Crescent Newcastle Pty Ltd
Proposed Multi - Building Residential Development
11-17 Mosbri Crescent, The Hill, Newcastle

754-NTLGE220504-AO.Rev5

Mine Subsidence Grouting Remediation Strategy
Summary Report

9 November 2021



Technology
is the product
of intelligence
not the
cause of it

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Proposed Multi-Building Residential Development

Prepared for
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9 November 2021

754-NTLGE220504-AO.Rev5

Quality information

Revision history

Revision	Description	Date	Originator	Reviewer	Approver
V0 Draft	Initial Issue	18/08/2020	Simon Baker	Jules Darras	Simon Baker
Revision 1	Updated Report	19/08/2020	Simon Baker	Jules Darras	Simon Baker
Revision 2	Updated Report	24/08/2020	Simon Baker	Jules Darras	Simon Baker
Revision 3	Updated Report	20/10/2020	Simon Baker	Jules Darras	Simon Baker
Revision 4	Updated Report	21/08/2021	Simon Baker	Jules Darras	Simon Baker
Revision 5	Updated Report	9/11/2021	Simon Baker	Jules Darras	Simon Baker

Distribution

Report Status	No. of copies	Format	Distributed to	Date
V0 Draft	1	PDF	Richard Anderson – Mark Purdy	18/08/2020
Revision 1	1	PDF	Richard Anderson – Mark Purdy	19/08/2020
Revision 2	1	PDF	Richard Anderson – Mark Purdy	24/08/2020
Revision 3	1	PDF	Richard Anderson – Mark Purdy	20/10/2020
Revision 4	1	PDF	Richard Anderson – Mark Purdy	4/08/2021
Revision 5	1	PDF	Richard Anderson – Mark Purdy	9/11/2021

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Executive Summary

The Site located at 11-17 Mosbri Crescent in Cooks Hill is known to be located over abandoned workings in both the Yard Seam and the Borehole Seam which was mined by the Australian Agricultural Company (AACo). The Yard Seam mine workings are at a depth of 41m to 45m while the Borehole Seam is at a depth of 90m to 100m with variations due to surface topography.

While the workings are currently supporting the overburden, should the coal pillars fail, the resultant surface response was assessed to have the potential to be too large for the proposed development. As such, remediation in the form of mine grouting has been proposed for The Site.

Two remediation methods have been proposed for The Site to account for the two different abandoned mine workings. Due to the unmapped nature of the mine workings within the Yard Seam, Coffey developed a strategy which recommends drilling a regular pattern of boreholes at 10m centres in the north south direction and 20m centres in the east west direction. This will allow some mapping of the actual voids and/or workings at mine level. Where voids are encountered, grout will be injected to fill the void (refer to Drawing 3).

For the Borehole Seam however, as the mine workings are mapped, due to this seam being mined at a later date, it was decided a more targeted approach was appropriate. The strategy developed by Ditton Geotechnical Services (DgS) in consultation with Coffey Services Australia Pty Ltd (Coffey), taking account of recommendations by Subsidence Advisory NSW (SANSW) and Galvin and Associates Pty Ltd (GAPL), involves grouting bords each side of selected coal pillars creating large coal pillars that extend across the whole site, while leaving some bords ungrouted. The positive effect of the grouting was modelled using a combination of Lamodel (boundary element numerical model) to assess the revised pillar stability with the subsidence profile assessed using SDPS 3-D Influence Function Model.

Since the initial Development Application, minor modifications to the proposed building layout have been developed (Appendix E). With the above in mind DgS has reconfigured the grouting layout in their latest report. This layout is based on an earlier layout reviewed and approved by SANSW and GAPL.

In all cases, the mine workings will be drilled and grouted from within The Site boundary, with any grouting that may be needed beyond the boundary to be completed using directional boreholes drilled from within The Site targeting the mining bord at mine level (that is 90m to 100m below ground) at the desired location. Any grouting outside the limits of The Site will not be beneath private property.

It is concluded that the proposed grouting strategy will satisfy SANSW requirements that the building can be designed to be “Safe, Serviceable and Repairable” should areas of mine workings around The Site become unstable and crush (fail).

Due to the surrounding topography, the subsidence profile had the potential to behave differently to a level area. This includes additional surface cracking, valley closure and valley uplift and is referred to as unconventional subsidence. The assessed magnitudes of potential unconventional subsidence have been assessed and provided by DgS (COF-009/3 Rev1 dated 31 December 2019 and COF-009/2a dated 22 August 2020). Northrop have indicated these values can be incorporated into the design of the development and as such the risk of non-conforming subsidence can be mitigated Ref NL180367E01 Revision C dated 23 August 2020.

1. Introduction

Crescent Newcastle Pty Ltd (Crescent) is proposing to develop The Site located at 11-17 Mosbri Crescent, The Hill, Newcastle NSW into a series of residential apartments. This report presents a summary of the proposed grouting remediation to reduce mine subsidence risk.

The Site is known to be located over abandoned workings in both the Yard Seam and the Borehole Seam that was mined by the Australian Agricultural Company (AACo). The Yard Seam mine workings are at a depth of 41m to 45m while the Borehole Seam is at a depth of 90m to 100m with variations due to surface topography.

To assist in the design and development approval process, Crescent engaged Coffey Services Australia Pty Ltd (Coffey) to complete investigation into the mine workings at both coal seams and to undertake initial numerical modelling of the Borehole Seam to assess preferred grouting locations. Further numerical modelling and assessment of ground response was completed by Ditton Geotechnical Services (DgS). A list of previous reports is provided below:

- Coffey Report 754-NTLGE220504-AH Rev4 dated 9 November 2021 *Mine Subsidence Investigation Report* (included as Appendix A to this report)
- Coffey Report 754-NTLGE220504-AI Rev1 dated 12 March 2019 *Mine Subsidence Assessment Report*
- DgS Report COF-009/1 dated 14 March 2019 *Independent Review of the Worst-Case Mine Subsidence and Grouting Plan Assessment for the Proposed Multi-Storey Building Re-Development*
- Coffey Letter 754-NTLGE220504-AK.Rev1 dated 20 September 2019 *Coffey response to Galvin and Associates review comments*
- Coffey Letter 754-NTLGE220504-AM.Rev1 dated 13 February 2020 *Discussion and review of DgS Reports after meeting with GAPL and comment on slope stability*
- DgS Letter COF-009/2 (Rev 1) dated 31 December 2020 *Addendum to Independent Peer Review of the Worst-Case Mine Subsidence and Grouting Plan Assessment for the Proposed Multi-Storey Building Re-Development at 11 - 17 Mosbri Crescent, The Hill*
- DgS Letter COF-009/3 (Rev 1) dated 31 December 2020 *Updated Response to Galvin and Associates Letter to SA NSW (29/08/19) regarding the Worst-Case Mine Subsidence and Grouting Plan Assessment for 11 - 17 Mosbri Crescent, The Hill*
- DgS Letter COF-009/2a dated 22 August *2020 Further Addendum to Worst-Case Mine Subsidence and Grouting Plan Assessment for the Proposed Multi-Storey Building Re-Development at 11 - 17Mosbri Crescent, The Hill* (included as Appendix B to this report).

The above list includes the latest version of each report.

The revised subsidence profile using the proposed grout layout was assessed by Northrop Consulting Engineers Pty Ltd (Northrop) Ref NL180367E01 Revision C dated 23 August 2020.

Subsidence Advisory NSW (SANSW) have engaged additional consultants to peer review the project on their behalf. These documents include:

- Galvin and Associates Pty Ltd (GAPL) report 2019-1b dated August 2019 EXPERT REVIEW RE: Surface Subsidence Predictions for Mosbri Crescent, Newcastle
- GAPL report 2020-2a dated March 2020 EXPERT REVIEW RE: Surface Subsidence Predictions for Mosbri Crescent, Newcastle
- Mine Subsidence Engineering Consultants Pty Ltd (MSEC) dated 7 April 2020 11-17 *Mosbri Crescent, The Hill Independent advice regarding estimated subsidence impacts*

SANSW provided General Terms of Approval (GTA) *DA 2019/00061 - 11-17 MOSBRI CRESCENT THE HILL; LOT 1 DP 204077, TBA19-04135 & TSUB19-00543*

Since the initial Development Application, minor modifications to the proposed building layout have been incorporated into the application. In summary the amended plans rationalise the basement carpark and marginally reduce building heights (Appendix E), thereby enabling the basement car park to be moved further away from the eastern and northern property boundary further away from slope as shown below in Figure 1. The amended plans do not change the number of apartments, with GFA or overall development fundamentals remaining substantially the same. With the above in mind DgS has reconfigured the proposed grouting layout in their latest report.

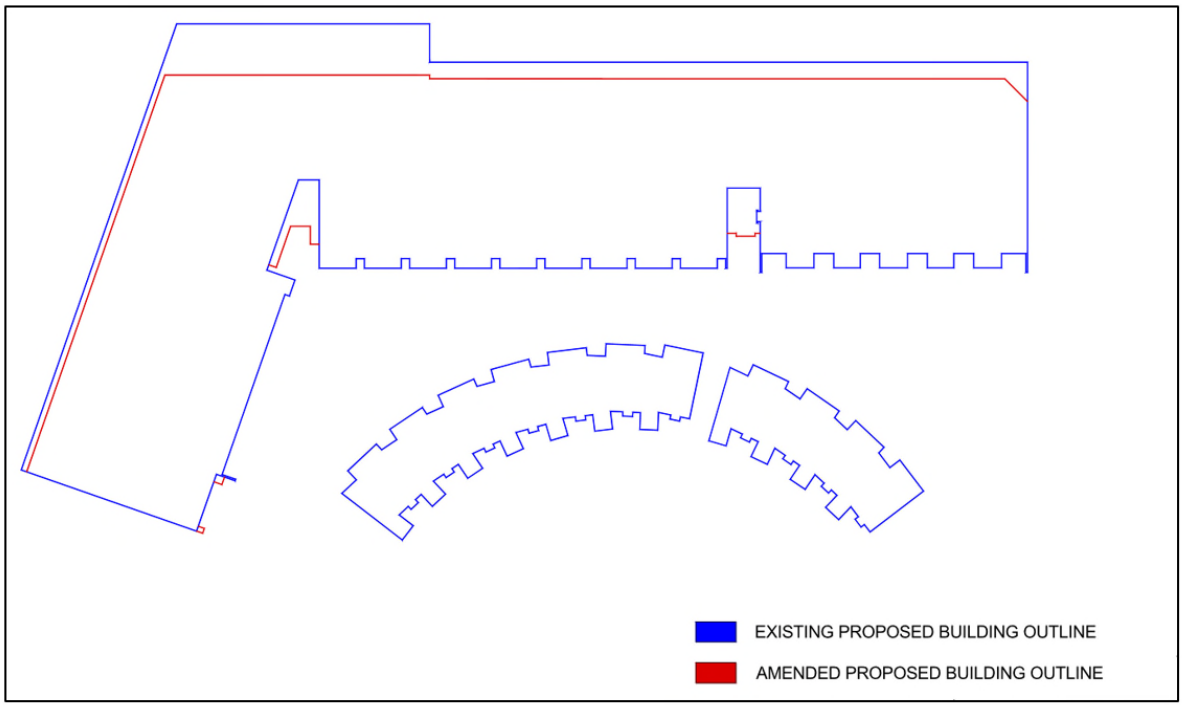


Figure 1: Building outline comparison plan - first floor

2. Glossary

Term	Description
AACo	Australian Agricultural Company
Angle of Draw	The mine workings around The Site which are expected to have a significant effect on The Site. In the Newcastle area, using empirical data from collapse over coal mines, this angle is assumed to be one horizontal to two vertical, i.e. mine workings at 90m depth have an angle of draw of 45m.
Bord	The mining void along the side of the pillar (usually the longer side) refer to Figure 3.
Collapse/ rubble	The collapsed roof material, and poor-quality coal encountered within the mine workings reducing the void height.
Colliery	A coal mine and the buildings and equipment associates with it.
Cut-through	The mining void at the end of the coal pillar (usually short side) refer to Figure 3.
Creep	Name given to the process of crushing (convergence) of a coal pillar which transfers load to neighbouring coal pillar which then fail, transferring load to the next pillar and so forth until a sufficiently large pillar is encountered or the overburden reduces applying less load to the coal pillars. Also referred to as a 'pillar run'.
Factor of Safety	The ratio of the assessed strength of object (in this case coal pillars) relative to applied load.
Fault	A discontinuity in the mine overburden strata where beds are realigned relative to each other. The locations of significant faults are shown on mine plans as visible in Figure 2.
Full Grout	Typically referring to a method of grouting where boreholes are drilled at close centres and grout is infilled until the voids are generally filled.
Grout	Flyash a fine silt sized by-product of power stations mixed with cement to create a product which will cure to create a rigid element, currently set at 5MPa. This material will apply confining pressure to coal pillars as well as reduce the void space at mine level.
Heading	A major mine tunnel (within the coal seam) used for access. Regularly headings have additional support relative the standard mine bords.
Unconventional subsidence	Term used to describe subsidence that behaves different to normal, due to changes in topography. This includes additional surface cracking, valley closure and valley uplift.
Overburden	The soil and rock units above the mine workings.
Pillar	The block of coal left within the mine to support the overburden (refer to Figure 3).
Pit	Term given to a coal mine typically named after the shaft from which it was mined.
Selective Grout	Typically referring to a method of grouting where grout is used to protect critical pillars below and around The Site.
Shaft	Term given to a vertical entry/exit tunnel to the coal seam
Valley Closure	The observed behaviour of valley formations converging during nearby mining
Valley Uplift	The observed behaviour of valley formations lifting at the centre during nearby mining

Several of the above are shown below in Figure 2 and Figure 3.

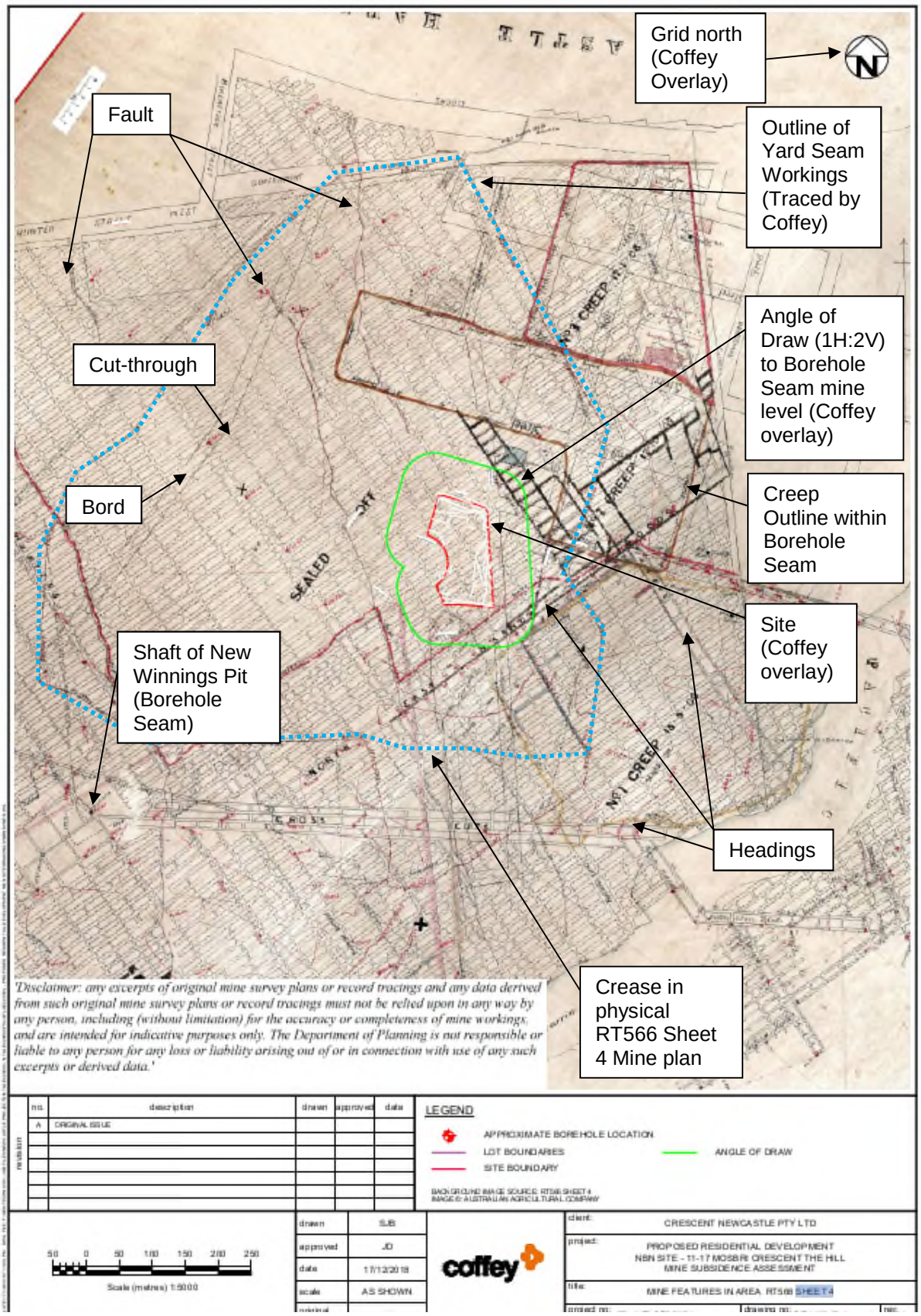


Figure 2: Example Coffey drawing reproducing part of historical mine plan RT566 Sheet 4. Markings on drawings are historic except following items added by Coffey including Site boundary (red), angle of draw outline (green), and surface contours (white) and tittle block.

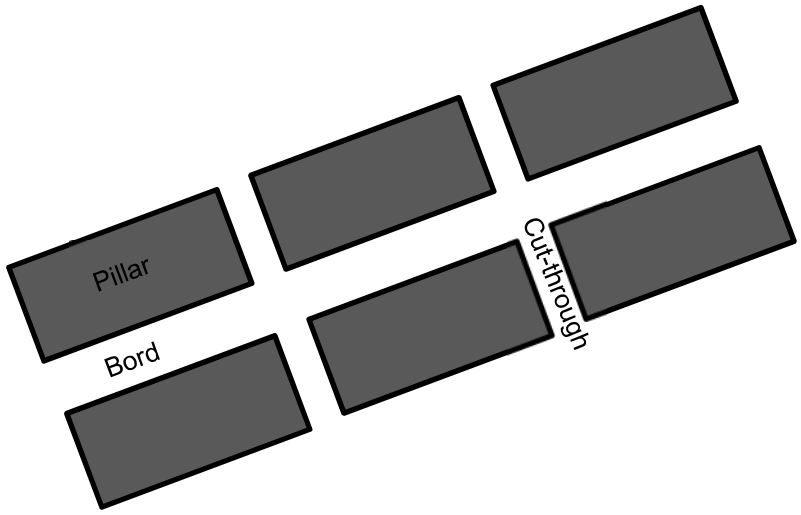


Figure 3: Close up view of bord versus cut-through

3. Grout Remediation

3.1. Yard Seam Remediation Strategy

A summary of points regarding the Yard Seam remediation is provided below:

- The Yard Seam is at a depth of 41m to 45m below ground level.
- Due to the age of the workings, mapping of Yard Seam is very limited. An outline of the Yard Seam workings by Australian Agricultural Company is shown on Sheet 4 of RT566 (reproduced in part on Drawing 4).
- A record tracing RT654 (Exhibit Y Royal Commission of Earth Subsidence at Newcastle) is available for the project although it only has an outline of the area worked as well.
- Conditions of the Yard Seam encountered at The Site and elsewhere are presented in Coffey Report 754-NTLGE220504-AH Rev3 dated 14 January 2019 *Mine Subsidence Investigation Report.* In this report the workings in the Yard Seam may be summarised as follows:
  - At The Site, the mine workings have been largely infilled with rubble, thereby reducing open void space.
  - Elsewhere (not verified within The Site due to the rubble) the Yard Seam pillars are 1.5m up to 2.0m wide with bords approximately 5m wide and 0.9m to 1.2m in height.
- As the Yard Seam workings are unmapped, Coffey report 754-NTLGE220504-AH Rev3 dated 14 January 2019 recommended to drill boreholes at 10m centres north to south and 20m centres east to west. The layout is shown on Drawing 3 shows a minor update to the original drilling locations with a boundary of boreholes around The Site with a nominal pillar layout based on previous investigations. This nominal pillar layout will be updated during drilling works for grout boreholes.
- When a void is encountered during drilling, it is proposed to fill the voids with grout.

- It is currently proposed to grout the Yard Seam first to provide stabilising of this seam to reduce grout loss into this seam when drilling to the Borehole Seam.
- The GAPL final submission made following point: *"It cannot be concluded from this description that the bords of all pillars in the Yard Seam will be fully grouted. They need to be because the pillars are very narrow (1.6 to 2.7 m wide), are separated by wide bords and have a very high probability of failure (low safety factor)"*. In response Coffey notes:
  - The actual mine layout will be confirmed during the drilling phase
  - Coffey proposes to fully grout encountered bords
  - Should a portion of a single bord be missed based on the layout, the bord width to overburden ratio will be less than 0.125 which is below empirical data for subsidence over longwall panels[1].
- Yard Seam remediation is estimated to require approximately 71 boreholes and a volume of grout in the order of 1,400m^3 to 2,000m^3 (20m^3 to 30m^3 per borehole). Due to the spacing of the boreholes, the grouting may be considered a bulk grouting solution.
- After grouting, the potential for subsidence from the Yard Seam can be considered to be ameliorated.
- Following grouting, timely validation of the physical and mechanical properties of the cemented backfill (comprising grout, grout-injected rubble and voids) is required. Validation will identify the need for modifications to structural design, if any. Validation is a typical risk management control that is embedded in any approval to proceed. Further details regarding validation are provided at Section 3.4 of this report.

3.2. Borehole Seam Remediation Strategy

A summary of points regarding the Borehole Seam remediation is provided below:

- The Borehole Seam is at a depth of 90m to 100m depth.
- This seam was mined by AACo from the New Winning Pit (refer to Figure 2 for location).
- The condition at mine level was investigated by Coffey (report 754-NTLGE220504-AH.Rev1 dated 14 January 2019 (Appendix A). In this report:
  - Bord widths of 4.5m and 5.8m were observed for BH01 and BH04 respectively.
  - Void heights of 0.5m and 1.65m were observed for BH01 and BH04 respectively.
  - Rubble heights of 3.6m and 6.6m were observed for BH01 and BH04 respectively.
- The grout remediation strategy and works program proposes to grout (backfill) the Borehole Seam mine workings in a systematic pattern. The strategy has been able to be developed as a more targeted approach for the Borehole Seam than the Yard Seam because historical mapping of the workings in the Borehole Seam is available as summarised in DGS report COF-009/2a dated 22 August 2020 (attached as Appendix B).
- The systematic pattern will be partially grout the old workings, backfilling select rows of bords using grout to effectively form larger strip pillars running across The Site. The proposed strategy is shown in attached Drawing 2 with sectional views along a bord shown on Drawing 6.
- This pattern will provide support to two sides of eight and a half pillars beneath The Site, with generally four boreholes per pillar targeting 7m from the end of each pillar. This will typically involve drilling vertically to reach the pillars at a depth of 90m to 95m.
- Directional boreholes will be drilled from within The Site to support a further seven pillars within the angle of draw (zone in which mine workings will influence The Site) targeting voids that are

[1] With reference to Holla 1987 (Holla, L. 'Mining Subsidence in NSW – 2. Surface Subsidence Prediction in the Newcastle Coalfield'. Jan 1987. NSW Department of Mineral Resources)

outside The Site boundary but not beneath private residences. Grouting adjoining mine workings on a more targeted approach allows for the grouting works to be spread over a greater area thereby reducing peak subsidence values for The Site.

- This proposed grout extent is assessed to provide sufficient pillar strength to prevent further failure from Creep events (i.e. progressive failure and collapse of adjoining pillars) from passing through The Site [2].
- Targeted grouting using a directional boreholes approach has been adopted throughout Newcastle for a number of other larger key sites in the last 5 years including:
  - University of Newcastle NewSpace (9 storeys), with a site area of 3,800m^2 (note this project was completed six years ago). Inclination from vertical up to 30°.
  - Sky Residences (180 units over 19 storeys) with a site area of 3,400m^2. Inclination from vertical up to 20°.
  - The Verve, two towers up to 19 storeys with a site area of 4700m^2. Inclination from vertical up to 24°.
  - Birdrwood Park two towers up to 14 Storeys and one up to 26 storeys with a total site area of 7800m^2. Unknown angle but up to 15° from vertical.
  - East End (14 Storeys high over three blocks 26,000m^2).
  - Law Courts (Mostly vertical only) with a site area of 2800m^2 (note this project was completed eight years ago)
  - University of Newcastle Honeysuckle City Campus Development, Site 1 only, with a site as of 7,700m^2. Inclination from vertical up to 14°.
  - 124 Parry Street eight storeys with a site area of 1100m^2. Unknown angle but up to 15° from vertical.
  - 116 Parry Street eight storeys with a site area of 490m^2. Unknown angle but up to 15° from vertical.
- All drilling including directional drilling will commence from within The Site boundary. Attached Drawing 2 depicts the directional drilling which commences from within The Site. No surface activities will occur outside The Site.
- As can be seen in Drawing 6, the point at which the grouting borehole leaves The Site to reach the Borehole Seam at mine level are at least 15m below the ground surface at the boundary of The Site and not beneath private property. Note Drawing 5 only has 14m due to the curve of Mosbri Crescent.
- As the surface level of Arcadia Park is generally 5m or more above The Site, the depth at which the grouting borehole enters below the park will be approximately 26m below the park at the property boundary.
- The final point at which the grouting borehole reaches the Borehole Seam at mine level is at a depth of 90 metres and will typically be within 20m of site boundary.
- The proposed strategy results in 52 grouting boreholes to the Borehole Seam. This borehole pattern is shown on Drawing 2. (Attached drawing updates Drawing 12 from Coffey Report 754-NTLGE220504-AH.Rev3 dated 14 January 2020. This drawing was revised based on the updated grout layout developed by DgS in conjunction with Coffey using the recommendations from SANSW and GAPL to suit the revised Development Application.
- A total of 32 grouting boreholes will reach the Borehole Seam within the boundary of The Site and 20 will extend beyond the boundary of The Site. All of the boreholes targeting areas outside The Site will be terminate beneath the road reserve or crown land. There is no grouting proposed under private property outside the limits of The Site.

[2] Based on a factor of safety of 2 and including abutment loading refer to COF-009/2a dated 22 August 2020.

- The subsidence analysis and grouting design by DgS is based on the worst-case mining height i.e. full Borehole Seam thickness. However, drilling indicates that full extraction did not occur everywhere within The Site. Thus, the approach to analysis is considered to be conservative with respect to assessed factors of safety of the pillars and potential convergence.
- The proposed grout strength of 5MPa is a minimum and the average strength will be higher. Where drilling of previous grouting has been completed (i.e. University of Newcastle Honeysuckle City Campus) the grout has been found to have an even higher strength to what was placed (i.e. the grout strength will increase over time).
- The proposed grout extent is to be controlled by utilising low slump grout[3].
- To improve penetration of the rubble it is proposed the rubble to be in-filled with a high mobility (high slump) grout.
- Conservatively the modelling is based on the assumption that there will be some imperfections in the grouting as outlined in DgS report COF-009/2a dated 22 August 2020. These include very low strength and modulus values for the lower rubble to account for the potential of low permeability, allowing for areas between boreholes with small voids.
- The effect of the proposed program of grout remediation to the subsidence profiles is shown on Drawings 1a to 3b of DGS report COF-009/2a dated 22 August 2020. The resultant subsidence profile was assessed by NL180367E01 Revision C dated 23 August 2020 to be within tolerable levels for the proposed development to be designed to remain safe serviceable and repairable with only 'very slight' damage, as defined in AS2870 – 2011 as requested in the SA NSW GTA dated October 2019.
- As with the Yard Seam, following grouting, timely validation of the physical and mechanical properties of the cemented backfill (comprising grout, grout-injected rubble and voids) is required. Further details regarding validation are provided at Section 3.4 of this report.
- Any water that is expelled from the mine workings during the grouting process, is to be temporary stored onsite and mixed with grout before returning to the mine workings.
- Drilling cuttings developed from the drilling process are to be temporary stored and including in the grouting within the upper void area.

3.3. Residual Unconventional Subsidence

Unconventional subsidence relates to subsidence profile being affected due to the surrounding topography. This type of subsidence could affect The Site whether or not The Site is grouted Unconventional subsidence is possible on The Site but Coffey understands that the magnitude of ground response is manageable from a structural engineering viewpoint (refer to Northrop NL180367E01 Revision C dated 23 August 2020).

The potential for residual downhill unconventional subsidence effects after grouting was assessed in DgS report COF009/3 dated 31 December 2019 using historical data at The Hill as well as measurement data from nearby coal mines and measurements from subsidence profiles over longwall mines. DgS has revised the cracking zones from unconventional subsidence based on the updated grouting layout in Figure 4 of DGS report COF-009/2a dated 22 August 2020.

[3] It is noted that if it is necessary to prevent flow outside the building footprint it will be necessary to drill additional boreholes to allow a fast setting/low slump grout to be installed.

Valley closure and valley uplift were assessed by DgS, using generalised models developed by MSEC, based on empirical data (observations and measurements) of these types of unconventional subsidence[4].

Coffey notes that the models developed by MSEC for the particular features (valley closure and valley uplift) of unconventional subsidence have been developed for a different location with different terrain. Based on our review, Coffey concurs that DgS used an appropriately conservative approach to estimate unconventional subsidence specifically for The Site based on the following:

- The MSEC valley closure model method uses upper limit (i.e. maximum rather than average) best fit lines for each of the variables.
- The major subsidence events have already occurred to the south (Creep 1), East (Creep 2) and north (Creep 3). If the mine panel width in the model is reduced to the distance between grout locations and historical creep events, the magnitude of unconventional settlement may reduce further.
- The confining pressure under The Hill is reduced due to the coast on the northern, eastern and southern sides.

3.4. Post Remediation Validation

As noted by GAPL, it will be critical that the grout as injected meets the parameters as adopted by DgS in their model/s. Coffey proposes the following verification of the mine workings and grout:

- Verification of height of void with camera prior to grouting
- Verification of width void width using sonar prior to grouting. It is noted that where rubble fills the void, sonar may not be achievable or representative of mine width.
- Track volume placed in each location during grouting
- Strength testing with modulus to rupture of grout injected into the mine workings during grouting
- Coring of selected locations (minimum 2 locations) following grouting. This will allow review of grout penetration into the rubble.
- Utilise both density and sonic tools to assess in-situ properties of the grout after grouting.
- Utilise pressuremeter testing apparatus which will provide shear modulus for different levels after grouting

GAPL notes where unfavourable verification data is obtained during grouting, then modification of the structural design may be necessary to adopt even more conservative parameters. Although acknowledged, the likelihood of unfavourable results is reduced by:

- Careful monitoring or grouting operations during grouting
- Testing grout strength before the project starts and during grouting works.
- The maximum void and working heights have been adopted in numerical models. This is a conservative approach.
- The numerical models assume relatively steep (conservative) angle of repose of grout at mine level. Flatter angles are typically achieved.

[4] MSEC – General Discussion on Systematic and Non Systematic Mine Subsidence Ground Movements August 2007

4. Conclusion

This report presents a summary of the factual findings previously reported by Coffey and a description of the agreed strategy to remediate the mine workings. This strategy has been developed by DgS in consultation with Coffey and Northrop considering recommendations by GAPL and SANSW.

This report includes updated drawings where modification to the strategy has been developed since reports originally submitted with the Development Application.

It is concluded the proposed grouting strategy will satisfy SANSW requirements that the building can be designed to be “Safe, Serviceable and Repairable” should areas of mine workings around The Site become unstable and crush (fail).

The assessed magnitudes of potential non-conforming subsidence have been provided. Northrop have indicated these values can be incorporated into the design of the development and as such the risk of non-conforming subsidence can be mitigated NL180367E01 Revision C dated 23 August 2020 (Appendix F).

Guidance on the uses and limitations of this report is presented in the attached sheet, ‘Important Information about your Coffey Report’, which should be read in conjunction with this report.

If you have any questions regarding this report or should you require further assistance on this project, please contact the undersigned.

For and on behalf of Tetra Tech Coffey,



Simon Baker

Senior Geotechnical Engineer

Important information about your **Coffey** Environmental Report

Introduction

This report has been prepared by Coffey for you, as Coffey's client, in accordance with our agreed purpose, scope, schedule and budget.

The report has been prepared using accepted procedures and practices of the consulting profession at the time it was prepared, and the opinions, recommendations and conclusions set out in the report are made in accordance with generally accepted principles and practices of that profession.

The report is based on information gained from environmental conditions (including assessment of some or all of soil, groundwater, vapour and surface water) and supplemented by reported data of the local area and professional experience. Assessment has been scoped with consideration to industry standards, regulations, guidelines and your specific requirements, including budget and timing. The characterisation of site conditions is an interpretation of information collected during assessment, in accordance with industry practice,

This interpretation is not a complete description of all material on or in the vicinity of the site, due to the inherent variation in spatial and temporal patterns of contaminant presence and impact in the natural environment. Coffey may have also relied on data and other information provided by you and other qualified individuals in preparing this report. Coffey has not verified the accuracy or completeness of such data or information except as otherwise stated in the report. For these reasons the report must be regarded as interpretative, in accordance with industry standards and practice, rather than being a definitive record.

Your report has been written for a specific purpose

Your report has been developed for a specific purpose as agreed by us and applies only to the site or area investigated. Unless otherwise stated in the report, this report cannot be applied to an adjacent site or area, nor can it be used when the nature of the specific purpose changes from that which we agreed.

For each purpose, a tailored approach to the assessment of potential soil and groundwater contamination is required. In most cases, a key objective is to identify, and if possible quantify, risks that both recognised and potential contamination pose in the context of the agreed purpose. Such risks may be financial (for example, clean up costs or constraints on site use) and/or physical (for example, potential health risks to users of the site or the general public).

Limitations of the Report

The work was conducted, and the report has been prepared, in response to an agreed purpose and scope, within time and budgetary constraints, and in reliance on certain data and information made available to Coffey.

The analyses, evaluations, opinions and conclusions presented in this report are based on that purpose and scope, requirements, data or information, and they could change if such requirements or data are inaccurate or incomplete.

This report is valid as of the date of preparation. The condition of the site (including subsurface conditions) and extent or nature of contamination or other environmental hazards can change over time, as a result of either natural processes or human influence. Coffey should be kept appraised of any such events and should be consulted for further investigations if any changes are noted, particularly during construction activities where excavations often reveal subsurface conditions.

In addition, advancements in professional practice regarding contaminated land and changes in applicable statues and/or guidelines may affect the validity of this report. Consequently, the currency of conclusions and recommendations in this report should be verified if you propose to use this report more than 6 months after its date of issue.

The report does not include the evaluation or assessment of potential geotechnical engineering constraints of the site.

Interpretation of factual data

Environmental site assessments identify actual conditions only at those points where samples are taken and on the date collected. Data derived from indirect field measurements, and sometimes other reports on the site, are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact with respect to the report purpose and recommended actions.

Variations in soil and groundwater conditions may occur between test or sample locations and actual conditions may differ from those inferred to exist. No environmental assessment program, no matter how comprehensive, can reveal all subsurface details and anomalies. Similarly, no professional, no matter how well qualified, can reveal what is hidden by earth, rock or changed through time.

The actual interface between different materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but

steps can be taken to reduce the impact of unexpected conditions.

For this reason, parties involved with land acquisition, management and/or redevelopment should retain the services of a suitably qualified and experienced environmental consultant through the development and use of the site to identify variances, conduct additional tests if required, and recommend solutions to unexpected conditions or other unrecognised features encountered on site. Coffey would be pleased to assist with any investigation or advice in such circumstances.

Recommendations in this report

This report assumes, in accordance with industry practice, that the site conditions recognised through discrete sampling are representative of actual conditions throughout the investigation area. Recommendations are based on the resulting interpretation.

Should further data be obtained that differs from the data on which the report recommendations are based (such as through excavation or other additional assessment), then the recommendations would need to be reviewed and may need to be revised.

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Unless otherwise agreed between us, the report has been prepared for your benefit and no other party. Other parties should not rely upon the report or the accuracy or completeness of any recommendation and should make their own enquiries and obtain independent advice in relation to such matters.

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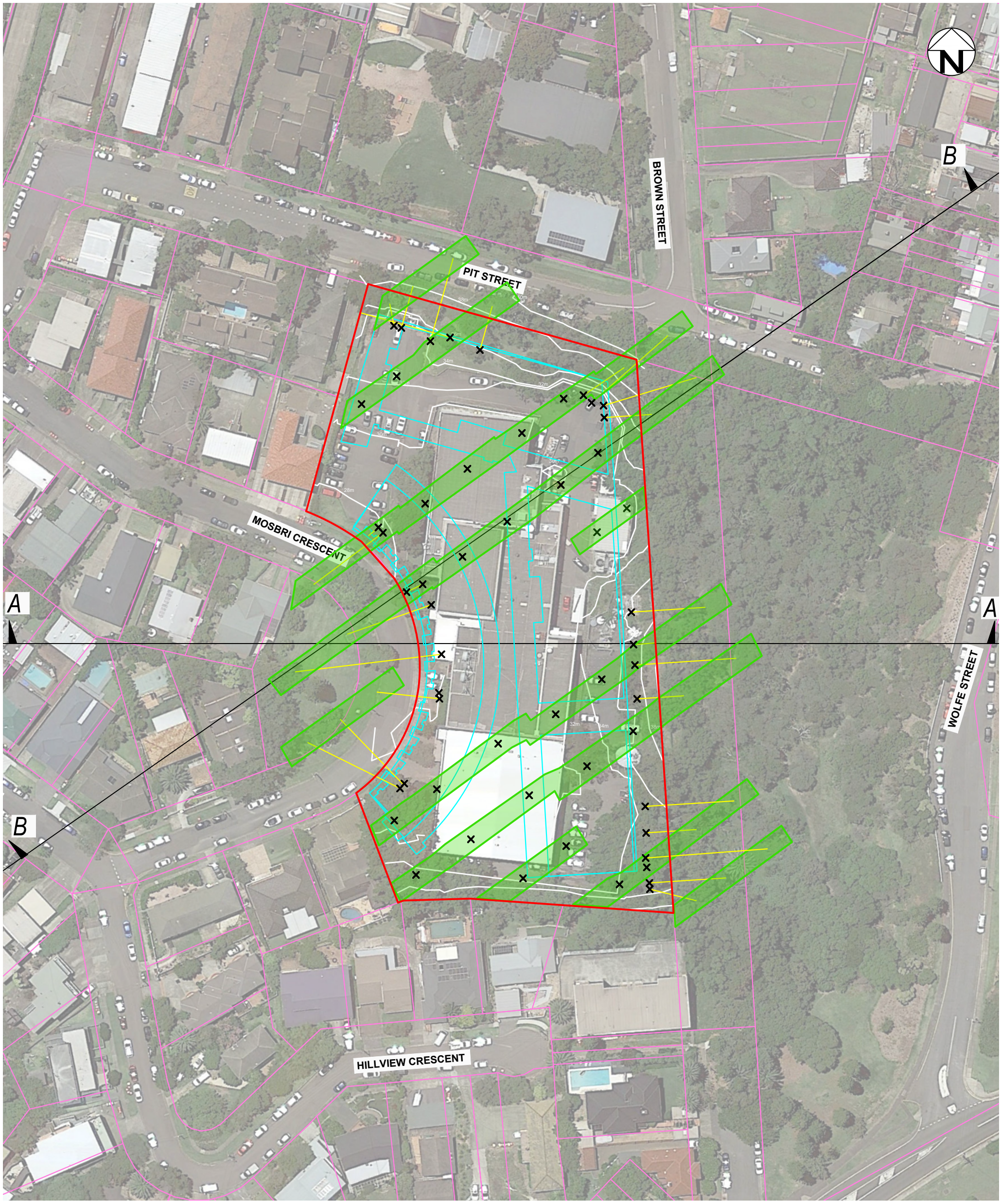
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Responsibility

Environmental reporting relies on interpretation of factual information using professional judgement and opinion and has a level of uncertainty attached to it, which is much less exact than other design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. As noted earlier, the recommendations and findings set out in this report should only be regarded as interpretive and should not be taken as accurate and complete information about all environmental media at all depths and locations across the site.

