	J	85	>3	Ca	6		
																29.07	B	60	1-3	Ca	6		
														1		29.45	J	90	>3	Ca	3		
														1		29.75	J	85	<1	Ca	3		
30	16	6		1.52	100	86	84									30.02	J	85	1-3	Ca	3		
														1		30.25	J	85	<1	Ca	3		
														1		30.58	B	70	1-3	N	3		
														3		30.7	B	70	>3	N	3		
											@30.81 Slickensided bedding fracture on shale surface, possible transition zone.					30.8	B	70	>3	N	0		
31														2		30.93	J	80	<1	FeOx	3		
																31.1	B	20	1-3	FeOx	3		
														3		31.15	B	20	>3	FeOx	3		
																31.22	B	60	>3	FeOx	3		
	17	6		1.52	100	99	61							2		31.29	J	80	>3	FeOx	3		
																31.41	B	70	>3	FeOx	3		
																31.62	B	70	>3	N	3		
32														1		32.11	J	0	1-3	Ca	0-1		
														2		32.45	J	80	<1	FeOx	3		
																32.62	B	20	1-3	FeOx	3		
														3		32.67	B	20	>3	FeOx	3		
																32.74	B	60	>3	FeOx	3		
33	18	7		1.52	100	95	66									32.81	J	80	>3	FeOx	3		
														2		32.93	B	70	>3	FeOx	3		
																33.14	B	70	>3	N	0-1		
																33.63	J	0	1-3	Ca	0-1		
														1		33.86	J	25	1-3	Ca	0-1		
34														3		33.93	B	50	1-3	N	3		
																34.07	J	65	<1	N	1		
														1		34.42	J	25	1-3	Ca	0-1		
	19	7		1.52	100	68	44							2		34.47	J	80	>3	N	3		
																34.5	B	60	>3	FeOx	3		
																34.79	B	60	1-3	Ca	3		
35														3		34.99	J	80	<1	N	3		

CODES: DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation

DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese

WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-14

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
36	20	7		1.52	100	86	76				@ 35.38 m: bedding becomes more apparent			3		35	B	20	>3	CL	3		
																35.1	J	80	1-3	Fe	3		
														4		35.16	B	20	1-3	FeOx	3		
																35.26	B	60	1-3	FeOx	6		
																35.46	B	70	>3	Ca	3		
																35.55	B	80	<1	Ca	3		
																35.58	J	80	1-3	Ca	3		
																35.62	B	60	<1	N	3		
																36.29	J	80	1-3	Ca	3		
														2		36.5	J	80	1-3	N	3		
																36.63	B	20	<1	N	0-1		
														2		36.73	J	80	>3	Ca	6		
37																36.91	J	10	<1	FeOx	0-1		
																36.99	J	80	1-3	N	6		
														2		37.28	J	80	1-3	Ca	3		
	21	8		1.52	100	93	56							1						N			
																37.63	J	85	>3	Fe	6		
														2		37.66	B	15	<1	Ca	1		
38																37.85	J	70	1-3	Ca	3		
														2		38.01	J	70	1-3	N	3		
																				N			
														1		38.41	B	70	1-3	N	3		
																38.78	B	10	1-3	Ca	0-1		
39	22	8		1.52	100	100	46							1									
																39.23	J	60	>3	N	3		
														1		39.41	J	85	1-3	N	3		
														2		39.53	B	20	1-3	N	1		
														1		39.84	J	85	>3	Ca	6		
40											@ 40.01-46.51 m brown to grey sandstone.			5		40.03	B	85	1-3	N	3		
																40.08	B	75	1-3	N	3		
																40.12	J	60	>3	N	1		
																40.16	J	85	1-3	N	3		
																40.29	J	85	1-3	N	3		
	23	8		1.52	100	78	70							2		40.41	J	85	<1	N	3		
																40.68	B	85	<1	N	3		
41																40.79	J	60	>3	N	0		
														1		40.83	B	80	<1	Ca	3		
																41.33	B	60	>3	N	3		
																		50	1-3		6		
42																42.1	B	70	1-3	N	3		
	24	9		1.52	100	89	79							2		42.27	B	70	1-3	Ca	1-3		
																42.39	J	80	1-3	Fe	1-3		
														5		42.44	J	80	1-3	Ca	1-3		
																42.47	J	80	1-3	Fe	1-3		
43														2		42.59	B	70	1-3	Ca	3		
																42.67	J	80	1-3	Fe	3		
																42.72	J	80	1-3	Ca	3		
														1		42.73	J	80	1-3	N	3		
																43.11	B	75	<1	N	3		
	25	9		1.52	100	88	84							1		43.44	B	75	1-3	Fe	3		
																43.64	B	75	1-3	Ca	3		
														2		43.77	J	85	>3	Fe	6		
44																				Ca			
														2		44.06	B	60	1-3	N	3		
																44.13	J	80	<1	N	3		
														2		44.29	J	80	<1	Ca	3		
																44.46	B	60	1-3	Ca	3		

CODES: DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation

DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese

WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-14

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
45	26	10		1.52	100	100	84							2		44.9	B	60	1-3	Ca Ca	3		
																45.1	J	90	>3	Ca N Ca	3		
														1		45.59	B	60	1-3	Fe Ca	3		
46														1		45.9	J	85	>3	N	6		
														2		46.17	B	70	3	Ca	1-3		
																46.29	B	70	>3	N	3		
														3		46.41	J	80	>3	Ca	6		
	27	10		1.52	100	86	48									46.48	J	80	>3	FeOx	6		
														2		46.5	J	10	1-3	Ca	2		
47																46.64	J	90	<1	FeOx	3		
														1		46.67	J	90	<1	Coal	3		
																47.11	B	30	>3	N N N	0-1		
											46.51 1073.66 @ 46.51-47.23 m: Coal Seam (40 mm), low density, friable, black and slickensided. 47.23 1072.94												
											47.41 1072.76 SANDSTONE, fine grained, fresh, R2, bedding at 60 degree TCA, mm scale healed joints and bedding fractures.			1		47.73	J	90	>3	N	6		
48											47.91 1072.26 @ 47.41-47.91 m: Coal Seam (2 mm), low density, friable, black and slickensided.					47.91	J	16	1-3	Coal	0-1		
	28	10		1.52	100	100	87	R2	F		SANDSTONE, fine grained, fresh, R2, bedding at 60 degree TCA, mm scale healed joints and bedding fractures.			1									
49											@ 49.1 m: Bedding at 20 degrees TCA.												
	29	11		1.52	100	93	82							1		49.23	B	20	1-3	Ca	1-3		
50											50.63 1069.54 End of Hole at: 50.6 m												
51																							
52																							
53																							
54																							

DISCONTINUITY DATA

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

DRAFT

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

OVERBURDEN DRILLHOLE LOG BG13-15

STARTED: Sept 02, 2013 **FINISHED:** Sept 04, 2013
DRILL METHOD: ODEX/HQ3 Coring
GROUND ELEV. (m): 1121.4
COORDINATES (m): N 6091782 E 626465

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
					Disturbed drill pad material	
			0%		0.6 / 1120.8 No Recovery; rock in SPT sampler.	
	4 8 5 6	15-SPT-01				
1						
2						
			22%		2.1 / 1119.3 CLAY (CI), gravelly (coarse grained, 30mm, subrounded), some silt, low to intermediate plasticity, brown to grey, glacial till matrix. [GLACIAL TILL]	
	5 21 R	15-SPT-02				
3						
			53%		3.9 / 1117.6 SAND (SP) and GRAVEL (GP), Sand is medium grained, some silt, poorly graded, compact, brown, moist, homogeneous; Gravel is fine grained, poorly graded, subrounded, grey, moist. [GLACIAL TILL]	
4	3 8 12 16	15-SPT-03				
5					5.2 / 1116.3 GRAVEL (GP), fine to coarse, sandy, some silt, some clay, 30 mm max, angular to subangular, grey to brown, moist, homogenous, pockets of silty clay. [GLACIAL TILL]	
	12 13 12 12	15-SPT-04	91%			
6						
					6.7 / 1114.7 Vibrating Wire Piezometer installed at 6.5 m depth (VW25850) - Grouted installation	
			60%		GRAVEL (GP), fine to coarse, sandy, some silt, 30 mm max, subangular, dark brown. [GLACIAL TILL]	
7	9 16 50	15-SPT-05			7.4 / 1114.0 @ 6.98 m : Highly weathered shale @ 7.38 m: Highly fractured and weathered rubble zone, with clay infill (high plastic, soft, grey)	
					Highly fractured zone of Shale and Sandstone fragments. [WEATHERED BEDROCK]	
8						
9						
10						

