COAL ASSESSMENT REPORT TITLE PAGE AND SUMMARY

TITLE OF REPORT:
Coal Assessment Report for the Hermann (Area C) tenures, Mt. Hermann area, British Columbia

TOTAL COST: $1,170,545.29 (for Tenures 383180 through 383183)

AUTHOR(S): **C.G. Cathyl-Huhn P.Geo**
SIGNATURE(S):
NOTICE OF WORK PERMIT NUMBER(S)/DATE(S): **CX-9-9 / November 9, 2020**

YEAR OF WORK: **2020-2021 licence term** REPORT DATE: **January 10, 2022**
PROPERTY NAME: **Hermann Project (Mine 164053)** APPROVAL: **20-1640353-1109**
COAL LICENSE(S) AND/OR LEASES ON WHICH PHYSICAL WORK WAS DONE: **Coal Licences 383180, 383181, and 383183, within 'Area C' of the Hermann tenures**

MINERAL INVENTORY MINFILE NUMBER(S), IF KNOWN: **93P 031**
MINING DIVISION: **Liard (Peace region)**

NTS / BCGS: **NTS 93I/14 and 93P/3 BCGS 093P.004 and 093I.094**
LATITUDE: **55° 00' 04.5" N**
LONGITUDE: **121° 08' 50.5" W** (at centre of work)
UTM Zone: **10N** EASTING: **618500** NORTHING: **6096500**

OWNER(S): **Conuma Resources Limited**
MAILING ADDRESS: **200-235 Front Street, Tumbler Ridge, B.C. V0C 2W0 Canada**

OPERATOR(S): **Conuma Resources Limited**
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REPORT KEYWORDS

bituminous coal, Gates Formation, Falher Member, Notikewin Member, Torrens Member, Gething Formation, Chamberlain Member, Bullmoose Member, Gaylard Member, Boulder Creek Formation, Paddy Member, Walton Creek Member, Cadotte Member, Bullmoose Fault, Mesa Fault, decollement

REFERENCES TO PREVIOUS ASSESSMENT WORK AND ASSESSMENT REPORT NUMBERS:

Coal Assessment Report 1057 (principal reference); also Reports 515, 609, 614, 616, 617, 618, 724, 739, 746, 753, 910, 942, 950, and 999; Petroleum Assessment Report 863; Oil and Gas Commission files WA 5099 and WA 9997.

Hermann_2021_220107g.odt/pdf

SUMMARY OF TYPES OF WORK IN THIS REPORT		EXTENT OF WORK (in metric units)	ON WHICH TENURES
GEOLOGICAL (scale, area)			
	Ground, mapping	**none**	**not applicable**
	Photo interpretation	**none**	**not applicable**
GEOPHYSICAL (line-kilometres)			
	Ground (Specify types)	**none**	**not applicable**
		none	**not applicable**
	Airborne (Specify types)	**none**	**not applicable**
		none	**not applicable**
	Borehole geophysics (wireline logs)		
	Gamma -- 9 boreholes	**908.90 metres**	**383180, 383181, and 383183**
	Neutron -- 9 boreholes	**906.24 metres**	**383180, 383181, and 383183**
	Resistivity -- 9 boreholes	**908.90 metres**	**383180, 383181, and 383183**
	Caliper -- 9 boreholes	**908.90 metres**	**383180, 383181, and 383183**
	Deviation -- 9 boreholes	**909.26 metres**	**383180, 383181, and 383183**
	Dipmeter -- 8 boreholes	**787.39 metres**	**383180, 383181, and 383183**
	Other -- Acoustic televiewer - 8 boreholes	**785.20 metres**	**383180, 383181, and 383183**
	Core **-- 8 diamond-drill boreholes (HQ size)**	**791.15 metres**	**383180, 383181, and 383183**
	Core -- **4 diamond-drill boreholes (nine-inch drilled bulk sample)**	**469.68 metres**	**383181**
	Non-core -- **4 boreholes**	**137.5 metres**	**383180, 383181, and 383183**
SAMPLING AND ANALYSES			
Total number of samples**: 289, all from drilled bulk sample boreholes**			
	Proximate (including sulphur and s.g.)	**13**	**383181**
	Free swelling index (FSI)	**13**	**383181**
	Light transmittance (oxidation test)	**11**	**383181**
	Ultimate	**13**	**383181**
	Sulphur forms	**11**	**383181**
	Gieseler fluidity (ddpm)	**13**	**383181**
	Ruhr dilatometer	**13**	**383181**
	Ash chemistry (mineral analysis of ash)	**13**	**383181**
	Ash fusion temperatures (Celsius)	**13**	**383181**
	Petrographic (maceral determination)	**13**	**383181**
	Sapozhnikov test (GB/T479-2000)	**9**	**383181**
	Vitrinite reflectance	**13**	**383181**
	Coking	**1**	**383181**
	Wash tests (**Jig tests**)	**none**	**383181**
PROSPECTING (scale/area)		**none**	**not applicable**
PREPARATORY/PHYSICAL		**none**	**not applicable**
Line/grid (km)		**none**	**not applicable**
Trench (number, metres)		**none**	**not applicable**
Bulk sample(s) -- **drilled bulk sample (see above)**		**1**	**383181**

Section 4 and Appendix B remain confidential under the terms of the Coal Act Regulation and have been removed from the public version.

https://www.bclaws.gov.bc.ca/civix/document/id/complete/statreg/251_2004

Frontispiece: Outcrop of the Hermann E1, E2, E3, and E4 coal beds. Coals dip 40 to 50 degrees to northeast, within the imbricate core of a triangle zone bounded by the Mesa Thrust and the Marmot Thrust. View is to the northwest. E1 coal is at the top of the coal exposure, and E4 coal is at the base. The industrial structure in the foreground is the surface facility of suspended natural-gas well c-02-B / 93-P-3

1 Table of contents

1.1 List of tables

1.2 List of maps

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2 Introduction and situation

This report, titled *Coal Assessment Report for the Hermann (Area C) tenures, Mt. Hermann area, British Columbia,* presents results of drilling programme conducted during the 2020-2021 work term by Conuma Resources Limited (Conuma). The report has been submitted by Conuma in keeping with obligations under the *Coal Act* and the *Coal Act Regulation*.

2.1 Property description

The Hermann coal property consists of provincially-granted Crown coal tenures comprising thirteen coal licences, numbered 383180-383183, 405136-405142, 417327, and 417485. All tenures are contiguous, with no freehold inholdings or adjacencies. Tenures 383180, 383181, 383182, and 383183 comprise Area 'C', an informal name (see **Map 2-2**) for the four mutually-adjacent coal licences which share a common anniversary date of December 18th. Areas 'A', 'B', and 'D' constitute the remainder of the Hermann property.

Tenure anniversary dates vary (refer to **Table 2-1**): the most immediately-upcoming date is April 25, 2022, for coal licence 417327. An application to convert coal licences 383180, 383181, 383182, 383183, 405139, 417327, and 417485 into a coal lease was submitted by Conuma in October of 2019. At the time of this report's writing, the application is still being considered by the Crown.

2.2 Terms of reference of this report

The principal focus of this report is coal-quality investigations and a coking test, done on large-diameter core samples of coal and associated rocks, collected from a four-hole drilled bulk-sample site situated within tenure 383181. Mention is also made of year-2021 geotechnical drilling conducted within several tenures, including off-property drilling done within tenure 417036, in support of facility design for the proposed Hermann Pit of the Wolverine Mining Complex. Tenure 417036 is held by Peace River Coal, who agreed to Conuma's access to the tenure for the purposes of geotechnical drilling.

Cost analysis and exploratory work statistics presented within the present report consider solely the work done within tenures 383180 through 383183 (sharing a common anniversary date, and here referred-to as Area 'C' of the Hermann coal property. Interpretation of results for geotechnical and hydrological drilling within nearby tenures 417327 and 417036 is still underway, and will be further reported with the upcoming Coal Assessment Report for Tenure 417327.

2.3 Property history

The Hermann coal licences were awarded by the Crown to Western Canadian Coal Corp. (WCCC) between the years 2000 and 2006, and subsequently acquired by Walter Energy Inc. and associated firms – including the Walter Canadian Coal Partnership (WCCP) – in the course of a corporate merger in 2011. In 2016, WCCP's ownership of the Hermann property was transferred to Conuma, as part of a regional-scale purchase of WCCP's tenures.

Drilling of exploratory boreholes commenced at Hermann in 1976, under the auspices of Denison Mines. Up until 2019, and under the auspices of several companies including Conuma, historic drilling totalled 307 boreholes with aggregate length of at least 32,105.8 metres. Length of drilling may have been somewhat greater, but historic records are incomplete.

2.4 Current physical work

Current physical work on the Hermann coal property and also within adjoining tenure 417036 (held by Peace River Coal, and accessed by agreement) comprises the drilling of 24 boreholes with total length of 1475.63 metres, broken down as follows:

- Current work within the Hermann Area 'C' coal licences (tenures 383180 through 383183) comprises the drilling of 16 boreholes with total length of 1398.33 metres, at an estimated total cost (including coal-quality analysis and coking testwork) of $1,170,545.29;
- Current work elsewhere within the Hermann property (within tenure 417327) comprises 1 borehole with a total length of 7.6 metres; and
- Current work on Peace River Coal's adjoining tenure 417036 comprises the drilling of 7 boreholes, none of which approached known or potential coal-measures, with total length of 69.7 metres.

Positions, depths, and details of current boreholes are reported within **Tables 2-3, A-1**, and **A-2,** of this report. **Appendix A** presents geological and geophysical logging details of year-2021 boreholes, along with core descriptions for the four large-diameter boreholes which were cored. **Appendix B** provides proximate and additional analyses on core samples of coal and rock. **Appendices C** and **D** present as-recorded and as-interpreted geophysical logs, respectively.

To date, 323 boreholes are known to have been drilled at Hermann, with total length of at least 33,504.13 metres. The majority of these boreholes have been geophysically logged.

Coal Assessment Reports No.950, 999, and 1057 (CAR-950, CAR-999 and CAR-1057) are the primary background reference sources for the present report. The interested reader is directed there to obtain a more detailed recounting of historic (pre-2021) exploratory work, and of the broader geological setting of the Hermann coal property.

Estimated overall cost of exploratory work within Hermann Area 'C' (thus within tenures 383180 through 383183) during the 2020-2021 work term is $1,170,545.29, for a unit cost of $840.68 per metre drilled.

2.5 Location and access

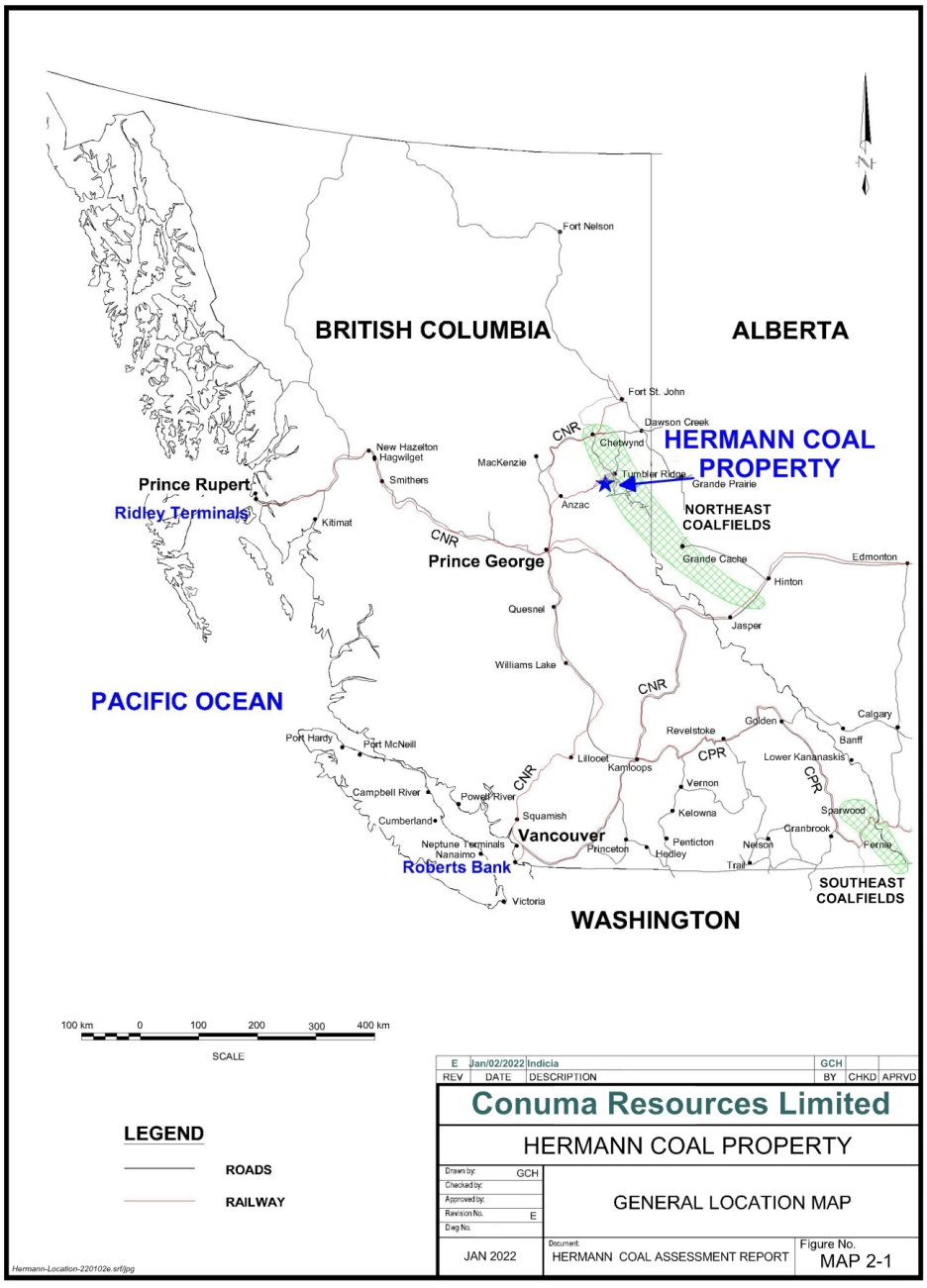
General location of the property is depicted within **Maps 2-1** and **2-2**, whereas coal tenure (**Table 2-1**) is depicted in relation to the local topographic setting of the Hermann coal property within **Map 2-3**.

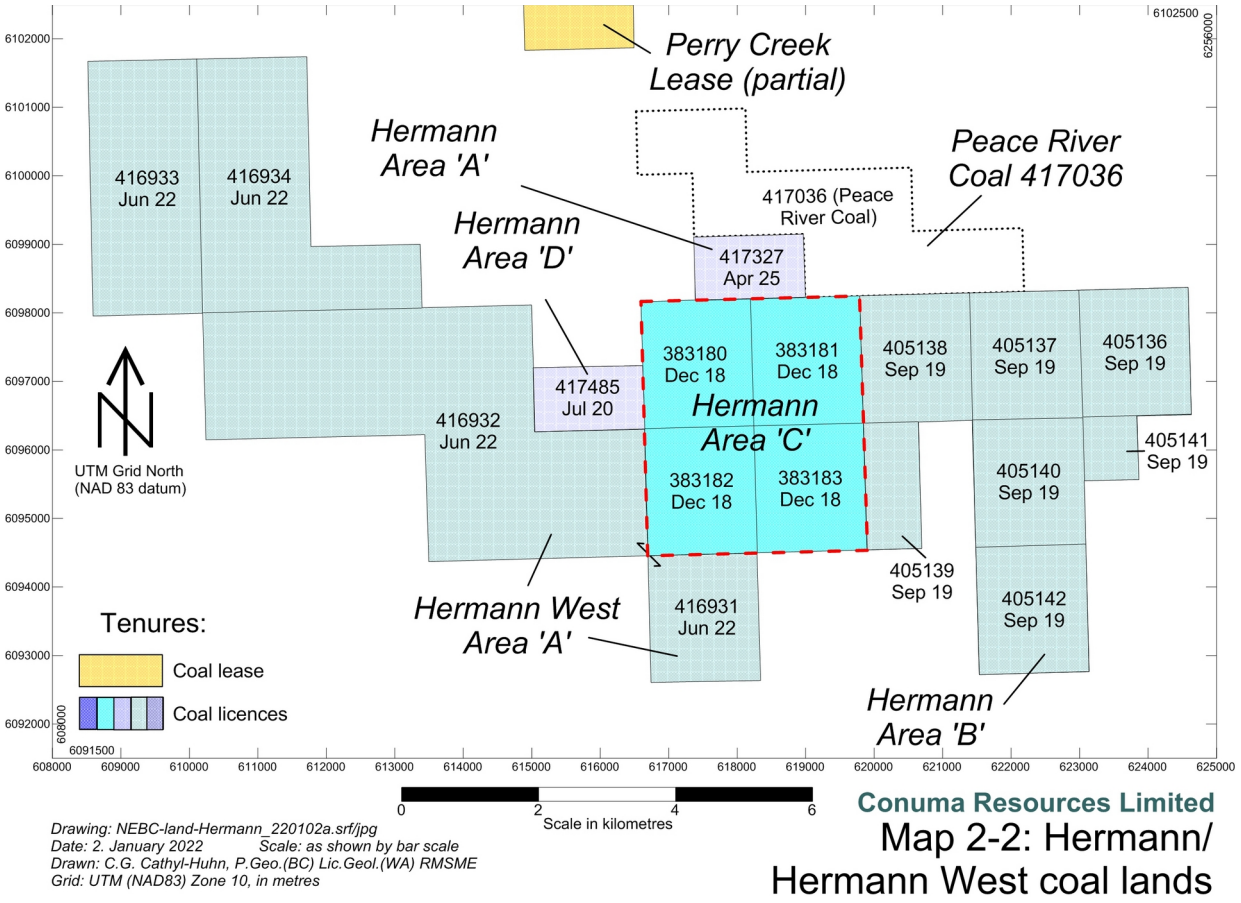
The Hermann coal property is accessible via all-weather highways and roads, at a driving distance of 128 kilometres south from Chetwynd town, and 33 kilometres southwest from Tumbler Ridge town, within map-areas 93 P/03 and 93I/14 of Canada’s National Topographic System.

Highway access is via route BC-29, connecting Chetwynd to Tumbler Ridge, thence southward a further 15 kilometres on route BC-52. From a well-marked junction at this point, access is via the first 9 kilometres of the Murray River Forest Service Road (FSR), which skirts the southern side of Teck Corporation’s mothballed Quintette coal-washery, passes through two culverted tunnels beneath Quintette’s former coal-haulage roads, and then crosses the Murray River.

Map 2-1: General location map

Hermann-Location-220102e.jpg





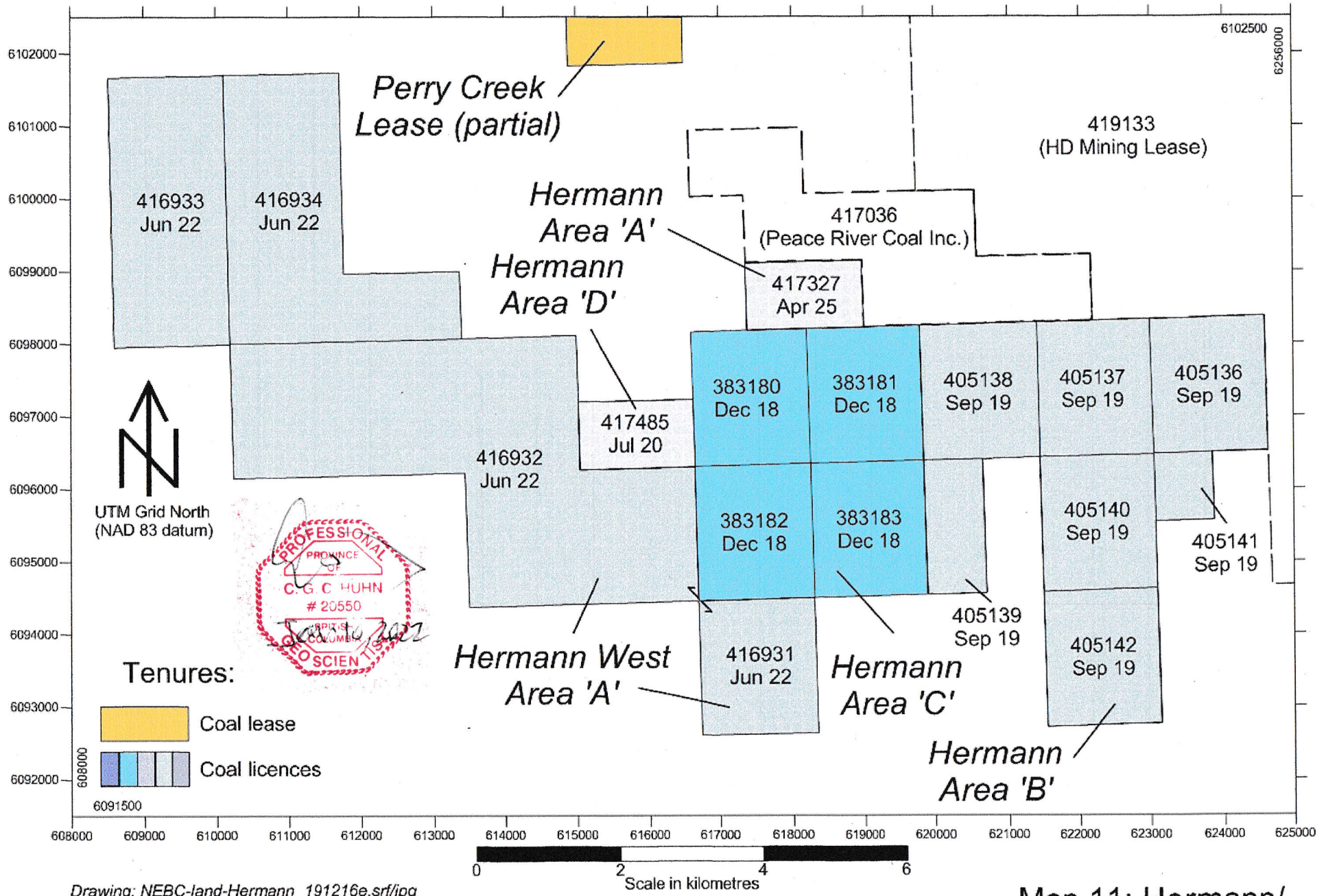
NEBC-land-Hermann_220102a.jpg

Immediately past the river-crossing, Quintette's former Mesa coal-haulage road, now signposted as the Mast Creek Petroleum Development Road (Mast Creek PDR) extends a further 9 kilometres westward to its crossing with the non-status Nabors Road, which extends southward into the Hermann coal property (as shown on **Map 2-3**). From this junction, the Mesa coal-haulage road extends northwestward to the former Quintette Mine open-pits atop Mt. Sheriff and Mt. Frame. The northward extension of the Nabors Road is now sign-posted as the Mast Creek PDR; following this route an additional 13.9 kilometres northward eventually leads to a bridge across Wolverine River, and a junction with kilometre 8.3 of the Wolverine FSR.

2.5.1 Road and trail access details

The non-status Nabors Road runs generally southerly across the Hermann coal property, ending at a natural-gas well (d-64-J / 93-I-14) situated south of Area 'C', but within Conuma's adjoining Hermann West coal property. A network of coal-exploration trails extends outward to the east and west of the Nabors Road; these trails are in various states of repair, but most are presently suitable as walking routes, or for usage by all-terrain vehicles.

Within the southwestern corner of the Hermann coal property, the non-status Viewpoint Road branches eastward from the Nabors Road, and winds around the contours of hills. Numerous coal-exploration trails, most of which are now overgrown by brush and timber, extend to the northeast and southeast from the road's termination on the southern flank of Mt. Hermann. The



Drawing: NEBC-land-Hermann_191216e.srf/jpg
Date: 16.December, 2019 Scale: as shown by bar scale
Drawn: C.G. Cathyl-Huhn, P.Geo.(BC) Lic.Geol.(WA) RMSME
Grid: UTM (NAD83) Zone 10, in metres

Map 11: Hermann/ Hermann West coal lands

upper slopes of Mt. Hermann and its adjoining western ridgeline are sparsely-timbered, affording good off-trail access by walking. A disused radio shack occupies the peak of the mountain. The Hermann property's eastern end is more difficult to reach than its central area and western end. Walking access only is afforded by a network of old coal-exploration trails, now mostly overgrown, extends northwestward from the Murray River FSR, switch-backing up the southeastern and eastern flanks of Mt. Hermann. The initial portions of these trails are controlled by Teck Corporation, as part of their former Quintette minesite, and access must therefore be negotiated with Teck.

2.5.2 Airborne access

An unattended, paved airstrip is situated south of Tumbler Ridge; the airstrip is served by various chartered air-transportation firms, from airports at Prince George, Chetwynd and Dawson Creek. Numerous helicopter landing-points are available atop ridges above timberline, and in a large clearing situated west of the natural-gas wellsite at d-83-J / 93-I-14.

2.5.3 Regulatory setting of surface access

Surface access for drilling and other exploratory works is regulated by the provincial government, subject to the *Coal Act Regulations* and the *Mines Act*. The Hermann coal property is situated within Block 4 of Canfor Inc.'s Tree Farm Licence No.48. The property is furthermore situated within the Dawson Creek Land and Resource Management Plan area, and the Foothills Resource Management Zone, allowing for multiple resource uses, including coal-mining. Oil and gas tenures exist throughout the Hermann coal property, and natural gas was recently (summer of 2014) actively produced from a wellhead (c-02-B / 93-P-3) situated within Coal Licence 383181, although that well is presently suspended from production.

2.6 Tenure details

The Hermann property as a whole comprises 13 coal licences (**Maps 2-2 and 2-3**) which were acquired from the Crown by Western Canadian Coal at various times between the years 2000 and 2006, subsequently acquired by Walter Energy after its acquisition of Western Coal, and thereafter sold to Conuma.

Coal licences grant to their holder the exclusive right to explore for coal, subject to consultation with local First Nations, coordination of access with other tenure-holders (such as oil and gas firms, other mineral-tenure holders, guide-outfitters, trappers, and timber companies), and the successful submission of an exploratory work plan. Coal licences do not, in and of themselves, confer the ownership of coal upon their holder (as the coal remains the property of the Crown via the province of British Columbia), but coal licences can under appropriate circumstances be converted into coal leases, upon which a scheme of mining may be established. A coal lease application was recently (October, 2019) made, covering portions of the Hermann coal property.

Table 2-1 presents statistical and cadastral details of the 13 tenures, whose aggregate area is 3,193 hectares, and whose annual rental cost is $69,800. Exploration has taken place in most years since work began in 1976, up until 2019 ('historic work'), and during year-2021 ('current' work for purposes of this report).

The term of coal licences is one year, which may normally be extended upon the payment

of an area-based annual rental fee as prescribed by the l *Coal Act Regulation*. Hermann is now within its fourth and fifth five-year span of increased rental fees, at $20 to $25/hectare. Upcoming rental for the 13 Hermann coal licences is $69,800. Considering just the four licences (383180 through 383183) which comprise Area 'C', their upcoming total rental will be $29,700.

Table 2-1: Coal tenures comprising the Hermann coal property

Land description			Area (ha)	Anniversary dates		Annual rental rate ($/ha)	Annual rental fee (rate times area)	Sub-area
Tenure	Blocks	Units		Issued on	Renew by			
383180	93P/3 Block B	3, 4, 13, 14	297.00	Dec.18, 2000	Dec.18, 2022	$25	$7425	Area C
383181	93P/3 Block B	1, 2, 11, 12	297.00	Dec.18, 2000	Dec.18, 2022	$25	$7425	Area C
383182	93I/14 Block J	83, 84, 93, 94	297.00	Dec.18, 2000	Dec.18, 2022	$25	$7425	Area C
383183	93I/14 Block J	81, 82, 91, 92	297.00	Dec.18, 2000	Dec.18, 2022	$25	$7425	Area C
405136	93P/3 Block A	5, 6, 15, 16	297.00	Sep.19, 2003	Sep.19, 2022	$20	$5940	Area B
405137	93P/3 Block A	7, 8, 17, 18	297.00	Sep.19, 2003	Sep.19, 2022	$20	$5940	Area B
405138	93P/3 Block A	9, 10, 19, 20	297.00	Sep.19, 2003	Sep.19, 2022	$20	$5940	Area B
405139	93I/14 Block I	90, 100	148.00	Sep.19, 2003	Sep.19, 2022	$20	$2960	Area B
405140	93I/14 Block I	87, 88, 97, 98	297.00	Sep.19, 2003	Sep.19, 2022	$20	$5940	Area B
405141	93I/14 Block I	96	74.00	Sep.19, 2003	Sep.19, 2022	$20	$1480	Area B
405142	93I/14 Block I	67, 68, 77, 78	297.00	Sep.19, 2003	Sep.19, 2022	$20	$5940	Area B
417327	93P/3 Block B	22, 23	149.00	Apr.25, 2006	Apr.25, 2022	$20	$2980	Area A
417485	93P/3 Block B	5, 6	149.00	Jul.20, 2006	Jul.20, 2022	$20	$2980	Area D
13 coal licences / 43 units			3193 ha				$69,800	

Note: the four licences comprising Area 'C' are inlined in heavy black.

2.7 Infrastructure and geomatics

Electrical power is potentially available from B.C. Hydro's Quintette substation, served by 230-KV transmission line 2L323. Sub-transmission and distribution lines, formerly serving the western Quintette mines, were removed subsequent to those mines' closure.

Telecommunications are available via satellite and cellular telephone systems. Satellite access is excellent in upland areas, but unreliable in the heavily-wooded hillsides. Cellular coverage also inconsistent, owing to issues of line-of-sight in mountainous country.

Base-mapping for Hermann is freely available from the provincial government's Base Map Online Store, which affords a facility for downloading shaded-relief topographic maps of the British Columbia Geographic System (BCGS) at 1:20,000 scale. BCGS map-sheets 093I.094, 093I.095, 093P.004, and 093P.005 cover the property and adjoining areas. Georeferenced satellite photography is freely available via the *Google Earth* web-service. In general, this imagery is amenable to studies of gross geological and geomorphological structure, and for the general tracing of roadways and vehicular access trails, but its level of detail is insufficient to allow for trafficability determinations.

2.8 Physiography, landscapes and climate of the Hermann property

Terrain (**Map 2-3**) is generally mountainous, with very steep hillslopes, capped by rolling sub-alpine plateaux which have been dissected by steep gullies and ravines. Two creeks, M20 Creek and Nabors Creek, drain the majority of the property, with lesser drainages into K6 Creek, Twenty Creek, M14 Creek and South Hermann Creek.

Coniferous forest covers the lower slopes of Mt. Hermann and adjoining ridgelines, declining in size and vigour with increasing altitude and wind-exposure. Near the treeline, forest cover is diminished to dense tangles of wind-sculpted krummholz. In the past several years, considerable clear-cut logging has been done within and adjacent to the Hermann coal property. In the summer of 2020, a forest fire (the Tentfire Creek wildfire) burned the forest cover within the southwestern portion of the property.

Soil cover is generally patchy, consisting mainly, till, alluvium and peat at lower elevations, and talus and colluvium at higher elevations. Thicker soils (including unconsolidated parent materials) are known to be present within the deep, glacially-rounded valley of Murray River, and in isolated areas on the southeastern face of Mt. Sheriff.

Hermann has a continental montane to alpine climate, characterised by long, moderately cold, snowy winters and short, rainy, warm summers. Snow and frost may occur in any month of the year, and isolated snowfields persist on north-facing slopes into July. The coldest weather usually occurs from January through March, where temperatures of –40C occasionally occur. Winds are generally gusty and ongoing, with rare calm periods. Convective thunderstorms frequently occur during summer months, bringing intense rain-showers and occasional hail.

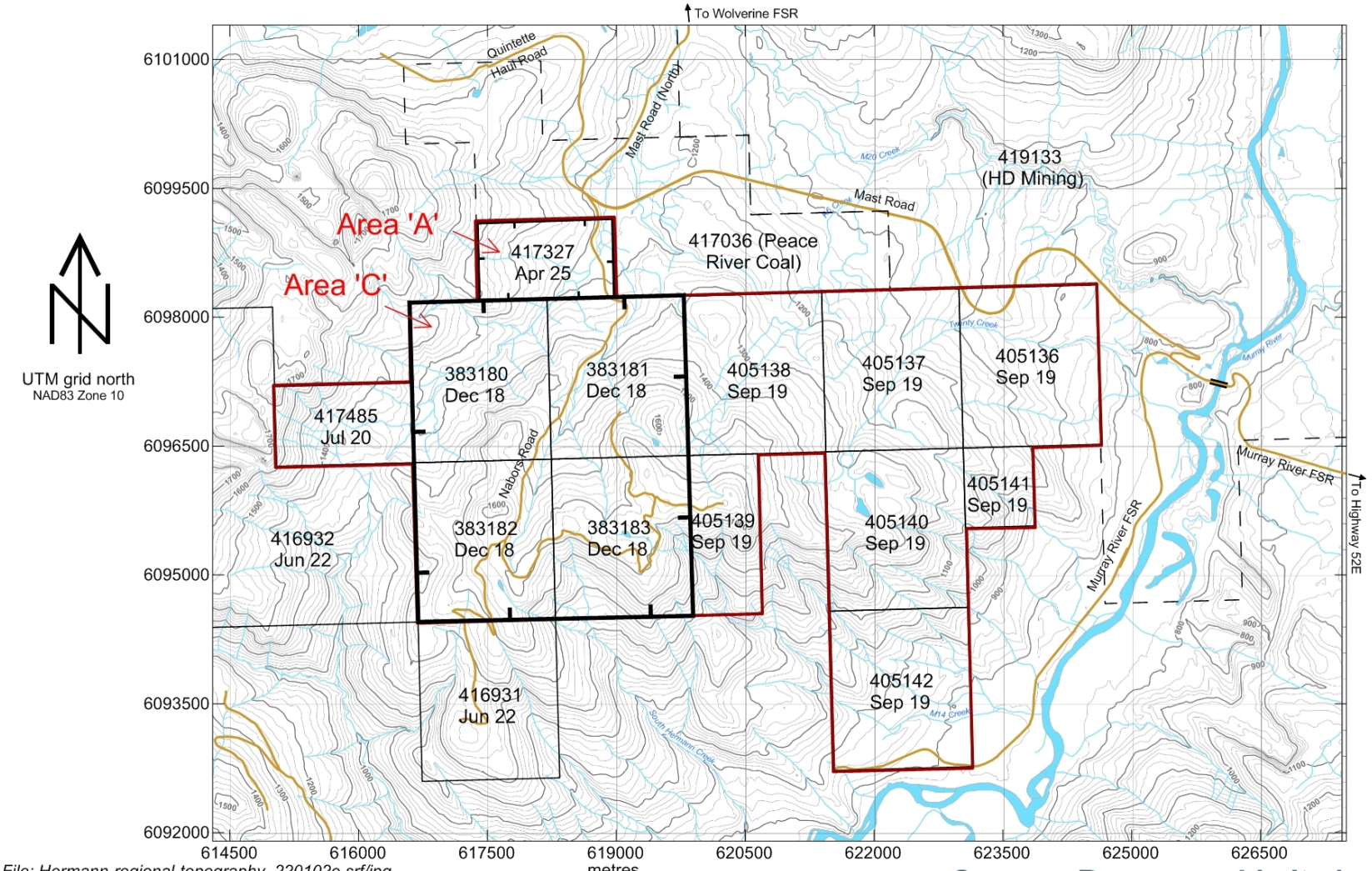
2.9 Synopsis of current (year-2021) exploration

‘Current work’, for the purposes of this report, comprises drilling (**Map 2-4**, **Table 2-2**, and **Appendix A**), coal-quality sampling and analysis via a large-diameter drilled bulk sample (**Appendix B**), and both geophysical and positional surveying of boreholes. Fieldwork was managed by contracted geologists from Apex Geoscience Ltd., who provided daily progress reports through-out the drilling programmes, as well as tracking accrued costs relative to purchase orders..

In all, 24 boreholes were drilled, principally for geotechnical purposes, with a lesser but still significant component of coal-quality investigation via rotary-drilling and large-diameter diamond-drilling.

Amongst these 24 boreholes, 7 were drilled off-tenure (with respect to the Hermann property as a whole) for geotechnical investigations in support of mine facility design. The off-tenure work was done by agreement with Peace River Coal, the owners of the tenure (Coal Licence 417036) where the 7 off-tenure boreholes were drilled. None of the 7 off-tenure boreholes entered known or potentially coal-bearing rocks. One additional borehole was drilled within the Hermann property but outside the confines of the four tenures which comprise Area 'C'. The remaining 16 boreholes were drilled within Area 'C', and are thus included within the annual statistical return for tenures 383180 through 383183.

