Geochemical Assessment of Mine and Power Station Waste Materials

KOGAN CREEK COAL MINE

Prepared for: ***CS Energy Limited***

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EXECUTIVE SUMMARY

The geology of Kogan Creek Coal Mine (KCCM) is well defined and understood by CS Energy Limited (CS Energy) geologists. The depositional environment of the coal in the KCCM sequence was an alluvial environment with marginal marine influences at a regional level, and this has resulted in a very low to negligible sulfide sulfur content in the coal and overburden. The coal from the mine is fed directly to the Kogan Creek Power Station.

The total sulfur concentrations in the sedimentary and carboniferous overburden and interburden from surface to the M coal seam and then through to the R coal seam are low to very low and this has resulted in classification of the overwhelming majority of the materials using acid base accounting methods as non-acid forming (NAF). The total sulfur and NAF classification was verified using sulfide sulfur testing. Due to the contiguous nature of the geology of this very uniform deposit and a good understanding of the depositional environment, the samples analysed from this program are considered to be indicative of the broader geological units within this deposit.

The samples of overburden and interburden materials included in this assessment represent approximately $6Mm^3$ of spoil materials likely to be generated from the next phase of open cut mining. The KCCM deposit has very uniform geology and stratigraphy as evidenced by the mining of approximately $40Mm^3$ at the project to date. This provides additional confidence in the 'representativeness' of the overburden and interburden (spoil) samples collected for the current study. Notwithstanding, it is recommended that on-going assessment of overburden and interburden samples from resource drilling programs be completed on a bi-annual basis to verify the predicted NAF geochemical nature of spoil reporting to the in-pit Spoil Storage Areas (**SSA**). This will be a particularly cost effective exercise, if representative samples are collected from the resource drilling programs.

The low elemental concentrations in the sedimentary and carboniferous overburden and interburden (spoil) materials result in a benign geochemical classification in terms of its potential to produce metalliferous drainage or saline drainage. However, the spoil contains a disproportionate amount of exchangeable sodium and this contributes to classification of the spoil as sodic and potentially susceptible to dispersion and erosion.

At the power station, fly ash, economiser ash, boiler ash and bottom ash (collectively referred to as **ash**) is contained in the 80 ha Initial Ash Disposal Area (**IADA**) and 72 ha Out of Pit Ash Cell (**OPAC**). The IADA has been substantially been filled, but retains one year ash storage capacity, and has essentially been replaced/substituted by the OPAC. There are other options for permanent storage of ash that may be considered in the longer term. One method involves placement of the ash within cells at the SSA followed by capping. Another method involves spreading the ash at the SSA prior to covering with spoil.

Regular testing of the ash completed over the life of mine verifies that the quality of the ash has remained consistent and this again verifies the consistent chemistry within the coal seams of the deposit. The KCCM overburden and interburden geochemistry is comparable with many of the coal deposits in the Bowen Basin that are dominated by NAF geology. Comparison of KCCM ash with data from other ash producers verifies KCCM ash is at the low end of the scale in terms of metalliferous content, and therefore poses a low risk relative to other ash sources. This is attributed to the low sulfide content and low metalliferous content of the coal.

Monthly leach tests of kinetic leach columns (KLC) have been completed from September 2014 to until March 2015. The KLC tests on ash, spoil, and ash mixed with spoil, indicate that the ash contains elements such as Al, As, B, Cr, F, Mo and V that are potentially mobile when the ash and spoil is mixed at a ratio of 1:1. Conversely at higher ratios of 1:5 to 1:20, the

concentrations of these elements decrease substantially. This is attributed to the benign and less alkaline geochemical nature of the spoil and the effect of mixing these materials.

At an operational level there are options for containing ash in the spoil and these could include intimate mixing of ash and spoil at a desired ratio (**co-mingling**) or end tipping, or placement of the ash in layers (**co-disposal**). The preliminary KLC test results indicate that co-mingling would provide lower concentrations of major, minor and trace elements in surface runoff or seepage. Placement of ash in cells or layers within the spoil could also be undertaken at an operational scale but based on the results of the kinetic leach tests, this could contribute to the ash becoming a potential source of elements such as Al, As, B, Cr, F, Mo and V. Controlling the rate and concentration at which these elements may be mobilised from the ash would then be a function of implementing engineering controls. The fundamental principle would be to have the ash controlled as a zero flux material whereby there is no (or virtually negligible) lateral or horizontal movement of pore water from the ash into the surrounding spoil.

Notwithstanding, the spoil surrounding the ash will significantly attenuate the potential mobility of these element from the ash materials due to geochemical controls that reduce the mobility of the elements through spoil such as sorption of elements within the minerals in the spoil (most likely through precipitation or co-precipitation reactions). These chemical processes should contribute to immobilisation of the elements within the spoil and limit the potential for them to be leached from the SSA.

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GLOSSARY of TERMS and ACRONYMS

Acid	A measure of hydrogen ion (H^+) concentration generally expressed as pH.
Acid Base Account	Evaluation of the balance between acid generation and acid neutralisation processes. Generally determines the maximum potential acidity (MPA) and the inherent acid neutralising capacity (ANC), as defined below.
AMD	Acid and Metalliferous Drainage from mine waste materials characterised by low pH, elevated metal concentrations, high sulfate concentrations and high salinity. See also "NMD".
ANC	Acid Neutralising Capacity, expressed as kg H_2SO_4 per tonne of sample. A measure of a sample's maximum potential ability to neutralise acid.
ANC: MPA Ratio	The ratio of the acid neutralising capacity to the maximum potential acidity of a sample. Used to assess the risk of a sample generating acid conditions.
EC	Electrical Conductivity, expressed as µS/cm.
eCEC	Effective cation exchange capacity provides a measure of the amount of exchangeable cations (Ca, Mg, Na and K) in a sample.
ESP	Exchangeable sodium percentage provides a measure of the sodicity of materials and propensity to erode.
Floor	Samples obtained from immediately below / within the coal seam.
Interburden	Mine waste material between mined coal seams. In this report interburden typically refers to units between mined coal seams comprising major rock types (e.g. sandstone) and carboniferous waste see also "Parting".
Kinetic Test	Procedure used to measure the geochemical/weathering behaviour of a sample of mine material over time.
KLC test	Kinetic leach column tests are procedures used to measure the geochemical/ weathering behaviour of a sample of mine material over time.
LoR	Limit of Reporting. Laboratory detection limit for the reporting of results for a particular geochemical test.
MPA	Maximum Potential Acidity. Calculated by multiplying the total sulfur or sulfide-sulfur (Scr) content of a sample by 30.6 (stoichiometric factor) and expressed as kg H_2SO_4 per tonne.
NAF	Non Acid Forming. Geochemical classification criterion for a sample that will not generate acid conditions.
NMD	Neutral mine drainage typically caused by exposure of sulfide minerals in mine waste materials to oxygen and water and then neutralisation by gangue minerals. Typically characterised by neutral pH and elevated concentrations of salts, sulfate and metals.

NAPP	Net Acid Producing Potential, expressed as kg H_2SO_4 per tonne. Calculated by subtracting the ANC from the MPA.
Overburden	Overburden material overlying the uppermost mined resource. See also "Interburden" and "Parting".
PAF	Potentially Acid Forming. Geochemical classification criterion for a sample that has the potential to generate acid conditions.
Parting	Thin band generally less than 0.5m thick of mine waste material from between economic coal seam plys; it typically contains a high proportion of organic carboniferous material.
ROM	Run-of-Mine. Coal as it comes from the mine prior to screening or processing.
Roof	Samples obtained from immediately above / within the coal seam.
%S	Percent sulfur. A measurement unit for the sulfur content of a sample material.
Scr	Chromium reducible sulfur. Analytical procedure to determine the sulfide sulfur concentration in a sample.
SO_4	Sulfate.
Spoil	Materials such as overburden, interburden, coal seam roof, floor and parting that report as waste to the in-pit Spoil Storage Area (SSA).
Static test	Procedure for characterising the geochemical nature of a sample at a single point in time. Static tests may include measurements of mineral and chemical composition of a sample and the Acid Base Account.
Tailings	Fine-grained mineral waste materials produced from the CHPP as part of the processing and washing of coal. Tailings, also called 'fines' or 'fine reject' typically comprise very fine-grained mudstone, claystone and sandstone present in CHPP wastewater, which is filtered to remove the water from the tailings, leaving behind 'dewatered tailings'. See also "Coarse Reject".
Total Sulfur	Total sulfur content of a sample generally measured using a 'LECO' analyser expressed as %S.
TSS	Total suspended solids is a measurement of the suspended solids concentration in a water sample.

1 INTRODUCTION, BACKGROUND AND CONTEXT

RGS was commissioned by CS Energy Limited (CS Energy) to complete a geochemical assessment of mine waste from Kogan Creek Coal Mine and coal ash from Kogan Creek Power Station. The mine and power station are collectively referred to as Kogan Creek Coal Mine (**KCCM**) in this report and are both located in the western Darling Downs of Queensland near the town of Chinchilla (**Figure 1-1**). The coal mine delivers approximately 2.5Mtpa of Run-of-Mine (ROM) raw coal from to the power station. The coal is not washed and subsequently no wash plant is required and no coal reject or tailing is produced.

To access the coal, **overburden** comprising sedimentary units is removed and transferred to storage areas which progressively refill the void after the coal has been mined, allowing for land rehabilitation to occur post-closure. The mine site has a shallow overburden thickness and coal starts at approximately 12-15m below the surface. The three main coal seams (M, N and O) have a total thickness of 12m and dip gently to the south west. The coal sits in relatively flat 0.1m to 3m thick seams with **parting** layers of sedimentary and carboniferous units between each coal seam within the **interburden**. The coal is selectively mined from the parting and transported to the run of mine (ROM) pad, where it is loaded into the crusher and conveyed directly to the power station.

In this report mine waste which includes overburden, interburden, coal parting and reject coal, are collectively referred to as **spoil**. The spoil is hauled to the in-pit **spoil storage areas** (SSA).

At the power station, fly ash, economiser ash, boiler ash and bottom ash (collectively referred to as **ash**) is contained in the:

- 80ha Initial Ash Disposal Area (**IADA**)
- 72ha Out of Pit Ash Cell (**OPAC**)

The IADA has been substantially been filled and contains 1,947,840m^3 of ash material, but retains approximately one year's additional ash storage capacity, should a need for emergency/additional storage capacity arise in future. The IADA has essentially been replaced by the OPAC, which now receives all ash material from the power station and contains 1,896,616m^3 of ash material. The OPAC has a calculated ash storage capacity (to crest height) of 2,103,384m^3.

There are other options for permanent storage of ash that may be considered in the longer term and these include:

- Placement of ash within cells at the SSA prior to capping
- Spreading ash at the SSA prior to covering with spoil.

The geochemical characteristics of the spoil and ash materials are required as part of an evaluation of the merits of the two potential permanent 'ash within spoil' storage options listed above. Subject to the geochemical assessment providing favourable results, it is understood that CS Energy will complete the work required to seek regulatory approval for the preferred permanent ash storage option.

1.1 Objective

The overall objective of the RGS scope of work was to evaluate the geochemical nature of the spoil and ash materials likely to be produced at KCCM and identify potential environmental risks and opportunities that may be associated with mining, handling and storing these materials.

Source: This product incorporates data which is: © Commonwealth of Australia (Geoscience Australia) 2004.

Figure 1-1: Location Map

1.2 Scope of Work

The RGS scope of work for KCCM included three stages of work. The Stage 1 geochemical assessment involved a site visit, review of existing data, the development of a sampling protocol for KCCM in July 2014 (RGS, 2014a), followed by sampling and static geochemical testing of relevant spoil and ash materials. Stage 2 commenced in September 2014 and included kinetic assessment of spoil and ash. Stage 3 commenced in November 2014 and included provision of this report addressing the geochemical characterisation, environmental risk assessment and development of management options for spoil and ash materials likely to be generated at KCCM.

Specific tasks completed within the three stages of work included:

Stage 1 – July/August 2014

- A site visit to gain an understanding of KCCM layout and ensure that the material sampling protocol was understood by site personnel and completed according to written guidelines.
- Desktop review of available literature.
- Implementation of the material sampling and geochemical testing program aligned with the exploration drilling program for KCCM.
- Collection of drill core materials from the exploration drilling program and preparation of representative mine (spoil) and power station (ash) waste samples for geochemical testing.
- Static geochemical testing of spoil and ash materials.

Stage 2 – September 2014 to March 2015

- Kinetic leach column geochemical testing of spoil and ash materials.

Stage 3 – November 2014 to April 2015

- Presentation and interpretation of static and kinetic geochemical test results for spoil and ash materials.
- Development and presentation of preliminary conclusions and recommendations for the environmental management of spoil and ash materials.

1.3 Report Structure

The structure of this report is as follows:

Section 2	Summary of the site visit, document and data review process and the sampling and analytical program
Section 3	Description of the regional and local geology
Section 4	Presentation of the geotechnical, geochemical and hydrogeological aspects related to the handling, placement and containment of the ash products from KCCM and a comparison of the elemental and leachable major, minor and trace element data demonstrating the consistent quality of the ash products over time
Section 5	Stage 1 sampling/testing methodology

Section 6	Interpretation and discussion of the spoil characterisation and classification
Section 7	Interpretation and discussion of the ash characterisation and classification
Section 8	Stage 2 preliminary outcomes of the kinetic leach cell testing program
Section 9	Stage 3 conclusions and management implications
Section 10	Forward works (recommendations)
Section 11	List of references
Attachments	Raw data and supporting information

2 SITE VISIT AND DOCUMENT REVIEW

2.1 Site Visit

A site visit was completed by RGS on the 24 July 2014 to meet with, and discuss the geochemical project with, site personnel and develop an appreciation of KCCM operations including the geology and mining method.

2.2 Desktop Review

The desktop review completed by RGS included geological data, current and proposed exploration drilling programs, proposed mining methods and mine plan, processing methods, and conceptual mine and power station waste disposal and management strategies. Discussions were held with CS Energy personnel to identify and discuss the most relevant technical information and to understand the project description.

Geological information was obtained from exploration drill-hole logs, geological reports, and through discussions with KCCM consultant geologists Xenith Consulting Pty Ltd (Xenith). Supplementary data and information was requested and reviewed to provide additional perspective to KCCM mine waste management process. The four primary reports included the following references:

- 2014 Resource Estimate Report by Xenith Consulting Pty Ltd that is presented in **Section 3.1** and **3.2**
- 2013 Ash Rehandling Geotechnical Assessment by Golding Contractors Pty Ltd that is presented in **Section 4.2**
- 1999 Impact Assessment of Ash Disposal on the Groundwater Regime for the Proposed Kogan Creek Power Station by Australian Groundwater & Environmental Consultants Pty Ltd (AGE) (also presented in **Section 4.2**)
- 2013 Kogan Creek Power Station and Mine Triennial Groundwater Monitoring Review by Environmental Management Strategies.

The outcomes of the desktop review are discussed in **Section 3** and **Section 4**.

2.3 Sampling and Analytical Plan

Based on the outcome of the data and document review and discussions with the site geologist and the CS Energy project team, a good understanding of the geological environment (lithology and stratigraphy) at the site was developed. RGS produced a sampling and analytical program to characterise and classify spoil and ash and provided this to KCCM for implementation. The sampling and analytical program methodology for Stage 1 and Stage 2 is provided in **Section 5.**

3 GEOLOGY

The geological description below was sourced from Xenith (2014).

3.1 Regional Geology

KCCM is located on the north-eastern margin of the Early Jurassic to Early Cretaceous Surat Basin. The Surat Basin extends from the Moreton Basin East of the Kumbarilla Ridge to Roma in the West and as far North as Taroom, covering a total area of 270,000 km^2 (Xenith, 2014). The Surat Basin occurs stratigraphically above the north-south trending Permian to Triassic Sydney-Gunnedah-Bowen Basin system; with the Gunnedah Basin underlying in the east and the Bowen Basin in the northeast.

3.1.1 Structure

The Surat Basins' extents are limited by the New England Fold Belt towards the easternmost part of the Basin. The Nebine Ridge delineates the boundary between the Surat Basin and the Eromanga Basin to the west. In Queensland the Kumbarilla Ridge divides the Surat Basin from the Clarence-Moreton Basin to the east. The northern and southern extents of the Surat Basin are limited by the outcropping of its stratigraphic succession (NSW Trade & Investment, 2013). Similar to the Bowen Basin, the deposits within the Surat Basin are typically flat-lying, with dips increasing in areas proximal to interpreted faulting. The deposits are laterally restricted, resulting in sub-basins, approximately 10 km in length.

3.1.2 Stratigraphy

Sediments within the Surat Basin consist of Jurassic to Cretaceous fluvial, lacustrine and marginal marine sediments, and coal-bearing successions. The deposits are laterally restricted (NSW Trade & Investment, 2013). The economically mineable coal seams within KCCM are restricted to the upper portion of the Juandah Coal Measures of the Walloon Subgroup, and are the equivalents of the Macalister and Nangram seams (**Figure 3-1**). The Juandah Coal Measures are unconformably overlain by the Springbok Sandstone and overlie the Tangalooma Sandstone, which in turn overlie the Taroom Coal Measures. The Walloon Subgroup is mostly composed of siltstones and silty sandstones, and only relatively small intervals of coal (approximately 10%) which have been deposited by swamps or lakes.

3.2 Local Geology

3.2.1 Stratigraphy

The stratigraphic units in KCCM are the upper portion of the Late Jurassic Springbok Sandstone and the Middle Jurassic Juandah Coal Measures. Historically, six distinct coal intervals have been defined in the Juandah Coal Measures; including, from the top of the sequence: Kogan, Macalister, Nangram, Wambo, Iona and Argyle. These seams occur as numerous thin coal plies within a fine grained sediment unit, separated by relatively massive alluvial channel and point bar sandstone units. Limited information suggests that the Kogan Seam has often been eroded by the unconformably overlying Springbok Sandstone, and in some cases the minor coal seams in the Springbok Sandstone may have been misinterpreted as the Kogan Seam in the Juandah Coal Measures. Generally, the Springbok Sandstone consists of an upper sandstone unit, a middle fine-grained unit often containing thin, relatively dirty coal seams, and a lower sandstone unit.

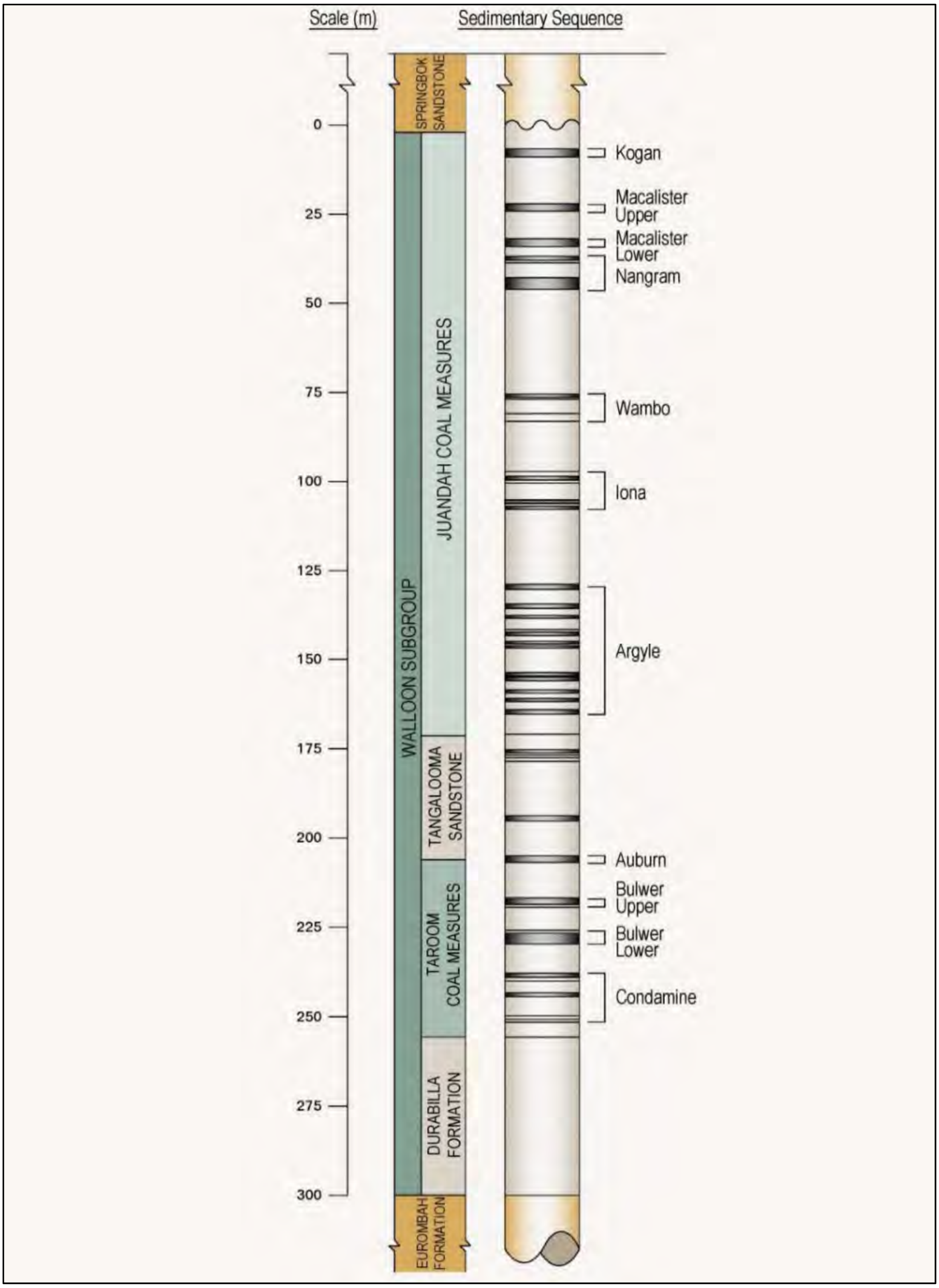

Figure 3-1: Regional Stratigraphy of the Surat Basin

Source Xenith Consulting

3.2.2 Coal Seams

The coal seams in the KCCM area have been informally named into major seams, in descending order K, M, N, O, R, S, T and U (**Figure 3-3**). The M, N and O seams are correlative to the Macalister and Nangram seams; whereas the R, S and T seams are correlative to the Wambo Seam.

The seams have then been further subdivided into plies which represent the mining method which is used in the open cut mine, with the seam correlations made based on geophysical log signatures. A minimum thickness of 0.10 m was used to define a coal seam, with any coaly sections less than 0.10 m incorporated into a parting band and given a stone band name. Any stone bands less than 0.10 m thick were incorporated into the coal seam that existed above or below it.

Odd-numbered plies are the coal bands, while even-numbered plies represent the interburden or parting stone bands. The current resource estimate model has incorporated a "parent-child" relationship and these relationships are present in the lower plies of the M Seam (M9-17), the upper and lower plies of the N Seam (N1-3 and N7-11), all plies of the O Seam (O1-3 and O5-7), and the middle plies of the T Seam (T3-5).

The seams are subdivided as follows, and shown in **Figure 3-2**:

- M Seam consists of plies M1 – M18
- N Seam consists of N1 – N12
- O Seam consists of O1 – O8
- R Seam consists of plies R – RS
- S Seam consists of plies S1 – S6, and
- T Seam Consists of plies T1 – T7.

The geochemical assessment included units from surface to through to the base of the R seam. The coal seams within KCCM show some variation on a ply basis in terms of seam thickness and quality characteristics. Seam splitting and coalescence is common, as is deterioration into stony-coal material over relatively short distances.

Soft tuffaceous mudstone bands do exist within the coal seams or can sometimes be greater than 0.10 m thickness, in which case they are named separately. These soft bands are interpreted to be reworked ash fall tuffs.

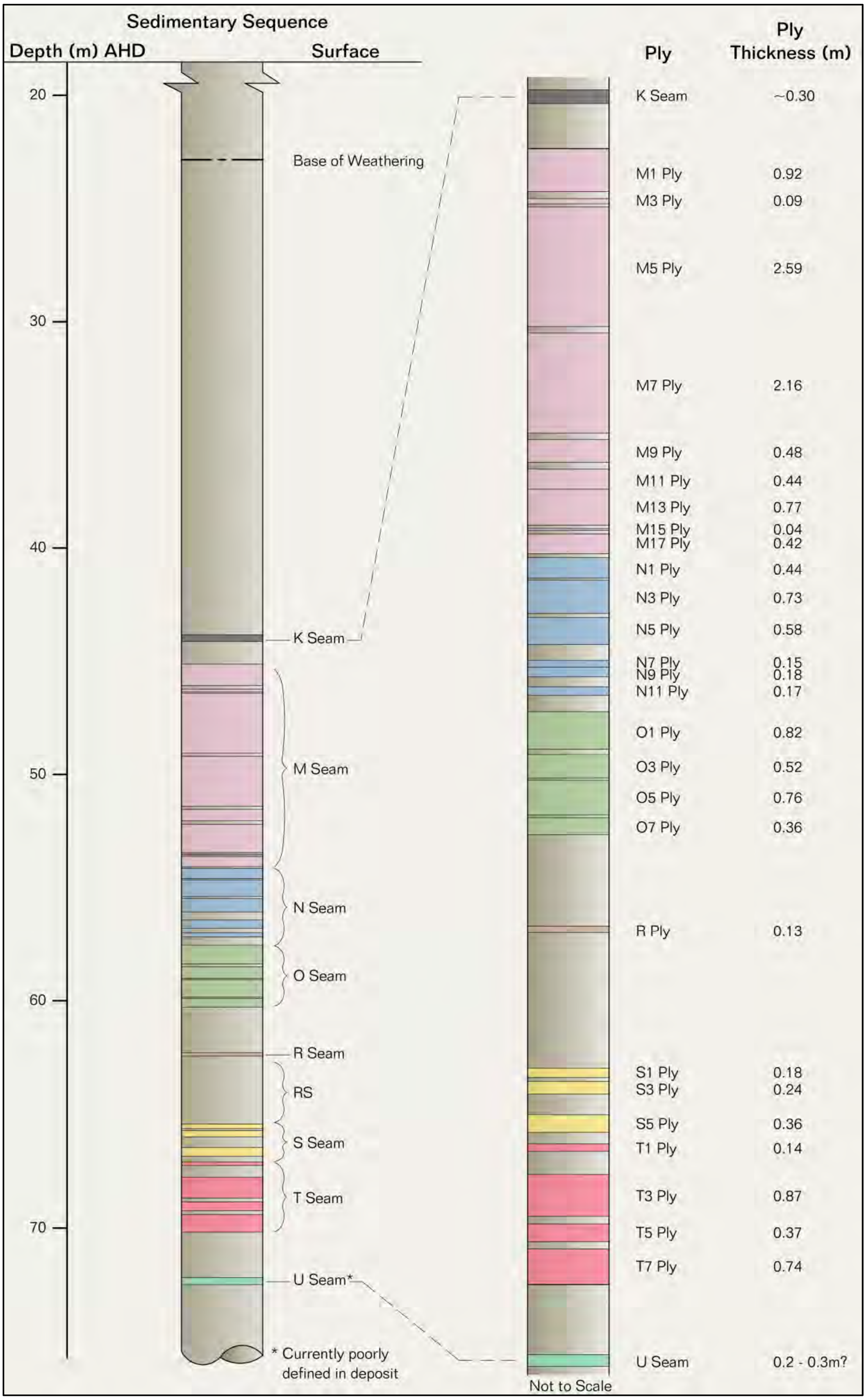

Figure 3-2: Local Stratigraphy of the Kogan Creek Coal Mine

Source Xenith Consulting

3.2.3 Structural Framework

3.2.3.1 Faults

The general structure of KCCM shows a gentle dip to the South with the seams sub-cropping along the northern and eastern margin of the deposit (**Figure 3-3**). Seam dips range from 1 degree up to a maximum of 5 degrees in the vicinity of the interpreted fault lines.

Within the deposit, three major faults have been interpreted with the general North-South trend. These faults are regarded as being a moderate size with throws ranging from 2 m up to 20 m along the western-most fault.

These faults have been interpreted but have not been modelled, as further definition drilling will be required to assist interpretation as to how they may be related to sedimentary washouts.

3.2.3.2 Base of Weathering

The base of weathering has been logged in the majority of the holes within KCCM drilling database. This horizon represents the upper cut-off for the coal seams. Depth of weathering ranges from a minimum of 8 m to a maximum of 42 m in the southeast of the topographical high area.

3.2.3.3 Depth of Cover

Due to the shallow dip of the seams to the South, the general depth of cover to the M Seam increases from the sub-crop zone in the North of the deposit (approximately 15 m) to approximately 60 m at the southern lease boundary (**Figure 3-3**). The overburden thickness is related to the topographic high areas across the deposit.

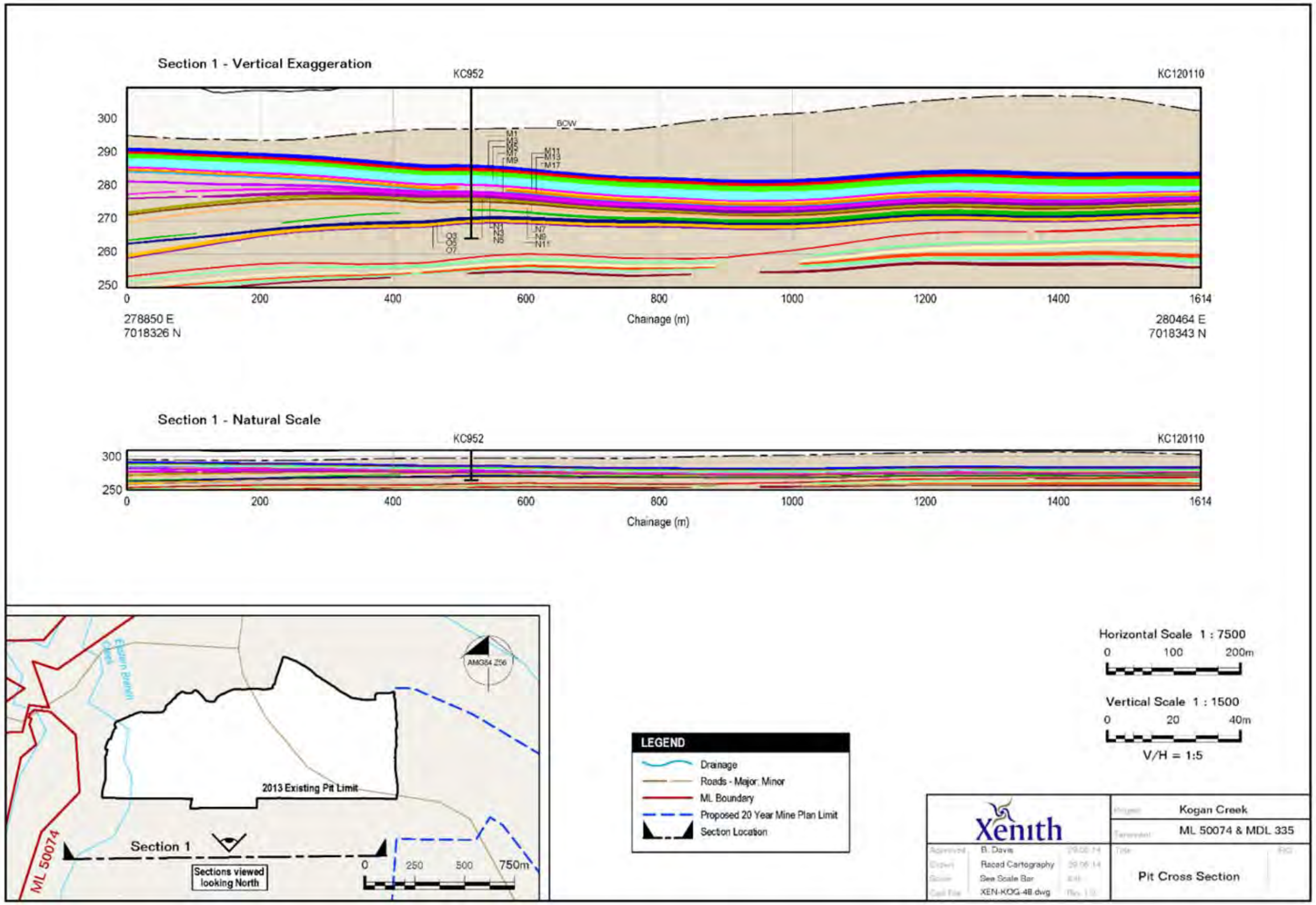

Figure 3-3: Typical Pit Cross Section at Kogan Creek Coal Mine

Source: Xenith Consulting

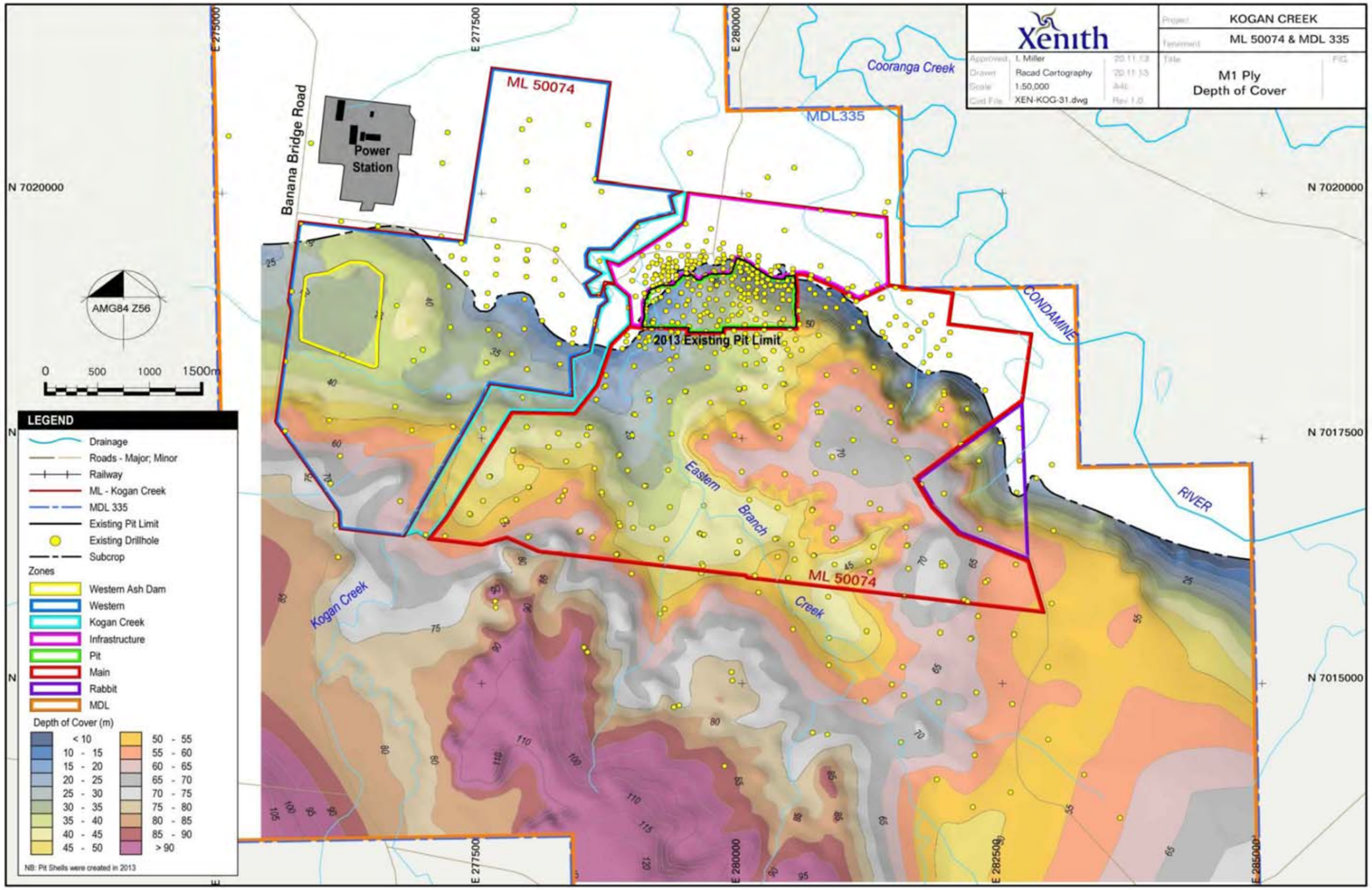

Figure 3-4: Depth of Cover at the Kogan Creek Coal Mine

Source: Xenith Consulting

4 COAL AND ASH

4.1 Coal and Sulfur Geochemistry

Sulfur in coal is derived from two sources that include the original plant materials and ambient fluids in the coal forming environment. Abundance of sulfur in coal is controlled by depositional environments and the diagenesis of the coal seams and overlying strata. Typically low-sulfur coal seams were deposited in an alluvial environment and the peat was not influenced by seawater. The sulfur in these low-sulfur coals is derived mostly from its parent plant materials.

In contrast, high sulfur coal seams are generally associated with marine strata where sulfate in the seawater diffuses into the peat and is reduced by microorganisms to hydrogen sulfide, elemental sulfur and polysulfides. During early diagenesis in a reducing environment, ferric iron is reduced to ferrous iron, which reacts with hydrogen sulfide to form iron monosulfide. Iron monosulfide is later transformed by reaction with elemental sulfur into minerals such as pyrite or marcasite.

Organic sulfur is formed by reaction of reduced sulfur species with the premaceral humic substances formed by bacterial decomposition of the peat. Organic sulfur species in coals are mainly thiols, sulfides, di-sulfides, and thiophene and its derivatives. The thiophenic fraction of organic sulfur increases with the carbon content of coals. Organic sulfur compounds formed in peat are mostly thiols and sulfides, which gradually convert to thiophenes with increasing coal maturation. Thus, the organic sulfur species in coal evolve during the history of coal formation.

At the KCCM site, the depositional environment of the coal in the stratigraphic sequence was an alluvial environment with marginal marine influences at a regional level. The coal is therefore typically low sulfur and is a thermal coal, fed directly into the adjacent power station.

4.2 Ash

4.2.1 Geotechnical

In 1999 geotechnical, geochemical and hydrogeological evaluations of KCCM ash were completed (AGE, 1999). The geotechnical properties of the ash were stated as follows:

- Bulk density of 1.3 to 1.52t/m^3
- Ash moisture content of 23 to 27%
- Permeability of 5 x 10^{-7} to 5 x 10^{-9}m/sec
- 5 to 10% of annual rain likely to infiltrate into the ash impoundment

In 2013 a geotechnical investigation assessed the in-situ and re-compacted geotechnical properties of KCCM OPAC ash storage area (Golding, 2013). Golding investigated the practicality of a long-term ash rehandling operation to eliminate further construction of ash containment structures.

Golding determined that the in-situ ash deposit is predominantly dense, stiff, partly saturated, and essentially not liquefiable, and that in-situ ash is relatively strong, but not strong enough to support direct trafficking by the rigid body trucks currently working at the mine.

Golding also determined that the ash material is primarily fly-ash, a fine globular glassy silicate, but includes other accessory minerals. Some fly-ash particles have hollow inclusions with fluid in-fills, of which a proportion are light enough to float in water and are called cenospheres.

The geotechnical properties of the ash from the Golding study are as follows:

- Dumped dry density of 1.04t/m^3
- Dry density of 1.08t/m^3
- In-situ dry density of 1.17t/m^3
- In-situ moisture content of 29%
- Particle specific density 1.95t/m^3
- Swell (prime to dump) +12.5%
- Slurry bulk density of 1.53t/m^3
- Slurry solids density to OPAC is 65 to 71%
- Beach angle of 2-3%
- Particle density of 1.95t/m^3
- Permeability of 5×10^{-7} to 5×10^{-8}m/sec
- In-situ permeability of 5×10^{-6}m/sec

Figure 4-1: Overview of OPAC

Source: Golding (2013)

4.2.2 Geochemical

In 1999 AGE analysed samples of coal from the M, N and O seams and produced ash from each seam using pilot scale milling and combustion equipment at ACIRL (AGE, 1999). The samples were then analysed for total elemental concentrations and the Toxicity Characteristic Leaching Procedure (TCLP) to evaluate elemental enrichment and potential seepage quality.

Table 4-1 compares the 1999 AGE TCLP data with KCCM TCLP results from 2008 to 2012 and verifies that the results between laboratory assessment and field data are consistent and within a similar low range of concentrations.

The TCLP water quality concentrations are presented alongside ANZECC & ARCANZ (2000) guideline "low risk trigger" values for protection of livestock drinking water quality. Again, these guideline values are provided for context only and are not intended to be interpreted as "maximum permissible levels" for site water storage or discharge. Direct comparison of these results can also be misleading as the TCLP is completed under slightly acidic conditions compared to the typically alkaline pH conditions in ash. Notwithstanding, the only element which has a slightly elevated concentration in TCLP leachate is molybdenum from fly ash.

Table 4-1: TCLP Data (AGE 1999) and KCCM (2007 to 2012)

Parameter/Metal	ASH TCLP Leachate Analysis (mg/L)					
	AGE Study 1999			KCCM Monitoring Data		
	M Seam	N Seam	O Seam	KCCM Fly Ash TCLP data 2008 to 2012	KCCM Bottom Ash TCLP data 2007 to 2012	ANZECC#
pH (Initial)	12	11.7	11.5	11.7	NA	
EC (Initial)	7,360	3,100	2,800	NA	NA	
Aluminium (Al)	4.8	14	11	NA	NA	
Arsenic (As)	0.005	0.026	0.011	< 0.1	< 0.1	0.5
Barium (Ba)	0.5	0.66	0.63	2.4	2.2	-
Beryllium (Be)	<0.01	<0.01	<0.01	< 0.1	< 0.1	-
Boron (B)	3	2.6	1.5	3.6	0.6	5
Cadmium (Cd)	<0.001	0.003	0.001	< 0.05	< 0.05	0.01
Calcium (Ca)	550	380	260	NA	NA	1,000
Chloride (Cl)	7.4	3	4.9	NA	NA	-
Chromium (Cr)	0.07	0.12	0.07	< 0.1	< 0.1	1
Cobalt (Co)				< 0.1	< 0.1	1
Copper (Cu)	<0.05	0.05	0.05	< 0.1	< 0.1	1
Fluoride (F)	<0.1	<0.1	<0.1	NA	NA	2
Iron (Fe)	0.2	0.65	0.59	< 0.1	0.2	-
Lead (Pb)	<0.001	<0.001	<0.001	< 0.1	< 0.1	0.1
Magnesium (Mg)	9.3	9.1	7.3	0.3		-
Manganese (Mn)	0.44	0.44	0.37	NA	0.1	-
Mercury (Hg)	<0.0005	<0.0005	<0.0005	NA	NA	0.002
Molybdenum (Mo)	0.11	0.15	0.11	0.2	NA	0.15
Nickel (Ni)	0.36	0.1	0.11	< 0.1	< 0.1	1
Potassium (K)	1.6	2.4	2.1	NA	NA	-
Selenium (Se)	<0.0005	<0.0005	<0.0005	< 0.1	< 0.1	0.02
Silver (Ag)	0.03	0.03	0.03	< 0.1	< 0.1	-
Sodium (Na)	1,420	1,530	1,620	NA	NA	-
Sulfate (SO^4)	110	90	70	NA	NA	1,000
Thallium (Tl)				< 0.05	< 0.05	-
Uranium (U)	0.007	0.018	0.009	NA	NA	0.2
Vanadium (V)	0.03	0.03	0.01	0.1	< 0.1	-
Zinc (Zn)	0.26	0.31	0.43	< 0.1	< 0.2	20

NA = No data available

\# ANZECC & ARCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water (low risk trigger levels).

Total elemental characterisation of the ash was undertaken by KCCM from 2007 to 2012. The results of the total elemental analyses summarised in **Table 4-2** and **Table 4-3** show that over this period the ash results are consistent, have low element concentrations and a narrow distribution of results verifying that the geochemical properties of the ash have remained consistent over time. KCCM ash data are compared with median soil concentrations and the average concentrations of nine coal samples used in a study on fly ash by ACARP in 2001 (ACARP, 2001).

The data show that KCCM ash major, minor and trace element concentrations are less than median soil concentrations and the ACARP ash values in **Table 4-2** and **Table 4-3**. This provides evidence that KCCM ash "sits" at the lower end of the scale for Australian coal ash when considering major, minor and trace element concentrations[1], with only boron and tin having a total concentration slightly greater than the ACARP average ash concentration values for these elements in fly and bottom ash, respectively.

Table 4-2: KCCM Fly Ash Total Metals by ICP-AES / MS 2008 to 2012

Element	Median soil concentration (mg/kg)	ACARP Average ash concentration (mg/kg)	Minimum (mg/kg)	Average (mg/kg)	Median (mg/kg)	Maximum (mg/kg)
Arsenic (As)	6	14	7	8.6	8	10.1
Barium (Ba)	500	1,694	270	360	310	500
Beryllium (Be)	0.3	13	1	1.1	1.1	1.1
Bismuth (Bi)	-	-	0.5	0.5	0.5	0.5
Boron (B)	20	47	60	60	60	60
Cadmium (Cd)	0.35	0.53	0.2	0.2	0.2	0.2
Chromium (Cr)	70	72	3	4.9	4	8.6
Cobalt (Co)	8	44	2	2.8	3	3.8
Copper (Cu)	30	79	5	7	6	11.1
Lead (Pb)	35	61	6	8.3	8	10.3
Manganese (Mn)	1000	484	27	54	33	92
Mercury (Hg)	-	0.11	NA	NA	NA	NA
Molybdenum (Mo)	1.2	9.8	4	4.7	4.7	5.3
Nickel (Ni)	50	96	2	2.4	2.4	2.7
Vanadium (V)	90	146	33	43.6	39	66
Zinc (Zn)	90	250	18	24.8	24.5	32

NA = No data available

[1] This may be due to variations in the analytical method used in the ACARP work in comparison to the work undertaken by KCCM. For example there are various methods that can be used to measure the "total fraction" such as 2, 3 or 4 Acid digestions methods. Other differences may be that the ACARP study utilised a pilot scale plant to produce ash whereas the KCCM ash is from an operating facility. Nevertheless, the data does verify that KCCM ash has low elemental concentrations.

Table 4-3: KCCM Bottom Ash Total Metals by ICP-AES / MS 2007 to 2012

Element	Average median soil concentration (mg/kg)	ACARP Average ash concentration (mg/kg)	Minimum (mg/kg)	Average (mg/kg)	Median (mg/kg)	Maximum (mg/kg)
Antimony (Sb)	1	2	0.1	0.8	1	1
Arsenic (As)	6	14	1.1	2.2	2.5	2.5
Barium (Ba)	500	1,694	120	210	140	340
Beryllium (Be)	0.3	13	0.5	0.5	0.5	0.5
Bismuth (Bi)	NA	NA	0.1	0.4	0.5	0.5
Boron (B)	20	47	2.5	2.5	2.5	2.5
Cadmium (Cd)	0.35	0.53	0.1	0.4	0.5	0.5
Chromium (Cr)	70	72	1	1	1	1
Cobalt (Co)	8	44	1.0	1.1	1.0	1.4
Copper (Cu)	30	79	2.5	4.0	2.5	6.4
Lead (Pb)	35	61	1.2	2.2	2.5	2.5
Manganese (Mn)	1,000	484	10	38	12	93
Mercury (Hg)		0.11	NA	NA	NA	NA
Molybdenum (Mo)	1.2	10	1.0	2.2	2.5	2.5
Nickel (Ni)	50	96	1.4	25.7	12.0	93.0
Selenium (Se)	0.4	3	0.5	1.5	1.5	2.5
Silver (Ag	NA	NA	1.2	2.2	2.5	2.5
Strontium (Sr)	250	NA	97.9	1,744	1,744	3,390
Thallium (Tl)	9	NA	0.1	0.1	0.1	0.3
Tin (Sn)	4	7	0.6	6	5	17
Vanadium (V)	90	147	2.5	10	5	19
Zinc (Z)	90	161	2.5	3.1	2.5	5.0

NA = No data available

4.2.3 Ash Dam Water Quality

A series of surface water quality datasets were provided by CS Energy and from 2006 to 2014, are summarised in **Table 4-4**. The surface water quality concentrations are presented alongside ANZECC & ARCANZ (2000) guideline "low risk trigger" values for protection of livestock drinking water quality and show slightly elevated maximum values for fluoride, aluminium and molybdenum. Again, these guideline values are provided for context only and are not intended to be interpreted as "maximum permissible levels" for site water storage or discharge.

Table 4-4: KS02 Ash Dam Water Quality 2006 to Oct 2014

Parameter	Unit	LOR	Minimum	Average	Median	Maximum	ANZECC#
pH	pH Unit	0.01	5.3	7.46	7.81	8.90	-
Electrical Conductivity @ 25°C	µS/cm	1	3	991	962	2,120	3,580
Alkalinity by PC Titrator							
Hydroxide Alkalinity (as $CaCO_3$)	mg/L	1	<1	<1	<1	<1	-
Carbonate Alkalinity (as $CaCO_3$)	mg/L	1	4	4	4	4	-
Bicarbonate Alkalinity (as $CaCO_3$)	mg/L	1	12	70	77	129	-
Total Alkalinity (as $CaCO_3$)	mg/L	1	12	71	77	129	-
Major Cations							
Calcium (Ca)	mg/L	1	1	4	4	9	1,000
Magnesium (Mg)	mg/L	1	1	5	5	13	-
Sodium (Na)	mg/L	1	16	229	233	559	-
Potassium (K)	mg/L	1	1	3	2	5	-
Major Anions							
Boron (B)	mg/L	0.05	0.32	0.75	0.62	1.77	5
Chloride (Cl)	mg/L	1	10	160	143	875	-
Fluoride (F)	mg/L	0.1	0.2	0.9	0.7	2.3	2
Sulfate (SO_4)	mg/L	1	1	218	147	537	1,000
Dissolved Metals by ICP-MS							
Aluminium (Al)	mg/L	0.01	0.01	1.08	0.18	6.16	5
Antimony (Sb)	mg/L	0.001	0.001	0.001	0.001	0.001	-
Arsenic (As)	mg/L	0.001	0.002	0.022	0.017	0.062	0.5
Barium (Ba)	mg/L	0.001	0.043	0.081	0.066	0.174	-
Beryllium (Be)	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	-
Cadmium (Cd)	mg/L	0.000	0.0001	0.0001	0.0001	0.0002	0.01
Chromium (Cr)	mg/L	0.001	0.001	0.003	0.002	0.007	1
Cobalt (Co)	mg/L	0.001	0.002	0.002	0.002	0.002	1
Copper (Cu)	mg/L	0.001	0.001	0.004	0.002	0.011	1
Iron (Fe)	mg/L	0.05	0.05	0.72	0.83	1.6	-
Lead (Pb)	mg/L	0.001	0.002	0.003	0.002	0.004	0.1
Manganese (Mn)	mg/L	0.001	0.001	0.007	0.004	0.022	-
Molybdenum (Mo)	mg/L	0.001	0.068	0.167	0.159	0.326	0.15
Nickel (Ni)	mg/L	0.001	0.001	0.003	0.002	0.010	1
Selenium (Se)	mg/L	0.01	0.010	0.019	0.020	0.020	0.02
Zinc (Zn)	mg/L	0.005	0.005	0.065	0.051	0.318	20

ANZECC & ARCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water (low risk trigger levels).

4.2.4 Handling and Placement

In 1999 AGE completed a feasibility study for ash management at KCCM using (1) a dedicated ash emplacement area (AEA) and (2) using in-pit placement. The proposed approach was to utilise a dedicated AEA for 2 years and then utilise in-pit placement that was to include progressive encapsulation of ash under spoil. AGE determined that the in-pit placement of ash within the backfilled SSA would have negligible adverse environmental impacts on groundwater.

In 2013 Golding evaluated and suggested transportation, handling and disposal options for the ash in the in-pit spoil storage areas that could include paddock dumping ash and tip-head dumping with the spoil.

Paddock dumping ash practices were to place the ash at the base of an advancing overburden spoil dump lift so that it was be covered as soon as practicable following placement. Tip-head heights for covering ash were recommended not to exceed 15 m above the base of the placed ash. Spoil windrows at the paddock-dumping level were expected to be useful to delineate the limits of ash placement. In the event of a heavy rainfall event while loose paddock-dumped ash was still exposed, it was thought that the mass could become saturated and softened. This was not expected to adversely impact on tip-head stability, provided that free-draining water had been removed from the basal level at the margins of the ash. A minimum lateral and vertical separating thickness of 10 m of overburden spoil was to be maintained from any medium- to long-term exposed dump surface.

No consideration was given in the Golding report to tip-head dumping of ash material. However their report noted that there is an emerging technology for tip-head co-dumping of paste-consistency CHPP fine and coarse rejects being implemented at several coal mine sites in New South Wales and Queensland. They found that the rehandled ash was stronger than most of the spoil waste at KCCM, so in principle there would be no known geotechnical reasons why tip-head dumping of ash could not take place.

5 METHODOLOGY

This section provides the methodology used for the sampling, geochemical characterisation and classification of representative samples of spoil and ash.

5.1 Investigation Strategy

RGS developed a site-specific investigation strategy to characterise the geochemistry of spoil and ash that will be generated at KCCM. The strategy was developed taking into account Australian (ACARP, 2008; DME, 1995; DITR; 2007; and DEHP, 2013) and international (INAP, 2009) technical guidelines for the geochemical assessment of mine waste materials. The sampling program was based on the expected geological variability and complexity in rock types, potential for significant environmental and/or health impacts, size of operation, sample representation requirements, mine and power station waste volumes, level of confidence in predictive ability, and cost effectiveness.

The investigation strategy focussed on the collection of representative samples of the spoil and ash types that will be generated at KCCM. The sample types used in the RGS assessment were:

- **Overburden** that includes Sandstone, Siltstone and Claystone that will be mined in the open pit and placed in the spoil storage area (**SSA**);
- **Interburden** materials that included major rock types (eg. Sandstone, Siltstone and Claystone) and carboniferous materials such as coal roof and floor and partings that are placed in the spoil storage area (**SSA**), and
- **Ash** that is currently stored in the power station ash emplacement areas (**AEA**) - ie.: IADA or OPAC.

5.2 Sampling Strategy

5.2.1 Spoil

For the collection of spoil samples, the sampling strategy used detailed site-specific exploration and geological data, to allow the targeted collection of representative samples of overburden, interburden, roof, floor and partings including the main rock types from the stratigraphic profile at KCCM. In addition, the strategy was designed to provide a representative distribution of samples from across the proposed mining areas. This combined approach allowed RGS to accurately sample materials that will report as spoil at KCCM operations.

Representative samples of spoil materials were collected from a resource drilling campaign completed in mid-2014 by Xenith Consulting. All drill holes were logged and sampled by a suitably qualified geologist to ensure the collection of representative samples. A total of 145 samples of drill core and drill chip materials were collected from 10 drill holes from the 2014 resource drilling program and included in the geochemical testing program.

The drill hole sampling locations are provided in **Figure 5-1** (AMD Drill holes flagged with red circles) with the drill hole spacing being typically in the range 150 to 200m. The samples represent approximately 6Mm^3 of spoil materials likely to be generated from the next phase of open cut mining. The KCCM deposit has very uniform geology and stratigraphy as evidenced by the mining of approximately 40Mm^3 at the project, to date. This provides additional confidence in the 'representativeness' of the spoil samples collected for the current study.

The location of the spoil samples within each drill hole is in the stratigraphic logs in **Attachment A2** and photographs of the drill core from the drill holes are in **Attachment A2.** The tabulated geochemical results for the 10 holes are provided in **Attachment B.** A range of overburden, interburden, roof, floor and partings samples were included in the geochemical assessment program to represent the spoil that will be excavated and report to the SSA during mining activities, as summarised in **Table 5-1**.

Drill core samples comprised full core taken from targeted drill core depth intervals typically up to 0.5m in length. Drill chip samples typically comprised 1 to 2kg of material stored in plastic sample bags. All samples were stored in a cool dry location until dispatch to Australian Laboratory Services in Brisbane (ALS Brisbane) for geochemical testing.

Table 5-1: Summary of samples used in geochemical assessment program

SAMPLE TYPE	NO. OF SAMPLES	ROCK TYPES (Spoil)	NO. OF SAMPLES
SPOIL		Sand or Clay (topsoil)	14
Overburden (including topsoil)	72	Sandstone	55
Interburden	12	Claystone	56
Coal Seam Roof, Parting and Floor	61	Siltstone	14
ASH		Carb. Mudstone	3
Coal Ash	2	Mixed Lithology	3
Total No. of Samples	147	Total No. of Samples	145

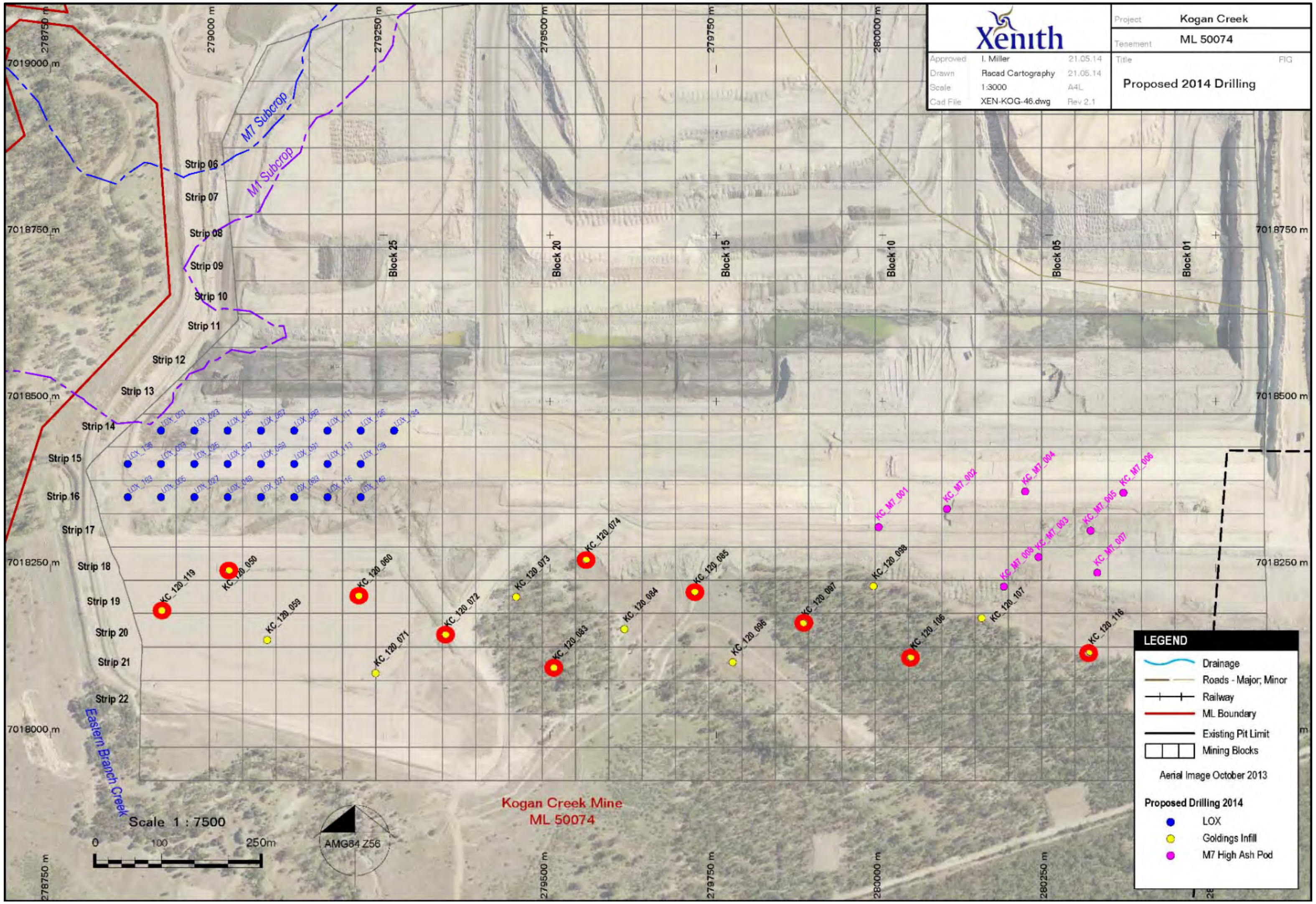

Figure 5-1: Spoil Drill Hole Locations

5.2.2 Ash

For ash, two 20 litre samples of power station ash were collected from the discharge point into the OPAC. One sample was from a drier area adjacent to the spigot and a one sample was wet and collected from the discharge stream (**Figure 5-2**).

Figure 5-2: Ash sample sites

5.3 Geochemical Tests

A series of static and kinetic geochemical tests were completed on the spoil and ash samples. All static geochemical tests were completed by ALS Brisbane laboratory and kinetic leach column (KLC) tests were completed at the RGS 'in house' laboratory, with collected leachate analysed at ALS Brisbane.

The spoil and ash samples received by ALS Brisbane were prepared by crushing (where necessary) and pulverising the samples to ≤75 µm particle size. This standard laboratory procedure provides a homogenous sample, but also generates a large sample surface area in contact with the resultant assay solution, thereby providing greater potential for dissolution and reaction, and represents an assumed initial 'worst case' scenario for these materials.

The geochemical test program was designed to assess the degree of risk from the presence and potential oxidation of sulfides, acid generation and the presence/leaching of soluble metals/metalloids and salts. The assessment also included characterisation of standard soil parameters on selected overburden materials including salinity, exchangeable cations and sodicity. A summary of the parameters used in the geochemical assessment of mine and power station waste materials is in **Attachment A1**.

5.3.1 Static geochemical test methodology

Static geochemical tests provide a 'snapshot' of the geochemical characteristics of a sample material at a single point in time. These tests were staged to screen a large number of samples before selecting either individual and/or composite samples for more detailed static test work. The Acid Base Account (ABA) was used as a screening procedure whereby the acid-neutralising and acid-generating characteristics of a material were assessed. All 145 spoil samples and two ash samples were screened using ABA.

The ABA screening included static geochemical testing for the following parameters:

- pH (1:5 w:v, sample: deionised water) [pH probe and meter]
- Electrical conductivity (EC) (1:5 w:v, sample: deionised water) [EC probe and meter]
- Total sulfur [Leco method]
- Acid neutralising capacity (ANC) [AMIRA, 2002 method].

The results of the screening assessment are discussed in **Section 6**. Where initial ABA screening results indicated that the total sulfur content was greater than average crustal abundance (0.1%) for this element (INAP, 2009), most of these samples were selected for further sulfur speciation testing. A total of 16 samples were tested for chromium reducible sulfur testing (Scr) [AS 4969.7-2008 method].

From the total sulfur (or Scr where available) and ANC results, the maximum potential acidity (MPA) and net acid producing potential (NAPP) of the samples was calculated. Where available, the MPA and NAPP values were calculated using Scr data instead of total sulfur data. Scr data (for fresh samples) generally provides a more accurate representation of the MPA that could theoretically be generated, as acid generation primarily occurs from the oxidation of reactive sulfides (eg. pyrite), whereas total sulfur includes other forms of sulfur such as sulfate and organic sulfur, which in comparison, produce negligible acidity.

After the results of the ABA screening tests were received and interpreted, 19 individual spoil samples (and the two ash samples) were selected, prepared and subjected to multi-element analysis. The samples were selected based on material type, location, lithology and geochemical characteristics. All selected samples underwent multi-element testing on both the solid and soluble fractions for:

- Total alkalinity and acidity (PC titrator measured as $CaCO_3$)(1:5 w:v water extract)
- Total metals/metalloids (Al, As, B, Cd, Cr, Co, Cu, Fe, P, Pb, Mn, Mo, Ni, Sb, Se, Th, U, V and Zn) in solids [HCl and HNO_3 acid digest followed by FIMS and/or ICP-AES/MS]
- Total cations (Ca, Mg, Na and K) [HCl and HNO_3 acid digest followed by ICP-AES/MS]
- Soluble metals/metalloids (Al, As, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Mo, Ni, Sb, Se, Th, U, V and Zn) [ICP-AES/MS and FIMS (1:5 w:v water extracts)]
- Major cations (Ca, Mg, Na and K) [ICP-AES/MS (1:5 w:v water extracts)]
- Major anions (F – coal ash only), Cl, SO_4 and PO_4) [discrete analyser and PC titrator (1:5 w:v water extracts)].

Nine (9) of the 19 selected spoil samples described above were subjected to an Exchangeable Cation test to measure exchangeable Ca, Mg, Na and K. Exchangeable cation data was then used to evaluate the potential 'soil quality' and sodicity of materials represented by these samples. From the results of the exchangeable cation test, the Effective Cation Exchange Capacity (eCEC) and Exchangeable Sodium Percentage (ESP) were calculated.

For the two power station waste (coal ash) samples, the range of geochemical tests described above was supplemented by additional geochemical tests, appropriate for a coal ash material, including:

- Total organic carbon [inorganic carbon digestion followed by LECO analyser]
- Multi-element analyses in solids (those elements listed above plus Ba, Be, Ag, Tl, Sn and Ti, [HCl and HNO_3 acid digest followed by ICP-AES and/or ICP-MS, where required]
- Total and soluble mercury (Hg) [FIMS method]
- Soluble hexavalent and trivalent chromium [alkaline digest + discrete analyser]
- Nitrogen compounds (in both solid and soluble forms): ammonia (NH_4), total kjeldahl nitrogen (TKN), nitrate (NO_3), nitrite (NO_2), total nitrogen and cyanide (CN) [discrete analyser and segmented flow analyser]
- Total and dissolved (soluble) phosphorus [discrete analyser]
- Radionuclide activity: Gross alpha, gross beta and potassium-corrected gross beta in water [ASTM D7283 - liquid scintillation counting method]
- Total Dissolved Solids (1:5 w:v at 180^{o}C)
- Moisture Content (1:5 w:v at 103^{o}C)
- ASLP bottle leach procedure using deionised water [AS 4439.3-1997] to simulate multi-element solubility under neutral pH conditions. Soluble multi-element analyses included (Al, As, B, Cd, Cr, Co, Cu, Fe, Pb, Mn, Mo, Ni, Sb, Se, Th, U, V and Zn) [ICP-AES/MS].

The static geochemical test work program is summarised in **Table 5-2**.

Table 5-2: Summary of Static Geochemical Test Program

Geochemical Tests	Spoil	Ash
pH, EC, total sulfur, ANC	145 samples	2 samples
Scr	16 samples	2 samples
Multi-elements in solids	19 samples	2 samples
Exchangeable cations	9 samples	-
Soluble multi-elements and major ions in water extracts	19 samples	2 samples
Various additional geochemical tests for ash	-	2 samples

Summary results tables for the static geochemical test program are provided in **Attachment B**. The ALS test results for the static geochemical test program are in **Attachment C**.

5.3.2 ABA Classification Method

The ABA test data was used to classify the acid forming nature of the spoil and ash materials. These classification criteria generally reflect Australian (DITR, 2007) and international (INAP, 2009) guideline criteria for classification of mine waste materials. **Table 5-3** provides a summary of the classification criteria used by RGS to geochemically classify the sample materials.

Table 5-3: Geochemical Classification Criteria for Spoil and Ash Materials

Geochemical Classification	Total Sulfur or Sulfide Sulfur[1] (%)	NAPP (kg H_2SO_4/t)	ANC:MPA Ratio
Non-Acid Forming – Barren[2]	≤ 0.1	-	-
Non-Acid Forming	> 0.1	≤ 0	≥ 2
Uncertain[3]	> 0.1	> - 5 and ≤ +5	<2
Potentially Acid Forming-Low Capacity	> 0.1	> +5 and ≤ +10	<2
Potentially Acid Forming	> 0.1	> +10	<2

Notes:
1. If total sulfur or sulfide sulfur is less than or equal to 0.1 %, the NAPP and ANC:MPA ratio are not required for material classification as the sample is essentially barren of oxidisable sulfur.
2. A sample classified as NAF can be further described as 'barren' if the total sulfur and/or sulfide sulfur content is less than or equal to 0.1 per cent, as the sample essentially has negligible acid generating capacity.
3. Samples that fall outside the stated NAF and PAF classification categories based on the criteria provided are classified as Uncertain.

5.3.3 Kinetic geochemical test methodology

Following receipt and interpretation of the static geochemical test results for spoil and ash materials, nine Kinetic Leach Column (KLC) tests were completed on various samples of these materials at the RGS 'in-house' laboratory in Brisbane.

Approximately 1-2 kg of each selected sample was accurately weighed and used in the KLC tests with the weight varying according to the sample bulk density. Heat lamps were used on a daily basis to simulate sunshine, increase surface temperature and ensure that the KLC test materials dried and were subject to oxidising conditions between leaching events (essentially an assumed 'worst case' scenario for sulfide oxidation and potential acid/salt generation). A description of the KLC test methodology and schematic of the KLC test arrangement are provided in **Attachment A1**.

The KLC test material for spoil consisted of crushed drill core material passing through a nominal 5-10 mm sieve size. The (dry) ash sample was used in the KLC tests on an 'as received' basis. Approximately 1 litre of deionised water was accurately weighed and slowly added to the top of each KLC sample, and allowed to free-drain through the solids. The nine KLC tests commenced on 14 October 2014 and were operated under a monthly watering and leaching regime for a 26 week test period (ie seven leaching events) until 14 March 2015.

All leachate samples collected from the KLC tests were sent to ALS Brisbane laboratory for analysis of various parameters including:

- pH and EC [PC titrator]
- Alkalinity and Acidity [PC titrator]
- Soluble metals and metalloids (Al, Fe, Sb, As, Ba, Be, B, Cd, Cr, Co, Cu, Pb, Mn, Mo, Ni, Se, Ag, Tl, Th, Sn, Ti, U, V, Zn) [by ICP-MS]
- Dissolved mercury [FIMS method]
- Dissolved hexavalent chromium [discrete analyser]

- Major cations (Ca, Mg, K, Na) [by ICP-AES]
- Dissolved sulfate - turbidimetric [discrete analyser]
- Dissolved chloride and fluoride [discrete analyser and PC titrator]
- Nitrogen compounds: ammonia (NH_4), total kjeldahl nitrogen (TKN), nitrate (NO_3), nitrite (NO_2), total nitrogen and total cyanide (CN) [by discrete analyser and segmented flow analyser]
- Dissolved phosphate (measured as ‘total phosphorous’ in nutrient form by discrete analyser).

6 SPOIL CHARACTERISATION AND CLASSIFICATION

An explanation of the methodology used geochemically characterise and classify the 145 spoil samples including a description of the ABA screening method, is provided in **Section 5.3**, and a glossary of terms and acronyms used is listed on **Page vii**. The data trends are discussed in this section and presented in **Figure 6-1** to **Figure 6-9** and **Table 6-1**.

6.1 pH and EC

The hydrogen ion concentration (**pH**) of the deionised water used in the pH tests is typically in the pH range 5.0 to 6.5. The **pH$_{1:5}$** of the 145 samples spoil ranges from pH 4.6 to pH 9.9 and has a slightly alkaline numerical average pH of 8.1 (**Figure 6-1**).

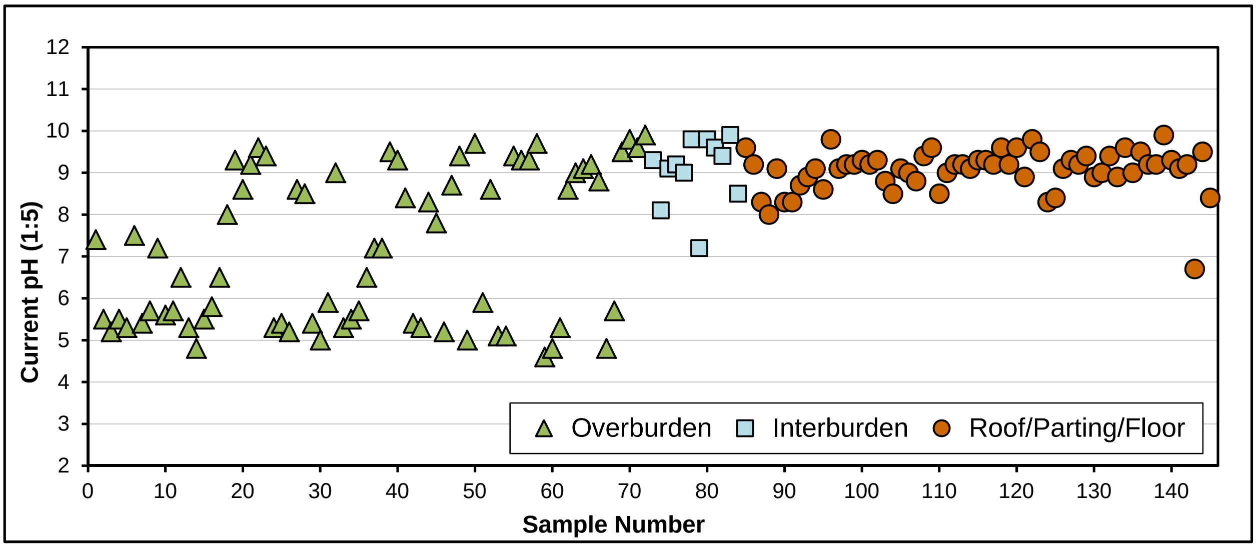

Figure 6-1: pH results for spoil

The data in **Figure 6-2** show three broad groups of samples with similar pH values:

- from 0 to 24m depth interval there is a group of samples that include topsoil, subsoil and weathered overburden all from above the pre-mining water table characterised by pH of 4.8 to 5.9.
- from 0 to 24m depth there is also a group of samples with a pH in the range of 6.5 to 7.8. These particular samples include soil from 0 to 10m depth dominated by sand and clay, as well as six samples of overburden and interburden.
- from 10 to 58m depth there is a group of samples including overburden and interburden and roof, floor and partings characterised by pH values in the range of 8.0 to 9.9.

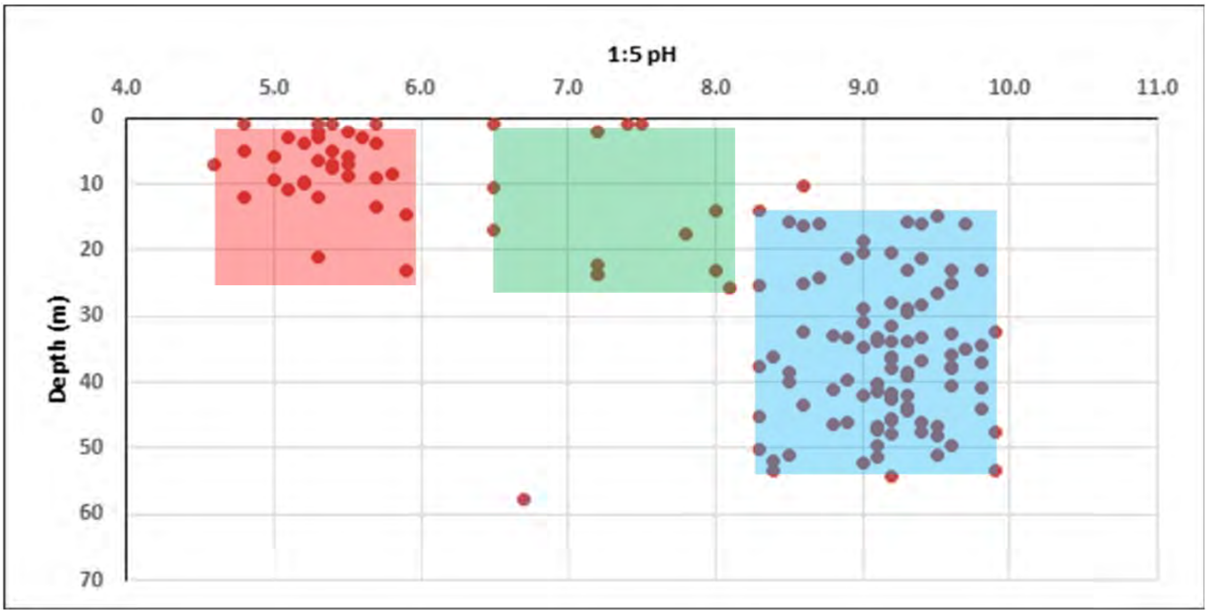

Figure 6-2: pH results by depth for spoil

The optimum soil pH for the majority of agronomic field, pasture, vegetable and fruit crops in Australia is pH 5 to 7, with most plants able to grow in soils at pH 5.5 to 6 (Hazleton and Murphy, 2007). The soils and non-consolidated weathered overburden above the pre-mining groundwater table at KCCM therefore have a pH within the range required to support agronomic and pasture species (**Figure 6-2**).

The electrical conductivity (**$EC_{1:5}$**) of the spoil samples ranges from 14 to 3,140 µS/cm and has a low average value of 213µS/cm. One spoil sample has an EC value greater than 2,000µS/cm and represents a composite sand (drill chip) overburden material sampled from drill hole MC5019 (H10) at 46-60m depth (**Figure 6-3**).

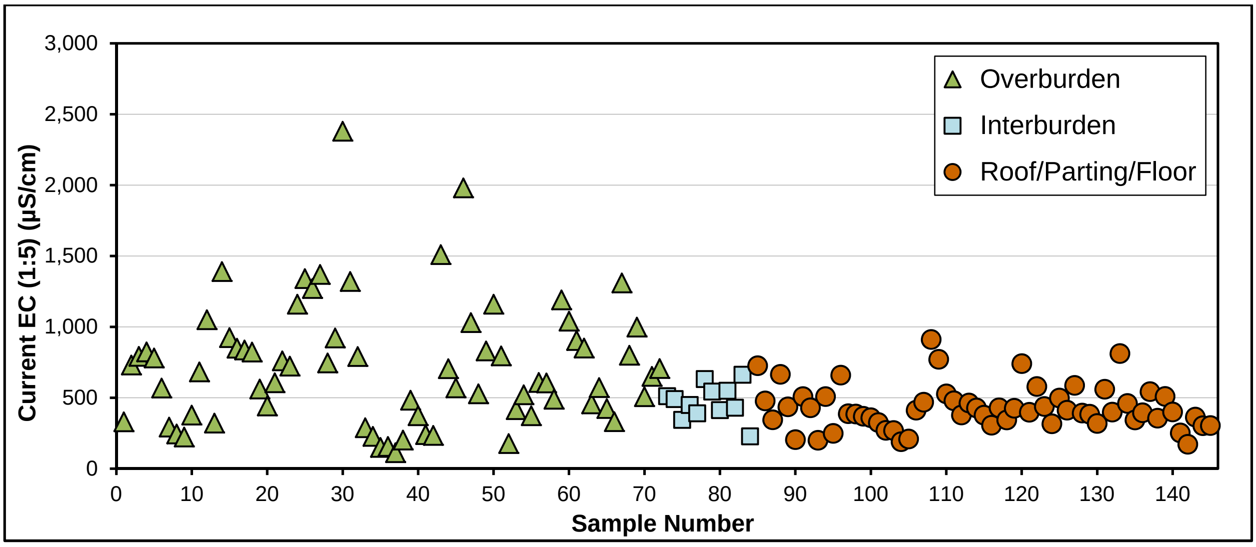

Figure 6-3: EC results for spoil

The data in **Figure 6-4** show two broad groups of samples with similar EC values:

- from 0 to 18m depth interval there is a group of samples that includes topsoil, subsoil and weathered overburden from above the pre-mining water table, characterised by EC values of 149 to 2,380µS/cm; three of these are outside the shaded area on **Figure 6.4**, with anomalous EC values of 1,510, 1,980 and 2,380µS/cm.

- from 18 to 58m depth interval there is a group of samples including overburden and interburden and roof, floor and partings that are characterised by an EC range of 112 to 911µS/cm.

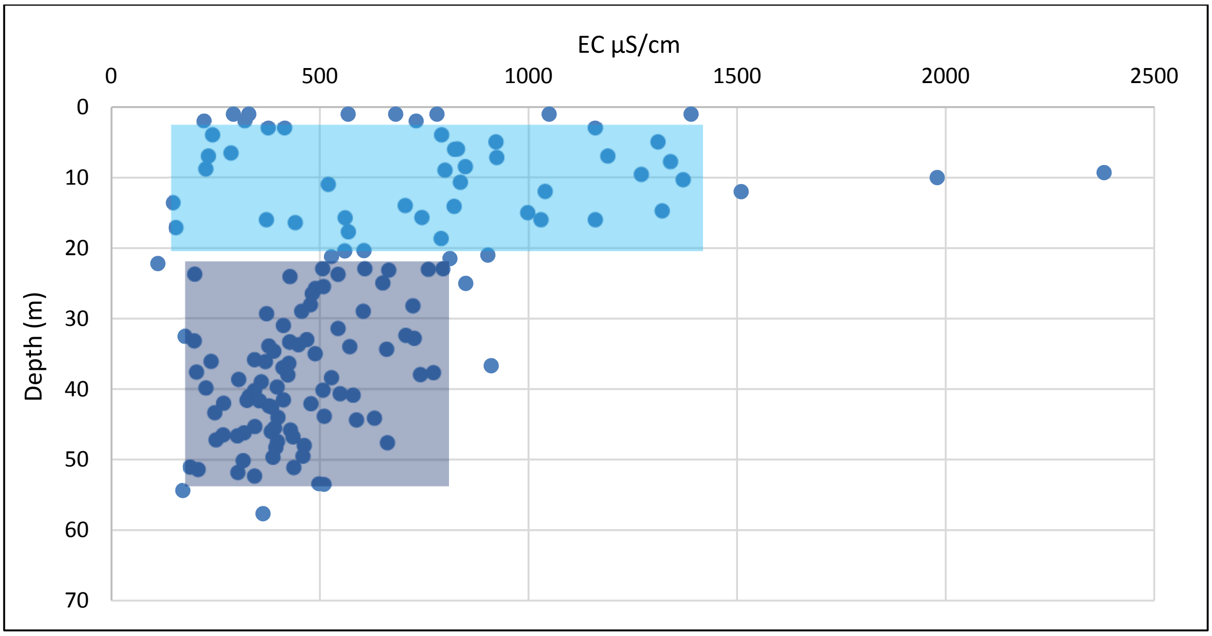

Figure 6-4: EC results by depth for spoil

The EC data collectively ranges from 112 to 2,380µS/cm. Hazelton and Murphy (2007) define soils with an EC of < 2000µS/cm as having negligible effects on agronomic plants, but that at EC values of 2,000 to 4,000µS/cm yields of sensitive crops could be affected. Spoil and interburden below 10m depth is dominated by moderate to strong alkalinity and low EC values. The alkaline pH will provide some buffering against acid generation by any sulfide minerals. Sulfide mineral concentrations at KCCM are very low and discussed in the following sections.

The complete pH and EC results are provided in **Attachment B (Table B1)** and the ALS certificates of analysis are provided in **Attachment C**.

6.2 Acid Base Account

Sulfur: The total sulfur (**S**) content of the 145 spoil samples ranges from < 0.02% to 0.47%, and has a median value of 0.04%S, which is low compared to the average crustal abundance (0.1 %) for this element (INAP, 2009). Materials with total sulfur content less than or equal to 0.1%S are essentially barren of sulfur, and generally represent background concentrations, since they have negligible capacity to generate acidity through sulfide oxidation.

Sulfide Sulfur (**Scr**) analysis was undertaken on 16 of the 145 spoil samples to quantify the proportion of the S present as Scr. All of the 16 samples tested had Scr values significantly less than the S values (ie. below the 1:1 S to Scr ratio). This indicates that much of the sulfur is likely to be present as non-reactive forms of sulfur such as organic sulfur and sulfate which, in comparison to a reactive sulfur form such as pyrite, have negligible capacity to generate acidity if exposed to oxidising conditions (**Figure 6-5**) (overleaf).

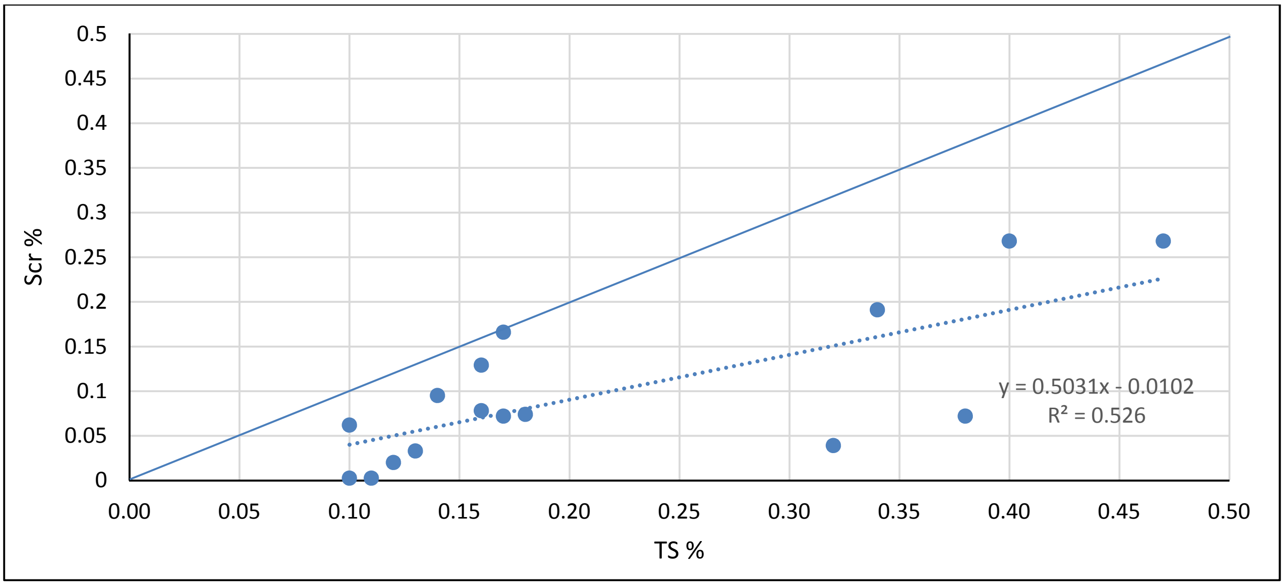

Figure 6-5: Correlation between S and Scr in spoil

Figure 6-6 shows a plot of the sulfide sulfur content of the 245 spoil samples where Scr has been used instead of total sulfur, for the 16 samples where this information is available. Most of the spoil samples (96.5%) have sulfide sulfur content less than or equal to 0.1%S and none of samples have sulfide sulfur content greater than 0.3%S. The five samples with sulfide sulfur concentrations slightly above the background concentration in soil for this parameter represent coal seam parting and floor samples.

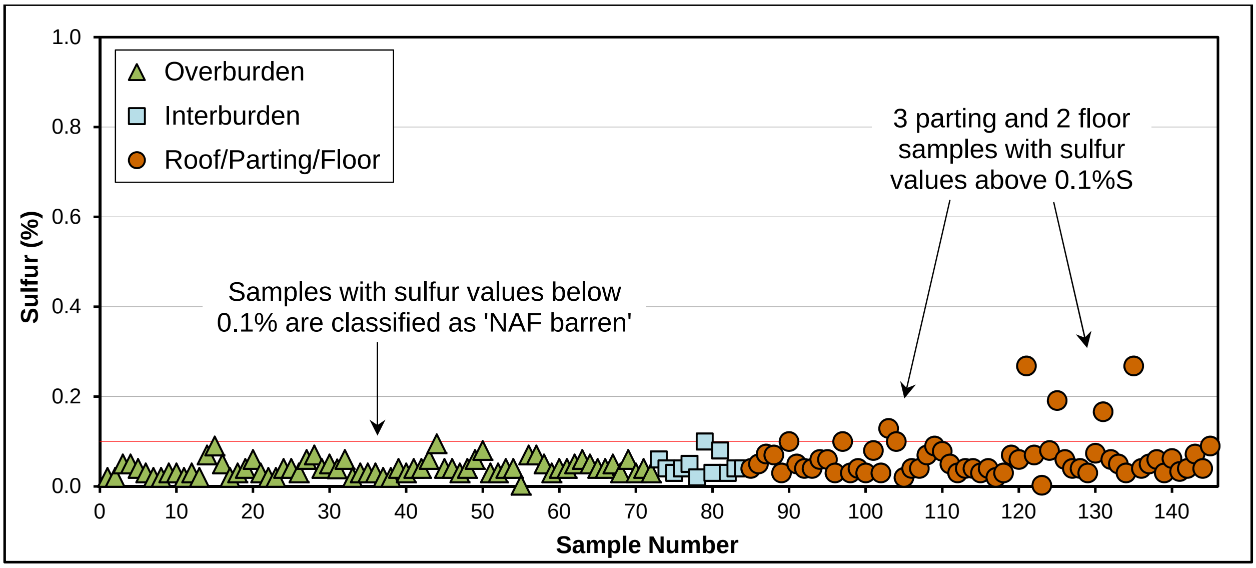

Figure 6-6: Sulfide Sulfur Results for spoil

MPA and ANC: The maximum potential acidity (**MPA**) of the 145 spoil samples ranges from 0.08 to 8.2kgH_2SO_4/t, and is very low with a median value of 1.2kgH_2SO_4/t. The acid neutralising capacity (**ANC**) of the spoil samples ranges from 0.3 to 201 kg H_2SO_4/t and has a median value of 6.9kgH_2SO_4/t (ie. many times greater than the median MPA). The MPA and ANC results for the spoil samples in **Figure 6-7** (overleaf) clearly show that the ANC significantly exceeds the MPA for most of the samples.

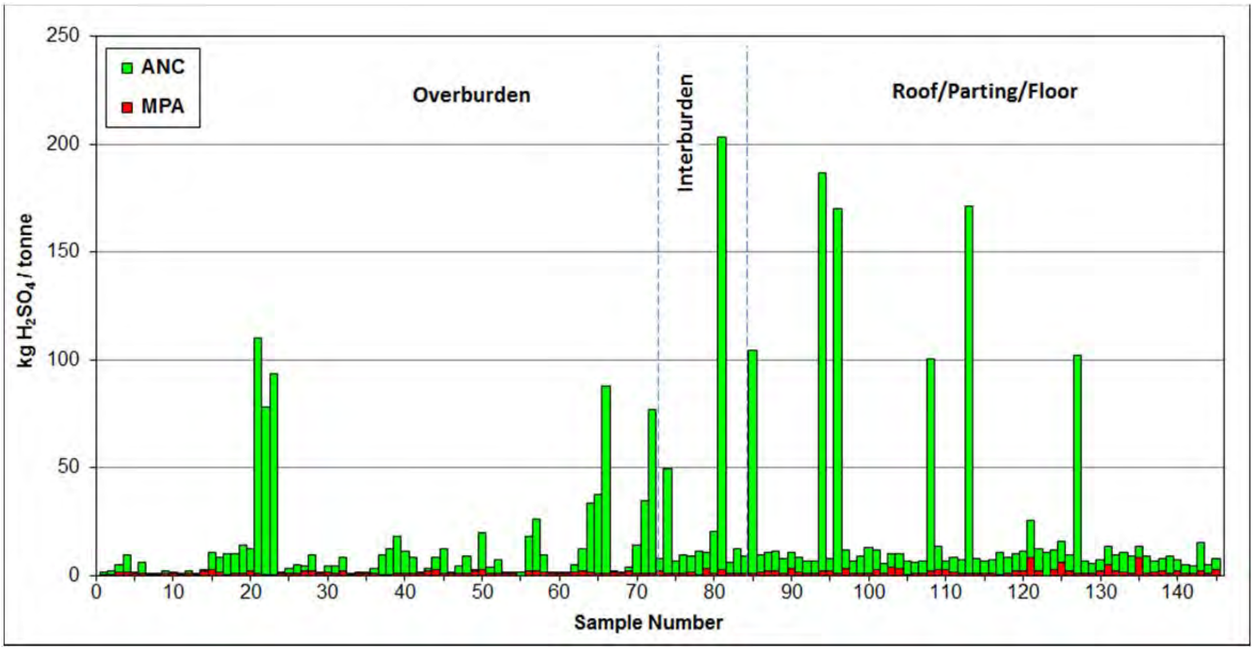

Figure 6-7: MPA and ANC results for spoil

NAPP: The net acid producing potential (**NAPP**) is the balance between the capacity of a sample to generate acidity (MPA) minus its capacity to neutralise acidity (ANC) as shown in **Figure 6-8**. The calculated NAPP value for the samples ranges from -198 to +2.9kg H_2SO_4/t and has a negative average value of -15kgH_2SO_4/t. The NAPP data illustrates that the vast majority of spoil samples have NAPP values that are strongly negative or close to zero.

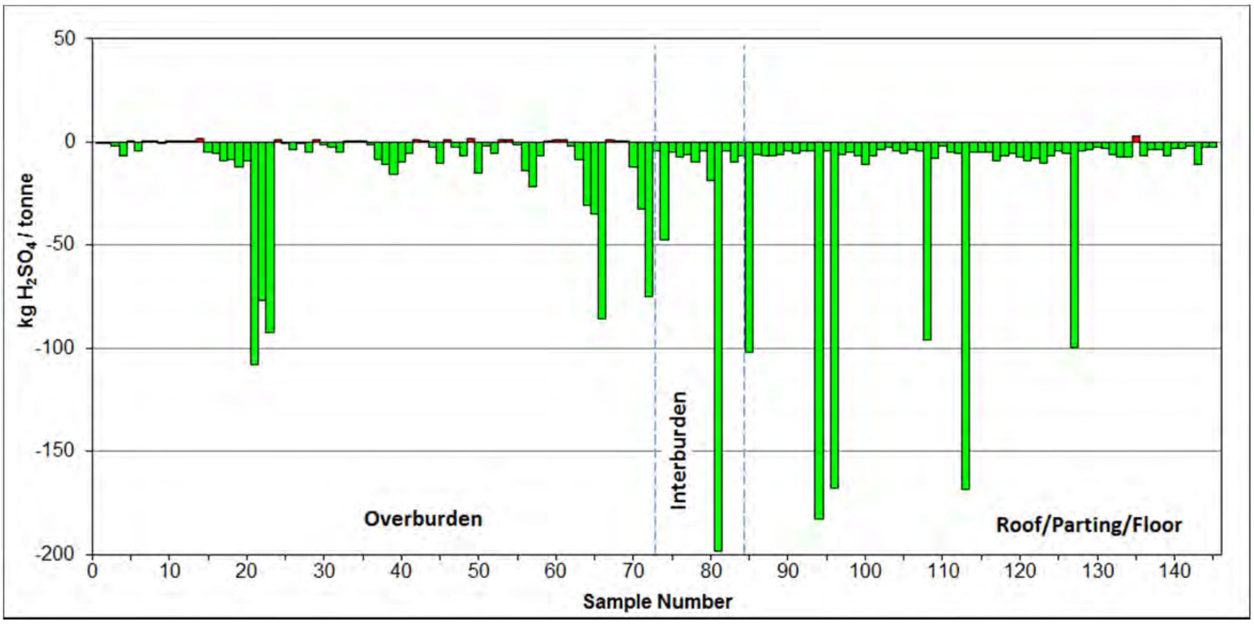

Figure 6-8: NAPP results for spoil

6.2.1 Spoil Classification

The ANC:MPA ratio of the spoil samples ranges from 0.12 to 184 and is typically elevated (median 4.5). In simplistic terms, this means that the ANC is substantially greater than the small amount of MPA that could theoretically be generated from the spoil samples.

Figure 6-9 shows a plot of ANC versus MPA for the spoil samples. ANC:MPA ratio lines have been plotted on the graph to illustrate the factor of safety associated with the samples, in terms of risk and potential for generation of Acid and Metalliferous Drainage (AMD).

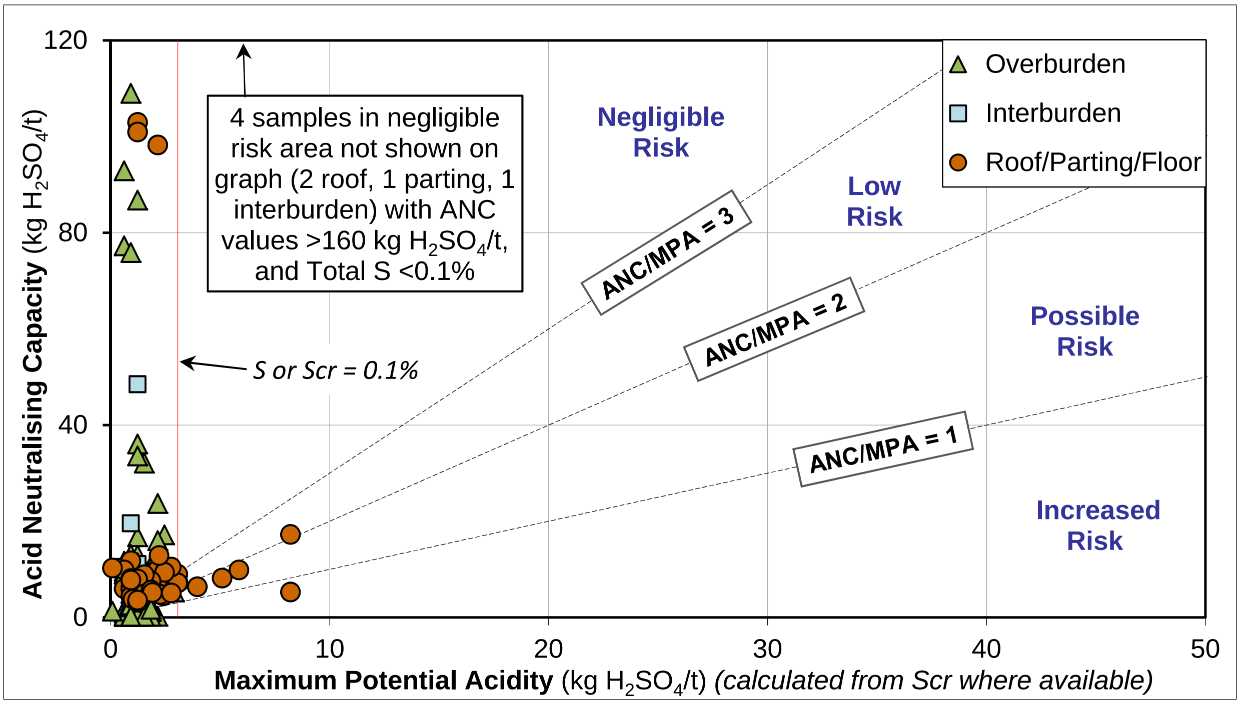

Figure 6-9: ANC:MPA ratio for spoil

Generally those samples with a sulfide sulfur content of <0.1%S and an ANC:MPA ratio of greater than 2 are considered to represent material with a low to negligible risk of acid generation and a high factor of safety in terms of potential for AMD (DITR, 2007; INAP, 2009).

The majority of the samples fall within the negligible and low risk domains in the graph and therefore have a high factor of safety and very low risk of acid generation. Given the typically low sulfide sulfur content of the materials, the risk of generating any significant AMD and/or neutral mine drainage (NMD) from bulk spoil materials is negligible. None of the 145 spoil samples have a significantly positive NAPP value (ie. all less than 3kgH_2SO_4/t).

The ABA test data presented in **Attachment B (Table B1)** and discussed in this section has been used to classify the acid forming nature of the spoil materials. **Table 6-1** provides a summary of the criteria used by RGS to classify the net acid producing potential of the samples and a breakdown of the number of samples in each classification category by material type.

The results in **Table 6-1** verify that 141 samples (97.2%) of the 145 samples tested fall in the Non-Acid Forming-Barren (NAF-Barren) and Non-Acid Forming (NAF) geochemical classification categories, due to very low sulfur content and/or elevated ANC.

The remaining 2.8% of the spoil samples are classified as Uncertain. It should be noted that the four spoil samples classified as Uncertain have relatively low sulfide sulfur contents (less than 0.3%S), low NAPP values and therefore individually, have very limited capacity to generate any significant acidity. None of the samples testes are classified as Potentially Acid Forming (PAF).

Spoil materials will be well mixed at the in-pit SSA and bulk spoil materials will be dominated by NAF materials with excess ANC.

Table 6-1: Geochemical Classification of Spoil Materials

Geochemical Classification	Total Sulfur or Sulfide Sulfur[1] (%)	NAPP (kgH_2SO_4/t)	ANC/ MPA Ratio	No. of Samples	% of Samples
NAF – Barren[2]	≤ 0.1	-	-	140	96.5
NAF	> 0.1	≤ 0	≥ 2	1	0.7
Uncertain[3]	> 0.1	> - 5 and ≤ +5	<2	4	2.8
PAF-LC	> 0.1	> +5 and ≤ +10	<2	0	0
PAF	> 0.1	> +10	<2	0	0

Notes:
1. If total sulfur or sulfide sulfur is less than or equal to 0.1%S, the NAPP and ANC/MPA ratio are not required for material classification as the sample is essentially barren of oxidisable sulfur.
2. A sample classified as NAF can be further described as 'barren' if the total sulfur and/or sulfide sulfur content is less than or equal to 0.1%S, as the sample essentially has negligible acid generating capacity.
3. Samples that fall outside the stated NAF/PAF classification categories based on the criteria provided are classified as Uncertain.

Overall, from an ABA perspective, the **spoil materials** represented by the samples tested can be regarded as **NAF**. Most sample materials also have significant excess ANC that should be available to more than adequately buffer the negligible amount of acidity that could theoretically be produced from a very small proportion of these materials. Therefore, these materials have a **high factor of safety** and a **negligible risk of acid generation**.

6.3 Major, Minor and Trace Element Concentrations and Leaching Potential

A brief description of the methods used to evaluate the potential for the spoil materials to produce metalliferous drainage and a summary of the results is provided in this section.

6.3.1 Element Concentrations

Multi-element scans were carried out on 19 selected individual and composite samples of spoil to identify any elements (metals/metalloids) present in these materials at concentrations that may be of environmental concern with respect to materials handling, storage, and water quality. The identity of the 19 selected samples is provided in **Table B2** (**Attachment B**). The results were compared to potentially relevant guideline criteria to determine any concerns related to mine operation and final rehabilitation. To provide relevant context, RGS has compared the total metal/metalloid concentration in samples to National Environmental Protection Council (NEPC) Health-based Investigation Levels (HIL(C)) for soils in public open spaces (NEPC, 2013).

The results from multi-element testing (total metals/metalloids) of the 19 selected samples are provided in **Table B3 (Attachment B)** indicate that the spoil materials typically have low total metal and metalloid concentrations in solids, mostly below the laboratory limit of reporting (LoR) and all below the applied NEPC (HIL(C)) guideline for soils.

6.3.2 Element Enrichment

To provide additional context and in line with mining industry guidelines (DITR, 2007; INAP, 2009), the multi-element results described in **Section 6.3.1** were also compared to the average background concentration (average crustal abundance) of those elements (metal/metalloids) in soil and rock. From this comparison, a geochemical abundance index (GAI) was calculated.

The GAI quantifies an assay result for a particular element in terms of the average crustal abundance for that element. The index, based on a log (2) scale, is expressed in seven integer increments (0 to 6), which correspond to enrichment factors from 0 to over 96 times average crustal abundance, as shown in **Table 6-2**.

Table 6-2: Geochemical Abundance Index (GAI) values and Enrichment Factor

GAI	Enrichment factor	GAI	Enrichment factor
0	Less than 3-fold enrichment	4	24 – 48 fold enrichment
1	3 – 6 fold enrichment	5	48 – 96 fold enrichment
2	6 – 12 fold enrichment	6	Greater than 96 fold enrichment
3	12 – 24 fold enrichment		

As a general rule, a GAI greater than or equal to 3 indicates enrichment to a level that may warrant further investigation. This is the case with some environmentally important 'trace' elements, such as As, Cd, Cu and Zn, rather than with major rock-forming elements, such as Ca, Mg, K and Na.

Elements identified as enriched may not necessarily be a concern for revegetation, drainage water quality or public health, but their significance should still be evaluated. Similarly, because an element is not enriched does not mean it will never be a concern, because under some conditions (eg. low pH) the solubility of common environmentally important elements such as Al, Cu, Cd, Fe, Ni and Zn increases significantly.

The GAI results presented in **Table B4** (**Attachment B**) demonstrate that all 19 spoil samples tested have GAI values less than 3 for all elements, thus verifying that the spoil has low elemental enrichment. The spoil materials will be well mixed at the SSA and bulk spoil materials will not be significantly enriched with any elements compared to average crustal abundance.

The initial solubility of metals/metalloids in water extracts from spoil materials is discussed in **Section 6.3.3,** and the longer term solubility is discussed in terms of kinetic leach column (KLC) test results in **Section 8**.

6.3.3 Element Leaching Potential

RGS has compared the multi-element results in water extracts from the 19 spoil samples described in **Sections 6.3.1** and **6.3.2** with Australian guidelines and relevant receiving water quality criteria in **Table B5** (**Attachment B**).

It should be recognised that direct comparison of geochemical data with guideline values can be misleading. For the purpose of this study, guideline values are only provided for broad context and should not be interpreted as arbitrary 'maximum' values or 'trigger' values. Using sample pulps (ground to passing 75µm) provides a very high surface area to solution ratio, which encourages mineral reaction and dissolution of the solid phase. As such, the results of screening tests on water extract solutions represent an assumed 'worst case' scenario for undiluted leachate from overburden materials. Actual runoff and/or seepage water quality from overburden emplacement areas would be better than the multi-element results due to the less optimum conditions for leaching, and the significant dilution from fresh rainfall runoff. The results are therefore not representative of site drainage water quality.

The pH of the water extracts ranges from pH 5 to 10 (numerical average of 8.5) and is typically above the pH range of the deionised water used in the water extract tests (ie. pH 5.0 to 6.5). This indicates that these materials are likely to contribute alkalinity to contact water. This conclusion is supported by the total alkalinity results for the water extracts, which range from 3 to 444mg/L (median 158mg/L).

The EC in the water extracts is typically low, ranging from 236 to 925µS/cm (median 452 µS/cm). This confirms that these materials exhibit low salinity and low concentrations of dissolved solids when in contact with water. The dominant major cation in the water extracts is sodium, and the dominant major soluble anions are typically chloride, bicarbonate and sulfate. The median soluble sulfate concentration (35mg/L) is substantially below the applied livestock water quality guideline criterion (1,000mg/L) for this parameter.

The concentration of most trace metals/metalloids tested in the 19 water extracts is below the laboratory limit of reporting (LoR) and below the applied water quality guideline criteria (ANZECC & ARCANZ, 2000). The concentrations of aluminium (2 samples), arsenic (12 samples), boron (2 samples), copper (2 samples) and zinc (3 samples) were occasionally above ANZECC & ARCANZ, 2000 freshwater guideline trigger values for 95% species protection. However, only one of these samples had an arsenic concentration slightly greater than the applied livestock drinking water guideline (0.5mg/L). The median arsenic concentration (0.032mg/L) in the water extracts is more than two orders of magnitude less than the applied livestock drinking water guideline for this element.

It should be noted that the slightly elevated concentrations of a few elements in water extracts from a few samples represent a "worst case" scenario in that all samples are crushed and pulverised to less than 75µm before analytical testing commences at ALS laboratory. Consequently, the sample particles have a significantly larger surface area for potential reaction and leaching than for materials in a field situation.

Overall, the leachable metal results in **Attachment B (Table B5)** indicate that dissolved metal/metalloid concentrations in the initial surface runoff and seepage from spoil materials at the SSA is unlikely to significantly impact upon the quality of surface and groundwater resources.

The ALS laboratory certificates for the multi-element analysis of the samples are provided in **Attachment C**.

6.4 Effective Cation Exchange Capacity and Sodicity

In order to evaluate the potential 'soil quality' of spoil materials at KCCM, the effective cation exchange capacity and exchangeable sodium percentage was investigated for nine individual spoil samples selected to best represent materials that will report to the SSA. The results are provided in **Table B3** (**Attachment B**).

6.4.1 Effective cation exchange capacity (eCEC)

The eCEC of the nine selected spoil samples ranges from 11.5 to 50.7meq/100g. The median value of 21.5meq/100g is within the moderate range for agricultural soils (**Table 6-3**) (Hazelton and Murphy, 2007). These results suggest that from a revegetation viewpoint, most spoil materials will provide a reasonable growth medium for vegetation roots, without the need for fertiliser addition.

Table 6-3: Ratings for Effective Cation Exchange Capacity

eCEC Rating	CEC (meq/100g)
Very Low	<6
Low	6-12
Moderate	12-25
High	25-40
Very High	>40

The eCEC results can also provide an indication of unbalanced nutrient ratios macro-nutrient deficiencies. The proportions of each exchangeable cation relative to eCEC are provided in

Table 6-4 along with 'desirable' proportions of each major cation. When compared to the 'desirable' ranges for exchangeable cations in soil, the median K proportion in spoil materials is within the 'desirable' ranges, the median Ca proportion is low, the median Mg proportion is high, and the exchangeable Na proportion is very high.

Table 6-4: Proportion of eCEC for Major Exchangeable Cations

Exchangeable Cation	Desirable ranges for plant growth (% eCEC)	Range and Median values of Selected Samples (% eCEC)	eCEC samples compared to 'desirable' ranges
Calcium (Ca)	65 – 80	0.9 – 64.1 (median = 11.1)	Low
Magnesium (Mg)	10 – 15	9.9 – 54.9 (median = 40.0)	High
Potassium (K)	1 – 5	0.9 – 5.1 (median = 1.1)	Acceptable
Sodium (Na)	0 – 1	25.1 – 51.3 (median = 44.1)	Very High

If the exchangeable Ca:Mg ratio in a spoil is less than 2, then a material may require some amelioration (such as addition of gypsum) before it can be used as part of a vegetation growth layer. The exchangeable cation results in **Table B3** (**Attachment B**) indicate that the sample materials have exchangeable Ca:Mg ratios ranging from 0.02 to 6.5 (median 0.28) and some may require amelioration to be successfully used as part of a vegetation growth layer.

6.4.2 Exchangeable sodium percentage (ESP)

The exchangeable sodium percentage (ESP) results for the nine spoil samples ranges from 24.9 to 47.8% and have an average value of 43%. Generally samples with ESP values less than 6 are considered non-sodic and unlikely to be susceptible to dispersion and erosion. Samples with ESP values greater than 6 are considered moderately sodic, whereas samples with ESP values greater than 14 are considered to be strongly sodic and may be susceptible to dispersion and erosion (Isbell, 2002; and Northcote and Skene, 1972). The ESP results indicate that the spoil samples are classified as highly sodic and material represented by these samples is therefore likely to be susceptible to dispersion and erosion.

6.4.3 Summary of eCEC and ESP Results

Overall, the CEC and ESP results indicate that from a revegetation viewpoint, most spoil materials will provide a reasonable growth medium for vegetation roots, without the need for fertiliser addition, however the addition of gypsum may prove beneficial due to low exchangeable calcium levels in spoil. The spoil also has elevated exchangeable Na which increases the ESP and potential for spoil to be sodic and prone to dispersion. Materials with dispersive properties may not be suitable for direct use on external faces of remediated spoil piles due to the potential for erosion although again, gypsum addition may help to address this issue.

However, dispersive spoil which is prone to developing low hydraulic conductivity may actually be very useful from an engineering perspective to develop low permeability covers or layers, and assist with the management of ash within the SSA.

The ALS laboratory certificates for the nine spoil samples described in this section are in **Attachment C**.

6.5 Summary of Results

- Spoil refers to all mined waste reporting to the SSA and therefore typically includes non-organic strata such as sandstone, siltstone and claystone in the overburden and interburden and organic carboniferous partings, coal roof and coal floor strata.
- Total sulfur concentrations in the 145 spoil samples are very low and the correlation between total sulfur and sulfide sulfur (Scr) verifies that a proportion of the sulfur is present as non-acid producing sulfate minerals such as gypsum or as organic sulfur species.
- The spoil has very low sulfide sulfur content (some 50% of the sulfur is sulfidic) and it is therefore highly unlikely that the spoil would generate acidity.
- The low concentrations of sulfide sulfur in the samples indicates that even with complete oxidation of all sulfide minerals, the seepage and runoff from the spoil would have low sulfate concentrations and should therefore not create issues related to NMD or saline drainage from elevated sulfate.
- The spoil materials have a broad range of ANC values, which are typically far in excess of the MPA that could be generated from the small amount of sulfide sulfur.
- The bulk excavated spoil material generated by KCCM is considered to be NAF and has a high factor of safety with respect to potential for AMD.
- The concentration of metals/metalloids in excavated spoil materials will be low, within applied health-based guideline criteria for soils, and is therefore unlikely to present any environmental issues associated with revegetation and rehabilitation activities.
- Surface runoff and seepage from spoil will be pH neutral to slightly alkaline. Salinity will be low due to the relatively low concentrations of dissolved solids with major ions in contact water dominated by sodium, chloride, bicarbonate and sulfate.
- Static leach tests indicate that trace metals/metalloids and major ions will be sparingly soluble in surface runoff and seepage from spoil. Subject to the implementation of standard industry practices relating to site water management, dissolved concentrations of major, minor and trace elements should remain within water quality guideline criteria defined in the Environmental Authority for the site. As such, initial seepage from KCCM spoil should not present any significant environmental risks for on-site or downstream water quality. Dilution effects from rainfall and natural attenuation are also likely to occur in the field and further reduce the concentrations of soluble metals and metalloids in surface runoff and seepage.
- Spoil materials are likely to be sodic and therefore are therefore likely to be susceptible to dispersion and erosion.
- Whilst fertiliser and gypsum addition could be considered for some spoil materials (if used on the exterior of the SSA as cover material) to provide a reasonable growth medium for revegetation and rehabilitation works, such amelioration measures should not be required for bulk spoil materials.

7 ASH CHARACTERISATION AND CLASSIFICATION

7.1 pH and EC

The $pH_{1:5}$ of the two bulk ash samples is 11.7 indicating that the ash samples from the power station are alkaline (caustic). The $EC_{1:5}$ of the ash samples is <1,600µS/cm and is considered to be slightly brackish. Salinity in surface runoff and seepage from ash is expected to be slightly brackish due to the relatively concentrations of dissolved solids with major ions in contact water dominated by calcium, sodium, chloride, and hydroxide.

7.2 Acid Base Account

The ABA results for the two ash samples (wet and dry) are provided in **Table 7-1.** An explanation of the methodology used in this section, is provided in **Section 5** and a glossary of technical terms and acronyms used is listed on **page vii**.

Table 7-1: Static Geochemical Results for Power Station Ash

ALS No.	Sample ID	Moisture Content (%)	pH[1]	EC[1]	Total S	Scr[2]	MPA[2]	ANC[2]	NAPP[2]	ANC: MPA Ratio	Sample Classification[3]
				µS/cm	%		kg H_2SO_4/t				
EB1419070001	Kogan Creek Ash WET	28.4	11.6	1,570	0.06	0.003	0.08	44.2	-44.1	577.3	NAF (Barren)
EB1419070002	Kogan Creek Ash DRY	14.2	11.6	1,170	0.04	0.003	0.08	41.2	-41.1	538.1	NAF (Barren)

1. pH and EC values provided for a 1:5 sample:water slurry.
2. Scr = Chromium Reducible Sulfur; MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity and NAPP = Net Acid Producing Potential.
3. Sample classification criteria provided at **Section 5.3.2**.

The ash samples have very low total and sulfide sulfur concentrations with moderate ANC values. The ANC:MPA ratios result in classification of the ash as **NAF-Barren**.

7.3 Major, Minor and Trace Element Concentrations

Multi-element scans were carried out on the two bulk ash samples to identify any elements (metals/metalloids) present in this material at concentrations that may be of environmental concern with respect to material handling, storage, and water quality. The results were compared to potentially relevant guideline criteria to determine any concerns related to ash handling, storage and final rehabilitation. To provide relevant context, RGS has compared the total metal/metalloid concentration in the bulk ash sample to National Environmental Protection Council (NEPC) Health-based Investigation Levels (HIL(C)) for soils in public open spaces (NEPC, 2013).

The results from multi-element testing (total metals/metalloids) of the two ash sample are presented in **Attachment B (Table B6)**. The results indicate that ash materials are likely to have low total metal and metalloid concentrations in solids, many below the laboratory limit of reporting (LoR) and all below the applied NEPC (HIL(C)) guideline for soils.

7.3.1 Element Enrichment

To provide additional context and in line with mining industry guidelines (DITR, 2007; INAP, 2009), the multi-element results were also compared to the average background concentration (average crustal abundance) of those elements (metal/metalloids) in soil and rock.

The GAI results in **Attachment B (Table B6)** indicate that the two ash samples tested have GAI values less than 3 for all elements and are not significantly enriched compared to average crustal abundance.

7.3.2 Element Leaching Potential

The results from water extracts (1:5 sample:water) tests on the two ash samples are provided in **Table B7** (**Attachment B**). RGS has compared the results of the water extract tests for the ash samples with Australian water quality guidelines and relevant receiving water quality criteria (ANZECC & ARCANZ, 2000). It should also be recognised that direct comparison of geochemical data with guideline values can be misleading. For the purpose of this study, guideline values are only provided for broad context and should not be interpreted as arbitrary 'maximum' values or 'trigger' values.

The concentration of trace metals/metalloids in the water extracts from the ash samples is mostly below the laboratory LoR, although aluminium, boron, chromium and zinc are present at levels which exceed the applied freshwater ecosystem water quality guideline trigger value for 95% species protection. The trace metal/metalloid concentrations in the water extracts are less than the applied livestock drinking water quality guideline criteria for all elements other than aluminium, the concentration of which marginally exceeds the applied guideline value (5mg/L) for this element.

Guideline values for nutrients are only available for ammonia, nitrate and nitrite. Most of these nutrients in the bottle leachate from the ash samples are present at concentrations well below the applied guideline values. Guideline values are not available for other nutrients (P, TKN and Total N), however the concentrations of these parameters are typically low in the samples.

The results of the water extract tests described above indicate that the ash has limited potential to leach elements. This is confirmed by groundwater and surface water monitoring data from the site and overall this suggests that the potential for significant adverse impacts to surface and groundwater resources from ash materials at KCCM is limited.

Overall, results indicate that dissolved metal/metalloid and nutrient concentrations in initial surface runoff and seepage from ash materials is likely to be low and, with the possible exception of aluminium, less than applied livestock drinking water quality guideline criteria.

7.3.3 Radioactive Elements

Some trace elements commonly found in coal ash are naturally radioactive, such as uranium (U), thorium (Th) and their decay products, such as potassium (K), polonium (Po), lead (Pb), radium (Ra) and radon (Rn). The radionuclide content of coal is usually below the content of local soil, but this depends on where the mine is located. Furthermore, the radionuclide content of coal combustion ash is generally greater than the source coal (Cooper, 2005). Cooper also reported various background levels for coal and coal combustion ash throughout Australia, as well as background levels for natural soils and rocks.

The findings presented in Cooper (2005) demonstrate that most coals and combustion ash have radionuclide levels below or within the range typically found naturally in soils and rocks. Coal and combustion ash from Queensland have average radionuclide contents compared to other Australian states, however there is a wide range of values for coal combustion ash in Queensland, and other Australian states.

The results of a 'screening level' analyses of the gross alpha and gross beta activity in bottle leachate from the coal ash sample are presented in **Attachment B (Table B7).** The results demonstrate that the radionuclide activities for gross alpha and gross beta (and potassium-40 corrected beta) are less than the laboratory LoR. These results were also supported by soluble uranium and thorium concentrations in water extracts from the coal ash sample at levels below the laboratory LoR. The screening levels are very low, such that it is not necessary to undertake a detailed radionuclide assessment for the coal ash sample.