Continued Next Page

Su - kPa
25 75 125 175 225
UC/2 P.PEN/2
WATER1 WATER2 WATER3
% FINES SPT N LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B3.1 Pond
LOGGED BY: JW **CHECKED BY: RP**
SHEET 1 **OF** 5 **HOLE NO.:** BG13-15

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-15

STARTED: Sept 02, 2013 **FINISHED:** Sept 04, 2013
DRILL METHOD: ODEX/HQ3 Coring
GROUND ELEV. (m): 1121.4
COORDINATES (m): N 6091782 E 626465

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
20 40 60 80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
11						
					11.4 1110.0	
12					Bedrock Contact @ 11.44 m, See Rock Log	
					End of Overburden Drill Log at 11.4 m.	
13						
14						
15						
16						
17						
18						
19						
20						

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B3.1 Pond
LOGGED BY: JW **CHECKED BY:** RP
SHEET 2 **OF** 5 **HOLE NO.:** BG13-15

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-15

Klohn Crippen Berger

DATE STARTED: September 02, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 3 OF 5
DATE FINISHED: September 04, 2013	LOGGED BY: JW	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 1121.442
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 31.1	COORDINATES (m): E 626464.958 N 6091782.264
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 11.44	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Norm Dillabough	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
11.44								R1	SW		SHALE, slightly weathered, R1, dark grey, inter-mixed with sandstone (light grey to brown), no apparent bedding.			2		11.45	J	90	>3	CL	3		
																11.54	B	50	1-3	FeOx	6		
12	3	1		1.52	100	74	72																
12.43																12.28	J	90	>3	CL	6		
1109.01											SANDSTONE, medium to coarse grained, slightly weathered, R1, grey-brown, weak, bedding with darker sandstone and shale at 70 degrees TCA. @ 12.81 m Rubble Zone			2		12.51	J	90	>3	CL	3		
														1									
13														6									
13.31																13.14	J	90	>3	N	6		
1108.13											CONGLOMERATE, coarse grained clasts in fine grained grey sandstone matrix. Clasts are mixed lithology (Shale, sandstone, Quartz, Feldspar, Calcite), slight FeOx staining. @ 14.07-14.8 m: SAND, Clayey and gravel, fine to coarse grained, dark grey, stiff, moist			2		13.23	J	80	>3	FeOx	3		
	4	2		1.52	72	16	11																
14																							15-Core-02
														2		14.52	J	80	>3	N	6		
														6									
15	5	2		1.52	54	52	35				@ 15.08-15.13 m: CLAY and GRAVEL infill			1		15.04	J	80	>3	N	6		
																15.08	J	70	>3	CL	3		15-Core-03
15.86																							
1105.58								R2	HW		SANDSTONE interbedded with Shale/Siltstone (mm scale laminations), highly weathered and fractured, R2, grey, with FeOx staining in discontinuities. Bedding at 20 degrees TCA.			6		16.19	J	85	>3	CL	6		
16														4		16.2	J	70	>3	CL	6		
	6	2		1.52	100	0	18									16.26	J	70	>3	CL	6		
														6		16.34	J	70	>3	CL	6		
																16.76	J	70	1-3	FeOx	6		
17											@ 16.86 bedding planes thicken (~ 5 mm)			4		16.8	J	85	1-3	FeOx	6		
																16.94	Fol	20	1-3	FeOx	6		
														6		17.13	J	90	1-3	FeOx	6		
																17.52	J	80	>3	FeOx	6		
														3		17.58	J	80	>3	FeOx	6		
																17.66	J	90	>3	FeOx	6		
18	7	3		1.52	64	0	15				@ 18.39 - 18.91m highly fractured Zone			6									
														6									
														6									
19																18.98	J	80	>3	FeOx	6		
														3		19.14	J	70	<1	FeOx	3		
														2		19.19	J	70	<1	FeOx	3		

CODES: DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation

DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese

WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

Klohn Crippen Berger

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-15

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
20	8	3		1.52	100	38	53	R3	MW		@ 19.51 m Shale becomes more abundant and stronger. Finer grained sandstone. Decreased FeOx staining			4 6 3 3 6 6 6		19.25 19.39 19.59 19.62 19.63 19.65 20.16 20.21 20.31 20.61 20.64 20.72	J J J J B J J J J B B B	85 85 85 85 20 85 80 80 80 60 60 60	1-3 1-3 >3 >3 1-3 1-3 1-3 >3 1-3 <1 <1 <1	FeOx FeOx FeOx FeOx FeOx FeOx FeOx N N N FeOx & Ca FeOx & Ca	6 6 3 3 3 3 3 3 3 5 5 5		
21	9	3		1.52	100	74	54																
22	10	4		1.52	100	68	82							1 1 1 1 3		21.78 22.13 22.52 22.77 22.86 22.92 23.01	J J J J J J J	85 90 90 85 80 70 85	>3 1-3 1-3 >3 >3 1-3 >3	FeOx FeOx FeOx FeOx FeOx FeOx FeOx	3 3 3 3 3 3 3		
23											23.49 1097.95												
24	11	4		1.52	95	61	41	R1	MW		SHALE, moderately weathered, R1, dark grey, very weak, trace Ca healed fractures, bedding at 10 - 20 degrees TCA.			2 6 6 6 2		23.74 23.77 24.69 24.87	J B J J	85 15 90 80	>3 >3 >3 <1	CL N FeOx N	6 1 6 3		
25																							
26	12	4		1.52	100	93	64				@ 25.67 m Clay Infill												
27								R0	CW		26.70 1094.74 @ 29. 6-26.7 m: Completely weathered Shale. Abundant FeOx staining, soil consistency.			6 2		26.86 27.04	J J	80 80	<1 <1	N N	3 3		
28	13	5		1.52	97	56	62							3 2 5 2 1		27.17 27.24 27.41 27.55 27.69 27.82 27.89 27.98 28.02 28.05 28.18	J J S J J J J J J J J	85 85 80 85 90 85 85 85 85 85 60	>3 >3 1-3 1-3 >3 >3 >3 >3 >3 >3 <1	CL FeOx FeOx N N CL N FeOx FeOx FeOx FeOx	6 3 3 6 6 6 6 6 3 3		
	14	5		1.52	99	82	69							3		28.24 28.44	B B	30 70	1-3 1-3	FeOx & Ca N	6 6		

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-15

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
														1		28.74	J	80	>3	FeOx	3		
																28.78	J	80	1-3	FeOx	3		
														3		28.92	J	70	1-3	FeOx	6		
																28.97	B	30	>3	FeOx	1-3		
																29.27	B	40	1-3	Ca	1-3		
														6		29.29	B	40	1-3	Ca	3		
30																29.52	J	60	>3	FeOx			
	15	5		1.52	95	28	45	R1	HW		29.59 1091.85 SHALE, highly weathered, R1, dark grey, very weak, trace Ca healed fractures, bedding at 10 - 20 degrees TCA.			6		30.19	J	80	>3	FeOx	3		
																30.22	B	70	1-3	FeOx	3		
																30.25	B	70	>3	FeOx	3		
																30.31	B	40	1-3	FeOx	6		
														6		30.4	J	80	1-3	FeOx	6		
31											31.11 1090.33 End of Hole at: 31.1 m					30.48	J	80	1-3	FeOx	6		
																30.87	J	80	1-3	FeOx	6		
														3		30.9	J	70	>3	FeOx	6		
																30.99	J	90	1-3	FeOx	6		
32																							
33																							
34																							
35																							
36																							
37																							
38																							

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KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

OVERBURDEN DRILLHOLE LOG BG13-16

STARTED: Sept 04, 2013 **FINISHED:** Sept 06, 2013
DRILL METHOD: HQ3 Coring
GROUND ELEV. (m): 1125.6
COORDINATES (m): N 6092428 E 626825

Su - kPa: 25 75 125 175 225 | UC/2 P.PEN/2
WATER1 WATER2 WATER3
% FINES SPT N LPT N
W_P% W% W_L%
20 40 60 80

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
0					CLAY (CL), sandy, some gravel (FG-CG), low plasticity, brown, mc at PL, homogenous. [GLACIAL TILL]	
1.5 (1124.1)					SILT and GRAVEL in drill cuttings, Iron Oxide staining.	
3.1 (1122.6)	10 R	16-SPT-02	24%		SAND (SP), silty, some gravel, fine grained, subrounded, orange to brown, medium grained sand in wet brown low plastic silt, glacial till matrix. Some fragments of coarse grained white sand in pockets adjacent to clay/silt in sample spoon.	
3.7 (1122.0)					CLAY (CI), sandy, some gravel (fine to coarse grained, subrounded), some silt, moist, grey to brown, traces of Iron Oxide staining, homogenous.	
4.3 (1121.4)					Weathered bedrock (Refer to Rock Log)	
					Vibrating Wire Piezometer installed at 6.5 m depth (VW25862) - Grouted installation	
7.0 (1118.6)					Bedrock Contact @ 7.0 m, See Rock Log	
					End of Overburden Drill Log at 7.0 m.	