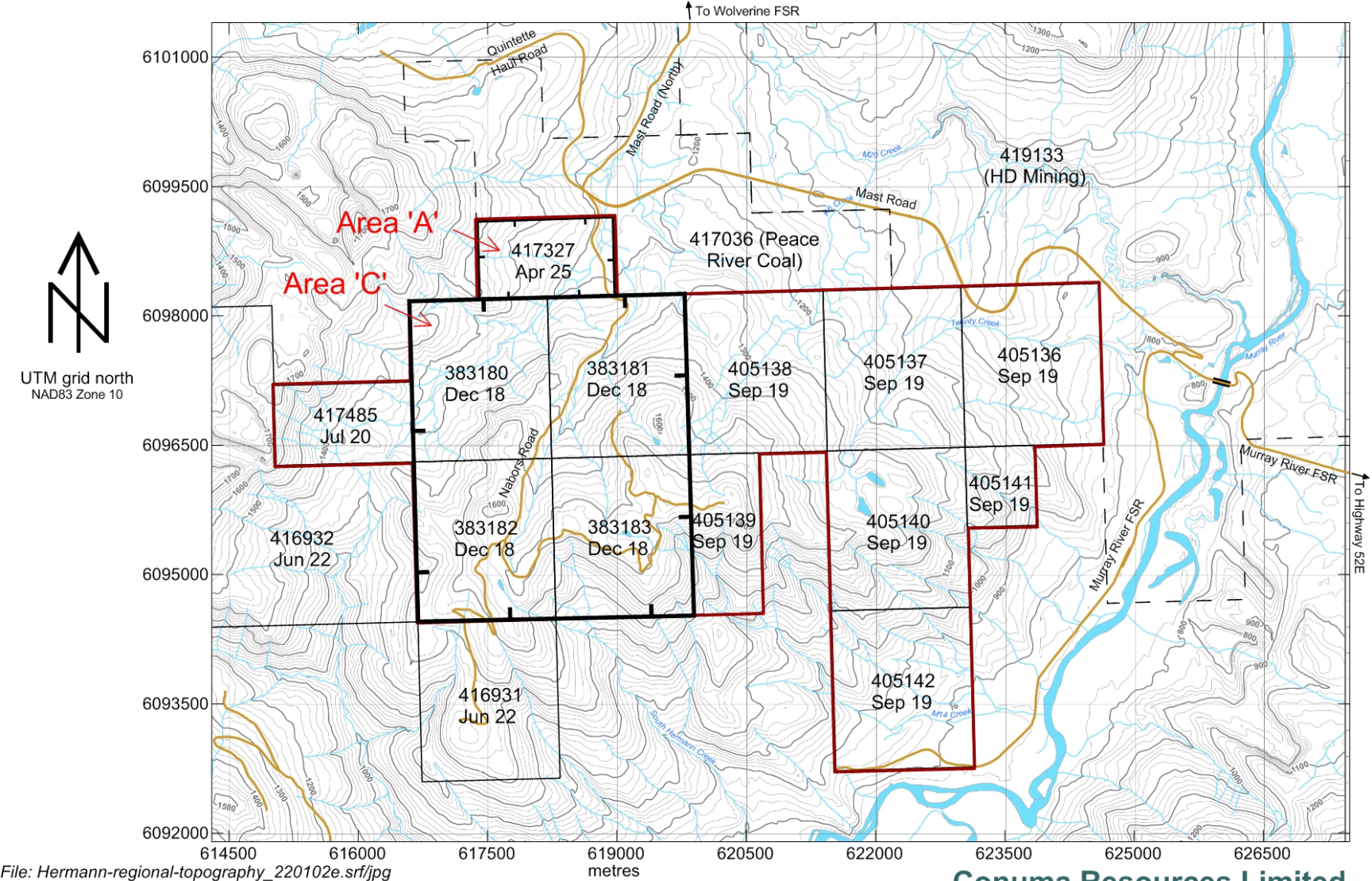
Geotech Drilling Services drilled the shallow geotechnical boreholes. Good Earth Drilling Services drilled all the cored boreholes, including the slim-hole coring and the large-diameter drilled bulk sample. Good Earth also drilled the non-coring pilot hole for the bulk sample array.



File: Hermann-regional-topography_220102e.srf/jpg
Drawn: C.G. Cathyl-Huhn PGeo LicGeol RMSME
Projection: Universal Transverse Mercator Scale: as shown
Grid: UTM NAD83 Zone 10 (in metres) Date: 2 Jan 2022
Base map from Lorax Environmental
Tenure information from Mineral Titles Online
Hermann-regional-topography_220102e.jpg

Conuma Resources Limited
Hermann coal property: Area 'C'

Map 2-3: Coal tenure and topography

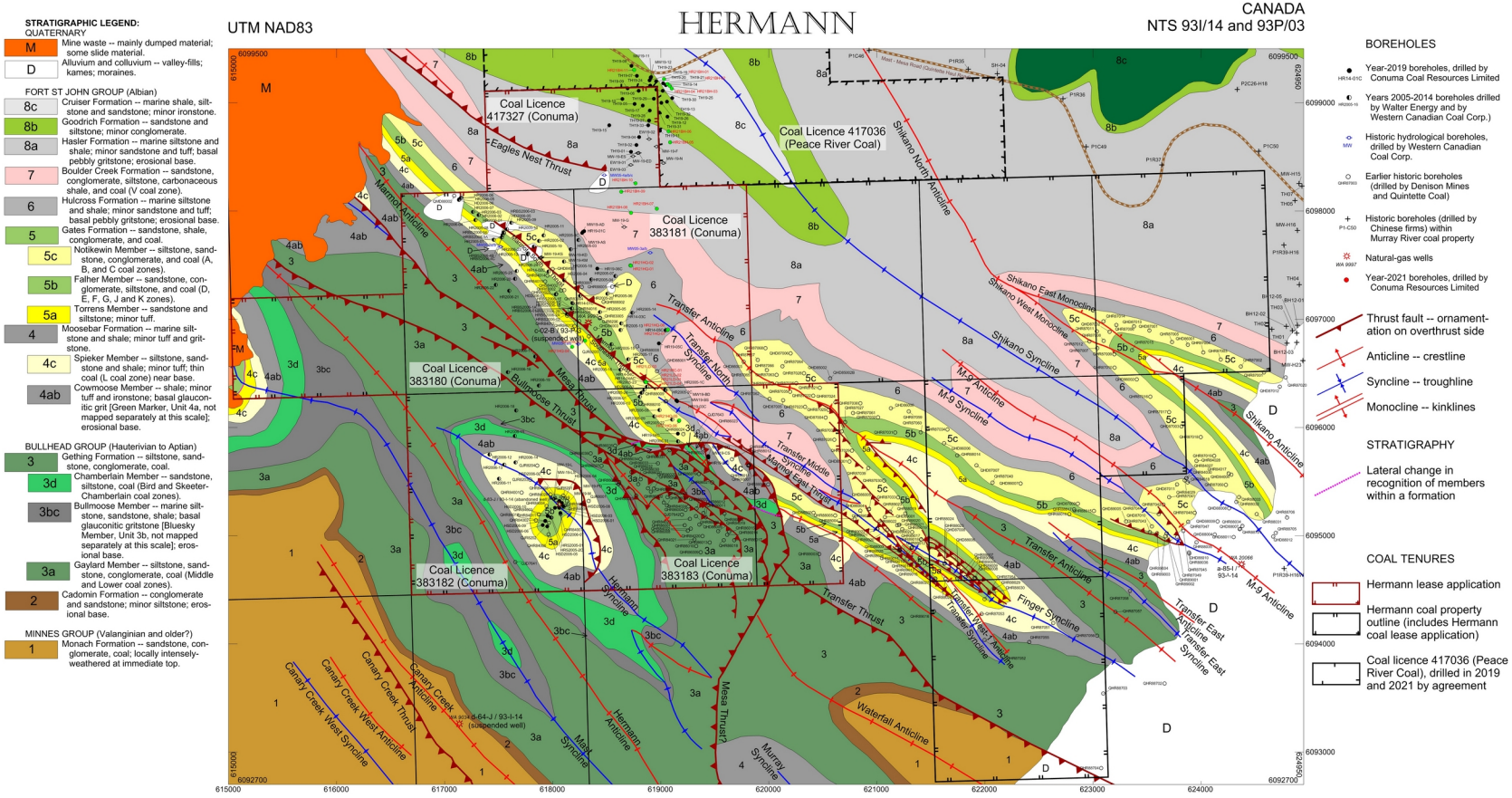


File: Hermann-regional-topography_220102e.srf/jpg
Drawn: C.G. Cathyl-Huhn PGeo LicGeol RMSME
Projection: Universal Transverse Mercator Scale: as shown
Grid: UTM NAD83 Zone 10 (in metres) Date: 2 Jan 2022
Base map from Lorax Environmental
Tenure information from Mineral Titles Online

Conuma Resources Limited

Hermann coal property: Area 'C'

Map 2-3: Coal tenure and topography



Drawing file: Hermann-Main-workmap_220102y4.srf/jpg
Date: 2022 January 2 Horizontal datum: UTM Zone 10N NAD83 Scale: as shown
Geology adapted from work by Dr. P.B. Jones (1960), Dr. A.C. Chowdry (1971), G.P. Gormley P.Geol. (1974-1977); D.G.S. Johnson P.Geol. (1982-1990), W.E. Kilby P.Geo. and C.B. Wrightson P.Geo. (1987 and 1988), from regional compilation by A.S. Legun P.Geo. (1979) and from structural studies by C.G. Cathyl-Huhn P.Geo. (2013-2019).
Drawn by: C.G. Cathyl-Huhn P.Geo.(BC) Lic.Geol.(WA) RMSME

Scale: as shown	**Conuma Resources Limited**	Refer to Map 2-2 for additional detail concerning coal tenures.
UTM NAD 83	Geological Map of Hermann Coal Property	
Revision: Y4		
Drawn: GCH		
JAN 2022	HERMANN COAL ASSESSMENT	Map 2-4

Map 2-4

Hermann-Main-workmap_220102y4.jpg

STRATIGRAPHIC LEGEND:

QUATERNARY

- M — Mine waste -- mainly dumped material; some slide material.
- D — Alluvium and colluvium -- valley-fills; kames; moraines.

FORT ST JOHN GROUP (Albian)

- 8c — Cruiser Formation -- marine shale, siltstone and sandstone; minor ironstone.
- 8b — Goodrich Formation -- sandstone and siltstone; minor conglomerate.
- 8a — Hasler Formation -- marine siltstone and shale; minor sandstone and tuff; basal pebbly gritstone; erosional base.
- 7 — Boulder Creek Formation -- sandstone, conglomerate, siltstone, carbonaceous shale, and coal (V coal zone).
- 6 — Hulcross Formation -- marine siltstone and shale; minor sandstone and tuff; basal pebbly gritstone; erosional base.
- 5 — Gates Formation -- sandstone, shale, conglomerate, and coal.
  - 5c — Notikewin Member -- siltstone, sandstone, conglomerate, and coal (A, B, and C coal zones).
  - 5b — Falher Member -- sandstone, conglomerate, siltstone, and coal (D, E, F, G, J and K zones).
  - 5a — Torrens Member -- sandstone and siltstone; minor tuff.
- 4 — Moosebar Formation -- marine siltstone and shale; minor tuff and gritstone.
  - 4c — Spieker Member -- siltstone, sandstone and shale; minor tuff; thin coal (L coal zone) near base.
  - 4ab — Cowmoose Member -- shale; minor tuff and ironstone; basal glauconitic grit [Green Marker, Unit 4a, not mapped separately at this scale]; erosional base.

BULLHEAD GROUP (Hauterivian to Aptian)

- 3 — Gething Formation -- siltstone, sandstone, conglomerate, coal.
  - 3d — Chamberlain Member -- sandstone, siltstone, coal (Bird and Skeeter-Chamberlain coal zones).
  - 3bc — Bullmoose Member -- marine siltstone, sandstone, shale; basal glauconitic gritstone [Bluesky Member, Unit 3b, not mapped separately at this scale]; erosional base.
  - 3a — Gaylard Member -- siltstone, sandstone, conglomerate, coal (Middle and Lower coal zones).
- 2 — Cadomin Formation -- conglomerate and sandstone; minor siltstone; erosional base.

MINNES GROUP (Valanginian and older?)

- 1 — Monach Formation -- sandstone, conglomerate, coal; locally intensely-weathered at immediate top.

UTM NAD83

HERMANN

CANADA
NTS 93I/14 and 93P/03

Coal Licence 417327 (Conuma)
Coal Licence 417036 (Peace River Coal)
Coal Licence 383181 (Conuma)
Coal Licence 383180 (Conuma)
Coal Licence 383182 (Conuma)
Coal Licence 383183 (Conuma)

Eagles Nest Thrust
Marmot Anticline
Marmot Syncline
Transfer Anticline
Transfer North Syncline
Transfer Middle Syncline
Marmot East Thrust
Mesa Thrust
Bullmoose Thrust
Shikano North Anticline
Shikano East Monocline
Shikano West Monocline
Shikano Syncline
Shikano Anticline
M-9 Anticline
M-9 Syncline
Transfer Thrust
Transfer West-1 Anticline
Transfer Syncline
Finger Syncline
Transfer East Anticline
Transfer East Syncline
Hermann Syncline
Hermann Anticline
Mast Syncline
Canary Creek Anticline
Canary Creek Thrust
Canary Creek West Anticline
Canary Creek West Syncline
Waterfall Anticline
Murray Syncline
Mesa Thrust?

Mast - Mesa Road (Quintette Haul Road)

c-02-B / 93-P-3 (suspended well)
WA 9034 d-64-J / 93-I-14 (suspended well)
WA 20066 a-85-I / 93-I-14

615000 6099500 624950 6092700

615000 616000 617000 618000 619000 620000 621000 622000 623000 624000

6099000 6098000 6097000 6096000 6095000 6094000 6093000

BOREHOLES

- HR14-01C — Year-2019 boreholes, drilled by Conuma Coal Resources Limited
- HR2005-16 — Years 2005-2014 boreholes drilled by Walter Energy and by Western Canadian Coal Corp.)
- MW — Historic hydrological boreholes, drilled by Western Canadian Coal Corp.
- QHR87003 — Earlier historic boreholes (drilled by Denison Mines and Quintette Coal)
- P1-C50 — Historic boreholes (drilled by Chinese firms) within Murray River coal property
- WA 9997 — Natural-gas wells
- Year-2021 boreholes, drilled by Conuma Resources Limited

STRATIGRAPHY

- Thrust fault -- ornamentation on overthrust side
- Anticline -- crestline
- Syncline -- troughline
- Monocline -- kinklines
- Lateral change in recognition of members within a formation

COAL TENURES

- Hermann lease application
- Hermann coal property outline (includes Hermann coal lease application)
- Coal licence 417036 (Peace River Coal), drilled in 2019 and 2021 by agreement

Drawing file: Hermann-Main-workmap_220102y4.srf/jpg
Date: 2022 January 2 Horizontal datum: UTM Zone 10N NAD83 Scale: as shown
Geology adapted from work by Dr. P.B. Jones (1960), Dr. A.C. Chowdry (1971), G.P. Gormley P.Geol. (1974-1977); D.G.S. Johnson P.Geol. (1982-1990), W.E. Kilby P.Geo. and C.B. Wrightson P.Geo. (1987 and 1988), from regional compilation by A.S. Legun P.Geo. (1979) and from structural studies by C.G. Cathyl-Huhn P.Geo. (2013-2019).
Drawn by: C.G. Cathyl-Huhn P.Geo.(BC) Lic.Geol.(WA) RMSME

metres
0 1000 2000 3000 4000

UTM Grid North

Geodetic North is 1°33' (28 mils) west of Grid North

Scale: as shown

Conuma Resources Limited

Refer to Map 2-2 for additional detail concerning coal tenures.

UTM NAD 83
Revision: Y4
Drawn: GCH
JAN 2022

Geological Map of Hermann Coal Property

HERMANN COAL ASSESSMENT

Map 2-4

Map 2-4

Shallow geotechnical drilling concentrated on unconsolidated and semi-consolidated Drift materials, whereas coal-quality drilling was aimed at collecting a drilled bulk sample of the potentially-mineable coals within the Falher coal-measures. Thin Notikewin coals were intersected by some of the deeper geotechnical boreholes, but these holes' primary purpose was rock-mechanics investigation rather than coal-quality investigation.

Table 2-2: Current drilling during 2020-2021 work term

Borehole	UTM NAD83		Metres		Drilling method	Cross-reference to location of logs within this report	Tenure within which borehole was drilled
	Easting	Northing	Elevation	Total depth			
Year-2021							
HR21BH-01	619029.64	6099220.63	1177.48	10.5	ODEX	Appendix A	417036
HR21BH-02	619060.84	6099173.8	1179.25	10.5	ODEX	Appendix A	417036
HR21BH-03	619083.73	6099158.19	1179.62	12	ODEX	Appendix A	417036
HR21BH-04	619101.41	6099133.14	1180.05	10.1	ODEX	Appendix A	417036
HR21BH-05	619086.54	6098636.25	1192.68	9	ODEX	Appendix A	417036
HR21BH-06	619073.19	6098736.31	1186.48	8.8	ODEX	Appendix A	417036
HR21BH-07	618963.8	6098021.58	1274.32	4	ODEX	Appendix A	383181
HR21BH-08	618724.13	6097983.2	1268.78	2.4	ODEX	Appendix A	383181
HR21BH-09	618634.35	6098178.08	1229.61	9.1	ODEX	Appendix A	383181
HR21BH-10	618765.87	6098256.76	1217.24	7.6	ODEX	Appendix A	417327
HR21BH-11	618753.1	6099303.63	1185.49	8.8	ODEX	Appendix A	417036
HR21HQ-01	618718.1	6097497.16	1307.67	55	HQ diamond coring	Appendix A	383181
HR21HQ-02	618724.47	6097495.83	1307.14	61	HQ diamond coring	Appendix A	383181
HR21HQ-03	618298.33	6096802	1406.13	100.1	HQ diamond coring	Appendix A	383181
HR21HQ-04	618180.66	6096744.67	1432.84	195	HQ diamond coring	Appendix A	383180
HR21HQ-05	619168.71	6096060.15	1605.88	75.05	HQ diamond coring	Appendix A	383183
HR21HQ-06	619170.24	6096063.07	1605.96	84	HQ diamond coring	Appendix A	383183
HR21HQ-07	619063.76	6096901.16	1492.24	104	HQ diamond coring	Appendix A	383181
HR21HQ-08	619066.05	6096903.65	1492.38	117	HQ diamond coring	Appendix A	383181
HR21LD-01	618864.69	6096419.48	1519.22	117.92	Large-diameter coring	Appendix A	383181
HR21LD-02	618862	6096420	1517	118.07	Large-diameter coring	Appendix A	383181
HR21LD-03	618860	6096421	1517	118.72	Large-diameter coring	Appendix A	383181
HR21LD-04	618858	6096422	1517	114.97	Large-diameter coring	Appendix A	383181
HR21RC-01	618865.38	6096417.61	1518.77	122	Air-rotary (non-coring)	Appendix A	383181
Totals (including off-tenure drilling in tenure 417036)				1475.63	24 boreholes		
Totals (tenures 383180-383183, and tenure 417327)				1405.93	17 boreholes		
Totals (only Area 'C': tenures 383180 to 383183)				1398.33	16 boreholes		

Note: Approximate positions for HR21LD-02 through -04. Elevations of these boreholes are estimated from LIDAR contours.

2.10 Synopsis of historic (1976-2019) exploration

During their previous ownership of the property, Denison Mines, Quintette Coal Ltd., Western Canadian Coal Corporation, Western Coal, and Walter Energy (acting through its various subsidiaries, including the Walter Canadian Coal Partnership) conducted substantial but sporadic drilling programmes within the Hermann property, initially under the designation of the Johnson and Porkchop prospects (Denison's earliest names for the area). After acquiring the Hermann

coal licences in 2016, Conuma continued drilling in Hermann Area 'C' and adjoining tenures in 2019.

Table 2-3 summarises historic drilling. Historic work commenced in 1976 with Denison's helicopter-supported drilling of three diamond-drill boreholes in the QJD 76-series, and ended in 2019 with Conuma's substantial drilling programme, including the HR 19-series deep diamond-drill holes. During the time span between 1976 and 2019, road access was developed and expanded by the oil and gas industry, logging companies, and the various coal companies involved in the drilling of the Hermann coal tenures. Availability of roads effectively removed the initial requirement for heli-drilling.

Objectives of historic drilling initially were subregional-scale delineation of coal-bearing formations (CAR-609 by Gormley, 1976), and broad structural definition (CAR-515 by Gunn, 1980; CAR-616 by Johnson, 1983), progressing to intensive coal-quality, hydrological, geotechnical (Stewart, 2007; Stewart and Hogarth, 2007), and geochemical investigations (CAR-739 and -746 by Johnson, 1988 and 1989).

Historic work has been extensively synthesised in CAR-950 (Cathyl-Huhn and Avery, 2014), CAR-999 (Cathyl-Huhn, 2015), and in CAR-1057 (Cathyl-Huhn, 2019).

Table 2-3: Historic drilling during years 1976 through 2019

Borehole	UTM NAD83		Metres		Drilling method	Coal Assessment Report in which logs and other data located?
	Easting	Northing	Elevation	Total depth		
Year-1976						
QJD7641	617654	6094756	1565	213	Diamond	609
QJD7642	619196.19	6095193.27	1627	183	Diamond	609
QJD7643	619343.67	6095961.5	1641.49	264.5	Diamond	609
Year-1980						
QJR8001	618332.99	6095320.63	1603	123	Rotary	614; coordinates corrected
Year-1982						
QJR8201	618097.57	6095370.88	1597.7	70	Rotary	616
QJR8202	617965.47	6095118.08	1608.3	70	Rotary	616
QJR8203	617792.67	6095516.58	1548.95	49	Rotary	616
QJR8204	617858.07	6095647.68	1540.9	70	Rotary	616
QJR8205	618334.89	6096840.53	1399	70	Rotary	616
QJR8206	618435.19	6097009.73	1373.1	61	Rotary	616
Year-1983						
QHR83001	618269.47	6097298.48	1409.9	164	Rotary	617
QHR83002	618076.27	6097265.18	1389.6	176	Rotary	617
QHR83003	618033.57	6097232.98	1387.7	96	Rotary	617
QHR83004	618182.77	6097149.18	1408.1	150	Rotary	617
QHR83005	618436.87	6097012.68	1373	187	Rotary	617

Table 2-3: Historic drilling during years 1976 through 2019 (continued)

Borehole	UTM NAD83		Metres		Drilling method	Coal Assessment Report in which logs and other data located?
	Easting	Northing	Elevation	Total depth		
Year-1984						
QHD84001	618000.522	6097464.09	1302.92	215.3	Diamond	618
QHD84002	618107.117	6097269.71	1390.14	204.7	Diamond	618
QHD84003	618395.78	6096912.27	1388.48	153.29	Diamond	618
QHR84001	617713.311	6095398.37	1563.89	50	Rotary	618
QHR84002	617844.346	6095140.97	1588.8	30	Rotary	618
QHR84003	617872.152	6095195.69	1588.72	30	Rotary	618
QHR84004	617942.549	6095274.12	1588.68	30	Rotary	618
QHR84005	617980.367	6095381.75	1574.23	30	Rotary	618
QHR84006	617961.303	6095011.37	1605.85	50	Rotary	618
QHR84007	618072.043	6095199.36	1597.02	60	Rotary	618
QHR84008	618102.589	6095267.59	1597.71	60	Rotary	618
QHR84009	618131.774	6095317.53	1598.2	50	Rotary	618
QHR84010	617931.495	6095135.89	1609.84	60	Rotary	618
QHR84011	617952.922	6095180.97	1609.15	67	Rotary	618
QHR84012	618246.17	6096981.18	1400.9	109.5	Rotary	618
QHR84013	618202.57	6096935.98	1411.2	91.3	Rotary	618
QHR84014	617951.57	6097403.98	1310.9	97.4	Rotary	618
QHR84015	617930.87	6097349.08	1317.4	60.8	Rotary	618
QHR84016	618155.97	6097087.38	1408.8	83.5	Rotary	618
QHR84019	619529.98	6095041.52	1564.2	42.5	Rotary	618
QHR84020	619386.34	6094995.09	1582.43	36.6	Rotary	618
QHR84021	619311.592	6094963.96	1587.32	36	Rotary	618
QHR84022	619276.553	6095063.37	1605.49	41	Rotary	618
QHR84023	619268.175	6095154.01	1614.39	43	Rotary	618
QHR84024	619256.508	6095268.95	1624.91	42	Rotary	618
QHR84025	618133.37	6097031.58	1412.8	66.8	Rotary	618
QHR84026	618030.04	6095327.44	1597.16	42.5	Rotary	618
Year-1985						
QHD85002	620568.98	6096453.52	1519.76	145.08	Diamond	724
QHD85002B	620568.98	6096453.52	1519.76	225	Diamond	724
Year-1986						
QHD86001	623878.74	6096762.96	953.93	147	Diamond	724
QHD86002	623403.75	6096442.61	1025.53	120.1	Diamond	724
QHD86003	619768.2	6096605.89	1532.05	225.86	Diamond	724; coordinates corrected
QHD86006	621621.58	6095854.09	1325.06	99.06	Diamond	724
QHD86007	622330.32	6095482.36	1292.95	138.68	Diamond	724; coordinates corrected
QHD86009	619358.13	6095101.72	1598.15	*no data*	Diamond	724: missing from file

Table 2-3: Historic drilling during years 1976 through 2019 (continued)

Borehole	UTM NAD83		Metres		Drilling method	Coal Assessment Report in which logs and other data located?
	Easting	Northing	Elevation	Total depth		
QHR86001	619058.09	6095278.59	1622.56	>44.4	Rotary	724: no logs on file
QHR86002	619028.93	6095305.4	1627	>40.5	Rotary	724: no logs on file
QHR86003	619062.35	6095355.98	1629.31	>35.0	Rotary	724: no logs on file
QHR86004	619229.06	6095238.56	1626.41	>24.9	Rotary	724: no logs on file
QHR86005	619332.13	6095251.75	1604.78	>114.4	Rotary	724: no logs on file
QHR86006	619326.21	6095178.77	1609.04	>76.0	Rotary	724: no logs on file
QHR86007	619220.75	6095096.56	1612.87	>33.5	Rotary	724: no logs on file
QHR86009	619369.95	6094845.4	1570.38	>30.0	Rotary	724: no logs on file
QHR86010	619327.92	6094902.92	1579.44	>29.0	Rotary	724: no logs on file
QHR86011	619416.02	6095169.03	1587.5	>77.5	Rotary	724: no logs on file
QHR86012	619395.56	6095208.63	1586.51	>91.0	Rotary	724: no logs on file
QHR86013	619453.23	6094936.73	1564.92	>39.0	Rotary	724: no logs on file
QHR86014	619615.01	6095008.43b	1539.35	>49.0	Rotary	724: no logs on file
QHR86015	619632.98	6095035.24	1538.6	*no data*	Rotary	724: no data given in report
QHR86016	619588.95	6095201.9	1557.95	*no data*	Rotary	724: no data given in report
QHR86017	619680.68	6094956.7	1515.45	*no data*	Rotary	724: no data given in report
QHR86018	619583	6094957	1536	>28.0	Rotary	724: no logs on file; coordinates corrected
QHR86019	619353.86	6095569.67	1632.26	>107.0	Rotary	724: no logs on file
QHR86020	618936.46	6095434.9	1619.51	>81.7	Rotary	724: no logs on file
QHR86021	619474.291	6095491.4	1610.81	*no data*	Rotary	724: no data given in report
QHR86022	619437.96	6095728.415	1620.59	79	Rotary	724
QHR86023	619386.324	6095802.888	1622.7	103.5	Rotary	724
QHR86024	619208.86	6095938.593	1626.43	146	Rotary	724
QHR86025	618773.365	6095371.102	1610.18	*no data*	Rotary	724: no data given in report
QHR86026	618615.009	6095494.096	1628.64	*no data*	Rotary	724: no data given in report
QHR86027	618451.513	6095644.621	1649.64	*no data*	Rotary	724: no data given in report
QHR86028	618909.58	6095405.452	1618.35	*no data*	Rotary	724: no data given in report
QHR86029	618882.284	6095438.041	1618.19	*no data*	Rotary	724: no data given in report
QHR86030	618791.31	6095474.506	1613.15	*no data*	Rotary	724: no data given in report
QHR86031	618813.528	6095520.721	1615.17	*no data*	Rotary	724: no data given in report
QHR86032	618728.767	6095585.275	1620.62	*no data*	Rotary	724: no data given in report
QHR86033	618973.23	6095668.633	1616.82	*no data*	Rotary	724: no data given in report
QHR86034	618811.466	6095706.778	1604.73	*no data*	Rotary	724: no data given in report
QHR86035	618577.97	6095831.131	1613.9	*no data*	Rotary	724: no data given in report
QHR86036	618350.722	6095759.451	1605.34	*no data*	Rotary	724: no data given in report
QHR86037	619083.644	6095788.511	1604.72	*no data*	Rotary	724: no data given in report

Table 2-3: Historic drilling during years 1976 through 2019 (continued)

Borehole	UTM NAD83		Metres		Drilling method	Coal Assessment Report in which logs and other data located?
	Easting	Northing	Elevation	Total depth		
Year-1987						
QHD87001	623521.58	6096895.18	1021.15	160.79	Diamond	739
QHD87002	623153.5	6096884.08	1081.36	99.12	Diamond	739
QHD87003	623818.71	6096008.56	996.29	177.52	Diamond	739
QHD87004	620525.53	6096090.78	1589.74	151.1	Diamond	739
QHD87005	620133.27	6096251.31	1573.26	185.78	Diamond	739
QHD87006	620201.83	6096684.3	1486.07	202.44	Diamond	739; coordinates corrected
QHD87007	621921.42	6095648.02	1329.15	120.63	Diamond	739
QHD87008	621630.18	6094744.46	1167	138.62	Diamond	739
QHD87009	622860.49	6095294.33	1108.43	105.14	Diamond	739
QHD87013	623380.3	6096934.41	1011.15	143.7	Diamond	739
QHR87002	624368.25	6096561.78	879.9	156.3	Rotary	739
QHR87003	624181.68	6096627.98	895.45	140	Rotary	739
QHR87004	624020.59	6096692.28	931.67	121.8	Rotary	739
QHR87005	623730.88	6096788.17	985.67	117.5	Rotary	739
QHR87006	623214.91	6096947.31	1057.87	182	Rotary	739
QHR87007	623039.86	6096732.32	1117.65	170.2	Rotary	739
QHR87008	623099.39	6096799.67	1107.99	107.3	Rotary	739
QHR87009	623196.43	6096676.79	1108.97	132.3	Rotary	739
QHR87010	623199.42	6096553.26	1109.67	164.4	Rotary	739
QHR87011	623035.36	6096887.3	1107.81	121.5	Rotary	739
QHR87012	622966.53	6096796	1116.81	183.3	Rotary	739
QHR87013	623380.3	6096934.11	1041.15	143.7	Rotary	739
QHR87014	623097.29	6096979.28	1076.9	207.4	Rotary	739
QHR87015	623359.48	6096714.25	1079.99	56.7	Rotary	739
QHR87016	623530.54	6096283.99	1071.99	146.6	Rotary	739
QHR87017	623704.65	6096142.28	1014.93	164.8	Rotary	739; coordinates corrected
QHR87021	620472.24	6096365.95	1572.82	168.8	Rotary	739
QHR87022	620411.11	6096292.93	1580.6	144.6	Rotary	739
QHR87023	620335.71	6096188.74	1601.62	171	Rotary	739
QHR87024	620615.88	6096232.49	1564.25	128.5	Rotary	739
QHR87025	620550.16	6096163.19	1585.04	110	Rotary	739
QHR87028	620324.69	6096500.05	1542.16	172	Rotary	739
QHR87034	621653.44	6095981.15	1319	108	Rotary	739; coordinates corrected
QHR87035	620196.65	6096330.93	1558.01	129	Rotary	739
QHR87036	620254.13	6096407.72	1544.31	117.6	Rotary	739
QHR87040	622069.76	6095489.37	1361.19	98.2	Rotary	739
QHR87051	622631.36	6094192.2	857.5	147.7	Rotary	739

Table 2-3: Historic drilling during years 1976 through 2019 (continued)

Borehole	UTM NAD83		Metres		Drilling method	Coal Assessment Report in which logs and other data located?
	Easting	Northing	Elevation	Total depth		
QHR87052	621996.21	6094034.94	951.88	127.9	Rotary	739
QHR87053	621968.94	6094275.85	1034.79	86	Rotary	739
QHR87054	621996.2	6094412.84	1049.43	99	Rotary	739; coordinates corrected
QHR87055	622409.61	6094016.83	890.45	55.6	Rotary	739
QHR87056	623037.01	6094075.13	857.51	91.3	Rotary	739
QHR87062	620006.83	6096263.04	1544.99	178.9	Rotary	739
QHR87063	620071.55	6096485.17	1508.25	109.9	Rotary	739
QHR87064	620125.26	6096565.64	1499.61	103.6	Rotary	739
QHR87065	619832.81	6096517.06	1519.31	146.7	Rotary	739; coordinates corrected
QHR87066	619980.65	6096528.55	1505.69	85.2	Rotary	739
QHR87067	619898.33	6096623.04	1499.61	42	Rotary	739
QHR87068	619968.09	6096733.07	1484.15	79.3	Rotary	739
Year-2008						
QHD88001	618966.005	6096517.98	1556.25	217	Diamond	746
QHD88002	620413.656	6095211.855	1161.97	217.5	Diamond	746
QHD88006	621750.86	6094711.08	1168.19	73.76	Diamond	746
QHR88001	618549.86	6097300.11	1342.07	208.28	Rotary	746
QHR88002	618469.99	6097159.22	1352.07	200.18	Rotary	746
QHR88003	620468.26	6094828.61	1332.38	58.88	Rotary	746
QHR88005	620613.02	6095186.3	1444.25	147.72	Rotary	746
QHR88006	619992.97	6095474	1540.25	166.62	Rotary	746
QHR88007	619813.33	6095646.24	1586.88	78.2	Rotary	746
QHR88008	618782.11	6096749.33	1464.54	234.48	Rotary	746
QHR88009	619051	6096242.85	1566.86	96.56	Rotary	746
QHR88010	619042.4	6096240.89	1565.81	232.22	Rotary	746
QHR88011	619810.2	6095646.78	1586.98	198.2	Rotary	746
QHR88012	619818.71	6095650.44	1587.17	47.58	Rotary	746
QHR88013	619659.56	6095706.52	1610.59	138.72	Rotary	746
QHR88014	621742.86	6095740.51	1324.72	95.3	Rotary	746
QHR88015	623009.07	6095227.3	1068.53	111.88	Rotary	746
QHR88016	622779.21	6095197.79	1112.54	74.76	Rotary	746
QHR88017	622824.51	6095242.88	1117.09	84.08	Rotary	746
QHR88018	620031.27	6096404.65	1522.53	125.02	Rotary	746
QHR88023	621627.32	6094741.82	1166.96	173.78	Rotary	746
QHR88024	621626.85	6094741.08	1167.16	132.22	Rotary	746; coordinates corrected
QHR88027	621541.87	6094602.21	1081.14	53.44	Rotary	746
QHR88028	621635.07	6094600.83	1087.83	54.32	Rotary	746
QHR88029	622084.66	6094509.78	1072.37	53.32	Rotary	746

Table 2-3: Historic drilling during years 1976 through 2019 (continued)

Borehole	UTM NAD83		Metres		Drilling method	Coal Assessment Report in which logs and other data located?
	Easting	Northing	Elevation	Total depth		
QHR88030	622040.26	6094470.09	1059.79	53.32	Rotary	746
QHR88703	623093.63	6093539.86	788.71	45.7	Rotary	746
QHR88704	623075.43	6092851.21	781.02	50.6	Rotary	746
QMD88002	617087.45	6098141.75	1360.9	247.5	Diamond	746
Year-1989						
QHR89005	621819.88	6094615.67	1126.23	108.16	Rotary	753
QHR89006	621819.54	6094615.15	1126.25	119.5	Rotary	753
QHR89007	621743.94	6094603.1	1121.83	48.32	Rotary	753
QHR89008	621910.65	6094609.43	1123.31	99.54	Rotary	753
QHR89009	621903.15	6094608.19	1123.34	130.88	Rotary	753
QHR89015	621468.85	6094730.16	1134.85	85	Rotary	753
QHR89016	621529.34	6094301.17	1078.01	192	Rotary	753
Year-2005						
HR2005-01	617454.415	6097733.493	1279.557	311.22	Rotary	950
HR2005-1C	619037.927	6096347.605	1573.272	160.99	Diamond	950
HR2005-02	617873.253	6097723.704	1243.078	192.33	Rotary	950
HR2005-2C	619042.235	6096343.362	1573.147	300.05	Diamond	950
HR2005-03	618167.727	6097645.879	1260.345	193.75	Rotary	950
HR2005-3C	618237.619	6097733.157	1280.896	276.67	Diamond	950
HR2005-04	618358.291	6097368.33	1392.579	278.26	Rotary	950
HR2005-05	618436.746	6097064.88	1366.2	166.98	Rotary	950
HR2005-06	618507.253	6097235.859	1347.686	208.35	Rotary	950
HR2005-07	618580.279	6097398.221	1334.03	204.55	Rotary	950
HR2005-08	617536.573	6097779.037	1280.17	137.31	Rotary	950
HR2005-09	617618.171	6097891.9	1271.439	226.57	Rotary	950
HR2005-10	617575.997	6097830.362	1277.385	188.81	Rotary	950
HR2005-11	617915.562	6097774.347	1231.057	204.33	Rotary	950
HR2005-12	617769.049	6097601.105	1253.234	153.25	Rotary	950
HR2005-13	618628.408	6096900.91	1394.19	195.42	Rotary	950
HR2005-14	618737.151	6097058.706	1393.754	188.19	Rotary	950
HR2005-15	618545.152	6096768.414	1402.552	128.2	Rotary	950
HR2005-16	618627.684	6096534.201	1452.933	170.42	Rotary	950
HR2005-17	618699.181	6096629.161	1460.85	94.11	Rotary	950
HR2005-18	618105.271	6097532.604	1312.069	206.12	Rotary	950
HR2005-19	617826.266	6097672.003	1246.955	174.74	Rotary	950
HR2005-20	618253.766	6097217.521	1412.759	231.54	Rotary	950
HR2005-21	619160.255	6095872.122	1605.118	162.15	Rotary	950
HR2005-22	619105.058	6096072.033	1590.969	171.38	Rotary	950
HR2005-23	618874.259	6096375.879	1519.92	180.31	Rotary	950
HR2005-24	618821.848	6096319.971	1501.834	125.17	Rotary	950
HR2005-25	617667.182	6097444.798	1263.23	100.36	Rotary	950