Drawings

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revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE	SJB	JD	24/08/2020
	B	MINOR AMMENDMENTS	SJB	JD	20/10/2020
	C	MINOR AMMENDMENTS	SJB	JD	9/11/2021

LEGEND

- LOT BOUNDARIES
- SITE BOUNDARY
- PROPOSED BOREHOLE TRAJECTORY LINES
- SECTION LINES (DRAWING 5 AND 6)
- PROPOSED BUILDING OUTLINES
- PROPOSED GROUT LOCATIONS AT MINE LEVEL AND PRELIMINARY FLOW AT 1M VOID

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.2
AERIAL IMAGE ©: SINCLAIR KNIGHT MERZ 2014

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Scale (metres) 1:1000

drawn	SJB
approved	JD
date	9/11/2021
scale	AS SHOWN
original size	A3

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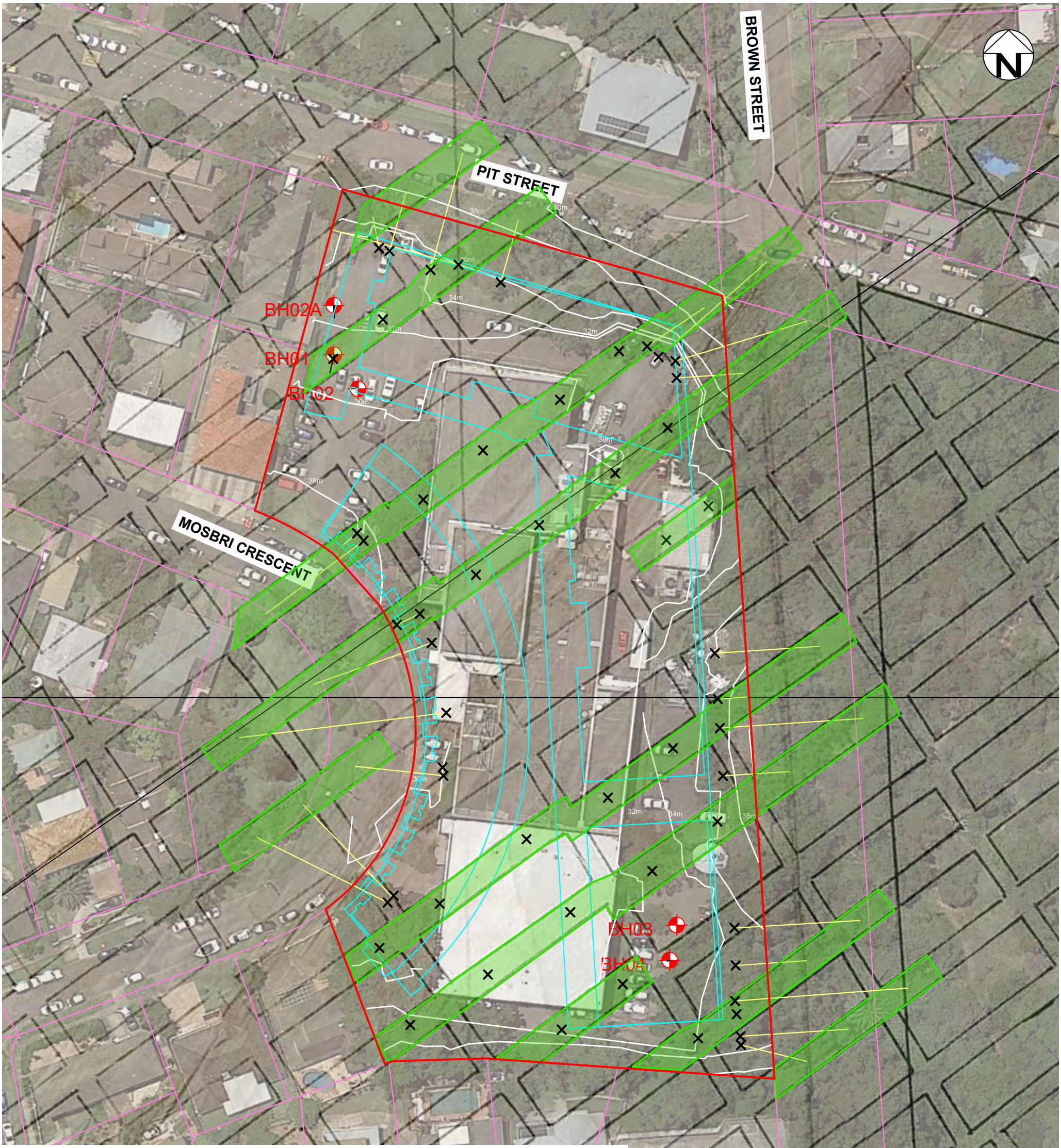
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project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: PROPOSED BOREHOLE SEAM GROUT LAYOUT

project no: 754-NTLGE220504 | drawing no: DRAWING 1 | rev: C

PLOT DATE: 9/11/2021 4:18:52 PM DWG FILE: F:\GEOTECHNICS\1. JOB FILES\NEWCASTLE PROJECTS\NTLGE220000\754-NTLGE220504 - PROPOSED RESIDENTIAL DEVELOPMENT NBN SITE\DRAWINGS\AO 9_11_2021.DWG



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LEGEND

- LOT BOUNDARIES
- SITE BOUNDARY
- PROPOSED BOREHOLE TRAJECTORY LINES
- SECTION LINES (DRAWING 5 AND 6)
- PROPOSED BUILDING OUTLINES
- PROPOSED GROUT LOCATIONS AT MINE LEVEL AND PRELIMINARY FLOW AT 1M VOID
- PREVIOUS BOREHOLE LOCATION
- SUGGESTED DEEP BOREHOLE LOCATION

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.2
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BACKGROUND IMAGE RT566 AUSTRALIAN AGRICULTURAL COMPANY SHEET 8

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date	9/11/2021
scale	AS SHOWN
original size	A3

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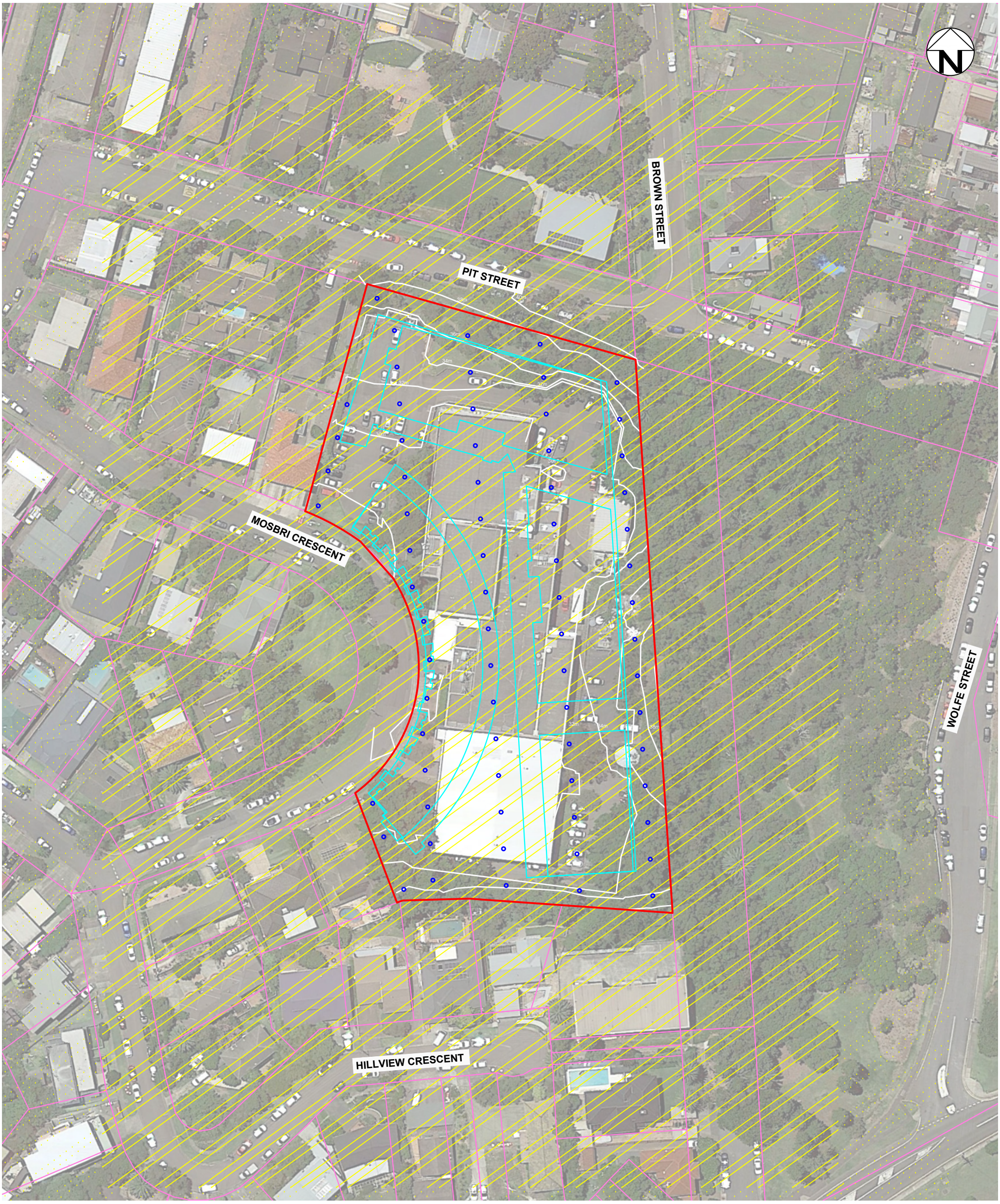
client: CRESCENT NEWCASTLE PTY LTD

project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: PROPOSED BOREHOLE SEAM GROUT LAYOUT WITH MINE WORKINGS

project no: 754-NTLGE220504 | drawing no: DRAWING 2 | rev: C

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revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

LEGEND

- SITE BOUNDARY
- LOT BOUNDARIES
- NOMINAL PILLAR LAYOUT YARD SEAM
- PROPOSED BUILDING OUTLINES
- PROPOSED YARD SEAM GROUT LOCATIONS AT MINE LEVEL

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.2
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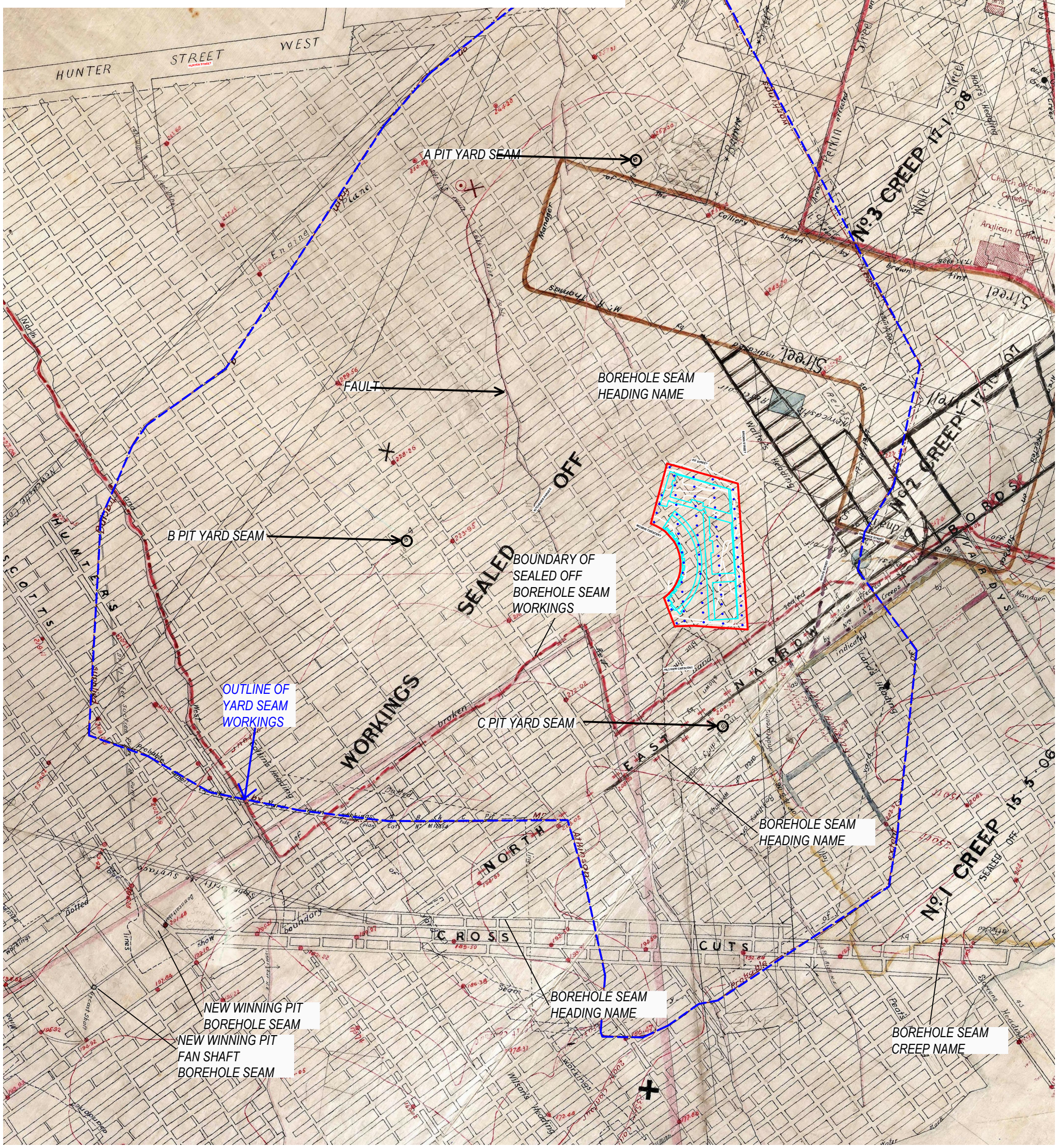
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NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: PROPOSED GROUT LAYOUT YARD SEAM

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revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

LEGEND

- SITE BOUNDARY
- YARD SEAM OUTLINE ON RT566
- PROPOSED BUILDING OUTLINES
- PROPOSED YARD SEAM GROUT LOCATIONS AT MINE LEVEL

BACKGROUND IMAGE: AUSTRALIAN AGRICULTURAL COMPANY RT566 SHEET 4:
NOTE WORKINGS SHOWN ON RT ARE OF THE BOREHOLE SEAM

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Scale (metres) 1:4000

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date	9/11/2021
scale	AS SHOWN
original size	A3

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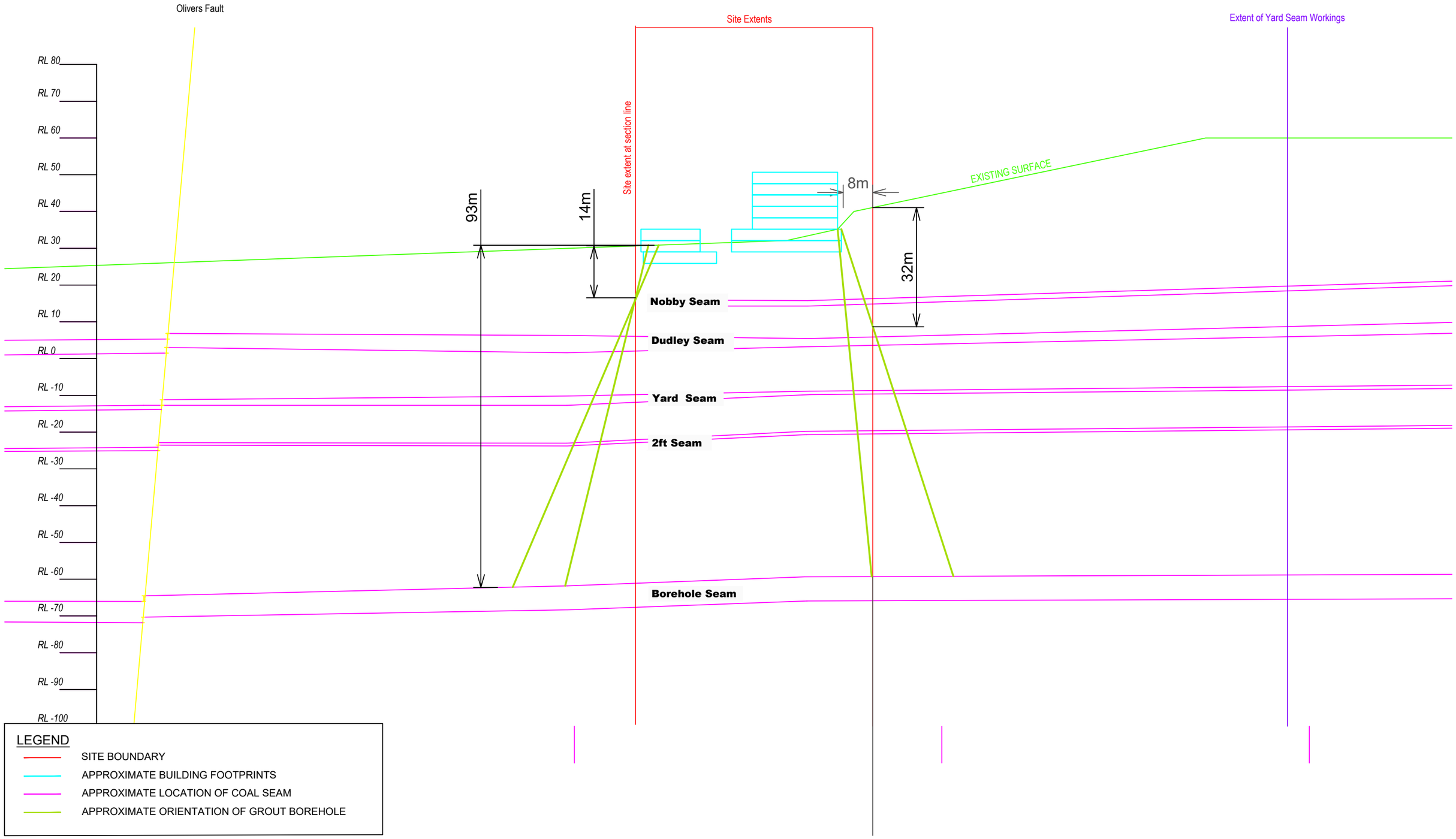
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project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: FEATURES OF FROM RT566 SHEET 4

project no: 754-NTLGE220504 | drawing no: DRAWING 4 | rev: A

PLOT DATE: 9/11/2021 4:19:43 PM DWG FILE: F:\GEOTECHNICS\1 JOB FILES\NEWCASTLE PROJECTS\NTLGE220000\754-NTLGE220504 - PROPOSED RESIDENTIAL DEVELOPMENT NBN SITE\DRAWINGS\AO 9_11_2021.DWG



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date	9/11/2021
scale	AS SHOWN
original size	A3

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client: CRESCENT NEWCASTLE PTY LTD

project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: SECTION AA PERPENDICULAR TO SITE

project no: 754-NTLGE220504 | drawing no: DRAWING 5 | rev: A

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RL 80
RL 70
RL 60
RL 50
RL 40
RL 30
RL 20
RL 10
RL 0
RL -10
RL -20
RL -30
RL -40
RL -50
RL -60
RL -70
RL -80
RL -90
RL -100

Olivers Fault

Site extent at furthest borehole perpendicular

Site extent at section line

Site extent at section line

6m

6m

EXISTING SURFACE

15m

26m

90m

Nobby Seam

Dudley Seam

Yard Seam

2ft Seam

Borehole Seam

Borehole Projection

LEGEND

- SITE BOUNDARY
- APPROXIMATE BUILDING FOOTPRINTS
- APPROXIMATE LOCATION OF COAL SEAM
- PROPOSED ORIENTATION OF GROUT BOREHOLE

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

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date	9/11/2021
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original size	A3

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client: CRESCENT NEWCASTLE PTY LTD

project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: SECTION BB ALONG A MINE WORKING BORD

project no: 754-NTLGE220504 | drawing no: DRAWING 6 | rev: A

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Appendix A – Coffey Report 754-NTLGE220504-AH for factual information on mine workings

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Crescent Newcastle Pty Ltd
Proposed Multi - Building Residential Development
11-17 Mosbri Crescent, Cooks Hill NSW 2300

754-NTLGE220504-AH.Rev4

Mine Subsidence Investigation Report

9 November 2021



Technology
is the product
of intelligence
not the
cause of it

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Proposed Multi - Building Residential Development 11-17 Mosbri Crescent, Cooks Hill, NSW 2300

Prepared for
Crescent Newcastle Pty Ltd

Prepared by
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9 November 2021

754-NTLGE220504-AH.Rev3

Quality information

Revision history

Revision	Description	Date	Originator	Reviewer	Approver
Version 0	Report Draft	6/11/2018	Simon Baker	Jules Darras	Simon Baker
Revision 1	Report Final	28/11/2018	Simon Baker	Jules Darras	Simon Baker
Revision 2	Report Final	17/12/2018	Simon Baker	Jules Darras	Simon Baker
Revision 3	Report Final	14/01/2019	Simon Baker	Jules Darras	Simon Baker
Revision 4	Report Final	9/11/2021	Simon Baker	Jules Darras	Simon Baker

Distribution

Report Status	No. of copies	Format	Distributed to	Date
Draft	1	PDF	Richard Anderson, Mark Purdy	6/11/2018
Final	1	PDF	Richard Anderson, Mark Purdy	28/11/2018
Revision 2	1	PDF	Richard Anderson, Mark Purdy	17/12/2018
Revision 3	1	PDF	Richard Anderson, Mark Purdy	14/01/2019
Revision 4	1	PDF	Richard Anderson, Mark Purdy	9/11/2021

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Appendix B – Downhole geophysics
Appendix C – Downhole camera

1. Introduction

Crescent Newcastle Pty Ltd (Crescent) commissioned Coffey Services Australia Pty Ltd (Coffey) to carry out a mine subsidence investigation for the proposed multi building residential development located at 11-17 Mosbri Crescent, Cooks Hill, NSW.

This report addresses the scope of work outlined in our proposal referenced as 754-NTLGE220504.P01.Rev02, Section 2.2 Mine Subsidence Investigation, dated 27 August 2018. Preliminary contamination assessment and geotechnical investigations will be reported separately.

The currently proposed development will include:

- Construction of residential accommodation comprising 172 dwellings, being:
  - Eleven (11) two storey townhouse style dwellings fronting Mosbri Crescent, located above a basement car park containing 34 visitor spaces and 11 resident spaces;
  - Three (3) residential flat buildings (Building A, B, and C) containing 161 dwellings, ranging from one to three bedrooms; being
    - Building A including a nine (9) storey east wing and six (6) storey west wing;
    - Building B comprising seven (7) storeys and a roof top communal open space, with (9) town house style dwellings facing the internal courtyard;
    - Building C comprising five (5) levels;
- Interconnected car parking for Building A, B & C located on the ground floor and first level, contains 1 visitor spaces and 196 resident spaces;
- Pedestrian path, providing connection from Mosbri Crescent to Kitchener Parade; and
- Associated landscaping, communal open space, services and site infrastructure.

Site is sloping south westerly towards Mosbri Crescent Reserve and existing ground RLs within the footprint of the Building A, B and C varies between RL 36m AHD and RL 38.00m AHD. The combined basement levels will require excavation of approximately 8.5m to 9.5m below existing ground level (RL 28.10m AHD and RL 29.60m AHD) at the rear (eastern) side of the property although the proposed excavation is generally less than 4m.

Two storey townhouses are proposed along Mosbri Crescent with single basement level. Maximum excavation required for the proposed townhouses will be approximately 4.5m below ground level (basement RL 25.40m AHD to RL 27.40m AHD).

Vehicular access to the proposed development is via ramp from Mosbri Crescent connecting with proposed basements driveways, located next to apartment building located at 9 Mosbri Crescent, north western side of site.

Prior to this report Coffey was given following documents:

- Site Survey Plan prepared by Monteath & Powys Pty Ltd, titled as “Detail Survey Over Lot 1 DP204077, NBN Studios, Mosbri Crescent, The Hill”, referenced as 15/047 and dated 10/4/15, inclusive;
- Preliminary Architectural Drawings prepared by Marchese Partners International Pty Ltd, titled as “11-17 Mosbri Crescent, The Hill NSW 2300”, referenced as job 171114 and comprises of drawing from DA2.01 to DA2.11, dated as 10/10/2018, water marked as **work in progress**.

This report presents the results of the mine subsidence investigation carried out to assess the current conditions in the two mine levels encountered under the site. Results of the mine subsidence modelling will be provided in a separate report.

The site is known to be located over abandoned workings in both the Yard Seam and the Borehole Seam.

2. Scope of work undertaken

This mine subsidence assessment was based on the following:

- Review of previous job files in the area.
- Setting out borehole locations by survey based on review of mine workings plans
- Preparation of safety documentation, liaison with DYBD and organising an underground service locator to clear the proposed drilling areas
- Drilling four boreholes to the base of the Borehole Seam
- Downhole survey using downhole geophysics, camera, sonar and acoustic viewer
- Coal pillars stability assessment using rectangular pillar theories, incorporated in the Modified UNSW Power Law strength equation as presented in Galvin et al (1998). The Factor of Safety (FOS) of the pillars and the likelihood of subsidence occurring were estimated by this method.

3. Investigation Methodology

3.1. Borehole Drilling

The site investigation was conducted between 3 September 2018 to 21 September 2018, comprising drilling of four boreholes. The workings of the Borehole Seam are fairly well documented and as such, the boreholes were set out targeting either bords or pillars in the Borehole Seam.

Boreholes BH01 and BH03 were fully cored, targeting a bord and a pillar of the Borehole Seam respectively. BH01 and BH03 were drilled using a Comacchio 450 using HQ sized diamond bit. BH01 was drilled to a depth of 102.1m and BH03 was drilled to a depth 102.14m.

Boreholes BH02A and BH04 were drilled by washbore method with a polycrystalline diamond (PCD) targeting a pillar and a bord of the Borehole Seam respectively. BH02A was drilled to a depth of 102.0m and BH4 was drilled to 101.6m.

Borehole BH02 was abandoned after a conflict with underground infrastructure.

The borehole locations are shown on the site plan, attached.

Point load testing was undertaken in the lab on selected recovered core with the results summarised on the borehole logs. All fieldwork, including the logging of subsurface profile and collection of samples was carried out by a geotechnical engineer from Coffey. Borehole BH01 was cased to a depth of 45.3m due to loss of circulation at or above the Yard Seam.

Borehole BH02A was able to hold water through the Yard Seam without casing. There was no circulation loss to the base of the Borehole Seam workings indicating that no open joints were encountered.

Boreholes BH03 and BH04 were cased to depths of 45.5m and 44.6m respectively after encountering Yard Seam workings and were then able to hold water until encountering the Borehole Seam.

3.2. Downhole Observations

Following drilling the boreholes were sounded with:

- Geophysical survey to assess alignment, deviation, relative rock density (Refer to Appendix B)
- Acoustic televiewer to log rock structure, defects and open joints (Refer to Appendix B)
- Sonar to assess the dimension of encountered voids

- A camera to observe conditions within any encountered voids (Refer to Appendix C)

4. Laboratory testing

Point load tests were undertaken on select core samples in accordance with RMST223 in our Newcastle NATA accredited lab. The test results are indicated on the logs and are summarised in the Figure 1.

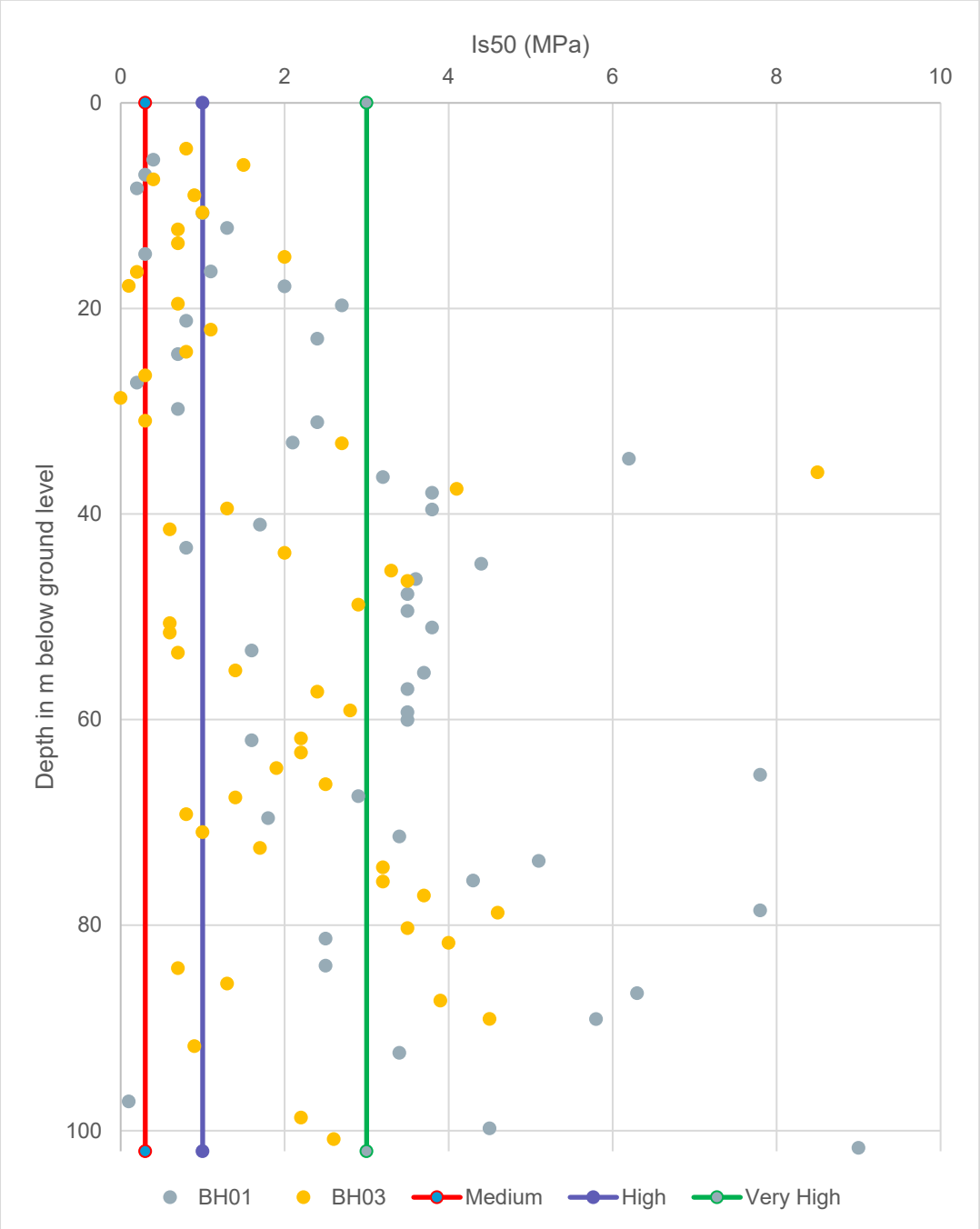


Figure 1: Summary of point load testing

From the testing the rock strength above the Yard Seam is generally low to medium strength, while below the Two Foot Seam the rock strength is generally high to very high.

5. Surface conditions

The site is an irregular shaped land with an approximate area of 1.2ha and consists of properties 11-17 Mosbri Crescent, Cooks Hill.

At the time of the investigation, a two / three storey commercial building was present within the site (NBN building), covering one third of the site area with a single basement level carpark. A couple of sheds, cooling tower and satellite dish were present within the rear portion of the property. A two level carpark was present towards the north and few parking bays at the back of the exiting NBN building. The remaining site area being covered in associated pavements, grassed area and several mature trees scattered along the site boundary. Vehicular access to site was via driveways from Mosbri Crescent.

The site is located within the Newcastle City Council area, adjacent to Mosbri Crescent carriageway, which is a minor road reserve within the local area. The site shares eastern boundary with Arcadia Park reserve located uphill. The site is bounded by the following properties, public roads and infrastructure:

- Kitchener Parade carriageway and road reserve to the north of the site
- Arcadia Park to the east of the site
- Two and three storey residential buildings and Mosbri Crescent to the north west and west of site boundary; and
- Single and double storey residential buildings to south and south west of the site

The site topography during the investigation slopes was generally gently to moderately sloping and has an angle of approximately 10° towards the south west to west.

6. Ground model

6.1. Regional geology

Based on the 1:100,000 scale Newcastle Coalfield Geology map, the site is underlain by rocks and soils derived from the late Permian aged Lambton Subgroup of the Newcastle Coal Measures comprising sandstone, siltstone, claystone, coal and tuff. This corresponds to site observations with high plasticity clay soils underlain by sandstone.

6.2. Subsurface conditions

At the locations of the boreholes, the site is overlayed by fill material to a depths of between 0.25m and 2.8m. Fill is underlain by residual soils grading into extremely weathered material comprising clay materials to a depth of 4.7m. It is noted the boreholes were carried out in accessible areas only which comprise the current carpark or paved areas. Further drilling will be required at later stage to confirm the preliminary ground model.

The borehole location plan is provided in Drawing 1. All borehole logs from the site investigation are provided in Appendix A with downhole geophysics provided in Appendix B.

The interpreted geotechnical units encountered at the site are shown in Table 1.

Table 1: Summary of ground model stratigraphy

Stratum	Depth to base of unit below ground level (m)				Comments
	BH01	BH02A	BH03	BH04	
Fill	0.4	0.25	0.45	2.8	Bitumen overlying sandy gravel followed by sandy clay. (Sandy clay and uncontrolled fill encountered in BH04)
Residual soil/extremely weathered material	4.2	NE	3.4	4.6	Clay to sandy clay medium plasticity
Bar Beach Formation	25.05	26.05	17.2	16.8	Interbedded and interlaminated sandstone and siltstone. Typically low to medium strength
Dudley Seam Upper?	26.55	27.7	18.5	18.1	Coal
Dudley Split	27.8	28.6	27.35	27.3	Interbedded and interlaminated sandstone and siltstone. Typically medium strength. Significantly thicker on the southern side of the site.
Dudley Seam (AKA Dirty Seam)	29.68	30.3	29.4	29	Coal not mined under the site. Nearby mining from C Pit
Bogey Hole Formation	42.9	43.8	41.65	41.7	Interbedded and interlaminated sandstone and siltstone Typically very high strength. Note lower 1.5m has collapsed into the mine workings
Yard Seam	43.7	44.9	43.15	42.8	Mined by AACo from the C Pit
Tighes Hill Formation	54.4	55.5	52.75	52.6	Interbedded and interlaminated sandstone and siltstone Typically high to very high strength
Two Foot Seam	55.0	56.1	53.2	53.4	Not mined
Tighes Hill Formation Continued	93.2	94.8	92.6	92.1	Interbedded and interlaminated sandstone and siltstone Typically high to very high strength
Borehole Seam	99.3	100.7	98.7	98.7	Mined by AACo from the Sea/ New Winnings Pit
Waratah Sandstone	>102.1	>102	102.14	101.6	Fine to coarse grained sandstone, very high strength
Notes: > Limit of investigation NE Not encountered					

Boreholes BH01, BH03 and BH04 encountered workings within the Yard Seam at depths of 41.55m to 43.5m, 41.6m to 43.15m and 41.7m to 42.8m respectively.

Groundwater inflows were not encountered within soil profile during the site investigation, however water inflow was observed during downhole camera work. The stationary water levels after encountering the mine workings was approximately 3m AHD.

6.3. Downhole Observations

Following drilling and as a part of the mine subsidence investigation, on 4 September 2018, a CCTV camera was used to observe conditions in the borehole BH01. Some water was observed flowing into the boreholes from 12m BGL (approximately 19m AHD) although the source could not be positively identified. Similar water was observed in BH03 on the 13 September 2018 from approximately 20m BGL 13m AHD. No such water was observed in BH04 on the 14 September 2018.

Sonar was used within the Yard Seam of BH01 and BH03 as well as the Borehole Seam for boreholes BH01 and BH04. Sonar data was used to confirm dimension of voids and data is presented on drawings, Drawing 2, Drawing 3, Drawing 7 to Drawing 10.

Acoustic televiewer was used in all boreholes except the lower portion of BH03. The information indicates that the overburden rock is nearly horizontally bedded with some open fractures. Data is provided in Appendix B. The data suggests that the overburden and interborder is not disturbed enough to have previously undergone significant subsidence.

Downhole camera was typically used to verify the presence of large voids at mine level. Screen shots are provided in Appendix C.

6.3.1. Overburden / interburden

A summary of the joints and washout defects observed in the televiewer is provided in Figure 2.

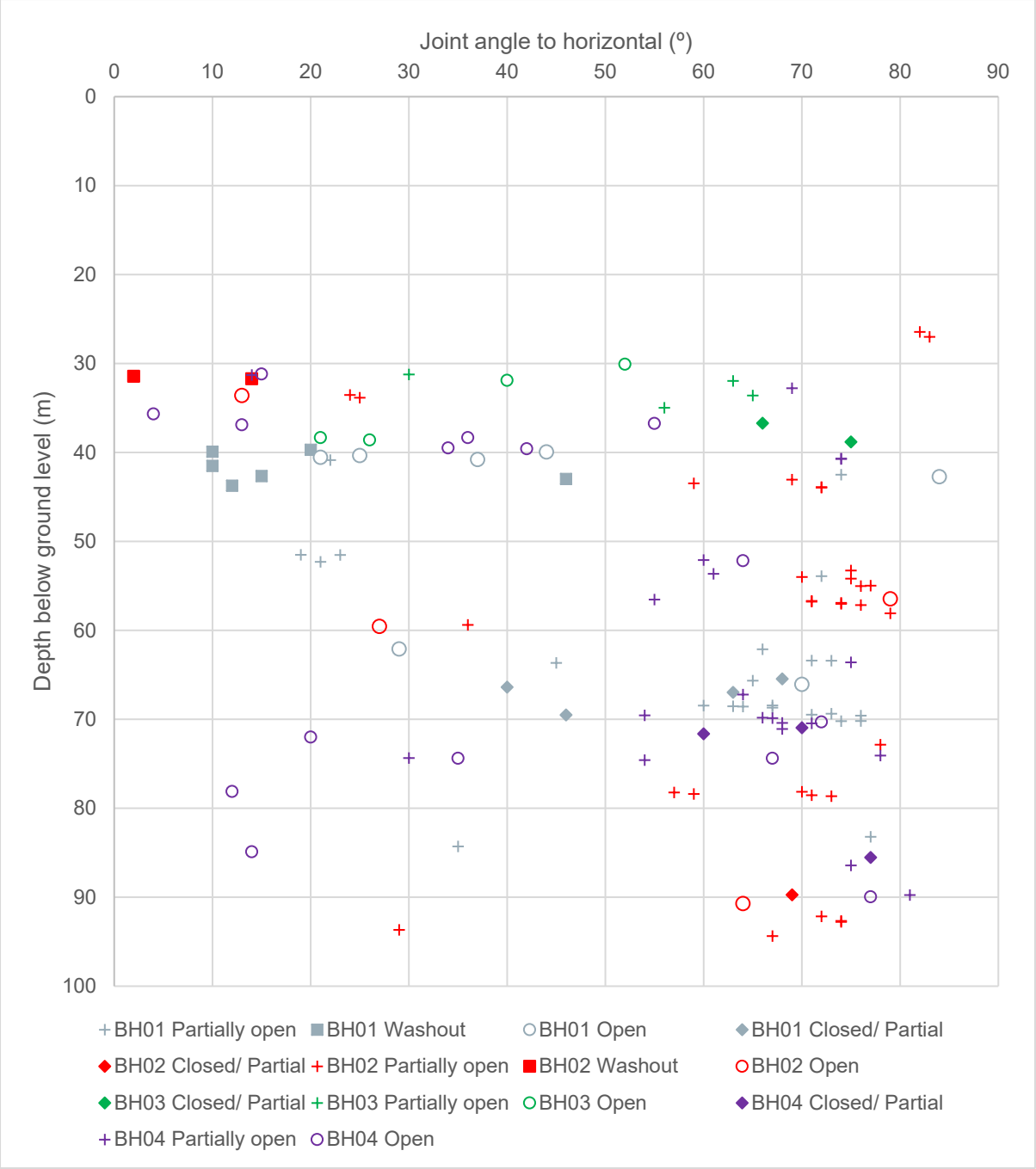


Figure 2: Summary of defects from televiewer

Based on the above there is an increased density of defects above the Yard Seam which corresponds to the delamination and roof cave in in this area.