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: B3.1 Pipeline
LOGGED BY: JW **CHECKED BY:** RP
SHEET 1 **OF** 4 **HOLE NO.:** BG13-16

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-16

Klohn Crippen Berger

DATE STARTED: September 04, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 2 OF 4
DATE FINISHED: September 06, 2013	LOGGED BY: JW	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 1125.641
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 25	COORDINATES (m): E 626824.93 N 6092428.293
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 4.27	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Norm Dillabough	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
5	1	1		0.92	100	42	47	R2 R0 R3	HW SW		SHALE, Highly weathered, R2, grey, weak, bedding at 35 degree TCA. 4.77 / 1120.87 @ 4.77-4.82 m: Rubble Zone SANDSTONE, slightly weathered, R3, grey, Ca healed fractures along bedding (35 degrees TCA) and in joints (20 degrees TCA). 5.19 / 1120.45			6 6									
6	2	1		1.52	72	9	66	R0-R1	MW		5.54 / 1120.10 @ 5.2-5.5 m: Rubble Zone SHALE, moderately weathered, R0-R1, highly fractured along bedding (~75 degrees TCA). Slight FeOx staining within fractures.			6 5 6 6		5.58 5.6 5.67 5.73 5.76	B B B B B	80 80 75 75 75	<1 <1 <1 <1 <1	FeOx FeOx FeOx FeOx FeOx	3 3 3 3 3		
7	3	1		1.52	57	0	40				Bedding at 60 degrees TCA @ 7.17 m - 7.61 m Rubble Zone with FeOx and Clay in fractures @ 7.61 m - 7.70 m Quartzite Cobble			5 6 6 6		6.77 6.81 6.85 6.89 6.96	B B B B J	60 60 60 60 85	1-3 1-3 1-3 1-3 1-3	CL CL CL CL CL	3 3 3 3 3		
8								R3 R1	MW HW		7.81 / 1117.83 @ 7.7-7.81 m: SANDSTONE, coarse grained, moderately weathered, R3, greyish brown and black, grey grains			6 6 6 6									
9	4	1		1.52	100	74	76	R4	F		8.69 / 1116.95 SANDSTONE, fine to medium grained, highly weathered, R1, grey - brown, Iron Oxide staining, highly fractured, trace fragments of conglomerate rubble CONGLOMERATE, fresh, R4, brown and grey matrix with white, orange and black clasts. Coarse grained sandstone matrix, clasts are coarse grained, rounded to subrounded, 10 mm @ 8.84 m: Rubble Zone @ 9.43 m decrease in grain size @ 9.76 m: Rubble Zone			6 6									
10	5	2		1.52	100	66	66							6									
11											@11.09 m: 0.7 m fine grained Sandstone cobble, clay gouge at contact with conglomerate 11.49 / 1114.15 @11.29 Quartzite,fine grained, brownish Pink, very hard,			6		11.64	B	80	<1	N	3		
12	6	2		1.52	100	72	62	R1	SW		SHALE, fine grained, slightly weathered, R1, grey to dark grey, bedding at 30-50 degrees TCA			1 6		11.93 11.97 12.01	J B J	90 40 85	1-3 1-3 >3	FeOx FeOx FeOx	3 6 6		

DRAFT

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-16

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
											@12.0 m Clay Infill			1		12.02	B	40	<1	CL	6		
																12.04	B	30	<1	CL	6		
																12.19	B	50	<1	N	3		
																12.24	B	50	>3	FeOx	3		
13											@12.81 - 13.06 m : Rubble Zone												
											13.06 / 1112.58 SAND (SW), fine to medium grained, silty, well graded, compact, subrounded, brown, moist, homogenous												16-Core-01
	7	2		1.52	25	0	0	R4 R1	F SW		13.40 / 1112.24 [Weathered Rock].			2		13.54	B	60	1-3	N	3		
											1112.14 CONGLOMERATE, fresh, R4, brown and grey matrix with white, orange and black clasts. Coarse grained sandstone matrix, clasts are coarse grained, rounded to subrounded, 10 mm					13.6	J	90	>3	Ca	6		
14														2		13.75	B	60	>3	N	6		
																13.83	B	60	>3	N	6		
														6									
														6									
											14.74 / 1110.90 SHALE and SANDSTONE (interbedded), grey to dark grey, brown, bedding at 60 degrees TCA.			3		14.75	S	60	1-3	FeOx	6		
15	8	3		1.52	89	76	65				@14.34 - 14.74 m: Rubble Zone (likely sloughed material)					14.9	J	130	1-3	FeOx	3		
														2		14.94	B	50	<1	FeOx	3		
																15.11	B	50	1-3	FeOx	3		
																15.19	J	85	>3	FeOx	6		
											SANDSTONE, fine grained, interbedded with shale (1-10mm scale), slightly weathered, R1, weak, grey to dark grey, bedding at 140 degrees TCA			1		15.68	B	45	>3	FeOx	1		
16											@ 15.11 - 15.21 m: Highly fractured zone			1		15.96	J	80	>3	CL	3		
											16.21 / 1109.43 @15.86 m: Clay and sand infill					16.17	B	70	1-3	Ca	3		
								R1	F					2		16.22	B	70	1-3	N	3		
	9	3		1.52	100	95	75				SHALE, fine grained, interbedded with Sandstone, fresh, R1, medium strength, grey to dark grey, bedding at 140 degrees TCA					16.56	B	40	<1	N	3		
17														1		16.95	B	70	<1	N	3		
														1									
											@17.37 m : Becomes darker grey.			6									
														3		17.79	B	70	1-3	N	3		
18	10	3		1.52	100	88	87									17.85	B	70	1-3	N	3		
																17.86	J	85	1-3	N	3		
																18.3	J	85	>3	N	3		
														1									
19														1		19.02	B	30	<1	N	1-3		
																19.27	J	70	<1	N	1-3		
	11	4		1.52	99	91	81							1									
																19.79	J	85	1-3	N	6		
20														1		19.81	B	30	1-3	N	3		
														3		20.25	J	60	1-3	N	3		
																20.33	J	60	1-3	N	3		
														1		20.5	J	20	<1	N	3		
21	12	4		1.52	100	100	71							1		21.51	J	85	1-3	N	3		
														1									

DRAFT

CODES:
DISCONT. TYPE: J: Joint, B: Bedding, S: Shear, Fol: Foliation
DISCONT. INFILL: N: None, Cl: Clay, Qtz: Quartz, FeOx: Iron, Ca: Calcite, MnOx: Manganese
WEATHERING: F: Fresh, SW: Slightly, MW: Moderately, HW: Highly, CW: Completely, RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled, 1: Smooth, Planar, 3: Slightly Rough, Undulating, 5: Rough Undulating, Stepped, 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1), R1: Very Weak (1-5), R2: Weak (5-25), R3: Medium Strong (25-30), R4: Strong (50-100), R5: Very Strong (100-250), R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-16

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
22											@ 21.96 m : Bedding at 20 - 50 degrees TCA.					21.94	B	60	>3	N	3		
														1		22.33	J	85	1-3	N	6		
	13	5		1.52	99	89	96									22.87	B	20	<1	N	3		
23														4		23.01	J	80	<1	N	3		
																23.04	J	90	>3	N	3		
																23.09	B	20	1-3	N	3		
	14	5		1.52	100	100	100									23.81	B	50	1-3	N	3		
24														1									
											25.00												
25											1100.64 End of Hole at: 25.0 m			1		24.83	J	85	1-3	N	3		
26																							
27																							
28																							
29																							
30																							
31																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

DRAFT

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

OVERBURDEN DRILLHOLE LOG BG13-17

STARTED: Sept 07, 2013 **FINISHED:** Sept 08, 2013
DRILL METHOD: HQ3 Coring
GROUND ELEV. (m): 845.8
COORDINATES (m): N 6096715 E 626764