7.4 Summary of Results

- The ash has an alkaline pH of 11.7 and an average hydroxide alkalinity of 128mg/L measured in the static geochemical assessment that uses a 1:5 solid to water extract. This indicates that the ash will produce **alkaline surface runoff and seepage**.
- Total sulfide sulfur concentrations in the two ash samples is below the LoR (0.005 %S), and this confirms that the ash has **no potential to produce acid drainage**.
- The coal ash materials have moderate ANC values (43kg H_2SO_4/tonne) due to the presence of CaO in the ash.
- The ash has a high factor of safety with respect to potential for acid generation and is likely to be acid consuming (AC).
- Salinity in surface runoff and seepage from ash is expected to be slightly brackish due to the concentrations of dissolved solids with major ions in contact water dominated by calcium, sodium, chloride, and hydroxide.
- Total major, minor and trace element concentrations in the ash are significantly lower than NEPC HIL-C levels and within the range of average crustal abundance and median soil data, inferring a low potential for the ash to contribute to elevated concentrations of the measured elements in surface runoff and/or seepage.
- Radionuclide testing of ash indicates that radioactivity levels are very low, such that it is not necessary to undertake a detailed radionuclide assessment for the ash materials.
- Static leach tests indicate that most trace metals/metalloids and major ions will be sparingly soluble in surface runoff and seepage from ash. Exceptions include aluminium, boron, chromium and zinc which are present in water extracts at levels which exceed the applied freshwater ecosystem water quality guideline trigger value for 95% species protection. However, only Al is present at a concentration, which marginally exceeds the applied livestock drinking water guideline value (5mg/L) for this element. Subject to the implementation of standard industry practices relating to site water management, dissolved concentrations of major, minor and trace elements should remain within water quality guideline criteria defined in the Environmental Authority for the site. As such, surface runoff and seepage from ash is not expected to present any significant environmental risks for on-site or downstream water quality. Dilution effects from rainfall and natural attenuation of alkaline pH levels and metal solubility (eg. aluminium) are also likely to occur in the field and further reduce the concentrations of soluble metals and metalloids in surface runoff and seepage.

8 KINETIC LEACH COLUMN (KLC) TESTS – SPOIL AND ASH

8.1 Purpose

The purpose of KCL tests is to simulate leaching of a solid sample (eg. spoil) with laboratory grade deionised water over a period of time (weeks, months or years) so that the long term behaviour of the material can be understood. Leachate characteristics measured include pH, EC, acidity, alkalinity, major ions and a range of dissolved metals/metalloids.

The approach developed for KCCM spoil and ash samples was to complete leach events on a monthly basis for six months (ie. seven leach events) and then evaluate any need for additional leach testing to be completed.

Hence, seven monthly leach cycles have been completed over a period of six months. The raw data received from ALS is included in **Attachment C**, and the KLC leachate concentrations are presented alongside ANZECC & ARCANZ (2000) guideline “low risk trigger” values for protection of livestock drinking water quality in **Attachment D**. These guideline values are provided for context only and are not intended to be interpreted as “maximum permissible levels” for site water storage or discharge. Water quality trends in leachate from the KLC tests are also provided graphically in **Attachment D**.

8.2 Objectives

The objectives of the KLC tests were to evaluate the spoil and ash materials (including the effect of mixing spoil and ash materials) and to **quantify rates** of:

- sulfide oxidation and acid generation or acid neutralisation;
- release of salinity from the samples into the KLC leachate; and
- release of major, minor and trace metals/metalloids from the samples into the KLC leachate.

8.3 Use and Limitations of Kinetic Data

The leachate data from KLC tests can be used in numerical water quality models to evaluate potential impacts, although numerical modelling is beyond the current scope of work completed for this report.

On their own, the data from KLC tests cannot be used directly to infer potential impacts on surface water and groundwater resources for a number of reasons that include:

- The samples used in laboratory scale tests do not have the same particle size distribution as materials in the field.
- The ratio of water to sample is not the same as that which occurs in the field on a daily, weekly, monthly or annual basis. It should be noted that the ratio of sample to water in most of the KLC tests is approximately 2:1 (w/v) (ie. concentrated), whereas the ratio of sample to water generally used in multi-element tests where results can (arbitrarily) be compared against guideline concentrations to provide relevant context is an order of magnitude more dilute at 1:5 (w/v). Whilst arbitrary comparisons against guideline concentrations can be useful in some situations and help to provide relevant context, such comparisons cannot be directly extrapolated to the field situation at KCCM.
- The samples in the laboratory are generally not subjected to the extreme types of meteorological conditions that can occur in the field, even if infrequently (ie. drought and evapo-concentration or flood and dilution).

- The KLC tests simulate water contact with the solid samples under fully oxidised, partially saturated, surface conditions. As such, the columns are not simulating bulk material that may be placed under saturated conditions in a dam or conditions below the water table.
- The KLC tests do not consider or account directly for the precipitation of solutes from the ash within the spoil stored at the SSA.

At the time of report writing, seven leach events had been completed over six months and the results received from ALS, hence a complete dataset is available for interpretation and assessment. Some of the trends of note for the KLC test results are presented below.

The objective of the KLC testing is to simulate, albeit at a smaller scale, the effect of co-disposal or co-mingling of mine spoil with ash from the Kogan Creek Power Station. The range of ratios tested allows the effect of mixing to be evaluated across a wide range of conditions.

8.4 Sample Selection

The samples selected for KLC tests were obtained by compositing sub-samples of the same lithological unit into larger samples for tests KLC2, KLC3 and KLC4 to produce a bulk composite spoil sample (KLC5). The sample details of the individual samples used to produce composite samples are provided in **Table B8** (**Attachment B**). The representative spoil samples were then mixed with ash at ratios ranging from 1:1 to 1:20 (ash-to-spoil) to generate the tests for KLC6 to KLC9. The samples being assessed using KLC tests comprise:

- KLC1 = ash
- KLC2 = sandstone
- KLC3 = siltstone
- KLC4 = claystone
- KLC5 = combined 2, 3 and 4 (spoil)
- KLC6 = KLC1 + KLC5 mixed at ratio of 1:1 (ash-to-spoil)
- KLC7 = KLC1 + KLC5 mixed at ratio of 1:5 (ash-to-spoil)
- KLC8 = KLC1 + KLC5 mixed at ratio of 1:10 (ash-to-spoil)
- KLC9 = KLC1 + KLC5 mixed at ratio of 1:20 (ash-to-spoil)

8.5 Results

8.5.1 Ash

The seven leach cycles of the KLC test on the ash sample (KLC1) indicate that:

- The KLC1 leachate pH was moderated and reduced from 10.4 to 8.3 as alkalinity leached from the ash.
- Acidity values in KLC1 leachate ranged from <1 to 14mg/L and were typically low (average 3.3mg/L).
- Total alkalinity in KLC1 leachate decreased from 610 to 55mg/L (through the loss of soluble oxide minerals and sparingly soluble carbonate minerals) but were at least an order of magnitude greater than acidity values.
- The EC value decreased from 2,170 to 404mg/L due to the loss of soluble major ions such as sodium and chloride, which showed a decreasing trend over the test period.

- There was an increase in some major ions as sparingly soluble minerals released calcium and sulfate, however the concentrations of these parameters was relatively low. The concentrations of sodium and chloride showed a decreasing trend through the test period.
- Dissolved metal/metalloid concentrations generally showed a decreasing trend in leachate from ash (KLC1), however metals such as boron, hexavalent chromium, fluoride, molybdenum and selenium persisted at an elevated concentration. Observed trends for dissolved metals/metalloids from ash are provided below and compared (where appropriate) to livestock drinking water guideline criteria (ANZECC and ARCANZ, 2000).
  - The aluminium concentration was elevated during the first two leach events from the ash sample (KLC1), although the leachate concentration reduced to below the applied livestock drinking water guideline (5mg/L) for the third and subsequent leach events.
  - Boron concentrations initially showed an increasing trend for the ash sample (KLC1) and were above the applied livestock drinking water guideline (5mg/L) from the third to the sixth leaching events. Boron concentrations were significantly attenuated by mixing ash with spoil.
  - Hexavalent chromium concentrations were typically elevated in leachate from the ash sample (KLC1) compared to the livestock drinking water guideline (0.001 mg/L). However, hexavalent chromium concentrations were significantly attenuated by mixing ash with spoil.
  - Fluoride concentrations were typically elevated in leachate from the ash sample (KLC1) compared to the livestock drinking water guideline (2 mg/L). However, fluoride concentrations were significantly attenuated by mixing ash with spoil.
  - Molybdenum concentrations in leachate from the ash sample (KLC1) were elevated compared to the livestock drinking water guideline (0.15mg/L) throughout the test period, but generally showed a decreasing trend. Molybdenum concentrations were significantly attenuated by mixing ash with spoil.
  - Selenium was present at elevated concentrations in leachate from the ash sample (KLC1) compared to the livestock drinking water guideline value (0.02mg/L), but showed a decreasing trend and were significantly attenuated by mixing ash with spoil.

Whilst the concentration of some metals/metalloids was elevated compared to livestock drinking water guidelines in KLC leachate from ash these concentrations were significantly attenuated by mixing ash with spoil. At higher mixing ratios, most metal/metalloid concentrations were very low and less than the laboratory LoR.

The KLC data from the ash samples for the seven leach events was compared to the range of data from the KS02 ash dam monitoring site in **Table 8-1** (overleaf). The monitoring site in the ash dam has water quality data available from 2007 to October 2014. The water in the dam is affected by the addition of rain and losses as evaporation or seepage, therefore laboratory results would not be expected to correlate directly with dam water quality. However, the KLC test data are generally within the range of water quality results observed in the existing ash dam.

The water quality concentrations from the KLC tests and KS02 ash dam monitoring site are presented alongside ANZECC & ARCANZ (2000) guideline “low risk trigger” values for protection of livestock drinking water quality and show slightly elevated maximum values for boron, fluoride, aluminium, molybdenum and selenium. Again, these guideline values are provided for context only and are not intended to be interpreted as “maximum permissible levels” for site water storage or discharge.

Table 8-1: Ash Dam and Kinetic Leach Data Comparison

Surface water data for KS02 provided by CS Energy	Unit	LOR	Minimum	Average	Median	Maximum	Mean KLC value for Ash	ANZECC#
pH	pH	0.01	5.3	7.5	7.8	8.9	9.9	-
Electrical Conductivity @ 25°C	µS/cm	1	3	991	962	2,120	1,243	3,580
Alkalinity by PC Titrator								
Hydroxide Alkalinity (as $CaCO_3$)	mg/L	1	-	-	-	-	117	-
Carbonate Alkalinity (as $CaCO_3$)	mg/L	1	4	4	4	4	163	-
Bicarbonate Alkalinity (as $CaCO_3$)	mg/L	1	12	71	77	129	48	-
Total Alkalinity (as $CaCO_3$)	mg/L	1	12	71	77	129	170	-
Major Cations								
Calcium (Ca)	mg/L	1	1	4	4	9	32	1,000
Magnesium (Mg)	mg/L	1	1	5	5	13	1	-
Sodium (Na)	mg/L	1	16	229	233	559	214	-
Potassium (K)	mg/L	1	1	3	2	5	8	-
Major Anions								
Boron (B)	mg/L	0.05	0.32	0.75	0.62	1.77	5.4	5
Chloride (Cl)	mg/L	1	10	160	143	875	142	-
Fluoride (F)	mg/L	0.1	0.2	0.9	0.7	2.3	2.6	2
Sulfate (as SO_4)	mg/L	1	1	218	147	537	195	1,000
Dissolved Metals/Metalloids by ICP-MS								
Aluminium (Al)	mg/L	0.01	0.01	1.1	0.2	6.2	6.8	5
Antimony (Sb)	mg/L	0.001	0.001	0.001	0.001	0.001	0.01	-
Arsenic (As)	mg/L	0.001	0.002	0.022	0.017	0.062	0.027	0.5
Barium (Ba)	mg/L	0.001	0.043	0.081	0.066	0.174	0.067	-
Beryllium (Be)	mg/L	0.001	-	-	-	-	<0.001	-
Cadmium (Cd)	mg/L	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.01
Chromium (Cr)	mg/L	0.001	0.001	0.003	0.002	0.007	0.18	1
Cobalt (Co)	mg/L	0.001	0.002	0.002	0.002	0.002	<0.001	1
Copper (Cu)	mg/L	0.001	0.001	0.004	0.002	0.011	0.001	1
Iron (Fe)	mg/L	0.05	0.05	0.72	0.83	1.61	<0.05	-
Lead (Pb)	mg/L	0.001	0.002	0.003	0.002	0.004	<0.001	0.1
Manganese (Mn)	mg/L	0.001	0.001	0.007	0.004	0.022	0.002	-
Molybdenum (Mo)	mg/L	0.001	0.068	0.167	0.159	0.326	0.769	0.15
Nickel (Ni)	mg/L	0.001	0.001	0.003	0.002	0.01	<0.001	1
Selenium (Se)	mg/L	0.01	0.01	0.09	0.02	0.02	0.07	0.02
Thallium (Tl)	mg/L	0.001	-	-	-	-	<0.001	-
Thorium (Th)	mg/L	0.001	-	-	-	-	<0.001	-
Vanadium (V)	mg/L	0.01	-	-	-	-	0.46	-
Zinc (Zn)	mg/L	0.005	0.005	0.065	0.051	0.318	<0.005	20

\# ANZECC & ARCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water (low risk trigger levels).

8.5.2 Spoil

The KLC test results for spoil demonstrate that there is no significant geochemical difference between the three individual spoil types (sandstone, siltstone and claystone) and the composite spoil sample. The KLC test results associated with the three spoil samples (KLC2, KLC3, KLC4) and one composite spoil sample (KLC5) are presented in this section and indicate that.

- The leachate pH from spoil was in the range pH 6.7 to 8.9 and was typically slightly alkaline (median 7.9). The leachate pH generally remains within the pH neutral to slightly alkaline range.

- The total alkalinity of the KLC leachate from spoil was in the range 1 to 147mg/L and showed a decreasing trend over the test period. The total acidity value was very low (<5mg/L) in all leachate samples and therefore net alkalinity values were all positive.
- The EC value measured in KLC leachate from spoil was in the range 708 to 46 mg/L due to the loss of soluble major ions such as sodium and chloride, and generally showed a decreasing trend over the test period.
- Most metals/metalloids were present in KLC leachate from spoil at concentrations below or slightly above the laboratory LoR, verifying that most elements are sparingly soluble in contact water with spoil.
- All metals/metalloids tested in KLC leachate from spoil were present at concentrations below applied livestock drinking water quality guideline criteria.

8.5.3 Ash and Spoil Mixtures

The different ratios of ash and spoil (1:1 to 1:20) mixtures tested provided a range of mixing scenarios and a range of potential water quality data that may be encountered if ash and spoil were to be co-mingled within the SSA.

The 1:1 ratio ash and spoil KLC test (KLC6) had elevated concentrations of boron, hexavalent chromium, fluoride, molybdenum and selenium compared to applied livestock drinking water guideline criteria (ANZECC & ARCANZ, 2000).

In the other columns mixed at higher ash to spoil ratios ranging from 1:5 to 1:20 ash:spoil (KLC7 to KLC9, the leachate chemistry was more indicative of the leachate chemistry from spoil and concentrations of dissolved metals/metalloids in KLC leachate were substantially lower.

The correlation between laboratory KLC data and field data (**Table 8-1**) from the ash pond indicate that the data from the various spoil:ash mixtures provides reliable results to evaluate potential field application of co-mingling of ash and spoil.

9 CONCLUSIONS

RGS has completed a static geochemical assessment of spoil (145 samples) and ash (two samples) produced by KCCM and has completed seven KLC test leaching events conducted over six months.

The purpose of this assessment was to characterise the geochemistry of the spoil and ash and evaluate reactions and leachate chemistry that may occur under field conditions when ash and spoil are co-mingled or co-disposed in spoil storage areas (SSA).

9.1 Summary of Results

The samples of spoil collected and tested within the M to R coal seams of the deposit are predominantly NAF or NAF Barren and have a high factor of safety with respect to potential for AMD, NMD and/or saline drainage. The spoil has low elemental concentrations of metals and metalloids. The geology and the geochemistry of the spoil and coal and the resultant ash has been consistent over the current life of mine. Due to the nature of the deposit and the depositional environment under which the spoil and coal was laid down it is considered likely that the samples and the results from this evaluation can be reliably extrapolated throughout the future mine area to be mined at this deposit.

KCCM ash is currently contained within the 80 ha Initial Ash Disposal Area (**IADA**) and at the 72ha Out of Pit Ash Cell (**OPAC**). Future management of the ash could include transfer and placement within the SSA. The ash is geochemically classified as NAF-Barren and is also likely to be Acid Consuming.

The quality of contact water with ash and spoil has been evaluated over time using KLC tests. The KLC test results obtained to date indicate that:

- Most spoil materials including sandstone, siltstone and claystone are inert in terms of AMD, NMD and saline drainage potential. A composite sample of these three units was used to mix with the ash and this sample has the same characteristics as the individual units.
- Ash is likely to be acid consuming (AC) and contains metals/metalloids such as boron, fluoride, molybdenum and selenium which are potentially mobile under alkaline conditions; and can have elevated concentrations in contact water compared to applied livestock drinking water guideline criteria (ANZECC and ARCANZ, 2000).
- When the spoil is mixed 1:1 with ash, concentrations of elements including Al, As, B, F, Cr, Mo and V can increase in the short term, predominantly due to changes in the pH and alkalinity of the ash. It is probable that the pool of these soluble elements is relatively finite and when the soluble fraction is leached from the ash concentrations will approach the laboratory LoR for most elements. Sequential extractions of the ash rather than TCLP or other selective leaching methods has the potential to quantify the mass of soluble, exchangeable, carbonate, oxide, organic, and residual elements from ash.
- When the spoil is mixed 1:5 to 1:20 with ash, concentrations of elements including Al, As, B, F, Cr, Mo and V are significantly reduced. This is mostly a function of material dilution as the ash is mixed with the spoil. However, there are also geochemical controls that reduce the mobility of the elements within the ash through spoil such as sorption of elements within the minerals in the spoil most likely through precipitation or co-precipitation reactions. These chemical processes should contribute to immobilisation of the elements within the spoil and limit the potential for them to be leached from the SSA.

Based on the static and preliminary KLC test assessment of the ash and spoil the following management considerations are relevant to KCCM.

9.2 Management Considerations

Based on the benign nature of the spoil no special management measures are considered necessary for spoil handling and storage in the SSA. However the acquired data indicate that the spoil is sodic and therefore spoil placed on the exterior of the SSA should be amended with gypsum to improve soil structure and reduce the potential for erosion of these materials. The sodic and dispersive nature of the spoil could be used advantageously to provide low permeability material as part of the containment design of the ash within the spoil at the SSA.

Under field conditions at an operational scale the rate and the concentration of the elements that may be leached from the ash is likely to be a function of the:

- way the ash and spoil are mixed; and,
- hydraulic controls that limit the passage of water into and through the ash and or spoil.

The potential for mobile elements in the ash to be leached to surface water or groundwater must therefore consider:

- the **SSA geometry** and the **physical location** of the ash and whether it is located;
  - below the post mining groundwater level which could result in the movement of elements directly to the groundwater
  - above the post mining groundwater level in areas that could allow seepage from within the ash/spoil to drain to surface water or to infiltrate into the groundwater
- the **emplacement method** and whether the ash is;
  - placed as a slurry or a filter cake/paste
  - end tipped into zones within the spoil which will result in the ash containing substantial pore voids that could contain and carry water
  - paddock dumped and compacted in layers to induce low permeability and restrict the movement of water into and through the ash
  - mixed with (co-mingled) with spoil
- the **containment method** that addresses whether there is a need for low permeability covers over the ash;
- **site meteorology** including;
  - local climatic conditions and meteorological extremes
  - the water balance of the SSA that determines how much of the rain enters the SSA
  - infiltration recharges groundwater
  - infiltration reports as seepage to surface water.

10 FORWARD WORKS RECOMMENDATIONS

This geochemical assessment has verified that KCCM spoil has a very low potential to produce AMD, NMD or saline drainage due to the inherent geochemical characteristics of the spoil. Despite this low risk, it is recommended that CS Energy develop and implement a spoil waste management program (SWMP) to verify the geochemical characteristics within new resource areas prior to mining to demonstrate that that the low level of risk is verified in the larger scale field situation. This could be readily achieved by undertaking analysis of samples from within the site resource drilling programs to verify that the low total sulfur concentrations measured in this study are contiguous within the current mining block and subsequent blocks that are to be developed and mined by CS Energy. This approach would be particularly cost effective as the majority of the costs are already inherent in the resource drilling programs, rather than in the geochemical sampling and testing program. The suite of analyses on nominally 100 samples would include pH, EC, total sulfur, ANC on all samples and multi element analysis on selected solids and water extracts. The purpose of the SWMP would be to ensure that the low risk rating of the site is maintained by recording and documenting the geochemical properties of the spoil and ash over the life of the operations. Documented verification of the low risk would add considerable quantitative proof to the establishment and progressive reduction in environmental risk and financial assurance. The proposed SWMP would be incorporated into the existing site Mine Waste Management Plan or Plan of Operations.

Based on the KLC test results to date, it is recommended that intimate mixing of ash with spoil will provide a preferential outcome from a geochemical perspective. The KLC test results infer that intimate mixing at a ratio greater than 1:5 (ash:spoil) could negate the need for any significant engineering controls within the SSA. If a co-disposal approach is considered (ie. placement of ash in layers or cells or via end tipping over the working face), the data suggest that there is the potential for the ash to leach elevated concentrations of elements such as Al, As, B, Cr, F, Mo and V into the surrounding spoil material. The potential for the ash to leach these elements is dependent (1) on the rate at which water passes into and through the ash, and (2) the geochemical processes that control the release of the element (eg. solubility controls) and (3) geochemical processes that are likely to lead to precipitation of the leached elements within the bulk of the spoil storage area. If the objective of CS Energy is to control the release of elements from the ash to the environment beyond the KCCM site, intimate mixing of ash and spoil would provide this outcome. The KLC tests have provided leaching data to verify this assumption[2].

Based on the preliminary results of the KLC testing it is recommended that the next stage of work could be to evaluate potential placement and containment strategies at a larger scale. The scale up work should allow for the integrated collection and assessment of geotechnical, geochemical and hydrogeological aspects of the proposed co-mingling or co-disposal strategies to be quantified. Surface and groundwater monitoring programs are in place at KCCM to ensure any unexpected water quality due to ash and spoil geochemistry is detected. Concentrations of elements such as Al, As, B, F, Cr, Mo and V should be included in surface and groundwater monitoring program at the SSA.

[2] In the 2001 ACARP study on Trace Element Leaching From Fly Ash from Australian Power Stations there is a statement from Hassett (1994) who has considerable international recognition in this area and states that: "*each specific disposal project requires appropriate material characterization based on distinct attributes of that material*"...... "*Absolute containment of a waste and its leachate is impossible. Thus, since escape of leachate is inevitable, slow, controlled release of trace elements is essential to ensure low, nontoxic leachate concentrations which can be re-equilibrated in the environment.*"

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Attachment A1

Geochemical Assessment Methodology for Mine Waste Materials

A1a. Acid Generation and Prediction

Acid generation is caused by the exposure of sulfide minerals, most commonly pyrite (FeS_2), to atmospheric oxygen and water. Sulfur assay results are used to calculate the maximum amount of acid that could be generated by the sample, as a direct stoichiometric function of either the pyritic sulfur content, or by assuming that all sulfur not present as sulfate occurs as pyrite. Pyrite reacts under oxidising conditions to generate acid according to the reaction:

$$\mathbf{FeS_2 + \tfrac{15}{4}O_2 + \tfrac{7}{2}H_2O \dashrightarrow Fe(OH)_3 + 2\,H_2SO_4}$$

According to this reaction, the maximum potential acidity (MPA) of a sample containing one per cent sulfur as pyrite would be 30.6 kg H_2SO_4/t; *ie*. 30.6 kg of acid generated per tonne of rock.

The chemical components of the acid generation process consist of the above sulfide oxidation reaction and acid neutralisation, which is mainly provided by inherent carbonates and to a lesser extent silicate materials. The amount and rate of acid generation is determined by the interaction and overall balance of the acid generation and neutralisation components.

Determination of pH and Electrical Conductivity

pH and electrical conductivity (EC) are measured (and reported) on 1:5 weight/weight water extract. This gives an indication of the inherent acidity and salinity of the mineral waste material when initially exposed in an emplacement area.

Total sulfur (S), chromium-reducible sulfur (S_{cr}) and Maximum Potential Acidity (MPA)

Total sulfur concentration is determined by the LECO high temperature combustion method. The total sulfur is typically used to calculate the Maximum Potential Acidity (MPA), which is based on the assumption that all sulfur is present as reactive pyrite.

A more accurate estimate of the MPA can be achieved by determining pyritic sulfur and other sulfide forms directly, such as using the chromium-reducible sulfur (S_{cr}) test. S_{cr} is determined by the reduction of inorganic sulfur in a hot acidic chromous chloride solution, where evolved H_2S is carried in nitrogen gas and trapped in a zinc acetate trapping solution as zinc sulfide. This solution is then titrated with iodine. For the Project, S_{cr} was used instead of total sulfur to determine MPA, where S_{CR} data was available.

Acid neutralising capacity (ANC)

The ANC measures the capacity of a sample to react with and neutralise acid by addition of acid to a known weight of sample, then titration with NaOH to determine the amount of residual acid. The ANC can be further evaluated by slow acid titration to a set end-point and then calculation of the amount of acid consumed and evaluation of the resultant titration curve, called an Acid Buffering Characteristic Curve (ABCC).

Net acid producing potential (NAPP)

The NAPP is calculated from the MPA and ANC results and represents the balance between the inherent capacity of a sample to generate acid (MPA) and neutralise acid (ANC) expressed in units of kg H_2SO_4/t of sample. If the MPA is greater than the ANC (ie. a net excess of acidity) then the NAPP is positive. If the MPA is less than the ANC (ie. a net excess of alkalinity) then the NAPP is negative. A strongly positive NAPP result generally indicates that a sample is PAF, whereas a strongly negative NAPP generally indicates that a sample is NAF.

Net acid generation (NAG)

The standard NAG tests can sometimes be used to confirm the acid forming nature for coal mine waste materials, but should generally be used with caution as it can generate false positive results if the sample material contains a significant amount of organic materials (ACARP, 2008). The extended boil NAG test can address this issue, but it can be difficult to complete and interpretation of the acquired results can be complex.

A1b. Assessment of Element Enrichment and Solubility

In mineralised areas it is common to find a suite of enriched elements that have resulted from natural geological processes. Multi-element scans are carried out to identify any elements that are present in a material at concentrations that may be of environmental concern with respect to surface water quality and revegetation. The samples are typically analysed for the following elements, although the actual suite of elements tested is project specific:

Major elements	Al, Ca, Fe, K, Mg, Na, Si, and S
Minor elements	As, B, Cd, Co, Cr, Cu, F, Hg, Mn, Mo, Ni, P, Pb, Sb, Se, V, Zn

The assay result for each element is compared to either average background concentrations to evaluate any potential concerns related to rock emplacement or process residue facility operation and final rehabilitation, or compared to soil quality guidelines where applicable.

Elements identified as enriched may not necessarily be a concern for revegetation, drainage water quality, or public health but their significance should be evaluated. Similarly, because an element is not enriched does not mean it will never be a concern, because under some conditions (*eg.* low pH) the geochemical behaviour of common environmentally important elements such as Al, Cu, Cd, Fe and Zn increases significantly.

Water extracts or leaching tests can be used to determine the element solubilities under the existing pH conditions of the sample (*eg*. water extract leaching tests) or under changing conditions (*eg*. kinetic leach column tests). Where applicable, element concentrations in water extracts or leachates have been compared with applied water quality guidelines to determine their potential environmental significance.

A1c. Kinetic Leach Column Tests

Kinetic leach column (KLC) tests can be used to provide information on the reaction kinetics of mine waste materials. The major objectives of kinetics tests are to:

- Provide time-dependent data on the kinetics and rate of acid generation and acid neutralising reactions under laboratory controlled (or onsite conditions);
- Investigate metal release and drainage / seepage quality; and
- Assess treatment options such as addition of alkaline materials.

The KLC tests simulate the weathering process that leads to acid and base generation and reaction under laboratory controlled or site conditions. The kinetic tests allow an assessment of the acid forming characteristics and indicate the rate of acid generation, over what period it will occur, and what management controls may be required.

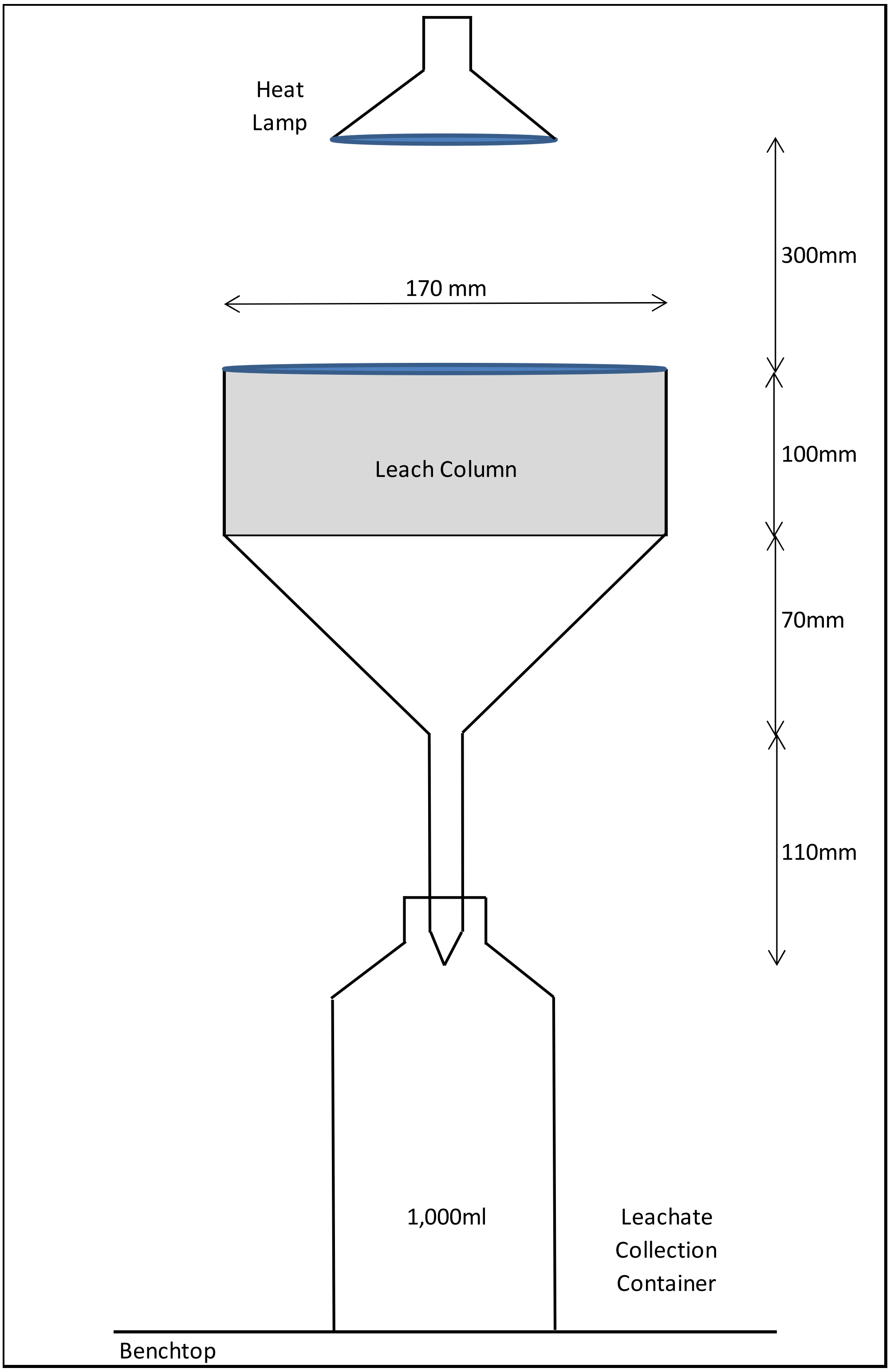
In KLC tests, water is added to a sample and used to leach the products and by-products of acid producing and consuming reactions. Samples of leachate are then collected and analysed. Intermittent water application is applied to simulate rainfall and heat lamps are used to simulate sunshine. These tests provide real-time information and may have to continue for several months or years. Monitoring includes trends in pH, sulfate, acidity or alkalinity, and metals/metalloids, for example. The pH of the collected leachate simulates the acid drainage process, acidity or alkalinity levels indicate the rate of acid production and acid neutralisation, and sulfate production can be related to the rate of sulfide oxidation. Metal/metalloid concentration data provides an assessment of metal solubility and leaching behaviour.

Figure A1 shows the KLC test set up used by RGS adapted from *AMIRA, 2002*. The columns are placed under heat lamps to allow the sample to dry between water additions to ensure adequate oxygen ingress into the sample material.

Approximately 2 kg of sample is generally used in the leach columns and depending on the physical nature of the material and particle size can be used on an as-received basis (*i.e.* no crushing as with fine rejects) or crushed to nominal 5 to 10 mm particle size (as with overburden). The sample in the column is initially leached with deionised water at a rate of about 400 ml/kg of sample and the initial leachate from the columns collected and analysed. Subsequent column leaching is carried out at a rate of about 400 ml/kg per month and again collected and analysed. The leaching rate can be varied to better simulate expected site conditions or satisfy test program data requirements. The column must be exposed to drying conditions in between watering events. The residual water content and air void content in the column can be determined by comparing the wet and dry column weights. A heat lamp is generally used above the sample during daylight hours to maintain the leach column surface temperature at about 30^{o}C.

Figure A1

Kinetic Leach Column Setup



Reference:

AMIRA (2002). AMIRA International. *ARD Test Handbook. Project P387A Prediction & Kinetic Control of Acid Mine Drainage.* Ian Wark Institute and Environmental Geochemistry International Pty Ltd. May 2002, Melbourne, VIC.

Attachment A2

Stratigraphic Logs

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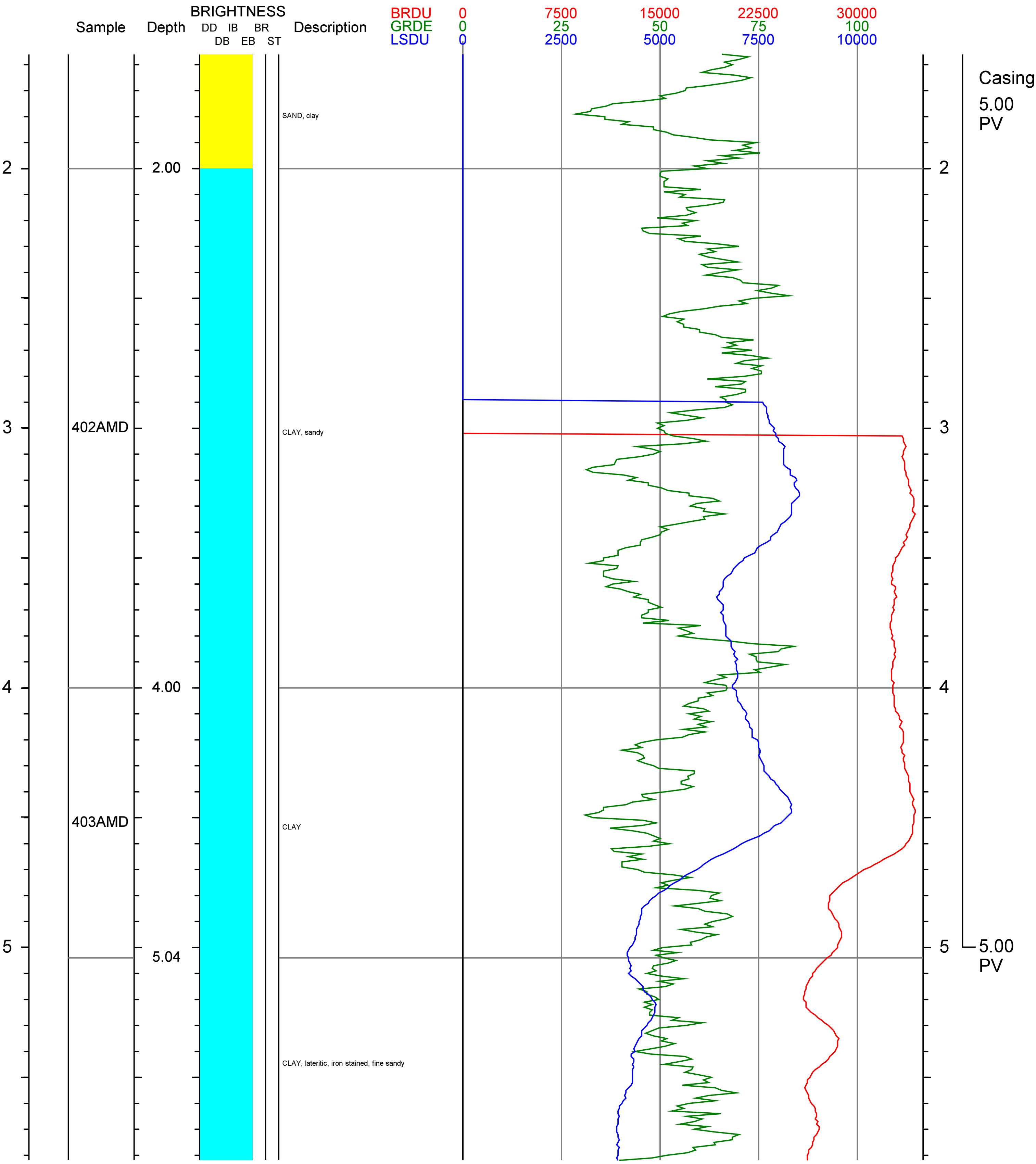
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14031C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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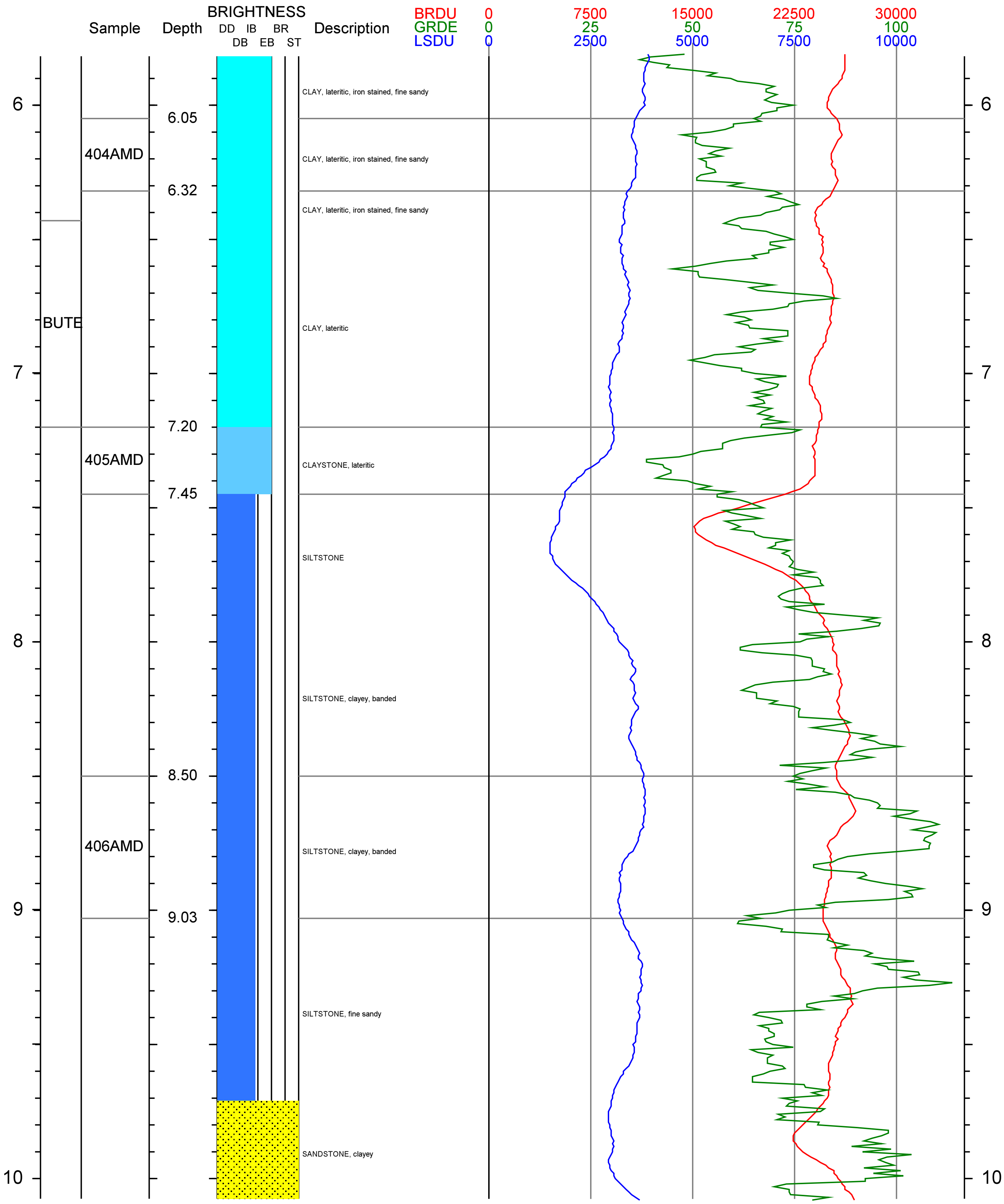

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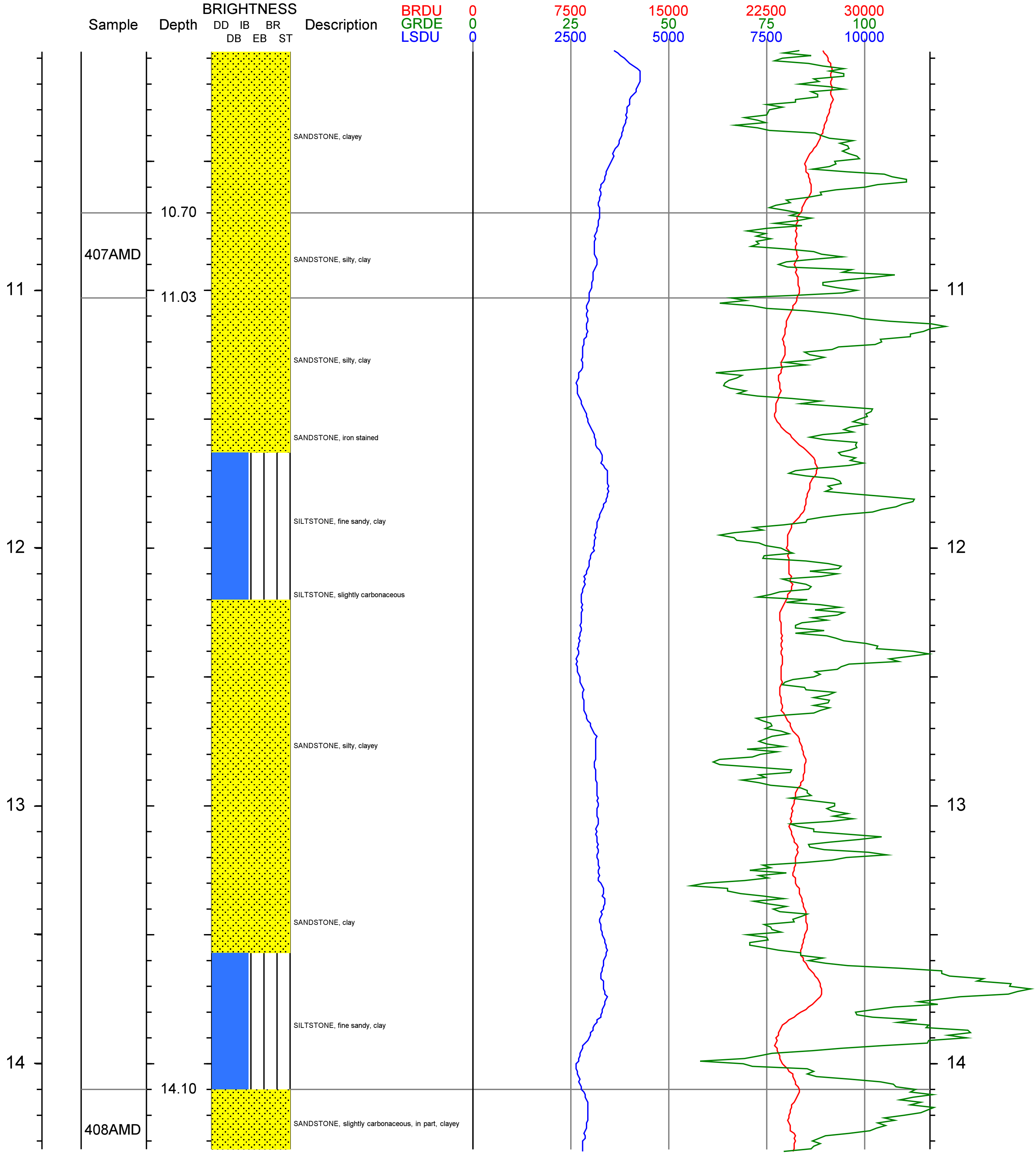

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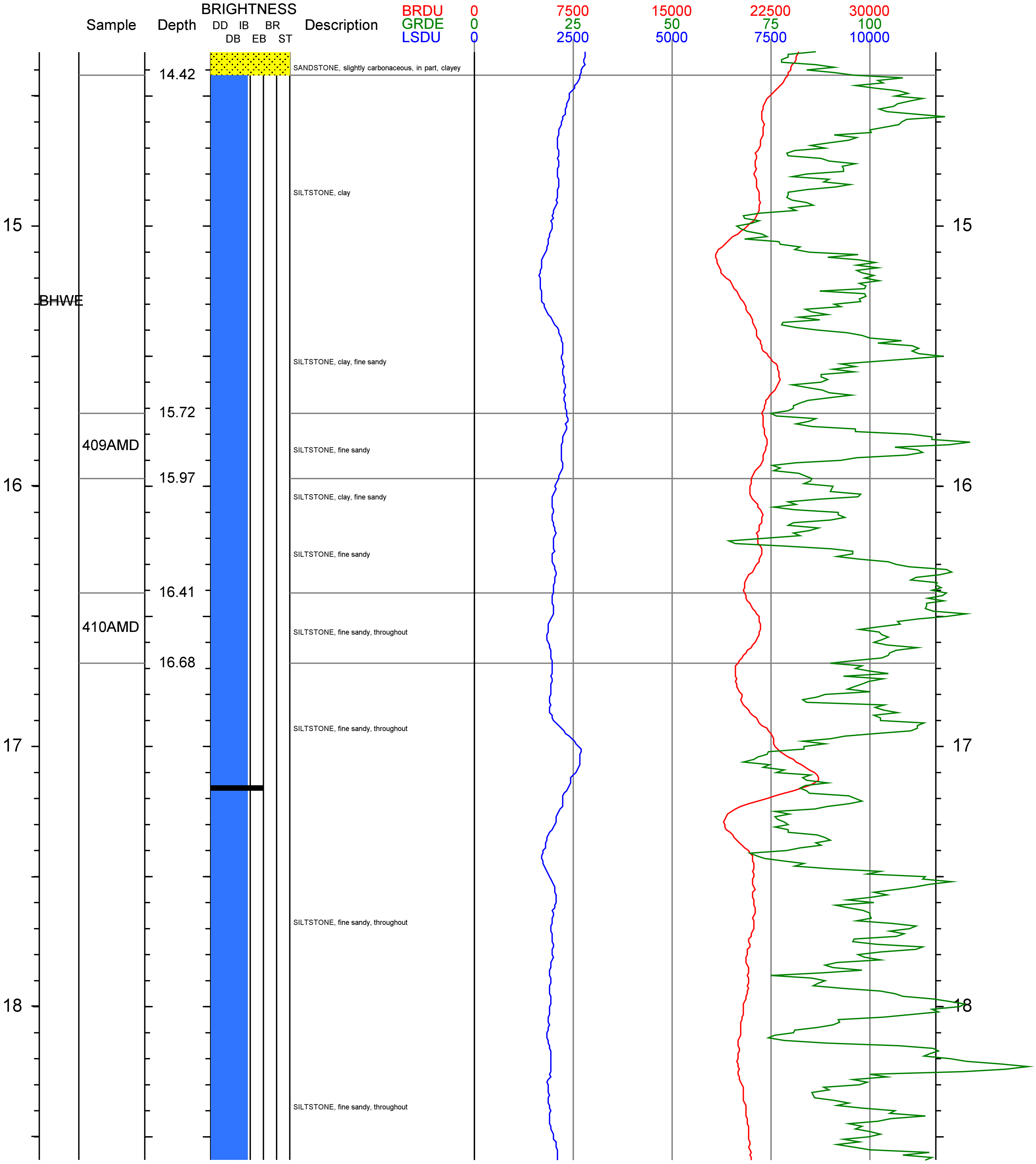

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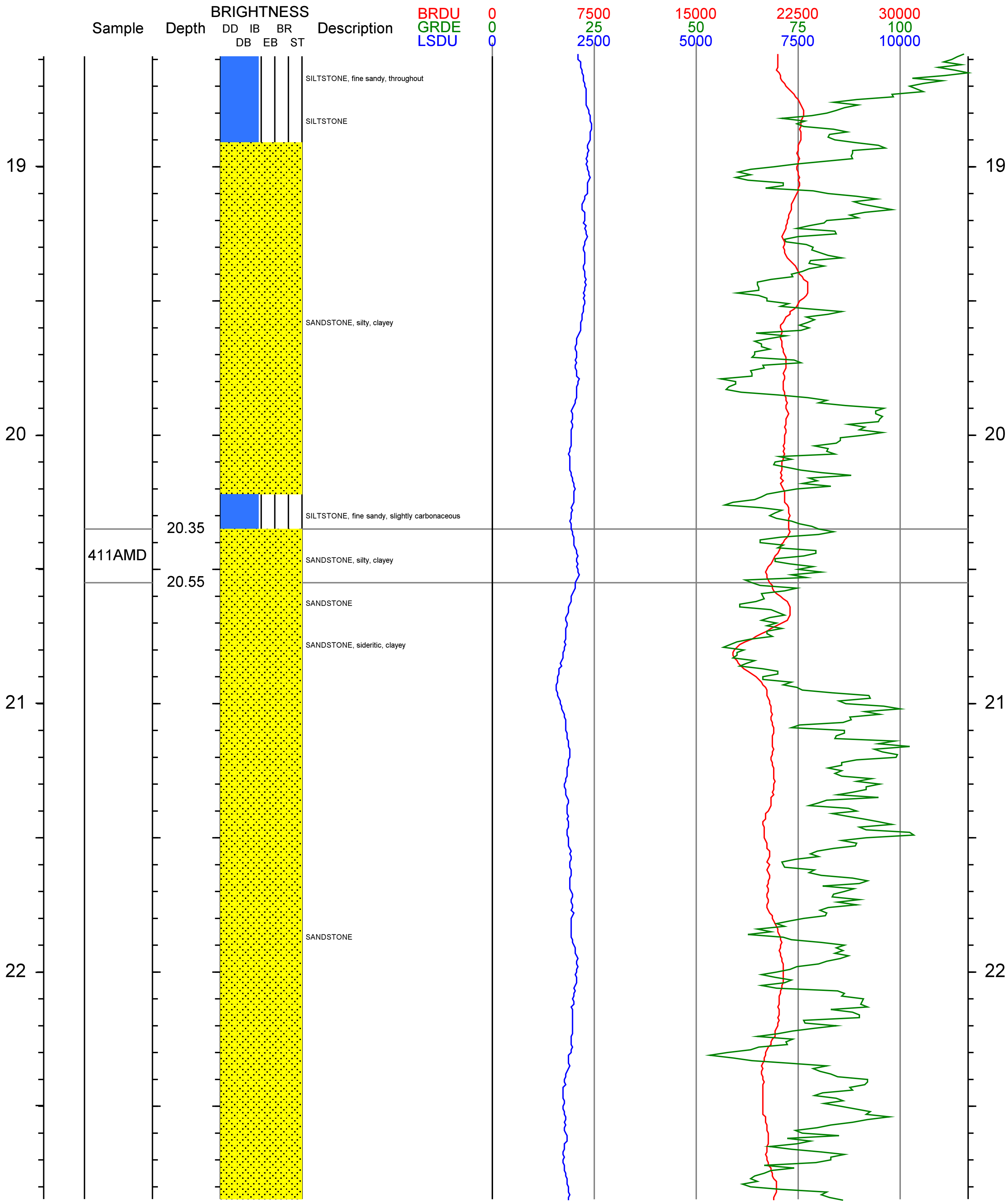

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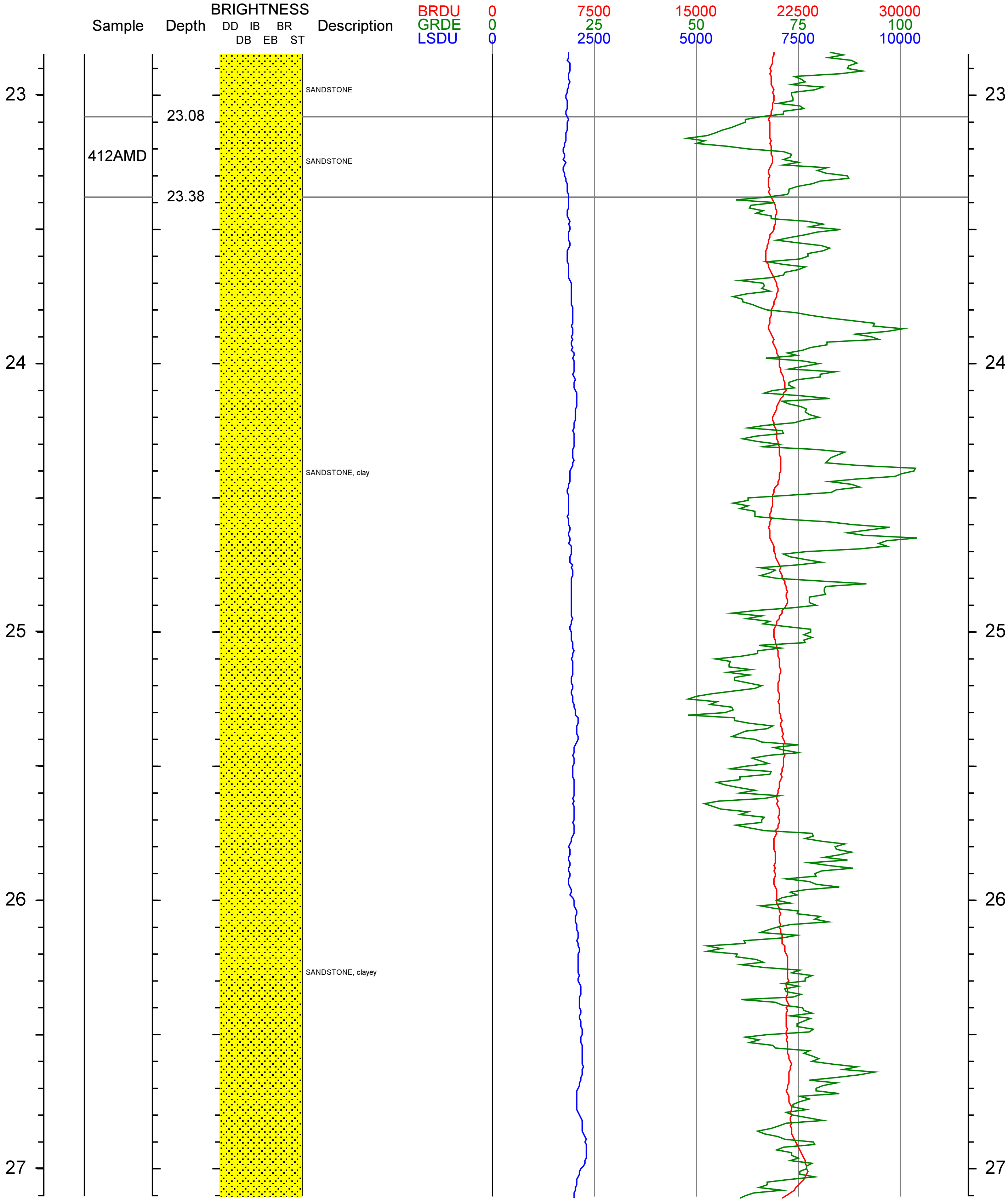

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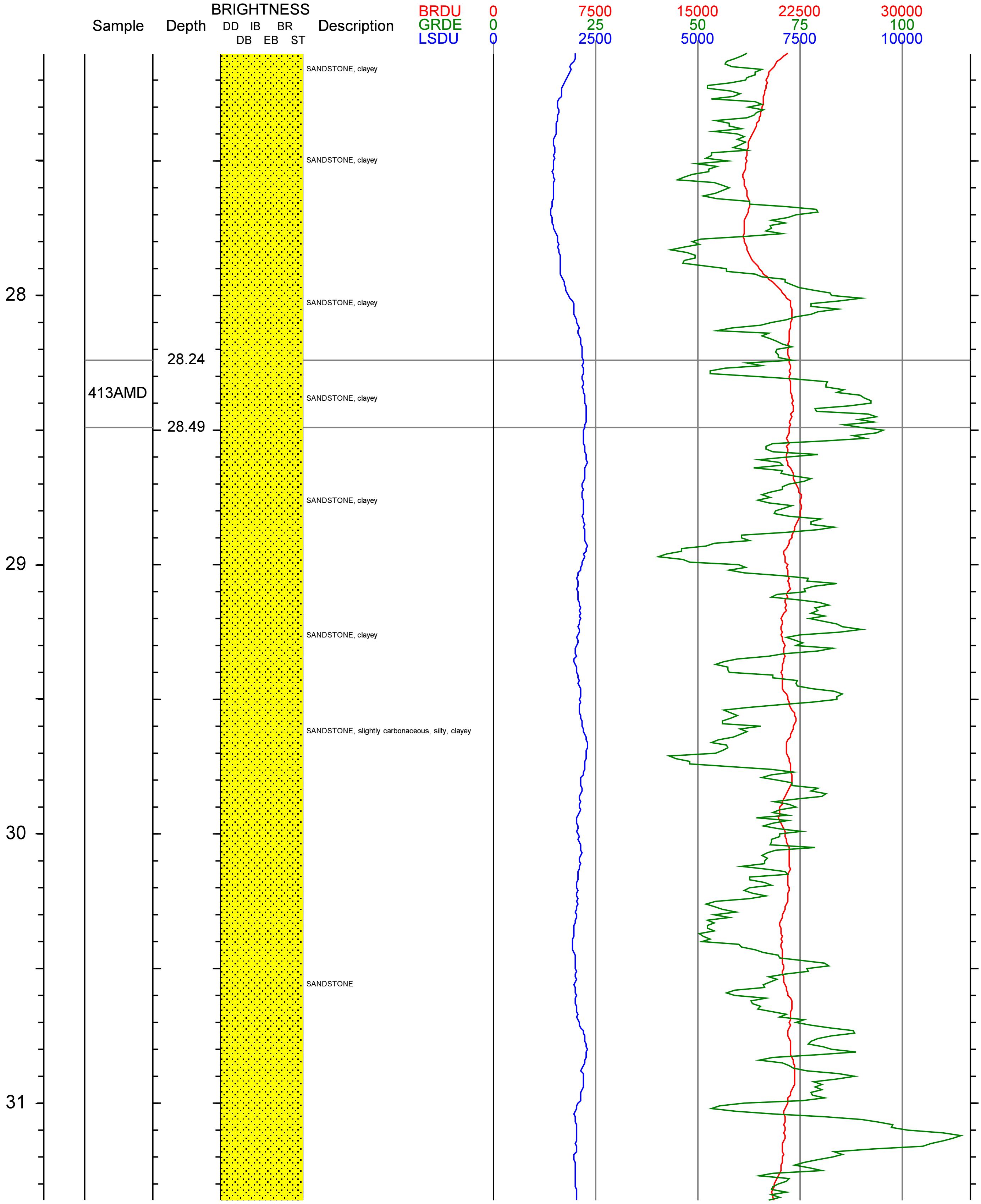

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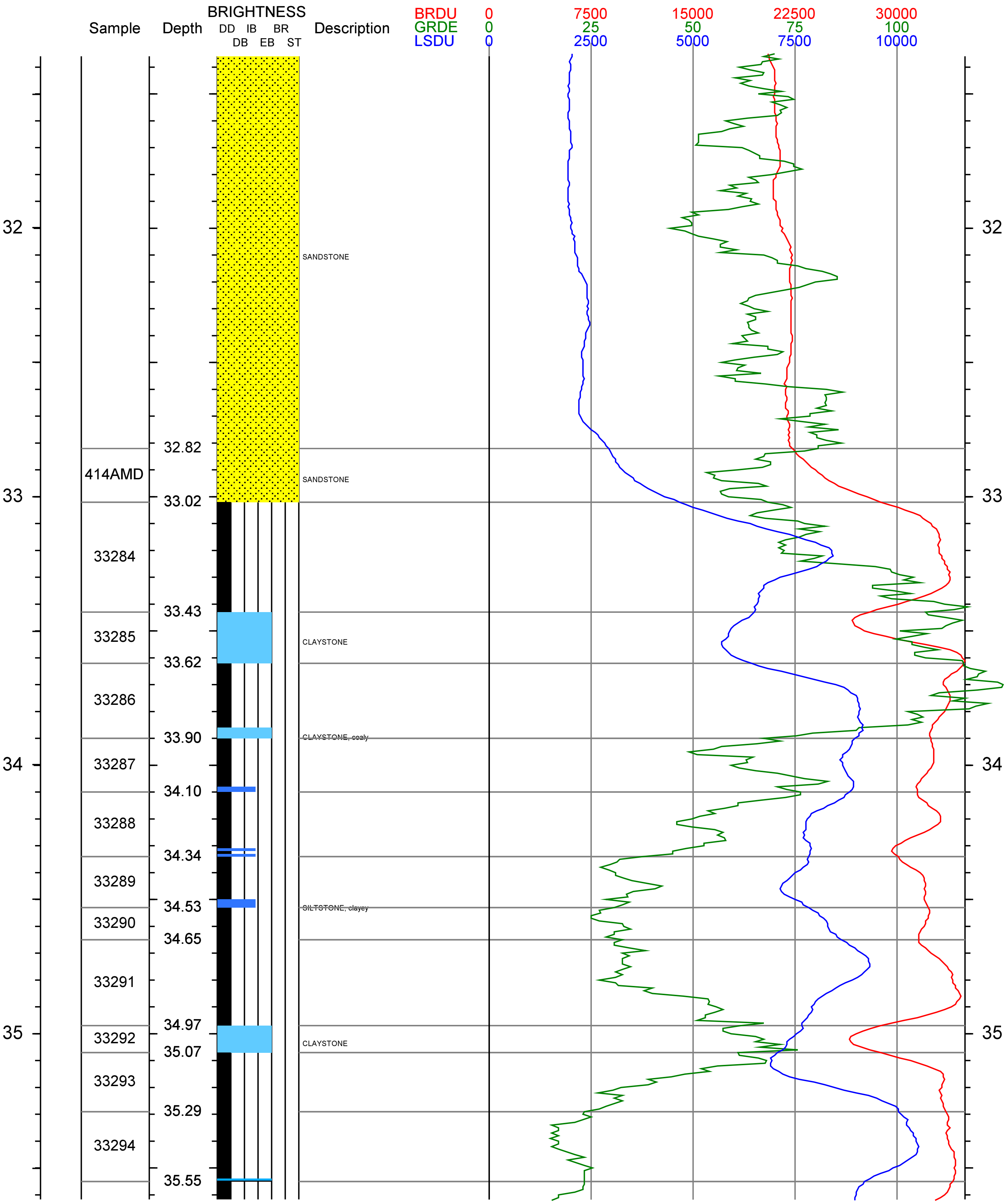

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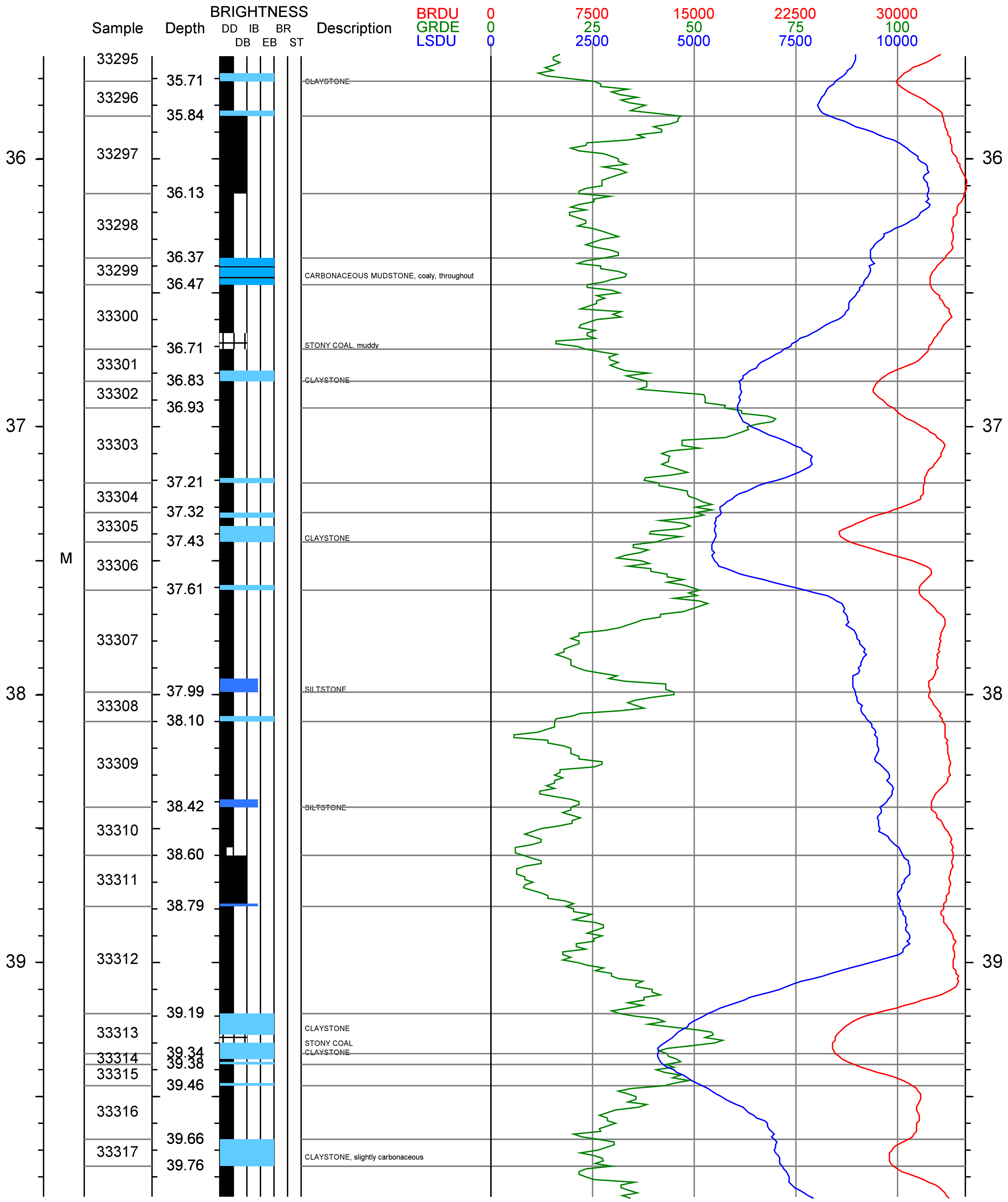

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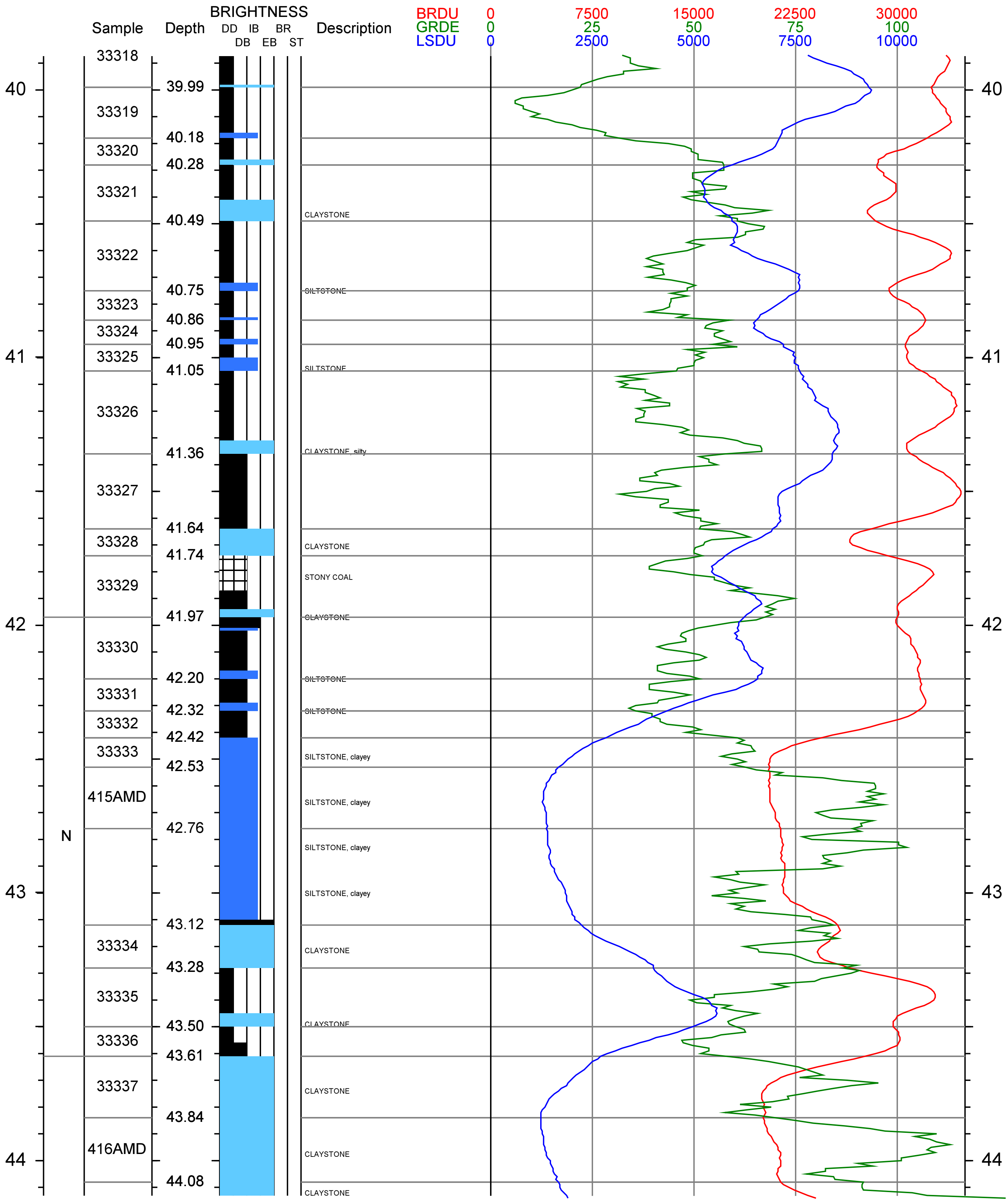

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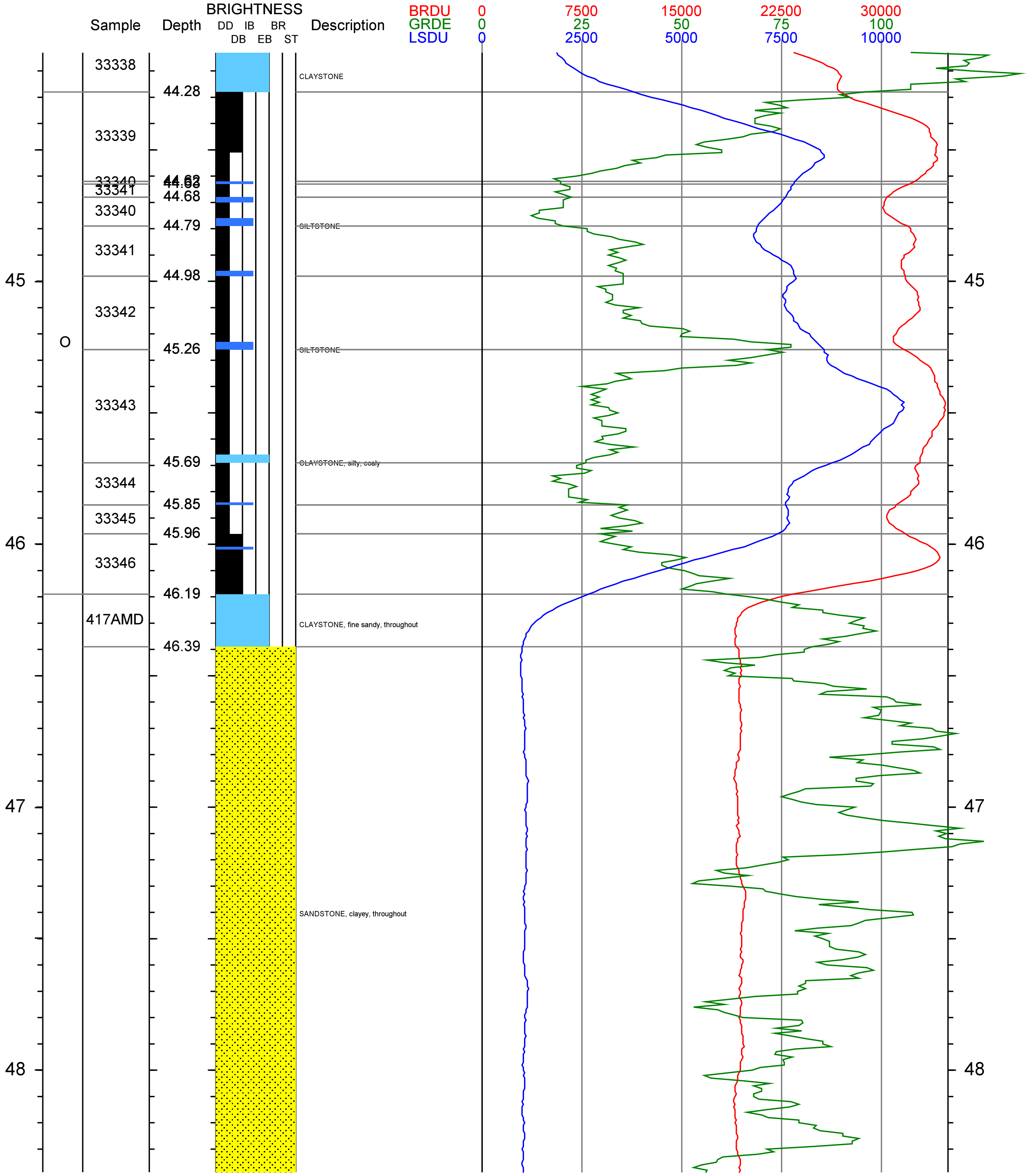

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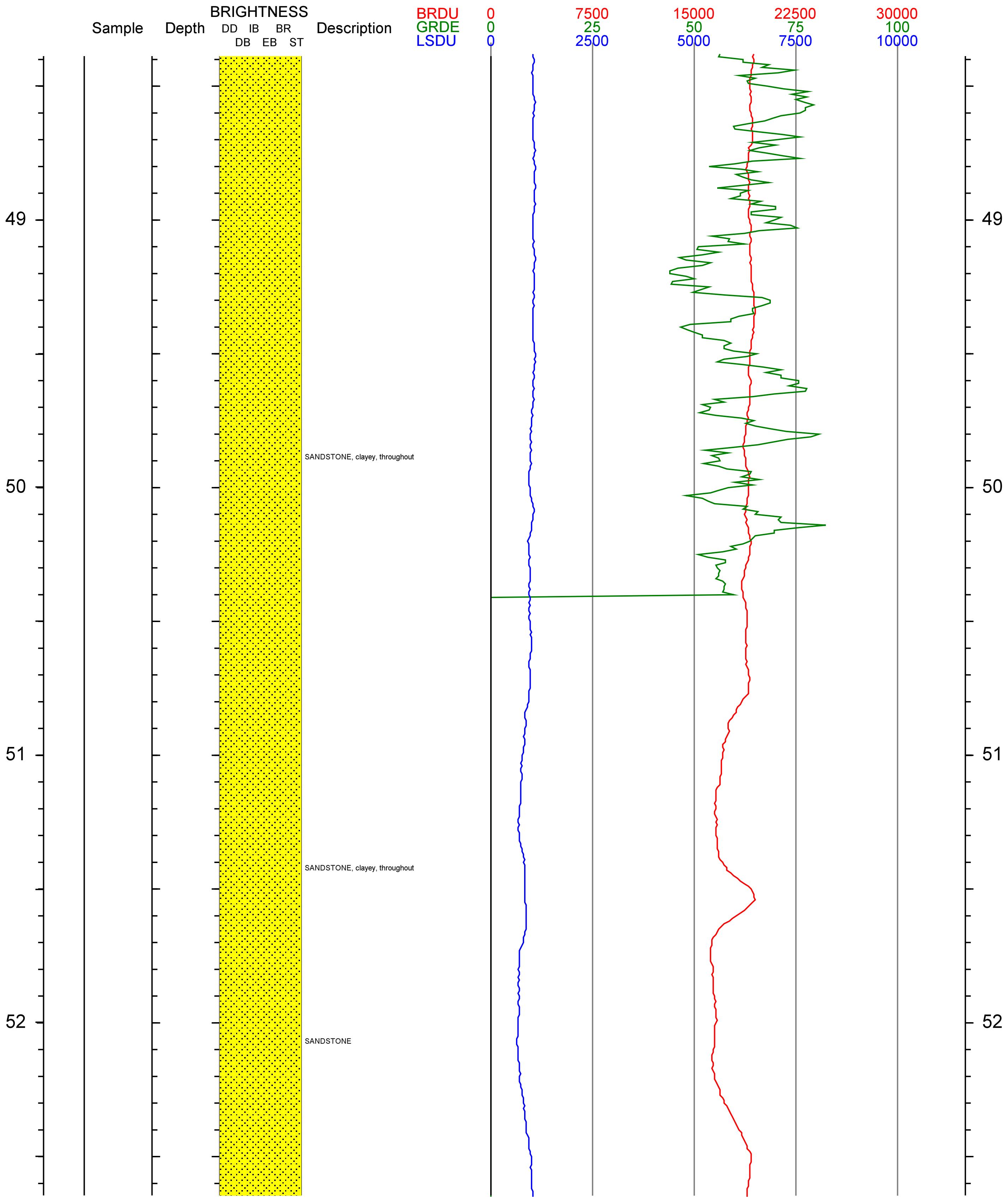

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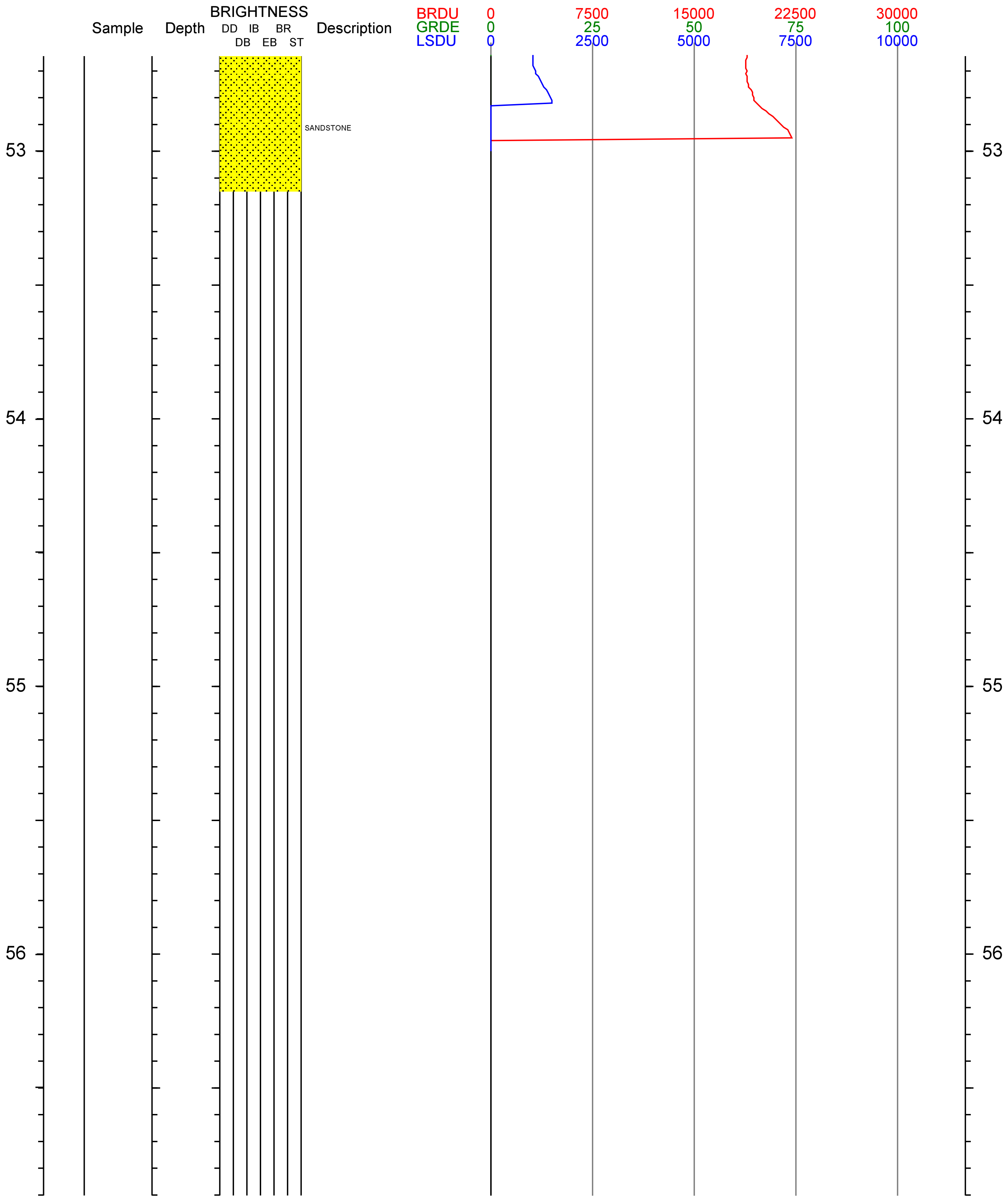

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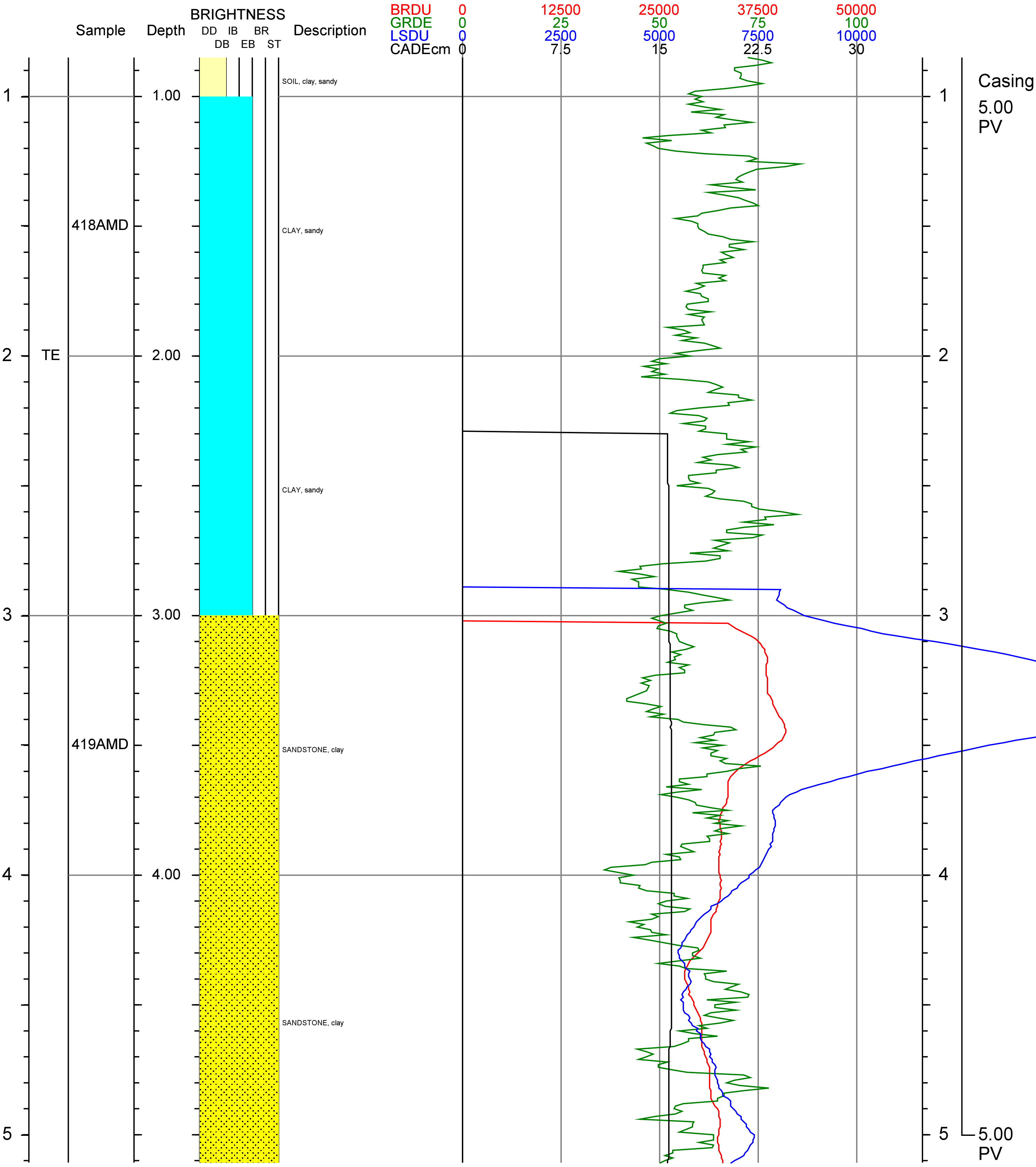

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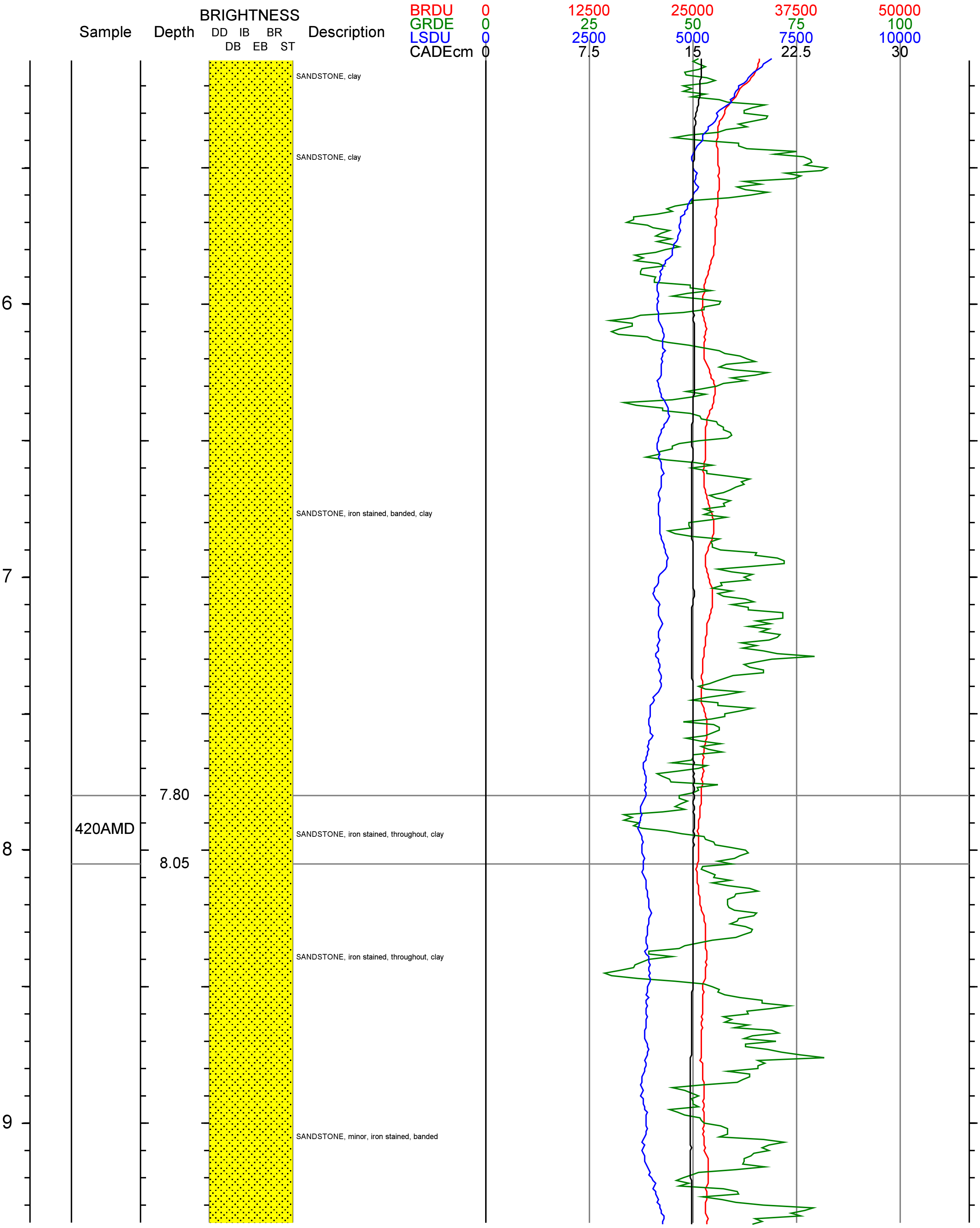

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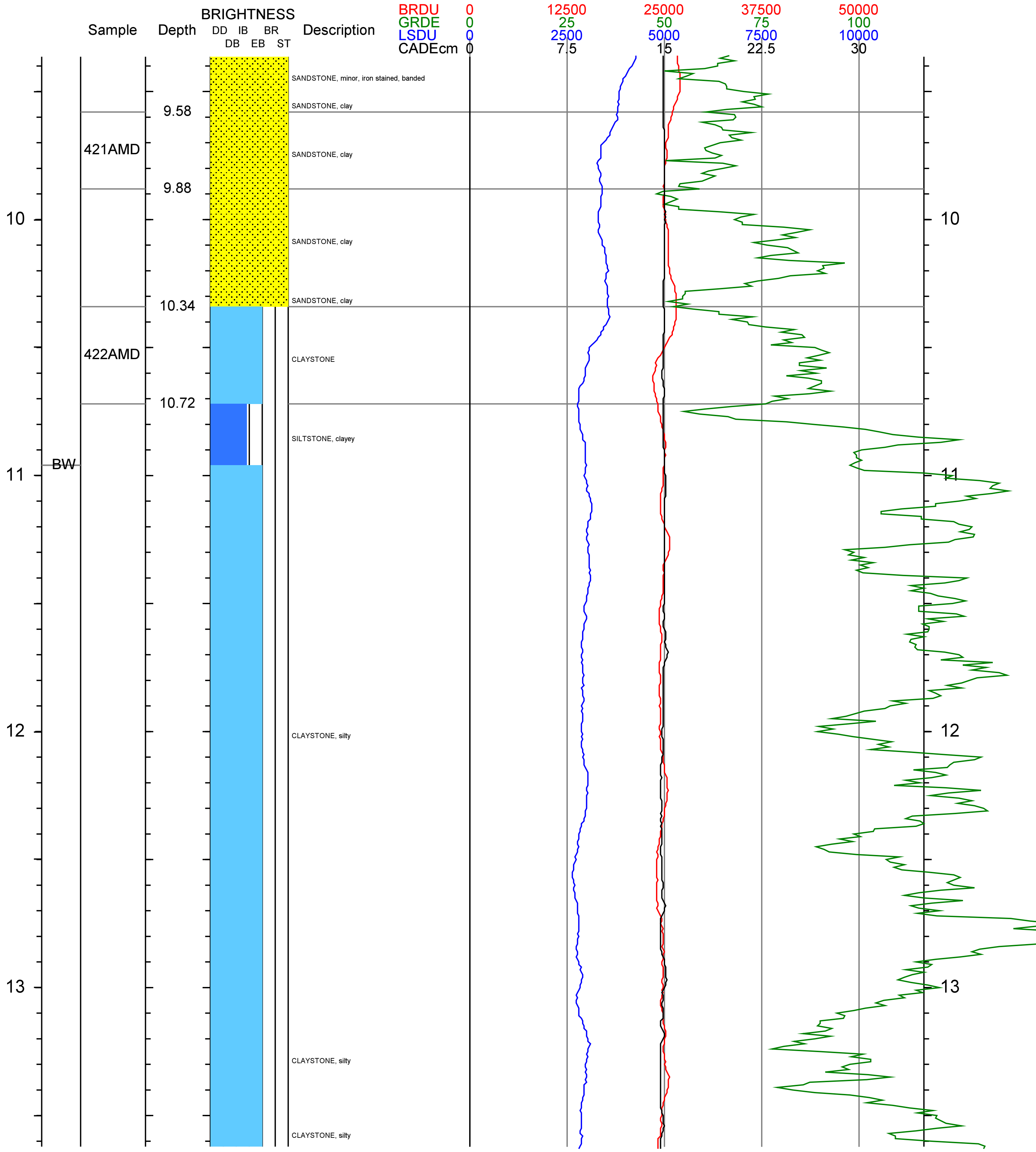

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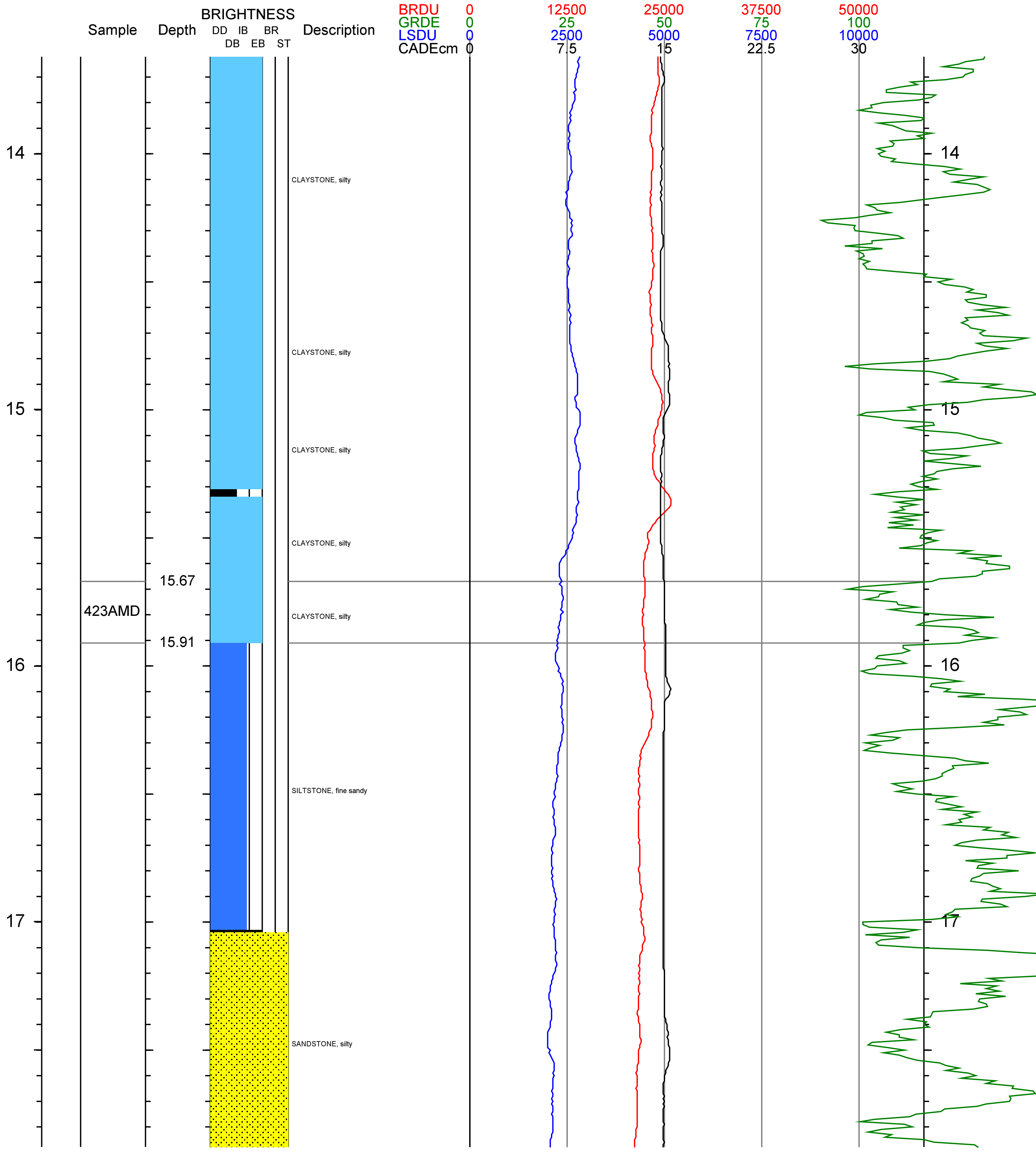

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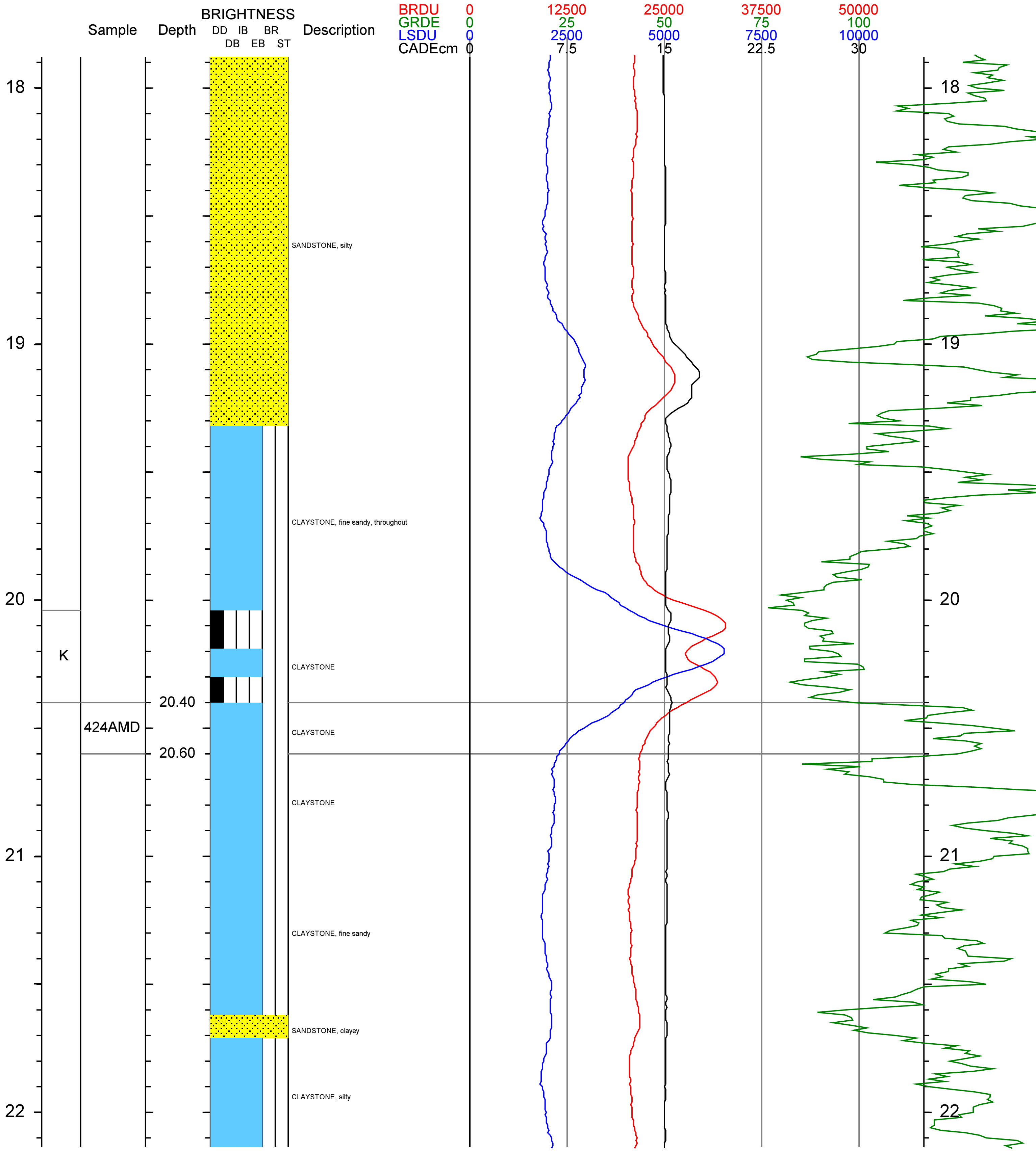

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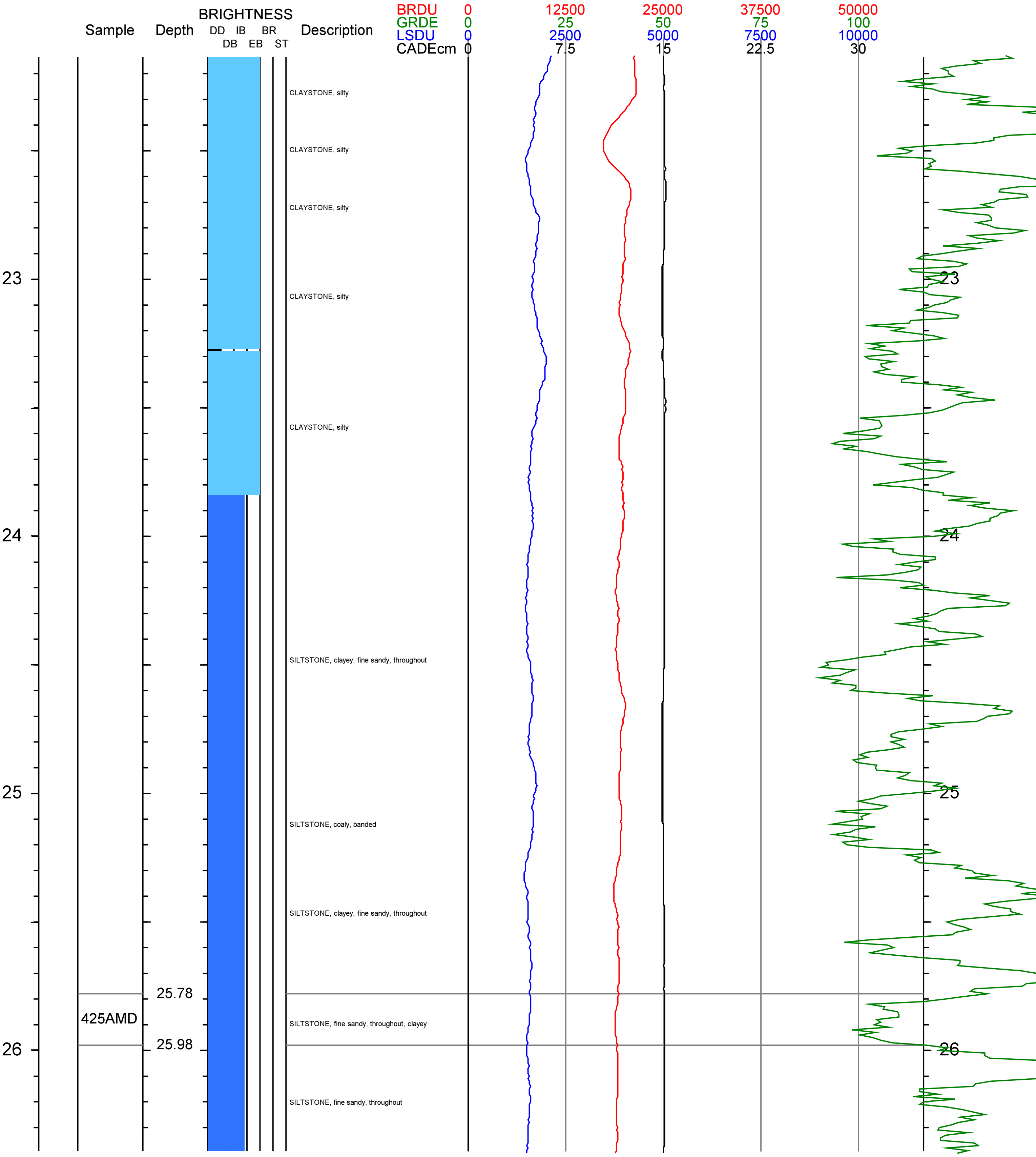

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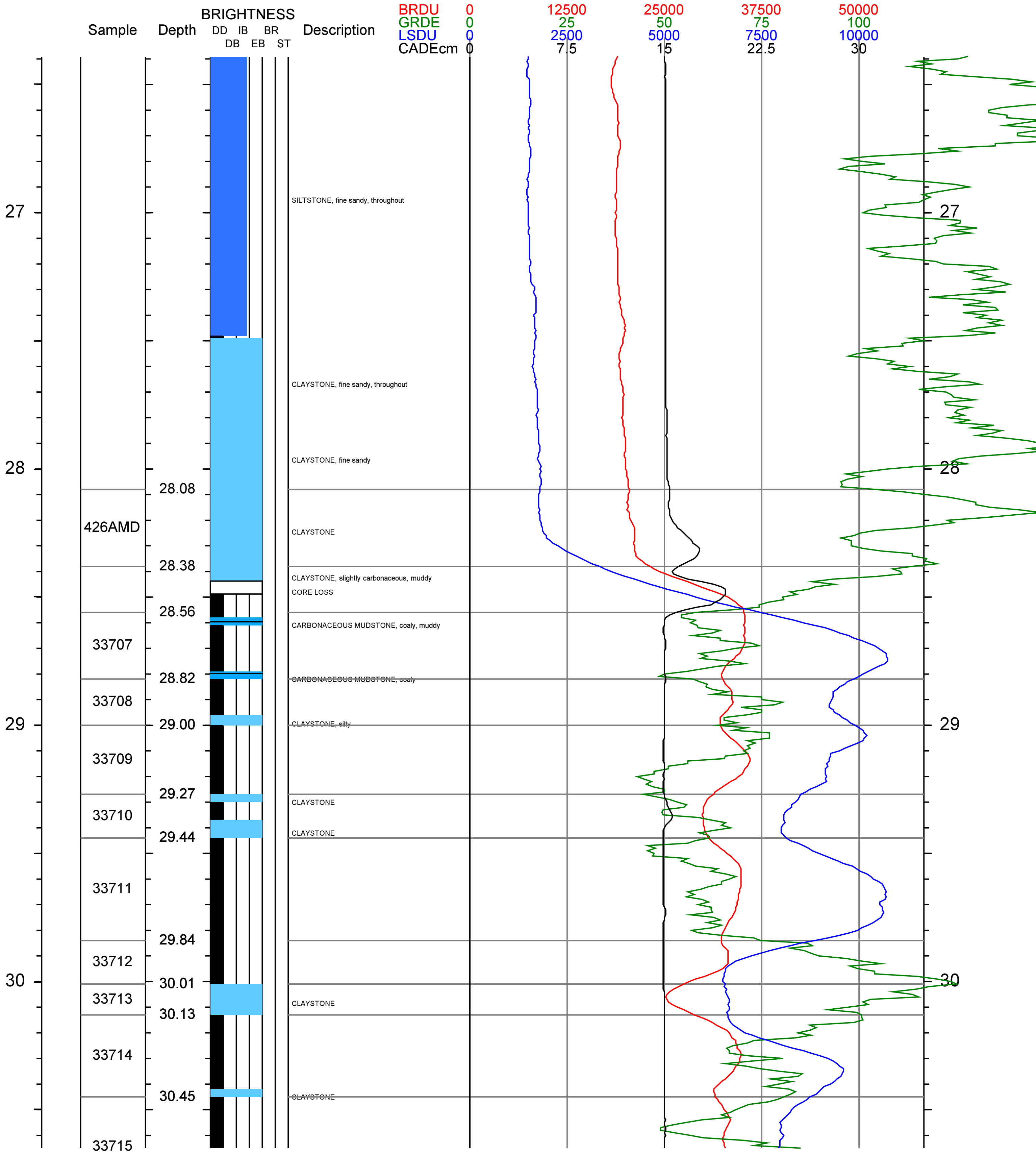

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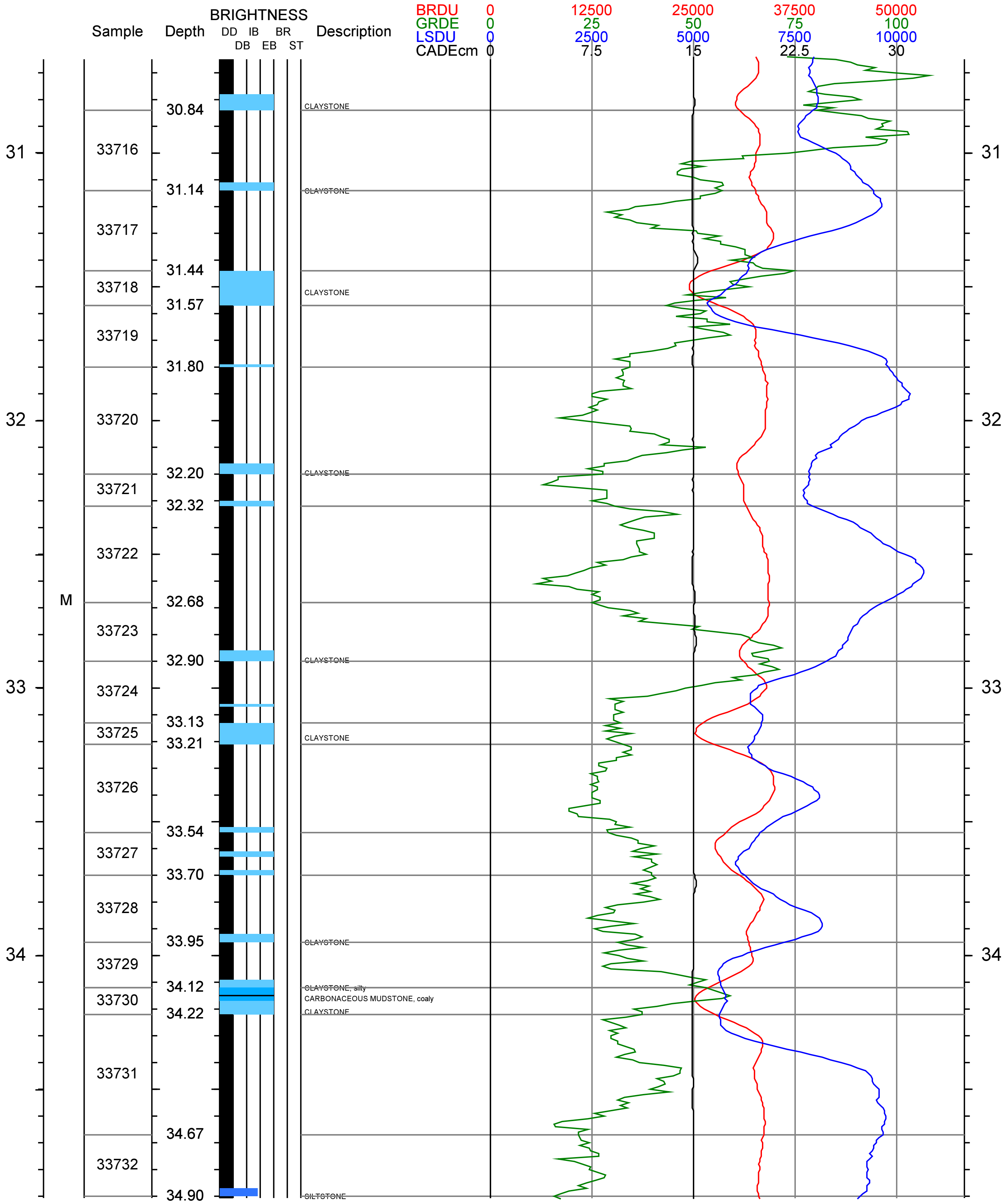

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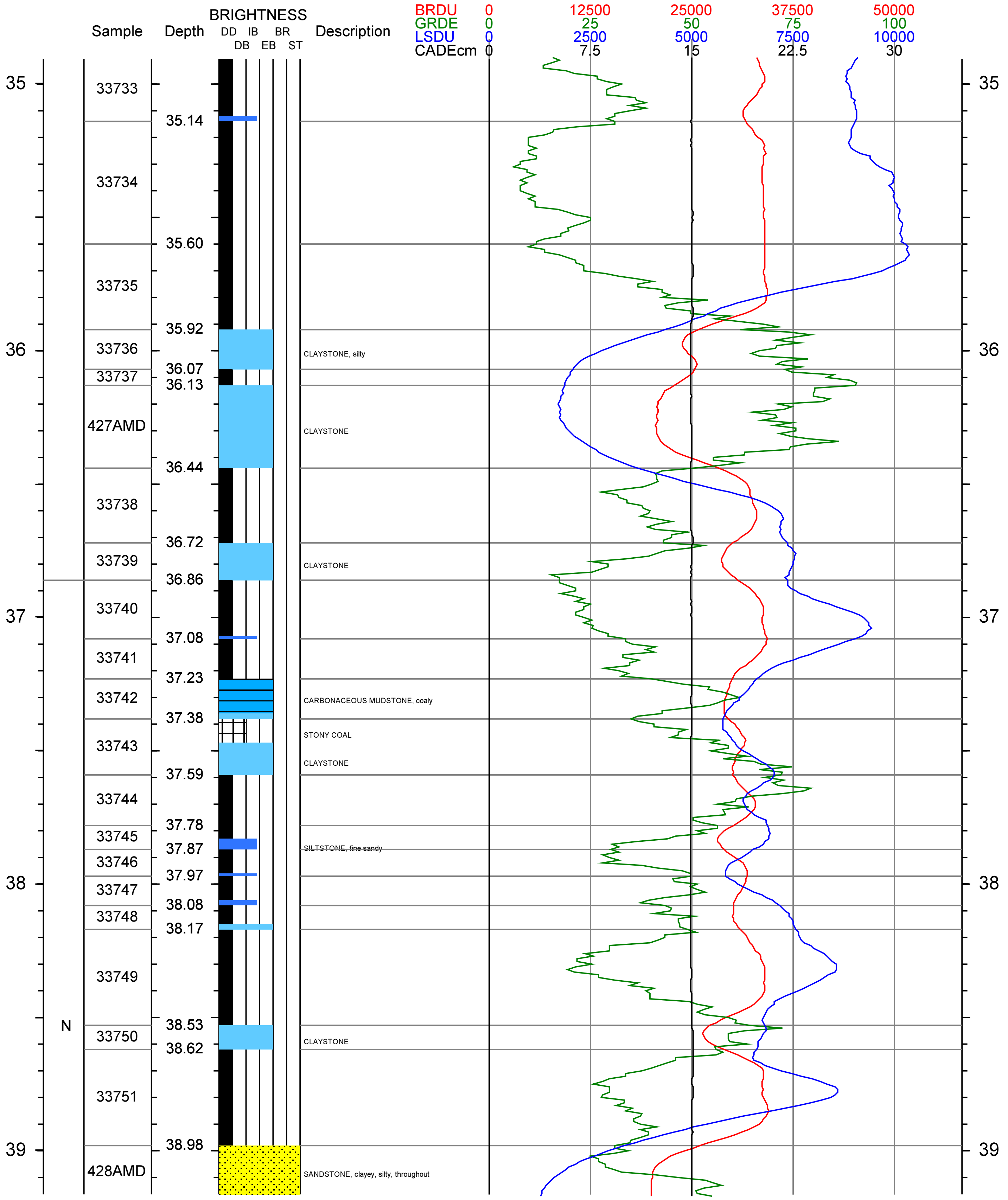

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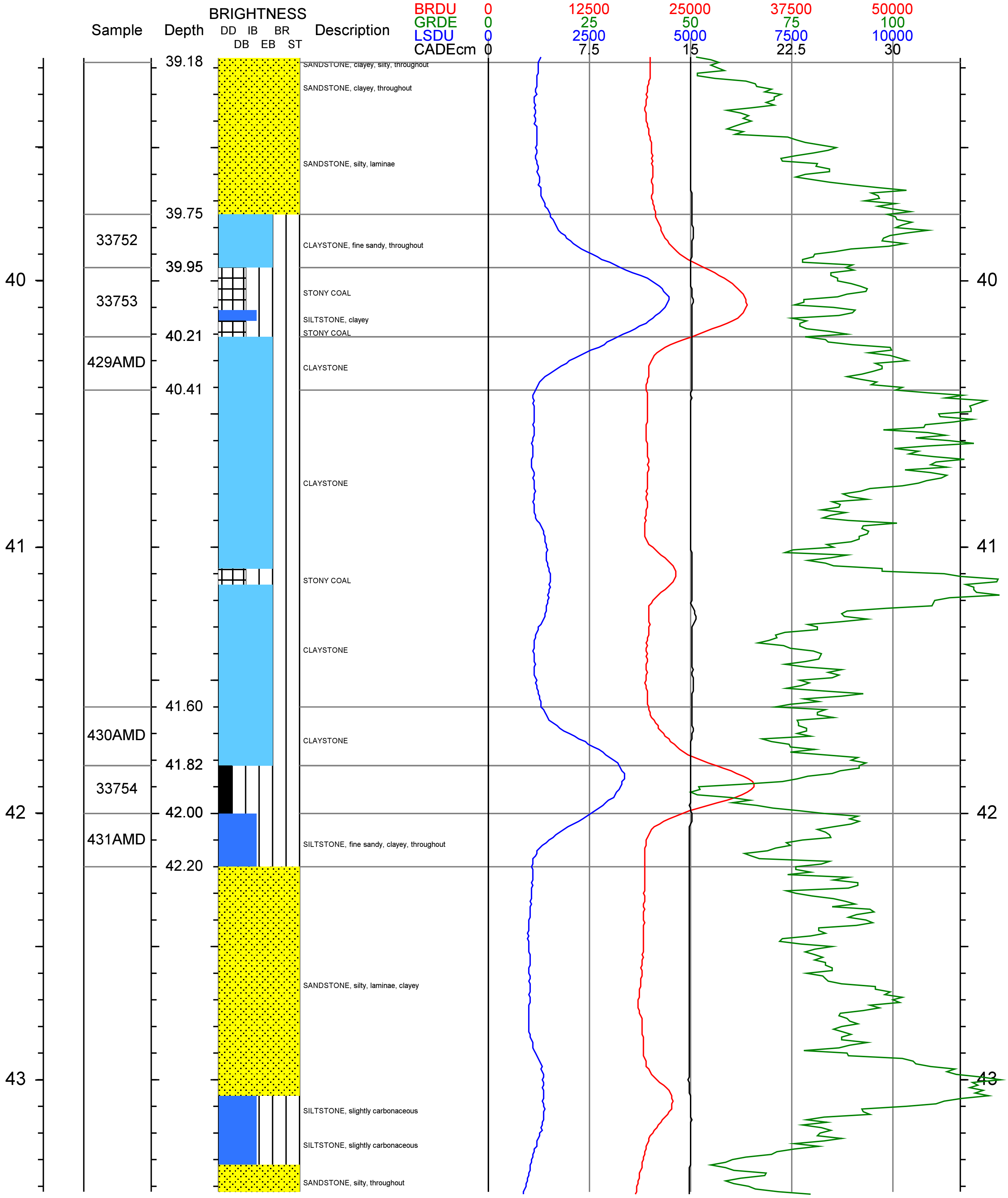