Within the lower portion, the defects are mostly closed with an increased density of open joints in BH04.

6.3.2. Yard Seam

The open voids encountered within the Yard Seam and Borehole Seam were scanned by a down hole sonar and inspected with CCTV camera. Although attempted, voids within the yard seam were too small to get clear sonar images.

The CCTV encountered the following:

- BH01 Clear void at mine level with smaller voids visible within the spanning overburden
- BH03 generally rubble within mine level
- BH04 very poor visibility with small voids

6.3.3. Borehole Seam

The sonar scans and CCTV footage encountered the following:

- BH01
  - 4.5m wide bord near the floor with the near pillar being only 0.7m away from the borehole
  - 4.2m wide at 0.2m from the top of void
  - The length of bord observed was 17m
  - A void height of approximately 0.5m with rubble on the floor
- BH04
  - 5.8m wide bord near the floor 22m in length with an interruption at 4.1m
  - 5.5m wide by 21m long at 0.5m above the floor
  - 4.8m wide near the roof of the void
  - Top of voids was hard to make out with the discoloured water while large blocks of siltstone were visible on the floor

7. Factual information on workings

7.1. Yard Seam

7.1.1. History

The Yard Seam was originally mined by the government using convict labour in the eastern parts of Newcastle. In the 1820's, due to inefficiencies of using labour not experienced in coal mining, the British Government decided to offload the burden of coal to private hands, the largest in the area being AACo which had previously been investing in wool.

In December 1831, AACo's A pit was officially opened with the first wagons of coal being released down the gravity powered railway that led to the harbour at the time. This Pit was approximately 260m north west of the site. Later in 1837, a second pit was installed to the Yard Seam (B Pit 330m west of the site) with a third C Pit in 1841. The workings under the site most likely being from the C Pit located 120m south of the site.

Due to the age of the workings, mapping is very limited. Outlines are shown on Sheet 4 of RT566 (Drawing 2). A record tracing RT654 (Exhibit Y Royal Commission of Earth Subsidence at Newcastle) is available for the project although it only has an outline of the area worked as well.

Operations ceased from the A pit in 1846 with work continuing from the C Pit, which closed in the 1850.

Coffey has now been involved in several projects which have investigated the condition of the Yard Seam mine workings. These include the Tax Office building, the Crown Development and the Acculon Development. Our findings from these projects are discussed below.

7.1.2. Working dimensions

Based on the previous investigations, the mine workings (bords) are typically about 5m in width with pillars about 1.5m up to 2m in width (generally around 1.7m wide) with a mined height of about 0.9m to 1.2m. The newer Yard Seam workings in the F Pit, located 770m south west of the site (RT566 Sheet 7) were larger due to being completed within a different era.

The following information was encountered around the Yard Seam within the subject site.

- BH01:
  - 41.65 – 0.11m tool drop followed by
  - 0.25m core loss (siltstone) and 0.1m of siltstone returned
  - 0.3m of core loss (small void only on CCTV)
  - 0.45m of siltstone (still in roof with bedding cored at horizontal)
  - 0.65m of no core with a 0.5m tool drop. Width of bord on sonar was less than 2m
  - 0.1m of coal at the base of the workings possibly intact.
- BH02A
  - Solid coal from 43.75m to 44.9 with a possible 0.2m thick silty layer
- BH03
  - 0.1m tool drop 41.62m
  - 0.1m siltstone
  - 0.33 tool drop
  - 0.35m of core loss
  - 0.7m of rubble including weathered siltstone and coal
- BH04
  - 0.2m tool drop at 38.15m
  - 3.45m siltstone/ sandstone
  - 0.6m coal
  - 0.2m silty layer
  - 0.11m tool drop at 42.5m
  - 0.2m coal

Although sonar imaging was attempted at the site, the voids were too small due to roof fall in with signals being bounced around. Voids encountered were generally less than 0.3m in height. Even the large void in BH01 could not get an image of the bord walls.

7.1.3. Previous grouting works

Previous grouting operations have been carried out in the Yard Seam in areas near the site. This was generally limited to the larger structures including the Telstra Building (400m north west; grouting records unavailable), Tax Office Building (420m north west), the Court House Building (490m north west) and the Acculon (460m north). Some of these sites are located outside the recorded mine workings boundaries. As such, the extent of the workings has been demonstrated to be outside the limits of workings shown on RT566.

7.2. Borehole Seam

7.2.1. History

The Borehole Seam was discovered in 1848. Mining was originally carried out by the AACo in the Hamilton area from the 'D Pit' shaft which was sunk at Denison Street and became operational in 1852 and later converted to an air shaft in 1877 for the No. 2 Pit. A nearby 'E Pit' was sunk in 1854 on Everton Street, 382m south west of D Pit and was primarily used for ventilation.

In 1861, the Australian Agricultural Company sank its No. 2 (169ft / 51.5 m deep) shaft near the intersection of Beaumont and Kemp Street, 1.3km south-west of the site. Later the 'Hamilton Pit' was sunk in 1872 near Lawson Street and Thomas St. These shafts were later combined for the mine generally known as the No. 2 Pit /Hamilton Pit workings.

In 1888, the AACo sunk its New Winning Pit in the Cooks Hill Area. According to Danvers Power (1912), the seam was worked by the bord and pillar method with pillar extraction in some areas. The nearest secondary workings are located over 350m to the south-west of the subject site with the main area of secondary workings being 500m south west of the site.

The workings of these two pits were separated by barrier coal which was originally 5 chains in width (RT566 Sheet 4), with this barrier later mined out (RT566 Sheet 8).

Danvers Power (1912) provides a description of the workings within the New Winnings Pit which indicates that headings were driven parallel and 70 yards (64m) apart, bords were 6 yards wide (5.4m) and 33 yards long (30m) and pillars were 12 yards wide (11m). This is a general representation of what was nominally aimed for in the pit, though pillars are generally slightly smaller under the site with the scaled pillar widths from RT566 generally being between 9.8m and 11.5m with an average of 10.6m. Similarly the scaled bord widths from the RT are 5.4m to 6.3m with an average of 5.8m.

The method of mining in bords is described by Danvers Powers (1912) to be as follows:

1. Middle Coal taken 7'7" (2.3m) with the Morgan band left in the mine;
2. Bottom Coal lifted 4'4" (1.3m) with the Jerry band being put to one side;
3. Top Coal dropped 4'1" (1.2m) with the aid of drums or ladders to stand on.

It is noted that the top coal stood up (did not collapse) better than the roof rock and so delamination and caving of the roof is expected, (this has been observed within numerous boreholes drilled in the area).

A passage from the 1908 Royal Commission below provides further information on the mined section. The sketch referred to is shown below as Figure 3.

> "The top lift (A) on the sketch is of an exceptionally tender nature and has little cohesive strength. The coal immediately above (B) is also of a very friable character. Following upon the third operation (dropping the top coal) the splint coal above, and frequently the shale roof, falls in the bords, and together with the dirt bands fill up more or less the space from which the coal has been excavated often to within about 3 feet of the top of the seam, thus, to some extent automatically supporting the pillars. The roof over the seam proper consists of splint coal and bands 4 feet, and overlying shale and sandstone."

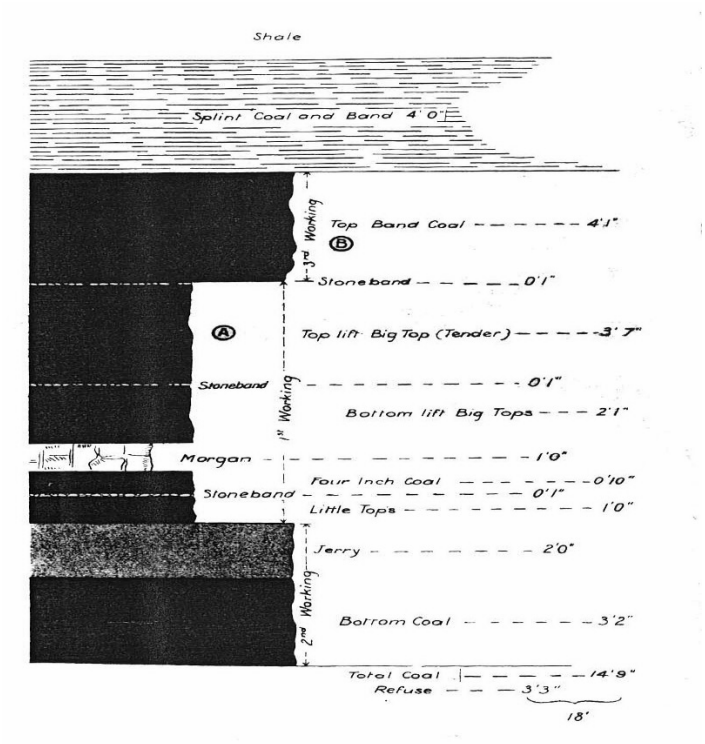


Figure 3: Borehole Seam section from 1908 Royal Commission

The above section is considered to be representative of the Borehole Seam in the area.

The mine workings of the No. 2 and Hamilton pits were abandoned in 1901 (RT566), while the New Wining Pit workings were abandoned in 1916.

7.2.2. Worked and current pillar heights

During mining, the poor quality splint coal was left in the roof of the mine workings as it had little commercial value. After the completion of mining, the upper split coal as well as some of the overlying laminated rock has fallen into the mine voids, as observed in several boreholes (by Coffey and others).

Modern borehole logs are available for several sites near the subject site including:

- The Court House Building, Bulk Fly Ash Grout
- The Acculon Building, Coffey report N08844/01-AD April 2004
- The GPT Development, Douglas Partners report 39826.14.R.001Rev1 July 2018
- 108 Church Street, Coffey report 754-NTLGE211941-AD May 2018

A summary of the findings from the current investigation combined with average Borehole Seam data from nearby projects is provided in Table 2.

Table 2: Summary of Borehole Seam data

Development	Location relative to site	Lower bound void (m)	Upper bound void (m)	Average Void (m)	Lower bound pillar height [2] (m)	Upper bound pillar height [2] (m)	Average Pillar height (m)	Full Seam thickness (m) (only)
BH01	Subject site			0.5			3.6	
BH02A								5.9
BH03								6.1
BH04				1.65			6.6	
Church [1]	330m north	-	-	-	-	-	-	6.0
Court House	500m north west	0.2	6.7	2.9	0.2	9.3	6.2	NA
Acculon	420m north	0.7	1.15	0.93	8.0	8.4	8.2	6.95
East End	400m north east	0.5	1.00	0.74	6.08	7.84	6.74	NA
New Winning Winding Shaft	570m south west							(22 feet) 6.7

Notes:

(1): evidence of crushing within coal pillar

(2): combined void plus rubble

NA: Accurate seam thickness not available

It is noted the bottom 2.5m of coal (Morgan Stone and below) in BH01 was still in place below the rubble.

The original pillar height at the New Winning Pit is shown to be 17’ 0.5” (5.19m), which is slightly less than the working section from the Royal Commission of 18’ (5.49m) given above.

7.2.3. Bord widths

After encountering voids at mine level, a sonar was used to scan the mine workings. The sonar scans encountered to following:

- BH01
  - 4.5m wide bord near the floor with the near pillar being only 0.7m away from the borehole
  - 4.2m wide at 0.2m from the top of void.
  - The length of bord observed was 17m
- BH04
  - 5.8m wide bord near the floor 22m in length with an interruption at 4.1m.
  - 5.5m wide by 21m long at 0.5m above the floor.
  - 4.8m wide near the roof of the void

7.2.4. Roof of workings

The immediate roof of the workings is comprised of a combination of silty coal overlain by siltstone and shale. Experience obtained from drilling numerous boreholes in the Borehole Seam workings in the Newcastle area shows that although prone to spalling and cave-in, the compressive strength of the immediate roof of the workings remains much greater than that of the underlying clean coal. Borehole BH01 had an axial I_{s50} strength of 3.4MPa while BH03 while BH03 had an axial I_{s50} strength of 0.9MPa (approximate UCS of 15MPa to 50MPa). Additionally, boreholes which have intersected mining bords show this material to 'arch' increasing the width of the pillar in this area. Therefore, punching failure of the workings into the roof is considered to be a non-credible case for these workings.

7.2.5. Borehole Seam floor conditions

The Waratah Sandstone forms the floor of the Borehole Seam.

A good knowledge base regarding the characteristics of the Waratah Sandstone beneath Newcastle is now available from numerous recent boreholes, carried out by Coffey in the area and records of old boreholes and mining conditions. Based on this, the Waratah Sandstone is considered:

- Free from tuffaceous clays, weaker rock beds or fractured zones
- At least 5 m thick
- Not prone to significant softening
- Not known to cause floor heave or pillar bearing capacity problems
- Very high to extremely high strength sandstone encountered in BH03

For the Waratah Sandstone, BH01 had an axial I_{s50} strength of 4.5MPa while BH03 while BH03 had an axial I_{s50} strength of 2.2MPa (approximate UCS of 80MPa and 40MPa). Therefore, punching failure of the workings into the floor is considered to be a non-credible case for these workings.

7.2.6. Discussion on the 1906 to 1908 subsidence events

As reported in the 1908 Royal Commission and summarised in a report by To, E.M. (1998), large scale subsidence events have occurred in the Borehole Seam workings beneath Newcastle. The consequences of these 'creeps' was cracks of up to 75mm width and surface depressions up to 825mm deep resulting in damage to buildings and infrastructure.

The crushing originated in an area of smaller square shaped pillars (with dimensions of 8m to 9m by 8m to 13m scaled off RT566) with subsequent crushing events potentially caused by the additional abutment loading associated with vertical stress redistribution away from the failed pillars. The locations of the three crush zones is shown on RT566 Sheet 4. The second crush zone is shown to be located between Church Street and Tyrell Street extending down to McCormack Street. The third zone is bounded by Perkin Street to the west and the limit of mining in the east.

Over more regularly shaped pillars near Tyrrell and Church streets, the subsidence measured was generally 600mm to 775mm. Another finding of the Commission was that the workings located in the shallower seams (i.e. the Dudley and Yard seams) may have contributed to the subsidence magnitude. The subsidence recorded in areas where the shallow seams were not worked was approximately half of the subsidence recorded for areas where shallow workings were present. That is approximately 300mm to 390mm.

No lives were lost and no buildings had to be demolished as a result of the 1906 – 1908 subsidence events. These events provide a valuable indication of the maximum subsidence or 'worst case' that could be expected from a large subsidence event. The failure was slow and access to some parts of the mine was possible for inspections during the creeps. Further expansion of the creeps halted without intervention. That is, the creeps eventually stopped on their own accord without human efforts to confine them. This subsidence event occurred while the mine workings were dewatered. Since then, the mine was abandoned with the water level within the mine allowed to rise, significantly

reducing the stress on the pillars and thereby reducing the likelihood of further pillar failure. In this sense, the Borehole Seam workings underlying Newcastle have undergone a large scale proof load test. Although the pillars are gradually weakening as the roof falls occur.

It is noted the subject site falls outside the drawn limits of subsidence.

7.2.7. Confidence in the mine working record tracing

Borehole verification work from more than twenty boreholes drilled into bords within the New Winning Pit mine workings have verified that record tracing RT566 Sheet 8 is a close representation of the mine workings. Slight discrepancies exist between Sheet 4 and Sheet 8 however some of this may be due to scaling issues, plan damage (folding) and issues arising from stitching the separate images that make up the mine plans.

It is noted that a 10m shift in the mine workings was applied at the site after encountering a void at mine level within the first borehole BH01 where a pillar was expected. Remaining boreholes were then able to target mine workings as expected. This appears to be partly due to mis-alignment of the workings in the area of East End development 400m north east of the site which had been originally projected to the site.

7.2.8. Previous grouting works

Previous grouting workings have been carried out in the Borehole Seam. This was generally limited to the larger structures including:

- The Court House Building (500m north west)
- NeW Space (610m west north west)
- Icon Central (800m west).
- East End development 420m north of the site.

8. Discussion

8.1. State of mine workings

8.1.1. Yard Seam

It was not possible to verify the dimensions of mine workings within the Yard Seam due to the small void heights at mine level. The seam thickness was 1.2m thick at BH02A. This borehole also held water during drilling, indicating the overburden and Yard Seam was relatively free of fracture defects suggesting that pillars at mine level have not undergone crushing

However, with the size of void encountered at mine level being significantly filled with apparent roof collapse rubble, the potential for future pillar instability has been reduced.

8.1.2. Borehole Seam

Although the seam thickness encountered within BH02A and BH03 was approximately 600mm thinner that at the New Winning Shaft, the coal recovered in the cored borehole BH03 appears to be relatively solid with the only weak zone (core loss) being near the top of the coal pillar just below the ‘Splint Coal’. In this zone, the geophysical density plots did not record a very low density that would suggest crushed coal in either borehole BH02A or BH03. As such it does not appear that the pillars have crushed in this area.

As the surrounding area to the north, east and south east is known to have crushed (i.e. Creep 1 and Creep 2 from 1906 and 1907, refer to Drawing 4) the workings within the Borehole Seam have a marginal factor of safety and may crush in the future.

8.2. Pillar stability assessment

8.2.1. Pillar factor of safety methodology

In order to quantify pillar stability, a factor of safety (FOS) is used. The factor of safety of an individual pillar is the ratio of pillar strength to pillar load. There are many published methods in practice around the world to estimate pillar strength. All are simplifications and, thus have limitations. In Australia, the UNSW Pillar Design method (Galvin et al 1998) is commonly used. This approach is based on semi-empirical relationships, derived from a database of failed and un-failed pillars. It is only valid where roof and floor conditions are good and where full pillar yield does not exist. In general, as discussed above based on core drilling of the seam this appears to be the case in this area.

An angle of draw defines a zone around a mined area or 'panel' that would be affected, should pillar failure occur. Due to the mainly fine grained and low strength nature of the overburden, an angle of draw of approximately 26.5° (2V:1H) has been adopted in this report.

The strength of the pillars with a width to height ratio $\leq$5 (S_p in MPa) can be estimated using Equation 1.

$$S_p = \frac{8.6(Q.w)^{0.51}}{h^{0.84}} \quad (1)$$

Where: w = width of pillar (m), h = height of pillar (m).

Where the width to height ratio is >5, the equation is modified to Equation 2.

$$S_p = \frac{27.63(Q)^{0.51}}{w^{0.22}h^{0.11}}\left\{0.29\left[\left(\frac{w}{5h}\right)^{2.5} - 1\right] + 1\right\} \quad (2)$$

Where: Q = shape factor:

- For width less than 6: $Q = \frac{2L}{L+w}$ (3)
- For width greater than 6: $Q = \left(\frac{2L}{L+w}\right)^{\frac{R-3}{3}}$ (4)

Where R = width/height

The assessed load applied to the coal pillars is obtained by the weight of all the overburden layers within the tributary area, expressed as a vertical pressure on the top of the pillar. The tributary area is typically taken the midway along bords and cut throughs surrounding a pillar, as shown in Figure 4.

Where: 'TW' is the tributary width and 'TL' is the tributary length.

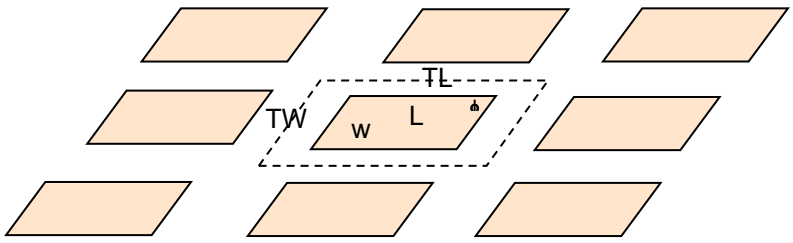


Figure 4: Tributary model

8.2.2. Pillar stability calculations

Yard Seam

For these calculations we have adopted three heights:

1. Lower bound pillar height based on inferred mined height of bords approximately 0.9m
2. The upper bound pillar height based on the maximum height (assuming all coal strength parameters) after roof collapse based on borehole data at the Acculon Site (approximately 1.6m)
3. Yard Seam thickness of 1.2m based on BH02A

For the pillar plan dimensions, we have adopted three widths:

1. 1.6m wide by 16m long
2. 1.9m wide by 16m long
3. 2.7m wide by 40m long (taken as the average pillar width of Yard Seam mine workings on RT566 Sheet 7 (unlikely to be applicable)

For the overburden load, we have adopted four states:

1. ‘Dry state’ equivalent to during mining under the site (i.e. 41m of cover)
2. ‘Dry state’ with abutment allowing for crush front under the site (i.e. 41m of cover)
3. ‘Dry state’ east of the site under the hill assuming 60m of cover
4. ‘Dry state’ east of the site under the hill assuming 60m of cover

It the above cases, the bord width has been set at 5.4m which is approximately 6 yards.

Borehole Seam

For these calculations we have adopted four heights:

1. The smaller height of pillar (i.e. above Morgan Stone) encountered in BH01 of 3.6m
2. The height of better quality coal (i.e. including Morgan and Jerry or height of full seam minus the top split coal) estimated at 4.7m encountered in BH03
3. The full coal pillar height of 6.1m encountered in BH03
4. The maximum pillar height (assuming all coal strength parameters) after roof collapse based on borehole data of BH04 being 6.6m

For the pillar plan dimensions we have adopted two widths:

1. Actually drawn plan dimensions
2. Less 1m to the drawn plan widths to model potential robbing of the pillars

For the overburden stress we have adopted eight states:

1. ‘Dry state’ equivalent to during mining under the site
2. A current ‘Flooded State’ allowing for buoyancy effect of pore pressures after flooding of the workings. Although the water table within the workings is at approximately 3m AHD, we have assumed that the water table may be lowered to approximately 50% (RL-28m) under the site
3. ‘Dry state’ with abutment loading under the site
4. ‘Flooded State’ with abutment loading under the site
5. 5 to 8: repeat of 1 to 4 with additional 20m of cover as present within the ‘Creep 1 area’

These variations provide 'what if' scenarios so that an assessment can be made on how stable the workings are, even if the pillars aren't as expected.

The results of the analysis are presented in Tables 3 to 5 for the Yard Seam and Borehole Seam under the site and under The Hill (east of the site) respectively. In our opinion, the case of an equivalent 6.1m height of flooded workings is most likely for the Borehole Seam workings and the other cases provide a sensitivity assessment on the base case. These cases are shown in bold.

Results

Table 3: Summary of pillar stability calculations for Yard Seam

Pillar	Width (m)	Length (m)	Tributary width (m)	Tributary length (m)	Abutment loading	Factor of safety					
Location						Under site			East of site		
Pillar height (m)						0.9	1.2	1.6	0.9	1.2	1.6
Pillar 1	1.6	16	7.0	19	No Abutment	2.2	1.7	1.4	1.5	1.2	0.9
					With Abutment	1.6	1.2	1.0	1.0	0.8	0.6
Pillar 2	1.9	16	7.3	19	No Abutment	2.7	2.1	1.7	1.9	1.5	1.2
					With Abutment	1.9	1.5	1.2	1.2	1.0	0.8
Pillar 3	2.7	40	8.1	43	No Abutment	4.5	3.6	2.8	3.2	2.5	2.0
					With Abutment	3.8	3.0	2.4	2.5	2.0	1.6

Table 4: Summary of pillar stability calculations for Borehole Seam under the site

Pillar	Width (m)	Length (m)	Scaled tributary width (m)	Tributary length (m)	Abutment loading	Factor of safety							
Height (m)						**3.6**		**4.7**		6.1		**6.6**	
Dry/ Flooded						**Dry**	**Flooded**	**Dry**	**Flooded**	Dry	Flooded	**Dry**	**Flooded**
Pillar 1	8.8	27.9	14.2	31.95	No Abutment	2.0	2.4	1.6	2.0	**1.3**	**1.6**	1.2	1.5
					With Abutment	1.3	1.6	1.0	1.3	**0.9**	**1.1**	0.8	1.0
	7.8				No Abutment	1.7	2.0	1.3	1.6	**1.1**	**1.3**	-	-
					With Abutment	1.1	1.3	0.9	1.1	**0.7**	**0.9**	-	-
Pillar 2	10.0	29.4	15.5	33.25	No Abutment	2.2	2.7	1.8	2.2	**1.5**	**1.8**	1.4	1.7
					With Abutment	1.5	1.8	1.2	1.5	**1.0**	**1.2**	0.9	1.1
	9.0				No Abutment	1.9	2.3	1.5	1.9	**1.3**	**1.5**	-	-
					With Abutment	1.2	1.5	1.0	1.2	**0.8**	**1.0**	-	-
Pillar 3	10.5	28.3	15.9	32.9	No Abutment	2.3	2.8	1.8	2.3	**1.5**	**1.8**	1.4	1.7
					With Abutment	1.5	1.8	1.2	1.5	**1.0**	**1.2**	0.9	1.1
	9.5				No Abutment	2.0	2.4	1.6	1.9	**1.3**	**1.6**	-	-
					With Abutment	1.3	1.6	1.0	1.3	**0.9**	**1.0**	-	-
Pillar 4	12.3	28.2	17.6	31.95	No Abutment	2.7	3.4	2.2	2.7	**1.8**	**2.2**	1.7	2.0
					With Abutment	1.8	2.2	1.4	1.7	**1.2**	**1.4**	1.1	1.3
	11.3				No Abutment	2.4	2.9	1.9	2.3	**1.6**	**1.9**	-	-
					With Abutment	1.5	1.9	1.2	1.5	**1.0**	**1.3**	-	-
Pillar 5	11.7	30.4	17.4	34.7	No Abutment	2.5	3.1	2.0	2.5	**1.6**	**2.0**	1.5	1.9
					With Abutment	1.7	2.1	1.3	1.7	**1.1**	**1.4**	1.0	1.3
	10.7				No Abutment	2.2	2.7	1.8	2.2	**1.4**	**1.8**	-	-
					With Abutment	1.4	1.8	1.2	1.4	**1.0**	**1.2**	-	-
Pillar 6	18.2	62.9	22.8	67.45	No Abutment	4.6	5.6	3.4	4.2	**2.6**	**3.2**	2.5	3.0
					With Abutment	3.6	4.4	2.7	3.3	**2.1**	**2.5**	1.9	2.4

Pillar	Width (m)	Length (m)	Scaled tributary width (m)	Tributary length (m)	Abutment loading	Factor of safety							
Height (m)						3.6		4.7		6.1		6.6	
Dry/ Flooded						Dry	Flooded	Dry	Flooded	Dry	Flooded	Dry	Flooded
	17.2				No Abutment	4.2	5.1	3.1	3.8	**2.4**	**2.9**	-	-
					With Abutment	3.3	4.0	2.4	3.0	**1.9**	**2.3**	-	-

Table 5: Summary of pillar stability calculations for Borehole Seam east of the site under the hill

Pillar	Width (m)	Length (m)	Scaled tributary width (m)	Tributary length (m)	Abutment loading	Factor of safety							
Height (m)						3.6		4.7		6.1		6.6	
Dry/ Flooded						Dry	Flooded	Dry	Flooded	Dry	Flooded	Dry	Flooded
Pillar 1	8.8	27.9	14.2	31.95	No Abutment	1.6	2.0	1.3	1.6	**1.1**	**1.3**	1.0	1.2
					With Abutment	1.0	1.2	0.8	1.0	**0.7**	**0.8**	0.6	0.8
	7.8				No Abutment	1.4	1.7	1.1	1.4	**0.9**	**1.1**	-	-
					With Abutment	0.8	1.0	0.7	0.8	**0.6**	**0.7**	-	-
Pillar 2	10.0	29.4	15.5	33.25	No Abutment	1.8	2.3	1.5	1.8	**1.2**	**1.5**	1.1	1.4
					With Abutment	1.0	1.2	0.8	1.0	**0.6**	**0.8**	0.6	0.7
	9.0				No Abutment	1.6	1.9	1.3	1.6	**1.0**	**1.3**	-	-
					With Abutment	0.8	1.0	0.7	0.8	**0.6**	**0.7**	-	-
Pillar 3	10.5	28.3	15.9	32.9	No Abutment	1.9	2.3	1.5	1.9	**1.2**	**1.5**	1.2	1.4
					With Abutment	1.0	1.2	0.8	1.0	**0.7**	**0.8**	0.6	0.8
	9.5				No Abutment	1.6	2.0	1.3	1.6	**1.1**	**1.3**	-	-
					With Abutment	0.9	1.1	0.7	0.9	**0.6**	**0.7**	-	-
Pillar 4	12.3	28.2	17.6	31.95	No Abutment	2.3	2.8	1.8	2.2	**1.5**	**1.8**	1.4	1.7
					With Abutment	1.2	1.5	1.0	1.2	**0.8**	**1.0**	0.7	0.9
	11.3				No Abutment	2.0	2.4	1.6	1.9	**1.3**	**1.6**	-	-
					With Abutment	1.1	1.3	0.9	1.1	**0.7**	**0.9**	-	-

Pillar	Width (m)	Length (m)	Scaled tributary width (m)	Tributary length (m)	Abutment loading	Factor of safety							
Height (m)						**3.6**		**4.7**		6.1		**6.6**	
Dry/ Flooded						**Dry**	**Flooded**	**Dry**	**Flooded**	Dry	Flooded	**Dry**	**Flooded**
Pillar 5	11.7	30.4	17.4	34.7	No Abutment	2.1	2.6	1.7	2.1	**1.4**	**1.7**	1.3	1.6
					With Abutment	1.1	1.4	0.9	1.1	**0.7**	**0.9**	0.7	0.9
	10.7				No Abutment	1.8	2.2	1.5	1.8	**1.2**	**1.5**	-	-
					With Abutment	1.0	1.2	0.8	1.0	**0.6**	**0.8**	-	-
Pillar 6	18.2	62.9	22.8	67.45	No Abutment	3.8	4.7	2.8	3.5	**2.1**	**2.6**	2.0	2.5
					With Abutment	2.1	2.6	1.6	2.0	**1.2**	**1.5**	1.2	1.4
	17.2				No Abutment	3.4	4.2	2.5	3.1	**2.0**	**2.4**	-	-
					With Abutment	1.9	2.4	1.4	1.8	**1.1**	**1.4**	-	-

Based on the above the coal pillars would be expected to have a marginal factor of safety against failure when allowing for the abutment load. The historical pillar run in the area appears to have stopped at large coal pillars like Pillar 4 and Pillar 6 or at the lower mined height evident in BH01.

8.3. Likelihood of pillar failure

The UNSW pillar design methodology includes a relationship between factor of safety and probability of failure. This is based on a statistical analysis of the data set of failed and un-failed cases.

It should be noted that to be included in the data set, the area mined would have to:

- Be regular and large enough for tributary load to be a good approximation of the pillar load
- Have involved the crushing of many adjacent pillars of similar widths and heights
- Have a sufficient time pass after completion of mining
- Have the failure confirmed to be due to pillar crushing rather than punching failure of the floor or roof of the workings
- Have all pillar dimensions known

Table 6 provides a summary of factor of safety versus probability and likelihood of failure.

Table 6: Pillar factor of safety and probability (after Galvin 1998)

Factor of safety	Likelihood of failure	probability of failure
0.87	8 in 10	0.8
1.00	5 in 10	0.5
1.22	1 in 10	0.1
1.30	5 in 100	0.05
1.38	2 in 100	0.02
1.44	1 in 100	0.01
1.63	1 in 1000	0.001
1.79	1 in 10000	0.0001
1.95	1 in 100000	0.00001
2.11	1 in 1000000	0.000001

Based on the above it is considered that failure of the mine workings within the Borehole Seam is considered likely to possible.

8.4. Estimated subsidence

8.4.1. Yard Seam

As borehole data indicates that the workings have not previously collapsed, it is likely that stresses induced by crushing in the Borehole Seam workings can result in future crushing in the Yard Seam. This is currently limited to a degree by the pillar support and the residual size of voids as a result of roof collapse that has already occurred.

For this assessment the following has been adopted:

- The two void heights of 0.3 and 0.5m (rounded)
- Pillar width of 1.6m

- Bord width of 5.4m
- A pillar bulking factor of 1.3

To estimate the amount of crush the following formula has been adopted.

$$Crush = \frac{\left[\left(H_v \times W_{(B+P)}\right) - W_P \times H_{Crush} \times BF_P\right]}{W_{(B+P)}}$$

Where

- H_v = height of void remaining
- $W_{(B+P)}$ = width of bord and pillar
- W_P = width of pillar
- H_{Crush} = Height of pillar being mobilised by the crush
- BF_P = bulking factor of pillar crushing

Using this information, it is estimated that the convergence (crush) of the seam may be between 0.2m and 0.3m.

Using the depths to workings of 42m, the subsidence parameters estimated for the site with reference to Holla (1987) are provided in Table 7.

Table 7: Subsidence parameters for Yard Seam assuming no grouting

Parameter	Lower bound	Upper bound
Maximum subsidence, Smax (mm)	200	300
Maximum tensile strain, +Emax (mm/m)	2	3
Maximum compressive strain, -Emax (mm/m)	3	4.5
Maximum tilt, Gmax (mm/m)	8	13
Tensile curvature radius (convex) (km)	5	3.5
Compression curvature radius (concave) (km)	3.3	2.2

8.4.2. Borehole Seam

Void heights of 0.5m (BH01) and 1.65m (BH04) were encountered at the site. Working on the assumption that the pillars have not previously been subject to convergence (crush), and based on calculations similar to those used on the Yard Seam, the amount of crush that can occur at seam level in the future is estimated at between 150mm and 300mm.

Using the depths to workings of 93m, the subsidence parameters estimated for the site with reference to Holla (1987) are provided in Table 7.

Table 8: Subsidence parameters for Borehole Seam assuming no grouting

Parameter	Lower bound	Upper bound
Maximum subsidence, Smax (mm)	130	250
Maximum tensile strain, +Emax (mm/m)	0.7	1.5
Maximum compressive strain, -Emax (mm/m)	1	2
Maximum tilt, Gmax (mm/m)	3	6
Tensile curvature radius (convex) (km)	14	7.5
Compression curvature radius (concave) (km)	10	5

The above estimations do not include the mine workings grouting which is reported separately.

9. Closing remarks

Further advice on the uses and limitations of this report is presented in the attached document, 'Important Information about your Coffey Report'.