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
0					SILT (ML), sandy (fine grained), some clay, low plasticity, grey to brown, dry, homogenous, some Iron Oxide staining and leach stain. [WEATHERED BEDROCK]	
1	16 12 19 28	17-SPT-01	100%		@ 1.17 m: decrease in sand content	
2					2.4 843.4	
3						
4						
5					Bedrock Contact @ 4.0 m, See Rock Log End of Overburden Drill Log at 4.0 m.	
6						
7						
8						
9						
10						

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
× – – – – ▲ – – – – ×
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: Onsite Storage Pond
LOGGED BY: JW **CHECKED BY:** RP
SHEET 1 **OF** 4 **HOLE NO.:** BG13-17

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-17

Klohn Crippen Berger

DATE STARTED: September 07, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 2 OF 4
DATE FINISHED: September 08, 2013	LOGGED BY: JW	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 845.811
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 22.3	COORDINATES (m): E 626763.575 N 6096715.02
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 2.44	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Norm Dillabough	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
3	1	1		1.52	66	22	38	R0	HW		SHALE, Grey, fine grained, highly to completely weathered, R0, poor RQD, FeOx staining apparent, rubbled appearance.			6									
								R1	MW		@3.14 m- 3.45 m Moderately weathered.			6									
														6									
														1		3.35	J	90	>3	FeOx	3		
4	2	1		1.52	99	76	67							5		3.97	J	15	1-3	FeOx	3		
																4.02	J	90	>3	FeOx	6		
																4.13	J	15	<1	FeOx	3		
														1		4.17	J	25	1-3	FeOx	3		
																4.24	J	80	>3	FeOx	6		
																4.39	J	80	1-3	N	3		
5														2		4.64	J	80	1-3	FeOx	3		
																4.72	J	90	1-3	CL	1-3		
														2		4.95	J	70	1-3	N	3		
																4.96	J	50	1-3	N	6		
														3		5.2	J	75	<1	N	3		
6	3	1		1.52	100	39	49									5.25	J	80	1-3	CL	3		
														6		5.28	J	90	1-3	CL	3		
																5.51	J	90	<1	CL	3		
														6		5.58	J	90	<1	CL	3		
																5.59	J	80	1-3	FeOx	3		
														5		5.66	J	0	1-3	FeOx	6		
																5.71	J	85	>3	FeOx	3		
7														4		5.78	J	90	1-3	CL	1-3		
																6.09	J	0	>3	N	1-3		
														2		6.16	J	85	<1	N	1-3		
																6.22	B	90	<1	N	1-3		
														1		6.27	B	90	<1	N	1-3		
																6.36	J	80	<1	N	3		
											@7.34 m Bedding Fractures at 15 degrees TCA.					6.41	B	70	<1	CL	3		
														3		6.51	J	90	<1	N	3		
																6.55	B	70	<1	N	3		
8	4	2		1.52	100	76	74				@7.77 m Visible laminations of darker grey and light grey to brown.			2		6.64	J	85	<1	FeOx	3		
																6.77	B	70	<1	N	6		
														2		6.94	J	85	>3	N	6		
																7.2	J	85	1-3	N	6		
														1		7.34	B	15	1-3	N	3		
																7.42	J	85	1-3	N	3		
																7.52	J	70	<1	N	3		
											@8.54 m Bedding at 80 - 90 degrees TCA, interbedded with fine grained sandstone.			3		7.63	J	80-90	1-3	N	6		
9																7.83	B	70	1-3	N	3		
														3		8	J	90	1-3	CL	1-3		
																8.05	J	45	<1	Ca	3		
	5	2		1.52	100	69	72							1		8.11	B	70	<1	CL	1-3		
																8.62	B	85	<1	CL	3		
														2		8.74	J	50	<1	N	3		
																8.79	J	120	<1	N	3		
10														1		8.88	B	80	<1	N	3		
																9.06	B	80	<1	N	3		
											@ 10.07 m becomes darker grey.			1		9.12	J	60	1-3	N	1-3		
																9.36	J	90	1-3	N	3		

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES: DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation

DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese

WEATHERING: F: Fresh SW: Slightly MW: Moderately HW: Highly CW: Completely RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-17

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
11	6	2		1.52	100	66	72				@ 10.50 m slickensided fracture faces.			4		9.56	B	90	1-3	N	3		
																9.63	J	90	1-3	N	6		
														2		9.94	J	60	>3	N	3		
																10.35	J	90	1-3	N	6		
														1		10.47	J	150	1-3	N	0-1		
																10.5	J	70	>3	N	0-1		
														2		10.53	J	50	1-3	N	0-1		
																10.61	J	0	>3	N	6		
														1		10.72	B	90	1-3	N	0-1		
																10.96	J	85	1-3	N	1-3		
12								R1	SW		@11.59 m Pyrite Lens (25 mm). Interbedded SHALE with light grey siltstone, with healed clay veins.	Vibrating Wire Piezometer installed at 11.0 m depth (VW25848) - Grouted installation				11.09	B	85	1-3	CL	1-3		
														5		11.28	B	90	<1	N	1		
	7	3		1.52	98	74	76									11.45	B	80	<1	N	1		
														3		11.67	B	70	1-3	N	3		
																11.93	J	80	>3	N	3		
														2		11.97	J	55	<1	N	1		
13											@12.71 m clay infill.					12.1	B	75	<1	CL	1-3		
																12.15	J	85	1-3	N	6		
																12.18	J	85	1-3	N	6		
																12.3	B	85	1-3	N	3		
																12.33	J	0	1-3	N	1-3		
																12.44	J	65	<1	N	1-3		
														2		12.57	B	80	1-3	N	3		
	8	3		1.52	91	86	75									12.71	B	80	>3	CL	6		
14														2		13.26	J	160	<1	N	3		
																13.37	B	85	>3	CL	3		
														2		13.59	B	85	>3	N	1-3		
											@14.24 m Shear Zone with clay infill and angular rock fragments.					13.74	J	25	1-3	N	1		
														4		13.98	B	85	1-3	N	1		
																14.05	J	65	1-3	N	0		
														2		14.16	B	90	1-3	CL	1		
15																14.18	J	60	<1	N	0		
														5		14.24	J	90	1-3	CL	0		
																14.71	J	85	>3	N	0-1		
	9	3		1.52	94	55	62	R0	CW HW		@15.22 - 16.62 m Completely weathered Shale. Rock structure intact, soil consistency. @15.3 - 15.37 m: Rubble Zone with clay. @15.87 m : Sandstone Layer, light grey- brown. @16.17 m Light grey siltstone laminations, fresh, mm scale.			6		14.77	J	130	1-3	N	1-3		
																14.95	B	90	1-3	N	1		
														6		15	B	115	1-3	N	0		
																15.09	J	60	1-3	N	3-6		
																15.15	B	80	1-3	N	0-1		
16														1		15.21	B	50	1-3	N	0-1		
																15.81	J	85	1-3	N	0-1		
																	J	85	>3		3		
														1		16.69	B	90	1-3	N	3		
17	10	4		1.52	100	96	93							1		16.9	J	110	1-3	N	3		
											@17.09 m Fine to medium grained sandstone laminations, up to 25 mm, bedding at 80-90 degrees TCA.			2		17.19	B	85	1-3	N	3		
																17.27	J	110	1-3	N	3		
														1		17.47	J	110	1-3	N	3		
																17.73	B	85	<1	N	3		
18														2		17.85	B	80	1-3	N	3		
																18	B	85	<1	N	6		
														5		18.07	B	85	1-3	N	3		
	11	4		1.52	100	74	97									18.12	B	80	>3	N	3		
														1		18.22	B	80	<1	N	3		
																18.25	B	80	<1	N	6		
											@ 18.53 m Lensed sandstone appearance.			1		18.57	B	85	<1	N	3-6		
19																18.66	B	85	1-3	N	3-6		
														1		18.98	B	85	1-3	N	3		

CODES: DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation

DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese

WEATHERING: F: Fresh SW: Slightly MW: Moderately HW: Highly CW: Completely RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

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GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-17

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	DISCONTINUITY DATA: FRACTURE ZONE	DISCONTINUITY DATA: DISCONT. DEPTH (m)	DISCONTINUITY DATA: DISCONT. TYPE	DISCONTINUITY DATA: ANGLE (From Core Axis)	DISCONTINUITY DATA: APERTURE (<1,1-3,>3mm)	DISCONTINUITY DATA: INFILL TYPE	DISCONTINUITY DATA: JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
21	12	4		1.52	100	100	100							1		21.57	B	85	1-3	N	3		
	13	5		1.52	100	80	85							1		21.65	B	85	1-3	N	3		
22														2		21.85	J	85	1-3	N	3		
														2		21.88	J	180	1-3	N	3		
											@21.96 m Possible shear zone.					21.95	J	85	>3	N	6		
											22.30					22.1	J	85	>3	N	3		
											823.51 End of Hole at: 22.3 m												
23																							
24																							
25																							
26																							
27																							
28																							
29																							