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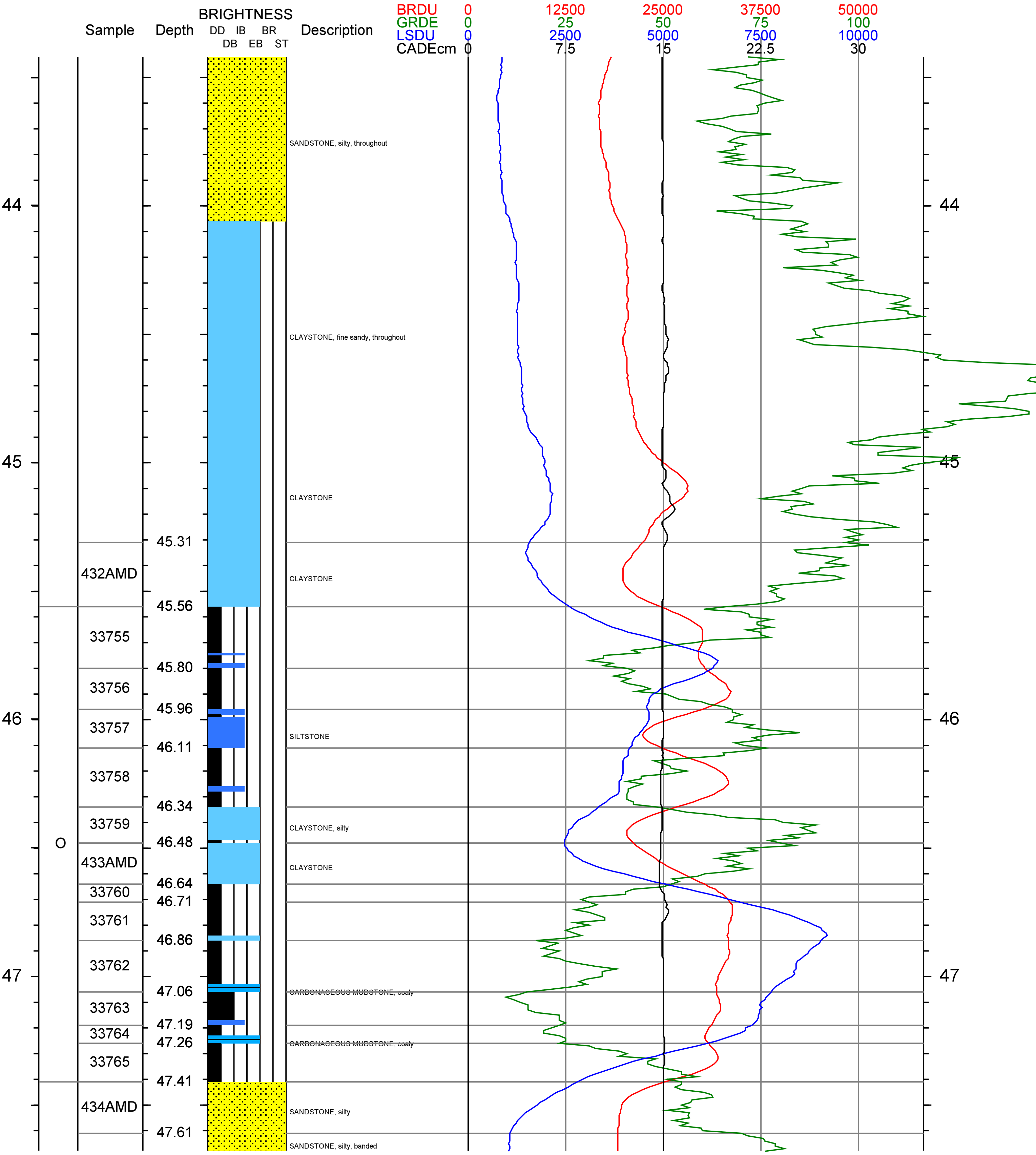

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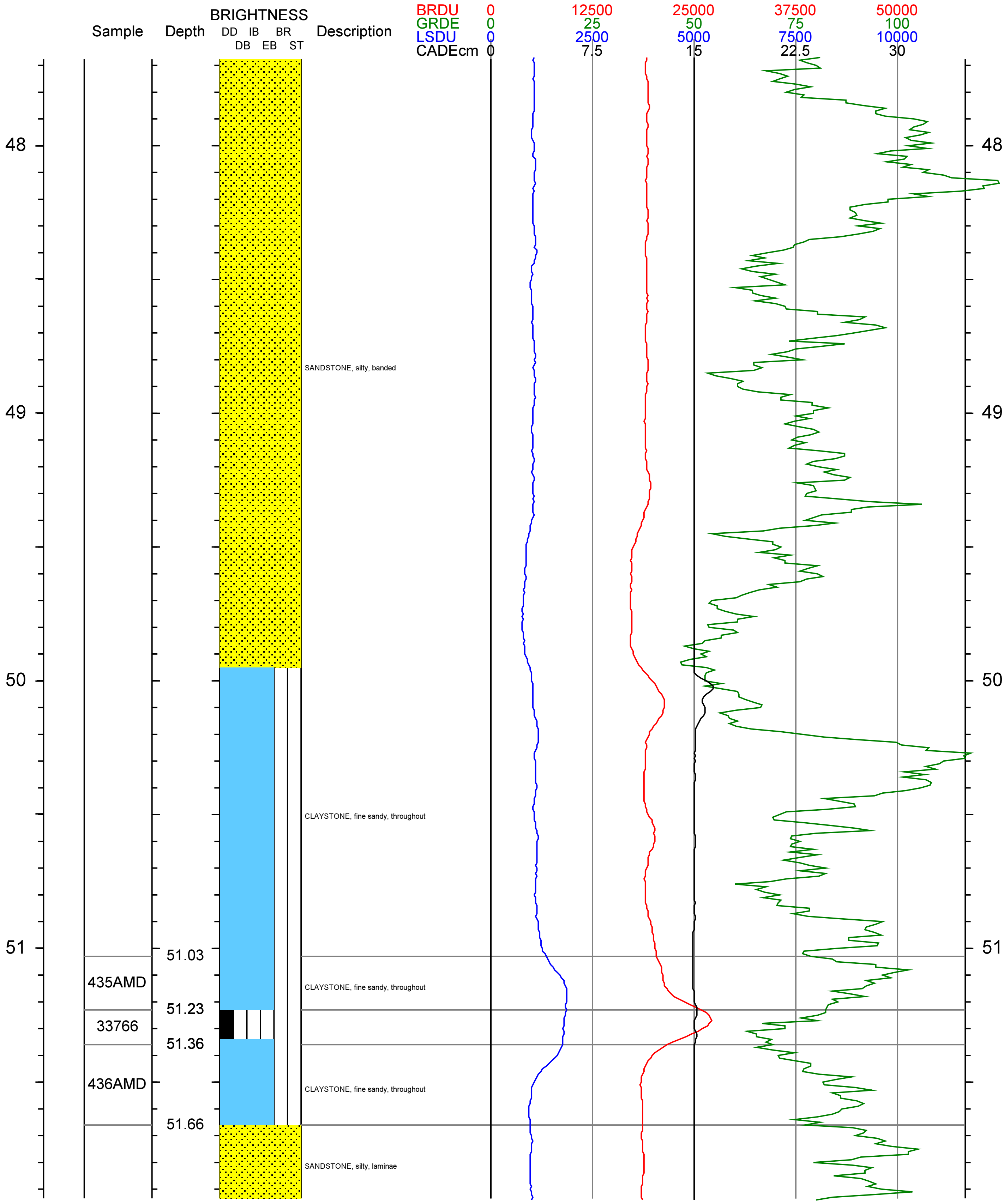

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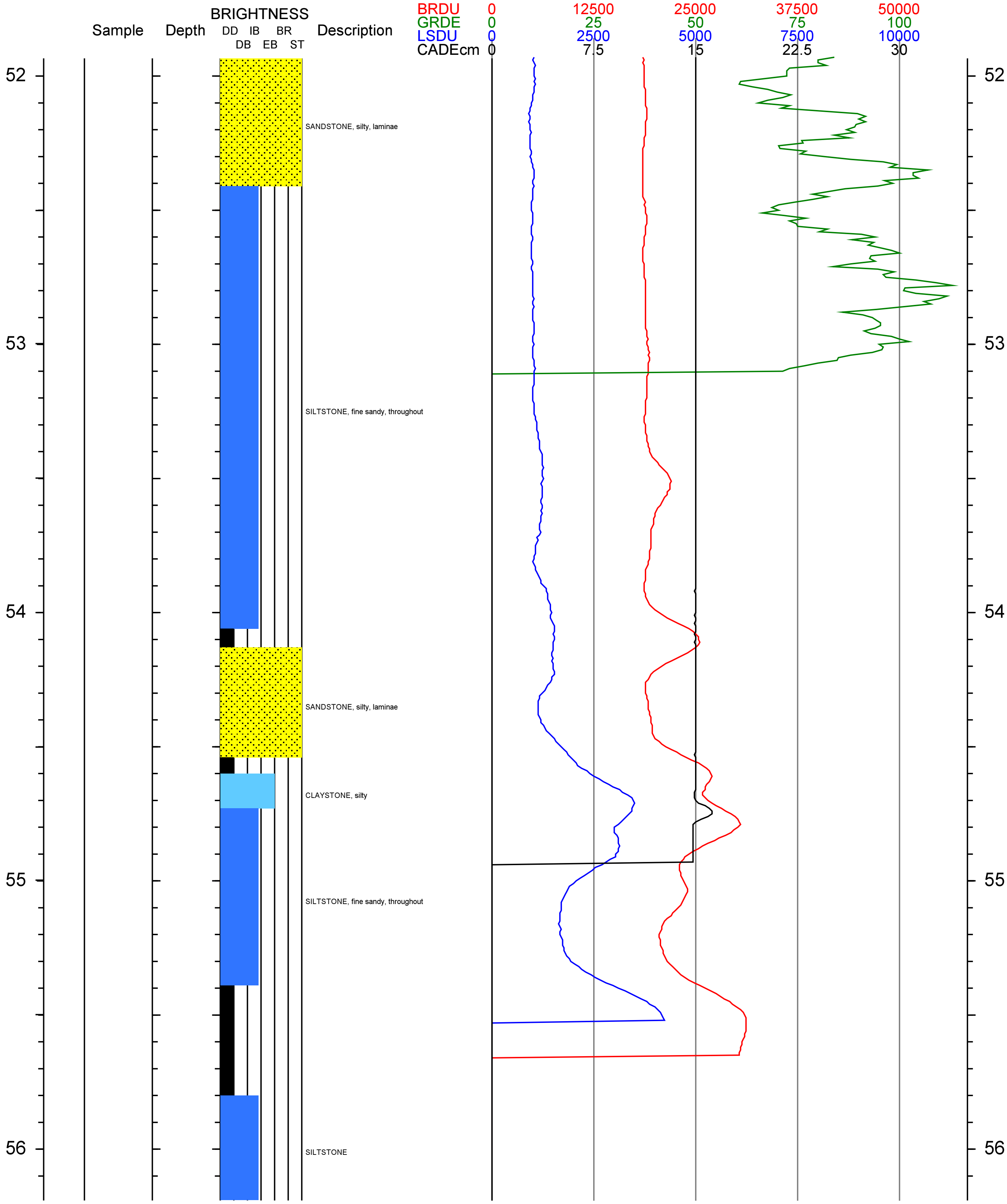

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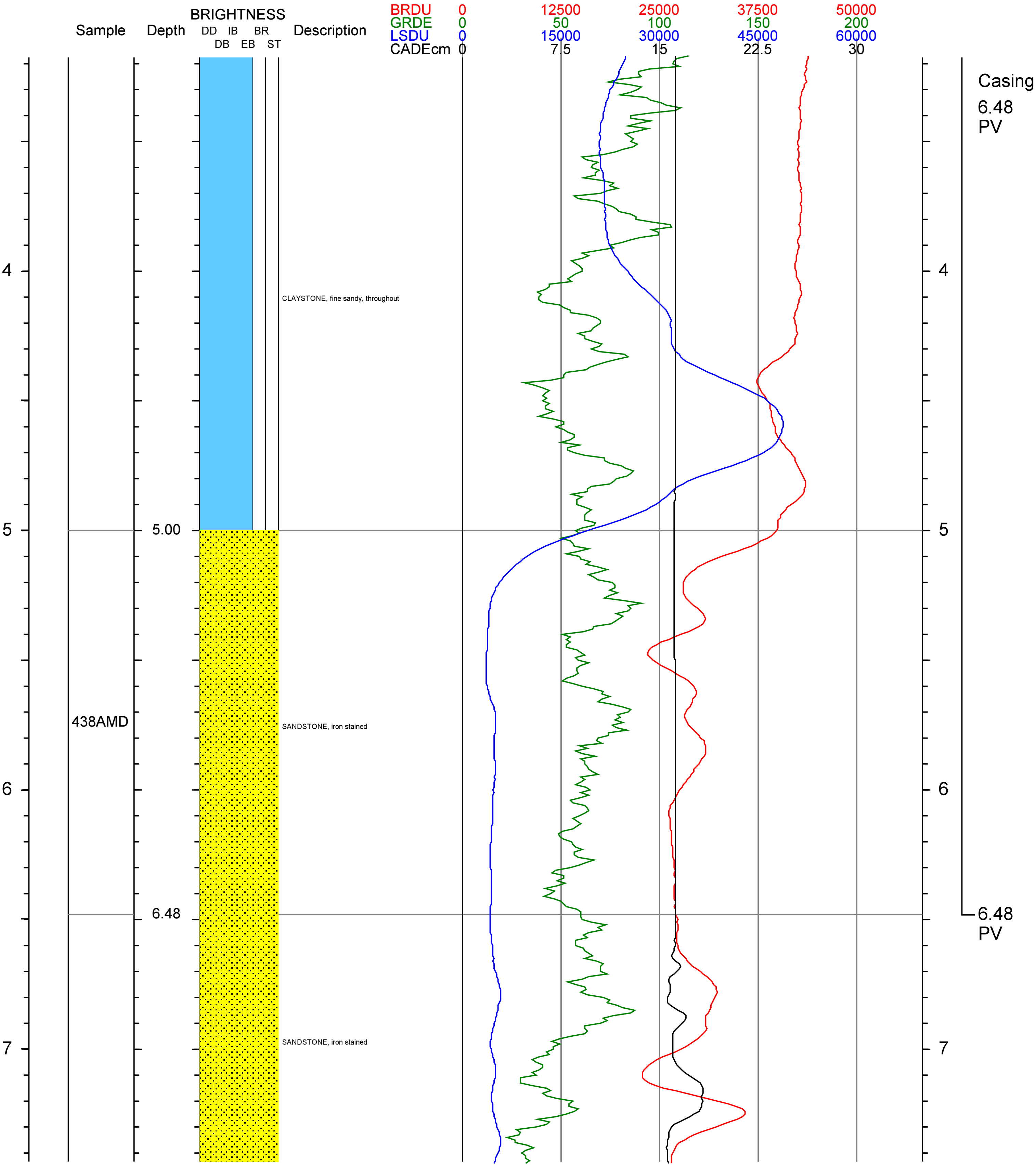

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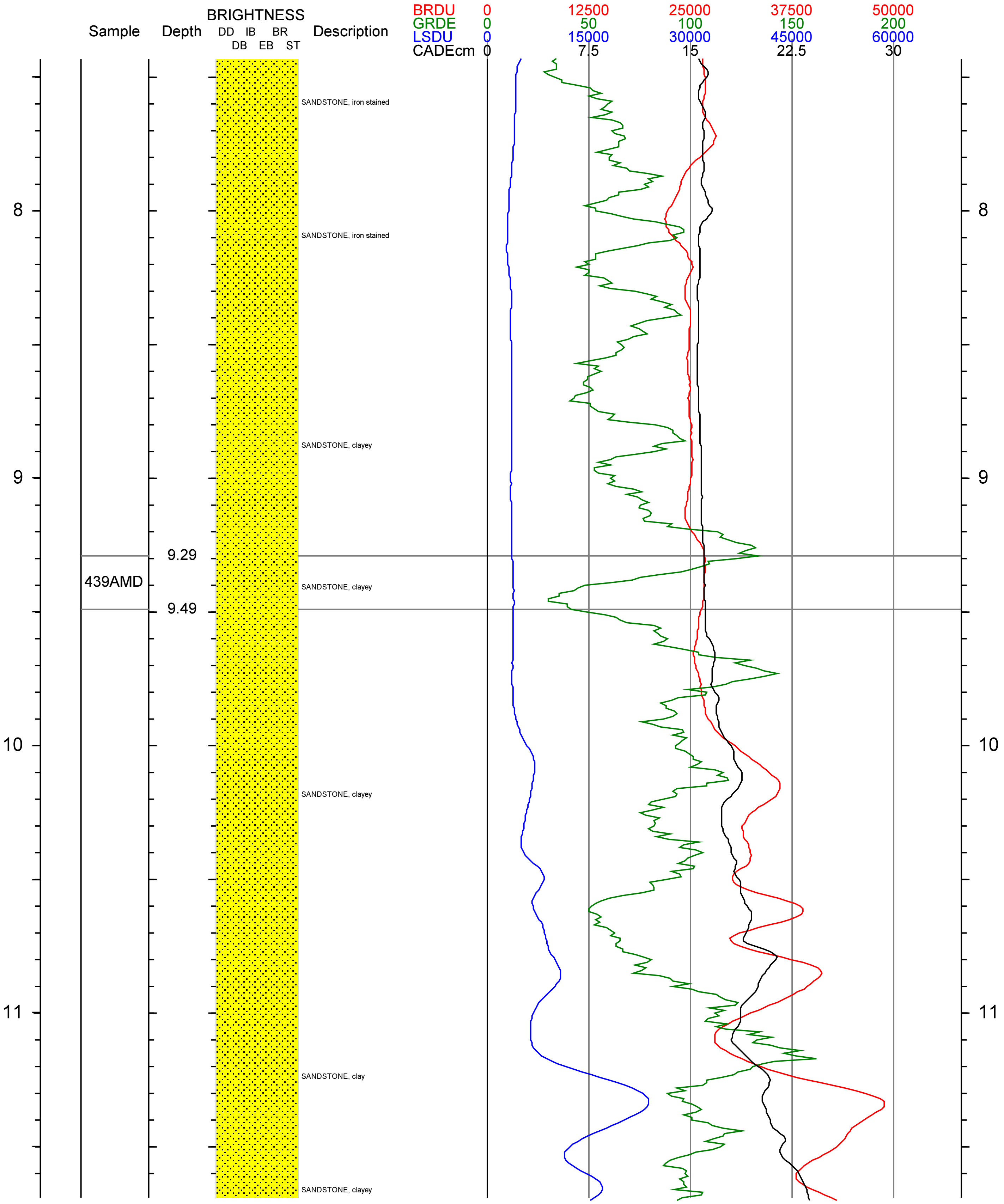

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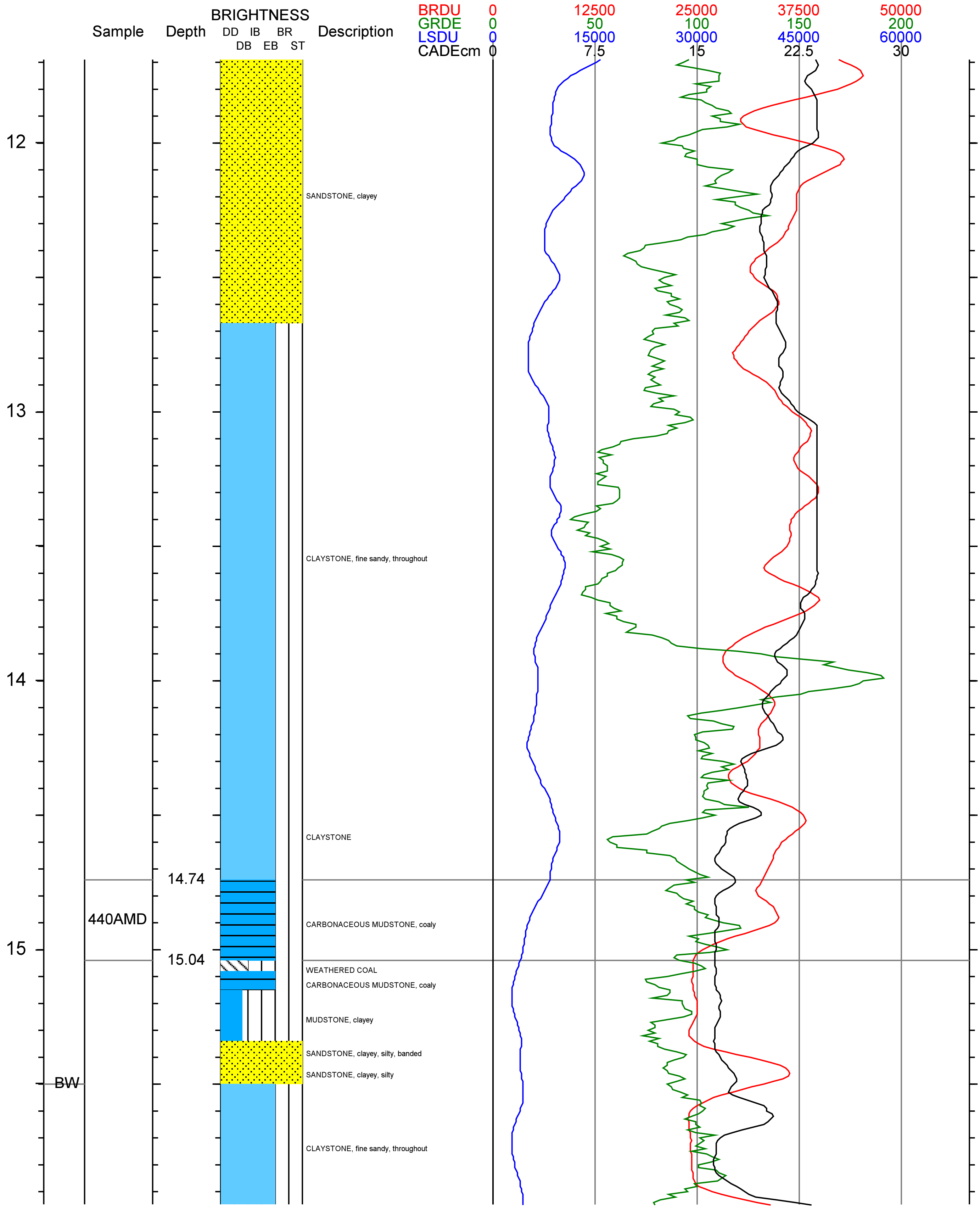

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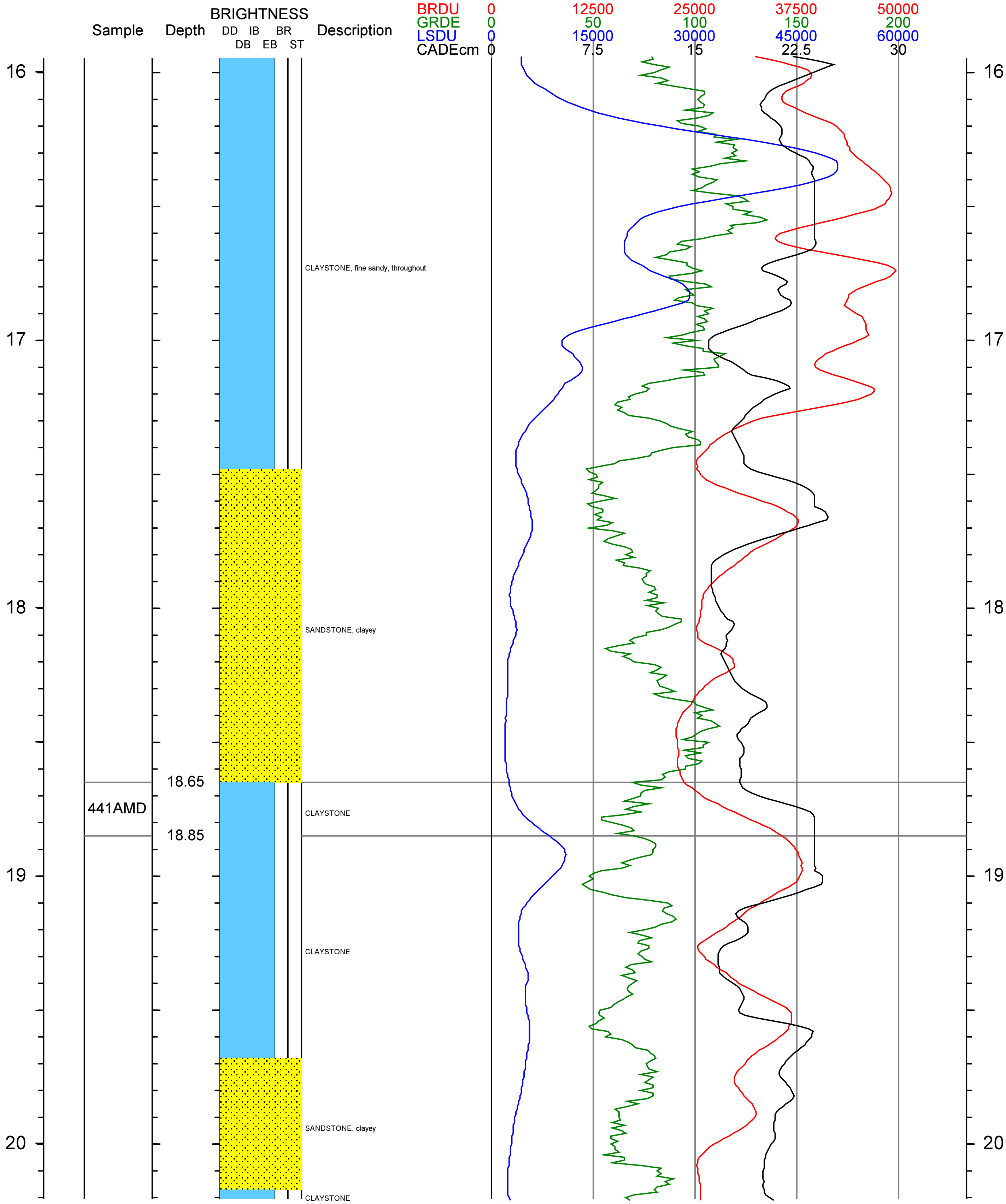

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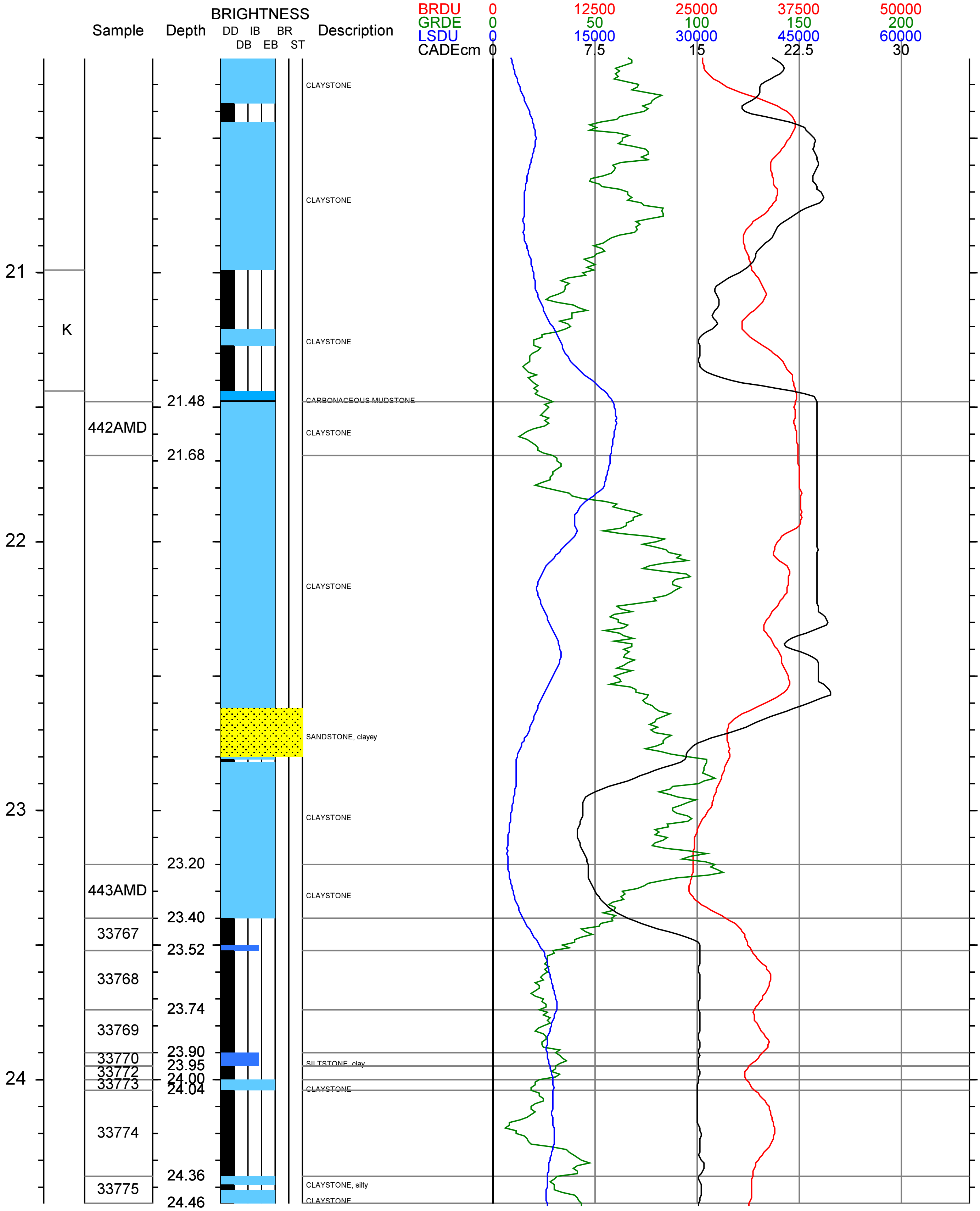

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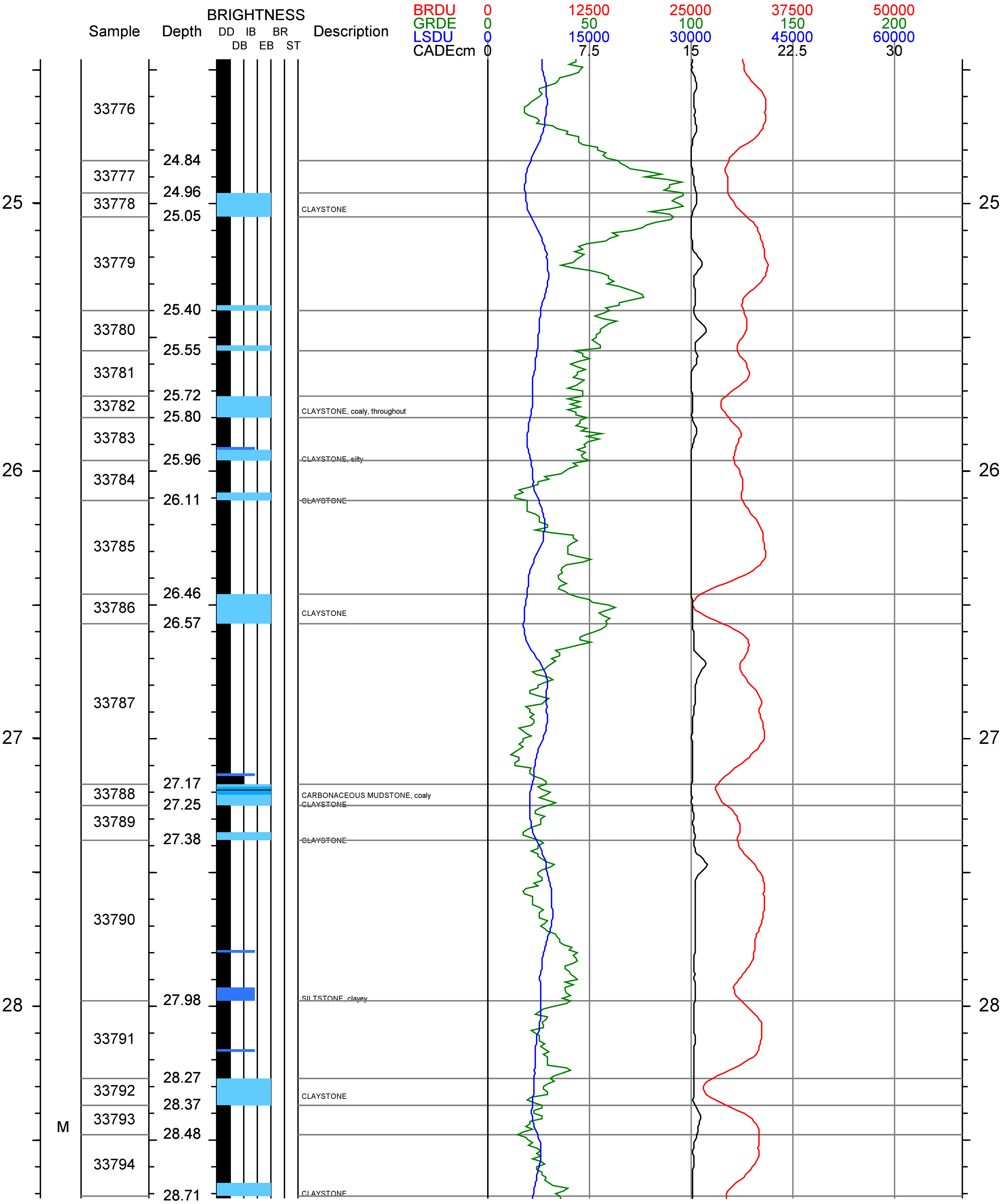

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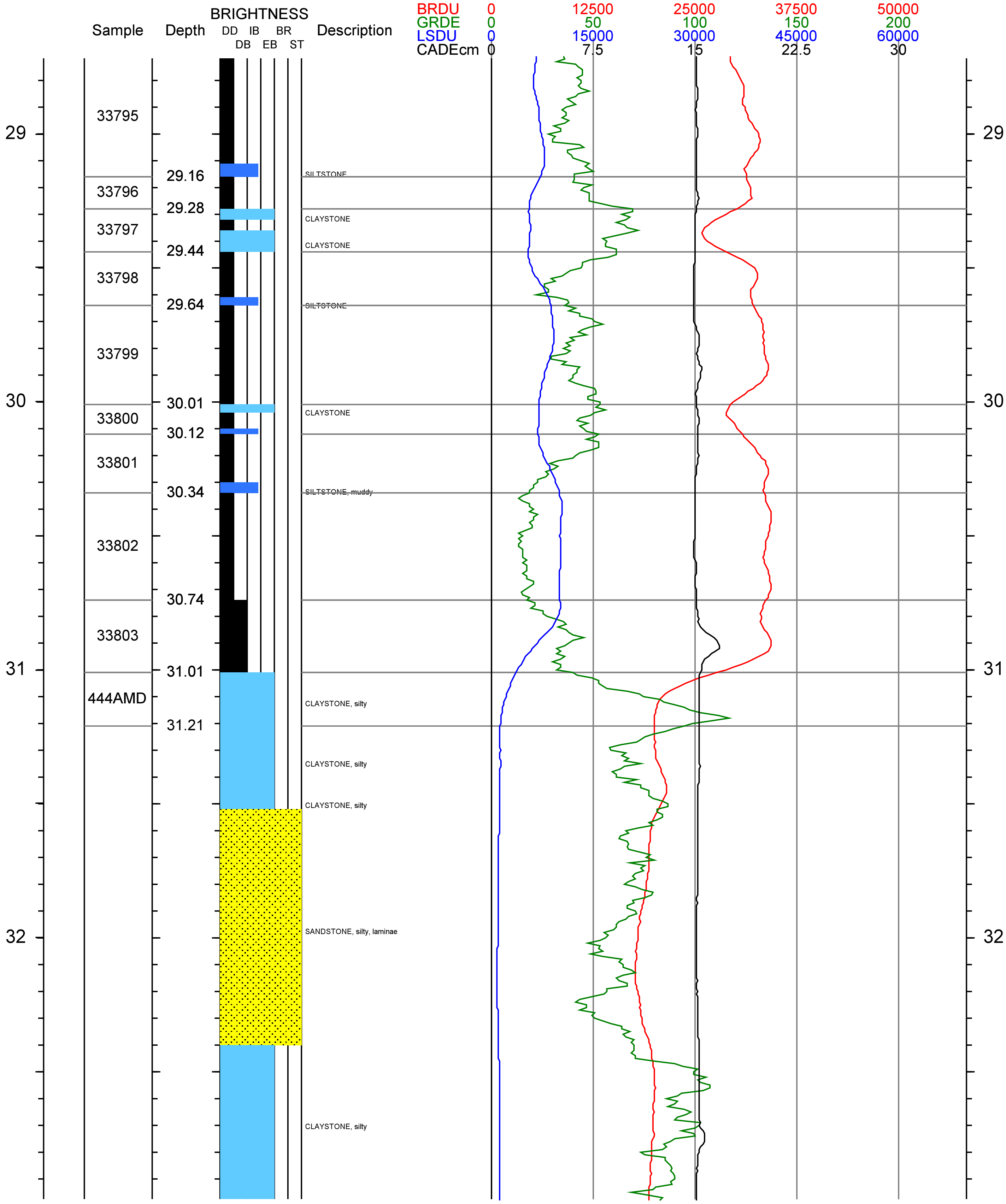

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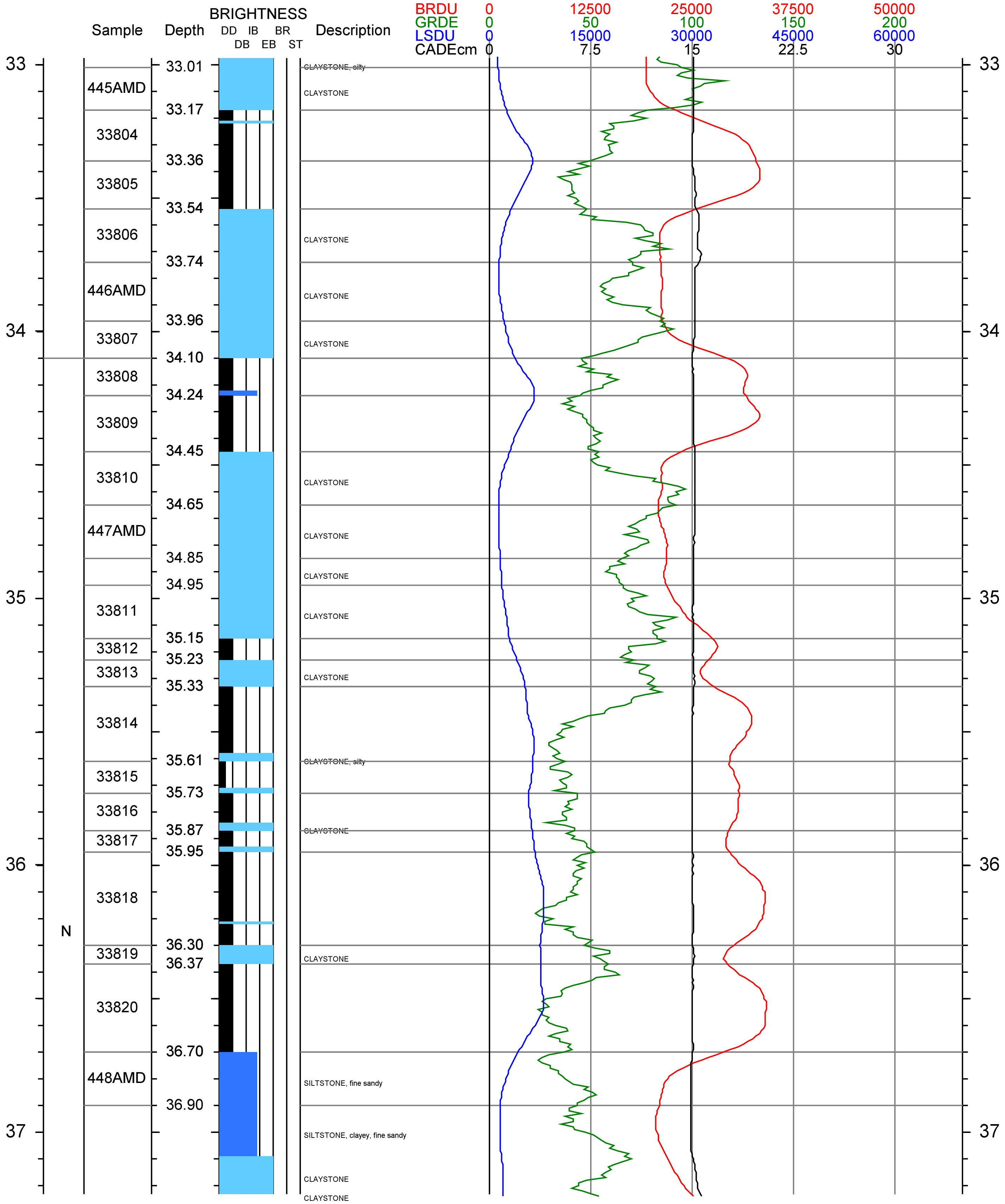

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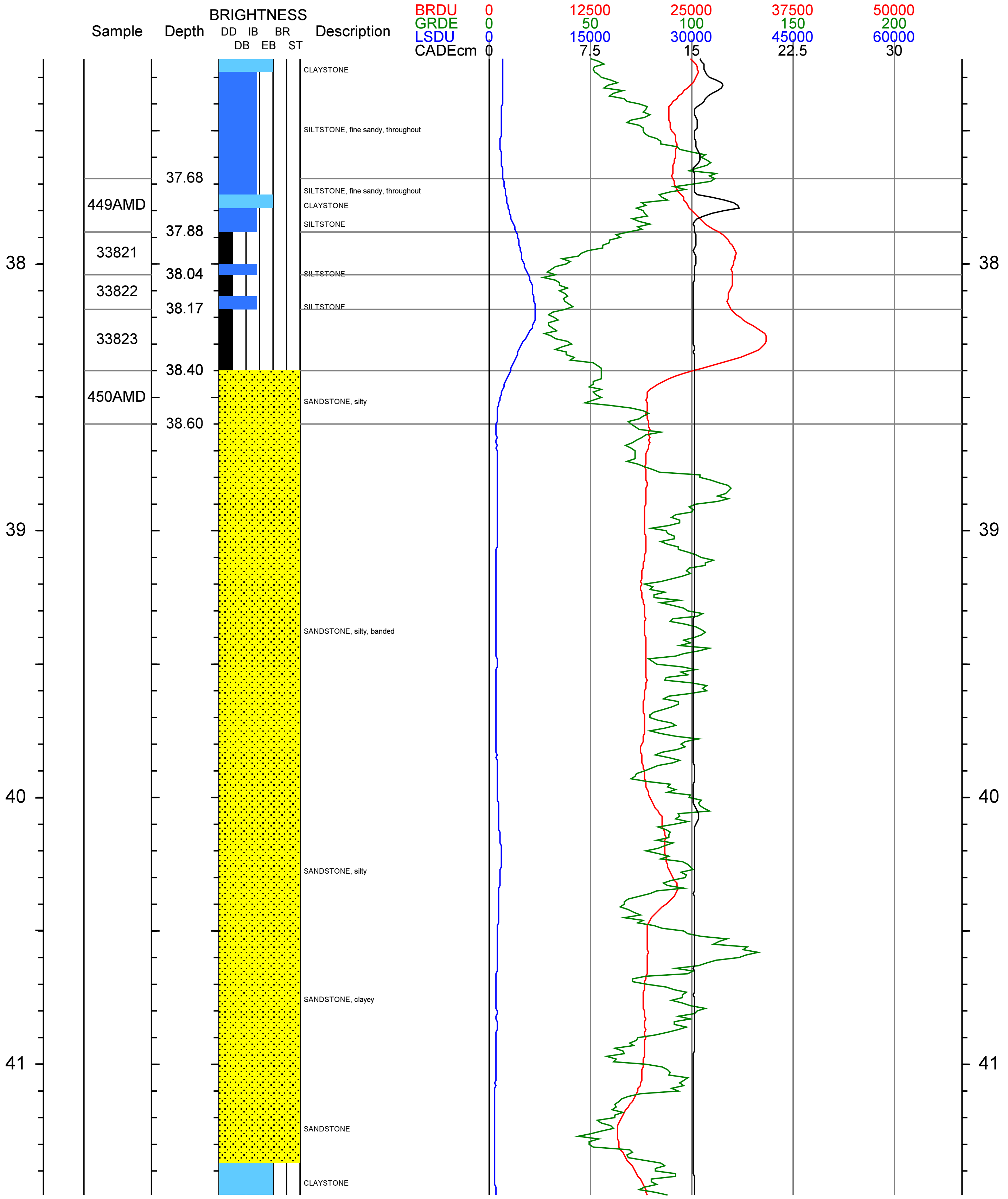

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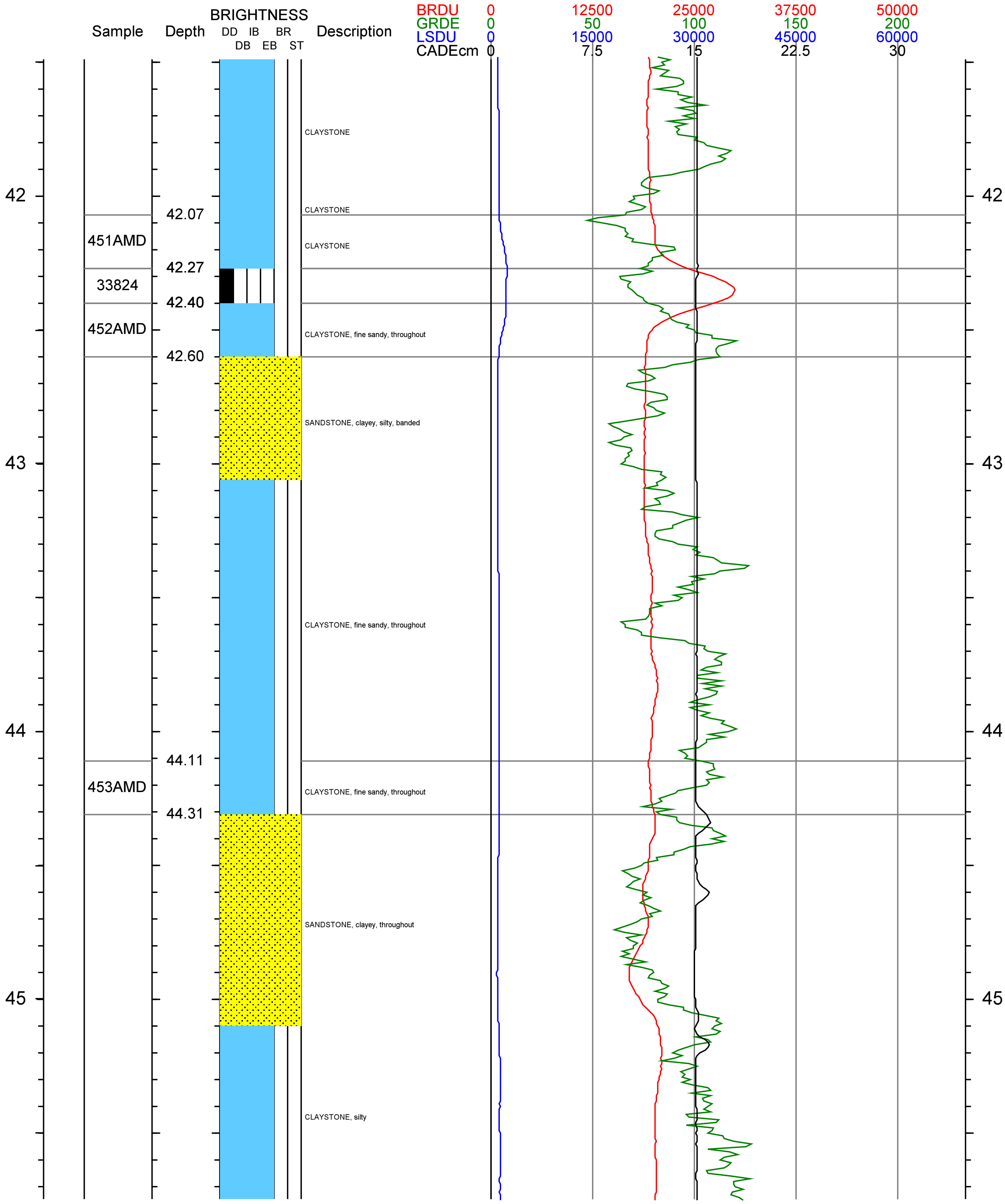

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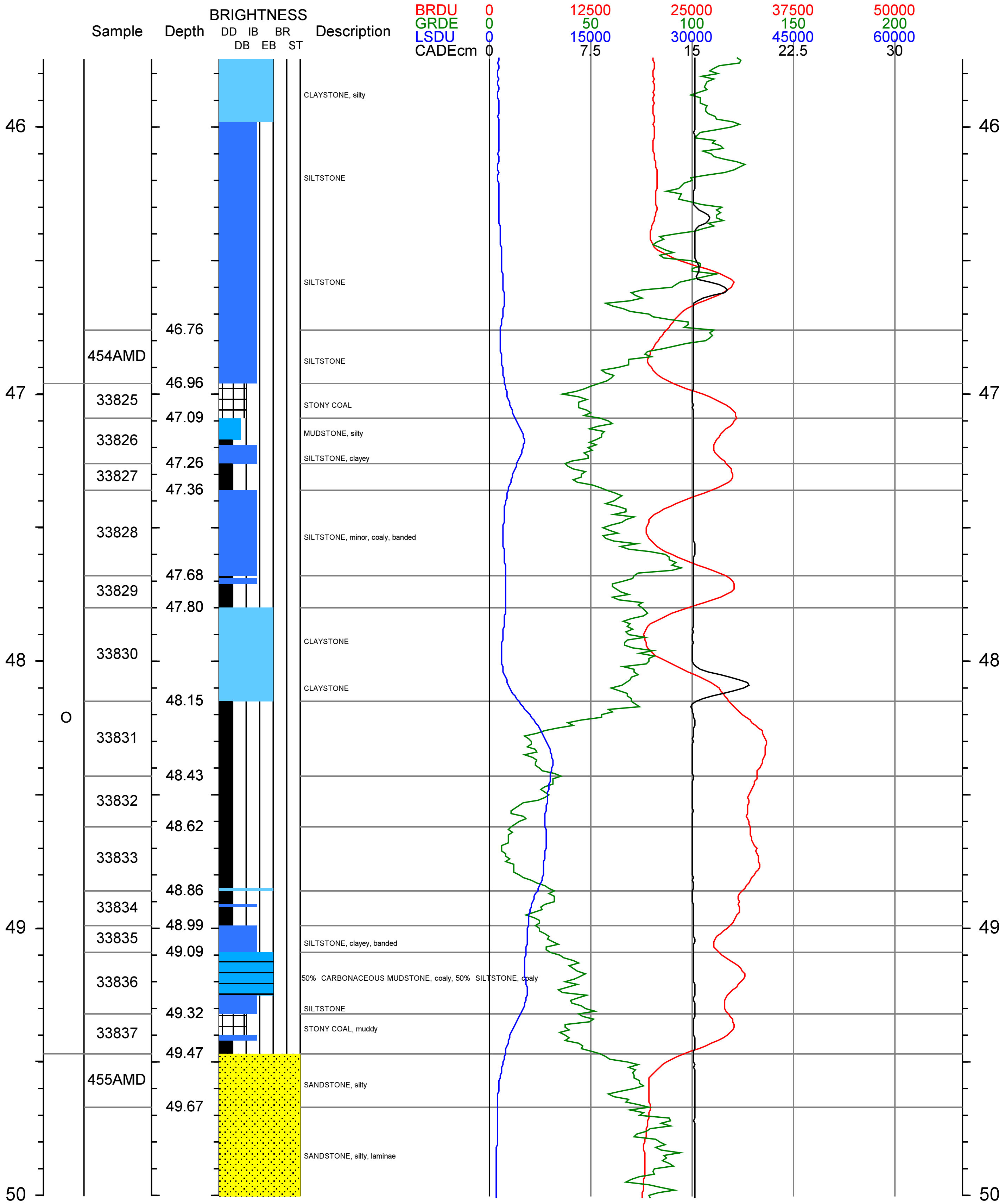

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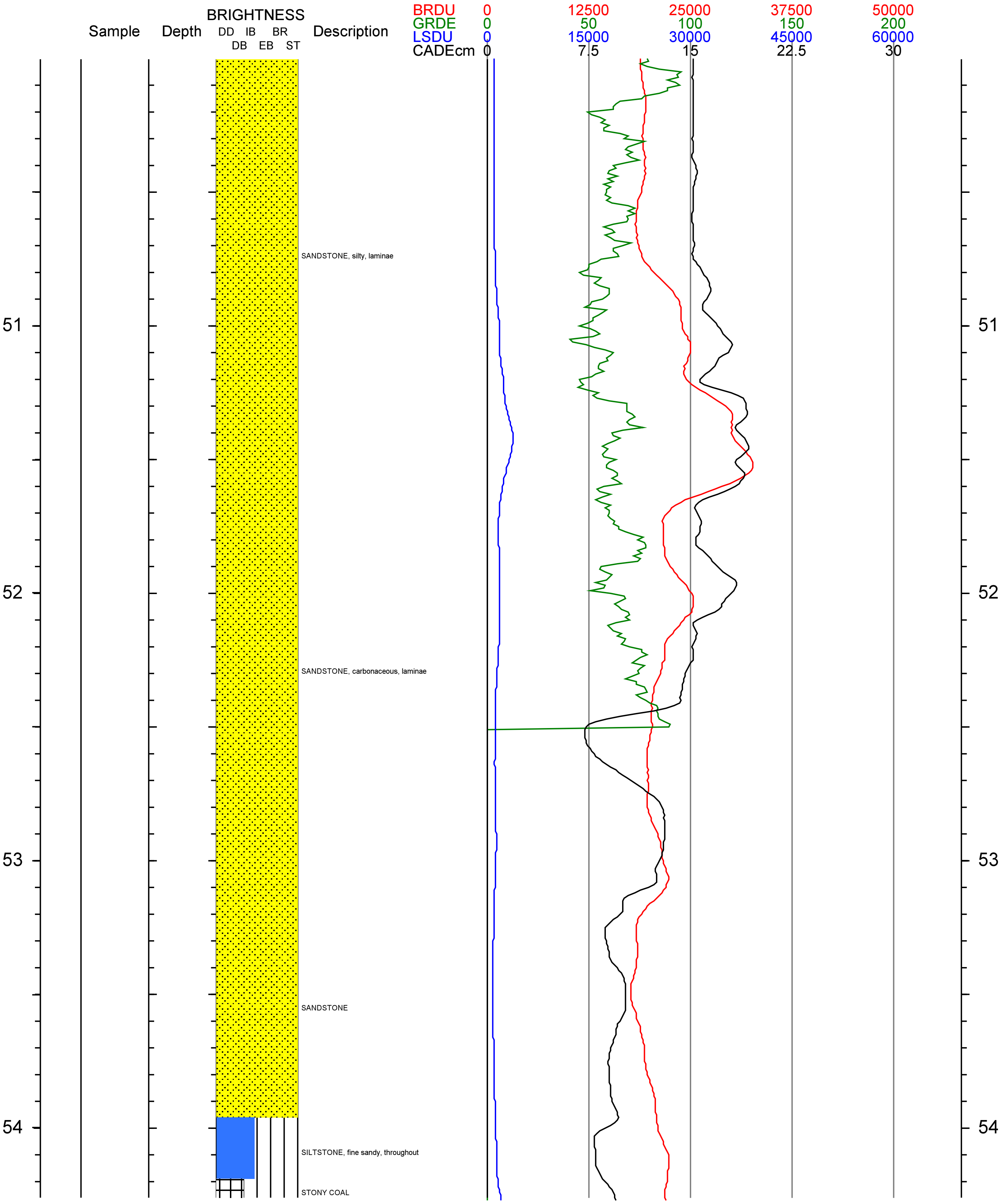

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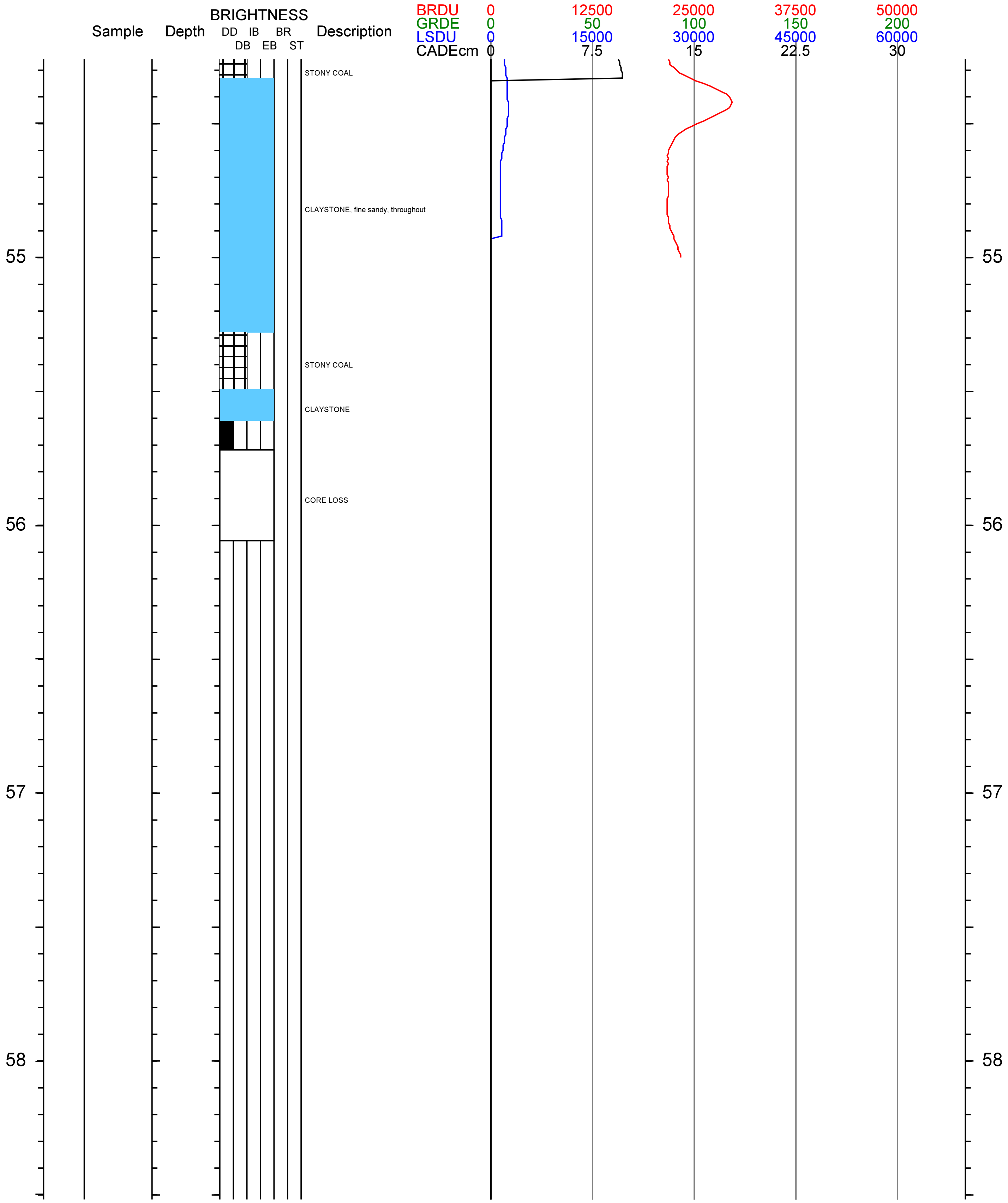

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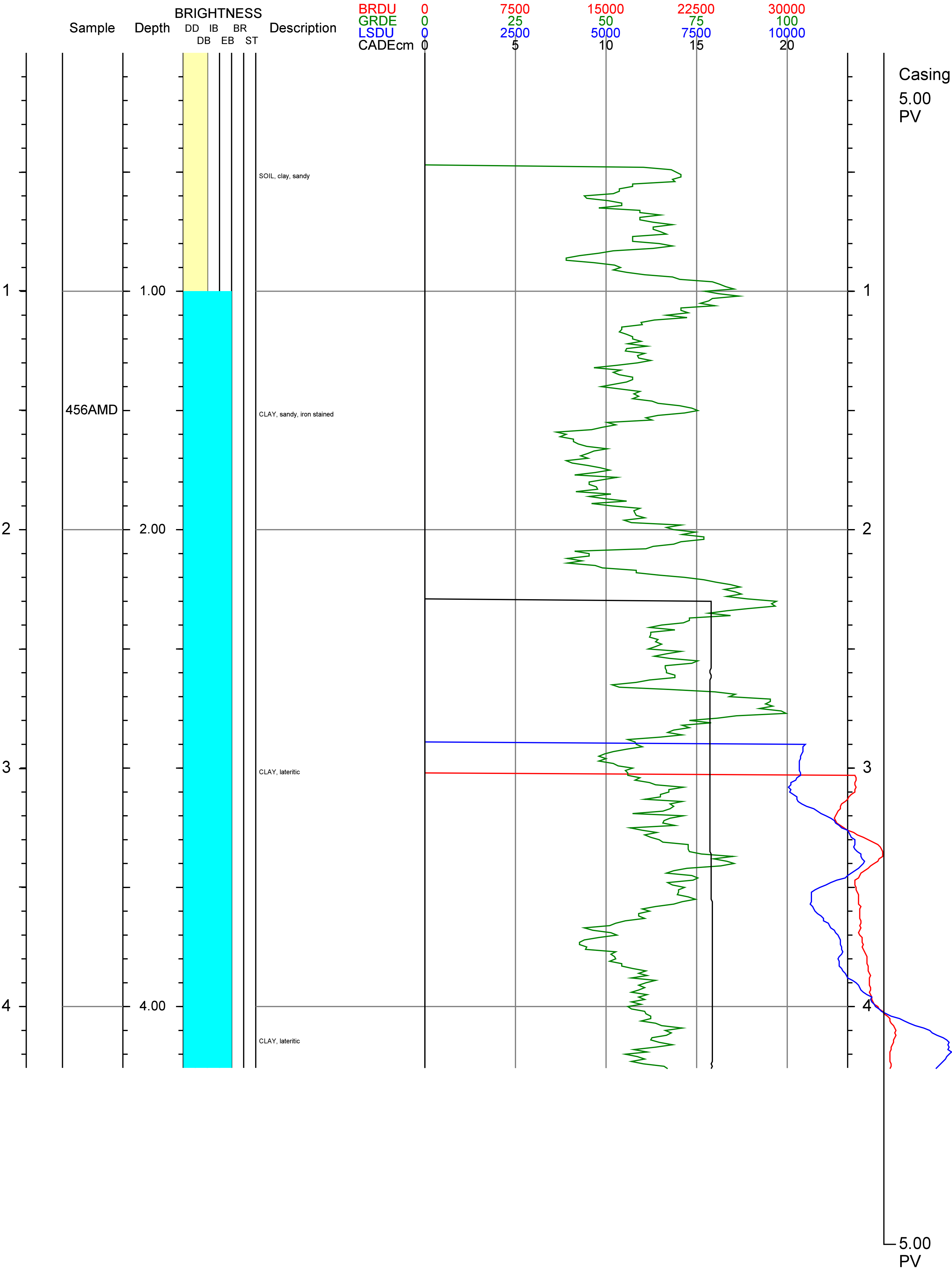

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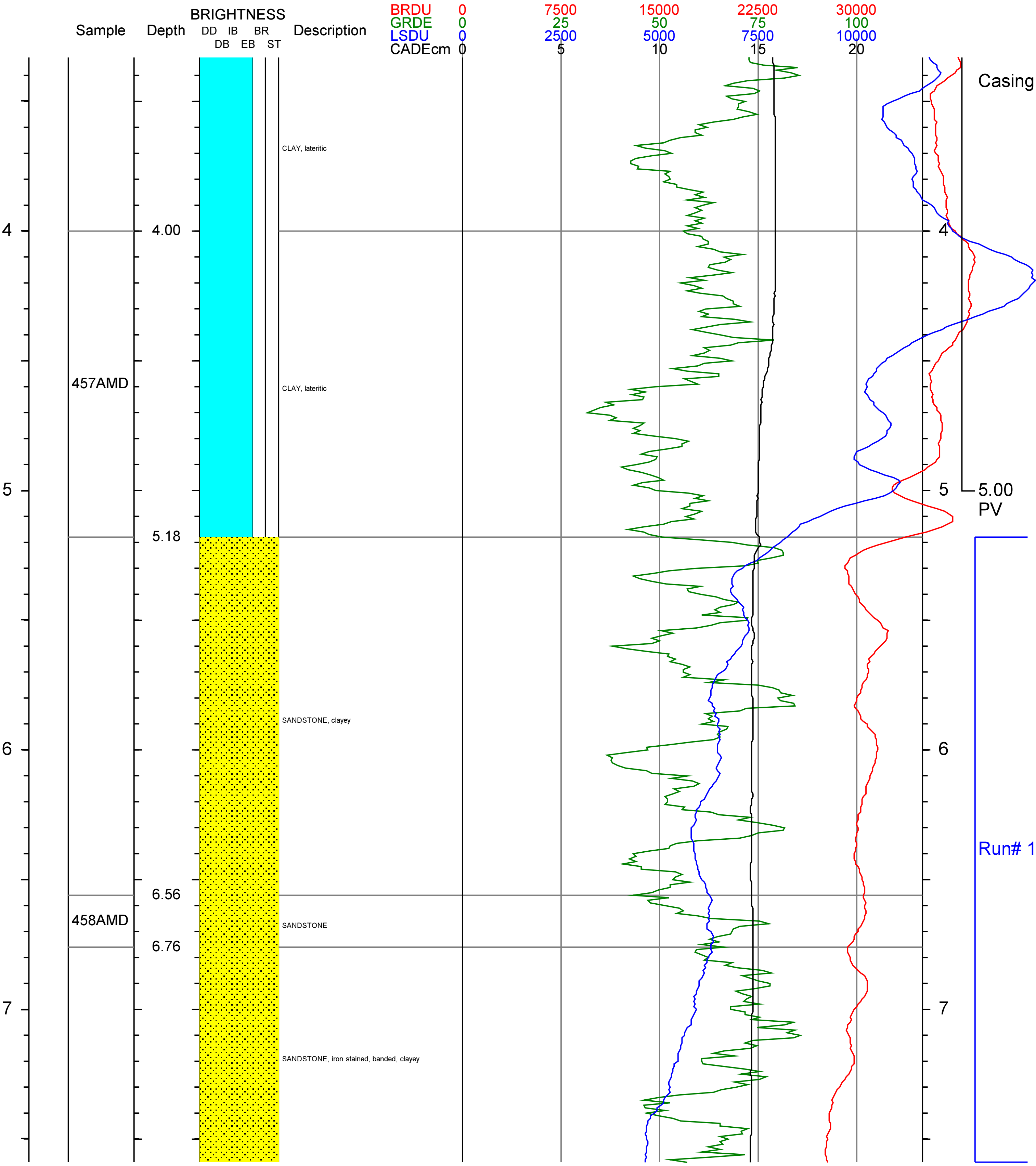
HOLE KC14038C

SCALE 1:20

GEOPHYSICAL PROFILE
HOLE



CSENERGY
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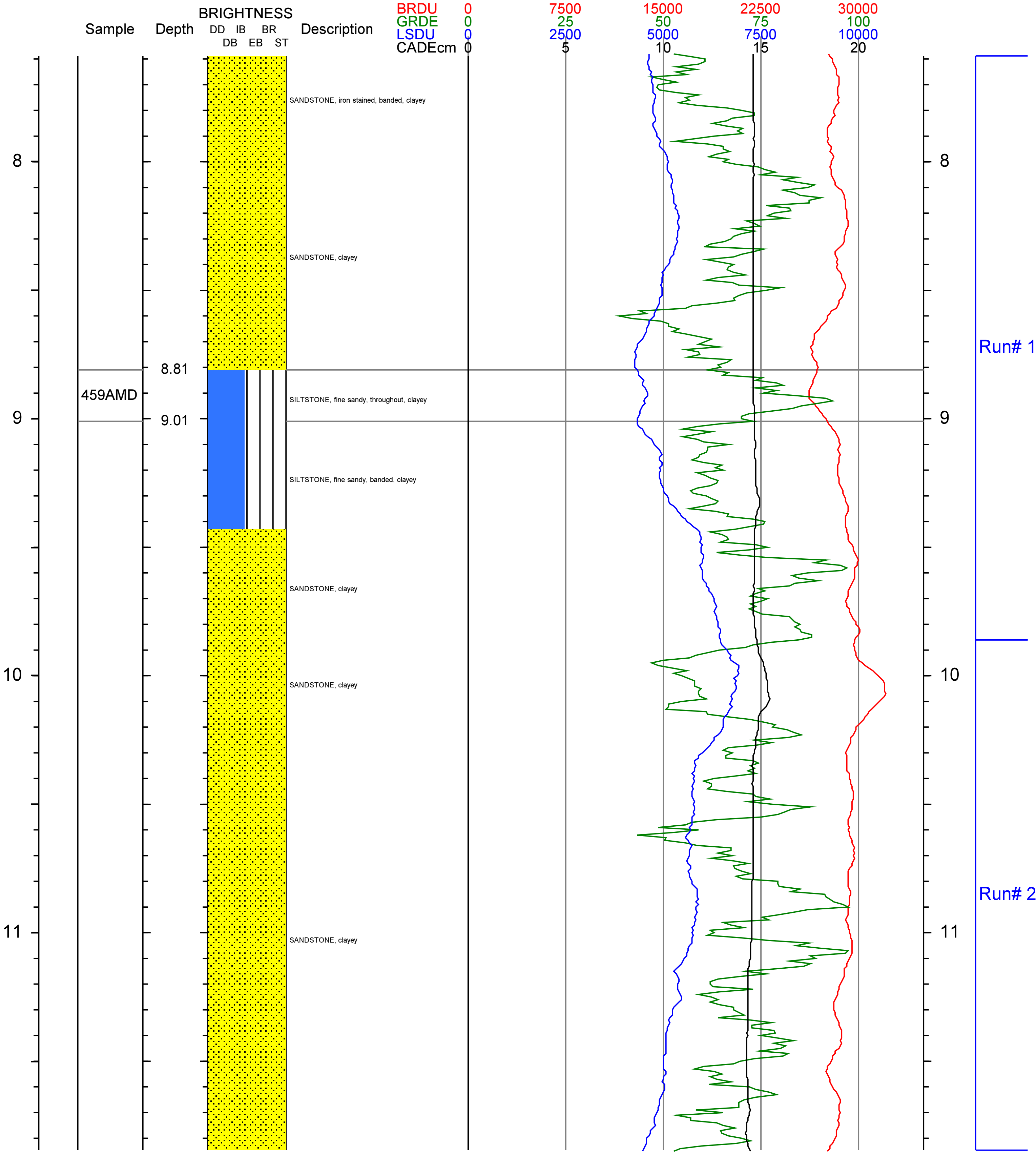
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14038C

SCALE 1:20
GEOPHYSICAL PROFILE
HOLE



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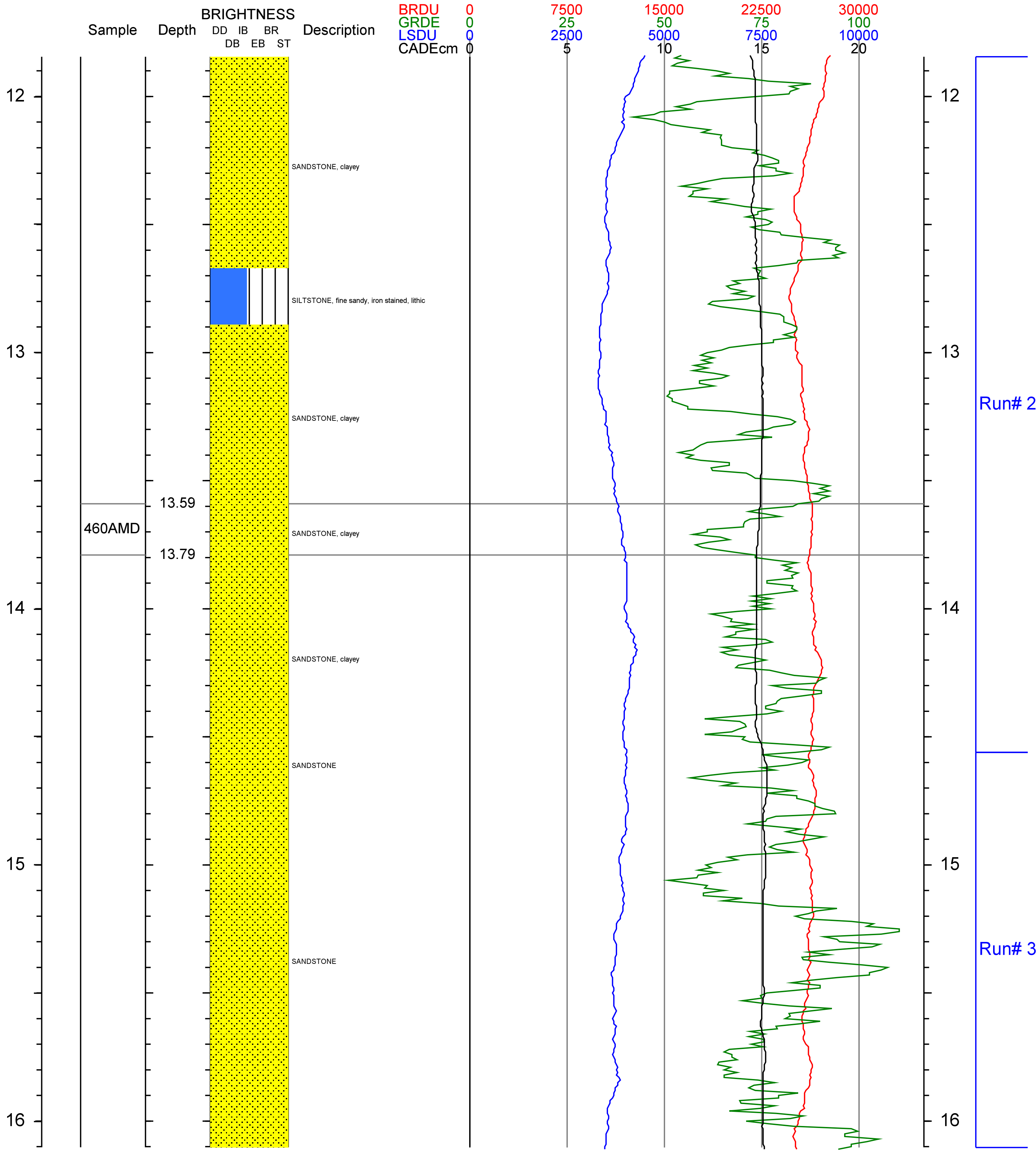

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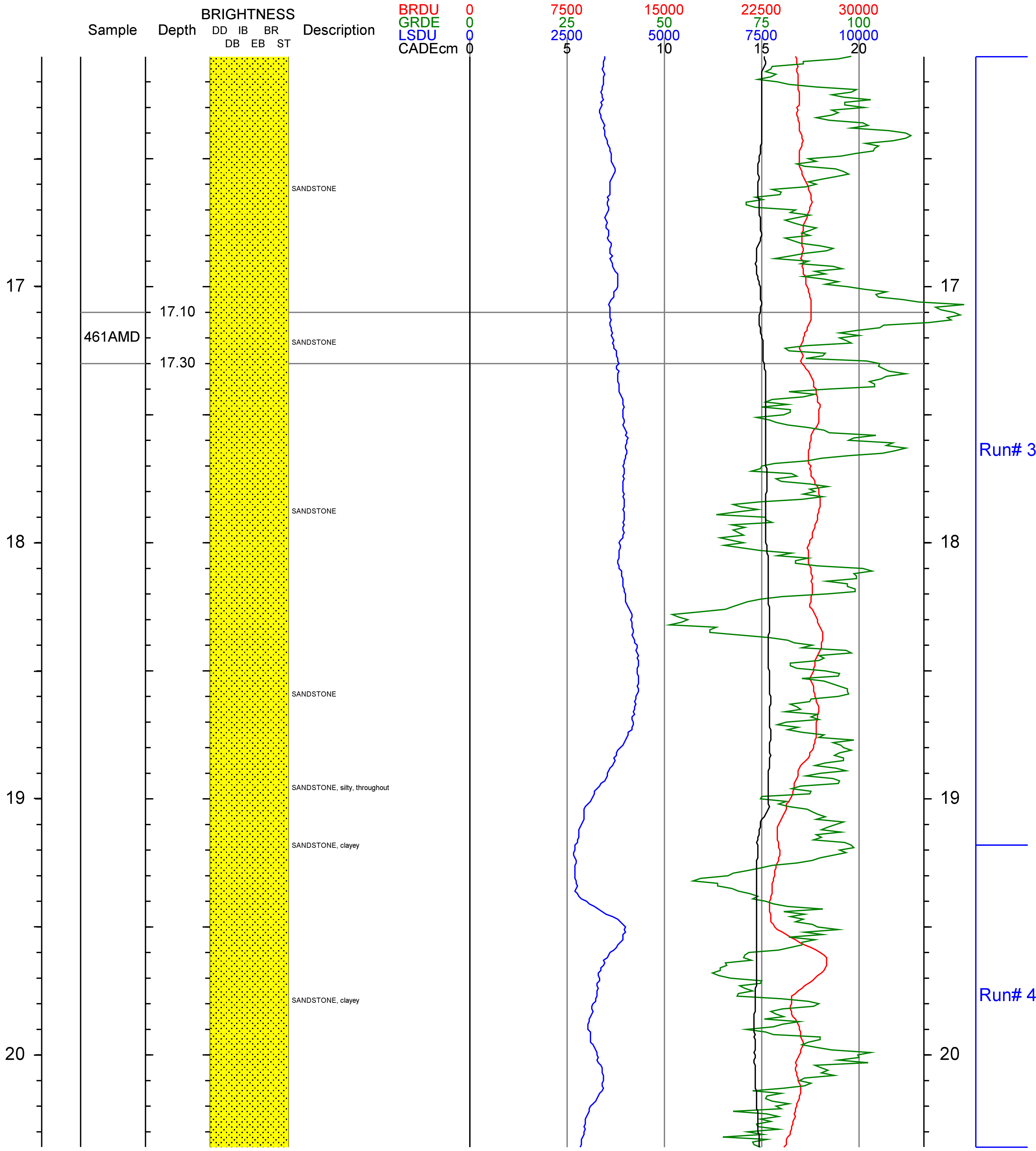

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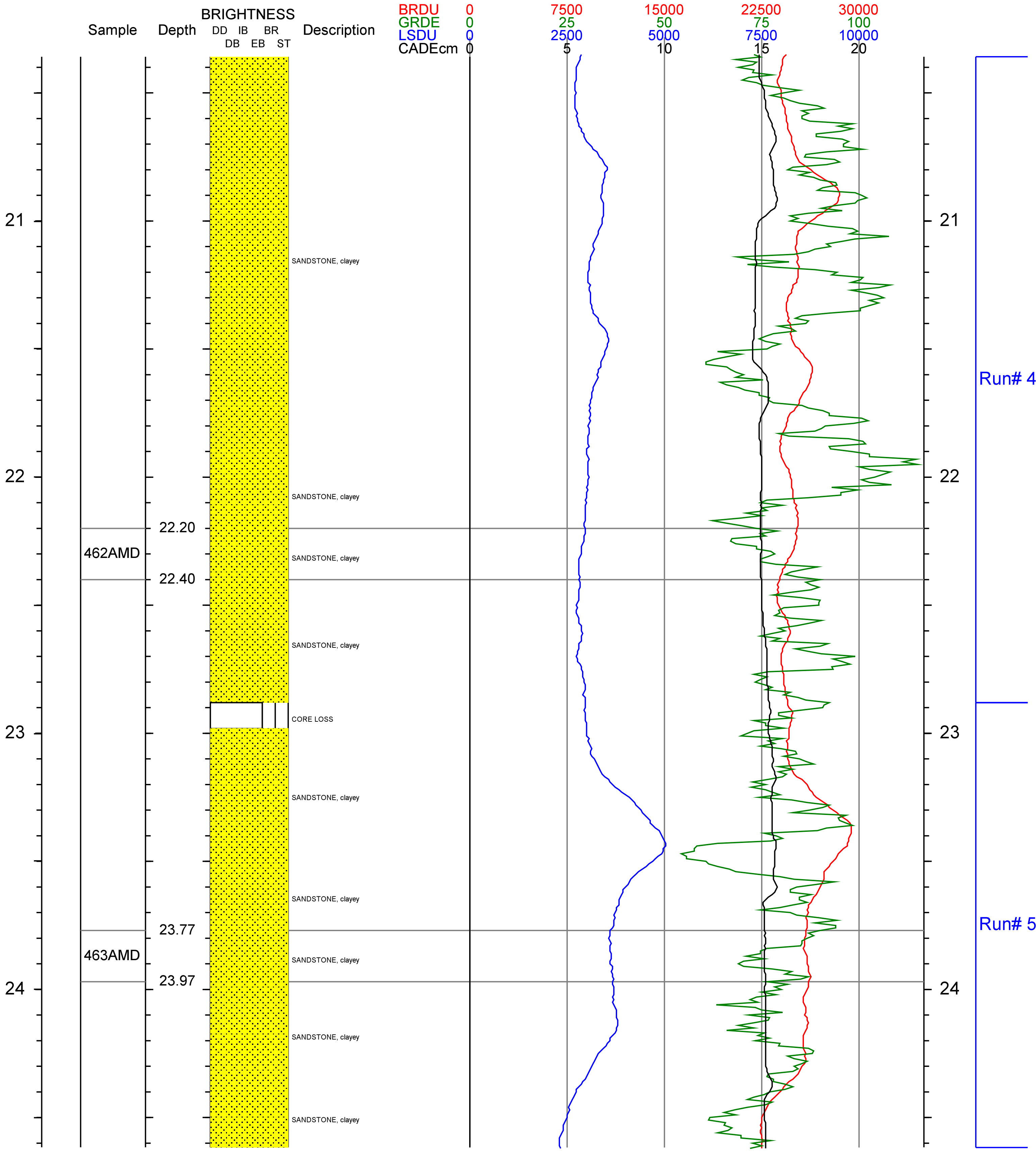

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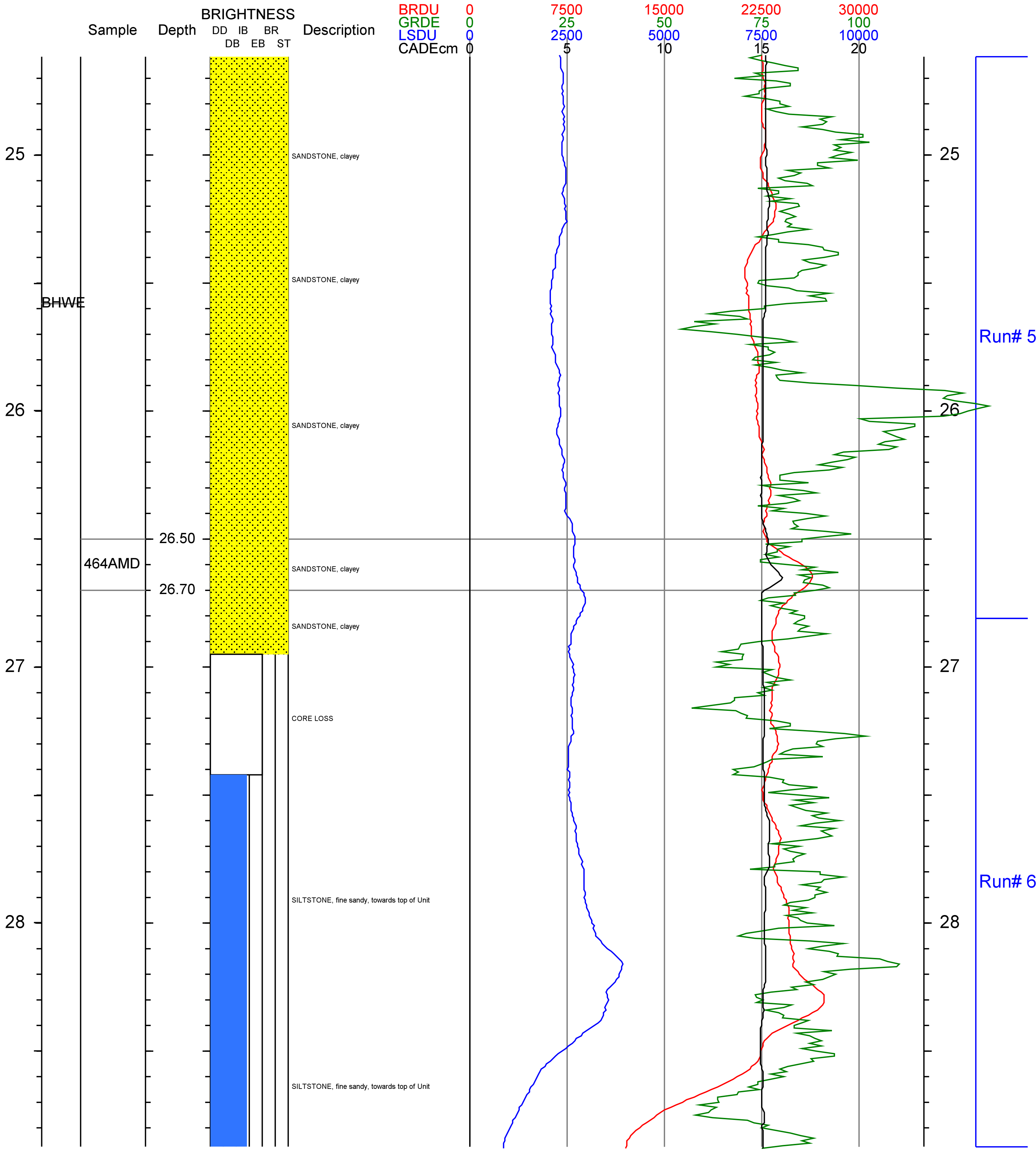

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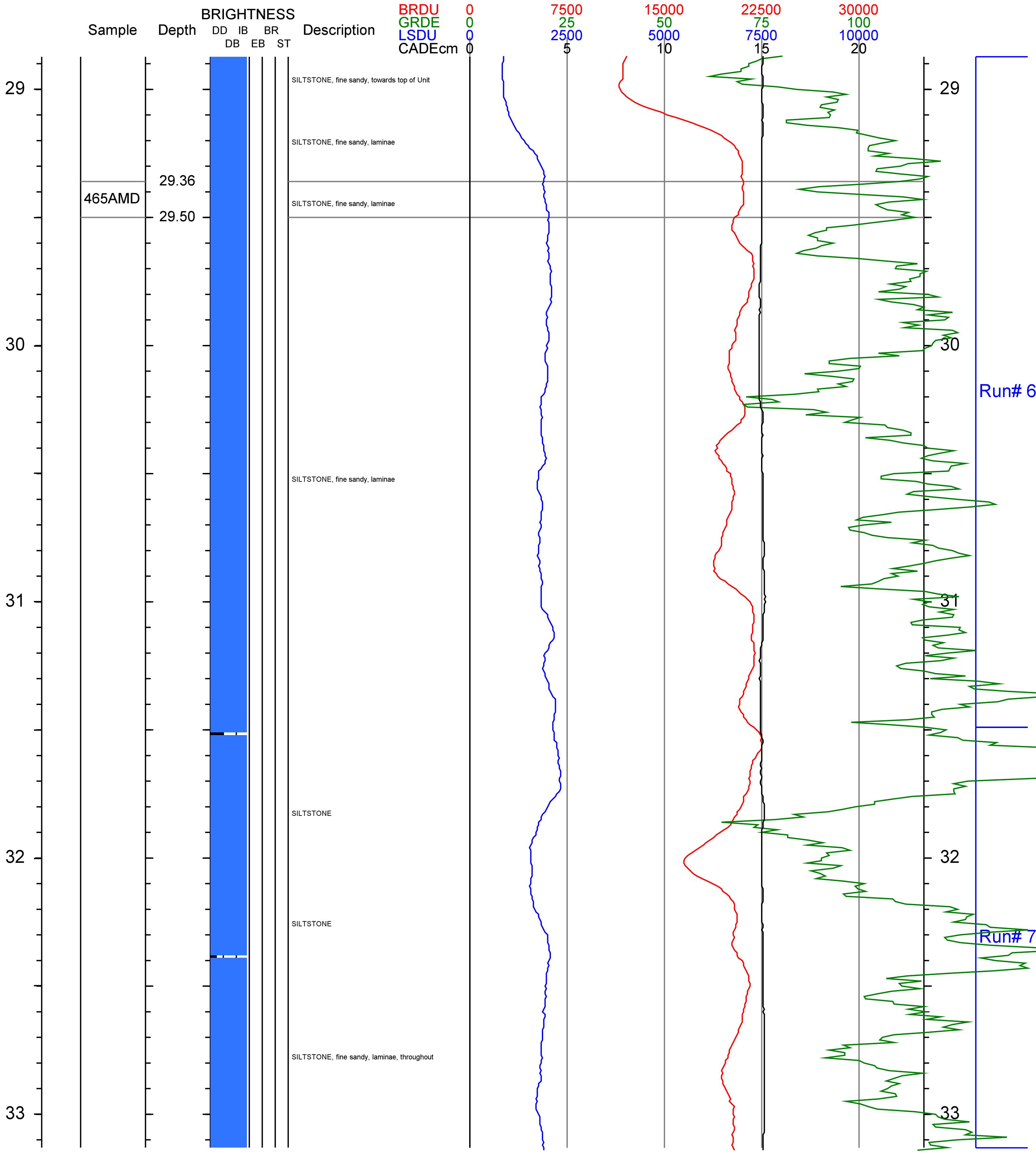

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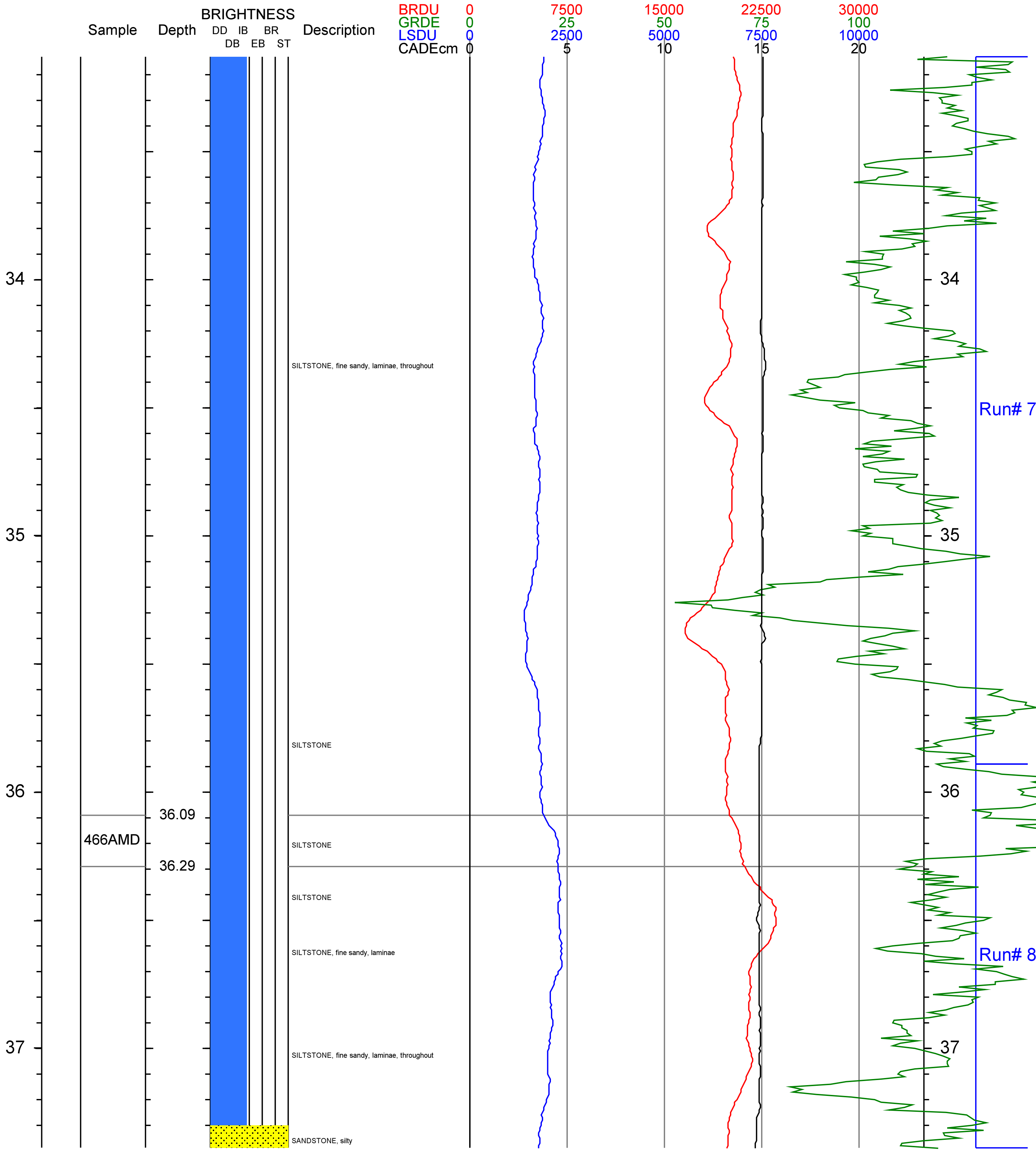

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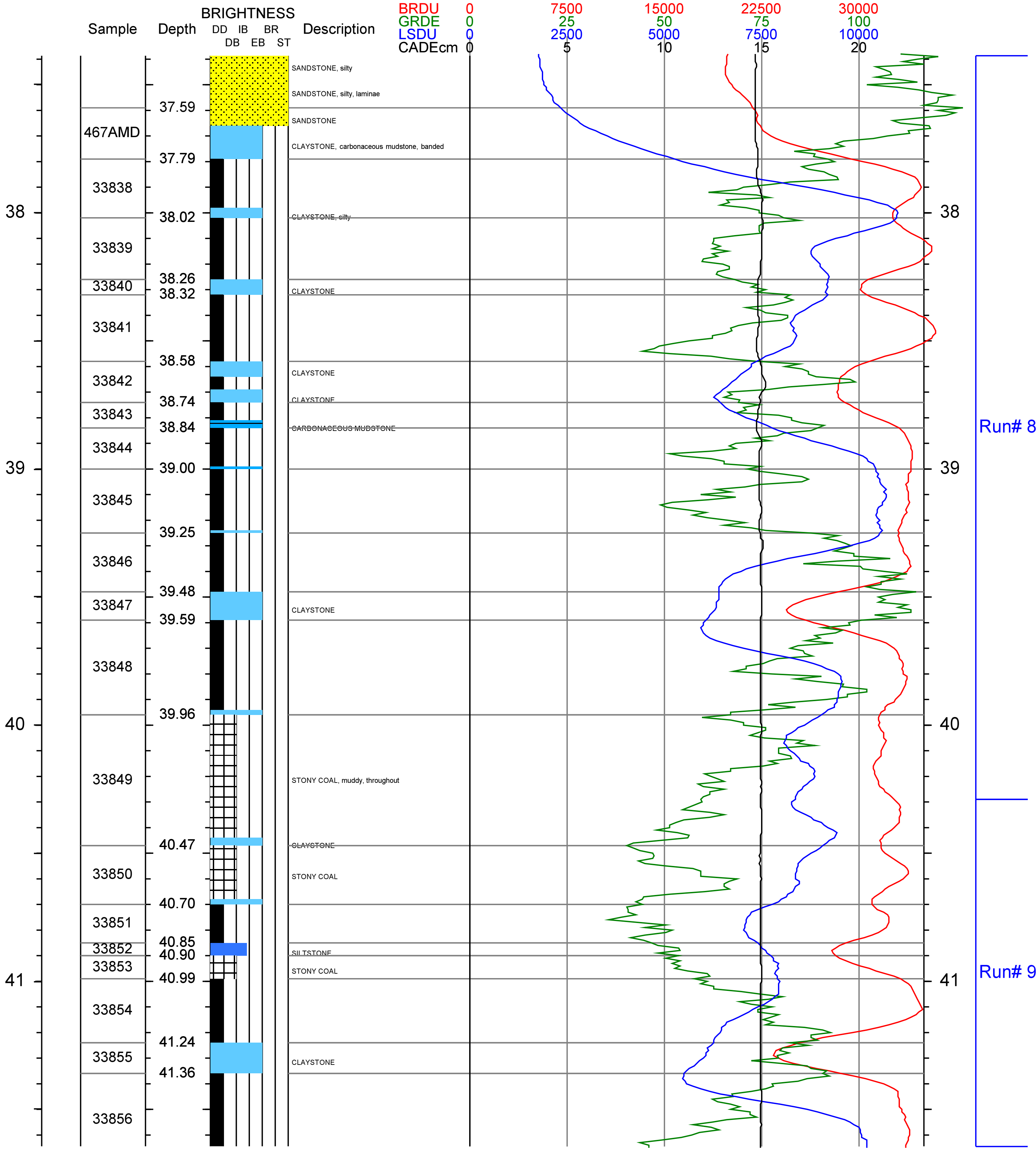

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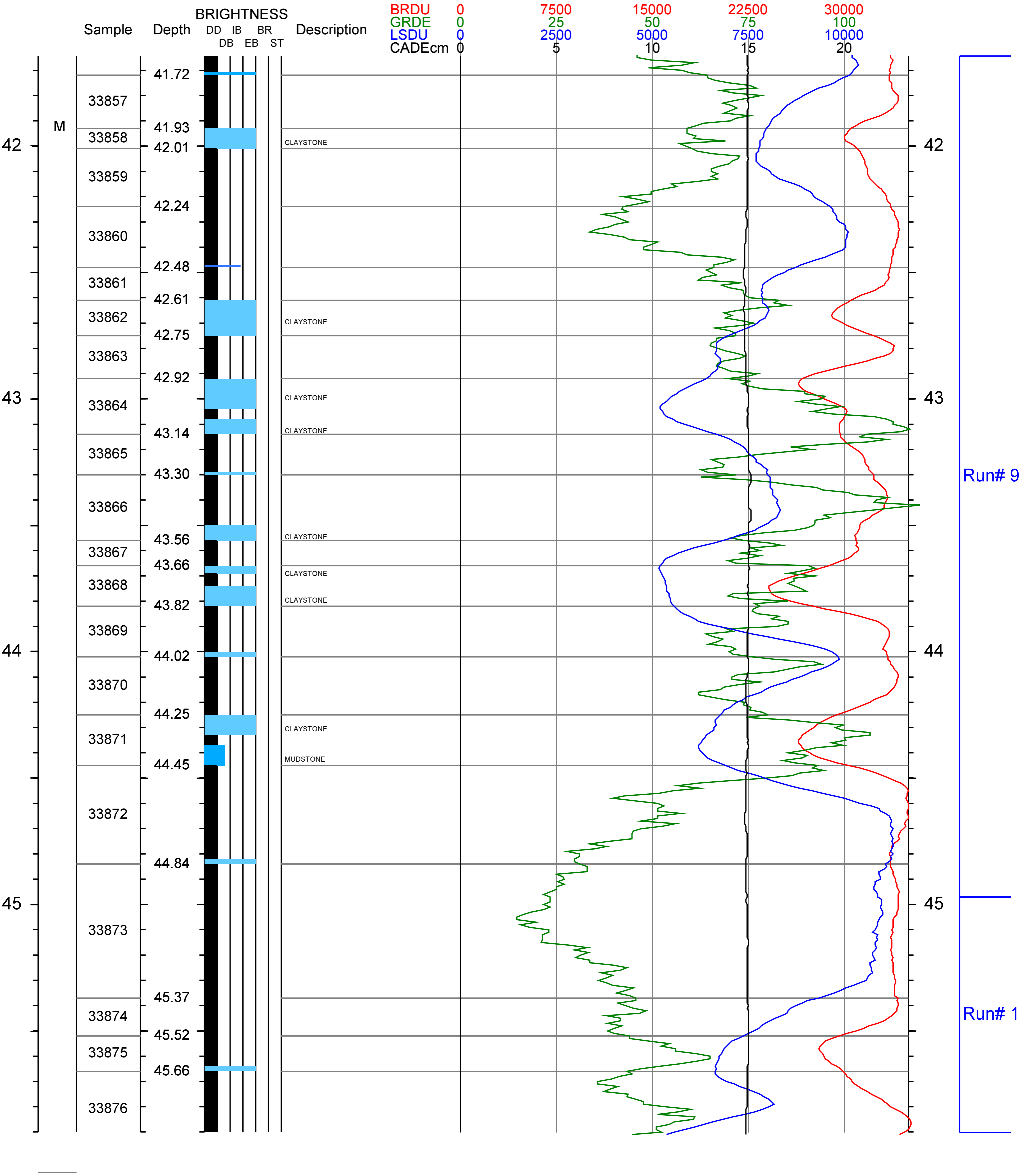

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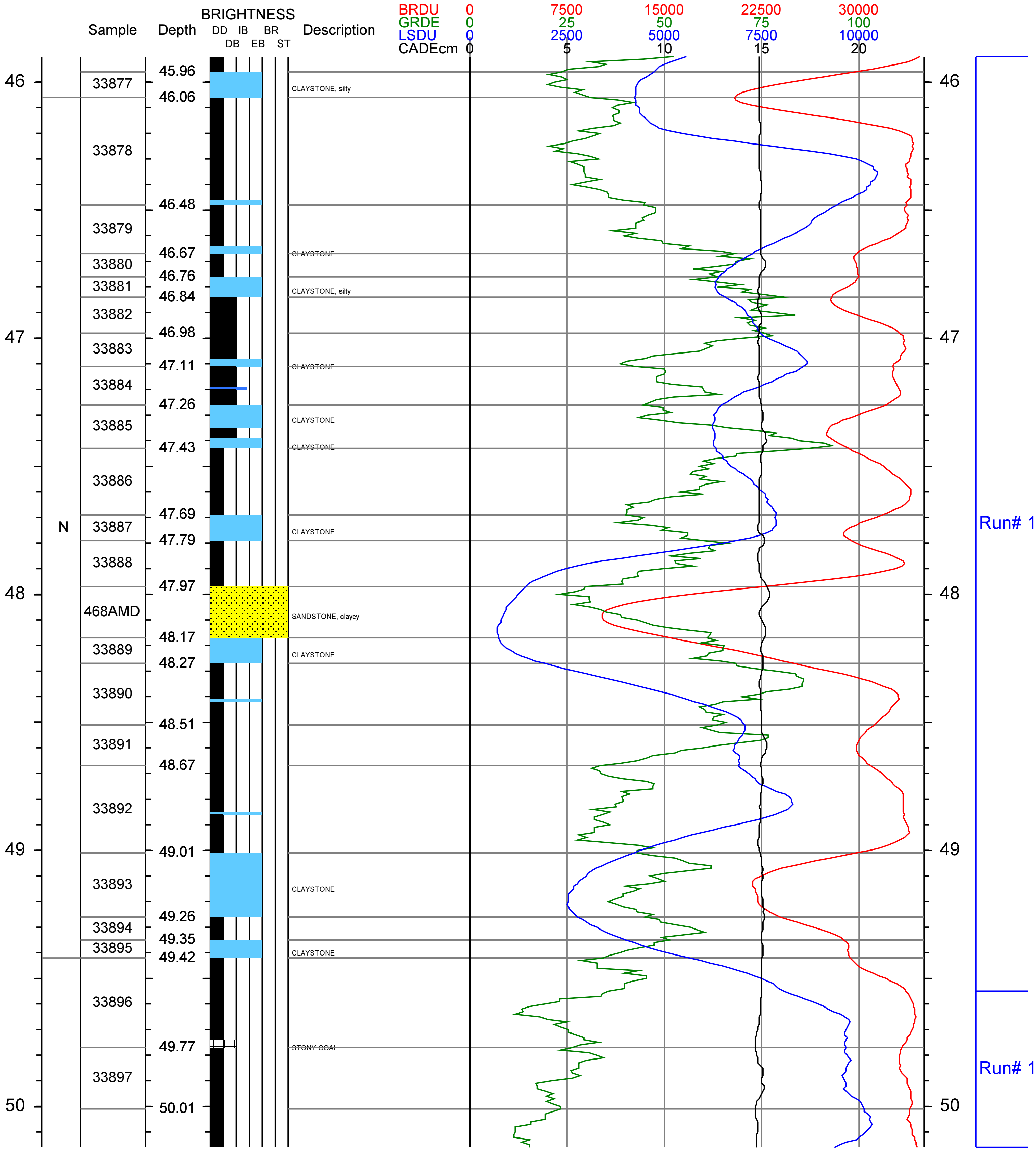

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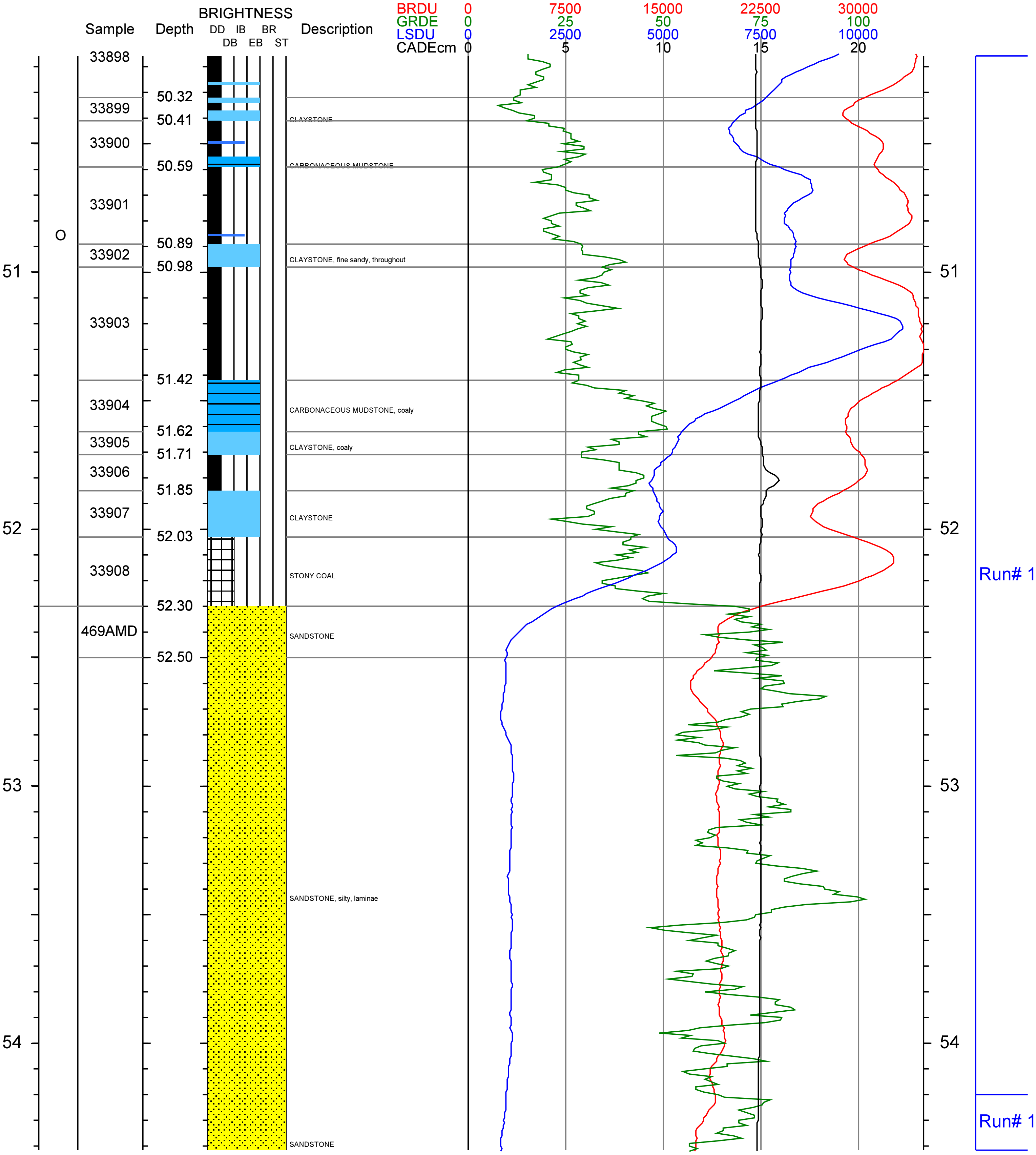

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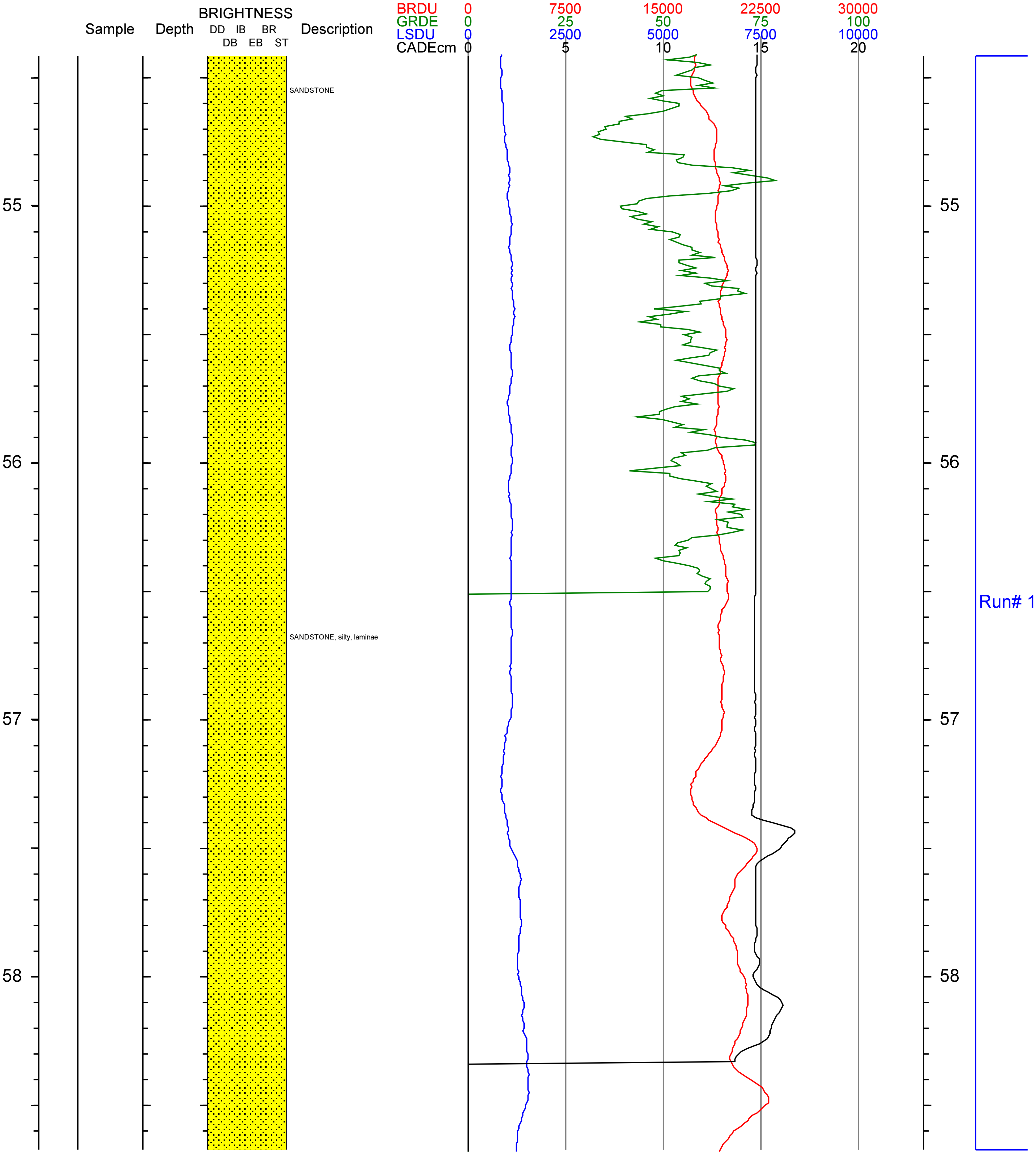


CSENERGY
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14038C

SCALE 1:20

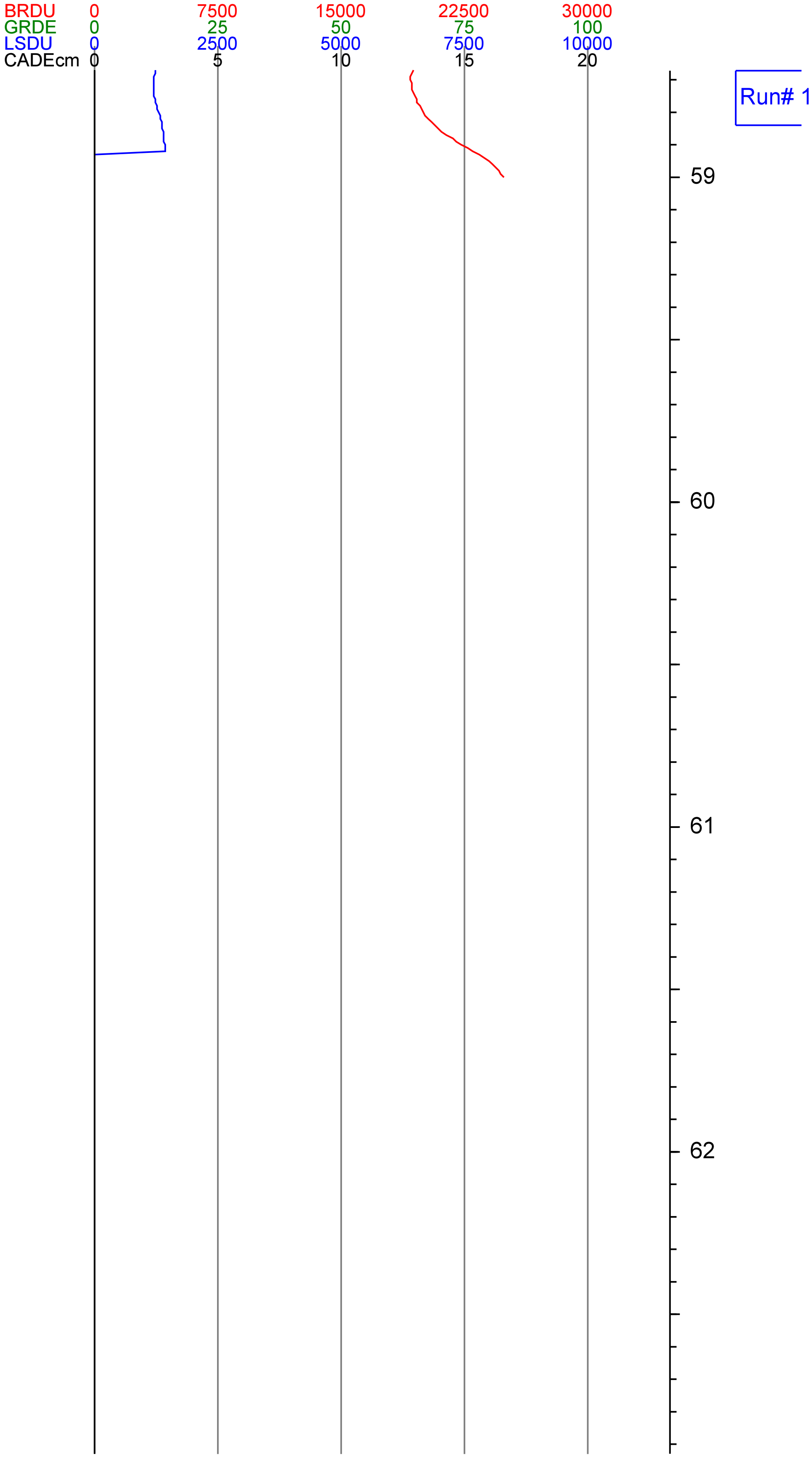
GEOPHYSICAL PROFILE

HOLE

Sample | Depth | BRIGHTNESS DD DB IB EB BR ST | Description

SANDSTONE, silty, laminae

59
60
61
62



CSENERGY
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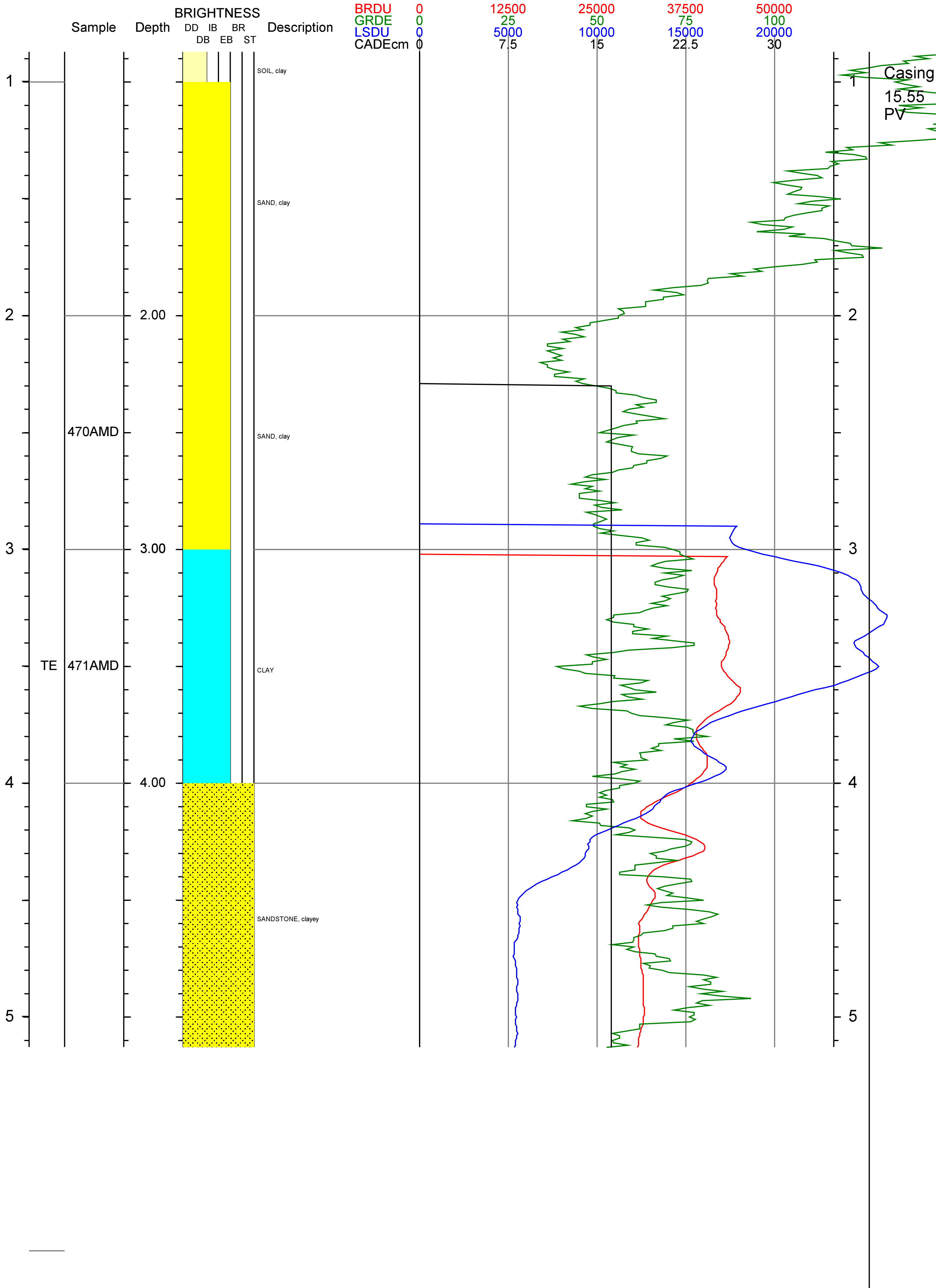
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14039C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