Signature:	
Full name:	Simon Baker
Title:	Senior Geotechnical Engineer
Date:	9 November 2021

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way. Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment. Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Drawings

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revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

LEGEND

- APPROXIMATE BOREHOLE LOCATION
- LOT BOUNDARIES
- SITE BOUNDARY

AERIAL IMAGE SOURCE: GOOGLE EARTH PRO 7.1.2
AERIAL IMAGE ©: SINCLAIR KNIGHT MERZ 2014

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Scale (metres) 1:1000

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approved	JD
date	17/12/2018
scale	AS SHOWN
original size	A3

coffey

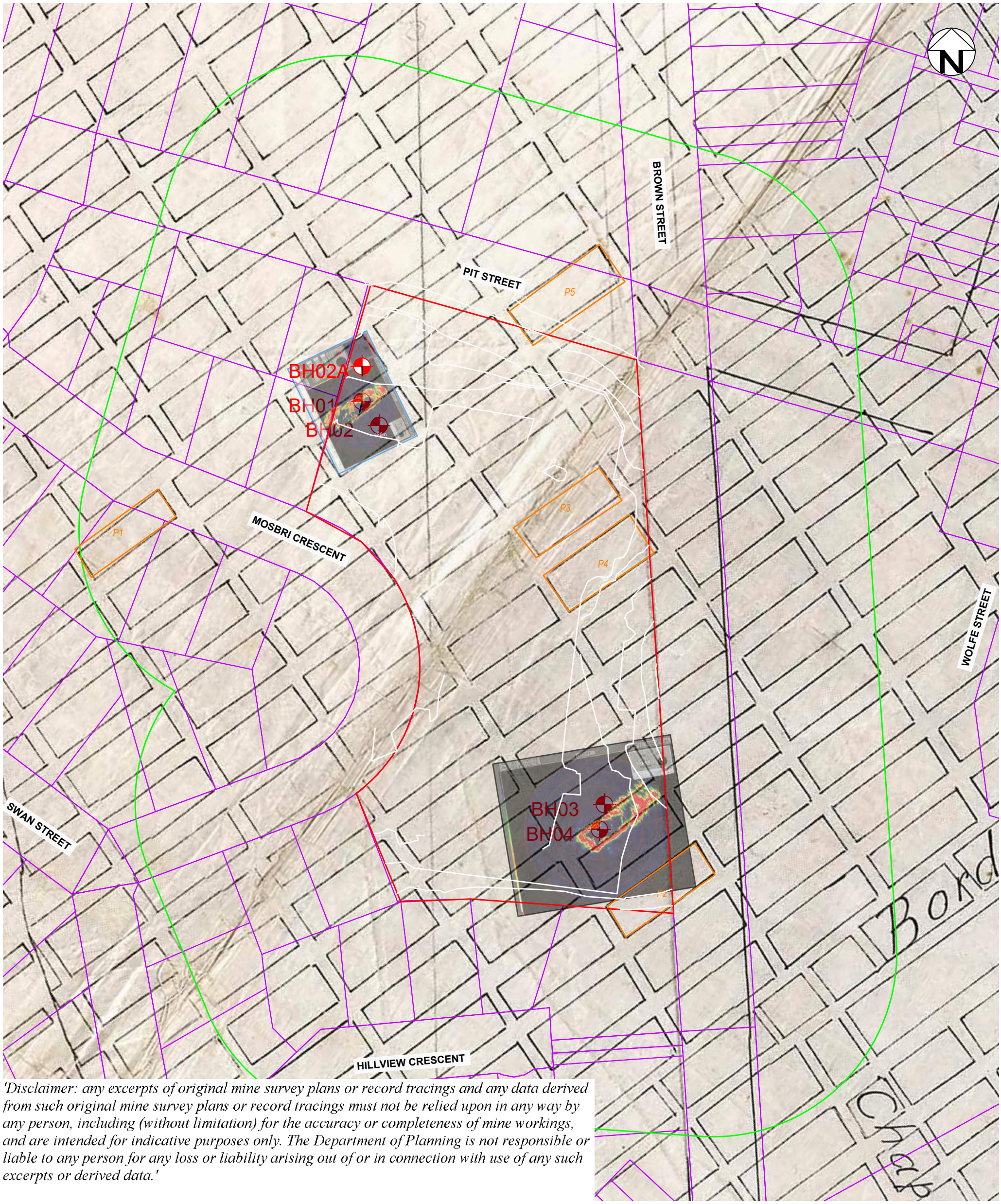
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project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: BOREHOLE LOCATION PLAN

project no: 754-NTLGE220504 | drawing no: DRAWING 1 | rev: A

PLOT DATE: 17/12/2018 7:13:43 PM DWG FILE: F:\GEOTECHNICS\1. JOB FILES\NEWCASTLE PROJECTS\NTLGE220000 - NTLGE229999\754-NTLGE220504 - PROPOSED RESIDENTIAL DEVELOPMENT NBN SITE\DRAWINGS\NBN MINE.DWG



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revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

LEGEND

- APPROXIMATE BOREHOLE LOCATION
- LOT BOUNDARIES
- SITE BOUNDARY
- ANGLE OF DRAW

BACKGROUND IMAGE SOURCE: RT566 SHEET 8
IMAGE ©: AUSTRALIAN AGRICULTURAL COMPANY

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Scale (metres) 1:1000

drawn	SJB
approved	JD
date	17/12/2018
scale	AS SHOWN
original size	A3

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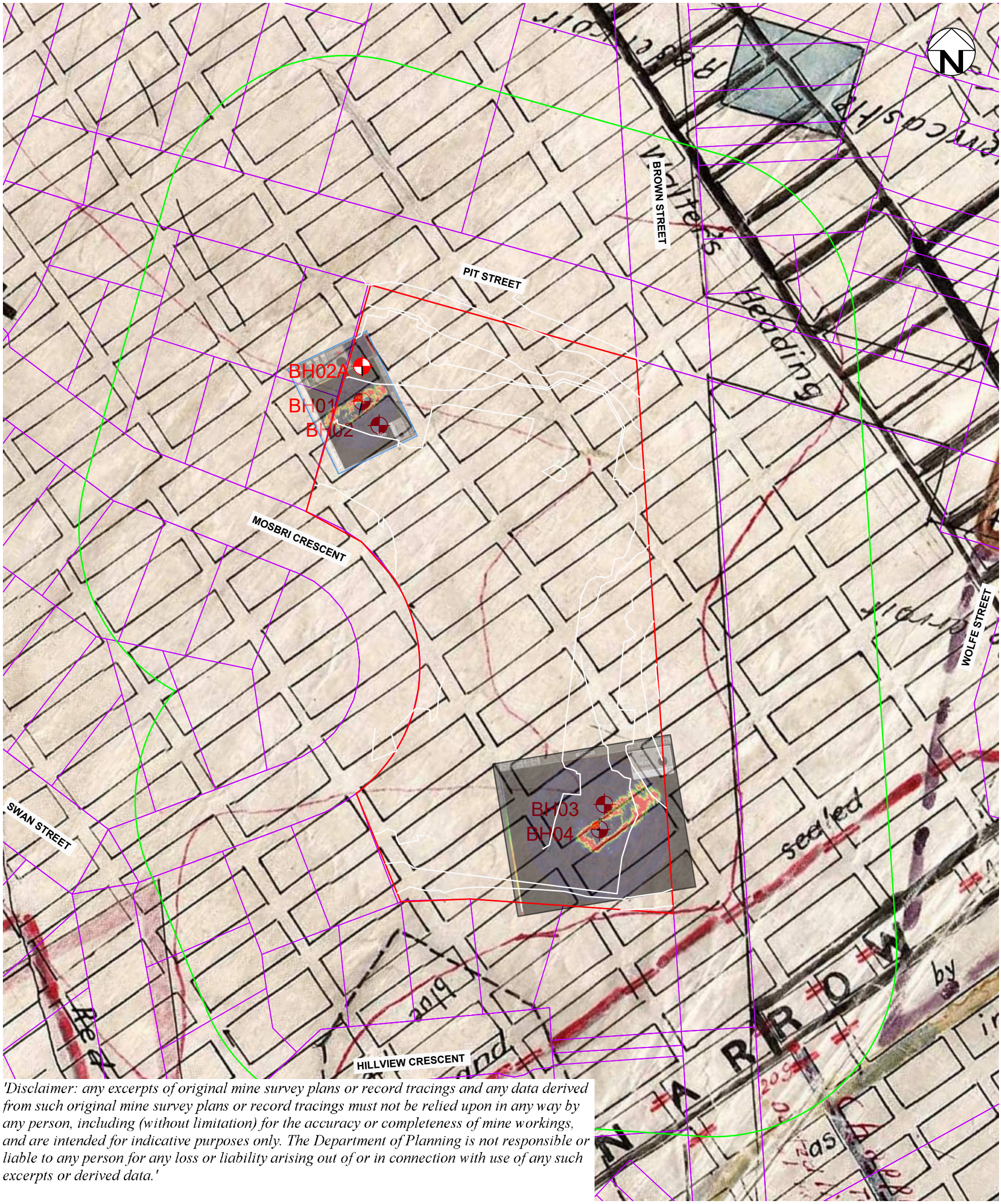
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project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: SITE RELATIVE TO MINE WORKINGS WITHIN
BOREHOLE SEAM RT566 SHEET 8

project no: 754-NTLGE220504 | drawing no: DRAWING 2 | rev: A

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LEGEND

- APPROXIMATE BOREHOLE LOCATION
- LOT BOUNDARIES
- SITE BOUNDARY
- ANGLE OF DRAW

BACKGROUND IMAGE SOURCE: RT566 SHEET 4
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approved	JD
date	17/12/2018
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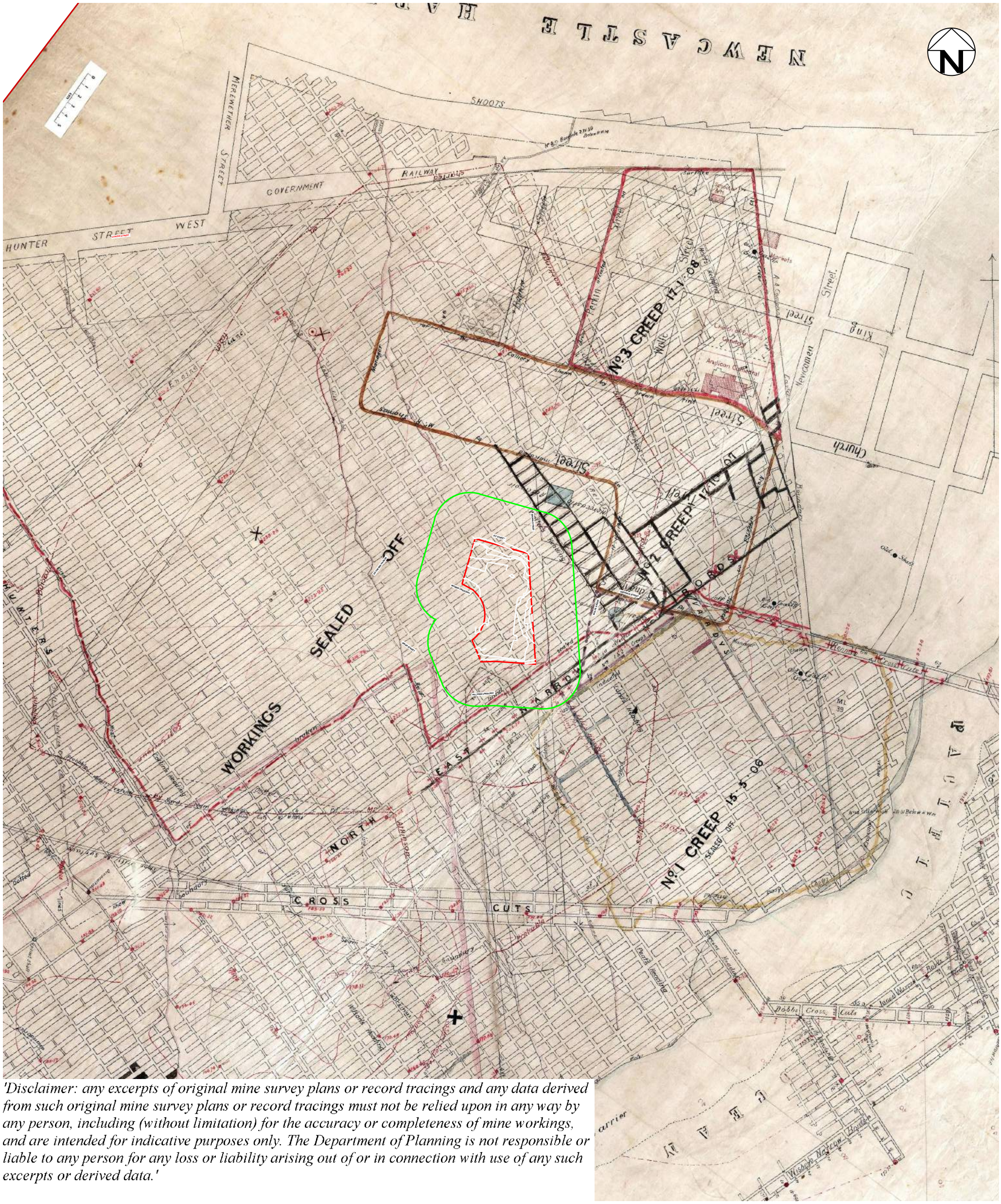
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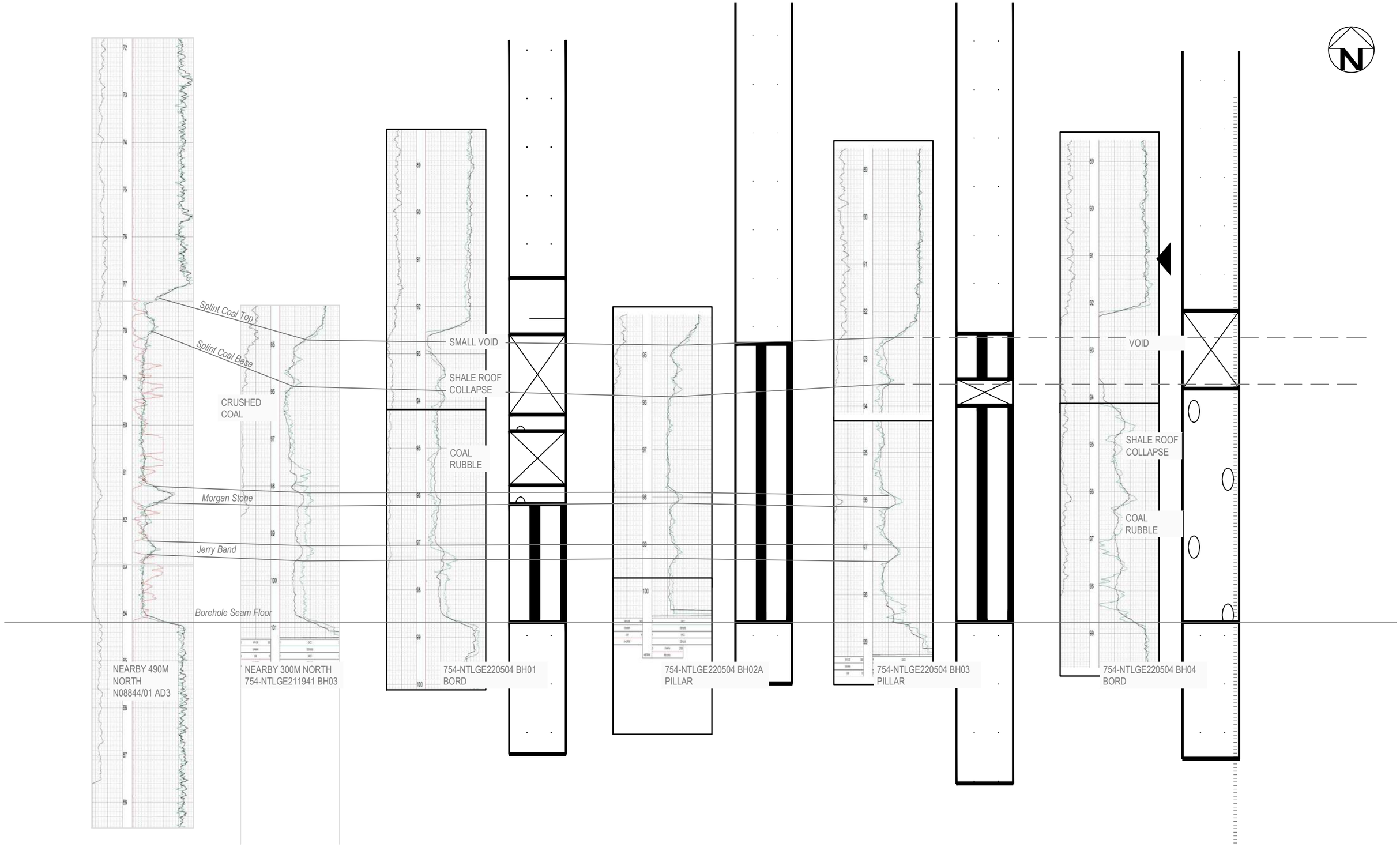
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NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

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project no: 754-NTLGE220504 | drawing no: DRAWING 3 | rev: A

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NEWCASTLE
SHOOTS
MEREWETHER STREET
RAILWAY
GOVERNMENT
HUNTER STREET WEST
No.3 CREEP 17-1-08
No.2 CREEP 12-10-07
No.1 CREEP 15-5-06
SEALED OFF
WORKINGS
EAST
NORTH
CROSS CUTS
Stockbury
Perth
Wallis
Mangrove
Callaris
Newcomen
King
Church
Street
Parish Boundary
Old Shaft
Old Cut
Old Gravel Pit
Old Quarry
Wilsons Heading
Pearls Heading
Dabbs Cross Cuts
Tunnel Warren
Wiseguy Narrow Heading
Carrier
Indicated Fault
Surface
Anglican Cathedral
Council of Christian Churches
Holy Trinity Church
Scots Church
A.A. Company's Office
Police Station
Courthouse
Post Office
Telegraph Office
Public School
Hospital
Barracks
Gaol
Custom House
Wharf
Quay
Steam Crane
Steam Ferry
Pier
Jetty
Railway Station
Railway Goods Shed
Railway Engine Shed
Railway Turntable
Railway Coal Stage
Railway Water Tank
Railway Signal Box
Railway Signal
Railway Crossing
Railway Gate
Railway Platform
Railway Bridge
Railway Tunnel
Railway Viaduct
Railway Culvert
Railway Embankment
Railway Cutting
Railway Fence
Railway Boundary
Railway Line
Railway Siding
Railway Station Master's House
Railway Station Master's Office
Railway Station Master's Garden
Railway Station Master's Yard
Railway Station Master's Residence



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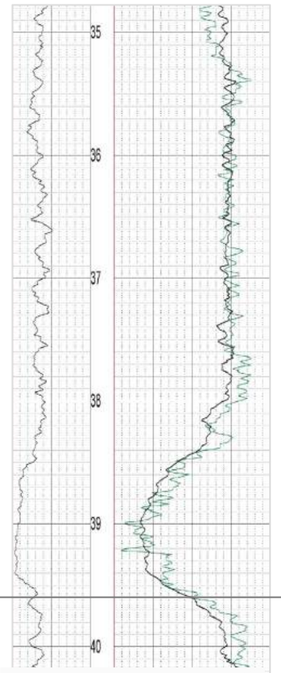
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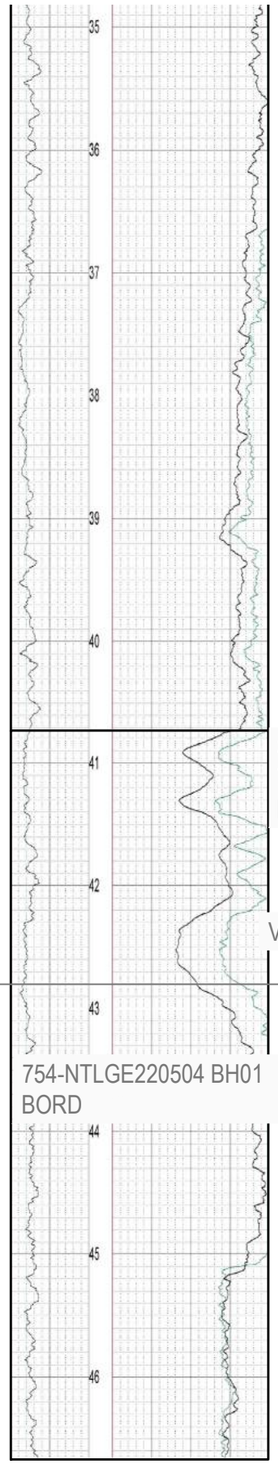
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project no: 754-NTLGE220504 | drawing no: DRAWING 5 | rev: A

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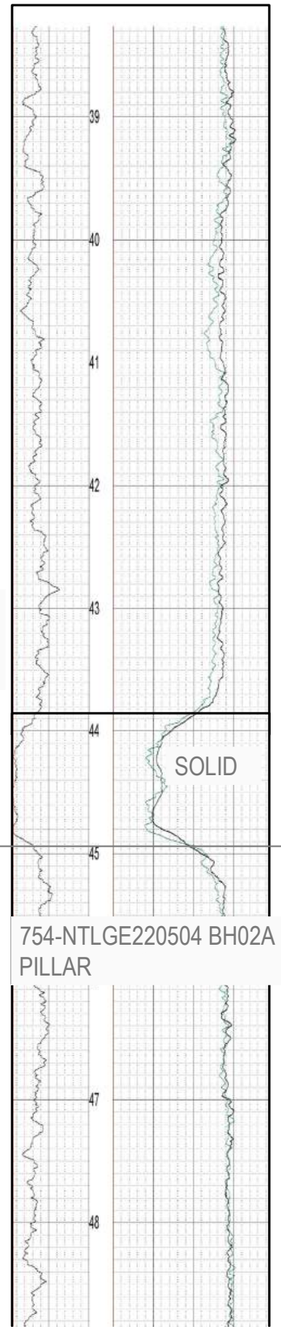
NEARBY 300M NORTH
754-NTLGE211941 BH03



SMALL VOIDS IN ROOF

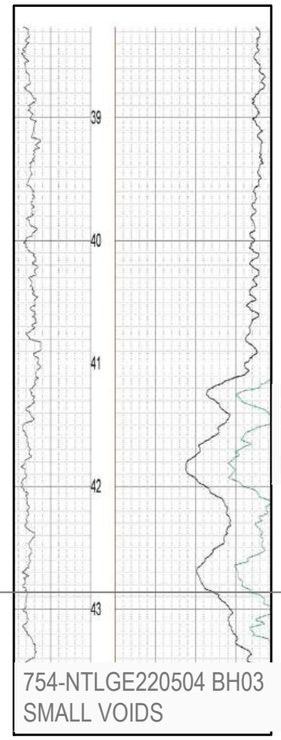
VOID

754-NTLGE220504 BH01
BORD



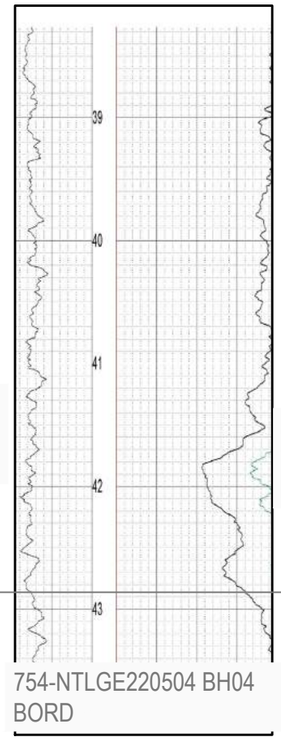
SOLID

754-NTLGE220504 BH02A
PILLAR



SMALL VOIDS IN ROOF

754-NTLGE220504 BH03
SMALL VOIDS



SMALL VOIDS IN ROOF

754-NTLGE220504 BH04
BORD

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

drawn	SJB
approved	JD
date	17/12/2018
scale	NTS
original size	A3

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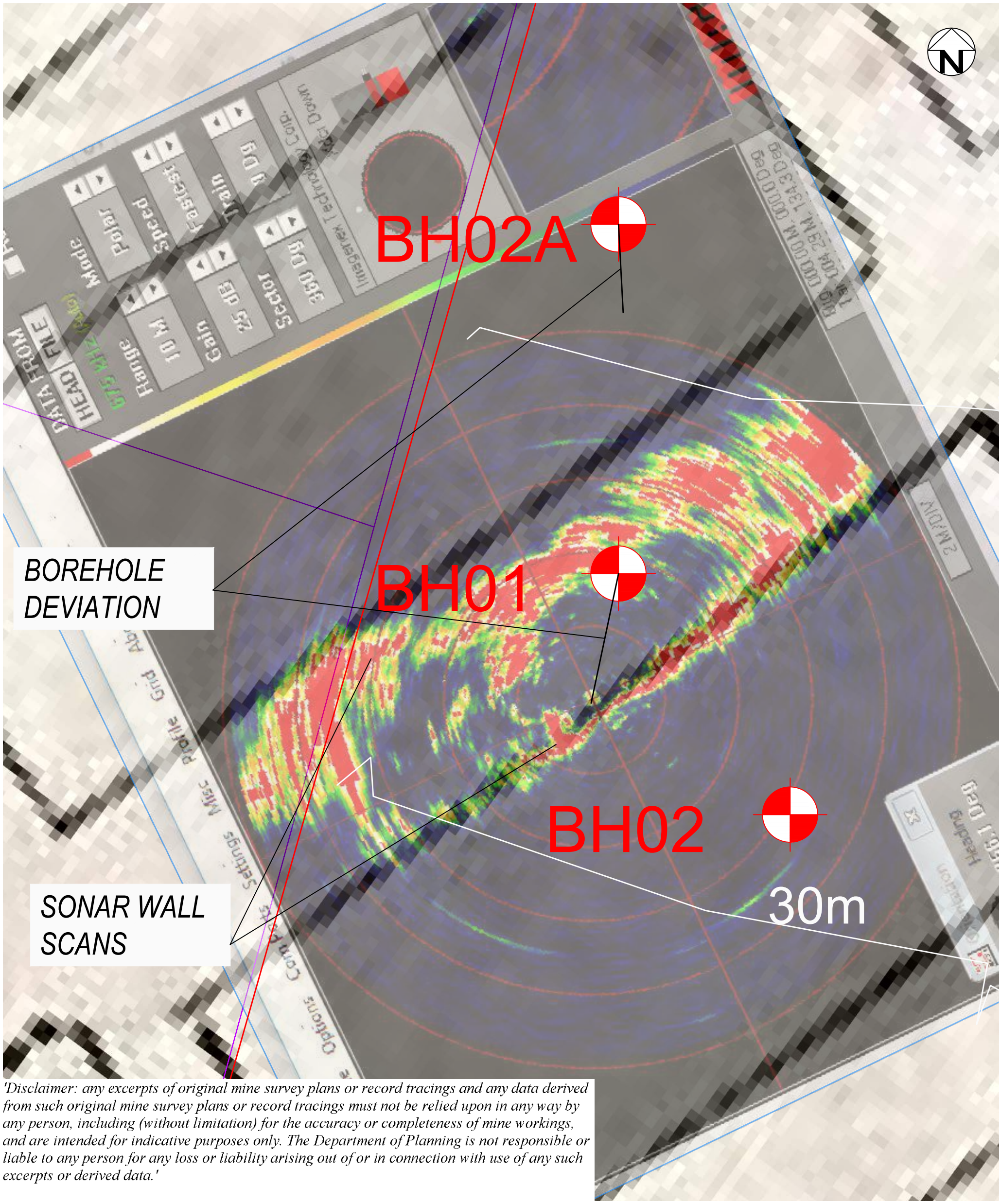
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project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: YARD SEAM SECTIONS

project no: 754-NTLGE220504 | drawing no: DRAWING 6 | rev: A

PLOT DATE: 17/12/2018 7:12:31 PM DWG FILE: F:\GEOTECHNICS\1. JOB FILES\NEWCASTLE PROJECTS\NTLGE220000 - NTLGE229999\754-NTLGE220504 - PROPOSED RESIDENTIAL DEVELOPMENT NBN SITE\DRAWINGS\NBN MINE.DWG



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revision no.	description	drawn	approved	date
A	ORIGINAL ISSUE			

LEGEND

- APPROXIMATE BOREHOLE LOCATION
- LOT BOUNDARIES
- SITE BOUNDARY
- ANGLE OF DRAW

BACKGROUND IMAGE SOURCE: RT566 SHEET 8
IMAGE ©: AUSTRALIAN AGRICULTURAL COMPANY

1 0 1 3 5

Scale (metres) 1:100

drawn	SJB
approved	JD
date	17/12/2018
scale	AS SHOWN
original size	A3

coffey

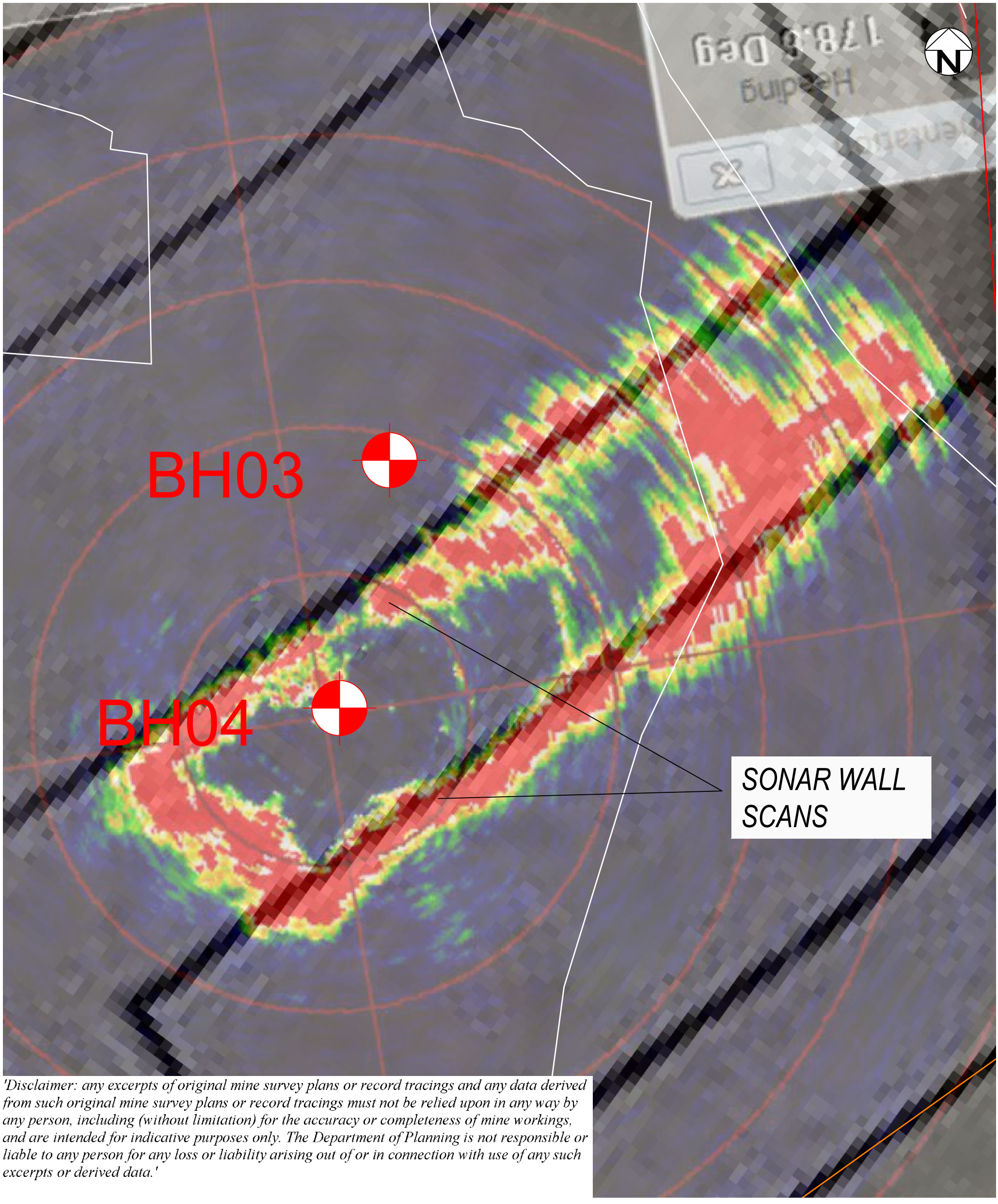
client: CRESCENT NEWCASTLE PTY LTD

project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: SONAR OF BOREHOLE SEAM IN BH01

project no: 754-NTLGE220504 | drawing no: DRAWING 7 | rev: A

PLOT DATE: 17/12/2018 7:12:17 PM DWG FILE: F:\GEOTECHNICS\1. JOB FILES\NEWCASTLE PROJECTS\NTLGE220000 - NTLGE229999\754-NTLGE220504 - PROPOSED RESIDENTIAL DEVELOPMENT NBN SITE\DRAWINGS\NBN MINE.DWG



'Disclaimer: any excerpts of original mine survey plans or record tracings and any data derived from such original mine survey plans or record tracings must not be relied upon in any way by any person, including (without limitation) for the accuracy or completeness of mine workings, and are intended for indicative purposes only. The Department of Planning is not responsible or liable to any person for any loss or liability arising out of or in connection with use of any such excerpts or derived data.'

revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

LEGEND

- APPROXIMATE BOREHOLE LOCATION
- LOT BOUNDARIES
- SITE BOUNDARY
- ANGLE OF DRAW

BACKGROUND IMAGE SOURCE: RT566 SHEET 8
IMAGE ©: AUSTRALIAN AGRICULTURAL COMPANY

1 0 1 3 5

Scale (metres) 1:100

drawn	SJB
approved	JD
date	17/12/2018
scale	AS SHOWN
original size	A3

coffey

client: CRESCENT NEWCASTLE PTY LTD

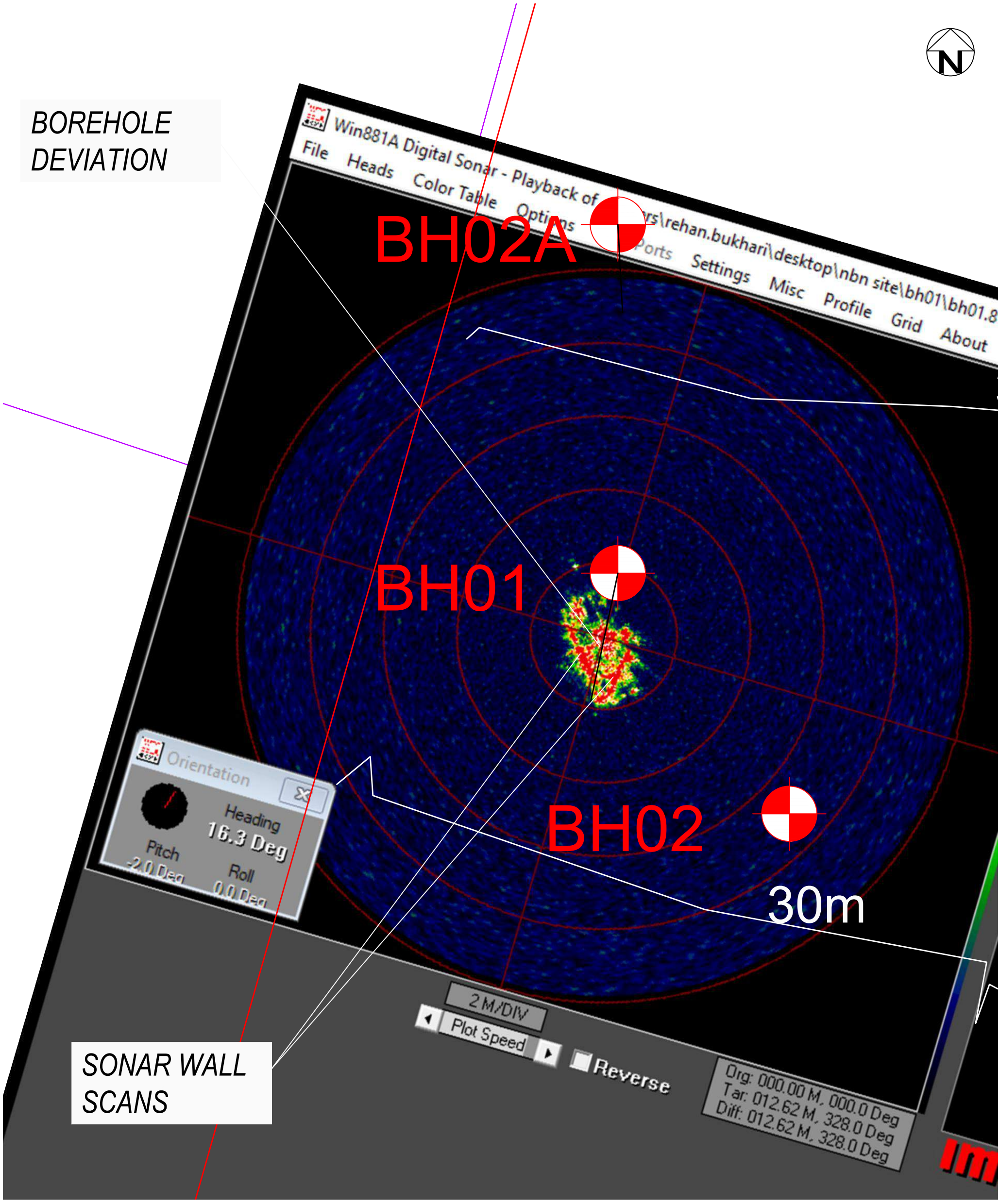
project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: SONAR OF BOREHOLE SEAM IN BH04

project no: 754-NTLGE220504 | drawing no: DRAWING 8 | rev: A

PLOT DATE: 17/12/2018 7:12:04 PM DWG FILE: F:\GEOTECHNICS\1. JOB FILES\NEWCASTLE PROJECTS\NTLGE220000 - NTLGE229999\754-NTLGE220504 - PROPOSED RESIDENTIAL DEVELOPMENT NBN SITE\DRAWINGS\NBN MINE.DWG

BOREHOLE DEVIATION



SONAR WALL SCANS

revision no.	description	drawn	approved	date
A	ORIGINAL ISSUE			

LEGEND

- APPROXIMATE BOREHOLE LOCATION
- LOT BOUNDARIES
- SITE BOUNDARY
- ANGLE OF DRAW

1 0 1 3 5

Scale (metres) 1:100

drawn	SJB
approved	JD
date	17/12/2018
scale	AS SHOWN
original size	A3

coffey

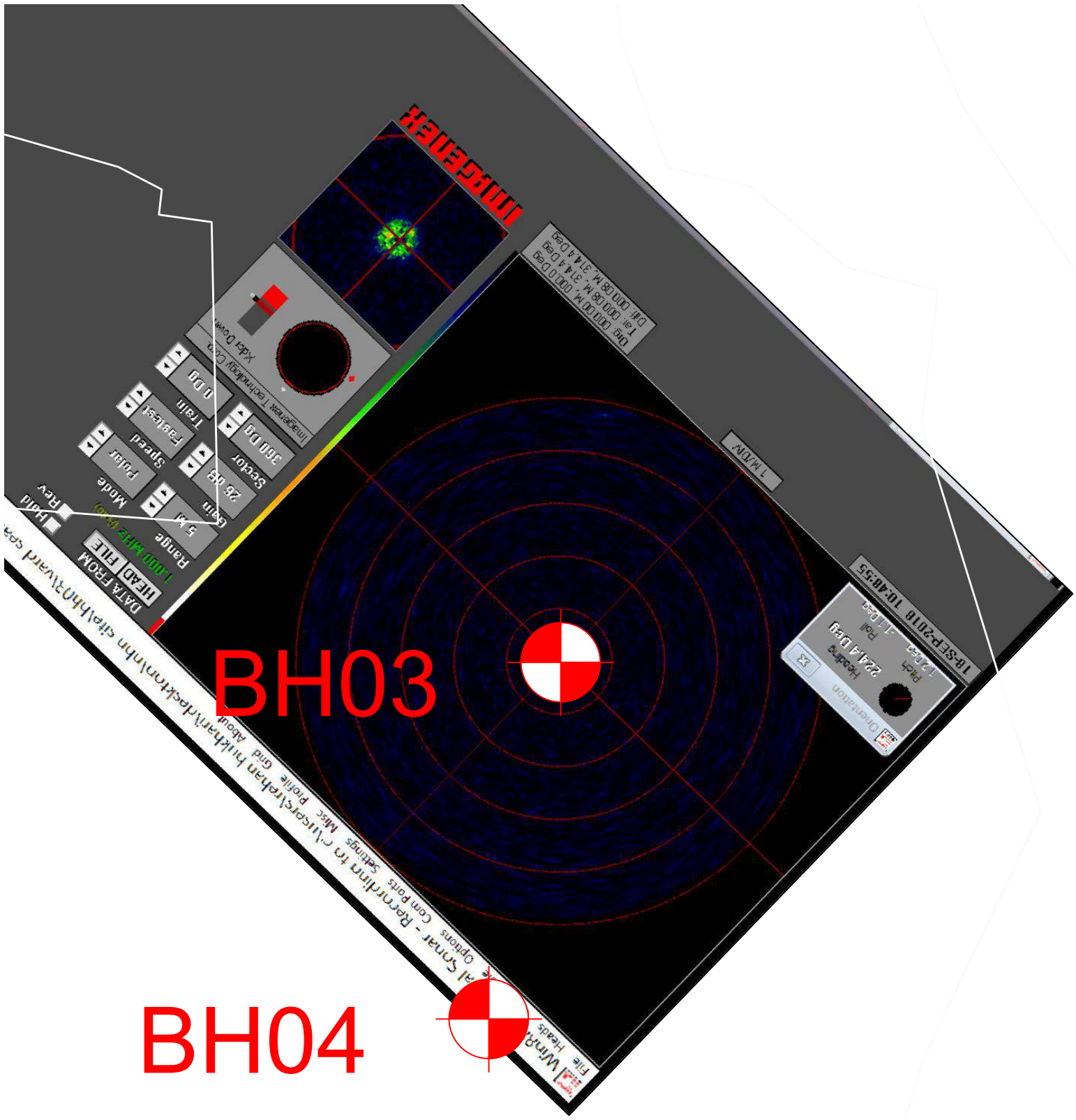
client: CRESCENT NEWCASTLE PTY LTD

project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: SONAR OF YARD SEAM IN BH01

project no: 754-NTLGE220504 | drawing no: DRAWING 9 | rev: A

PLOT DATE: 17/12/2018 7:11:51 PM DWG FILE: F:\GEOTECHNICS\1. JOB FILES\NEWCASTLE PROJECTS\NTLGE220000 - NTLGE229999\754-NTLGE220504 - PROPOSED RESIDENTIAL DEVELOPMENT NBN SITE\DRAWINGS\NBN MINE.DWG



revision	no.	description	drawn	approved	date
	A	ORIGINAL ISSUE			

LEGEND

- APPROXIMATE BOREHOLE LOCATION
- LOT BOUNDARIES
- SITE BOUNDARY
- ANGLE OF DRAW

1 0 1 3 5

Scale (metres) 1:100

drawn	SJB
approved	JD
date	17/12/2018
scale	AS SHOWN
original size	A3

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client: CRESCENT NEWCASTLE PTY LTD

project: PROPOSED RESIDENTIAL DEVELOPMENT
NBN SITE - 11-17 MOSBRI CRESCENT THE HILL
MINE SUBSIDENCE ASSESSMENT

title: SONAR OF YARD SEAM IN BH03

project no: 754-NTLGE220504 | drawing no: DRAWING 10 | rev: A

PLOT DATE: 17/12/2018 7:11:42 PM DWG FILE: F:\GEOTECHNICS\1 JOB FILES\NEWCASTLE PROJECTS\NTLGE220000 - NTLGE229999\754-NTLGE220504 - PROPOSED RESIDENTIAL DEVELOPMENT NBN SITE\DRAWINGS\NBN MINE.DWG

Appendix A – Borehole logs

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Engineering Log - Borehole

Borehole ID.	***BH01***
sheet:	1 of 14
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***03 Sep 2018***
principal:	date completed: ***07 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,684.10 (MGA94) | surface elevation: 31.39 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD			E	31			CL-CI	**FILL: BITUMEN**: black, 50mm thick, fine to coarse gravel.	M			**FILL- WEARING COURSE**
									<Wp			**FILL**
			E				CH	**FILL: Sandy CLAY**: low to medium plasticity, grey, with fine grained sand.	>Wp			
								CLAY: high plasticity, grey and pale grey, with orange lamination.				**RESIDUAL SOIL**
					1.0							
			D + E	30			CL-CI	**CLAY**: low to medium plasticity, pale brown and grey, orange laminations, with fine sand, trace of fine gravel.	<Wp			
			E		2.0			2.0 m: becoming more pale grey and pale brown				
				29								
			E									
			E		3.0							
			B	28								
			E		4.0							
				27			SP	**SANDSTONE**: fine grained, orange, extremely weathered, very low to low strength.	M			**HIGHLY WEATHERED MATERIAL**
								Borehole BH01 continued as cored hole				
					5.0							
				26								
					6.0							
				25								
					7.0							
				24								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- 1 2 3 no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Cored Borehole