Table 2-3: Historic drilling during years 1976 through 2019 (continued)

Borehole	UTM NAD83		Metres		Drilling method	Coal Assessment Report in which logs and other data located?
	Easting	Northing	Elevation	Total depth		
HRS2005-01	617989.262	6095167.898	1606.769	85.05	Rotary	950
HRS2005-2C	617984.534	6095166.252	1606.81	40.52	Diamond	950
MW05-1a	618240	6096769.9	1422.46	55	Rotary	Groundwater-monitoring (hydrological) boreholes -- see CAR-950 for details.
MW05-1b	618237.4	6096767.3	1422.46	20.7	Rotary	
MW05-2a	617520.5	6097672.6	1262.82	60.1	Rotary	
MW05-2b	617523.4	6097674.6	1262.82	27.1	Rotary	
MW05-3a	618902.2	6097617.5	1291.58	51.5	Rotary	
MW05-3b	618903.9	6097619.7	1291.58	26.2	Rotary	
MW05-4a	618477.7	6098334.4	1201.44	81.7	Rotary	
MW05-4b	618475.4	6098331.8	1201.44	51.2	Rotary	
MW05-4c	618473.5	6098328.8	1201.44	13	Rotary	
Year-2006						
HD2006-01	618827.329	6096321.766	1502.437	175.38	Diamond	950
HD2006-02	618849.035	6096348.117	1510.935	178.96	Diamond	950
HD2006-03	618029.092	6097230.022	1385.964	134.25	Diamond	950
HD2006-04	618106.087	6097359.688	1363.463	213.61	Diamond	950
HD2006-05	617548.83	6097796.998	1280.208	143.42	Diamond	950
HD2006-06	617135.161	6098106.903	1347.132	142.44	Diamond	950
HR2006-01	617313.684	6097961.961	1308.71	103.18	Rotary	950
HR2006-02	617314.81	6097963.346	1307.944	157.97	Rotary	950
HR2006-03	617262.564	6097992.294	1314.786	177.65	Rotary	950
HR2006-04	617286.179	6097915.647	1314.011	127.7	Rotary	950
HR2006-05	617149.073	6098120.927	1346.039	105.47	Rotary	950
HR2006-06	617153.933	6098123.222	1344.452	149.59	Rotary	950
HR2006-07	617131.494	6098104.002	1347.057	71.3	Rotary	950
HR2006-08	618988.509	6096159.796	1549.267	108.57	Rotary	950
HR2006-09	618940.192	6096102.269	1543.267	120.32	Rotary	950
HR2006-10	618806.323	6096285.003	1498.275	84.34	Rotary	950
HR2006-11	617502.624	6095526.003	1580.82	no data	Rotary	950; caved in
HR2006-12	617414.475	6095750.177	1595.686	107.02	Rotary	950
HR2006-13	617550.785	6095656.159	1597.909	107.38	Rotary	950
HR2006-14	617656.484	6095675.823	1593.462	101.17	Rotary	950
HR2006-15	617650.684	6095922.313	1563.955	107.04	Rotary	950
HR2006-16	617585.001	6096509.52	1547.547	124.24	Rotary	950
HR2006-17	617837.452	6096655.771	1524.966	106.98	Rotary	950
HR2006-18	617662.963	6096155.429	1557.217	112.71	Rotary	950
HR2006-19	617872.843	6096386.208	1509.198	79.04	Rotary	950
HR2006-20	617651.4	6097373.8	1268	101.31	Rotary	950
HR2006-21	617597.411	6097262.975	1276.604	74.64	Rotary	950
HR2006-22	617473.467	6097317.927	1270.532	93.39	Rotary	950
HR2006-23	617773.397	6097608.433	1253.257	134.39	Rotary	950
HR2006-24	617768.216	6097602.312	1253.909	91	Rotary	950

Table 2-3: Historic drilling during years 1976 through 2019 (continued)

Borehole	UTM NAD83		Metres		Drilling method	Coal Assessment Report in which logs and other data located?
	Easting	Northing	Elevation	Total depth		
HRBS2006-01	618177.024	6097098.576	1408.292	79.66	Rotary	Pilot holes for bulk-sample drilling -- see CAR-950
HRBS2006-02	618134.533	6097048.813	1413.409	36.72	Rotary	
HRBS2006-03	617546.429	6097803.723	1280.739	83.11	Rotary	
HRBS2006-04	617531.153	6097756.979	1277.563	91.6	Rotary	
HRBS2006-1A	618177.024	6097098.576	1408.292	74.7	Diamond	Bulk-sample drilling; logs and other data in CAR-950
HRBS2006-1B	618177.024	6097098.576	1408.292	49.26	Diamond	
HRBS2006-1D	618177.024	6097098.576	1408.292	46.29	Diamond	
HRBS2006-1E	618177.024	6097098.576	1408.292	44.8	Diamond	
HRBS2006-2A	618134.533	6097048.813	1413.409	32.46	Diamond	
HRBS2006-2B	618134.533	6097048.813	1413.409	29.64	Diamond	
HRBS2006-4A	617531.153	6097756.979	1277.563	19.91	Diamond	
HRBS2006-4B	617531.153	6097756.979	1277.563	77.08	Diamond	
HRBS2006-4C	617531.153	6097756.979	1277.563	83.01	Diamond	
HSD2006-01	618021.305	6095257.013	1595.782	32.24	Diamond	950
HSD2006-02	618062.259	6095320.725	1592.792	29.89	Diamond	950
HSD2006-03	618061.055	6095257.655	1592.663	34.37	Diamond	950
HSD2006-04	618085.454	6095301.732	1592.847	27.86	Diamond	950
HSD2006-05	617948.833	6095084.413	1606.064	37.33	Diamond	950
HSD2006-06	617908.288	6095098.615	1604.336	31.2	Diamond	950
HSD2006-07	618070.745	6095208.143	1591.477	29.67	Diamond	950
HSD2006-08	618098.479	6095272.235	1592.451	36.58	Diamond	950
HSD2006-09	617933.639	6095136.065	1604.413	33.83	Diamond	950
HSD2006-10	617955.365	6095182.607	1603.822	37.11	Diamond	950
Year-2014						
HR14-01C	618183.535	6097152.412	1407.367	158.6	Spot core	950
HR14-02C	617973.239	6097434.26	1305.282	122.72	Spot core	950
HR14-03C	618608.845	6096741.185	1419.816	119.32	Spot core	950
HR14-04C	618857.69	6096418.994	1517.806	171.29	Spot core	950
HR14-04AC	618856.965	6096424.924	1517.651	155	Spot core	950
HR14-05C	619053.861	6096895.978	1493.536	272	Spot core	950
Year-2019						
HR19-01C	618290.265	6097814.668	1284.111	397	Diamond	1057
HR19-02C	619438.508	6095734.459	1620.333	353.2	Diamond	1057
HR19-03C	619143.858	6096250.684	1597.888	352.85	Diamond	1057
HR19-04C	619158.648	6095942.101	1613.341	250.65	Diamond	1057
HR19-05C	618981.573	6096776.43	1516.424	249.65	Diamond	1057
HR19-06C	618411.445	6097468.327	1372.192	334.54	Diamond	1057
MW19-04-BD	619145.726	6096248.572	1597.998	224.6	Rotary	1057
MW19-05-AD	618280.697	6097807.995	1283.631	127.4	Rotary	1057
MW19-06-AS	618271.966	6097796.219	1283.573	54.96	Rotary	1057
MW19-07-BS	619151.152	6096241.124	1599.388	100.5	Rotary	1057

Table 2-3: Historic drilling during years 1976 through 2019 (continued)

Borehole	UTM NAD83		Metres		Drilling method	Coal Assessment Report in which logs and other data located?
	Easting	Northing	Elevation	Total depth		
MW19-09-CD	619440.279	6095722.696	1620.902	137.16	Rotary	1057
MW19-10-CS	619438.806	6095728.154	1620.981	76.2	Rotary	1057
MW19-11	618910.91	6099238.379	1166.654	45.72	Rotary	1057
MW19-12	618906.202	6099231.486	1166.087	4.57	Rotary	1057
TH19-01	618725.317	6098546.628	1183.528	17	Sonic	1057
TH19-02	618775.029	6098610.458	1184.307	17	Sonic	1057
TH19-03	not drilled					
TH19-04	618800.142	6098683.01	1182.096	6	Sonic	1057
TH19-05	618758.885	6098990.18	1186.082	15.2	Sonic	1057
TH19-06	618795.538	6099112.098	1183.811	15.2	Sonic	1057
TH19-07	618779.969	6099249.765	1185.401	6	Sonic	1057
TH19-08	618727.796	6099340.819	1185.021	6	Sonic	1057
TH19-09	618693.376	6099134.553	1208.62	15.2	Sonic	1057
TH19-10	618645.489	6099035.145	1219.956	15.2	Sonic	1057
TH19-11	618992.541	6098741.345	1186.165	9.14	Sonic	1057
TH19-12	619061.09	6098871.479	1184.683	6	Sonic	1057
TH19-13	619105.242	6099043.806	1181.834	6	Sonic	1057
TH19-14	619046.162	6099163.488	1179.147	6.1	Sonic	1057
TH19-15	618522.404	6098791.867	1219.986	15.2	Sonic	1057
TH19-16	not drilled					
TH19-17	618832.626	6098974.881	1172.358	9.9	Sonic	1057
TH19-18	not drilled					
TH19-19	618897.18	6099208.599	1166.484	15.7	Sonic	1057
TH19-20	618957.985	6099199.268	1175.602	12.2	Sonic	1057
TH19-21	619022.924	6099181.26	1181.777	12.8	Sonic	1057
TH19-22	not drilled					
TH19-23	618907.574	6099234.819	1166.248	12.7	Sonic	1057
TH19-24	618903.339	6099160.088	1172.693	12.2	Sonic	1057
TH19-25	619018.474	6099110.316	1179.553	6	Sonic	1057
TH19-26	619005.058	6098999.351	1178.104	6	Sonic	1057
TH19-27	618892.454	6098836.373	1180.567	9.1	Sonic	1057
TH19-28	618898.27	6098928.64	1176.101	6	Sonic	1057
TH19-29	618935.685	6099037.778	1176.214	6	Sonic	1057
TH19-30	618959.404	6099121.705	1176.28	6.7	Sonic	1057
TH19-31	618986.801	6098910.447	1179.831	5.3	Sonic	1057
TH19-32	619058.207	6099010.156	1180.874	6	Sonic	1057
TH19-33	618884.427	6098793.589	1181.171	9.1	Sonic	1057
MW-19-ES	618789.41	6098534.09	1195.69	10.85	Rotary	1057
MW-19-ED	618795.1	6098536.11	1195.76	30	Rotary	1057
MW-19-F	618963.15	6098597.71	1190.58	18	Rotary	1057
MW-19-G	618664.2	6097848.88	1279.85	15.6	Rotary	1057
MW-19-PD	619022.08	6098432.22	1200.23	131	Rotary	1057

Table 2-3: Historic drilling during years 1976 through 2019 (concluded)

Borehole	UTM NAD83		Metres		Drilling method	Coal Assessment Report in which logs and other data located?
	Easting	Northing	Elevation	Total depth		
MW-19-KS	618609.6	6095500.95	1628.25	31.4	Rotary	1057
MW-19-KM	617887.02	6097563.22	1255.87	49.7	Rotary	1057
MW-19-KD	617892.27	6097566.7	1255.33	110	Rotary	1057
MW-19-LS	617897.4	6097569.72	1254.72	10.9	Rotary	1057
MW-19-L	618014.63	6095341.13	1593.19	37.3	Rotary	1057
MW-19-M	618009.43	6095335.94	1593.1	45.4	Rotary	1057
MW-19-N	618114.35	6095278.68	1596.85	16	Rotary	1057
EW19-01	618742.4	6098506.2	1196	84.89	Rotary	1057
EW19-02	618893	6098664	1186	86.41	Rotary	1057
EW19-03	618722	6098426	1200	103.63	Rotary	1057
Total: 307 boreholes	*years 1976 to 2019*			*Total: 32,105.80 m*		

Note: GPS coordinates only for EW19-01 through -03, since as-built survey has not yet been done as of date of this report. Elevations of these wells are estimated from LIDAR contours.

2.11 Natural gas wells

In addition to the current and historic exploratory boreholes, testholes, and hydrological test wells, two natural gas exploration wells have been drilled within the Hermann coal property, as shown on **Map 2-4** and listed in **Table 2-4**. Both of these wells started within the Gates Formation (within the Lower Cretaceous Fort St. John Group), and they have gone onward to deeper exploration targets within underlying Triassic carbonate rocks. One of the wells (d-83-J / 93-I-14) was abandoned in 2013, whereas the other gas well (c-02-B / 93-P-03) is shut-in, and is not currently producing.

Table 2-4: Natural gas wells within the Hermann coal property

Well Authorisation (WA) number	Well name	Status	NAD 83 position	
			Easting	Northing
5099	d-83-J / 93-I-14	abandoned	618065	6095289
9997	c-02-B / 93-P-3	suspended (not currently producing)	618330	6096968

2.12 Acknowledgements and professional responsibility

Chris Pichurski PhD PEng and Dave Thompson PGeo provided Conuma's technical direction of the year-2021 drilling programme.

Geological and operational management support were provided by Apex Geoscience Ltd., led by their project geologist, Jerry Holmes PGeo. Core logging and sampling of coal was done by Apex's exploration team, comprising Karys Leonard-Fortune GIT and Adriana Matesoi.

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Wood Environmental (Bradley Jackman) and Piteau Associates (Marianne Rosted P.Eng.) provided engineering support to the geotechnical drilling programme. DWB Consulting provided environmental support, led by environmental specialist Ryan Bouchard.

Gwyneth Cathyl-Huhn PGeo., accepts overall professional responsibility for the contents of this report, and has duly signed and sealed the original copy thereof.

3 Geology

Regional and local geology (**Map 2-4**) of Hermann -- and of the Sukunka-Quintette coalfield in general -- is known mainly from the extensive work of D.F. Stott (1960; 1961; 1963; 1968; 1973; 1974; 1982; 1998), and D.W. Gibson (1992a, 1992b) on behalf of the Geological Survey of Canada. In 1970, a photogeological study of the eastern end of the Hermann coal property was published as an illustration within a technical paper by C.D.A. Dahlstrom.

As well, numerous coal-company technical reports (cited in **Section 8** of this report) are available as open-file documents from the British Columbia Geological Survey Branch. Copies of the reports are freely available for download via the provincial Survey's *Coalfile* website, after a three-year embargo. Most of these reports have been censored to exclude coal-quality data, as such data are to be held confidential by the Crown in keeping with the provisions of the *Coal Act Regulation*.

3.1 Regional geology

The Hermann coal property lies within the Sukunka-Quintette coalfield of northeastern British Columbia, part of the Foothills structural province of the Canadian Cordillera. The majority of sedimentary rocks within the Sukunka-Quintette coalfield are clastic in nature, ranging in grain-size from claystones and mudstones through conglomerates. Lesser amounts of biologically- and chemically-derived sedimentary rocks are present, comprising coals, banded and nodular ironstones, glauconite-rich sandstones and gritstones, and impure dolomites.

Volcanic rocks constitute a very small component of the Early Cretaceous strata, comprising very fine- to fine-grained tuffs (locally altered to bentonites or tonsteins), interpreted to have originated as wind-borne distal ash-fall deposits from contemporaneous volcanoes situated upwind and far to the southwest of the property. The volcanic rocks characteristically occur as very thin (at most a few decimetres) yet regionally-extensive bands, thus useful as markers for structural and stratigraphic correlations (Duff and Gilchrist, 1981; Kilby, 1984a).

All rocks exposed at the ground surface are of Early Cretaceous age, belonging to the Minnes (Berriasian to Valanginian stages), Bullhead (Barremian to Aptian stages) and Fort St. John (Albian stage) groups. Within the Hermann property, total thickness of the Lower Cretaceous rocks is 2380 to 2560 metres, although some of this thickness is likely attributable to thrust-induced structural telescoping of the rock.

3.1.1 Tectonostratigraphic context of Early Cretaceous coal-measures

During much of the Early Cretaceous, the Western Interior of North America was occupied by a shallow seaway, variably-designated by different authors as the Western Interior Sea, the Boreal Sea, or by analogues of formation names, such as the Clearwater Sea, Hulcross Sea or Moosebar Sea. Depths of the seaway, magnitude of accommodation space for sediments, and overall shoreline trends, were largely controlled by vertical movements within a complexly-block-faulted crystalline basement terrane of Precambrian age, the Peace River Arch.

Sediments of the Minnes Group and the basal part of the Bullhead Group were derived from actively-eroding upland areas within the North American craton, particularly from the Peace River Arch. The receiving basin during this early time period lay to the west of the craton, within an actively-subsiding continental shelf which prograded westwards into the

ancestral Pacific Ocean. Subsequently, slightly later within the earliest Cretaceous era, sediments of the upper part of the Bullhead Group and of the Fort St. John Group were derived from actively-rising thrust-faulted tectonic forelands. These forelands were situated to the west and southwest of the contemporaneous seaway, synchronous with the docking of allochthonous tectonic terranes against the western margin of the North American craton.

Coal deposits formed as peatlands within the non-marine portions of the clastic sedimentary successions. Kalkreuth and Leckie (1989) recognised the close association between actively-subsiding shoreface sandstone deposits and the overlying presence of thick coal beds; this association is well-established within the upper part (Chamberlain Member) of the Gething Formation and the middle part (Falher Member) of the Gates Formation, within the Sukunka-Quintette coalfield, including the Hermann property.

3.1.2 Thin-skinned deformation and thrust-faulting

The Hermann coal property, and the coalfield within which it is contained, is characterised by a thin-skinned deformational style comprising folded, laterally-arcuate thrust faults and associated fault-bend folds (Jones, 1979).

Age relationships amongst the thrusts are as generally observed within the Cordilleran fold-thrust belts of North America, with the oldest thrusts occupying stratigraphically-higher positions, generally to the tectonic inboard (hence, to the southwest) of the stratigraphically-lower and younger thrusts. Breakback structural stacking is generally absent. Most, but not all, of the thrusts dip to the southwest (except where subsequently folded) and strike to the northwest. Thrusts range in scale from mesoscopic features with stratigraphic displacements of a few decimetres to a few metres, to regionally-throughgoing faults and fault zones (such as the Bullmoose and Mesa faults) with stratigraphic displacements of several hundred metres.

Regionally, the basal Cowmoose Member of the Moosebar Formation, and the younger Hasler Formation, are often zones of *décollement* (tectonic detachment), characterised by near-bedding-parallel thrust faults (Cooper and others, 2004). Other *décollement* zones, of at least local significance, may be hosted by soft, low-strength tuff bands within the Hulcross and Gates formations. Such zones are of practical significance to mining, in the event that they are exposed at adverse orientations within mine walls (Rostad and Hogarth, 2019).

3.2 Local geology

A table of formations, including an enumeration of coal beds with coal zones, and estimates of formation thicknesses, is presented as **Table 3-1**. Stratigraphy is discussed in greater detail within **Section 4** of this report.

3.2.1 Local stratigraphy

Within the Hermann property, rocks belonging to the uppermost Minnes, Bullhead and all but the uppermost Fort St. John groups are exposed at the ground surface. Approximately 1130 metres of Bullhead and Fort St. John rocks remain in place, following Tertiary-Quaternary episodes of fluviatile erosion and glacial scouring. An additional 1350 metres of Minnes Group strata underlies the Bullhead Group; these deeper rocks are known mainly from the records of natural-gas wells.

Formations mapped (see **Map 2-4** and **Table 3-1**) as being present at outcrop range

downwards from the Cruiser Formation (map-unit 8c, the youngest mapped formation) to the Monach Formation (map-unit 1, the oldest mapped formation). The ages of these rocks span 145 to 100.5 million years before present, based on off-property paleontological evidence and limited tephrachronological dating (also off-property).

3.2.2 Local structure

The Hermann coal property consists of a moderately-deformed stack of marine and non-marine strata, generally present in normal ('tops-up') stratigraphic position, albeit with generally-steep bedding-surface dips. Exceptions to this general situation are presented by the complexly-faulted and folded area between the Hermann Syncline and the northeast-facing 'nose' of the Mesa Thrust, which may be a displacement-transfer zone between the southward-terminating Bullmoose Thrust and the throughgoing Mesa Thrust.

As a general consideration, thrust faults at Hermann are inferred to have developed in the typical downward-younging sequence of successive faulting, although out-of-sequence thrusting is possible within the previously-mentioned 'nose' area.

Thrust faults are locally folded, as exemplified by the hairpin curvature of the Marmot East Thrust around the nose of the Transfer Syncline. A similar folded-thrust structure is mapped around the northwest-plunging nose of the Transfer Anticline. An imbricate stack of thrusts is mapped in the complexly-structured area between the Hermann Syncline and the Transfer Middle Syncline, where the Bullmoose Thrust appears to be truncated by, or possibly be involved in a displacement-transfer zone with, the underlying Mesa Thrust.

Thrust faults typically exhibit northeastward vergence, consistent with an overall northeastward direction of tectonic transport. The map pattern of the component thrusts within the Marmot thrust system suggests that these faults are southwest-verging components of a triangle zone; however, this supposition remains uncertain, and it is possible that instead these thrusts are simply the exposed trailing edge of an incipient klippe (in which case the Marmot thrusts might represent the 'beheaded' northeastward continuations of the Mesa Thrust).

The *en echelon* overlap of thrust-faults (as seen in the nearby Hermann West property, and in parts of the nearby former Quintette mines) is less well-developed at Hermann, other than within the complexly-faulted zone of the Mesa Thrust's 'nose' within Coal Licences 383183 and 405139. Bedding-plane detachments are occasionally seen within soft muddy siltstones and mudstones of the Falher Member of the Gates Formation, as well as within the relative less-competent upper part of the Spieker Member of the Moosebar Formation, immediately below the competent sandstones of the Torrens Member of the Gates Formation.

Bedding dips within the Hermann coal property are generally steeper than those observed in nearby properties such as Hermann West. Dips of 45 to 70 degrees are typical within the folded rocks of the property's northwestern and eastern portions. In the eastern part of the Hermann property (beyond the eastern boundary of the Area 'C' coal licences) the bulk of tectonic shortening appears to have been accomplished by folding rather than by over-thrusting. The most economically-significant of the folds is the Hermann Syncline, whose gently-warped core preserves basal coal-measures of the Falher Member. Also of significance is the Transfer Anticline, which brings the Falher coal measures close to the ground surface.

Table 3-1: Table of formations for the Hermann coal property

Geological Age		Lithostratigraphic Units				Thickness	Map-Units		Coal Beds/Coal Zones	
		Group	Formation	Member	Division				Bed	Zone
Quaternary			Mine waste			>50 m?	M			
			Drift			nil to 80 m	D			
Early Cretaceous	Late Albian	Fort St. John	Cruiser			>15 m?	8c			
			Goodrich			50 m?	8b			
			Hasler			150 m?	8a			
	Late Middle Albian to Late Albian		Boulder Creek	Paddy		130 m	7			
				Walton Creek					V coal zone	
				Cadotte						
	Middle Albian		Hulcross			105 m	6			
	Late Early Albian		Gates	Notikewin		90 to 115 m	5	5c	A coal bed	
									B coal bed	
									C coal bed	
				Falher		70 to 90 m		5b	D coal bed	
									E1-E3 coals	E
									E4 coal bed	
									F1 coal bed	F
									F2/G1 coal bed	
									G2 coal bed	G
									G3 coal bed	
									J1 coal bed	J
									J2 coal bed	
									J3 coal bed	
									K1-K3 coals	K
				Torrens	Upper Quintette sandstone	25 to 32 m		5a		
					medial siltstone	15 to 18 m			L coal bed and ash-band near base	
					Lower Quintette sandstone	35 m				
			Moosebar	Spieker		49 to 55 m	4	4c		
				Cowmoose		60 to 70 m		4b		
				Green Marker		0.1 to 17 m		4a		
		Bull-head	Gething	Chamberlain		30 to 40 m	3	3d	Bird coal zone	
									Skeeter – Chamberlain coal zone	
				Bullmoose		25 to 35 m		3c		
				Bluesky		nil to 15 m		3b		
	Hauterivian to Late Early Albian			Gaylard		150 to 160 m		3a	Gething coal zone(s): GT1 / GT2 coals	
	Barremian		Cadomin			30 to 85 m	2			
	Valanginian and older?	Minnes	Monach (and older formations below)			1300 to 1400 m	1		Coals present, not yet studied in detail	

3.3 Stratigraphic details

The following discussion presents details of the lithology, contained coal beds, inferred origin, typical thickness and contact relationships of the various surficial and bedrock units present within the Hermann coal property as a whole, keyed to the regional map-unit numbers used in **Map 2-4** and **Table 3-1**. Geological units are discussed in stratigraphic order from uppermost (youngest) to lowermost (oldest) within the exposed sequence of strata.

3.3.1 Quaternary surficial deposits (map-units M and D)

Unconsolidated surficial deposits of Quaternary age comprise mine waste (map-unit M) and valley-bottom and hillside Drift (map-unit D). The extent of both classes of surficial deposits has been mapped by means of *Google Earth* satellite imagery, and by interpretation of topographic boundaries adjacent to the valley-floor of Murray River, supported by borehole records in those areas which have been drilled.

3.3.1.1 Mine waste (map-unit M)

Associated with the historic open-pit mining operations at Quintette are mine waste dumps, consisting of overburden and interburden rocks removed during mining operations. Thickness of dumped material is inferred to be substantial, locally greater than 50 metres.

3.3.1.2 Drift (map-unit D)

The flat-bottomed floor of the Murray River valley is occupied by the river's meander-belt, and by adjoining alluvial fans of tributary creeks which drain nearby upland areas. The banks of the river, where exposed by channel-migration processes, show crudely-bedded silts, sands and gravels which are interpreted as fluvial deposits. Glacial and glaciolacustrine sediments, of broadly Pleistocene age, may underlie the near-surface fluvial deposits. Thickness of the valley-filling Drift, where drilled within the M-9 and Shikano synclines, ranges from a few metres to at least 78 metres. The base of the valley-fill has often been unreachable by historic drilling, although this may be to some extent due to past workers being disinterested in pursuing bedrock to depths beyond those deemed reasonable for surface mining.

Isolated bodies of thick Drift also form narrow channel-fills and isolated hillside wedges within the northwestern corner of the Hermann property. The outlines of these bodies of Drift (as depicted in **Map 2-4**) are mapped at inferred 20-metre depth to bedrock.

3.3.2 Fort St. John Group (map-units 8c through 4a)

An incomplete section of the Fort St. John Group is present at Hermann, owing to the group's top contact having been stripped off by erosion during Tertiary uplift of the rocks, and further scouring by glaciers during the Quaternary era.

The youngest of the completely-drilled Fort St. John rock-units is the Hulcross Formation, of which a complete section was intersected in boreholes HR19-01C and MW19-AD, and nearly-complete sections were encountered in boreholes HR2005-3C, HR19-05C, and HR14-05C. Partial sections of the basal beds of the overlying Boulder Creek Formation were drilled in boreholes HR19-01C and MW19-AD.

Thicknesses and lithologies of the Cruiser, Goodrich, and Hasler formations are principally known from examination of outcrop sections (augmented by partial information concerning their drilled thicknesses in nearby properties), as only the basal portion of the Hasler has been intersected by drilling at Hermann.

The Cruiser, Goodrich and Hasler formations are considered by Stott (1968) to be lateral equivalents of the Shaftesbury Formation of the Alberta Syncline, where the Goodrich sandstone is not recognisable within a thick sequence of fine-grained rocks. During the Denison-Quintette era of exploration at Hermann, coal-company geologists did not consider as relevant the tripartite division of the strata overlying the Boulder Creek Formation, and thus they mapped these rocks as Shaftesbury.

3.3.2.1 Cruiser Formation (map-unit 8c)

The Cruiser Formation is the uppermost formation within the Fort St. John Group. The Cruiser is reported by Stott (1968) to comprise 105 metres of dark grey mudstone with frequent interbeds of siltstone and occasional interbeds of fine-grained, silty sandstone. Bands of discoidal to spheroidal sideritic concretions occasionally occur. The formation's age, on the basis of marine fossils, ranges from Late Albian to Cenomanian.

Within the Hermann coal property, only the basal 15 metres or so of the Cruiser Formation is inferred to have been preserved from erosion, within the core of the Shikano Syncline; this part of the formation is therefore noted to be of Late Albian age in **Table 3-1**. The basal contact of the Cruiser Formation with the underlying Goodrich Formation is abrupt (Stott, 1968), and possibly disconformable.

3.3.2.2 Goodrich Formation (map-unit 8b)

The Goodrich Formation is reported (Stott, 1968) to comprise approximately 50 metres of medium- to thick-bedded, locally cliff-forming sandstone, with frequent interbeds of siltstone and mudstone. At Hermann, the Goodrich Formation is preserved within the core of the Shikano Syncline. The Goodrich is of Late Albian age, as established by its molluscan fauna (Stott, 1968). The basal contact of the Goodrich Formation with the underlying Hasler Formation is gradational.

3.3.2.3 Hasler Formation (map-unit 8a)

The Hasler Formation (Stott, 1968) comprises approximately 150 metres of dark grey, locally rusty-weathering mudstone with frequent interbeds of siltstone and occasional interbeds of fine-grained, silty sandstone. The Hasler is probably of Late Albian age, on the basis of the probable Late Albian age assigned to the underlying Boulder Creek Formation (Gibson, 1992b). The abrupt base of the Hasler Formation is locally marked by a thin (a few centimetres to decimetres) layer of pebbly mud-matrix conglomerate.

3.3.2.4 Boulder Creek Formation (map-unit 7)

The Boulder Creek Formation comprises 130 metres of ridge-forming, competent, thick-bedded to massive, coarse-grained sandstone and conglomerate, with thin interbeds of siltstone, variably-carbonaceous mudstone and occasional thin (a few decimetres) coal beds, of which the most consistently-present was designated as the V coal zone by Walter Energy.

Details of Hulcross ash bands in current and selected historic boreholes: **Table 3-2**

Borehole	Tops of geological markers (depths in metres from geophysical log interpretation)																				
	Drift	Cadotte Mb. of Boulder Creek Fm.	Hul-cross Fm.	Ash-20	Ash-18	Ash-17	Ash-16	Ash-15	Ash-14	Ash-13	Ash-12	Ash-9	Ash-8	Ash-7	Ash-6	Ash-5	Ash-4	Ash-2	Ash-1	Basal Hulcross grit unit	Notikew-in Mb. of Gates Fm.
HR21HQ-01	15.70		starts												18.95	24.80	26.05	33.40	NR	33.75	34.20
HR21HQ-02	17.35		starts												19.70	25.95	27.30	35.30	NR	35.95	36.10
HR21HQ-07 *--- Fault at 21.90* *--- Fault at 25.25*	18.00		starts					18.70	----- ----- NR	30.95	NR	57.90	58.80	NR	79.05	84.90	86.35	NR	NR	94.00	94.70
HR21HQ-08	15.50		starts						24.20	26.00	NR	42.50	44.35	61.90	67.75	72.30	73.85	78.70	NR	81.05	81.60
									Note: HR21HQ-08 has 11-Ash at 35.10 and 10-Ash at 38.85												
HR19-01C	0.70	starts	16.30	28.40	36.75	38.90	45.30	51.40	NR	60.20	61.95	NR	87.00	NR	107.00	113.10	114.45	NR	121.80	122.25	122.60
HR19-03C	0.30		starts											NR	15.90	24.20	25.50	NR	NR	33.87	34.05
HR19-05C *--- Fault at 21.50* *--- Fault at 37.00*	4.45		starts		16.90 ----- 25.55	18.65 ----- 29.22 -----	----- 43.20	53.30	NR	55.50	57.40	89.95	91.80	NR	109.85	114.94	115.95	121.92	123.20	123.26	123.27
HR19-06C	2.30		starts										23.90	NR	43.20	48.85	50.00	NR	57.00	58.00	58.27
MW19-AD	0.70	starts	14.30	26.50	35.45	38.05	44.95	51.45	NR	60.40	62.20	NR	79.55	100.35	106.90	112.90	114.25	NR	121.40	122.00	122.70
MW19-BD	1.75		starts											4.70	15.10	22.90	24.50	NR	NR	33.85	34.25
HR2005-3C	5.2		starts				12.70	18.55	NR	24.90	26.55	36.55	37.40	NR	58.15	64.10	65.35	NR	72.95	74.10	74.50
HR14-05C *--- Fault at 16.55* *--- Fault at 25.10* *--- Fault at 27.25*	8.9		starts				9.30	15.20 ----- 18.25	NR	23.65 ----- ----- 27.45	28.80	51.20	51.85	NR	69.45	NR	75.50	81.80	82.25	82.55	83.70

Note: NR denotes 'not recognised'.

Gibson (1992b) recognised three members (the Cadotte, Walton Creek, and Paddy members) within the Boulder Creek Formation, on the basis of lithostratigraphy. Gibson's basal Cadotte Member is represented at Hermann by a conspicuous ridge-forming zone of conglomerate and sandstone (as recognised by Johnson, 1990), but it is difficult to distinguish the overlying Walton Creek coal-measures from the uppermost Paddy Member of the formation, owing to lack of good exposure of these rocks. At Hermann, the bottom of the Cadotte Member was cored in borehole HR19-01C, and drilled open-hole by borehole MW19-AD.

The Boulder Creek Formation is of Late Middle Albian to probable Late Albian age, based on its angiosperm flora (Gibson, 1992b). The basal contact of the Boulder Creek Formation with the underlying Hulcross Formation is abrupt or erosional at local scale, and possibly gradational by intertonguing at regional scale.

3.3.2.5 Hulcross Formation (map-unit 6)

The Hulcross Formation, of Middle Albian age within the Early Cretaceous (Stelck and Leckie, 1988; Gibson, 1992b) comprises 105 metres of thinly-interbedded, locally-concretionary medium grey siltstone, fine-grained sandstone and dark grey mudstone with occasional very thin but extremely-persistent interbeds of soft, light grey to white, tuffaceous volcanic ash. Some of the ash bands locally manifest as harder, medium grey claystones, which are more difficult to recognise in the absence of gamma-ray observations.

Regionally, 20 such 'ash bands' are traceable within the Hulcross Formation. At local scale within the Hermann property, 18 of these 20 ash bands (**Table 3-2**) have been recognised on the basis of their anomalously-high gamma-log geophysical response.

The Hulcross ash bands are potentially planes of weakness within the strata, and therefore of interest in rock-mechanics studies. The ash bands, as well, provide a means of discerning fault offsets within the Hulcross Formation.

Mesoscale (a few decimetres to a few metres thick) fining-upward sequences reminiscent of proximate turbidites or tempestites are common within the Hulcross, as are trace-fossils and poorly-preserved shell fossils. Fine-grained pyrite is locally-abundant within the Hulcross rocks, which are inferred to have been deposited beneath a stratified water column within a restricted-circulation seaway (Stelck and Leckie, 1988). The disconformable base of the Hulcross Formation is characteristically marked by a thin (generally a few decimetres, and rarely up to a metre or so thick) erosive-based bed of cherty pebbly sandstone or gritstone. This informally-named basal grit unit is also noted in **Table 3-2**.