CSENERGY
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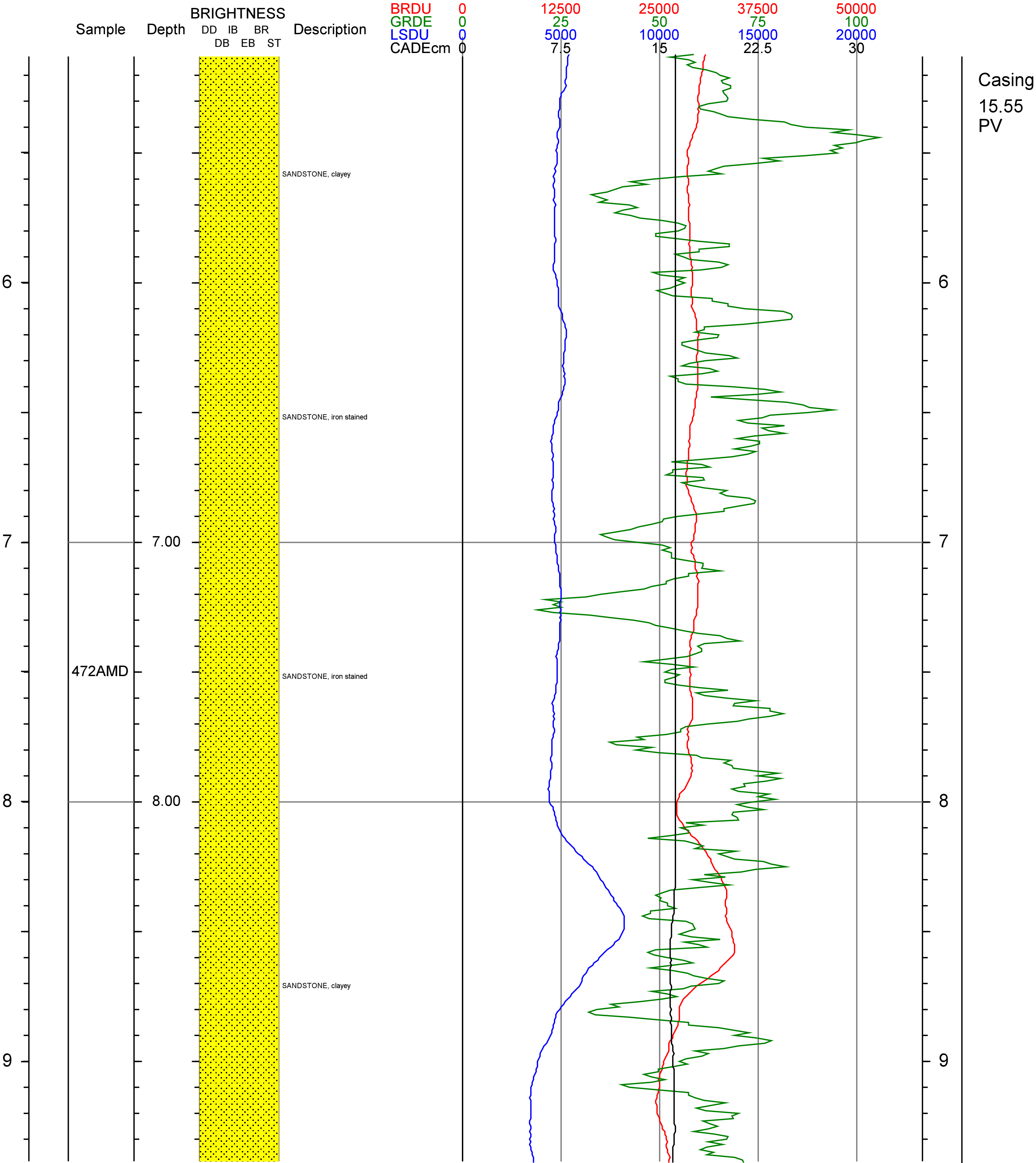
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14039C

SCALE 1:20
GEOPHYSICAL PROFILE
HOLE



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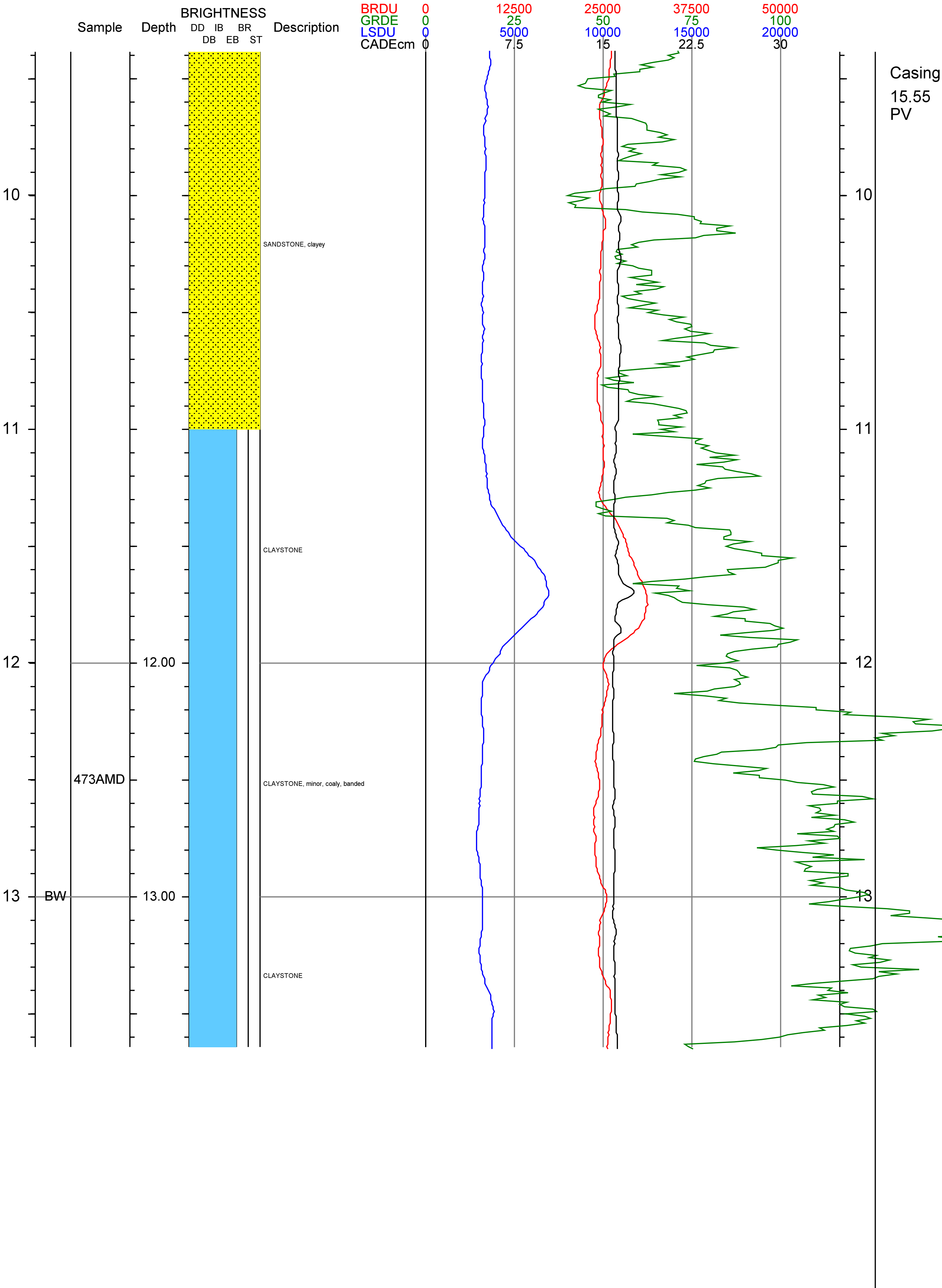

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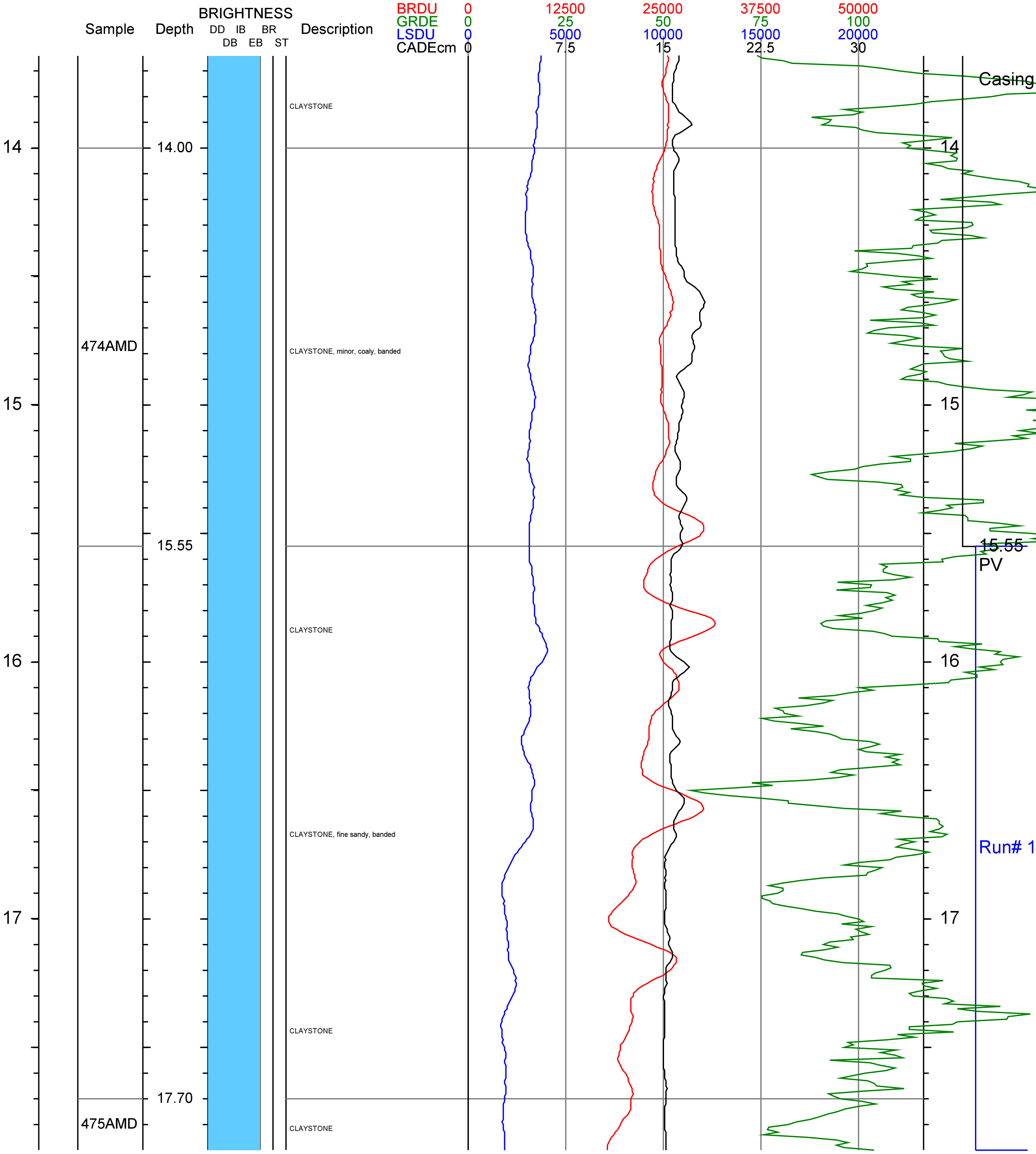

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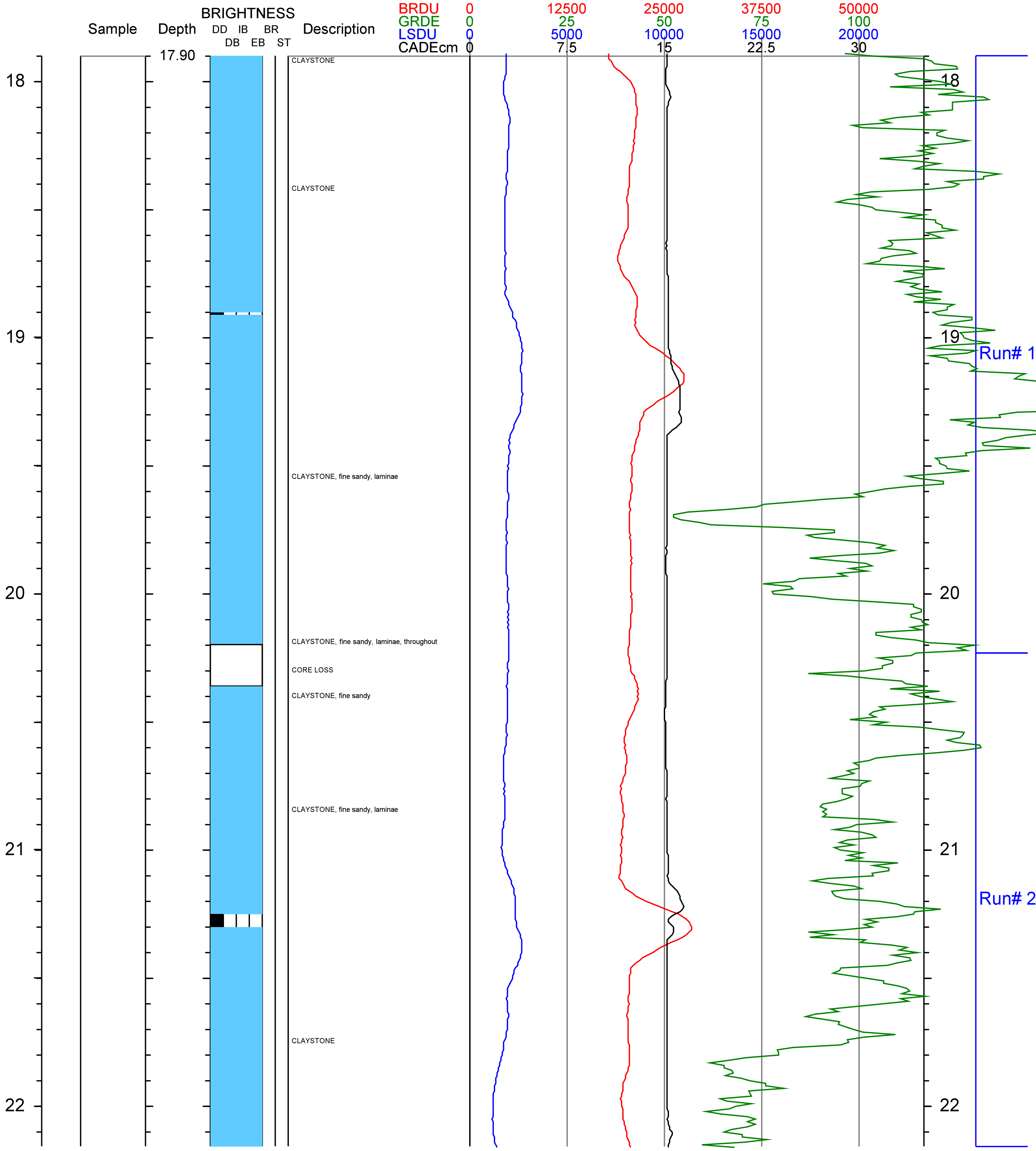

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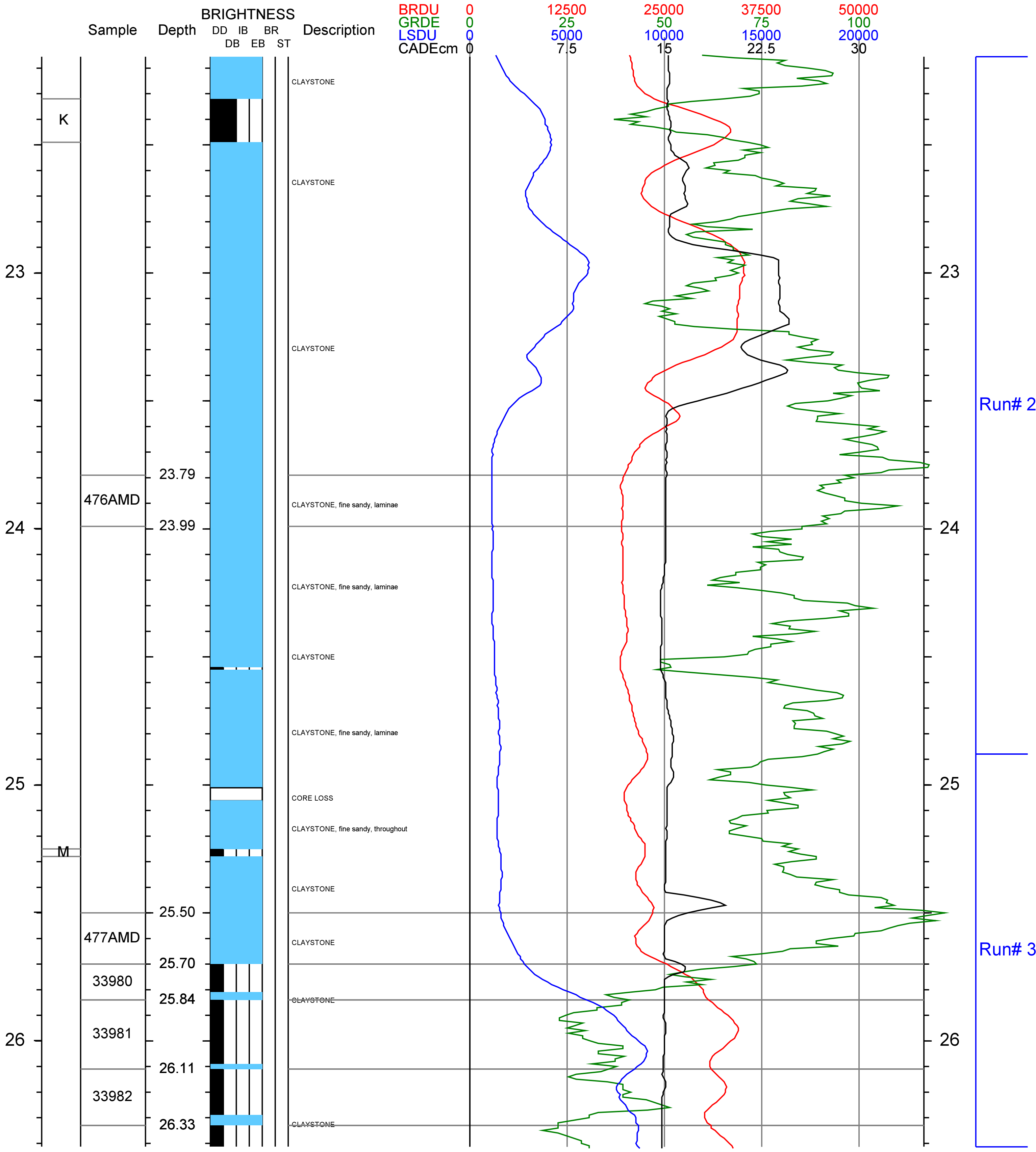

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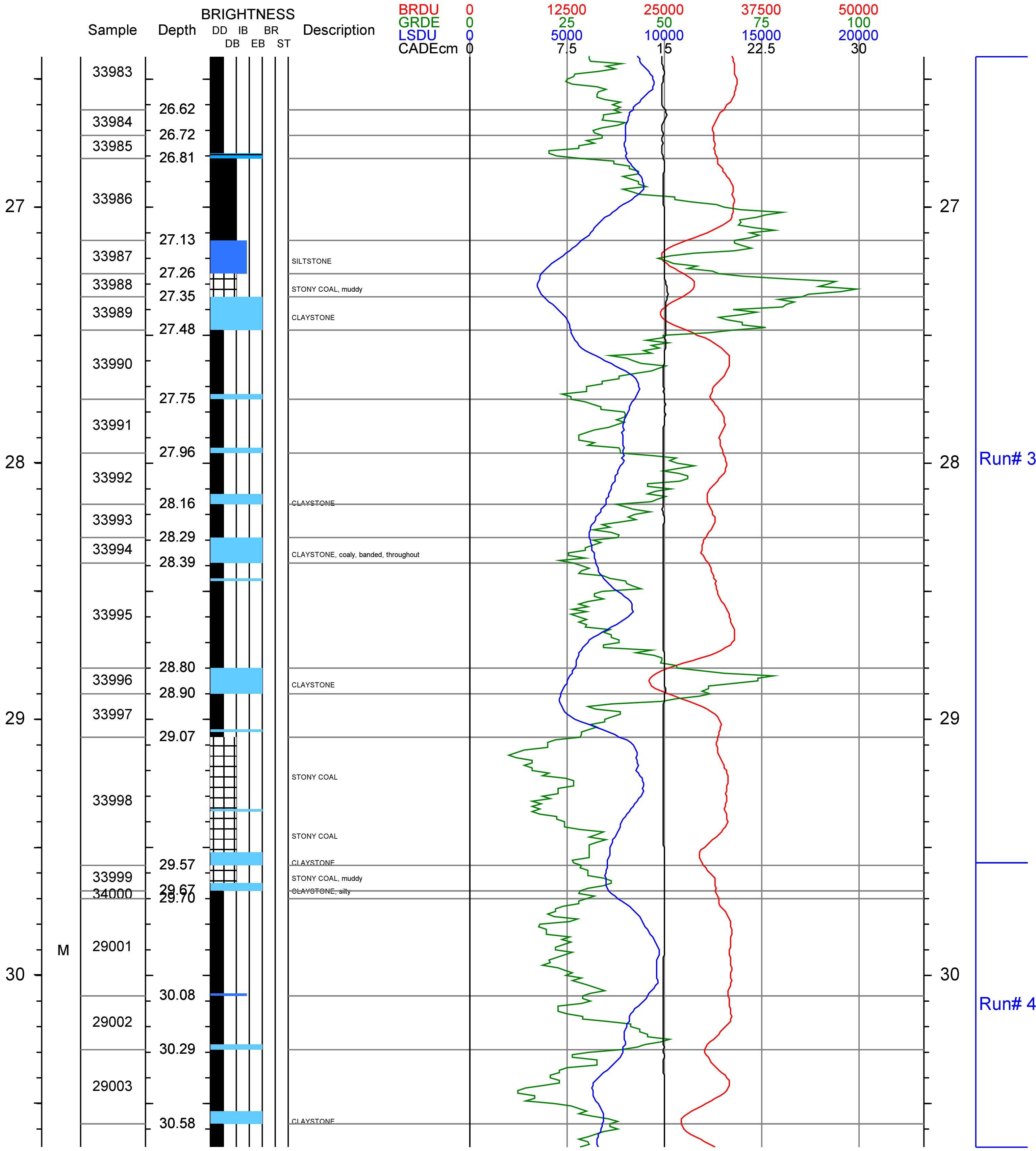

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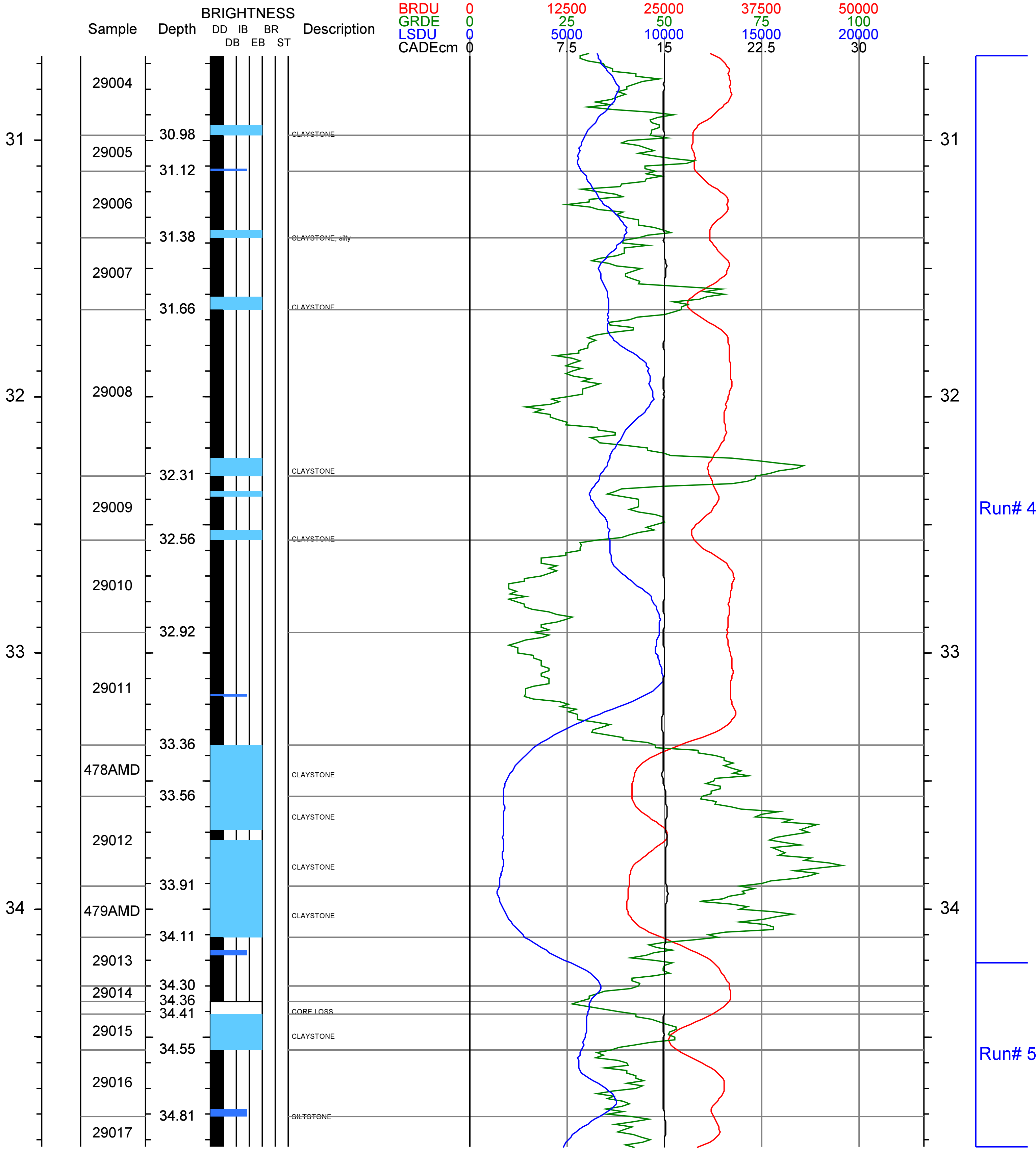

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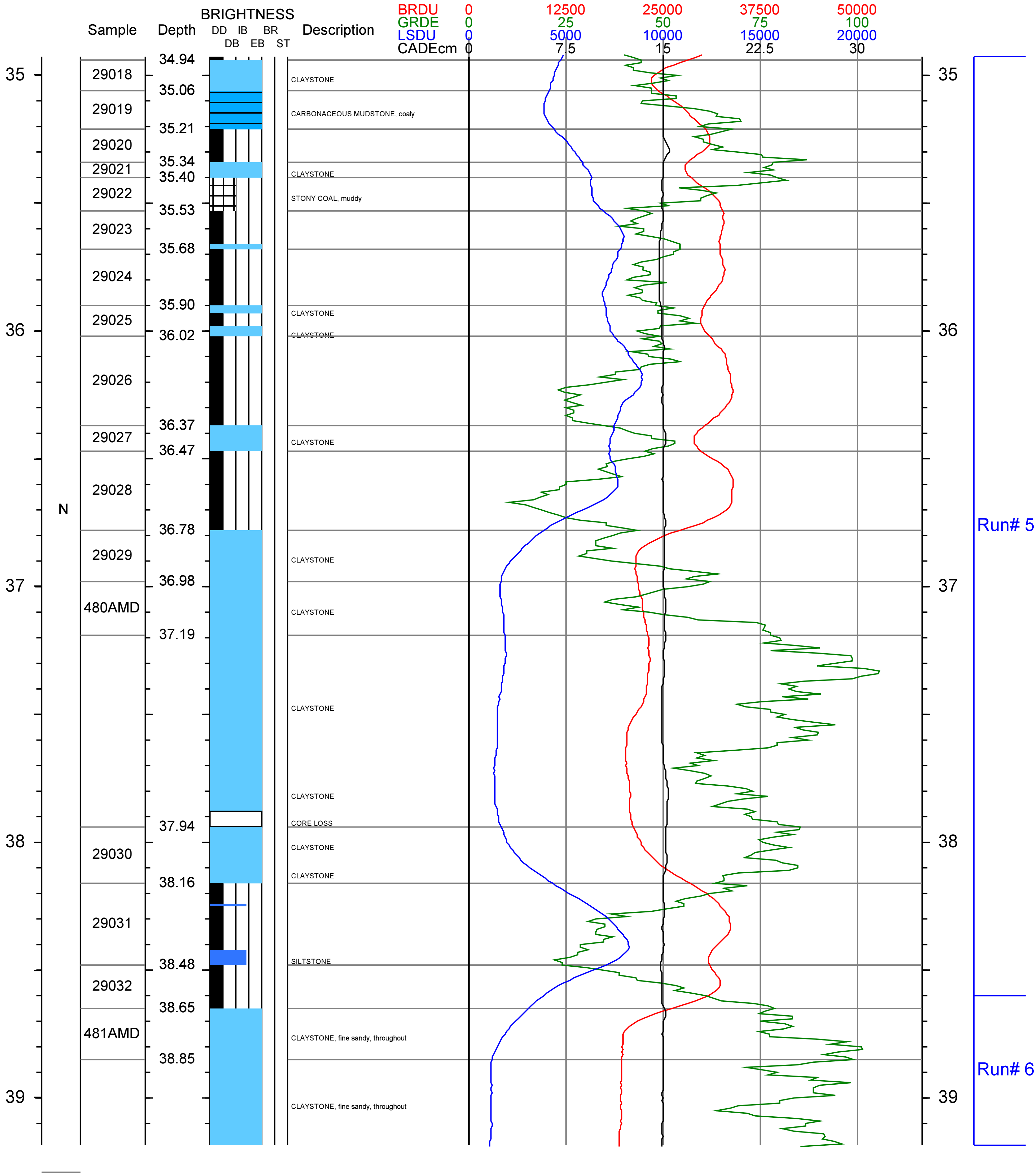

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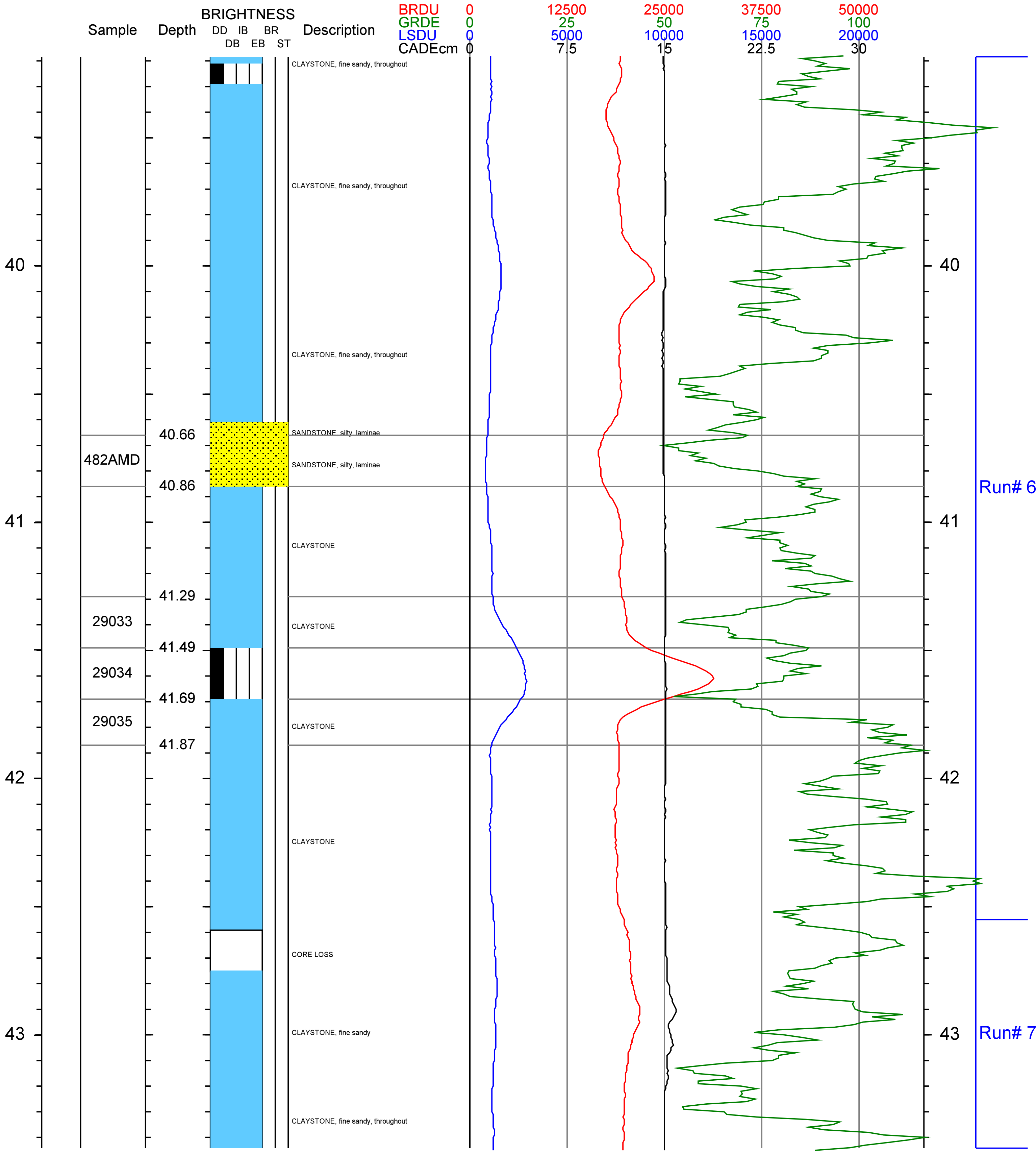

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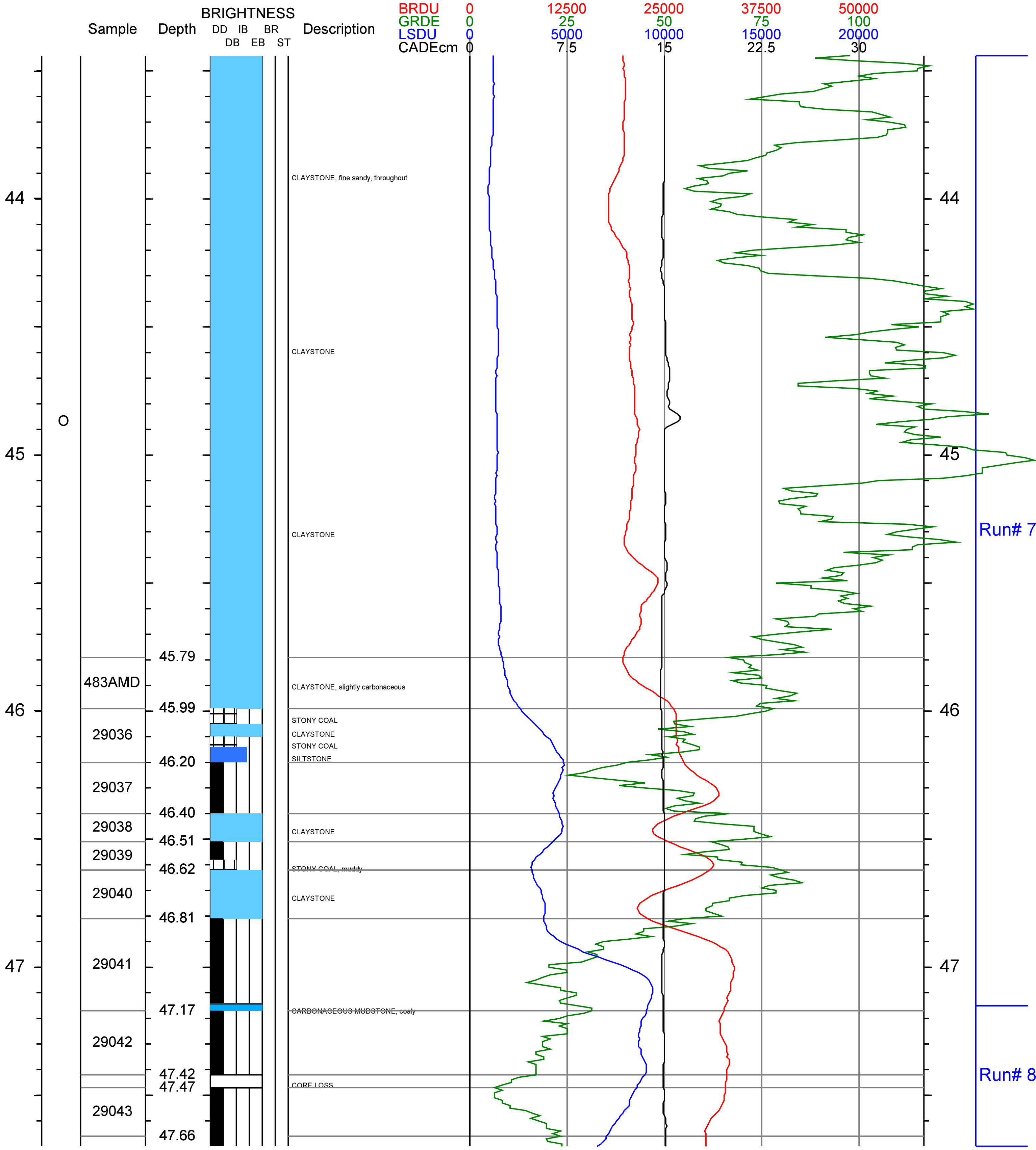

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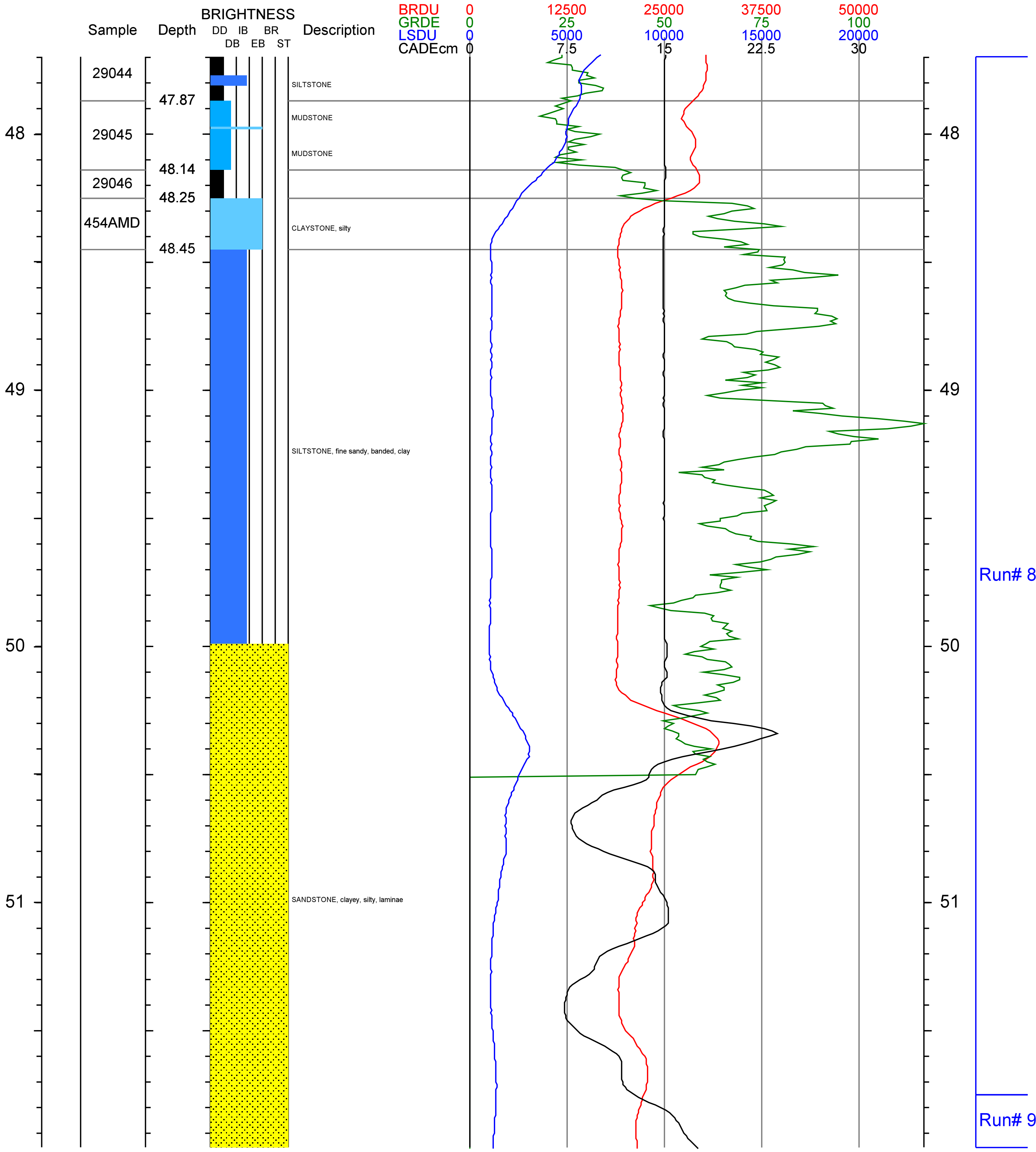

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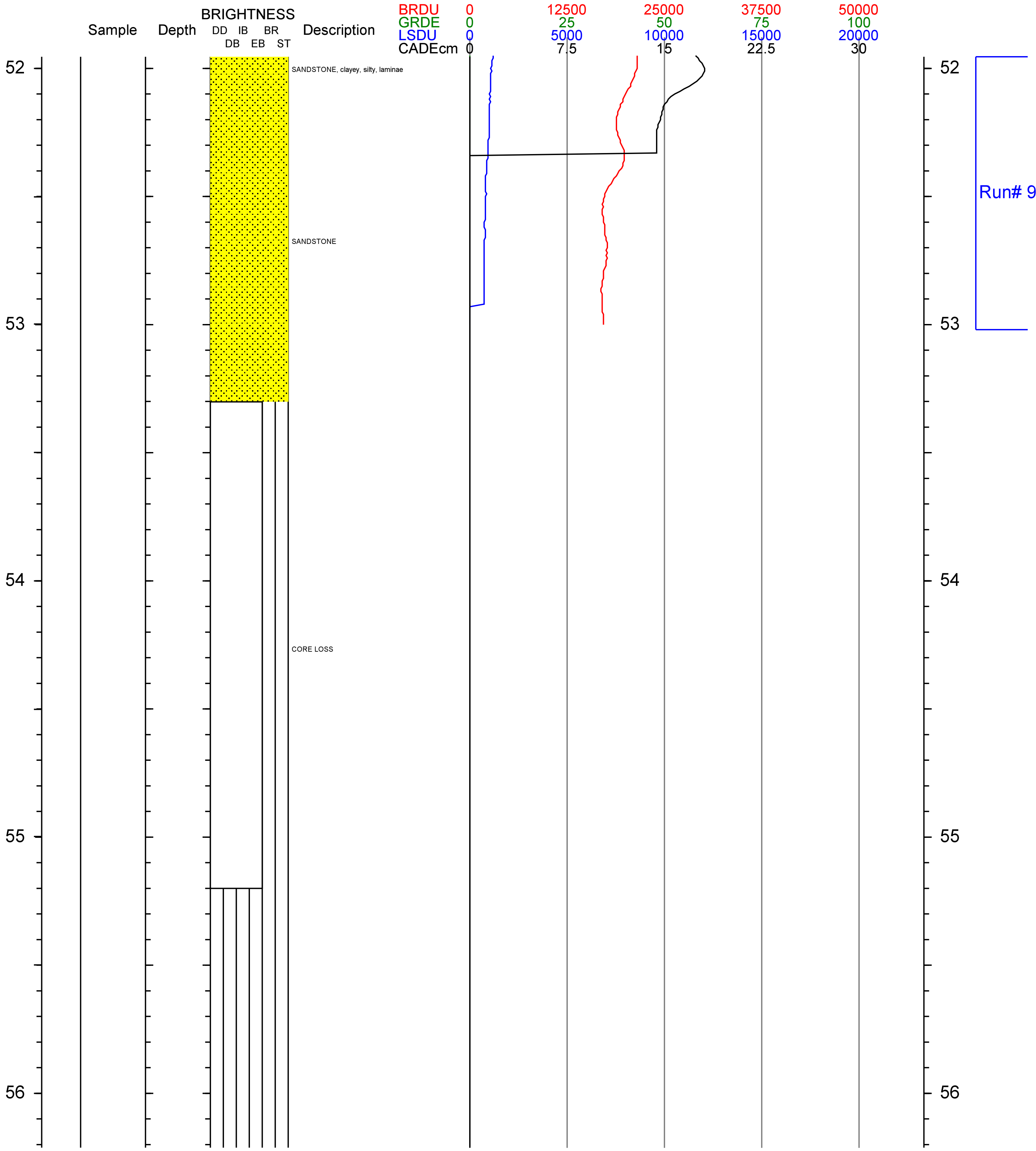

CSENERGY
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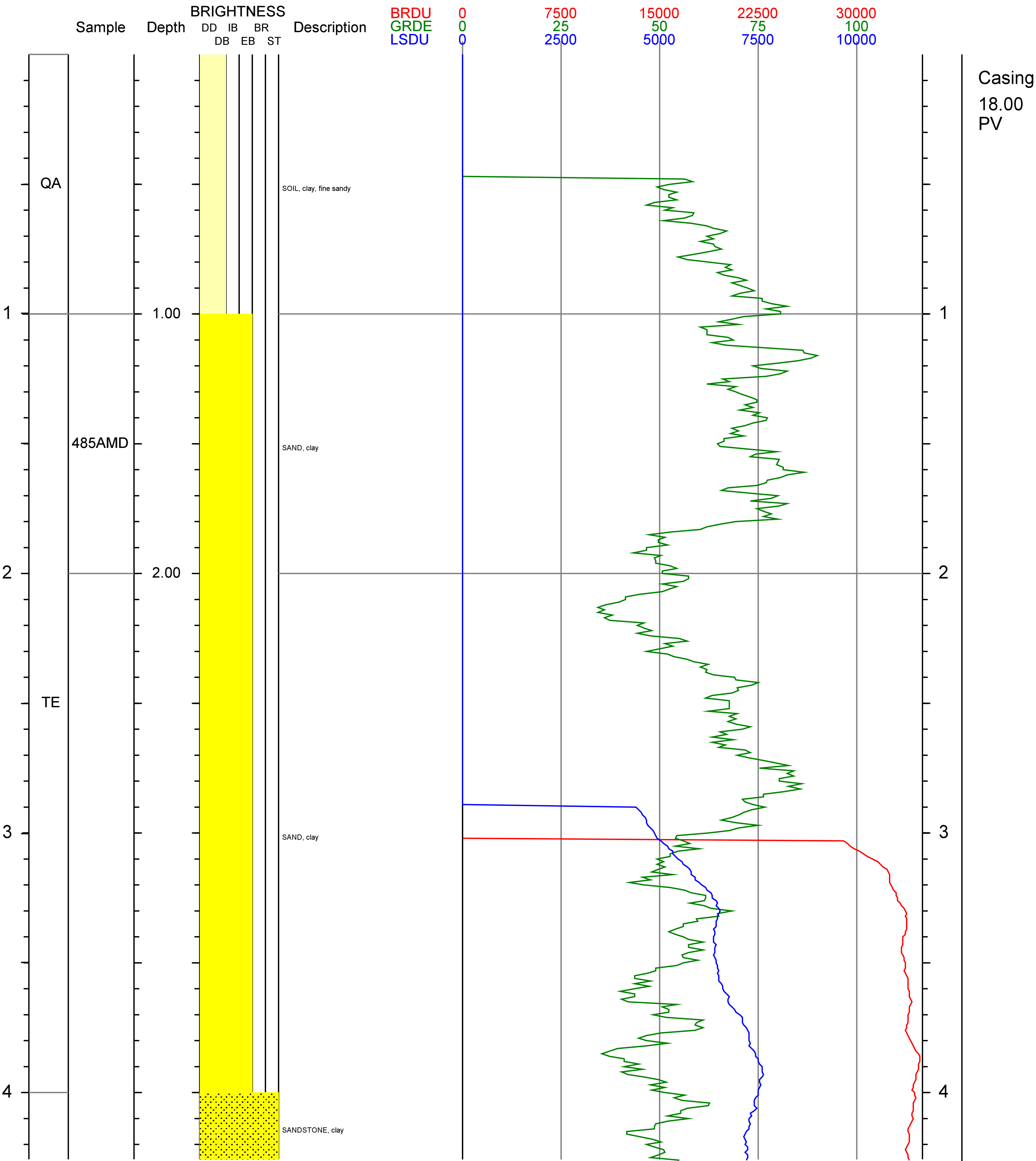
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14040C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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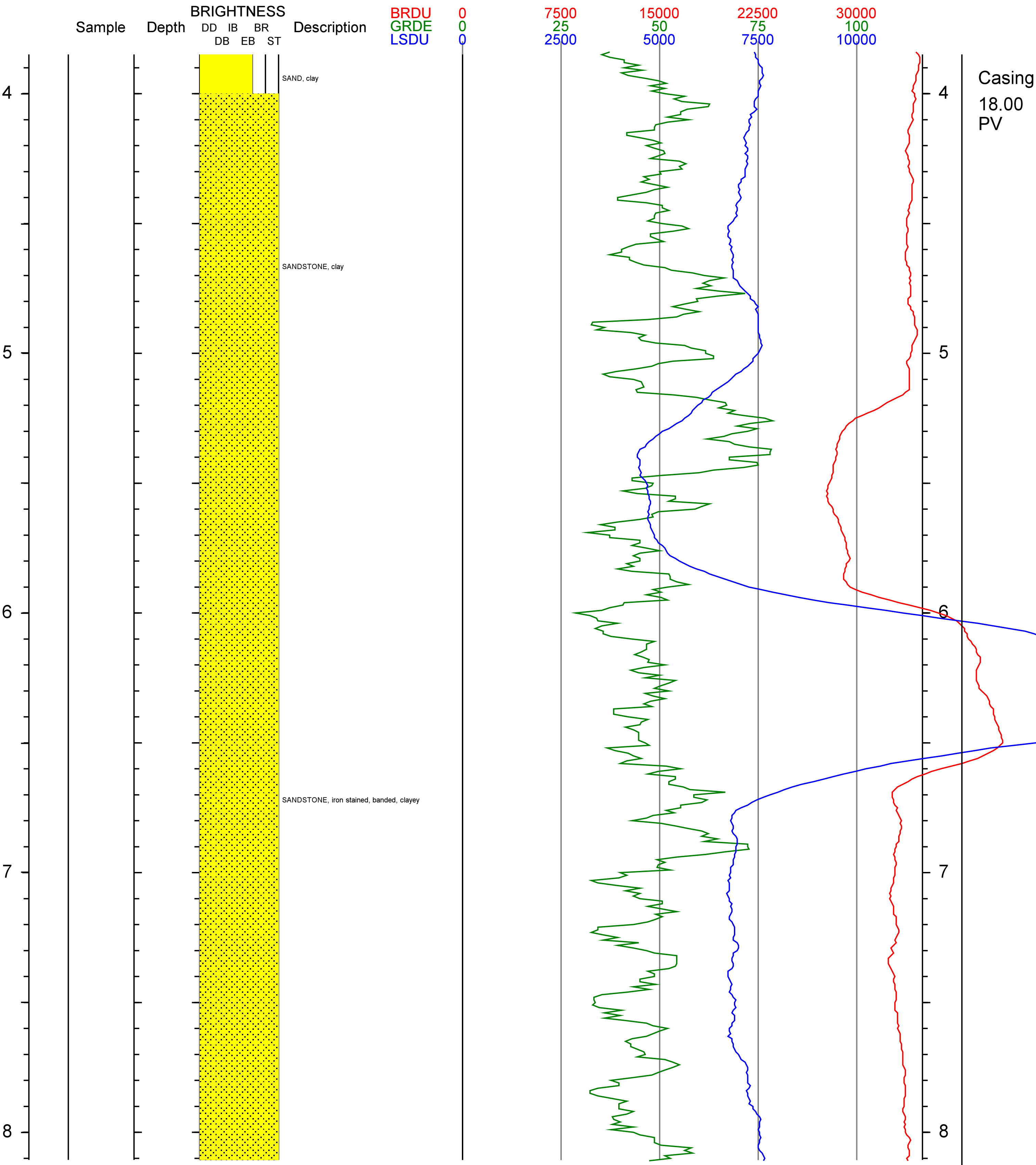
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14040C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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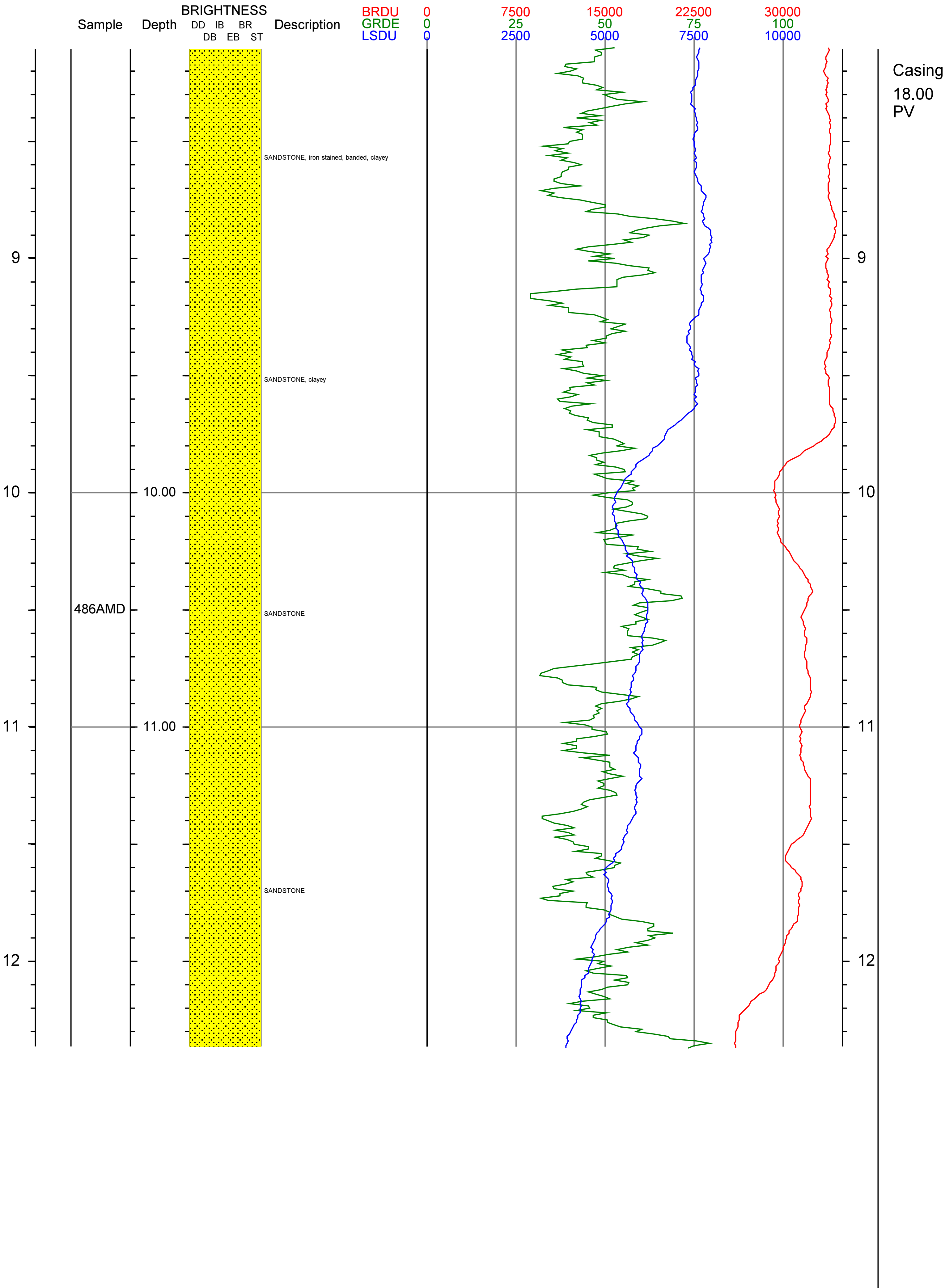

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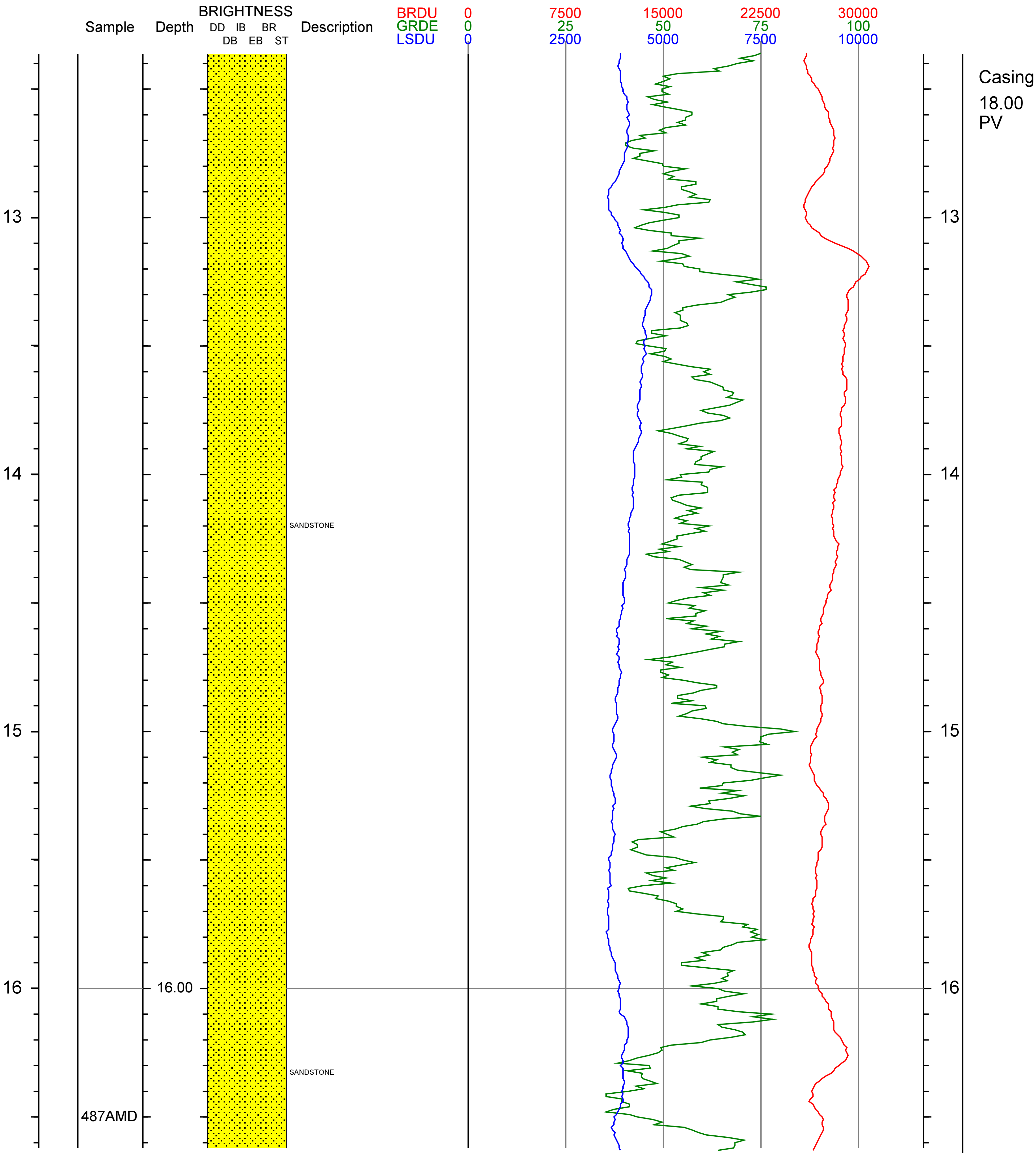

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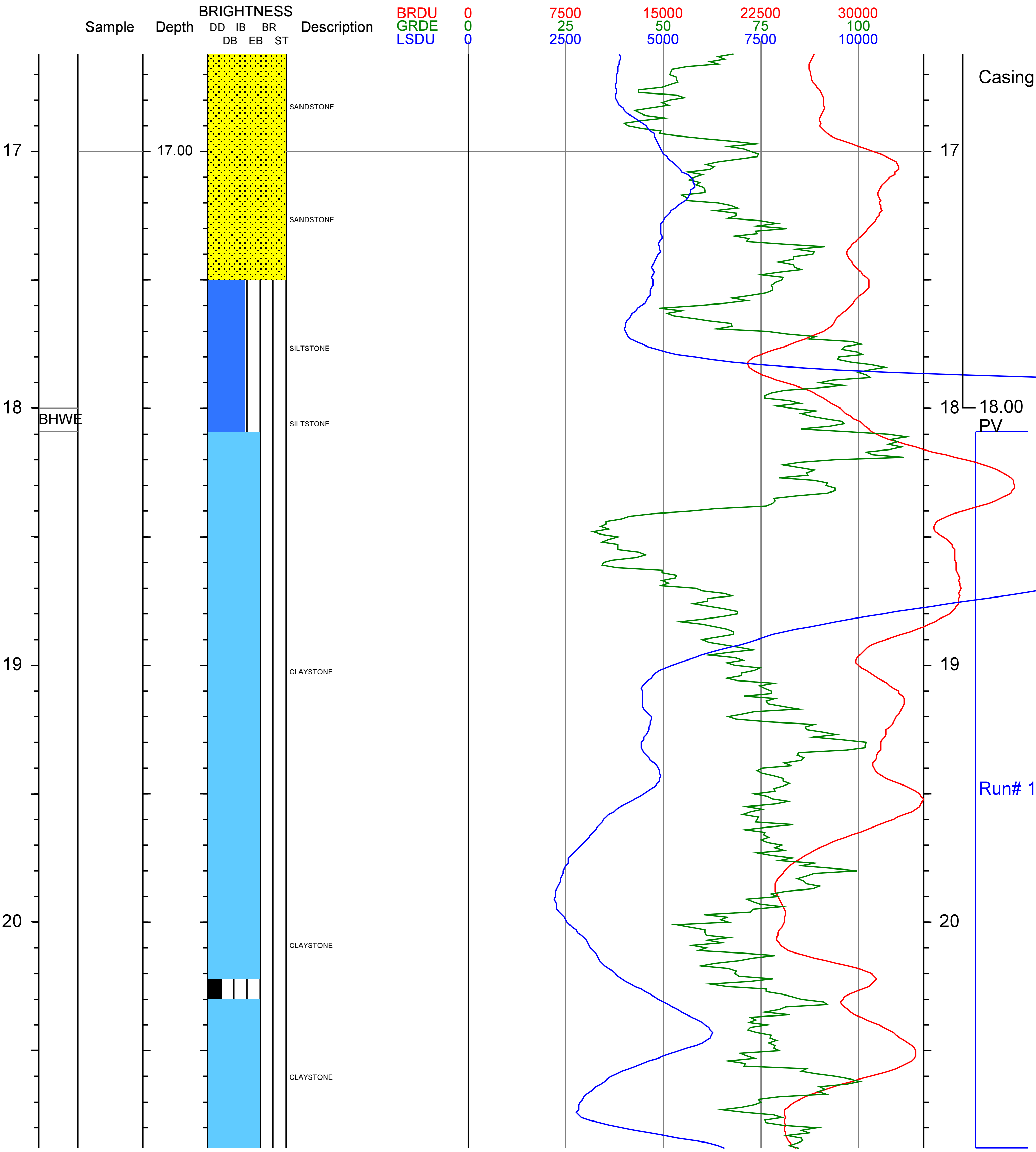

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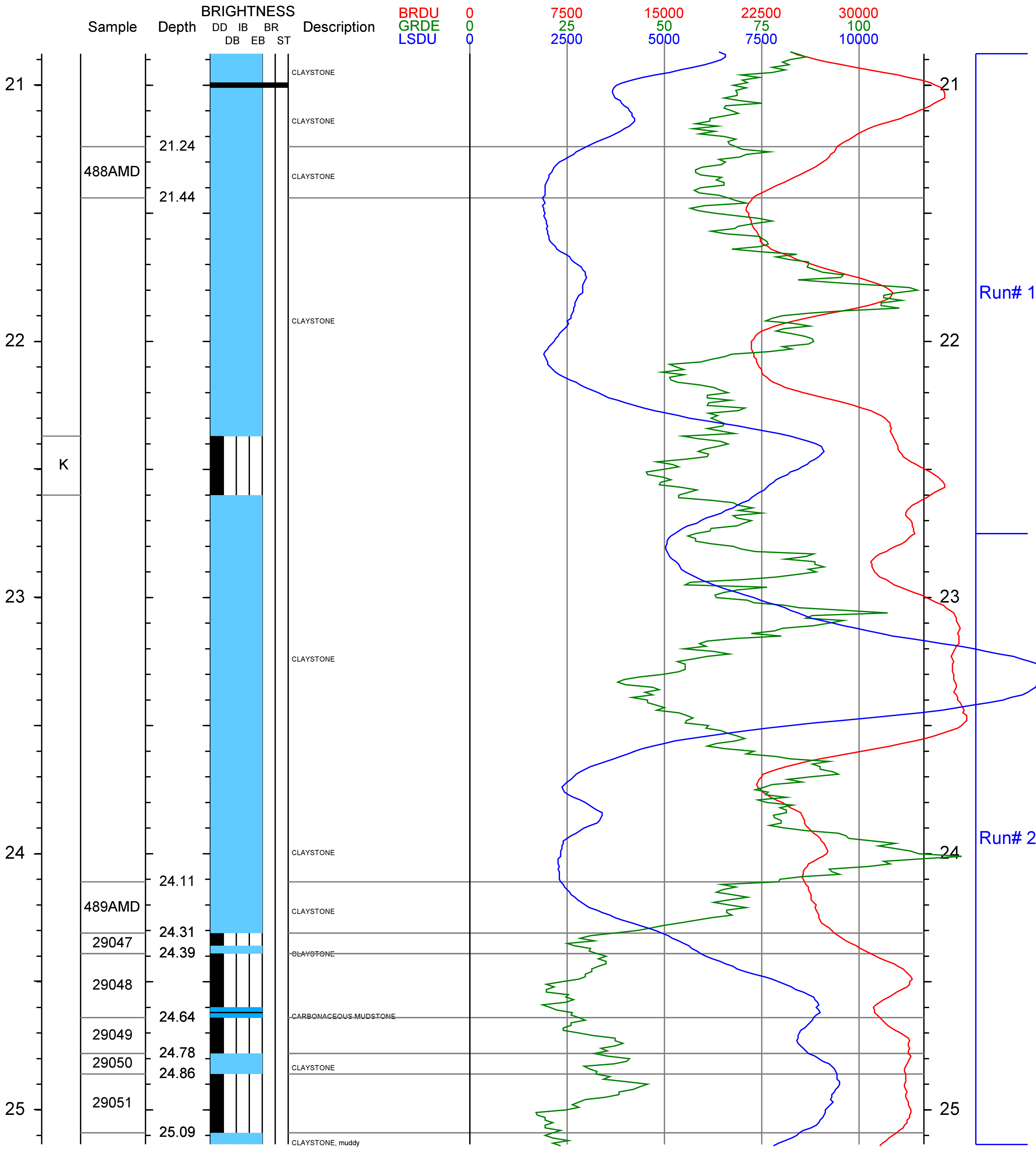

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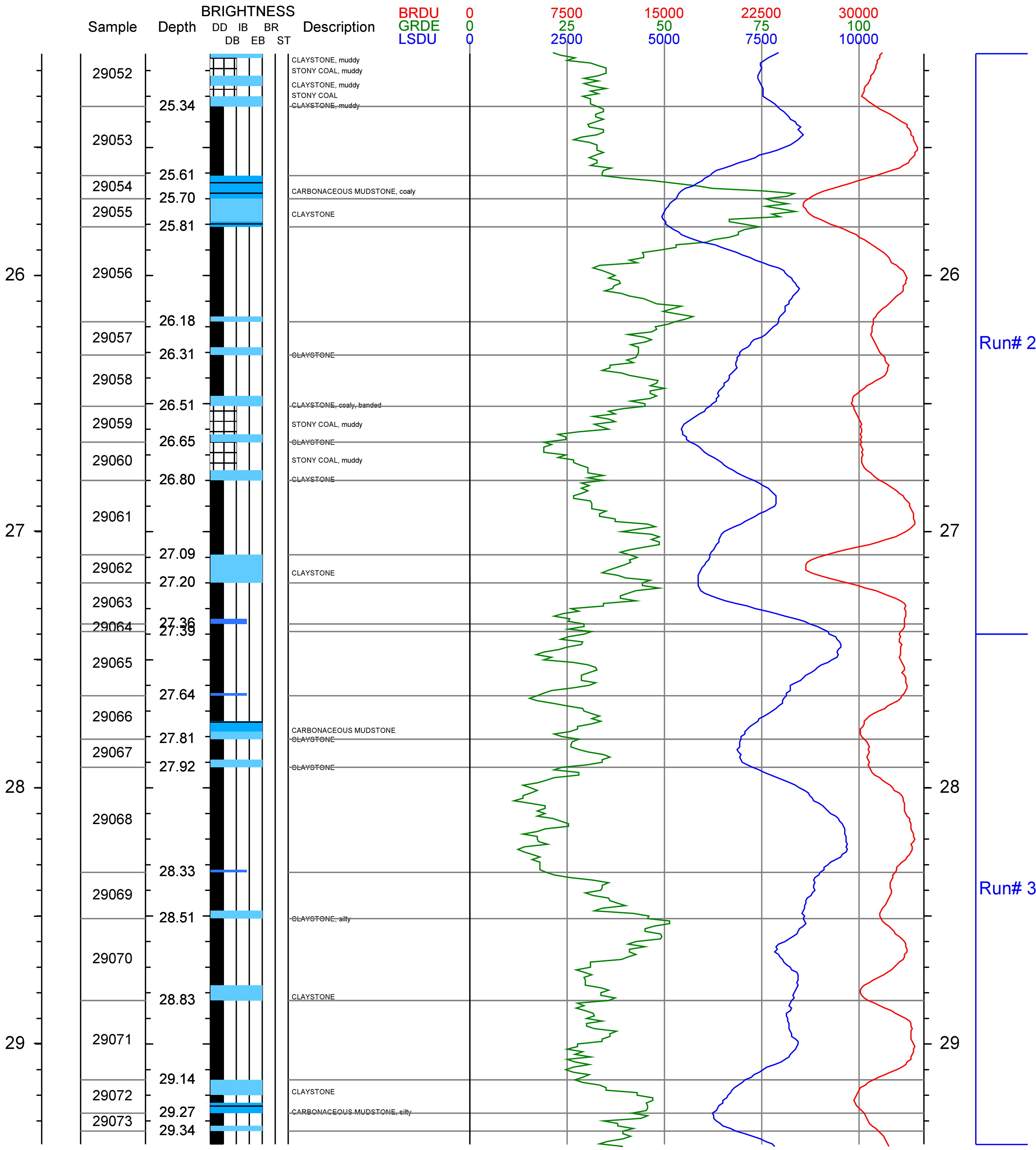

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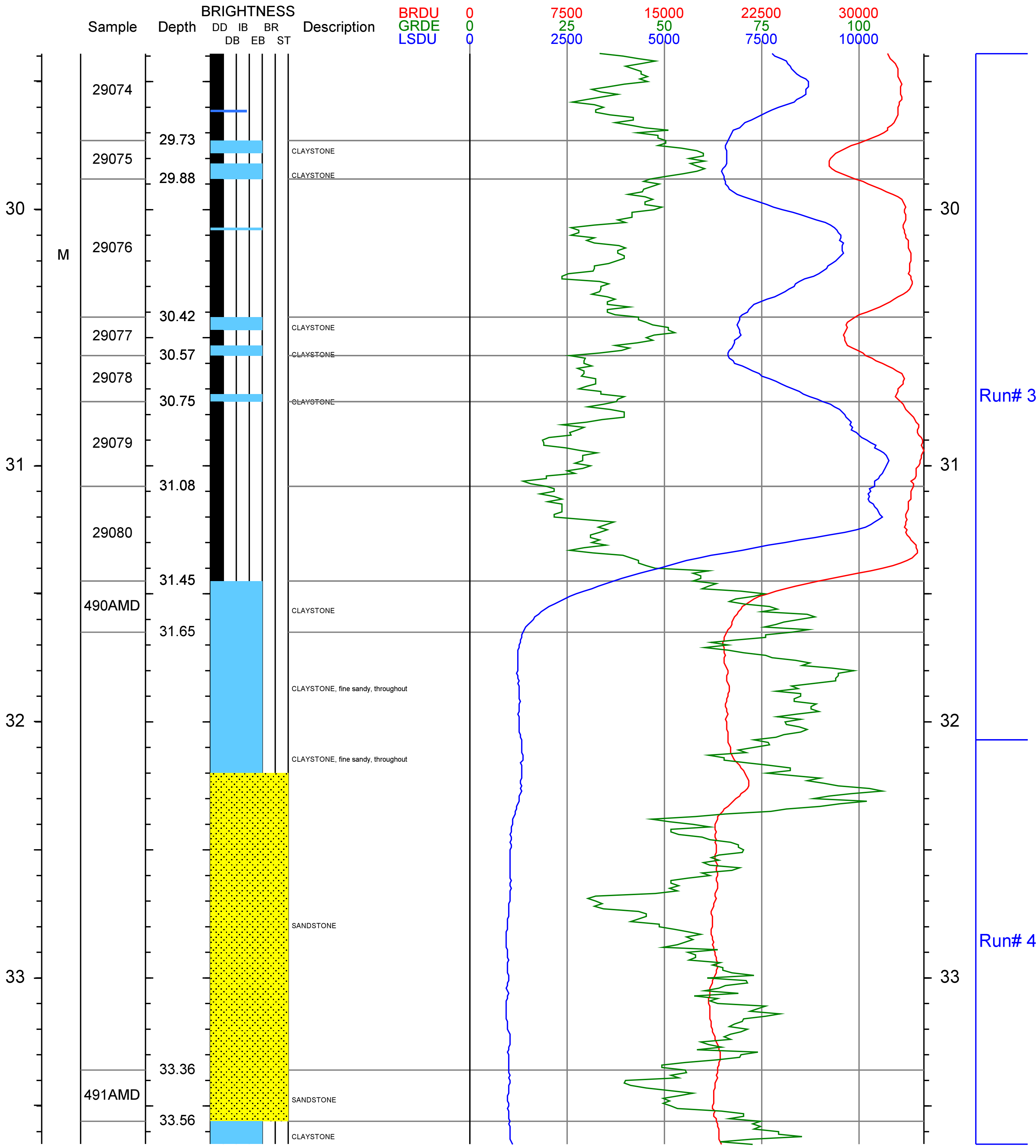

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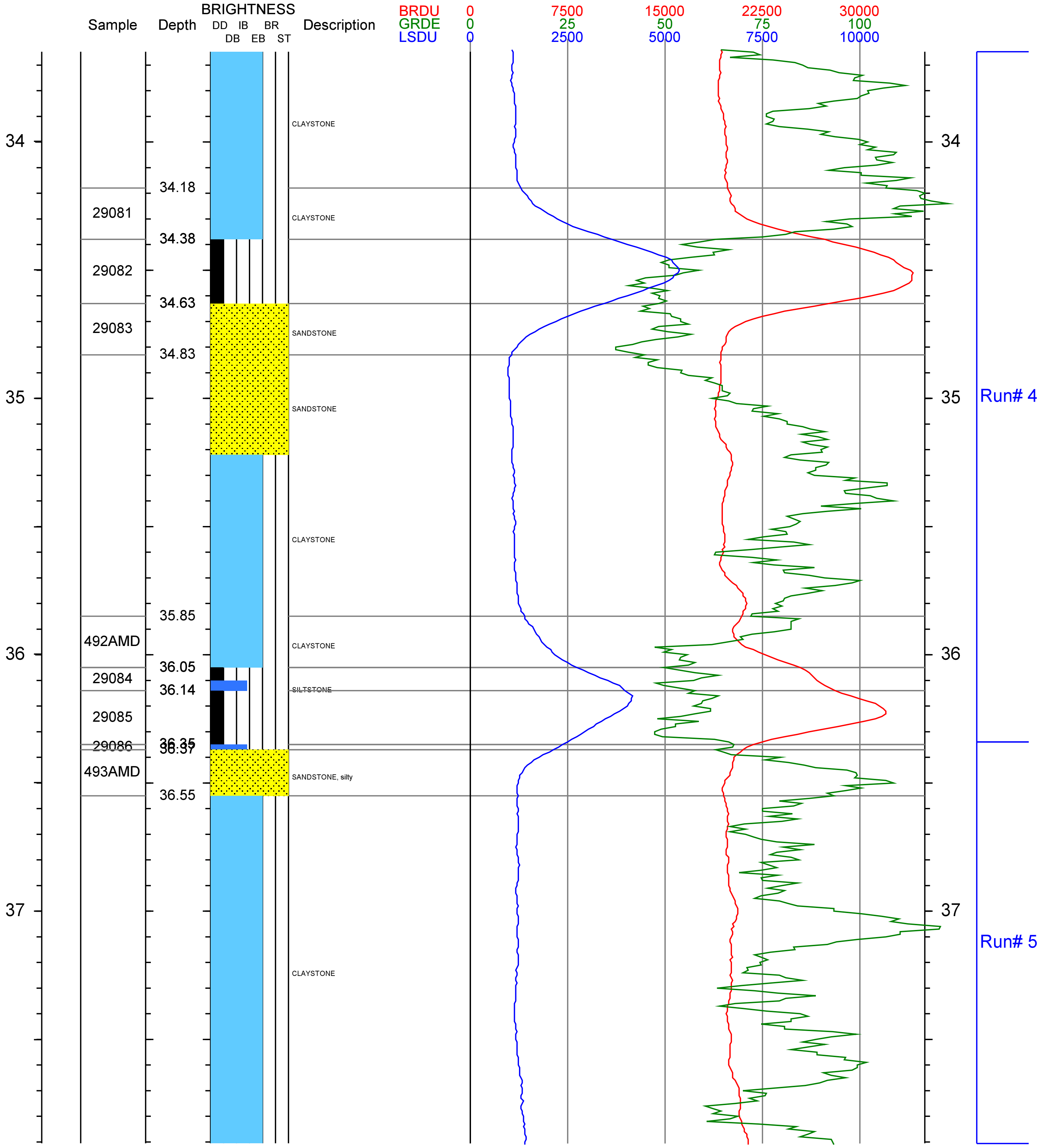

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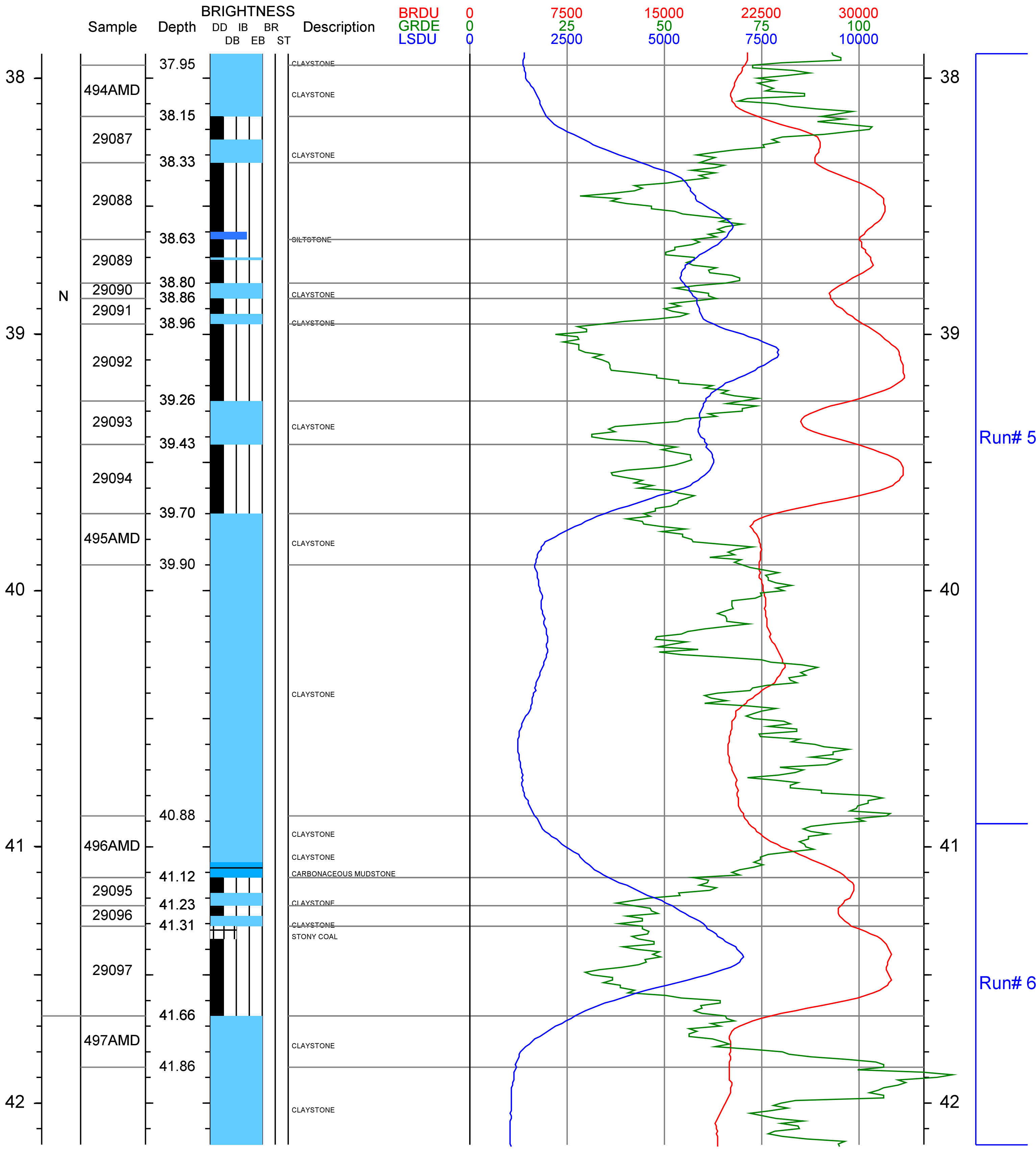

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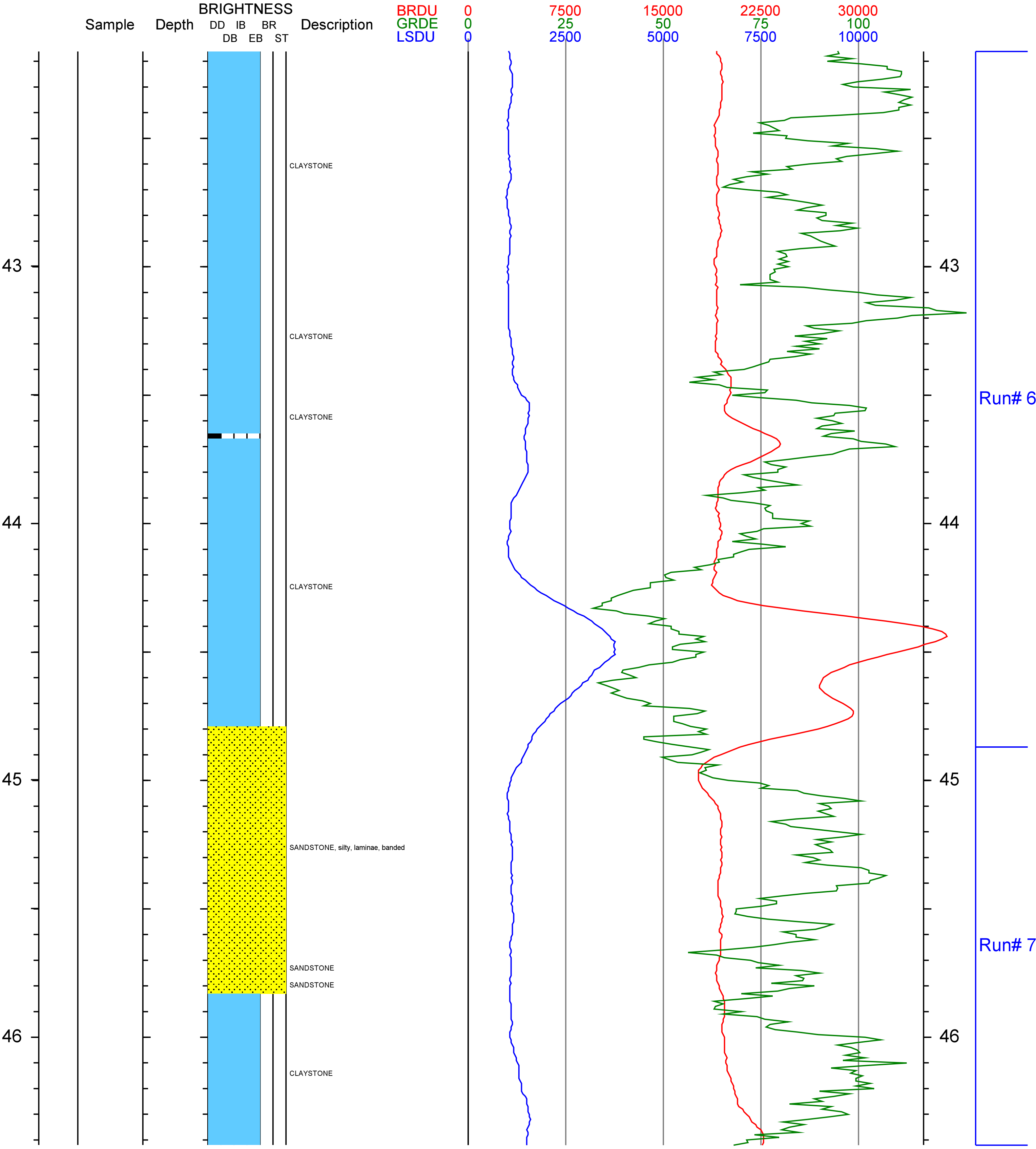

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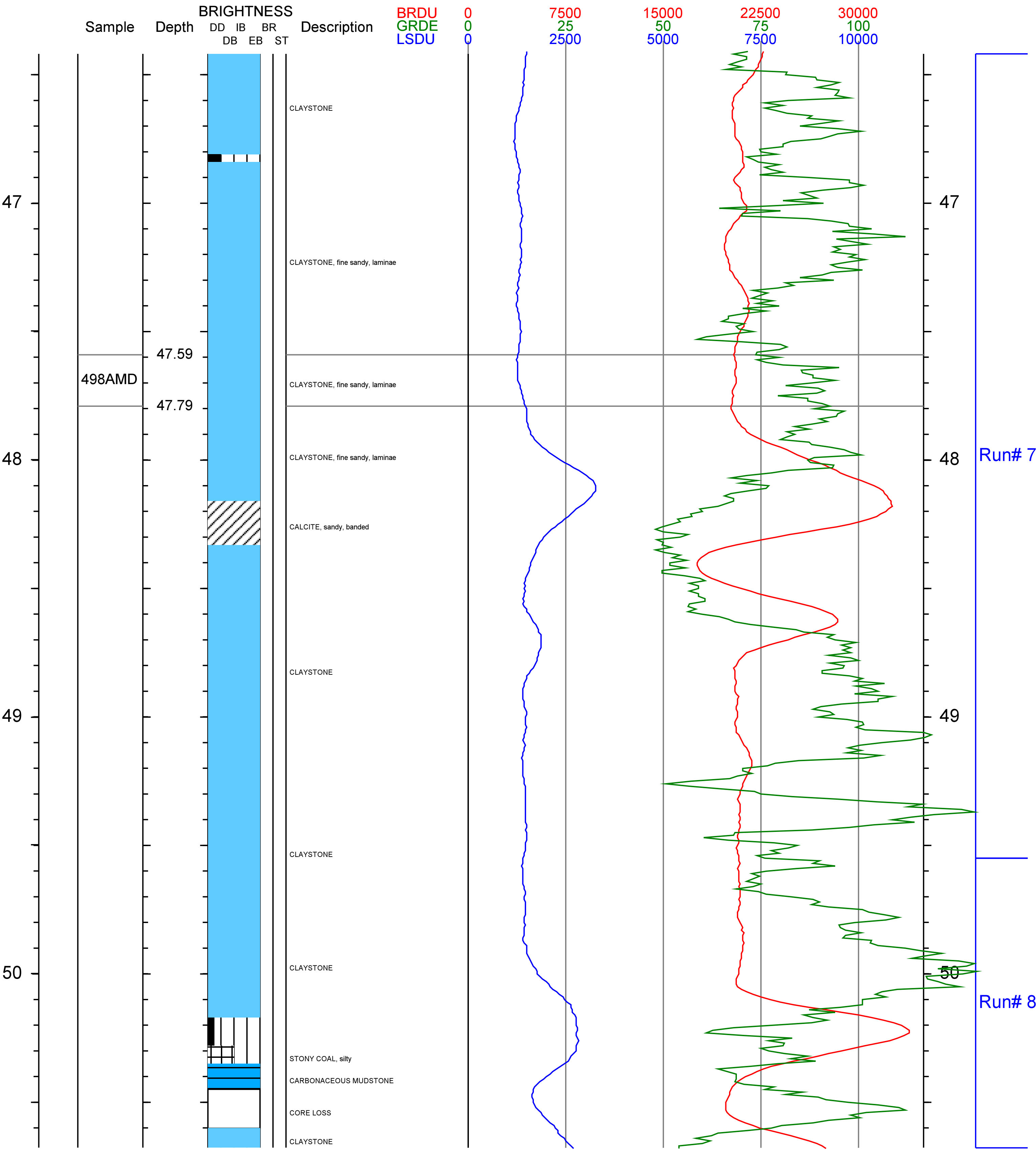

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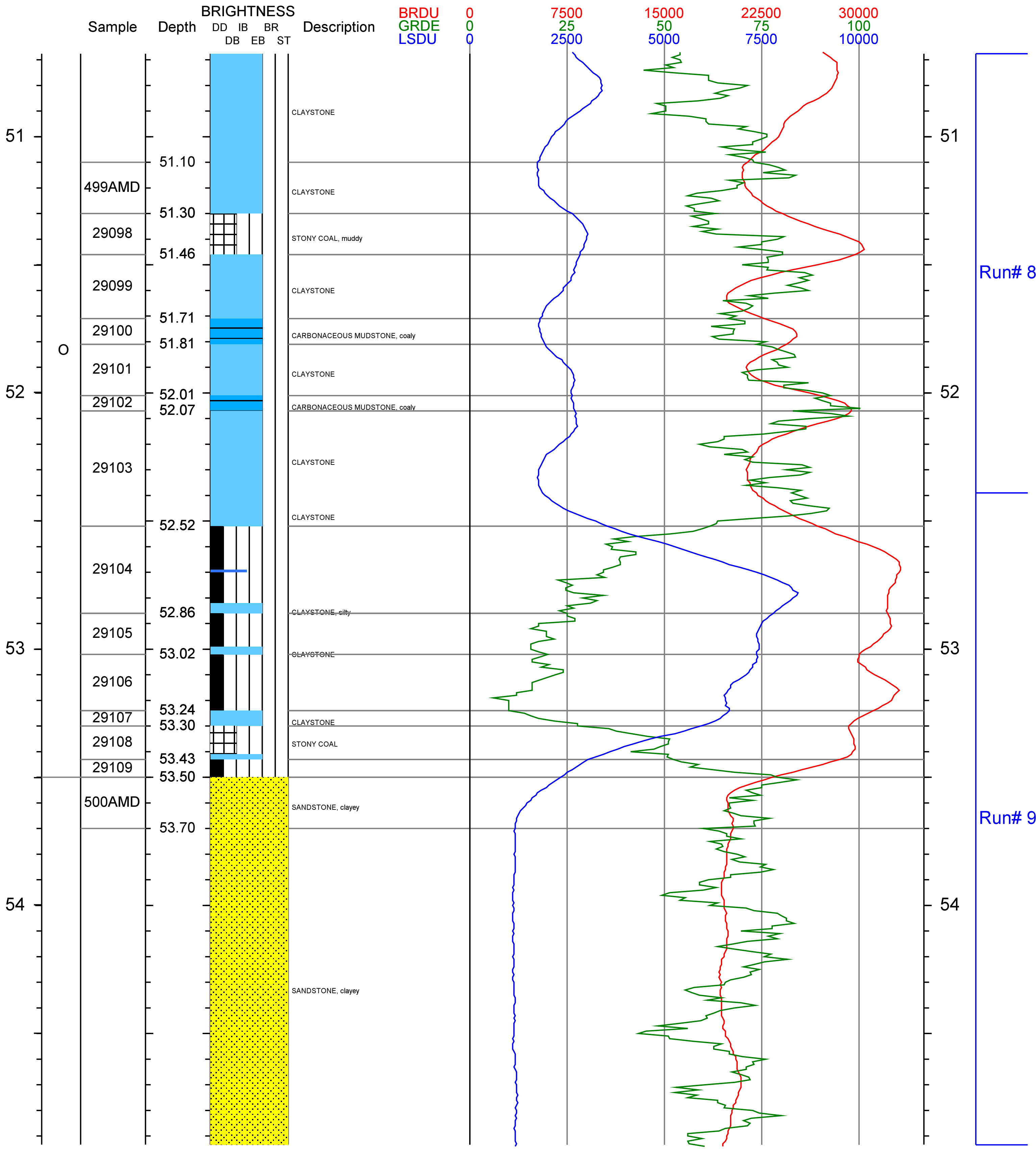

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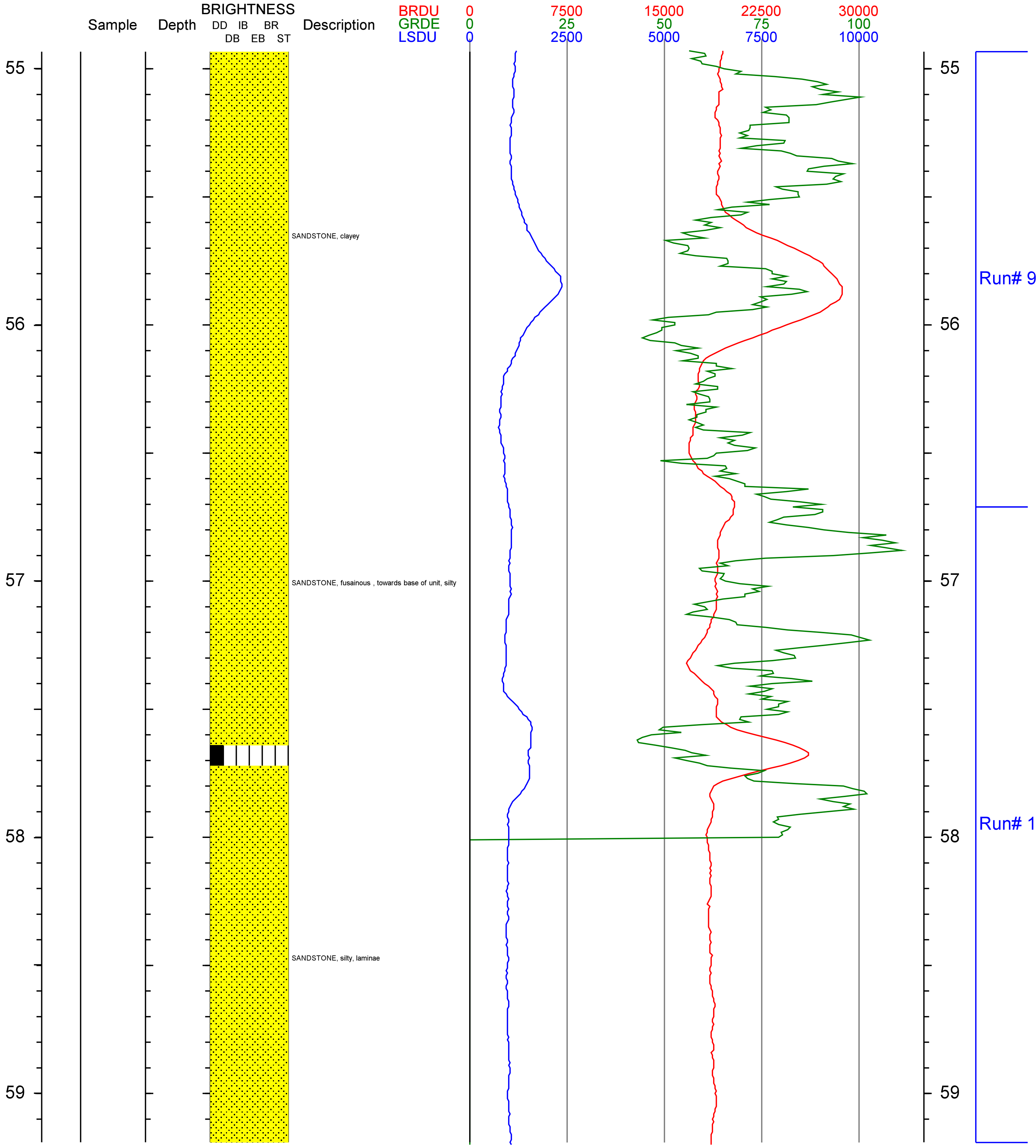

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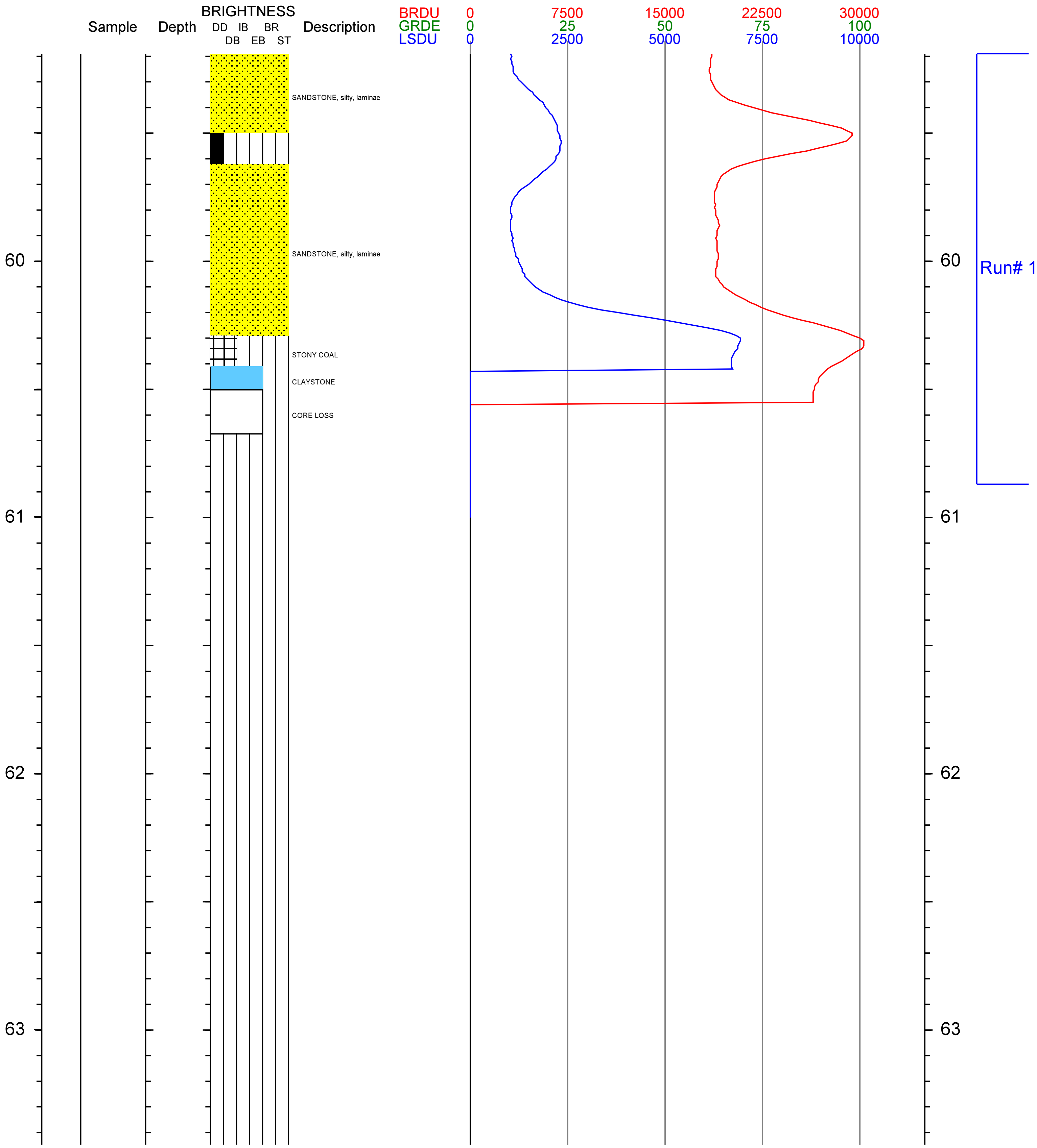
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14040C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



CSENERGY
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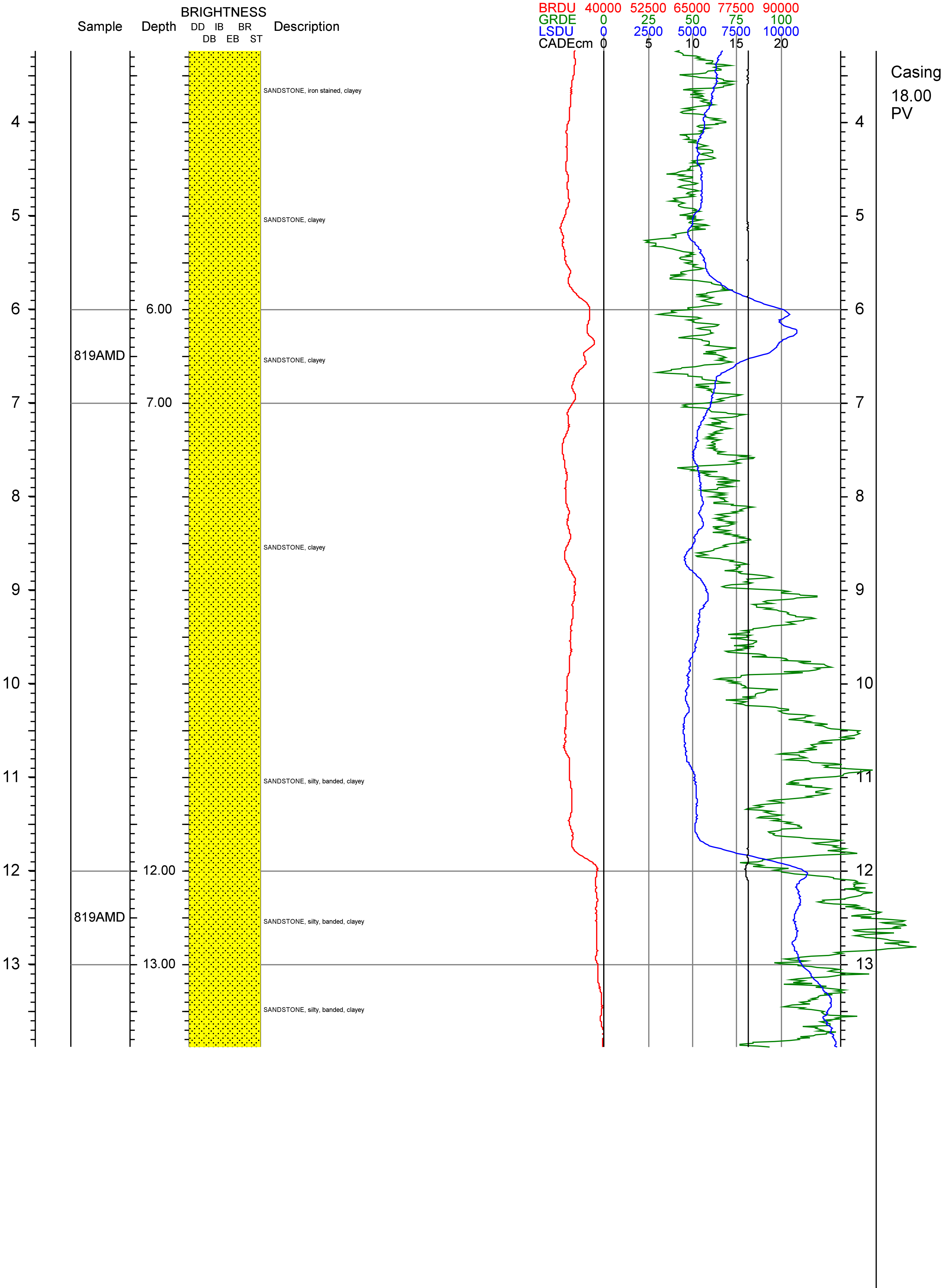
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14042C

SCALE 1:50

GEOPHYSICAL PROFILE

HOLE

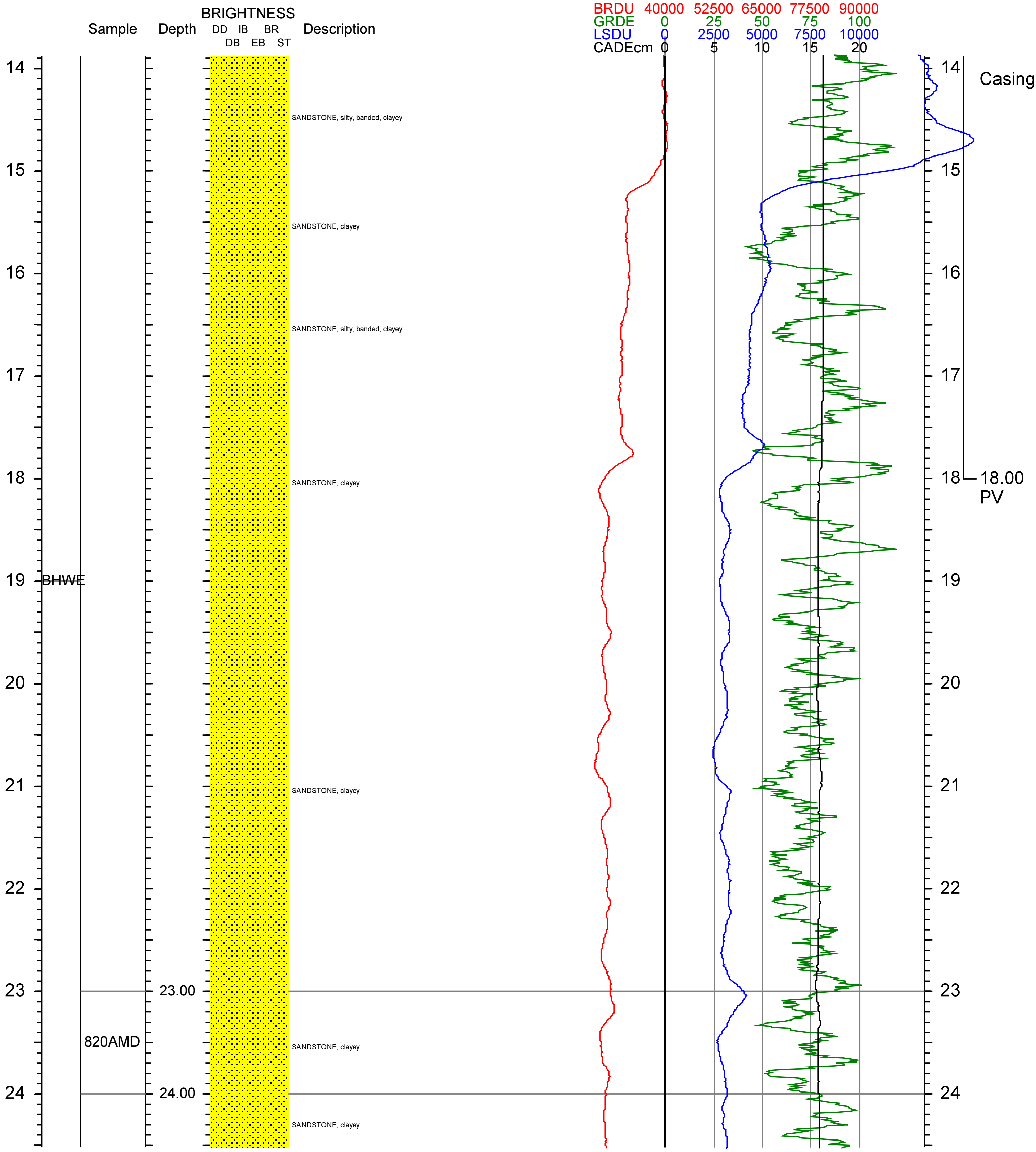


CSENERGY
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14042C

SCALE 1:50

GEOPHYSICAL PROFILE

HOLE



CSENERGY
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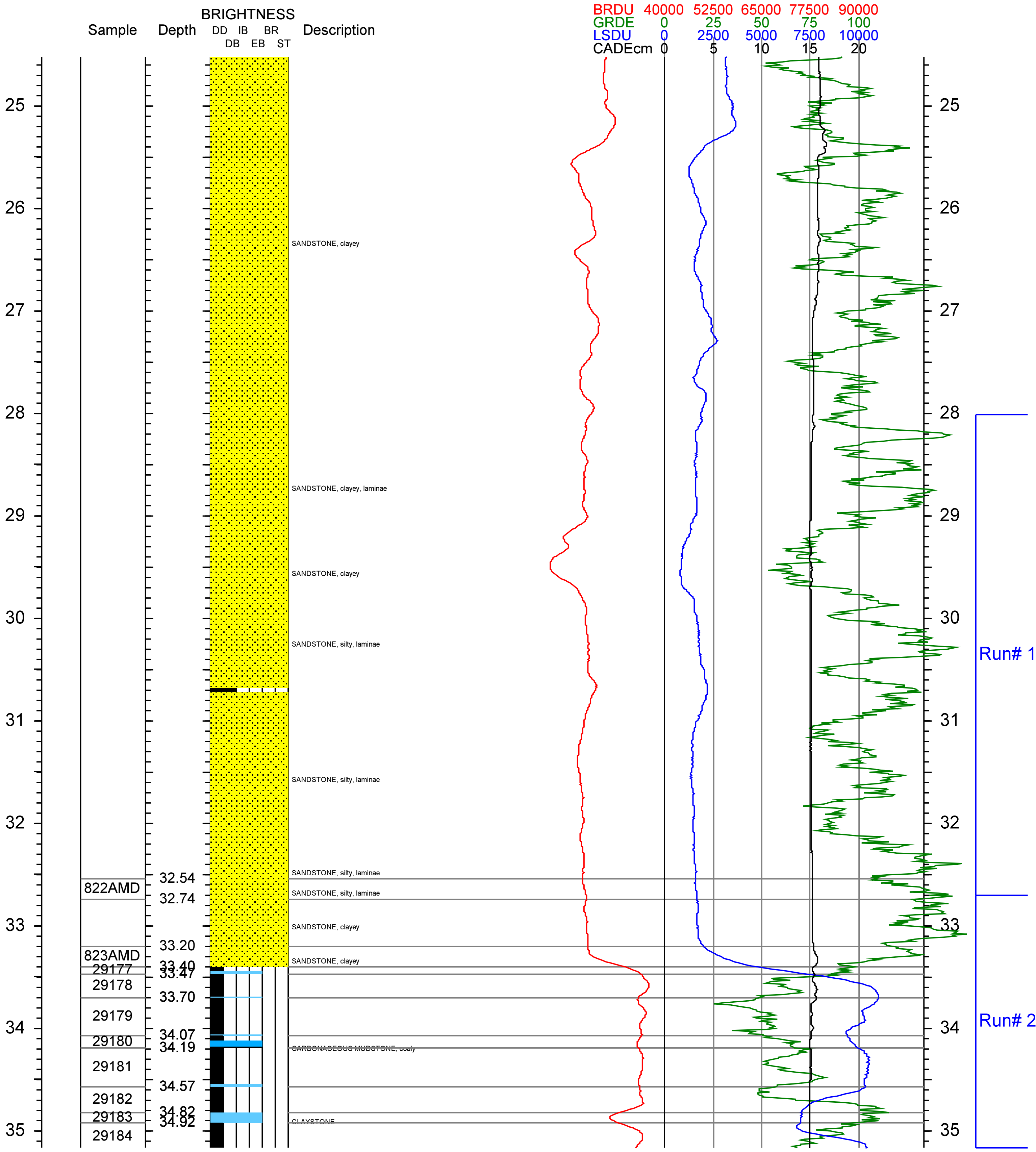
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14042C

SCALE 1:50

GEOPHYSICAL PROFILE
HOLE



CSENERGY
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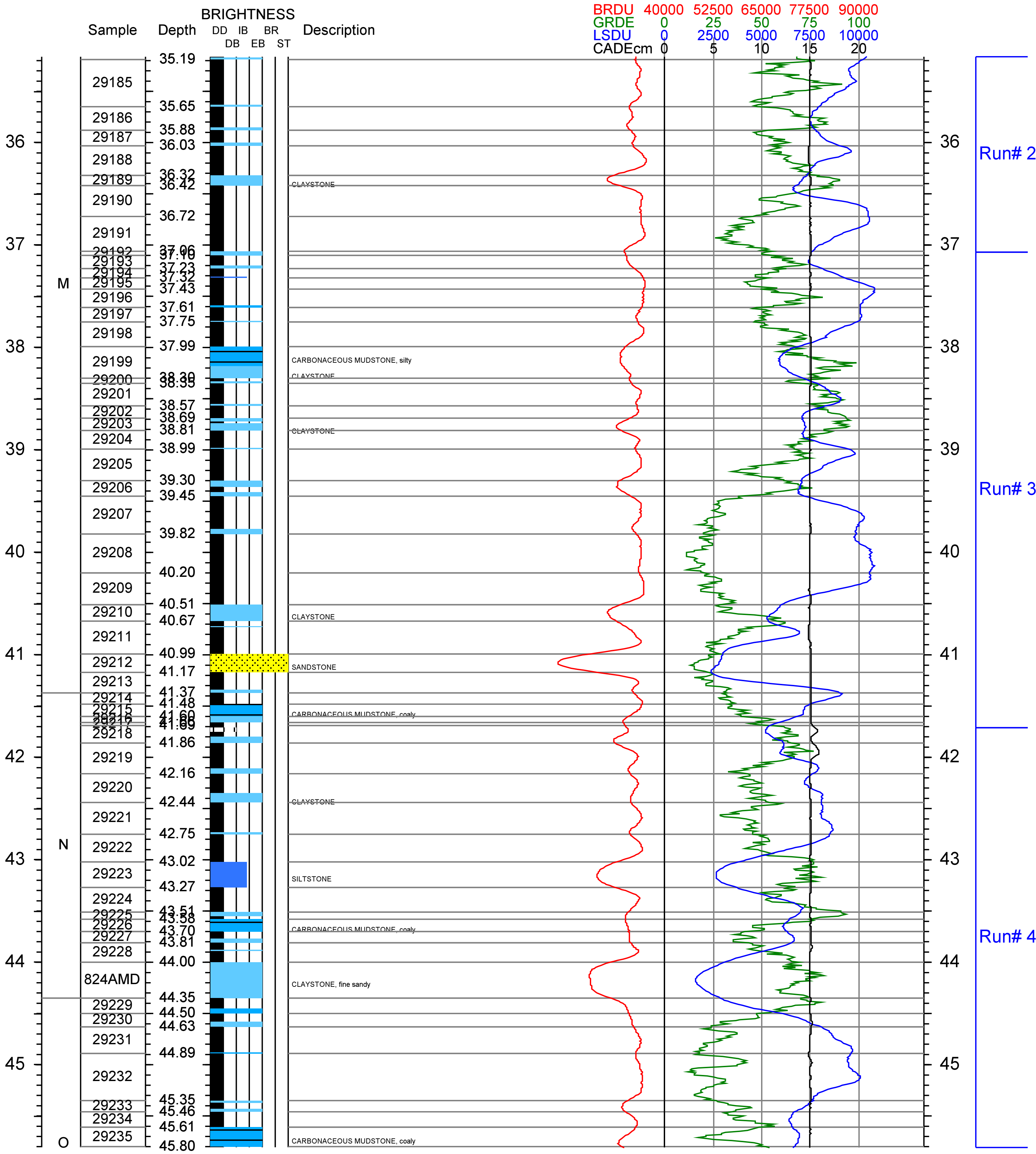
HOLE KC14042C

SCALE 1:50

GEOPHYSICAL PROFILE
HOLE



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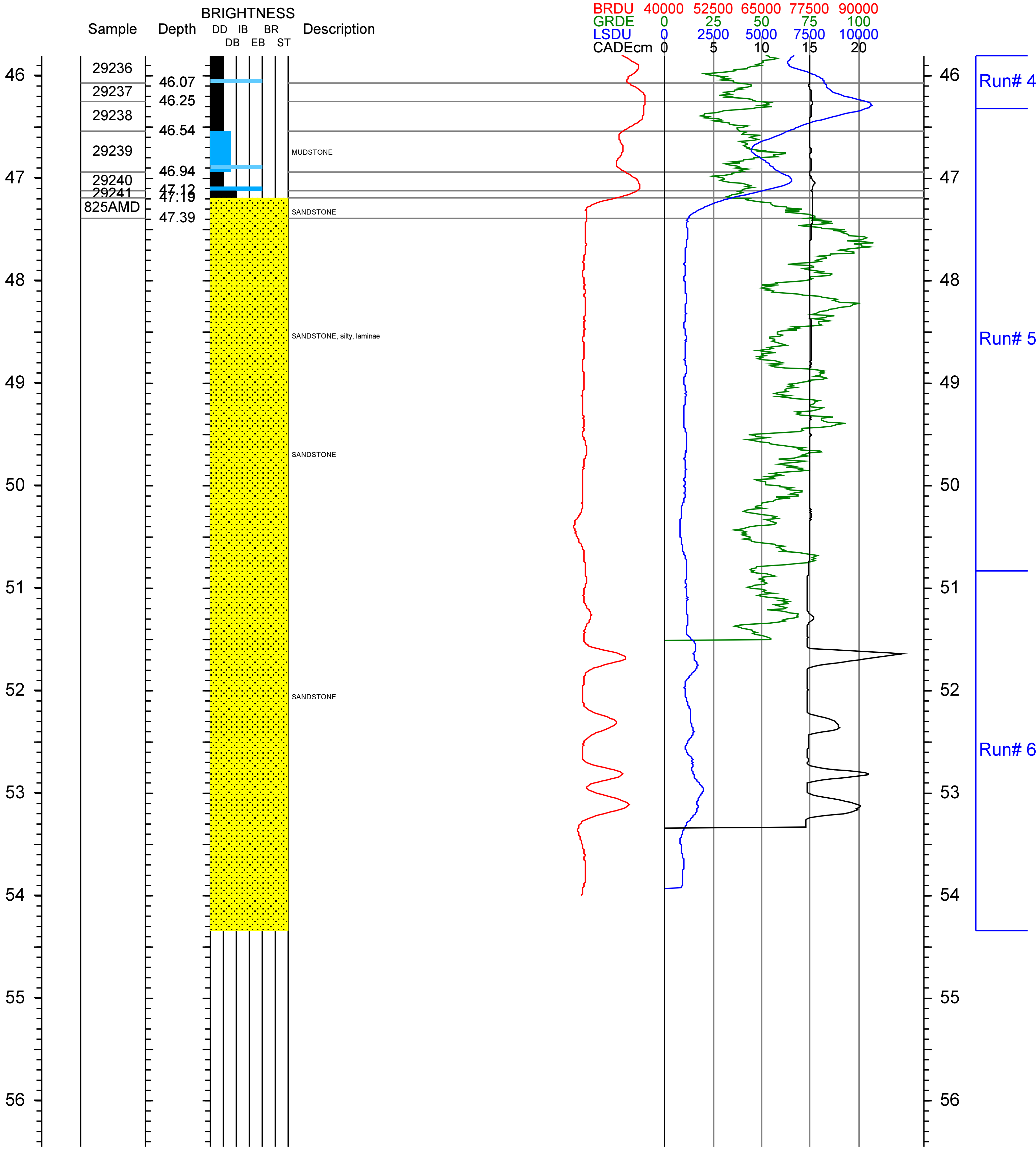
SCALE 1:50