Borehole ID.	***BH01***
sheet:	2 of 14
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***03 Sep 2018***
principal:	date completed: ***07 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		31									
			1.0								
		30									
			2.0								
		29									
			3.0								
		28									
			4.0								
		27			started coring at 4.55m						
HQ			5.0		**SANDSTONE**: fine to medium grained, brown/orange and grey, with sitlstone bands and black carbonaceous laminations.	DW	CX D	a=0.40 d=0.20 a=0.30 d=0.40	82%		PT, 0 - 5°, PL, RO, CN JT, 30°, PL, RO, CN JT, 75 - 90°, CU, RO, SN PT, 0°, PL, VR, SN PT, 20°, PL, RO, SN Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described
		26									
			6.0								
		25									
			7.0								
		24									

method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	3 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ		23	9.0		**SANDSTONE**: fine to medium grained, brown/orange and grey, with sitlstone bands and black carbonaceous laminations. *(continued)* 8.00 m: becoming grey 8.55 m: 250mm of carbonaceous laminations	MW - HW		a=0.20 d=0.40	82%		PT, 5°, PL, RO, SN
		22	10.0						71%		JT, 50°, PL, RO, SN JT, 50°, PL, RO, SN
		21			**NO CORE:** 0.18 m						
			11.0		**SANDSTONE**: fine to medium grained, brown and grey, with sitlstone bands and black carbonaceous laminations.	HW		a=1.00 d=1.00			JT, 70°, PL, RO, SN JT, 40°, PL, RO, SN JT, 30°, PL, RO, SN PT, 0°, PL, RO, SN
		20				XW			0%		
						HW					
		19	12.0			SW - FR		a=1.30 d=0.80			CS, IR, RO, SN JT, 70°, PL, RO, SN
			13.0		**SILTSTONE**: grey to dark grey, with sandstone bands and black carbonaceous laminations.						JT, 35°, PL, RO, SN
		18							82%		
					NO CORE: 0.15 m						
			14.0		**SANDSTONE**: fine grained, grey, with sitlstone bands and black carbonaceous laminations.	SW - FR					
		17			14.57 m: 70mm sandstone band			a=0.30 d=0.20			SM, 0°, PL, RO, CO
			15.0		15.00 m: 150mm sandstone band						
		16			15.30 m: 150mm sandstone band with carbonaceous laminations				97%		

Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described

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method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test
RR rock roller/tricone

water
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
core recovered (graphic symbols indicate material)
no core recovered

core run & RQD
barrel withdrawn
RQD = Rock Quality Designation (%)

weathering & alteration*
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

roughness
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

coating
CN clean
SN stain
VN veneer
CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	4 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ		15			**SANDSTONE**: fine to medium grained, grey, with sitlstone bands and black carbonaceous laminations.	SW - FR		a=1.10 d=0.20			
			17.0		16.85 m: 110mm dark grey-brown siltstone band				97%		PT, 5°, PL, RO, SN
		14									
			18.0		17.85 m: 350mm dark grey-brown siltstone band			a=2.00 d=0.70			
		13			18.40 m: 160mm carbonaceous laminations						
					18.65 m: 70mm siltstone band						
			19.0			XW					PT, 5°, PL, RO, SN
		12				HW					PT, 5°, PL, RO, SN
						SW - FR			89%		JT, 40°, PL, RO, SN
											JT, 45°, CU, RO, CN
								a=2.70 d=0.80			JT, 70°, PL, RO, SN
			20.0								PT, 0°, PL, RO, SN
					SILTSTONE: dark grey to grey, brown to pale brown laminations, with sandstone laminations.						JT, 70°, PL, RO, SN
		11									JT, 70°, PL, RO, SN
			21.0					a=0.80 d=0.60			JT, 70°, PL, SO, SN
		10									
			22.0								JT, 70°, PL, SO, SN
		9							88%		JT, 75°, CU, SO, CN
											PT, 0°, PL, SO, CN
			23.0					a=2.40 d=0.50			
		8									

Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	5 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ	14/09/18	7	25.0		**SILTSTONE**: dark grey to grey, brown to pale brown laminations, with sandstone laminations. *(continued)*	SW - FR		a=0.70 d=0.60			JT, 75°, CU, SO, CN PT, 5°, PL, RO, SN
						MW					
		6			**COAL**: black, shiny, cleated.	HW			38%		CS, 0°, PL, RO, CN JT, 80°, ST, RO, CN
		5	26.0								JT, 80°, IR, RO, CN
					NO CORE: 0.24 m						
		4	27.0		**SILTSTONE**: grey-dark grey.	MW - SW		a=0.20 d=0.10			
		3	28.0		**COAL**: black, shiny cleated, with slitstone bands and laminations. 28.40 m: 130mm siltstone band 28.62 m: 80mm siltstone band	HW			77%		CS JT, 90°, PL, RO, CN JT, 70°, CU, RO, CN
		2	29.0		29.28 m: 20mm siltstone laminations 29.32 m: 150mm siltstone band 29.50 m: 170mm siltstone laminations						PT, 5°, PL, SL, CO PT, 5°, PL, SL, CO PT, 5°, PL, SL, CO JT, 80°, PL, RO, CN JT, 70°, PL, RO, CN PT, PL, SL, CO PT, 5°, PL, SL, CO PT, 5°, PL, SL, CO PT, 5°, PL, SL, CO
		1	30.0		**SILTSTONE**: grey to dark grey, with sandstone bands and black carbonaceous laminations.	MW		a=0.70 d=0.30			PT, 5°, CU, RO, SN
		0	31.0		31.36 m: 650mm sandstone band with carbonaceous laminations			a=2.40 d=0.30	74%		PT, 10°, PL, RO, CO PT, 10°, PL, RO, CO PT, 10°, PL, RO, CO PT, 10°, PL, RO, CO PT, 5°, PL, RO, SN PT, 5°, PL, RO, SN JT, 45°, PL, SO, SN PT, 0°, PL, RO, CO PT, 0°, PL, RO, CO PT, 0°, PL, RO, CO

Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
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Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	6 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular	general
HQ		-1	33.0		**SILTSTONE**: grey to dark grey, with sandstone bands and black carbonaceous laminations. *(continued)*	MW	O1 X	a=2.10 d=0.50	74%		PT, 0°, PL, RO, CO PT, 10°, PL, RO, CO PT, 0°, PL, RO, CO JT, 80°, CU, RO, CN JT, 80°, PL, RO, CO PT, 5°, PL, RO, CO PT, 0°, PL, SO, CN	Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described
		-2			**SANDSTONE**: fine to medium grained, with sitlstone bands and black carbonaceous laminations.	MW - SW					PT, 10°, CU, SO, CN PT, 10°, CU, SL, CN	
			34.0		34.00 m: 60mm siltstone band						SZ, RO, SN PT, 5°, PL, RO, SN	
		-3							75%		PT, 5°, PL, SO, CN PT, 5°, PL, RO, CN PT, 0°, PL, SO, CN	
			35.0					a=6.20 d=5.70			PT, 0°, IR, VR, SN PT, 5°, PL, RO, SN	
		-4									PT, 5°, PL, RO, SN	
			36.0		35.75 m: 130mm siltstone band							
		-5						a=3.20 d=2.50			PT, 0°, PL, VR, SN PT, 5°, CU, RO, SN PT, 0°, PL, SO, CN	
			37.0		37.06 m: 100mm siltstone band 37.25 m: 280mm carbonaceous laminations						PT, 0°, PL, SO, CN PT, 5°, PL, SO, SN PT, 5°, PL, SO, SN PT, 0°, PL, SO, CN PT, 20°, PL, RO, CN	
		-6							90%		JT, 80 - 90°, UN, RO, SN	
			38.0					a=3.80 d=3.80			PT, 5°, PL, RO, SN	
		-7			38.48 m: 250mm carbonaceous laminations						PT, 5°, CU, RO, SN PT, 10°, PL, VR, SN PT, 5°, CU, RO, SN	
			39.0		39.10 m: 460mm siltstone and carbonaceous laminations						PT, 5°, PL, RO, SN	
		-8							60%		PT, 5°, PL, RO, SN PT, 5°, PL, RO, SN PT, 5°, PL, RO, SN PT, 5°, PL, RO, SN PT, 5°, PL, RO, SN PT, 5°, PL, RO, SN CS, PL, RO, SN JT, 40°, PL, RO, SN	
								a=3.80 d=2.60				

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method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test
RR rock roller/tricone

water
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
core recovered (graphic symbols indicate material)
no core recovered

core run & RQD
barrel withdrawn
RQD = Rock Quality Designation (%)

weathering & alteration*
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

roughness
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

coating
CN clean
SN stain
VN veneer
CO coating

coffey
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Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	7 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) | surface elevation: 31.39 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm | vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular	general
HQ	100% loss	-9		**SANDSTONE**: fine to medium grained, with sitlstone bands and black carbonaceous laminations. *(continued)*	MW - SW					PT, 0°, PL, RO, SN PT, 5°, PL, RO, SN PT, 0°, PL, RO, VN	Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described
			41.0	41.00 m: 40mm siltstone band		O X	a=1.70 d=0.40	60%		PT, 5°, CU, RO, SN PT, 5°, PL, RO, SN	
		-10								PT, 5°, PL, RO, SN PT, 0°, ST, RO, SN	
				NO CORE: 0.11 m **TOOL DROP**: small void on CCTV.							
				NO CORE: 0.25 m siltstone on density plots.				14%			
			42.0	**SILTSTONE**: grey to dark grey.	MW - SW						
		-11		**NO CORE:** 0.30 m **TOOL DROP**: small void on CCTV.	MW					JT, 85°, PL, RO, SN	
				SILTSTONE: grey to dark grey.		O	a=0.80 d=0.60	15%		PT, 0°, PL, RO, CN PT, 0°, PL, RO, CN	
				NO CORE: 0.15 m siltstone on density plots.							
			43.0	**NO CORE:** 0.50 m **TOOL DROP**: void on CCTV.							
		-12		**NO CORE:** 0.10 m coal on density plots, fallin/rubble.	HW					JT, 80°, PL, RO, SN PT, 0°, PL, RO, SN PT, 0°, PL, RO, SN PT, 5°, PL, RO, SN	
				COAL: black, shiny, cleated, floor of mine.	MW					PT, 5°, PL, RO, CO PT, 5°, PL, RO, CO PT, 5°, PL, RO, CO	
			44.0	**SILTSTONE**: dark grey, with black carbonaceous laminations.	SW - FR			58%			
		-13		**SANDSTONE**: fine to medium grained, grey to dark grey, with sitlstone bands and black carbonaceous laminations.						PT, 0°, PL, SO, CN	
			45.0			O X	a=4.40 d=1.30				
				NO CORE: 0.08 m	HW						
		-14		**SANDSTONE**: fine to medium grained, grey to dark grey, with sitlstone bands and black carbonaceous laminations.	XW SW - FR					PT, 0°, PL, SO, CN	
			46.0								
		-15		46.30 m: 100mm carbonaceous laminations		O	a=3.60 d=2.20	92%			
	50% loss		47.0								
		-16		47.60 m: 200mm carbonaceous laminations		O	a=3.50	100%		PT, 0°, PL, SO, CN	

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn
- RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
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Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	8 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ	50% loss	-17	49.0		**SANDSTONE**: fine to medium grained, grey to dark grey, with sitlstone bands and black carbonaceous laminations. *(continued)*	SW - FR		d=2.90			
		-18			49.06 m: 60mm carbonaceous laminations			a=3.50 d=3.30	100%		PT, 10°, PL, RO, SN
		-19	50.0		50.55 m: 400mm carbonaceous laminations						PT, 5°, PL, RO, SN
		-20	51.0					a=3.80 d=2.60			
		-21	52.0		51.75 m: 100mm carbonaceous laminations 52.20 m: 600mm carbonaceous laminations				100%		PT, 10°, PL, RO, SN
		-22	53.0					a=1.60 d=0.10			
		-23	54.0		**COAL**: black, shiny cleated.	HW					CS, 0°, PL, CN JT, 85°, PL, RO, CN
		-24	55.0		**SANDSTONE**: fine to medium grained, grey to dark grey, with sitlstone bands and black carbonaceous laminations.	SW - FR		a=3.70 d=0.10	97%		

Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	9 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ	50% loss	-25	57.0		**SANDSTONE**: fine to medium grained, grey to dark grey, with sitlstone bands and black carbonaceous laminations. *(continued)*	SW - FR			97%		PT, 10°, PL, RO, SN
					56.62 m: 60mm coal seam			a=3.50 d=1.00			
		-26									
			58.0		57.98 m: 920mm siltstone, dark grey to black band						PT, 0°, PL, RO, CO PT, 0°, PL, RO, CO
		-27			58.60 m: 50mm carbonaceous laminations				95%		
			59.0								
		-28			59.38 m: 80mm coarse sandstone band			a=3.50 d=0.60			PT, 10°, PL, RO, SN
			60.0					a=3.50 d=0.20			
		-29			60.20 m: 600mm carbonaceous laminations						
			61.0								PT, PL, RO, SN
		-30			61.40 m: 170mm carbonaceous laminations				94%		PT, PL, RO, SN
			62.0					a=1.60 d=0.30			
		-31									JT, 80°, PL, SO, CN
											PT, PL, RO, SN
			63.0		62.75 m: 150mm coal, black, shiny cleated band						CS, 0°, PL, CN
		-32							94%		
											PT, 0°, PL, RO, SN

Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
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- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	10 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular	general
HQ	50% loss	-33	65.0		**SANDSTONE**: fine to medium grained, grey to dark grey, with sitlstone bands and black carbonaceous laminations. *(continued)*	SW - FR		a=7.80 d=3.30	94%		JT, 80°, PL, SO, CN	
		-34									PT, 0°, PL, SO, CN	
		-35	66.0								JT, 80°, PL, RO, SN PT, 0°, PL, RO, SN	
		-36	67.0					a=2.90 d=1.00	100%			Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described
		-37	68.0								PT, 0°, PL, RO, SN	
		-38	69.0		69.30 m: 180mm carbonaceous laminations			a=1.80 d=2.30			PT, 0°, PL, RO, SN	
		-39	70.0						87%		JT, 80°, PL, RO, CN PT, 0°, PL, RO, SN PT, 0°, PL, RO, SN	
		-40	71.0		71.00 m: 1.2m medium to coarse sandstone band			a=3.40 d=3.70			JT, 90°, CU, RO, SN	

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
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water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
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graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
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Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	11 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ	50% loss	-41	73.0		**SANDSTONE**: fine to medium grained, grey to dark grey, with sitlstone bands and black carbonaceous laminations. *(continued)*	SW - FR			87%		PT, 0°, PL, RO, SN
		-42						a=5.10 d=4.70	100%		
		-43	74.0		74.36 m: 160mm siltstone band 74.52 m: 220mm medium to coarse grained sandstone 74.82 m: 50mm carbonaceous laminations						PT, 5°, PL, RO, SN
		-44	75.0								PT, 0°, PL, RO, CN
		-45	76.0		75.69 m: 250mm carbonaceous laminations **SANDSTONE**: fine to medium grained, grey to dark grey and brown, with sitlstone bands and black carbonaceous laminations.			a=4.30 d=0.70	100%		Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described
		-46	77.0		77.13 m: 50mm carbonaceous laminations						PT, 5°, PL, RO, SN
		-47	78.0		78.58 m: 20mm carbonaceous laminations			a=7.80 d=5.60	100%		
		-48	79.0		79.20 m: 1.08m carbonaceous laminations						PT, 5°, PL, RO, SN

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	12 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ	50% loss	-49			**SANDSTONE**: fine to medium grained, grey to dark grey and brown, with sitlstone bands and black carbonaceous laminations. *(continued)*	SW - FR			100%		
			81.0		80.82 m: 80mm carbonaceous laminations 81.00 m: 430mm carbonaceous laminations			a=2.50 d=1.40			
		-50									
		-51	82.0						100%		
		-52	83.0								
			84.0					a=2.50 d=0.40			
		-53			84.20 m: 300mm carbonaceous laminations						PT, 0°, PL, RO, SN
		-54	85.0		85.38 m: 70mm carbonaceous laminations				92%		PT, 5°, PL, RO, SN
			86.0								PT, 0°, PL, RO, SN
		-55			86.29 m: 20mm carbonaceous laminations						PT, 15°, PL, RO, CO, 10 mm
					86.58 m: 100mm carbonaceous laminations 86.73 m: 50mm siltstone band			a=6.30 d=1.80			
			87.0		87.15 m: 100mm siltstone band						
		-56							100%		PT, 10°, PL, RO, SN

Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

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- 10/10/12, water level on date shown
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- complete drilling fluid loss
- partial drilling fluid loss
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- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

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- RS residual soil
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strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
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Engineering Log - Cored Borehole

Borehole ID.	**BH01**
sheet:	13 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**03 Sep 2018**
principal:	
date completed:	**07 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ	50% loss	-57	89.0		**SANDSTONE**: fine to medium grained, grey to dark grey and brown, with sitlstone bands and black carbonaceous laminations. *(continued)* 88.05 m: 0.5m carbonaceous laminations 88.64 m: 210mm siltstone band 89.12 m: 300mm carbonaceous laminations	SW - FR		a=5.80 d=0.90	100%		PT, 10°, PL, RO, CN
		-58									
		-59	90.0		90.40 m: 90mm carbonaceous laminations						PT, 20°, PL, RO, SN
		-60	91.0						97%		JT, 70°, PL, SO, CN
		-61	92.0		**SILTSTONE**: dark grey, black with grey laminations, with carbonaceous laminations.			a=3.40 d=0.40			PT, 0°, PL, RO, SN JT, 80°, PL, RO, CN
		-62	93.0		**NO CORE:** 0.55 m **TOOL DROP**: 0.5m void on CCTV.						
		-63	94.0		**NO CORE:** 1.15 m 1.15m Coal in density plots				0%		
		-64	95.0		**CAVE-IN: COAL**: black, shiny, cleated.	MW			0%		CS, IR, SO, CO
					NO CORE: 1.15 m Coal in density plots				17%		

Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
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water
- 10/10/12, water level on date shown
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- complete drilling fluid loss
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- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

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Engineering Log - Cored Borehole

Borehole ID.	***BH01***
sheet:	14 of 14
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***03 Sep 2018***
principal:	date completed: ***07 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,684.10 (MGA94) surface elevation: 31.39 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ		-65			**NO CORE:** 1.15 m *(continued)*						
					CAVE-IN: COAL: black, shiny, cleated.	MW					
			97.0		**COAL**: black, dull and shiney. 96.80 m: Floor of mine?				17%		CS, IR, RO, CN
		-66			97.30 m: 300mm of dull coal			a=0.10 d=0.10			PT, 40°, PL, RO, CN JT, 60°, ST, RO, CN CS, IR, RO, CN
			98.0								
		-67							0%		CS, IR, RO, CN
			99.0								
		-68			99.27 m: 30mm siltstone, dark grey	FR					
					SANDSTONE: fine to coarse grained, grey.			a=4.50 d=3.80			
			100.0		100.05 m: 100mm coal band						
		-69			100.52 m: 180mm medium to coarse grained sandstone				93%		PT, 0°, PL, RO, SN
			101.0								
		-70			101.26 m: 20mm medium to coarse grained sandstone 101.45 m: 25mm medium to coarse grained sandstone 101.78 m: 120mm conglomerate band			a=9.00 d=3.10			PT, 5°, UN, RO, SN
			102.0								
		-71			Borehole BH01 terminated at 102.10 m Target depth						
			103.0								
		-72									

Defects are: PT, 0 - 10°, PL, RO, CN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

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Engineering Log - Borehole

Borehole ID.	***BH02***
sheet:	1 of 1
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***10 Sep 2018***
principal:	date completed: ***10 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,624.50; N: 6,355,677.60 (MGA94) | surface elevation: 30.94 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: | hole diameter : 100 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD/T		Not Observed	E					**FILL: BITUMEN**: Black, fine to coarse subangular gravel.				**FILL- WEARING COURSE**
			E				CL	**FILL: Sandy GRAVEL**: fine to coarse grained, brown, with some cobbles 63mm to 80mm.	M	St		**FILL- PAVEMENT**
			E	30			CL	**FILL: Sandy CLAY**: low to medium plasticity, dark grey, grey and brown, fine to medium sand, some surounded sized gravel.	>Wp	VSt		**FILL**
			SPT 3, 3, 8 N*=11		1.0			**FILL: CLAY**: medium plasticity, grey and pale grey, with orange.				
			E	29			SC	**CLAYEY SAND**: fine to coarse grained, pale brown and pale grey.	M			**RESIDUAL SOIL**
			SPT 6, 8, 9 N*=17	28	2.0		CL	**Sandy CLAY**: medium plasticity, grey, fine to medium grained sand.	~Wp	H		
					3.0		CL	**CLAY**: medium plasticity, orange mottled pale grey.	<Wp			**EXTREMELY WEATHERED MATERIAL**
			SPT 15/10mm HB N*=R	27	4.0			Borehole BH02 terminated at 4.01 m Safety reasons				
				26	5.0							
				25	6.0							
				24	7.0							
				23								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- no resistance
- ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	1 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***20 Sep 2018***
principal:	date completed: ***21 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD RR N		Not Observed	E E	32 31 30 29 28 27 26 25	1.0 2.0 3.0 4.0 5.0 6.0 7.0			**FILL: BITUMEN PAVEMENT**: black, 50mm.	M			**FILL- WEARING COURSE**
								FILL: Gravelly SAND: fine to coarse grained, brown and pale grey, with angular to sub-angular gravel.				**FILL- PAVEMENT**
								SANDSTONE.				**HIGHLY WEATHERED BECOMING MODERATELY WEATHERED MATERIAL**

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- 1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	2 of 13
project no.	***754-NTLGE220504***
client:	***Crescent Newcastle Pty Ltd***
date started:	***20 Sep 2018***
principal:	
date completed:	***21 Sep 2018***
project:	***Proposed Multi Building Residential Development***
logged by:	***MJ***
location:	***11 - 13 Mosbri Crescent, Cooks Hill, NSW***
checked by:	***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		24 23 22 21 20 19 18 17	9.0 10.0 11.0 12.0 13.0 14.0 15.0			**SANDSTONE**. *(continued)*				**MODERATELY WEATHERED TO SLIGHTLY WEATHERED**

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

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e.g. AD/T
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support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
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samples & field tests
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- U## undisturbed sample ##mm diameter
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classification symbol & soil description based on Unified Classification System

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F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey
A TETRA TECH COMPANY

Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	3 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***20 Sep 2018***
principal:	date completed: ***21 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		16 15 14 13 12 11 10 9	17.0 18.0 19.0 20.0 21.0 22.0 23.0			**SANDSTONE**. *(continued)*				**MODERATELY WEATHERED TO SLIGHTLY WEATHERED**

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density
- VS very soft
- S soft
- F firm
- St stiff
- VSt very stiff
- H hard
- Fb friable
- VL very loose
- L loose
- MD medium dense
- D dense
- VD very dense

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Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	4 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***20 Sep 2018***
principal:	date completed: ***21 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		8 7 6 5 4 3 2 1	25.0 26.0 27.0 28.0 29.0 30.0 31.0			**SANDSTONE**. *(continued)*				**MODERATELY WEATHERED TO SLIGHTLY WEATHERED**
								COAL.				
								SILTSTONE.				
								COAL.				
								SILTSTONE.				**FRESH**
								COAL.				
								SANDSTONE.				

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	5 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***20 Sep 2018***
principal:	date completed: ***21 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		0 -1 -2 -3 -4 -5 -6 -7	33.0 34.0 35.0 36.0 37.0 38.0 39.0			**SANDSTONE**. *(continued)*				**FRESH**

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
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- Wl liquid limit

consistency / relative density

VS	very soft
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F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	6 of 13
project no.	***754-NTLGE220504***
client:	***Crescent Newcastle Pty Ltd***
date started:	***20 Sep 2018***
principal:	
date completed:	***21 Sep 2018***
project:	***Proposed Multi Building Residential Development***
logged by:	***MJ***
location:	***11 - 13 Mosbri Crescent, Cooks Hill, NSW***
checked by:	***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		-8 -9 -10 -11 -12 -13 -14 -15	41.0 42.0 43.0 44.0 45.0 46.0 47.0			**SANDSTONE**. *(continued)* **COAL**: black. **SANDSTONE**: grey.				**FRESH**

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
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classification symbol & soil description based on Unified Classification System

moisture
- D dry
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Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	7 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***20 Sep 2018***
principal:	date completed: ***21 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		-16 -17 -18 -19 -20 -21 -22 -23	49.0 50.0 51.0 52.0 53.0 54.0 55.0			**SANDSTONE**: grey. *(continued)*				**FRESH**
								COAL: black.				

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix, e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
10-Oct-12 water level on date shown
water inflow
water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
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- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
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Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	8 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***20 Sep 2018***
principal:	date completed: ***21 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		-24 -25 -26 -27 -28 -29 -30 -31	57.0 58.0 59.0 60.0 61.0 62.0 63.0			**SANDSTONE**.				**FRESH**

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
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- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
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- D disturbed sample
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- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
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Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	9 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***20 Sep 2018***
principal:	date completed: ***21 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		-32 -33 -34 -35 -36 -37 -38 -39	65.0 66.0 67.0 68.0 69.0 70.0 71.0			**SANDSTONE**. *(continued)*				**FRESH**

CDF_0_9_06_LIBRARY.GLB rev:AS Log COF BOREHOLE: NON CORED 754-NTLGE220504.GPJ <<DrawingFile>> 30/10/2018 11:35

method
- AD auger drilling*
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- HA hand auger
- W washbore
- RR rock roller/tricone

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support
- M mud
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penetration
1 2 3 — no resistance ranging to refusal

water
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- water inflow
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samples & field tests
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classification symbol & soil description based on Unified Classification System

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A TETRA TECH COMPANY

Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	10 of 13
project no.	***754-NTLGE220504***
client:	***Crescent Newcastle Pty Ltd***
date started:	***20 Sep 2018***
principal:	
date completed:	***21 Sep 2018***
project:	***Proposed Multi Building Residential Development***
logged by:	***MJ***
location:	***11 - 13 Mosbri Crescent, Cooks Hill, NSW***
checked by:	***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		-40 -41 -42 -43 -44 -45 -46 -47	73.0 74.0 75.0 76.0 77.0 78.0 79.0			**SANDSTONE**. *(continued)*				**FRESH**

CDF_0_9_06_LIBRARY.GLB rev:AS Log COF BOREHOLE: NON CORED 754-NTLGE220504.GPJ <<DrawingFile>> 30/10/2018 11:35

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
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e.g. AD/T
- B blank bit
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support
- M mud
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penetration
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water
- 10-Oct-12 water level on date shown
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samples & field tests
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Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	11 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***20 Sep 2018***
principal:	date completed: ***21 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

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drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		-48 -49 -50 -51 -52 -53 -54 -55	81.0 82.0 83.0 84.0 85.0 86.0 87.0			**SANDSTONE**. *(continued)*				**FRESH**

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
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penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
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CDF_0_9_06_LIBRARY.GLB rev:AS Log COF BOREHOLE: NON CORED 754-NTLGE220504.GPJ <<DrawingFile>> 30/10/2018 11:35

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Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	12 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***20 Sep 2018***
principal:	date completed: ***21 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		-56 -57 -58 -59 -60 -61 -62 -63	89.0 90.0 91.0 92.0 93.0 94.0 95.0			**SANDSTONE**. *(continued)* **COAL**: black.				**FRESH**

CDF_0_9_06_LIBRARY.GLB rev:AS Log COF BOREHOLE: NON CORED 754-NTLGE220504.GPJ <<DrawingFile>> 30/10/2018 11:35

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
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* bit shown by suffix, e.g. AD/T
- B blank bit
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support
- M mud
- C casing
- N nil

penetration
- 1 2 3 no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
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samples & field tests
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- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH02A***
sheet:	13 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***20 Sep 2018***
principal:	date completed: ***21 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,619.90; N: 6,355,693.60 (MGA94) | surface elevation: 32.40 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		Not Observed		-64 -65 -66 -67 -68 -69 -70 -71	97.0 98.0 99.0 100.0 101.0 102.0 103.0			**COAL**: black. *(continued)* **SANDSTONE**: grey. Borehole BH02A terminated at 102.0 m Target depth				**FRESH**

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH03***
sheet:	1 of 14
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***17 Sep 2018***
principal:	date completed: ***20 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,685.80; N: 6,355,574.40 (MGA94) | surface elevation: 32.75 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD			E				GP	**FILL: BITUMEN**: black, 50mm.	M			**FILL- WEARING COURSE**
								FILL: Sandy GRAVEL: fine to coarse grained, grey, angular to sub-angular, fine grained sand.				**FILL- PAVEMENT**
			E	32			CI	**Sandy CLAY**: medium plasticity, mottled red and brown.	>Wp	St - VSt		**RESIDUAL SOIL**
			SPT 5, 7, 10 N=17		1.0							
			B	31			CI	**CLAY**: medium plasticity, pale grey and red mottled orange.	>Wp			
			SPT 21, 30/90mm N=R		2.0		CL	**Sandy CLAY**: low plasticity, orange mottled pale brown, fine grained sand.	<Wp	VSt - H		**EXTREMELY WEATHERED ROCK**
				30	3.0							
N				29	4.0			Borehole BH03 continued as cored hole				
				28	5.0							
				27	6.0							
				26	7.0							
				25								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- no resistance
- ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	2 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
		32	1.0		started coring at 3.40m						
		31	2.0								
		30	3.0								
HQ		29	4.0		**SANDSTONE**: fine to medium grained, brown to pale brown, grey to dark grey, with siltstone bands.	DW					PT, 0°, PL, RO, CN
						XW					PT, 40°, IR, RO, SN PT, 10°, IR, RO, SN Drilling Break
		28	5.0			DW		a=0.80 d=0.10	72%		PT, 0°, PL, RO, VN JT, 70°, PL, RO, SN Drilling Break
		27	6.0		**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations.	SW - FR		a=1.50 d=0.60			PT, 5 - 10°, ST, SN Drilling Break Drilling Break
		26	7.0					a=0.40 d=0.70	97%		PT, 0°, PL, VR, CN Drilling Break PT, 5°, CU, RO, SN PT, 5°, CU, RO, CN Drilling Break
		25									

Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described

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method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test
RR rock roller/tricone

water
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
core recovered (graphic symbols indicate material)
no core recovered

core run & RQD
barrel withdrawn
RQD = Rock Quality Designation (%)

weathering & alteration*
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

roughness
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

coating
CN clean
SN stain
VN veneer
CO coating

coffey
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Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	3 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ		24	9.0		**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations. *(continued)* 8.10 m: 50mm siltstone band	SW - FR			97%		Drilling Break
		23			9.15 m: 50mm carbonaceous laminations			a=0.90 d=0.50			Drilling Break
		22	10.0 11.0					a=1.00 d=0.80	100%		
		21	12.0		11.60 m: 170mm carbonaceous laminations 12.12 m: 200mm siltstone band			a=0.70 d=0.20			PT, 0°, PL, VR, CO
		20	13.0		13.25 m: 180mm siltstone band				87%		
		19	14.0					a=0.70 d=1.40			
		18	15.0								JT, 40°, IR, RO, SN JT, 40°, PL, RO, SN JT, 70°, PL, RO, SN JT, 70°, ST, RO, SN
		17						a=2.00 d=0.60	85%		

Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described

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method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test
RR rock roller/tricone

water
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
core recovered (graphic symbols indicate material)
no core recovered

core run & RQD
barrel withdrawn
RQD = Rock Quality Designation (%)

weathering & alteration*
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

roughness
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

coating
CN clean
SN stain
VN veneer
CO coating

coffey
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Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	4 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ		16	17.0		**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations. *(continued)*	SW - FR		a=0.20 d=0.20	85%		
		15	18.0		**COAL**: black, shiny, cleated.	XW / DW		a=0.10 d=0.00			CS, IR, SO, CN
					NO CORE: 0.25 m						
		14	19.0		**COAL**: black, shiny, cleated. **SANDSTONE**: fine to coarse grained, grey, dark grey, with siltstone bands and carbonaceous laminations. 19.10 to 20.28 m: becoming fine to coarse grained	XW / MW / SW - FR		a=0.70 d=0.90	63%		CS, IR, SO, CN JT, 80°, PL, RO, CN
		13	20.0		20.26 m: 60mm carbonaceous laminations						
		12	21.0		21.15 m: 50mm siltstone band						
		11	22.0					a=1.10 d=0.90	100%		Drilling Break
		10	23.0								
		9			23.50 m: coal on density plot						

Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
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Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	5 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ	21/09/18	8	25.0		**SANDSTONE**: fine to coarse grained, grey, dark grey, with siltstone bands and carbonaceous laminations. *(continued)*	SW - FR		a=0.80 d=1.00	100%		JT, 80°, PL, RO, CN
		7	26.0		**SILTSTONE**: grey and pale brown, with carbonaceous laminations.	MW - SW		a=0.30 d=0.20	87%		SM, 0°, PL, VR, CO SM, 0°, PL, RO, SN
		6	27.0		**COAL**: black, shiny, cleated.	MW					PT, 5°, PL, RO, CN PT, 5°, PL, RO, CN
		5	28.0		**SILTSTONE**: grey to brown.				37%		PT, 0°, PL, RO, CN
					NO CORE: 0.16 m Coal in density plot.						
		4			**COAL**: black.	MW		a=0.00 d=0.10			CS, IR, VR, CN
			29.0		**SILTSTONE**: dark grey to black.						
					NO CORE: 0.40 m Coal to siltstone in density plot.				14%		
		3			**SILTSTONE**: grey, with carbonaceous laminations.	MW					PT, ST, RO, SN
			30.0		**NO CORE:** 0.10 m Siltstone in density plot.						
					SILTSTONE: grey, with carbonaceous laminations.	MW					
		2	31.0					a=0.30 d=0.40	52%		
		1				SW - FR					PT, ST, RO, SN

Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	***BH03***
sheet:	6 of 14
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***17 Sep 2018***
principal:	date completed: ***20 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular	general
HQ		0	33.0		**SANDSTONE**: fine to medium grained, grey, with siltstone bands and carbonaceous laminations. *(continued)* 32.10 m: 100mm siltstone band with carbonaceous laminations	SW - FR		a=2.70 d=1.70	52%		PT, UN, RO, SN	Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described
		-1	34.0		33.80 m: 300mm siltstone band with carbonaceous laminations				96%		JT, 40°, PL, RO, SN	
		-2	35.0									
		-3	36.0					a=8.50 d=7.80			JT, 40°, PL, RO, SN	
		-4	37.0								PT, 0°, IR, RO, SN	
		-5	38.0					a=4.10 d=2.10	95%			
		-6	39.0		38.35 m: 150mm carbonaceous laminations						JT, 70°, PL, RO, CN	
		-7			39.15 m: becoming dark grey sandstone, thinly bedded carbonaceous lamination			a=1.30 d=1.20	57%		PT, 10°, UN, RO, SN PT, 10°, PL, RO, SN	

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
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Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	7 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular	general
HQ	100% loss	-8	41.0		**SANDSTONE**: fine to medium grained, grey, with siltstone bands and carbonaceous laminations. *(continued)* 40.20 m: 100 mm siltstone band	SW - FR					PT, 0°, PL, RO, CN PT, 0°, PL, RO, CN PT, 0°, PL, RO PT, 0°, ST, RO, SN	Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described
		-9			**NO CORE:** 0.10 m Tool drop.			a=0.60 d=0.10	57%		JT, 70°, PL, RO, CN CS, IR, RO PT, 5°, PL, RO, SN CS, PL, RO, CN	
			42.0		**CAVE IN: SILTSTONE**: grey. **NO CORE:** 0.33 m **TOOL DROP**. **NO CORE:** 0.35 m **CAVE IN**: Siltstone in density plot.	MW					CS, IR, RO, CN	
		-10			**CAVE IN: SILTSTONE AND COAL**: dark grey and black.	XW			15%		CS, IR, RO, CO	
			43.0			MW						
		-11			**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations.	SW - FR		a=2.00 d=0.90	89%		PT, 5°, PL, RO, CN	
		-12	44.0									
			45.0		**NO CORE:** 0.15 m Sandstone in density plot.							
		-13			**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations.	SW - FR		a=3.30 d=2.90				
			46.0		46.51 m: 20mm carbonaceous laminations			a=3.50 d=1.90	92%			
		-14			46.72 m: 200mm carbonaceous laminations							
			47.0									
		-15										

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	8 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ		-16	49.0		**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations. *(continued)*	SW - FR	O X	a=2.90 d=0.20			JT, 90°, CU, RO, SN
		-17			49.50 m: 100mm carbonaceous laminations				98%		
			50.0		50.10 m: 20mm carbonaceous laminations						
		-18					O X	a=0.60 d=0.40			
			51.0		51.00 m: becoming pale grey, grey-dark grey laminations 51.25 m: becoming fine grained		O X	a=0.60 d=0.20			
		-19									
			52.0		52.25 m: 200 mm tuff band				95%		
		-20	53.0		**COAL**: black, dull, cleated.	DW					
		-21			**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations.	SW - FR	O X	a=0.70 d=0.30			JT, 45°, PL, RO, CN
			54.0								
		-22									JT, 80°, PL, RO, SN
			55.0		55.00 m: 100 mm siltstone band, grey		O X	a=1.40 d=0.40	83%		
		-23									

Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
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- PQ wireline core (85.0mm)
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- RR rock roller/tricone

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- 10/10/12, water level on date shown
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- partial drilling fluid loss
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graphic log / core recovery
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- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	***BH03***
sheet:	9 of 14
project no.	***754-NTLGE220504***
client:	***Crescent Newcastle Pty Ltd***
date started:	***17 Sep 2018***
principal:	
date completed:	***20 Sep 2018***
project:	***Proposed Multi Building Residential Development***
logged by:	***MJ***
location:	***11 - 13 Mosbri Crescent, Cooks Hill, NSW***
checked by:	***RB***

position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ		-24	57.0		**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations. *(continued)* 56.10 m: 200mm coal, black, dull band	SW - FR		a=2.40 d=1.70	83%		CS, IR, SO, CN JT, 80°, PL, RO, SN
		-25	58.0		58.52 m: 1.48m siltstone, dark grey band			a=2.80 d=1.50	100%		
		-26	59.0								
		-27	60.0		60.60 m: 50 mm coal band						CS, 0°, PL, RO, CN CS, 0°, PL, CN
		-28	61.0						90%		
		-29	62.0		62.00 m: 500mm carbonaceous laminations			a=2.20 d=0.10			PT, 40°, PL, RO, SN
		-30	63.0		63.10 m: 1.55m siltstone, dark grey band			a=2.20 d=0.50	100%		
		-31									

Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described

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method & support
- AS auger screwing
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- NMLC NMLC core (51.9 mm)
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RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
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- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	10 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
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position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

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method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ		-32	65.0		**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations. *(continued)*	SW - FR		a=1.90 d=0.50	100%		
		-33	66.0		66.38 m: 20mm carbonaceous laminations			a=2.50 d=0.40			
		-34	67.0								
		-35	68.0		68.50 m: becoming fine to coarse grained			a=1.40 d=0.40	100%		
		-36	69.0		69.00 to 69.20 m: 200 mm siltstone band			a=0.80 d=0.20			
		-37	70.0								
		-38	71.0						97%		PT, 0°, PL, RO, CN PT, 5°, ST, RO, CN
		-39			71.55 to 71.65 m: 100 mm siltstone band			a=1.00 d=0.50			JT, 80°, CU, VR, CN PT, 0°, PL, SO, CN

Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described

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method & support
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AD auger drilling
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W washbore
NMLC NMLC core (51.9 mm)
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core recovered (graphic symbols indicate material)
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RQD = Rock Quality Designation (%)

weathering & alteration*
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

roughness
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

coating
CN clean
SN stain
VN veneer
CO coating

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	11 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
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method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ					**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations. *(continued)*	SW - FR					JT, 80°, PL, RO, SN
		-40						a=1.70 d=0.40			
			73.0		73.03 m: 100mm carbonaceous laminations						
		-41							100%		
			74.0		73.90 m: 150 mm siltstone band						
					74.25 m: becoming medium to coarse grained			a=3.20 d=2.30			
		-42									
			75.0								JT, 70°, CU, RO, CN
		-43						a=3.20 d=3.00			
			76.0		76.12 m: 60mm siltstone, dark grey band						
					76.40 m: 100 mm tuff band				91%		
		-44									
			77.0		77.10 m: 50mm carbonaceous laminations			a=3.70 d=1.80			JT, 55°, PL, RO, CN
		-45									
			78.0		77.85 m: 300 mm siltstone band						
		-46			78.65 m: 310mm carbonaceous laminations						
			79.0		78.96 m: 140mm siltstone, dark grey band			a=4.60 d=1.10	80%		
		-47									

Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
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water
- 10/10/12, water level on date shown
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graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
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*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	12 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
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position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ		-48	81.0		**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations. *(continued)* 80.53 m: 100 mm siltstone band	SW - FR		a=3.50 d=3.10	80%		JT, 90°, UN, RO, CN
		-49	82.0		81.20 m: 400mm carbonaceous laminations			a=4.00 d=3.00			
		-50	83.0		82.30 m: 600mm carbonaceous laminations 82.90 m: 100 mm siltstone band				63%		CS, 0 - 25°, IR, RO, CN
		-51	84.0		83.60 m: 200mm carbonaceous laminations			a=0.70 d=0.10			CS, IR, RO, CN JT, 80°, PL, RO, SN
		-52	85.0		84.60 m: 230mm carbonaceous laminations 85.00 m: 30 mm siltstone band						JT, 60°, UN, RO, SN
		-53	86.0		85.60 m: 100 mm siltstone band 85.78 m: 40mm carbonaceous laminations			a=1.30 d=0.00	84%		JT, 70°, PL, RO, CN PT, 10°, PL, RO, SN JT, 80°, PL, RO, SN
		-54	87.0		86.27 m: 30mm carbonaceous laminations 86.30 m: 200mm siltstone band 86.56 m: 20mm siltstone band 86.70 m: 100mm carbonaceous laminations 86.80 m: 30mm siltstone band 86.90 m: 100mm siltstone band 87.00 m: 30mm carbonaceous laminations						JT, 60°, PL, RO, CN JT, 60°, PL, RO, CN JT, 70°, PL, RO, SN
		-55						a=3.90 d=3.90	100%		

Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described

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method & support
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AD auger drilling
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
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SPT standard penetration test
RR rock roller/tricone

water
10/10/12, water level on date shown
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complete drilling fluid loss
partial drilling fluid loss
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no core recovered

core run & RQD
barrel withdrawn
RQD = Rock Quality Designation (%)

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HW highly weathered
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MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
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JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

roughness
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

coating
CN clean
SN stain
VN veneer
CO coating

coffey
A TETRA TECH COMPANY

Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	13 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ		-56	89.0		**SANDSTONE**: fine to medium grained, grey, dark grey, with siltstone bands and carbonaceous laminations. *(continued)* 88.18 m: 100mm siltstone band 88.42 m: 100mm siltstone band 88.90 m: 200mm siltstone band 89.30 m: 180mm siltstone band 89.60 m: 130mm carbonaceous laminations	SW - FR		a=4.50 d=2.50	100%		
		-57	90.0		90.16 m: 200mm siltstone band 90.45 m: 130mm carbonaceous laminations						
		-58	91.0						68%		JT, 80°, PL, RO, SN PT, 15°, PL, RO, SN JT, 50°, CU, RO, SN SM, 0°, PL, RO, SN
		-59	92.0		91.60 m: 50mm coal band 91.70 m: 300mm siltstone, dark grey band			a=0.90 d=0.10			JT, 50°, PL, RO, SN PT, 5°, PL, RO, SN JT, 50°, PL, RO, SN
		-60	93.0		**COAL**: black, shiny, cleated.	DW			0%		CS, IR, RO, CO
		-61	94.0		**NO CORE:** 0.56 m Coal in density plot.				0%		
		-62	95.0		**COAL**: black, shiny, cleated.	DW			30%		JT, 50°, PL, RO, CN JT, 50°, PL, RO, CN JT, 80°, PL, RO, CN JT, 80°, PL, RO, CN
		-63									

Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described

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method & support
- AS auger screwing
- AD auger drilling
- CB claw or blade bit
- W washbore
- NMLC NMLC core (51.9 mm)
- NQ wireline core (47.6mm)
- HQ wireline core (63.5mm)
- PQ wireline core (85.0mm)
- SPT standard penetration test
- RR rock roller/tricone

water
- 10/10/12, water level on date shown
- water inflow
- complete drilling fluid loss
- partial drilling fluid loss
- 25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
- core recovered (graphic symbols indicate material)
- no core recovered

core run & RQD
- barrel withdrawn

RQD = Rock Quality Designation (%)

weathering & alteration*
- RS residual soil
- XW extremely weathered
- HW highly weathered
- DW distinctly weathered
- MW moderately weathered
- SW slightly weathered
- FR fresh

*W replaced with A for alteration

strength
- VL very low
- L low
- M medium
- H high
- VH very high
- EH extremely high

defect type
- PT parting
- JT joint
- SZ shear zone
- SS shear surface
- CO contact
- CS crushed seam
- SM seam

planarity
- PL planar
- CU curved
- UN undulating
- ST stepped
- IR Irregular

roughness
- SL slickensided
- POL polished
- SO smooth
- RO rough
- VR very rough

coating
- CN clean
- SN stain
- VN veneer
- CO coating

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Engineering Log - Cored Borehole

Borehole ID.	**BH03**
sheet:	14 of 14
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**17 Sep 2018**
principal:	
date completed:	**20 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,685.80; N: 6,355,574.40 (MGA94) surface elevation: 32.75 m (AHD) angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted drilling fluid: non / water hole diameter : 96 mm vane id.:

drilling information | **material substance** | **rock mass defects**

method & support	water	RL (m)	depth (m)	graphic log	material description **ROCK TYPE**: grain characterisics, colour, structure, minor components	weathering & alteration	estimated strength & Is50 (X = axial; O = diametral) VL L M H VH EH	samples, field tests & Is(50) (MPa) a = axial; d = diametral	core run & RQD	defect spacing (mm) 30 100 300 1000 3000	additional observations and defect descriptions (type, inclination, planarity, roughness, coating, thickness, other) particular / general
HQ		-64	97.0		**COAL**: black, shiny, cleated. *(continued)* 96.34 m: 130mm siltstone band 96.90 m: 220mm siltstone band	DW			41%		CS, IR, SO, CO SZ, IR, RO, CN JT, 80°, PL, RO, CN JT, 70°, IR, RO, CN CS, IR, RO, CN CS, IR, RO, CN
		-65	98.0		98.00 m: 20mm siltstone band 98.25 m: 50mm sandstone band 98.50 m: 120mm sandstone band						
		-66	99.0		**SANDSTONE**: medium to coarse grained, pale grey, with siltstone and conglomerate bands.	FR		a=2.20 d=1.70	100%		Defects are: PT, 0 - 10°, PL, RO, SN, unless otherwise described
		-67	100.0								
		-68	101.0		100.85 m: 50mm siltstone band			a=2.60 d=4.10			
		-69	102.0		101.78 m: 50mm conglomerate band						
		-70	103.0		Borehole BH03 terminated at 102.14 m Target depth			a=3.10 d=2.20			
		-71									

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method & support
AS auger screwing
AD auger drilling
CB claw or blade bit
W washbore
NMLC NMLC core (51.9 mm)
NQ wireline core (47.6mm)
HQ wireline core (63.5mm)
PQ wireline core (85.0mm)
SPT standard penetration test
RR rock roller/tricone

water
10/10/12, water level on date shown
water inflow
complete drilling fluid loss
partial drilling fluid loss
25uL water pressure test result (lugeons) for depth interval shown

graphic log / core recovery
core recovered (graphic symbols indicate material)
no core recovered

core run & RQD
barrel withdrawn
RQD = Rock Quality Designation (%)

weathering & alteration*
RS residual soil
XW extremely weathered
HW highly weathered
DW distinctly weathered
MW moderately weathered
SW slightly weathered
FR fresh
*W replaced with A for alteration

strength
VL very low
L low
M medium
H high
VH very high
EH extremely high

defect type
PT parting
JT joint
SZ shear zone
SS shear surface
CO contact
CS crushed seam
SM seam

planarity
PL planar
CU curved
UN undulating
ST stepped
IR Irregular

roughness
SL slickensided
POL polished
SO smooth
RO rough
VR very rough

coating
CN clean
SN stain
VN veneer
CO coating

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Engineering Log - Borehole

Borehole ID.	**BH04**
sheet:	1 of 13
project no.	**754-NTLGE220504**
client:	**Crescent Newcastle Pty Ltd**
date started:	**12 Sep 2018**
principal:	
date completed:	**14 Sep 2018**
project:	**Proposed Multi Building Residential Development**
logged by:	**MJ**
location:	**11 - 13 Mosbri Crescent, Cooks Hill, NSW**
checked by:	**RB**

position: E: 385,684.5; N: 6,355,567.6 (MGA94) | surface elevation: 32.8 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
AD			E				GW	**FILL: BITUMEN PAVEMENT**: black, 20mm.				**FILL- WEARING COURSE**
							SW	**FILL: Sandy GRAVEL**: fine to coarse grained, sub-angular to angular, grey, with fine grained sand.	M	F - St		**FILL- PAVEMENT**
			E	32			CL	**FILL: CLAYEY SAND**: fine to coarse grained, brown and red.	<Wp			**FILL - UNCONTROLLED**
					1.0			**FILL: Sandy CLAY**: low plasticity, brown, dark brown, pale grey, fine to coarse grained sand, with fine grained grained angular to sub-angular gravel.				
			E				CL	**FILL: Sandy CLAY**: low plasticity, dark brown, mottled orange, fine grained sand, with fine grained sub-angular to sub-rounded gravel and glass pieces.		St - H		
			SPT 5, 5, 5 N=10	31								
			E		2.0							
			SPT 3, 4, 5 N=9	30								
					3.0		CL-CI	**Sandy CLAY**: low to medium plasticity, dark brown and dark grey, fine to coarse grained sand.	~Wp			**RESIDUAL SOIL**
			B				CL-CI	**CLAY**: low to medium plasticity, mottled orange and brown, with fine rounded to sub-rounded gravel.				
				29								
					4.0		CL-CI	**Sandy CLAY**: low to medium plasticity, dark grey, with medium to course grained sand, with fine angular to sub-angular gravel.	>Wp			
							CL-CI	**Gravelly CLAY**: fine to medium grained, low to medium plasticity, pale grey and grey, with rounded to sub-rounded gravel, trace of fine to coarse grained sand.				**EXTREMELY WEATHERED MATERIAL**
N			SPT 7, 25/30mm N=R	28	5.0			**SANDSTONE**: fine grained, pale grey and orange.				**HIGHLY WEATHERED BECOMING MODERATELY WEATHERED MATERIAL**
RR								**SANDSTONE**.				
				27								
					6.0							
				26								
					7.0							
				25								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- no resistance
- ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

coffey
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Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	2 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***12 Sep 2018***
principal:	date completed: ***14 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,684.5; N: 6,355,567.6 (MGA94) | surface elevation: 32.8 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N				24 23 22 21 20 19 18 17	9.0 10.0 11.0 12.0 13.0 14.0 15.0			**SANDSTONE**. *(continued)*				**MODERATELY WEATHERED TO SLIGHTLY WEATHERED**

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description
based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	3 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***12 Sep 2018***
principal:	date completed: ***14 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,684.5; N: 6,355,567.6 (MGA94) | surface elevation: 32.8 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR				16	17.0			**SANDSTONE**. *(continued)*				**MODERATELY WEATHERED TO SLIGHTLY WEATHERED**
				15	18.0			**COAL**: black.				
				14	19.0			**SILTSTONE**.				
N				13	20.0			**SANDSTONE**.				**FRESH**
				12	21.0							
				11	22.0							
				10	23.0							
				9								

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- 1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	4 of 13
project no.	***754-NTLGE220504***
client:	***Crescent Newcastle Pty Ltd***
date started:	***12 Sep 2018***
principal:	
date completed:	***14 Sep 2018***
project:	***Proposed Multi Building Residential Development***
logged by:	***MJ***
location:	***11 - 13 Mosbri Crescent, Cooks Hill, NSW***
checked by:	***RB***

position: E: 385,684.5; N: 6,355,567.6 (MGA94) | surface elevation: 32.8 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		14/09/18		8	25.0			**SANDSTONE**. *(continued)*				**FRESH**
				7	26.0							
				6	27.0			**TUFF**.				
				5	28.0			**COAL**: black, with some sand.				
				4	29.0			**SILTSTONE**.				
				3	30.0							
				2	31.0							
				1				**SANDSTONE**.				

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	5 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***12 Sep 2018***
principal:	date completed: ***14 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,684.5; N: 6,355,567.6 (MGA94) | surface elevation: 32.8 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N		◀		0 -1 -2 -3 -4 -5 -6 -7	33.0 34.0 35.0 36.0 37.0 38.0 39.0			**SANDSTONE**. *(continued)* 38.15 m: 200mm tool drop				**FRESH**

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	6 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***12 Sep 2018***
principal:	date completed: ***14 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,684.5; N: 6,355,567.6 (MGA94) | surface elevation: 32.8 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N				-8 -9 -10 -11 -12 -13 -14 -15	41.0 42.0 43.0 44.0 45.0 46.0 47.0			**SANDSTONE**. *(continued)* **COAL**: black. **SILTSTONE**. **COAL**. 42.5 m: 110mm tool drop **SANDSTONE**.				**FRESH**

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method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	7 of 13
project no.	***754-NTLGE220504***
client:	***Crescent Newcastle Pty Ltd***
date started:	***12 Sep 2018***
principal:	
date completed:	***14 Sep 2018***
project:	***Proposed Multi Building Residential Development***
logged by:	***MJ***
location:	***11 - 13 Mosbri Crescent, Cooks Hill, NSW***
checked by:	***RB***

position: E: 385,684.5; N: 6,355,567.6 (MGA94) | surface elevation: 32.8 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR / N				-16	49.0			**SANDSTONE**. *(continued)*				**FRESH**
				-17	50.0							
				-18	51.0							
				-19	52.0							
				-20	53.0			**COAL**.				
				-21	54.0			**SANDSTONE**.				
				-22	55.0			**SILTSTONE**.				
				-23				**SANDSTONE**.				

CDF_0_9_06_LIBRARY.GLB rev:AS Log COF BOREHOLE: NON CORED 754-NTLGE220504.GPJ <<DrawingFile>> 31/10/2018 13:47

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
- W washbore
- RR rock roller/tricone

* bit shown by suffix
e.g. AD/T
- B blank bit
- T TC bit
- V V bit

support
- M mud
- C casing
- N nil

penetration
- 1 2 3 — no resistance ranging to refusal

water
- 10-Oct-12 water level on date shown
- water inflow
- water outflow

samples & field tests
- B bulk disturbed sample
- D disturbed sample
- E environmental sample
- SS split spoon sample
- U## undisturbed sample ##mm diameter
- HP hand penetrometer (kPa)
- N standard penetration test (SPT)
- N* SPT - sample recovered
- Nc SPT with solid cone
- VS vane shear; peak/remouded (kPa)
- R refusal
- HB hammer bouncing

classification symbol & soil description based on Unified Classification System

moisture
- D dry
- M moist
- W wet
- Wp plastic limit
- Wl liquid limit

consistency / relative density

VS	very soft
S	soft
F	firm
St	stiff
VSt	very stiff
H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	8 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***12 Sep 2018***
principal:	date completed: ***14 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
location: ***11 - 13 Mosbri Crescent, Cooks Hill, NSW***	checked by: ***RB***

position: E: 385,684.5; N: 6,355,567.6 (MGA94) | surface elevation: 32.8 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N				-24 -25 -26 -27 -28 -29 -30 -31	57.0 58.0 59.0 60.0 61.0 62.0 63.0			**SANDSTONE**. *(continued)* **SILTSTONE**. **SANDSTONE**.				**FRESH**

CDF_0_9_06_LIBRARY.GLB rev:AS Log COF BOREHOLE: NON CORED 754-NTLGE220504.GPJ <<DrawingFile>> 31/10/2018 13:47

method
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Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	9 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***12 Sep 2018***
principal:	date completed: ***14 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
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drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (SOIL TYPE: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR				-32	65.0			**SANDSTONE**. *(continued)*				**FRESH**
				-33	66.0							
N				-34	67.0							
				-35	68.0							
				-36	69.0			**SILTSTONE**.				
				-37	70.0			**SANDSTONE**.				
				-38	71.0			**SILTSTONE**.				
				-39				**SANDSTONE**.				

CDF_0_9_06_LIBRARY.GLB rev:AS Log COF BOREHOLE: NON CORED 754-NTLGE220504.GPJ <<DrawingFile>> 31/10/2018 13:47

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Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	10 of 13
project no.	***754-NTLGE220504***
client:	***Crescent Newcastle Pty Ltd***
date started:	***12 Sep 2018***
principal:	
date completed:	***14 Sep 2018***
project:	***Proposed Multi Building Residential Development***
logged by:	***MJ***
location:	***11 - 13 Mosbri Crescent, Cooks Hill, NSW***
checked by:	***RB***

position: E: 385,684.5; N: 6,355,567.6 (MGA94) | surface elevation: 32.8 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description **SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR N				-40 -41 -42 -43 -44 -45 -46 -47	73.0 74.0 75.0 76.0 77.0 78.0 79.0			**SANDSTONE**. *(continued)*				**FRESH**

CDF_0_9_06_LIBRARY.GLB rev:AS Log COF BOREHOLE: NON CORED 754-NTLGE220504.GPJ <<DrawingFile>> 31/10/2018 13:47

method
- AD auger drilling*
- AS auger screwing*
- HA hand auger
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Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	11 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***12 Sep 2018***
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project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
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drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR				-48	81.0			**SANDSTONE**. *(continued)*				**FRESH**
	N			-49	82.0							
				-50	83.0			**SILTSTONE**.				
				-51	84.0							
				-52	85.0							
				-53	86.0			**SANDSTONE**.				
				-54	87.0							
				-55								

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VD	very dense

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Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	12 of 13
project no.	***754-NTLGE220504***
client: ***Crescent Newcastle Pty Ltd***	date started: ***12 Sep 2018***
principal:	date completed: ***14 Sep 2018***
project: ***Proposed Multi Building Residential Development***	logged by: ***MJ***
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position: E: 385,684.5; N: 6,355,567.6 (MGA94) | surface elevation: 32.8 m (AHD) | angle from horizontal: 90°

drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR / N		◀		-56	89.0			**SANDSTONE**. *(continued)*				**FRESH**
				-57	90.0			**SANDSTONE**.				
				-58	91.0							
				-59	92.0			**NO CORE:** 1.65m (92.10-93.75 m) Tool drop.				
				-60	93.0							
				-61	94.0			**CAVE IN: SILTSTONE AND COAL**				
				-62	95.0							
				-63								

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H	hard
Fb	friable
VL	very loose
L	loose
MD	medium dense
D	dense
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Engineering Log - Borehole

Borehole ID.	***BH04***
sheet:	13 of 13
project no.	***754-NTLGE220504***
client:	***Crescent Newcastle Pty Ltd***
date started:	***12 Sep 2018***
principal:	
date completed:	***14 Sep 2018***
project:	***Proposed Multi Building Residential Development***
logged by:	***MJ***
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drill model: Comacchio 450P, Track mounted | drilling fluid: non / water | hole diameter : 96 mm

drilling information | **material substance**

method & support	penetration 1 2 3	water	samples & field tests	RL (m)	depth (m)	graphic log	classification symbol	material description (**SOIL TYPE**: plasticity or particle characteristic, colour, secondary and minor components)	moisture condition	consistency / relative density	hand penetrometer (kPa) 100 200 300 400	structure and additional observations
RR				-64	97.0			**CAVE IN: SILTSTONE AND COAL** *(continued)*				**FRESH**
				-65	98.0							
N				-66	99.0			**SANDSTONE**.				
				-67	100.0							
				-68	101.0							
				-69	102.0			Borehole BH04 terminated at 101.60 m Target depth				
				-70	103.0							
				-71								

CDF_0_9_06_LIBRARY.GLB rev:AS Log COF BOREHOLE: NON CORED 754-NTLGE220504.GPJ <<DrawingFile>> 31/10/2018 13:47

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Appendix B – Downhole geophysics

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Coffey Geotechnics

Borehole BH01 TOP

ACOUSTIC TELEVIEWER PETROPHYSICAL REPORT

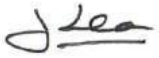
Groundsearch Australia Pty. Limited

15 October 2018

DISCLAIMER

The data used in this report were obtained using equipment manufactured by the Century Geophysical Corporation. The interpretations given in this report are based on judgement and experience of Groundsearch Australia's personnel. They are provided for Coffey Geotechnics sole use in accordance with a specified brief. As such, the interpretation outcomes do not necessarily address all aspects of ground conditions and behaviour on the subject site. The responsibility of Groundsearch Australia is solely to Coffey Geotechnics and it is not intended that any third party rely upon this report. This report shall not be reproduced either wholly or in part without the written permission of Groundsearch Australia Pty. Limited.

For and on behalf of Groundsearch Australia Pty. Limited



John Lea BSc (Hons) FAusIMM
Principal Geologist
Managing Director

Executive summary

The data contained in this report were obtained from one 9.6 cm diameter, vertical, cored borehole that was drilled as a component of the 2018 geotechnical exploration programme for Coffey Geotechnics at NBN office, Newcastle NSW.

Century Geophysical Corporation downhole 9804 acoustic televiewer and 9329 density tools were run to collect data in the field on 14 September 2018. The bottom section was logged on 9 September 2018. This report is for data from 29.00 to 44.50 mbgl. The 9239 density tool was run inside steel casing and data were corrected for the steel. Therefore, there are no caliper or resistivity data.

The 31 identified features are interpreted as the SWL, bedding, fractures and a void at the base of the log. The bedding to fractures ratio is 3:1.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

Page #

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2.0 Interpretation Methodology 5
3.0 Borehole BH01 TOP Interpretation 7

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Table 3 BH01 TOP fracture histogram data 11

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Figure 2 BH01 TOP features dip angles data distribution 9
Figure 3 BH01 TOP features dip directions data distribution 9
Figure 4 BH01 TOP bedding dip directions data rose diagram 10
Figure 5 BH01 TOP bedding dip angles histogram 10
Figure 6 BH01 TOP bedding dip directions histogram 10
Figure 7 BH01 TOP fracture dip directions data rose diagram 11
Figure 8 BH01 TOP fracture dip angles data histogram 11
Figure 9 BH01 TOP fracture dip directions data histogram 11

Appendix 1 1:20 Interpretation logs – 29.00 to 44.50 mbgl

1.0 Background technical information

The data contained in this report were obtained from one 9.6 cm diameter, vertical, cored borehole that was drilled as a component of the 2018 geotechnical exploration programme for Coffey Geotechnics at NBN office, Newcastle NSW.

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The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

Subsequent processing and interpretation of data were carried out by Groundsearch.

The ATV takes an oriented image of the borehole using high-resolution sound waves. This acoustic image is displays amplitude variations. This information is used to detect bedding planes, fractures, and other borehole anomalies without the need to have clear fluid filling the boreholes. The tool works only in fluid-filled boreholes.

The televiewer digitises 256 measurements around the borehole at each high-resolution sample interval. These data can be oriented to North and displayed real-time while logging using the Visual Compu-Log System.

Analysis software includes colour adjustment, fracture dip and strike determination, and classification of features. It allows information to be displayed on the graphical screen, plot, and in report format.

2.0 Interpretation methodology

It should be noted that the ATV is a bowspring-type, centralised tool and is affected by poor wallrock conditions known as rugosity.

The ATV data interpretation procedure is based on the superposition of curves on feature logs directly onto the computer screen by using a subjective, manual; two-point definition of a feature's top and base to produce a sine curve. The sides of the time and amplitude plots represent magnetic north and magnetic south is in the centre of each plot. The low side, or trough, of the sine curve defines the dip direction of the feature.

The logging program automatically records the televiewer tool slant angle and bearing and corrects for any borehole deviations. The curves are automatically given an identification number for subsequent referencing in a report file.

There are possibly more bedding planes and structural fractures appearing in the televiewer logs that have not been included in this report due to their poor graphic definition or the inability to resolve their geometry by superposing a sine curve using the program's two point method.

This report contains a;

- Text summary of the interpreted features
- Circular representation of interpreted features
- Logs that show geological features with their subjective, numbered interpretation curves shown at 1:20 scale. The logs are in standard format whereby the optical image of the borehole wall is "flattened" onto the plot. The logs have the following additional features to enhance geological interpretations of the strata;
    - Amplitude image differentials
    - Time image differentials that indicate higher strength zones in **GREEN** and lower strength zones in **RED**
    - Tadpoles that represent feature dip and dip direction
    - Open fractures in **RED**
    - Partially open fractures in **MAGENTA**
    - Natural gamma
    - Slant (dip angle)
    - Slant angle bearing
    - Long and short space density
- Table containing feature curve ID, top, base, dip angle, dip azimuth, feature description and the generalised rock type that hosts the feature
- Graphical representations of the interpreted features

3.0 Borehole BH01 TOP interpretation

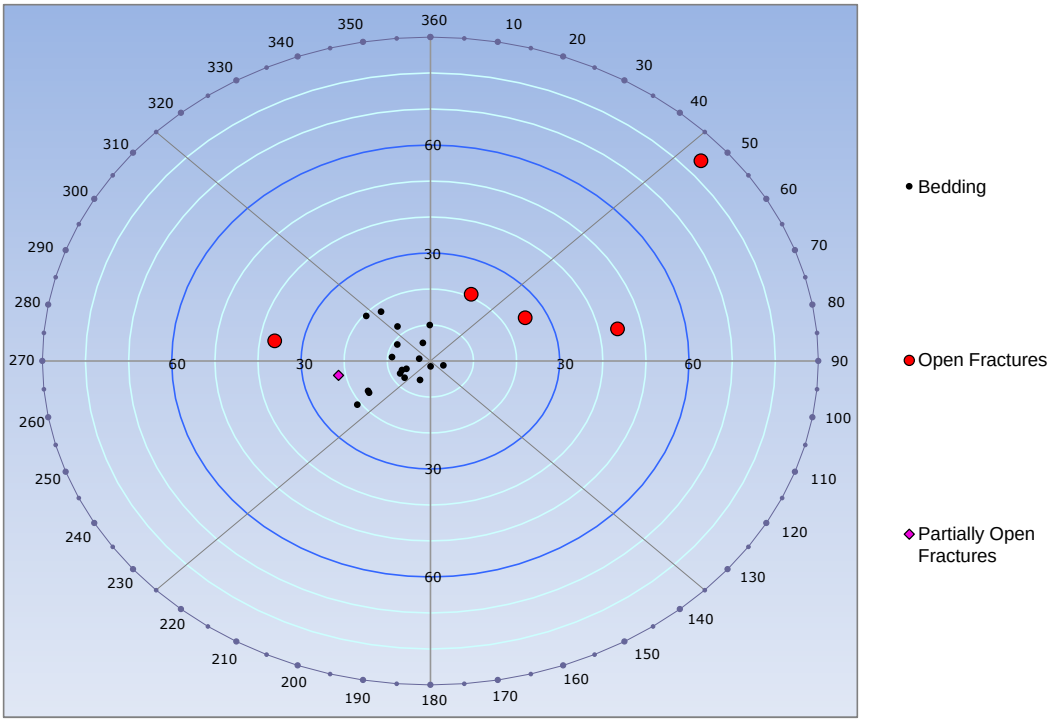
The 31 identified features are interpreted as the SWL, bedding, fractures and a void at the base of the log. The bedding to fractures ratio is 3:1.

A description of each interpreted feature is presented in Table 1 and the log is presented in Appendix 1.

Table 1 Interpreted features report for BH01 TOP

FEATURE ID	DIP (DEG)	AZIMUTH (DEG)	MIDPOINT (MBGL)	TOP (M)	BASE (M)	TYPE OF FEATURE	GENERALISED ROCK TYPE
1	2	1	29.45	29.45	29.45	SWL	Overburden
2	18	320	34.61	34.60	34.63	Bedding plane	Overburden
3	19	310	34.65	34.63	34.67	Bedding plane	Overburden
4	10	359	34.69	34.68	34.70	Bedding plane	Overburden
5	17	238	37.98	37.97	38.00	Bedding plane	Overburden
6	20	45	39.70	39.68	39.72	Top of washout	Overburden
7	10	74	39.91	39.90	39.92	Base of washout	Overburden
8	44	78	39.95	39.91	40.00	Fracture plane - open	Overburden
9	3	284	40.19	40.19	40.20	Bedding plane	Overburden
10	25	61	40.45	40.43	40.48	Fracture plane - open	Overburden
11	21	27	40.55	40.53	40.57	Fracture plane - open	Overburden
12	3	112	40.61	40.61	40.62	Bedding plane	Overburden
13	6	204	40.66	40.66	40.67	Bedding plane	Overburden
14	37	279	40.79	40.75	40.82	Fracture plane - open	Overburden
15	22	259	40.85	40.83	40.87	Fracture plane - partially open	Overburden
16	8	244	40.95	40.94	40.96	Bedding plane	Overburden
17	9	301	41.01	41.00	41.01	Bedding plane	Overburden
18	8	232	41.03	41.02	41.04	Bedding plane	Overburden
19	6	249	41.15	41.14	41.16	Bedding plane	Overburden
20	7	249	41.31	41.31	41.32	Bedding plane	Overburden
21	9	277	41.49	41.48	41.50	Bedding plane	Overburden
22	10	247	41.51	41.50	41.52	Top of washout	Overburden
23	15	115	42.65	42.64	42.66	Base of washout	Overburden
24	84	48	42.73	42.36	43.10	Fracture plane - open	Overburden
25	46	244	42.97	42.92	43.02	Top of washout	Overburden
26	12	316	43.73	43.72	43.74	Base of washout	Overburden
27	12	321	43.98	43.97	43.99	Bedding plane	Overburden
28	5	341	44.06	44.06	44.06	Bedding plane	Overburden
29	2	178	44.10	44.10	44.10	Bedding plane	Overburden
30	21	234	44.17	44.15	44.19	Bedding plane	Overburden
31	17	240	44.21	44.20	44.23	Bedding plane	Overburden
FEATURE ID	DIP (DEG)	AZIMUTH (DEG)	MIDPOINT (MBGL)	TOP (M)	BASE (M)	TYPE OF FEATURE	GENERALISED ROCK TYPE

Figure 1 BH01 TOP circular plan representation of interpreted features



The 18 identified sedimentary features are predominantly bedding planes that appear to range in dip from flat-lying to 21^0. Figures 2 and 3 show the distribution of the planes' dip angles and dip direction with depth.

Table 2 details the variation in the dip angle and dip direction data. Figure 4 shows the dip direction data in a rose diagram with the bedding planes' dip angle and dip direction data shown as histograms in Figures 5 and 6.

The six fractures are identified as open (5) andpartially open (1). The fracture dip angles range from 21 to 84^0.

Table 3 details the variation in the fractures' dip angle and dip direction data. Figure 7 shows the dip direction data in a rose diagram with the fractures' plane dip angle and dip direction data as histograms in Figures 8 and 9.

Figure 2 BH01 TOP feature dip angle data distribution

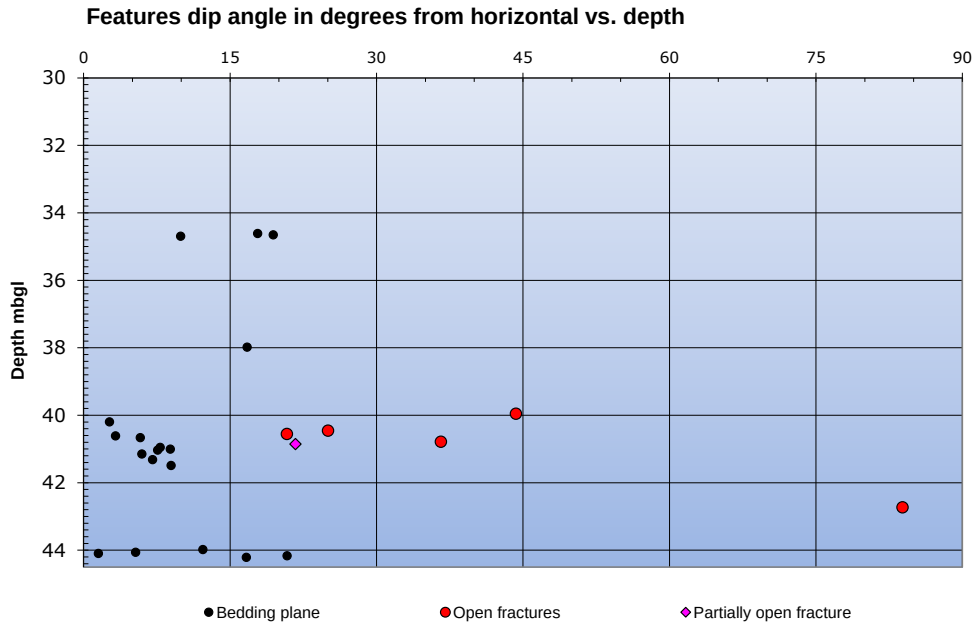


Figure 3 BH01 TOP feature dip direction data distribution

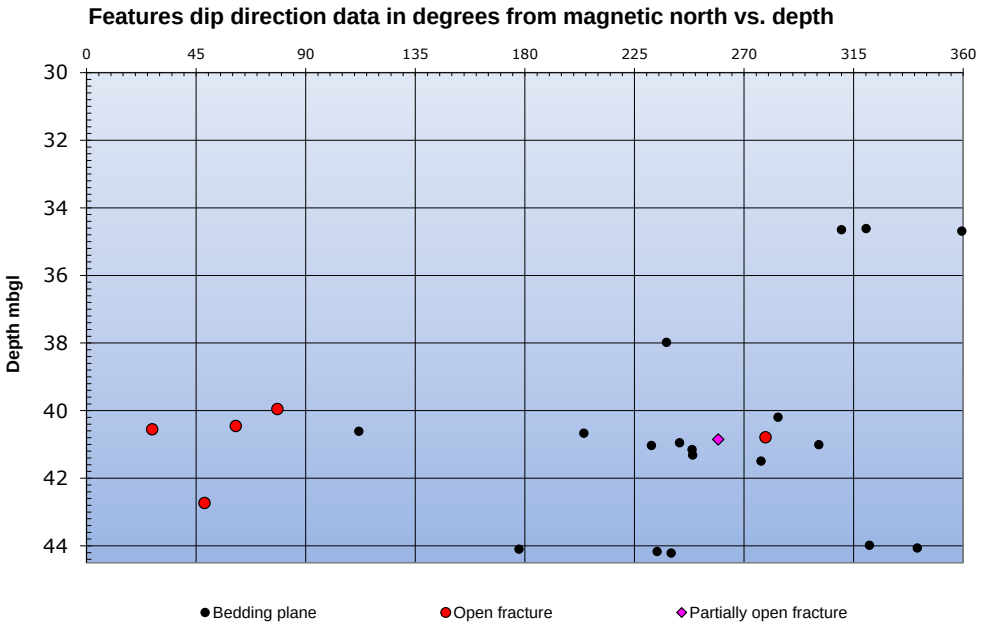


Table 2 BH01 TOP bedding histogram data

Dip Distribution Total: 18			Orientation Distribution Total: 18		
Dip Range	Count	%	Bearing Range	Count	%
0 to 10	12	66.7	0 to 10	0	0.0
10 to 20	5	27.8	10 to 20	0	0.0
20 to 30	1	5.6	20 to 30	0	0.0
30 to 40	0	0.0	30 to 40	0	0.0
40 to 50	0	0.0	40 to 50	0	0.0
50 to 60	0	0.0	50 to 60	0	0.0
60 to 70	0	0.0	60 to 70	0	0.0
70 to 80	0	0.0	70 to 80	0	0.0
80 to 90	0	0.0	80 to 90	0	0.0
			90 to 100	0	0.0
			100 to 110	0	0.0
			110 to 120	1	5.6
			120 to 130	0	0.0
			130 to 140	0	0.0
			140 to 150	0	0.0
			150 to 160	0	0.0
			160 to 170	0	0.0
			170 to 180	1	5.6
			180 to 190	0	0.0
			190 to 200	0	0.0
			200 to 210	1	5.6
			210 to 220	0	0.0
			220 to 230	0	0.0
			230 to 240	3	16.7
			240 to 250	4	22.2
			250 to 260	0	0.0
			260 to 270	0	0.0
			270 to 280	1	5.6
			280 to 290	1	5.6
			290 to 300	0	0.0
			300 to 310	2	11.1
			310 to 320	0	0.0
			320 to 330	2	11.1
			330 to 340	0	0.0
			340 to 350	1	5.6
			350 to 360	1	5.6