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DRAFT

CODES:
- DISCONT. TYPE: J: Joint; B: Bedding; S: Shear; Fol: Foliation
- DISCONT. INFILL: N: None; Cl: Clay; Qtz: Quartz; FeOx: Iron; Ca: Calcite; MnOx: Manganese
- WEATHERING: F: Fresh; SW: Slightly; MW: Moderately; HW: Highly; CW: Completely; RS: Residual Soil
- ROUGHNESS: 0: Polished/Slickensided/Gouge Filled; 1: Smooth, Planar; 3: Slightly Rough, Undulating; 5: Rough Undulating, Stepped; 6: Very Rough, Stepped
- ROCK STRENGTH (MPa): R0: Extremely Weak (<1); R1: Very Weak (1-5); R2: Weak (5-25); R3: Medium Strong (25-30); R4: Strong (50-100); R5: Very Strong (100-250); R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-18

Klohn Crippen Berger

DATE STARTED: September 08, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 1 OF 3
DATE FINISHED: September 09, 2013	LOGGED BY: JW	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 855.273
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 19	COORDINATES (m): E 627071.192 N 6096529.62
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 2.29	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Norm Dillabough	AZIMUTH/ANGLE FROM VERT.: N/A	

Core runs

RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m) 5 10 15	RUN LENGTH (m)	TCR (%) 25 50 75	RQD (%) 25 50 75	SCR (%) 25 50 75
1	1		1.52	67	0	0
2	1		1.52	99	0	0
3	1		1.52	100	14	54
4	2		1.52	95	46	53
5	2		1.52	99	83	69

Description

DEPTH (m) / ELEV.	HARDNESS	ROCK MASS WEATHERING	DESCRIPTION	DRILLING REMARKS
0.00			No Recovery	
0.76 / 854.51	S5 / R0	CW / HW	CLAY (CI), silty, some sand, low to intermediate plasticity, firm to stiff, grey- brown, with orange FeOx discoloration, Mc<PL, lensed appearance, Rock structure intact. [Weathered Bedrock] @1.06 m Rubble Zone Highly Weathered.	
2.29 / 852.98	R0	HW	SHALE, grey to brown, highly to completely weathered, very weak, highly fractured, laminations of shale and siltstone, FeOx staining. [Weathered Bedrock]	
3.02 / 852.25	S5	CW	CLAY (CI), silty, some sand, low to intermediate plasticity, firm to stiff, grey- brown, with orange FeOx discoloration, Mc<PL, lensed appearance, Rock structure intact. [Weathered Bedrock]	
3.81 / 851.46	R1	MW	SHALE, grey to brown, moderately weathered, R1, interbedded with Sandstone, bedding at 80-90 degrees TCA, FeOx staining	Vibrating WIre Piezometer installed at 4.0 m depth (VW25846) - Grouted installation
5.64 / 849.63			Clay infill at top of run (Intermediate plasticity, grey, Mc~PL).	
6.86 / 848.41	R1	SW	SHALE, grey to brown, moderately weathered, R1, interbedded with Sandstone, bedding at 80-90 degrees TCA, FeOx staining.	

Fracture frequency (No. Per 30 cm) 2 4: 6, 6, 6, 6, 6, 6, 6, 6, 6, 4, 5, 6, 3, 3, 2, 3, 2, 1, 3, 2

Discontinuity data

DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC
5.08	B	85	<1	N	3
5.14	J	70	<1	N	3
5.2	B	90	<1	N	3
5.27	B	90	<1	N	3
5.34	B	85	>3	CL	6
5.4	B	85	>3	CL	6
5.5	B	85	>3	CL	6
5.53	B	85	>3	CL	6
5.57	B	85	>3	CL	6
6.06	B	85	1-3	N	6
6.2	J	80	<1	N	3
6.23	B	85	1-3	N	6
6.35	B	85	1-3	N	3
6.48	B	85	1-3	N	3
6.53	B	70	>3	N	6
6.67	J	70	>3	CL	3
6.71	B	85	1-3	N	3
6.89	B	85	1-3	CL	3
6.99	B	85	<1	N	3
7.03	B	85	<1	N	6
7.2	J	70	1-3	N	6

Columns also shown: PIEZOMETER DETAILS, FRACTURE ZONE, PERMEABILITY (m/sec), SAMPLE RETAINED: 18-Core-01, 18-Core-02, 18-Core-03

CODES:
DISCONT. TYPE: J: Joint; B: Bedding; S: Shear; Fol: Foliation
DISCONT. INFILL: N: None; Cl: Clay; Qtz: Quartz; FeOx: Iron; Ca: Calcite; MnOx: Manganese
WEATHERING: F: Fresh; SW: Slightly; MW: Moderately; HW: Highly; CW: Completely; RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled; 1: Smooth, Planar; 3: Slightly Rough, Undulating; 5: Rough Undulating, Stepped; 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1); R1: Very Weak (1-5); R2: Weak (5-25); R3: Medium Strong (25-30); R4: Strong (50-100); R5: Very Strong (100-250); R6: Extremely Strong (>250)

Klohn Crippen Berger

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-18

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONTINUITY DATA: DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
																7.38	B	90	<1	N	3		
														2		7.64	J	140	1-3	N	3		
																7.79	J	75	>3	N	3		
														1		7.88	B	85	>3	N	3		
																8.04	B	85	1-3	N	1-3		
																8.16	B	85	1-3	N	3		
9														3		8.29	J	160	<1	N	3		
	6	2		1.52	97	93	96				@8.38 - 9.13 m Increased Sandstone interbeds, laminated to end of run.			2		8.46	B	85	>3	N	3		
																8.69	B	85	1-3	N	3		
														2		8.81	B	85	>3	N	3		
																8.83	B	85	1-3	N	3		
														1		8.99	B	85	1-3	N	3		
10																9.27	B	85	1-3	N	3		
																9.52	J	55	<1	N	3		
														1		9.55	B	85	>3	N	3		
																9.68	J	55	<1	N	3		
														2		10.04	B	85	<1	N	3		
																10.26	B	85	<1	N	3		
	7	3		1.52	100	89	69							3		10.34	J	170	<1	N	3		
																10.51	B	85	<1	N	3		
11																10.72	J	60	<1	N	3		
														1		10.75	J	35	1-3	N	6		
																10.9	J	145	1-3	N	3		
														1		11.17	J	85	1-3	N	6		
																11.5	J	20	1-3	N	3		
											@11.42 m Sandstone bed to 10 mm, Shale bed to 20 mm.			4		11.51	J	10	1-3	N	3		
																11.6	B	80	>3	N	3		
12														1		11.68	J	35	>3	N	6		
																11.86	B	80	>3	N	6		
	8	3		1.52	100	81	82							1		12.21	J	100	<1	N	3-6		
																12.62	B	85	<1	N	3		
13																12.94	J	175	<1	N	3		
											@ 12.94 - 13.54 m Long Joint at 175 degrees TCA.			1									
	9	3		1.52	100	100	59																
14																							
15																							
											@ 14.9 m: Decrease in sandstone bedding.												
	10	4		1.52	100	100	91							2		15.23	B	85	<1	N	3		
																15.35	J	130	<1	N	3		
														1		15.63	B	85	<1	N	3-6		
16																							
														1		16.22	B	85	1-3	N	3		
																16.61	B	85	1-3	N	3		
	11	4		1.52	100	88	89							1									
17														1									
																17.15	B	85	1-3	N	3		
														2		17.19	B	85	1-3	N	3		
																17.31	J	45	1-3	N	3		

CODES: DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation

DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese

WEATHERING: F: Fresh SW: Slightly MW: Moderately HW: Highly CW: Completely RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

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GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-18

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
18	12	4		1.52	100	100	100							1		17.64	J	85	1-3	N	3		
														1		18.31	J	135	<1	N	3		
														1		18.64	J	120	<1	N	3		
19											19.00 836.27 End of Hole at: 19.0 m												
20																							
21																							
22																							
23																							
24																							
25																							
26																							
27																							

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CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese
WEATHERING: F: Fresh SW: Slightly MW: Moderately HW: Highly CW: Completely RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

OVERBURDEN DRILLHOLE LOG BG13-19

STARTED: Sept 10, 2013 **FINISHED:** Sept 11, 2013
DRILL METHOD: HQ3 Coring
GROUND ELEV. (m): 854.8
COORDINATES (m): N 6096464 E 626984

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
0					SAND, some clay, some silty, cuttings are bits of broken rock. [WEATHERED BEDROCK]	
2.1 (852.7)					Bedrock Contact @ 2.1 m, See Rock Log End of Overburden Drill Log at 2.1 m.	