3.3.2.6 Gates Formation (map-unit 5)

The Gates Formation, of late Early Albian age within the Early Cretaceous (Stott, 1982; Wan, 1996), comprises 235 to 290 metres of interbedded sandstone, siltstone, conglomerate, shale and coal at Hermann. At Hermann, and within the Sukunka-Quintette coalfield generally, the Gates Formation may be usefully subdivided into three members, in order from top down:

- Notikewin Member (map-unit 5c), comprising 90 to 115 metres of interbedded, locally-glauconitic sandstone and siltstone, with minor conglomerate, carbonaceous mudstone and generally-thin coal (A1, A, B and C coal zones);

- Falher Member (map-unit 5b), comprising 70 to 90 metres of muddy to sandy siltstone, channel-filling sandstone and generally-thick coal (D, E, F, G, J and K coal zones), with lesser amounts of carbonaceous mudstone and silty mudstone; and
- Torrens Member (map-unit 5a), comprising 75 to 85 metres of sandstone, with a laterally-persistent medial zone of siltstone and mudstone.

The A1, A, and C coal zones, although not of workable thickness, serve as structural markers within Area 'C' of the Hermann property.

The B coal zone does locally reach and surpass a metre in thickness, but it may be sufficiently-isolated from other coals, such that it is more likely to be wasted.

The D coal zone (situated near the top of the Falher Member, is generally absent within Area 'C', but it is present further to the east, within the northeastern part of the property (within the Grizzly and Transfer exploration prospects), and also present within Quintette's former Sheriff and Deputy mining areas, situated to the northwest of Area 'C'. The coal zone's absence within Area 'C' is likely due to wide-spread erosion of the uppermost Falher coal-measures, prior to the onset of Notikewin sedimentation.

In Area 'C', the E coal zone comprises two closely-associated groupings of coals: the E123 coals (in the upper half of the zone), and the E4 coals (in the lower half of the zone). For purposes of mine design, the E4 coals may more conveniently be modelled as a zone in their own right.

Also in Area 'C', the F and G coal zones are involved in a Z-shaped split, with the F1 and closely-associated G2 and G3 coals being the upper and lower flats of the Z-geometry, and the F2 coal passing stratigraphically obliquely downward from northwestward proximity to the F1 coal, to southeastward proximity to the G2 and G3 coals.

The J coal zone in Area 'C' comprises three (or locally, four) persistent coal beds, from top down the J1, J2, and J3 coals. The J2 may locally manifest as two closely-adjacent coals (the J2U and the underlying J2L), separated by a few centimetres of dirty fusainous coal, interpreted as a peat-fire horizon at the top of the J2L.

The K coal zone in Area 'C' comprises three coal beds, from top down the K1, K2, and K3. Each of these coals is locally split; furthermore, the coals and their second-order splits (**Table 3-3**) are frequently found to be laterally lithified and replaced by coaly or carbonaceous mudstones.

Coals of the Gates Formation, and their enclosing sedimentary rocks, were deposited on the shoreline of the Western Interior Seaway between 108.7 and 111.0 million years ago, as part of an extensive complex of coastal plains, deltas and estuaries within the Sukunka-Quintette coalfield. Throughout the period of Gates Formation sedimentation, the shallow waters of the Western Interior Seaway generally lay a few tens of kilometres northeast of Hermann, with the exception of a few isolated ‘marine bands’ associated with more substantial transgressions of the sea into and atop coal-forming coastal plain sediments. Splits were occasionally induced within the Gates coal beds, by crevasse-splays from river channels, and perhaps also by drowning of coal-forming wetlands beneath lakes and ponds.

Within the Hermann coal property, numerous coal zones, each comprising one or more individually-recognisable coal beds, are present within the Gates Formation. Coal zones and coal beds are designated by an upward-progressing system of lettering, from the K zone near the base of the formation, to the C, B and A zones near the top of the formation. This scheme of designation has been generally applied within the Quintette portion of the coalfield, and is the inverse of the 'bottoms-up' naming scheme used at Sukunka, Bullmoose and East Bullmoose.

Table 3-3: Split hierarchy of coals within Gates Formation at Hermann

Member within Gates Formation	Coal zone	First-order splits	Second-order splits	Comments
Notikewin Member	**A1**	not recognised	not recognised	only locally present; may be scoured-out by basal Hulcross
	A	not recognised	not recognised	locally observed as coaly rock
	B	B1	not recognised	locally attains mineable thickness
		B2		
	C		not recognised	
Falher Member	**D**	D1	not recognised	within Hermann Area 'C', D-zone is generally absent (due to sub-Notikewin erosion?)
		D2		
		D3		
	E	E1		
			E1L	
		E2	E2U	ash-band between these coals
			E2L	
		E3	E3U	
			E3L	
		E4	E4R	Denison Mines initially correlated the E4 with F-zone of Sheriff / Deputy area
			E4U	
			E4L	
	F	F1	not recognised	remains close to E4 but pinches out
		F2		locally approaches G: old name was G1
	G	[G1]		[now recognised as F2]
		G2	locally merge?	thin but persistent; good markers
		G3		
	H/I	not recognised	not recognised	local lenses of coaly rock
	J	J1	J1	
		J2	J2U	
			J2L	
		J3	J3	
	K	K1	K1U	Thicknesses and interbed intervals change rapidly; possibly pockety distribution?
			K1L	
		K2	K2U	
			K2L	
		K3	K3L	
			K3L	
Torrens Member	**L**	L-ash		regionally-extensive ash-band discovered by Quintette Coal
		L	not recognised	local lenses of coaly rock or thin coal

3.3.2.6.1 Notikewin Member (map-unit 5c)

The Notikewin Member of the Gates Formation comprises 70 to 90 metres of siltstone and sandstone with minor conglomerate, variably-carbonaceous, locally root-bearing mudstone, and moderately-persistent coal beds (within the A1, A, B and C coal zones). The Notikewin coals locally attain potentially-mineable thicknesses, greater than 2.5 metres in the case of the B coal bed, as noted by Johnson (1990), most often in the cores of folds where the coal's thicknesses may have been increased by cataclastic or plastic flow.

At Hermann, the basal few metres to few tens of metres of the Notikewin Member are often represented by a competent, ledge-forming bed of erosive-based sandstone and conglomerate. The basal part of the Notikewin has also been informally termed the 'Babcock Member' by Quintette Coal's geologists, although this usage is now deprecated.

The basal contact of the Notikewin Member with the underlying Falher Member is disconformable, and locally deeply-scoured, and thus implicated in the general absence of the D coal zone within Area 'C' at Hermann.

3.3.2.6.2 Falher Member (map-unit 5b)

The Falher Member of the Gates Formation comprises 70 to 90 m of muddy to sandy siltstone, channel-filling sandstone and generally thick coal (within the D, E, F, G, J and K coal zones), accompanied by lesser proportions of carbonaceous mudstone and silty mudstone. Overall, the Falher Member contains proportionately more coal than the overlying Notikewin Member.

As noted previously, the D coal zone, at the top of the Falher Member, is often found to be absent in boreholes. In non-cored boreholes, recognition of the Falher-Notikewin contact is rendered more difficult when well-sorted uppermost Falher sandstone is directly overlain by well-sorted basal Notikewin conglomerate, inasmuch as gamma-ray logs fail to distinguish between the two clay-poor lithologies.

The Falher Member is of Late Early Albian age (Wan, 1996). Its basal contact with the underlying Torrens Member of the Gates Formation is abrupt, marked by an undulating surface, possibly originating as relict sandbars or sand-waves.

Regionally, within the Sukunka-Quintette coalfield and also within the adjoining Deep Basin hydrocarbon play area of northeastern British Columbia and northwestern Alberta, the Falher Member may readily be divided into five or six semi-formal subdivisions, designated by letters from top downwards, as the Falher A through Falher F (Leckie and Walker, 1982). Such a subdivision might be useful in more detailed resolution of coal-zone and washouts at Hermann, but this has not yet been attempted.

3.3.2.6.3 Torrens Member (map-unit 5a)

Within the Sukunka-Quintette coalfield, the term 'Torrens Member' is often applied as a local name for the thick sandstone underlying the lowest of the mineable Gates coal beds. Within the northern part of the Quintette area (including the Hermann and Hermann West coal properties, and extending through the Perry Creek and East Bullmoose areas), however, there are two of these sandstone units, the Upper Quintette

and Lower Quintette sandstones, separated by the Medial Siltstone, an informally-named, fine-grained 'silty zone' of interbedded siltstone, sandstone and shale, with minor tuff and rare thin coal.

The two Torrens sandstones are probably of marine origin, but the silty zone comprises both marine and non-marine rocks, including thin coaly stringers at a few of the sites where it has been reached by drilling within the Hermann coal property. The overall stratigraphic thickness of the three sub-units of the Torrens Member at Hermann is 75 to 85 metres.

Details of Torrens ash bands in historic and current boreholes: **Table 3-4**

Borehole	Top of Upper Quintette	Top of Medial Siltstone	Top of L-Ash	Base of L-Ash	Top of Lower Quintette	Top of Spieker
QJR8205	27.2	58.2	DNR @ 63.8	DNR	DNR	DNR
QHR87054	ND	ND	54.15	54.94	ND	ND
HR2005-1		starts	23.3	24.55	27.1	60.3
HR2005-13	165.25	187.95	DNR @ 195.2	DNR	DNR	DNR
HR2005-16	starts	32.1				
fault 47.0-47.05		f/47.05				
fault 48.15-48.35		f/48.35	NR	NR	48.6	54.4
fault 54.7-54.9						f/54.9
fault 62.95-63.0	f/63.0?	87.2	99.65			
fault 100.15-100.2			f/100.2			
fault 108.85-108.9		f/108.9	NR	NR	120.5	130.55
HR2005-21	17.7					
fault 58.1-58.2	f/58.2	74.2	74.45	74.7	DNR	DNR
HR2005-22	108.8	128.3	NR	NR	142	156.3
HR2006-01	107.2	124.7	138.9	139.3		
fault 149.25-149.3		f/149.3	NR	NR	162.45	DNR @ 175.15
HR2006-09	30.4	79.6	NR	NR	102.15	DNR @ 120.2
HR19-01C	302.5	334.4	349.85	350.25	362.05	359.4
fault 364.5-364.6						f/364.6
fault 373.4-373.6		f/373.6	NR	NR	376.15	
fault 384.6-384.75		f/384.75	385.35	385.9	DNR @ 396.62	DNR
HR19-02C		309.2	343.7	DNR @ 349.6	DNR	DNR
HR21HQ-03		starts	20.6	20.9	21.35	
fault 31.3-31.45	f/31.45	33.9	81.5	82.15	83.1	DNR @ 99.5
HR21HQ-04		starts	28	28.3		
fault 28.3-28.6		f/28.6	50.65	50.8	51.45	59.05

File: L-ash_220105b.doc

Notes: f/ indicates faulted contact; DNR indicates horizon not reached; NR indicates no record; 'ND indicates no data

The top of the Upper Quintette sandstone is almost always root-penetrated, at times distinctly softer, darker and carbonaceous to coaly (likely originating as an ancient soil horizon beneath the J3 coal bed), and thus readily distinguishable from the underlying

harder, lighter-coloured and cleaner main body of the sandstone. The Upper Quintette sandstone's surface undulates at the scale of a few metres to a few tens of metres, probably representative of relict sand-bars and sand-waves, formed within a shallow-marine setting.

In earlier reports, the Upper Quintette sandstone was frequently designated as the 'Sheriff Member' of the Gates Formation.

In terms of true stratigraphic thickness. the Upper Quintette sandstone is 25 to 32 metres thick at Hermann. The underlying Medial Siltstone unit is 15 to 18 metres thick, and the Lower Quintette sandstone is 35 metres thick. Thickness is demonstrated by all three of these units having been intersected, nearly normal to their bedding, in the d-83-J / 93-I-14 natural-gas well situated within the trough of Hermann Syncline.

As noted, in historic practice at Hermann, coal-exploration boreholes have seldom penetrated far into the Torrens Member, and have therefore generally left the Medial Siltstone unit untested as to the presence of coal. This paucity of data was addressed by deep drilling in several of the year-2019 diamond-drill holes, which failed to encounter an expected coal bed within the Medial Siltstone. However, an ash-band (denoted as the L-ash), occasionally with a soft, mealy, and incoherent texture, was encountered near the base of the Medial Siltstone.

As indicated in **Table 3-4**, the L-ash is locally several decimetres thick. Presence of similar rocks at approximately the same stratigraphic level was previously noted by geotechnical consultants working in the Quintette mines (where it was called the 42-metre band, for it position below the floor of the lowest workable coal).

The age of the Torrens Member is presumed to be Late Early Albian. The basal contact of the Torrens Member with the underlying Spieker Member of the Moosebar Formation is gradational by interbedding (Carmichael, 1983).

3.3.2.7 Moosebar Formation (map-unit 4)

The Moosebar Formation comprises 109 to 125 metres of dark grey, locally-concretionary mudstone and siltstone, with minor thin interbeds of sandstone and tuff, and a thin basal conglomerate. Concretions are sideritic, and distinctly rusty-weathering, concentrated in laterally-persistent bands, a few decimetres thick, which may represent diastem-induced hardgrounds. Tuff bands within the Moosebar Formation are very thin (a few millimetres to a few decimetres) but also regionally-persistent. Moosebar tuffs are not tabulated in the present report, owing to few boreholes having intersected the formation.

Variations in the Moosebar's thickness are likely due to intertonguing with the southward-thickening sandstone of the basal Torrens Member of the Gates Formation. Some variation in thickness may also be due to structural telescoping of the relatively-incompetent Moosebar rocks between the stronger rocks of the Gates and Gething formations.

The Moosebar Formation is of Early Albian age (Stott, 1968). Its basal contact with the underlying Gething Formation is abrupt, and generally erosional, characteristically marked by a very thin band of variably-glauconitic gritty sandstone or pebbly gritstone, informally denoted as the Green Marker.

At Hermann, and within the Sukunka-Quintette coalfield generally, the Moosebar Formation may be conveniently divided into three units. In order from top down, these are the Spieker, Cowmoose, and (unnamed) basal gritstone of the Green Marker.

3.3.2.7.1 Spieker Member (map-unit 4c)

The Spieker Member comprises 49 to 55 metres of thinly-interbedded, overall coarsening-upward sandy siltstone and sandstone, pervasively-bioturbated and possibly originating as proximal shallow-marine turbidites (Leckie, 1983) in front of the advancing Falher/Torrens paleodelta. Sandstone beds become thicker, coarser, and more abundant towards the top of the Spieker, and on the whole the Spieker Member is a transitional unit (Duff and Gilchrist, 1981) between the underlying Cowmoose mudstone and the overlying Torrens sandstones.

In contrast to previously-studied areas further to the northwest, the Spieker Member at Hermann contains a single thin coal bed near its base (Johnson, 1980). The thickest drilled intersection of this coal bed is 0.5 metres, in borehole QHR88003.

The age of the Spieker Member is presumed to be Early Albian to possibly late Early Albian. However, this unit has thus far yielded no diagnostic fossils. The basal contact of the Spieker with the underlying Cowmoose Member is drawn at the base of the lowest band of sandy siltstone overlying the mudstones. This contact is inferred to be locally abrupt or erosional, but regionally-interfingering.

3.3.2.7.2 Cowmoose Member (map-unit 4b)

The Cowmoose Member of the Moosebar Formation comprises 60 to 70 metres of rubbly-weathering, dark grey to black siltstone and mudstone, punctuated by laterally-persistent bands crowded with ironstone concretions, locally-abundant dolomitic nodules, and several thin (a few millimetres to a few decimetres) but laterally-persistent bands of light olive drab to white tuff. The tuff bands are useful as local structural markers (Duff and Gilchrist, 1981; Kilby, 1984a) in properties situated northwest of Hermann, but insufficient drilling has been done (within the Moosebar at Hermann) to extend that line of evidence to Hermann's structural geology.

The age of the Cowmoose Member is Early Albian (Stott, 1968). The basal contact of the mudstones over the underlying Green Marker is gradational to abrupt, and generally easily-recognised on geophysical logs.

3.3.2.7.3 Green Marker (map-unit 4a)

The basal Green Marker of the Moosebar Formation comprises 0.1 to 17 metres of locally-glauconitic, distinctively dark green to grey-green, chert-rich lithic arenite to pebble-conglomerate. Stott (1968, page 40, in his discussion of the “Gething-Moosebar Problem”) suggested that the basal gritstone unit might be equivalent to the Bluesky Formation of the Alberta Plains, but that correlation is now understood to be incorrect (Kilby, 1984b; Gibson, 1992a). The age of the Green Marker is presumed to be Early Albian. Its basal contact with the underlying Chamberlain Member of the Gething Formation is presumed to

be abrupt, and locally erosional.

Upon the accompanying geological map (**Map 2-4**), map-units 4a and 4b are depicted together as map-unit 4ab, owing to the impracticality of depicting the thin Green Marker by itself at the given scale of mapping.

3.3.3 Bullhead Group (map-units 3 and 2)

The Bullhead Group consists of two formations, the Gething Formation which comprises the majority of the group's thickness, and the thinner basal Cadomin Formation (Stott, 1963; 1968; 1973). Both formations are well-represented in outcrop at Hermann, and they have been extensively-drilled within those parts of the property where potentially-strippable coal might have been expected to exist. Documentation of this drilling is incomplete, and some question remains as to the stratigraphic horizon (within the Gething Formation as a whole) at which some of the coal was encountered.

3.3.3.1 Gething Formation (map-unit 3)

The Gething Formation, of Early Aptian to Early Albian age within the Early Cretaceous (Gibson, 1992a), comprises thin to thick interbeds of siltstone, sandstone, mudstone and coal, with lesser amounts of gritstone, pebble-conglomerate, ironstone and tuff.

The Gething Formation originated as a complex of non-marine to shallow-marine sedimentary deposits, laid down by meandering and braided streams and rivers within a widely-extensive belt of coastal deltas, of which two (the Gaylard and Chamberlain paleodeltas) extended into the Quintette Mountain area, including the Hermann coal property.

Coals of the Gething Formation at Hermann, and their enclosing sedimentary rocks, were deposited between 111 and 123 million years ago (Gibson, *ibid.*), on the basis of regional plant-fossil and foraminiferal zonations.

Following upon suggestions made by coal-company geologists (Wallis and Jordan, 1974) and subsequent correlation by the British Columbia Geological Survey (Duff and Gilchrist, 1981; Legun, 1990), Gibson formally divided the Gething Formation into three members: the upper, non-marine to transitional Chamberlain Member, the middle marine Bullmoose Member, and the basal, non-marine to transitional Gaylard Member. A fourth member of the Gething Formation, the Bluesky Member, is also inferred to be present between the base of the Bullmoose Member and the top of the Gaylard Member.

In the geological map (**Map 2-4**), the Gething Formation is locally mapped as three stratigraphically-based map-units: the Chamberlain Member (map-unit 3d), the undivided Bullmoose and Bluesky members (map-unit 3bc) and the Gaylard Member (map-unit 3a). Where the extent of outcrop exposure does not support this cartographic distinction, the Gething Formation has been mapped as an undivided whole (map-unit 3).

3.3.3.1.1 Chamberlain Member (map-unit 3d)

The Chamberlain Member comprises 30 to 40 metres of thickly-interbedded, brown-weathering sandstone and siltstone, containing two regionally-significant coal zones: the Bird Zone (containing one or more coal beds) near the member's top, and the Skeeter-Chamberlain Zone (again, containing one or more coal beds) within the

member's middle. The basal quarter to third of the Chamberlain Member's thickness comprises one or two regionally-extensive thick beds of marine sandstone, known informally as the Chamberlain Sandstone (*per* prior usage by Wallis and Jordan, 1974).

The Chamberlain Member is inferred to form near-surface bedrock in small fault-bounded tectonic 'slices' immediately to the southwest of, and therefore structurally-above, the Mesa Thrust. An isolated outlier of the Chamberlain Member is also inferred to be present within the core of the Mast Syncline, near the southwestern corner of the Hermann property.

The Chamberlain coal-measures were also encountered in natural-gas well d-83-J / 93-I-14, near the centre of the Hermann Syncline; these beds are therefore mappable around the periphery of the syncline, although they have been only sparsely-drilled within this area.

The age of the Chamberlain Member is late Early Albian (Gibson, 1992a). The basal contact of the Chamberlain Member with the underlying Bullmoose Member is drawn at the base of the thick basal sandstone(s). This contact is generally abrupt at local scale, but probably gradational by interfingering at the regional scale.

3.3.3.1.2 Bullmoose Member (map-unit 3c)

The Bullmoose Member comprises 25 to 35 metres of thinly-interbedded, recessive-weathering mudstone, siltstone and minor sandstone of turbiditic aspect, forming one or more coarsening-upward sequences. The Bullmoose does not contain any coal, other than isolated coalified logs and coarse, poorly-preserved 'plant trash', likely of drifted origin. Regionally, the Bullmoose does, however, contain locally-abundant molluscan fossils, including *Pecten (Entolium)* cf. *irenense* McLearn (Gibson, 1992a) and *Yoldia kissoumi* (Duff and Gilchrist, 1981), which, although not age-diagnostic, are characteristic of the unit.

In a departure from historic mapping (which placed the Moosebar Formation there), the Bullmoose Member of the Gething Formation has recently been interpreted to form most of the exposed core of the Mast Syncline, within the southwestern corner of the Hermann coal property (Cathyl-Huhn and Avery, 2014). The Bullmoose Member is also considered to form bedrock within the immediate northeastern corner of the Mesa Fault's structural nose, situated between the Hermann Syncline and the Transfer Middle Syncline.

The Bullmoose Member is of late Early Albian age (Gibson, 1992a); its basal contact with the underlying Bluesky Member is generally gradational but locally abrupt.

3.3.3.1.3 Bluesky Member (map-unit 3b)

The Bluesky Member of the Gething Formation comprises up to 15 metres of pebbly mudstone to gritty pebble-conglomerate, at times slightly to moderately glauconitic, with occasional pyrite flecks. The basal contact of the Bluesky with the underlying Gaylard Member has not been directly observed at Hermann; however, elsewhere within the Sukunka-Quintette coalfield it is generally abrupt to erosional. The age of

the Bluesky Member is likely to be late Early Albian.

The Bluesky Member of the Gething Formation, as its name implies, is likely to be correlative and perhaps laterally-continuous (if not strictly coeval) with the Bluesky Formation of the Dawson Creek area (Kilby, 1984b; Legun, 1990).

Map-units 3b and 3c are depicted together as map-unit 3bc within **Map 2-4**, owing to the impracticability of representing the Bluesky Member separately at the given map-scale.

3.3.3.1.4 Gaylard Member (map-unit 3a)

The Gaylard Member comprises about 150 to 160 metres of thickly-interbedded siltstone, mudstone and brown-weathering channel-filling sandstone, accompanied by minor ironstone, tuff, gritstone and conglomerate. At Hermann, the Gaylard Member is contains numerous coal beds, some of which are several metres thick. CAR-618 (Johnson, 1985) and CAR-724 (Gormley, 1987) provide partial documentation of these coals, for which many borehole logs are missing. The most intensively-explored area of Gaylard coals lies within the structural 'nose' above the Mesa Thrust, within the 'Hermann Gething' area as named by Quintette Coal's geologists. Coal-quality results for these coals are mostly missing from their reports (and, following a diligent search of government records) now presumed lost.

The age of the Gaylard Member is Hauterivian to late Early Albian (Gibson, 1992a). Its basal contact with the underlying Cadomin Formation is gradational by interfingering at local and regional scale (Stott, 1968; Johnson, 1972; Gibson, 1992a), being most readily-drawn at the top of a bed of coarse-grained, often gritty and occasionally pebbly sandstone, which may laterally grade into more typical pebble-conglomerate characteristic of the Cadomin.

3.3.3.2 Cadomin Formation (map-unit 2)

The Cadomin Formation immediately underlies the Gething Formation, forming the basal part of the Bullhead Group (Stott, 1968). The Cadomin is resistant to erosion, and typically forms ledges to cliffs beneath the more-subdued slopes of the Gaylard Member. This ledge-forming geometry is locally well-developed along the southwest-facing slopes bounding Canary Creek, and along the southwestern shoulder of Mt. Frame.

The Cadomin Formation comprises one or more thick beds of coarse-grained, gritty to pebbly sandstone and pebble-to boulder-conglomerate (McLean, 1981) with occasional lenses of siltstone and pebbly gritstone, and rare thin lenses of dirty coal. Sandy phases of the Cadomin Formation thus strongly resemble the basal pebbly sandstones of the Gaylard Member, and the Cadomin's distinction from the Gaylard locally rests mainly upon the Cadomin Formation's greater lateral continuity.

Within the Hermann coal property, the top of the Cadomin Formation has only been reached by the two natural-gas wells (c-02-B / 93-P-03, and d-83-J / 93-I-14).

At Hermann, the Cadomin Formation inferred to be 30 to 85 metres thick. Its basal contact with the underlying Monach Formation is likely to be erosional, with considerable local scour into the older sediments. Regionally, the base of the Cadomin

marks a northeastward-deepening angular contact, cutting down into successively-older rocks of the Minnes Group (Stott, 1973).

3.3.4 Minnes Group (map-unit 1)

The Minnes Group, despite being known to contain coal within its outcrop belt along the southwestern fringe of the Sukunka-Quintette coalfield, is virtually unexplored in the vicinity of the Hermann property. The total thickness of the Minnes Group is estimated to be 1300 to 1400 metres, although some of this apparent thickness may be due to folding and thrust-faulting.

The Minnes Group in the Hermann area comprises three formations: from top down, the Monach, Beattie Peaks and Monteith formations. Of these three, only the Monach Formation is expected to outcrop at or near Hermann.

3.3.4.1 Monach Formation (map-unit 1)

The Monach Formation comprises ledge-forming sandstone and quartzite, with lesser amounts of interbedded siltstone and conglomerate, and occasional thin coals, inferred to locally form the uppermost part of the Minnes Group (Stott, 1998). The geophysical log of natural-gas well d-83-J indicates numerous coal beds within the Monach, although they are generally no more than a metre thick.

The Monach Formation is of Berriasian to Valanginian age (Stott, 1998). The Monach Formation is at least 420 metres thick in the Hermann area, as indicated by well d-83-J, although this thickness may reflect tectonic telescoping and thickening of the formation.

5 Coal quality

Coal quality data for composited coal and associated rock bands, as taken from the year-2021 drilled bulk sample boreholes, are presented (on a confidential basis) within **Appendix B**. Composites were assembled on a zone-by-zone basis, covering the major coal zones of the Falher Member, with the exception of D zones (which was absent at the bulk-sample site) and K zone (which was not reached by the bulk-sample boreholes). In all, 289 ply samples were collected, and 10 raw coal composites (E1 through J3 coals) were assembled and tested.

Work done to date comprises preliminary and bulk-scale jigging in Roben jigs, a full suite of head clean-coal analyses including proximate and associated analyses, plastometry (FSI, Gieseler fluidity, Ruhr dilatometry, and Sapohznikov tests), major-oxide ash chemistry and determination of ash fusion temperatures, Hardgrove grindability, light transmittance, and petrography (including determination of mean maximum reflectance of vitrinite).

The majority of the analytical work, including the jigging was done at Birtley Coal and Minerals Testing's laboratory in Calgary, Alberta. Petrographic work was done by CoalTech Petrographic Associates. G-index determination was done by SGS. Sapozhnikov tests (to determine X- and Y-values) were done by Pearson and Associates.

Jigging was selected as a means of laboratory-scale coal washing, in recognition that the alternative approach (of using heavy liquids including perchlorethylene) could potentially be deleterious to Gieseler fluidity results.

Finally, two preliminary blends were assembled, targeting two different ash yields, followed by the assembly of a multi-drum blend of clean coals, which was submitted for a coking test at CANMET's test facility in Bell's Corners, Ontario.

6 Reclamation

Technical records from the Denison-Quintette and Western-Walter eras of coal exploration at Hermann do not provide much detail of past reclamation practice. During site and access reconnaissance in the autumn of 2020, previously-used drilling trails (from year-2019 and earlier) were found to be still open and driveable, with the exception of local areas of blowdowns, and some cross-ditching at the junctions of drill trails with main access roads.

The year-2021 drilling programme was conducted during the late winter months. Existing roads and trails were used, in the interest of avoiding additional disturbance. Much of the roadwork consisted of blading snow off existing roads, and scattering gravel as required for safe passage over steep or icy road segments. Extensive use was made of wood mulching, as a means to minimise disturbance and maintain safe access At the closure of work in each area, drill pads and trails were progressively-reclaimed, in keeping with instructions from the Inspectorate of Mines.

With the exception of those drill trails and pads required for ongoing access to hydrological wells and piezometers, drill trails and pads have been reclaimed by scattering of appropriately-bucked woody debris and/or wood mulch. Seeding with appropriate native species was done on drill pads and roads.

7 Statement of estimated costs

Cost estimates have been compiled for the three phases (termed DR-1, DR-2, and DR-3) of the year-2021 drilling within Area 'C' of the Hermann coal property. Costs here-presented pertain to tenures 383180 through 383183 (whose anniversary date is December 18th), with effective date also of December 18th, to coincide with the end of the 2020-2021 work term. Total exploration cost for the 2020-2021 work term is estimated to be $1,170,545.29.

Invoicing is still incomplete for some activities, notably analytical work; exploration costs shown below in **Table 7-1** and **Table 7-2** are therefore a minimum estimate. For purposes of comparison, British Columbia average unit costs are presented at the bottom line of **Table 7-2**.

The following major contractors serviced the drilling programme:

- APEX Geoscience -- project management and geological support;
- Avalanche Trucking -- trucking services;
- Birtley Coal & Minerals Testing (GWIL Industries) -- coal jig-tests and clean-coal analysis;
- Century Wireline Services -- geophysical logging of 9 boreholes (all of them within Area 'C');
- CoalTech Petrographic Associates -- coal petrography on clean coal composites and blends;
- Ecofor -- environmental monitoring;
- Geotech Drilling Services -- shallow geotechnical drilling (11 holes, of which only 3 were within Area 'C';
- Good Earth Drilling Services -- deep diamond-core drilling (12 holes, of which all 12 were in Area 'C'), accompanied by the drilling of one non-coring pilot hole, also within Area 'C'. Four of the cored boreholes were part of an array of large-diameter boreholes, intended to obtain a drilled bulk sample of coal and associated rocks;
- Pearson and Associates -- Sapozhnikov testing of clean coal composites and product blends, obtained from the drilled bulk samples;
- Piteau Associates -- geotechnical supervision, logging, and testwork;
- SGS -- Arsenic testing of clean coals, and determination of Chinese G-index of clean coals; and
- Wood Environmental & Infrastructure Solution -- geotechnical supervision of shallow DR-2 drilling, to support of mine-facility design.

Drilling and field support costs have been derived from a budget tracking spreadsheet constructed by Jerry Holmes PGeo of Apex Geoscience, assembled by tracking daily quantities of contractors' work as costed-out against purchase orders.

Cost breakdowns for DR-1 and DR-3 drilling and site-specific support activities are straightforward, insofar as these phases of work were accomplished entirely within Area 'C'.

The case of the DR-2 phase of drilling is more complicated, insofar as that part of the overall programme was performend within several tenures, not all of which were held by Conuma. Furthermore, DR-2 work was done within two areas of the Hermann property: Area 'C' (the subject of the present report) and Area 'A', with a different anniversary date and therefore to be reported sibsequently.

Tenure-based cost breakdown for the DR-2 phase of drilling has been estimated by

weighting total DR-2 costs by the percentage of total DR-2 drilling length devoted to three tenure cases:

- Off-property drilling of 7 holes (75.1% of metreage) in Peace River Coal's tenure 417036;
- In-property Area 'A' drilling of 1 hole (8.2% of metreage) in Conuma's tenure 417327; and
- In-property Area 'C' drilling of 4 holes (16.7% of metreage) in Conuma's tenures 383180 through 383183.

Tables 7-1 and **7-2** present cost breakdowns for DR-1 and DR-3 (all of which was within Area 'C'), and for that portion of DR-2 which saw work within Area 'C'.

Table 7-1: Estimated cost breakdown by activity, during DR-1 and DR-3 work phases, on tenures 383180-383183

Year	Boreholes within HR21HQ-series (8 holes), HR21LD-series (4 holes), and HR21RC-series (1 borehole)	Number of holes	Meterages		Estimated drilling costs		Estimated non-drilling costs					Totals
			Rotary drilling	Diamond core drilling	Rotary drilling	Diamond core drilling	Geophysical logging	Coal analyses	Catwork (incl. snow clearing, water truck, and mobility support)	Personnel (geological supervision, core-logging, and sampling	Geotech consultants	
2020-2021		13 holes	122.0 m	1260.83 m	$22,468.75	$654,667.31	$64,669.82	$95,468.97	$133,885.00	$100,677.59	$88,429.29	$1,160,266.73
			combined 1382.83 m									
			Meterages		*unit costs per metre of drilling*							
2020-2021	as above	13holes	122.0 m	1260.83 m	$184.17/m	$519.24/m	$70.82/m	$203.26/m (bulk sample only)	$96.82/m	$72.81/m	$111.77/m	$839.05/m
			combined 1382.83 m									
British Columbia average unit costs per metre, for comparison			n/a	n/a	$201.53/m	$210.34/m	$17.56/m	n/a	$23.30/m	$20.49/m	n/a	n/a

Note: analytical costs are chargeable to DR-3 (large-diameter core drilling for bulk sample). The bulk sample holes were not geophysically logged.

Table 7-2: Estimated cost breakdown by activity, during DR-2 work phase, on tenures 383180-383183

Year	Boreholes within HR21BH-series (BH-07, -08, and -09)	Number of holes	Meterages		Estimated drilling costs		Estimated non-drilling costs					Totals
			Rotary drilling	Diamond core drilling	Rotary drilling	Diamond core drilling	Geophysical logging	Coal analyses	Catwork (incl. snow clearing, water truck, and mobility support)	Personnel (geological supervision, core-logging, and sampling	Geotech / Environmental consultants	
2020-2021		3 holes	15.5 m	nil	$6500.55	nil	nil	nil	nil	nil	$8778.01	$15,278.56
			combined 15.5 m									
			Meterages		*unit costs per metre of drilling*							
2020-2021	as above	3 holes	15.5 m	nil	$419.39/m	nil	nil	nil	nil	nil	$566.32/m	$985.71/m
			combined 15.5 m									
British Columbia average unit costs per metre, for comparison			n/a	n/a	$201.53/m	$210.34/m	$17.56/m	n/a	$23.30/m	$20.49/m	n/a	n/a

8 References

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9 Conclusions and recommendations

The Hermann coal property contains substantial coal resources and reserves (as enumerated in **Section 4** of this report) hosted by coal-measures of Early Cretaceous age, within the Gates Formation. Coal is also known to be present within the slightly older Gething Formation, but neither resources nor reserves are currently recognised within these older coals. Information concerning their quality is sparse, owing to loss of historic coal-quality reports.

9.1 Conclusions

The coal-measures of the Hermann property are deformed by folded and imbricate thrust faults and associated folds, consistent with an overall thin-skinned structural style. Normal stratigraphic sequences are preserved within the coal-measures, and their contained coal beds present recognisable and readily-correlatable geophysical log responses. Overturned strata are rare. Structural complexity is greater in the fault-bend areas within Tenure 383183. The nature of the structural decapitation of the Gates coal-measures (beneath an overrunning klippe of Gething coal-measures) is not well-understood, and its resolution will require appropriately-spaced drilling, supported by structural mapping of the exposed bedrock.

Physical work in Area 'C' of the Hermann coal property during the 2020-2021 work programme comprised drilling of 16 boreholes, with total length of 1398.33 metres, at a cost of **$1,170,545.29** (Canadian dollars) and a unit cost of **$840.68** per metre drilled. Including historic work conducted between 1976 and 2019, total drilling to date comprises 334 boreholes with an aggregate length of at least 33,504.13 metres.

The programme cost includes substantial analytical work, performed on core samples recovered by the year-2021 drilled bulk samples. Results of jig testing, and of analyses on the resultant clean coal composite, are presented in **Appendix B**. Results of a coking test on a clean coal product blend sample are also presented. Cost to date of the analytical work is **$95,468.97** (Canadian). This amount is included in the overall programme cost of $1,170,545.29 (Canadian).

9.2 Recommendations

Continued maintenance of the Hermann coal tenures in 'good standing' under the *Coal Act* (via payment of rentals and submission of work reports) is essential to ongoing operations, including the Hermann open-pit and ancillary facilities. The next upcoming coal assessment reporting date is April 25th (for tenure 417327, within Area 'A' of the Hermann property: see **Map 2-3**).

The Hermann coal property merits further work:

- Structural mapping of exposed bedrock, in conjunction with appropriately-spaced drilling within the fault-bend area of tenure 383183, between the Mesa and Bullmoose thrust. This work is essential to defining the subsurface extent of the Gates coal-measures beneath the overthrust plates of Moosebar and Gething strata.
- Structural infill and step-out drilling within tenures 383180, 383181, and 417327. These drill sites will have to be re-permitted owing to the expiry of the original authorisation. These boreholes will afford the potential for upgrading the level-of-assurance of Gates Formation coal resources, along with better definition of subsurface geological structure.
- Sampling and analysis of near-surface Gething coals situated within tenure 383183.