Figure 5 BH01 TOP bedding dip angles histogram

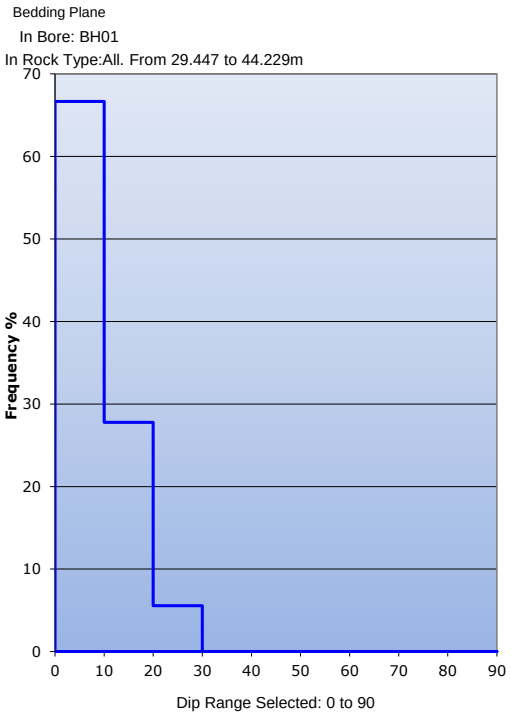


Figure 4 BH01 TOP bedding dip direction data rose diagram

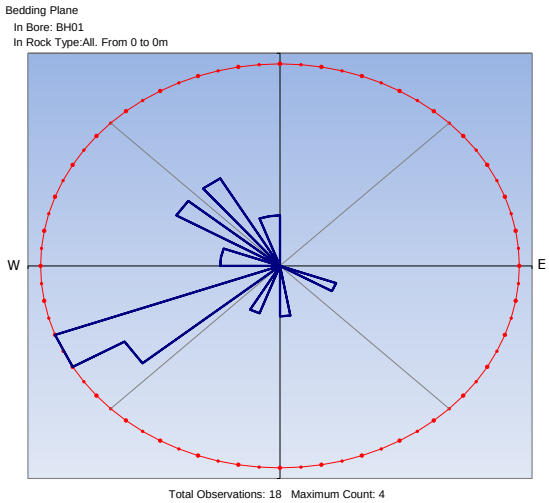


Figure 6 BH01 TOP bedding dip directions histogram

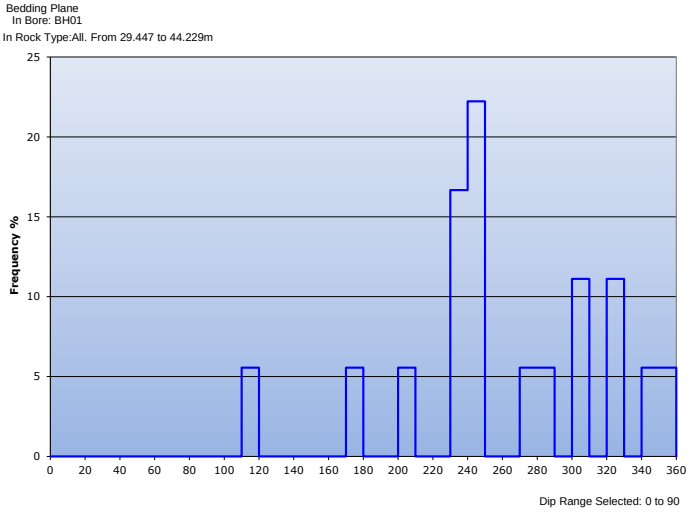


Table 3 BH01 TOP fractures histogram data

Dip Distribution Total: 6			Orientation Distribution Total: 6		
Dip Range	Count	%	Bearing Range	Count	%
0 to 10	0	0.0	0 to 10	0	0.0
10 to 20	0	0.0	10 to 20	0	0.0
20 to 30	3	50.0	20 to 30	1	16.7
30 to 40	1	16.7	30 to 40	0	0.0
40 to 50	1	16.7	40 to 50	1	16.7
50 to 60	0	0.0	50 to 60	0	0.0
60 to 70	0	0.0	60 to 70	1	16.7
70 to 80	0	0.0	70 to 80	1	16.7
80 to 90	1	16.7	80 to 90	0	0.0
			90 to 100	0	0.0
			100 to 110	0	0.0
			110 to 120	0	0.0
			120 to 130	0	0.0
			130 to 140	0	0.0
			140 to 150	0	0.0
			150 to 160	0	0.0
			160 to 170	0	0.0
			170 to 180	0	0.0
			180 to 190	0	0.0
			190 to 200	0	0.0
			200 to 210	0	0.0
			210 to 220	0	0.0
			220 to 230	0	0.0
			230 to 240	0	0.0
			240 to 250	0	0.0
			250 to 260	1	16.7
			260 to 270	0	0.0
			270 to 280	1	16.7
			280 to 290	0	0.0
			290 to 300	0	0.0
			300 to 310	0	0.0
			310 to 320	0	0.0
			320 to 330	0	0.0
			330 to 340	0	0.0
			340 to 350	0	0.0
			350 to 360	0	0.0

Figure 8 BH01 TOP fractures dip angles histogram

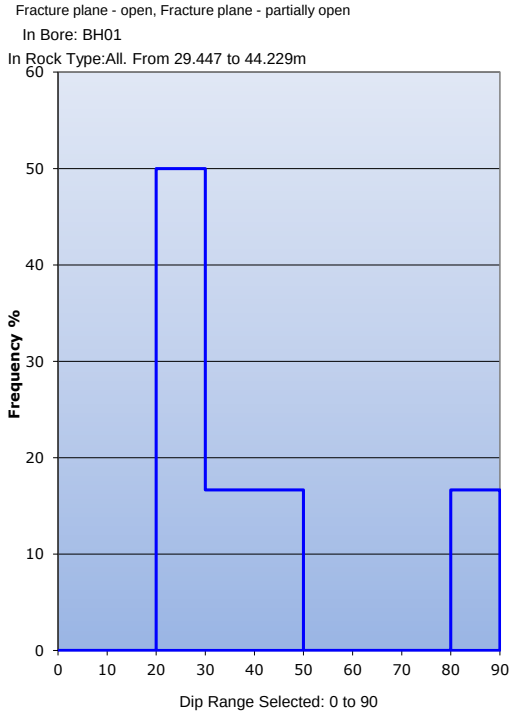


Figure 7 BH01 TOP fractures dip direction data rose diagram

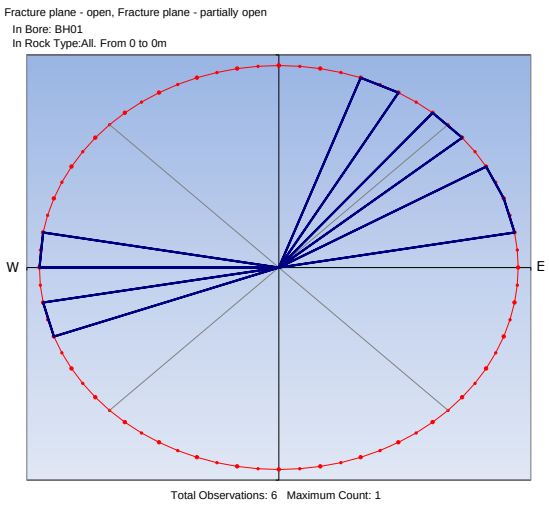
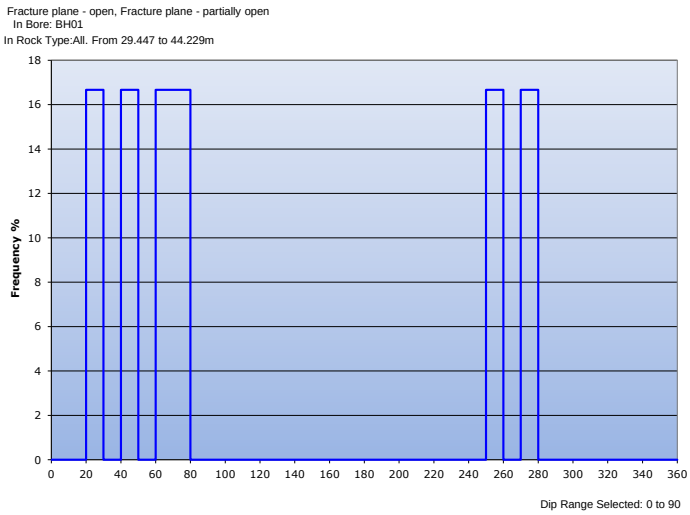


Figure 9 BH01 TOP fractures dip directions histogram



Appendix 1

Appendix 1 ***1:20 Interpretation logs – 29.00 to 44.50 mbgl***

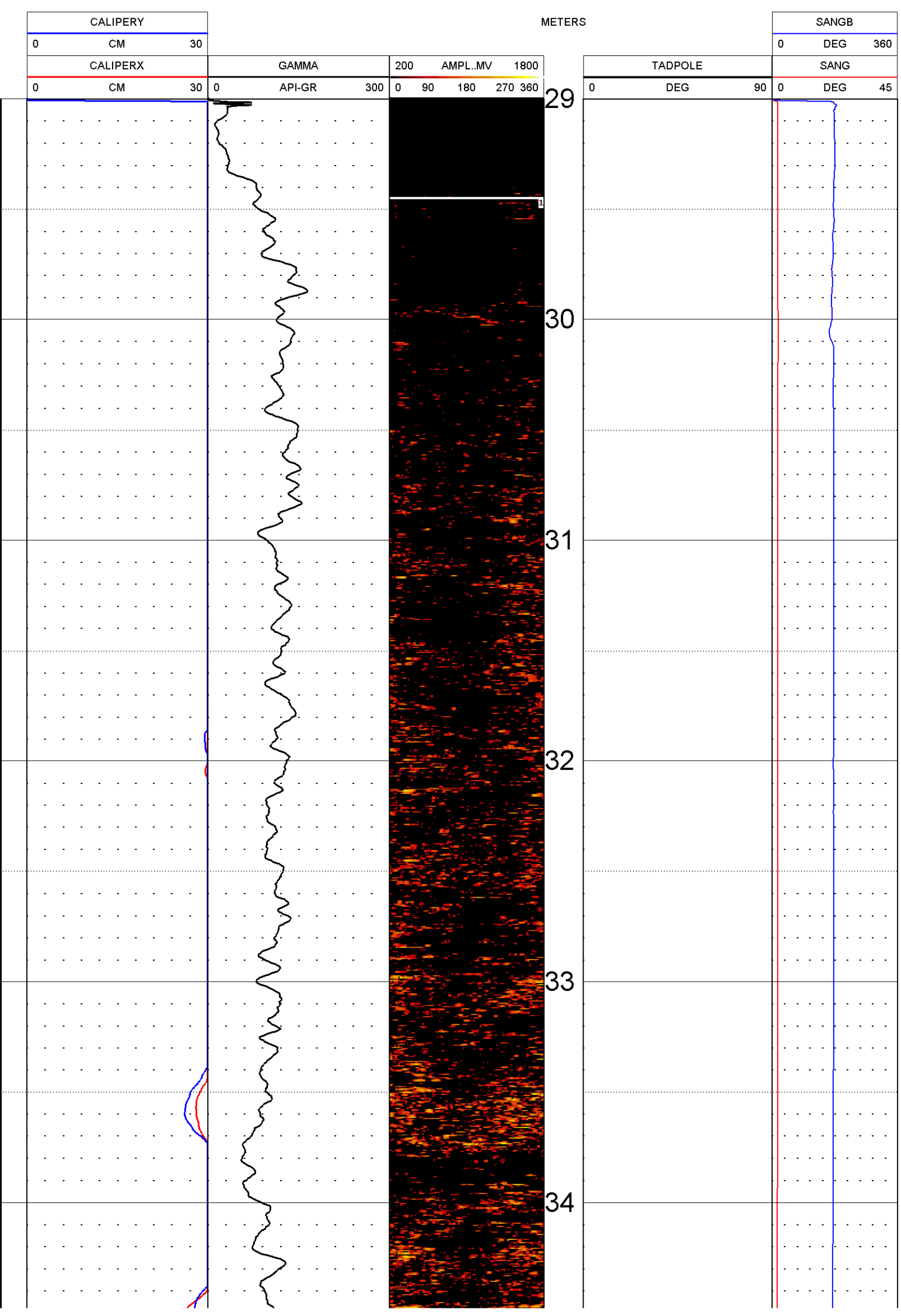


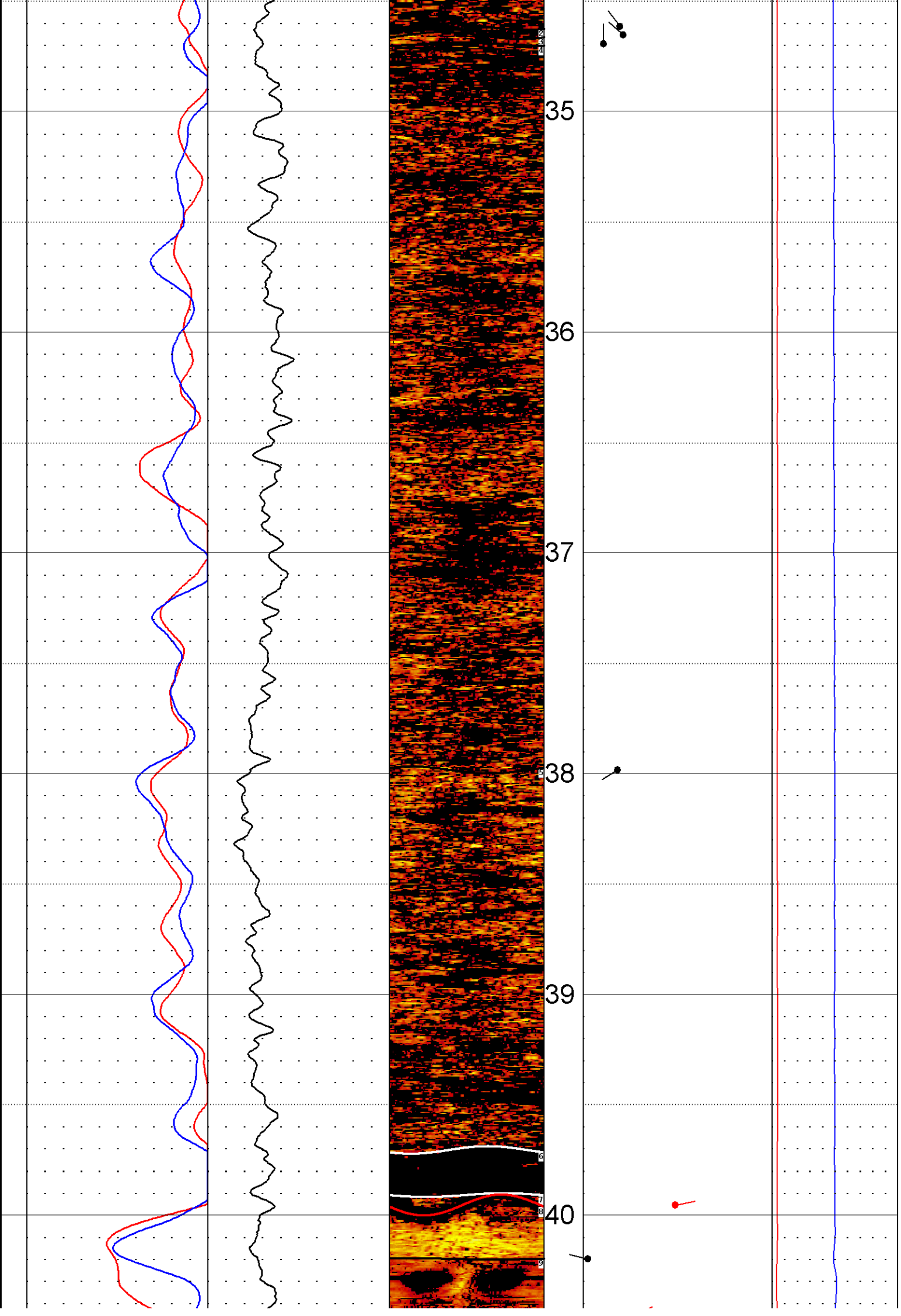
BH01 Top ATV 1:20

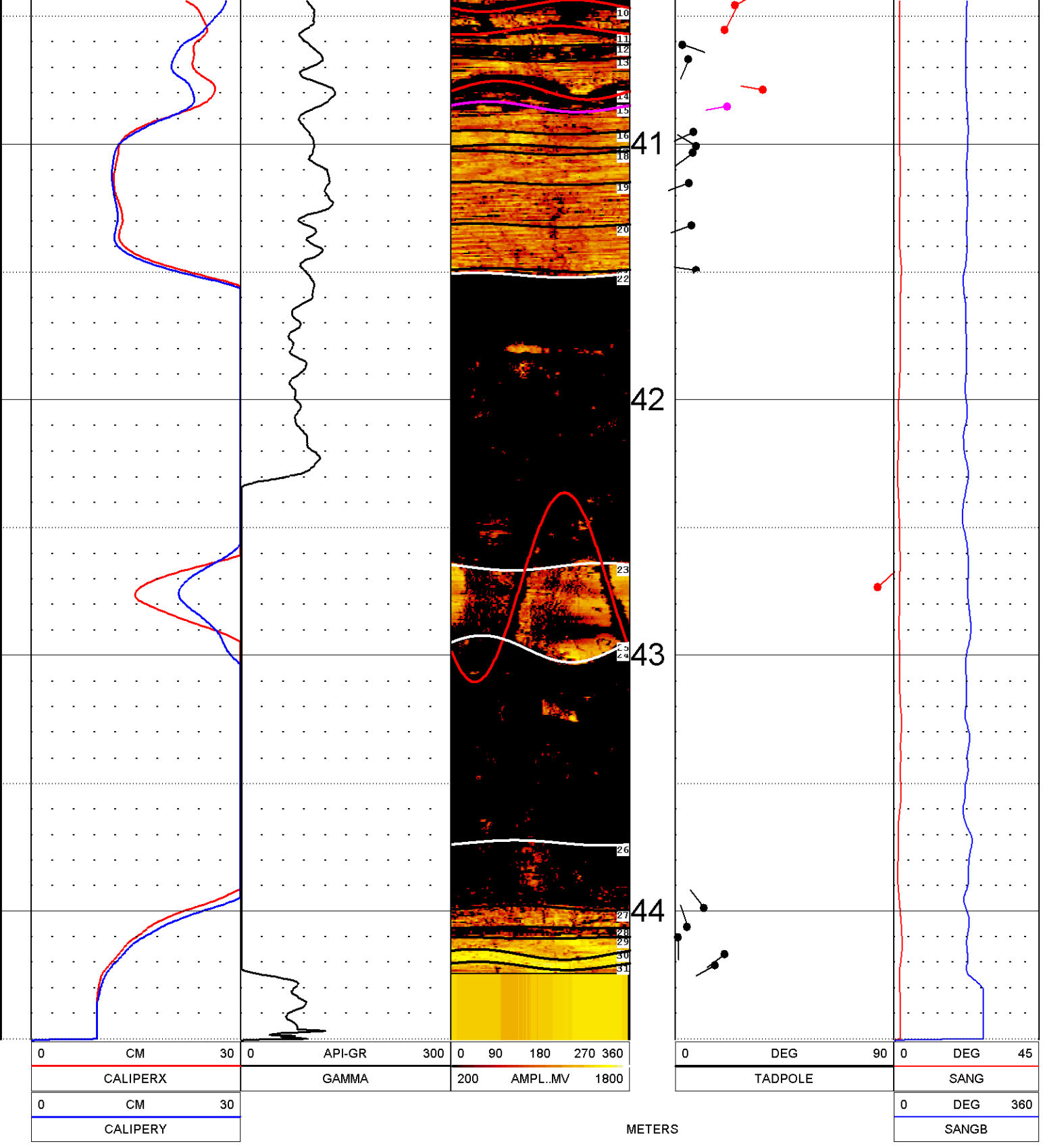
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LOCATION/FIELD	:				SON,TV		
COUNTY	:				ne		
LOCATION	:	NEWCASTLE					
SECTION	:	N/A	TOWNSHIP	: N/A		RANGE	: N/A
DATE	:	09/14/18	PERMANENT DATUM	: -0.9			
DEPTH DRILLER	:	101.6				KB	: N/A
LOG BOTTOM	:	44.500	LOG MEASURED FROM:	N/A		DF	: N/A
LOG TOP	:	29.000	DRL MEASURED FROM:	N/A		GL	: NA
CASING DIAMETER	:	10.	LOGGING UNIT	: T107			
CASING TYPE	:	PVC	FIELD OFFICE	: RUTHERFORD			
CASING THICKNESS:		.5	RECORDED BY	: P WOODWARD			
BIT SIZE	:	9.9	BOREHOLE FLUID	: 0		FILE	: PROCESSED
MAGNETIC DECL.	:	0	RM	: N/A		TYPE	: 9804A
MATRIX DENSITY	:	2.65	RM TEMPERATURE	: N/A		LGDATE	: 09/14/18
NEUTRON MATRIX	:	SANDSTONE	MATRIX DELTA T	: 177		LGTIME	: 13:08
						THRESH:	99999

NE, 743'FNL, 661'FEL

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


CALIPERY
0 CM 30
CALIPERX
0 CM 30
GAMMA
0 API-GR 300
METERS
200 AMPL..MV 1800
0 90 180 270 360
TADPOLE
0 DEG 90
SANGB
0 DEG 360
SANG
0 DEG 45
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GAMMA
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TADPOLE
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METERS

Coffey Geotechnics

Borehole BH01

ACOUSTIC TELEVIEWER PETROPHYSICAL REPORT

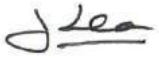
Groundsearch Australia Pty. Limited

27 September 2018

DISCLAIMER

The data used in this report were obtained using equipment manufactured by the Century Geophysical Corporation. The interpretations given in this report are based on judgement and experience of Groundsearch Australia's personnel. They are provided for Coffey Geotechnics sole use in accordance with a specified brief. As such, the interpretation outcomes do not necessarily address all aspects of ground conditions and behaviour on the subject site. The responsibility of Groundsearch Australia is solely to Coffey Geotechnics and it is not intended that any third party rely upon this report. This report shall not be reproduced either wholly or in part without the written permission of Groundsearch Australia Pty. Limited.

For and on behalf of Groundsearch Australia Pty. Limited



John Lea BSc (Hons) FAusIMM
Principal Geologist
Managing Director

Executive summary

The data contained in this report were obtained from one 9.6 cm diameter, vertical, cored borehole that was drilled as a component of the 2018 geotechnical exploration programme for Coffey Geotechnics at NBN office, Newcastle NSW.

Century Geophysical Corporation downhole 9804 acoustic televiewer and 9329 density tools were run to collect data in the field on 7 September 2018. This report is for data from 44.00 to 93.61 mbgl. The 9239 density tool was run inside steel casing and data were corrected for the steel. Therefore, there are no caliper or resistivity data.

The 203 identified features are interpreted as the SWL, bedding, fractures and a void at the base of the log. The bedding to fractures ratio is 6.2:1.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

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Appendix 1 1:20 Interpretation logs – 44.00 to 93.61 mbgl

1.0 Background technical information

The data contained in this report were obtained from one 9.6 cm diameter, vertical, cored borehole that was drilled as a component of the 2018 geotechnical exploration programme for Coffey Geotechnics at NBN office, Newcastle NSW.

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The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

Subsequent processing and interpretation of data were carried out by Groundsearch.

The ATV takes an oriented image of the borehole using high-resolution sound waves. This acoustic image is displays amplitude variations. This information is used to detect bedding planes, fractures, and other borehole anomalies without the need to have clear fluid filling the boreholes. The tool works only in fluid-filled boreholes.

The televiewer digitises 256 measurements around the borehole at each high-resolution sample interval. These data can be oriented to North and displayed real-time while logging using the Visual Compu-Log System.

Analysis software includes colour adjustment, fracture dip and strike determination, and classification of features. It allows information to be displayed on the graphical screen, plot, and in report format.

2.0 Interpretation methodology

It should be noted that the ATV is a bowspring-type, centralised tool and is affected by poor wallrock conditions known as rugosity.

The ATV data interpretation procedure is based on the superposition of curves on feature logs directly onto the computer screen by using a subjective, manual; two-point definition of a feature's top and base to produce a sine curve. The sides of the time and amplitude plots represent magnetic north and magnetic south is in the centre of each plot. The low side, or trough, of the sine curve defines the dip direction of the feature.

The logging program automatically records the televiewer tool slant angle and bearing and corrects for any borehole deviations. The curves are automatically given an identification number for subsequent referencing in a report file.

There are possibly more bedding planes and structural fractures appearing in the televiewer logs that have not been included in this report due to their poor graphic definition or the inability to resolve their geometry by superposing a sine curve using the program's two point method.

This report contains a;

- Text summary of the interpreted features
- Circular representation of interpreted features
- Logs that show geological features with their subjective, numbered interpretation curves shown at 1:20 scale. The logs are in standard format whereby the optical image of the borehole wall is "flattened" onto the plot. The logs have the following additional features to enhance geological interpretations of the strata;
    - Amplitude image differentials
    - Time image differentials that indicate higher strength zones in **GREEN** and lower strength zones in **RED**
    - Tadpoles that represent feature dip and dip direction
    - Open fractures in **RED**
    - Partially open fractures in **MAGENTA**
    - Discontinuous fractures in **DARK BLUE**
    - Closed fracture in **GREEN**
    - Natural gamma
    - Slant (dip angle)
    - Slant angle bearing
    - Long and short space density
- Table containing feature curve ID, top, base, dip angle, dip azimuth, feature description and the generalised rock type that hosts the feature
- Graphical representations of the interpreted features

3.0 Borehole BH01interpretation

The 203 identified features are interpreted as the SWL, bedding, fractures and a void at the base of the log. The bedding to fractures ratio is 6.2:1.

A description of each interpreted feature is presented in Table 1 and the log is presented in Appendix 1.

Table 1 Interpreted features report for BH01

FEATURE ID	DIP (DEG)	AZIMUTH (DEG)	MIDPOINT (MBGL)	TOP (M)	BASE (M)	TYPE OF FEATURE	GENERALISED ROCK TYPE
1	2	16	45.04	45.04	45.04	SWL	Overburden
2	3	62	45.48	45.48	45.48	Bedding plane	Overburden
3	5	303	45.69	45.69	45.70	Bedding plane	Overburden
4	2	343	46.24	46.24	46.24	Bedding plane	Overburden
5	7	255	46.45	46.44	46.45	Bedding plane	Overburden
6	13	349	47.13	47.12	47.14	Bedding plane	Overburden
7	15	349	47.16	47.15	47.17	Bedding plane	Overburden
8	10	46	47.21	47.21	47.22	Bedding plane	Overburden
9	4	313	50.53	50.52	50.53	Bedding plane	Overburden
10	6	25	50.67	50.67	50.67	Bedding plane	Overburden
11	5	25	50.68	50.68	50.69	Bedding plane	Overburden
12	7	15	50.71	50.71	50.72	Bedding plane	Overburden
13	7	337	50.76	50.76	50.77	Bedding plane	Overburden
14	10	66	50.79	50.78	50.80	Bedding plane	Overburden
15	11	357	50.85	50.84	50.86	Bedding plane	Overburden
16	9	357	50.95	50.95	50.96	Bedding plane	Overburden
17	13	352	51.03	51.02	51.04	Bedding plane	Overburden
18	19	92	51.50	51.48	51.51	Fracture plane - partially open	Overburden
19	23	305	51.52	51.50	51.54	Fracture plane - partially open	Overburden
20	12	295	51.53	51.52	51.54	Bedding plane	Overburden
21	21	301	52.33	52.31	52.34	Fracture plane - partially open	Overburden
22	74	231	52.48	52.30	52.66	Fracture plane - partially open	Overburden
23	8	98	53.32	53.31	53.33	Bedding plane	Overburden
24	12	124	53.36	53.35	53.38	Bedding plane	Overburden
25	5	340	53.44	53.44	53.44	Bedding plane	Overburden
26	6	288	53.46	53.45	53.46	Bedding plane	Overburden
27	3	23	53.49	53.49	53.49	Bedding plane	Overburden
28	2	269	53.53	53.53	53.54	Bedding plane	Overburden
29	11	349	53.75	53.74	53.75	Top of coal unit	COAL SEAM
30	8	335	53.80	53.79	53.80	Bedding plane	COAL SEAM
31	72	264	53.91	53.76	54.07	Fracture plane - partially open	COAL SEAM
32	5	349	54.05	54.05	54.05	Bedding plane	COAL SEAM
33	7	331	54.11	54.10	54.11	Bedding plane	COAL SEAM
34	11	342	54.20	54.19	54.21	Bedding plane	COAL SEAM
35	10	347	54.21	54.21	54.22	Bedding plane	COAL SEAM
36	9	354	54.32	54.32	54.33	Base of coal unit	COAL SEAM
37	9	350	54.37	54.37	54.38	Bedding plane	Interburden

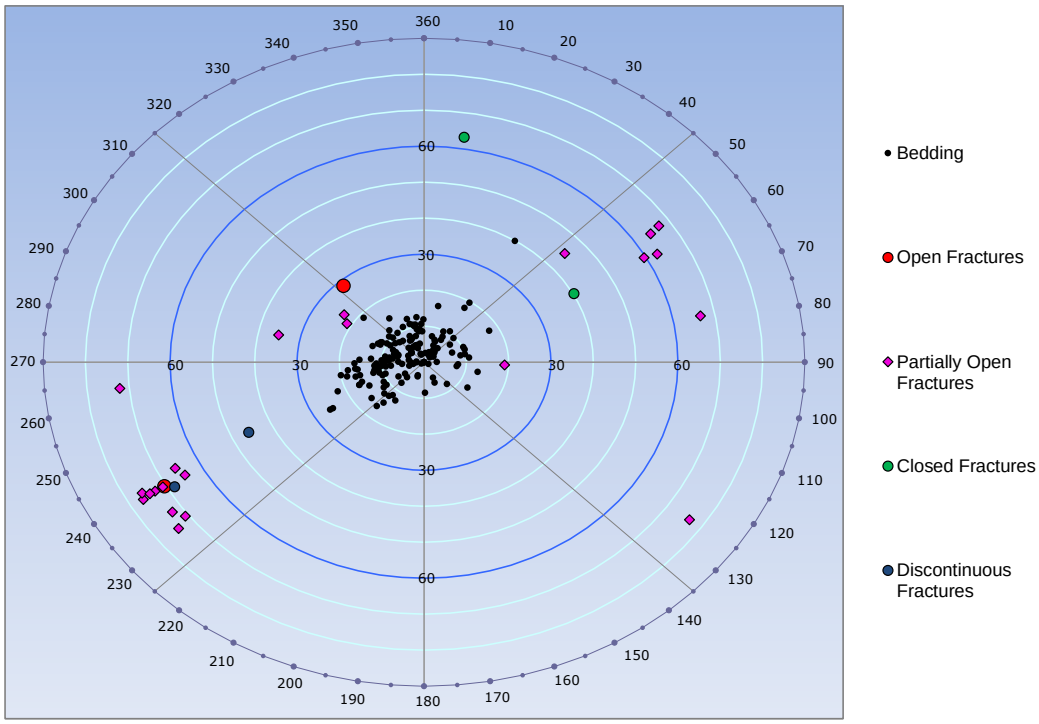
38	9	352	54.41	54.41	54.42	Bedding plane	Interburden
39	4	202	54.45	54.44	54.45	Bedding plane	Interburden
40	6	234	54.49	54.48	54.49	Bedding plane	Interburden
41	5	154	54.50	54.49	54.51	Bedding plane	Interburden
42	9	178	54.53	54.52	54.54	Bedding plane	Interburden
43	6	156	54.57	54.56	54.58	Bedding plane	Interburden
44	4	296	54.64	54.64	54.64	Bedding plane	Interburden
45	4	280	54.65	54.65	54.65	Bedding plane	Interburden
46	13	102	55.06	55.05	55.07	Bedding plane	Interburden
47	3	268	55.58	55.57	55.58	Bedding plane	Interburden
48	9	78	55.71	55.70	55.71	Bedding plane	Interburden
49	8	138	55.77	55.76	55.78	Bedding plane	Interburden
50	13	274	55.89	55.87	55.90	Bedding plane	Interburden
51	10	301	55.91	55.90	55.91	Bedding plane	Interburden
52	7	288	55.92	55.92	55.93	Bedding plane	Interburden
53	8	278	55.94	55.94	55.95	Bedding plane	Interburden
54	11	323	56.52	56.52	56.53	Bedding plane	Interburden
55	7	305	56.78	56.77	56.78	Bedding plane	Interburden
56	6	259	56.81	56.80	56.81	Bedding plane	Interburden
57	11	83	56.87	56.86	56.88	Bedding plane	Interburden
58	10	70	56.90	56.89	56.91	Bedding plane	Interburden
59	10	77	56.92	56.91	56.93	Bedding plane	Interburden
60	40	33	57.46	57.42	57.49	Bedding plane	Interburden
61	4	312	57.55	57.55	57.56	Bedding plane	Interburden
62	4	38	57.63	57.63	57.63	Bedding plane	Interburden
63	8	52	57.69	57.68	57.69	Bedding plane	Interburden
64	7	334	57.74	57.74	57.75	Bedding plane	Interburden
65	2	343	57.95	57.95	57.96	Bedding plane	Interburden
66	12	360	58.50	58.50	58.51	Bedding plane	Interburden
67	16	12	58.57	58.55	58.58	Bedding plane	Interburden
68	8	320	58.83	58.82	58.83	Bedding plane	Interburden
69	3	28	59.31	59.31	59.31	Bedding plane	Interburden
70	4	40	60.08	60.08	60.08	Bedding plane	Interburden
71	7	68	60.11	60.10	60.11	Bedding plane	Interburden
72	2	276	60.47	60.47	60.47	Bedding plane	Interburden
73	4	42	60.78	60.78	60.79	Bedding plane	Interburden
74	8	94	61.84	61.83	61.84	Bedding plane	Interburden
75	2	30	61.86	61.86	61.86	Bedding plane	Interburden
76	4	254	61.98	61.98	61.98	Bedding plane	Interburden
77	1	116	62.02	62.02	62.02	Bedding plane	Interburden
78	29	318	62.09	62.06	62.11	Fracture plane - open	Interburden
79	15	326	62.13	62.11	62.14	Bedding plane	Interburden
80	66	243	62.13	62.02	62.25	Fracture plane - partially open	Interburden
81	11	333	62.14	62.14	62.15	Bedding plane	Interburden
82	13	341	62.17	62.16	62.18	Bedding plane	Interburden
83	5	318	62.27	62.26	62.27	Bedding plane	Interburden
84	5	336	62.42	62.42	62.43	Bedding plane	Interburden
85	8	345	63.09	63.09	63.09	Bedding plane	Interburden
86	10	28	63.20	63.19	63.21	Bedding plane	Interburden
87	8	32	63.22	63.21	63.22	Bedding plane	Interburden

88	4	38	63.24	63.24	63.24	Bedding plane	Interburden
89	5	40	63.25	63.25	63.25	Bedding plane	Interburden
90	5	333	63.36	63.35	63.36	Bedding plane	Interburden
91	3	8	63.38	63.38	63.38	Bedding plane	Interburden
92	71	241	63.39	63.24	63.53	Fracture plane - partially open	Interburden
93	73	241	63.41	63.24	63.57	Fracture plane - partially open	Interburden
94	45	48	63.65	63.61	63.69	Fracture plane - partially open	Interburden
95	11	346	64.09	64.08	64.10	Bedding plane	Interburden
96	11	36	65.10	65.09	65.10	Bedding plane	Interburden
97	20	33	65.16	65.15	65.17	Bedding plane	Interburden
98	18	32	65.17	65.16	65.18	Bedding plane	Interburden
99	3	54	65.38	65.38	65.38	Bedding plane	Interburden
100	3	55	65.40	65.40	65.41	Bedding plane	Interburden
101	68	240	65.45	65.32	65.58	Fracture plane - discontinuous	Interburden
102	7	22	65.48	65.48	65.48	Bedding plane	Interburden
103	65	241	65.66	65.55	65.76	Fracture plane - partially open	Interburden
104	70	241	66.07	65.93	66.21	Fracture plane - open	Interburden
105	40	62	66.38	66.34	66.41	Fracture plane - closed	Interburden
106	18	60	66.40	66.39	66.42	Bedding plane	Interburden
107	63	9	66.97	66.89	67.05	Fracture plane - closed	Interburden
108	4	340	67.06	67.05	67.06	Bedding plane	Interburden
109	5	264	67.78	67.77	67.78	Bedding plane	Interburden
110	3	259	67.85	67.85	67.86	Bedding plane	Interburden
111	2	343	68.13	68.13	68.13	Bedding plane	Interburden
112	1	239	68.15	68.15	68.16	Bedding plane	Interburden
113	67	56	68.44	68.34	68.54	Fracture plane - partially open	Interburden
114	60	61	68.45	68.38	68.53	Fracture plane - partially open	Interburden
115	63	61	68.53	68.44	68.61	Fracture plane - partially open	Interburden
116	64	56	68.56	68.47	68.65	Fracture plane - partially open	Interburden
117	2	342	68.58	68.58	68.58	Bedding plane	Interburden
118	4	33	68.61	68.61	68.61	Bedding plane	Interburden
119	67	79	68.69	68.59	68.80	Fracture plane - partially open	Interburden
120	7	33	68.75	68.74	68.75	Bedding plane	Interburden
121	73	235	69.37	69.20	69.53	Fracture plane - partially open	Interburden
122	71	233	69.47	69.32	69.62	Fracture plane - partially open	Interburden
123	46	245	69.51	69.46	69.56	Fracture plane - discontinuous	Interburden
124	76	240	69.58	69.36	69.80	Fracture plane - partially open	Interburden
125	4	316	69.70	69.70	69.71	Bedding plane	Interburden
126	5	328	69.78	69.77	69.78	Bedding plane	Interburden
127	3	40	70.06	70.06	70.06	Bedding plane	Interburden
128	76	241	70.19	69.99	70.40	Fracture plane - partially open	Interburden
129	74	241	70.20	70.02	70.38	Fracture plane - partially open	Interburden
130	12	263	71.52	71.51	71.53	Bedding plane	Interburden
131	12	256	71.54	71.53	71.55	Bedding plane	Interburden
132	9	300	71.94	71.93	71.94	Bedding plane	Interburden
133	9	280	71.97	71.96	71.98	Bedding plane	Interburden
134	10	273	71.98	71.97	71.99	Bedding plane	Interburden
135	9	272	72.20	72.19	72.21	Bedding plane	Interburden
136	10	268	72.27	72.26	72.28	Bedding plane	Interburden
137	12	265	72.29	72.28	72.30	Bedding plane	Interburden

138	8	279	73.58	73.57	73.58	Bedding plane	Interburden
139	12	317	73.69	73.68	73.69	Bedding plane	Interburden
140	9	308	73.72	73.71	73.72	Bedding plane	Interburden
141	7	289	74.15	74.14	74.15	Bedding plane	Interburden
142	6	285	74.17	74.16	74.17	Bedding plane	Interburden
143	8	295	74.74	74.73	74.75	Bedding plane	Interburden
144	13	290	74.82	74.81	74.83	Bedding plane	Interburden
145	11	299	74.83	74.82	74.84	Bedding plane	Interburden
146	15	273	76.35	76.34	76.37	Bedding plane	Interburden
147	16	263	76.38	76.37	76.40	Bedding plane	Interburden
148	16	257	76.39	76.38	76.40	Bedding plane	Interburden
149	11	240	76.55	76.54	76.56	Bedding plane	Interburden
150	11	311	76.79	76.79	76.80	Bedding plane	Interburden
151	10	323	76.81	76.80	76.82	Bedding plane	Interburden
152	9	274	77.53	77.53	77.54	Bedding plane	Interburden
153	19	311	77.64	77.63	77.65	Bedding plane	Interburden
154	12	234	78.90	78.89	78.91	Bedding plane	Interburden
155	11	235	78.92	78.91	78.93	Bedding plane	Interburden
156	19	258	79.29	79.27	79.30	Bedding plane	Interburden
157	17	256	79.31	79.30	79.33	Bedding plane	Interburden
158	10	250	79.51	79.51	79.52	Bedding plane	Interburden
159	8	273	80.15	80.15	80.16	Bedding plane	Interburden
160	7	278	80.17	80.16	80.17	Bedding plane	Interburden
161	8	263	80.24	80.24	80.25	Bedding plane	Interburden
162	11	268	80.30	80.29	80.31	Bedding plane	Interburden
163	6	271	80.60	80.59	80.60	Bedding plane	Interburden
164	8	314	81.80	81.80	81.81	Bedding plane	Interburden
165	2	47	81.90	81.89	81.90	Bedding plane	Interburden
166	3	89	81.91	81.91	81.91	Bedding plane	Interburden
167	77	125	83.20	82.98	83.42	Fracture plane - partially open	Interburden
168	13	227	83.79	83.78	83.81	Bedding plane	Interburden
169	12	221	83.85	83.84	83.86	Bedding plane	Interburden
170	35	282	84.29	84.25	84.32	Fracture plane - partially open	Interburden
171	11	260	85.02	85.01	85.03	Bedding plane	Interburden
172	12	259	85.04	85.03	85.05	Bedding plane	Interburden
173	9	273	85.13	85.13	85.14	Bedding plane	Interburden
174	16	222	85.24	85.22	85.25	Bedding plane	Interburden
175	7	293	85.32	85.32	85.33	Bedding plane	Interburden
176	10	313	86.28	86.28	86.29	Bedding plane	Interburden
177	11	295	86.30	86.30	86.31	Bedding plane	Interburden
178	12	298	86.32	86.31	86.33	Bedding plane	Interburden
179	25	239	86.67	86.65	86.69	Bedding plane	Interburden
180	26	239	86.69	86.67	86.71	Bedding plane	Interburden
181	11	260	87.34	87.33	87.35	Bedding plane	Interburden
182	10	250	87.39	87.38	87.40	Bedding plane	Interburden
183	11	254	87.41	87.40	87.41	Bedding plane	Interburden
184	10	264	87.43	87.42	87.44	Bedding plane	Interburden
185	9	262	87.45	87.44	87.46	Bedding plane	Interburden
186	17	248	87.91	87.90	87.93	Bedding plane	Interburden

187	16	250	87.93	87.92	87.94	Bedding plane	Interburden
188	22	248	88.26	88.24	88.28	Bedding plane	Interburden
189	16	231	88.35	88.34	88.37	Bedding plane	Interburden
190	20	259	88.96	88.95	88.98	Bedding plane	Interburden
191	18	263	89.00	88.99	89.02	Bedding plane	Interburden
192	16	269	89.02	89.01	89.03	Bedding plane	Interburden
193	16	264	89.05	89.04	89.06	Bedding plane	Interburden
194	14	243	89.50	89.49	89.51	Bedding plane	Interburden
195	17	247	89.67	89.66	89.68	Bedding plane	Interburden
196	12	219	89.99	89.98	90.00	Bedding plane	Interburden
197	15	220	90.00	89.98	90.01	Bedding plane	Interburden
198	6	224	92.11	92.10	92.12	Bedding plane	Interburden
199	4	200	92.12	92.11	92.13	Bedding plane	Interburden
200	7	236	92.15	92.14	92.15	Bedding plane	Interburden
201	8	223	92.16	92.15	92.16	Bedding plane	Interburden
202	13	212	92.17	92.16	92.18	Bedding plane	Interburden
203	18	196	92.45	92.43	92.47	Top of void	Interburden
FEATURE ID	**DIP (DEG)**	**AZIMUTH (DEG)**	**MIDPOINT (MBGL)**	**TOP (M)**	**BASE (M)**	**TYPE OF FEATURE**	**GENERALISED ROCK TYPE**

Figure 1 BH01 circular plan representation of interpreted features



The 173 identified sedimentary features are predominantly bedding planes that appear to range in dip from flat-lying to 40^0. Figures 2 and 3 show the distribution of the planes' dip angles and dip direction with depth.