GEOPHYSICAL PROFILE

HOLE



CSENERGY
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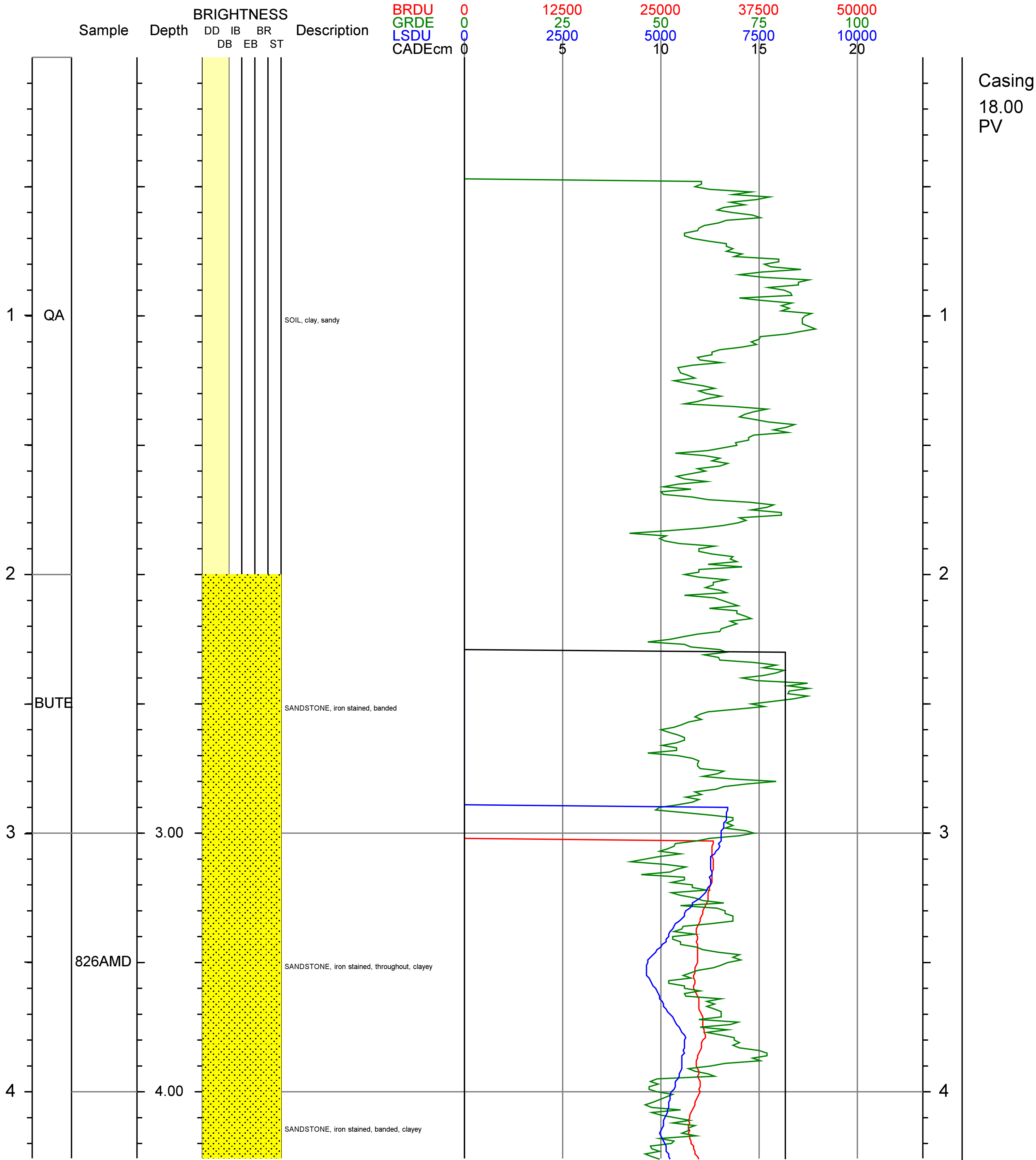
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

SCALE 1:20
GEOPHYSICAL PROFILE
HOLE



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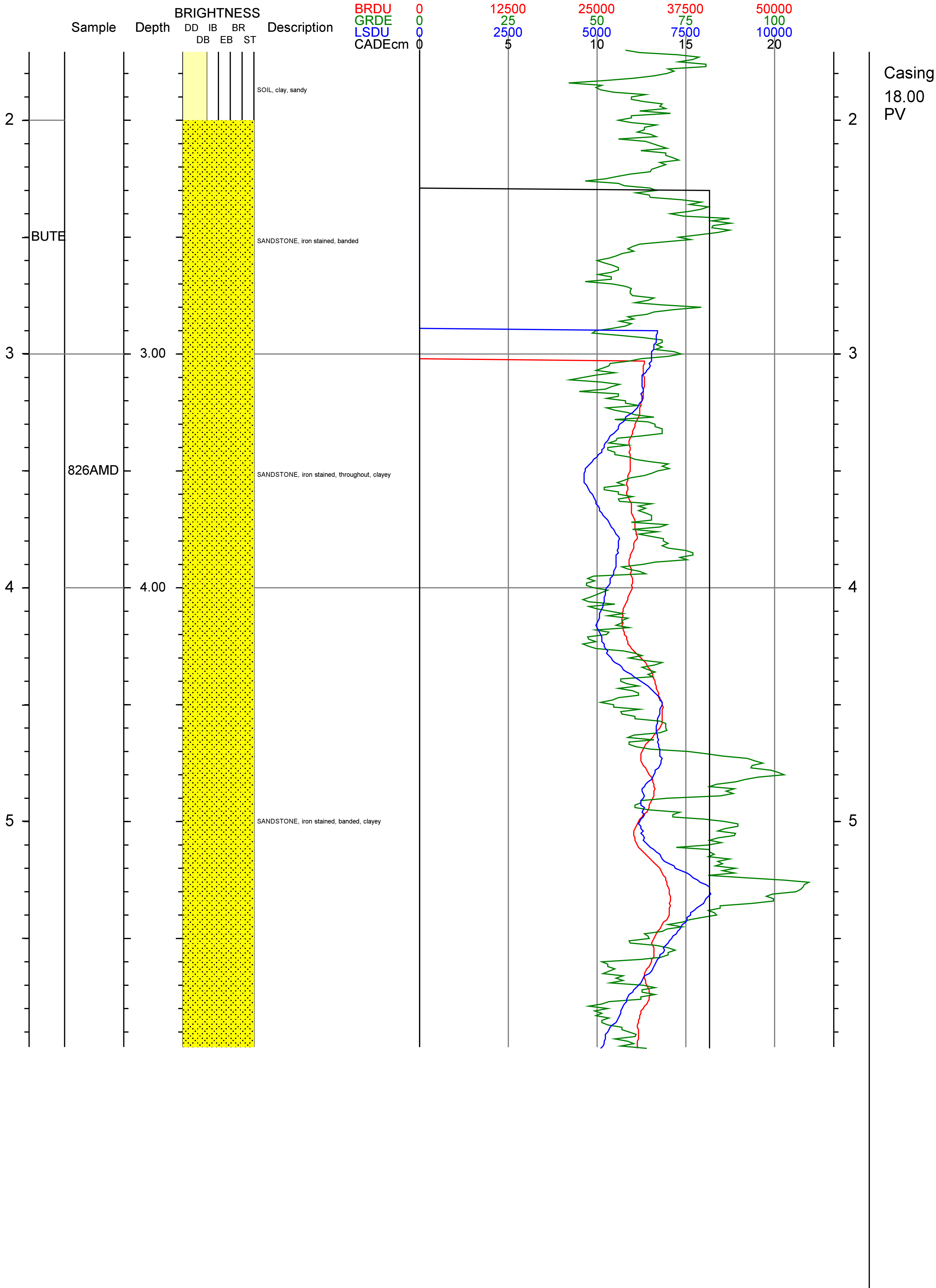
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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HOLE KC14043C

SCALE 1:20
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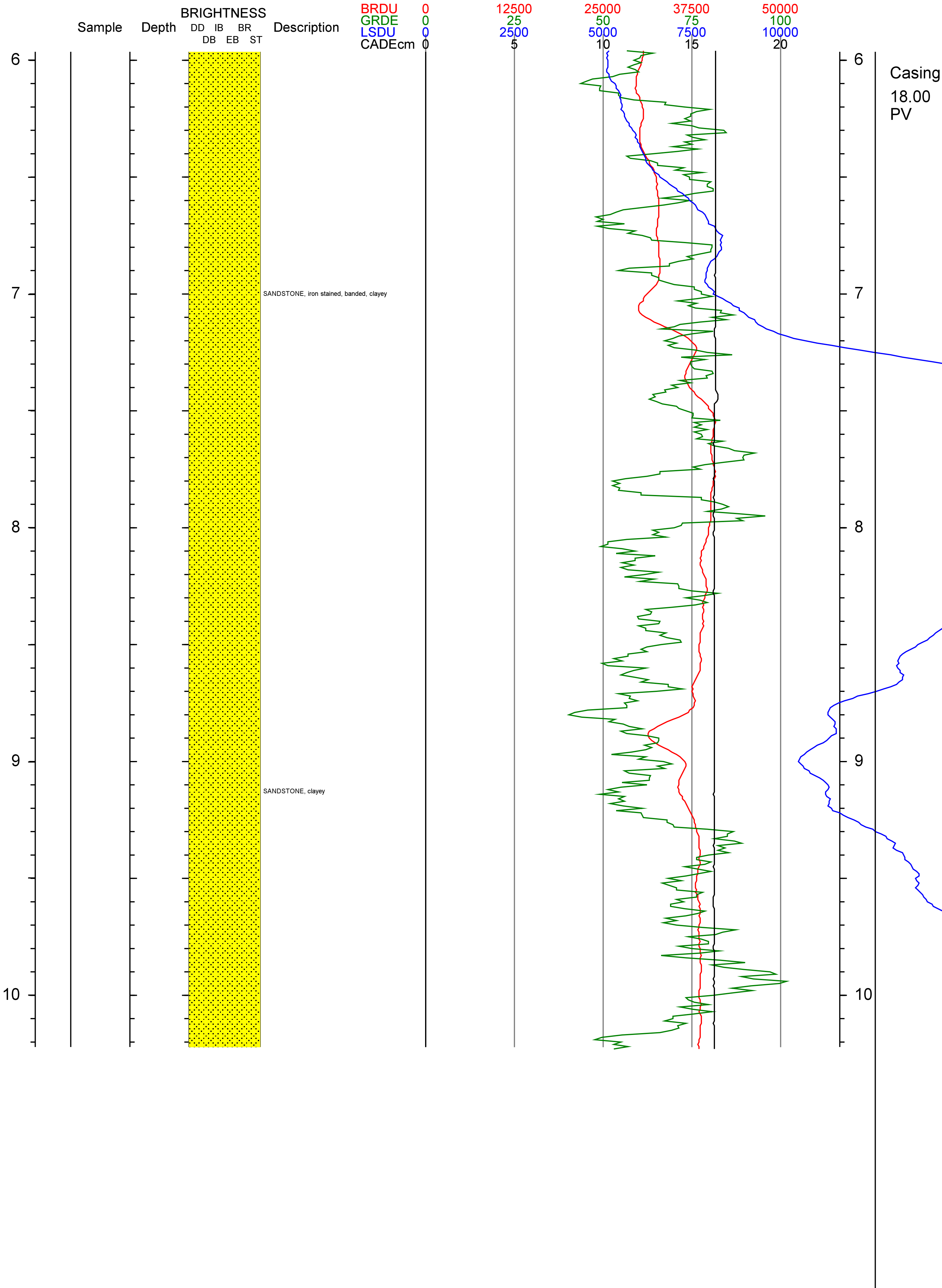
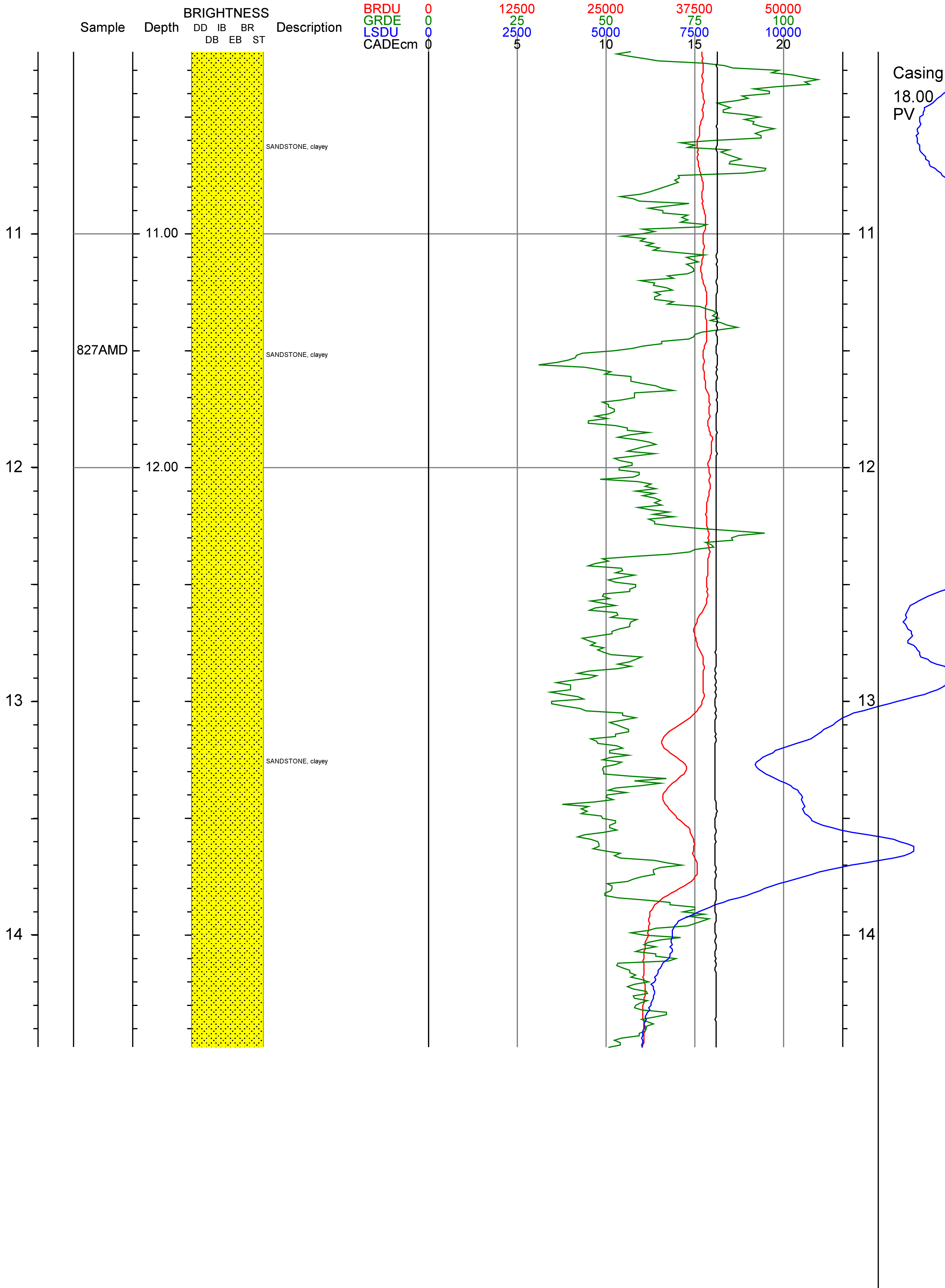


CSENERGY
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE

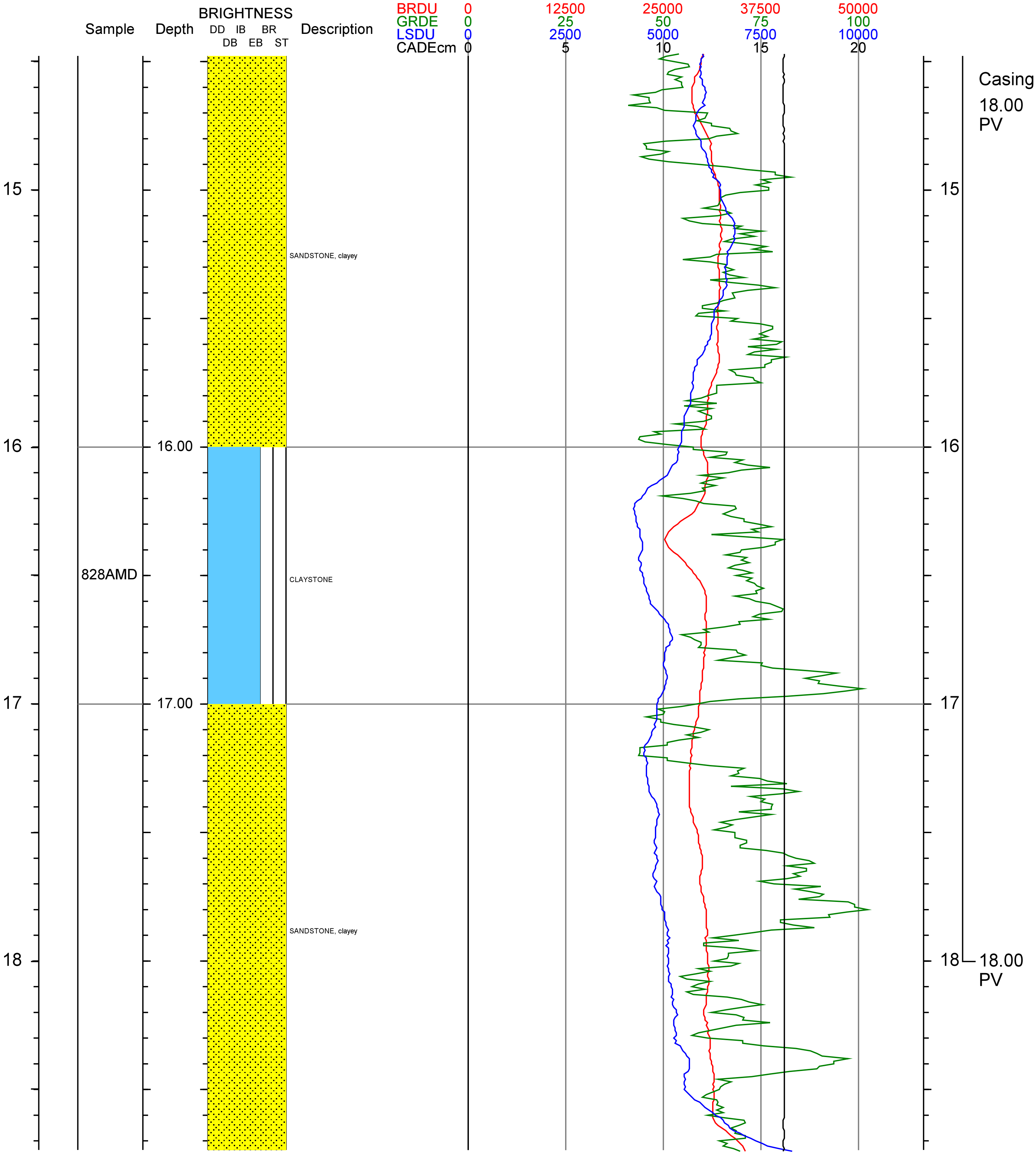


CSENERGY
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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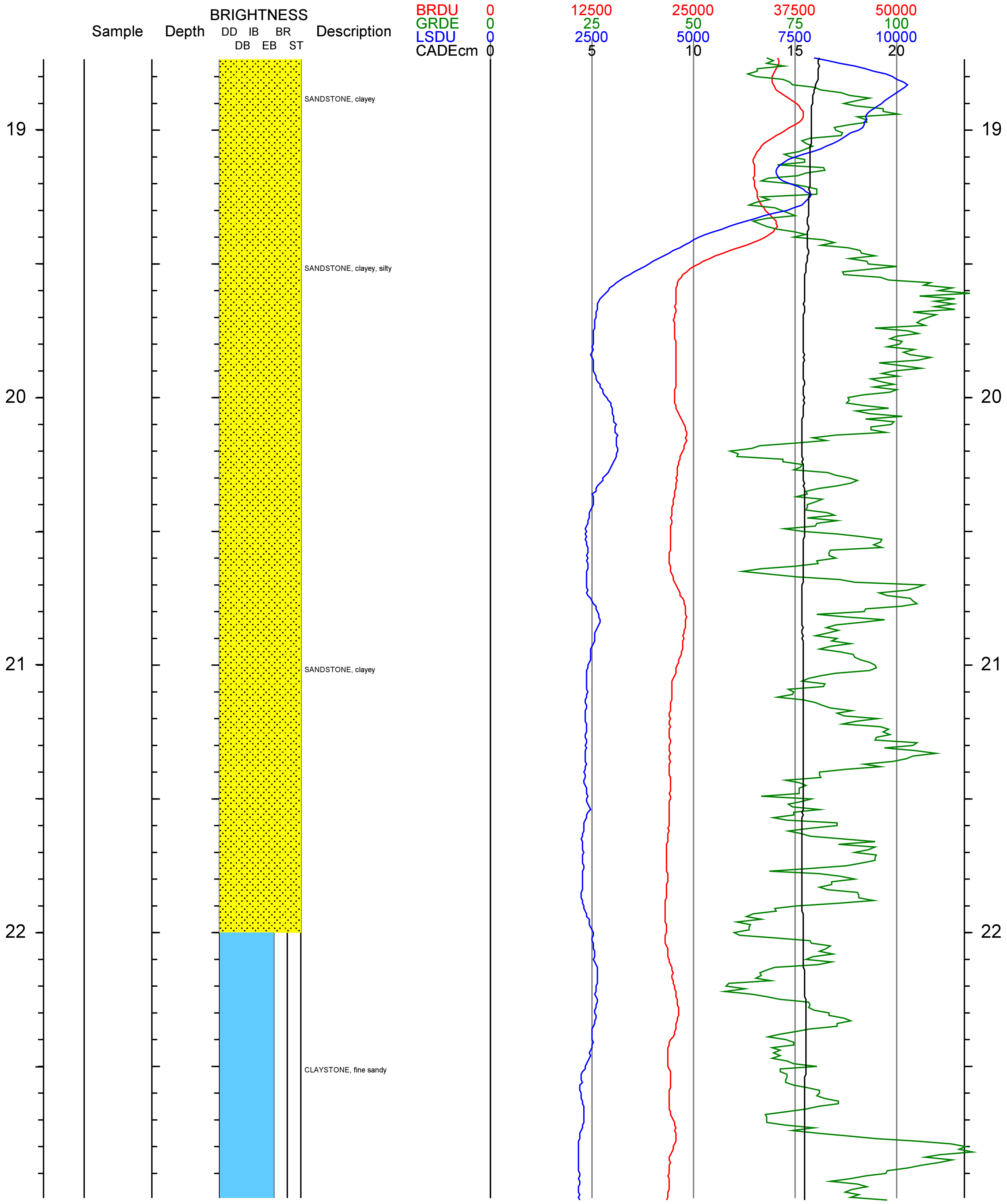
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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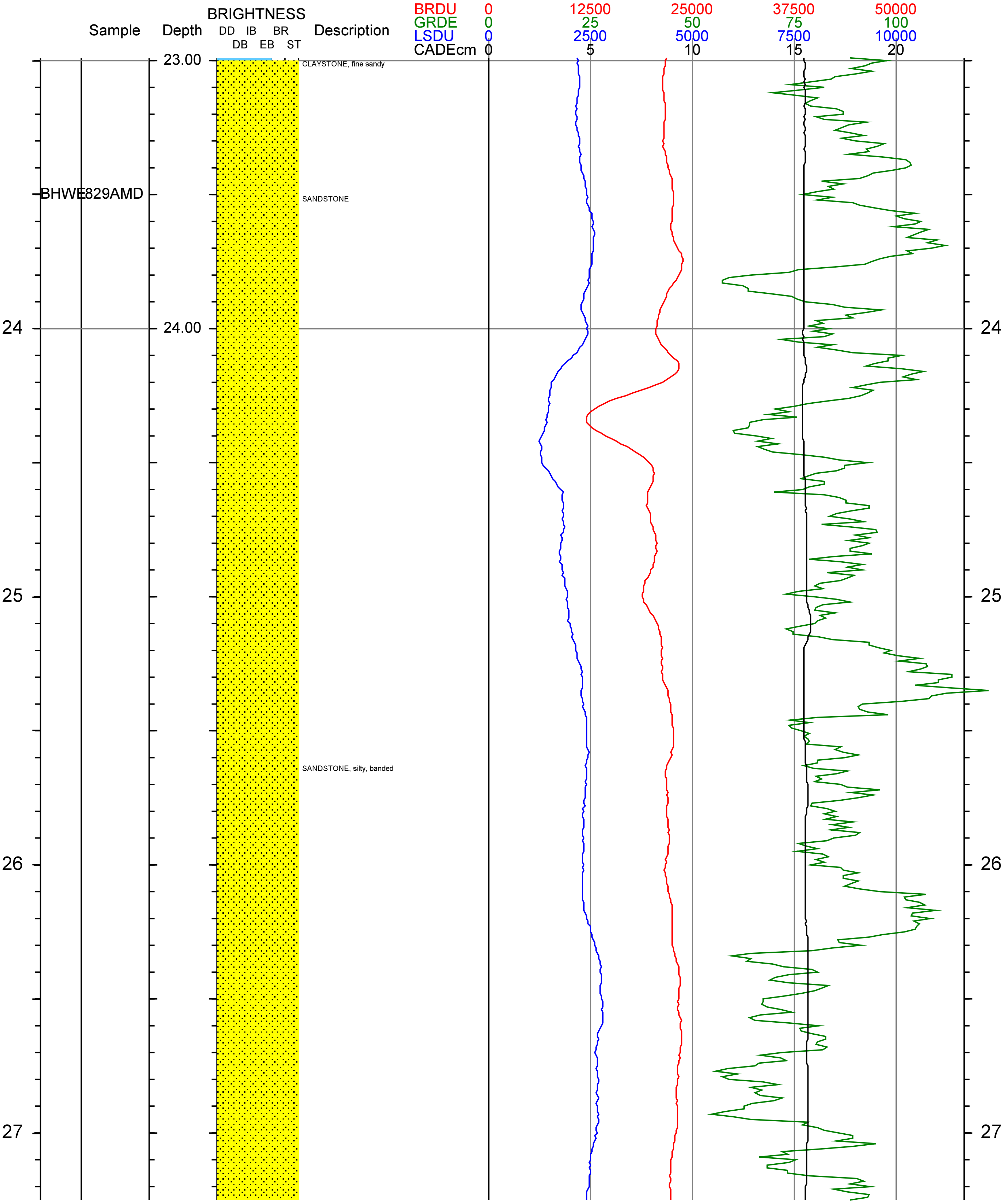
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

SCALE 1:20

GEOPHYSICAL PROFILE
HOLE



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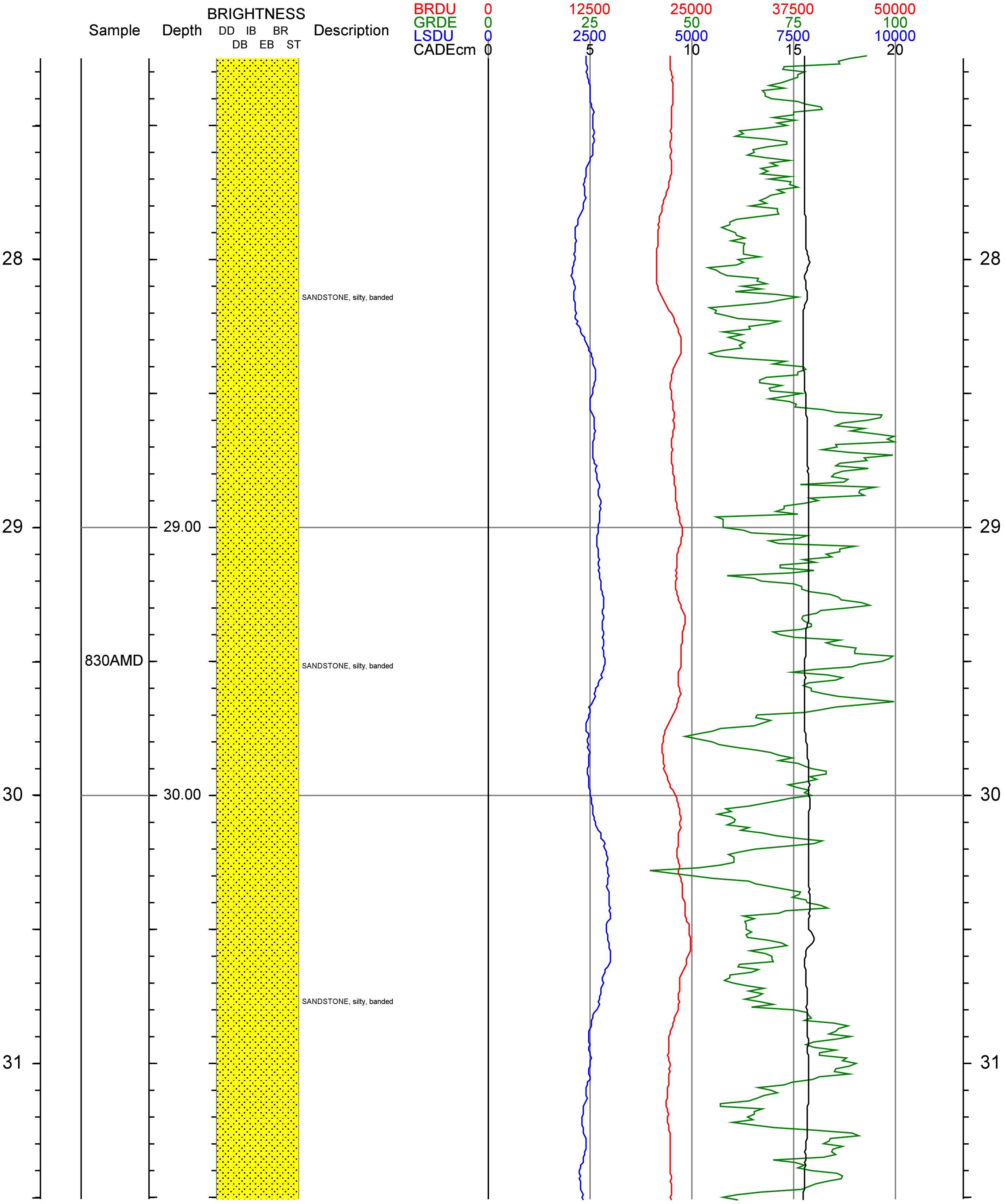
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

SCALE 1:20

GEOPHYSICAL PROFILE
HOLE



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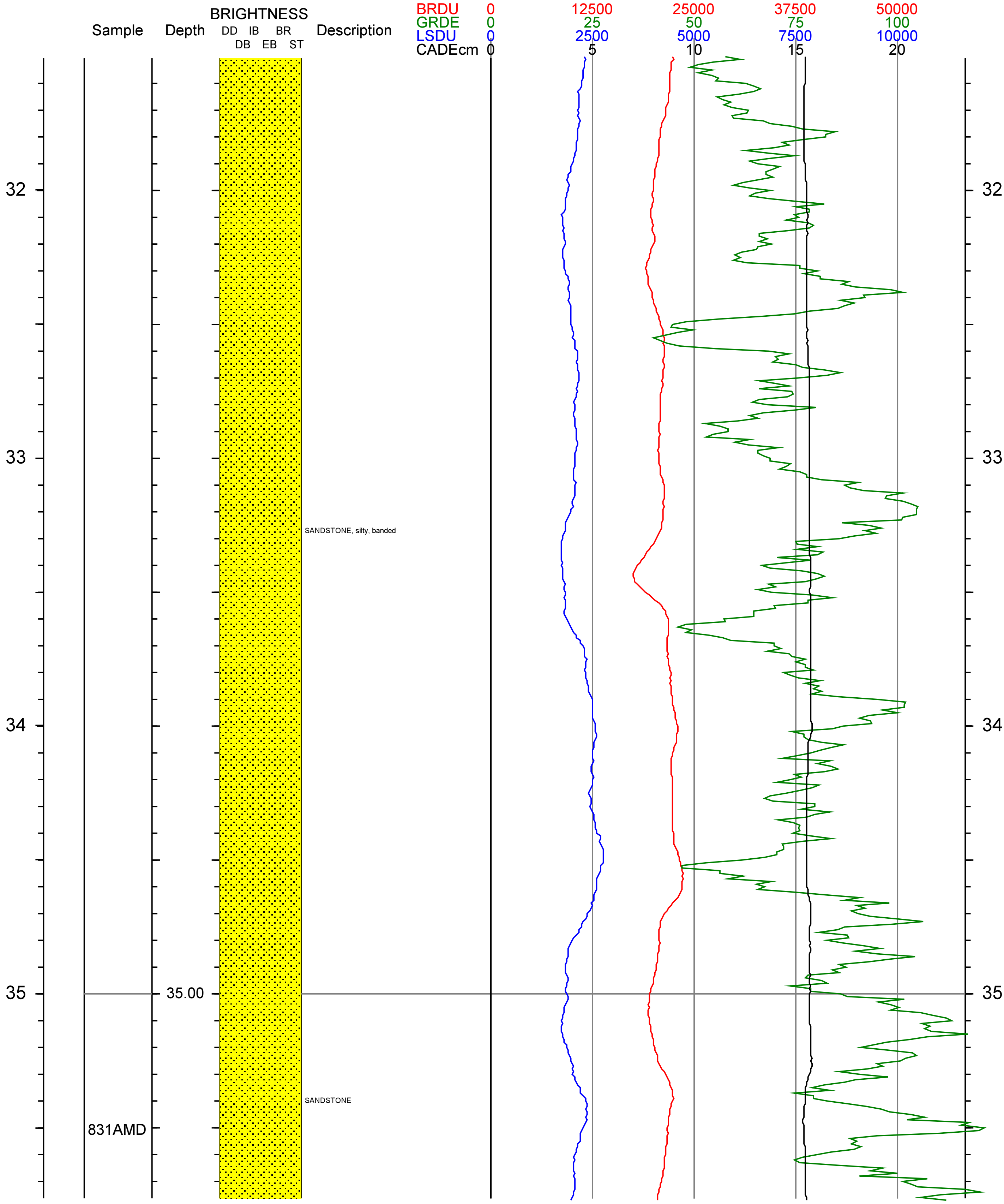
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

SCALE 1:20
GEOPHYSICAL PROFILE
HOLE



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LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

SCALE 1:20

GEOPHYSICAL PROFILE
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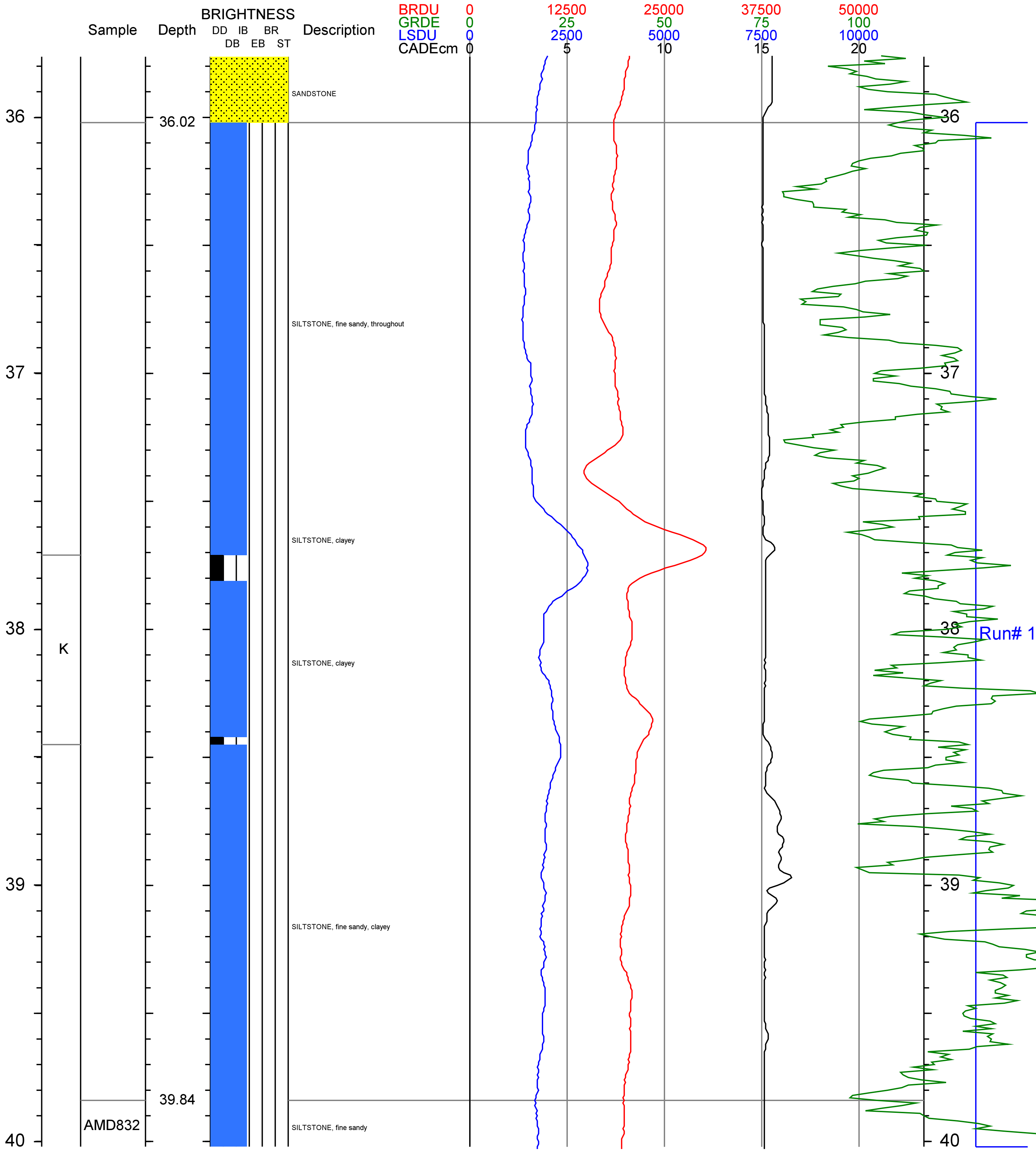

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LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

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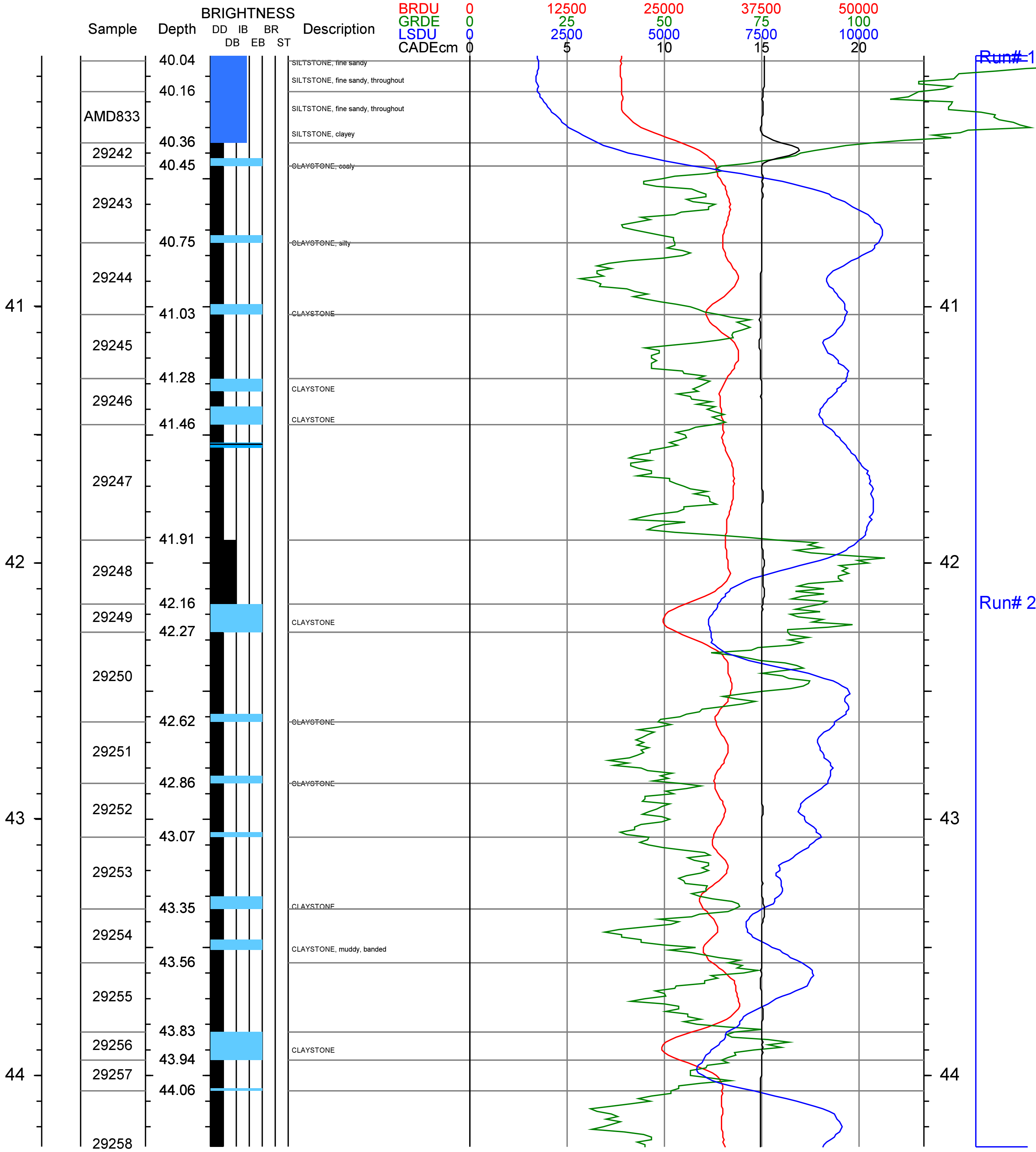

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LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

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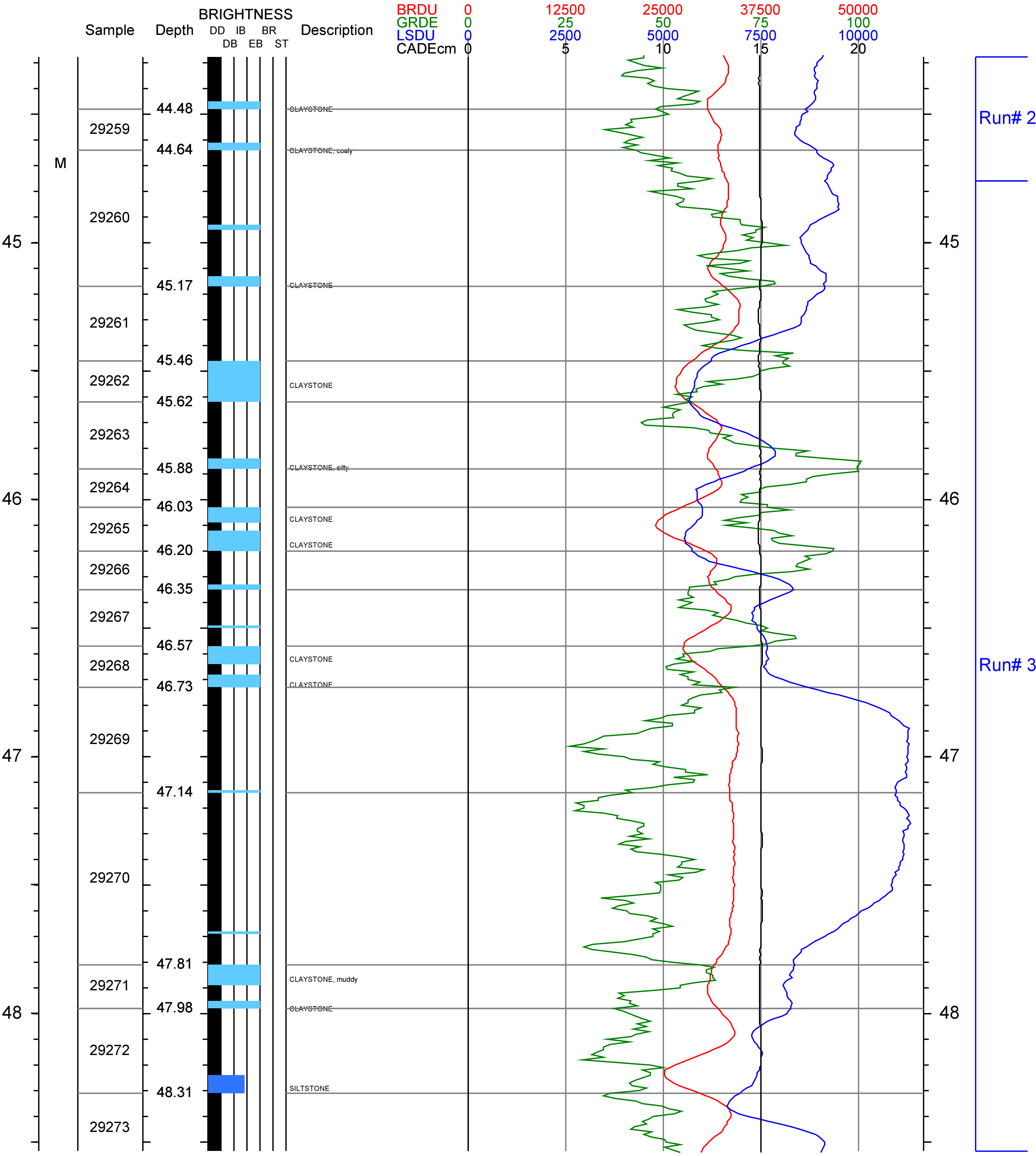
GEOPHYSICAL PROFILE

HOLE



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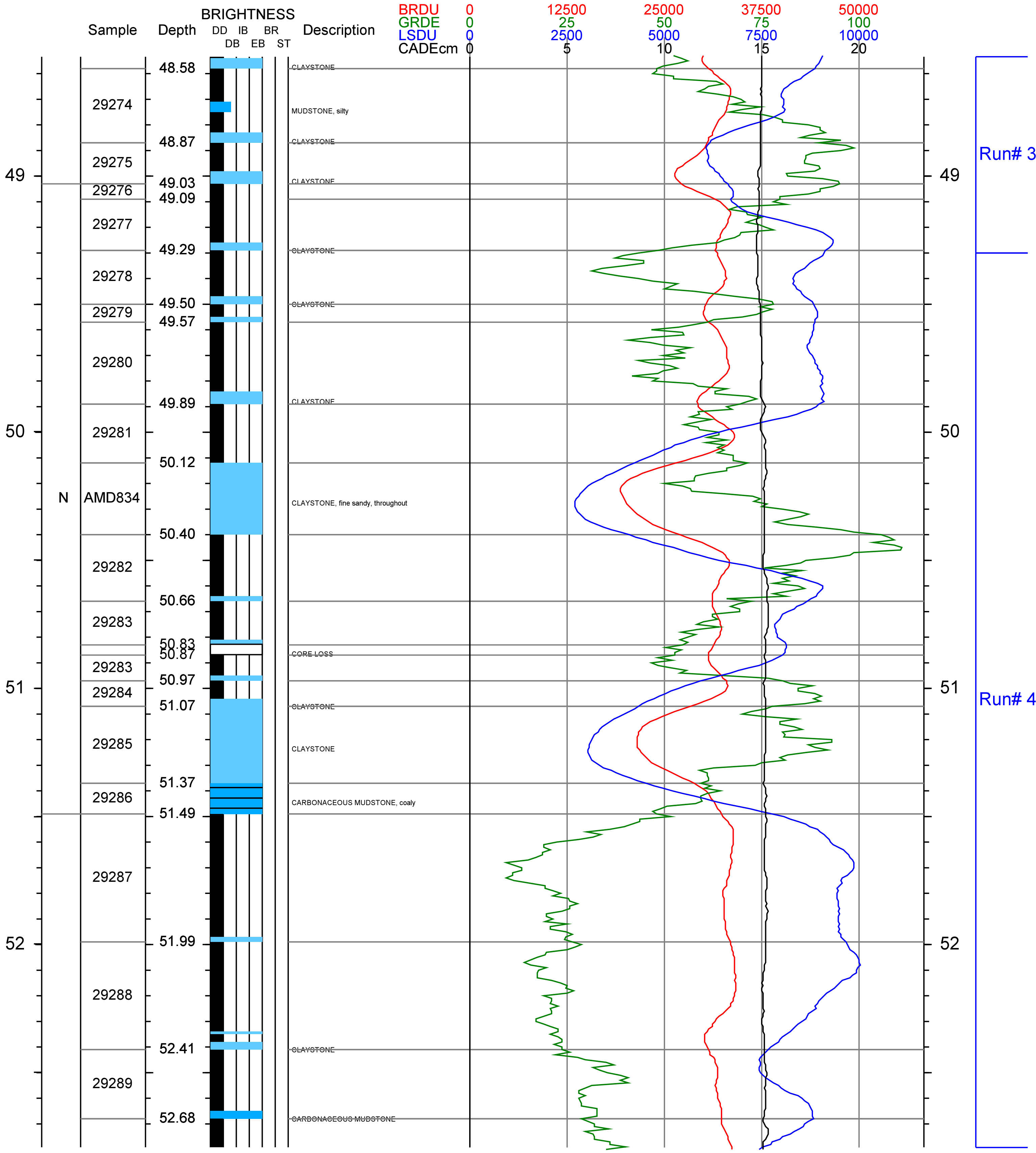
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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GEOPHYSICAL PROFILE
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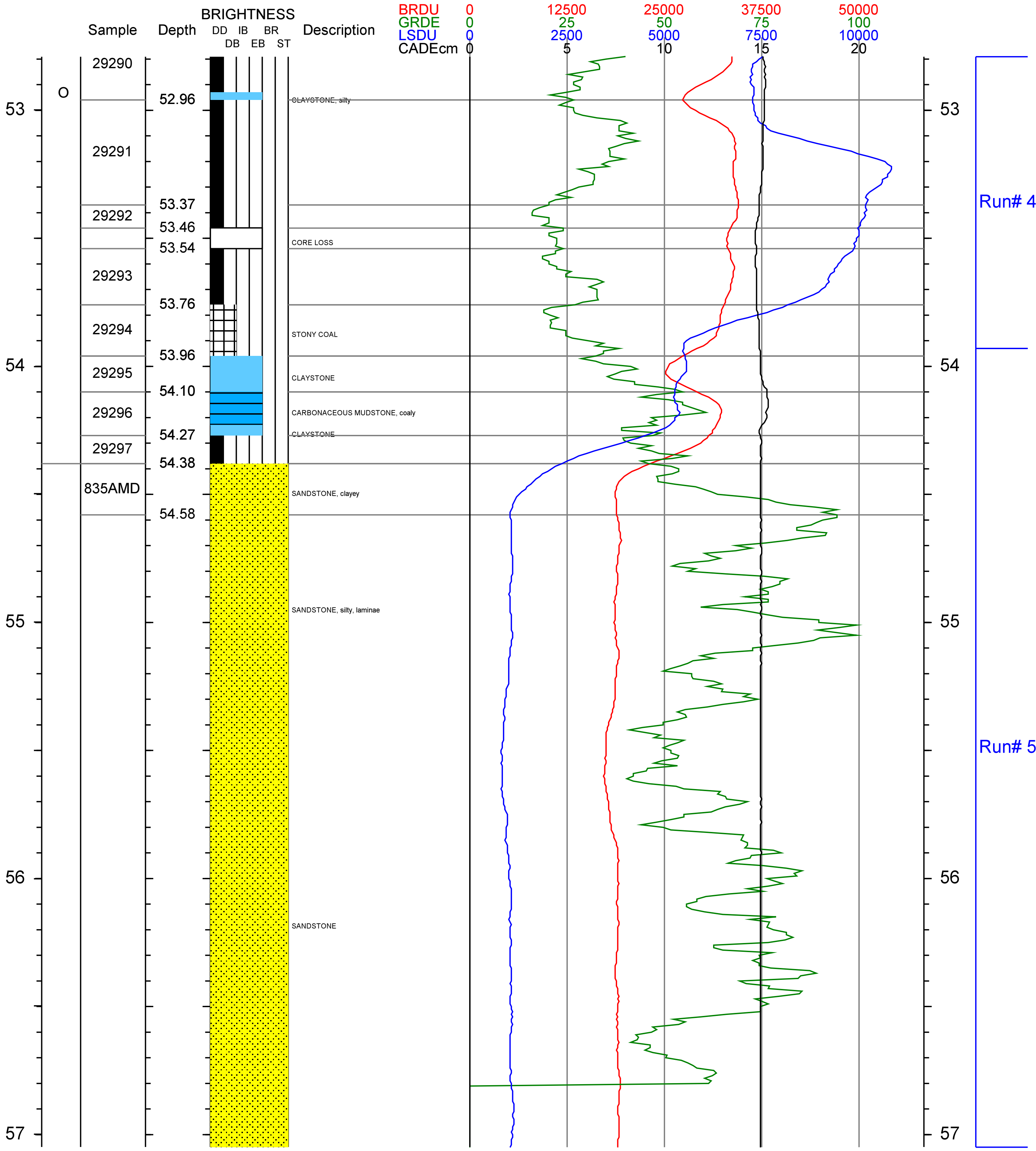

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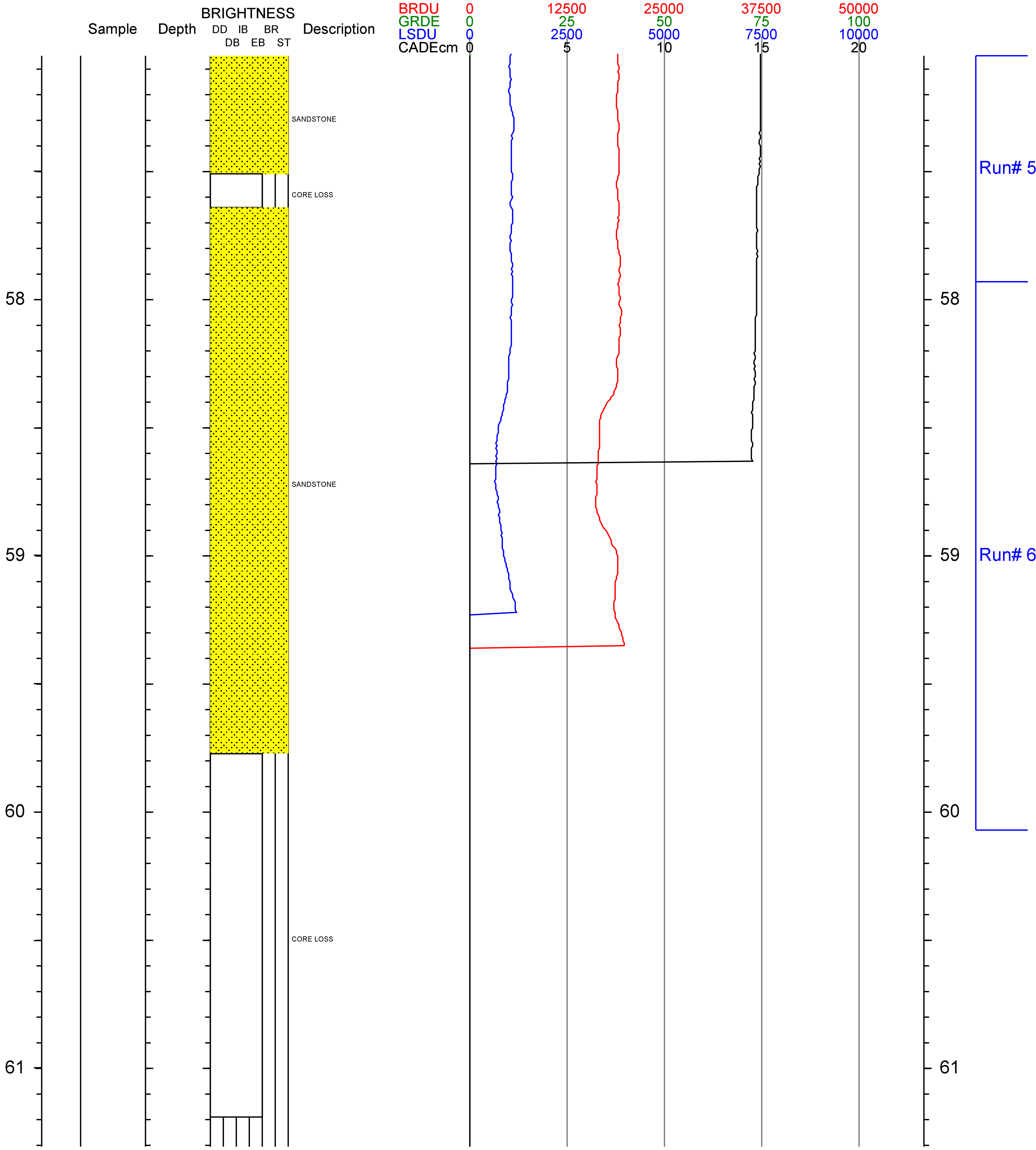
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14043C

SCALE 1:20

GEOPHYSICAL PROFILE
HOLE



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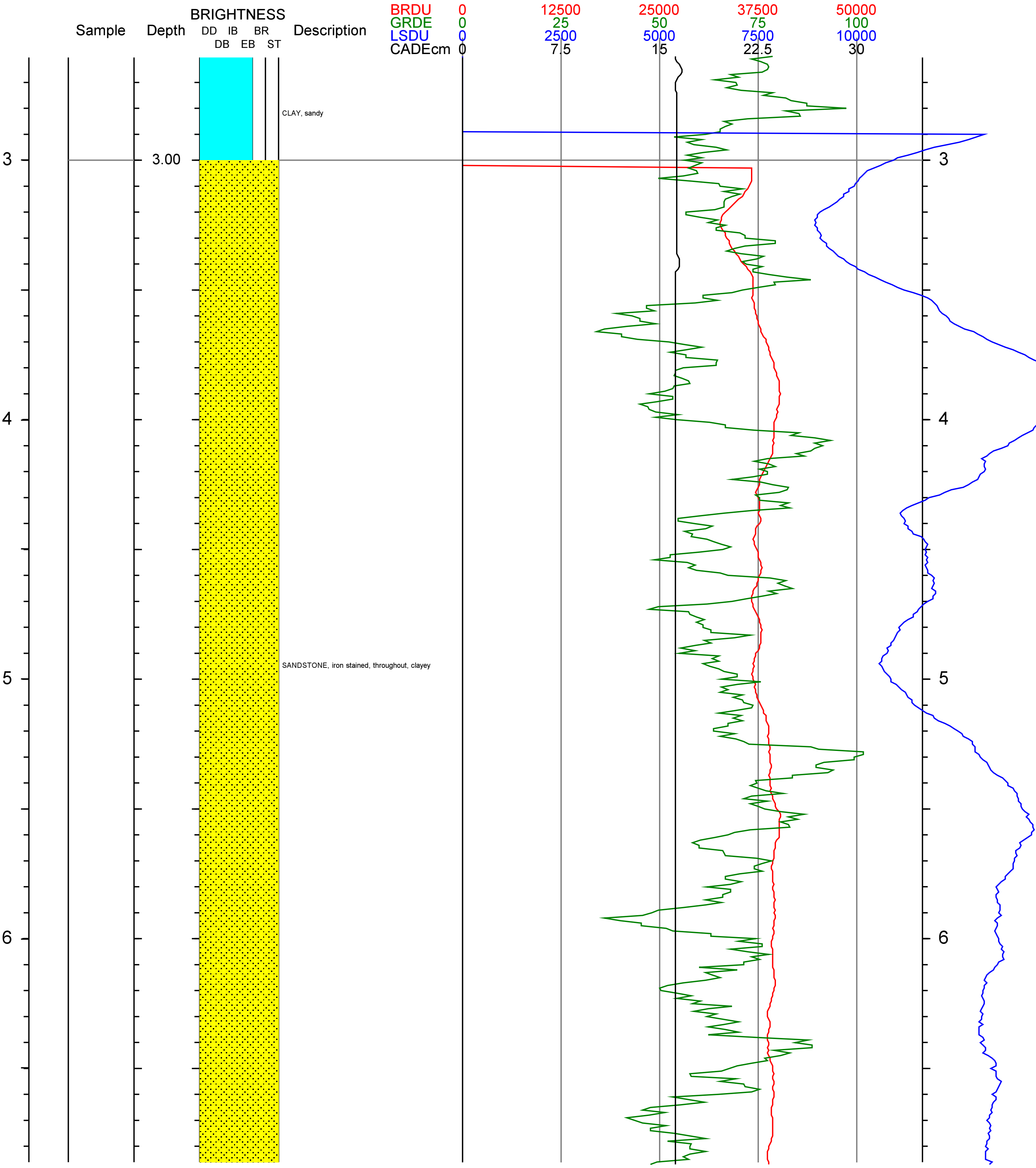
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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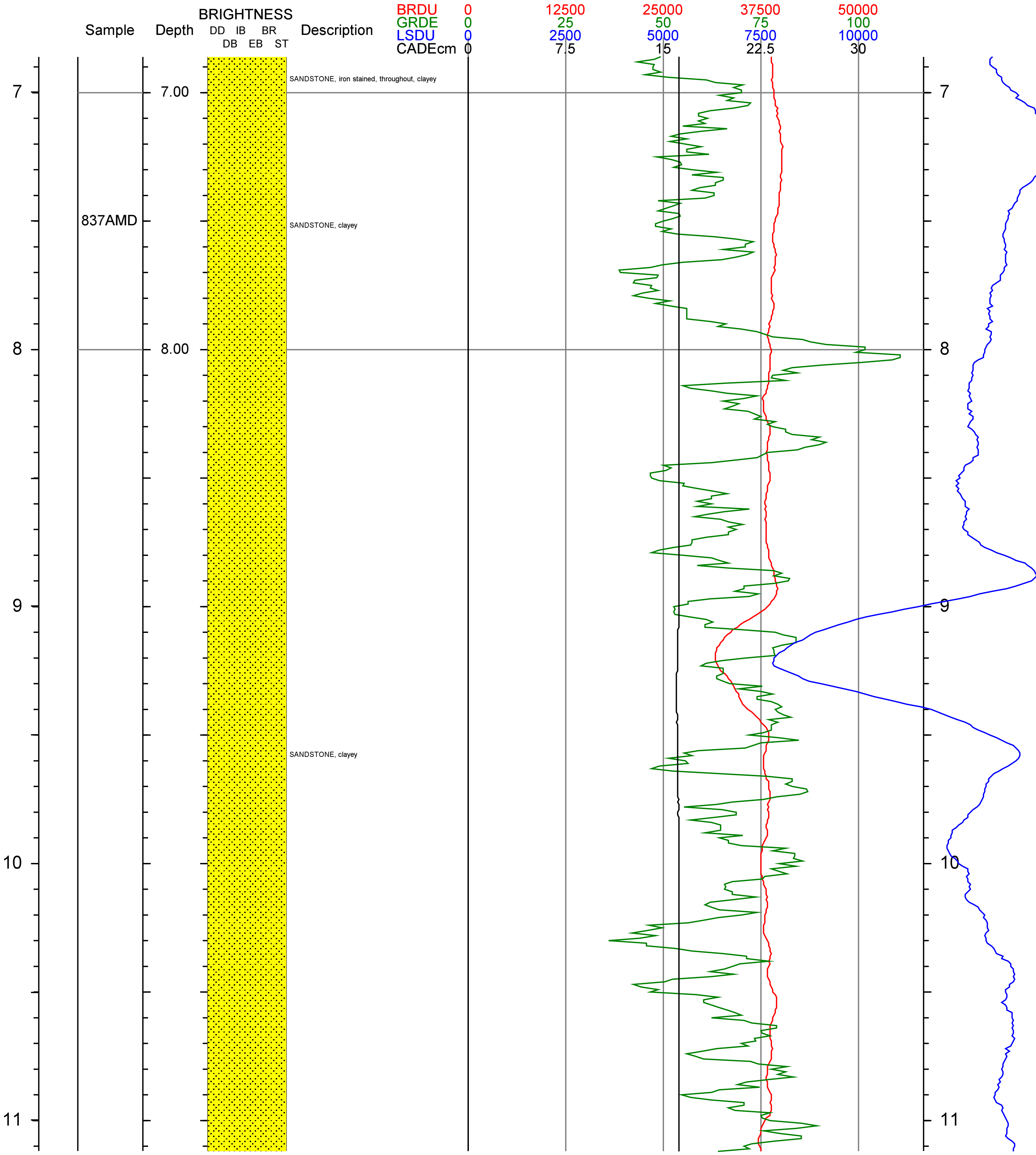
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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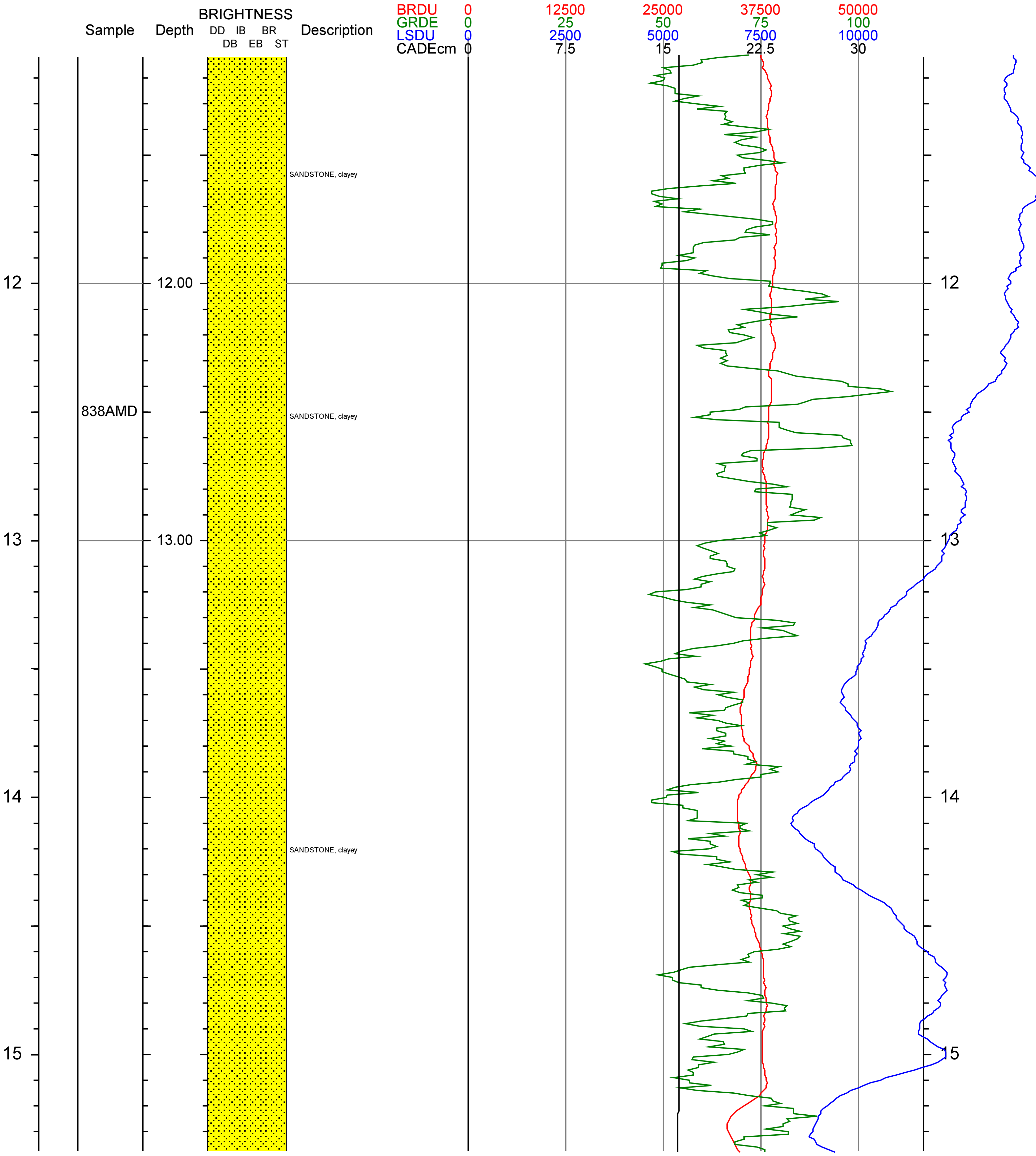
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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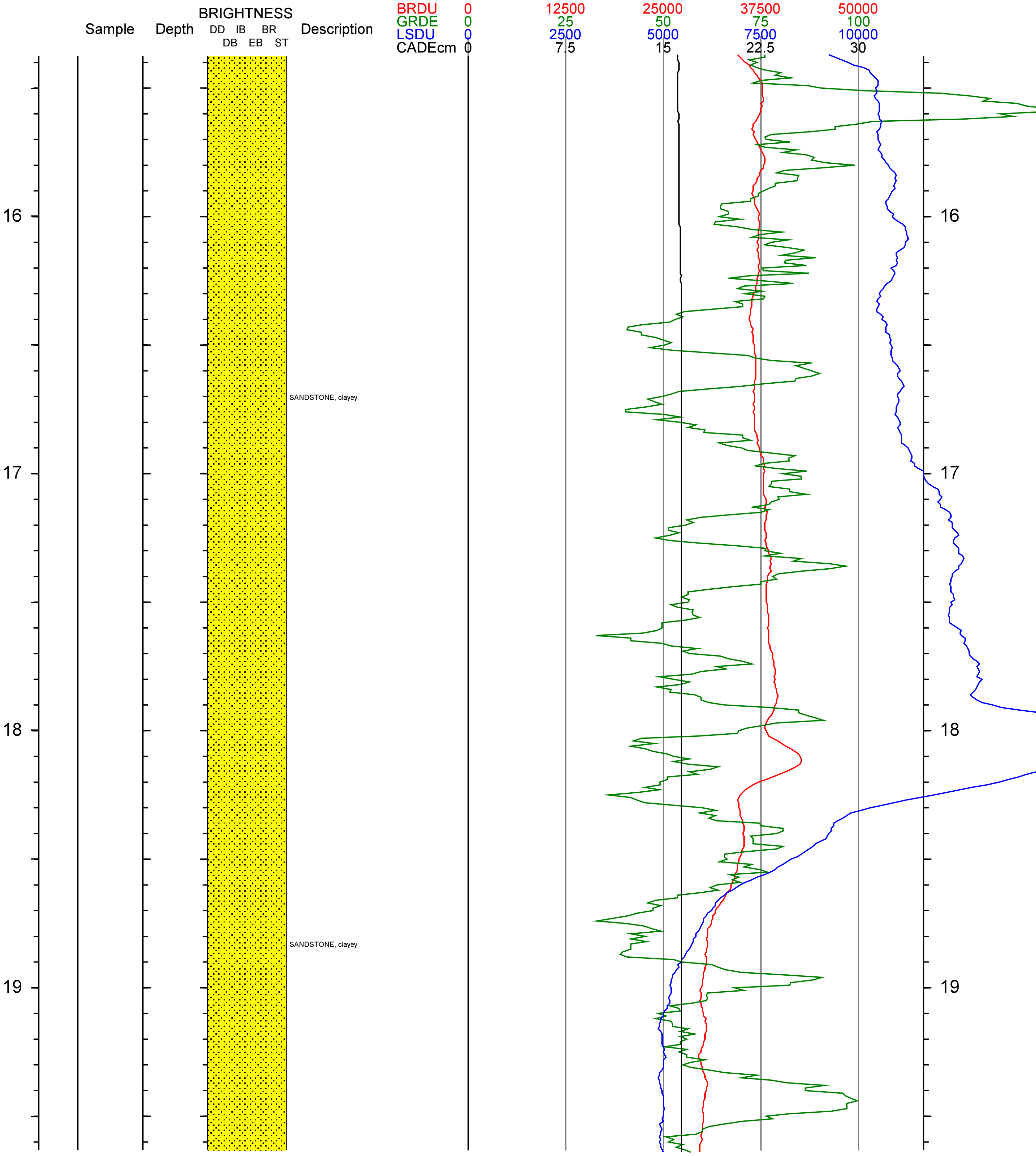
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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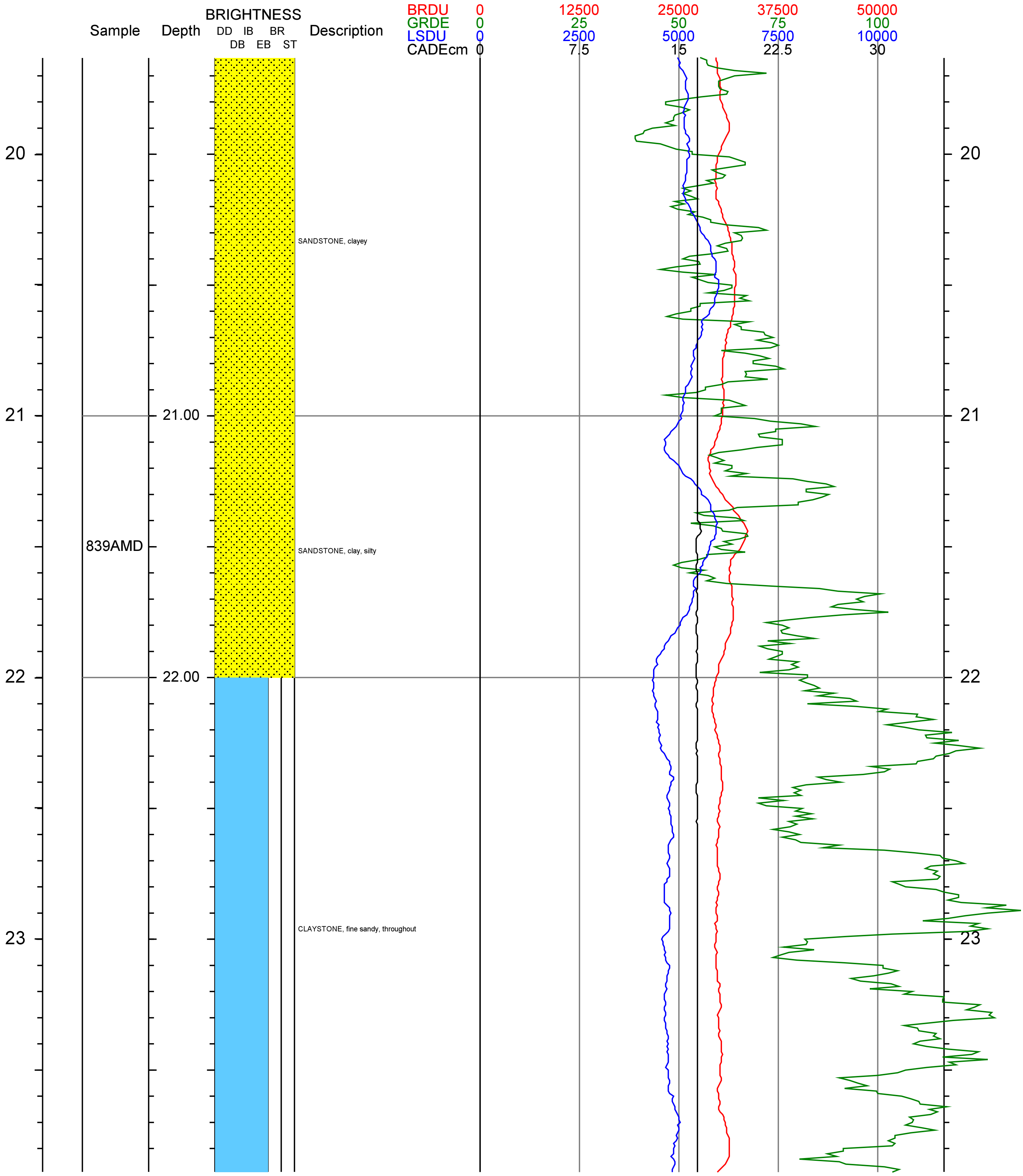
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

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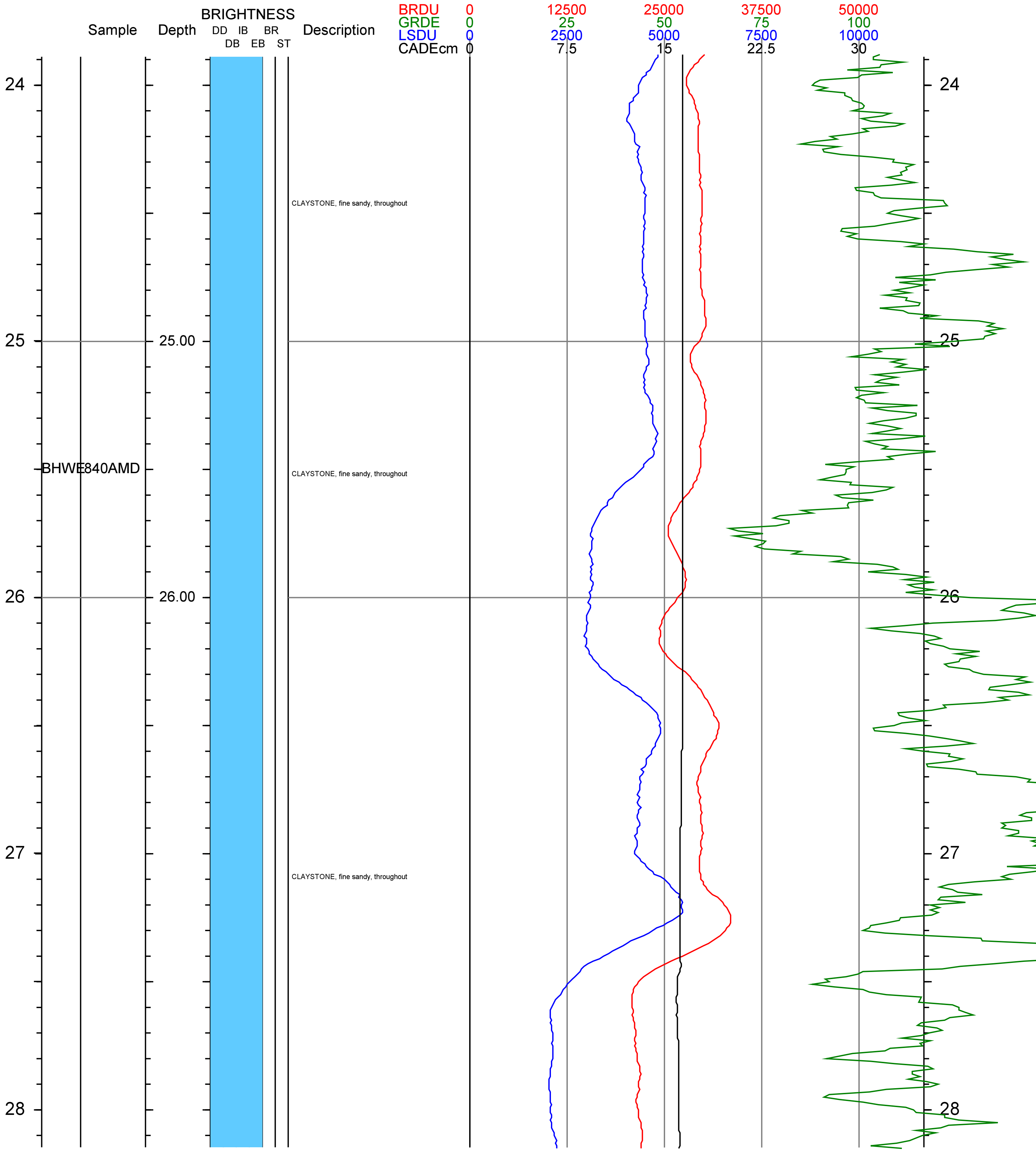

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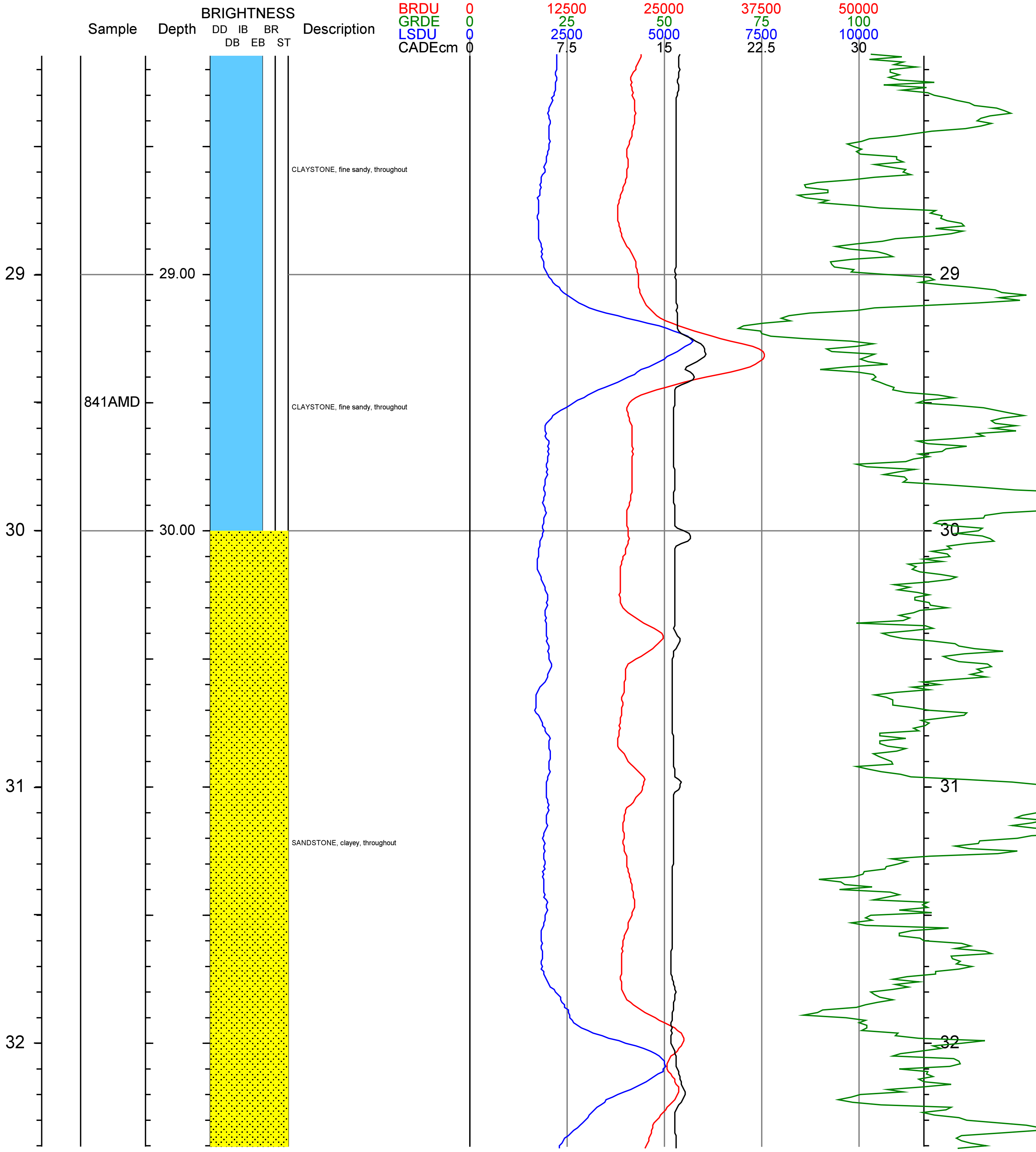
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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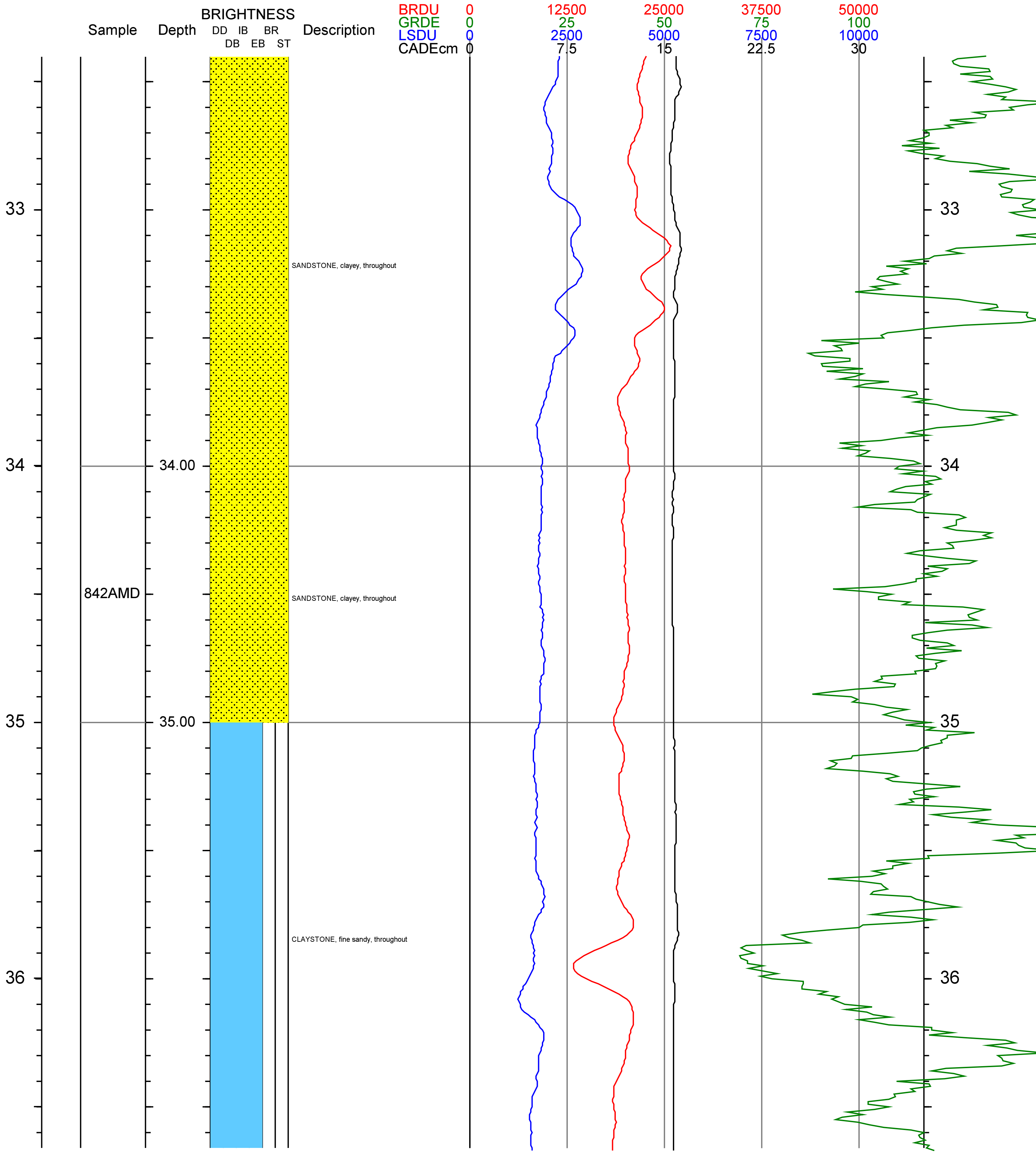
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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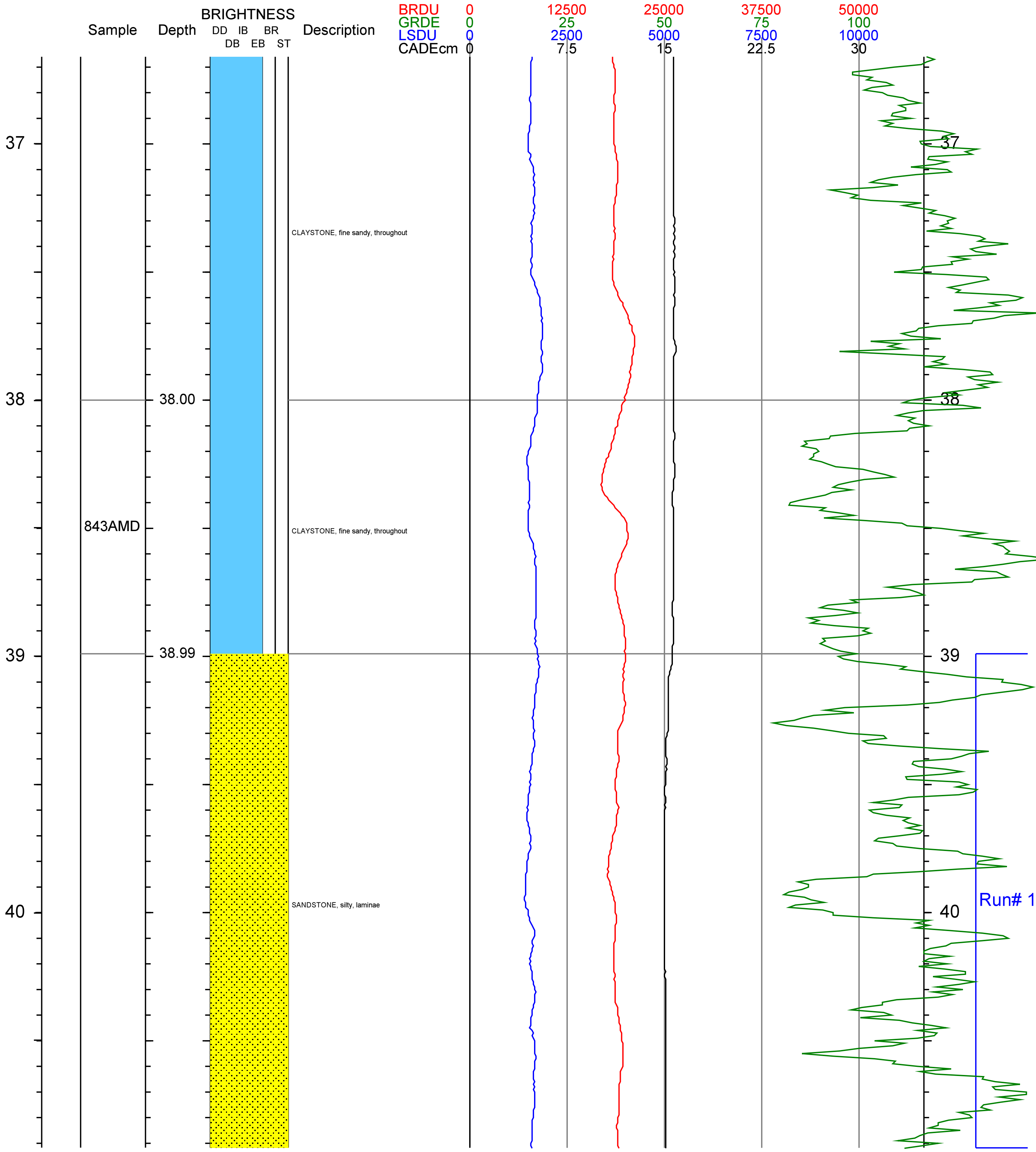
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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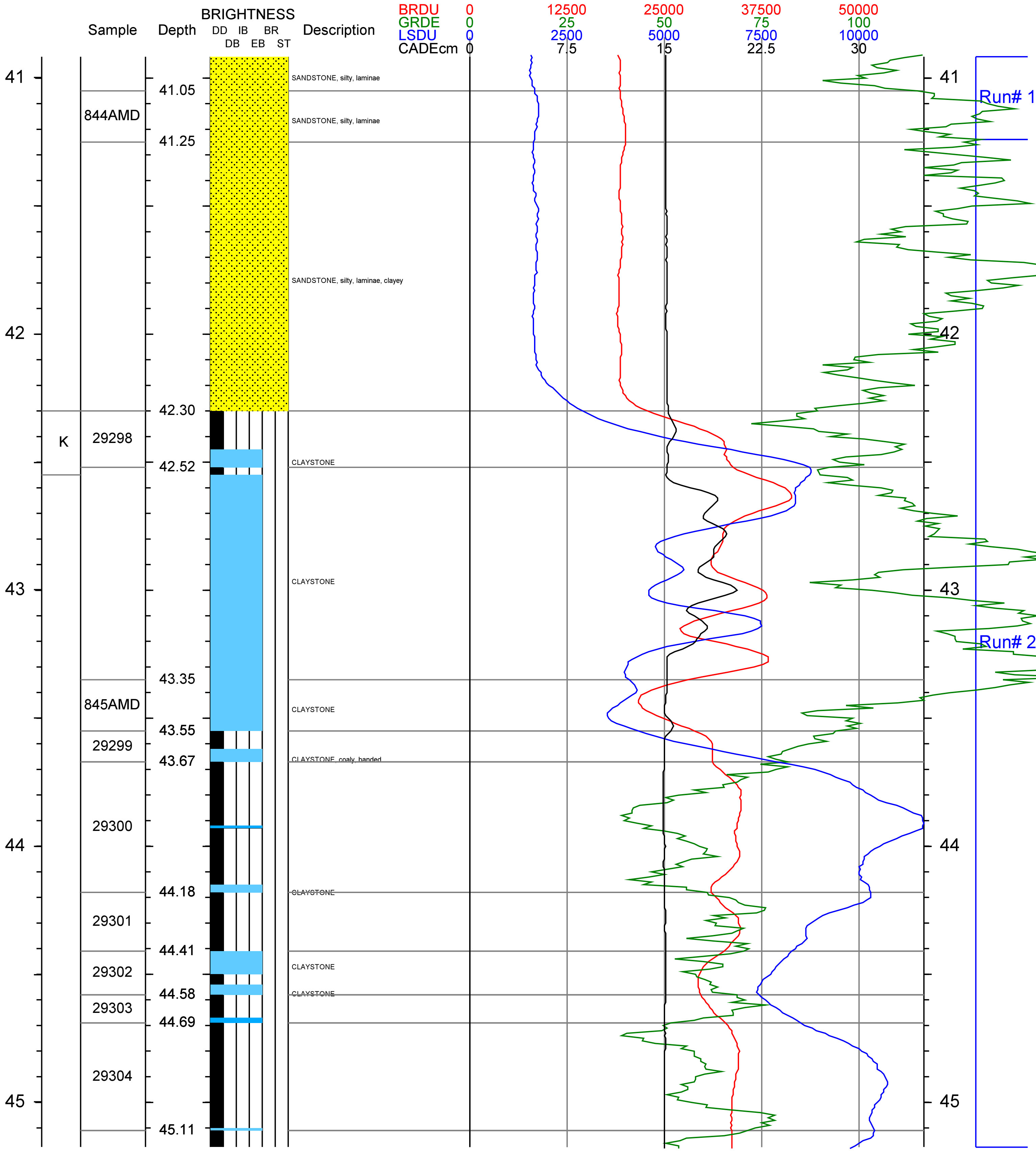
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE
HOLE

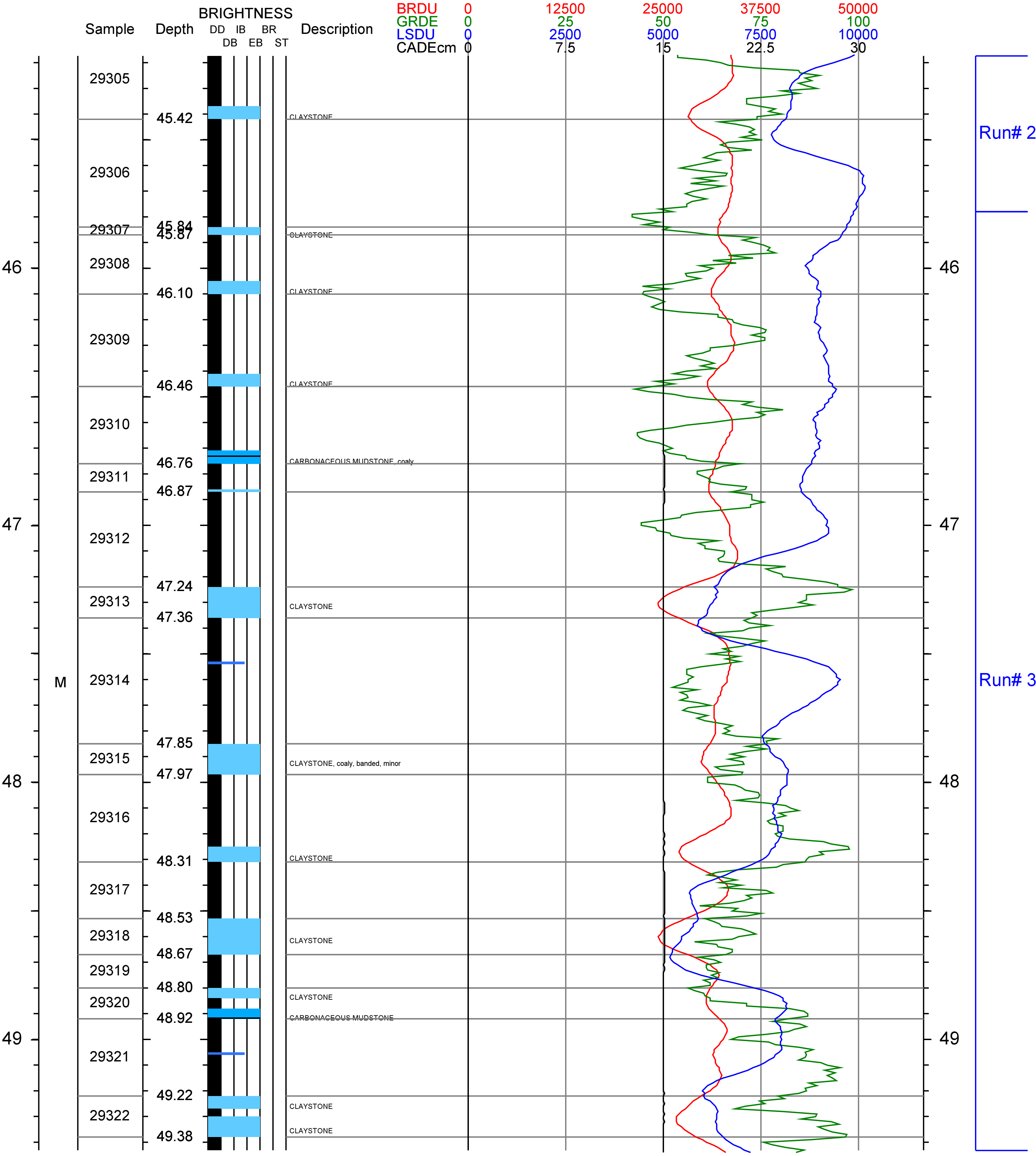


CSENERGY
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE

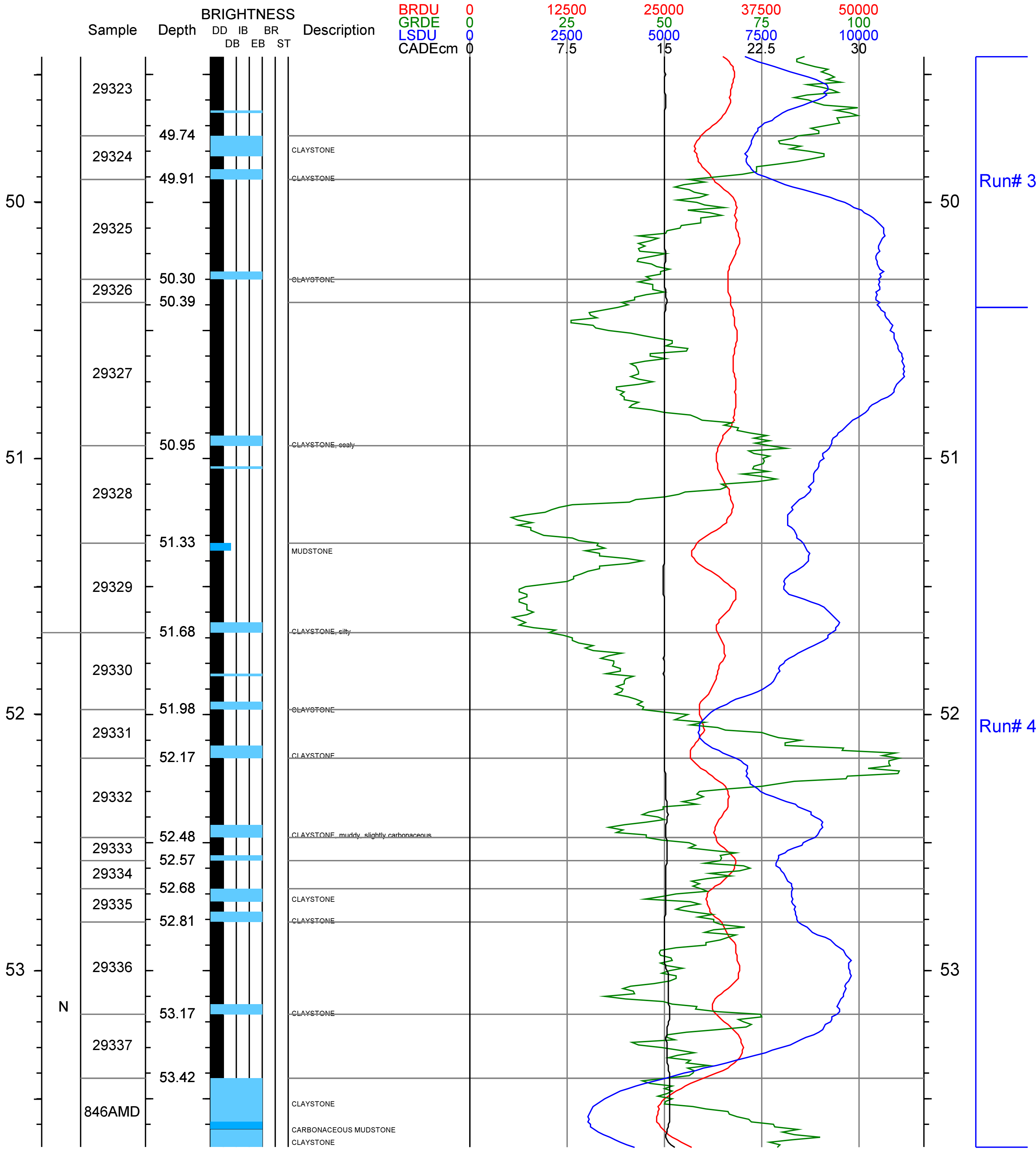


CSENERGY
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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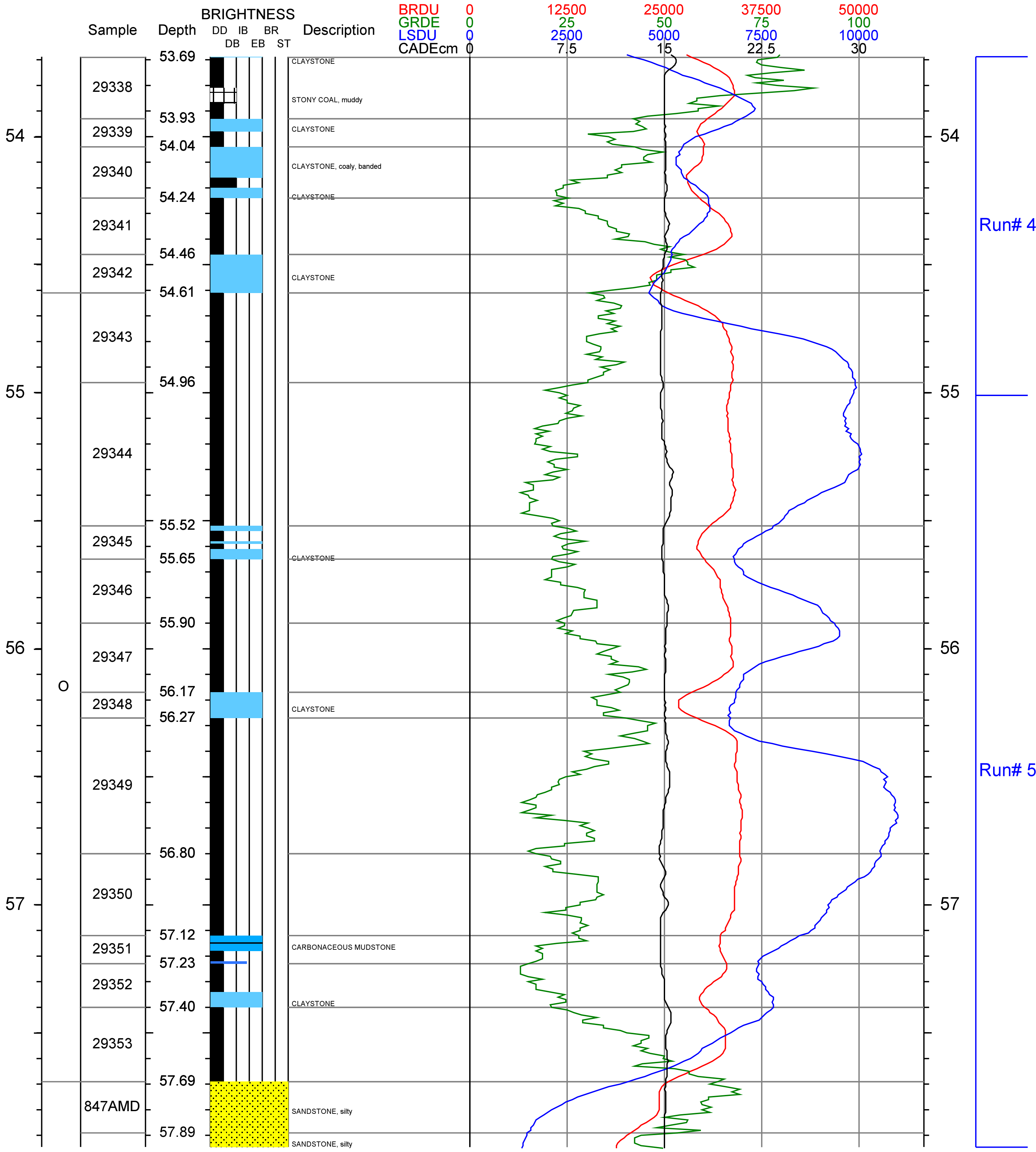
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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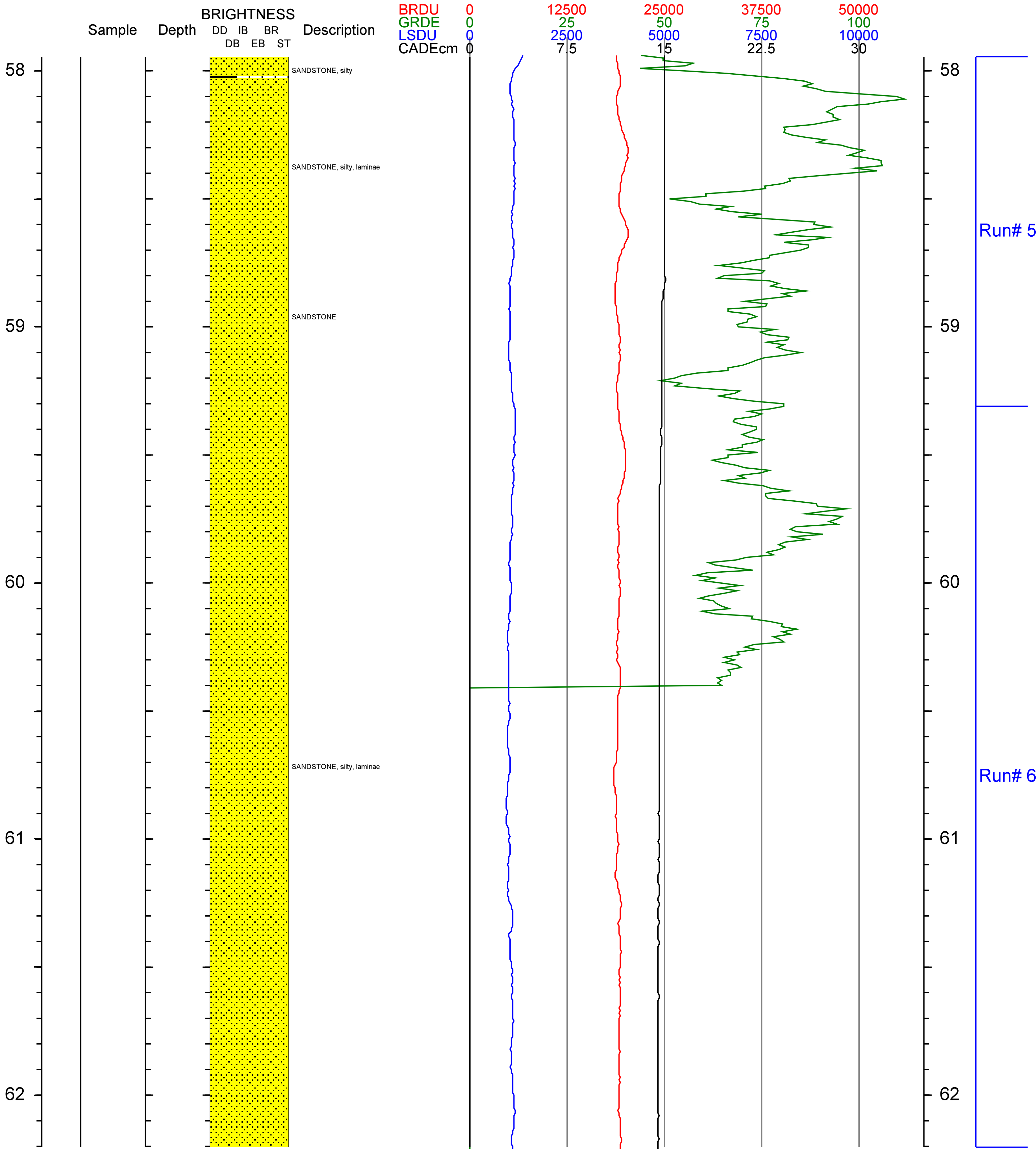
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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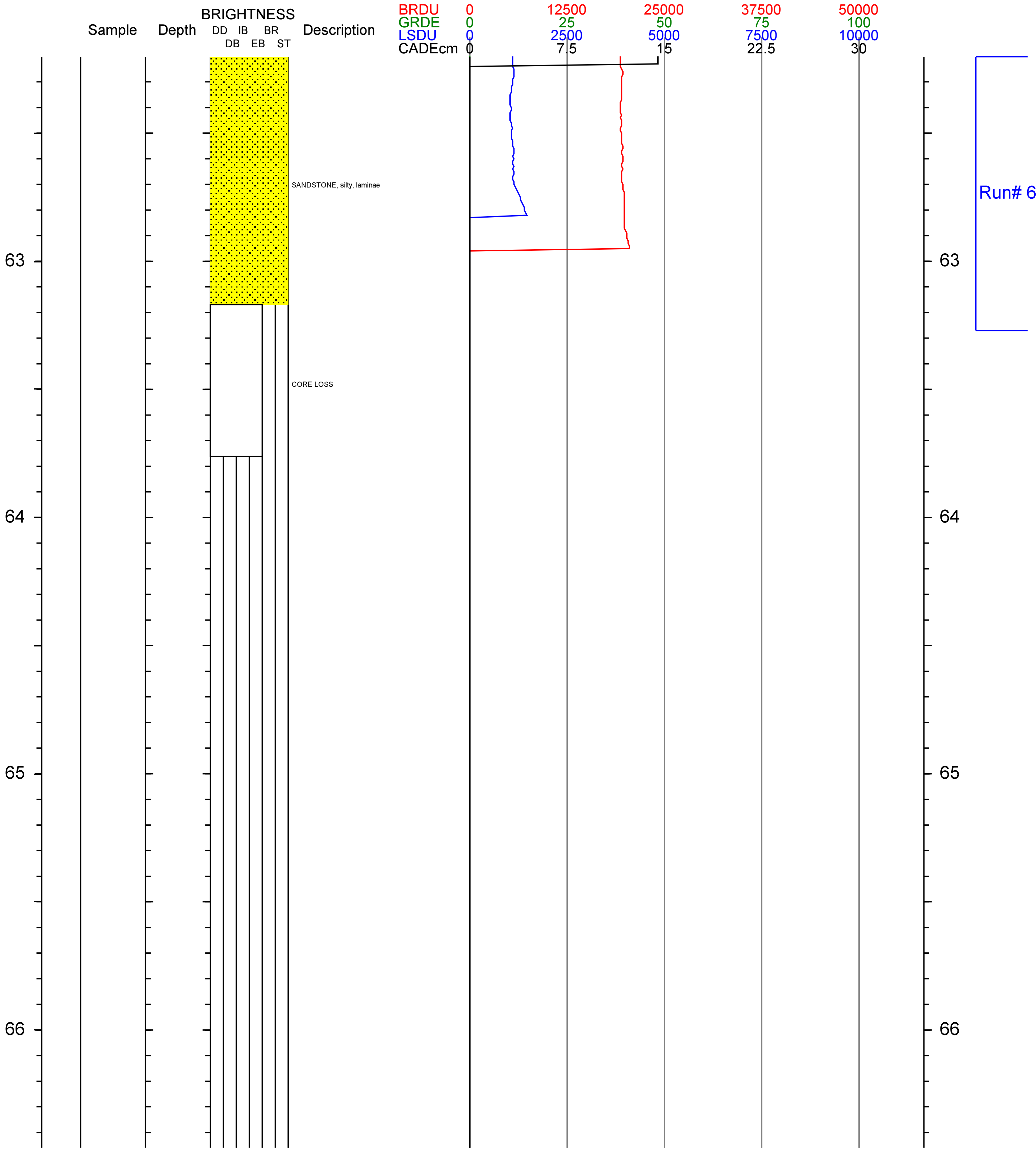
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14044C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE

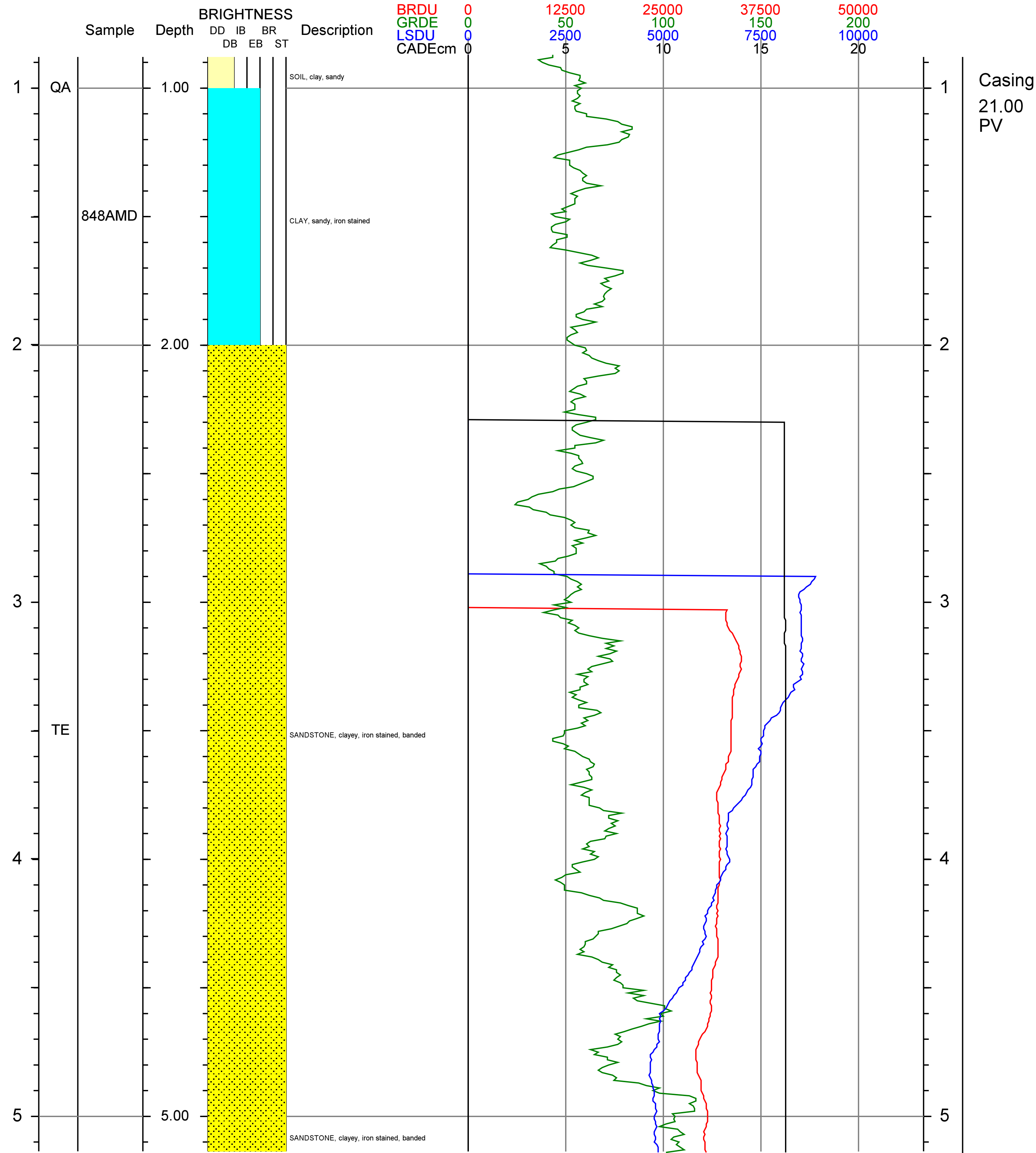


CSENERGY
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14045C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE

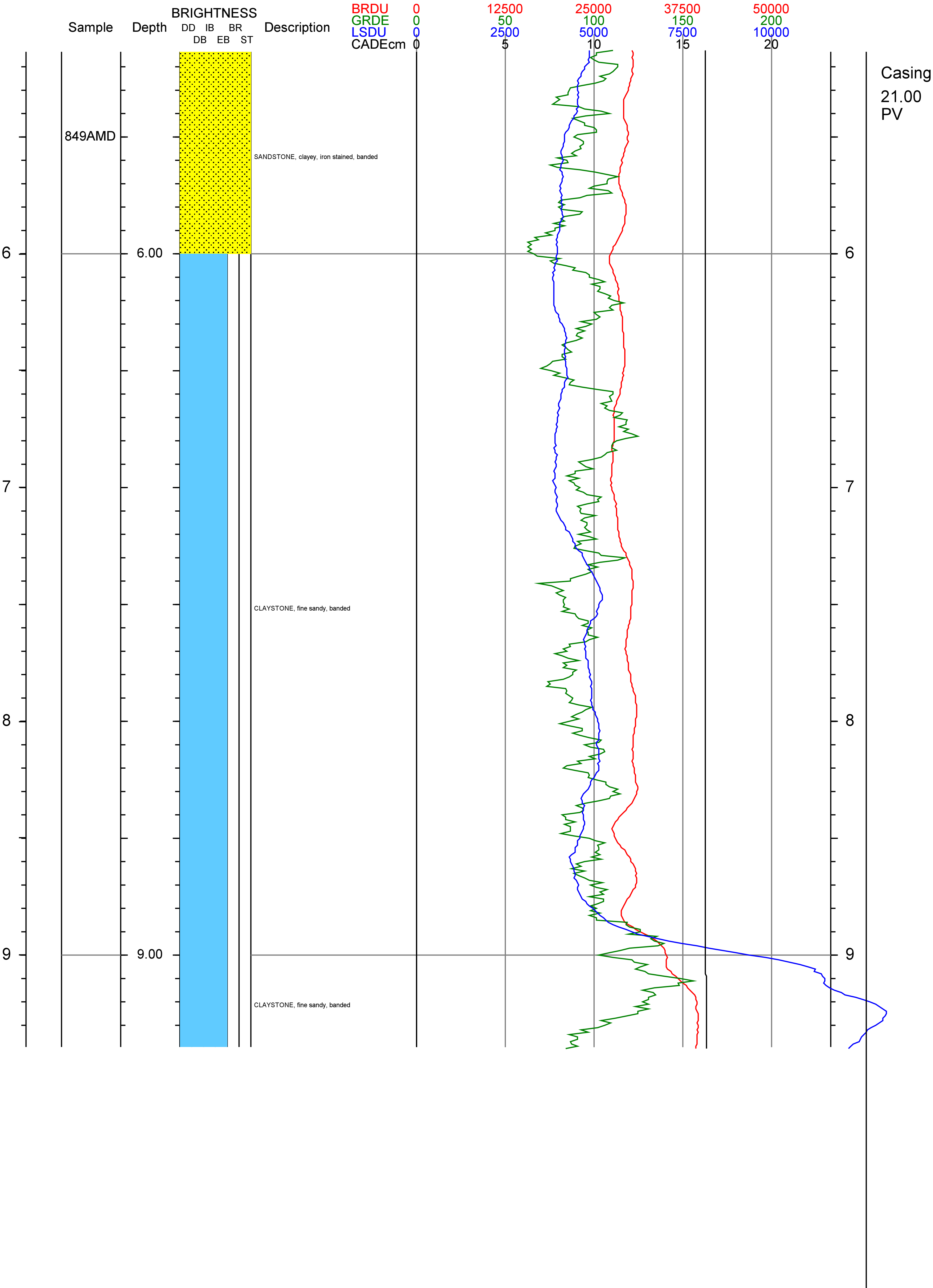


CSENERGY
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14045C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE

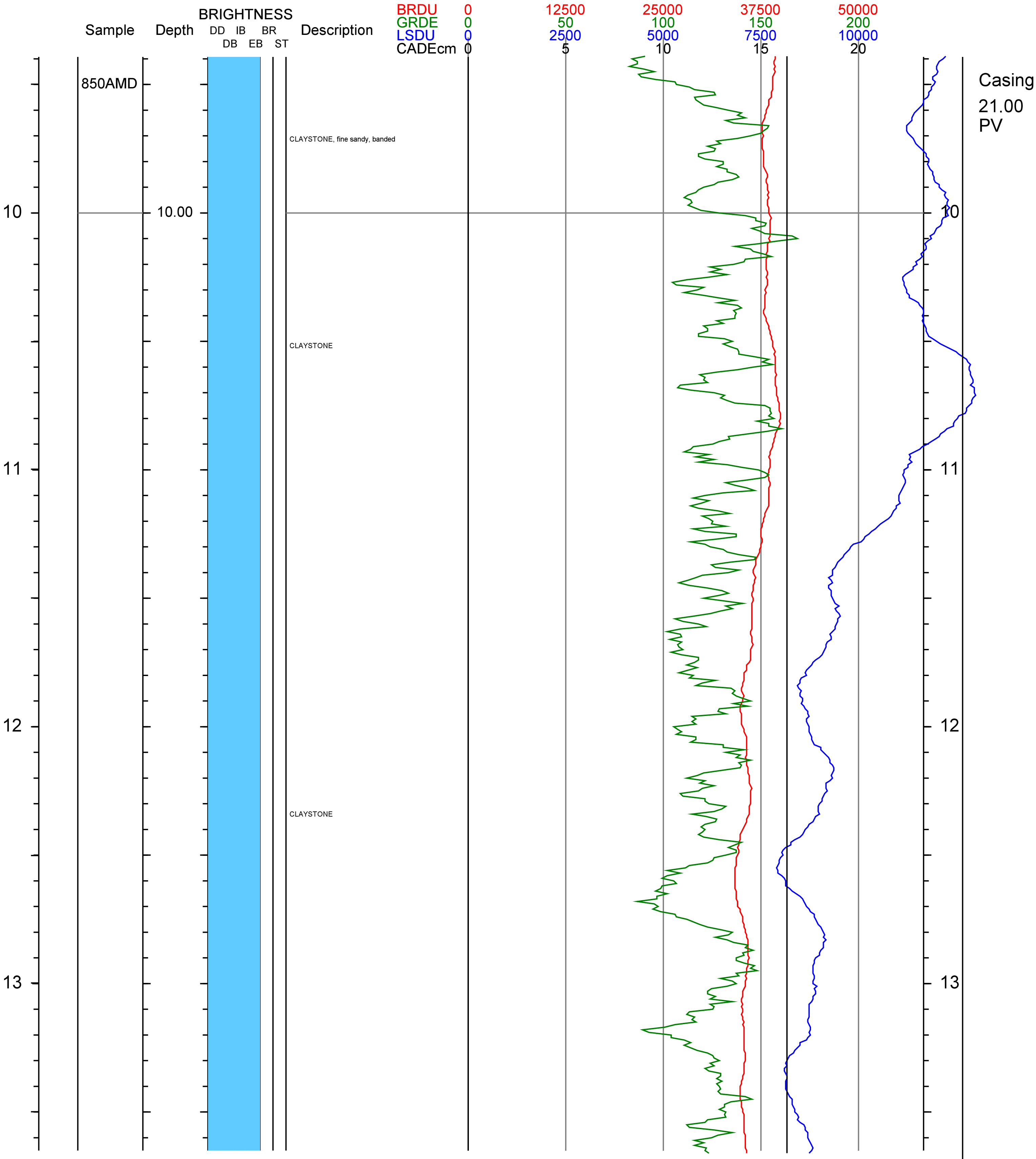


CSENERGY
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14045C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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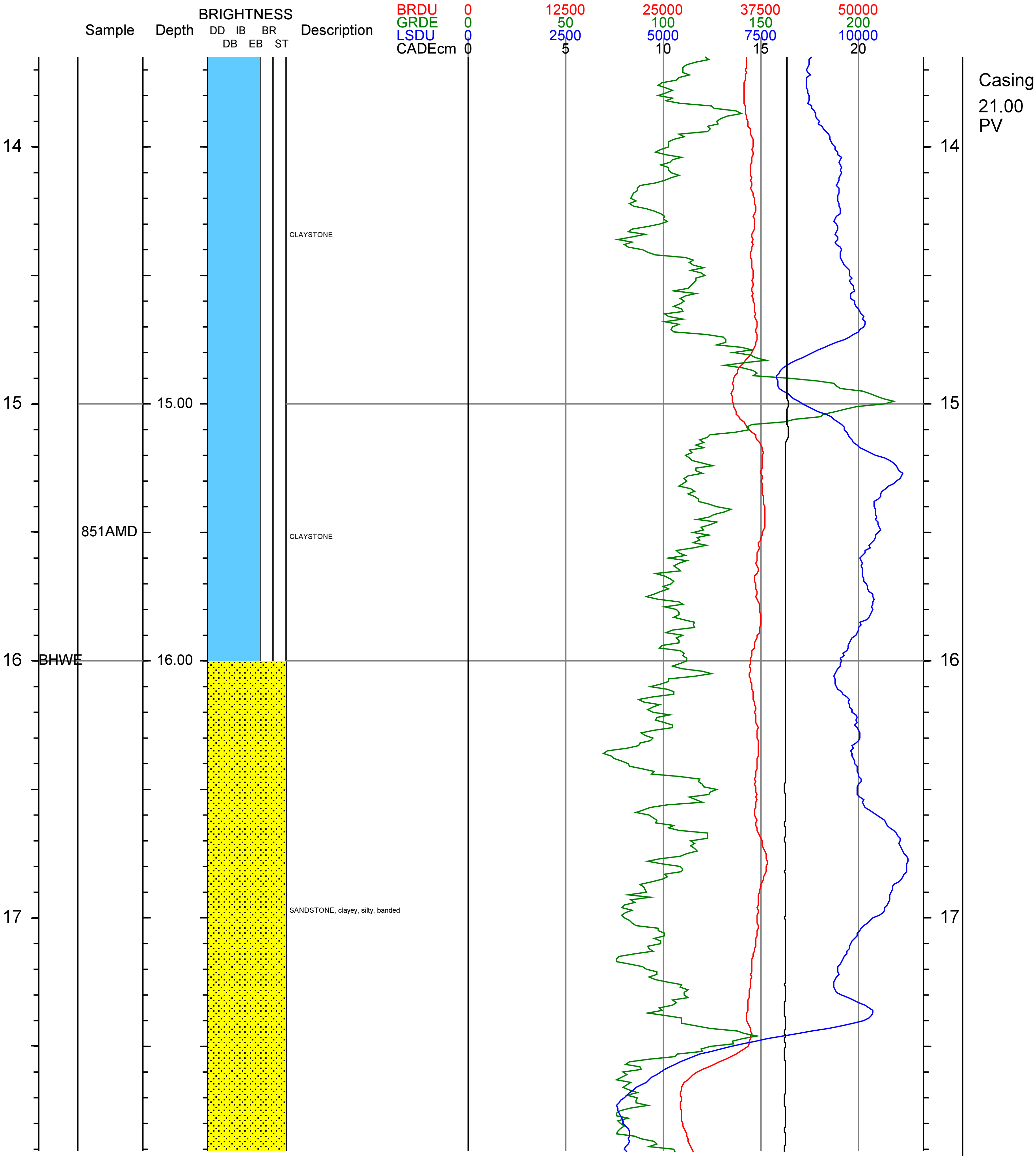
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14045C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE

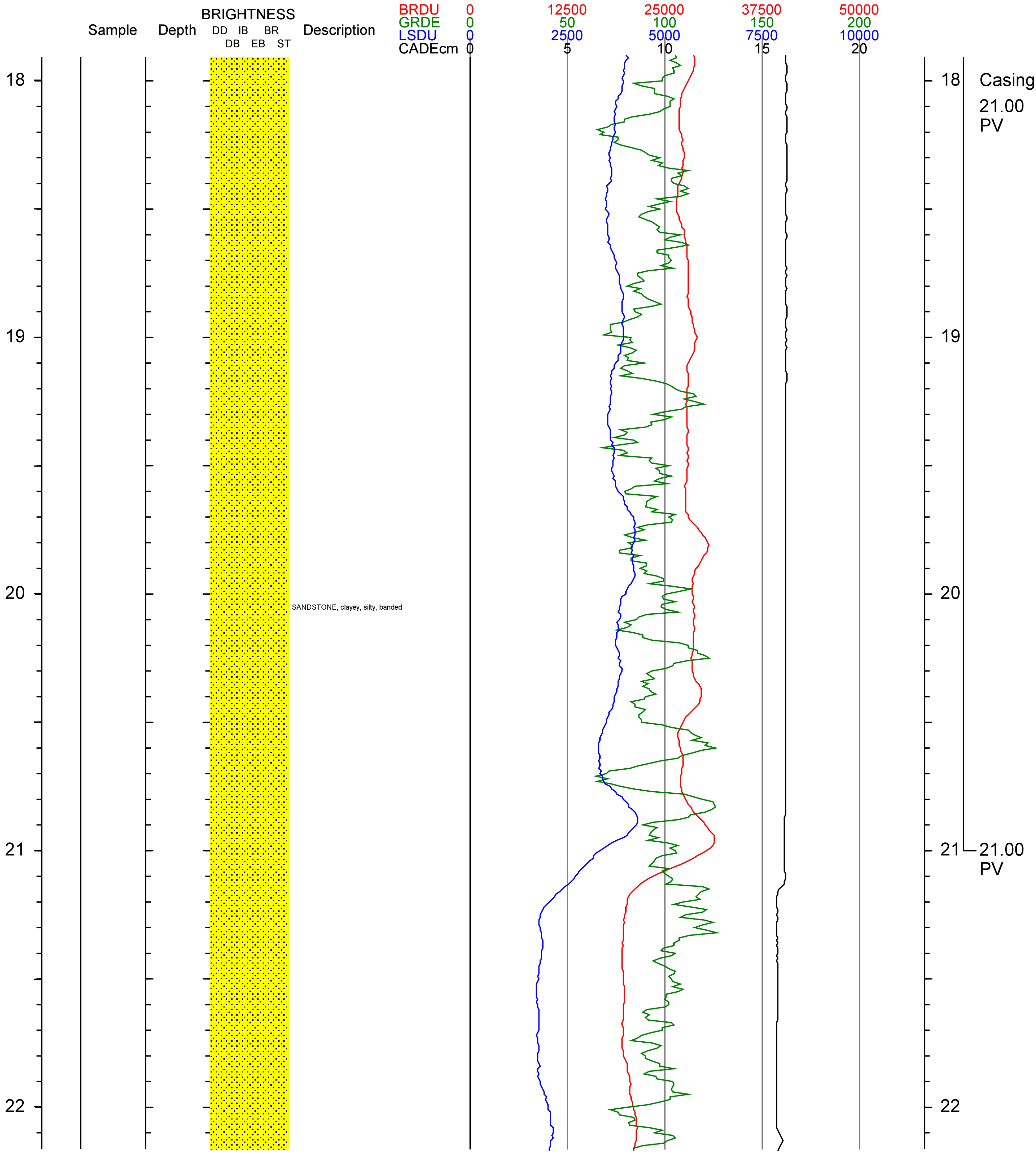


CSENERGY
KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14045C

SCALE 1:20

GEOPHYSICAL PROFILE

HOLE



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KOGAN CREEK
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14045C

SCALE 1:20

GEOPHYSICAL PROFILE
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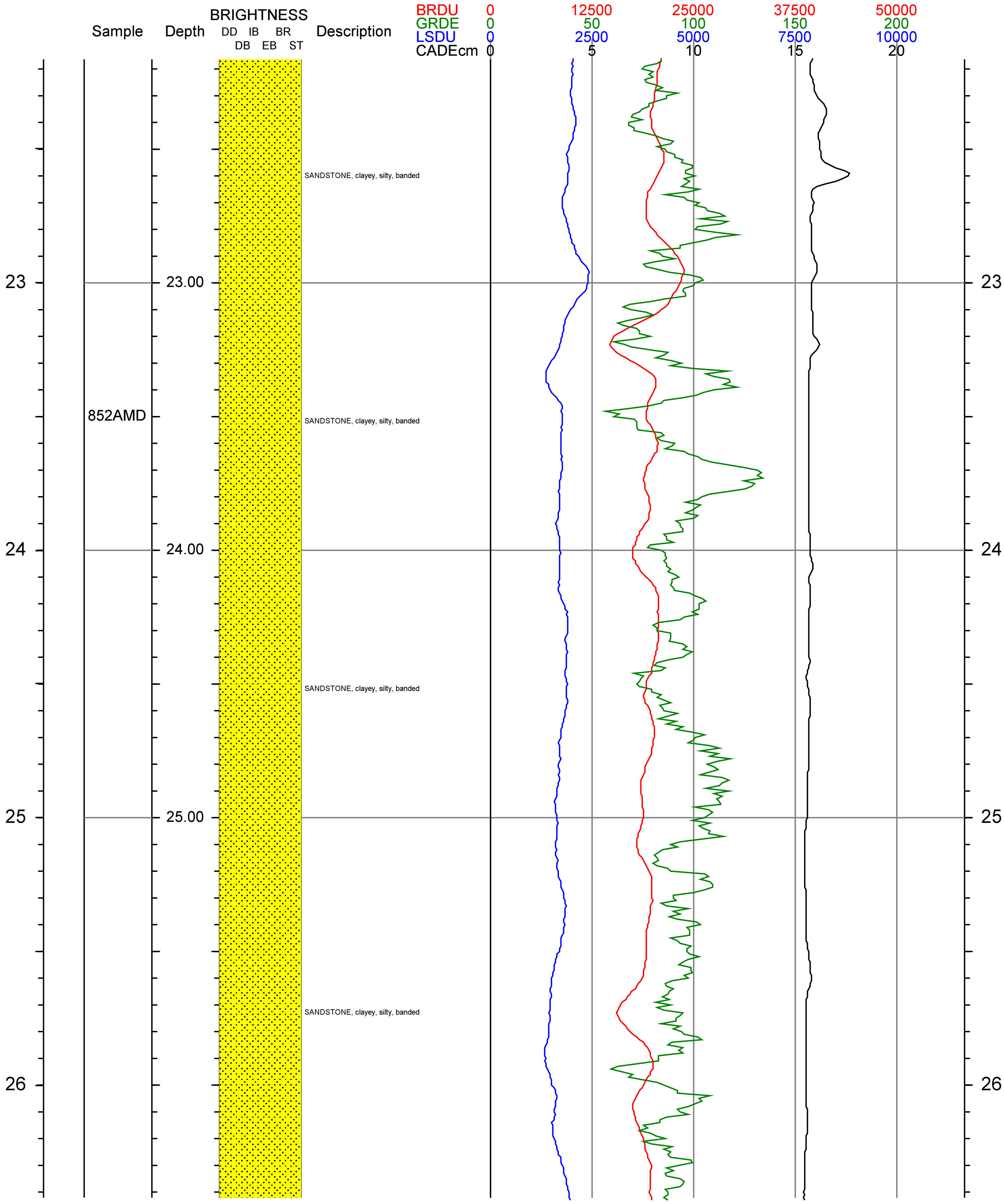

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LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14045C

SCALE 1:20

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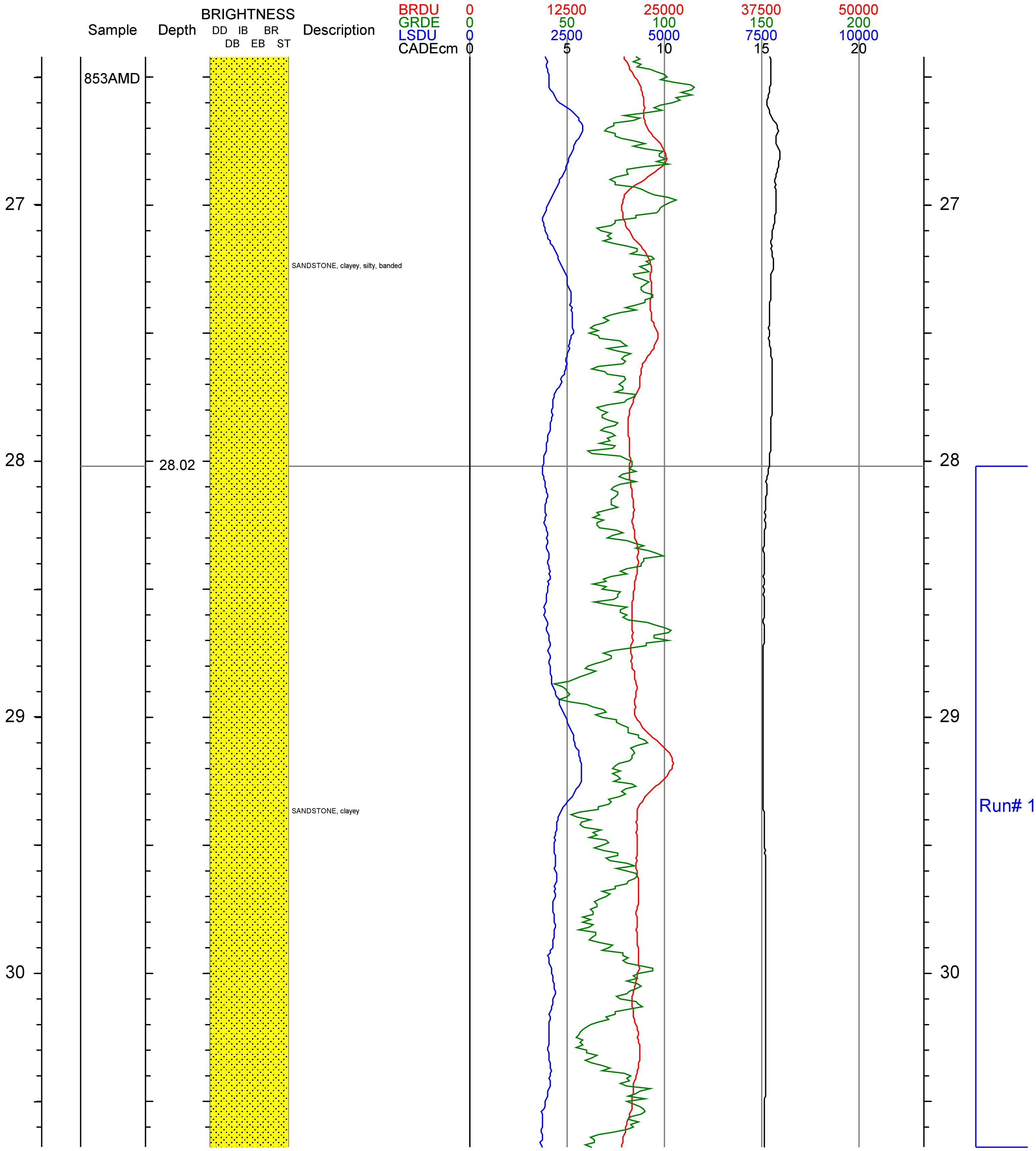

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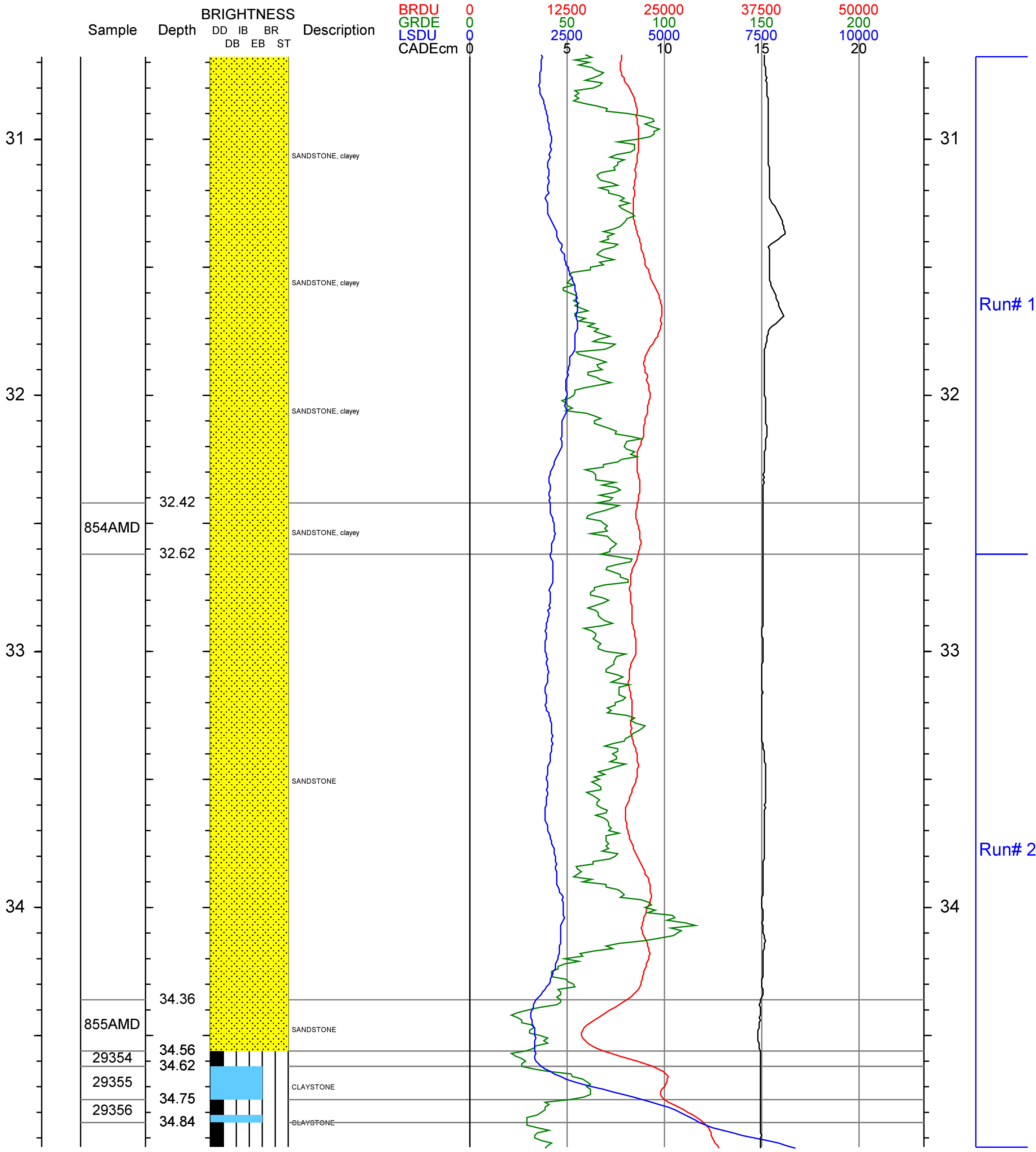

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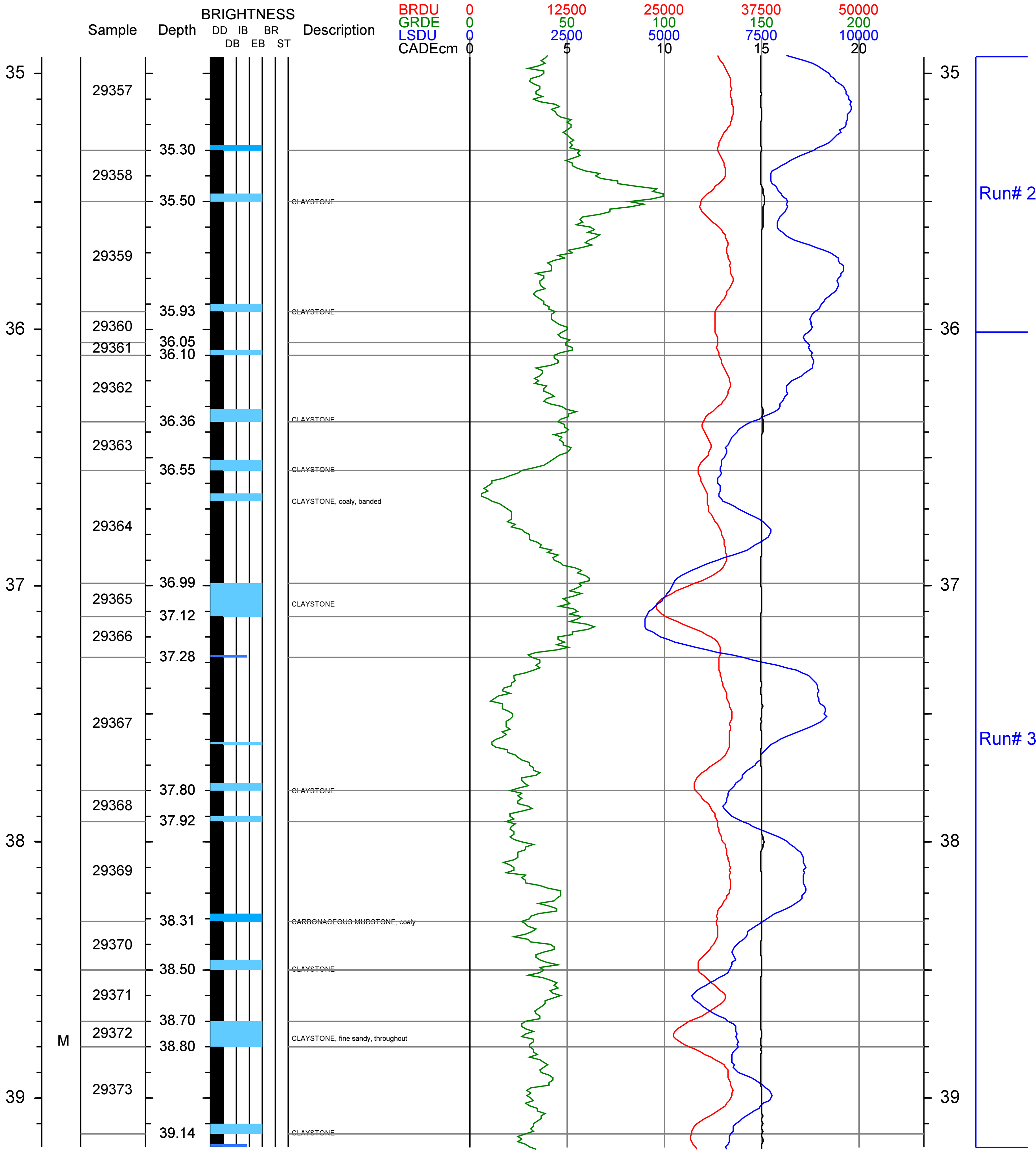
LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14045C

SCALE 1:20
GEOPHYSICAL PROFILE
HOLE



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LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14045C

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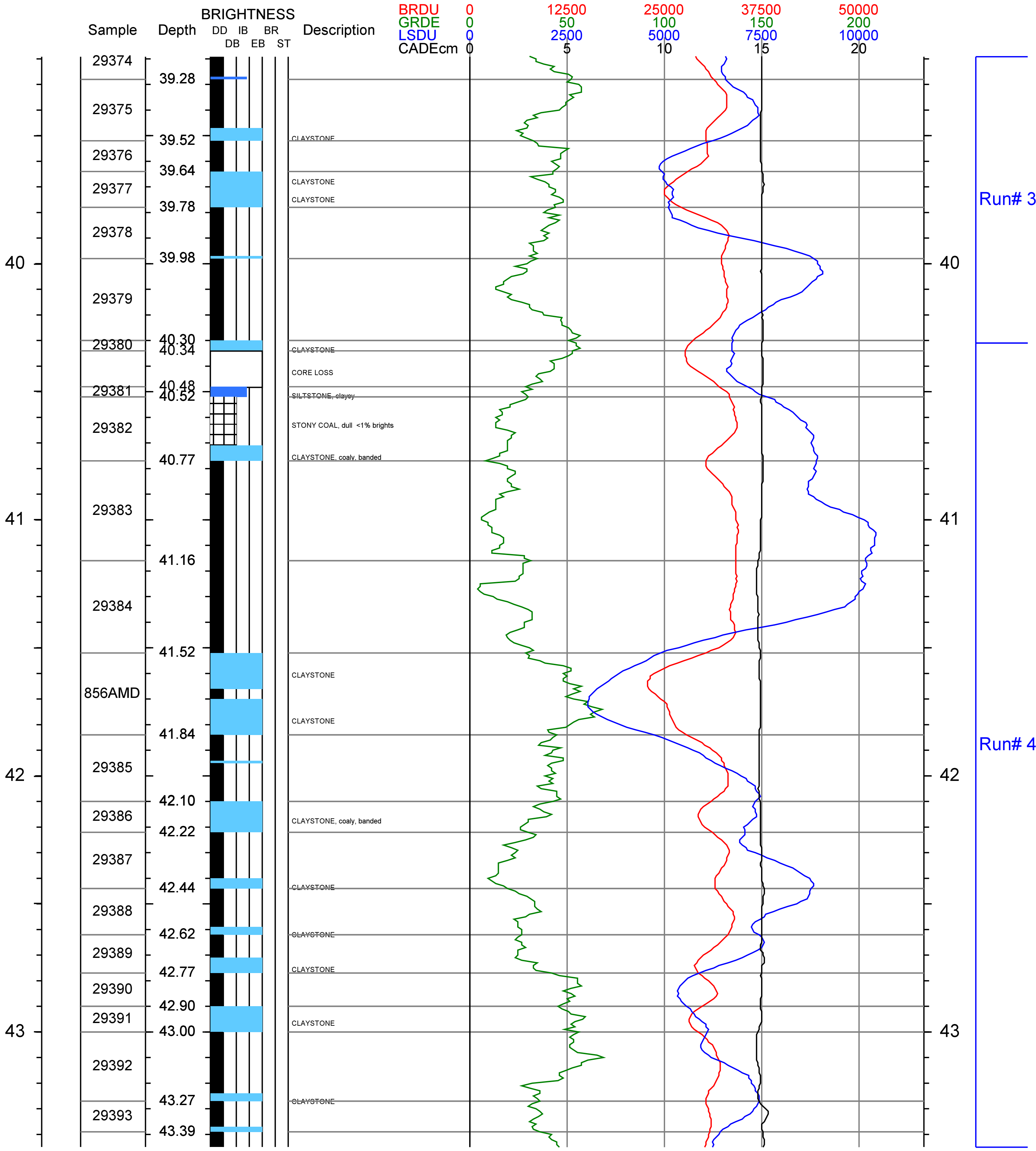

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HOLE KC14045C

SCALE 1:20

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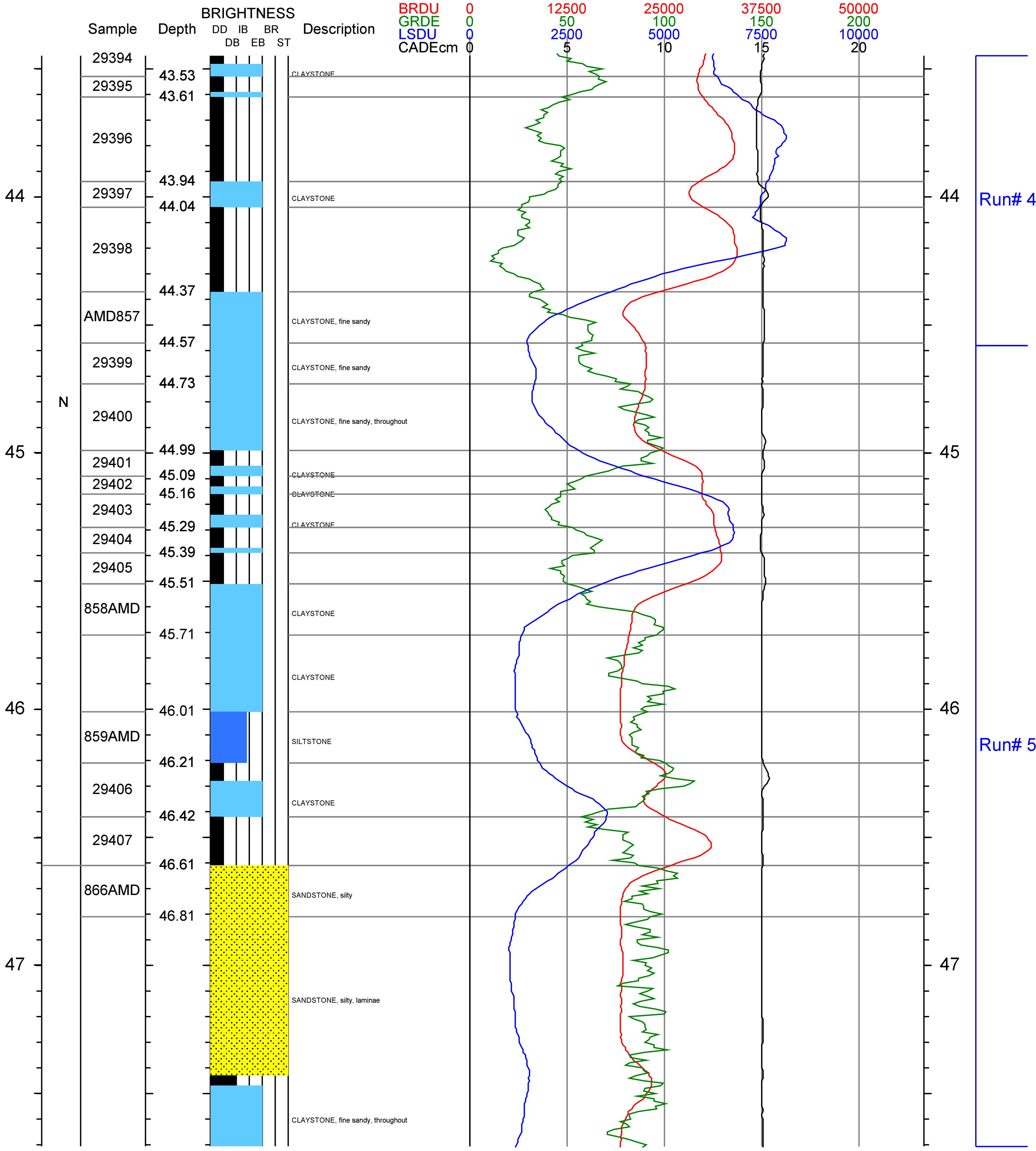

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LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14045C

SCALE 1:20
GEOPHYSICAL PROFILE
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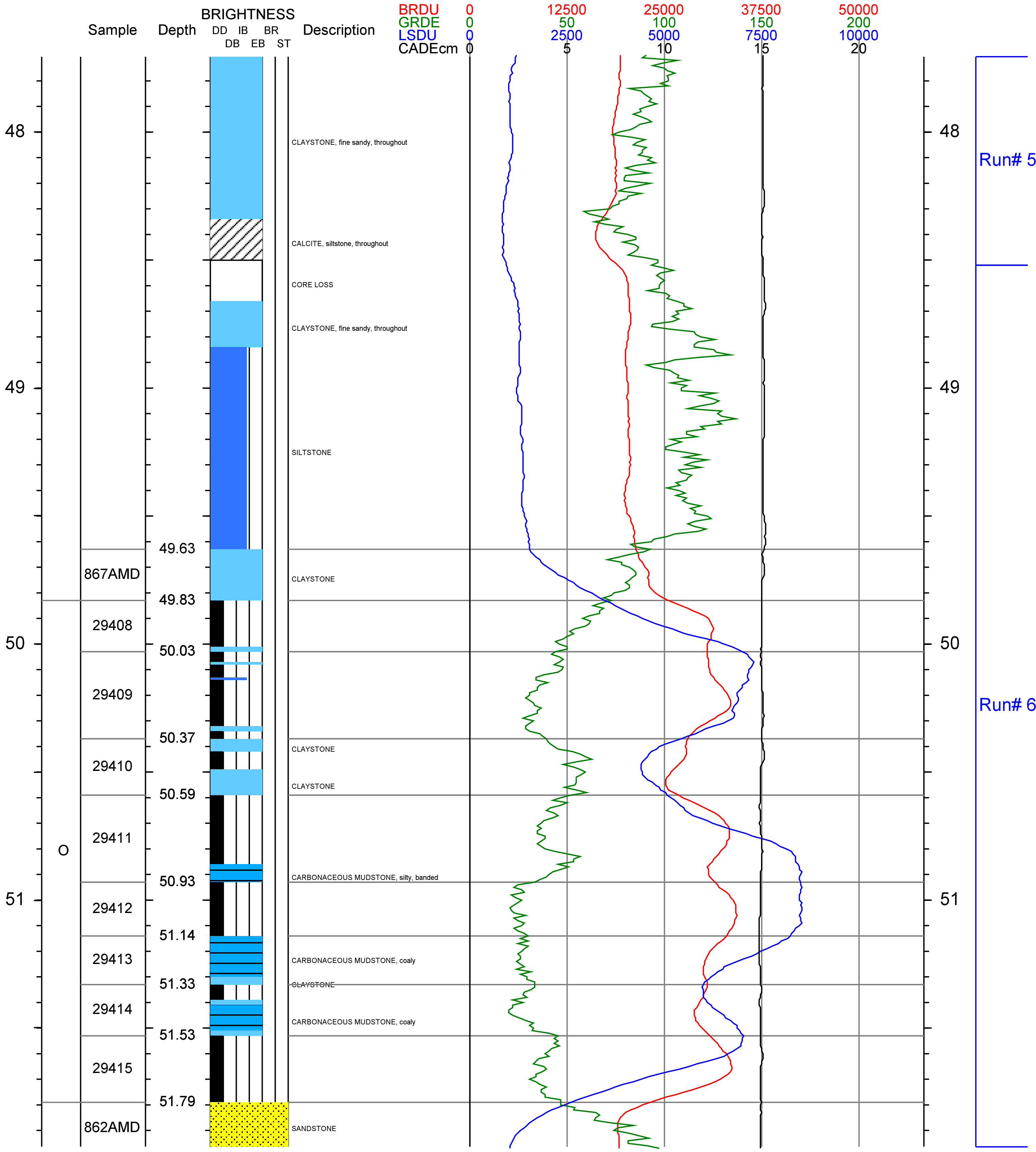

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LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
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GEOPHYSICAL PROFILE

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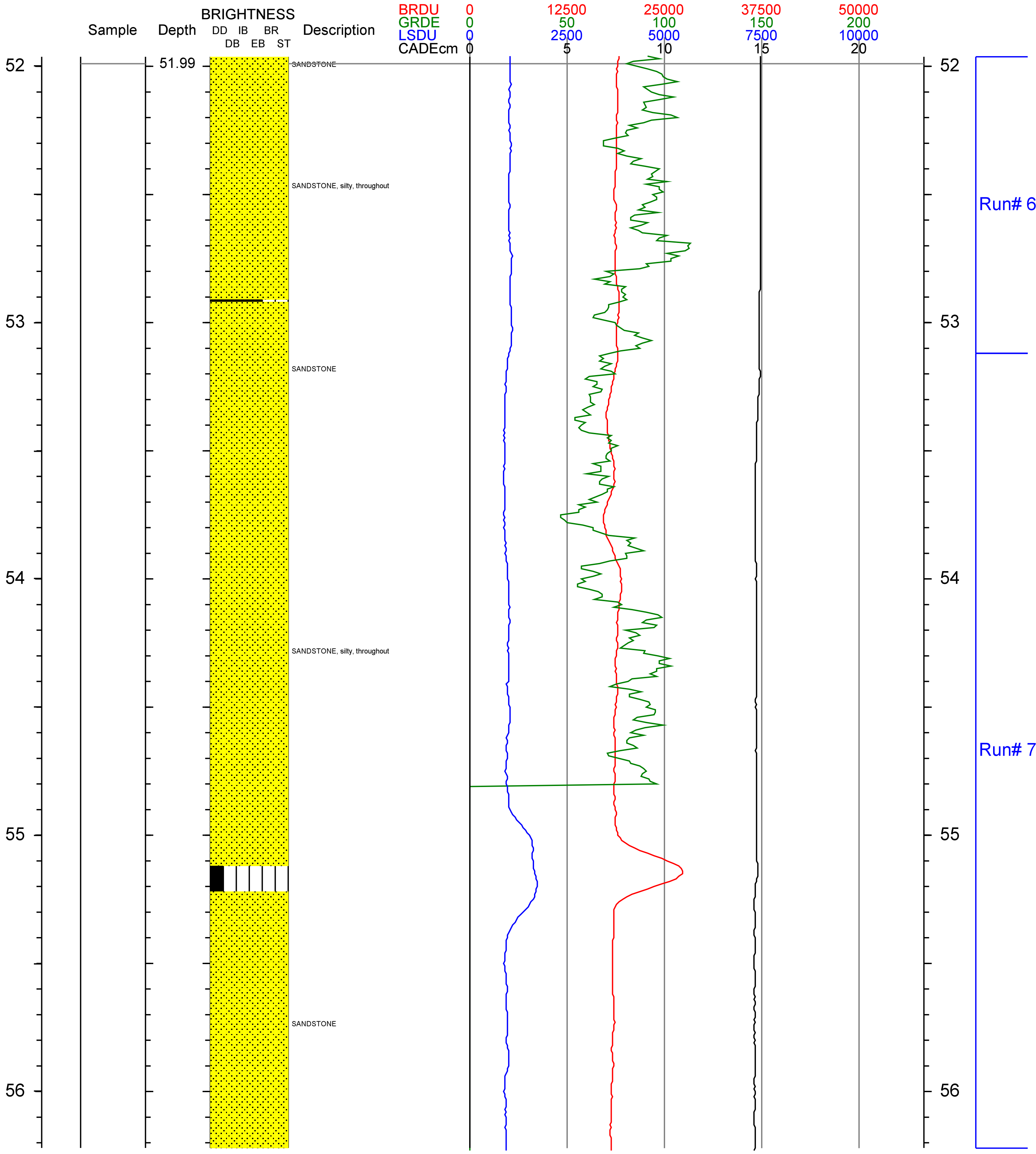

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LITHOTYPE PROFILE (SEE LEGEND FOR CODES)
HOLE KC14045C

SCALE 1:20

GEOPHYSICAL PROFILE

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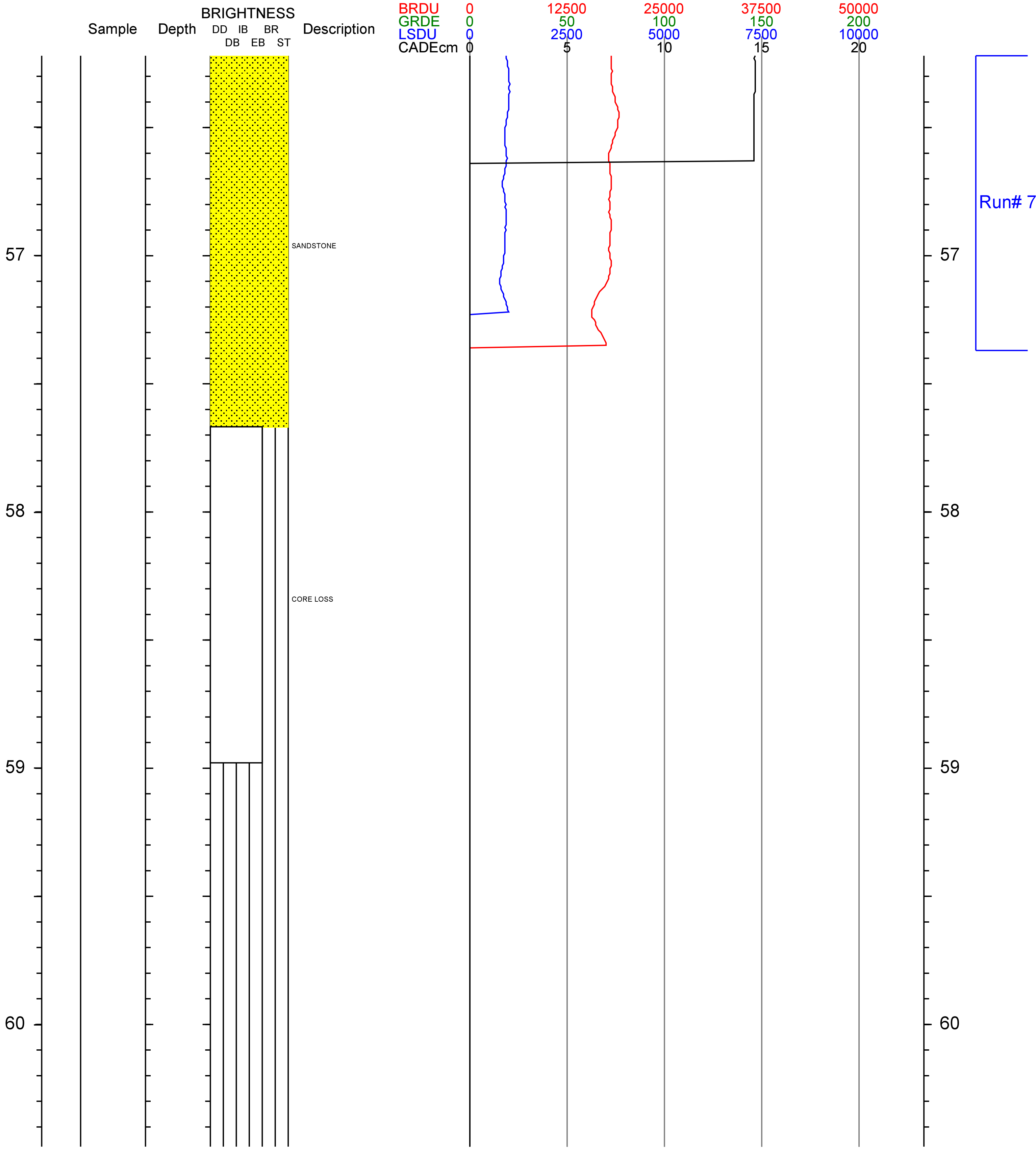

Attachment A3

Stratigraphic Photographs

SUBSOIL - Clay

KC14031C – RGS No.4 – AMD404 – Clay

OVERBURDEN – Claystone

KC14031C

RGS No.15 – AMD405 – Claystone

KC14036C

RGS No.27 – AMD422 – Claystone

KC14036C

RGS No.28 – AMD423 – Claystone

KC14037C

RGS No.32 – AMD441 – Claystone

OVERBURDEN – Claystone

KC14039C

RGS No.45 – AMD475 – Claystone

KC14040C

RGS No.48 – AMD488 – Claystone

OVERBURDEN – Sandstone

KC14031C

RGS No.17 – AMD407 – Sandstone

KC14031C

RGS No.22 – AMD412 – Sandstone

KC14036C

RGS No.25 – AMD420 – Sandstone

KC14036C

RGS No.26 – AMD421 – Sandstone

OVERBURDEN – Sandstone

KC14037C

RGS No.30 – AMD439 – Sandstone

KC14045C

RGS No.72 – AMD854 – Sandstone

KC14038C

RGS No.33 – AMD458 – Sandstone

KC14038C

RGS No.35 – AMD460 – Sandstone

KC14038C

RGS No.36 – AMD461 – Sandstone

KC14038C

RGS No.38 – AMD463 – Sandstone

OVERBURDEN – Sandstone

KC14042C

RGS No.52 – AMD822 – Sandstone

KC14042C

RGS No. 52 – AMD822 – Sandstone

OVERBURDEN – Siltstone, Carbonaceous Mudstone

KC14038C

RGS No.40 – AMD465 – Siltstone

KC14038C

RGS No.41 – AMD466 – Siltstone

KC14031C

RGS No.20 – AMD410 – Siltstone

KC14037C

RGS No.31 – AMD440 – Carb. Mudstone

INTERBURDEN – (from inbetween K, M and N seams) – Claystone

KC14036C

RGS No.75 – AMD429 – Claystone

KC14037C

RGS No.76 – AMD446 – Claystone

KC14037C

RGS No.78 – AMD453 – Claystone

KC14039C

RGS No.80 – AMD480 – Claystone

KC14040C

RGS No.83 – AMD498 – Claystone

KC14039C

RGS No.79 – AMD476 – Claystone

INTERBURDEN – (from inbetween K, M and N seams) – Siltstone, Sandstone

KC14043C

RGS No.84 – AMD832 – Siltstone

KC14040C

RGS No.82 – AMD491 – Sandstone

ROOF – (M seam) – Claystone

KC14039C – M seam

RGS No.91 – AMD477 – Claystone

KC14044C – M seam

RGS No.95 – AMD845 – Claystone

ROOF – (O seam) – Claystone

KC14036C – O seam

RGS No.87 – AMD432 – Claystone

KC14045C – O seam

RGS No.97 – AMD861 – Claystone

ROOF – (M seam) – Sandstone

KC14042C – M seam

RGS No.93 – AMD823 – Sandstone

KC14045C – M seam

RGS No.96 – AMD855 – Sandstone

ROOF – (M seam) – Siltstone

KC14043C – M seam

RGS No.94 – AMD833 – Siltstone

PARTING (N seam) – Claystone

KC14036C – N seam

RGS No.101 – AMD430 – Claystone

KC14039C – N seam

RGS No.116 – AMD481 – Claystone

PARTING (N seam) – Claystone

KC14040C – N seam

RGS No.120 – AMD494 – Claystone

KC14045C – N seam

RGS No.127 – AMD857 – Claystone

PARTING (M and O seam) – Claystone

KC14037C – M seam

RGS No.106 – AMD444 – Claystone

KC14039C – O seam

RGS No.117 – AMD483 – Claystone

PARTING (P seam) – Claystone

KC14036C – P seam

RGS No.104 – AMD435 – Claystone

PARTING (N seam) – Siltstone

KC14031C – N seam

RGS No.98 – AMD415 – Siltstone

KC14045C – N seam

RGS No.129 – AMD859 – Siltstone

PARTING (N seam) – Sandstone

KC14037C – N seam

RGS No.110 – AMD450 – Sandstone

FLOOR (O seam) – Claystone

KC14031C – O seam

RGS No.130 – AMD417 – Claystone

KC14039C – O seam

RGS No.136 – AMD484 – Claystone

FLOOR (K seam) – Claystone

KC14037C – K seam

RGS No.133 – AMD442 – Claystone

FLOOR (M seam) – Claystone

KC14040C – M seam

RGS No.137 – AMD490 – Claystone

FLOOR (N seam) – Claystone

KC14042C – N seam

RGS No.140 – AMD824 – Claystone

FLOOR (O seam) – Sandstone

KC14038C – O seam

RGS No.135 – AMD469 – Sandstone

KC14043C – O seam

RGS No.142 – AMD835 – Sandstone

KC14044C – O seam

RGS No.143 – AMD847 – Sandstone

KC14045C – O seam

RGS No.145 – AMD862 – Sandstone

FLOOR (N seam) – Sandstone

KC14045C – N seam

RGS No.144 – AMD860 – Sandstone

Attachment B

Static Geochemical Test Results

LIST OF TABLES

Table B1: Acid Base Account (ABA) Results for Spoil Materials

RGS Sample No.	ALS Laboratory Number	Client Sample ID	Drill Hole No.	Depth Interval (m)			Sample Type	Proximity to Coal Seam	Lith Code	Lithology Description	pH[1]	EC[1]	Total S	Scr[2]	MPA[2]	ANC[2]	NAPP[2]	ANC: MPA Ratio	Sample Classification[3]
				from	to	range						(µS/cm)	(%)		(kg H_2SO_4/t)				
OVERBURDEN - SOIL																			
1	EB1440704001	401AMD	KC14031C	1.00	2.00	1.00	Topsoil	-	SA	Sand	7.4	330	0.02		0.61	0.9	-0.29	1.47	NAF (Barren)
2	EB1440704002	402AMD	KC14031C	2.00	4.00	2.00	Subsoil	-	CL	Clay	5.5	731	0.02		0.61	1.5	-0.89	2.45	NAF (Barren)
3	EB1440704003	403AMD	KC14031C	4.00	5.04	1.04	Subsoil	-	CL	Clay	5.2	792	0.05		1.53	3.6	-2.07	2.35	NAF (Barren)
4	EB1440704004	404AMD	KC14031C	6.05	6.32	0.27	Subsoil	-	CL	Clay	5.5	823	0.05		1.53	7.9	-6.37	5.16	NAF (Barren)
5	EB1440704018	418AMD	KC14036C	1.00	2.00	1.00	Topsoil	-	CL	Clay	5.3	781	0.04		1.23	0.5	0.73	0.41	NAF (Barren)
6	EB1440704037	437AMD	KC14037C	1.00	3.00	2.00	Topsoil	-	CL	Clay	7.5	568	0.03		0.92	5.0	-4.08	5.44	NAF (Barren)
7	EB1440704056	456AMD	KC14038C	1.00	2.00	1.00	Topsoil	-	CL	Clay	5.4	293	0.02		0.61	0.3	0.36	0.41	NAF (Barren)
8	EB1440704057	457AMD	KC14038C	4.00	5.18	1.18	Subsoil	-	CL	Clay	5.7	244	0.02		0.61	0.3	0.36	0.41	NAF (Barren)
9	EB1440704070	470AMD	KC14039C	2.00	3.00	1.00	Topsoil	-	SA	Sand	7.2	223	0.03		0.92	1.4	-0.48	1.52	NAF (Barren)
10	EB1440704071	471AMD	KC14039C	3.00	4.00	1.00	Subsoil	-	CL	Clay	5.6	377	0.03		0.92	0.3	0.67	0.27	NAF (Barren)
11	EB1440704085	485AMD	KC14040C	1.00	2.00	1.00	Topsoil	-	SA	Sand	5.7	682	0.02		0.61	0.3	0.36	0.41	NAF (Barren)
12	EB1440704101	818AMD	KC14042C	1.00	2.00	1.00	Topsoil	-	CL	Clay	6.5	1,050	0.03		0.92	0.9	0.02	0.98	NAF (Barren)
13	EB1440704116	836AMD	KC14044C	2.00	3.00	1.00	Topsoil	-	CL	Clay	5.3	321	0.02		0.61	0.3	0.36	0.41	NAF (Barren)
14	EB1440704128	848AMD	KC14045C	1.00	2.00	1.00	Topsoil	-	CL	Clay	4.8	1390	0.07		2.14	0.3	1.89	0.12	NAF (Barren)
OVERBURDEN																			
15	EB1440704005	405AMD	KC14031C	7.20	7.45	0.25	Overburden	-	CS	Claystone	5.5	924	0.09		2.76	7.7	-4.94	2.79	NAF (Barren)
16	EB1440704006	406AMD	KC14031C	8.50	9.03	0.53	Overburden	-	SL	Siltstone	5.8	849	0.05		1.53	7.1	-5.57	4.64	NAF (Barren)
17	EB1440704007	407AMD	KC14031C	10.70	11.03	0.33	Overburden	-	SS	Sandstone	6.5	837	0.02		0.61	9.6	-8.99	15.67	NAF (Barren)
18	EB1440704008	408AMD	KC14031C	14.10	14.42	0.32	Overburden	-	SS	Sandstone	8.0	822	0.03		0.92	9.3	-8.38	10.12	NAF (Barren)
19	EB1440704009	409AMD	KC14031C	15.72	15.97	0.25	Overburden	-	SL	Siltstone	9.3	561	0.04		1.23	13.0	-11.78	10.61	NAF (Barren)
20	EB1440704010	410AMD	KC14031C	16.41	16.68	0.27	Overburden	-	SL	Siltstone	8.6	442	0.06		1.84	10.8	-8.96	5.88	NAF (Barren)
21	EB1440704011	411AMD	KC14031C	20.35	20.55	0.20	Overburden	-	SS	Sandstone	9.2	606	0.03		0.92	109.0	-108.08	118.64	NAF (Barren)
22	EB1440704012	412AMD	KC14031C	23.08	23.38	0.30	Overburden	-	SS	Sandstone	9.6	760	0.02		0.61	77.3	-76.69	126.20	NAF (Barren)
23	EB1440704013	413AMD	KC14031C	28.24	28.49	0.25	Overburden	-	SS	Sandstone	9.4	723	0.02		0.61	92.9	-92.29	151.67	NAF (Barren)
24	EB1440704019	419AMD	KC14036C	3.00	4.00	1.00	Overburden	-	SS	Sandstone	5.3	1,160	0.04		1.23	0.3	0.98	0.20	NAF (Barren)
25	EB1440704020	420AMD	KC14036C	7.80	8.05	0.25	Overburden	-	SS	Sandstone	5.4	1,340	0.04		1.23	1.8	-0.58	1.47	NAF (Barren)
26	EB1440704021	421AMD	KC14036C	9.58	9.88	0.30	Overburden	-	SS	Sandstone	5.2	1,270	0.03		0.92	4.3	-3.38	4.68	NAF (Barren)
27	EB1440704022	422AMD	KC14036C	10.34	10.72	0.38	Overburden	-	CS	Claystone	8.6	1,370	0.06		1.84	2.4	-0.56	1.31	NAF (Barren)
28	EB1440704023	423AMD	KC14036C	15.67	15.91	0.24	Overburden	-	CS	Claystone	8.5	745	0.07		2.14	7.2	-5.06	3.36	NAF (Barren)
29	EB1440704038	438AMD	KC14037C	5.00	6.48	1.48	Overburden	-	SS	Sandstone	5.4	922	0.04		1.23	0.3	0.98	0.20	NAF (Barren)
30	EB1440704039	439AMD	KC14037C	9.29	9.49	0.20	Overburden	-	SS	Sandstone	5.0	2,380	0.05		1.53	3.0	-1.47	1.96	NAF (Barren)
31	EB1440704040	440AMD	KC14037C	14.74	15.04	0.30	Overburden	-	XM	Carbonaceous Mudstone	5.9	1,320	0.32	0.039	1.19	3.4	-2.21	2.85	NAF (Barren)
32	EB1440704041	441AMD	KC14037C	18.65	18.85	0.20	Overburden	-	CS	Claystone	9.0	791	0.06		1.84	6.4	-4.56	3.48	NAF (Barren)
33	EB1440704058	458AMD	KC14038C	6.56	6.76	0.20	Overburden	-	SS	Sandstone	5.3	288	0.02		0.61	0.3	0.36	0.41	NAF (Barren)
34	EB1440704059	459AMD	KC14038C	8.81	9.01	0.20	Overburden	-	SL	Siltstone	5.5	228	0.03		0.92	0.3	0.67	0.27	NAF (Barren)
35	EB1440704060	460AMD	KC14038C	13.59	13.79	0.20	Overburden	-	SS	Sandstone	5.7	149	0.03		0.92	0.3	0.67	0.27	NAF (Barren)
36	EB1440704061	461AMD	KC14038C	17.10	17.30	0.20	Overburden	-	SS	Sandstone	6.5	156	0.03		0.92	2.2	-1.28	2.39	NAF (Barren)
37	EB1440704062	462AMD	KC14038C	22.20	22.40	0.20	Overburden	-	SS	Sandstone	7.2	112	0.02		0.61	9.0	-8.39	14.69	NAF (Barren)
38	EB1440704063	463AMD	KC14038C	23.77	23.97	0.20	Overburden	-	SS	Sandstone	7.2	201	0.02		0.61	11.7	-11.09	19.10	NAF (Barren)

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RGS Sample No.	ALS Laboratory Number	Client Sample ID	Drill Hole No.	Depth Interval (m)			Sample Type	Proximity to Coal Seam	Lith Code	Lithology Description	pH[1]	EC[1]	Total S	Scr[2]	MPA[2]	ANC[2]	NAPP[2]	ANC: MPA Ratio	Sample Classification[3]
				from	to	range						(µS/cm)	(%)		(kg H_2SO_4/t)				
39	EB1440704064	464AMD	KC14038C	26.50	26.70	0.20	Overburden	-	SS	Sandstone	9.5	482	0.04		1.23	16.8	-15.58	13.71	NAF (Barren)
40	EB1440704065	465AMD	KC14038C	29.36	29.50	0.14	Overburden	-	SL	Siltstone	9.3	373	0.03		0.92	10.5	-9.58	11.43	NAF (Barren)
41	EB1440704066	466AMD	KC14038C	36.09	36.29	0.20	Overburden	-	SL	Siltstone	8.4	240	0.04		1.23	6.9	-5.68	5.63	NAF (Barren)
42	EB1440704072	472AMD	KC14039C	7.00	8.00	1.00	Overburden	-	SS	Sandstone	5.4	234	0.04		1.23	0.3	0.98	0.20	NAF (Barren)
43	EB1440704073	473AMD	KC14039C	12.00	13.00	1.00	Overburden	-	CS	Claystone	5.3	1,510	0.06		1.84	1.2	0.64	0.65	NAF (Barren)
44	EB1440704074	474AMD	KC14039C	14.00	15.55	1.55	Overburden	-	CS	Claystone	8.3	705	0.14	0.095	2.91	5.3	-2.39	1.82	NAF (Barren)
45	EB1440704075	475AMD	KC14039C	17.70	17.90	0.20	Overburden	-	CS	Claystone	7.8	569	0.04		1.23	11.4	-10.18	9.31	NAF (Barren)
46	EB1440704086	486AMD	KC14040C	10.00	11.00	1.00	Overburden	-	SS	Sandstone	5.2	1,980	0.04		1.23	0.3	0.98	0.20	NAF (Barren)
47	EB1440704087	487AMD	KC14040C	16.00	17.00	1.00	Overburden	-	SS	Sandstone	8.7	1,030	0.03		0.92	3.3	-2.38	3.59	NAF (Barren)
48	EB1440704088	488AMD	KC14040C	21.24	21.44	0.20	Overburden	-	CS	Claystone	9.4	528	0.04		1.23	7.9	-6.68	6.45	NAF (Barren)
49	EB1440704102	819AMD	KC14042C	6.00	13.00	2.00	Overburden	-	SS	Sandstone	5.0	830	0.06		1.84	0.3	1.59	0.14	NAF (Barren)
50	EB1440704143	821AMD	KC14042C	16.00	17.00	1.00	Overburden	-	SS	Sandstone	9.7	1,160	0.08		2.45	17.2	-14.75	7.02	NAF (Barren)
51	EB1440704103	820AMD	KC14042C	23.00	24.00	1.00	Overburden	-	SS	Sandstone	5.9	795	0.03		0.92	2.6	-1.68	2.83	NAF (Barren)
52	EB1440704144	822AMD	KC14042C	32.54	32.74	0.20	Overburden	-	SS	Sandstone	8.6	177	0.03		0.92	6.5	-5.58	7.07	NAF (Barren)
53	EB1440704107	826AMD	KC14043C	3.00	4.00	1.00	Overburden	-	SS	Sandstone	5.1	416	0.04		1.23	0.3	0.98	0.20	NAF (Barren)
54	EB1440704108	827AMD	KC14043C	11.00	12.00	1.00	Overburden	-	SS	Sandstone	5.1	521	0.04		1.23	0.3	0.98	0.20	NAF (Barren)
55	EB1440704109	828AMD	KC14043C	16.00	17.00	1.00	Overburden	-	CS	Claystone	9.4	373	0.10	0.003	0.08	1.3	-1.22	16.98	NAF (Barren)
56	EB1440704110	829AMD	KC14043C	23.00	24.00	1.00	Overburden	-	SS	Sandstone	9.3	608	0.07		2.14	16.0	-13.86	7.46	NAF (Barren)
57	EB1440704111	830AMD	KC14043C	29.00	30.00	1.00	Overburden	-	SS	Sandstone	9.3	604	0.07		2.14	23.7	-21.56	11.06	NAF (Barren)
58	EB1440704112	831AMD	KC14043C	35.00	36.02	1.02	Overburden	-	SS	Sandstone	9.7	489	0.05		1.53	8.2	-6.67	5.36	NAF (Barren)
59	EB1440704117	837AMD	KC14044C	7.00	8.00	1.00	Overburden	-	SS	Sandstone	4.6	1,190	0.03		0.92	0.3	0.67	0.27	NAF (Barren)
60	EB1440704118	838AMD	KC14044C	12.00	13.00	1.00	Overburden	-	SS	Sandstone	4.8	1,040	0.04		1.23	0.3	0.98	0.20	NAF (Barren)
61	EB1440704119	839AMD	KC14044C	21.00	22.00	1.00	Overburden	-	SS	Sandstone	5.3	903	0.04		1.23	0.3	0.98	0.20	NAF (Barren)
62	EB1440704120	840AMD	KC14044C	25.00	26.00	1.00	Overburden	-	CS	Claystone	8.6	850	0.05		1.53	3.2	-1.67	2.09	NAF (Barren)
63	EB1440704121	841AMD	KC14044C	29.00	30.00	1.00	Overburden	-	CS	Claystone	9.0	457	0.06		1.84	10.5	-8.66	5.71	NAF (Barren)
64	EB1440704122	842AMD	KC14044C	34.00	35.00	1.00	Overburden	-	SS	Sandstone	9.1	572	0.05		1.53	32.1	-30.57	20.96	NAF (Barren)
65	EB1440704123	843AMD	KC14044C	38.00	38.99	0.99	Overburden	-	CS	Claystone	9.2	424	0.04		1.23	36.1	-34.88	29.47	NAF (Barren)
66	EB1440704124	844AMD	KC14044C	41.05	41.25	0.20	Overburden	-	SS	Sandstone	8.8	331	0.04		1.23	86.8	-85.58	70.86	NAF (Barren)
67	EB1440704129	849AMD	KC14045C	5.00	6.00	1.00	Overburden	-	SS	Sandstone	4.8	1,310	0.05		1.53	0.3	1.28	0.16	NAF (Barren)
68	EB1440704130	850AMD	KC14045C	9.00	10.00	1.00	Overburden	-	CS	Claystone	5.7	800	0.03		0.92	0.3	0.67	0.27	NAF (Barren)
69	EB1440704131	851AMD	KC14045C	15.00	16.00	1.00	Overburden	-	CS	Claystone	9.5	998	0.06		1.84	1.7	0.14	0.93	NAF (Barren)
70	EB1440704132	852AMD	KC14045C	23.00	24.00	1.00	Overburden	-	SS	Sandstone	9.8	507	0.03		0.92	13.1	-12.18	14.26	NAF (Barren)
71	EB1440704133	853AMD	KC14045C	25.00	28.02	3.02	Overburden	-	SS	Sandstone	9.6	651	0.04		1.23	33.6	-32.38	27.43	NAF (Barren)
72	EB1440704134	854AMD	KC14045C	32.42	32.62	0.20	Overburden	-	SS	Sandstone	9.9	706	0.03		0.92	75.9	-74.98	82.61	NAF (Barren)
INTERBURDEN																			
73	EB1440704016	416AMD	KC14031C	43.84	44.08	0.24	Interburden	N and O	CS	Claystone	9.3	511	0.06		1.84	6.0	-4.16	3.27	NAF (Barren)
74	EB1440704025	425AMD	KC14036C	25.78	25.98	0.20	Interburden	K and M	SL	Siltstone	8.1	490	0.04		1.23	48.5	-47.28	39.59	NAF (Barren)
75	EB1440704029	429AMD	KC14036C	40.21	40.41	0.20	Interburden	N seam	CS	Claystone	9.1	344	0.03		0.92	6.0	-5.08	6.53	NAF (Barren)
76	EB1440704046	446AMD	KC14037C	33.74	33.96	0.22	Interburden	M and N	CS	Claystone	9.2	449	0.04		1.23	8.2	-6.98	6.69	NAF (Barren)
77	EB1440704047	447AMD	KC14037C	34.65	34.85	0.20	Interburden	N seam	CS	Claystone	9.0	390	0.05		1.53	7.3	-5.77	4.77	NAF (Barren)
78	EB1440704053	453AMD	KC14037C	44.11	44.31	0.20	Interburden	N and O	CS	Claystone	9.8	631	0.02		0.61	10.5	-9.89	17.14	NAF (Barren)

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				from	to	range						(µS/cm)	(%)		($kg\ H_2SO_4/t$)				
79	EB1440704076	476AMD	KC14039C	23.79	23.99	0.20	Interburden	K and M	CS	Claystone	7.2	544	0.10		3.06	7.6	-4.54	2.48	NAF (Barren)
80	EB1440704080	480AMD	KC14039C	36.98	37.19	0.21	Interburden	N seam	CS	Claystone	9.8	412	0.03		0.92	19.6	-18.68	21.33	NAF (Barren)
81	EB1440704082	482AMD	KC14039C	40.66	40.86	0.20	Interburden	N seam	SS	Sandstone	9.6	549	0.08		2.45	201.0	-198.55	82.04	NAF (Barren)
82	EB1440704091	491AMD	KC14040C	33.36	33.56	0.20	Interburden	M and N	SS	Sandstone	9.4	429	0.03		0.92	5.1	-4.18	5.55	NAF (Barren)
83	EB1440704098	498AMD	KC14040C	47.59	47.79	0.20	Interburden	N and O	CS	Claystone	9.9	662	0.04		1.23	11.1	-9.88	9.06	NAF (Barren)
84	EB1440704113	832AMD	KC14043C	39.84	40.04	0.20	Interburden	K and M	SL	Siltstone	8.5	228	0.04		1.23	7.9	-6.68	6.45	NAF (Barren)
ROOF																			
85	EB1440704014	414AMD	KC14031C	32.82	33.02	0.20	Roof	M seam	SS	Sandstone	9.6	726	0.04		1.23	103.0	-101.78	84.08	NAF (Barren)
86	EB1440704026	426AMD	KC14036C	28.08	28.38	0.30	Roof	M seam	CS	Claystone	9.2	478	0.05		1.53	7.8	-6.27	5.09	NAF (Barren)
87	EB1440704032	432AMD	KC14036C	45.31	45.56	0.25	Roof	O seam	CS	Claystone	8.3	345	0.17	0.072	2.21	8.7	-6.50	3.95	NAF (Barren)
88	EB1440704043	443AMD	KC14037C	23.20	23.40	0.20	Roof	M seam	CS	Claystone	8.0	665	0.07		2.14	8.9	-6.76	4.15	NAF (Barren)
89	EB1440704054	454AMD	KC14037C	46.76	46.96	0.20	Roof	O seam	SL	Siltstone	9.1	436	0.03		0.92	7.0	-6.08	7.62	NAF (Barren)
90	EB1440704067	467AMD	KC14038C	37.59	37.79	0.20	Roof	M seam	SS, CS	Sandstone, Claystone	8.3	205	0.10		3.06	7.4	-4.34	2.42	NAF (Barren)
91	EB1440704077	477AMD	KC14039C	25.50	25.70	0.20	Roof	M seam	CS	Claystone	8.3	509	0.05		1.53	7.0	-5.47	4.57	NAF (Barren)
92	EB1440704089	489AMD	KC14040C	24.11	24.31	0.20	Roof	M seam	CS	Claystone	8.7	429	0.04		1.23	5.7	-4.48	4.65	NAF (Barren)
93	EB1440704104	823AMD	KC14042C	33.20	33.40	0.20	Roof	M seam	SS	Sandstone	8.9	200	0.04		1.23	5.6	-4.38	4.57	NAF (Barren)
94	EB1440704145	833AMD	KC14043C	40.16	40.36	0.20	Roof	M seam	SL	Siltstone	9.1	508	0.06		1.84	185.0	-183.16	100.68	NAF (Barren)
95	EB1440704125	845AMD	KC14044C	43.35	43.55	0.20	Roof	M seam	CS	Claystone	8.6	249	0.06		1.84	6.1	-4.26	3.32	NAF (Barren)
96	EB1440704135	855AMD	KC14045C	34.36	34.56	0.20	Roof	M seam	SS	Sandstone	9.8	660	0.03		0.92	169.0	-168.08	183.95	NAF (Barren)
97	EB1440704141	861AMD	KC14045C	49.63	49.83	0.20	Roof	O seam	CS	Claystone	9.1	388	0.10		3.06	9.0	-5.94	2.94	NAF (Barren)
PARTING																			
98	EB1440704015	415AMD	KC14031C	42.53	42.76	0.23	Parting	N seam	SL	Siltstone	9.2	385	0.03		0.92	5.5	-4.58	5.99	NAF (Barren)
99	EB1440704027	427AMD	KC14036C	36.13	36.44	0.31	Parting	M seam	CS	Claystone	9.2	370	0.04		1.23	7.6	-6.38	6.20	NAF (Barren)
100	EB1440704028	428AMD	KC14036C	38.98	39.18	0.20	Parting	N seam	SS	Sandstone	9.3	360	0.03		0.92	11.8	-10.88	12.84	NAF (Barren)
101	EB1440704030	430AMD	KC14036C	41.60	41.82	0.22	Parting	N seam	CS	Claystone	9.2	326	0.08		2.45	9.2	-6.75	3.76	NAF (Barren)
102	EB1440704031	431AMD	KC14036C	42.00	42.20	0.20	Parting	N seam	SL	Siltstone	9.3	270	0.03		0.92	4.7	-3.78	5.12	NAF (Barren)
103	EB1440704033	433AMD	KC14036C	46.48	46.64	0.16	Parting	O seam	CS	Claystone	8.8	269	0.16	0.129	3.95	6.4	-2.45	1.62	Uncertain
104	EB1440704035	435AMD	KC14036C	51.03	51.23	0.20	Parting	P seam	CS	Claystone	8.5	190	0.10		3.06	7.2	-4.14	2.35	NAF (Barren)
105	EB1440704036	436AMD	KC14036C	51.36	51.66	0.30	Parting	P seam	CS	Claystone	9.1	209	0.02		0.61	6.0	-5.39	9.80	NAF (Barren)
106	EB1440704044	444AMD	KC14037C	31.01	31.21	0.20	Parting	M seam	CS	Claystone	9.0	413	0.04		1.23	4.7	-3.48	3.84	NAF (Barren)
107	EB1440704045	445AMD	KC14037C	33.01	33.17	0.16	Parting	M seam	CS	Claystone	8.8	469	0.04		1.23	5.4	-4.18	4.41	NAF (Barren)
108	EB1440704048	448AMD	KC14037C	36.70	36.90	0.20	Parting	N seam	SL	Siltstone	9.4	911	0.07		2.14	98.3	-96.16	45.85	NAF (Barren)
109	EB1440704049	449AMD	KC14037C	37.68	37.88	0.20	Parting	N seam	SL, CS	Siltstone, Claystone	9.6	772	0.09		2.76	10.5	-7.74	3.81	NAF (Barren)
110	EB1440704050	450AMD	KC14037C	38.40	38.60	0.20	Parting	N seam	SS	Sandstone	8.5	528	0.16	0.078	2.39	4.5	-2.11	1.88	NAF (Barren)
111	EB1440704051	451AMD	KC14037C	42.07	42.27	0.20	Parting	N seam	CS	Claystone	9.0	479	0.05		1.53	6.6	-5.07	4.31	NAF (Barren)
112	EB1440704052	452AMD	KC14037C	42.40	42.60	0.20	Parting	N seam	CS	Claystone	9.2	379	0.03		0.92	6.2	-5.28	6.75	NAF (Barren)
113	EB1440704068	468AMD	KC14038C	47.97	48.17	0.20	Parting	N seam	SS	Sandstone	9.2	463	0.04		1.23	170.0	-168.78	138.78	NAF (Barren)
114	EB1440704078	478AMD	KC14039C	33.36	33.56	0.20	Parting	M seam	CS	Claystone	9.1	428	0.04		1.23	6.3	-5.08	5.14	NAF (Barren)
115	EB1440704079	479AMD	KC14039C	33.91	34.11	0.20	Parting	M seam	CS	Claystone	9.3	378	0.03		0.92	6.0	-5.08	6.53	NAF (Barren)

Table B1: Acid Base Account (ABA) Results for Spoil Materials

RGS Sample No.	ALS Laboratory Number	Client Sample ID	Drill Hole No.	Depth Interval (m)			Sample Type	Proximity to Coal Seam	Lith Code	Lithology Description	pH[1]	EC[1]	Total S	Scr[2]	MPA[2]	ANC[2]	NAPP[2]	ANC: MPA Ratio	Sample Classification[3]
				from	to	range						(µS/cm)	(%)		($kg\ H_2SO_4/t$)				
116	EB1440704081	481AMD	KC14039C	38.65	38.85	0.20	Parting	N seam	CS	Claystone	9.3	306	0.04		1.23	5.8	-4.58	4.73	NAF (Barren)
117	EB1440704083	483AMD	KC14039C	45.79	45.99	0.20	Parting	O seam	CS	Claystone	9.2	430	0.12	0.02	0.61	9.9	-9.29	16.16	NAF (Barren)
118	EB1440704092	492AMD	KC14040C	35.85	36.05	0.20	Parting	N seam	CS	Claystone	9.6	344	0.03		0.92	7.7	-6.78	8.38	NAF (Barren)
119	EB1440704093	493AMD	KC14040C	36.37	36.55	0.18	Parting	N seam	SS	Sandstone	9.2	426	0.07		2.14	7.8	-5.66	3.64	NAF (Barren)
120	EB1440704094	494AMD	KC14040C	37.95	38.15	0.20	Parting	N seam	CS	Claystone	9.6	741	0.06		1.84	9.2	-7.36	5.01	NAF (Barren)
121	EB1440704095	495AMD	KC14040C	39.70	39.90	0.20	Parting	N seam	CS	Claystone	8.9	398	0.40	0.27	8.21	17.3	-9.09	2.11	NAF
122	EB1440704096	496AMD	KC14040C	40.88	41.12	0.24	Parting	N seam	CS, XM	Claystone, Carbonaceous Mudstone	9.8	580	0.07		2.14	10.0	-7.86	4.66	NAF (Barren)
123	EB1440704099	499AMD	KC14040C	51.10	51.30	0.20	Parting	O seam	CS	Claystone	9.5	438	0.11	0.003	0.08	10.3	-10.22	134.53	NAF (Barren)
124	EB1440704114	834AMD	KC14043C	50.12	50.40	0.28	Parting	N seam	CS	Claystone	8.3	317	0.08		2.45	9.4	-6.95	3.84	NAF (Barren)
125	EB1440704126	846AMD	KC14044C	53.42	53.69	0.27	Parting	N seam	CS, XM	Claystone, Carbonaceous Mudstone	8.4	498	0.34	0.19	5.85	9.9	-4.05	1.69	Uncertain
126	EB1440704136	856AMD	KC14045C	41.52	41.84	0.32	Parting	M seam	CS, CO	87.5% Claystone, 12.5% Coal (dull)	9.1	413	0.06		1.84	7.4	-5.56	4.03	NAF (Barren)
127	EB1440704137	857AMD	KC14045C	44.37	44.57	0.20	Parting	N seam	CS	Claystone	9.3	588	0.04		1.23	101.0	-99.78	82.45	NAF (Barren)
128	EB1440704138	858AMD	KC14045C	45.51	45.71	0.20	Parting	N seam	CS	Claystone	9.2	392	0.04		1.23	5.5	-4.28	4.49	NAF (Barren)
129	EB1440704139	859AMD	KC14045C	46.01	46.21	0.20	Parting	N seam	SL	Siltstone	9.4	384	0.03		0.92	4.4	-3.48	4.79	NAF (Barren)
FLOOR																			
130	EB1440704017	417AMD	KC14031C	46.19	46.39	0.20	Floor	O seam	CS	Claystone	8.9	319	0.18	0.074	2.27	4.8	-2.53	2.12	NAF (Barren)
131	EB1440704024	424AMD	KC14036C	20.40	20.60	0.20	Floor	K seam	CS	Claystone	9.0	560	0.17	0.166	5.08	8.2	-3.12	1.61	Uncertain
132	EB1440704034	434AMD	KC14036C	47.41	47.61	0.20	Floor	O seam	SS	Sandstone	9.4	399	0.06		1.84	7.6	-5.76	4.14	NAF (Barren)
133	EB1440704042	442AMD	KC14037C	21.48	21.68	0.20	Floor	K seam	CS	Claystone	8.9	812	0.05		1.53	8.9	-7.37	5.81	NAF (Barren)
134	EB1440704055	455AMD	KC14037C	49.47	49.67	0.20	Floor	O seam	SS	Sandstone	9.6	460	0.03		0.92	8.1	-7.18	8.82	NAF (Barren)
135	EB1440704069	469AMD	KC14038C	52.30	52.50	0.20	Floor	O seam	SS	Sandstone	9.0	344	0.47	0.268	8.21	5.3	2.91	0.65	Uncertain
136	EB1440704084	484AMD	KC14039C	48.25	48.45	0.20	Floor	O seam	CS	Claystone	9.5	395	0.04		1.23	8.0	-6.78	6.53	NAF (Barren)
137	EB1440704090	490AMD	KC14040C	31.45	31.65	0.20	Floor	M seam	CS	Claystone	9.2	544	0.05		1.53	4.9	-3.37	3.20	NAF (Barren)
138	EB1440704097	497AMD	KC14040C	41.66	41.86	0.20	Floor	N seam	CS	Claystone	9.2	356	0.06		1.84	5.7	-3.86	3.10	NAF (Barren)
139	EB1440704100	500AMD	KC14040C	53.50	53.70	0.20	Floor	O seam	SS	Sandstone	9.9	510	0.03		0.92	7.8	-6.88	8.49	NAF (Barren)
140	EB1440704105	824AMD	KC14042C	44.00	44.35	0.35	Floor	N seam	CS	Claystone	9.3	400	0.10	0.062	1.90	5.2	-3.30	2.74	NAF (Barren)
141	EB1440704106	825AMD	KC14042C	47.19	47.39	0.20	Floor	O seam	SS	Sandstone	9.1	252	0.13	0.033	1.01	3.8	-2.79	3.76	NAF (Barren)
142	EB1440704115	835AMD	KC14043C	54.38	54.58	0.20	Floor	O seam	SS	Sandstone	9.2	172	0.04		1.23	3.2	-1.98	2.61	NAF (Barren)
143	EB1440704127	847AMD	KC14044C	57.69	57.89	0.20	Floor	O seam	SS	Sandstone	6.7	364	0.38	0.072	2.21	12.9	-10.70	5.85	NAF (Barren)
144	EB1440704140	860AMD	KC14045C	46.61	46.81	0.20	Floor	N seam	SS	Sandstone	9.5	303	0.04		1.23	3.6	-2.38	2.94	NAF (Barren)
145	EB1440704142	862AMD	KC14045C	51.79	51.99	0.20	Floor	O seam	SS	Sandstone	8.4	304	0.09		2.76	5.1	-2.34	1.85	NAF (Barren)

Notes

1. Current pH, EC, Alkalinity and Acidity provided for 1:5 sample:water extracts
2. Scr = Chromium Reducible Sulfur; MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; and NAPP = Net Acid Producing Potential.
3. Sample classification detail provided in report text.

Table B2: Spoil Samples Selected for Additional Geochemical (Multi-Element) Tests

RGS Sample No.	ALS Laboratory Number	Client Sample ID	Drill Hole No.	Depth Interval (m)			Sample Type	Proximity to Coal Seam	Lith Code	Lithology Description	pH[1]	EC[1]	Total S	Scr[2]	MPA[2]	ANC[2]	NAPP[2]	ANC: MPA Ratio	Sample Classification[3]
				from	to	range						(µS/cm)	(%)		($kg\ H_2SO_4/t$)				
OVERBURDEN - SOIL																			
1	EB1440704004	404AMD	KC14031C	6.05	6.32	0.27	Subsoil	-	CL	Clay	5.5	823	0.05		1.53	7.9	-6.37	5.16	NAF (Barren)
OVERBURDEN - ROCK																			
2	EB1440704107	826AMD	KC14043C	3.00	4.00	1.00	Overburden	-	SS	Sandstone	5.1	416	0.04		1.23	0.3	0.98	0.20	NAF (Barren)
3	EB1440704118	838AMD	KC14044C	12.00	13.00	1.00	Overburden	-	SS	Sandstone	4.8	1,040	0.04		1.23	0.3	0.98	0.20	NAF (Barren)
4	EB1440704008	408AMD	KC14031C	14.10	14.42	0.32	Overburden	-	SS	Sandstone	8.0	822	0.03		0.92	9.3	-8.38	10.12	NAF (Barren)
5	EB1440704011	411AMD	KC14031C	20.35	20.55	0.20	Overburden	-	SS	Sandstone	9.2	606	0.03		0.92	109.0	-108.08	118.64	NAF (Barren)
6	EB1440704064	464AMD	KC14038C	26.50	26.70	0.20	Overburden	-	SS	Sandstone	9.5	482	0.04		1.23	16.8	-15.58	13.71	NAF (Barren)
7	EB1440704059	459AMD	KC14038C	8.81	9.01	0.20	Overburden	-	SL	Siltstone	5.5	228	0.03		0.92	0.3	0.67	0.27	NAF (Barren)
8	EB1440704023	423AMD	KC14036C	15.67	15.91	0.24	Overburden	-	CS	Claystone	8.5	745	0.07		2.14	7.2	-5.06	3.36	NAF (Barren)
9	EB1440704123	843AMD	KC14044C	38.00	38.99	0.99	Overburden	-	CS	Claystone	9.2	424	0.04		1.23	36.1	-34.88	29.47	NAF (Barren)
INTERBURDEN																			
10	EB1440704080	480AMD	KC14039C	36.98	37.19	0.21	Interburden	within N seam	CS	Claystone	9.8	412	0.03		0.92	19.6	-18.68	21.33	NAF (Barren)
ROOF																			
11	EB1440704135	855AMD	KC14045C	34.36	34.56	0.20	Roof	above M seam	SS	Sandstone	9.8	660	0.03		0.92	169.0	-168.08	183.95	NAF (Barren)
12	EB1440704043	443AMD	KC14037C	23.20	23.40	0.20	Roof	above M seam	CS	Claystone	8.0	665	0.07		2.14	8.9	-6.76	4.15	NAF (Barren)
PARTING																			
13	EB1440704031	431AMD	KC14036C	42.00	42.20	0.20	Parting	within N seam	SL	Siltstone	9.3	270	0.03		0.92	4.7	-3.78	5.12	NAF (Barren)
14	EB1440704048	448AMD	KC14037C	36.70	36.90	0.20	Parting	within N seam	SL	Siltstone	9.4	911	0.07		2.14	98.3	-96.16	45.85	NAF (Barren)
15	EB1440704079	479AMD	KC14039C	33.91	34.11	0.20	Parting	within M seam	CS	Claystone	9.3	378	0.03		0.92	6.0	-5.08	6.53	NAF (Barren)
16	EB1440704099	499AMD	KC14040C	51.10	51.30	0.20	Parting	within O seam	CS	Claystone	9.5	438	0.11	0.003	0.08	10.3	-10.22	134.53	NAF (Barren)
17	EB1440704138	858AMD	KC14045C	45.51	45.71	0.20	Parting	within N seam	CS	Claystone	9.2	392	0.04		1.23	5.5	-4.28	4.49	NAF (Barren)
FLOOR																			
18	EB1440704106	825AMD	KC14042C	47.19	47.39	0.20	Floor	below O seam	SS	Sandstone	9.1	252	0.13	0.033	1.01	3.8	-2.79	3.76	NAF (Barren)
19	EB1440704097	497AMD	KC14040C	41.66	41.86	0.20	Floor	below N seam	CS	Claystone	9.2	356	0.06		1.84	5.7	-3.86	3.10	NAF (Barren)

Notes

1. Current pH, EC, Alkalinity and Acidity provided for 1:5 sample:water extracts
2. Scr = Chromium Reducible Sulfur; MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; and NAPP = Net Acid Producing Potential.
3. Sample classification detail provided in report text.

Table B3: Multi-Element Test Results for Selected Spoil Materials

		Material Type →	Overburden									Interburden
		RGS Sample Number →	1	2	3	4	5	6	7	8	9	10
		ALS Laboratory ID →	EB1442332001	EB1442332026	EB1442332028	EB1442332002	EB1442332003	EB1442332015	EB1442332014	EB1442332005	EB1442332029	EB1442332019
		Lithology →	Clay	Sandstone	Sandstone	Sandstone	Sandstone	Sandstone	Siltstone	Claystone	Claystone	Claystone
		Sample IDs + depth interval →										
Parameters	Detection Limit	NEPC[1] Health-Based Investigation Level (HILs)-C	404AMD KC14031C 6.05-6.32m	826AMD KC14043C 3.00-4.00m	838AMD KC14044C 12.00-13.00m	408AMD KC14031C 14.10-14.42m	411AMD KC14031C 20.35-20.55m	464AMD KC14038C 26.50-26.70m	459AMD KC14038C 8.81-9.01m	423AMD KC14036C 15.67-15.91m	843AMD KC14044C 38.00-38.99m	480AMD KC14039C 36.98-37.19m
Major Elements	All units mg/kg											
Aluminium (Al)	50	-	8,040	3,450	6,120	7,670	5,610	7,860	7,980	5,440	5,990	6,580
Calcium (Ca)	50	-	270	90	520	2,640	9,400	7,260	60	1,290	15,200	7,920
Iron (Fe)	50	-	66,400	57,800	6,690	10,600	157,000	8,480	37,700	5,200	41,900	4,830
Magnesium (Mg)	50	-	2,340	490	2,220	4,070	3,600	3,880	1,140	2,720	3,890	3,720
Potassium (K)	50	-	300	70	310	860	550	350	230	1,010	1,010	630
Sodium (Na)	50	-	5,040	920	3,190	6,980	3,010	4,960	2,000	3,520	1,020	8,290
Minor Elements	All units mg/kg											
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic (As)	5	300	<5	<5	<5	<5	<5	11	<5	<5	<5	<5
Barium (Ba)	10	-	40	30	320	20	40	40	20	20	60	30
Beryllium (Be)	1	90	<1	<1	<1	1	1	<1	1	6	1	<1
Boron (B)	50	20,000	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium (Cr) - hexavalent	2	300 **	12	62	10	10	11	7	9	5	7	<2
Cobalt (Co)	2	300	7	<2	5	22	30	25	16	17	24	3
Copper (Cu)	5	17,000	8	<5	<5	24	19	31	9	28	36	39
Lead (Pb)	5	600	<5	<5	<5	13	8	10	7	12	17	26
Manganese (Mn)	5	19,000	34	24	24	111	3,040	352	355	34	1,050	13
Mercury (Hg)	0.1	80	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	1,200	5	<2	4	17	14	14	9	11	24	5
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Silver (Ag)	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Thallium (Tl)	0.1	-	0.1	<0.1	0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	<0.1
Thorium (Th)	0.1	-	3.2	3.1	0.9	3.8	2.3	4.6	1.2	4	4.6	6.1
Uranium (U)	0.1	-	0.1	0.2	<0.1	0.5	0.3	0.6	0.2	0.5	0.5	0.8
Vanadium (V)	5	-	88	197	19	43	98	25	48	16	46	<5
Zinc (Zn)	5	30,000	37	<5	32	51	62	140	37	157	102	48
Exchangable Cations	All units meq/100g (except Exchangable Sodium Percentage (%))											
Exch. Calcium	0.1	-	-	-	2.1	4.2	-	9.2	0.1	1.0	-	17.3
Exch. Magnesium	0.1	-	-	-	11.8	15.2	-	10.4	5.3	6.8	-	5.3
Exch. Potassium	0.1	-	-	-	0.2	0.4	-	0.4	0.1	0.5	-	0.5
Exch. Sodium	0.1	-	-	-	7.4	18.3	-	15.9	5.9	6.5	-	20.8
Cation Exchange Capacity	0.1	-	-	-	21.5	38.0	-	35.9	11.5	14.9	-	44.0
Calcium:Magnesium Ratio	-	-	-	-	0.18	0.28	-	0.88	0.02	0.15	-	3.26
Exchangable Sodium Percentage	0.1%	-	-	-	29.5	47.8	-	44.2	29.5	43.0	-	47.3

Notes: < indicates less than the laboratory limit of reporting. Shaded cells exceed applied guideline limit.

** Guideline level for Cr(VI) = 300 mg/kg. Guideline level for Cr(III) = 24% of total Cr.

1. NEPC (2013). National Environmental Protection Council (NEPC). *National Environmental Protection (Assessment of Site Contamination) Measure (NEPM)*, Amendment of Schedule B1-B7 of 1999 version. *Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use*.

Table B3: Multi-Element Test Results for Selected Spoil Materials

	Material Type →		Roof		Parting					Floor	
	RGS Sample Number →		**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
	ALS Laboratory ID →		EB1442332032	EB1442332011	EB1442332007	EB1442332012	EB1442332018	EB1442332023	EB1442332033	EB1442332025	EB1442332022
	Lithology →		Sandstone	Claystone	Siltstone	Siltstone	Claystone	Claystone	Claystone	Sandstone	Claystone
	Sample IDs + depth interval →										
Parameters	Detection Limit	NEPC[1] Health-Based Investigation Level (HILs)-C	855AMD KC14045C 34.36-34.56m	443AMD KC14037C 23.20-23.40m	431AMD KC14036C 42.00-42.20m	448AMD KC14037C 36.70-36.90m	479AMD KC14039C 33.91-34.11m	499AMD KC14040C 51.10-51.30m	858AMD KC14045C 45.51-45.71m	825AMD KC14042C 47.19-47.39m	497AMD KC14040C 41.66-41.86m
Major Elements	All units mg/kg										
Aluminium (Al)	50	-	4,110	5,690	4,580	4,950	3,830	6,600	4,240	3,310	7,020
Calcium (Ca)	50	-	29,500	1,290	1,370	32,300	2,200	4,030	2,170	1,430	1,690
Iron (Fe)	50	-	178,000	60,900	3,260	21,000	1,050	5,400	4,020	1,100	9,390
Magnesium (Mg)	50	-	9,680	3,420	1,470	8,980	1,220	2,740	1,240	820	2,650
Potassium (K)	50	-	240	940	1,020	530	1,080	710	1,100	850	870
Sodium (Na)	50	-	4,070	2,530	2,270	5,360	3,370	5,720	3,220	2,290	2,520
Minor Elements	All units mg/kg										
Antimony (Sb)	5	-	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic (As)	5	300	<5	<5	<5	<5	<5	<5	<5	<5	<5
Barium (Ba)	10	-	100	90	180	50	20	280	160	940	120
Beryllium (Be)	1	90	1	1	<1	<1	<1	1	<1	<1	<1
Boron (B)	50	20,000	<50	<50	<50	<50	<50	<50	<50	<50	<50
Cadmium (Cd)	1	90	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chromium (Cr) - hexavalent	2	300 **	8	4	4	<2	<2	4	<2	4	10
Cobalt (Co)	2	300	17	47	<2	<2	<2	3	<2	<2	3
Copper (Cu)	5	17,000	19	36	29	28	28	25	32	57	28
Lead (Pb)	5	600	8	10	18	13	24	21	19	21	15
Manganese (Mn)	5	19,000	4,460	3,390	30	142	<5	46	45	<5	76
Mercury (Hg)	0.1	80	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum (Mo)	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nickel (Ni)	2	1,200	11	15	<2	<2	<2	4	<2	<2	4
Selenium (Se)	5	700	<5	<5	<5	<5	<5	<5	<5	<5	<5
Silver (Ag)	2	-	<2	<2	<2	<2	<2	<2	<2	<2	<2
Thallium (Tl)	0.1	-	<0.1	<0.1	<0.1	0.2	0.1	<0.1	0.1	<0.1	0.1
Thorium (Th)	0.1	-	2.4	2.6	4.4	3.3	3.8	5.5	3.4	3.7	3.9
Uranium (U)	0.1	-	0.4	0.4	0.5	0.6	0.4	1	0.4	0.5	0.5
Vanadium (V)	5	-	78	27	11	6	11	27	12	21	18
Zinc (Zn)	5	30,000	91	53	19	<5	29	90	15	50	37
Exchangable Cations	All units meq/100g (except Exchangable Sodium Percentage (%))										
Exch. Calcium	0.1	-	-	0.9	4.7	32.5	-	-	-	-	-
Exch. Magnesium	0.1	-	-	7.2	1.3	5.0	-	-	-	-	-
Exch. Potassium	0.1	-	-	0.5	0.6	0.5	-	-	-	-	-
Exch. Sodium	0.1	-	-	5.3	5.2	12.7	-	-	-	-	-
Cation Exchange Capacity	0.1	-	-	13.9	11.8	50.7	-	-	-	-	-
Calcium:Magnesium Ratio	-	-	-	0.13	3.62	6.50	-	-	-	-	-
Exchangable Sodium Percentage	0.1%	-	-	37.5	43.4	24.9	-	-	-	-	-

Notes: < indicates less than the laboratory limit of reporting. Shaded cells exceed applied guideline limit.

** Guideline level for Cr(VI) = 300 mg/kg. Guideline level for Cr(III) = 24% of total Cr.

1. NEPC (2013). National Environmental Protection Council (NEPC). *National Environmental Protection (Assessment of Site Contamination) Measure (NEPM)*, Amendment of Schedule B1-B7 of 1999 version. *Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); public open spaces - recreational use*.

Table B4: Geochemical Abundance Index (GAI) Results for Selected Spoil Materials

		Material Type →	Overburden									Interburden
		RGS Sample Number →	1	2	3	4	5	6	7	8	9	10
		ALS Laboratory ID →	EB1442332001	EB1442332026	EB1442332028	EB1442332002	EB1442332003	EB1442332015	EB1442332014	EB1442332005	EB1442332029	EB1442332019
		Lithology →	Clay	Sandstone	Sandstone	Sandstone	Sandstone	Sandstone	Siltstone	Claystone	Claystone	Claystone
		Sample IDs + depth interval →										
Parameters	Detection Limit	Average Crustal Abundance[1]	404AMD KC14031C 6.05-6.32m	826AMD KC14043C 3.00-4.00m	838AMD KC14044C 12.00-13.00m	408AMD KC14031C 14.10-14.42m	411AMD KC14031C 20.35-20.55m	464AMD KC14038C 26.50-26.70m	459AMD KC14038C 8.81-9.01m	423AMD KC14036C 15.67-15.91m	843AMD KC14044C 38.00-38.99m	480AMD KC14039C 36.98-37.19m
Major Elements	All units in mg/kg		Geochemical Abundance Index									
Aluminium (Al)	50	71,000	0	0	0	0	0	0	0	0	0	0
Calcium (Ca)	50	15,000	0	0	0	0	0	0	0	0	0	0
Iron (Fe)	50	40,000	0	0	0	0	1	0	0	0	0	0
Magnesium (Mg)	50	5,000	0	0	0	0	0	0	0	0	0	0
Potassium (K)	50	14,000	0	0	0	0	0	0	0	0	0	0
Sodium (Na)	50	5,000	0	0	0	0	0	0	0	0	0	0
Minor Elements	All units in mg/kg		Geochemical Abundance Index									
Antimony (Sb)	5	5	0	0	0	0	0	0	0	0	0	0
Arsenic (As)	5	6	0	0	0	0	0	0	0	0	0	0
Barium (Ba)	10	500	0	0	0	0	0	0	0	0	0	0
Beryllium (Be)	1	6	0	0	0	0	0	0	0	0	0	0
Boron (B)	50	100	0	0	0	0	0	0	0	0	0	0
Cadmium (Cd)	1	0.35	0	0	0	0	0	0	0	0	0	0
Chromium (Cr)	2	70	0	0	0	0	0	0	0	0	0	0
Cobalt (Co)	2	8	0	0	0	1	1	1	0	1	1	0
Copper (Cu)	5	30	0	0	0	0	0	0	0	0	0	0
Lead (Pb)	5	35	0	0	0	0	0	0	0	0	0	0
Manganese (Mn)	5	1000	0	0	0	0	1	0	0	0	0	0
Mercury (Hg)	0.1	0.06	0	0	0	0	0	0	0	0	0	0
Molybdenum (Mo)	2	2	0	0	0	0	0	0	0	0	0	0
Nickel (Ni)	2	50	0	0	0	0	0	0	0	0	0	0
Selenium (Se)	5	0.4	0	0	0	0	0	0	0	0	0	0
Silver (Ag)	2	0.057	0	0	0	0	0	0	0	0	0	0
Thallium	0.1	0.95	0	0	0	0	0	0	0	0	0	0
Thorium (Th)	0.1	9	0	0	0	0	0	0	0	0	0	0
Uranium (U)	0.1	2	0	0	0	0	0	0	0	0	0	0
Vanadium (V)	5	90	0	1	0	0	0	0	0	0	0	0
Zinc (Zn)	5	90	0	0	0	0	0	0	0	0	0	0

Notes:
GAI's greater than or equal to 3 are highlighted.
1. Average Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
1. When no GARD Guide value is available for particular element, then values are taken from Bowen H.J.M.(1979) Environmental Chemistry of the Elements, Academic Press, New York, p42-43.

Table B4: Geochemical Abundance Index (GAI) Results for Selected Spoil Materials

	Material Type →		Roof		Parting					Floor	
	RGS Sample Number →		11	12	13	14	15	16	17	18	19
	ALS Laboratory ID →		EB1442332032	EB1442332011	EB1442332007	EB1442332012	EB1442332018	EB1442332023	EB1442332033	EB1442332025	EB1442332022
	Lithology →		Sandstone	Claystone	Siltstone	Siltstone	Claystone	Claystone	Claystone	Sandstone	Claystone
	Sample IDs + depth interval →										
Parameters	Detection Limit	Average Crustal Abundance[1]	855AMD KC14045C 34.36-34.56m	443AMD KC14037C 23.20-23.40m	431AMD KC14036C 42.00-42.20m	448AMD KC14037C 36.70-36.90m	479AMD KC14039C 33.91-34.11m	499AMD KC14040C 51.10-51.30m	858AMD KC14045C 45.51-45.71m	825AMD KC14042C 47.19-47.39m	497AMD KC14040C 41.66-41.86m
Major Elements	All units in mg/kg		Geochemical Abundance Index								
Aluminium (Al)	50	71,000	0	0	0	0	0	0	0	0	0
Calcium (Ca)	50	15,000	0	0	0	1	0	0	0	0	0
Iron (Fe)	50	40,000	2	0	0	0	0	0	0	0	0
Magnesium (Mg)	50	5,000	0	0	0	0	0	0	0	0	0
Potassium (K)	50	14,000	0	0	0	0	0	0	0	0	0
Sodium (Na)	50	5,000	0	0	0	0	0	0	0	0	0
Minor Elements	All units in mg/kg		Geochemical Abundance Index								
Antimony (Sb)	5	5	0	0	0	0	0	0	0	0	0
Arsenic (As)	5	6	0	0	0	0	0	0	0	0	0
Barium (Ba)	10	500	0	0	0	0	0	0	0	0	0
Beryllium (Be)	1	6	0	0	0	0	0	0	0	0	0
Boron (B)	50	100	0	0	0	0	0	0	0	0	0
Cadmium (Cd)	1	0.35	0	0	0	0	0	0	0	0	0
Chromium (Cr)	2	70	0	0	0	0	0	0	0	0	0
Cobalt (Co)	2	8	1	2	0	0	0	0	0	0	0
Copper (Cu)	5	30	0	0	0	0	0	0	0	0	0
Lead (Pb)	5	35	0	0	0	0	0	0	0	0	0
Manganese (Mn)	5	1000	2	1	0	0	0	0	0	0	0
Mercury (Hg)	0.1	0.06	0	0	0	0	0	0	0	0	0
Molybdenum (Mo)	2	2	0	0	0	0	0	0	0	0	0
Nickel (Ni)	2	50	0	0	0	0	0	0	0	0	0
Selenium (Se)	5	0.4	0	0	0	0	0	0	0	0	0
Silver (Ag)	2	0.057	0	0	0	0	0	0	0	0	0
Thallium	0.1	0.95	0	0	0	0	0	0	0	0	0
Thorium (Th)	0.1	9	0	0	0	0	0	0	0	0	0
Uranium (U)	0.1	2	0	0	0	0	0	0	0	0	0
Vanadium (V)	5	90	0	0	0	0	0	0	0	0	0
Zinc (Zn)	5	90	0	0	0	0	0	0	0	0	0

Notes:
GAI's greater than or equal to 3 are highlighted.
1. Average Crustal Abundance values sourced from the "GARD Guide", Chapter 5 (INAP, 2009).
1. When no GARD Guide value is available for particular element, then values are taken from Bowen H.J.M.(1979) Environmental Chemistry of the Elements, Academic Press, New York, p42-43.

Table B5: Multi-Element Results for Water Extracts from Selected Spoil Materials

			Material Type →	Overburden									Interburden
			RGS Sample Number →	1	2	7	3	4	5	6	8	9	10
			ALS Laboratory ID →	EB1442332001	EB1442332026	EB1442332014	EB1442332028	EB1442332002	EB1442332003	EB1442332015	EB1442332005	EB1442332029	EB1442332019
			Lithology →	Clay	Sandstone	Siltstone	Sandstone	Sandstone	Sandstone	Sandstone	Claystone	Claystone	Claystone
			Sample IDs + depth interval →	404AMD KC14031C 6.05-6.32m	826AMD KC14043C 3.00-4.00m	459AMD KC14038C 8.81-9.01m	838AMD KC14044C 12.00-13.00m	408AMD KC14031C 14.10-14.42m	411AMD KC14031C 20.35-20.55m	464AMD KC14038C 26.50-26.70m	423AMD KC14036C 15.67-15.91m	843AMD KC14044C 38.00-38.99m	480AMD KC14039C 36.98-37.19m
Parameters	Detection Limit	Water Quality Guidelines: Aquatic Ecosystems (freshwater)[1]	Water Quality Guidelines: Livestock Drinking Water[2]										
pH	0.01 pH unit	6 to 9	-	6.1	5.3	5.6	5.0	7.8	9.7	9.6	9.3	9.1	10.0
Electrical Conductivity	1 µS/cm	<1,000#	3,580^	727	369	251	925	542	628	452	821	390	587
Carbonate Alkalinity ($mgCaCO_3/L$)	0.2 mg/L	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	61	51	20	20	163
Bicarbonate Alkalinity ($mgCaCO_3/L$)	0.2 mg/L	-	-	23	3	77	5	128	250	234	133	204	260
Total Alkalinity ($mgCaCO_3/L$)	0.2 mg/L	-	-	23	3	77	5	128	312	286	153	224	424
Acidity ($mgCaCO_3/L$)	0.2 mg/L	-	-	38	2	5	2	2	<0.2	<0.2	<0.2	<0.2	<0.2
Net Alkalinity ($mgCaCO_3/L$)	0.2 mg/L	-	-	-15	0	72	3	125	312	286	153	224	424
Major Ions	All units mg/L												
Calcium (Ca)	2	-	1,000	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Magnesium (Mg)	2	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Potassium (K)	2	-	-	<2	<2	<2	<2	<2	<2	<2	4	6	<2
Sodium (Na)	2	-	-	142	82	42	188	148	142	84	172	94	<2
Chloride (Cl)	2	-	-	198	96	36	278	160	40	20	220	26	24
Fluoride (F)	0.2	-	2	<0.2	<0.2	<0.2	<0.2	1.0	0.4	1.4	3.0	0.8	0.6
Phosphate (PO_4)	0.06	-	-	<0.06	<0.06	<0.06	<0.06	0.61	0.86	4.29	2.45	0.18	0.18
Sulfate (SO_4)	2	-	1,000	60	54	42	72	60	12	52	74	28	<2
Trace Metals/Metalloids	All units mg/L												
Aluminium (Al)	0.02	0.055	5	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.800	<0.02	1.360
Antimony (Sb)	0.002	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	<0.002	0.002
Arsenic (As) - pentavalent	0.002	0.013 **	0.5	<0.002	<0.002	<0.002	<0.002	<0.002	0.032	0.642	0.080	0.016	0.032
Barium (Ba)	0.002	-	-	<0.002	0.012	<0.002	0.024	0.286	<0.002	<0.002	0.638	<0.002	0.406
Beryllium (Be)	0.002	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Boron (B)	0.2	0.37	5	<0.2	<0.2	<0.2	<0.2	0.40	<0.2	<0.2	<0.2	<0.2	<0.2
Cadmium (Cd)	0.002	0.0002	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium (Cr) - total	0.002	-	1 (total)	<0.002	<0.002	<0.002	<0.002	0.002	0.002	<0.002	0.004	<0.002	<0.002
Chromium (Cr) - (VI)*	0.0002	0.001 (hex)*	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Cobalt (Co)	0.002	-	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	<0.002	<0.002
Copper (Cu)	0.002	0.0014	1	<0.002	<0.002	<0.002	<0.002	0.034	<0.002	<0.002	0.004	<0.002	<0.002
Iron (Fe)	0.2	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Lead (Pb)	0.002	0.0034	0.1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Manganese (Mn)	0.002	1.90	-	<0.002	0.016	<0.002	0.002	0.004	<0.002	<0.002	0.004	<0.002	0.002
Mercury (Hg)	0.0001	0.0006	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum (Mo)	0.002	-	0.15	<0.002	<0.002	<0.002	<0.002	<0.002	0.028	0.112	0.042	0.044	0.026
Nickel (Ni)	0.002	0.011	1	<0.002	<0.002	<0.002	<0.002	0.020	<0.002	<0.002	<0.002	<0.002	<0.002
Selenium (Se)	0.02	0.011	0.020	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Silver (Ag)	0.002	0.00005	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Thallium	0.002	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Thorium (Th)	0.002	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Uranium (U)	0.002	-	0.2	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Vanadium (V)	0.02	-	-	<0.02	<0.02	<0.02	<0.02	0.02	0.12	0.08	0.18	0.04	0.06
Zinc (Zn)	0.01	0.008	20	<0.01	<0.01	<0.01	<0.01	0.054	<0.01	<0.01	0.072	<0.01	0.038

* Cr (VI) = hexavalent. ** 0.024 mg/Lfor trivalent Arsenic (III).
\# for still water bodies only, moving rivers at low flow rates should not exceed 2200µS/cm
^ calculated based on total dissolved solids (TDS) conversion rate of 0.67% of EC. TDS is an approximate measure of inorganic dissolved salts and should not exceed 2400mg/L for livestock drinking water.

Notes: < indicates concentration less than the detection limit. Shaded cells indicate values which exceed applied guideline values.
1. ANZECC & ARMCANZ (2000). Trigger values for aquatic ecosystems (95% species protection level)
2. ANZECC & ARMCANZ (2000). Recommended guideline limits for Livestock Drinking Water.
1 + 2. both taken from the "Australian and New Zealand Guidelines for Fresh and Marine Water Quality", National Water Quality Management Strategy, 2000, compilation by ANZECC and ARMCANZ.

Table B5: Multi-Element Results for Water Extracts from Selected Spoil Materials

			Material Type →	Roof		Parting					Floor	
			RGS Sample Number →	11	12	13	14	15	16	17	18	19
			ALS Laboratory ID →	EB1442332032	EB1442332011	EB1442332007	EB1442332012	EB1442332018	EB1442332023	EB1442332033	EB1442332025	EB1442332022
			Lithology →	Sandstone	Claystone	Siltstone	Siltstone	Claystone	Claystone	Claystone	Sandstone	Claystone
			Sample IDs + depth interval →	855AMD KC14045C 34.36-34.56m	443AMD KC14037C 23.20-23.40m	431AMD KC14036C 42.00-42.20m	448AMD KC14037C 36.70-36.90m	479AMD KC14039C 33.91-34.11m	499AMD KC14040C 51.10-51.30m	858AMD KC14045C 45.51-45.71m	825AMD KC14042C 47.19-47.39m	497AMD KC14040C 41.66-41.86m
		Water Quality Guidelines:										
Parameters	Detection Limit	Aquatic Ecosystems (freshwater)[1]	Livestock Drinking Water[2]									
pH	0.01 pH unit	6 to 9	-	9.7	8.1	9.5	9.6	9.5	9.5	9.3	9.1	9.2
Electrical Conductivity	1 µS/cm	<1,000[#]	3,580[^]	659	613	239	715	416	416	342	236	345
Carbonate Alkalinity (mg$CaCO_3$/L)	0.2 mg/L	-	-	71	<0.2	20	102	31	20	20	5	10
Bicarbonate Alkalinity (mg$CaCO_3$/L	0.2 mg/L	-	-	372	82	138	280	214	204	214	102	143
Total Alkalinity (mg$CaCO_3$/L)	0.2 mg/L	-	-	444	82	158	382	244	224	234	107	153
Acidity (mg$CaCO_3$/L)	0.2 mg/L	-	-	<0.2	5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Net Alkalinity (mg$CaCO_3$/L)	0.2 mg/L	-	-	444	77	158	382	244	224	234	107	153
Major Ions	All units mg/L											
Calcium (Ca)	2	-	1,000	<2	<2	<2	<2	<2	<2	<2	<2	<2
Magnesium (Mg)	2	-	-	<2	<2	<2	<2	<2	<2	<2	<2	<2
Potassium (K)	2	-	-	<2	2	<2	2	<2	2	<2	<2	2
Sodium (Na)	2	-	-	154	134	42	182	84	70	66	52	128
Chloride (Cl)	2	-	-	24	174	10	110	48	36	16	8	36
Fluoride (F)	0.2	-	2	0.4	1.0	0.4	0.6	0.4	0.4	0.4	0.4	0.4
Phosphate (PO_4)	0.06	-	-	0.61	0.12	0.31	0.06	0.31	0.25	0.31	0.43	0.18
Sulfate (SO_4)	2	-	1,000	22	26	10	18	18	20	12	46	52
Trace Metals/Metalloids	All units mg/L											
Aluminium (Al)	0.02	0.055	5	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Antimony (Sb)	0.002	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Arsenic (As) - pentavalent	0.002	0.013 **	0.5	0.066	0.006	0.026	0.004	0.032	0.090	0.022	0.060	0.036
Barium (Ba)	0.002	-	-	0.054	<0.002	0.004	0.146	0.046	0.062	<0.002	0.016	0.086
Beryllium (Be)	0.002	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Boron (B)	0.2	0.37	5	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.20
Cadmium (Cd)	0.002	0.0002	0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium (Cr) - total	0.002	-	1 (total)	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chromium (Cr) - (VI)*	0.0002	0.001 (hex)*	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Cobalt (Co)	0.002	-	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Copper (Cu)	0.002	0.0014	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Iron (Fe)	0.2	-	-	<0.2	<0.2	<0.2	<0.2	<0.2	0.20	<0.2	<0.2	0.20
Lead (Pb)	0.002	0.0034	0.1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Manganese (Mn)	0.002	1.90	-	<0.002	0.004	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Mercury (Hg)	0.0001	0.0006	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum (Mo)	0.002	-	0.15	0.040	0.014	0.008	0.008	0.010	0.020	0.018	0.010	0.018
Nickel (Ni)	0.002	0.011	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Selenium (Se)	0.02	0.011	0.020	<0.02	0.02	<0.02	<0.02	0.02	<0.02	0.02	0.02	<0.02
Silver (Ag)	0.002	0.00005	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Thallium	0.002	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Thorium (Th)	0.002	-	-	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Uranium (U)	0.002	-	0.2	<0.002	<0.002	<0.002	0.004	<0.002	<0.002	<0.002	<0.002	<0.002
Vanadium (V)	0.02	-	-	0.08	0.02	0.26	0.02	0.18	0.12	0.22	0.36	0.18
Zinc (Zn)	0.01	0.008	20	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

* Cr (VI) = hexavalent. ** 0.024 mg/Lfor trivalent Arsenic (III).
\# for still water bodies only, moving rivers at low flow rates should not exceed 2200µS/cm
^ calculated based on total dissolved solids (TDS) conversion rate of 0.67% of EC. TDS is an approximate measure of inorganic dissolved salts and should not exceed 2400mg/L for livestock drinking water.

Notes: < indicates concentration less than the detection limit. Shaded cells indicate values which exceed applied guideline values.
1. ANZECC & ARMCANZ (2000). Trigger values for aquatic ecosystems (95% species protection level)
2. ANZECC & ARMCANZ (2000). Recommended guideline limits for Livestock Drinking Water.
1 + 2. both taken from the "Australian and New Zealand Guidelines for Fresh and Marine Water Quality", National Water Quality Management Strategy, 2000, compilation by ANZECC and ARMCANZ.

Table B6: Multi-Element and Geochemical Abundance Index Results for Ash Materials

ALS Laboratory Number → / Material Description (as received) →		Multi-Element results			GAI results		
		EB1419070001	EB1419070002	NEPC[1] Health-Based Investigation Level (HILs-C)	Average Crustal Abundance[2]	Calculated Geochemical Abundance Index (GAI)[3]	
Analyte	LOR	ASH (wet)	ASH (dry)			ASH (wet)	ASH (dry)
Major Elements		all units in mg/kg				Geochemical Abundance Index	
Aluminium (Al)	50	31,600	25,800	-	71,000	0	0
Calcium (Ca)	50	29,700	24,400	-	15,000	0	0
Iron (Fe)	50	7,870	6,440	-	40,000	0	0
Magnesium (Mg)	50	890	770	-	5,000	0	0
Potassium (K)	50	2,490	2,130	-	14,000	0	0
Sodium (Na)	50	2,850	2,160	-	5,000	0	0
Alkalinity and Acidity		all units in mg/kg					
Carbonate Alkalinity as $CaCO_3$	1	536	408	-	-	-	-
Bicarbonate Alkalinity as $CaCO_3$	1	<1	<1	-	-	-	-
Total Alkalinity as $CaCO_3$	1	1,850	1,330	-	-	-	-
Acidity as $CaCO_3$	1	<1	<1	-	-	-	-
Net Alkalinity as $CaCO_3$	1	1,850	1,330	-	-	-	-
Nutrients		all units in mg/kg				Geochemical Abundance Index	
Ammonia as N	20	<20	<20	-	-	-	-
Nitrate (NO_3)	0.1	1.33	1.33	-	-	-	-
Nitrite (NO_2)	0.1	0.99	0.66	-	-	-	-
Nitrate + Nitrite as N (NOX) **	0.1	0.6	0.5	-	-	-	-
Total Kjeldahl Nitrogen (TKN)	20	<20	60	-	-	-	-
Total Nitrogen as N (TKN + NOX)	20	<20	60	-	470	0	0
Total Cyanide	1	<1	<1	240 @	-	-	-
Total Phosphorus as P	2	195	401	-	800	0	0
Total Organic Carbon (TOC)	0.2	3,200	3,300	-	29,400	0	0
Minor Elements		all units in mg/kg				Geochemical Abundance Index	
Antimony (Sb)	5	<5	<5	-	5	0	0
Arsenic (As)	5	9	9	300	6	0	0
Barium (Ba)	10	570	470	-	500	0	0
Beryllium (Be)	1	1	1	90	6	0	0
Boron (B)	50	100	80	20,000	100	0	0
Cadmium (Cd)	1	<1	<1	90	0.35	0	0
Chromium (Cr - total) #	2	135	117	- #	70	0	0
Cobalt (Co)	2	6	5	300	8	0	0
Copper (Cu)	5	17	14	17,000	30	0	0
Lead (Pb)	5	15	13	600	35	0	0
Manganese (Mn)	5	177	137	19,000	1,000	0	0
Mercury (Hg) - inorganic	0.1	0.2	0.1	80	0.06	1	0
Molybdenum (Mo)	2	6	5	-	2	1	1
Nickel (Ni)	2	6	4	1,200	50	0	0
Selenium (Se)	5	<5	<5	700	0.4	0	0
Silver (Ag)	2	<2	<2	-	0.057	0	0
Thallium (Tl)	0.1	0.2	0.1	-	0.95	0	0
Thorium (Th)	0.1	6.6	5.7	-	9	0	0
Uranium (U)	0.1	2.7	2.3	-	2	0	0
Vanadium (V)	5	88	73	-	90	0	0
Zinc (Zn)	5	34	29	30,000	90	0	0

Notes: LOR = limit of reporting (all units in mg/kg)

1. NEPC (2013). National Environmental Protection Council (NEPC). *National Environmental Protection (Assessment of Site Contamination) Measure (NEPM)* , Amendment of Schedule B1-B7 of 1999 version. *Guideline on Investigation Levels for Soil and Groundwater. Health-Based Investigation Level - HIL(C); generic land use - recreational public open spaces.*

2. Crustal Abundance values sourced from the "Gard Guide", chapter 5 (INAP, 2009). Where no Gard Guide value is available for a particular element, then values were taken from Bowen H.J.M.(1979) Environmental Chemistry of the Elements, Academic Press, New York, p42-43.