10 Statement of qualifications

I, C.G. Cathyl-Huhn P.Geo.(BC) Lic.Geol.(WA) RMSME, do hereby certify that:

a) I am currently employed on a full-time basis as Chief Geologist, by Conuma Resources Limited, in their Canadian head office in Tumbler Ridge, British Columbia.

b) This certificate applies to the current report, titled *Coal Assessment Report for the Hermann Project, Mt. Hermann area, British Columbia*, dated January 10, 2022.

c) I am a member (Professional Geoscientist, Licence No.20550) of the Association of Professional Engineers and Geoscientists of British Columbia, licensed as a geologist (Licence No.2089) in Washington State, a member (No.152081) of the Association for Iron & Steel Technology, and a founding Registered Member of the Society for Mining, Metallurgy and Exploration (SME, Registered Member No.518350). I have worked as a colliery geologist in four countries for over 43 years since my graduation from university.

d) I certify that by reason of my education, affiliation with professional associations, and past relevant work experience, having written numerous published and private geological reports and technical papers concerning coalfield geology, coal-mining geology and coal-resource estimation, that I am qualified as a Qualified Person as defined by Canadian *National Instrument 43-101* and a Competent Person as defined by the Australian *JORC Code*.

e) I have worked as Chief Geologist for Conuma Coal Resources Limited and Conuma Resources Limited since September of 2016.

f) My most recent visit to the Hermann coal property was in July of 2021.

g) I am the sole author of this report, titled *Coal Assessment Report for the Hermann Project, Mt. Hermann area, British Columbia*, dated January 10, 2022, concerning the Hermann coal property.

h) I accept professional responsibility for this report.

i) As of the date of this report, I am not independent of Conuma Resources Limited, pursuant to the tests in Section 1.4 of *National Instrument 43-101*, for the reason that I am a full-time employee of Conuma Resources Limited.

j) The effective date of this report is December 18, 2021.

"original signed and sealed by"

Dated this 10th day of January 2022. C.G. Cathyl-Huhn P.Geo. Lic.Geol. RMSME

Appendix A: Boreholes, geophysics, and core descriptions

A.1 Introduction to drilling programme

During the year-2021 drilling programme within and nearby the Hermann coal property, 24 boreholes were drilled for coal-quality sampling, hydrological monitoring, and geotechnical studies. Work was divided into three phases, denoted as DR-1, DR-2, and DR-3 respectively:

- DR-1: 8 diamond-drill geotechnical boreholes, some of which were completed as vibrating-wire piezometers. All of these boreholes were located within the Hermann Area 'C' tenures, and all of them were geophysically logged;
- DR-2: 11 non-coring geotechnical boreholes, of which two were completed with piezometers. Three of these boreholes were located within the Hermann Area 'C' tenures, and one was within another Hermann tenure, whereas seven were located off-tenure; none of these shallow holes were geophysically logged; and
- DR-3: 1 non-cored but geophysically-logged pilot hole, and an array of four closely-spaced large-diameter cored boreholes, which were not geophysically-logged.

Location (including tenures upon which the holes were drilled) and construction details of boreholes are presented in **Table A-1**. Surveyed positions and elevations were obtained for all of the DR-1 and DR-2 boreholes, and for the DR-3 pilot borehole as well as for one of the four large-diameter boreholes.

A.1.1 Contractors

Several contractors were engaged during the year-2021 drilling programme.

- Environmental surveys (in support of drilling) were undertaken by Ecofor.
- Industrial first-aid and security services were provided by 4Evergreen Resources LP.
- Geological services were provided by Apex Geoscience Ltd. Two core-loggers and a project geologist were on the property during the drilling programme; comprehensive daily reports of progress and accrued costs were prepared.
- Geotechnical supervision and logging were provided by Piteau Associates, and by Wood Environmental and Infrastructure Solutions.
- Drilling of the DR-1 and DR-3 cored boreholes was done by Good Earth Drilling Services Ltd., operating at HQ and nominal nine-inch core sizes.
- Drilling of the DR-2 non-cored boreholes was done by Geotech Drilling Services Ltd.
- Geophysical logging was done by Century Wireline Services, operated by field supervisors David Simmons, Barkley Hill, and Rylan Kobes.

A.2 Geophysical logging

Geophysical logging was undertaken in most of the deeper boreholes, including all 8 of the geotechnical diamond-drill holes (HR21HQ-series) and the non-cored pilot hole (HR21RC-01) for the large-diameter coring programme. A summary of geophysical tools run down each borehole, and the depths reached by each logging run, is presented in **Table A-2**.

During the year-2021 drilling programme, Century's geophysical logging unit was locally-based in Tumbler Ridge, and called-out to the borehole sites on an as-needed basis. Two hard-copy thermal printouts of each log were provided by Century's geophysical field supervisors, with one copy devoted for reference in Conuma's core-shed and the other copy placed within the technical files held within Conuma's Tumbler Ridge office. Digital copies of geophysical logs are presented in **Appendix C**, and scanned copies of interpreted density logs are presented in **Appendix D**.

The primary means of geophysical log presentation is digital. All digital logs are incorporated as attachments to the present report, organised by borehole and further sorted by presentation file format: LAS (Log ASCII Standard, as promulgated by the Canadian Well Logging Society), PDF (Adobe's proprietary Portable Document Format), and TIF (Tagged Image Format). The PDF version of the logs is readily printable by plotters, and by office photocopiers which support piecewise printing.

Logging tool types for each log are presented in **Table A-2**. A broader range of geophysical tools were run within the geotechnical HR21HQ-series cored boreholes, including Century's acoustic televiewer tool. A more restricted set of tools were run within the HR21RC-series pilot hole for the large-diameter coring array of four boreholes. The large-diameter holes of the HR21LD-series were not geophysically logged, and neither were the numerous shallow geotechnical boreholes of the HR21BH-series. Interpretations of geophysical logs are discussed in **Section A.3**, with results included within **Table A-3**.

A.3 Lithological interpretations of geophysical logs

Geophysical log interpretations (incorporated in **Table A-3**) were manually performed by the author on printed copies of the coal combination logs, based primarily on the compensated density-log response, in comparison with other logs as required.

A four-component density-based classification of clean and dirty coal, and of coaly and carbonaceous rock, was employed. It should be borne in mind that carbonaceous and coaly rocks, and coal itself occur within a continuum of ash levels and specific gravities; the choice density-based classification reflects technological concerns with density-based beneficiation processes, rather than inherent geological distinctions. Only limited interpretive effort was directed at non-carbonaceous rock, mainly to define the apertures and confidence-of-existence of fault zones, and to recognise volcanic ash ('tonstein' or 'bentonite') bands. Interpretive abbreviations and terms are given in **Table A-4**.

All thicknesses and depths in **Table A-3** are given in metres, with depths being taken along the boreholes' trajectories.

A.4 Compilation and presentation of core descriptions

Core descriptions were compiled by contracted loggers A.M. Matesoi and K.T. Leonard-Fortune GIT from Apex Geoscience, led by Apex's project geologist J. Holmes P.Geo. and acting under the guidance of D. Thompson P.Geo. from Conuma's Tumbler Ridge office.

A large-format (ledger-sized, 11x17 inches) core-logging form was used, allowing for

easy hand-written entry of descriptive text as well as borehole features such as drillers' depth blocks, core-run numbers, and apparent dip of bedding within the recovered cores. The hand-written core logs were subsequently transcribed into *Excel*-format worksheets, presented as digital files within this appendix, and summarised in **Tables A-5** through **A-8**. Alphabetic logging codes are explained in **Table A-9**.

Borehole statistics: **Table A-1**

Borehole	E UTM83	N UTM83	Elevation (m)	Site	Azimuth (deg)	Dip (deg)	Declin-ation (deg E)	Commenced	Completed	Casing (driller) (m)	TD (driller) (m)	Bit size (cm)	Cored	Geo-phy-sics	Tenure
HR21BH-01	619029.64	6099220.63	1177.48	20-03	0	-90		2 Feb 21	2 Feb 21	0	10.5		no	no	417036
HR21BH-02	619060.84	6099173.8	1179.25	20-04	0	-90		2 Feb 21	2 Feb 21	0	10.5		no	no	417036
HR21BH-03	619083.73	6099158.19	1179.62	20-05	0	-90		2 Feb 21	3 Feb 21	0	12		no	no	417036
HR21BH-04	619101.41	6099133.14	1180.05	20-06	0	-90		3 Feb 21	3 Feb 21	0	10.1		no	no	417036
HR21BH-05	619086.54	6098636.25	1192.68	20-01	0	-90		3 Feb 21	4 Feb 21	0	9		no	no	417036
HR21BH-06	619073.19	6098736.31	1186.48	20-02	0	-90		4 Feb 21	4 Feb 21	0	8.8		no	no	417036
HR21BH-07	618963.8	6098021.58	1274.32	20-11	0	-90		4 Feb 21	4 Feb 21	0	4		no	no	383181
HR21BH-08	618724.13	6097983.2	1268.78	20-12	0	-90		5 Feb 21	6 Feb 21	0	2.4		no	no	383181
HR21BH-09	618634.35	6098178.08	1229.61	20-09	0	-90		6 Feb 21	9 Feb 21	0	9.1		no	no	383181
HR21BH-10	618765.87	6098256.76	1217.24	20-10	0	-90		9 Feb 21	13 Feb 21	0	7.6		no	no	417327
HR21BH-11	618753.1	6099303.63	1185.49	20-07	0	-90		13 Feb 21	15 Feb 21	0	8.8		no	no	417036
HR21BH-12	*not*	*drilled*		20-08											
HR21HQ-01	618718.1	6097497.16	1307.67	HC-1A	215	-60	17.1	22 Jan 21	25 Jan 21	24	55	14.6	yes	yes	383181
HR21HQ-02	618724.47	6097495.83	1307.14	HC-2V	0	-90	17.1	25 Jan 21	26 Jan 21	18	61	14.6	yes	yes	383181
HR21HQ-03	618298.33	6096802	1406.13	MB-1A	225	-60	17.1	26 Jan 21	29 Jan 21	9	100.1	14.6	yes	yes	383181
HR21HQ-04	618180.66	6096744.67	1432.84	MA-1A	225	-60	17.1	29 Jan 21	3 Feb 21	12	195	14.6	yes	yes	383180
HR21HQ-05	619168.71	6096060.15	1605.88	HA-1A	210	-60	17.1	3 Feb 21	6 Feb 21	11.35	75.05	14.6	yes	yes	383183
HR21HQ-06	619170.24	6096063.07	1605.96	HA-2V	0	-90	17.1	6 Feb 21	9 Feb 21	12.2	84	14.6	yes	yes	383183
HR21HQ-07	619063.76	6096901.16	1492.24	HB-1A	250	-60	17.1	9 Feb 21	13 Feb 21	36	104	14.6	yes	yes	383181
HR21HQ-08	619066.05	6096903.65	1492.38	HB-2V	0	-90	17.1	13 Feb 21	15 Feb 21	42	117	14.6	yes	yes	383181
HR21LD-01	618864.69	6096419.48	1519.22	LD-1	0	-90		17 Feb 21	23 Feb 21	9.3	117.92	22.9	yes	no	383181
HR21LD-02	618862	6096420	1517	LD-2	0	-90		23 Feb 21	26 Feb 21	9	118.07	22.9	yes	no	383181
HR21LD-03	618860	6096421	1517	LD-3	0	-90		27 Feb 21	2 Mar 21	9	118.72	22.9	yes	no	383181
HR21LD-04	618858	6096422	1517	LD-4	0	-90		3 Mar 21	5 Mar 21	9	114.97	22.9	yes	no	383181
HR21RC-01	618865.38	6096417.61	1518.77	LD Pilot	0	-90	17.1	16 Feb 21	17 Feb 21	9	122	14.6	no	yes	383181
									Totals (all tenures)	209.85	1475.63		24 holes		
									Totals (four sub-ject tenures of Area 'C' only	209.85	1398.33		16 holes (4 cored)		

Note: for the purposes of the present report, the 'four subject tenures' are coal licences 383180 through 383183

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Geophysical statistics: **Table A-2**

Borehole	Borehole collar survey data			Logging date, tools run, and depths reached by each tool							Tenure in which borehole was drilled
	NAD83 UTM (Zone 10)		Ground elevation (metres)	Logging date	Gamma / Density / Caliper / Resistivity	Gamma / Neutron (open hole)	Gamma / Neutron (in drill rods)	Dipmeter	Deviation	Acoustic Televiewer	
	Easting	Northing			9239 tool	9058A tool	9058A tool	9411A tool	9411A tool		
HR21BH-01	619029.64	6099220.63	1177.48	not logged							417036
HR21BH-02	619060.84	6099173.8	1179.25	not logged							417036
HR21BH-03	619083.73	6099158.19	1179.62	not logged							417036
HR21BH-04	619101.41	6099133.14	1180.05	not logged							417036
HR21BH-05	619086.54	6098636.25	1192.68	not logged							417036
HR21BH-06	619073.19	6098736.31	1186.48	not logged							417036
HR21BH-07	618963.8	6098021.58	1274.32	not logged							383181
HR21BH-08	618724.13	6097983.2	1268.78	not logged							383181
HR21BH-09	618634.35	6098178.08	1229.61	not logged							383181
HR21BH-10	618765.87	6098256.76	1217.24	not logged							417327
HR21BH-11	618753.1	6099303.63	1185.49	not logged							417036
HR21BH-12	not drilled			not logged							not drilled
HR21HQ-01	618718.1	6097497.16	1307.67	25 Jan 21	54.76		54.88	54.86	54.85	51.13	383181
HR21HQ-02	618724.47	6097495.83	1307.14	26 Jan 21	60.74	60.66		60.75	60.74	60.34	383181
HR21HQ-03	618298.33	6096802	1406.13	29 Jan 21	99.68	99.62		99.84	99.84	98.13	383181
HR21HQ-04	618180.66	6096744.67	1432.84	2 Feb 21	194.76	193.12		194.77	194.76	194.05	383180
HR21HQ-05	619168.71	6096060.15	1605.88	6 Feb 21	74.24	74.22		74.21	74.33	73.53	383183
HR21HQ-06	619170.24	6096063.07	1605.96	8 Feb 21	83.3	82.98		83.4	83.4	80.0	383183
HR21HQ-07	619063.76	6096901.16	1492.24	13 Feb 21	103.42	103.06		103.46	103.46	112.67	383181
HR21HQ-08	619066.05	6096903.65	1492.38	15 Feb 21	116.24	115.9		116.1	116.1	115.35	383181
HR21LD-01	618864.69	6096419.48	1519.22	not logged							383181
HR21LD-02	618862	6096420	1517	not logged							383181
HR21LD-03	618860	6096421	1517	not logged							383181
HR21LD-04	618858	6096422	1517	not logged							383181
HR21RC-01	618865.38	6096417.61	1518.77	17 Feb 21	121.76	121.8			121.78		383181
File: Geophysical statistics_211228a.csv				all tenures	9 / 908.9	8 / 851.36	1 / 54.88	8 / 787.39	9 / 909.26	8 / 785.2	
				report area	9 / 908.9	8 / 851.36	1 / 54.88	8 / 787.39	9 / 909.26	8 / 785.2	

Lithological modelling file for year-2021 boreholes: **Table A-3**

HR21BH-01										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	10.5	10.5	DRIFT	DRIFT		DNR bedrock	619029.64	6099220.63	1177.48	10.5
HR21BH-02										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	10.5	10.5	DRIFT	DRIFT		DNR bedrock	619060.84	6099173.8	1179.25	10.5
HR21BH-03										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	12.0	12.0	DRIFT	DRIFT		DNR bedrock	619083.73	6099158.19	1179.62	12.0
HR21BH-04										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	10.1	10.1	DRIFT	DRIFT		DNR bedrock	619101.41	6099133.14	1180.05	10.1
HR21BH-05										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	9.0	9.0	DRIFT	DRIFT		DNR bedrock	619086.54	6098636.25	1192.68	9.0
HR21BH-06										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	8.8	8.8	DRIFT	DRIFT		DNR bedrock	619073.19	6098736.31	1186.48	8.8
HR21BH-07										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	0.6	0.6	DRIFT	DRIFT			618963.8	6098021.58	1274.32	4.0
0.6	4.0	3.4	R	HASLER	Starts in Hasler Formation	Unknown rock type				
HR21BH-08										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	0.9	0.9	DRIFT	DRIFT			618724.13	6097983.2	1268.78	2.4
0.9	2.4	1.5	R	HASLER	Starts in Hasler Formation near base	Siltstone and sandstone, light grey				
HR21BH-09										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	9.1	9.1	DRIFT	DRIFT		DNR bedrock	618634.35	6098178.08	1229.61	9.1
HR21BH-10										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	7.6	7.6	DRIFT	DRIFT		DNR bedrock	618765.87	6098256.76	1217.24	7.6
HR21BH-11										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	8.8	8.8	DRIFT	DRIFT		DNR bedrock	618753.1	6099303.63	1185.49	8,8
HR21HQ-01										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	15.7	15.7	DRIFT	DRIFT			618718.1	6097497.16	1307.67	55.0
15.7	18.95	3.25	R		Starts in Hulcross	Normal stratigraphy				
18.95	19.05	0.1	ASH	ASH-06						
19.05	24.8	5.75	R							
24.8	24.85	0.05	ASH	ASH-05						
24.85	26.05	1.2	R							
26.05	26.15	0.1	ASH	ASH-04						
26.15	33.40	7.25	R							

Lithological modelling file for year-2021 boreholes: **Table A-3 (continued)**

From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
33.40	33.55	0.15	ASH	ASH-02			618718.1	6097497.16	1307.67	55.0
33.55	33.75	0.2	R							
33.75	34.20	0.45	GRIT	BASE_HC	Basal Hulcross top					
34.20	43.30	9.1	R		Notikewin top					
43.30	43.35	0.05	ASH	ASH						
43.35	46.15	2.8	R							
46.15	46.5	0.35	CBSH	A1						
46.50	54.5	8	R							
54.50	550	0.5	ND			No data				
HR21HQ-02										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	17.35	17.35	DRIFT	DRIFT			618724.47	6097495.83	1307.14	61
17.35	19.7	2.35	R		Starts in Hulcross	Normal stratigraphy				
19.7	19.9	0.2	ASH	ASH-06						
19.9	25.95	6.05	R							
25.95	26.05	0.1	ASH	ASH-05						
26.05	27.3	1.25	R							
27.30	27.5	0.2	ASH	ASH-04						
27.50	35.3	7.8	R							
35.30	35.6	0.3	ASH	ASH-02						
35.60	35.95	0.35	R							
35.95	36.1	0.15	GRIT	BASAL_HC	Basal Hulcross top					
36.10	45.5	9.4	R		Notikewin top					
45.50	45.8	0.3	CBSH							
45.80	48.8	3	R							
48.8	49.2	0.4	CBSH	A1						
49.2	58.75	9.55	R							
58.75	58.98	0.23	CBSH							
58.98	59.75	0.77	C	A						
59.75	60	0.25	CBSH							
60	60.5	0.5	R							
60.5	61	0.5	ND			No data				
HR21HQ-03										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	8.6	8.6	DRIFT	DRIFT			618298.33	6096802	1406.13	100.1
8.6	18.4	9.8	R		Starts in Medial Siltstone	Normal stratigraphy				
18.4	18.6	0.2	CBSH							
18.6	18.7	0.1	R							
18.7	18.8	0.1	CBSH							
18.8	20.6	1.8	R							
20.6	20.9	0.3	ASH	L-ASH						
20.9	21.05	0.15	R							
21.05	21.2	0.15	CBSH							
21.2	21.35	0.15	R							
21.35	31.3	9.95	R		Lower Quintette top					
31.3	31.45	0.15	FAULT			Probable				
31.45	33.9	2.45	R		Starts in Upper Quintette	Normal stratigraphy				
33.9	81.5	47.6	R		Medial Siltstone top					
81.5	82.15	0.65	ASH	L-ASH						

Lithological modelling file for year-2021 boreholes: **Table A-3 (continued)**

From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
82.15	83.1	0.95	R				618298.33	6096802	1406.13	100.1
83.1	94.6	11.5	R		Lower Quintette top					
94.6	94.9	0.3	DC							
94.9	96.2	1.3	R							
96.2	96.3	0.1	CBSH							
96.3	99.3	3	R							
99.3	99.5	0.2	R							
99.5	100.1	0.6	ND			No data				
HR21HQ-04										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	11.55	11.55	DRIFT	DRIFT			618180.66	6096744.67	1432.84	195
11.55	28	16.45	R		Starts in Medial Siltstone	Normal stratigraphy				
28	28.3	0.3	ASH	L-ASH						
28.3	28.6	0.3	FAULT			Probable				
28.6	39.5	10.9	R		Starts in Upper Quintette	Normal stratigraphy				
39.5	40.1	0.6	R		Medial Siltstone top					
40.1	40.5	0.4	CBSH							
40.5	40.7	0.2	R							
40.7	40.8	0.1	CBSH							
40.8	50.65	9.85	R							
50.65	50.8	0.15	ASH	L-ASH						
50.8	51.45	0.65	R							
51.45	59.05	7.6	R		Lower Quintette top					
59.05	156.9	97.85	R		Spieker top					
156.9	194.5	37.6	R		Cowmoose top					
194.5	195	0.5	ND			No data				
HR21HQ-05										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	11.2	11.2	DRIFT	DRIFT			619168.71	6096060.15	1605.88	75.05
11.2	16.7	5.5	R		Starts in Notikewin	Normal stratigraphy				
16.7	16.85	0.15	CBSH							
16.85	17.2	0.35	CR	B						
17.2	17.75	0.55	FAULT			Probable				
17.75	29.6	11.85	R		Starts in Notikewin	Normal stratigraphy				
29.6	29.7	0.1	FAULT			Possible				
29.7	45.65	15.95	R		Starts in Notikewin	Normal stratigraphy				
45.65	45.85	0.2	CBSH							
45.85	46.45	0.6	DC	C1						
46.45	46.8	0.35	C	C1						
46.8	47.1	0.3	CR							
47.1	47.3	0.2	CBSH							
47.3	47.55	0.25	CR	C2						
47.55	47.75	0.2	CBSH							
47.75	73.85	26.1	R							
73.85	74.05	0.2	CBSH							
74.05	75.05	1	ND			No data				

Lithological modelling file for year-2021 boreholes: **Table A-3 (continued)**

HR21HQ-06										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	11.6	11.6	DRIFT				619170.24	6096063.07	1605.96	84
11.6	14	2.4	R		Starts in Notikewin	Normal stratigraphy				
14	14.25	0.25	C	B						
14.25	15.3	1.05	R							
15.3	15.8	0.5	CBSH							
15.8	16.4	0.6	R							
16.4	17.4	1	CBSH							
17.4	18.4	1	R							
18.4	18.75	0.35	CBSH							
18.75	20.9	2.15	R							
20.9	21.1	0.2	CBSH							
21.1	21.3	0.2	R							
21.3	21.65	0.35	CBSH							
21.65	80.35	58.7	R							
80.35	82.3	1.95	DC	C1						
82.3	82.5	0.2	CBSH							
82.5	82.9	0.4	R							
82.9	83.1	0.2	CBSH	C2						
83.1	84	0.9	ND			No data				
HR21HQ-07										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	18	18	DRIFT	DRIFT			619063.76	6096901.16	1492.24	104
18	18.7	0.7	R		Starts in Hulcross	Normal stratigraphy				
18.7	18.75	0.05	ASH	ASH-15						
18.75	21.9	3.15	R							
21.9	22.35	0.45	FAULT			Probable				
22.35	24.95	2.6	R		Starts in Hulcross	Normal stratigraphy				
24.95	25.25	0.3	FAULT			Possible				
25.25	30.95	5.7	R		Starts in Hulcross	Normal stratigraphy				
30.95	31.15	0.2	ASH	ASH-13						
31.15	45.55	14.4	R							
45.55	45.6	0.05	ASH	ASH-11						
45.6	50.15	4.55	R							
50.15	50.2	0.05	ASH	ASH-10						
50.2	57.9	7.7	R							
57.9	58	0.1	ASH	ASH-09						
58	58.8	0.8	R							
58.8	58.95	0.15	ASH	ASH-08						
58.95	79.05	20.1	R							
79.05	79.2	0.15	ASH	ASH-06						
79.2	84.9	5.7	R							
84.9	85	0.1	ASH	ASH-05						
85	86.35	1.35	R							
86.35	86.95	0.6	ASH	ASH-04						
86.95	94	7.05	R							
94	94.7	0.7	GRIT	BASE_HC	Basal Hulcross top					
94.7	103.2	8.5	R		Notikewin top					
103.2	104	0.8	ND			No data				

Lithological modelling file for year-2021 boreholes: **Table A-3 (continued)**

HR21HQ-08										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	15.5	15.5	DRIFT	DRIFT			619066.05	6096903.65	1492.38	117
15.5	24.2	8.7	R		Starts in Hulcross	Normal stratigraphy				
24.2	24.3	0.1	ASH	ASH-14						
24.3	26	1.7	R							
26	26.1	0.1	ASH	ASH-13						
26.1	35.1	9	R							
35.1	35.2	0.1	ASH	ASH-11						
35.2	38.85	3.65	R							
38.85	39	0.15	ASH	ASH-10						
39	42.5	3.5	R							
42.5	42.55	0.05	ASH	ASH-09						
42.55	44.35	1.8	R							
44.35	44.45	0.1	ASH	ASH-08						
44.45	61.9	17.45	R							
61.9	62	0.1	ASH	ASH-07						
62	67.75	5.75	R							
67.75	67.95	0.2	ASH	ASH-06						
67.95	72.3	4.35	R							
72.3	73	0.7	ASH	ASH-05						
73	73.85	0.85	R							
73.85	73.9	0.05	ASH	ASH-04						
73.9	78.7	4.8	R							
78.7	78.8	0.1	ASH	ASH-02						
78.8	81.05	2.25	R							
81.05	81.6	0.55	GRIT	BASAL_HC	Basal Hulcross top					
81.6	91.7	10.1	R		Notikewin top					
91.7	92	0.3	CBSH							
92	92.3	0.3	CR	A1						
92.3	92.45	0.15	CBSH							
92.45	105.62	13.17	R							
105.62	105.75	0.13	CBSH							
105.75	106.4	0.65	C	B						
106.4	106.55	0.15	CBSH							
106.55	116	9.45	R							
116	117	1	ND			No data				
HR21LD-01										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	51.3	51.3	ND			No data	618864.69	6096419.48	1519.22	117.92
51.3	55.33	4.03	R		Falher Member	Normal stratigraphy				
55.33	55.43	0.10	CBSH							
55.43	55.49	0.06	CBSS							
55.49	56.09	0.60	CR							
56/09	56.48	0.39	R							
56.48	56.66	0.18	DC	E1						
56.66	57.09	0.43	C	E1						
57.09	57.42	0.33	CR							
57.42	58.02	0.60	C	E2U						
58.02	58.04	0.02	CBSS							
58.04	58.72	0.68	C	E2L						
58.72	58.76	0.04	DC	E2L						
58.76	58.96	0.20	CBSS							
58.96	59.09	0.13	R							
59.09	59.23	0.14	CBSS							
59.23	59.84	0.61	C	E3U						

Lithological modelling file for year-2021 boreholes: **Table A-3 (continued)**

From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
59.84	59.88	0.04	DC	E3U			618864.69	6096419.48	1519.22	117.92
59.88	59.94	0.06	R							
59.94	60.05	0.11	CBSS							
60.05	60.59	0.54	C	E3L						
60.59	60.71	0.12	CR							
60.71	60.8	0.09	CBSS							
60.8	61.15	0.35	R							
61.15	62.8	1.65	R							
62.8	62.85	0.05	CBSS							
62.85	63.54	0.69	R							
63.54	63.73	0.19	CBSS							
63.73	63.76	0.03	C	E4R						
63.76	63.89	0.13	DC	E4R						
63.89	64.12	0.23	C	E4R						
64.12	64.23	0.11	DC	E4R						
64.23	64.3	0.07	CBSS							
64.3	64.46	0.16	CR							
64.46	66.17	1.71	C	E4U						
66.17	66.27	0.10	CR							
66.27	66.58	0.31	R							
66.58	68.45	1.87	C	E4L						
68.45	68.53	0.08	DC	E4L						
68.53	68.6	0.07	CR							
68.6	68.74	0.14	CBSS							
68.74	70.16	1.42	R							
70.16	70.22	0.06	CBSS							
70.22	80.1	9.88	ND			No data				
80.1	85.13	5.03	R							
85.13	85.23	0.10	CBSS							
85.23	85.42	0.19	C							
85.42	85.48	0.06	CBSH							
85.48	86.24	0.64	R							
86.24	86.96	0.72	C	F2						
86.96	87.22	0.26	CBSH							
87.22	87.37	0.15	CR							
87.37	87.63	0.26	C	G2						
87.63	87.75	0.12	CBSH	G2						
87.75	88.22	0.47	C	G2						
88.22	88.33	0.11	CR							
88.33	88.36	0.03	C							
88.36	88.46	0.10	CR							
88.46	88.83	0.37	R							
88.83	89.72	0.89	C	G3						
89.72	89.86	0.14	CR							
89.86	90.1	0.24	R							
90.1	90.32	0.22	CBSH							
90.32	91.1	0.78	R							
91.1	91.28	0.18	CBSH							
91.28	91.72	0.44	R							
91.72	105.22	13.5	ND			No data				
105.22	106.22	1	R							
106.22	106.4	0.18	DC							
106.4	106.55	0.15	CR							
106.55	106.82	0.27	R							
106.82	108.27	1.45	C	J1						
108.27	108.32	0.05	CR	J1						
108.32	108.53	0.21	C	J1						
108.53	109.92	1.39	C	J2U						
109.92	110.84	0.92	C	J2L						

Lithological modelling file for year-2021 boreholes: **Table A-3 (continued)**

From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
110.84	115.12	4.28	C	J3			618864.69	6096419.48	1519.22	117.92
115.12	115.22	0.1	CR							
115.22	115.42	0.2	CBSH							
115.42	115.52	0.1	C							
115.52	117.92	2.4	R							
HR21LD-02										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	55.22	55.22	ND			No data	618862	6096420	1517	118.07
55.22	56.81	1.59	R		Falher Member	Normal stratigraphy				
56.81	57.51	0.70	C	E1						
57.51	57.64	0.13	R							
57.64	58.59	0.95	C	E2U						
58.59	58.63	0.04	DC							
58.63	58.92	0.29	C	E2L						
58.92	59.48	0.56	R							
59.48	60.06	0.58	C	E3U						
60.06	60.26	0.20	R							
60.26	60.81	0.55	C	E3L						
60.81	60.91	0.10	CR							
60.91	63.73	2.82	R							
63.73	64.24	0.51	C	E4R						
64.24	64.34	0.10	R							
64.34	64.36	0.02	DC							
64.36	64.46	0.10	CR							
64.46	66.22	1.76	C	E4U						
66.22	66.31	0.09	CBSH							
66.31	66.59	0.28	R							
66.59	66.63	0.04	DC	E4L						
66.63	66.96	0.33	C	E4L						
66.96	67.00	0.04	CR	E4L						
67.00	68.39	1.39	C	E4L						
68.39	68.43	0.04	CR	E4L						
68.43	68.53	0.10	C	E4L						
68.53	68.73	0.20	CBSH							
68.73	69.08	0.31	R							
69.08	69.21	0.13	CBSH							
69.21	69.29	0.08	CR							
69.29	69.30	0.01	C							
69.30	69.41	0.11	CBSH							
69.41	69.62	0.21	R							
69.62	84.50	14.88	ND			No data				
84.50	85.26	0.76	R							
85.26	85.84	0.58	C	F2						
85.84	85.94	0.10	DC	F2						
85.94	86.19	0.25	R							
86.19	86.24	0.05	C							
86.24	86.37	0.13	R							
86.37	86.43	0.06	C							
86.43	87.08	0.65	R							
87.08	87.13	0.05	CBSH							
87.13	87.55	0.42	C	G2						
87.55	87.71	0.16	R	G2						
87.71	88.19	0.48	C	G2						
88.19	88.24	0.05	CBSH	G2						
88.24	88.29	0.05	C	G2						
88.29	88.70	0.41	R							
88.70	89.52	0.82	C	G3						

Lithological modelling file for year-2021 boreholes: **Table A-3 (continued)**

From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
89.52	89.65	0.13	R				618862	6096420	1517	118.07
89.65	89.75	0.10	C							
89.75	89.85	0.10	R							
89.85	89.87	0.02	C							
89.87	90.50	0.63	R							
90.50	90.60	0.10	C							
90.60	91.60	1.00	R							
91.60	104.17	12.57	ND			No data				
104.17	106.79	2.62	R							
106.79	108.51	1.72	C	J1						
108.51	108.83	0.32	C	J2U						
108.83	108.87	0.04	DC	J2U						
108.87	109.32	0.45	C	J2U						
109.32	109.35	0.03	DC	J2L						
109.35	110.5	1.15	C	J2L						
110.5	110.55	0.05	DC	J2L						
110.55	110.80	0.25	C	J2L						
110.80	115.21	4.41	C	J3						
115.21	115.23	0.02	DC	J3						
115.23	115.42	0.19	CBSH							
115.42	115.44	0.02	C							
115.44	118.07	2.63	R							
HR21LD-03										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	55.02	55.02	ND			No data	618860	6096421	1517	118.72
55.02	56.16	1.14	R		Falher Member	Normal stratigraphy				
56.16	56.28	0.12	CBSH							
56.28	56.66	0.38	R							
56.66	56.71	0.05	CBSH							
56.71	57.01	0.30	C	E1						
57.01	57.40	0.39	DC	E1						
57.40	57.62	0.22	CBSH							
57.62	58.23	0.61	C	E2U						
58.23	58.27	0.04	R							
58.27	58.95	0.68	C	E2L						
58.95	59.16	0.21	CR							
59.16	59.51	0.35	CBSH							
59.51	59.56	0.05	DC	E3U						
59.56	59.76	0.20	C	E3U						
59.76	59.84	0.08	DC	E3U						
59.84	60.30	0.46	C	E3U						
60.30	60.37	0.07	CR							
60.37	60.47	0.10	CBSH							
60.47	61.06	0.59	C	E3L						
61.06	61.21	0.15	CBSS							
61.21	63.70	2.49	R							
63.70	63.81	0.11	CBSH							
63.81	64.02	0.21	CR							
64.02	64.38	0.36	C	E4R						
64.38	64.47	0.09	DC	E4R						
64.47	64.68	0.21	CR							
64.68	64.73	0.05	DC	E4U						
64.73	66.32	1.59	C	E4U						
66.32	66.62	0.30	R							
66.62	66.71	0.09	CR							
66.71	68.66	1.95	C	E4L						
68.66	68.75	0.09	CR							

Lithological modelling file for year-2021 boreholes: **Table A-3 (continued)**

From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
68.75	69.64	0.89	R				618860	6096421	1517	118.72
69.64	69.65	0.01	C							
69.65	69.88	0.23	R							
69.88	69.92	0.04	C							
69.92	70.24	0.32	R							
70.24	70.32	0.08	CR							
70.32	80.32	10.0	ND			No data				
80.32	85.38	5.06	R							
85.38	85.40	0.02	DC	F2						
85.40	86.20	0.80	C	F2						
86.20	86.35	0.15	CBSH	F2						
86.35	86.51	0.16	C	F2						
86.51	86.54	0.03	DC	F2						
86.54	86.64	0.10	CBSH							
86.64	86.67	0.03	DC	G2						
86.67	87.08	0.41	C	G2						
87.08	87.14	0.06	CR	G2						
87.14	87.19	0.05	C	G2						
87.19	87.27	0.08	CBSH							
87.27	87.39	0.12	R							
87.39	87.59	0.20	CBSH							
87.59	88.68	1.09	R							
88.68	89.41	0.73	C	G3						
89.41	89.43	0.02	CR	G3						
89.43	89.49	0.06	C	G3						
89.49	89.58	0.09	CBSS							
89.58	89.67	0.09	CR							
89.67	89.77	0.10	CBSS							
89.77	90.70	0.93	R							
90.70	90.81	0.11	CBSH							
90.81	91.62	0.81	R							
91.62	106.17	14.55	ND			No data				
106.17	106.24	0.07	C							
106.24	106.84	0.60	R							
106.84	108.01	1.17	C	J1						
108.01	108.18	0.17	DC	J1						
108.18	108.31	0.13	C	J1						
108.31	108.38	0.07	DC	J2U						
108.38	109.02	0.64	C	J2U						
109.02	109.32	0.30	DC	J2U						
109.32	109.80	0.48	C	J2U						
109.80	109.88	0.08	CR	J2L						
109.88	110.96	0.08	C	J2L						
110.96	111.20	0.24	DC	J2L						
111.20	111.35	0.15	DC	J3						
111.35	112.20	0.85	C	J3						
112.20	112.22	0.02	CR	J3						
112.22	112.42	0.20	DC	J3						
112.42	114.94	2.52	C	J3						
114.94	114.97	0.03	CR	J3						
114.97	118.72	3.75	R							
HR21LD-04										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	55.57	55.57	ND			No data	618858	6096422	1517	114.97
55.57	57.15	1.58	R		Falher Member	Normal stratigraphy				
57.15	57.44	0.29	CBSH							
57.44	57.51	0.07	DC	E1						