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
× – – – – ▲ – – – – ×
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: Onsite Storage Pond
LOGGED BY: JW **CHECKED BY:** RP
SHEET 1 **OF** 4 **HOLE NO.:** BG13-19

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GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-19

Klohn Crippen Berger

DATE STARTED: September 10, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 2 OF 4
DATE FINISHED: September 11, 2013	LOGGED BY: JW	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 854.761
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 20.2	COORDINATES (m): E 626983.838 N 6096463.503
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 2.1	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Jon Rudolph	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	DISCONTINUITY DATA: FRACTURE ZONE	DISCONTINUITY DATA: DISCONT. DEPTH (m)	DISCONTINUITY DATA: DISCONT. TYPE	DISCONTINUITY DATA: ANGLE (From Core Axis)	DISCONTINUITY DATA: APERTURE (<1,1-3,>3mm)	DISCONTINUITY DATA: INFILL TYPE	DISCONTINUITY DATA: JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
3	1	1		1.52	99	7	7	R0	HW		SHALE and SANDSTONE (Interbedded), dark to light grey, highly weathered, R0, weak rock, bedding at 105 degrees TCA, FeOx staining, shale is predominant.			6		4.09	J	110	1-3	N	6		
4	2	1		0.92	100	54	99	R2-R3	SW		@4.04 m Sandstone is predominant. Fine grained, grey to light grey, slightly weathered, R2-R3, bedding at 90-100 degrees TCA (mm to 50 mm scale), medium strong sandstone, weak shale.	Vibrating Wire Piezometer installed at 3.5 m depth (VW25843) - Grouted installation		6		4.15	B	90	1-3	N	3		
5	3	1		1.52	100	55	54							6		4.23	B	90	1-3	N	3		
6														6		4.34	B	85	>3	N	6		
														6		4.42	B	85	1-3	N	3		
														6		4.52	J	110	>3	N	6		
														4		4.6	J	110	>3	Fe	6		
														3		4.74	B	110	<1	Ca	3		
														2		4.89	B	90	1-3	N	3-6		
														2		5.04	B	95	<1	N	3		
														3		5.14	B	90	1-3	N	3-6		
														3		5.2	J	85	1-3	N	3		
														3		5.21	B	95	1-3	N	3-6		
														3		5.32	J	115	<1	N	3-6		
														3		5.38	J	85	<1	N	3		
																5.5	B	90	<1	N	3		
																5.61	J	115	>3	N	6		
																5.74	J	105	<1	FeOx	3-6		
														1		5.81	B	80-90	1-3	N	3		
														3		5.96	J	95	>3	N	3		
7	4	2		1.52	97	61	90				@7.56 m CLAY infill, (3mm), sandy, high plasticity, grey, mc near PL, soft.			3		6.05	J	95	>3	FeOx	3		
														3		6.09	B	85	1-3	FeOx	3		
														2		6.16	B	95	1-3	N	3		
														4		6.31	B	110	>3	N	6		
														1		6.56	J	90	>3	N	3-6		
														3		6.91	B	100	1-3	N	3		
8											@8.17 m: Rubble Zone.					7	B	100	1-3	Ca	3		
																7.07	B	100	1-3	N	3		
																7.16	B	100	1-3	N	3		
																7.32	B	100	<1	N	3		
														2		7.42	B	90	1-3	N	3		
														2		7.52	B	100	1-3	N	3		
														4		7.56	B	100	<1	CL	3		
														1		7.66	J	70	<1	N	6		
9	5	2		1.52	97	95	92				@8.65 m Healed Ca fracture, dark grey bedding fractures, faces are glossy shale.			2		7.71	B	90	1-3	N	3		
														1		8.12	J	90	>3	N	6		
																8.16	B	95	1-3	R	3		
																8.33	J	90	1-3	N	3		
																8.49	B	95	1-3	N	3		
											@ 9.52 m decrease in sandstone bedding.			1		8.62	J	110	1-3	N	3		
																8.64	B	95	<1	N	3		
10														2		8.77	B	95	<1	N	3		
																8.89	B	95	<1	N	3		

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-19

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
														2		9.02	B	85	<1	N	3		
																9.66	B	90	<1	N	3-6		
														2		9.85	B	95	<1	N	1-3		
																9.88	B	95	1-3	N	1-3		
														2		10.19	B	95	<1	N	1-3		
																10.32	B	95	<1	N	1-3		
11	6	2		1.52	100	90	95							2		10.47	B	95	1-3	N	1-3		
																10.68	B	90	1-3	N	1-3		
														2		10.84	B	100	1-3	N	1-3		
																10.98	B	95	1-3	N	3		
														1		11.19	B	95	1-3	N	3		
																11.29	B	95	<1	N	3		
12	7	3		1.52	100	96	98				@11.04 m slightly brownish-grey sandstone, predominantly shale, some grey-brown siltstone/clay layers.			2		11.51	B	95	1-3	N	3		
																11.74	B	95	<1	N	3		
														1		11.87	J	35	1-3	N	3-6		
																11.99	B	95	1-3	N	1		
														1		12.29				CL			
																12.61	B	95	1-3	N	1-3		
13														1									
																12.89	B	85	>3	N	1		
	8	3		1.52	97	91	100							1		13.17	J	105	1-3	N	1-3		
														2		13.23	J	100	1-3	N	3		
14																							
																14.74	B	95	>3	N	1-3		
														4		14.76	B	95	>3	N	1-3		
15	9	3		1.52	100	84	81									14.78	B	95	>3	CL	1-3		
														2		14.83	J	45	1-3	QTZ	1-3		
																15.07	J	25	1-3	CL	1-3		
											15.60 839.16					15.22	B	90					
								R2	F		@15.51 m 15mm pyrite infill. SHALE, dark to light grey and brown, fresh, R2, trace sandstone in layers (mm scale).												
16														1		15.98	B	80	<1	N	3		
	10	4		1.52	97	100	100																
														1		16.66	B	90	<1	N	3		
17																							
																17.17	B	90	<1	N	1-3		
																17.19	B	90	<1	N	3		
																17.28	B	80	1-3	N	3		
																17.36	J	80	<1	N	3		
																17.67	B	85	<1	N	3		
18	11	4		1.52	100	70	93									17.73	B	95	1-3	N	3		
																18.01	B	90	1-3	N	3		
																18.4	B	80	1-3	N	3		
																18.42	B	95	1-3	N	0-1		
																18.74	B	95	>3	N	3		
19																18.9	B	95	>3	N	3		
	12	4		1.52	89	42	87									19.27	B	90	>3	N	3		
																19.33	B	90	>3	N	3		
																19.53	B	90	>3	N	3		

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES: DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation

DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese

WEATHERING: F: Fresh SW: Slightly MW: Moderately HW: Highly CW: Completely RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-19

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	DISCONTINUITY DATA: FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	DISCONT. ANGLE (From Core Axis)	DISCONT. APERTURE (<1,1-3,>3mm)	DISCONT. INFILL TYPE	DISCONT. JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
20																19.59	B	90	>3	N	3		
																19.68	B	90	>3	N	3		
																19.81	B	90	>3	N	3		
																19.91	B	90	>3	N	3		
																20.04	B	90	>3	N	3		
											20.16 834.60 End of Hole at: 20.2 m												
21																							
22																							
23																							
24																							
25																							
26																							
27																							
28																							
29																							

CODES: DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation

DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese

WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

OVERBURDEN DRILLHOLE LOG BG13-20

STARTED: Sept 11, 2013 **FINISHED:** Sept 12, 2013
DRILL METHOD: HQ3 Coring
GROUND ELEV. (m): 853.6
COORDINATES (m): N 6096593 E 626876

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
0					SAND, some clay, some silty, cutting are bits of broken rock. [WEATHERED BEDROCK]	
1.0 (852.5)					Bedrock Contact @ 1.0 m, See Rock Log	
					End of Overburden Drill Log at 1.0 m.	