3. GAI's greater than or equal to 3 are highlighted.

** calculated based on stoichiometric conversion factor:
1 mg/L of Nitrate as N = 4.43 mg/L of Nitrate (NO_3); and 1 mg/L of Nitrite as N = 3.29 mg/L of Nitrite (NO_2).

valence state not distinguished for total Cr, but NEPC HILs-C guideline values are 300 mg/kg (Cr- hexavalent), 24% of total Cr (trivalent)

@ up to 1,000 mg/kg for complex forms of cyanide.

Table B7: Multi-Element Results for Water Extracts from Ash Materials

Material Description (as received) →			ASH (wet)	ASH (dry)	Guideline Limits / Trigger Values	
ALS Laboratory Number →			EB1419070003	EB1419070004	Aquatic Ecosystems (95% species protection)[1]	Livestock Drinking Water[2]
Analyte	LOR	Units				
Physico-Chemical						
Moisture Content (dried at 103°C)	1	%	28.4	14.2	-	-
Total Dissolved Solids @ 180°C	10	mg/L	245	231	-	2,400
pH (1:5 sample:DI water)	0.01	ph unit	11.3	11.3	6 to 9	-
Electrical Conductivity at 25°C (1:5)	1	µs/cm	727	668	<1,000[@]	3,580[^]
Alkalinity and Acidity						
Hydroxide Alkalinity as $CaCO_3$	1	mg/L	134	123	-	-
Carbonate Alkalinity as $CaCO_3$	1	mg/L	48	56	-	-
Bicarbonate Alkalinity as $CaCO_3$	1	mg/L	<1	<1	-	-
Total Alkalinity as $CaCO_3$	1	mg/L	181	179	-	-
Acidity as $CaCO_3$	1	mg/L	<1	<1	-	-
Net Alkalinity as $CaCO_3$	1	mg/L	181	179	-	-
Leachable Ions						
Calcium (Ca)	1	mg/L	59	58	-	1,000
Magnesium (Mg)	1	mg/L	<1	<1	-	-
Potassium (K)	1	mg/L	2	1	-	-
Sodium (Na)	1	mg/L	48	40	-	-
Sulfate (SO_4)	1	mg/L	9	11	-	1,000
Fluoride (F)	0.1	mg/L	1.2	1.1	-	2
Chloride (Cl)	1	mg/L	34	27	-	-
Nutrients						
Ammonia as N	0.01	mg/L	0.07	0.01	0.9	-
Nitrate + Nitrite as N (NOX) **	0.01	mg/L	0.02	0.02	0.16	99.41
Total Kjeldahl Nitrogen (TKN)	0.1	mg/L	<0.1	<0.1	-	-
Total Nitrogen as N (TKN + NOX)	0.1	mg/L	<0.1	<0.1	-	-
Total Cyanide	0.004	mg/L	<0.004	<0.004	0.007	-
Total Phosphorus as P	0.01	mg/L	0.02	0.08	-	-
Metals and Metalloids						
Aluminium (Al)	0.01	mg/L	8.80	7.54	0.055	5
Antimony (Sb)	0.001	mg/L	0.002	0.003	-	-
Arsenic (As) - pentavalent	0.001	mg/L	0.007	0.009	0.013 *	0.5
Barium (Ba)	0.001	mg/L	0.793	0.559	-	-
Beryllium (Be)	0.001	mg/L	<0.001	<0.001	-	-
Boron (B)	0.05	mg/L	0.22	0.59	0.37	5
Cadmium (Cd)	0.0001	mg/L	<0.0001	<0.0001	0.0002	0.01
Chromium (Cr - total)	0.001	mg/L	0.020	0.033	-	1
Chromium VI (hexavalent)	0.001	mg/L	0.024	0.031	0.001 *	-
Cobalt (Co)	0.001	mg/L	<0.001	<0.001	-	1
Copper (Cu)	0.001	mg/L	0.001	<0.001	0.0014	1
Iron (Fe)	0.05	mg/L	<0.05	<0.05	-	1 [2]
Lead (Pb)	0.001	mg/L	<0.001	<0.001	0.0034	0.1
Manganese (Mn)	0.001	mg/L	<0.001	<0.001	1.9	2 [2]
Mercury (Hg) - inorganic	0.0001	mg/L	<0.0001	<0.0001	0.0006	0.002
Molybdenum (Mo)	0.001	mg/L	0.133	0.119	-	0.15
Nickel (Ni)	0.001	mg/L	<0.001	<0.001	0.011	1
Selenium (Se)	0.01	mg/L	<0.01	0.01	0.011	0.02
Silver (Ag)	0.001	mg/L	<0.001	<0.001	0.00005	-
Thallium	0.001	mg/L	<0.001	<0.001	-	-
Thorium (Th)	0.001	mg/L	<0.001	<0.001	-	-
Uranium (U)	0.001	mg/L	<0.001	<0.001	-	0.2
Vanadium (V)	0.01	mg/L	0.22	0.26	-	-
Zinc (Zn)	0.005	mg/L	0.030	0.035	0.008	20
Radionuclides - Bq/L						
Gross Alpha Activity	0.05	Bq/L	<0.05	<0.05	-	0.5
Gross Beta Activity (exc. K-40) [#]	0.10	Bq/L	<0.10	<0.10	-	0.5

Notes: # Gross Beta Activity results exclude Potassium-40, ie. results are "K^{40} corrected").
LOR = limit of reporting (all units in mg/kg). * Cr (VI) = hexavalent. * 0.024 mg/Lfor trivalent Arsenic (III)

1. ANZECC & ARMCANZ (2000). Trigger values for aquatic ecosystems (95% species protection level)
2. ANZECC & ARMCANZ (2000). Recommended guideline limits for Livestock Drinking Water (irrigation values used for Fe and Mn).

** calculated based on stoichiometric conversion factor:
1 mg/L of Nitrate as N = 4.43 mg/L of Nitrate (NO_3); and 1 mg/L of Nitrite as N = 3.29 mg/L of Nitrite (NO_2).

@ for still water bodies only, moving rivers at low flow rates should not exceed 2200µS/cm

^ calculated based on total dissolved solids (TDS) conversion rate of 0.67% of EC. TDS is an approximate measure of inorganic dissolved salts and should not exceed 2,400mg/L for livestock drinking water.

Table B8: Samples Selected for Kinetic Leach Column (KLC) Tests

KLC Sample No.	ALS Laboratory Number	Client Sample ID	Drill Hole No.	Depth Interval (m)			Sample Type	Proximity to Coal Seam	Lith Code	Lithology Description	pH[1]	EC[1]	Total S	Scr[2]	MPA[2]	ANC[2]	NAPP[2]	ANC: MPA Ratio	Sample Classification[3]
				from	to	range						(µS/cm)	(%)		(kg H_2SO_4/t)				
Ash Material																			
1	EB1419070002	Kogan Creek Ash - DRY		- N/A -			Dried Ash (14.2% moisture)		- N/A -		11.6	1,170	0.04	0.003	0.08	41.2	-41.1	538.1	NAF (Barren)
Overburden, Interburden, Parting/Roof/Floor																			
2	EB1440704060	460AMD	KC14038C	13.59	13.79	0.20	Overburden	-	SS	Sandstone	5.7	149	0.03		0.92	0.3	0.67	0.27	NAF (Barren)
	EB1440704061	461AMD	KC14038C	17.10	17.30	0.20	Overburden	-	SS	Sandstone	6.5	156	0.03		0.92	2.2	-1.28	2.39	NAF (Barren)
	EB1440704062	462AMD	KC14038C	22.20	22.40	0.20	Overburden	-	SS	Sandstone	7.2	112	0.02		0.61	9.0	-8.39	14.69	NAF (Barren)
	EB1440704063	463AMD	KC14038C	23.77	23.97	0.20	Overburden	-	SS	Sandstone	7.2	201	0.02		0.61	11.7	-11.09	19.10	NAF (Barren)
	EB1440704064	464AMD	KC14038C	26.50	26.70	0.20	Overburden	-	SS	Sandstone	9.5	482	0.04		1.23	16.8	-15.58	13.71	NAF (Barren)
	EB1440704102	819AMD	KC14042C	6.00	13.00	2.00	Overburden	-	SS	Sandstone	5.0	830	0.06		1.84	0.3	1.59	0.14	NAF (Barren)
	EB1440704143	821AMD	KC14042C	16.00	17.00	1.00	Overburden	-	SS	Sandstone	9.7	1,160	0.08		2.45	17.2	-14.75	7.02	NAF (Barren)
	EB1440704103	820AMD	KC14042C	23.00	24.00	1.00	Overburden	-	SS	Sandstone	5.9	795	0.03		0.92	2.6	-1.68	2.83	NAF (Barren)
	EB1440704144	822AMD	KC14042C	32.54	32.74	0.20	Overburden	-	SS	Sandstone	8.6	177	0.03		0.92	6.5	-5.58	7.07	NAF (Barren)
	EB1440704104	823AMD	KC14042C	33.20	33.40	0.20	Roof	above M seam	SS	Sandstone	8.9	200	0.04		1.23	5.6	-4.38	4.57	NAF (Barren)
3	EB1440704006	406AMD	KC14031C	8.50	9.03	0.53	Overburden	-	SL	Siltstone	5.8	849	0.05		1.53	7.1	-5.57	4.64	NAF (Barren)
	EB1440704009	409AMD	KC14031C	15.72	15.97	0.25	Overburden	-	SL	Siltstone	9.3	561	0.04		1.23	13.0	-11.78	10.61	NAF (Barren)
	EB1440704010	410AMD	KC14031C	16.41	16.68	0.27	Overburden	-	SL	Siltstone	8.6	442	0.06		1.84	10.8	-8.96	5.88	NAF (Barren)
	EB1440704065	465AMD	KC14038C	29.36	29.50	0.14	Overburden	-	SL	Siltstone	9.3	373	0.03		0.92	10.5	-9.58	11.43	NAF (Barren)
	EB1440704066	466AMD	KC14038C	36.09	36.29	0.20	Overburden	-	SL	Siltstone	8.4	240	0.04		1.23	6.9	-5.68	5.63	NAF (Barren)
	EB1440704025	425AMD	KC14036C	25.78	25.98	0.20	Interburden	inbetween K and M	SL	Siltstone	8.1	490	0.04		1.23	48.5	-47.28	39.59	NAF (Barren)
	EB1440704113	832AMD	KC14043C	39.84	40.04	0.20	Interburden	inbetween K and M	SL	Siltstone	8.5	228	0.04		1.23	7.9	-6.68	6.45	NAF (Barren)
	EB1440704145	833AMD	KC14043C	40.16	40.36	0.20	Roof	above M seam	SL	Siltstone	9.1	508	0.06		1.84	185.0	-183.16	100.68	NAF (Barren)
	EB1440704015	415AMD	KC14031C	42.53	42.76	0.23	Parting	within N seam	SL	Siltstone	9.2	385	0.03		0.92	5.5	-4.58	5.99	NAF (Barren)
	EB1440704031	431AMD	KC14036C	42.00	42.20	0.20	Parting	within N seam	SL	Siltstone	9.3	270	0.03		0.92	4.7	-3.78	5.12	NAF (Barren)
4	EB1440704073	473AMD	KC14039C	12.00	13.00	1.00	Overburden	-	CS	Claystone	5.3	1,510	0.06		1.84	1.2	0.64	0.65	NAF (Barren)
	EB1440704074	474AMD	KC14039C	14.00	15.55	1.55	Overburden	-	CS	Claystone	8.3	705	0.14	0.095	2.91	5.3	-2.39	1.82	NAF (Barren)
	EB1440704075	475AMD	KC14039C	17.70	17.90	0.20	Overburden	-	CS	Claystone	7.8	569	0.04		1.23	11.4	-10.18	9.31	NAF (Barren)
	EB1440704076	476AMD	KC14039C	23.79	23.99	0.20	Interburden	inbetween K and M	CS	Claystone	7.2	544	0.10		3.06	7.6	-4.54	2.48	NAF (Barren)
	EB1440704080	480AMD	KC14039C	36.98	37.19	0.21	Interburden	within N seam	CS	Claystone	9.8	412	0.03		0.92	19.6	-18.68	21.33	NAF (Barren)
	EB1440704077	477AMD	KC14039C	25.50	25.70	0.20	Roof	above M seam	CS	Claystone	8.3	509	0.05		1.53	7.0	-5.47	4.57	NAF (Barren)
	EB1440704078	478AMD	KC14039C	33.36	33.56	0.20	Parting	within M seam	CS	Claystone	9.1	428	0.04		1.23	6.3	-5.08	5.14	NAF (Barren)
	EB1440704079	479AMD	KC14039C	33.91	34.11	0.20	Parting	within M seam	CS	Claystone	9.3	378	0.03		0.92	6.0	-5.08	6.53	NAF (Barren)
	EB1440704081	481AMD	KC14039C	38.65	38.85	0.20	Parting	within N seam	CS	Claystone	9.3	306	0.04		1.23	5.8	-4.58	4.73	NAF (Barren)
	EB1440704083	483AMD	KC14039C	45.79	45.99	0.20	Parting	within O seam	CS	Claystone	9.2	430	0.12	0.02	0.61	9.9	-9.29	16.16	NAF (Barren)
	EB1440704084	484AMD	KC14039C	48.25	48.45	0.20	Floor	below O seam	CS	Claystone	9.5	395	0.04		1.23	8.0	-6.78	6.53	NAF (Barren)
Mixed Spoil																			
5	KLC 2 = approx. 34% by wt (kg)			details as listed above					SS	Sandstone	5.9	426	0.04	-	1.16	7.2	-6.05	6.20	NAF (Barren)
	KLC 3 = approx. 33% by wt (kg)			details as listed above					SL	Siltstone	6.8	435	0.04	-	1.29	30.0	-28.70	23.32	NAF (Barren)
	KLC 4 = approx. 33% by wt (kg)			details as listed above					CS	Claystone	6.3	562	0.06	0.05	1.52	8.0	-6.49	5.28	NAF (Barren)

Table B8: Samples Selected for Kinetic Leach Column (KLC) Tests

KLC Sample No.	ALS Laboratory Number	Client Sample ID	Drill Hole No.	Depth Interval (m) from	to	range	Sample Type	Proximity to Coal Seam	Lith Code	Lithology Description	pH[1]	EC[1] (µS/cm)	Total S (%)	Scr[2] (%)	MPA[2] (kg H_2SO_4/t)	ANC[2] (kg H_2SO_4/t)	NAPP[2] (kg H_2SO_4/t)	ANC: MPA Ratio	Sample Classification[3]
Mixed Spoil + Ash material																			
6	ratio of 1:1 ash-to-spoil		KLC 5	50% by wt (kg)			Over/Inter-burden, Parting/Roof/Floor			mixed rock	6.2	477	0.05	0.043	1.33	14.8	-13.51	11.17	NAF (Barren)
			KLC 1	50% by wt (kg)			Kogan Creek Ash - DRY		(14.2% moisture)		11.6	1,170	0.04	0.003	0.08	41.2	-41.1	538.1	NAF (Barren)
7	ratio of 1:5 ash-to-spoil		KLC 5	83% by wt (kg)			Over/Inter-burden, Parting/Roof/Floor			mixed rock	6.2	477	0.05	0.043	1.33	14.8	-13.51	11.17	NAF (Barren)
			KLC 1	17% by wt (kg)			Kogan Creek Ash - DRY		(14.2% moisture)		11.6	1,170	0.04	0.003	0.08	41.2	-41.1	538.1	NAF (Barren)
8	ratio of 1:10 ash-to-spoil		KLC 5	91% by wt (kg)			Over/Inter-burden, Parting/Roof/Floor			mixed rock	6.2	477	0.05	0.043	1.33	14.8	-13.51	11.17	NAF (Barren)
			KLC 1	9% by wt (kg)			Kogan Creek Ash - DRY		(14.2% moisture)		11.6	1,170	0.04	0.003	0.08	41.2	-41.1	538.1	NAF (Barren)
9	ratio of 1:20 ash-to-spoil		KLC 5	95% by wt (kg)			Over/Inter-burden, Parting/Roof/Floor			mixed rock	6.2	477	0.05	0.043	1.33	14.8	-13.51	11.17	NAF (Barren)
			KLC 1	5% by wt (kg)			Kogan Creek Ash - DRY		(14.2% moisture)		11.6	1,170	0.04	0.003	0.08	41.2	-41.1	538.1	NAF (Barren)

Notes

1. Current pH, EC, Alkalinity and Acidity provided for 1:5 sample:water extracts
2. Scr = Chromium Reducible Sulfur; MPA = Maximum Potential Acidity; ANC = Acid Neutralising Capacity; and NAPP = Net Acid Producing Potential.
3. Sample classification detail provided in report text.

Attachment C

ALS Laboratory Data (Certificates of Analysis)

CERTIFICATE OF ANALYSIS

Work Order	: **EB1440704**	Page	: 1 of 31
Amendment	: **1**		
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services EB
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: alan@rgsenv.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 07 3344 1222	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3344 1222	Facsimile	: +61-7-3243 7218
Project	: CS Energy Kogan Creek (RGS code 201407)	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 16-Aug-2014 10:00
Sampler	: ALAN ROBERTSON	Issue Date	: 11-Sep-2014 16:53
Site	: ----		
		No. of samples received	: 145
Quote number	: ----	No. of samples analysed	: 145

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics
Greg Vogel	Laboratory Manager	Brisbane Inorganics
Satishkumar Trivedi	2 IC Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- **ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.**
- **This report has been amended following changes to the analytical data reported. The quality system is being utilised to resolve this issue. The specific data affected includes the pH result for sample 436AMD.**

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	401AMD KC14031C	402AMD KC14031C	403AMD KC14031C	404AMD KC14031C	405AMD KC14031C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	*CAS Number*	*LOR*	*Unit*	EB1440704-001	EB1440704-002	EB1440704-003	EB1440704-004	EB1440704-005
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**7.4**	**5.5**	**5.2**	**5.5**	**5.5**
EA009: Nett Acid Production Potential								
^ **Acid Production Potential (APP)**	----	0.5	kg H2SO4/t	**0.6**	**0.6**	**1.5**	**1.5**	**2.8**
^ **Net Acid Production Potential**	----	0.5	kg H2SO4/t	**0.00**	**-0.8**	**-2.0**	**-6.4**	**-5.0**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**330**	**731**	**792**	**823**	**924**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**0.9**	**1.5**	**3.6**	**7.9**	**7.7**
^ **ANC as CaCO3**	----	0.1	% CaCO3	<0.1	**0.2**	**0.4**	**0.8**	**0.8**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.02**	**0.02**	**0.05**	**0.05**	**0.09**

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	406AMD KC14031C	407AMD KC14031C	408AMD KC14031C	409AMD KC14031C	410AMD KC14031C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-006	EB1440704-007	EB1440704-008	EB1440704-009	EB1440704-010
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.8	6.5	8.0	9.3	8.6
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	1.5	0.6	0.9	1.2	1.8
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-5.5	-8.8	-8.4	-11.8	-9.1
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	849	837	822	561	442
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	7.1	9.6	9.3	13.0	10.8
^ ANC as CaCO3	----	0.1	% CaCO3	0.7	1.0	0.9	1.3	1.1
Fizz Rating	----	0	Fizz Unit	0	0	0	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.05	0.02	0.03	0.04	0.06

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

			Client sample ID	411AMD KC14031C	412AMD KC14031C	413AMD KC14031C	414AMD KC14031C	415AMD KC14031C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-011	EB1440704-012	EB1440704-013	EB1440704-014	EB1440704-015
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.2	9.6	9.4	9.6	9.2
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	0.9	0.6	0.6	1.2	0.9
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-108	-76.6	-92.1	-102	-4.6
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	606	760	723	726	385
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	109	77.3	92.9	103	5.5
^ ANC as CaCO3	----	0.1	% CaCO3	11.1	7.9	9.5	10.5	0.6
Fizz Rating	----	0	Fizz Unit	3	2	2	2	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.02	0.02	0.04	0.03

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

			Client sample ID	416AMD KC14031C	417AMD KC14031C	418AMD KC14036C	419AMD KC14036C	420AMD KC14036C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-016	EB1440704-017	EB1440704-018	EB1440704-019	EB1440704-020
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.3	8.9	5.3	5.3	5.4
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	1.8	5.5	1.2	1.2	1.2
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-4.3	0.9	0.9	1.4	0.00
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	511	319	781	1160	1340
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	6.0	4.8	0.5	<0.5	1.8
^ ANC as CaCO3	----	0.1	% CaCO3	0.6	0.5	<0.1	<0.1	0.2
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.06	0.18	0.04	0.04	0.04

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	421AMD KC14036C	422AMD KC14036C	423AMD KC14036C	424AMD KC14036C	425AMD KC14036C
Client sampling date / time				[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1440704-021	EB1440704-022	EB1440704-023	EB1440704-024	EB1440704-025
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.2	8.6	8.5	9.0	8.1
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	0.9	1.8	2.1	5.2	1.2
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-3.3	-0.7	-4.9	-2.9	-47.4
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	1270	1370	745	560	490
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	4.3	2.4	7.2	8.2	48.5
^ ANC as CaCO3	----	0.1	% CaCO3	0.4	0.2	0.7	0.8	5.0
Fizz Rating	----	0	Fizz Unit	0	0	0	0	2
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.06	0.07	0.17	0.04

Analytical Results

Sub-Matrix: **ROCK**
(Matrix: **SOIL**)

			Client sample ID	426AMD KC14036C	427AMD KC14036C	428AMD KC14036C	429AMD KC14036C	430AMD KC14036C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-026	EB1440704-027	EB1440704-028	EB1440704-029	EB1440704-030
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.2	9.2	9.3	9.1	9.2
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	1.5	1.2	0.9	0.9	2.4
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-6.3	-6.6	-10.8	-5.0	-6.8
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	478	370	360	344	326
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	7.8	7.6	11.8	6.0	9.2
^ ANC as CaCO3	----	0.1	% CaCO3	0.8	0.8	1.2	0.6	0.9
Fizz Rating	----	0	Fizz Unit	1	0	1	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.05	0.04	0.03	0.03	0.08

Analytical Results

Sub-Matrix: **ROCK**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	431AMD KC14036C [16-Aug-2014] EB1440704-031 Result	432AMD KC14036C [16-Aug-2014] EB1440704-032 Result	433AMD KC14036C [16-Aug-2014] EB1440704-033 Result	434AMD KC14036C [16-Aug-2014] EB1440704-034 Result	435AMD KC14036C [16-Aug-2014] EB1440704-035 Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.3	8.3	8.8	9.4	8.5
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	0.9	5.2	4.9	1.8	3.1
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-3.8	-3.6	-1.5	-5.8	-4.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	270	345	269	399	190
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	4.7	8.7	6.4	7.6	7.2
^ ANC as CaCO3	----	0.1	% CaCO3	0.5	0.9	0.6	0.8	0.7
Fizz Rating	----	0	Fizz Unit	0	0	0	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.17	0.16	0.06	0.10

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	436AMD KC14036C	437AMD KC14037C	438AMD KC14037C	439AMD KC14037C	440AMD KC14037C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-036	EB1440704-037	EB1440704-038	EB1440704-039	EB1440704-040
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.1	7.5	5.4	5.0	5.9
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	0.6	0.9	1.2	1.5	9.8
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-5.3	-4.1	1.3	-1.3	6.4
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	209	568	922	2380	1320
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	6.0	5.0	<0.5	3.0	3.4
^ ANC as CaCO3	----	0.1	% CaCO3	0.6	0.5	<0.1	0.3	0.3
Fizz Rating	----	0	Fizz Unit	1	0	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.03	0.04	0.05	0.32

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	441AMD KC14037C	442AMD KC14037C	443AMD KC14037C	444AMD KC14037C	445AMD KC14037C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-041	EB1440704-042	EB1440704-043	EB1440704-044	EB1440704-045
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.0	8.9	8.0	9.0	8.8
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	1.8	1.5	2.1	1.2	1.2
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-4.5	-7.3	-6.8	-3.5	-4.2
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	791	812	665	413	469
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	6.4	8.9	8.9	4.7	5.4
^ ANC as CaCO3	----	0.1	% CaCO3	0.6	0.9	0.9	0.5	0.6
Fizz Rating	----	0	Fizz Unit	0	0	1	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.06	0.05	0.07	0.04	0.04

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	446AMD KC14037C	447AMD KC14037C	448AMD KC14037C	449AMD KC14037C	450AMD KC14037C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-046	EB1440704-047	EB1440704-048	EB1440704-049	EB1440704-050
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.2	9.0	9.4	9.6	8.5
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	1.2	1.5	2.1	2.8	4.9
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-7.1	-5.8	-96.1	-7.7	0.6
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	449	390	911	772	528
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	8.2	7.3	98.3	10.5	4.5
^ ANC as CaCO3	----	0.1	% CaCO3	0.8	0.7	10.0	1.1	0.4
Fizz Rating	----	0	Fizz Unit	0	1	2	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.04	0.05	0.07	0.09	0.16

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	451AMD KC14037C	452AMD KC14037C	453AMD KC14037C	454AMD KC14037C	455AMD KC14037C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-051	EB1440704-052	EB1440704-053	EB1440704-054	EB1440704-055
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.0	9.2	9.8	9.1	9.6
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	1.5	0.9	0.6	0.9	0.9
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-5.1	-5.3	-9.8	-6.2	-7.1
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	479	379	631	436	460
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	6.6	6.2	10.5	7.0	8.1
^ ANC as CaCO3	----	0.1	% CaCO3	0.7	0.6	1.1	0.7	0.8
Fizz Rating	----	0	Fizz Unit	1	0	0	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.05	0.03	0.02	0.03	0.03

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	456AMD KC14038C	457AMD KC14038C	458AMD KC14038C	459AMD KC14038C	460AMD KC14038C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-056	EB1440704-057	EB1440704-058	EB1440704-059	EB1440704-060
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**5.4**	**5.7**	**5.3**	**5.5**	**5.7**
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	**0.6**	**0.6**	**0.6**	**0.9**	**0.9**
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	**0.7**	**0.7**	**0.7**	**0.8**	**1.0**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**293**	**244**	**288**	**228**	**149**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	<0.5	<0.5	<0.5	<0.5
^ ANC as CaCO3	----	0.1	% CaCO3	<0.1	<0.1	<0.1	<0.1	<0.1
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.02**	**0.02**	**0.02**	**0.03**	**0.03**

Analytical Results

Sub-Matrix: **ROCK**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	461AMD KC14038C	462AMD KC14038C	463AMD KC14038C	464AMD KC14038C	465AMD KC14038C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1440704-061	EB1440704-062	EB1440704-063	EB1440704-064	EB1440704-065
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.5	7.2	7.2	9.5	9.3
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	0.9	0.6	0.6	1.2	0.9
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-1.4	-8.5	-11.2	-15.5	-9.6
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	156	112	201	482	373
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.2	9.0	11.7	16.8	10.5
^ ANC as CaCO3	----	0.1	% CaCO3	0.2	0.9	1.2	1.7	1.1
Fizz Rating	----	0	Fizz Unit	0	0	1	1	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.02	0.02	0.04	0.03

Analytical Results

Sub-Matrix: **ROCK**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	466AMD KC14038C	467AMD KC14038C	468AMD KC14038C	469AMD KC14038C	470AMD KC14039C
Client sampling date / time				[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1440704-066	EB1440704-067	EB1440704-068	EB1440704-069	EB1440704-070
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.4	8.3	9.2	9.0	7.2
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	1.2	3.1	1.2	14.4	0.9
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-5.6	-4.5	-169	9.0	-0.5
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	240	205	463	344	223
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	6.9	7.4	170	5.3	1.4
^ ANC as CaCO3	----	0.1	% CaCO3	0.7	0.8	17.4	0.5	0.1
Fizz Rating	----	0	Fizz Unit	1	0	3	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.04	0.10	0.04	0.47	0.03

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	471AMD KC14039C	472AMD KC14039C	473AMD KC14039C	474AMD KC14039C	475AMD KC14039C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-071	EB1440704-072	EB1440704-073	EB1440704-074	EB1440704-075
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.6	5.4	5.3	8.3	7.8
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	0.9	1.2	1.8	4.3	1.2
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	0.8	1.3	0.7	-0.9	-10.2
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	377	234	1510	705	569
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	<0.5	1.2	5.3	11.4
^ ANC as CaCO3	----	0.1	% CaCO3	<0.1	<0.1	0.1	0.5	1.2
Fizz Rating	----	0	Fizz Unit	0	0	0	0	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.04	0.06	0.14	0.04

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	476AMD KC14039C	477AMD KC14039C	478AMD KC14039C	479AMD KC14039C	480AMD KC14039C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-076	EB1440704-077	EB1440704-078	EB1440704-079	EB1440704-080
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	7.2	8.3	9.1	9.3	9.8
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	3.1	1.5	1.2	0.9	0.9
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-4.4	-5.5	-5.1	-5.0	-18.7
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	544	509	428	378	412
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	7.6	7.0	6.3	6.0	19.6
^ ANC as CaCO3	----	0.1	% CaCO3	0.8	0.7	0.6	0.6	2.0
Fizz Rating	----	0	Fizz Unit	1	1	0	0	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.10	0.05	0.04	0.03	0.03

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	481AMD KC14039C	482AMD KC14039C	483AMD KC14039C	454AMD KC14039C	485AMD KC14040C
Client sampling date / time				[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1440704-081	EB1440704-082	EB1440704-083	EB1440704-084	EB1440704-085
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.3	9.6	9.2	9.5	5.7
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	1.2	2.4	3.7	1.2	0.6
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-4.6	-198	-6.3	-6.7	0.7
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	306	549	430	395	682
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	5.8	201	9.9	8.0	<0.5
^ ANC as CaCO3	----	0.1	% CaCO3	0.6	20.5	1.0	0.8	<0.1
Fizz Rating	----	0	Fizz Unit	0	3	0	1	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.04	0.08	0.12	0.04	0.02

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	486AMD KC14040C	487AMD KC14040C	488AMD KC14040C	489AMD KC14040C	490AMD KC14040C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-086	EB1440704-087	EB1440704-088	EB1440704-089	EB1440704-090
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.2	8.7	9.4	8.7	9.2
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	1.2	0.9	1.2	1.2	1.5
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	1.2	-2.4	-6.6	-4.4	-3.3
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	1980	1030	528	429	544
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	3.3	7.9	5.7	4.9
^ ANC as CaCO3	----	0.1	% CaCO3	<0.1	0.3	0.8	0.6	0.5
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.04	0.03	0.04	0.04	0.05

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	491AMD KC14040C	492AMD KC14040C	493AMD KC14040C	494AMD KC14040C	495AMD KC14040C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-091	EB1440704-092	EB1440704-093	EB1440704-094	EB1440704-095
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**9.4**	**9.6**	**9.2**	**9.6**	**8.9**
EA009: Nett Acid Production Potential								
^ **Acid Production Potential (APP)**	----	0.5	kg H2SO4/t	**0.9**	**0.9**	**2.1**	**1.8**	**12.2**
^ **Net Acid Production Potential**	----	0.5	kg H2SO4/t	**-4.2**	**-6.9**	**-5.8**	**-7.4**	**-5.2**
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**429**	**344**	**426**	**741**	**398**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**5.1**	**7.7**	**7.8**	**9.2**	**17.3**
^ **ANC as CaCO3**	----	0.1	% CaCO3	**0.5**	**0.8**	**0.8**	**0.9**	**1.8**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**1**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.03**	**0.03**	**0.07**	**0.06**	**0.40**

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	496AMD KC14040C	497AMD KC14040C	498AMD KC14040C	499AMD KC14040C	500AMD KC14040C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-096	EB1440704-097	EB1440704-098	EB1440704-099	EB1440704-100
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.8	9.2	9.9	9.5	9.9
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	2.1	1.8	1.2	3.4	0.9
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-7.9	-3.7	-9.8	-6.8	-7.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	580	356	662	438	510
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	10.0	5.7	11.1	10.3	7.8
^ ANC as CaCO3	----	0.1	% CaCO3	1.0	0.6	1.1	1.0	0.8
Fizz Rating	----	0	Fizz Unit	0	0	1	0	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.07	0.06	0.04	0.11	0.03

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	818AND KC14042C	819AMD KC14042C	820AMD KC14042C	823AMD KC14042C	824AMD KC14042C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-101	EB1440704-102	EB1440704-103	EB1440704-104	EB1440704-105
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.5	5.0	5.9	8.9	9.3
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	0.9	1.8	0.9	1.2	3.1
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	2.0	-1.8	-4.5	-2.2
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	1050	830	795	200	400
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	0.9	<0.5	2.6	5.6	5.2
^ ANC as CaCO3	----	0.1	% CaCO3	<0.1	<0.1	0.3	0.6	0.5
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.06	0.03	0.04	0.10

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	825AMD KC14042C	826AMD KC14043C	827AMD KC14043C	828AMD KC14043C	829AMD KC14043C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-106	EB1440704-107	EB1440704-108	EB1440704-109	EB1440704-110
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.1	5.1	5.1	9.4	9.3
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	4.0	1.2	1.2	3.1	2.1
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	1.1	1.1	1.7	-13.9
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	252	416	521	373	608
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	3.8	<0.5	<0.5	1.3	16.0
^ ANC as CaCO3	----	0.1	% CaCO3	0.4	<0.1	<0.1	0.1	1.6
Fizz Rating	----	0	Fizz Unit	0	0	0	0	1
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.13	0.04	0.04	0.10	0.07

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

			Client sample ID	830AMD KC14043C	831AMD KC14043C	AMD832 KC14043C	834AMD KC14043C	835AMD KC14043C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-111	EB1440704-112	EB1440704-113	EB1440704-114	EB1440704-115
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.3	9.7	8.5	8.3	9.2
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	2.1	1.5	1.2	2.4	1.2
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-21.6	-6.6	-6.6	-7.1	-2.2
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	604	489	228	317	172
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	23.7	8.2	7.9	9.4	3.2
^ ANC as CaCO3	----	0.1	% CaCO3	2.4	0.8	0.8	1.0	0.3
Fizz Rating	----	0	Fizz Unit	1	0	1	1	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.07	0.05	0.04	0.08	0.04

Analytical Results

Sub-Matrix: **ROCK**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	836AMD KC140044C	837AMD KC140044C	838AMD KC140044C	839AMD KC140044C	840AMD KC140044C
Client sampling date / time				[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1440704-116	EB1440704-117	EB1440704-118	EB1440704-119	EB1440704-120
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.3	4.6	4.8	5.3	8.6
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	0.6	0.9	1.2	1.2	1.5
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	0.7	0.8	1.3	1.4	-1.8
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	321	1190	1040	903	850
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	<0.5	<0.5	<0.5	3.2
^ ANC as CaCO3	----	0.1	% CaCO3	<0.1	<0.1	<0.1	<0.1	0.3
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.03	0.04	0.04	0.05

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	841AMD KC140044C	842AMD KC140044C	843AMD KC140044C	844AMD KC140044C	845AMD KC140044C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-121	EB1440704-122	EB1440704-123	EB1440704-124	EB1440704-125
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.0	9.1	9.2	8.8	8.6
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	1.8	1.5	1.2	1.2	1.8
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-8.8	-30.7	-35.0	-85.6	-4.2
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	457	572	424	331	249
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	10.5	32.1	36.1	86.8	6.1
^ ANC as CaCO3	----	0.1	% CaCO3	1.1	3.3	3.7	8.8	0.6
Fizz Rating	----	0	Fizz Unit	1	2	2	2	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.06	0.05	0.04	0.04	0.06

Analytical Results

Sub-Matrix: **ROCK**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	846AMD KC140044C	847AMD KC140044C	848AMD KC14045C	849AMD KC14045C	850AMD KC14045C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1440704-126	EB1440704-127	EB1440704-128	EB1440704-129	EB1440704-130
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.4	6.7	4.8	4.8	5.7
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	10.4	11.6	2.1	1.5	0.9
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	-1.4	2.0	1.6	1.0
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	498	364	1390	1310	800
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	9.9	12.9	<0.5	<0.5	<0.5
^ ANC as CaCO3	----	0.1	% CaCO3	1.0	1.3	<0.1	<0.1	<0.1
Fizz Rating	----	0	Fizz Unit	0	1	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.34	0.38	0.07	0.05	0.03

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	851AMD KC14045C	852AMD KC14045C	853AMD KC14045C	854AMD KC14045C	855AMD KC14045C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1440704-131	EB1440704-132	EB1440704-133	EB1440704-134	EB1440704-135
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.5	9.8	9.6	9.9	9.8
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	1.8	0.9	1.2	0.9	0.9
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	-12.3	-32.5	-75.0	-168
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	998	507	651	706	660
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	1.7	13.1	33.6	75.9	169
^ ANC as CaCO3	----	0.1	% CaCO3	0.2	1.3	3.4	7.7	17.2
Fizz Rating	----	0	Fizz Unit	0	1	2	2	3
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.06	0.03	0.04	0.03	0.03

Analytical Results

Sub-Matrix: ROCK
(Matrix: SOIL)

			Client sample ID	856AMD KC14045C	AMD857 KC14045C	858AMD KC14045C	859AMD KC14045C	860AMD KC14045C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-136	EB1440704-137	EB1440704-138	EB1440704-139	EB1440704-140
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.1	9.3	9.2	9.4	9.5
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	1.8	1.2	1.2	0.9	1.2
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-5.7	-100	-4.4	-3.4	-2.5
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	413	588	392	384	303
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	7.4	101	5.5	4.4	3.6
^ ANC as CaCO3	----	0.1	% CaCO3	0.8	10.4	0.6	0.4	0.4
Fizz Rating	----	0	Fizz Unit	0	3	0	0	0
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.06	0.04	0.04	0.03	0.04

Analytical Results

Sub-Matrix: ROCK (Matrix: SOIL)			Client sample ID	861AMD KC14045C	862AMD KC14045C	821AMD KC14042C	822AMD KC14042C	AMD833 KC14043C
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1440704-141	EB1440704-142	EB1440704-143	EB1440704-144	EB1440704-145
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	9.1	8.4	9.7	8.6	9.1
EA009: Nett Acid Production Potential								
^ Acid Production Potential (APP)	----	0.5	kg H2SO4/t	3.1	2.8	2.4	0.9	1.8
^ Net Acid Production Potential	----	0.5	kg H2SO4/t	-6.0	-2.3	-14.6	-5.7	-183
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	388	304	1160	177	508
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	9.0	5.1	17.2	6.5	185
^ ANC as CaCO3	----	0.1	% CaCO3	0.9	0.5	1.8	0.7	18.9
Fizz Rating	----	0	Fizz Unit	0	0	1	0	3
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.10	0.09	0.08	0.03	0.06

CERTIFICATE OF ANALYSIS

Work Order	: **EB1442332**	Page	: 1 of 27
Amendment	: **1**		
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services EB
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
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Telephone	: +61 07 3344 1222	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3344 1222	Facsimile	: +61-7-3243 7218
Project	: 201407	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 11-Sep-2014 14:22
C-O-C number	: ----	Date Analysis Commenced	: 16-Sep-2014
Sampler	: ----	Issue Date	: 06-Nov-2014 14:55
Site	: ----		
		No. of samples received	: 33
Quote number	: ----	No. of samples analysed	: 33

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Matheson	Senior Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics
Satishkumar Trivedi	2 IC Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- **ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl (Method 15G1) is a more suitable method for the determination of exchange acidity (H+ + Al3+).**
- **LOR raised due to matrix interference.**
- **This report has been amended and re-released to allow the reporting of additional analytical data.**

Analytical Results

Sub-Matrix: **DI WATER LEACHATE**
(Matrix: **WATER**)

			Client sample ID	404AMD KC14031C 6.05-6.32m EB1440704-004	408AMD KC14031C 14.10-14.42m EB1440704-008	411AMD KC14031C 20.35-20.55m EB1440704-011	423AMD KC14036C 15.67-15.91m EB1440704-023	431AMD KC14036C 42.00-42.20m EB1440704-031
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-001	EB1442332-002	EB1442332-003	EB1442332-005	EB1442332-007
				Result	Result	Result	Result	Result
EG050G LL: Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	<0.001	<0.100	<0.001	<0.001	<0.001

Analytical Results

Sub-Matrix: **DI WATER LEACHATE**
(Matrix: **WATER**)

			Client sample ID	443AMD KC14037C 23.20-23.40m EB1440704-043	448AMD KC14037C 36.70-36.90m EB1440704-048	459AMD KC14038C 8.81-9.01m EB1440704-059	464AMD KC14038C 26.50-26.70m EB1440704-064	479AMD KC14039C 33.91-34.11m EB1440704-079
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-011	EB1442332-012	EB1442332-014	EB1442332-015	EB1442332-018
				Result	Result	Result	Result	Result
EG050G LL: Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Client sample ID	480AMD KC14039C 36.98-37.19m EB1440704-080	497AMD KC14040C 41.66-41.86m EB1440704-097	499AMD KC14040C 51.10-51.30m EB1440704-099	825AMD KC14042C 47.19-47.39m EB1440704-106	826AMD KC14043C 3.00-4.00m EB1440704-107
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-019	EB1442332-022	EB1442332-023	EB1442332-025	EB1442332-026
				Result	Result	Result	Result	Result
EG050G LL: Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Client sample ID	838AMD KC14044C 12.00-13.00m EB1440704-118	843AMD KC14044C 38.00-38.99m EB1440704-123	855AMD KC14045C 34.36-34.56m EB1440704-135	858AMD KC14045C 45.51-45.71m EB1440704-138	----
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	----
Compound	CAS Number	LOR	Unit	EB1442332-028	EB1442332-029	EB1442332-032	EB1442332-033	--------
				Result	Result	Result	Result	Result
EG050G LL: Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	404AMD KC14031C 6.05-6.32m EB1440704-004	408AMD KC14031C 14.10-14.42m EB1440704-008	411AMD KC14031C 20.35-20.55m EB1440704-011	417AMD KC14031C 46.19-46.39m EB1440704-017	423AMD KC14036C 15.67-15.91m EB1440704-023
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-001	EB1442332-002	EB1442332-003	EB1442332-004	EB1442332-005
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	6.1	7.8	9.7	----	9.3
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	727	542	628	----	821
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	----	----	0.074	----
ED008: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	----	4.2	----	----	1.0
^ Exchangeable Magnesium	----	0.1	meq/100g	----	15.2	----	----	6.8
^ Exchangeable Potassium	----	0.1	meq/100g	----	0.4	----	----	0.5
^ Exchangeable Sodium	----	0.1	meq/100g	----	18.3	----	----	6.5
^ Cation Exchange Capacity	----	0.1	meq/100g	----	38.0	----	----	14.9
^ Exchangeable Sodium Percent	----	0.1	%	----	47.8	----	----	43.0
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	115	638	1560	----	765
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	115	638	1250	----	663
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	<1	306	----	102
ED038A: Acidity								
Acidity	----	1	mg/kg	189	12	<1	----	<1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	300	300	60	----	370
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	990	800	200	----	1100
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	<10	----	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	<10	----	<10
Sodium	7440-23-5	10	mg/kg	710	740	710	----	860
Potassium	7440-09-7	10	mg/kg	<10	<10	<10	----	20
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	5040	6980	3010	----	3520
Potassium	7440-09-7	50	mg/kg	300	860	550	----	1010
Calcium	7440-70-2	50	mg/kg	270	2640	9400	----	1290
Magnesium	7439-95-4	50	mg/kg	2340	4070	3600	----	2720
EG005S : Soluble Metals by ICPAES								

Analytical Results

Sub-Matrix: PULP
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	404AMD KC14031C 6.05-6.32m EB1440704-004	408AMD KC14031C 14.10-14.42m EB1440704-008	411AMD KC14031C 20.35-20.55m EB1440704-011	417AMD KC14031C 46.19-46.39m EB1440704-017	423AMD KC14036C 15.67-15.91m EB1440704-023
Client sampling date / time				[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1442332-001	EB1442332-002	EB1442332-003	EB1442332-004	EB1442332-005
				Result	Result	Result	Result	Result
EG005S : Soluble Metals by ICPAES - Continued								
Boron	7440-42-8	1	mg/kg	<1	**2**	<1	----	<1
Iron	7439-89-6	1	mg/kg	<1	<1	<1	----	<1
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**8040**	**7670**	**5610**	----	**5440**
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	----	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	----	<5
Barium	7440-39-3	10	mg/kg	**40**	**20**	**40**	----	**20**
Beryllium	7440-41-7	1	mg/kg	<1	**1**	**1**	----	**6**
Boron	7440-42-8	50	mg/kg	<50	<50	<50	----	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	----	<1
Chromium	7440-47-3	2	mg/kg	**12**	**10**	**11**	----	**5**
Cobalt	7440-48-4	2	mg/kg	**7**	**22**	**30**	----	**17**
Copper	7440-50-8	5	mg/kg	**8**	**24**	**19**	----	**28**
Iron	7439-89-6	50	mg/kg	**66400**	**10600**	**157000**	----	**5200**
Lead	7439-92-1	5	mg/kg	<5	**13**	**8**	----	**12**
Manganese	7439-96-5	5	mg/kg	**34**	**111**	**3040**	----	**34**
Molybdenum	7439-98-7	2	mg/kg	<2	<2	<2	----	<2
Nickel	7440-02-0	2	mg/kg	**5**	**17**	**14**	----	**11**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	----	<5
Silver	7440-22-4	2	mg/kg	<2	<2	<2	----	<2
Vanadium	7440-62-2	5	mg/kg	**88**	**43**	**98**	----	**16**
Zinc	7440-66-6	5	mg/kg	**37**	**51**	**62**	----	**157**
EG020S: Soluble Metals by ICPMS								
Arsenic	7440-38-2	0.01	mg/kg	<0.01	<0.01	**0.16**	----	**0.40**
Selenium	7782-49-2	0.1	mg/kg	<0.1	<0.1	<0.1	----	<0.1
Silver	7440-22-4	0.01	mg/kg	<0.01	<0.01	<0.01	----	<0.01
Barium	7440-39-3	0.01	mg/kg	<0.01	**1.43**	<0.01	----	**3.19**
Thallium	7440-28-0	0.01	mg/kg	<0.01	<0.01	<0.01	----	<0.01
Beryllium	7440-41-7	0.01	mg/kg	<0.01	<0.01	<0.01	----	<0.01
Cadmium	7440-43-9	0.01	mg/kg	<0.01	<0.01	<0.01	----	<0.01
Cobalt	7440-48-4	0.01	mg/kg	<0.01	<0.01	<0.01	----	**0.01**
Chromium	7440-47-3	0.01	mg/kg	<0.01	**0.01**	**0.01**	----	**0.02**
Thorium	7440-29-1	0.01	mg/kg	<0.01	<0.01	<0.01	----	<0.01
Copper	7440-50-8	0.01	mg/kg	<0.01	**0.17**	<0.01	----	**0.02**

Analytical Results

Sub-Matrix: PULP
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	404AMD KC14031C 6.05-6.32m EB1440704-004	408AMD KC14031C 14.10-14.42m EB1440704-008	411AMD KC14031C 20.35-20.55m EB1440704-011	417AMD KC14031C 46.19-46.39m EB1440704-017	423AMD KC14036C 15.67-15.91m EB1440704-023
Client sampling date / time				[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1442332-001	EB1442332-002	EB1442332-003	EB1442332-004	EB1442332-005
				Result	Result	Result	Result	Result
EG020S: Soluble Metals by ICPMS - Continued								
Manganese	7439-96-5	0.01	mg/kg	<0.01	**0.02**	<0.01	----	**0.02**
Molybdenum	7439-98-7	0.01	mg/kg	<0.01	<0.01	**0.14**	----	**0.21**
Nickel	7440-02-0	0.01	mg/kg	<0.01	**0.10**	<0.01	----	<0.01
Lead	7439-92-1	0.01	mg/kg	<0.01	<0.01	<0.01	----	**0.01**
Antimony	7440-36-0	0.01	mg/kg	<0.01	<0.01	<0.01	----	**0.01**
Uranium	7440-61-1	0.01	mg/kg	<0.01	<0.01	<0.01	----	<0.01
Zinc	7440-66-6	0.05	mg/kg	<0.05	**0.27**	<0.05	----	**0.36**
Vanadium	7440-62-2	0.1	mg/kg	<0.1	**0.1**	**0.6**	----	**0.9**
Aluminium	7429-90-5	0.1	mg/kg	<0.1	<0.1	<0.1	----	**4.0**
EG020T: Total Metals by ICP-MS								
Thallium	7440-28-0	0.1	mg/kg	**0.1**	**0.1**	<0.1	----	**0.1**
Thorium	7440-29-1	0.1	mg/kg	**3.2**	**3.8**	**2.3**	----	**4.0**
Uranium	7440-61-1	0.1	mg/kg	**0.1**	**0.5**	**0.3**	----	**0.5**
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	<0.0005	<0.0005	<0.0005	----	<0.0005
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	----	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	<1	**5**	**2**	----	**15**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	**1.0**	**1.4**	----	**4.0**

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	424AMD KC14036C 20.40-20.60m EB1440704-024	431AMD KC14036C 42.00-42.20m EB1440704-031	432AMD KC14036C 45.31-45.56m EB1440704-032	433AMD KC14036C 46.48-46.64m EB1440704-033	440AMD KC14037C 14.74-15.04m EB1440704-040
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-006	EB1442332-007	EB1442332-008	EB1442332-009	EB1442332-010
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	----	9.5	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	239	----	----	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.166	----	0.072	0.129	0.039
ED008: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	----	4.7	----	----	----
^ Exchangeable Magnesium	----	0.1	meq/100g	----	1.3	----	----	----
^ Exchangeable Potassium	----	0.1	meq/100g	----	0.6	----	----	----
^ Exchangeable Sodium	----	0.1	meq/100g	----	5.2	----	----	----
^ Cation Exchange Capacity	----	0.1	meq/100g	----	11.8	----	----	----
^ Exchangeable Sodium Percent	----	0.1	%	----	43.4	----	----	----
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	----	791	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	----	689	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	----	102	----	----	----
ED038A: Acidity								
Acidity	----	1	mg/kg	----	<1	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	50	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	50	----	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	----	<10	----	----	----
Magnesium	7439-95-4	10	mg/kg	----	<10	----	----	----
Sodium	7440-23-5	10	mg/kg	----	210	----	----	----
Potassium	7440-09-7	10	mg/kg	----	<10	----	----	----
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	----	2270	----	----	----
Potassium	7440-09-7	50	mg/kg	----	1020	----	----	----
Calcium	7440-70-2	50	mg/kg	----	1370	----	----	----
Magnesium	7439-95-4	50	mg/kg	----	1470	----	----	----
EG005S : Soluble Metals by ICPAES								

Analytical Results

Sub-Matrix: PULP
(Matrix: SOIL)

			Client sample ID	424AMD KC14036C 20.40-20.60m EB1440704-024	431AMD KC14036C 42.00-42.20m EB1440704-031	432AMD KC14036C 45.31-45.56m EB1440704-032	433AMD KC14036C 46.48-46.64m EB1440704-033	440AMD KC14037C 14.74-15.04m EB1440704-040
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-006	EB1442332-007	EB1442332-008	EB1442332-009	EB1442332-010
				Result	Result	Result	Result	Result
EG005S : Soluble Metals by ICPAES - Continued								
Boron	7440-42-8	1	mg/kg	----	<1	----	----	----
Iron	7439-89-6	1	mg/kg	----	<1	----	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	**4580**	----	----	----
Antimony	7440-36-0	5	mg/kg	----	<5	----	----	----
Arsenic	7440-38-2	5	mg/kg	----	<5	----	----	----
Barium	7440-39-3	10	mg/kg	----	**180**	----	----	----
Beryllium	7440-41-7	1	mg/kg	----	<1	----	----	----
Boron	7440-42-8	50	mg/kg	----	<50	----	----	----
Cadmium	7440-43-9	1	mg/kg	----	<1	----	----	----
Chromium	7440-47-3	2	mg/kg	----	**4**	----	----	----
Cobalt	7440-48-4	2	mg/kg	----	<2	----	----	----
Copper	7440-50-8	5	mg/kg	----	**29**	----	----	----
Iron	7439-89-6	50	mg/kg	----	**3260**	----	----	----
Lead	7439-92-1	5	mg/kg	----	**18**	----	----	----
Manganese	7439-96-5	5	mg/kg	----	**30**	----	----	----
Molybdenum	7439-98-7	2	mg/kg	----	<2	----	----	----
Nickel	7440-02-0	2	mg/kg	----	<2	----	----	----
Selenium	7782-49-2	5	mg/kg	----	<5	----	----	----
Silver	7440-22-4	2	mg/kg	----	<2	----	----	----
Vanadium	7440-62-2	5	mg/kg	----	**11**	----	----	----
Zinc	7440-66-6	5	mg/kg	----	**19**	----	----	----
EG020S: Soluble Metals by ICPMS								
Arsenic	7440-38-2	0.01	mg/kg	----	**0.13**	----	----	----
Selenium	7782-49-2	0.1	mg/kg	----	<0.1	----	----	----
Silver	7440-22-4	0.01	mg/kg	----	<0.01	----	----	----
Barium	7440-39-3	0.01	mg/kg	----	**0.02**	----	----	----
Thallium	7440-28-0	0.01	mg/kg	----	<0.01	----	----	----
Beryllium	7440-41-7	0.01	mg/kg	----	<0.01	----	----	----
Cadmium	7440-43-9	0.01	mg/kg	----	<0.01	----	----	----
Cobalt	7440-48-4	0.01	mg/kg	----	<0.01	----	----	----
Chromium	7440-47-3	0.01	mg/kg	----	<0.01	----	----	----
Thorium	7440-29-1	0.01	mg/kg	----	<0.01	----	----	----
Copper	7440-50-8	0.01	mg/kg	----	<0.01	----	----	----

Analytical Results

Sub-Matrix: PULP
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	424AMD KC14036C 20.40-20.60m EB1440704-024	431AMD KC14036C 42.00-42.20m EB1440704-031	432AMD KC14036C 45.31-45.56m EB1440704-032	433AMD KC14036C 46.48-46.64m EB1440704-033	440AMD KC14037C 14.74-15.04m EB1440704-040
Client sampling date / time				[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1442332-006	EB1442332-007	EB1442332-008	EB1442332-009	EB1442332-010
				Result	Result	Result	Result	Result
EG020S: Soluble Metals by ICPMS - Continued								
Manganese	7439-96-5	0.01	mg/kg	----	<0.01	----	----	----
Molybdenum	7439-98-7	0.01	mg/kg	----	**0.04**	----	----	----
Nickel	7440-02-0	0.01	mg/kg	----	<0.01	----	----	----
Lead	7439-92-1	0.01	mg/kg	----	<0.01	----	----	----
Antimony	7440-36-0	0.01	mg/kg	----	<0.01	----	----	----
Uranium	7440-61-1	0.01	mg/kg	----	<0.01	----	----	----
Zinc	7440-66-6	0.05	mg/kg	----	<0.05	----	----	----
Vanadium	7440-62-2	0.1	mg/kg	----	**1.3**	----	----	----
Aluminium	7429-90-5	0.1	mg/kg	----	<0.1	----	----	----
EG020T: Total Metals by ICP-MS								
Thallium	7440-28-0	0.1	mg/kg	----	<0.1	----	----	----
Thorium	7440-29-1	0.1	mg/kg	----	**4.4**	----	----	----
Uranium	7440-61-1	0.1	mg/kg	----	**0.5**	----	----	----
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	----	<0.0005	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	<0.1	----	----	----
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	----	**2**	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	----	**0.5**	----	----	----

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	443AMD KC14037C 23.20-23.40m EB1440704-043	448AMD KC14037C 36.70-36.90m EB1440704-048	450AMD KC14037C 38.40-38.60m EB1440704-050	459AMD KC14038C 8.81-9.01m EB1440704-059	464AMD KC14038C 26.50-26.70m EB1440704-064
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-011	EB1442332-012	EB1442332-013	EB1442332-014	EB1442332-015
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	8.1	9.6	----	5.6	9.6
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	613	715	----	251	452
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	----	0.078	----	----
ED008: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	0.9	32.5	----	0.1	9.2
^ Exchangeable Magnesium	----	0.1	meq/100g	7.2	5.0	----	5.3	10.4
^ Exchangeable Potassium	----	0.1	meq/100g	0.5	0.5	----	0.1	0.4
^ Exchangeable Sodium	----	0.1	meq/100g	5.3	12.7	----	5.9	15.9
^ Cation Exchange Capacity	----	0.1	meq/100g	13.9	50.7	----	11.5	35.9
^ Exchangeable Sodium Percent	----	0.1	%	37.5	24.9	----	29.5	44.2
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	408	1910	----	383	1430
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	408	1400	----	383	1170
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	510	----	<1	255
ED038A: Acidity								
Acidity	----	1	mg/kg	24	<1	----	24	<1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	130	90	----	210	260
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	870	550	----	180	100
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	<10	----	<10	<10
Magnesium	7439-95-4	10	mg/kg	<10	<10	----	<10	<10
Sodium	7440-23-5	10	mg/kg	670	910	----	210	420
Potassium	7440-09-7	10	mg/kg	10	10	----	<10	<10
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	2530	5360	----	2000	4960
Potassium	7440-09-7	50	mg/kg	940	530	----	230	350
Calcium	7440-70-2	50	mg/kg	1290	32300	----	60	7260
Magnesium	7439-95-4	50	mg/kg	3420	8980	----	1140	3880
EG005S : Soluble Metals by ICPAES								

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	443AMD KC14037C 23.20-23.40m EB1440704-043	448AMD KC14037C 36.70-36.90m EB1440704-048	450AMD KC14037C 38.40-38.60m EB1440704-050	459AMD KC14038C 8.81-9.01m EB1440704-059	464AMD KC14038C 26.50-26.70m EB1440704-064
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-011	EB1442332-012	EB1442332-013	EB1442332-014	EB1442332-015
				Result	Result	Result	Result	Result
EG005S : Soluble Metals by ICPAES - Continued								
Boron	7440-42-8	1	mg/kg	<1	<1	----	<1	<1
Iron	7439-89-6	1	mg/kg	<1	<1	----	<1	<1
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**5690**	**4950**	----	**7980**	**7860**
Antimony	7440-36-0	5	mg/kg	<5	<5	----	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	----	<5	**11**
Barium	7440-39-3	10	mg/kg	**90**	**50**	----	**20**	**40**
Beryllium	7440-41-7	1	mg/kg	**1**	<1	----	**1**	<1
Boron	7440-42-8	50	mg/kg	<50	<50	----	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	----	<1	<1
Chromium	7440-47-3	2	mg/kg	**4**	<2	----	**9**	**7**
Cobalt	7440-48-4	2	mg/kg	**47**	<2	----	**16**	**25**
Copper	7440-50-8	5	mg/kg	**36**	**28**	----	**9**	**31**
Iron	7439-89-6	50	mg/kg	**60900**	**21000**	----	**37700**	**8480**
Lead	7439-92-1	5	mg/kg	**10**	**13**	----	**7**	**10**
Manganese	7439-96-5	5	mg/kg	**3390**	**142**	----	**355**	**352**
Molybdenum	7439-98-7	2	mg/kg	<2	<2	----	<2	<2
Nickel	7440-02-0	2	mg/kg	**15**	<2	----	**9**	**14**
Selenium	7782-49-2	5	mg/kg	<5	<5	----	<5	<5
Silver	7440-22-4	2	mg/kg	<2	<2	----	<2	<2
Vanadium	7440-62-2	5	mg/kg	**27**	**6**	----	**48**	**25**
Zinc	7440-66-6	5	mg/kg	**53**	<5	----	**37**	**140**
EG020S: Soluble Metals by ICPMS								
Arsenic	7440-38-2	0.01	mg/kg	**0.03**	**0.02**	----	<0.01	**3.21**
Selenium	7782-49-2	0.1	mg/kg	**0.1**	<0.1	----	<0.1	<0.1
Silver	7440-22-4	0.01	mg/kg	<0.01	<0.01	----	<0.01	<0.01
Barium	7440-39-3	0.01	mg/kg	<0.01	**0.73**	----	<0.01	<0.01
Thallium	7440-28-0	0.01	mg/kg	<0.01	<0.01	----	<0.01	<0.01
Beryllium	7440-41-7	0.01	mg/kg	<0.01	<0.01	----	<0.01	<0.01
Cadmium	7440-43-9	0.01	mg/kg	<0.01	<0.01	----	<0.01	<0.01
Cobalt	7440-48-4	0.01	mg/kg	<0.01	<0.01	----	<0.01	<0.01
Chromium	7440-47-3	0.01	mg/kg	<0.01	<0.01	----	<0.01	<0.01
Thorium	7440-29-1	0.01	mg/kg	<0.01	<0.01	----	<0.01	<0.01
Copper	7440-50-8	0.01	mg/kg	<0.01	<0.01	----	<0.01	<0.01

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	443AMD KC14037C 23.20-23.40m EB1440704-043	448AMD KC14037C 36.70-36.90m EB1440704-048	450AMD KC14037C 38.40-38.60m EB1440704-050	459AMD KC14038C 8.81-9.01m EB1440704-059	464AMD KC14038C 26.50-26.70m EB1440704-064
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-011	EB1442332-012	EB1442332-013	EB1442332-014	EB1442332-015
				Result	Result	Result	Result	Result
EG020S: Soluble Metals by ICPMS - Continued								
Manganese	7439-96-5	0.01	mg/kg	**0.02**	<0.01	----	<0.01	<0.01
Molybdenum	7439-98-7	0.01	mg/kg	**0.07**	**0.04**	----	<0.01	**0.56**
Nickel	7440-02-0	0.01	mg/kg	<0.01	<0.01	----	<0.01	<0.01
Lead	7439-92-1	0.01	mg/kg	<0.01	<0.01	----	<0.01	<0.01
Antimony	7440-36-0	0.01	mg/kg	<0.01	<0.01	----	<0.01	<0.01
Uranium	7440-61-1	0.01	mg/kg	<0.01	**0.02**	----	<0.01	<0.01
Zinc	7440-66-6	0.05	mg/kg	<0.05	<0.05	----	<0.05	<0.05
Vanadium	7440-62-2	0.1	mg/kg	**0.1**	**0.1**	----	<0.1	**0.4**
Aluminium	7429-90-5	0.1	mg/kg	<0.1	<0.1	----	<0.1	<0.1
EG020T: Total Metals by ICP-MS								
Thallium	7440-28-0	0.1	mg/kg	<0.1	**0.2**	----	<0.1	**0.1**
Thorium	7440-29-1	0.1	mg/kg	**2.6**	**3.3**	----	**1.2**	**4.6**
Uranium	7440-61-1	0.1	mg/kg	**0.4**	**0.6**	----	**0.2**	**0.6**
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	<0.0005	<0.0005	----	<0.0005	<0.0005
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	----	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**5**	**3**	----	<1	**7**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	**0.2**	**0.1**	----	<0.1	**7.0**

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	469AMD KC14038C 52.30-52.50m EB1440704-069	474AMD KC14039C 14.00-15.55m EB1440704-074	479AMD KC14039C 33.91-34.11m EB1440704-079	480AMD KC14039C 36.98-37.19m EB1440704-080	483AMD KC14039C 45.79-45.99m EB1440704-083
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-016	EB1442332-017	EB1442332-018	EB1442332-019	EB1442332-020
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	----	----	9.5	10.0	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	----	416	587	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.268	0.095	----	----	0.020
ED008: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	----	----	----	17.3	----
^ Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	5.3	----
^ Exchangeable Potassium	----	0.1	meq/100g	----	----	----	0.5	----
^ Exchangeable Sodium	----	0.1	meq/100g	----	----	----	20.8	----
^ Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	44.0	----
^ Exchangeable Sodium Percent	----	0.1	%	----	----	----	47.3	----
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	----	----	1220	2120	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	----	----	1070	1300	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	----	----	153	816	----
ED038A: Acidity								
Acidity	----	1	mg/kg	----	----	<1	<1	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	----	90	<10	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	----	240	120	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	----	----	<10	<10	----
Magnesium	7439-95-4	10	mg/kg	----	----	<10	<10	----
Sodium	7440-23-5	10	mg/kg	----	----	420	<10	----
Potassium	7440-09-7	10	mg/kg	----	----	<10	<10	----
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	----	----	3370	8290	----
Potassium	7440-09-7	50	mg/kg	----	----	1080	630	----
Calcium	7440-70-2	50	mg/kg	----	----	2200	7920	----
Magnesium	7439-95-4	50	mg/kg	----	----	1220	3720	----
EG005S : Soluble Metals by ICPAES								

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	469AMD KC14038C 52.30-52.50m EB1440704-069	474AMD KC14039C 14.00-15.55m EB1440704-074	479AMD KC14039C 33.91-34.11m EB1440704-079	480AMD KC14039C 36.98-37.19m EB1440704-080	483AMD KC14039C 45.79-45.99m EB1440704-083
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-016	EB1442332-017	EB1442332-018	EB1442332-019	EB1442332-020
				Result	Result	Result	Result	Result
EG005S : Soluble Metals by ICPAES - Continued								
Boron	7440-42-8	1	mg/kg	----	----	<1	<1	----
Iron	7439-89-6	1	mg/kg	----	----	<1	<1	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	----	3830	6580	----
Antimony	7440-36-0	5	mg/kg	----	----	<5	<5	----
Arsenic	7440-38-2	5	mg/kg	----	----	<5	<5	----
Barium	7440-39-3	10	mg/kg	----	----	20	30	----
Beryllium	7440-41-7	1	mg/kg	----	----	<1	<1	----
Boron	7440-42-8	50	mg/kg	----	----	<50	<50	----
Cadmium	7440-43-9	1	mg/kg	----	----	<1	<1	----
Chromium	7440-47-3	2	mg/kg	----	----	<2	<2	----
Cobalt	7440-48-4	2	mg/kg	----	----	<2	3	----
Copper	7440-50-8	5	mg/kg	----	----	28	39	----
Iron	7439-89-6	50	mg/kg	----	----	1050	4830	----
Lead	7439-92-1	5	mg/kg	----	----	24	26	----
Manganese	7439-96-5	5	mg/kg	----	----	<5	13	----
Molybdenum	7439-98-7	2	mg/kg	----	----	<2	<2	----
Nickel	7440-02-0	2	mg/kg	----	----	<2	5	----
Selenium	7782-49-2	5	mg/kg	----	----	<5	<5	----
Silver	7440-22-4	2	mg/kg	----	----	<2	<2	----
Vanadium	7440-62-2	5	mg/kg	----	----	11	<5	----
Zinc	7440-66-6	5	mg/kg	----	----	29	48	----
EG020S: Soluble Metals by ICPMS								
Arsenic	7440-38-2	0.01	mg/kg	----	----	0.16	0.16	----
Selenium	7782-49-2	0.1	mg/kg	----	----	0.1	<0.1	----
Silver	7440-22-4	0.01	mg/kg	----	----	<0.01	<0.01	----
Barium	7440-39-3	0.01	mg/kg	----	----	0.23	2.03	----
Thallium	7440-28-0	0.01	mg/kg	----	----	<0.01	<0.01	----
Beryllium	7440-41-7	0.01	mg/kg	----	----	<0.01	<0.01	----
Cadmium	7440-43-9	0.01	mg/kg	----	----	<0.01	<0.01	----
Cobalt	7440-48-4	0.01	mg/kg	----	----	<0.01	<0.01	----
Chromium	7440-47-3	0.01	mg/kg	----	----	<0.01	<0.01	----
Thorium	7440-29-1	0.01	mg/kg	----	----	<0.01	<0.01	----
Copper	7440-50-8	0.01	mg/kg	----	----	<0.01	<0.01	----

Analytical Results

Sub-Matrix: PULP
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	469AMD KC14038C 52.30-52.50m EB1440704-069	474AMD KC14039C 14.00-15.55m EB1440704-074	479AMD KC14039C 33.91-34.11m EB1440704-079	480AMD KC14039C 36.98-37.19m EB1440704-080	483AMD KC14039C 45.79-45.99m EB1440704-083
Client sampling date / time				[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1442332-016	EB1442332-017	EB1442332-018	EB1442332-019	EB1442332-020
				Result	Result	Result	Result	Result
EG020S: Soluble Metals by ICPMS - Continued								
Manganese	7439-96-5	0.01	mg/kg	----	----	<0.01	**0.01**	----
Molybdenum	7439-98-7	0.01	mg/kg	----	----	**0.05**	**0.13**	----
Nickel	7440-02-0	0.01	mg/kg	----	----	<0.01	<0.01	----
Lead	7439-92-1	0.01	mg/kg	----	----	<0.01	<0.01	----
Antimony	7440-36-0	0.01	mg/kg	----	----	<0.01	**0.01**	----
Uranium	7440-61-1	0.01	mg/kg	----	----	<0.01	<0.01	----
Zinc	7440-66-6	0.05	mg/kg	----	----	<0.05	**0.19**	----
Vanadium	7440-62-2	0.1	mg/kg	----	----	**0.9**	**0.3**	----
Aluminium	7429-90-5	0.1	mg/kg	----	----	<0.1	**6.8**	----
EG020T: Total Metals by ICP-MS								
Thallium	7440-28-0	0.1	mg/kg	----	----	**0.1**	<0.1	----
Thorium	7440-29-1	0.1	mg/kg	----	----	**3.8**	**6.1**	----
Uranium	7440-61-1	0.1	mg/kg	----	----	**0.4**	**0.8**	----
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	----	----	<0.0005	<0.0005	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	----	<0.1	<0.1	----
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	----	----	**2**	**3**	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	----	----	**0.5**	**0.3**	----

Analytical Results

Sub-Matrix: PULP
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	495AMJD KC14040C 39.70-39.90m EB1440704-095	497AMD KC14040C 41.66-41.86m EB1440704-097	499AMD KC14040C 51.10-51.30m EB1440704-099	824AMD KC14042C 44.00-44.35m EB1440704-105	825AMD KC14042C 47.19-47.39m EB1440704-106
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1442332-021	EB1442332-022	EB1442332-023	EB1442332-024	EB1442332-025
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	----	9.2	9.5	----	9.1
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	345	416	----	236
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.268	----	<0.005	0.062	0.033
ED008: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	----	----	----	----	----
^ Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	----	----
^ Exchangeable Potassium	----	0.1	meq/100g	----	----	----	----	----
^ Exchangeable Sodium	----	0.1	meq/100g	----	----	----	----	----
^ Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	----	----
^ Exchangeable Sodium Percent	----	0.1	%	----	----	----	----	----
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	----	765	1120	----	536
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	----	714	1020	----	510
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	----	51	102	----	26
ED038A: Acidity								
Acidity	----	1	mg/kg	----	<1	<1	----	<1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	260	100	----	230
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	180	180	----	40
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	----	<10	<10	----	<10
Magnesium	7439-95-4	10	mg/kg	----	<10	<10	----	<10
Sodium	7440-23-5	10	mg/kg	----	640	350	----	260
Potassium	7440-09-7	10	mg/kg	----	10	10	----	<10
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	----	2520	5720	----	2290
Potassium	7440-09-7	50	mg/kg	----	870	710	----	850
Calcium	7440-70-2	50	mg/kg	----	1690	4030	----	1430
Magnesium	7439-95-4	50	mg/kg	----	2650	2740	----	820
EG005S : Soluble Metals by ICPAES								

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	495AMJD KC14040C 39.70-39.90m EB1440704-095	497AMD KC14040C 41.66-41.86m EB1440704-097	499AMD KC14040C 51.10-51.30m EB1440704-099	824AMD KC14042C 44.00-44.35m EB1440704-105	825AMD KC14042C 47.19-47.39m EB1440704-106
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-021	EB1442332-022	EB1442332-023	EB1442332-024	EB1442332-025
				Result	Result	Result	Result	Result
EG005S : Soluble Metals by ICPAES - Continued								
Boron	7440-42-8	1	mg/kg	----	**6**	<1	----	<1
Iron	7439-89-6	1	mg/kg	----	**1**	**1**	----	<1
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	**7020**	**6600**	----	**3310**
Antimony	7440-36-0	5	mg/kg	----	<5	<5	----	<5
Arsenic	7440-38-2	5	mg/kg	----	<5	<5	----	<5
Barium	7440-39-3	10	mg/kg	----	**120**	**280**	----	**940**
Beryllium	7440-41-7	1	mg/kg	----	<1	**1**	----	<1
Boron	7440-42-8	50	mg/kg	----	<50	<50	----	<50
Cadmium	7440-43-9	1	mg/kg	----	<1	<1	----	<1
Chromium	7440-47-3	2	mg/kg	----	**10**	**4**	----	**4**
Cobalt	7440-48-4	2	mg/kg	----	**3**	**3**	----	<2
Copper	7440-50-8	5	mg/kg	----	**28**	**25**	----	**57**
Iron	7439-89-6	50	mg/kg	----	**9390**	**5400**	----	**1100**
Lead	7439-92-1	5	mg/kg	----	**15**	**21**	----	**21**
Manganese	7439-96-5	5	mg/kg	----	**76**	**46**	----	<5
Molybdenum	7439-98-7	2	mg/kg	----	<2	<2	----	<2
Nickel	7440-02-0	2	mg/kg	----	**4**	**4**	----	<2
Selenium	7782-49-2	5	mg/kg	----	<5	<5	----	<5
Silver	7440-22-4	2	mg/kg	----	<2	<2	----	<2
Vanadium	7440-62-2	5	mg/kg	----	**18**	**27**	----	**21**
Zinc	7440-66-6	5	mg/kg	----	**37**	**90**	----	**50**
EG020S: Soluble Metals by ICPMS								
Arsenic	7440-38-2	0.01	mg/kg	----	**0.18**	**0.45**	----	**0.30**
Selenium	7782-49-2	0.1	mg/kg	----	<0.1	<0.1	----	**0.1**
Silver	7440-22-4	0.01	mg/kg	----	<0.01	<0.01	----	<0.01
Barium	7440-39-3	0.01	mg/kg	----	**0.43**	**0.31**	----	**0.08**
Thallium	7440-28-0	0.01	mg/kg	----	<0.01	<0.01	----	<0.01
Beryllium	7440-41-7	0.01	mg/kg	----	<0.01	<0.01	----	<0.01
Cadmium	7440-43-9	0.01	mg/kg	----	<0.01	<0.01	----	<0.01
Cobalt	7440-48-4	0.01	mg/kg	----	<0.01	<0.01	----	<0.01
Chromium	7440-47-3	0.01	mg/kg	----	<0.01	<0.01	----	<0.01
Thorium	7440-29-1	0.01	mg/kg	----	<0.01	<0.01	----	<0.01
Copper	7440-50-8	0.01	mg/kg	----	<0.01	<0.01	----	<0.01

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)			Client sample ID	495AMJD KC14040C 39.70-39.90m EB1440704-095	497AMD KC14040C 41.66-41.86m EB1440704-097	499AMD KC14040C 51.10-51.30m EB1440704-099	824AMD KC14042C 44.00-44.35m EB1440704-105	825AMD KC14042C 47.19-47.39m EB1440704-106
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	EB1442332-021	EB1442332-022	EB1442332-023	EB1442332-024	EB1442332-025
				Result	Result	Result	Result	Result
EG020S: Soluble Metals by ICPMS - Continued								
Manganese	7439-96-5	0.01	mg/kg	----	<0.01	<0.01	----	<0.01
Molybdenum	7439-98-7	0.01	mg/kg	----	**0.09**	**0.10**	----	**0.05**
Nickel	7440-02-0	0.01	mg/kg	----	<0.01	<0.01	----	<0.01
Lead	7439-92-1	0.01	mg/kg	----	<0.01	<0.01	----	<0.01
Antimony	7440-36-0	0.01	mg/kg	----	<0.01	<0.01	----	<0.01
Uranium	7440-61-1	0.01	mg/kg	----	<0.01	<0.01	----	<0.01
Zinc	7440-66-6	0.05	mg/kg	----	<0.05	<0.05	----	<0.05
Vanadium	7440-62-2	0.1	mg/kg	----	**0.9**	**0.6**	----	**1.8**
Aluminium	7429-90-5	0.1	mg/kg	----	<0.1	<0.1	----	<0.1
EG020T: Total Metals by ICP-MS								
Thallium	7440-28-0	0.1	mg/kg	----	**0.1**	<0.1	----	<0.1
Thorium	7440-29-1	0.1	mg/kg	----	**3.9**	**5.5**	----	**3.7**
Uranium	7440-61-1	0.1	mg/kg	----	**0.5**	**1.0**	----	**0.5**
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	----	<0.0005	<0.0005	----	<0.0005
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	<0.1	<0.1	----	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	----	**2**	**2**	----	**2**
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	----	**0.3**	**0.4**	----	**0.7**

Analytical Results

Sub-Matrix: PULP (Matrix: SOIL)

Compound	CAS Number	LOR	Unit	826AMD KC14043C 3.00-4.00m EB1440704-107	828AMD KC14043C 16.00-17.00m EB1440704-109	838AMD KC14044C 12.00-13.00m EB1440704-118	843AMD KC14044C 38.00-38.99m EB1440704-123	846AMD KC14044C 53.42-53.69m EB1440704-126
Client sampling date / time				[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1442332-026	EB1442332-027	EB1442332-028	EB1442332-029	EB1442332-030
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.3	----	5.0	9.1	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	369	----	925	390	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	----	<0.005	----	----	0.191
ED008: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	----	----	2.1	----	----
^ Exchangeable Magnesium	----	0.1	meq/100g	----	----	11.8	----	----
^ Exchangeable Potassium	----	0.1	meq/100g	----	----	0.2	----	----
^ Exchangeable Sodium	----	0.1	meq/100g	----	----	7.4	----	----
^ Cation Exchange Capacity	----	0.1	meq/100g	----	----	21.5	----	----
^ Exchangeable Sodium Percent	----	0.1	%	----	----	29.5	----	----
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	13	----	26	1120	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	13	----	26	1020	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	<1	----	<1	102	----
ED038A: Acidity								
Acidity	----	1	mg/kg	12	----	12	<1	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	270	----	360	140	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	480	----	1390	130	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	----	<10	<10	----
Magnesium	7439-95-4	10	mg/kg	<10	----	<10	<10	----
Sodium	7440-23-5	10	mg/kg	410	----	940	470	----
Potassium	7440-09-7	10	mg/kg	<10	----	<10	30	----
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	920	----	3190	1020	----
Potassium	7440-09-7	50	mg/kg	70	----	310	1010	----
Calcium	7440-70-2	50	mg/kg	90	----	520	15200	----
Magnesium	7439-95-4	50	mg/kg	490	----	2220	3890	----
EG005S : Soluble Metals by ICPAES								

Analytical Results

Sub-Matrix: PULP
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	826AMD KC14043C 3.00-4.00m EB1440704-107	828AMD KC14043C 16.00-17.00m EB1440704-109	838AMD KC14044C 12.00-13.00m EB1440704-118	843AMD KC14044C 38.00-38.99m EB1440704-123	846AMD KC14044C 53.42-53.69m EB1440704-126
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
				EB1442332-026	EB1442332-027	EB1442332-028	EB1442332-029	EB1442332-030
				Result	Result	Result	Result	Result
EG005S : Soluble Metals by ICPAES - Continued								
Boron	7440-42-8	1	mg/kg	<1	----	<1	<1	----
Iron	7439-89-6	1	mg/kg	<1	----	<1	<1	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**3450**	----	**6120**	**5990**	----
Antimony	7440-36-0	5	mg/kg	<5	----	<5	<5	----
Arsenic	7440-38-2	5	mg/kg	<5	----	<5	<5	----
Barium	7440-39-3	10	mg/kg	**30**	----	**320**	**60**	----
Beryllium	7440-41-7	1	mg/kg	<1	----	<1	**1**	----
Boron	7440-42-8	50	mg/kg	<50	----	<50	<50	----
Cadmium	7440-43-9	1	mg/kg	<1	----	<1	<1	----
Chromium	7440-47-3	2	mg/kg	**62**	----	**10**	**7**	----
Cobalt	7440-48-4	2	mg/kg	<2	----	**5**	**24**	----
Copper	7440-50-8	5	mg/kg	<5	----	<5	**36**	----
Iron	7439-89-6	50	mg/kg	**57800**	----	**6690**	**41900**	----
Lead	7439-92-1	5	mg/kg	<5	----	<5	**17**	----
Manganese	7439-96-5	5	mg/kg	**24**	----	**24**	**1050**	----
Molybdenum	7439-98-7	2	mg/kg	<2	----	<2	<2	----
Nickel	7440-02-0	2	mg/kg	<2	----	**4**	**24**	----
Selenium	7782-49-2	5	mg/kg	<5	----	<5	<5	----
Silver	7440-22-4	2	mg/kg	<2	----	<2	<2	----
Vanadium	7440-62-2	5	mg/kg	**197**	----	**19**	**46**	----
Zinc	7440-66-6	5	mg/kg	<5	----	**32**	**102**	----
EG020S: Soluble Metals by ICPMS								
Arsenic	7440-38-2	0.01	mg/kg	<0.01	----	<0.01	**0.08**	----
Selenium	7782-49-2	0.1	mg/kg	<0.1	----	<0.1	<0.1	----
Silver	7440-22-4	0.01	mg/kg	<0.01	----	<0.01	<0.01	----
Barium	7440-39-3	0.01	mg/kg	**0.06**	----	**0.12**	<0.01	----
Thallium	7440-28-0	0.01	mg/kg	<0.01	----	<0.01	<0.01	----
Beryllium	7440-41-7	0.01	mg/kg	<0.01	----	<0.01	<0.01	----
Cadmium	7440-43-9	0.01	mg/kg	<0.01	----	<0.01	<0.01	----
Cobalt	7440-48-4	0.01	mg/kg	<0.01	----	<0.01	<0.01	----
Chromium	7440-47-3	0.01	mg/kg	<0.01	----	<0.01	<0.01	----
Thorium	7440-29-1	0.01	mg/kg	<0.01	----	<0.01	<0.01	----
Copper	7440-50-8	0.01	mg/kg	<0.01	----	<0.01	<0.01	----

Analytical Results

Sub-Matrix: **PULP**
(Matrix: **SOIL**)

			Client sample ID	**826AMD KC14043C 3.00-4.00m EB1440704-107**	**828AMD KC14043C 16.00-17.00m EB1440704-109**	**838AMD KC14044C 12.00-13.00m EB1440704-118**	**843AMD KC14044C 38.00-38.99m EB1440704-123**	**846AMD KC14044C 53.42-53.69m EB1440704-126**
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]
Compound	CAS Number	LOR	Unit	**EB1442332-026**	**EB1442332-027**	**EB1442332-028**	**EB1442332-029**	**EB1442332-030**
				Result	Result	Result	Result	Result
EG020S: Soluble Metals by ICPMS - Continued								
Manganese	7439-96-5	0.01	mg/kg	**0.08**	----	**0.01**	<0.01	----
Molybdenum	7439-98-7	0.01	mg/kg	<0.01	----	<0.01	**0.22**	----
Nickel	7440-02-0	0.01	mg/kg	<0.01	----	<0.01	<0.01	----
Lead	7439-92-1	0.01	mg/kg	<0.01	----	<0.01	<0.01	----
Antimony	7440-36-0	0.01	mg/kg	<0.01	----	<0.01	<0.01	----
Uranium	7440-61-1	0.01	mg/kg	<0.01	----	<0.01	<0.01	----
Zinc	7440-66-6	0.05	mg/kg	<0.05	----	<0.05	<0.05	----
Vanadium	7440-62-2	0.1	mg/kg	<0.1	----	<0.1	**0.2**	----
Aluminium	7429-90-5	0.1	mg/kg	<0.1	----	<0.1	<0.1	----
EG020T: Total Metals by ICP-MS								
Thallium	7440-28-0	0.1	mg/kg	<0.1	----	**0.1**	<0.1	----
Thorium	7440-29-1	0.1	mg/kg	**3.1**	----	**0.9**	**4.6**	----
Uranium	7440-61-1	0.1	mg/kg	**0.2**	----	<0.1	**0.5**	----
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	<0.0005	----	<0.0005	<0.0005	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	----	<0.1	<0.1	----
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	<1	----	<1	**4**	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	<0.1	----	<0.1	**0.3**	----

Analytical Results

Sub-Matrix: PULP
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	847AMD KC14044C 57.69-57.89m EB1440704-127	855AMD KC14045C 34.36-34.56m EB1440704-135	858AMD KC14045C 45.51-45.71m EB1440704-138	----	----
Client sampling date / time				[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	----	----
				EB1442332-031	EB1442332-032	EB1442332-033	--------	--------
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	----	9.7	9.3	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	----	659	342	----	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	0.072	----	----	----	----
ED008: Exchangeable Cations								
^ Exchangeable Calcium	----	0.1	meq/100g	----	----	----	----	----
^ Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	----	----
^ Exchangeable Potassium	----	0.1	meq/100g	----	----	----	----	----
^ Exchangeable Sodium	----	0.1	meq/100g	----	----	----	----	----
^ Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	----	----
^ Exchangeable Sodium Percent	----	0.1	%	----	----	----	----	----
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	----	2220	1170	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	----	1860	1070	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	----	357	102	----	----
ED038A: Acidity								
Acidity	----	1	mg/kg	----	<1	<1	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	110	60	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	120	80	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	----	<10	<10	----	----
Magnesium	7439-95-4	10	mg/kg	----	<10	<10	----	----
Sodium	7440-23-5	10	mg/kg	----	770	330	----	----
Potassium	7440-09-7	10	mg/kg	----	<10	<10	----	----
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	----	4070	3220	----	----
Potassium	7440-09-7	50	mg/kg	----	240	1100	----	----
Calcium	7440-70-2	50	mg/kg	----	29500	2170	----	----
Magnesium	7439-95-4	50	mg/kg	----	9680	1240	----	----
EG005S : Soluble Metals by ICPAES								

Analytical Results

Sub-Matrix: PULP
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	847AMD KC14044C 57.69-57.89m EB1440704-127	855AMD KC14045C 34.36-34.56m EB1440704-135	858AMD KC14045C 45.51-45.71m EB1440704-138	----	----
Client sampling date / time				[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	----	----
				EB1442332-031	EB1442332-032	EB1442332-033	--------	--------
				Result	Result	Result	Result	Result
EG005S : Soluble Metals by ICPAES - Continued								
Boron	7440-42-8	1	mg/kg	----	<1	<1	----	----
Iron	7439-89-6	1	mg/kg	----	<1	<1	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	----	**4110**	**4240**	----	----
Antimony	7440-36-0	5	mg/kg	----	<5	<5	----	----
Arsenic	7440-38-2	5	mg/kg	----	<5	<5	----	----
Barium	7440-39-3	10	mg/kg	----	**100**	**160**	----	----
Beryllium	7440-41-7	1	mg/kg	----	**1**	<1	----	----
Boron	7440-42-8	50	mg/kg	----	<50	<50	----	----
Cadmium	7440-43-9	1	mg/kg	----	<1	<1	----	----
Chromium	7440-47-3	2	mg/kg	----	**8**	<2	----	----
Cobalt	7440-48-4	2	mg/kg	----	**17**	<2	----	----
Copper	7440-50-8	5	mg/kg	----	**19**	**32**	----	----
Iron	7439-89-6	50	mg/kg	----	**178000**	**4020**	----	----
Lead	7439-92-1	5	mg/kg	----	**8**	**19**	----	----
Manganese	7439-96-5	5	mg/kg	----	**4460**	**45**	----	----
Molybdenum	7439-98-7	2	mg/kg	----	<2	<2	----	----
Nickel	7440-02-0	2	mg/kg	----	**11**	<2	----	----
Selenium	7782-49-2	5	mg/kg	----	<5	<5	----	----
Silver	7440-22-4	2	mg/kg	----	<2	<2	----	----
Vanadium	7440-62-2	5	mg/kg	----	**78**	**12**	----	----
Zinc	7440-66-6	5	mg/kg	----	**91**	**15**	----	----
EG020S: Soluble Metals by ICPMS								
Arsenic	7440-38-2	0.01	mg/kg	----	**0.33**	**0.11**	----	----
Selenium	7782-49-2	0.1	mg/kg	----	<0.1	**0.1**	----	----
Silver	7440-22-4	0.01	mg/kg	----	<0.01	<0.01	----	----
Barium	7440-39-3	0.01	mg/kg	----	**0.27**	<0.01	----	----
Thallium	7440-28-0	0.01	mg/kg	----	<0.01	<0.01	----	----
Beryllium	7440-41-7	0.01	mg/kg	----	<0.01	<0.01	----	----
Cadmium	7440-43-9	0.01	mg/kg	----	<0.01	<0.01	----	----
Cobalt	7440-48-4	0.01	mg/kg	----	<0.01	<0.01	----	----
Chromium	7440-47-3	0.01	mg/kg	----	<0.01	<0.01	----	----
Thorium	7440-29-1	0.01	mg/kg	----	<0.01	<0.01	----	----
Copper	7440-50-8	0.01	mg/kg	----	<0.01	<0.01	----	----

Analytical Results

Sub-Matrix: **PULP**
(Matrix: **SOIL**)

			Client sample ID	847AMD KC14044C 57.69-57.89m EB1440704-127	855AMD KC14045C 34.36-34.56m EB1440704-135	858AMD KC14045C 45.51-45.71m EB1440704-138	----	----
			Client sampling date / time	[16-Aug-2014]	[16-Aug-2014]	[16-Aug-2014]	----	----
Compound	CAS Number	LOR	Unit	EB1442332-031	EB1442332-032	EB1442332-033	--------	--------
				Result	Result	Result	Result	Result
EG020S: Soluble Metals by ICPMS - Continued								
Manganese	7439-96-5	0.01	mg/kg	----	<0.01	<0.01	----	----
Molybdenum	7439-98-7	0.01	mg/kg	----	**0.20**	**0.09**	----	----
Nickel	7440-02-0	0.01	mg/kg	----	<0.01	<0.01	----	----
Lead	7439-92-1	0.01	mg/kg	----	<0.01	<0.01	----	----
Antimony	7440-36-0	0.01	mg/kg	----	<0.01	<0.01	----	----
Uranium	7440-61-1	0.01	mg/kg	----	<0.01	<0.01	----	----
Zinc	7440-66-6	0.05	mg/kg	----	<0.05	<0.05	----	----
Vanadium	7440-62-2	0.1	mg/kg	----	**0.4**	**1.1**	----	----
Aluminium	7429-90-5	0.1	mg/kg	----	<0.1	<0.1	----	----
EG020T: Total Metals by ICP-MS								
Thallium	7440-28-0	0.1	mg/kg	----	<0.1	**0.1**	----	----
Thorium	7440-29-1	0.1	mg/kg	----	**2.4**	**3.4**	----	----
Uranium	7440-61-1	0.1	mg/kg	----	**0.4**	**0.4**	----	----
EG035S: Soluble Mercury by FIMS								
Mercury	7439-97-6	0.0005	mg/kg	----	<0.0005	<0.0005	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	----	<0.1	<0.1	----	----
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	----	**2**	**2**	----	----
EK071G: Reactive Phosphorus as P by discrete analyser								
Reactive Phosphorus as P	14265-44-2	0.1	mg/kg	----	**1.0**	**0.5**	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1419070**	Page	: 1 of 8
Amendment	: **2**		
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services EB
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: alan@rgsenv.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 07 3344 1222	Telephone	: +61 7 3243 7222
Facsimile	: +61 07 3344 1222	Facsimile	: +61 7 3243 7218
Project	: CS Energy Kogan Creek (RGS code 201407)	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: ----	Date Samples Received	: 07-AUG-2014
Sampler	: Site Staff	Issue Date	: 06-NOV-2014
Site	: Kogan Creek Mine		
		No. of samples received	: 4
Quote number	: BNBQ/218/14	No. of samples analysed	: 4

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **Analysis is performed by ALS Fyshwick (NATA Accreditation number 992).**
- **ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.**
- **It is recognised that EG050G LL-W (Water Leachable Hexavalent Chromium) is greater than EG020W (Water Leachable Chromium) for some samples. However, the difference is within experimental variation of the methods.**
- **This report has been amended and re-released to allow the reporting of additional analytical data.**

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics
Andrew Matheson	Senior Chemist	Brisbane Inorganics
Chris Lemaitre	Non-Metals Team Leader	Melbourne Inorganics
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics
Don Sirimanne	Technical Officer	Radionuclides
Greg Vogel	Laboratory Manager	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils
		Brisbane Inorganics
Satishkumar Trivedi	2 IC Acid Sulfate Soils Supervisor	Brisbane Acid Sulphate Soils
		Brisbane Inorganics

Analytical Results

Sub-Matrix: ASH (Matrix: SOIL)			Client sample ID	Kogan Creek Ash - WET	Kogan Creek Ash - DRY	Kogan Creek Ash - WET DI LEACH	Kogan Creek Ash - DRY DI LEACH	----
			Client sampling date / time	07-AUG-2014 15:00	07-AUG-2014 15:00	07-AUG-2014 15:00	07-AUG-2014 15:00	----
Compound	CAS Number	LOR	Unit	EB1419070-001	EB1419070-002	EB1419070-003	EB1419070-004	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	11.6	11.6	----	----	----
EA009: Nett Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-42.4	-40.0	----	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	1570	1170	----	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	44.2	41.2	----	----	----
ANC as CaCO3	----	0.1	% CaCO3	4.5	4.2	----	----	----
Fizz Rating	----	0	Fizz Unit	2	2	----	----	----
EA026 : Chromium Reducible Sulfur								
Chromium Reducible Sulphur	----	0.005	%	<0.005	<0.005	----	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1.0	%	28.4	14.2	----	----	----
ED037: Alkalinity								
Total Alkalinity as CaCO3	----	1	mg/kg	1850	1330	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/kg	<1	<1	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/kg	536	408	----	----	----
ED038A: Acidity								
Acidity	----	1	mg/kg	<1	<1	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.06	0.04	----	----	----
ED093T: Total Major Cations								
Sodium	7440-23-5	50	mg/kg	2850	2160	----	----	----
Potassium	7440-09-7	50	mg/kg	890	770	----	----	----
Calcium	7440-70-2	50	mg/kg	29700	24400	----	----	----
Magnesium	7439-95-4	50	mg/kg	2490	2130	----	----	----
EG005T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	31600	25800	----	----	----
Antimony	7440-36-0	5	mg/kg	<5	<5	----	----	----
Arsenic	7440-38-2	5	mg/kg	9	9	----	----	----
Barium	7440-39-3	10	mg/kg	570	470	----	----	----

Analytical Results

Sub-Matrix: ASH (Matrix: SOIL)			Client sample ID	Kogan Creek Ash - WET	Kogan Creek Ash - DRY	Kogan Creek Ash - WET DI LEACH	Kogan Creek Ash - DRY DI LEACH	----
			Client sampling date / time	07-AUG-2014 15:00	07-AUG-2014 15:00	07-AUG-2014 15:00	07-AUG-2014 15:00	----
Compound	CAS Number	LOR	Unit	EB1419070-001	EB1419070-002	EB1419070-003	EB1419070-004	----
EG005T: Total Metals by ICP-AES - Continued								
Beryllium	7440-41-7	1	mg/kg	1	1	----	----	----
Boron	7440-42-8	50	mg/kg	100	80	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	----	----	----
Chromium	7440-47-3	2	mg/kg	135	117	----	----	----
Cobalt	7440-48-4	2	mg/kg	6	5	----	----	----
Copper	7440-50-8	5	mg/kg	17	14	----	----	----
Iron	7439-89-6	50	mg/kg	7870	6440	----	----	----
Lead	7439-92-1	5	mg/kg	15	13	----	----	----
Manganese	7439-96-5	5	mg/kg	177	137	----	----	----
Molybdenum	7439-98-7	2	mg/kg	6	5	----	----	----
Nickel	7440-02-0	2	mg/kg	6	4	----	----	----
Selenium	7782-49-2	5	mg/kg	<5	<5	----	----	----
Silver	7440-22-4	2	mg/kg	<2	<2	----	----	----
Vanadium	7440-62-2	5	mg/kg	88	73	----	----	----
Zinc	7440-66-6	5	mg/kg	34	29	----	----	----
EG020T: Total Metals by ICP-MS								
Thallium	7440-28-0	0.1	mg/kg	0.2	0.1	----	----	----
Thorium	7440-29-1	0.1	mg/kg	6.6	5.7	----	----	----
Uranium	7440-61-1	0.1	mg/kg	2.7	2.3	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	0.2	0.1	----	----	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	1	mg/kg	<1	<1	----	----	----
Total Cyanide	57-12-5	0.004	mg/L	----	----	<0.004	<0.004	----
EK055: Ammonia as N								
Ammonia as N	7664-41-7	20	mg/kg	<20	<20	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N (Sol.)	----	0.1	mg/kg	0.3	0.2	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N (Sol.)	----	0.1	mg/kg	0.3	0.3	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N (Sol.)	----	0.1	mg/kg	0.6	0.5	----	----	----

Analytical Results

Sub-Matrix: ASH (Matrix: SOIL)			Client sample ID	Kogan Creek Ash - WET	Kogan Creek Ash - DRY	Kogan Creek Ash - WET DI LEACH	Kogan Creek Ash - DRY DI LEACH	----
			Client sampling date / time	07-AUG-2014 15:00	07-AUG-2014 15:00	07-AUG-2014 15:00	07-AUG-2014 15:00	----
Compound	CAS Number	LOR	Unit	EB1419070-001	EB1419070-002	EB1419070-003	EB1419070-004	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	20	mg/kg	<20	**60**	----	----	----
EK062: Total Nitrogen as N (TKN + NOx)								
^ Total Nitrogen as N	----	20	mg/kg	<20	**60**	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	2	mg/kg	**195**	**401**	----	----	----
EN60: Bottle Leaching Procedure								
Final pH	----	0.1	pH Unit	----	----	**11.3**	**11.2**	----
EN60Z-DI: Deionised Water Leach (Zero Headspace Extraction)								
Final pH	----	0.1	pH Unit	----	----	**10.8**	**10.9**	----
EP003: Total Organic Carbon (TOC) in Soil								
Total Organic Carbon	----	0.02	%	**0.32**	**0.33**	----	----	----

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek Ash - WET DI LEACH	Kogan Creek Ash - DRY DI LEACH	----	----	----
			Client sampling date / time	03-SEP-2014 14:00	03-SEP-2014 14:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1419070-003	EB1419070-004	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	11.3	11.3	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	727	668	----	----	----
EA015: Total Dissolved Solids								
Total Dissolved Solids @180°C	----	10	mg/L	245	231	----	----	----
EA250: Gross Alpha and Beta Activity								
Gross alpha	----	0.05	Bq/L	<0.05	<0.05	----	----	----
Gross beta activity - 40K	----	0.10	Bq/L	<0.10	<0.10	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	134	123	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	48	56	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	<1	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	181	179	----	----	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	9	11	----	----	----
ED045G: Chloride Discrete analyser								
Chloride	16887-00-6	1	mg/L	34	27	----	----	----
ED093W: Water Leachable Major Cations								
Calcium	7440-70-2	1	mg/L	59	58	----	----	----
Magnesium	7439-95-4	1	mg/L	<1	<1	----	----	----
Sodium	7440-23-5	1	mg/L	48	40	----	----	----
Potassium	7440-09-7	1	mg/L	2	1	----	----	----
EG020W: Water Leachable Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	8.80	7.54	----	----	----
Antimony	7440-36-0	0.001	mg/L	0.002	0.003	----	----	----
Arsenic	7440-38-2	0.001	mg/L	0.007	0.009	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	----	----	----
Barium	7440-39-3	0.001	mg/L	0.793	0.559	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	----	----	----
Chromium	7440-47-3	0.001	mg/L	0.020	0.033	----	----	----

Analytical Results

Sub-Matrix: DI WATER LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek Ash - WET DI LEACH	Kogan Creek Ash - DRY DI LEACH	----	----	----
			Client sampling date / time	03-SEP-2014 14:00	03-SEP-2014 14:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1419070-003	EB1419070-004	----	----	----
EG020W: Water Leachable Metals by ICP-MS - Continued								
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.001**	<0.001	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	----	----	----
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	----	----	----
Molybdenum	7439-98-7	0.001	mg/L	**0.133**	**0.119**	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	**0.01**	----	----	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	----	----	----
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	----	----	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	----	----	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	----	----	----
Vanadium	7440-62-2	0.01	mg/L	**0.22**	**0.26**	----	----	----
Zinc	7440-66-6	0.005	mg/L	**0.030**	**0.035**	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.22**	**0.59**	----	----	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	----	----	----
EG035W: Water Leachable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	----	----	----
EG050G LL-W: Hexavalent Chromium in Water Leachates by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	**0.024**	**0.031**	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**1.2**	**1.1**	----	----	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.07**	**0.01**	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	**0.01**	**0.01**	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
Nitrate as N	14797-55-8	0.01	mg/L	**0.01**	**0.01**	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.02**	**0.02**	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								

Analytical Results

Sub-Matrix: **DI WATER LEACHATE** (Matrix: **WATER**)

			Client sample ID	Kogan Creek Ash - WET DI LEACH	Kogan Creek Ash - DRY DI LEACH	----	----	----
			Client sampling date / time	03-SEP-2014 14:00	03-SEP-2014 14:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1419070-003	EB1419070-004	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued								
^ Total Nitrogen as N	----	0.1	mg/L	<0.1	<0.1	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.02**	**0.08**	----	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB1442800**	Page	: 1 of 8
Amendment	: **1**		
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services EB
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: alan@rgsenv.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 07 3344 1222	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3344 1222	Facsimile	: +61-7-3243 7218
Project	: 201407 Kogan Creek Coal - QLD.	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 18-Sep-2014 18:45
C-O-C number	: ----	Date Analysis Commenced	: 20-Sep-2014
Sampler	: MANDIE MATHESON	Issue Date	: 17-Nov-2014 18:20
Site	: ----		
		No. of samples received	: 9
Quote number	: ----	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

WORLD RECOGNISED ACCREDITATION

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics
Andrew Matheson	Senior Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- **It is recognised that EK061 (Total Kjeldahl Nitrogen) is less than EK055 (Ammonia) for some samples. However, the difference is within experimental variation of the methods.**
- **Sample was diluted due to matrix interference. LOR adjusted accordingly.**
- **This report has been amended and re-released to allow the reporting of additional analytical data (thallium).**

Analytical Results

Sub-Matrix: LEACHATE
(Matrix: WATER)

Client sample ID				Kogan Creek KLC - Ash (1)	Kogan Creek KLC - spoil (2)	Kogan Creek KLC - spoil (3)	Kogan Creek KLC - spoil (4)	Kogan Creek KLC - spoil (5)
Client sampling date / time				[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]
Compound	CAS Number	LOR	Unit	EB1442800-001	EB1442800-002	EB1442800-003	EB1442800-004	EB1442800-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	10.4	7.57	7.87	8.02	8.14
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	2170	285	708	336	239
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	117	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	493	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	<1	55	147	63	83
Total Alkalinity as CaCO3	----	1	mg/L	610	55	147	63	83
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	<1	3	<1
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	26	22	35	18	10
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	232	38	134	77	26
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	13	<1	<1	<1	<1
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	407	57	175	84	60
Potassium	7440-09-7	1	mg/L	21	<1	2	1	<1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	17.8	0.10	<0.01	0.02	0.06
Antimony	7440-36-0	0.001	mg/L	0.004	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.042	0.017	0.013	0.014	0.020
Boron	7440-42-8	0.05	mg/L	0.35	<0.05	<0.05	<0.05	<0.05
Barium	7440-39-3	0.001	mg/L	0.079	<0.001	<0.001	<0.001	<0.001
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	7440-47-3	0.001	mg/L	0.220	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.002	0.005	0.002	<0.001	0.002
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	0.09	<0.01	0.02	<0.01	<0.01

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - spoil (2)	Kogan Creek KLC - spoil (3)	Kogan Creek KLC - spoil (4)	Kogan Creek KLC - spoil (5)
			Client sampling date / time	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]
Compound	CAS Number	LOR	Unit	EB1442800-001	EB1442800-002	EB1442800-003	EB1442800-004	EB1442800-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Vanadium	7440-62-2	0.01	mg/L	**0.84**	<0.01	**0.02**	**0.01**	**0.01**
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	7439-98-7	0.001	mg/L	**1.21**	**0.013**	**0.036**	**0.023**	**0.015**
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	**0.260**	<0.001	<0.001	<0.001	<0.001
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**3.1**	**1.5**	**1.2**	**1.3**	**1.3**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.19**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	**0.12**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.18**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.30**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.5**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**0.8**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.04**	----	----	----	----
EN055: Ionic Balance								
^ Total Anions	----	0.01	meq/L	**19.3**	**2.63**	**7.44**	**3.80**	**2.60**
^ Total Cations	----	0.01	meq/L	**18.9**	**2.48**	**7.66**	**3.68**	**2.61**

Analytical Results

Sub-Matrix: **LEACHATE** (Matrix: **WATER**)			Client sample ID	**Kogan Creek KLC - Ash (1)**	**Kogan Creek KLC - spoil (2)**	**Kogan Creek KLC - spoil (3)**	**Kogan Creek KLC - spoil (4)**	**Kogan Creek KLC - spoil (5)**
			Client sampling date / time	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]
Compound	CAS Number	LOR	Unit	**EB1442800-001**	**EB1442800-002**	**EB1442800-003**	**EB1442800-004**	**EB1442800-005**
				Result	Result	Result	Result	Result
EN055: Ionic Balance - Continued								
^ **Ionic Balance**	----	0.01	%	**1.05**	**----**	**1.40**	**1.73**	**----**

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
			Client sampling date / time	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]	----
Compound	CAS Number	LOR	Unit	EB1442800-006	EB1442800-007	EB1442800-008	EB1442800-009	--------
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	9.99	8.53	8.07	8.42	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	2840	1310	1490	1120	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	221	8	<1	24	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	49	80	88	118	----
Total Alkalinity as CaCO3	----	1	mg/L	270	88	88	142	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	3	<1	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	263	138	161	98	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	610	290	338	234	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	17	4	5	1	----
Magnesium	7439-95-4	1	mg/L	<1	2	3	<1	----
Sodium	7440-23-5	1	mg/L	617	264	292	239	----
Potassium	7440-09-7	1	mg/L	6	3	3	3	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	2.04	0.02	<0.01	0.01	----
Antimony	7440-36-0	0.001	mg/L	0.015	0.002	0.002	0.002	----
Arsenic	7440-38-2	0.001	mg/L	0.136	0.033	0.026	0.045	----
Boron	7440-42-8	0.05	mg/L	4.29	0.65	0.45	0.24	----
Barium	7440-39-3	0.001	mg/L	0.044	0.010	0.015	0.003	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	0.0004	<0.0001	<0.0001	<0.0001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Chromium	7440-47-3	0.001	mg/L	0.430	0.071	0.041	0.004	----
Copper	7440-50-8	0.001	mg/L	0.003	0.002	0.002	0.003	----
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.001	0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	0.10	0.04	0.04	0.03	----

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
			Client sampling date / time	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]	----
Compound	CAS Number	LOR	Unit	EB1442800-006	EB1442800-007	EB1442800-008	EB1442800-009	--------
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Vanadium	7440-62-2	0.01	mg/L	**2.03**	**0.10**	**0.05**	**0.05**	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Molybdenum	7439-98-7	0.001	mg/L	**1.83**	**0.308**	**0.192**	**0.092**	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	**0.001**	<0.001	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	**0.491**	**0.076**	**0.045**	<0.001	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	<0.010	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**3.8**	**1.4**	**1.4**	**1.8**	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**1.84**	**0.07**	**0.04**	**0.15**	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	**0.23**	**0.10**	**0.08**	**0.13**	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.30**	**0.14**	**0.13**	**0.08**	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.53**	**0.24**	**0.21**	**0.21**	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**1.6**	**0.7**	**1.9**	**4.7**	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**2.1**	**0.9**	**2.1**	**4.9**	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.27**	**1.70**	**2.63**	**9.64**	----
EN055: Ionic Balance								
^ Total Anions	----	0.01	meq/L	**28.1**	**12.8**	**14.6**	**11.5**	----
^ Total Cations	----	0.01	meq/L	**27.8**	**11.9**	**13.3**	**10.5**	----

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
			Client sampling date / time	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]	[18-Sep-2014]	----
Compound	CAS Number	LOR	Unit	EB1442800-006	EB1442800-007	EB1442800-008	EB1442800-009	--------
				Result	Result	Result	Result	Result
EN055: Ionic Balance - Continued								
^ **Ionic Balance**	----	0.01	%	**0.46**	**3.62**	**4.94**	**4.38**	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB1444411**	Page	: 1 of 6
Amendment	: **1**		
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services EB
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: alan@rgsenv.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 07 3344 1222	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3344 1222	Facsimile	: +61-7-3243 7218
Project	: 201407 Kogan Creek Coal - QLD.	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 15-Oct-2014 19:00
C-O-C number	: ----	Date Analysis Commenced	: 16-Oct-2014
Sampler	: MANDIE MATHESON	Issue Date	: 17-Nov-2014 18:28
Site	: ----		
		No. of samples received	: 9
Quote number	: ----	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics
Andrew Matheson	Senior Chemist	Brisbane Inorganics
Greg Vogel	Laboratory Manager	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- **This report has been amended and re-released to allow the reporting of additional analytical data (thallium).**

Analytical Results

Sub-Matrix: LEACHATE
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - spoil (2)	Kogan Creek KLC - spoil (3)	Kogan Creek KLC - spoil (4)	Kogan Creek KLC - spoil (5)
Client sampling date / time				[15-Oct-2014]	[15-Oct-2014]	[15-Oct-2014]	[15-Oct-2014]	[15-Oct-2014]
				EB1444411-001	EB1444411-002	EB1444411-003	EB1444411-004	EB1444411-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	9.85	7.68	8.71	7.46	7.67
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1170	233	166	103	188
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	88	<1	3	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	13	6	23	7	10
Total Alkalinity as CaCO3	----	1	mg/L	101	6	26	7	10
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	2	5	<1	3	3
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	212	29	15	16	18
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	170	34	22	13	26
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	30	<1	<1	<1	<1
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	221	41	32	18	35
Potassium	7440-09-7	1	mg/L	8	<1	<1	<1	<1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	8.79	0.11	0.22	0.13	0.25
Antimony	7440-36-0	0.001	mg/L	0.010	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.022	0.002	0.002	<0.001	0.003
Boron	7440-42-8	0.05	mg/L	3.85	0.09	<0.05	<0.05	<0.05
Barium	7440-39-3	0.001	mg/L	0.084	<0.001	<0.001	<0.001	<0.001
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	7440-47-3	0.001	mg/L	0.237	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	0.001	0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	0.06	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - spoil (2)	Kogan Creek KLC - spoil (3)	Kogan Creek KLC - spoil (4)	Kogan Creek KLC - spoil (5)
			Client sampling date / time	[15-Oct-2014]	[15-Oct-2014]	[15-Oct-2014]	[15-Oct-2014]	[15-Oct-2014]
Compound	CAS Number	LOR	Unit	EB1444411-001	EB1444411-002	EB1444411-003	EB1444411-004	EB1444411-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Vanadium	7440-62-2	0.01	mg/L	**0.47**	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	7439-98-7	0.001	mg/L	**0.844**	**0.004**	**0.010**	**0.004**	**0.007**
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	<0.05	**0.06**	**0.06**	<0.05	**0.09**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	**0.232**	<0.001	<0.001	<0.001	<0.001
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.8**	**0.1**	**0.1**	<0.1	**0.1**
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.01**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	**0.11**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.11**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.22**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**0.2**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.04**	----	----	----	----

Analytical Results

Sub-Matrix: LEACHATE
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil +ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
Client sampling date / time				[15-Oct-2014]	[15-Oct-2014]	[15-Oct-2014]	[15-Oct-2014]	----
				EB1444411-006	EB1444411-007	EB1444411-008	EB1444411-009	--------
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**9.13**	**9.46**	**9.41**	**8.62**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**1410**	**235**	**181**	**154**	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**58**	**13**	**10**	**2**	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**95**	**22**	**20**	**14**	----
Total Alkalinity as CaCO3	----	1	mg/L	**153**	**35**	**30**	**16**	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	<1	<1	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**369**	**29**	**22**	**23**	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**81**	**27**	**21**	**14**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**7**	<1	<1	<1	----
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	----
Sodium	7440-23-5	1	mg/L	**309**	**43**	**33**	**29**	----
Potassium	7440-09-7	1	mg/L	**3**	<1	<1	<1	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.32**	**0.27**	**0.35**	**0.24**	----
Antimony	7440-36-0	0.001	mg/L	**0.017**	<0.001	<0.001	<0.001	----
Arsenic	7440-38-2	0.001	mg/L	**0.112**	**0.008**	**0.006**	**0.003**	----
Boron	7440-42-8	0.05	mg/L	**7.82**	**0.25**	**0.12**	**0.05**	----
Barium	7440-39-3	0.001	mg/L	**0.021**	<0.001	<0.001	<0.001	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	**0.0001**	<0.0001	<0.0001	<0.0001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Chromium	7440-47-3	0.001	mg/L	**0.152**	**0.002**	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	**0.001**	<0.001	<0.001	**0.002**	----
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	**0.04**	<0.01	<0.01	<0.01	----

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)

Compound	CAS Number	LOR	Unit	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil +ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
Client sampling date / time				[15-Oct-2014]	[15-Oct-2014]	[15-Oct-2014]	[15-Oct-2014]	----
				EB1444411-006	EB1444411-007	EB1444411-008	EB1444411-009	--------
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Vanadium	7440-62-2	0.01	mg/L	**0.63**	**0.03**	**0.02**	<0.01	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Molybdenum	7439-98-7	0.001	mg/L	**0.510**	**0.041**	**0.022**	**0.013**	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Uranium	7440-61-1	0.001	mg/L	**0.006**	<0.001	<0.001	<0.001	----
Iron	7439-89-6	0.05	mg/L	<0.05	**0.05**	**0.10**	**0.07**	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	**0.146**	<0.001	<0.001	<0.001	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**3.4**	**0.3**	**0.2**	**0.1**	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	**0.02**	**0.02**	**0.01**	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	**0.12**	**0.03**	**0.03**	**0.04**	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.05**	**0.01**	**0.02**	**0.01**	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.17**	**0.04**	**0.05**	**0.05**	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.4**	**2.4**	**2.3**	**1.4**	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**0.6**	**2.4**	**2.4**	**1.4**	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**1.04**	**3.52**	**4.00**	**2.35**	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB1446549**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services EB
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: alan@rgsenv.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 07 3344 1222	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3344 1222	Facsimile	: +61-7-3243 7218
Project	: 201407 Kogan Creek Coal - QLD.	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 18-Nov-2014 18:20
C-O-C number	: ----	Date Analysis Commenced	: 19-Nov-2014
Sampler	: MANDIE MATHESON	Issue Date	: 03-Dec-2014 09:21
Site	: ----		
		No. of samples received	: 9
Quote number	: ----	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- **Metals: Samples could not be analysed for metals due to Laboratory error.**

Analytical Results

Sub-Matrix: LEACHATE
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - Spoil (2)	Kogan Creek KLC - Spoil (3)	Kogan Creek KLC - Spoil (4)	Kogan Creek KLC - Spoil (5)
Client sampling date / time				[18-Nov-2014]	[18-Nov-2014]	[18-Nov-2014]	[18-Nov-2014]	[18-Nov-2014]
				EB1446549-001	EB1446549-002	EB1446549-003	EB1446549-004	EB1446549-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.49	8.03	7.90	6.98	7.46
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	1320	125	70	78	108
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	12	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	56	12	16	5	10
Total Alkalinity as CaCO3	----	1	mg/L	68	12	16	5	10
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	14	2	2	2	2
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	415	31	13	19	20
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	117	10	5	6	10
EG050G LL: Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	0.187	<0.001	<0.001	<0.001	<0.001
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	2.6	0.1	<0.1	<0.1	0.1
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.02	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	0.05	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	0.09	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.14	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.1	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	0.2	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - Spoil (2)	Kogan Creek KLC - Spoil (3)	Kogan Creek KLC - Spoil (4)	Kogan Creek KLC - Spoil (5)
			Client sampling date / time	[18-Nov-2014]	[18-Nov-2014]	[18-Nov-2014]	[18-Nov-2014]	[18-Nov-2014]
Compound	CAS Number	LOR	Unit	EB1446549-001	EB1446549-002	EB1446549-003	EB1446549-004	EB1446549-005
				Result	Result	Result	Result	Result
EK067G: Total Phosphorus as P by Discrete Analyser - Continued								
Total Phosphorus as P	----	0.01	mg/L	**0.02**	----	----	----	----

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
			Client sampling date / time	[18-Nov-2014]	[18-Nov-2014]	[18-Nov-2014]	[18-Nov-2014]	----
Compound	CAS Number	LOR	Unit	EB1446549-006	EB1446549-007	EB1446549-008	EB1446549-009	--------
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	9.10	9.33	8.86	8.01	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	659	156	128	74	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	41	11	5	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	95	21	18	13	----
Total Alkalinity as CaCO3	----	1	mg/L	136	32	23	13	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	2	2	2	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	129	24	20	17	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	30	12	13	4	----
EG050G LL: Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	0.029	<0.001	<0.001	<0.001	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	2.6	0.3	0.2	<0.1	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	0.03	0.01	0.01	0.01	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	0.04	0.01	0.02	<0.01	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	0.07	0.04	0.06	0.02	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	0.11	0.05	0.08	0.02	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	1.2	2.8	1.7	1.1	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	1.3	2.8	1.8	1.1	----
EK067G: Total Phosphorus as P by Discrete Analyser								

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
			Client sampling date / time	[18-Nov-2014]	[18-Nov-2014]	[18-Nov-2014]	[18-Nov-2014]	----
Compound	CAS Number	LOR	Unit	EB1446549-006	EB1446549-007	EB1446549-008	EB1446549-009	--------
				Result	Result	Result	Result	Result
EK067G: Total Phosphorus as P by Discrete Analyser - Continued								
Total Phosphorus as P	----	0.01	mg/L	**2.88**	**4.06**	**3.26**	**3.01**	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1448658**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services EB
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: alan@rgsenv.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 07 3344 1222	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3344 1222	Facsimile	: +61-7-3243 7218
Project	: 201407 Kogan Creek Coal - QLD.	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 16-Dec-2014 17:35
C-O-C number	: ----	Date Analysis Commenced	: 18-Dec-2014
Sampler	: MANDIE MATHESON	Issue Date	: 24-Dec-2014 15:20
Site	: ----		
		No. of samples received	: 9
Quote number	: ----	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

NATA WORLD RECOGNISED ACCREDITATION

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

Analytical Results

Sub-Matrix: LEACHATE
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - spoil (2)	Kogan Creek KLC - spoil (3)	Kogan Creek KLC - spoil (4)	Kogan Creek KLC - spoil (5)
			Client sampling date / time	[16-Dec-2014]	[16-Dec-2014]	[16-Dec-2014]	[16-Dec-2014]	[16-Dec-2014]
				EB1448658-001	EB1448658-002	EB1448658-003	EB1448658-004	EB1448658-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.06	7.51	7.23	6.73	7.36
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	962	64	48	58	106
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	60	6	7	4	8
Total Alkalinity as CaCO3	----	1	mg/L	60	6	7	4	8
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	9	1	2	3	3
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	184	14	10	12	27
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	105	7	5	7	8
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	48	<1	<1	2	<1
Magnesium	7439-95-4	1	mg/L	2	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	138	12	9	8	19
Potassium	7440-09-7	1	mg/L	3	<1	<1	<1	<1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	1.09	0.60	0.20	0.13	0.20
Antimony	7440-36-0	0.001	mg/L	0.013	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.019	0.002	<0.001	<0.001	0.001
Boron	7440-42-8	0.05	mg/L	9.31	<0.05	0.05	0.05	<0.05
Barium	7440-39-3	0.001	mg/L	0.050	0.001	0.001	0.010	0.002
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	7440-47-3	0.001	mg/L	0.143	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	0.002	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	0.06	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - spoil (2)	Kogan Creek KLC - spoil (3)	Kogan Creek KLC - spoil (4)	Kogan Creek KLC - spoil (5)
			Client sampling date / time	[16-Dec-2014]	[16-Dec-2014]	[16-Dec-2014]	[16-Dec-2014]	[16-Dec-2014]
Compound	CAS Number	LOR	Unit	EB1448658-001	EB1448658-002	EB1448658-003	EB1448658-004	EB1448658-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Vanadium	7440-62-2	0.01	mg/L	**0.26**	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	7439-98-7	0.001	mg/L	**0.605**	**0.003**	**0.002**	**0.001**	**0.002**
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	**0.005**	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	<0.05	**0.26**	**0.05**	<0.05	**0.07**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	**0.143**	<0.001	<0.001	<0.001	<0.001
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**3.0**	**0.1**	<0.1	<0.1	<0.1
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.01**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	**0.04**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.06**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.10**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**0.1**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.04**	----	----	----	----

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
			Client sampling date / time	[16-Dec-2014]	[16-Dec-2014]	[16-Dec-2014]	[16-Dec-2014]	----
Compound	CAS Number	LOR	Unit	EB1448658-006	EB1448658-007	EB1448658-008	EB1448658-009	--------
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**9.52**	**9.09**	**8.82**	**6.98**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**288**	**127**	**117**	**72**	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**41**	**9**	**5**	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**53**	**15**	**16**	**8**	----
Total Alkalinity as CaCO3	----	1	mg/L	**94**	**24**	**20**	**8**	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	<1	**2**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**39**	**25**	**20**	**19**	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**9**	**8**	**11**	**4**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**1**	<1	<1	<1	----
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	----
Sodium	7440-23-5	1	mg/L	**58**	**25**	**23**	**13**	----
Potassium	7440-09-7	1	mg/L	<1	<1	<1	<1	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.54**	**0.32**	**0.34**	**0.19**	----
Antimony	7440-36-0	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	----
Arsenic	7440-38-2	0.001	mg/L	**0.035**	**0.004**	**0.003**	**0.001**	----
Boron	7440-42-8	0.05	mg/L	**1.22**	**0.09**	**0.07**	<0.05	----
Barium	7440-39-3	0.001	mg/L	**0.004**	**0.002**	<0.001	**0.003**	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Chromium	7440-47-3	0.001	mg/L	**0.007**	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	**0.01**	<0.01	<0.01	<0.01	----

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
			Client sampling date / time	[16-Dec-2014]	[16-Dec-2014]	[16-Dec-2014]	[16-Dec-2014]	----
Compound	CAS Number	LOR	Unit	EB1448658-006	EB1448658-007	EB1448658-008	EB1448658-009	--------
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Vanadium	7440-62-2	0.01	mg/L	**0.16**	**0.02**	**0.01**	<0.01	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Molybdenum	7439-98-7	0.001	mg/L	**0.058**	**0.012**	**0.010**	**0.003**	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Uranium	7440-61-1	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	----
Iron	7439-89-6	0.05	mg/L	<0.05	**0.07**	**0.10**	**0.07**	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	**0.007**	<0.001	<0.001	<0.001	----
EK026SF: Total CN by Segmented Flow Analyser								
Total Cyanide	57-12-5	0.004	mg/L	<0.004	<0.004	<0.004	<0.004	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.8**	**0.2**	**0.1**	**0.1**	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.04**	**0.01**	**0.02**	<0.01	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	**0.03**	**0.01**	**0.01**	<0.01	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.02**	**0.02**	**0.06**	**0.03**	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.05**	**0.03**	**0.07**	**0.03**	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**2.6**	**2.1**	**1.4**	**0.9**	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**2.6**	**2.1**	**1.5**	**0.9**	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**8.64**	**2.91**	**2.86**	**2.08**	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB1510868**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services EB
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: alan@rgsenv.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 07 3344 1222	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3344 1222	Facsimile	: +61-7-3243 7218
Project	: 201407 Kogan Creek Coal - QLD.	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 15-Jan-2015 19:10
C-O-C number	: ----	Date Analysis Commenced	: 20-Jan-2015
Sampler	: MANDIE MATHESON	Issue Date	: 23-Jan-2015 17:03
Site	: ----		
		No. of samples received	: 9
Quote number	: ----	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

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- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

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Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

Analytical Results

Sub-Matrix: LEACHATE
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - spoil (2)	Kogan Creek KLC - spoil (3)	Kogan Creek KLC - spoil (4)	Kogan Creek KLC - spoil (5)
Client sampling date / time				[15-Jan-2015]	[15-Jan-2015]	[15-Jan-2015]	[15-Jan-2015]	[15-Jan-2015]
				EB1510868-001	EB1510868-002	EB1510868-003	EB1510868-004	EB1510868-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.28	7.02	6.92	6.85	6.98
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	736	67	52	73	63
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	64	3	6	4	4
Total Alkalinity as CaCO3	----	1	mg/L	64	3	6	4	4
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	2	1	2	1	1
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	137	14	9	12	12
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	84	6	4	8	6
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	29	<1	2	3	<1
Magnesium	7439-95-4	1	mg/L	1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	123	11	6	8	11
Potassium	7440-09-7	1	mg/L	2	<1	<1	<1	<1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	1.12	0.44	0.17	0.09	0.25
Antimony	7440-36-0	0.001	mg/L	0.013	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.029	0.002	<0.001	<0.001	<0.001
Boron	7440-42-8	0.05	mg/L	6.70	0.15	<0.05	<0.05	<0.05
Barium	7440-39-3	0.001	mg/L	0.053	0.002	0.002	0.011	<0.001
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	7440-47-3	0.001	mg/L	0.109	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	0.002	<0.001	<0.001	<0.001	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	0.06	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: LEACHATE
(Matrix: WATER)

			Client sample ID	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - spoil (2)	Kogan Creek KLC - spoil (3)	Kogan Creek KLC - spoil (4)	Kogan Creek KLC - spoil (5)
			Client sampling date / time	[15-Jan-2015]	[15-Jan-2015]	[15-Jan-2015]	[15-Jan-2015]	[15-Jan-2015]
Compound	CAS Number	LOR	Unit	EB1510868-001	EB1510868-002	EB1510868-003	EB1510868-004	EB1510868-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Vanadium	7440-62-2	0.01	mg/L	**0.37**	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	7439-98-7	0.001	mg/L	**0.461**	**0.006**	**0.002**	**0.002**	<0.001
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	**0.004**	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	<0.05	**0.20**	<0.05	<0.05	**0.09**
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	**0.135**	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**3.6**	**0.2**	**0.2**	<0.1	<0.1
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.02**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	**0.04**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.06**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.10**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**0.1**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.06**	----	----	----	----

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
			Client sampling date / time	[15-Jan-2015]	[15-Jan-2015]	[15-Jan-2015]	[15-Jan-2015]	----
Compound	CAS Number	LOR	Unit	EB1510868-006	EB1510868-007	EB1510868-008	EB1510868-009	--------
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**9.40**	**7.74**	**7.54**	**7.08**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**171**	**83**	**90**	**58**	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**22**	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**36**	**11**	**12**	**7**	----
Total Alkalinity as CaCO3	----	1	mg/L	**58**	**11**	**12**	**7**	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	**1**	**1**	**2**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**20**	**15**	**15**	**13**	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**3**	**6**	**8**	**3**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**1**	<1	<1	<1	----
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	----
Sodium	7440-23-5	1	mg/L	**34**	**14**	**16**	**10**	----
Potassium	7440-09-7	1	mg/L	<1	<1	<1	<1	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.60**	**0.31**	**0.41**	**0.28**	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Arsenic	7440-38-2	0.001	mg/L	**0.018**	**0.002**	**0.002**	**0.001**	----
Boron	7440-42-8	0.05	mg/L	**0.45**	**0.08**	<0.05	<0.05	----
Barium	7440-39-3	0.001	mg/L	**0.004**	**0.002**	**0.001**	**0.001**	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Chromium	7440-47-3	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
			Client sampling date / time	[15-Jan-2015]	[15-Jan-2015]	[15-Jan-2015]	[15-Jan-2015]	----
Compound	CAS Number	LOR	Unit	EB1510868-006	EB1510868-007	EB1510868-008	EB1510868-009	--------
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Vanadium	7440-62-2	0.01	mg/L	**0.08**	**0.01**	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	**0.008**	<0.005	<0.005	<0.005	----
Molybdenum	7439-98-7	0.001	mg/L	**0.016**	**0.005**	**0.005**	**0.002**	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Uranium	7440-61-1	0.001	mg/L	**0.001**	<0.001	<0.001	<0.001	----
Iron	7439-89-6	0.05	mg/L	<0.05	**0.08**	**0.13**	**0.11**	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	<0.001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.5**	**0.1**	**0.1**	<0.1	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.07**	**0.04**	**0.05**	**0.03**	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	**0.01**	<0.01	<0.01	<0.01	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.04**	**0.04**	**0.07**	**0.05**	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.05**	**0.04**	**0.07**	**0.05**	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**4.2**	**0.9**	**0.9**	**0.7**	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**4.2**	**0.9**	**1.0**	**0.8**	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**6.54**	**1.53**	**1.80**	**1.47**	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB1513033**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services EB
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: alan@rgsenv.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 07 3344 1222	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3344 1222	Facsimile	: +61-7-3243 7218
Project	: 201407 Kogan Creek Coal - QLD.	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 17-Feb-2015 18:20
C-O-C number	: ----	Date Analysis Commenced	: 18-Feb-2015
Sampler	: MANDIE MATHESON	Issue Date	: 27-Feb-2015 09:29
Site	: ----		
		No. of samples received	: 9
Quote number	: ----	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

WORLD RECOGNISED ACCREDITATION

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Andrew Epps	Senior Inorganic Chemist	Brisbane Inorganics
Andrew Matheson	Senior Chemist	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- **EK055 (Ammonia); LOR's have been raised due to matrix interference.**

Analytical Results

Sub-Matrix: LEACHATE
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - spoil (2)	Kogan Creek KLC - spoil (3)	Kogan Creek KLC - spoil (4)	Kogan Creek KLC - spoil (5)
Client sampling date / time				[17-Feb-2015]	[17-Feb-2015]	[17-Feb-2015]	[17-Feb-2015]	[17-Feb-2015]
				EB1513033-001	EB1513033-002	EB1513033-003	EB1513033-004	EB1513033-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.30	6.97	6.86	6.63	6.77
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	655	64	43	70	88
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	58	5	8	6	5
Total Alkalinity as CaCO3	----	1	mg/L	58	5	8	6	5
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	5	3	2	2	2
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	133	19	10	16	25
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	67	5	3	7	6
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	25	<1	1	3	3
Magnesium	7439-95-4	1	mg/L	1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	110	11	6	7	10
Potassium	7440-09-7	1	mg/L	2	<1	<1	<1	<1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	1.18	1.43	0.22	0.09	0.13
Antimony	7440-36-0	0.001	mg/L	0.010	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.035	0.001	<0.001	<0.001	<0.001
Boron	7440-42-8	0.05	mg/L	5.20	0.07	<0.05	<0.05	<0.05
Barium	7440-39-3	0.001	mg/L	0.045	0.003	0.002	0.016	0.005
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	7440-47-3	0.001	mg/L	0.087	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	<0.001	0.002	<0.001	0.002	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	0.06	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - spoil (2)	Kogan Creek KLC - spoil (3)	Kogan Creek KLC - spoil (4)	Kogan Creek KLC - spoil (5)
			Client sampling date / time	[17-Feb-2015]	[17-Feb-2015]	[17-Feb-2015]	[17-Feb-2015]	[17-Feb-2015]
Compound	CAS Number	LOR	Unit	EB1513033-001	EB1513033-002	EB1513033-003	EB1513033-004	EB1513033-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Vanadium	7440-62-2	0.01	mg/L	**0.41**	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	7439-98-7	0.001	mg/L	**0.462**	**0.001**	<0.001	**0.001**	<0.001
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	<0.05	**0.65**	**0.13**	<0.05	<0.05
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	**0.100**	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**3.5**	<0.1	<0.1	<0.1	<0.1
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.08**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	**0.03**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.10**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.13**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**0.1**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**0.2**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.10**	----	----	----	----

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
			Client sampling date / time	[17-Feb-2015]	[17-Feb-2015]	[17-Feb-2015]	[17-Feb-2015]	----
Compound	CAS Number	LOR	Unit	EB1513033-006	EB1513033-007	EB1513033-008	EB1513033-009	--------
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**9.14**	**7.42**	**7.21**	**6.94**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**126**	**75**	**79**	**58**	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**13**	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**33**	**11**	**8**	**7**	----
Total Alkalinity as CaCO3	----	1	mg/L	**46**	**11**	**8**	**7**	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	**2**	**2**	**2**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**17**	**15**	**17**	**16**	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**3**	**7**	**8**	**3**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**2**	**2**	<1	**1**	----
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	----
Sodium	7440-23-5	1	mg/L	**23**	**11**	**12**	**8**	----
Potassium	7440-09-7	1	mg/L	<1	<1	<1	<1	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.47**	**0.23**	**0.29**	**0.22**	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Arsenic	7440-38-2	0.001	mg/L	**0.012**	**0.002**	**0.002**	<0.001	----
Boron	7440-42-8	0.05	mg/L	**0.27**	<0.05	<0.05	<0.05	----
Barium	7440-39-3	0.001	mg/L	**0.004**	**0.006**	**0.002**	**0.003**	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----

Analytical Results

Sub-Matrix: LEACHATE
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
Client sampling date / time				[17-Feb-2015]	[17-Feb-2015]	[17-Feb-2015]	[17-Feb-2015]	----
				EB1513033-006	EB1513033-007	EB1513033-008	EB1513033-009	--------
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Vanadium	7440-62-2	0.01	mg/L	**0.05**	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Molybdenum	7439-98-7	0.001	mg/L	**0.008**	**0.004**	**0.003**	**0.002**	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Iron	7439-89-6	0.05	mg/L	<0.05	**0.06**	**0.10**	**0.07**	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	<0.001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.3**	<0.1	<0.1	<0.1	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.05	**0.02**	<0.01	<0.01	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
EK058G: Nitrate as N by Discrete Analyser								
^ **Nitrate as N**	14797-55-8	0.01	mg/L	**0.03**	**0.04**	**0.05**	**0.04**	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.03**	**0.04**	**0.05**	**0.04**	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**3.3**	**1.0**	**0.9**	**0.8**	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ **Total Nitrogen as N**	----	0.1	mg/L	**3.3**	**1.0**	**1.0**	**0.8**	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**4.65**	**1.32**	**1.42**	**1.55**	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB1514936**	Page	: 1 of 6
Client	: **RGS ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALAN ROBERTSON	Contact	: Customer Services EB
Address	: PO Box 3091 SUNNYBANK SOUTH QLD, AUSTRALIA 4109	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: alan@rgsenv.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 07 3344 1222	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3344 1222	Facsimile	: +61-7-3243 7218
Project	: 201407 Kogan Creek Coal - QLD.	QC Level	: NEPM 2013 Schedule B(3) and ALS QCS3 requirement
Order number	: ----	Date Samples Received	: 17-Mar-2015 18:25
C-O-C number	: ----	Date Analysis Commenced	: 18-Mar-2015
Sampler	: MANDIE MATHESON	Issue Date	: 23-Mar-2015 15:56
Site	: ----		
		No. of samples received	: 9
Quote number	: ----	No. of samples analysed	: 9

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Greg Vogel	Laboratory Manager	Brisbane Inorganics
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.