Lithological modelling file for year-2021 boreholes: **Table A-3 (continued)**

From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
57.51	58.12	0.61	C	E1			618858	6096422	1517	114.97
58.12	58.34	0.22	R							
58.34	58.85	0.51	C	E2U						
58.85	58.91	0.06	R							
58.91	59.06	0.15	DC	E2L						
59.06	59.59	0.53	C	E2L						
59.59	59.85	0.26	CBSH							
59.85	60.09	0.24	R							
60.09	60.73	0.64	C	E3U						
60.73	60.84	0.11	CBSH							
60.84	61.02	0.18	R							
61.02	61.72	0.70	C	E3L						
61.72	61.80	0.08	CR							
61.80	64.12	2.32	R							
64.12	64.22	0.10	CR							
64.22	64.43	0.21	C	E4R						
64.43	64.54	0.11	DC	E4R						
64.54	65.03	0.49	CR							
65.03	66.82	1.79	C	E4U						
66.82	66.87	0.05	CBSH							
66.87	66.90	0.03	C							
66.90	67.22	0.32	R							
67.22	67.62	0.40	C	E4L						
67.62	67.67	0.05	CBSS	E4L						
67.67	69.11	1.44	C	E4L						
69.11	69.61	0.50	R							
69.61	70.22	0.61	CBSH							
70.22	85.17	14.95	ND			No data				
85.17	85.74	0.57	R							
85.74	85.77	0.03	CBSH							
85.77	86.46	0.69	C	F2						
86.46	86.50	0.04	CBSH							
86.50	86.70	0.20	R							
86.70	86.80	0.10	DC							
86.80	86.88	0.08	C							
86.88	87.56	0.68	R							
87.56	87.73	0.17	CBSS							
87.73	87.76	0.03	DC	G2						
87.76	87.93	0.17	C	G2						
87.93	87.96	0.03	CR	G2						
87.96	88.02	0.06	CBSS	G2						
88.02	88.50	0.48	C	G2						
88.50	88.60	0.10	CR	G2						
88.60	88.67	0.07	C	G2						
88.67	89.09	0.42	R							
89.09	89.81	0.72	C	G3						
89.81	89.83	0.02	CR	G3						
89.83	90.01	0.18	C	G3						
90.01	90.16	0.15	CBSH							
90.16	90.19	0.03	DC							
90.19	90.29	0.10	CR							
90.29	90.62	0.33	R							
90.62	90.67	0.05	CBSH							
90.67	91.62	0.95	R							
91.62	106.30	14.88	ND			No data				
106.30	107.28	0.98	R							
107.28	109.00	1.72	C	J1						
109.00	109.90	0.90	C	J2U						
109.90	110.97	1.07	C	J2L						

Lithological modelling file for year-2021 boreholes: **Table A-3 (continued)**

From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
110.97	111.25	0.28	DC	J2			618858	6096422	1517	114.97
111.25	111.56	0.31	DC	J3						
111.56	114.25	2.69	C	J3						
114.25	114.36	0.11	DC	J3						
114.36	114.53	0.17	CBSH							
114.53	114.56	0.03	C							
114.56	114.97	0.41	R							
HR21RC-01										
From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
0	3.25	3.25	DRIFT	DRIFT			618865.38	6096417.61	1518.77	122
3.25	5.4	2.15	R		Starts in Notikewin	Normal stratigraphy				
5.4	5.6	0.2	CBSH							
5.6	6.3	0.7	DC	C						
6.3	6.6	0.3	R							
6.6	7	0.4	CR							
7	8.25	1.25	R							
8.25	8.4	0.15	CBSH							
8.4	11.95	3.55	R							
11.95	12.15	0.2	CBSH							
12.15	12.6	0.45	R							
12.6	13.1	0.5	CBSH							
13.1	19.7	6.6	R							
19.7	19.9	0.2	CBSH							
19.9	40.3	20.4	R		Notikewin base					
40.3	54.95	14.65	R		Falher top					
54.95	55.05	0.1	CBSH							
55.05	55.8	0.75	R							
55.8	56	0.2	CBSH							
56	56.2	0.2	DC	E1						
56.2	56.3	0.1	C	E1						
56.3	56.55	0.25	DC	E1						
56.55	56.7	0.15	CBSH							
56.7	56.9	0.2	CR							
56.9	57.4	0.5	C	E2U						
57.4	57.5	0.1	DC	E2L						
57.5	57.9	0.4	C	E2L						
57.9	58.1	0.2	DC	E2L						
58.1	58.6	0.5	CBSH							
58.6	58.65	0.05	CR							
58.65	59.15	0.5	C	E3U						
59.15	59.2	0.05	CR							
59.2	59.5	0.3	CBSH							
59.5	60.05	0.55	C	E3L						
60.05	63	2.95	R							
63	63.3	0.3	DC	E4R						
63.3	63.55	0.25	CR							
63.55	63.65	0.1	ASH							
63.65	63.85	0.2	DC	E4U						
63.85	65.3	1.45	C	E4U						
65.2	65.45	0.15	DC	E4U						
65.45	65.6	0.15	CBSH							
65.6	65.7	0.1	R							
65.7	65.9	0.2	CBSH							
65.9	67.35	1.45	C	E4L						
67.35	67.6	0.25	DC	E4L						
67.6	67.85	0.25	CBSH							
67.85	68.7	0.85	R							

Lithological modelling file for year-2021 boreholes: **Table A-3 (concluded)**

From	To	Thick	Lithology	Bed name	Stratigraphy	Comments	Easting	Northing	Collar	TD
68.7	68.8	0.1	CBSH				618865.38	6096417.61	1518.77	122
68.8	84.3	15.5	R							
84.3	84.4	0.1	CBSH							
84.4	85	0.6	C	F2						
85	85.1	0.1	CR							
85.1	85.65	0.55	CBSH							
85.65	86.2	0.55	R							
86.2	86.45	0.25	CR							
86.45	86.8	0.35	DC	G2						
86.8	86.95	0.15	C	G2						
86.95	87.05	0.1	DC	G2						
87.05	87.15	0.1	C	G2						
87.15	87.4	0.25	CBSH							
87.4	87.55	0.15	R							
87.55	87.8	0.25	CBSH							
87.8	88.4	0.6	C	G3						
88.4	88.6	0.2	CR							
88.6	88.85	0.25	CBSH							
88.85	105	16.15	R							
105	105.15	0.15	CBSH							
105.15	105.4	0.25	R							
105.4	105.65	0.25	CBSH							
105.65	107.9	2.25	C	J1						
107.9	108	0.1	CR							
108	108.1	0.1	DC							
108.1	108.35	0.25	CR							
108.35	110	1.65	C	J2U						
110	111.8	1.8	C	J2L						
111.8	114.9	3.1	C	J3						
114.9	115.1	0.2	CR							
115.1	121.5	6.4	R							
121.5	122	0.5	ND			No data				

File: Hermann-lith-2021_211229f.doc

Note: lithological codes used in this table, as well as in the Hermann geological model input files more generally, are explained in **Table A-4**. These codes differ from the Australian-derived coding system used for year-2021 core descriptions (as presented in **Tables A5** through **A-8**, and as explained in **Table A-9**).

Code table for lithology file: **Table A-4**

The following codes have been used in lithology files presented within Conuma's coal assessment reports. The codes furthermore serve as a basis for translation between human-readable borehole summaries, and input files for modelling software/ One addition (code CBST) has been made for the present report, in the light of its frequent use within the year-2021 large-diameter core descriptions.

Code	*Description*	*Comments*
ASH	Volcanic ash	Tonstein, bentonite, or tuff: high gamma-log response. Certain ash bands, such as the numbered ash bands within the Hul-cross Formation, or the L-ash band of the Gates Formation, are recognised as regionally-extensive marker beds.
C	Coal	Density <1.5 gm/cm^3 ; assumed to be the in-situ boundary between clean and dirty coal
CBSH	Carbshale	Carbonaceous rock, density 1.9 to 2.2 gm/cm^3
CBST	Carbonaceous sandstone	
CGL	Conglomerate	
CR	Coaly rock	1.7<Density<1.9 gm/cm^3
DC	Dirty coal	1.5<Density<1.7 gm/cm^3
DRIFT	Drift	Unconsolidated to semi-consolidated sediments above rockhead
FAULT	Fault	Fault, with associated level-of-assurance possible / probable / established
GRIT	Gritstone	
IRST	Ironstone	
ND	No data	In case of cored boreholes lacking geophysics: a non-cored interval; in case of geophysically-logged boreholes: a non-logged interval
R	Rock (undivided)	Density >2.2 gm/cm^3

Note: references to density are based upon the log response of Century Wireline's slimhole compensated density sonde. In practice, the 1.7 gm/cm^3 log response corresponds to approximately 40% ash, the upper ash limit of dirty coal.

Lithological description of large-diameter cores from borehole HR21LD-01: **Table A-5**

Run #	Drillers' depths in metres					Corrected depths in metres					Lithology		Sam-ple ID	ARD	Model lith-ology	Lithological description	seam compo-sites	Note: seam dip assumed 15 degrees		
				Recovery					Recovery									True thick-ness	Mineable flag first pass	Mineable flag second pass
	From	To	Inter-val	(m)	(%)	From	To	Inter-val	(m)	(%)	Code	Words								
	0	9.3	9.3	0	0	0	51.3	51.3	0	0	KLR	Core Loss, interpreted as rock		-	NL	Casing.		49.55		
	9.3	51.3	42	0	0			-	0	-	KLR	Core Loss, interpreted as rock		-		PDC to 51.30 m.		0		
1	51.3	51.9	0.6	0.6	100			-	0.6	-	ST	Siltstone		-		Interlaminated sandy siltstone with <1 cm silty mudstone laminae. Bedding angle increases downhole. Common coalified plant material. Hard, silicic rock (hard to break).		0		
1	51.9	52.0	0.1	0.1	100			-	0.1	-	ST	Siltstone	5430	0	-	As above. Interval sampled for geochem analysis.		0		
1	52.0	54.02	2.02	2.02	100			-	2.02	-	ST	Siltstone		-	-	Same rock as above.		0		
2	54.02	55.0	0.98	0.98	100			-	0.98	-	ST	Siltstone		-	-	Interlaminated sandy siltstone with <1 cm silty mud laminations. Grain size decreasing with depth, becoming primarily a muddy SLT towards the bottom. Gradational lower contact.		0		
2	55.0	55.33	0.33	0.33	100			-	0.33	-	ST	Siltstone		-	-	Primarily silt and mud, very soft to scrape.		0		
2	55.33	55.43	0.1	0.1	100			-	0.1	-	XM	Carbon-aceous Mudstone	5431	0	-	Complete loss of laminations - contact is abrupt as grain size drops to mud and is uniformly massive; common coalified plant material with <1% pyrite specks amongst coalified plants.		0		
3	55.43	55.49	0.06	0.06	100			-	0.06	-	XS	Carbon-aceous Sandstone		-	-	Broken, slickensides and polished fracture surfaces.		0		
3	55.49	56.09	0.6	0.6	100			-	0.6	-	ZM	Coaly Mudstone		-	-	Upper contact ground out. Occasional pyrite coal stringers common. Coalified plants common. Carbonaceous and hard with a brown scratch.		0		
3	56.09	56.3	0.21	0.21	100			-	0.21	-	CS	Claystone		-	-	Minor coal stringers.		0		
3	56.3	56.48	0.18	0.18	100			-	0.18	-	CS	Claystone	5432	0	-	As above. Intact (solid) floor contact with coal, @ about 16 BCN°.		0		
3	56.48	56.66	0.18	0.18	100			-	0.18	-	CO	Coal	5433	0	-	Coal and Bands: alternating thin bands of CCST/COAL/HCST. Seam E1 roof sample.	E1	0		
3	56.66	57.09	0.43	0.43	100			-	0.43	-	CO	Coal	5434	0	-	Dull & bright coal; minor ash (HCST) stringers. Solid Floor contact with HCST below.	E1	0		
3	57.09	57.42	0.33	0.33	100			-	0.33	-	CO	Coal	5435	0	-	Coal and Bands: alternating thin bands of HCST/CB/HCST/CCST/HCST/CBn. Parting E1-E2	E1	0		
3	57.42	57.49	0.07	0	0			-	0	-	KLC	Core Loss, interpreted as coal	5436	0	-	Potential coal loss?		0		
3	57.49	58.02	0.53	0.53	100			-	0.53	-	CO	Coal	5436	0	-	Dull & bright coal; almost intact.	E2	0		
4	58.02	58.04	0.02	0.02	100			-	0.02	-	XS	Carbon-aceous Sandstone	5437	0	-			0		
4	58.04	58.28	0.24	0.24	100			-	0.24	-	CO	Coal	5437	0	-	Dull banded coal. Up to 3% thin ash (HCST) bands near top of interval	E2	0		
4	58.28	58.72	0.44	0.44	100			-	0.44	-	CO	Coal	5438	0	-	Dull banded coal.	E2	0		
4	58.72	58.76	0.04	0.04	100			-	0.04	-	CO	Coal	5438	0	-	Bony coal.	E2	0		
4	58.76	58.96	0.2	0.2	100			-	0.2	-	XS	Carbo-naceous Sandstone	5439	0	-	Up to 5% coal stringers. Bottom contact intact, @ ~17° BCN.	ex-clude	0		
4	58.96	59.09	0.13	0.13	100			-	0.13	-	CS	Claystone	5439	0	-	Minor coal stringers; grades into CCST.	ex-clude	0		
4	59.09	59.23	0.14	0.14	100			-	0.14	-	XS	Carbon-aceous Sandstone	5440	0	-	CCST±HCST, with 1-2% coal stringers.	ex-clude	0		

Lithological description of large-diameter cores from borehole HR21LD-01: **Table A-5 (continued)**

Run #	Drillers' depths in metres					Corrected depths in metres					Lithology		Sam-ple ID	ARD	Model lith-ology	Lithological description	seam compo-sites	Note: seam dip assumed 15 degrees		
	From	To	Inter-val	Recovery (m)	Recovery (%)	From	To	Inter-val	Recovery (m)	Recovery (%)	Code	Words						True thick-ness	Mineable flag first pass	Mineable flag second pass
4	59.23	59.54	0.31	0.31	100			-	0.31	-	CO	Coal	5441	0	-	Dull banded coal	E3	0		
4	59.54	59.84	0.3	0.3	100			-	0.3	-	CO	Coal	5442	0	-	Dull banded coal. Solid bottom contact.	E3	0		
4	59.84	59.88	0.04	0.04	100			-	0.04	-	CO	Coal	5442	0	-	Bony coal. Solid floor contact.	E3	0		
4	59.88	59.94	0.06	0.06	100			-	0.06	-	CS	Claystone	5443	0	-		E3	0		
4	59.94	60.05	0.11	0.11	100			-	0.11	-	XS	Carbon-aceous Sandstone	5443	0	-	CCST±HCST, with minor coal stringers.	E3	0		
4	60.05	60.38	0.33	0.33	100			-	0.33	-	CO	Coal	5444	0	-	Dull banded coal with minor stony/ash bands.	E3	0		
4	60.38	60.59	0.21	0.21	100			-	0.21	-	CO	Coal	5445	0	-	Dull banded coal with 3-4% ash bands (up to 3-4 cm thick. Solid bottom contact, at ~18° BCN.	E3	0		
4	60.59	60.71	0.12	0.12	100			-	0.12	-	ZM	Coaly Mudstone	5446	0	-	Black and dense, with coal stringers possible bony coal?). Unclear/gradual bottom contact.		0		
4	60.71	60.8	0.09	0.09	100			-	0.09	-	XS	Carbon-aceous Sandstone	5446	0	-			0		
4	60.8	61.02	0.22	0.22	100			-	0.22	-	CS	Claystone	5447	0	-	Core catcher recovery.		0		
5	61.02	61.15	0.13	0.13	100			-	0.13	-	CS	Claystone		-	-	Grades into SLT.		0		
5	61.15	62.8	1.65	1.65	100			-	1.65	-	ST	Siltstone		-	-	Minor coal stringers. Thin + irregular calcite stringers at 62.72m. Increasingly muddy downwards.		0		
5	62.8	62.85	0.05	0.05	100			-	0.05	-	XS	Carbon-aceous Sandstone	5448	0	-	carbonaceous, with coal stringers. Sampled for ARD/geochem.		0		
5	62.85	63	0.15	0.15	100			-	0.15	-	CS	Claystone	5448	0	-	Silty. Faint bedding. Sampled for ARD/geochem.		0		
5	63	63.54	0.54	0.54	100			-	0.54	-	ST	Siltstone		-	-	Minor coaly/carbonaceous stringers. Broken only at bottom 2-3 cm.		0		
5	63.54	63.73	0.19	0.19	100			-	0.19	-	XS	Carbon-aceous Sandstone	5449	0	-	Up to 5% coal stringers.		0		
5	63.73	63.76	0.03	0.03	100			-	0.03	-	CO	Coal	5450	0	-	Dull coal.	E4	0		
5	63.76	63.89	0.13	0.13	100			-	0.13	-	CO	Coal	5450	0	-	Possibly bony coal?	E4	0		
5	63.89	64.12	0.23	0.23	100			-	0.23	-	CO	Coal	5450	0	-	Dull coal.	E4	0		
6	64.12	64.23	0.11	0.11	100			-	0.11	-	CO	Coal	5451	0	-	Possibly bony coal?	E4	0		
6	64.23	64.3	0.07	0.07	100			-	0.07	-	XS	Carbon-aceous Sandstone	5452	0	-	Bottom contact at ~15° BCN.	ex-clude	0		
6	64.3	64.46	0.16	0.16	100			-	0.16	-	ZC	Coaly Claystone	5452	0	-	Stony coal with irreg band of HCST near bottom.	ex-clude	0		
6	64.46	64.81	0.35	0.35	100			-	0.35	-	CO	Coal	5453	0	-		E4	0		
6	64.81	65.1	0.29	0.29	100			-	0.29	-	CO	Coal	5454	0	-		E4	0		
6	65.1	65.58	0.48	0.48	100			-	0.48	-	CO	Coal	5455	0	-		E4	0		
6	65.58	66.07	0.49	0.49	100			-	0.49	-	CO	Coal	5456	0	-		E4	0		
6	66.07	66.17	0.1	0.1	100			-	0.1	-	CO	Coal	5457	0	-	Sharp floor contact.	E4	0		
6	66.17	66.27	0.1	0.1	100			-	0.1	-	ZM	Coaly Mudstone	5458	0	-	Very carbonaceous with coal stringers.	ex-clude	0		
6	66.27	66.58	0.31	0.31	100			-	0.31	-	CS	Claystone	5459	0	-	Weakly carbonaceous with coal stringers. Sheared and coaly at the bottom contact.	ex-clude	0		
6	66.58	66.96	0.38	0.38	100			-	0.38	-	CO	Coal	5460	0	-	Bright banded coal.	E4	0		
6	66.96	67.12	0.16	0.16	100			-	0.16	-	CO	Coal	5460	0	-	As above. Core catcher recovery.	E4	0		
7	67.12	67.4	0.28	0.28	100			-	0.28	-	CO	Coal	5461	0	-		E4	0		
7	67.4	67.82	0.42	0.42	100			-	0.42	-	CO	Coal	5462	0	-		E4	0		

Lithological description of large-diameter cores from borehole HR21LD-01: **Table A-5 (continued)**

Run #	Drillers' depths in metres					Corrected depths in metres					Lithology		Sam-ple ID	ARD	Model lith-ology	Lithological description	seam compo-sites	Note: seam dip assumed 15 degrees		
	From	To	Inter-val	Recovery (m)	Recovery (%)	From	To	Inter-val	Recovery (m)	Recovery (%)	Code	Words						True thick-ness	Mineable flag first pass	Mineable flag second pass
7	67.82	68.06	0.24	0.24	100			-	0.24	-	CO	Coal	5463	0	-		E4	0		
7	68.06	68.45	0.39	0.39	100			-	0.39	-	CO	Coal	5464	0	-		E4	0		
7	68.45	68.53	0.08	0.08	100			-	0.08	-	CO	Coal	5465	0	-	Bony coal		0		
7	68.53	68.6	0.07	0.07	100			-	0.07	-	ZC	Coaly Claystone	5465	0	-	Stony coal.		0		
7	68.6	68.74	0.14	0.14	100			-	0.14	-	XS	Carbon-aceous Sandstone	5466	0	-	coal stringers at bottom contact.		0		
7	68.74	68.82	0.08	0.08	100			-	0.08	-	CS	Claystone		-	-	occasional coal stringers		0		
7	68.82	70.16	1.34	1.34	100			-	1.34	-	ST	Siltstone		-	-	With CST bands. Top 0.35m: signs of bioturbation. Coaly stringers throughout (up to 2 cm thick).		0		
7	70.16	70.22	0.06	0.06	100			-	0.06	-	XS	Carbon-aceous Sandstone		-	-	with coal stringers. Core catcher recovery.		0		
	70.22	80.1	9.88	0	0			-	0	-	KLR	Core Loss, interpreted as rock		-	-	PDC to 80.10 m.		0		
8	80.1	81.3	1.2	1.2	100			-	1.2	-	SS	Sandstone		-	-	Upper contact ground out. Occasional bioturbation, worm burrows filled with coarser grained sand; occasionally finer silty bands, layers of silt and clay. Very irreg lamination, soft sedim deformations are common.		0		
8	81.3	81.46	0.16	0.16	100			-	0.16	-	SS	Sandstone	5467	0	-	As above. Geochem/ARD sample.		0		
8	81.46	82.27	0.81	0.81	100			-	0.81	-	SS	Sandstone		-	-	Same rock unit as above.		0		
9	82.27	83.11	0.84	0.84	100			-	0.84	-	SS	Sandstone		-	-	Silty, fine SST; increasing clay downhole. Solid contact between units.		0		
9	83.11	83.32	0.21	0.21	100			-	0.21	-	SS	Sandstone		-	-	Medium-coarse SST with occasional 1-5 mm thin silty intervals. Cross-stratified beds with way up-truncation indicatiors. Occasional ripply bedding with increased silt content.		0		
9	83.32	84.43	1.11	1.11	100			-	1.11	-	SS	Sandstone		-	-	Medium-coarse x-bedded sandstone; calcite veining between 83.70-84 m, boudinage (?) with space-filling crystals.		0		
9	84.43	84.63	0.2	0.2	100			-	0.2	-	SS	Sandstone		-	-	Medium-coarse x-bedded sandstone. Bottom contact is sharp and erosional.		0		
9	84.63	85.13	0.5	0.5	100			-	0.5	-	CS	Claystone		-	-	Very fine mud - vague hint of laminations. Towards end becomes almost like coaly rock(?)		0		
9	85.13	85.23	0.1	0.1	100			-	0.1	-	XS	Carbon-aceous Sandstone	5469	0	-	Roof sample.		0		
9	85.23	85.31	0.08	0	0			-	0	-	KLC	Core Loss, interpreted as coal		-	-	Potential coal loss?		0		
9	85.31	85.42	0.11	0.11	100			-	0.11	-	CO	Coal	5470	0	-	Upper contact missing (probably fairly sharp). Coal: dull, no bright bands, very dense (no cleating), occasional sheared and polished surfaces. Recovered in the core catcher.		0		
10	85.42	85.48	0.06	0.06	100			-	0.06	-	XM	Carbon-aceous Mudstone		-	-	Carbonaceous mudstone; some coal at top of interval.		0		
10	85.48	85.6	0.12	0.12	100			-	0.12	-	CS	Claystone		-	-	Coal stringer at bottom.		0		
10	85.6	86.24	0.64	0.64	100			-	0.64	-	ST	Siltstone		-	-	SLT with some CST bands. Getting sandier on the bottom 0.25 m. Sharp contact with coal below at ~12° BCN.		0		

Lithological description of large-diameter cores from borehole HR21LD-01: **Table A-5 (continued)**

Run #	Drillers' depths in metres					Corrected depths in metres					Lithology		Sam-ple ID	ARD	Model lith-ology	Lithological description	seam compo-sites	Note: seam dip assumed 15 degrees		
	From	To	Inter-val	Recovery (m)	Recovery (%)	From	To	Inter-val	Recovery (m)	Recovery (%)	Code	Words						True thick-ness	Mineable flag first pass	Mineable flag second pass
10	86.24	86.32	0.08	0.08	100			-	0.08	-	CO	Coal	5468	0	-		F2	0		
10	86.32	86.52	0.2	0.2	100			-	0.2	-	CO	Coal	5471	0	-	Dull & bright coal.	F2	0		
10	86.52	86.76	0.24	0.24	100			-	0.24	-	CO	Coal	5472	0	-		F2	0		
10	86.76	86.96	0.2	0.2	100			-	0.2	-	CO	Coal	5473	0	-		F2	0		
10	86.96	87.22	0.26	0.26	100			-	0.26	-	XM	Carbon-aceous Mudstone	5474	0	-	Coal stringer below the top contact.	ex-clude	0		
10	87.22	87.37	0.15	0.15	100			-	0.15	-	ZM	Coaly Mudstone	5475	0	-	One 2 cm thick coal band below top contact; coal stringers at the bottom contact.	ex-clude	0		
10	87.37	87.63	0.26	0.26	100			-	0.26	-	CO	Coal	5476	0	-	Dull banded coal. Floor contact at ~10° BCN.	G2	0		
10	87.63	87.75	0.12	0.12	100			-	0.12	-	XM	Carbon-aceous Mudstone	5477	0	-	Coal stringers around top and bottom contacts.	ex-clude	0		
10	87.75	87.98	0.23	0.23	100			-	0.23	-	CO	Coal	5478	0	-		G2	0		
10	87.98	88.22	0.24	0.24	100			-	0.24	-	CO	Coal	5478	0	-		G2	0		
10	88.22	88.33	0.11	0.11	100			-	0.11	-	ZM	Coaly Mudstone	5479	0	-		ex-clude	0		
10	88.33	88.36	0.03	0.03	100			-	0.03	-	CO	Coal	5479	0	-		ex-clude	0		
10	88.36	88.46	0.10	0.10	100			-	0.1	-	XM	Carbon-aceous Mudstone	5479	0	-	With coal stringers.	ex-clude	0		
10	88.46	88.52	0.06	0	0			-	0	-	KLR	Core Loss, interpreted as rock		-	-	Potential rock loss?		0		
11	88.52	88.83	0.31	0.31	100			-	0.31	-	SS	Sandstone	5480	0	-	Few irreg dark laminae. Sharp bottom contact with coal.	ex-clude	0		
11	88.83	89.15	0.32	0.32	100			-	0.32	-	CO	Coal	5481	0	-		G3	0		
11	89.15	89.44	0.29	0.29	100			-	0.29	-	CO	Coal	5482	0	-		G3	0		
11	89.44	89.72	0.28	0.28	100			-	0.28	-	CO	Coal	5483	0	-	Somewhat sheared on bottom half. Sharp floor contact.	G3	0		
11	89.72	89.8	0.08	0.08	100			-	0.08	-	XM	Carbon-aceous Mudstone	5484	0	-	Floor sample.		0		
11	89.8	89.86	0.06	0.06	100			-	0.06	-	XM	Carbon-aceous Mudstone		-	-	Some coal stringers. Grades into CST.		0		
11	89.86	90.1	0.24	0.24	100			-	0.24	-	CS	Claystone		-	-			0		
11	90.1	90.32	0.22	0.22	100			-	0.22	-	XM	Carbon-aceous Mudstone		-	-	Up to 25% coal stringers.		0		
11	90.32	90.9	0.58	0.58	100			-	0.58	-	CS	Claystone		-	-	Up to 5% coal stringers. Black polished fracture/break surfaces.		0		
11	90.9	91.1	0.20	0	0			-	0	-	KLR	Core Loss, interpreted as rock		-	-	Potential rock loss?		0		
11	91.1	91.21	0.11	0.11	100			-	0.11	-	XM	Carbon-aceous Mudstone		-	-	Abundant coal stringers; black polished fracture/break surfaces. Possible core loss.		0		

Lithological description of large-diameter cores from borehole HR21LD-01: **Table A-5 (continued)**

Run #	Drillers' depths in metres					Corrected depths in metres					Lithology		Sam-ple ID	ARD	Model lith-ology	Lithological description	seam compo-sites	Note: seam dip assumed 15 degrees		
				Recovery					Recovery									True thick-ness	Mineable flag first pass	Mineable flag second pass
	From	To	Inter-val	(m)	(%)	From	To	Inter-val	(m)	(%)	Code	Words								
11	91.21	91.28	0.07	0.07	100			-	0.07	-	XM	Carbon-aceous Mudstone		-	-	As above but core is intact. Grading into SLT.		0		
11	91.28	91.4	0.12	0.12	100			-	0.12	-	ST	Siltstone		-	-			0		
11	91.4	91.72	0.32	0.32	100			-	0.32	-	SS	Sandstone		-	-			0		
	91.52	105.22	13.7	0	0			-	0	-	KLR	Core Loss, interpreted as rock		-	-	PDC to 102.22 m.		0		
12	105.22	105.79	0.57	0.57	100			-	0.57	-	SS	Sandstone		-	-	Silty sandstone.		0		
12	105.79	106.22	0.43	0.43	100			-	0.43	-	ST	Siltstone		-	-	Some ripple marks and bioturbation signs. 10 cm below top - one 9 cm thick CCST band. Sharp bottom contact.		0		
12	106.22	106.4	0.18	0.18	100			-	0.18	-	CO	Coal	5485	0	-	Bony coal; sheared.		0		
12	106.4	106.55	0.15	0.15	100			-	0.15	-	ZM	Coaly Mudstone	5485	0	-	Very broken and sheared; polished surfaces.		0		
12	106.55	106.82	0.27	0.27	100			-	0.27	-	SS	Sandstone	5486	0	-	silty; 1 cm thick coal coating on bottom end.		0		
13	106.82	107.29	0.47	0.47	100			-	0.47	-	CO	Coal	5487	0	-	Coal (dull & bright?). Only top 4 cm is broken, the rest is intact. Some creamy-white coating on bottom end surface and on some cleats.	J1	0		
13	107.29	107.55	0.26	0.26	100			-	0.26	-	CO	Coal	5488	0	-		J1	0		
13	107.55	107.80	0.25	0.25	100			-	0.25	-	CO	Coal	5489	0	-	Dull banded coal: sheared, white clay on cleats.	J1	0		
13	107.80	108.20	0.40	0.40	100			-	0.4	-	CO	Coal	5490	0	-	Occasional white clay on cleats.	J1	0		
13	108.20	108.27	0.07	0.07	100			-	0.07	-	CO	Coal	5491	0	-	As above.	J1	0		
13	108.27	108.32	0.05	0.05	100			-	0.05	-	ZM	Coaly Mudstone	5491	0	-	Irregular contacts.	J1	0		
13	108.32	108.53	0.21	0.21	100			-	0.21	-	CO	Coal	5491	0	-		J1	0		
13	108.53	108.77	0.24	0.24	100			-	0.24	-	CO	Coal	5492	0	-	Dull and bright.	J2	0		
13	108.77	109.11	0.34	0.34	100			-	0.34	-	CO	Coal	5493	0	-		J2	0		
13	109.11	109.41	0.30	0.30	100			-	0.3	-	CO	Coal	5494	0	-		J2	0		
13	109.41	109.63	0.22	0.22	100			-	0.22	-	CO	Coal	5495	0	-		J2	0		
13	109.63	109.92	0.29	0.29	100			-	0.29	-	CO	Coal	5495	0	-	Sheared coal.	J2	0		
14	109.92	110.37	0.45	0.45	100			-	0.45	-	CO	Coal	5496	0	-	Sheared and soft coal. Crumbles easily. No cleating or any other feature distinguishable due to the shearing. Contact with lower (harder) coal is distinct, abrupt transition to harder, denser coal.	J2	0		
14	110.37	110.84	0.47	0.47	100			-	0.47	-	CO	Coal	5497	0	-		J2	0		
14	110.84	111.04	0.20	0.20	100			-	0.2	-	CO	Coal	5498	0		As above. Slickensides and sheared surfaces are increasing downhole.	J3	0		
14	111.04	111.44	0.40	0.40	100			-	0.4	-	CO	Coal	5499	0		As above. Slickensides and sheared surfaces are increasing downhole.	J3	0		
14	111.44	111.64	0.20	0.20	100			-	0.2	-	CO	Coal	5500	0		As above. Slickensides and sheared surfaces are increasing downhole.	J3	0		
14	111.64	111.81	0.17	0.17	100			-	0.17	-	CO	Coal	5808			As above. Slickensides and sheared surfaces are increasing downhole.	J3	0		
14	111.81	112.00	0.19	0.19	100			-	0.19	-	CO	Coal	5809			As above. Bony coal layers are followed by sheared surfaces.	J3	0		
14	112.00	112.20	0.20	0.20	100			-	0.2	-	CO	Coal	5810			As above. Bony coal layers are followed by sheared surfaces.	J3	0		
14	112.20	112.45	0.25	0.25	100			-	0.25	-	CO	Coal	5811			As above. Bony coal layers are followed by sheared surfaces.	J3	0		
14	112.45	112.70	0.25	0.25	100			-	0.25	-	CO	Coal	5812			As above. Bony coal layers are followed by sheared surfaces.	J3	0		
14	112.70	112.92	0.22	0.22	100			-	0.22	-	CO	Coal	5813			As above. Bony coal layers are followed by sheared surfaces.	J3	0		

Lithological description of large-diameter cores from borehole HR21LD-01: **Table A-5 (concluded)**

Run #	Drillers' depths in metres					Corrected depths in metres					Lithology		Sam-ple ID	ARD	Model lith-ology	Lithological description	seam compo-sites	Note: seam dip assumed 15 degrees		
	From	To	Inter-val	Recovery (m)	Recovery (%)	From	To	Inter-val	Recovery (m)	Recovery (%)	Code	Words						True thick-ness	Mineable flag first pass	Mineable flag second pass
15	112.92	113.26	0.34	0.34	100			-	0.34	-	CO	Coal	5814			Shears between 20?-50?. Silvery-black. Occasional <1mm - 3mm bright bands. Very flaky due to shears. Some coal at the top dropped out of the core tube while it was being moved to the drill to the core shack (shears on angle, angled wedge slipped out, couldn't retrieve).	J3	0		
15	113.26	113.60	0.34	0.34	100			-	0.34	-	CO	Coal	5815			Increased amount and width of bright bands (~20%) visible after getting out of the sheared zone. Rare cleating.	J3	0		
15	113.60	113.75	0.15	0.15	100			-	0.15	-	CO	Coal	5816			Increased amount and width of bright bands (up to 30%). Silvery-black colour. Rare to no cleating. Still shearing in planes.	J3	0		
15	113.75	113.94	0.19	0.19	100			-	0.19	-	CO	Coal	5817			Thickness of bright bands has increased to ~3-10mm, silvery-black. Care cleating. Flaky where sheared, hard where bright bands are (bright bands are present ~50%).	J3	0		
15	113.94	114.16	0.22	0.22	100			-	0.22	-	CO	Coal	5818			Sheared. Hard to distinguish any features. Very flaky and soft. Silvery-black.	J3	0		
15	114.16	114.44	0.28	0.28	100			-	0.28	-	CO	Coal	5819			Sheared. Hard to distinguish any features. Very flaky and soft. Silvery-black.	J3	0		
15	114.44	114.74	0.30	0.30	100			-	0.3	-	CO	Coal	5820			Core loss at end of this sample potentially? Broken, can't piece together. Sheared. Occasional 2 cm by 2cm pyrite clumps. Rare to no bright bands. Very soft and broken.	J3	0		
15	114.74	114.94	0.20	0.20	100			-	0.2	-	CO	Coal	5821			Less shearing. Frequent thicker bright bands (between 1-5mm thick) totally ~50% bright bands.	J3	0		
15	114.94	115.12	0.18	0.18	100			-	0.18	-	CO	Coal	5822			Less shearing. Frequent thicker bright bands (between 1-5mm thick) totally ~50% bright bands.	J3	0		
15	115.12	115.22	0.10	0.10	100			-	0.1	-	ZM	Coaly Mudstone	5823					0		
15	115.22	115.42	0.20	0.20	100			-	0.2	-	XM	Carbon-aceous Mudstone				Finely laminated mdst. Sharp lower contact with lower coal.		0		
15	115.42	115.43	0.01	0.01	100			-	0.01	-	CO	Coal				Coal stuck to rock on upper contact		0		
15	115.43	115.51	0.08	0	0			-	0	-	KLC	Core Loss, interpreted as coal				Potential coal loss? Only fragments of CDB (?) coal. Driller said he felt the core loss was here in the rock -> he ground through it as it was unexpected.		0		
15	115.51	115.52	0.01	0.01	100			-	0.01	-	CO	Coal				Lower contact is lined with a plane of coal with pervasive calcite veining.		0		
15	115.52	115.85	0.33	0.33	100			-	0.33	-	CS	Claystone				Finely laminated mdst, abundant plant fossils. Starts to become more silty towards end. Lower contact is defined by a calcite vein plane.		0		
15	115.85	115.92	0.07	0.07	100			-	0.07	-	ST	Siltstone				Shoe from core catcher. Broken, feels silty.				
16	115.92	117.92	2.00	2.00	100			-	2	-	ST	Siltstone				Gradual transition to siltstone - gets coarser downhole, becoming more sandy (very fine to fine sand), with more distinct laminations. Soft sediment deformation is evident, however it convolutes the bedding so no BCN was taken.				
End of borehole at 117.92 metres, driller supplied depth																				

*Note: core description of HR21LD-01 by Adriana M. Matesoi and Karys T. Leonard-Fortune GIT; core-logging codes are defined in **Table A-9**; sample numbers are cross-referenced to the sample inventory presented in **Table B-1**; composites of coal seam/zone samples are documented in **Table B-2**.*

Lithological description of large-diameter cores from borehole HR21LD-02: **Table A-6**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam comp-osites	Coal / rock type	Additional descriptions and comments
	From	To	Run length	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity			
											1	2			1	2		Roof	Floor					
					0	9		9.00																Casing
					9	55.22		46.22															R-LOSS	PDC to 55.22 m.
1	55.22	58.12	2.90	2.88																				RUN # 1
					55.22	55.76	0.54			0.54	GR			FGR	SLS			20			SO		SST	Silty fine-grained sandstone. 3-5% pyrite. Convoluted bedding. At end, sheared coal stringer.
					55.76	56.00	0.24			0.24	GR			FGR							IN		SST	Top contact has 2mm coal seam, sheared, on it. End contact with another <2cm coal seam, broken at this point. Coal is dull &bright.
					56.00	56.81	0.81			0.81	MGR			FGR	TLA						IN		SLT	Fines downhole. Irregular coal stringers every ~20cm. Abrupt lower contact with coal.
					56.81	57.06	0.25		5824	0.25	BL										IN	E1	CDB	Abrupt upper contact - no coal appears to be missing (full recovery at top). 1-2 shears at top, however, remainder of coal is dark black (sometimes silvery bony coal layers are present at top ~10cm). Middle to end is well cleated, with ~35% bright bands . Intact and hard to break.
					57.06	57.51	0.45		5825	0.45	BL										IN	E1	CD&B	Bright band content increase in areas to >50%. 1-2% pyrite. Cleating frequent. Occasional smooth sheared planes at around ~20?. Abrupt solid contact.
					57.51	57.64	0.13			0.13	DGR			VFGR	TLA						IN		CCST	Clay - very fine grained visible laminations. Wavy contact with coal.
					57.64	57.94	0.30		5826	0.30	BL										IN	E2	CD&B	
					57.94	58.10	0.16		5827	0.16	BL										IN	E2	CDB	
					58.10	58.12		0.02	5827	0.02												E2	C-LOSS	Potential coal loss?
2	58.12	61.12	3.00	3.00																				RUN # 2
					58.12	58.50	0.38		5828	0.38	BL										SBK	E2	CDB	
					58.50	58.92	0.42		5829	0.42	BL										IN	E2	CD&B	CD&B with CDB at end. 9 cm in, there is a 4 cm band of CBn (bony coal). Becomes intensely brightly-banded after this point. CD&B. Rare cleating still. Wavy contact with bottom.
					58.92	59.06	0.14			0.14	DGR	MGR		VFGR							SO		HCST	Transitions from HCST to CST downhole. Clay grain-size visible, fine laminations. Many coalified plants. Fits perfectly with following piece.
					59.06	59.48	0.42			0.42	DGR	MGR		VFGR	TLA						SO		CST	CST with abundant coal streaks.
					59.48	59.76	0.28		5830	0.28	BL										IN	E3	CDB	Bright bands between 30-50% depending on section. Rare cleating. Silvery-black, common CBn bands. Ends with 45° smooth shear plane.
					59.76	60.06	0.30		5831	0.30	BL										IN	E3	CD&B	Increased frequency and width of bright bands (between 1mm-2cm bright bands). >50% bright bands. Rare cleating. Black and silvery-black. Fits in with next piece perfectly (ends with a sheared surface at 40°).
					60.06	60.26	0.20			0.20	DGR	MGR		VFGR	TLA						IN		CST	Grain-size visible. Abundant coal streaks. Abrupt solid lower contact with coal.