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: Onsite Storage Pond
LOGGED BY: MC **CHECKED BY:** RP
SHEET 1 **OF** 4 **HOLE NO.:** BG13-20

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-20

Klohn Crippen Berger

DATE STARTED: September 11, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 2 OF 4
DATE FINISHED: September 12, 2013	LOGGED BY: JW/MC	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 853.572
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 23.5	COORDINATES (m): E 626875.977 N 6096592.521
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 1	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Jon Rudolph	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
2	1	1		1.22	75	0	0	R0	HW-CW		SHALE, dark grey to black, highly weathered to completely weathered, highly fractured, R0, FeOx staining on fractures, extremely weak.			6									
														6									
														6									
														6									
														6									20-Core-01
3	2	1		1.52	99	0	0				@2.25 - 2.60 m CLAY, grey, high plastic, mc near PL, soft, homogeneous. @2.60 - 3.77 m: Rubble Zone and weathered shale (as above).			6									20-Core-02
														6									
														6									
														6									
														6									
4											3.77 849.80												
	3	1		1.52	99	0	36	R0	HW		SHALE, grey to dark grey, highly weathered, extremely weak, poor rock quality, highly fractured, FeOx staining in fractures, no visible bedding.											
											@4.67 - 5.29 m Clay infill in thin fractures.												
5														5		5.31	B	90	<1	CL	3		
														5		5.35	B	90	1-3	CL	3		
																5.36	J	0	<1	N	3		
														5		5.42	B	90	1-3	N	3		
																5.48	B	90	>3	N	6		
														5		5.64	J	95	>3	N	6		
																5.71	B	85	>3	N	3		
																5.77	B	115	<1	N	3		
														6		5.8	B	100	<1	N	1-3		
																5.87	B	100	<1	N	1-3		
														5		5.95	B	95	<1	N	1-3		
																5.99	B	95	<1	N	1-3		
6	4	2		1.52	95	19	15	R0	HW		@5.17 m : Planar fracture which polished surface. @5.29 m some interbedding of sandstone (light grey, R3)					6.07	B	95	<1	N	1-3		
																6.15	B	90	<1	N	1-3		
																6.17	B	95	<1	N	1-3		
														6		6.55	J	85	<1	N	1-3		
																6.59	B	95	<1	N	1-3		
7														4		6.6	B	95	<1	N	1-3		
																6.66	B	95	<1	N	1-3		
														5		6.7	B	95	<1	N	1-3		
																7.13	J	85	>3	N	1		
	5	2		1.52	98	45	58				@6.81 sandstone laminations and lenses to 30 mm.			2		7.19	J	85	>3	N	3		
														3		7.35	J	85	1-3	CL	1,3		
8														3		7.41	J	90	>3	CL	1		
																7.5	J	90	>3	CL	3		
														4		7.54	B	95	1-3	N	0,1		

DRAFT

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-20

Klohn Crippen Berger

(continued from previous page)

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC
	6	2		1.52	100	78	80			
10	7	3		1.52	100	86	99			
11–12	8	3		1.52	100	100	100			
13	9	3		1.52	89	100	100			
14–15	10	4		1.52	100	100	100			
16–17	11	4		1.52	91	87	100			
18	12	4		1.52	100	89	99			

DESCRIPTION

@11.37 m increased sandstone bedding.
@11.47 - 11.87 m Freshly healed joint.

DRILLING REMARKS

Vibrating Wire Piezometer installed at 11.1 m depth (VW25855) - Grouted installation

PIEZOMETER DETAILS

FRACTURE FREQ. (No. Per 30 cm) (scale 2 4): 3, 2, 1, 1, 3, 1, 2, 1, 1, 1, 1, 1, 2

FRACTURE ZONE

DISCONTINUITY DATA

DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC
7.58	J	45	>3	CL	3
7.63	B	95	<1	N	1
7.69	B	95	1-3	CL	3
7.76	J	70	1-3	CL	1
7.96	B	90	1-3	N	3
8.06	B	90	<1	N	1,3
8.18	J	110	<1	N	1,3
8.26	J	90	>3	N	3
8.37	B	90	>3	CL	1
8.41	B	90	>3	N	1
8.49	B	95	1-3	N	1
8.67	B	95	>3	N	3
8.7	J	80-90	>3	N	3
8.77	B	90	>3	N	1
8.91	B	95	1-3	N	1
8.97	B	95	>3	N	3
9.11	J	100	<1	N	1
9.14	J	100	<1	N	1
9.32	J	80	1-3	N	3
9.53	B	90	1-3	N	1
10.11	J	110	<1	N	1
10.34	J	90	>3	N	3
10.59	B	95	<1	N	1
10.67	B	95	1-3	N	1
10.73	B	95	1-3	N	1
11.15	B	90	1-3	N	1
12.91	B	95	1-3	N	1
13.18	B	90	<1	N	3
13.26	J	90	>3	N	3
15.03	J	80-90	<1	N	1,3
16.02	B	90	<1	N	1
16.39	B	90	<1	N	1
16.62	B	90	<1	N	1
17.07	B	90	<1	N	1
17.62	B	95	<1	N	1
17.77	B	95	<1	N	1

PERMEABILITY (m/sec) | **SAMPLE RETAINED**

CODES:
- DISCONT. TYPE: J: Joint; B: Bedding; S: Shear; Fol: Foliation
- DISCONT. INFILL: N: None; Cl: Clay; Qtz: Quartz; FeOx: Iron; Ca: Calcite; MnOx: Manganese
- WEATHERING: F: Fresh; SW: Slightly; MW: Moderately; HW: Highly; CW: Completely; RS: Residual Soil
- ROUGHNESS: 0: Polished/Slickensided/Gouge Filled; 1: Smooth, Planar; 3: Slightly Rough, Undulating; 5: Rough Undulating, Stepped; 6: Very Rough, Stepped
- ROCK STRENGTH (MPa): R0: Extremely Weak (<1); R1: Very Weak (1-5); R2: Weak (5-25); R3: Medium Strong (25-30); R4: Strong (50-100); R5: Very Strong (100-250); R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-20

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
19											18.97 834.60 SHALE, dark grey, very fine grained, medium strong, fresh laminated with fine grained sandstone laminations (typically < 1mm), some lenses of sandstone up to 3mm, thick bedding at 80 degrees TCA.			1		18.59	B	90	1-3	N	1		
								R3	F					1		19.03	B	75	<1	N	1		
	13	5		1.52	99	83	96									19.6	B	80	<1	N	1		
20														5		19.62	B	80	<1	N	6		
																19.63	B	80	<1	N	1		
														1		19.65	B	80	<1	N	1		
																19.74	B	70	1-3	N	6		
														1		19.98	B	80	1-3	N	1		
																20.23	B	80	1-3	N	1		
														2		20.53	B	80	<1	N	1		
21																20.77	B	70	1-3	N	1,3		
	14	5		1.52	99	89	96																
																21.71	B	80	<1	N	1		
22														3		21.9	B	80	<1	N	1		
																22	B	80	<1	N	1		
														1		22.4	J	10	<1	N	3		
	15	5		1.52	100	100	100																
23														2		23.14	B	80	<1	N	1		
											23.54 830.03 End of Hole at: 23.5 m					23.24	J	10	<1	N	3		
24																							
25																							
26																							
27																							
28																							

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 5: Rough Undulating, Stepped 3: Slightly Rough, Undulating 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R3: Medium Strong (25-30) R6: Extremely Strong (>250) R1: Very Weak (1-5) R4: Strong (50-100) R2: Weak (5-25) R5: Very Strong (100-250)

OVERBURDEN DRILLHOLE LOG BG13-21

STARTED: Sept 12, 2013 **FINISHED:** Sept 13, 2013
DRILL METHOD: HQ3 Coring
GROUND ELEV. (m): 842.7
COORDINATES (m): N 6096567 E 626614

DEPTH (m)	SPT BLOWS PER 0.15m	SAMPLE TYPE AND NO.	SAMPLE RECOVERY	SYMBOL	DESCRIPTION OF MATERIALS	INSTRUMENT DETAILS
0					SAND (SP), fine grained, trace silt, poorly graded, compact, moist, yellowish brown, trace organics.	
1.8 (840.9)					Bedrock Contact @ 1.8 m, See Rock Log	
					End of Overburden Drill Log at 1.8 m.	