- EA006: Sodium Adsorption ratio could not be determined as both the Mg and Ca results were less than reportable limits.

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - spoil (2)	Kogan Creek KLC - spoil (3)	Kogan Creek KLC - spoil (4)	Kogan Creek KLC - spoil (5)
			Client sampling date / time	[17-Mar-2015]	[17-Mar-2015]	[17-Mar-2015]	[17-Mar-2015]	[17-Mar-2015]
Compound	CAS Number	LOR	Unit	EB1514936-001	EB1514936-002	EB1514936-003	EB1514936-004	EB1514936-005
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	8.24	6.82	6.92	6.68	6.77
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	409	52	44	66	78
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	55	2	4	3	3
Total Alkalinity as CaCO3	----	1	mg/L	55	2	4	3	3
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	1	1	1
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	76	13	9	13	21
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	26	5	4	8	5
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	18	<1	2	6	4
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	<1
Sodium	7440-23-5	1	mg/L	68	8	5	7	7
Potassium	7440-09-7	1	mg/L	2	<1	<1	<1	<1
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	1.19	0.58	0.20	0.12	0.10
Antimony	7440-36-0	0.001	mg/L	0.009	<0.001	<0.001	<0.001	<0.001
Arsenic	7440-38-2	0.001	mg/L	0.034	<0.001	<0.001	<0.001	<0.001
Boron	7440-42-8	0.05	mg/L	4.12	<0.05	<0.05	<0.05	<0.05
Barium	7440-39-3	0.001	mg/L	0.031	<0.001	0.001	0.010	0.005
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Cadmium	7440-43-9	0.0001	mg/L	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium	7440-47-3	0.001	mg/L	0.053	<0.001	<0.001	<0.001	<0.001
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	<0.001	0.004	<0.001
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	7782-49-2	0.01	mg/L	0.04	<0.01	<0.01	<0.01	<0.01

Analytical Results

Sub-Matrix: LEACHATE
(Matrix: WATER)

Compound	CAS Number	LOR	Unit	Kogan Creek KLC - Ash (1)	Kogan Creek KLC - spoil (2)	Kogan Creek KLC - spoil (3)	Kogan Creek KLC - spoil (4)	Kogan Creek KLC - spoil (5)
Client sampling date / time				[17-Mar-2015]	[17-Mar-2015]	[17-Mar-2015]	[17-Mar-2015]	[17-Mar-2015]
				EB1514936-001	EB1514936-002	EB1514936-003	EB1514936-004	EB1514936-005
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Vanadium	7440-62-2	0.01	mg/L	**0.42**	<0.01	<0.01	<0.01	<0.01
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Molybdenum	7439-98-7	0.001	mg/L	**0.242**	**0.001**	<0.001	<0.001	<0.001
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium	7440-61-1	0.001	mg/L	**0.002**	<0.001	<0.001	<0.001	<0.001
Iron	7439-89-6	0.05	mg/L	<0.05	**0.22**	<0.05	<0.05	<0.05
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	**0.051**	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**2.9**	<0.1	<0.1	<0.1	<0.1
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	<0.01	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	**0.03**	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.04**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.07**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	<0.1	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**0.08**	----	----	----	----

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
			Client sampling date / time	[17-Mar-2015]	[17-Mar-2015]	[17-Mar-2015]	[17-Mar-2015]	----
Compound	CAS Number	LOR	Unit	EB1514936-006	EB1514936-007	EB1514936-008	EB1514936-009	--------
				Result	Result	Result	Result	Result
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**9.55**	**7.22**	**7.27**	**7.01**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**105**	**73**	**77**	**56**	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**15**	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**21**	**7**	**5**	**4**	----
Total Alkalinity as CaCO3	----	1	mg/L	**36**	**7**	**5**	**4**	----
ED038A: Acidity								
Acidity as CaCO3	----	1	mg/L	<1	<1	<1	**1**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**12**	**15**	**15**	**15**	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**2**	**6**	**8**	**3**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**2**	**2**	<1	**2**	----
Magnesium	7439-95-4	1	mg/L	<1	<1	<1	<1	----
Sodium	7440-23-5	1	mg/L	**20**	**9**	**14**	**7**	----
Potassium	7440-09-7	1	mg/L	<1	<1	<1	<1	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	**0.47**	**0.14**	**0.17**	**0.23**	----
Antimony	7440-36-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Arsenic	7440-38-2	0.001	mg/L	**0.009**	<0.001	<0.001	<0.001	----
Boron	7440-42-8	0.05	mg/L	**0.20**	<0.05	<0.05	<0.05	----
Barium	7440-39-3	0.001	mg/L	**0.005**	**0.006**	**0.002**	**0.004**	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----

Analytical Results

Sub-Matrix: LEACHATE (Matrix: WATER)			Client sample ID	Kogan Creek KLC - spoil + ash (6)	Kogan Creek KLC - spoil + ash (7)	Kogan Creek KLC - spoil + ash (8)	Kogan Creek KLC - spoil + ash (9)	----
			Client sampling date / time	[17-Mar-2015]	[17-Mar-2015]	[17-Mar-2015]	[17-Mar-2015]	----
Compound	CAS Number	LOR	Unit	EB1514936-006	EB1514936-007	EB1514936-008	EB1514936-009	--------
				Result	Result	Result	Result	Result
EG020F: Dissolved Metals by ICP-MS - Continued								
Vanadium	7440-62-2	0.01	mg/L	**0.04**	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Molybdenum	7439-98-7	0.001	mg/L	**0.006**	**0.004**	**0.003**	**0.002**	----
Silver	7440-22-4	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thallium	7440-28-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Thorium	7440-29-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Uranium	7440-61-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	**0.05**	**0.07**	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG050G LL-F: Dissolved Hexavalent Chromium by Discrete Analyser - Low Level								
Hexavalent Chromium	18540-29-9	0.001	mg/L	<0.001	----	----	----	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	**0.2**	<0.1	<0.1	<0.1	----
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.02**	<0.01	**0.01**	<0.01	----
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.03**	**0.03**	**0.06**	**0.02**	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.03**	**0.03**	**0.06**	**0.02**	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**2.4**	**0.6**	**0.5**	**0.5**	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser								
^ Total Nitrogen as N	----	0.1	mg/L	**2.4**	**0.6**	**0.6**	**0.5**	----
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**3.83**	**1.07**	**1.02**	**1.32**	----

Attachment D

KLC Test Results and Trends

RGS-KLC # 1 : Kogan Creek Project

KLC Test Results: Ash Material (dry)

Weight (kg)	1.54	Total S (%)	0.040	ANC	41.20
pH (1:5)	11.6	Scr (%)	0.0025	NAPP	-41.12
EC (µS/cm)	1,170	MPA	0.08	ANC:MPA	538.12

Date		**18-Sep-14**	**16-Oct-14**	**18-Nov-14**	**16-Dec-14**	**15-Jan-15**	**17-Feb-15**	**17-Mar-15**
Week		**0**	**4**	**9**	**13**	**17**	**22**	**26**
Leach Number		**1**	**2**	**3**	**4**	**5**	**6**	**7**
ALS Laboratory Number		EB1442800	EB1444411	EB1446549$	EB1448658	EB1510868	EB1513033	EB1514936
Volume Collected (L)		0.700	0.719	0.675	0.663	0.657	0.731	0.535
Cum. Volume (L)		0.70	1.42	2.09	2.76	3.41	4.15	4.68
Pore Volumes		0.5	1.1	1.6	2.0	2.5	3.1	3.5
pH		10.40	9.79	8.43	8.24	8.36	8.42	8.26
EC (µS/cm)		2,170	1,134	1,312	896	703	657	404
Acidity (mg/L)*		<1	2	14	<1	2	5	<1
Hydroxide Alkalinity (mg/L)*		117	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity (mg/L)*		493	88	12	60	<1	<1	<1
Bicarbonate Alkalinity (mg/L)*		<1	13	56	60	64	58	55
Total Alkalinity (mg/L)*		610	101	68	9	64	58	55
Net Alkalinity (mg/L)*		610	99	54	51	62	53	55
Dissolved elements (mg/L)	**Guideline Limits #**							
Silver (Ag)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium (Al)	5	17.8	8.79	4.94	1.09	1.12	1.18	1.19
Arsenic (As)	0.5	0.042	0.022	0.021	0.019	0.029	0.035	0.034
Boron (B)	5	0.35	3.85	6.58	9.31	6.70	5.20	4.12
Barium (Ba)	-	0.079	0.084	0.067	0.05	0.053	0.045	0.031
Beryllium (Be)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	1,000	13	30	39	48	29	25	18
Cadmium (Cd)	0.01	0.0002	0.0002	0.0002	0.0002	0.0001	0.0002	0.0001
Chloride (Cl)	-	232	170	117	105	84	67	26
Cobalt (Co)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	1	0.220	0.237	0.191	0.143	0.109	0.087	0.053
Hexavalent-(Cr)	0.001	0.260	0.232	0.187	0.143	0.135	0.100	0.051
Copper (Cu)	1	0.002	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Fluoride (F)	2	3.1	0.8	2.6	3.0	3.6	3.5	2.9
Iron (Fe)	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury (Hg)	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Potassium (K)	-	21	8	6	3	2	2	2
Magnesium (Mg)	-	<1	<1	1	2	1	1	<1
Manganese (Mn)	-	<0.001	<0.001	0.001	0.002	0.002	<0.001	<0.001
Molybdenum (Mo)	0.15	1.210	0.844	0.725	0.605	0.461	0.462	0.242
Sodium (Na)	-	407	221	180	138	123	110	68
Nickel (Ni)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus (P)	-	0.04	0.04	0.02	0.04	0.06	0.1	0.08
Lead (Pb)	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sulfate (SO_4)	1,000	26	212	415	184	137	133	76
Antimony (Sb)	-	0.004	0.010	0.012	0.013	0.013	0.01	0.009
Selenium (Se)	0.02	0.09	0.06	0.06	0.06	0.06	0.06	0.04
Thallium (Tl)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium (Th)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium (U)	0.2	<0.001	0.001	0.003	0.005	0.004	0.002	0.002
Vanadium (V)	-	0.84	0.47	0.37	0.26	0.37	0.41	0.42
Zinc (Zn)	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calculations**								
SO_4 Release Rate		12	99	182	79	58	63	26
Cumulative SO_4 Release		12	111	293	372	430	493	520
Ca Release Rate		5.9	14.0	17.1	20.7	12.4	11.9	6.3
Cumulative Ca Release		5.9	19.9	37.0	57.7	70.0	81.9	88.2
Mg Release Rate		0.2	0.2	0.4	0.9	0.4	0.5	0.2
Cumulative Mg Release		0.2	0.5	0.9	1.8	2.2	2.7	2.8
Residual ANC (%)		100.0	99.9	99.8	99.6	99.6	99.5	99.4
Residual Sulfur (%)		99.0	90.8	75.6	69.0	64.1	58.8	56.6
SO_4/(Ca+Mg) molar ratio		0.78	2.87	4.26	1.50	1.87	2.08	1.68

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential

ANZECC & ARCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water (low risk trigger levels).

$ The KLC leachate results for 18 November 2014 were extrapolated for all elements apart from chlorine, hexavalent chromium, fluoride, phosphorus and sulfate due to a technical issue at ALS laboratory.

RGS-KLC # 2 : Kogan Creek Project

KLC Test Results: Spoil - Sandstone

Weight (kg)	1.64	**Total S (%)**	0.038	**ANC**	7.21
pH (1:5)	5.9	**Scr (%)**	-	**NAPP**	-6.05
EC (µS/cm)	426	**MPA**	1.16	**ANC:MPA**	6.20

Date		**18-Sep-14**	**16-Oct-14**	**18-Nov-14**	**16-Dec-14**	**15-Jan-15**	**17-Feb-15**	**17-Mar-15**
Week		**0**	**4**	**9**	**13**	**17**	**22**	**26**
Leach Number		**1**	**2**	**3**	**4**	**5**	**6**	**7**
ALS Laboratory Number		EB1442800	EB1444411	EB1446549$	EB1448658	EB1510868	EB1513033	EB1514936
Volume Collected (L)		0.721	0.807	0.746	0.796	0.815	0.787	0.796
Cum. Volume (L)		0.72	1.53	2.27	3.07	3.89	4.67	5.47
Pore Volumes		0.5	1.1	1.7	2.3	2.9	3.5	4.1
pH		7.57	8.64	8.23	6.69	7.02	7.98	8.47
EC (µS/cm)		285	224	105	69	61	58	46
Acidity (mg/L)*		<1	5	2	<1	1	3	<1
Hydroxide Alkalinity (mg/L)*		<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity (mg/L)*		<1	<1	<1	6	<1	<1	<1
Bicarbonate Alkalinity (mg/L)*		55	6	12	6	3	5	2
Total Alkalinity (mg/L)*		55	6	12	1	3	5	2
Net Alkalinity (mg/L)*		55	1	10	5	2	2	2
Dissolved elements (mg/L)	**Guideline Limits #**							
Silver (Ag)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium (Al)	5	0.10	0.11	0.36	0.60	0.44	1.43	0.58
Arsenic (As)	0.5	0.017	0.002	0.002	0.002	0.002	0.001	<0.001
Boron (B)	5	<0.05	0.09	0.05	<0.05	0.15	0.07	<0.05
Barium (Ba)	-	<0.001	<0.001	0.001	0.001	0.002	0.003	<0.001
Beryllium (Be)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	1,000	<1	<1	<1	<1	<1	<1	<1
Cadmium (Cd)	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chloride (Cl)	-	38	34	10	7	6	5	5
Cobalt (Co)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent-(Cr)	0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Copper (Cu)	1	0.005	0.001	0.001	<0.001	<0.001	0.001	<0.001
Fluoride (F)	2	1.5	0.1	0.1	0.1	0.2	<0.1	<0.1
Iron (Fe)	-	<0.05	0.06	0.16	0.26	0.20	0.65	0.22
Mercury (Hg)	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Potassium (K)	-	<1	<1	<1	<1	<1	<1	<1
Magnesium (Mg)	-	<1	<1	<1	<1	<1	<1	<1
Manganese (Mn)	-	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Molybdenum (Mo)	0.15	0.013	0.004	0.004	0.003	0.006	0.001	0.001
Sodium (Na)	-	57	41	27	12	11	11	8
Nickel (Ni)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus (P)	-	-	-	-	-	-	-	-
Lead (Pb)	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sulfate (SO_4)	1,000	22	29	31	14	14	19	13
Antimony (Sb)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (Se)	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium (Tl)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium (Th)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium (U)	0.2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (V)	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc (Zn)	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calculations**								
SO_4 Release Rate		10	14	14	7	7	9	6
Cumulative SO_4 Release		10	24	38	45	52	61	67
Ca Release Rate		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cumulative Ca Release		0.2	0.5	0.7	0.9	1.2	1.4	1.7
Mg Release Rate		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cumulative Mg Release		0.2	0.5	0.7	0.9	1.2	1.4	1.7
Residual ANC (%)		100.0	100.0	99.9	99.9	99.9	99.9	99.8
Residual Sulfur (%)		99.1	97.9	96.7	96.1	95.4	94.6	94.1
SO_4/(Ca+Mg) molar ratio		6.93	9.14	9.77	4.41	4.41	5.99	4.10

< indicates less than the analytical detection limit.   * Acidity and alkalinity data calculated in mg $CaCC_3$/L.

** SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential

ANZECC & ARCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water (low risk trigger levels).

$ The KLC leachate results for 18 November 2014 were extrapolated for all elements apart from chlorine, hexavalent chromium, fluoride, phosphorus and sulfate due to a technical issue at ALS laboratory.

RGS-KLC # 3 : Kogan Creek Project

KLC Test Results: Spoil - Siltstone

Weight (kg)	1.60	Total S (%)	0.042	ANC	29.99
pH (1:5)	6.8	Scr (%)	-	NAPP	-28.70
EC (µS/cm)	435	MPA	1.29	ANC:MPA	23.32

Date		18-Sep-14	16-Oct-14	18-Nov-14	16-Dec-14	15-Jan-15	17-Feb-15	17-Mar-15
Week		0	4	9	13	17	22	26
Leach Number		1	2	3	4	5	6	7
ALS Laboratory Number		EB1442800	EB1444411	EB1446549$	EB1448658	EB1510868	EB1513033	EB1514936
Volume Collected (L)		0.724	0.798	0.678	0.771	0.780	0.760	0.781
Cum. Volume (L)		0.72	1.52	2.20	2.97	3.75	4.51	5.29
Pore Volumes		0.5	1.1	1.6	2.2	2.8	3.3	3.9
pH		7.87	8.90	8.53	7.26	7.61	7.78	8.14
EC (µS/cm)		708	150	67	52	55	46	53
Acidity (mg/L)*		<1	<1	2	<1	2	2	1
Hydroxide Alkalinity (mg/L)*		<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity (mg/L)*		<1	3	<1	7	<1	<1	<1
Bicarbonate Alkalinity (mg/L)*		147	23	16	7	6	8	4
Total Alkalinity (mg/L)*		147	26	16	2	6	8	4
Net Alkalinity (mg/L)*		147	26	14	5	4	6	3
Dissolved elements (mg/L)	**Guideline Limits #**							
Silver (Ag)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium (Al)	5	<0.01	0.22	0.21	0.20	0.17	0.22	0.20
Arsenic (As)	0.5	0.013	0.002	0.001	<0.001	<0.001	<0.001	<0.001
Boron (B)	5	<0.05	<0.05	0.05	0.05	<0.05	<0.05	<0.05
Barium (Ba)	-	<0.001	<0.001	0.001	0.001	0.002	0.002	0.001
Beryllium (Be)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	1,000	<1	<1	<1	<1	2	1	2
Cadmium (Cd)	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chloride (Cl)	-	134	22	5	5	4	3	4
Cobalt (Co)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent-(Cr)	0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Copper (Cu)	1	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoride (F)	2	1.2	0.1	<0.1	<0.1	0.2	<0.1	<0.1
Iron (Fe)	-	<0.05	0.06	0.06	0.05	<0.05	0.13	<0.05
Mercury (Hg)	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Potassium (K)	-	2	<1	<1	<1	<1	<1	<1
Magnesium (Mg)	-	<1	<1	<1	<1	<1	<1	<1
Manganese (Mn)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum (Mo)	0.15	0.036	0.01	0.006	0.002	0.002	<0.001	<0.001
Sodium (Na)	-	175	32	21	9	6	6	5
Nickel (Ni)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus (P)	-	-	-	-	-	-	-	-
Lead (Pb)	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sulfate (SO_4)	1,000	35	15	13	10	9	10	9
Antimony (Sb)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (Se)	0.02	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium (Tl)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium (Th)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium (U)	0.2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (V)	-	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc (Zn)	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calculations**								
SO_4 Release Rate		16	7	6	5	4	5	4
Cumulative SO_4 Release		16	23	29	34	38	43	47
Ca Release Rate		0.2	0.2	0.2	0.2	1.0	0.5	1.0
Cumulative Ca Release		0.2	0.5	0.7	0.9	1.9	2.4	3.4
Mg Release Rate		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cumulative Mg Release		0.2	0.5	0.7	0.9	1.2	1.4	1.7
Residual ANC (%)		100.0	100.0	100.0	100.0	100.0	100.0	100.0
Residual Sulfur (%)		98.7	98.1	97.7	97.3	97.0	96.6	96.2
SO_4/(Ca+Mg) molar ratio		11.03	4.73	4.10	3.15	1.33	2.29	1.33

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential

ANZECC & ARCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water (low risk trigger levels).

$ The KLC leachate results for 18 November 2014 were extrapolated for all elements apart from chlorine, hexavalent chromium, fluoride, phosphorus and sulfate due to a technical issue at ALS laboratory.

RGS-KLC # 4 : Kogan Creek Project

KLC Test Results: Spoil - Claystone

Weight (kg)	1.68	Total S (%)	0.063	ANC	8.01
pH (1:5)	6.3	Scr (%)	0.050	NAPP	-6.49
EC (µS/cm)	562	MPA	1.52	ANC:MPA	5.28

Date		18-Sep-14	16-Oct-14	18-Nov-14	16-Dec-14	15-Jan-15	17-Feb-15	17-Mar-15
Week		0	4	9	13	17	22	26
Leach Number		1	2	3	4	5	6	7
ALS Laboratory Number		EB1442800	EB1444411	EB1446549$	EB1448658	EB1510868	EB1513033	EB1514936
Volume Collected (L)		0.756	0.816	0.734	0.782	0.783	0.779	0.785
Cum. Volume (L)		0.76	1.57	2.31	3.09	3.87	4.65	5.44
Pore Volumes		0.6	1.2	1.7	2.3	2.9	3.4	4.0
pH		8.02	8.33	7.45	8.12	7.38	7.49	7.93
EC (µS/cm)		336	101	82	62	83	84	76
Acidity (mg/L)*		3	3	2	<1	1	2	1
Hydroxide Alkalinity (mg/L)*		<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity (mg/L)*		<1	<1	<1	4	<1	<1	<1
Bicarbonate Alkalinity (mg/L)*		63	7	5	4	4	6	3
Total Alkalinity (mg/L)*		63	7	5	3	4	6	3
Net Alkalinity (mg/L)*		60	4	3	1	3	4	2
Dissolved elements (mg/L)	**Guideline Limits #**							
Silver (Ag)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium (Al)	5	0.02	0.13	0.13	0.13	0.09	0.09	0.12
Arsenic (As)	0.5	0.014	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Boron (B)	5	<0.05	<0.05	0.05	0.05	<0.05	<0.05	<0.05
Barium (Ba)	-	<0.001	<0.001	0.01	0.01	0.011	0.016	0.01
Beryllium (Be)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	1,000	<1	<1	1	2	3	3	6
Cadmium (Cd)	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chloride (Cl)	-	77	13	6	7	8	7	8
Cobalt (Co)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent-(Cr)	0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Copper (Cu)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoride (F)	2	1.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Iron (Fe)	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury (Hg)	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Potassium (K)	-	1	<1	<1	<1	<1	<1	<1
Magnesium (Mg)	-	<1	<1	<1	<1	<1	<1	<1
Manganese (Mn)	-	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	0.004
Molybdenum (Mo)	0.15	0.023	0.004	0.002	0.001	0.002	0.001	<0.001
Sodium (Na)	-	84	18	13	8	8	7	7
Nickel (Ni)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus (P)	-	-	-	-	-	-	-	-
Lead (Pb)	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sulfate (SO_4)	1,000	18	16	19	12	12	16	13
Antimony (Sb)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (Se)	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium (Tl)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium (Th)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium (U)	0.2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (V)	-	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc (Zn)	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calculations**								
SO_4 Release Rate		8	8	8	6	6	7	6
Cumulative SO_4 Release		8	16	24	30	35	43	49
Ca Release Rate		0.2	0.2	0.4	0.9	1.4	1.4	2.8
Cumulative Ca Release		0.2	0.5	0.9	1.8	3.2	4.6	7.5
Mg Release Rate		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cumulative Mg Release		0.2	0.5	0.7	0.9	1.2	1.4	1.6
Residual ANC (%)		100.0	100.0	99.9	99.9	99.8	99.8	99.7
Residual Sulfur (%)		99.6	99.2	98.7	98.4	98.1	97.7	97.4
SO_4/(Ca+Mg) molar ratio		5.67	5.04	4.35	1.77	1.31	1.75	0.79

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential

ANZECC & ARCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water (low risk trigger levels).

$ The KLC leachate results for 18 November 2014 were extrapolated for all elements apart from chlorine, hexavalent chromium, fluoride, phosphorus and sulfate due to a technical issue at ALS laboratory.

RGS-KLC # 5 : Kogan Creek Project

KLC Test Results: Spoil Composite

Weight (kg)	1.89	**Total S (%)**	0.048	**ANC**	14.84
pH (1:5)	6.2	**Scr (%)**	0.043	**NAPP**	-13.51
EC (µS/cm)	477	**MPA**	1.33	**ANC:MPA**	11.17

Date		**18-Sep-14**	**16-Oct-14**	**18-Nov-14**	**16-Dec-14**	**15-Jan-15**	**17-Feb-15**	**17-Mar-15**
Week		**0**	**4**	**9**	**13**	**17**	**22**	**26**
Leach Number		**1**	**2**	**3**	**4**	**5**	**6**	**7**
ALS Laboratory Number		EB1442800	EB1444411	EB1446549$	EB1448658	EB1510868	EB1513033	EB1514936
Volume Collected (L)		0.747	0.744	0.693	0.783	0.803	0.775	0.789
Cum. Volume (L)		0.75	1.49	2.18	2.97	3.77	4.55	5.33
Pore Volumes		0.6	1.1	1.6	2.2	2.8	3.4	4.0
pH		8.14	8.70	8.44	7.66	7.72	7.69	7.83
EC (µS/cm)		239	180	100	101	67	85	75
Acidity (mg/L)*		<1	3	2	<1	1	2	1
Hydroxide Alkalinity (mg/L)*		<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity (mg/L)*		<1	<1	<1	8	<1	<1	<1
Bicarbonate Alkalinity (mg/L)*		83	10	10	8	4	5	3
Total Alkalinity (mg/L)*		83	10	10	3	4	5	3
Net Alkalinity (mg/L)*		83	7	8	5	3	3	2
Dissolved elements (mg/L)	**Guideline Limits #**							
Silver (Ag)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium (Al)	5	0.06	0.25	0.23	0.20	0.25	0.13	0.10
Arsenic (As)	0.5	0.02	0.003	0.002	0.001	<0.001	<0.001	<0.001
Boron (B)	5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium (Ba)	-	<0.001	<0.001	<0.001	0.002	<0.001	0.005	0.005
Beryllium (Be)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	1,000	<1	<1	<1	<1	<1	3	4
Cadmium (Cd)	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chloride (Cl)	-	26	26	10	8	6	6	5
Cobalt (Co)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent-(Cr)	0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Copper (Cu)	1	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoride (F)	2	1.3	0.1	0.1	<0.1	<0.1	<0.1	<0.1
Iron (Fe)	-	<0.05	0.09	0.08	0.07	0.09	<0.05	<0.05
Mercury (Hg)	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Potassium (K)	-	<1	<1	<1	<1	<1	<1	<1
Magnesium (Mg)	-	<1	<1	<1	<1	<1	<1	<1
Manganese (Mn)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum (Mo)	0.15	0.015	0.007	0.005	0.002	<0.001	<0.001	<0.001
Sodium (Na)	-	60	35	27	19	11	10	7
Nickel (Ni)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus (P)	-	-	-	-	-	-	-	-
Lead (Pb)	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sulfate (SO_4)	1,000	10	18	20	27	12	25	21
Antimony (Sb)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (Se)	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium (Tl)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium (Th)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium (U)	0.2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (V)	-	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc (Zn)	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calculations**								
SO_4 Release Rate		4	7	7	11	5	10	9
Cumulative SO_4 Release		4	11	18	30	35	45	54
Ca Release Rate		0.2	0.2	0.2	0.2	0.2	1.2	1.7
Cumulative Ca Release		0.2	0.4	0.6	0.8	1.0	2.2	3.9
Mg Release Rate		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cumulative Mg Release		0.2	0.4	0.6	0.8	1.0	1.2	1.4
Residual ANC (%)		100.0	100.0	100.0	100.0	100.0	99.9	99.9
Residual Sulfur (%)		99.7	99.2	98.7	97.9	97.6	96.9	96.3
SO_4/(Ca+Mg) molar ratio		3.15	5.67	6.30	8.51	3.78	2.73	1.82

<   indicates less than the analytical detection limit.   * Acidity and alkalinity data calculated in mg $CaCC_3$/L.

** SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential

ANZECC & ARCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water (low risk trigger levels).

$ The KLC leachate results for 18 November 2014 were extrapolated for all elements apart from chlorine, hexavalent chromium, fluoride, phosphorus and sulfate due to a technical issue at ALS laboratory.

RGS-KLC # 6 : Kogan Creek Project

KLC Test Results: Ash-to-Spoil at 1:1

Weight (kg)	1.46	Total S (%)	0.044	ANC	28.02
pH (1:5)	6.5	Scr (%)	0.023	NAPP	-27.32
EC (µS/cm)	824	MPA	0.70	ANC:MPA	39.88

Date		18-Sep-14	16-Oct-14	18-Nov-14	16-Dec-14	15-Jan-15	17-Feb-15	17-Mar-15
Week		0	4	9	13	17	22	26
Leach Number		1	2	3	4	5	6	7
ALS Laboratory Number		EB1442800	EB1444411	EB1446549[$]	EB1448658	EB1510868	EB1513033	EB1514936
Volume Collected (L)		0.698	0.807	0.653	0.722	0.630	0.693	0.701
Cum. Volume (L)		0.70	1.51	2.16	2.88	3.51	4.20	4.90
Pore Volumes		0.5	1.1	1.6	2.1	2.6	3.1	3.6
pH		9.99	9.02	8.95	9.30	9.37	9.41	9.24
EC (µS/cm)		2,840	1,398	643	258	153	115	91
Acidity (mg/L)*		<1	<1	<1	<1	<1	<1	<1
Hydroxide Alkalinity (mg/L)*		<1	<1	<1	41	<1	<1	<1
Carbonate Alkalinity (mg/L)*		221	58	41	53	22	13	15
Bicarbonate Alkalinity (mg/L)*		49	95	95	94	36	33	21
Total Alkalinity (mg/L)*		270	153	136	<1	58	46	36
Net Alkalinity (mg/L)*		270	153	136	94	58	46	36
Dissolved elements (mg/L)	**Guideline Limits [#]**							
Silver (Ag)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium (Al)	5	2.04	0.32	0.43	0.54	0.60	0.47	0.47
Arsenic (As)	0.5	0.136	0.112	0.074	0.035	0.018	0.012	0.009
Boron (B)	5	4.29	7.82	4.52	1.22	0.45	0.27	0.20
Barium (Ba)	-	0.044	0.021	0.013	0.004	0.004	0.004	0.005
Beryllium (Be)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	1,000	17	7	4	1	1	2	2
Cadmium (Cd)	0.01	0.0004	0.0001	0.001	<0.0001	<0.0001	<0.0001	<0.0001
Chloride (Cl)	-	610	81	30	9	3	3	2
Cobalt (Co)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	1	0.430	0.152	0.08	0.007	0.001	<0.001	<0.001
Hexavalent-(Cr)	0.001	0.491	0.146	0.029	0.007	<0.001	<0.001	<0.001
Copper (Cu)	1	0.003	0.001	0.001	<0.001	<0.001	<0.001	<0.001
Fluoride (F)	2	3.8	3.4	2.6	0.8	0.5	0.3	0.2
Iron (Fe)	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury (Hg)	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Potassium (K)	-	6	3	1	<1	<1	<1	<1
Magnesium (Mg)	-	<1	<1	<1	<1	<1	<1	<1
Manganese (Mn)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum (Mo)	0.15	1.83	0.51	0.29	0.058	0.016	0.008	0.006
Sodium (Na)	-	617	309	184	58	34	23	20
Nickel (Ni)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus (P)	-	0.27	1.04	2.88	8.64	6.54	4.65	3.83
Lead (Pb)	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sulfate (SO_4)	1,000	263	369	129	39	20	17	12
Antimony (Sb)	-	0.015	0.017	0.01	0.002	<0.001	<0.001	<0.001
Selenium (Se)	0.02	0.10	0.04	0.03	0.01	<0.01	<0.01	<0.01
Thallium (Tl)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium (Th)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium (U)	0.2	<0.001	0.006	0.004	0.002	0.001	<0.001	<0.001
Vanadium (V)	-	2.03	0.63	0.39	0.16	0.08	0.05	0.04
Zinc (Zn)	20	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	<0.005
Calculations **								
SO_4 Release Rate		126	205	58	19	9	8	6
Cumulative SO_4 Release		126	331	388	408	416	425	430
Ca Release Rate		8.1	3.9	1.8	0.5	0.4	1.0	1.0
Cumulative Ca Release		8.1	12.0	13.8	14.3	14.8	15.7	16.7
Mg Release Rate		0.2	0.3	0.2	0.2	0.2	0.2	0.2
Cumulative Mg Release		0.2	0.5	0.7	1.0	1.2	1.4	1.7
Residual ANC (%)		99.9	99.9	99.9	99.9	99.9	99.8	99.8
Residual Sulfur (%)		90.4	74.9	70.5	69.1	68.4	67.8	67.4
SO_4/(Ca+Mg) molar ratio		6.16	19.68	11.16	8.92	4.57	2.51	1.77

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential

[#] ANZECC & ARCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water (low risk trigger levels).

[$] The KLC leachate results for 18 November 2014 were extrapolated for all elements apart from chlorine, hexavalent chromium, fluoride, phosphorus and sulfate due to a technical issue at ALS laboratory.

RGS-KLC # 7 : Kogan Creek Project

KLC Test Results: Ash-to-Spoil at 1:5

Weight (kg)	1.45	**Total S (%)**	0.023	**ANC**	9.66
pH (1:5)	6.6	**Scr (%)**	0.018	**NAPP**	-9.10
EC (µS/cm)	297	**MPA**	0.56	**ANC:MPA**	17.33

Date		**18-Sep-14**	**16-Oct-14**	**18-Nov-14**	**16-Dec-14**	**15-Jan-15**	**17-Feb-15**	**17-Mar-15**
Week		**0**	**4**	**9**	**13**	**17**	**22**	**26**
Leach Number		**1**	**2**	**3**	**4**	**5**	**6**	**7**
ALS Laboratory Number		EB1442800	EB1444411	EB1446549$	EB1448658	EB1510868	EB1513033	EB1514936
Volume Collected (L)		0.867	0.599	0.650	0.753	0.736	0.702	0.740
Cum. Volume (L)		0.87	1.47	2.12	2.87	3.61	4.31	5.05
Pore Volumes		0.6	1.1	1.6	2.1	2.7	3.2	3.7
pH		8.53	9.50	9.18	9.02	8.69	8.67	8.43
EC (µS/cm)		1,310	226	147	113	81	89	68
Acidity (mg/L)*		<1	<1	2	<1	1	2	<1
Hydroxide Alkalinity (mg/L)*		<1	<1	<1	9	<1	<1	<1
Carbonate Alkalinity (mg/L)*		8	13	11	15	<1	<1	<1
Bicarbonate Alkalinity (mg/L)*		80	22	21	24	11	11	7
Total Alkalinity (mg/L)*		88	35	32	<1	11	11	7
Net Alkalinity (mg/L)*		88	35	30	24	10	9	7
Dissolved elements (mg/L)	**Guideline Limits #**							
Silver (Ag)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium (Al)	5	0.02	0.27	0.29	0.32	0.31	0.23	0.14
Arsenic (As)	0.5	0.033	0.008	0.006	0.004	0.002	0.002	<0.001
Boron (B)	5	0.65	0.25	0.17	0.09	0.08	<0.05	<0.05
Barium (Ba)	-	0.010	<0.001	<0.001	0.002	0.002	0.006	0.006
Beryllium (Be)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	1,000	4	<1	<1	<1	<1	2	2
Cadmium (Cd)	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chloride (Cl)	-	290	27	12	8	6	7	6
Cobalt (Co)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	1	0.071	0.002	0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent-(Cr)	0.001	0.076	<0.001	<0.001	<0.001	-	-	-
Copper (Cu)	1	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoride (F)	2	1.4	0.3	0.3	0.2	0.1	<0.1	<0.1
Iron (Fe)	-	<0.05	0.05	0.06	0.07	0.08	0.06	<0.05
Mercury (Hg)	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Potassium (K)	-	3	<1	<1	<1	<1	<1	<1
Magnesium (Mg)	-	2	<1	<1	<1	<1	<1	<1
Manganese (Mn)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum (Mo)	0.15	0.308	0.041	0.027	0.012	0.005	0.004	0.004
Sodium (Na)	-	264	43	34	25	14	11	9
Nickel (Ni)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus (P)	-	1.70	3.52	4.06	2.91	1.53	1.32	1.07
Lead (Pb)	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sulfate (SO_4)	1,000	138	29	24	25	15	15	15
Antimony (Sb)	-	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (Se)	0.02	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium (Tl)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium (Th)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium (U)	0.2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (V)	-	0.10	0.03	0.02	0.02	0.01	<0.01	<0.01
Zinc (Zn)	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calculations**								
SO_4 Release Rate		83	12	11	13	8	7	8
Cumulative SO_4 Release		83	94	105	118	126	133	141
Ca Release Rate		2.4	0.2	0.2	0.3	0.3	1.0	1.0
Cumulative Ca Release		2.4	2.6	2.8	3.1	3.3	4.3	5.3
Mg Release Rate		1.2	0.2	0.2	0.3	0.3	0.2	0.3
Cumulative Mg Release		1.2	1.4	1.6	1.9	2.1	2.4	2.6
Residual ANC (%)		99.9	99.9	99.9	99.8	99.8	99.8	99.8
Residual Sulfur (%)		88.0	86.3	84.7	82.8	81.7	80.7	79.6
SO_4/(Ca+Mg) molar ratio		7.89	9.14	7.56	7.88	4.73	2.22	2.22

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.

** SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential

ANZECC & ARCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water (low risk trigger levels).

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RGS-KLC # 8 : Kogan Creek Project

KLC Test Results: Ash-to-Spoil at 1:10

Weight (kg)	1.68	**Total S (%)**	0.024	**ANC**	8.61
pH (1:5)	6.5	**Scr (%)**	0.020	**NAPP**	-8.00
EC (µS/cm)	270	**MPA**	0.61	**ANC:MPA**	14.16

Date		**18-Sep-14**	**16-Oct-14**	**18-Nov-14**	**16-Dec-14**	**15-Jan-15**	**17-Feb-15**	**17-Mar-15**
Week		**0**	**4**	**9**	**13**	**17**	**22**	**26**
Leach Number		**1**	**2**	**3**	**4**	**5**	**6**	**7**
ALS Laboratory Number		EB1442800	EB1444411	EB1446549$	EB1448658	EB1510868	EB1513033	EB1514936
Volume Collected (L)		0.693	0.656	0.609	0.748	0.754	0.684	0.723
Cum. Volume (L)		0.69	1.35	1.96	2.71	3.46	4.14	4.87
Pore Volumes		0.5	1.0	1.5	2.0	2.6	3.1	3.6
pH		8.07	9.44	8.99	8.92	8.70	8.49	8.60
EC (µS/cm)		1,490	162	120	104	82	75	82
Acidity (mg/L)*		3	<1	2	<1	1	2	<1
Hydroxide Alkalinity (mg/L)*		<1	<1	<1	5	<1	<1	<1
Carbonate Alkalinity (mg/L)*		<1	10	5	16	<1	<1	<1
Bicarbonate Alkalinity (mg/L)*		88	20	18	20	12	8	5
Total Alkalinity (mg/L)*		88	30	23	<1	12	8	5
Net Alkalinity (mg/L)*		85	30	21	20	11	6	5
Dissolved elements (mg/L)	**Guideline Limits #**							
Silver (Ag)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium (Al)	5	<0.01	0.35	0.35	0.34	0.41	0.29	0.17
Arsenic (As)	0.5	0.026	0.006	0.005	0.003	0.002	0.002	<0.001
Boron (B)	5	0.45	0.12	0.1	0.07	<0.05	<0.05	<0.05
Barium (Ba)	-	0.015	<0.001	<0.001	<0.001	0.001	0.002	0.002
Beryllium (Be)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	1,000	5	<1	<1	<1	<1	<1	<1
Cadmium (Cd)	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chloride (Cl)	-	338	21	13	11	8	8	8
Cobalt (Co)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	1	0.041	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent-(Cr)	0.001	0.045	<0.001	<0.001	<0.001	-	-	-
Copper (Cu)	1	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fluoride (F)	2	1.4	0.2	0.2	0.1	0.1	<0.1	<0.1
Iron (Fe)	-	<0.05	0.1	0.1	0.1	0.13	0.1	0.05
Mercury (Hg)	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Potassium (K)	-	3	<1	<1	<1	<1	<1	<1
Magnesium (Mg)	-	3	<1	<1	<1	<1	<1	<1
Manganese (Mn)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum (Mo)	0.15	0.192	0.022	0.016	0.010	0.005	0.003	0.003
Sodium (Na)	-	292	33	28	23	16	12	14
Nickel (Ni)	1	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus (P)	-	2.63	4.00	3.26	2.86	1.8	1.42	1.02
Lead (Pb)	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sulfate (SO_4)	1,000	161	22	20	20	15	17	15
Antimony (Sb)	-	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (Se)	0.02	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium (Tl)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium (Th)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium (U)	0.2	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (V)	-	0.05	0.02	0.01	0.01	<0.01	<0.01	<0.01
Zinc (Zn)	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calculations**								
SO_4 Release Rate		66	9	7	9	7	7	6
Cumulative SO_4 Release		66	75	82	91	98	105	111
Ca Release Rate		2.1	0.2	0.2	0.2	0.2	0.2	0.2
Cumulative Ca Release		2.1	2.3	2.4	2.7	2.9	3.1	3.3
Mg Release Rate		1.2	0.2	0.2	0.2	0.2	0.2	0.2
Cumulative Mg Release		1.2	1.4	1.6	1.8	2.1	2.3	2.5
Residual ANC (%)		99.9	99.9	99.9	99.8	99.8	99.8	99.8
Residual Sulfur (%)		90.8	89.6	88.6	87.4	86.4	85.5	84.6
SO_4/(Ca+Mg) molar ratio		6.75	6.93	6.30	6.30	4.73	5.36	4.73

< indicates less than the analytical detection limit.   * Acidity and alkalinity data calculated in mg $CaCC_3$/L.

** SO_4, Ca and Mg release rates calculated in mg/kg/flush.

Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity

MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential

ANZECC & ARCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water (low risk trigger levels).

$ The KLC leachate results for 18 November 2014 were extrapolated for all elements apart from chlorine, hexavalent chromium, fluoride, phosphorus and sulfate due to a technical issue at ALS laboratory.

RGS-KLC # 9 : Kogan Creek Project

KLC Test Results: Ash-to-Spoil at 1:20

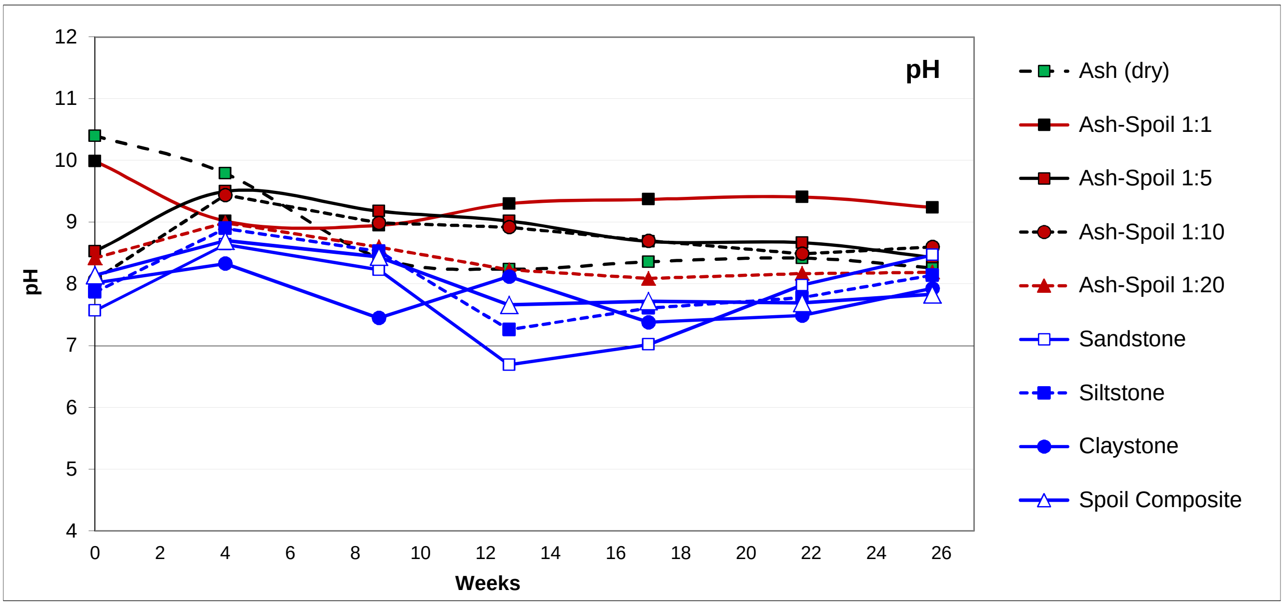
Weight (kg)	1.65	**Total S (%)**	0.024	**ANC**	8.08
pH (1:5)	6.5	**Scr (%)**	0.021	**NAPP**	-7.45
EC (µS/cm)	256	**MPA**	0.63	**ANC:MPA**	12.75

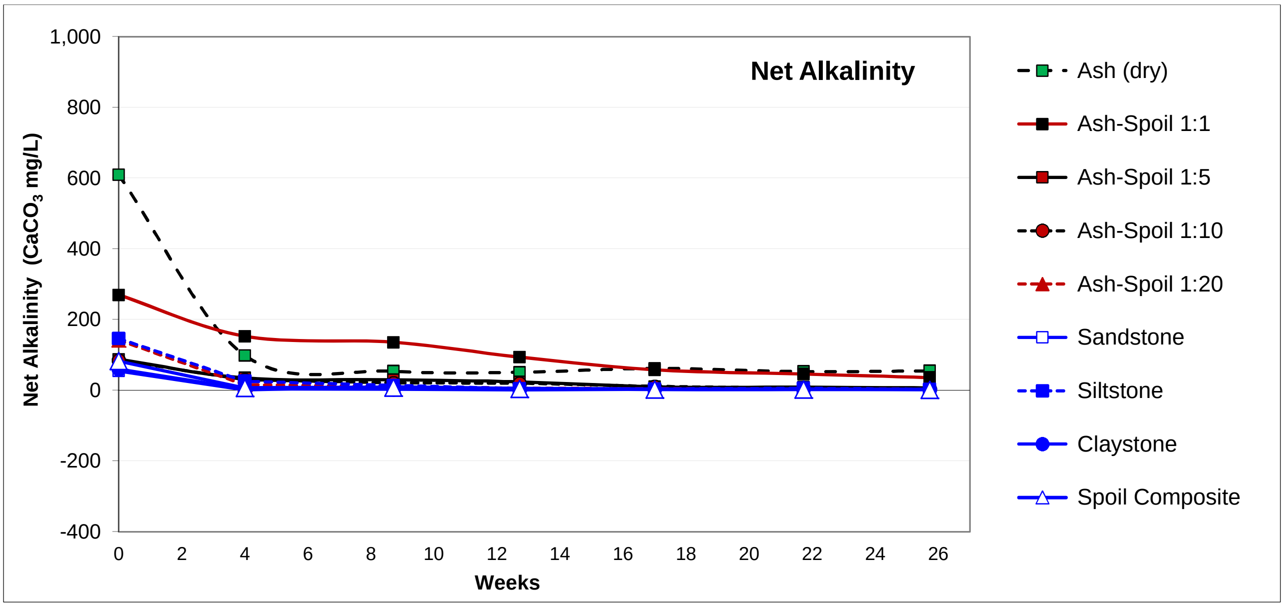
Date	**18-Sep-14**	**16-Oct-14**	**18-Nov-14**	**16-Dec-14**	**15-Jan-15**	**17-Feb-15**	**17-Mar-15**
Week	**0**	**4**	**9**	**13**	**17**	**22**	**26**
Leach Number	**1**	**2**	**3**	**4**	**5**	**6**	**7**
ALS Laboratory Number	EB1442800	EB1444411	EB1446549$	EB1448658	EB1510868	EB1513033	EB1514936
Volume Collected (L)	0.657	0.834	0.721	0.772	0.809	0.779	0.787
Cum. Volume (L)	0.66	1.49	2.21	2.98	3.79	4.57	5.36
Pore Volumes	0.5	1.1	1.6	2.2	2.8	3.4	4.0
pH	8.42	8.99	8.60	8.23	8.09	8.17	8.19
EC (µS/cm)	1,120	141	73	74	59	63	56
Acidity (mg/L)*	<1	<1	2	<1	2	2	1
Hydroxide Alkalinity (mg/L)*	<1	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity (mg/L)*	24	2	<1	8	<1	<1	<1
Bicarbonate Alkalinity (mg/L)*	118	14	13	8	7	7	4
Total Alkalinity (mg/L)*	142	16	13	2	7	7	4
Net Alkalinity (mg/L)*	142	16	11	6	5	5	3

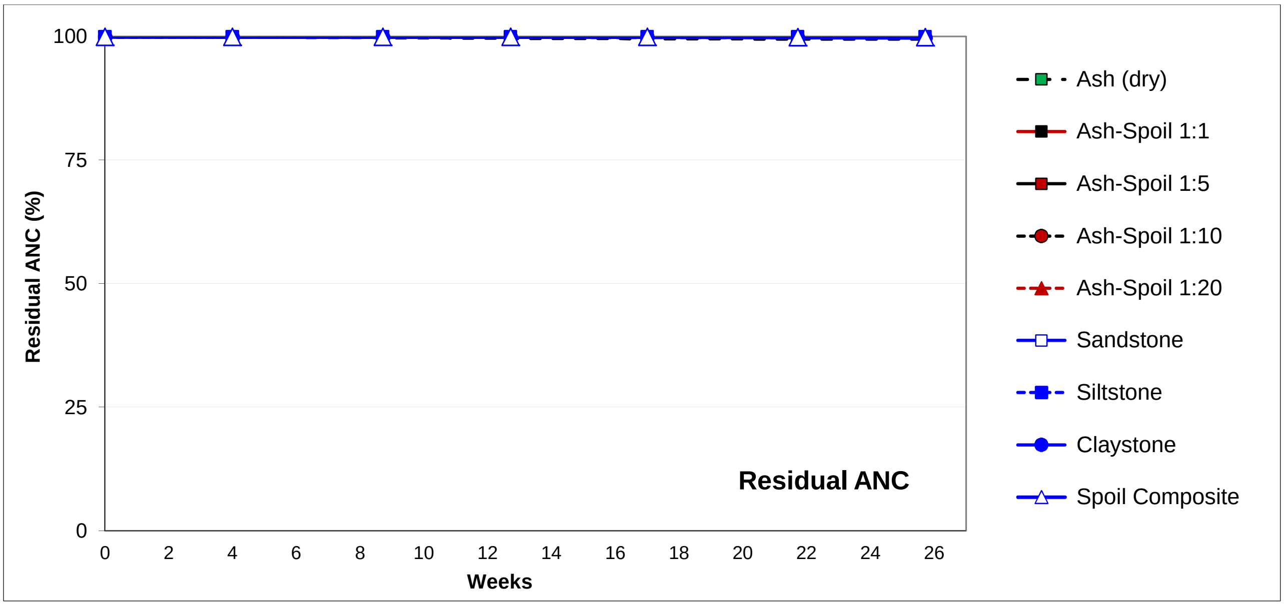
Dissolved elements (mg/L)	**Guideline Limits #**						
Silver (Ag)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminium (Al)	5	0.01	0.24	0.22	0.19	0.28	0.22	0.23
Arsenic (As)	0.5	0.045	0.003	0.002	0.001	0.001	<0.001	<0.001
Boron (B)	5	0.24	0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium (Ba)	-	0.003	<0.001	<0.001	0.003	0.001	0.003	0.004
Beryllium (Be)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Calcium (Ca)	1,000	1	<1	<1	<1	<1	1	2
Cadmium (Cd)	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chloride (Cl)	-	234	14	4	4	3	3	3
Cobalt (Co)	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	1	0.004	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexavalent-(Cr)	0.001	<0.001	<0.001	<0.001	<0.001	-	-	-
Copper (Cu)	1	0.003	0.002	0.002	<0.001	<0.001	<0.001	<0.001
Fluoride (F)	2	1.8	0.1	<0.1	0.1	<0.1	<0.1	<0.1
Iron (Fe)	-	<0.05	0.07	0.07	0.07	0.11	0.07	0.07
Mercury (Hg)	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Potassium (K)	-	3	<1	<1	<1	<1	<1	<1
Magnesium (Mg)	-	<1	<1	<1	<1	<1	<1	<1
Manganese (Mn)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum (Mo)	0.15	0.092	0.013	0.008	0.003	0.002	0.002	0.002
Sodium (Na)	-	239	29	0.2	13	10	8	7
Nickel (Ni)	1	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phosphorus (P)	-	9.64	2.35	3.01	2.08	1.47	1.55	1.32
Lead (Pb)	0.1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Sulfate (SO_4)	1,000	98	23	17	19	13	16	15
Antimony (Sb)	-	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (Se)	0.02	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium (Tl)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thorium (Th)	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium (U)	0.2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vanadium (V)	-	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc (Zn)	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

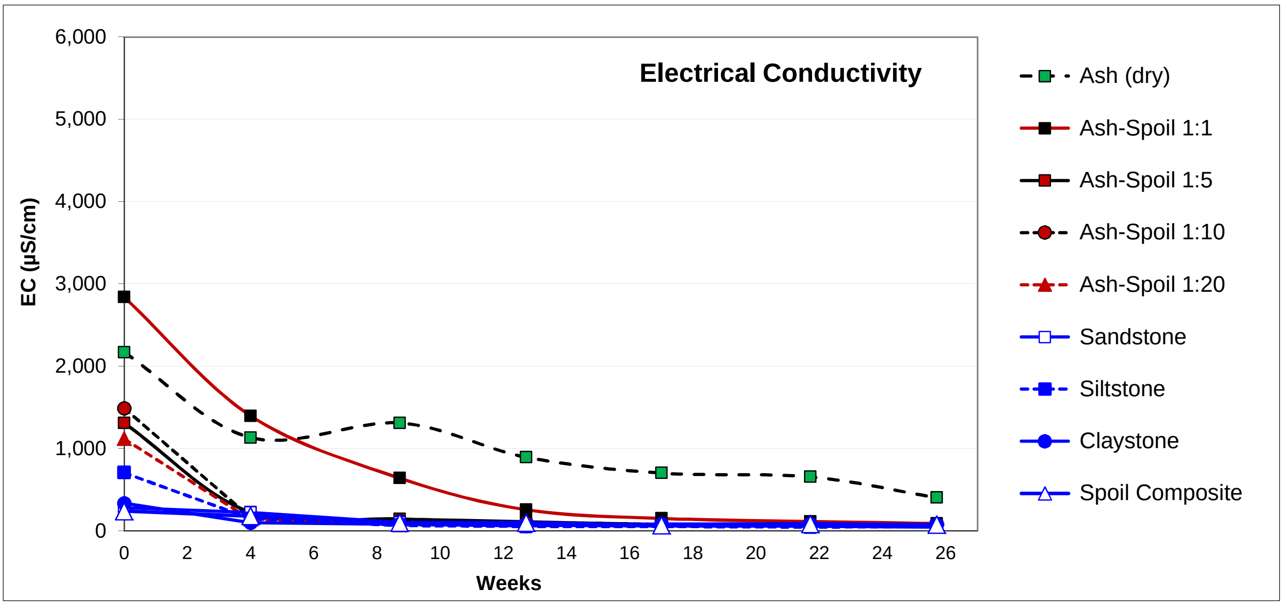
Calculations**							
SO_4 Release Rate	39	12	7	9	6	8	7
Cumulative SO_4 Release	39	51	58	67	74	81	88
Ca Release Rate	0.4	0.3	0.2	0.2	0.2	0.5	1.0
Cumulative Ca Release	0.4	0.7	0.9	1.1	1.4	1.8	2.8
Mg Release Rate	0.2	0.3	0.2	0.2	0.2	0.2	0.2
Cumulative Mg Release	0.2	0.5	0.7	0.9	1.2	1.4	1.6
Residual ANC (%)	100.0	100.0	99.9	99.9	99.9	99.9	99.8
Residual Sulfur (%)	94.6	92.9	91.9	90.7	89.8	88.7	87.7
SO_4/(Ca+Mg) molar ratio	22.41	7.25	5.36	5.99	4.10	3.66	2.22

< indicates less than the analytical detection limit. * Acidity and alkalinity data calculated in mg $CaCO_3$/L.
** SO_4, Ca and Mg release rates calculated in mg/kg/flush.
Total S = Total Sulfur; Scr = Chromium Reducible Sulfur; and ANC = Acid Neutralising Capacity
MPA = Maximum Potential Acidity, and NAPP = Net Acid Producing Potential
# ANZECC & ARCANZ (2000). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT (2000). Livestock drinking water (low risk trigger levels).
$ The KLC leachate results for 18 November 2014 were extrapolated for all elements apart from chlorine, hexavalent chromium, fluoride, phosphorus and sulfate due to a technical issue at ALS laboratory.

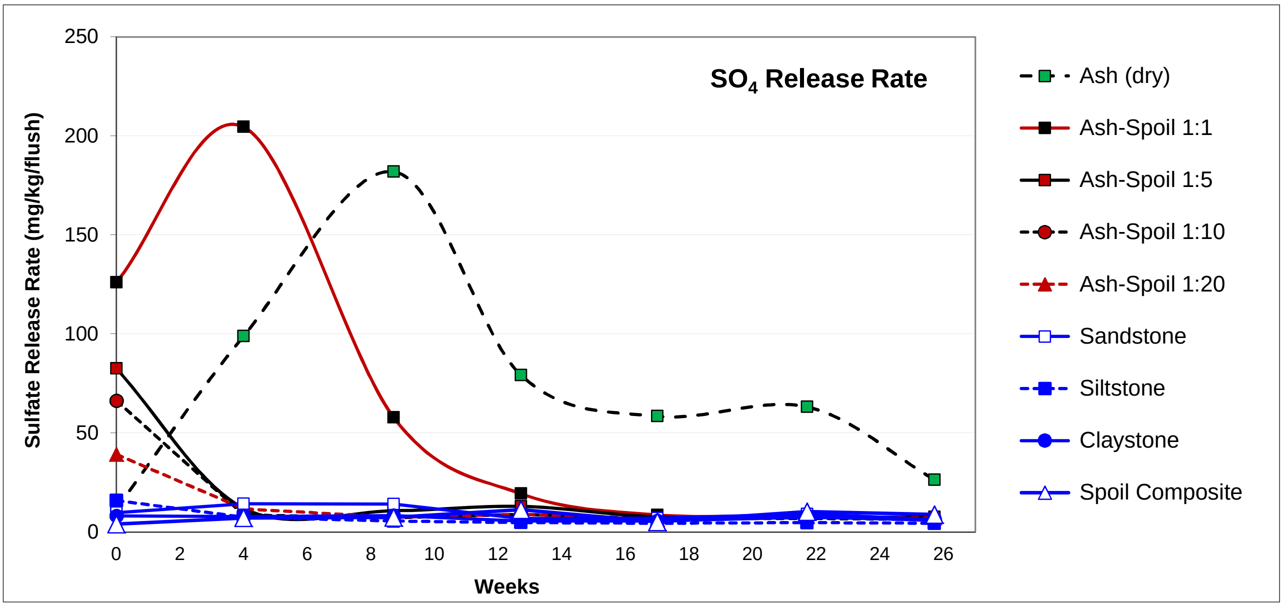

pH
12
11
10
9
8
7
6
5
4
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite


Net Alkalinity
Net Alkalinity (CaCO3 mg/L)
1,000
800
600
400
200
0
-200
-400
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite

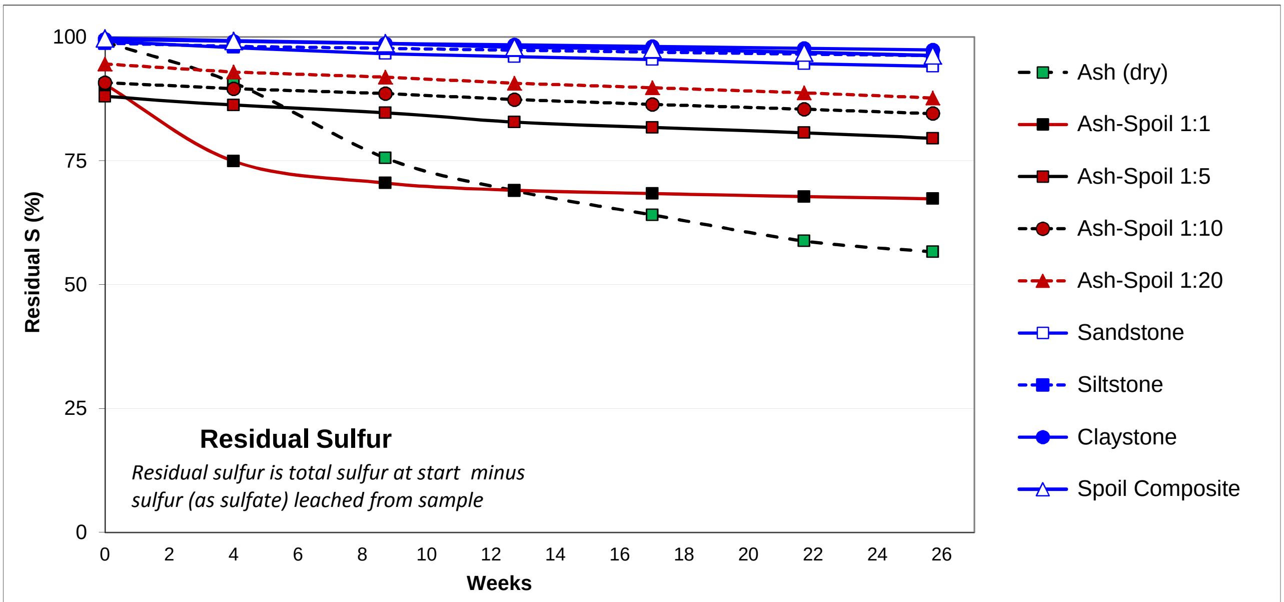

Residual ANC
Residual ANC (%)
100
75
50
25
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite



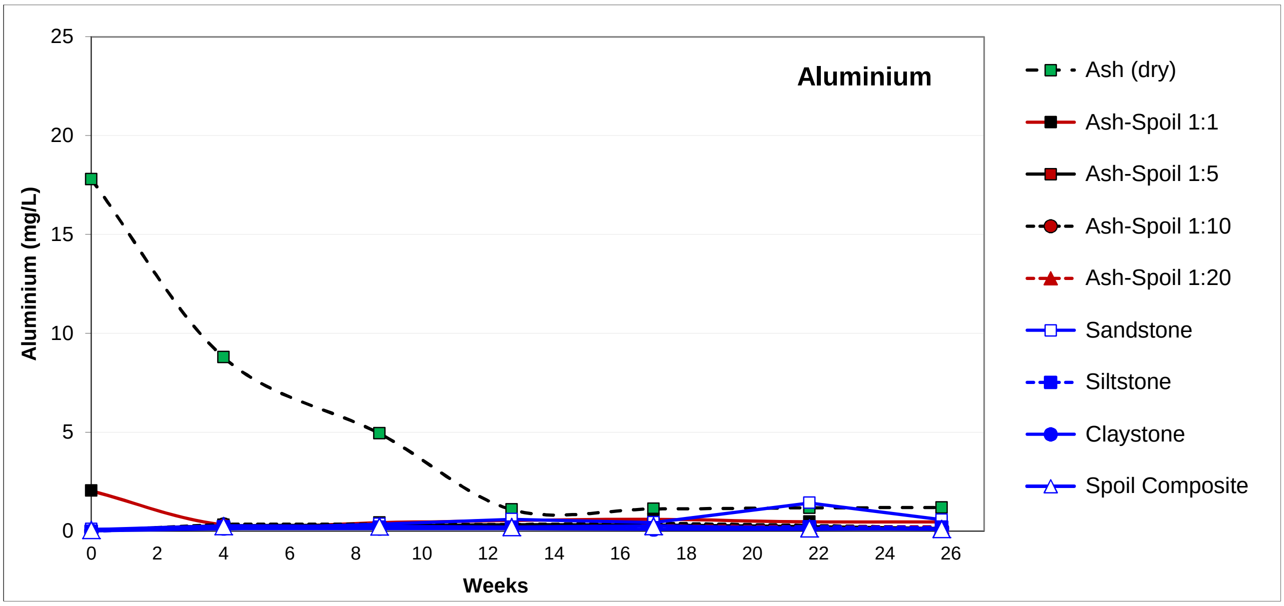
Electrical Conductivity
EC (µS/cm)
6,000
5,000
4,000
3,000
2,000
1,000
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite



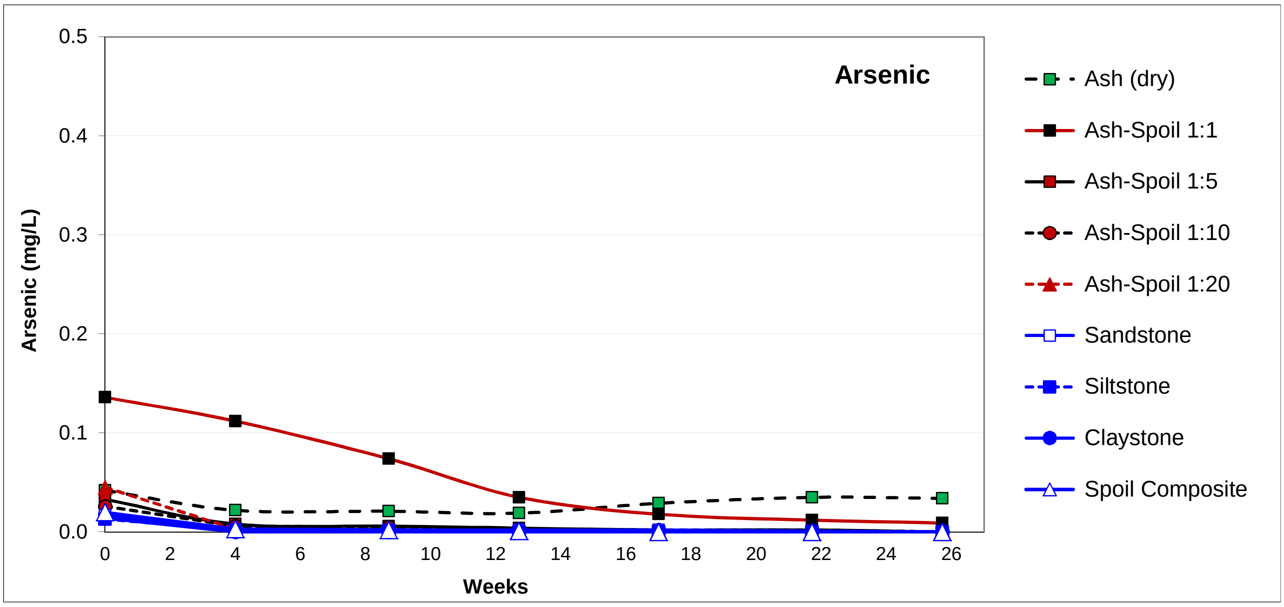
SO_4 Release Rate
Sulfate Release Rate (mg/kg/flush)
250
200
150
100
50
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite



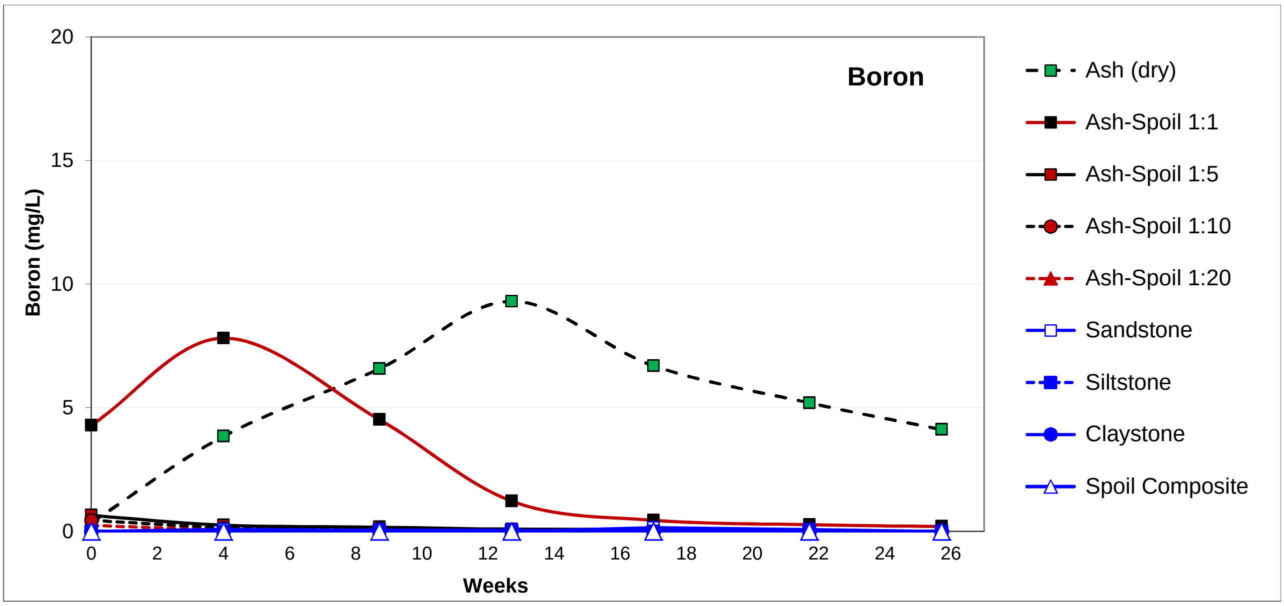
Residual Sulfur
Residual sulfur is total sulfur at start minus sulfur (as sulfate) leached from sample
Residual S (%)
100
75
50
25
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite



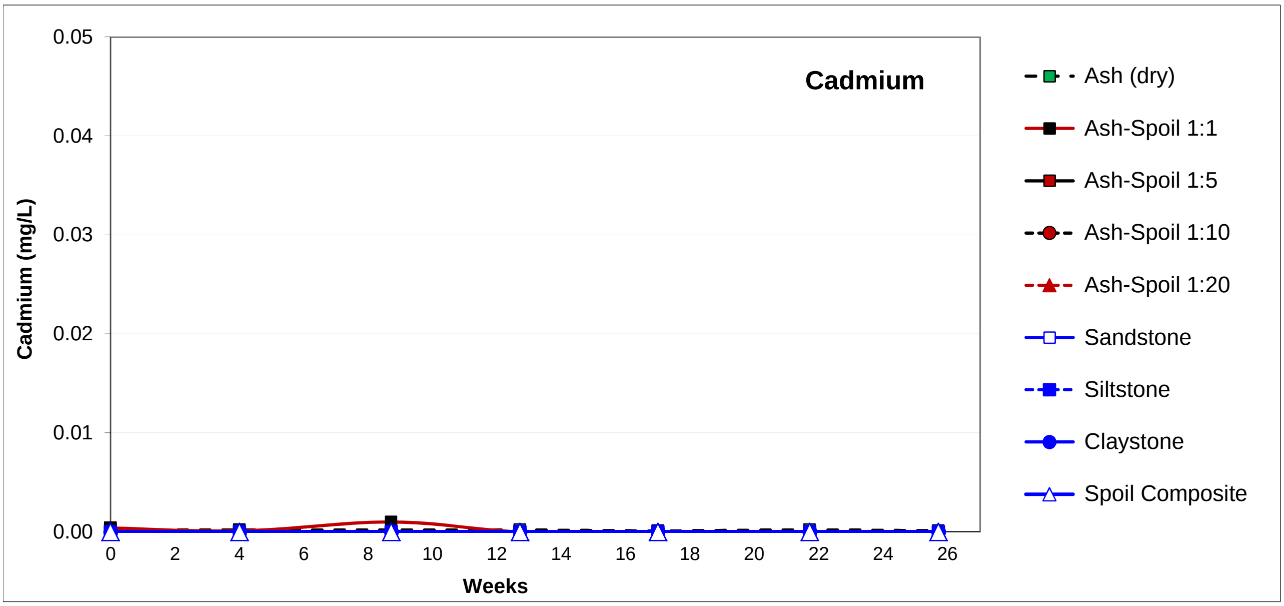
Aluminium
Aluminium (mg/L)
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite

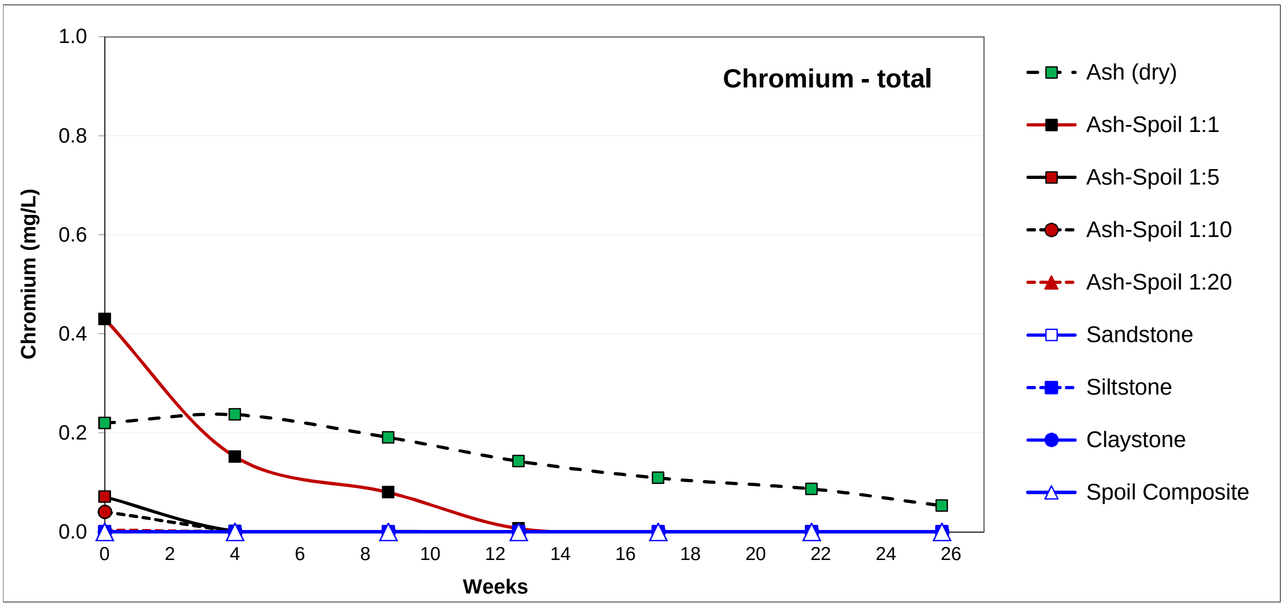


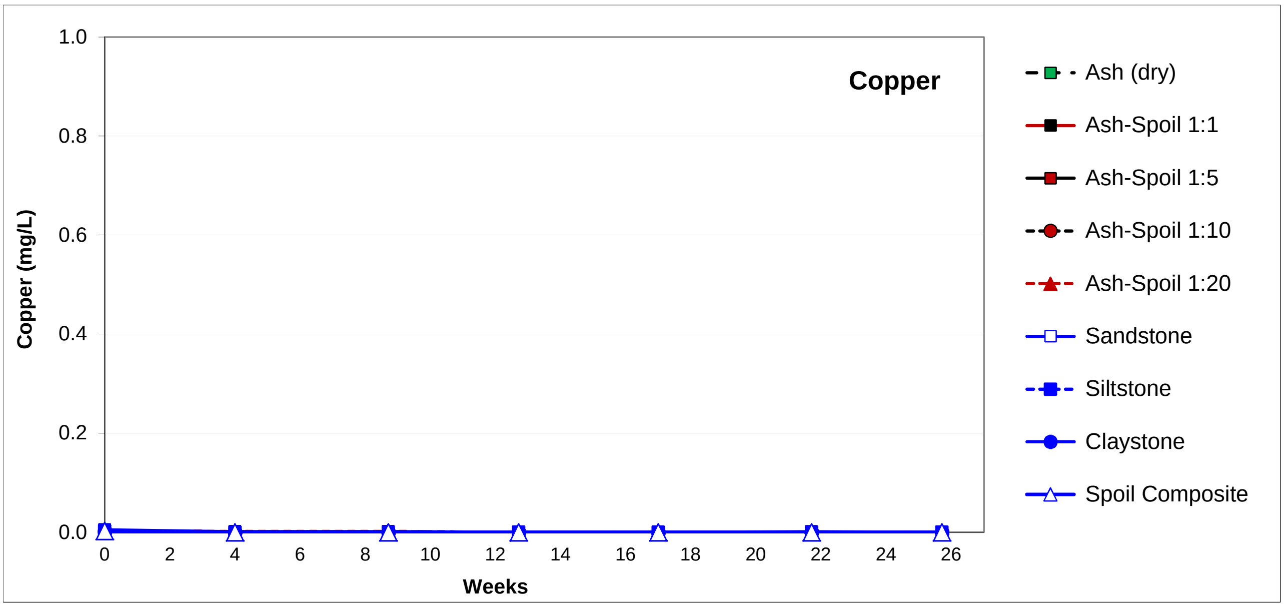
Arsenic
Arsenic (mg/L)
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite

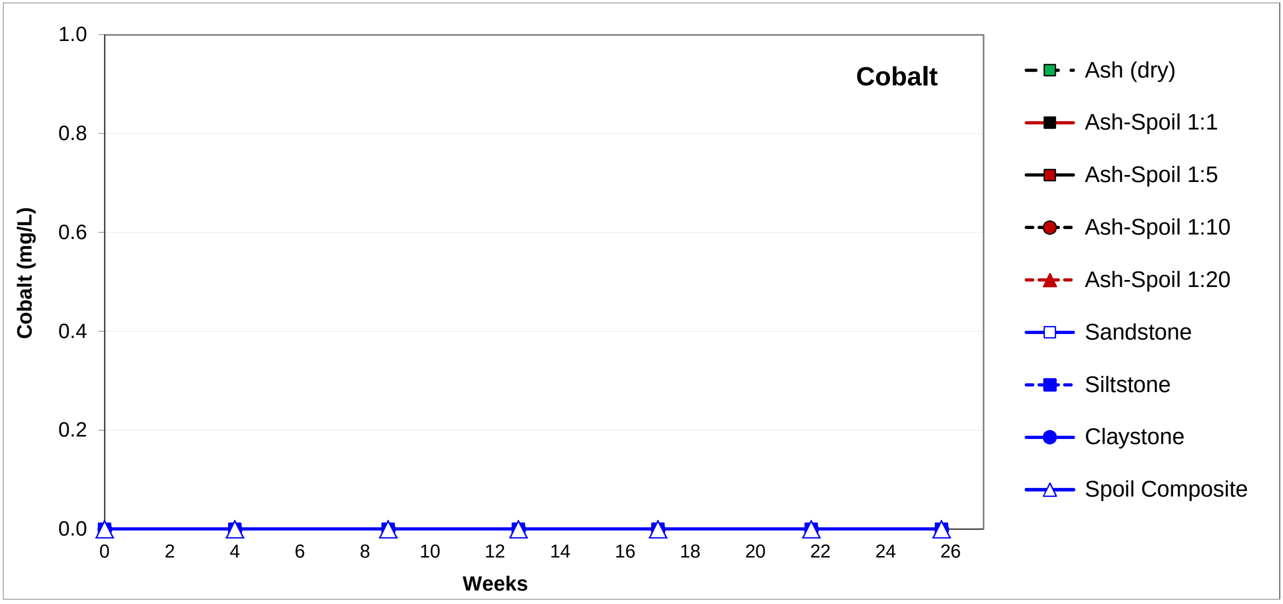


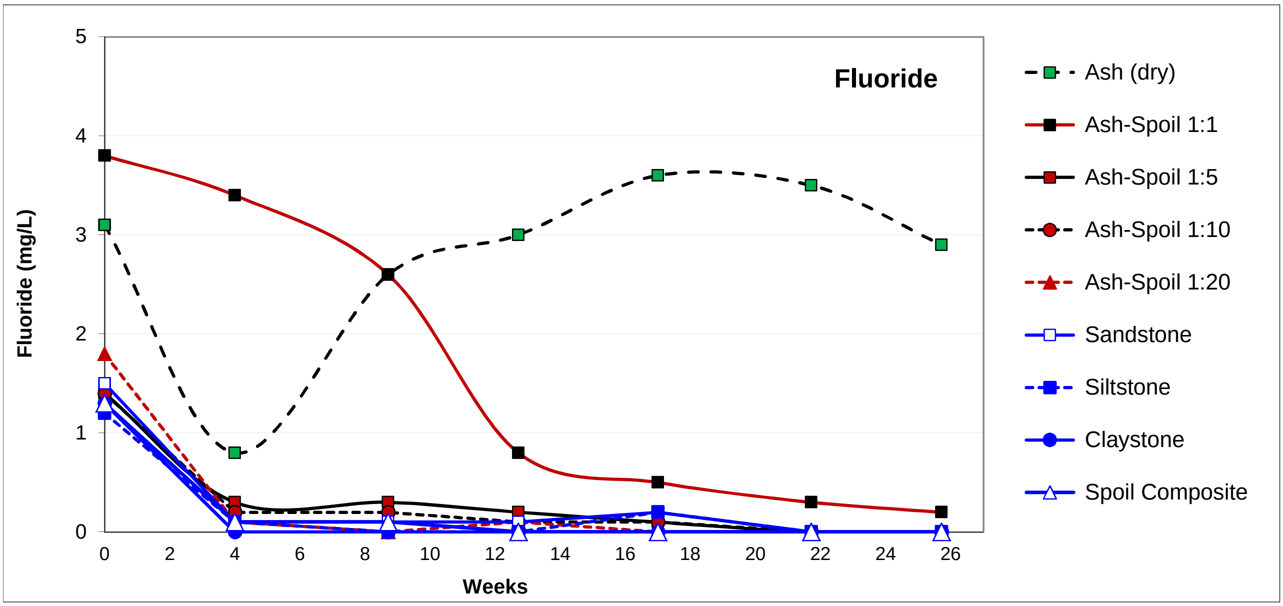
Boron
Boron (mg/L)
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite

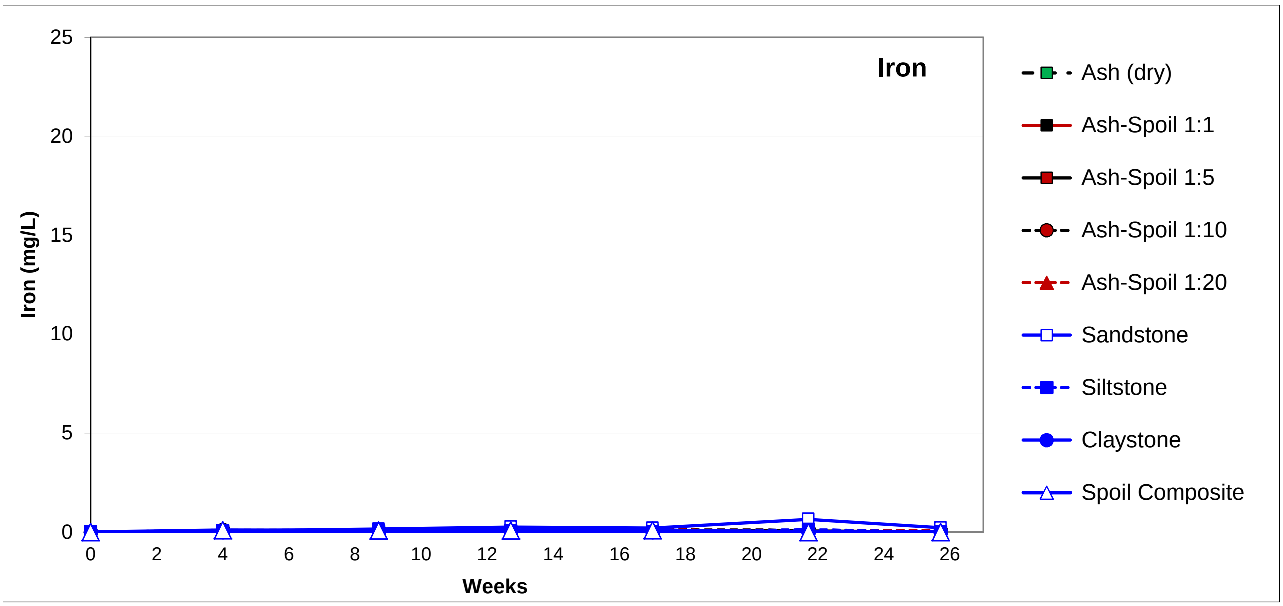

Cadmium
Cadmium (mg/L)
0.05
0.04
0.03
0.02
0.01
0.00
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite

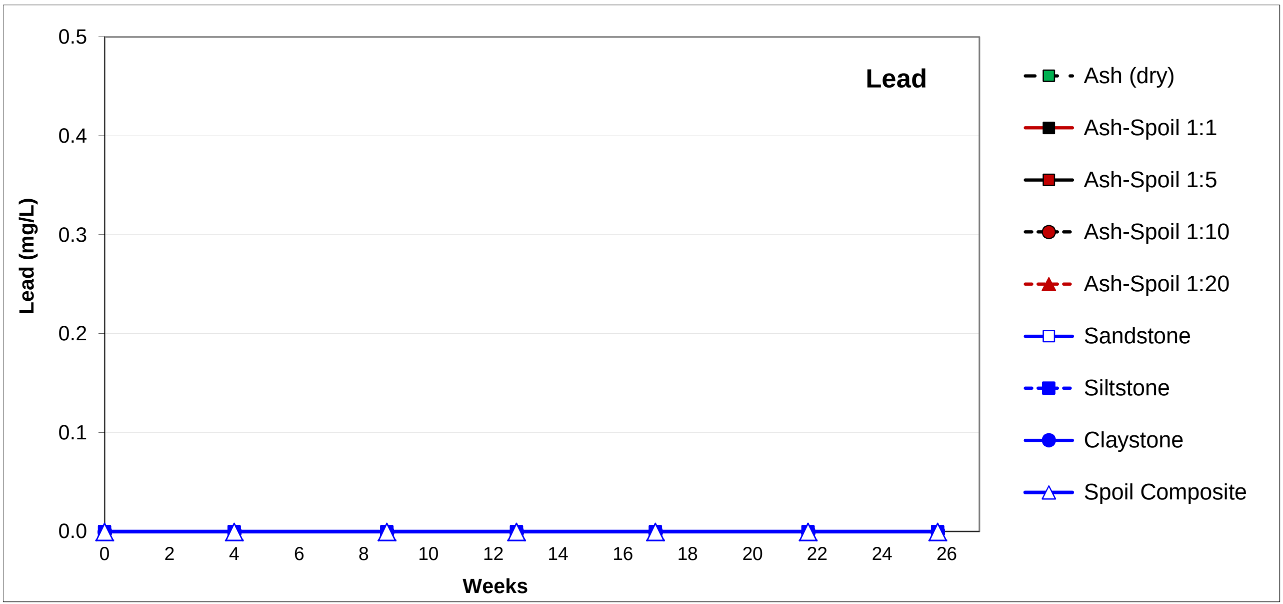

Chromium - total
Chromium (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite


Copper
Copper (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite

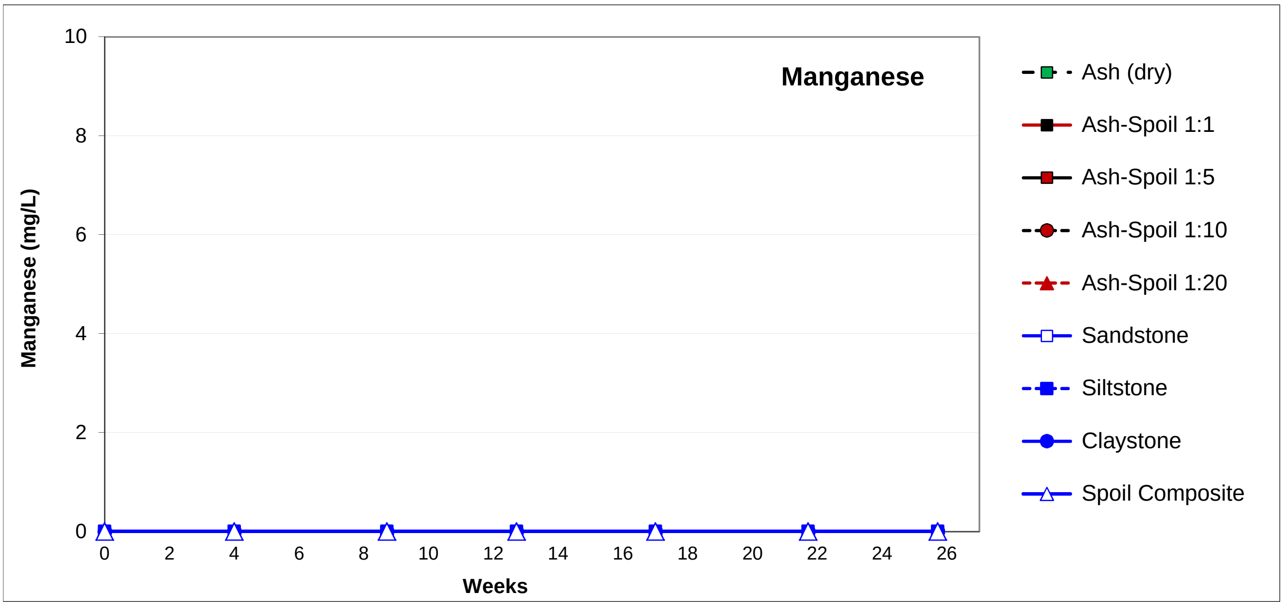

Cobalt
Cobalt (mg/L)
1.0
0.8
0.6
0.4
0.2
0.0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite


Fluoride
Fluoride (mg/L)
5
4
3
2
1
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite

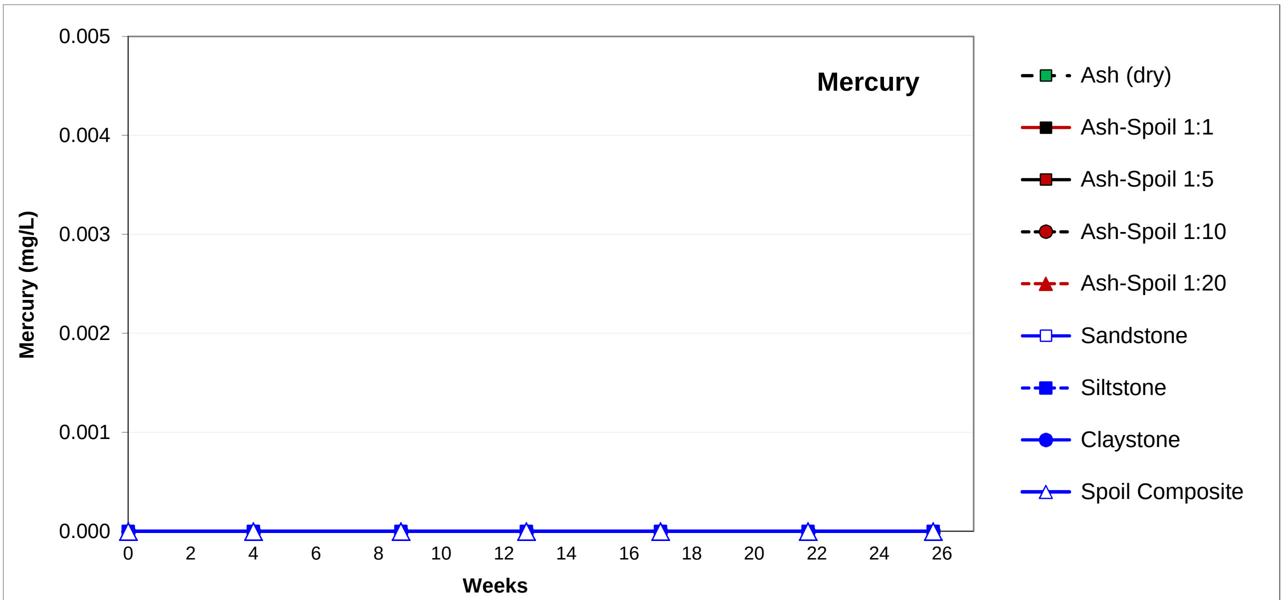

Iron
Iron (mg/L)
25
20
15
10
5
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite



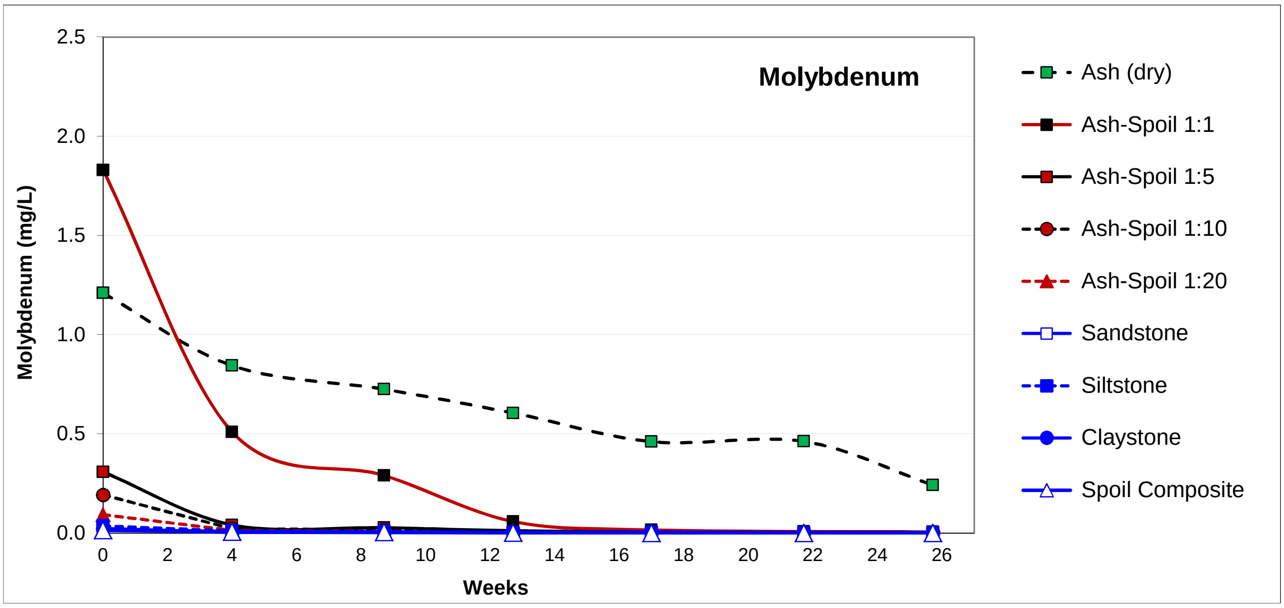
Lead
Lead (mg/L)
0.5
0.4
0.3
0.2
0.1
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite

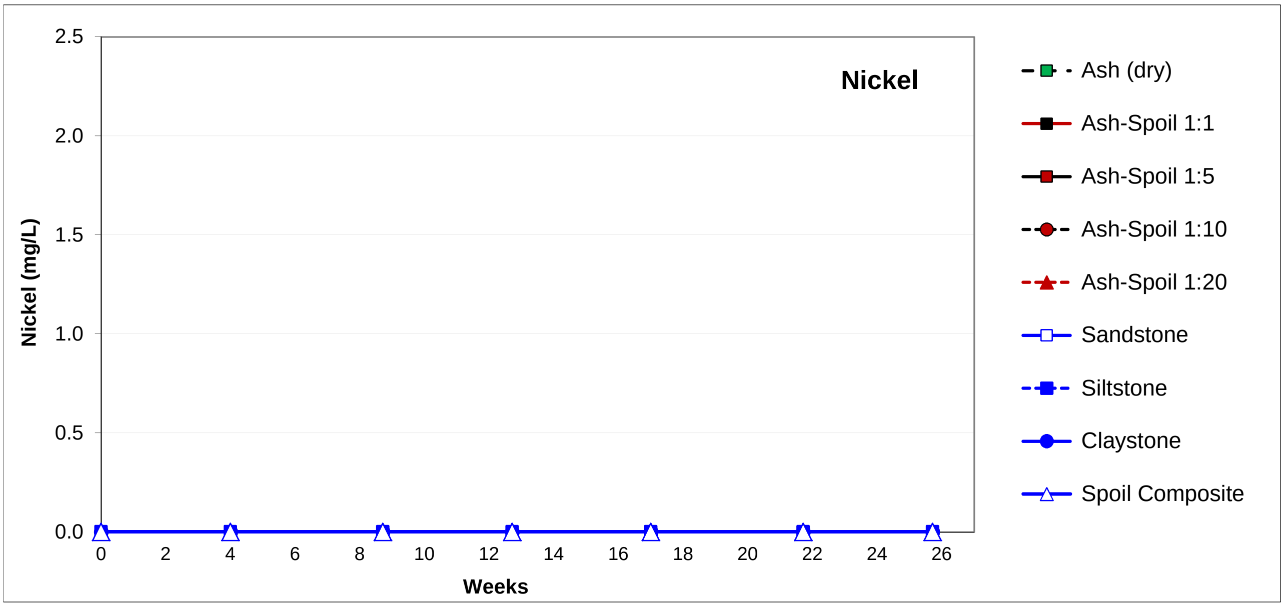


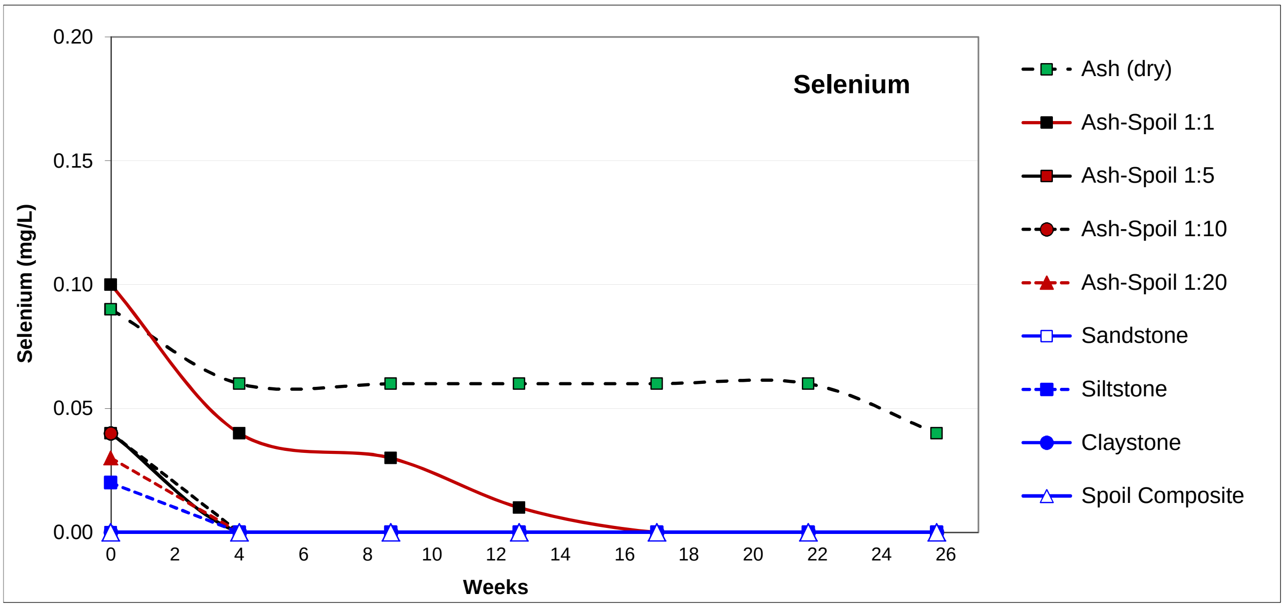
Manganese
Manganese (mg/L)
10
8
6
4
2
0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite

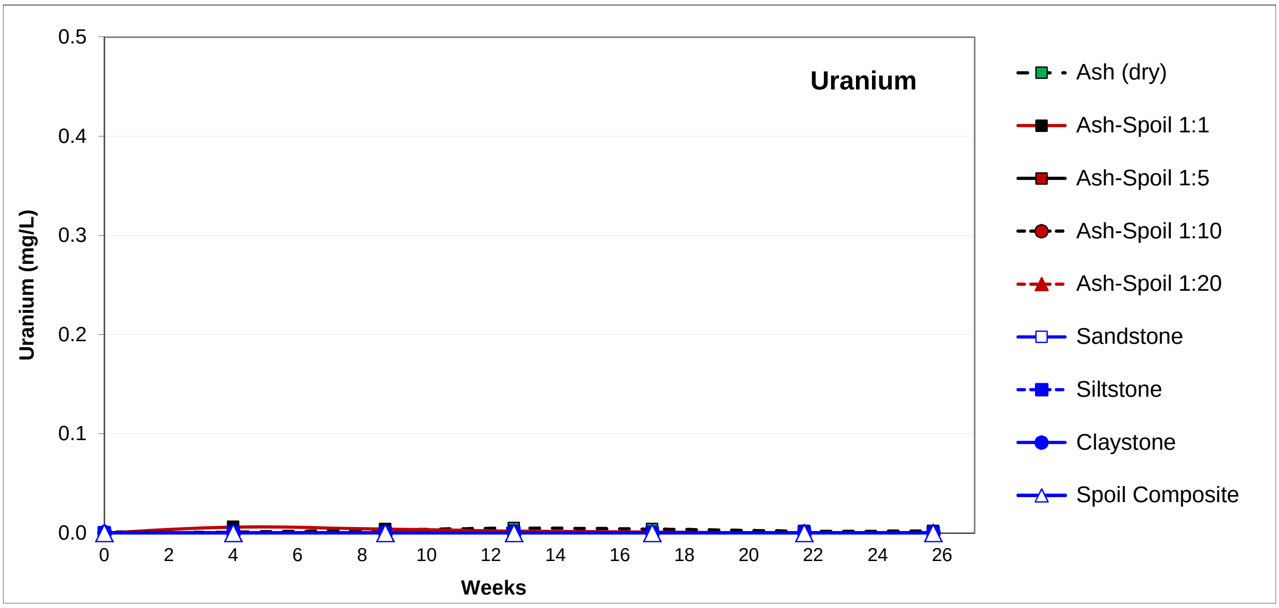


Mercury
Mercury (mg/L)
0.005
0.004
0.003
0.002
0.001
0.000
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite

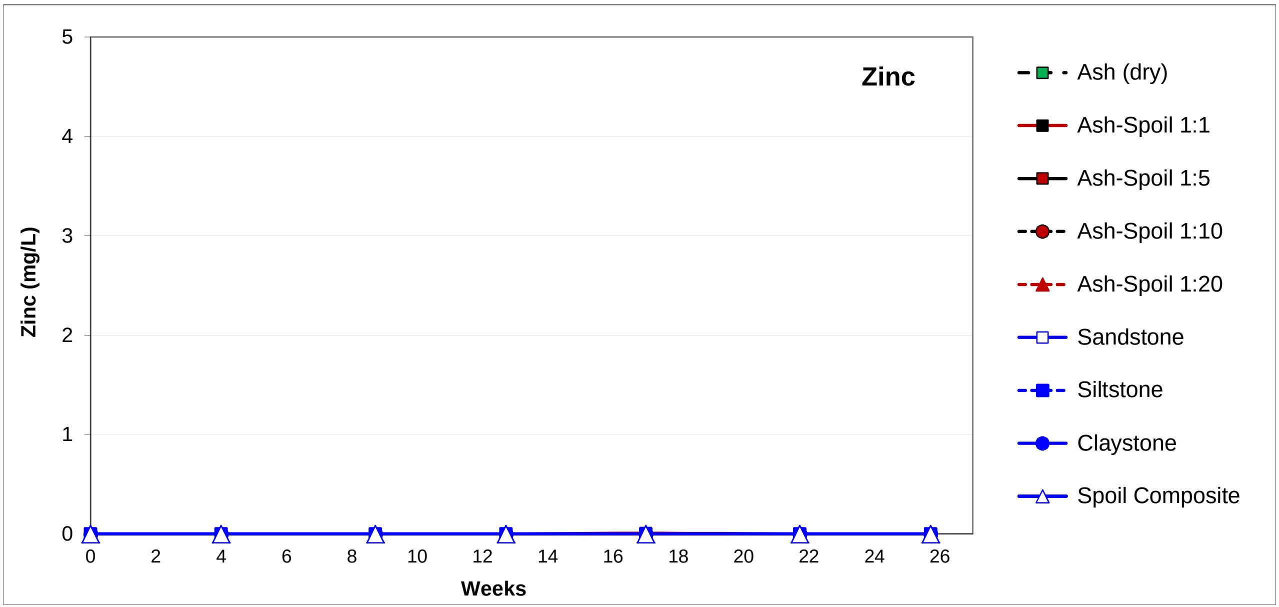

Molybdenum
Molybdenum (mg/L)
2.5
2.0
1.5
1.0
0.5
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite


Nickel
Nickel (mg/L)
2.5
2.0
1.5
1.0
0.5
0.0
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite


Selenium
Selenium (mg/L)
0.20
0.15
0.10
0.05
0.00
0
2
4
6
8
10
12
14
16
18
20
22
24
26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite



Uranium
Uranium (mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite



Zinc
Zinc (mg/L)
0
1
2
3
4
5
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Weeks
Ash (dry)
Ash-Spoil 1:1
Ash-Spoil 1:5
Ash-Spoil 1:10
Ash-Spoil 1:20
Sandstone
Siltstone
Claystone
Spoil Composite

RGS

LEADERS IN MINING
GEOCHEMISTRY