Lithological description of large-diameter cores from borehole HR21LD-02: **Table A-6 (continued)**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam comp-osites	Coal / rock type	Additional descriptions and comments
	From	To	Run length	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Stru c-ture	BCN		HCL re-action	Core qual-ity			
											1	2			1	2		Roof	Floor					
					60.26	60.66	0.40		5832	0.40	BL						HSH	22	19		IN	E3	CD	40cm in, sheared zone (flaky, soft), until end of sample. Contact at 19° (good reading). Occasional bright bands, mostly sheared so features are indistinguishable.
					60.66	60.81	0.15		5833	0,15.	BL									z	MBK	E3	CD&B	Becomes less dense + very brightly banded towards end. Thick (<1cm-2cm) bright bands. Very frequent (~60%) bright bands. Black-silver. No cleating. Contact with lower rock is abrupt (had to piece core back together to see that).
					60.81	61.12	0.31			0.31	DGR	MGR		VFGR	TLA						MBK		CST	~10cm of HCST at top, immediately becomes CST with distinct grain-size and laminations visible. Still abundant coalified plants and coal stringers. Shoe is broken up.
3	61.12	64.12	3.00	3.00																				RUN # 3
					61.12	61.76	0.64			0.64	MGR			FGR							IN		SLT	Coarsening downhole. Gradual contact. Shear parallel to core axis
					61.76	63.01	1.25			1.25	GR	MGR			XBE	RMA					IN		SST	Silty fine-grained sandstone. Cross stratified and ripples are visible. Finely laminated silty intervals.
					63.01	63.63	0.62			0.62	MGR			FGR	TLA						IN		SLT	Transition back to vfgr, finely laminated
					63.63	63.73	0.10			0.10	DGR	MGR		VFGR							IN		CST	Gradual transition to HCST. Increased coal streaks. Roof of coal. Abrupt contact.
					63.73	64.12	0.39		5834	0.39	BL										IN	E4	CD&B	50-60% bright bands. Rare cleating, rare HCST layers.
4	64.12	67.12	3.00	3.00																				RUN # 4
					64.12	64.24	0.12		5835	0.12	BL										SBK	E4	COAL	Dull banded +CBn (12.3kg)
					64.24	64.34	0.10		5836	0.10	DGR											ex-clude	CST	Solid but irregular bottom contact.
					64.34	64.36	0.02		5836	0.02	BL											ex-clude	CBN	Bony coal
					64.36	64.46	0.10		5836	0.10	BL	DBR										ex-clude	HCST	With coal stringers
					64.46	64.96	0.50		5837	0.50	BL								15		IN	E4	CDB	COAL; floor contact intact at ~15° BCN
					64.96	65.31	0.35		5838	0.35	BL										IN	E4	CD&B	Dull and Bright, bands
					65.31	65.69	0.38		5839	0.38	BL										IN	E4	CDB	
					65.69	66.05	0.36		5840	0.36	BL										IN	E4	COAL	
					66.05	66.22	0.17		5841	0.17	BL								12		IN	E4	CD&B	Dull and Bright. Floor contact sharp at ~12° BCN
					66.22	66.31	0.09		5842	0.09	DBR	BL									IN	ex-clude	CCST	With coal stringers. (2-3%). Grades into CST
					66.31	66.59	0.28			0.28	BL								11		IN	ex-clude	CST	Bottom contact at 11° BCN.
					66.59	66.63	0.04		5843	0.04	BL										IN	E4	CBN	Bony coal; sheared
					66.63	66.96	0.33		5843	0.33	BL										IN	E4	CD&B	
					66.96	67.00	0.04		5844	0.04	BR	BL									IN	E4	HCST	With coal stringers
					67.00	67.12	0.12		5844	0.12	BL										IN	E4	CD&B	
5	67.12	69.62	2.50	2.44																				RUN # 5
					67.12	67.18		0.06	5845	0.06												E4	C-LOSS	Potential coal loss?
					67.18	67.30	0.12		5845	0.12	BL										HBK	E4	COAL	
					67.30	67.69	0.39		5845	0.39	BL										IN	E4	CD&B	
					67.69	68.09	0.40		5846	0.40	BL										SBK	E4	CD&B	HBK at bottom, SBK at top.

Lithological description of large-diameter cores from borehole HR21LD-02: **Table A-6 (continued)**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam comp-osites	Coal / rock type	Additional descriptions and comments
	From	To	Run length	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity			
											1	2			1	2		Roof	Floor					
					68.09	68.39	0.30		5847	0.30	BL								15		SBK	E4	COAL	BKn at top. Floor contact solid at 15° BCN.
					68.39	68.43	0.04		5848	0.04	BL	DBR									SO	E4	HCST	
					68.43	68.53	0.10		5848	0.10	BL								15		SO	E4	COAL	Floor contact irregular (~15° BCN)
					68.53	68.73	0.20			0.20	DBR	BL									IN		CCST	Grades into CST
					68.73	69.08	0.35			0.35	GR	BR									SO		CST	Thin coal stringers near bottom contact. Grades into HCST
					69.08	69.21	0.13			0.13	DGR	BL									SO		CCST	Grades into HCST
					69.21	69.30	0.09			0.09	BL	DBR									SBK		HCST	Bottom is marked by a 1cm CBr coal
					69.30	69.41	0.11			0.11	DGR	BL									IN		CCST	Grades into cst
					69.41	69.51	0.10			0.10	DGR	BR									IN		CST	Grades into SLT
					69.51	69.62	0.11			0.11	GR										IN		SLT	
					69.62	84.50	14.88			14.88													R-LOSS	PDC to 84.5 m.
6	84.5	87.5	3.00	2.81																				RUN # 6
					84.50	85.26	0.76			0.76	MGR	BR		FGR	LA			17	13		IN		SLT	Clayey siltstone. Sharp bottom contact.
					85.26	85.52	0.26		5849	0.26	BL										IN	F2	CDB	Dull banded coal. Floor contact intact.
					85.52	85.84	0.32		5850	0.32	BL										IN	F2	COAL	Floor contact intact.
					85.84	85.94	0.10		5601	0.10	BL										IN	F2	CBN	Bony coal.
					85.94	86.19	0.25			0.25	DGR			VFGR	MBE						SO		CST	Upper and bottom contacts irregularly shaped, with coal stringers.
					86.19	86.24	0.05			0.05	BL										IN		COAL	Maybe bony coal (?).
					86.24	86.37	0.13			0.13	DGR			VFGR							IN		CST	Irregular bottom contact
					86.37	86.43	0.06			0.06	BL										SO		COAL	Dull banded. Irregular floor contact
					86.43	87.08	0.65			0.65	GR	BR		VFGR							IN		CST	Silty
					87.08	87.13	0.05			0.05	DGR	BL		VFGR	MBE						SBK		CCST	With coal stringers
					87.13	87.32	0	0.19	5602	0.19												G2	C-LOSS	Potential coal loss?
					87.32	87.50	0.18		5602	0.18	BL										HBK	G2	COAL	
7	87.5	90.6	3.10	3.00																				RUN # 7
					87.50	87.55	0.05		5603	0.05	BL										SO	G2	CDB	Bright bands of varying width (<1mm-3mm), ~25-30% bright bands. Rare cleating. Hard. Wavy contact.
					87.55	87.71	0.16			0.16	MGR			FGR	TLA	SLS					IN		SLT	Not CST; can see silty laminations, common coal slivers (stringers), occasional coalified plants. Convoluted bedding.
					87.71	88.29	0.58		5604	0.58	BL										IN	G2	CD&B	Abundant, >50% bright bands. No cleating visible. Silvery-black. Very hard. Last 10cm is 5cm of CCST followed by 5 cm of CD&B. Abrupt lower contact.
					88.29	88.70	0.41			0.41	DGR			VFGR							SO		SLT	Muddy siltstone. Very fine grained, plant fossils are abundant. No coal stringers. Abrupt lower contact.
					88.70	89.08	0.38		5605	0.38	BL										SO	G3	CBB	Abundant >60%, bright bands. Some areas up to 80% bright bands. Rare cleating.
					89.08	89.38	0.30		5606	0.30	BL						SSH				SO	G3	CBB	Abundant >60% bright bands. Cleating common. Some shearing at bottom
					89.38	89.52	0.14		5607	0.14	BL						HSH				MBK	G3	CD	Sheared - flaky and soft, cannot distinguish any other features. Smooth-sheared planes, abrupt lower contact.

Lithological description of large-diameter cores from borehole HR21LD-02: **Table A-6 (continued)**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam comp-osites	Coal / rock type	Additional descriptions and comments
	From	To	Run length	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity			
											1	2			1	2		Roof	Floor					
					89.52	89.65	0.13			0.13	DGR			VFGR							IN		CST	Mdst with coal streaks, coalified plant matter and abundant plant fossils (deciduous leaves, fern leaves, wood chunks)
					89.65	89.75	0.10		5608	0.10	BL										SO	G3	CDB	Occasional bright bands (between 10-20%), rare cleating. Heavy, somewhat hard. Too many bright bands to be bony coal. Abrupt, solid contact.
					89.75	89.85	0.10			0.10	DGR			VFGR	TLA						IN		CST	Mdst with coaly streaks, plant fossils.
					89.85	89.87	0.02			0.02	BL										IN		COAL	CDB - bright bands and cleating visible in this small layer. Top contact intact, sharp lower contact, slightly ground out. Coalified wood?
					89.87	90.5	0.63			0.63	DGR			VFGR	TLA						IN		CST	Mdst with coal streaks and seams, plant fossils. Many small coal seams (can tell because of coaly surface on the inside of the broken slices) may have been all ground out? Pulverised coal in between rock chunks. Chunks do not fit perfectly with one another. These thin coal seams is where all the core loss was?
					90.5	90.6	0	0.10															C-LOSS	Potential loss of coal stringers between rock chunks - see note above.
8	90.6	91.6	1.00	1.00																				RUN # 8
					90.6	91.19	0.59			0.59	DGR			VFGR	TLA						IN		CST	Mdst with coal streaks (coalified wood chunks maybe?) Plant fossils common. Abrupt lower contact with SST.
					91.19	91.6	0.41			0.41	DGR			FGR				5?			SO		SST	Fine sand, distinct regular beds, very hard to break.
					91.6	104.17	12.57			12.57													R-LOSS	PDC to 104.17 m.
9	104.17	106.92	2.75	2.66																				RUN # 9
					104.17	104.53	0.36			0.36	DGR	GR		VFGR	LA			11	10		SO		SLT	Muddy siltstone. Alternating laminations of mud/silt., resulting in a distinct dark grey/light grey alternating pattern. Laminations of mud and silt vary in width, but never exceed 5cm wide. Great BCN readings.
					104.53	105.53	1.00			1.00	DGR	GR		VFGR	LA			11	9		SO		SLT	Same unit as above. 23 cm in, there is a 5 cm band of bioturbation in a very fine grained silty sand. Immediately goes back to alternating silt/mud laminations.
					105.53	106.03	0.50			0.50	DGR	GR		VFGR	LA			12			MBK		SLT	Same unit as above (alternating silt/mud laminations). Solid lower contact
					106.03	106.16	0.13			0.13	LGR			FGR	TLA						SO		SLT	NO MUD, only silt, can see it is coarser than the muddy siltstone above. Very white-grey coloured. Lower contact is abrupt.
					106.16	106.34	0.18			0.18	BL	DGR		VFGR	MBE		MSH				HBK		CST	Black mudstone that has been sheared smooth many planes perpendicular to core axis. Core does not piece together very well. Some calcite mineral growth as slickenlines on polished surfaces, however when broken open, can distinctly see clay grain-size and rare coal streaks. Lower contact missing.

Lithological description of large-diameter cores from borehole HR21LD-02: **Table A-6 (continued)**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam comp-osites	Coal / rock type	Additional descriptions and comments
	From	To	Run length	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity			
											1	2			1	2		Roof	Floor					
					106.34	106.39	0.05			0.05	LGR			FGR	TLA						HBK		SLT	NO MUD, only silt. Same as light band at 106.03-106.16m. Contacts missing. Fits poorly with adjacent pieces.
					106.39	106.79	0.40			0.40	DGR	GR		VFGR	LA				11		SO		SLT	Back to alternating silt/mud, with increased mud content downhole. Carbonate veining at lower contact. Solid abrupt contact with coal.
					106.79	106.83	0.04		5609	0.04	BL										HBK	J1	CD	Dull coal. While upper contact was stuck to above rock, most was loose in the shoe. No bright bands, no cleating, no shears. Broken coal. Loss here?
					106.83	106.92	0	0.09	5609	0.09												J1	C-LOSS	Potential coal loss?
10	106.92	109.97	3.05	3.05																				RUN # 10
					106.92	107.09	0.17		5610	0.17	BL						SSH				IN	J1	CD&B	Dull and bright coal; somewhat sheared, whitish clay on some cleats.
					107.09	107.33	0.24		5611	0.24	BL						SSH				IN	J1	CD&B	As above
					107.33	107.53	0.20		5612	0.20	BL						MSH				IN	J1	COAL	Sheared coal
					107.53	107.77	0.24		5613	0.24	BL						SSH				IN	J1	CDB	Dull with bands of fusain (up to 2cm thick)
					107.77	107.88	0.11		5613	0.11	BL						MSH				IN	J1	COAL	Minor white clay on cleats
					107.88	107.91	0.03		5614	0.03	BL						MSH				SBK	J1	COAL	CDB?
					107.91	108.07	0.16		5614	0.16	BL						SSH				IN	J1	CDB	
					108.07	108.27	0.20		5615	0.20	BL						SSH				IN	J1	CDB	Irregularly shaped.
					108.27	108.33	0.06		5615	0.06	BL						SSH				IN	J1	CD&B	Dull coal with bands of HCST (25-30%)
					108.33	108.61	0.28		5616	0.28	BL											J1	COAL	
					108.61	108.83	0.22		5617	0.22	BL								10			J2	CDB	Dull banded
					108.83	108.87	0.04		5617	0.04	BL								10			J2	CBN	Bony coal
					108.87	108.93	0.06		5617	0.06	BL											J2	CDB	Dull banded
					108.93	109.2	0.27		5618	0.27	BL											J2	CDB	
					109.2	109.32	0.12		5619	0.12	BL											J2	CD&B	Dull and bright. Solid, irregular contact at bottom.
					109.32	109.35	0.03		5619	0.03	BL											J2	ST	Stony (?) coal. Irregularly shaped band.
					109.35	109.42	0.07		5619	0.07	BL											J2	CD&B	
					109.42	109.68	0.26		5620	0.26	BL											J2	CD&B	
					109.68	109.78	0.10		5621	0.10	BL											J2	CD&B	
					109.78	109.97	0.19		5621	0.19	BL											J2	CDB	Core catcher recovered
11	109.97	113.07	3.10	3.12																				RUN # 11
					109.97	110.27	0.30		5622	0.30	BL										IN	J2	CD	
					110.27	110.5	0.23		5623	0.23	BL										SO	J2	CDB	
					110.5	110.55	0.05		5624	0.05	BL										SO	J2	ST	Stony coal? Irregularly shaped band.
					110.55	110.8	0.25		5624	0.25	BL										SO	J2	CDB	
					110.8	111.12	0.32		5625	0.32	BL										IN	J3	CD	Mostly dull coal
					111.12	111.52	0.40		5626	0.40	BL										IN	J3	CDB	
					111.52	111.94	0.42		5627	0.42	BL										SO	J3	CDB	
					111.94	112.24	0.30		5628	0.30	BL										SO	J3	CD&B	Dull and bright coal
					112.24	112.58	0.34		5629	0.34	BL										IN	J3	CDB	
					112.58	112.94	0.36		5630	0.36	BL										SBK	J3	CD	Kind of soft dull coal.
					112.94	113.09	0.15		5631	0.15	BL										MBK	J3	CDB	Recovered in core catcher.
12	113.07	116.07	3.00	3.05																				RUN # 12
					113.09	113.14	0.05		5632	0.05	BL										HBK	J3	CDB	

Lithological description of large-diameter cores from borehole HR21LD-02: **Table A-6 (concluded)**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam comp-osites	Coal / rock type	Additional descriptions and comments
	From	To	Run length	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity			
											1	2			1	2		Roof	Floor					
					113.14	113.41	0.27		5632	0.27	BL										SBK	J3	CDB	
					113.41	113.76	0.35		5633	0.35	BL						SSH				IN	J3	CDB	Somewhat sheared and soft. Fusain lenses throughout (2mm - 1cm thick)
					113.76	114.16	0.40		5634	0.40	BL						SSH				SBK	J3	COAL	Mostly dull and somewhat sheared.
					114.16	114.51	0.35		5635	0.35	BL						MSH				SBK	J3	CD	As above
					114.51	114.74	0.23		5636	0.23	BL										IN	J3	CDB	Dull banded
					114.74	115.04	0.30		5637	0.30	BL										SO	J3	CDB	
					115.04	115.21	0.17		5638	0.17	BL										SO	J3	CDB	
					115.21	115.23	0.02		5638	0.02	BL						MSH		3		SO	J3	ST	Stony coal (?); sheared. Floor contact sharp and sheared.
					115.23	115.42	0.19			0.19	DGR	BR		VFGR	MBE				3		SO		CCST	Few 3-4mm thin coaly stringers with some whitish clay. Bottom contact solid, out 2-3° BCN
					115.42	115.44	0.02			0.02	BL										SO		CD&B	One coal band
					115.44	115.51	0.07			0.07	GR			VFGR							IN		CST	Occasional carbonaceous stringers with white clay material. Grades into SLT
					115.51	115.99	0.48			0.48	GR			VFGR	WBE	TLA		2	0		IN		SLT	Siltstone
					115.99	116.14	0.15			0.15	GR								0		SO		SLT	As above
13	116.07	118.07	2.00	2.00																				RUN # 13
					116.07	118.07	2.00			2.00	GR	DGR		FGR	TLA				7		IN		SLT	Siltstone with sandy laminated bands
End of hole at 118.07 metres (driller supplied depth)																								

*Note: core description of HR21LD-02 by Adriana M. Matesoi and Karys T. Leonard-Fortune GIT; core-logging codes are defined in **Table A-9**; sample numbers are cross-referenced to the sample inventory presented in **Table B-1**; composites of coal seam/zone samples are documented in **Table B-2**.*

Lithological description of large-diameter cores from borehole HR21LD-03: **Table A-7**

Run #	Drillers' depths in metres				Descriptive log in metres																		Seam compo-sites	Coal / rock type	Additional descriptions and comments
	From	To	Core run	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity				
											1	2			1	2		Roof	Floor						
					0	9	0																R-LOSS	Casing to 9 m
					9	55.02	0																R-LOSS	PDC down to 55.02 m
1	55.02	58.12	3.10	3.02																				RUN # 1
					55.02	55.81	0.79				GR	BR	SWE	FGR	TLA						SO		SLT	Sandy siltstone. Minor fractures filled with coaly material. Grades into CCST
					55.81	56.16	0.35				DGR	BR		VFGR	MBE						IN		CST	Irregular coaly stringers; 2 cm thick coal coating on top end. Grades into carb claystone.
					56.16	56.28	0.12				DBR	BL		VFGR	MBE						IN		CCST	Carb claystone with up to 40% bands/ stringers of bright coal.
					56.28	56.66	0.38				DGR	BR		VFGR	TLA						SO		CST	Irregular shaped thin coal stringers (3-4%). Grades into CCST.
					56.66	56.71	0.05				BL	DGR		VFGR	ILA				17		SO		CCST	Floor contact sharp at ~17˚ BCN
					56.71	56.84	0.13		5639		BL				ILA						SO	E1	COAL	Dull > Bright coal with up to 5% ash (CCST) mm thin bands. Kind of heavy, but still coal.
					56.84	57.01	0.17		5639		BL								14		IN	E1	COAL	As above. Solid floor contact at ~14˚BCN.
					57.01	57.4	0.39		5640		BL				ILA						IN	E1	C&B	Coal and bands (70/30): Coal is CDB with thin HCST/CCST bands up to 2cm thick. Irregular bottom contact.
					57.4	57.62	0.22				DGR	BL		VFGR	TLA						SO		CCST	Minor coal stringers. Irregular shaped floor contact with coal.
					57.62	57.76	0.14		5641		BL											E2	CD&B	Dull and Bright Coal
					57.76	58.04	0.28		5641		BL											E2	CD&B	As above; core catcher recovery.
					58.04	58.12	0	0.08	5641													E2	C-LOSS	Potential coal loss?
2	58.12	61.12	3.00	3.09																				RUN # 2
					58.12	58.23	0.11		5642		BL										IN	E2	COAL	Dull and bright; irregular floor contact.
					58.23	58.27	0.04		5642		GR	MGR		VFGR							SO	E2	CST	
					58.27	58.5	0.23		5643		BL										IN	E2	CD&B	Dull and bright coal.
					58.5	58.78	0.28		5644		BL										IN	E2	CD&B	as above.
					58.78	58.95	0.17		5645		BL								12		IN	E2	CD&B	As above, floor contact sharp at 12˚
					58.95	59.16	0.21		5646		BL	DBR		VFGR							IN		HCST	With coal stringers/ bands (up to 25% of the interval). Gradational floor contact.
					59.16	59.51	0.35				DGR	BL		VFGR	MBE				10		IN		CCST	
					59.51	59.56	0.05		5647		BL										IN	E3	CBN	Bony + Stony with few bright stringers.
					59.56	59.76	0.20		5648		BL										SO	E3	CD&B	Dull and bright coal.
					59.76	59.84	0.08		5649		BL										SO	E3	CBN	Bony coal
					59.84	60.12	0.28		5649		BL										IN	E3	CD&B	dull and bright
					60.12	60.3	0.18		5650		BL										IN	E3	CD&B	as above.
					60.3	60.37	0.07		21701		BL										SBK	ex-clude	HCST	with coal stringers. Grades into CCST
					60.37	60.47	0.10		21701		BL	DGR									IN	ex-clude	CCST	Abundant (up to 20%) coal stringers. Irregular floor contact
					60.47	60.7	0.23		21702		BL								10		IN	E3	CDB	Dull banded coal
					60.7	61.06	0.36		21703		BL						MSH				SBK	E3	CD&B	sheared coal.
					61.06	61.21	0.15				DGR	BL									SBK		CSST	with coal stringers; core catcher recovery.
3	61.12	64.22	3.10	2.99																				RUN # 3
					61.21	61.33	0.12				DGR			VFGR	TLA						SBK		CST	With black polished breaking surfaces. Grades into SLT

Lithological description of large-diameter cores from borehole HR21LD-03: **Table A-7 (continued)**

Run #	Drillers' depths in metres				Descriptive log in metres																		Seam compo-sites	Coal / rock type	Additional descriptions and comments
	From	To	Core run	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity				
											1	2			1	2		Roof	Floor						
					61.33	61.51	0.18				DGR	BR		VFGR	TLA						SO		SLT	Grades into SST
					61.51	62.95	1.44				MGR	BR		FGR	LA			12	11		SO		SST	
					62.95	63.05	0.10				MGR			VFGR	TLA						IN		SLT	Grades into CST
					63.05	63.15	0.10				DGR			VFGR	MBE						MBK		CST	Black polishes breaks/ fractures.
					63.15	63.7	0.55				DGR			VFGR	TLA						SO		CST	Lower half of interval is cut by many coal stringers (up to 2 cm thick). Grades into CCST
					63.7	63.81	0.11				BL	DGR		VFGR	ILA						IN		CCST	Coal stringers throughout. Floor contact very irregularly shaped.
					63.81	63.87	0.06		21704												SBK		HCST	with coal stringers. Crushed coal at floor.
					63.87	64.02	0.15		21704		BL				ILA						IN		HCST	with up to 25% coal stringers. Irregular floor contact
					64.02	64.15	0.13		21705												IN	E4	CDB	Dull banded coal
					64.15	64.2	0.05		21705												SBK	E4	CDB	As above. Core catcher recovery.
					64.2	64.22	0	0.02	21705													E4	C-LOSS	Potential coal loss?
4	64.22	67.22	3.00	2.90																				RUN # 4
					64.22	64.38	0.16		21706												IN	E4	CD	Dull coal
					64.38	64.47	0.09		21706												IN	E4	CBN	Bony coal. Irregular floor contact.
					64.47	64.68	0.21														SO		HCST	with coal bands & stringers (up to 3-4 cm thick). Floor contact solid, irregularly shaped. No sample.
					64.68	64.73	0.05		21707												SO	E4	CBN	Possibly bony coal. Irregular floor contact.
					64.73	64.94	0.21		21707												SBK	E4	CD&B	Dull and bright coal.
					64.94	65.18	0.24		21708												IN	E4	CD&B	as above.
					65.18	65.49	0.31		21709												SO	E4	CD&B	
					65.49	65.7	0.21		21710												SO	E4	CD&B	
					65.7	66.01	0.31		21711												SO	E4	CD&B	
					66.01	66.32	0.31		21712										17		IN	E4	CD&B	Thin calcite stringers at the floor contact. Floor contact at 17˚ BCN.
					66.32	66.62	0.30				DGR	BR		VFGR	TLA						IN		CST	Irregular coal stringers throughout. Floor contact very irregularly shaped.
					66.62	66.71	0.09				DGR	BL		VFGR	LA						IN		CSST	Floor contact very irregularly shaped.
					66.71	67.06	0.35		21713										10		IN	E4	CD&B	BCN floor approximately 10˚.
					67.06	67.12	0.06		21713												SBK	E4	CD&B	Recovered in the core catcher.
					67.12	67.22	0	0.10	21713													E4	C-LOSS	Potential coal loss?
5	67.22	70.32	3.10	2.96																				RUN # 5
					67.22	67.31	0	0.09	21714													E4	C-LOSS	Coal below was broken and falling out of the tray etc, didn't recover the rest here?
					67.31	67.39	0.08		21714		BL						HSH				HBK	E4	CD	Very broken and flaky. Likely coal loss above? Rare bright bands. Slivery grey.
					67.39	67.63	0.24		21714		BL						SSH				IN	E4	CD	Rare bright bands. No cleating.
					67.63	67.91	0.28		21715		BL						HSH				IN	E4	COAL	Sheared so badly cannot distinguish any features. Flakes and falls apart in hand.
					67.91	68.25	0.34		21716		BL						HSH				IN	E4	COAL	Sheared so badly cannot distinguish any features. Flakes and falls apart in hand.
					68.25	68.48	0.23		21717		BL						HSH				IN	E4	CD	Occasional bright bands, however there are thin mdst laminations that occur towards the end for a stretch of around 4cm. No cleating

Lithological description of large-diameter cores from borehole HR21LD-03: **Table A-7 (continued)**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam compo-sites	Coal / rock type	Additional descriptions and comments
	From	To	Core run	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity			
											1	2			1	2		Roof	Floor					
					68.48	68.66	0.18		21718		BL										IN	E4	COAL	No more shearing. Well cleated, intact coal and bony coal. Very heavy. Many bright bands. CDB and CBn.
					68.66	68.75	0.09				BL	DGR		VFGR							SO		HCST	Stony coal (no grain-size visible) - very heavy, black. Transitions to streaked mdst. Solid lower contact.
					68.75	69.17	0.42				DGR			VFGR	TLA	FOS					SO		CST	Silty mdst. Abundant fossilised plants. Some coalified wood with geochemical pyrite. Fits with next piece perfectly.
					69.17	69.64	0.47				DGR	MGR		VFGR	TLA	FOS					SO		SLT	Gradual transition to a muddy siltstone, increased fossilised plants, some infrequent bands of CCST 3 cm thick. Abrupt intact contact with coal.
					69.64	69.65	0.01				BL										SBK		COAL	Coal is from fossilised wood potentially? Missing lower contact, as it is ground and pulverised.
					69.65	69.88	0.23				DGR	MGR		VFGR	TLA	FOS							SLT	Muddy siltstone with fossilised plant, occasional HCST layer. Abrupt intact lower contact with coal.
					69.88	69.9	0.02				BL												CD	Cleared, no bands, missing lower contact, lots of broken pieces and bottom piece does not match well.
					69.9	69.92	0	0.02															C-LOSS	Potential coal loss?
					69.92	70.24	0.32				DGR	MGR		VFGR	TLA	FOS							SLT	Muddy siltstone, occasional plant fossils, increased coaly stringers. Missing lower contact.
					70.24	70.29	0.05				DGR	BL		VFGR			MSH				HBK		HCST	Core catcher - broken and sheared, lots of coal streaks.
					70.29	70.32	0	0.03															R-LOSS	HCST loss at end?
					70.32	80.32	0	10.00															R-LOSS	PDC down to 80.32 m
6	80.32	82.52	2.20	2.20																				RUN # 6
					80.32	82.52	2.20												11				SLT	NL - Not logged. Photos taken.
7	82.52	85.42	2.90	2.90																				RUN # 7
					82.52	83.22	0.70				DGR	MGR		VFGR	TLA						SO		SLT	Abrupt contact with lower unit
					83.22	83.39	0.17				LGR			F-MGR	WBE	RCL			19		SO		SST	Wavy bedding, some rip up clasts, very light grey with fine-med sand, with <1mm silty layers occasionally
					83.39	84.31	0.92				LGR			F-MGR	XBE	RMA					SO		SST	Cross bedding and way up truncations. 3 fracture filling carbonate veins (<1cm)
					84.31	84.76	0.45				LGR			F-MGR	XBE						SO		SST	Coarsening downhole, larger beds and higher bedding angle. SHARP erosional lower contact at 23˚ BCN.
					84.76	85.38	0.62				DGR			VFGR	TLA						SO		CST	mdst with occasional 4cm beds of silty sandstone. Missing contact with coal? Hard to piece together because its so hard to rotate the core (heavy)
					85.38	85.42	0.04		21719		BL	DGR										F2	COAL	First 2cm are stony coal, the rest has 10-15% bright bands. No cleating.
8	85.42	88.62	3.20	3.10																				RUN # 8
					85.42	85.52	0	0.10	21720													F2	C-LOSS	Possible coal loss?

Lithological description of large-diameter cores from borehole HR21LD-03: **Table A-7 (continued)**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam compo-sites	Coal / rock type	Additional descriptions and comments
	From	To	Core run	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity			
											1	2			1	2		Roof	Floor					
					85.52	85.94	0.42		21720		BL										IN	F2	CD&B	Dull and bright coal
					85.94	86.2	0.26		21721		BL										SO	F2	CDB	Dull banded coal
					86.2	86.35	0.15		21722		DGR	DBR		VFGR	TLA						SBK	ex-clude	CCST	Bottom 0.05m (contact with coal): crushed, fractured and coaly.
					86.35	86.51	0.16		21723		BL										SBK	F2	CDB	crushed and broken at roof contact. Floor contact intact and irregularly shaped.
					86.51	86.54	0.03		21724		BL										SO		CBN	Bony coal
					86.54	86.64	0.10		21724		DBR	BL		VFGR	ILA						SO		CCST	Up to 30% coal stringers. Floor contact irregular.
					86.64	86.67	0.03		21724		BL										SO		CBN	Bony (?) coal
					86.67	86.86	0.19		21725		BL										IN	G2	CDB	Dull banded coal
					86.86	87.08	0.22		21726		BL										IN	G2	CDB	as above. Floor contact irregularly shaped
					87.08	87.14	0.06		21727		DBR	BL		VFGR	TLA						SO	G2	HCST	with coal stringers
					87.14	87.19	0.05		21727		BL										IN	G2	COAL	thin HCST bandlets
					87.19	87.27	0.08				DGR	BL		VFGR	MBE						SO		CCST	with coal stringers. Grades into CST
					87.27	87.39	0.12				DGR			VFGR							SO		CST	Floor contact irregularly shaped
					87.39	87.59	0.20				BL	DBR		VFGR	ILA						IN		HCST	10-15% coal stringers. Floor contact irregular.
					87.59	88.27	0.68				DGR	BR		VFGR	ILA						SO		CST	Carb at roof contact, increasingly silty towards bottom. Occasional thin coaly stringers
					88.27	88.62	0.35				MGR			VFGR	TLA						IN		SLT	
9	88.62	91.62	3.00	2.90																				RUN # 9
					88.62	88.68	0.06				MGR	BR		VFGR	TLA				12		IN		CST	Claystone.
					88.68	88.88	0.20		21728		BL										IN	G3	COAL	Possibly dull banded.
					88.88	89.12	0.24		21729		BL										IN	G3	COAL	
					89.12	89.41	0.29		21730		BL								10		IN	G3	CD&B	Dull and bright. Sharp floor contact at ~10° BCN.
					89.41	89.43	0.02		21731		DBR	BL		VFGR			SSH				IN	G3	HCST	Sharp and sheared bottom contact.
					89.43	89.49	0.06		21731		BL		SWE				MSH				IN	G3	COAL	Sheared coal; crushed at both contacts.
					89.49	89.58	0.09				DBR			VFGR	ILA						IN		CSST	Carbonaceous, with coal stringers; grades into HCST.
					89.58	89.67	0.09				BL	DBR		VFGR	ILA	TLA					IN		HCST	Up to 30% coal stringers/bands. Crushed at the Floor contact.
					89.67	89.77	0.10				DBR			VFGR	TLA						SO		CSST	With coal stringers. Grades into CST.
					89.77	90.3	0.53				DGR	DBR		VFGR	TLA						SO		CST	Slightly carbonaceous; 5-10% coal stringers.
					90.3	90.7	0.40				DGR			VFGR							SO		CST	Silty but grades into carbonaceous.
					90.7	90.81	0.11				DGR	BL									SBK		CCST	With coal stringers. Grades into CST.
					90.81	90.87	0.06				GR	MBR		FGR	TLA						IN		CST	Silty. Floor contact sharp, weavey.
					90.87	91.52	0.65				LGR			FGR	WBE	TLA		10		MFI	IN		SST	Show some reaction with HCl. Hair-thin calcite stringers around upper contact.
					91.62	106.17	0	14.55															R-LOSS	PDC down to 106.17 m
10	106.17	109.32	3.15	3.08																				RUN # 10
					106.17	106.24	0	0.07															C-LOSS	Potential coal loss?
					106.24	106.62	0.38				BL										MBK		CST	First 0.38m is CST with carbonate veining. Abrupt contact.
					106.62	106.84	0.22														IN		SLT	Abrupt lower contact
					106.84	106.99	0.15		21732		BL						SSH				MBK	J1	CDB	First perfectly with next piece. Slicken lines and white fault gouge (clay) on shear slickensided planes. Common bright bands.