Su - kPa
25 75 125 175 225
◇ UC/2 △ P.PEN/2
WATER1 ▽ WATER2 ▼ WATER3 ▼
★ % FINES ■ SPT N □ LPT N
W_P% W% W_L%
× – – – – ▲ – – – – ×
20 40 60 80

Klohn Crippen Berger

PROJECT NO.: M09684A05
PROJECT: Quintette 2013 Site Investigation
LOCATION: Onsite Storage Pond
LOGGED BY: MC **CHECKED BY:** RP
SHEET 1 **OF** 4 **HOLE NO.:** BG13-21

KCBL_OVERBURDEN_DRILLLOGS-SI QUINTETTE 2013 OVERBURDEN LOGS - COPY.GPJ KC_DATA.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-21

Klohn Crippen Berger

DATE STARTED: September 12, 2013	LOCATION: Tumbler Ridge, BC	BIT SIZE AND TYPE: HQ3 Diamond	SHEET 2 OF 4
DATE FINISHED: September 13, 2013	LOGGED BY: MC	RIG MAKE AND MODEL: Fraste Multidrill XL (Track)	COLLAR ELEVATION (m): 842.709
CLIENT: Teck	CHECKED BY: RP	TOTAL DEPTH (m): 20.32	COORDINATES (m): E 626614.127 N 6096566.995
PROJECT NAME: Quintette 2013 Site Investigation	DRILLING CO.: Geotech Drilling	BEDROCK DEPTH (m): 1.8	COORDINATE SOURCE: Teck Survey
PROJECT NO.: M09684A05	DRILLER: Jon Rudolph	AZIMUTH/ANGLE FROM VERT.: N/A	

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75							2 4									
2								R0	HW		SHALE, dark grey, very fine grained, very weak, highly fractured, bedding at 70 degrees TCA, majority of fractures are along bedding (smooth and planar), with FeOx staining and some clay infill.											
3	1	1		0.86	100	0	0							6									
4	2	1		1.524	80	0	0							6									
5	3	1		1.524	95	0	0				@5.98 - 6.11 m fragmented rock in a clay matrix.			6									
6											@6.32 -6.52 m fragmented rock in a clay matrix.			6									
											6.60 836.11			6									
7	4	2		1.524	97	0	57	R2	SW		SHALE, dark grey, very fine grained, weak, slightly weathered, bedding at 60 degrees TCA, laminations of fine grained sandstone typically < 1mm thick, some lenses of sandstone up to 20 mm thick.	Vibrating Wire Piezometer installed at 6.6 m depth (VW25849) - Grouted installation		6		7.24	B	60	<1	Ca	1		
														5		7.28	B	60	<1	Ca	1		
														6		7.33	B	60	<1	N	1		
														6		7.38	B	60	<1	N	1		
														6		7.42	B	60	<1	N	1		
8														4		7.8	B	60	<1	N	1		
														6		7.88	J	30	1-3	CL	3		
														4		7.93	B	70	1-3	N	1		
														6		7.97	B	70	1-3	N	1		
														6		8.15	B	60	<1	N	1,3		
9	5	2		1.524	99	19	40							6		8.22	B	60	<1	N	1,3		
														6		8.23	B	60	<1	Ca	3		
														6		8.39	B	60	<1	CL	1,3		

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None Cl: Clay Qtz: Quartz FeOx: Iron Ca: Calcite MnOx: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-21

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	ANGLE (From Core Axis)	APERTURE (<1,1-3,>3mm)	INFILL TYPE	JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
10								R3	F		@9.65 m beds of fine grained sandstone < 5 mm thick, no longer highly fractured.			6		10	B	60	<1	N	1		
														2		10.15	B	60	<1	N	1		
	6	2		1.524	100	67	80							1		10.35	B	60	<1	N	1		
														3		10.73	B	60	<1	N	1		
11																10.77	J	50	<1	N	1		
														1		10.79	J	50	<1	N	1		
																10.9	J	80	<1	N	1,3		
														2		11.22	J	80	1-3	N	1		
																11.41	B	60	1-3	N	1		
														1		11.57	B	60	1-3	Py	5		
12	7	3		1.524	100	95	99							2		11.99	B	60	<1	Py	1		
																12.01	B	60	<1	Py	1		
														2		12.34	B	60	<1	N	1		
																12.36	B	60	1-3	N	6		
13														1		12.82	B	60	1-3	N	1,3		
														2		13.1	J	20	<1	N	3		
	8	3		1.524	100	51	59				@13.38 - 13.52 m: fractured rock with clay infill.					13.13	B	60	<1	N	1		
														6									
14														6									
														3		13.98	B	60	<1	N	1		
																14.03	J	30	<1	N	3		
																14.05	B	60	<1	N	1		
																14.53	B	60	<1	N	1,3		
														2		14.81	B	60	<1	Py	1		
15	9	3		1.524	100	95	100							1		15.02	B	60	1-3	N	1		
																15.45	B	60	<1	N	3		
														2		15.5	B	60	1-3	N	1,3		
																15.81	B	70	1-3	N	1,3		
16														3		15.85	J	70	1-3	N	0		
																15.88	B	60	1-3	N	0		
														1		16.14	B	60	1-3	N	0		
	10	4		1.524	100	80	90									16.68	J	40	1-3	N	3		
														4		16.76	B	60	<1	N	1		
17																16.83	J	5	1-3	N	3		
																16.93	B	60	1-3	N	1		
																17.59	B	60	<1	N	1		
														1									
18	11	4		1.524	100	68	81							3		18.05	J	50	1-3	N	1		
																18.09	B	60	1-3	CL	1		
														2		18.12	J	60	<1	N	1		
																18.23	B	70	<1	N	6		
											@18.50 - 19.01 m fractured zone, fractures are parallel to the bedding, smooth, planar.			6		18.44	B	60	<1	N	1		
19														6									
											@19.10 -19.45 m fracture zone.			2		19.22	B	60	1-3	N	1,3		

KCBL_ROCK-SI_W/ DISCONTINUITIES-V3 QUINTETTE 2013 ROCK LOG - COPY.GPJ ROCK-LOG.GDT 14/1/27

CODES:
DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation
DISCONT. INFILL: N: None Fe Ox: Iron Cl: Clay Ca: Calcite Qtz: Quartz Mn Ox: Manganese
WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil
ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped
ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

GEOLOGIC DRILL LOG OF BOREHOLE NO.: BG13-21

Klohn Crippen Berger

DEPTH (m)	RUN NUMBER	BOX NUMBER	AVG DRILL RATE (min/m)	RUN LENGTH (m)	TCR (%)	RQD (%)	SCR (%)	HARDNESS	ROCK MASS WEATHERING	LITHOLOGY GRAPHIC	DESCRIPTION	DRILLING REMARKS	PIEZOMETER DETAILS	DISCONTINUITY DATA: FRACTURE FREQ. (No. Per 30 cm)	DISCONTINUITY DATA: FRACTURE ZONE	DISCONT. DEPTH (m)	DISCONT. TYPE	DISCONT. ANGLE (From Core Axis)	DISCONT. APERTURE (<1,1-3,>3mm)	DISCONT. INFILL TYPE	DISCONT. JRC	PERMEABILITY (m/sec)	SAMPLE RETAINED
			5 10 15		25 50 75	25 50 75	25 50 75				(continued from previous page)			2 4									
20	12	4		1.524	100	62	78	R3	F		19.45 823.26 SANDSTONE, fine grained, grey, strong, fresh, interbedded with shale up to 20 mm thick, bedding at 60 degrees TCA, some quartz infill, trace , mm thick quartz veins. 20.32 822.39 End of Hole at: 20.3 m			6 4 1		19.28 19.76 19.77 19.82 19.83 20.12	B J J B B B	60 40 40 60 60 60	<1 >3 >3 1-3 1-3 1-3	N Qtz Qtz N N N	1,3 3 3 1 1 3		
21																							
22																							
23																							
24																							
25																							
26																							
27																							
28																							

DRAFT

DISCONT. TYPE: J: Joint B: Bedding S: Shear Fol: Foliation

DISCONT. INFILL: N: None FeOx: Iron Cl: Clay Ca: Calcite Qtz: Quartz MnOx: Manganese

WEATHERING: F: Fresh HW: Highly SW: Slightly CW: Completely MW: Moderately RS: Residual Soil

ROUGHNESS: 0: Polished/Slickensided/Gouge Filled 1: Smooth, Planar 3: Slightly Rough, Undulating 5: Rough Undulating, Stepped 6: Very Rough, Stepped

ROCK STRENGTH (MPa): R0: Extremely Weak (<1) R1: Very Weak (1-5) R2: Weak (5-25) R3: Medium Strong (25-30) R4: Strong (50-100) R5: Very Strong (100-250) R6: Extremely Strong (>250)

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