Lithological description of large-diameter cores from borehole HR21LD-03: **Table A-7 (continued)**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam compo-sites	Coal / rock type	Additional descriptions and comments
	From	To	Core run	Recov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity			
											1	2			1	2		Roof	Floor					
					106.99	107.32	0.33		21733		BL						SSH				IN	J1	CD	Mostly dull - rare bright bands. No cleating. Common sheared surfaces, common coney coal layers ~2cm thick. Fits with next piece perfectly.
					107.32	107.57	0.25		21734		BL										SO	J1	CD&B	Bright bands slightly more than 20%, Occasional sheared surfaces. Silvery-black
					107.57	107.82	0.25		21735		BL						HSH				IN	J1	CD	Very sheared. Polished smooth shear planes, very soft and flakes and falls apart in hand. Hard to distinguish features because of shearing. Can see bright bands occasionally.
					107.82	108.01	0.19		21736		BL										SO	J1	CDB	Common ST and CBn layers (<3cm). Bright coal and cleating common.
					108.01	108.04	0.03		21737		BL										IN	J1	CBN	Bony coal, heavy, dull and black
					108.04	108.15	0.11		21737		BL										IN	J1	CBN	CBN and ST
					108.15	108.18	0.03		21737		BL										IN	J1	ST	Stony coal, no grain-szie visible.
					108.18	108.31	0.13		21737		BL										IN	J1	CD	Dull, no bright coal.
					108.31	108.35	0.04		21738		BL										IN	J2	CBN	with CD bands (<2cm)
					108.35	108.38	0.03		21738		BL	DGR									IN	J2	ST	with CD bands (<2cm)
					108.38	108.51	0.13		21738		BL										IN	J2	CD	Less than 20% bright bands. Rare cleating. Rare CBN bands
					108.51	108.81	0.3		21739		BL										IN	J2	CD	with some (30% of this sample) CD&B. Occasional cleating.
					108.81	109.02	0.21		21740		BL						SSH				IN	J2	CD	with cleating (occasional), rare bright bands (~5%), some shearing
					109.02	109.32	0.3		21741		BL										IN	J2	CBN	with CD bands. Occasional 1-2cm thick HCST bands (grain-size visible).
11	109.32	112.52	3.20	3.10																				RUN # 11
					109.32	109.62	0.3		21742		BL										IN	J2	CD	Majority CD. However, 10cm in there are alternating beds of CD&B,(well cleated with thick bright bands) and ST (<1cm).
					109.62	109.7	0.08		21743		BL										IN	J2	CD&B	
					109.7	109.8	0.1		21743		BL						MSH				IN	J2	CDB	40% HCST, 60% CDB (can see grain-size in HCST)
					109.8	109.88	0.08		21743		BL										IN	J	HCST	60% HCST, 40% CDB (can see grain-size in HCST). Polished surfaces because of shearing
					109.88	110.28	0.4		21744		BL	DGR									IN	J2	CDB	Noticed that really nice CD&B or CBB occur alongside bands of ST or HCST, this is why I labelled this unit CDB because of the dilution of bright bands by bands of HCST and ST. Well cleated coal.
					110.28	110.38	0.1		21745		BL	DGR					HSH				IN	J2	CD	Rare bright bands
					110.38	110.58	0.2		21745		BL						HSH				IN	J2	COAL	Indistinguishable features due to intense shearing. Extremely soft and flaky, falls apart.
					110.58	110.96	0.38		21746		BL						SSH				IN	J2	COAL	Sheared. Indistinguishable last ~10cm is stony coal layers with well cleated CD&B layers (<2cm bands)
					110.96	110.99	0.03		21747		BL						SSH				IN	J2	ST	ST only
					110.99	111.2	0.21		21747		BL										IN	J2	CD	CD&ST

Lithological description of large-diameter cores from borehole HR21LD-03: **Table A-7 (concluded)**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam compo-sites	Coal / rock type	Additional descriptions and comments
	From	To	Core run	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity			
											1	2			1	2		Roof	Floor					
					111.2	111.63	0.43		21748		BL										IN	J3	COAL	First 15cm is ST bands alternating with CBB (each band of ST and CBB are ~1cm in width). Rest of coal is slightly cheated and dull
					111.63	112.01	0.38		21749		BL						SSH				IN	J3	COAL	Alternating bands (~1-2cm thick each) of CBn and CD, with bright bands that never exceed 20%. No cleating
					112.01	112.2	0.19		21750		BL						MSH				IN	J3	CD	Rare bright bands, stony bands common.
					112.2	112.22	0.02		21750		BL	DGR									IN	J3	HCST	Can see grain-size.
					112.22	112.42	0.20		21751		BL										HBK	J3	CD	Abundant stony and bony coal layers ~1-3cm thick. Rare bright bands in dull coal. No cleating. Shoe recovery.
					112.42	112.52	0	0.10	21751													J3	C-LOSS	Potential coal loss?
12	112.52	115.72	3.20	3.12																				RUN # 12
					112.52	112.6	0	0.08	21752													J3	C-LOSS	Potential coal loss?
					112.6	112.8	0.20		21752		BL										MBK	J3	CD	Rare bright bands, occasional 2cm bands of bony coal. Some shears
					112.8	113.02	0.22		21753		BL										PUL	J3	COAL	Extremely broken and disintegrated. Not flaky. Indistinguishable features.
					113.02	113.4	0.38		21754		BL										IN	J3	CD	Bright bands ~5%, but thick (~1cm wide) with a conchoical fracture. Rare bony coal layers
					113.4	113.66	0.26		21755		BL										IN	J3	CD	Rare bright bands ~1-2%. Silvery-black. Occasional bony coal layers.
					113.66	113.94	0.28		21756		BL										IN	J3	CDB	More bright bands in clusters. ~25%. Rare thin bands of ST
					113.94	114.13	0.19		21757		BL										IN	J	CDB	Still very heavy, some shearing. Very hard. ~20% bright bands
					114.13	114.46	0.33		21758		BL										SBK	J3	CD&B	Increased bright band content. Occasional clumps of cleated coal (shear interrupt cleating). Some dull sections.
					114.46	114.66	0.20		21759		BL										IN	J3	COAL	Indistinguishable features because of intense shearing. Flaky and soft.
					114.66	114.94	0.28		21760		BL								7		IN	J3	COAL	Hard to distinguish features due to shearing. There is a nice 5cm stretch of unsheared CD&B. Contact sharp at 7˚ BCN.
					114.94	114.97	0.03				DGR			VFGR							IN		HCST	
					114.97	115.72	0.75				GR	MGR		FGR							IN		SLT	Muddy siltstone. 20 cm in there is a 5 cm interval of CST with carbonate veining. Coarsens downhole to a sandy siltstone (very hard to break).
13	115.72	118.72	3.00	3.00																				RUN # 13
					115.72	118.72	3.00																ROCK	NL - This interval was not logged.
End of hole at 118.72 metres (driller supplied depth)																								

*Note: core description of HR21LD-03 by Adriana M. Matesoi and Karys T. Leonard-Fortune GIT; core-logging codes are defined in **Table A-9**; sample numbers are cross-referenced to the sample inventory presented in **Table B-1**; composites of coal seam/zone samples are documented in **Table B-2**.*

Lithological description of large-diameter cores from borehole HR21LD-04: **Table A-8**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam	Coal / rock type	Additional descriptions and comments
	From	To	Run length	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity			
											1	2			1	2		Roof	Floor					
					0	9	0	9		9													R-LOSS	Casing.
					9	55.49	0	46.49		46.49													R-LOSS	PDC to 55.57 m.
1	55.57	58.12	2.55	2.55																				RUN # 1
					55.57	56.06	0.49			0.49	MGR	BR									IN		SLT	Finely down. SLT (sandy lenses). Grades into CST
					56.06	56.35	0.29			0.29				VFGR							SBK		CST	Slightly carbonaceous. Up to 20% stringers of bright coal (mostly at bottom 10 (?) cm. Very broken and fractured at bottom 5 cm.
					56.35	57.15	0.80			0.8	MGR	BR		VFGR							IN		CST	As above but much less coal stringers.
					57.15	57.44	0.29			0.29	DGR	DBR		VFGR							IN		CCST	Moderately carbonaceous, minor coal stringers. Floor contact sharp at 13˚ BCN.
					57.44	57.51	0.07		21761	0.07	BL	DBR									SO	E1	C&B	Coal (hard, bony) with HCST bands (50/50). Irregularly shaped floor contact.
					57.51	57.69	0.18		21761	0.18	BL										SO	E1	COAL	Dull banded coal ; minor ash (HCST or ST) stringers <1cm thin all together.
					57.69	58.00	0.31		21762	0.31	BL										SO	E1	COAL	Dull and bright coal: nicely banded and cleated.
					58.00	58.12	0.12		21762	0.12	BL	DBR									IN	E1	C&B	Coal (dull banded) with one 2 cm thick irregularly shaped HCST band.
2	58.12	61.12	3.00	3.00																				RUN # 2
					58.12	58.24	0.12			0.12	DGR	MGR		VFGR	TLA						IN		SLT	Muddy siltstone with coalified plants and common sheared surfaces. ~2-5% pyrite
					58.24	58.34	0.10			0.1	DGR	BL		VFGR	TLA						IN		CCST	Abundant coaly streaks. ~5% pyrite (lots of disseminated). Common sheared surfaces in many directions. Abrupt solid contact with coal
					58.34	58.62	0.28		21763	0.28	BL										SO	E2	CD	Mostly (60%+) dull, rare bright bands (which are well cleated). Small pinched out bands (<1cm) of HCST
					58.62	58.85	0.23		21764	0.23	BL										SO	E2	CBB	More than 60% bright coal. Ever surface is banded, cleating near lower contact. Solid lower contact. No pyrite visible?
					58.85	58.91	0.06		21765	0.06	DGR	MGR		VFGR	TLA						SO	E2	SLT	Not HCST: muddy siltstone with no coaly streaks. Very hard to break. Laminations and grain size are visible. Trace pyrite. Solid lower contact.
					58.91	59.06	0.15		21766	0.15	BL										SO	E2	CD&B	Silvery black. Occasional cleating. Common bright coal and bright bands ~50%. 3-4 1cm bands of ST coal (cannot see grain-size, but very black and hard
					59.06	59.31	0.25		21767	0.25	BL										SO	E2	CDB	Very hard and heavy, however still a significant amount of bright bands. (~30-40%). Some hard dull stretches of silvery black heavy dirty coal.
					59.31	59.59	0.28		21768	0.28	BL										SO	E2	CBB	Bright coal exceeds 60%. Abundant bright bands and bright coal. Rare cleating.
					59.59	59.85	0.26			0.26	DGR	BL		VFGR	TLA	FOS					SO		CCST	Silty mdst with abundant coal streaks. Coalified plant fossils, rare sheared surfaces.
					59.85	59.95	0.10			0.1	DGR	MGR		VFGR	TLA						SO		SLT	Very hard, no coaly streaks. Abrupt lower contact with lower coal- streaked SLT.
					59.95	60.03	0.08			0.08	MGR	BL		FGR	TLA						SO		SLT	With little mud, but increased amount of coal stringers. Some pyrite (1-2%).

Lithological description of large-diameter cores from borehole HR21LD-04: **Table A-8 (continued)**

Run #	Drillers' depths in metres				Descriptive log in metres																		Seam compo-sites	Coal / rock type	Additional descriptions and comments
	From	To	Core run	Recov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity				
											1	2			1	2		Roof	Floor						
					60.03	60.09	0.06			0.06	MGR	BL		FGR	TLA						SO		SLT	Same as above. Abrupt solid lower contact.
					60.09	60.43	0.34		21769	0.34	BL										SO	E3	COAL	First 20cm is matte-black stony coal with rare thin pinched out HCST laminations (ILA) and occasional CD bands. Rest is CDB.
					60.43	60.73	0.30		21770	0.3	BL										SO	E3	CD&B	Silvery grey bright coal with deep black bright bands. At lower contact, increased frequency and thickness of CBN bands (<1cm-1.5cm).
					60.73	60.84	0.11			0.11	DGR	BL		VFGR	TLA				20		SO		CCST	Abundant mm-thick coal streaks, can see grain-size and laminations. Abrupt lower contact at 20 degrees BCN.
					60.84	61.02	0.18			0.18	DGR	MGR		FGR							SO		SLT	Sandy siltstone. Very hard, no coal streaks, rare fossils. Lower contact missing with coal from shoe.
					61.02	61.12	0.10		21771	0.1	BL	DGR									IN	E3	CD&B	Shoe recovery. First 4 cm is alternating bands (b/w 0.5-1cm thick) of HCST and CD&B. The remainder is CBB with no hint of any dull or dirty coal.
3	61.12	64.22	3.10	3.10																					RUN # 3
					61.12	61.30	0.18		21772	0.18	BL										HBK	E3	COAL	Although broken, have full recover.
					61.30	61.47	0.17		21772	0.17	BL										IN	E3	CD	Mostly dull coal with occasional cleated areas with thin bright bands. Very hard to break.
					61.47	61.72	0.25		21773	0.25	BL										SO	E3	CD&B	Last 5cm is HCST with coal bands. Mostly all coal is CD&B
					61.72	61.8	0.08			0.08	DBR	BL		VFGR	TLA						SO		HCST	Many coaly streaks. Grain-size visible. Abrupt lower contact.
					61.8	61.99	0.19			0.19	DGR	MGR		VFGR	TLA						SO		SLT	Muddy siltstone. Fits with next piece perfectly
					61.99	62.86	0.87			0.87	DGR	MGR		FGR	TLA						SO		SLT	Less muddy
					62.86	63.72	0.86			0.86	DGR	MGR		FGR	TLA						SO		SLT	
					63.72	64.12	0.40			0.4	DGR			VFGR	TLA						IN		SLT	Muddy siltstone. Lower contact missing
					64.12	64.22	0.10			0.1	DGR	BL		VFGR	TLA						SBK		HCST	Shoe recovery. HCST with cm of coal at bottom.
4	64.22	67.22	3.00	3.00						0															RUN # 4
					64.22	64.43	0.21		21774	0.21	BL										SO	E4	CDB	First 4 cm is C&B. 10cm interval of CD&B with thick, very well cleating bright coal. Somewhat irregular contact with HCST
					64.43	64.54	0.11		21775	0.11	BL	DGR									SO	E4	CBN	Bony coal with occasional cleated bright bands. Contact defined by end of bright bands and coal streaks.
					64.54	65.03	0.49		56001	0.49	BL										SO	ex-clude	ST	Matte black-silvery coloured. CANNOT SEE GRAINSIZE, cannot distinguish laminations, unsure what this is? Sampling it as unsure. Stony coal, Fire in peat bog coal? Last 10cm is HCST (can see grain-size and laminations)
					65.03	65.28	0.25		56002	0.25	BL										SO	E4	CDB	Occasional instances of C&B, mostly (80%) CDB with occasional cleating, bright bands up to 30-40%.
					65.28	65.54	0.26		56003	0.26	BL										SO	E4	CDB	Less bright bands (~25-35%)
					65.54	65.87	0.33		56004	0.33	BL										SO	E4	CDB	Mostly CDB however there are thick (5+cm) areas of extremely well cleated CBR throughout the interval.

Lithological description of large-diameter cores from borehole HR21LD-04: **Table A-8 (continued)**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam compo-sites	Coal / rock type	Additional descriptions and comments
	From	To	Core run	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour 1	Colour 2	Weath-ering	Grain size	Bedding sedimentary structure 1	Bedding sedimentary structure 2	Struc-ture	BCN Roof	BCN Floor	HCL re-action	Core qual-ity			
					65.87	66.09	0.22		56005	0.22	BL										SO	E4	CD&B	Thick bands (5cm+) of dull coal diluting the thick bright coal bands (well cleated).
					66.09	66.28	0.19		56006	0.19	BL										SO	E4	CBB	Bright coal and extremely well cleated bright bands (70-80%).
					66.28	66.59	0.31		56007	0.31	BL										SO	E4	CBB	65-75% bright coal and bands.
					66.59	66.82	0.23		56008	0.23	BL										SO	E4	CBB	~60% bright coal.
					66.82	66.87	0.05			0.05	DGR			VFGR							SO		CCST	carbonaceous, can see grain-size. Missing lower contact.
					66.87	66.9	0.03			0.03	BL										SBK		COAL	Tiny seam of coal.
					66.9	67.22	0.32			0.32	DGR			VFGR							SBK		CST	Silty mdst.
5	67.22	70.22	3.00	3.00						0														RUN # 5
					67.22	67.51	0.29		56009	0.29	BL								17		IN	E4	CDB	Frequent bright bands; occasional cleating.
					67.51	67.62	0.11		56010	0.11	BL										IN	E4	CBB	Bright coal, occasional bright bands; rare cleating. Abrupt lower contact (at ~17°)
					67.62	67.67	0.05		56010	0.05	DBR						GO				IN	E4	CSST	Seams like soft, sheared clay, like a fault gouge more son than a mudstone.
					67.67	68.02	0.35		56011	0.35	BL						HSH				IN	E4	COAL	very sheared; features indistinguishable.
					68.02	68.49	0.47		56012	0.47	BL						HSH				IN	E4	COAL	Soft and flaky, breaks apart in hand. Sheared with indistinguishable features; smooth polished surfaces.
					68.49	68.78	0.29		56013	0.29	BL						HSH				IN	E4	COAL	Same as above.
					68.78	68.92	0.14		56014	0.14	BL						HSH				IN	E4	COAL	Even softer than above.
					68.92	69.00	0.08		56014	0.08	BL						HSH				IN	E4	COAL	Increased polished surfaces.
					69.00	69.04	0.04		56015	0.04	BL										SO	E4	CDB	Bright bands; no more shearing.
					69.04	69.11	0.07		56015	0.07	BL								19		SO	E4	CD	Dull coal; rare bright bands. No cleating. Abrupt lower contact @ 19°.
					69.11	69.32	0.21			0.21	DGR			VFGR	TLA	FOS					SO		CST	Mudstone with abundant coalified plant fossils that have geochemical pyrite surrounding them
					69.32	69.61	0.29			0.29	DGR	MGR		VFGR	TLA	FOS					SO		SLT	Muddy siltstone with plant fossils with geochem pyrite. Very hard.
					69.61	69.81	0.20			0.2	BL	DGR		VFGR	TLA	FOS					IN		CCST	Carbonaceous muddy siltstone. Coalified wood. Missing lower contact.
					69.81	70.00	0.19			0.19	MGR			FGR	TLA						IN		SST	Silty sandstone with common coaly beds.
					70.00	70.22	0.22			0.22	MGR			FGR	TLA						SBK		SST	As above.
					70.22	85.17	0	14.95		14.95													R-LOSS	PDC to 85.17 m.
6	85.17	88.37	3.20	3.20						0														RUN # 6
					85.17	85.34	0.17			0.17	LGR			F-MGR	XBE	RCL					IN		SST	Light grey, fine grained, x-bedded sandstone. Lower contact is erosional, with rip-up clasts just above contact.
					85.34	85.74	0.4			0.4	MGR	DGR		VFGR	ILA	MBE					IN		CST	Silty mudstone, mostly massive. Gradational bottom contact.
					85.74	85.77	0.03			0.03	DGR			VFGR					13		IN		CCST	Carbonaceous mudstone. Sharp and weavey floor contact with the coal below.
					85.77	86.05	0.28		56016	0.28	BL										SO	F2	COAL	Mostly dull banded coal; one 1.5 cm thin bony band at top of interval; minor ash (HCST) sleavers at bottom.
					86.05	86.46	0.41		56017	0.41	BL										IN	F2	CD&B	Dull and bright coal. Floor contact irregularly shaped and partially broken.

Lithological description of large-diameter cores from borehole HR21LD-04: **Table A-8 (continued)**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam compo-sites	Coal / rock type	Additional descriptions and comments
	From	To	Core run	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity			
											1	2			1	2		Roof	Floor					
					86.46	86.50	0.04			0.04	BL	DBR		VFGR							SO		HCST	Very fine highly carb mudstone. Intact floor contact, irreg shaped (erosional?)
					86.50	86.70	0.20			0.2	MGR			VFGR	MBE						SO		CST	Silty mudstone, mostly massive.
					86.7	86.8	0.10			0.1	BL						SSH				SBK		CBN	Bony (?); wet and sheared coal.
					86.8	86.88	0.08			0.08	BL										IN		COAL	Dull banded coal. Floor contact is very irreg (like scoured surfaces).
					86.88	87.56	0.68			0.68	MGR			VFGR	MBE						IN		CST	Silty. Coalified plant fragments (roots?). Gradational floor contact.
					87.56	87.73	0.17			0.17	DGR	BL		VFGR							IN		CSST	Carbonaceous mudstone. Irreg floor contact with the coal below.
					87.73	87.76	0.03		56018	0.03	BL										SO	G2	COAL	Possibly bony.
					87.76	87.93	0.17		56018	0.17	BL										SO	G2	CDB	Dull banded coal; minor carb mudstone stringers.
					87.93	87.96	0.03		56019	0.03	BL	DBR		VFGR							SO	ex-clude	HCST	Very fine highly carb mudstone band. Grades into CCST.
					87.96	88.02	0.06		56019	0.06	DGR										SO	ex-clude	CSST	Very fine carb mudstone band. Irreg floor contact with the coal below.
					88.02	88.09	0.07		56020	0.07	BL										IN	G2	CDB	Dull banded coal; minor carb mudstone stringers.
					88.09	88.37	0.28		56020	0.28	BL										SBK	G2	CD&B	Dull and bright coal. Mostly in the core catcher recovered .
7	88.37	91.37	3.00	3.25						0														RUN # 7
					88.37	88.48	0.11		56021	0.11	BL										IN	G2	CD&B	Dull and bright coal. Irreg floor contact.
					88.48	88.5	0.02		56021	0.02	BL										SO	G2	COAL	Bony coal? (Hard and dull, weak cleating).
					88.50	88.60	0.10		56021	0.1	BL	DBR		VFGR							SO	G2	C&B	Coal and bands: highly carb mudstone with up to 20% coal stringers
					88.60	88.67	0.07		56021	0.07	BL										IN	G2	CD&B	Dull and bright coal
					88.67	88.73	0.06			0.06	MGR	DGR		VFGR							IN		CST	Silty mudstone; grades into SLT.
					88.73	89.09	0.36			0.36	MGR			FGR	WBE	TLA			13		SO		SLT	Wavey carbonaceous laminae; locally ichno-fossils (worms, burrows). Abrupt floor contact with coal below (~13° BCN)
					89.09	89.24	0.15		56022	0.15	BL										IN	G3	CD&B	Dull and bright coal
					89.24	89.57	0.33		56023	0.33	BL										IN	G3	COAL	Dull and bright
					89.57	89.81	0.24		56024	0.24	BL										IN	G3	COAL	As above
					89.81	89.83	0.02		56025	0.02	DBR	BL		VFGR							IN	G3	HCST	Fine band of highly carbonaceous mudstone.
					89.83	90.01	0.18		56025	0.18	BL						HSH				IN	G3	COAL	Very sheared coal ; occasionally some white clay on cleats and shearing plane; crushed at floor contact.
					90.01	90.16	0.15			0.15	DGR			VFGR							SO		CCST	Moderately carbonaceous with few coal stringers. Gradual, somewhat irregular bottom contact.
					90.16	90.19	0.03			0.03	BL	DGR									IN		CBN	Bony coal.
					90.19	90.26	0.07			0.07	DBR	BL			TLA		SSH				SO		HCST	Up to 25% coal stringers
					90.26	90.29	0.03			0.03	DBR	BL			TLA						SBK		HCST	As above; irregular floor contact (but intact)
					90.29	90.62	0.33			0.33	GR			FGR	ILA						IN		SLT	siltstone grading into mudstone
					90.62	90.67	0.05			0.05	BL	DBR									IN		CSST	carbonaceous mudstone.
					90.67	91.62	0.95			0.95	DGR	BR		VFGR	ILA	MBE					MBK		CST	mostly intact core, v. broken only locally. Grades into carb mudstone.
					91.62	106.3	0	14.68															R-LOSS	PDC to 106.30 m.
8	106.3	109.52	3.22	3.22						0														RUN # 8

Lithological description of large-diameter cores from borehole HR21LD-04: **Table A-8 (continued)**

Run #	Drillers' depths in metres				Descriptive log in metres																			
	From	To	Core run	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core qual-ity	Seam compo-sites	Coal / rock type	Additional descriptions and comments
											1	2			1	2		Roof	Floor					
					106.3	106.75	0.45			0.45	MGR	BR		VFGR	TLA						SO		CST	Mdst - no fossils or lamination disturbances of anykind.Ubiquitous.
					106.75	106.86	0.11			0.11	BL	DGR		VFGR	TLA						SBK		CST	Mdst - black compared to surrounding mdst. 5% pyrite in microscopic streaks between laminations.
					106.86	107.28	0.42			0.42	DGR	GR		VFGR	TLA						IN		SLT	A small 10 cm interval of MGR/BR mdst again and then grain size gradually coarsening downhole up to fine sand and silt. Disseminated pyrite ~5%. Sharp lower contact with coal (some coal attached to the end of this rock)
					107.28	107.43	0.15		56026	0.15	BL										HBK	J1	COAL	Some sheared planes (white fault gouge/clay on slickenside surface) and many broken surfaces make it hard to distinguish features. Bright bands do occur more frequently at bottom. No cleating.
					107.43	107.65	0.22		56026	0.22	BL						SSH				IN	J1	CD&B	Frequent bright coal.
					107.65	107.90	0.25		56027	0.25	BL						SSH				IN	J1	COAL	Can see bright coal in areas not sheared.
					107.90	108.08	0.18		56028	0.18	BL						HSH				IN	J1	COAL	Hard to distinguish features due to shearing.
					108.08	108.28	0.20		56028	0.2	BL						SSH				IN	J1	CD	Can see dull coal with rare bright bands where not sheared.
					108.28	108.68	0.40		56029	0.4	BL						SSH				IN	J1	CD	Bright bands are rare. Shears very frequent. No cleating. Very hard, but did not find and ST or CBn. Can see bright bands on outside of cut core.
					108.68	109.00	0.32		56030	0.32	BL						SSH				IN	J1	CDB	Bright bands ~20%. Dull coal seems to be well cleated in areas.
					109.00	109.26	0.26		56031	0.26	BL						SSH				IN	J2	CD	Less than 20% bright bands. Rare cleating.
					109.26	109.52	0.26		56032	0.26	BL						SSH				HBK	J2	COAL	Sheared, small broken pieces and slices of core from shoe recovery. Hard to distinguish any feature.
9	109.52	112.72	3.20	3.20						0														RUN # 9
					109.52	109.69	0.17		56033	0.17	BL										SBK	J2	CDB	Top shoe recovery. Hard coal. No shears
					109.69	109.90	0.21		56034	0.21	BL										SO	J2	CDB	Contains some hard (stony?) bands (5 - 7 cm in thickness), heavy and hard to break.
					109.90	110.10	0.20		56035	0.2	BL	DGR		VFGR							SO	J2	CD&B	Dull & bright coal with about 3 cm HCST bands.
					110.10	110.39	0.29		56036	0.29	BL						HSH				IN	J2	CDB	Looks like dull banded coal from cut core exterior, but too sheared to distinguish on internal surfaces.
					110.39	110.59	0.20		56037	0.2	BL						HSH				IN	J2	CD	Sheared coal. Abrupt contact with the (non-sheared) coal below.
					110.59	110.67	0.08		56037	0.08	BL										SO	J2	CD&B	No shear.
					110.67	110.97	0.30		56038	0.3	BL										SO	J2	CD&B	~50% bright bands; no shear.
					110.97	111.25	0.28		50639	0.28	BL										SO	J2	C&B	Coal and bands of HCST (HCST is hard, can see grain-size)
					111.25	111.56	0.31		56040	0.31	BL										SO	J3	C&B	Very hard; abundant bright bands, rare cleating, solid contact with coal below.
					111.56	111.61	0.05		56040	0.05	BL										IN	J3	CBR	BRIGHT BANDS! Super light, falls apparent easily due to cleating shape (breaks in cubes)

Lithological description of large-diameter cores from borehole HR21LD-04: **Table A-8 (concluded)**

Run #	Drillers' depths in metres				Descriptive log in metres																	Seam compo-sites	Coal / rock type	Additional descriptions and comments
	From	To	Core run	Re-cov. length	From	To	Length	Loss (m)	Sam-ple #	True thick-ness	Colour		Weath-ering	Grain size	Bedding sedimentary structure		Struc-ture	BCN		HCL re-action	Core quality			
											1	2			1	2		Roof	Floor					
					111.61	111.86	0.25		56041	0.25	BL						HSH				IN	J3	COAL	Sheared, flaky, breaks apart in hand; indistinguishable features.
					111.86	112.16	0.30		56042	0.3	BL						HSH				IN	J3	COAL	Appears dull on cut core surface. Indistinguishable features because of shear. Flaky, falls apart in hand.
					112.16	112.40	0.24		56043	0.24	BL						HSH				IN	J3	COAL	Features indistinguishable.
					112.40	112.55	0.15		56044	0.15	BL										IN	J3	COAL	Looks like dull banded coal from cut core exterior?
					112.55	112.72	0.17		56044	0.17	BL						HSH				IN	J3	COAL	Shoe recovery.
10	112.72	114.92	2.20	2.25																				RUN # 10
					112.72	113.22	0.50		56045	0.5	BL										PUL	J3	COAL	Highly broken, pulverised and sheared.
					113.22	113.47	0.25		56046	0.25	BL										SO	J3	CD&B	Silvery-black and black; very hard. Abundant bright bands with 3-7mm of ST coal bands (maybe HCST, cant see grain-size though).
					113.47	113.66	0.19		56047	0.19	BL										SO	J3	CDB	~30-40% bright bands. Very hard.
					113.66	114.04	0.38		56048	0.38	BL						SSH				SO	J3	CD&B	Looks like dull & bright form core exterior - hard to tell once broken open because of shearing.
					114.04	114.25	0.21		56049	0.21	BL						SSH				SO	J3	CD&B	Looks like dull & bright form core exterior - hard to tell once broken open because of shearing.
					114.25	114.36	0.11		56050	0.11	BL			VFGR							SO	J3	C&B	Coal and bands . Very heavy.
					114.36	114.53	0.17			0.17	DGR			VFGR	FOS						SO		CSST	Mdst with coaly streaks, coalified plant fossils
					114.53	114.56	0.03			0.03	BL										SBK		COAL	Coal seam
					114.56	114.97	0.41			0.41	DGR			VFGR	FOS						IN		SLT	Muddy siltstone.
End of hole at 114.92 metres (driller supplied depth); at 114.97 metres based on recovered core																								

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*Note: core description of HR21LD-04 by Adriana M. Matesoi and Karys T. Leonard-Fortune GIT; core-logging codes are defined in **Table A-9** ; sample numbers are cross-referenced to the sample inventory presented in **Table B-1**; composites of coal seam/zone samples are documented in **Table B-2**.*

Code table for core descriptions: **Table A-9**

COLOUR		
BL	Black	Colour should be taken from dry fresh rock face or break
GR	Grey	
DGR	Dark grey	
MGR	Medium grey	
LGR	Light grey	
BR	Brown	
DBR	Dark brown	
MBR	Medium brown	
LBR	Light brown	
RBR	Reddish brown	
OBR	Orange brown	
WEATHERING		
SWE	Slightly weathered	<20% of rock fragments oxidised
MWE	Moderately weathered	20% - 50% of rock fragments oxidised
HWE	Highly weathered	>50% of rock fragments oxidised
GRAIN SIZE		
VFGR	Very fine grained	
FGR	Fine grained	Grain size: 1/16mm - 1.00mm
F-MGR	Fine grained to medium grained	
MGR	Medium grained	Grain size: 1mm - 1.50mm
M-CGR	Medium grained to coarse grained	
CGR	Coarse grained	Grain size: 1.50mm - 2.00mm
GRN	Granular	Grain size: 2.00mm - 4.00mm
PEB	Pebble	Grain size: 4.00mm - 64.00mm
COB	Cobble	Grain size: 64.00mm - 256.00mm
BEDDING / SEDIMENTARY STRUCTURE		
LA	Laminated	
TLA	Thinly laminated	Individual layers <5mm thick
ILA	Irregularly laminated	Wavy or non-planar layers
MBE	Massive bedding	No apparent thin individual beds
XBE	Cross-bedding	Laminations oblique to the bed containing them
WBE	Wavy bedding	
RMA	Ripple marks	
RCL	Rip-up clasts	
WBU	Worm burrows	
SLS	Slump structures (soft sediment deformation)	
FOS	Fossils (specify type)	
BIO	Bioturbation	
CORE QUALITY		
SO	Solid	No break in the entire core or if present, is an induced one
IN	Intact	Although broken, the pieces can be put or made to fit together with no indication of core loss
SBK	Slightly broken	Core is broken into at least 3 pieces and cannot be made to fit together
MBK	Moderately broken	Core is broken into 4-8 pieces and cannot be put or made to fit together
HBK	Highly broken	Core is broken into more than 8 pieces and cannot be put or made to fit together
PUL	Pulverised	

Code table for core descriptions: **Table A-9 (concluded)**

COAL/ROCK TYPE		
CBR	Bright coal	>80% bright coal
CBB	Bright banded coal	60% - 80% bright coal
CD&B	Dull and Bright coal	40% - 60% bright coal
CDB	Dull banded coal	20% - 40% bright coal
CD	Dull coal	<20% bright coal
CBN	Bony coal	
ST	Stony coal	Highly carbonaceous claystone with black streak
COAL	Coal (unidentified)	
C&B	Coal and bands	Coal with less than 50% rock bands/laminae.
GO	Gouge	
CGL	Conglomerate	Grain size: >2mm
SST	Sandstone	Grain size: 1/16 - 2mm
SLT	Siltstone	Grain size: 1.25mm - 1.16mm (gritty)
CST	Claystone	Grain size: <1/25mm (smooth)
LST	Limestone	
CSST	Carbonaceous sandstone	
CCST	Carbonaceous claystone	Dark grey, less carbonaceous than HCST
HCST	Highly carbonaceous claystone	Dark grey to black, less carbonaceous than stony coal
C-LOSS	Coal Loss	
R-LOSS	Rock Loss	
STRUCTURE		
FO	Fold	Indicate additional features in additional description column
UPD	Upside-down	Indicate additional features in additional description column
FLT	Fault	Indicate thickness of fault in additional description column
BX	Breccia	Indicate thickness of breccia zone in additional description column
FZ	Fault zone	Indicate thickness of fault zone in additional description column
SL	Slickensided	Indicate nature, attitude in additional description column
PO	Polished surfaces	Indicate nature, attitude in additional description column
GO	Fault gouge	Indicate thickness and nature of gouge in additional description column
WFR	Slightly fractured	With 1 - 3 structural breaks (fracture, joint)
MFR	Moderately fractured	With 4 - 8 structural breaks (fracture, joint)
HFR	Highly fractured	With >8 structural breaks (fracture, joint)
SSH	Slightly sheared	With 1 - 3 sheared planes
MSH	Moderately sheared	With 4 - 8 sheared planes
HSH	Highly sheared	With > 8 sheared planes
REACTION TO HYDROCHLORIC ACID		
-	None	
WFI	Weak fizz	
MFI	Moderate fizz	
SFI	Strong fizz	

File: Hermann-2021-code-table_211225b.doc
Collation: Appendix A_220101c.doc

Appendix C: Digital copies of geophysical logs

Attached to the digital version of this report (and included as a supporting file for the paper version) are uninterpreted geophysical logs for those of the year-2021 boreholes which were logged.

Three formats are presented: LAS, PDF, and TIF.

Appendix D: Scans of interpreted density logs

Following in the paper version of this report are copies of interpreted density logs for those of the year-2021 diamond-drill holes which were geophysically logged, along with the interpreted density log for the bulk-sample pilot hole.

For purposes of comparison, scans of interpreted density logs for boreholes HR14-04C and HR14-04CA (both of them near the bulk sample pilot hole HR21RC-01) are provided.

Attached in both the paper and digital versions of this report are the page-by-page geophysical-log scans from which the printed versions can be produced as desired.

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