Table 2 details the variation in the dip angle and dip direction data. Figure 4 shows the dip direction data in a rose diagram with the bedding planes' dip angle and dip direction data shown as histograms in Figures 5 and 6.

The 28 fractures are identified as open (7%), partially open (79%), discontinuous (7%) and closed (7%). The fracture dip angles range from 19 to 77^0.

Table 3 details the variation in the fractures' dip angle and dip direction data. Figure 7 shows the dip direction data in a rose diagram with the fractures' plane dip angle and dip direction data as histograms in Figures 8 and 9.

Figure 2 BH01 feature dip angle data distribution

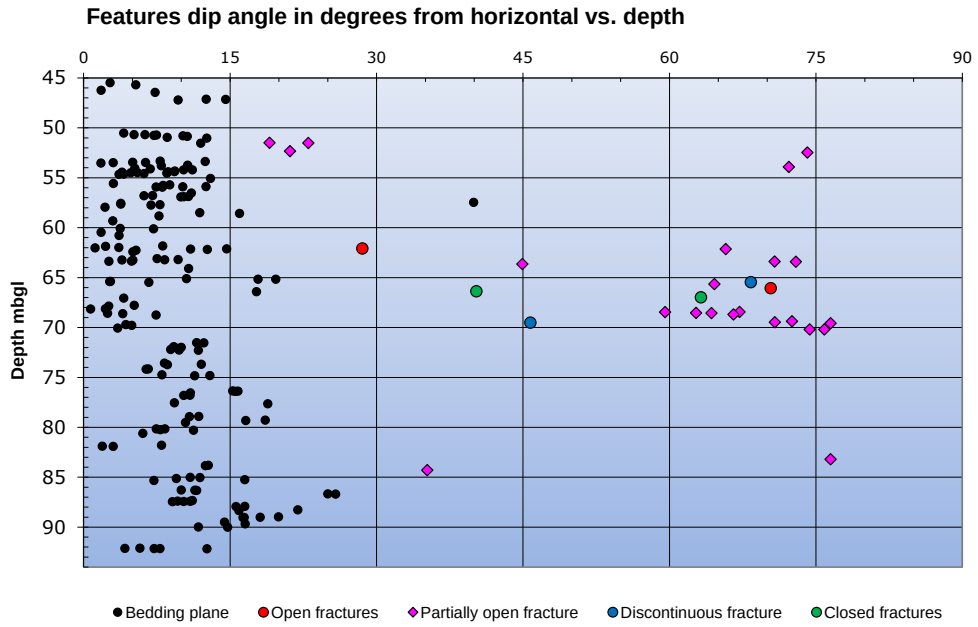


Figure 3 BH01 feature dip direction data distribution

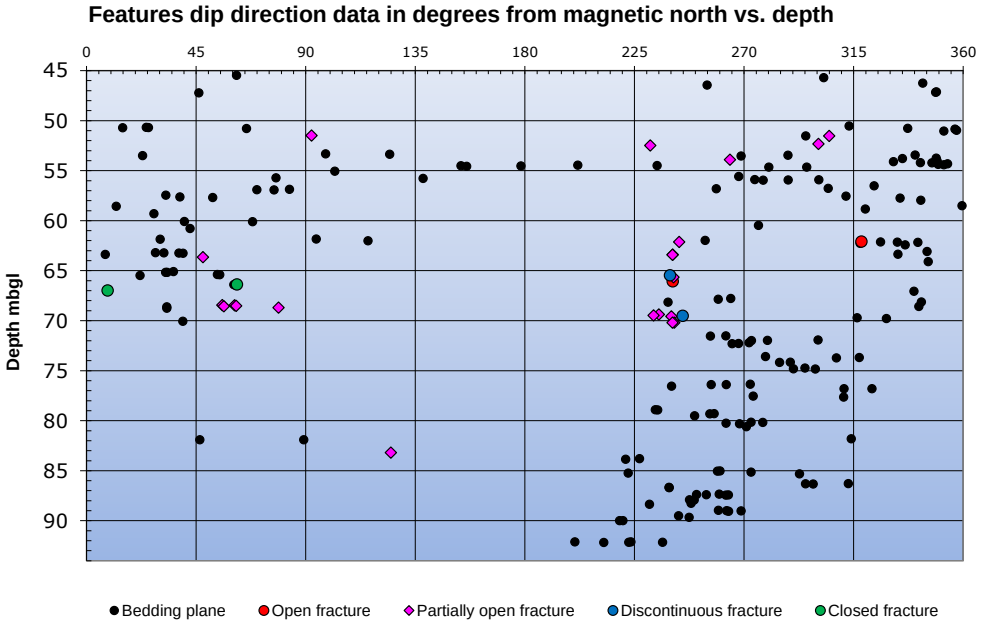


Table 2 BH01 bedding histogram data

Dip Distribution Total: 173			Orientation Distribution Total: 173		
Dip Range	Count	%	Bearing Range	Count	%
0 to 10	101	58.4	0 to 10	1	0.6
10 to 20	68	39.3	10 to 20	2	1.2
20 to 30	3	1.7	20 to 30	6	3.5
30 to 40	1	0.6	30 to 40	12	6.9
40 to 50	0	0.0	40 to 50	4	2.3
50 to 60	0	0.0	50 to 60	3	1.7
60 to 70	0	0.0	60 to 70	5	2.9
70 to 80	0	0.0	70 to 80	2	1.2
80 to 90	0	0.0	80 to 90	2	1.2
			90 to 100	2	1.2
			100 to 110	1	0.6
			110 to 120	1	0.6
			120 to 130	1	0.6
			130 to 140	1	0.6
			140 to 150	0	0.0
			150 to 160	2	1.2
			160 to 170	0	0.0
			170 to 180	1	0.6
			180 to 190	0	0.0
			190 to 200	0	0.0
			200 to 210	2	1.2
			210 to 220	2	1.2
			220 to 230	6	3.5
			230 to 240	8	4.6
			240 to 250	7	4.0
			250 to 260	13	7.5
			260 to 270	15	8.7
			270 to 280	13	7.5
			280 to 290	5	2.9
			290 to 300	8	4.6
			300 to 310	5	2.9
			310 to 320	10	5.8
			320 to 330	4	2.3
			330 to 340	8	4.6
			340 to 350	15	8.7
			350 to 360	6	3.5

Figure 5 BH01 bedding dip angles histogram

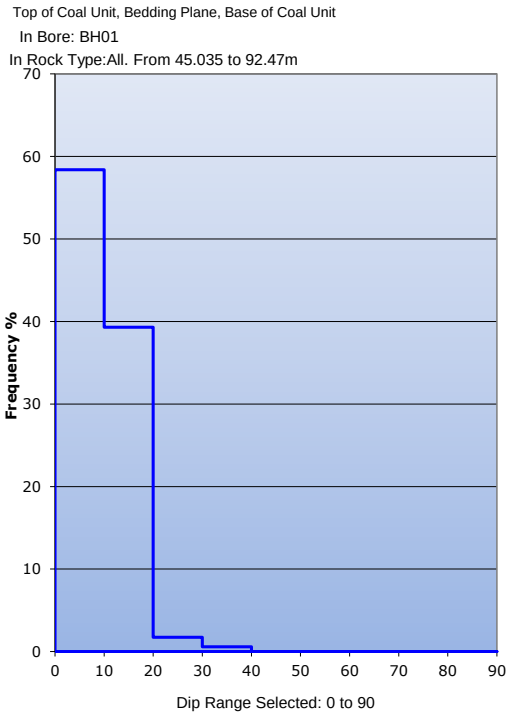


Figure 4 BH01 bedding dip direction data rose diagram

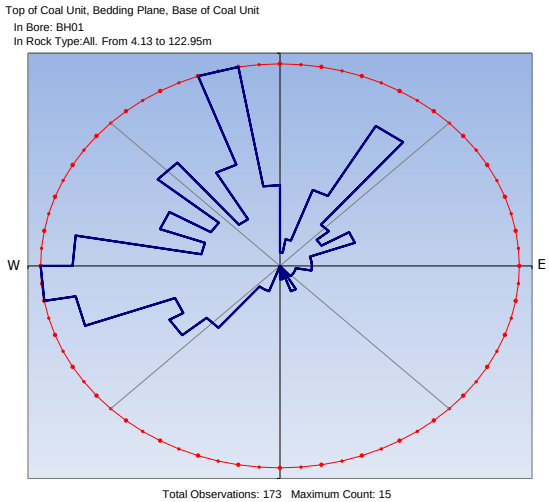


Figure 6 BH01 bedding dip directions histogram

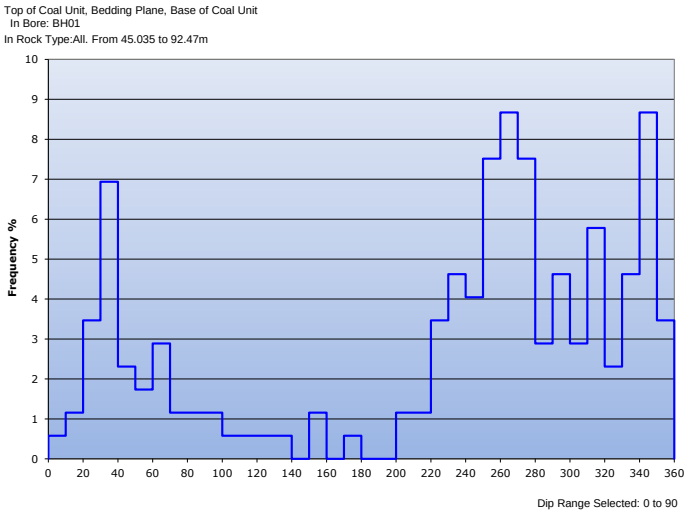


Table 3 BH01 fractures histogram data

Dip Distribution Total: 28			Orientation Distribution Total: 28		
Dip Range	Count	%	Bearing Range	Count	%
0 to 10	0	0.0	0 to 10	1	3.6
10 to 20	1	3.6	10 to 20	0	0.0
20 to 30	3	10.7	20 to 30	0	0.0
30 to 40	1	3.6	30 to 40	0	0.0
40 to 50	3	10.7	40 to 50	1	3.6
50 to 60	1	3.6	50 to 60	2	7.1
60 to 70	8	28.6	60 to 70	3	10.7
70 to 80	11	39.3	70 to 80	1	3.6
80 to 90	0	0.0	80 to 90	0	0.0
			90 to 100	1	3.6
			100 to 110	0	0.0
			110 to 120	0	0.0
			120 to 130	1	3.6
			130 to 140	0	0.0
			140 to 150	0	0.0
			150 to 160	0	0.0
			160 to 170	0	0.0
			170 to 180	0	0.0
			180 to 190	0	0.0
			190 to 200	0	0.0
			200 to 210	0	0.0
			210 to 220	0	0.0
			220 to 230	0	0.0
			230 to 240	4	14.3
			240 to 250	9	32.1
			250 to 260	0	0.0
			260 to 270	1	3.6
			270 to 280	0	0.0
			280 to 290	1	3.6
			290 to 300	0	0.0
			300 to 310	2	7.1
			310 to 320	1	3.6
			320 to 330	0	0.0
			330 to 340	0	0.0
			340 to 350	0	0.0
			350 to 360	0	0.0

Figure 8 BH01 fractures dip angles histogram

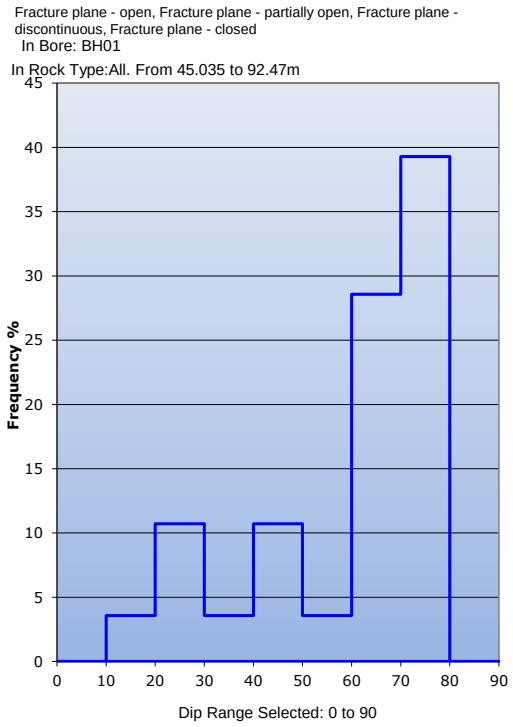


Figure 7 BH01 fractures dip direction data rose diagram

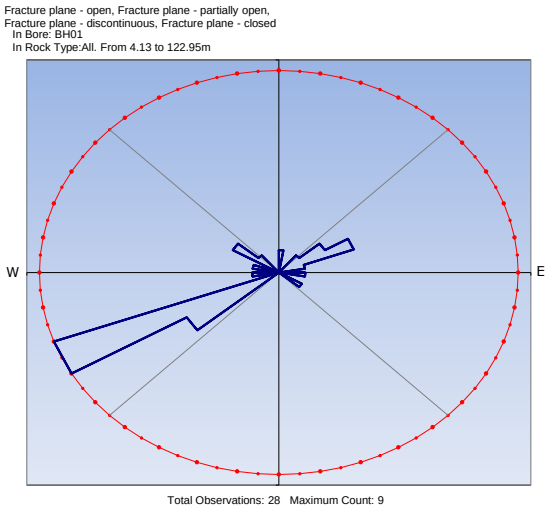
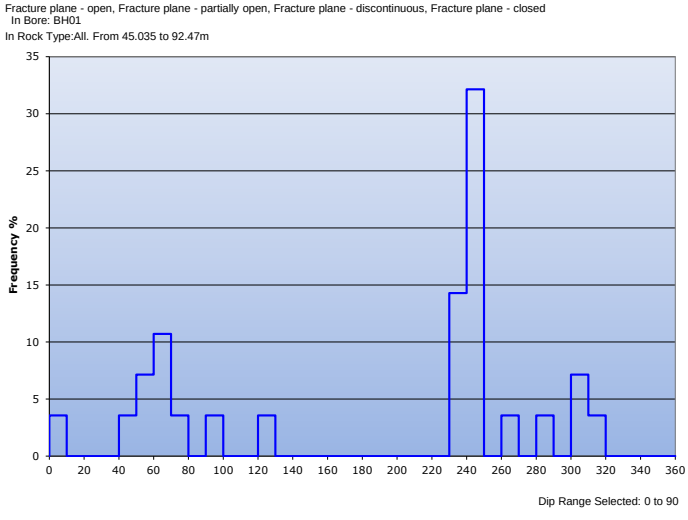


Figure 9 BH01 fractures dip directions histogram



Appendix 1

Appendix 1 ***1:20 Interpretation logs – 44.00 to 93.61 mbgl***

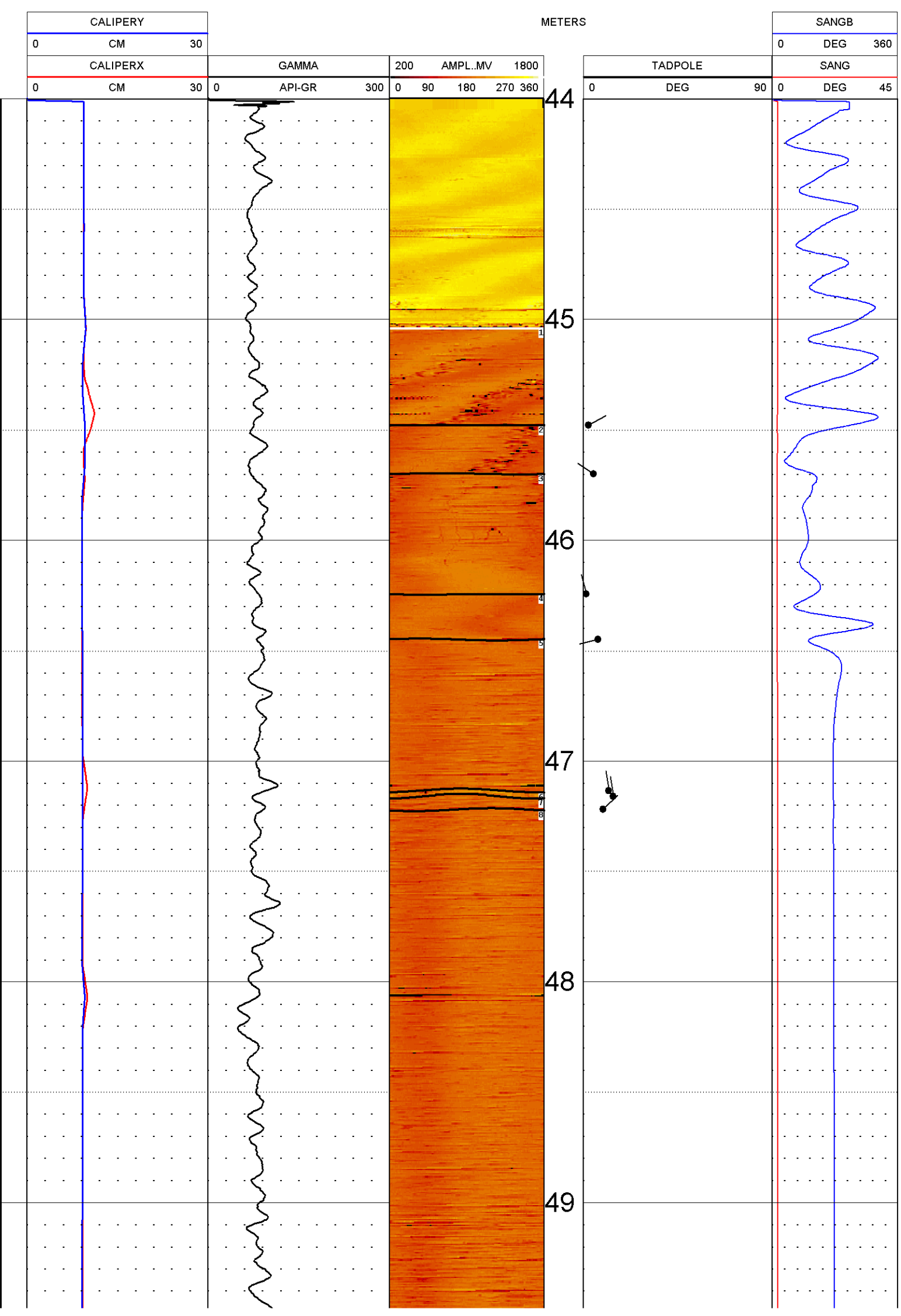


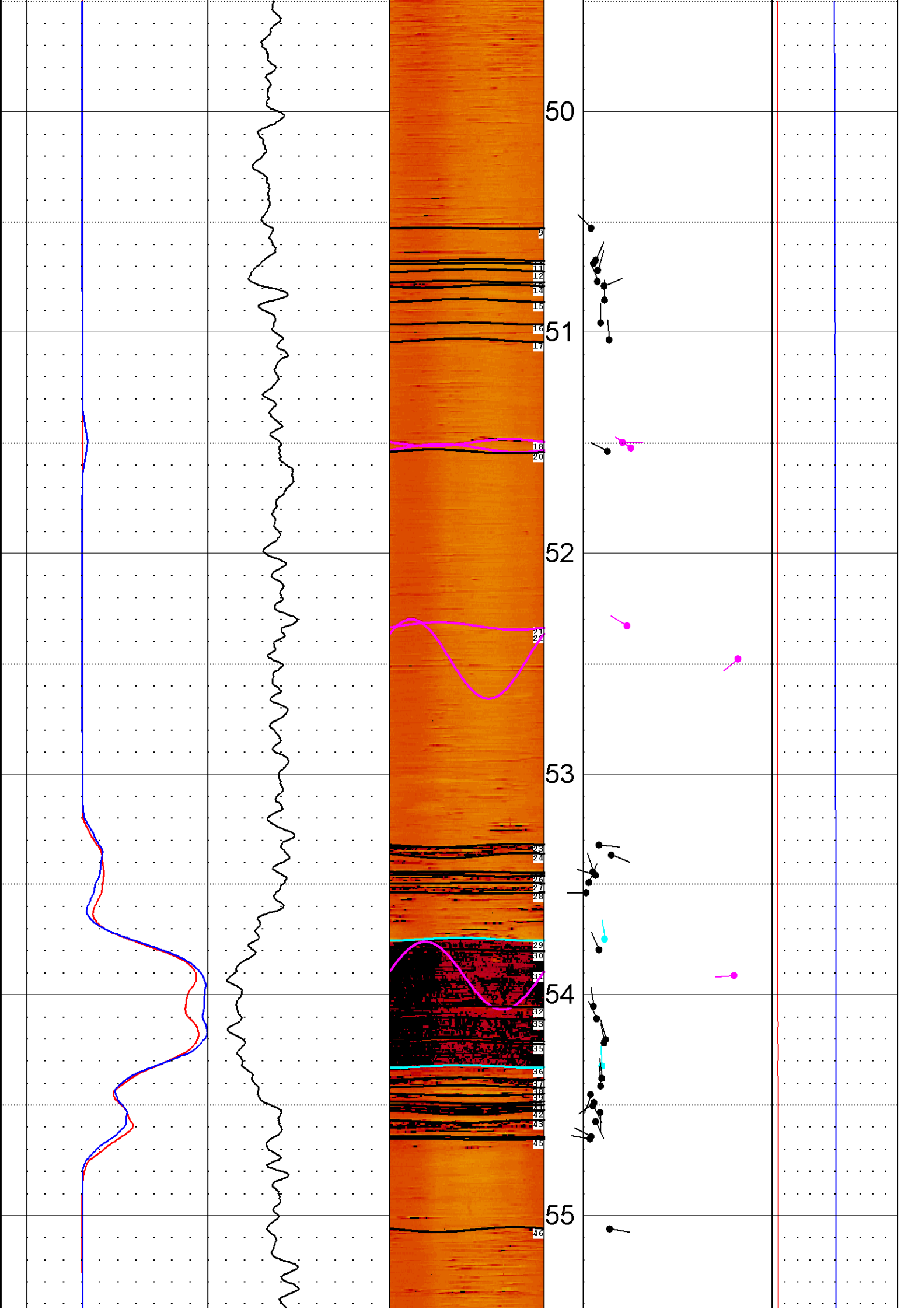
BH01 ATV 1:20

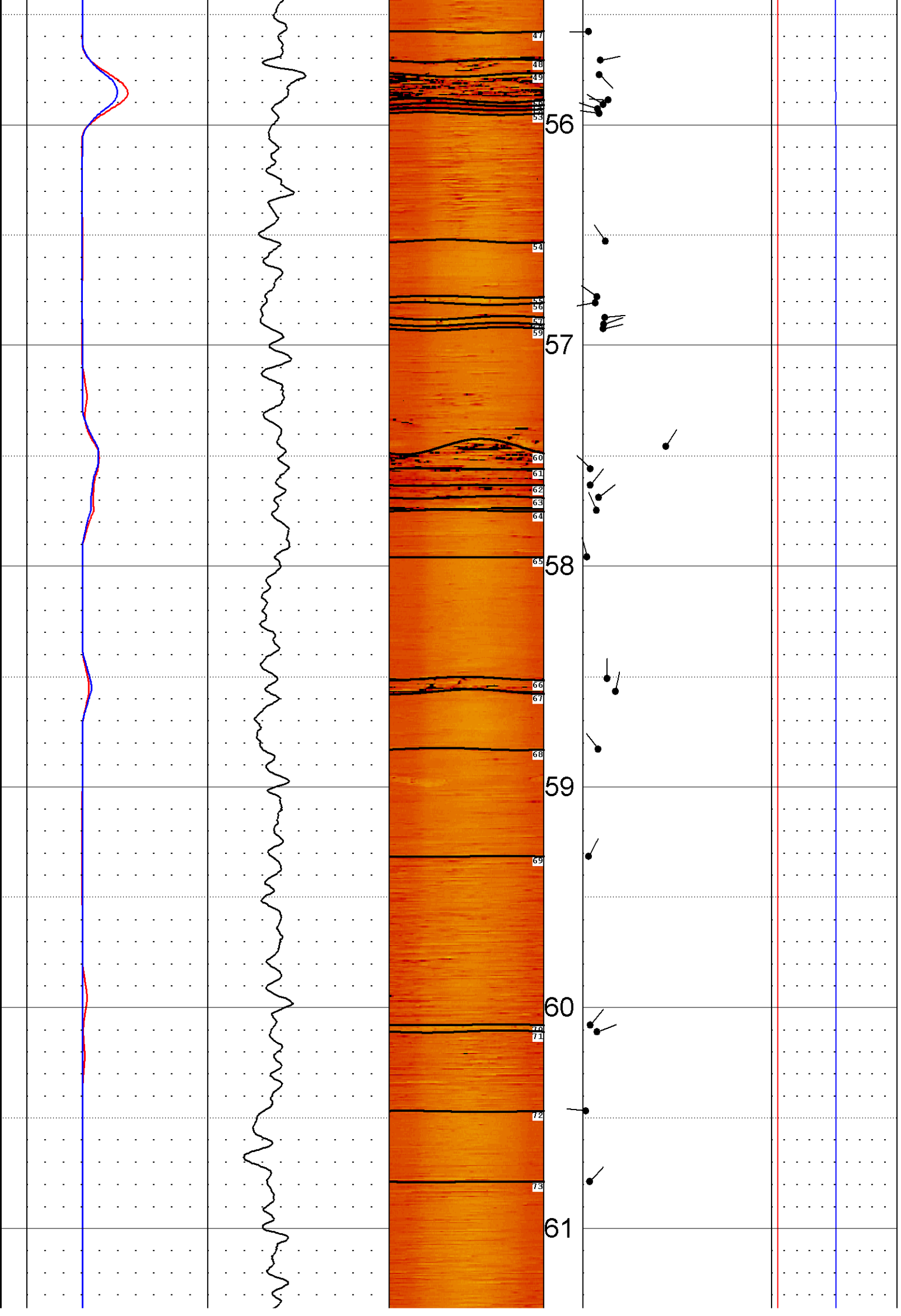
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COUNTY	:				ne		
LOCATION	:	NEWCASTLE					
SECTION	:	N/A	TOWNSHIP	: N/A		RANGE	: N/A
DATE	:	09/07/18	PERMANENT DATUM	:			
DEPTH DRILLER	:	102.1				KB	: N/A
LOG BOTTOM	:	93.610	LOG MEASURED FROM:	N/A		DF	: N/A
LOG TOP	:	44.000	DRL MEASURED FROM:	N/A		GL	: NA
CASING DIAMETER	:	10.	LOGGING UNIT	: T107			
CASING TYPE	:	STEEL	FIELD OFFICE	: RUTHERFORD			
CASING THICKNESS:		.5	RECORDED BY	: A DAVIS			
BIT SIZE	:	9.6	BOREHOLE FLUID	: 0		FILE	: PROCESSED
MAGNETIC DECL.	:	0	RM	: N/A		TYPE	: 9804A
MATRIX DENSITY	:	2.65	RM TEMPERATURE	: N/A		LGDATE	: 09/07/18
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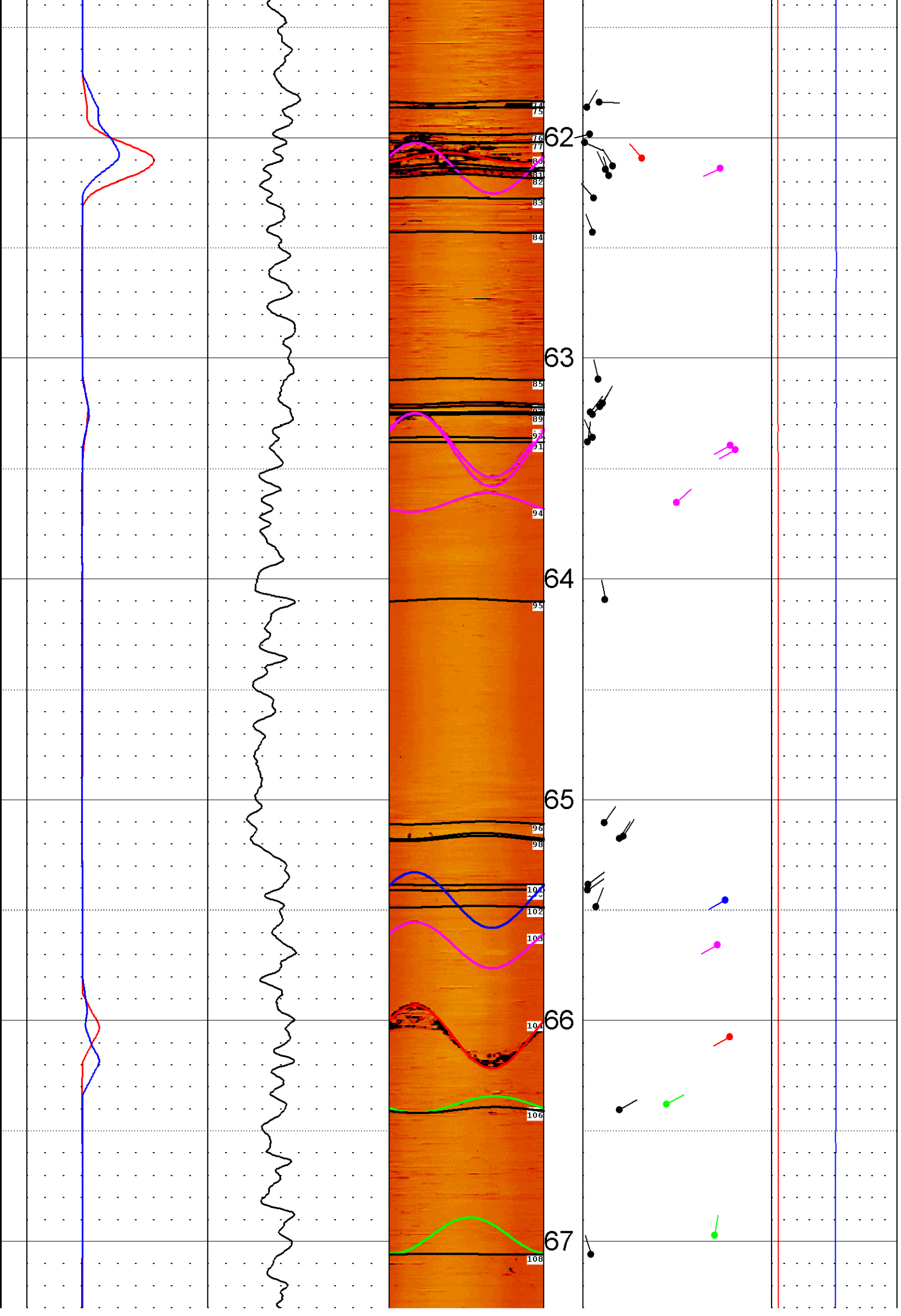
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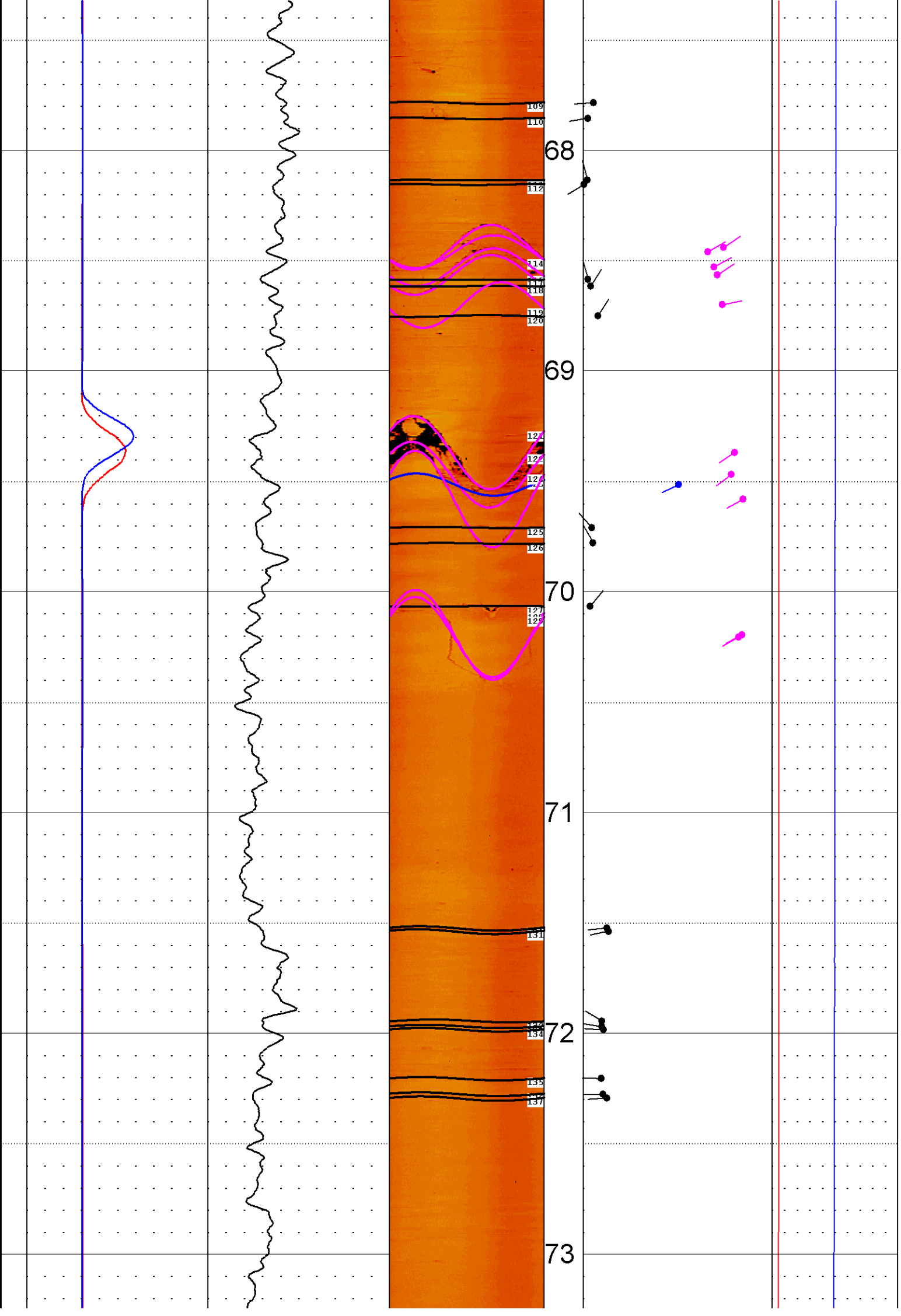
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

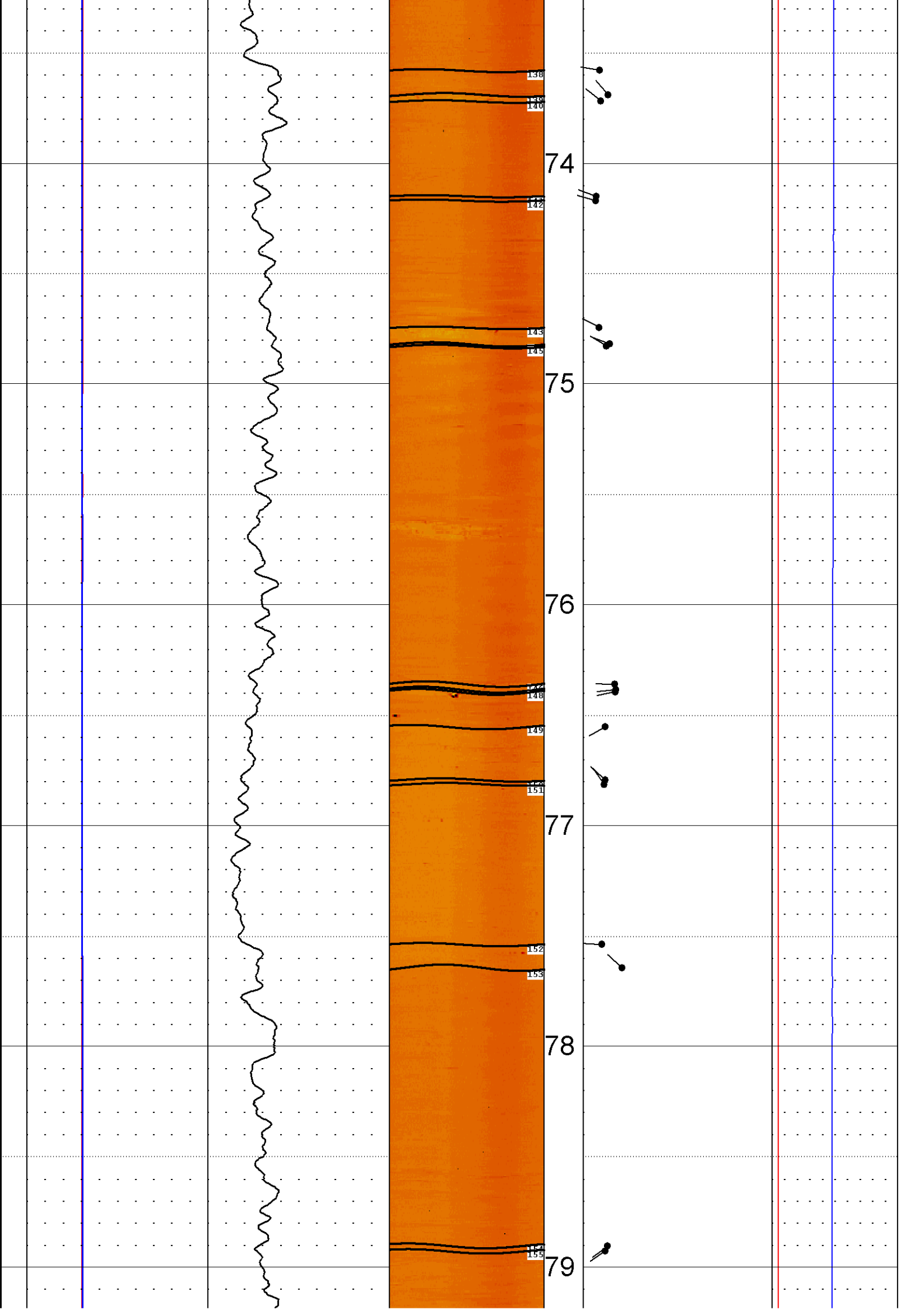

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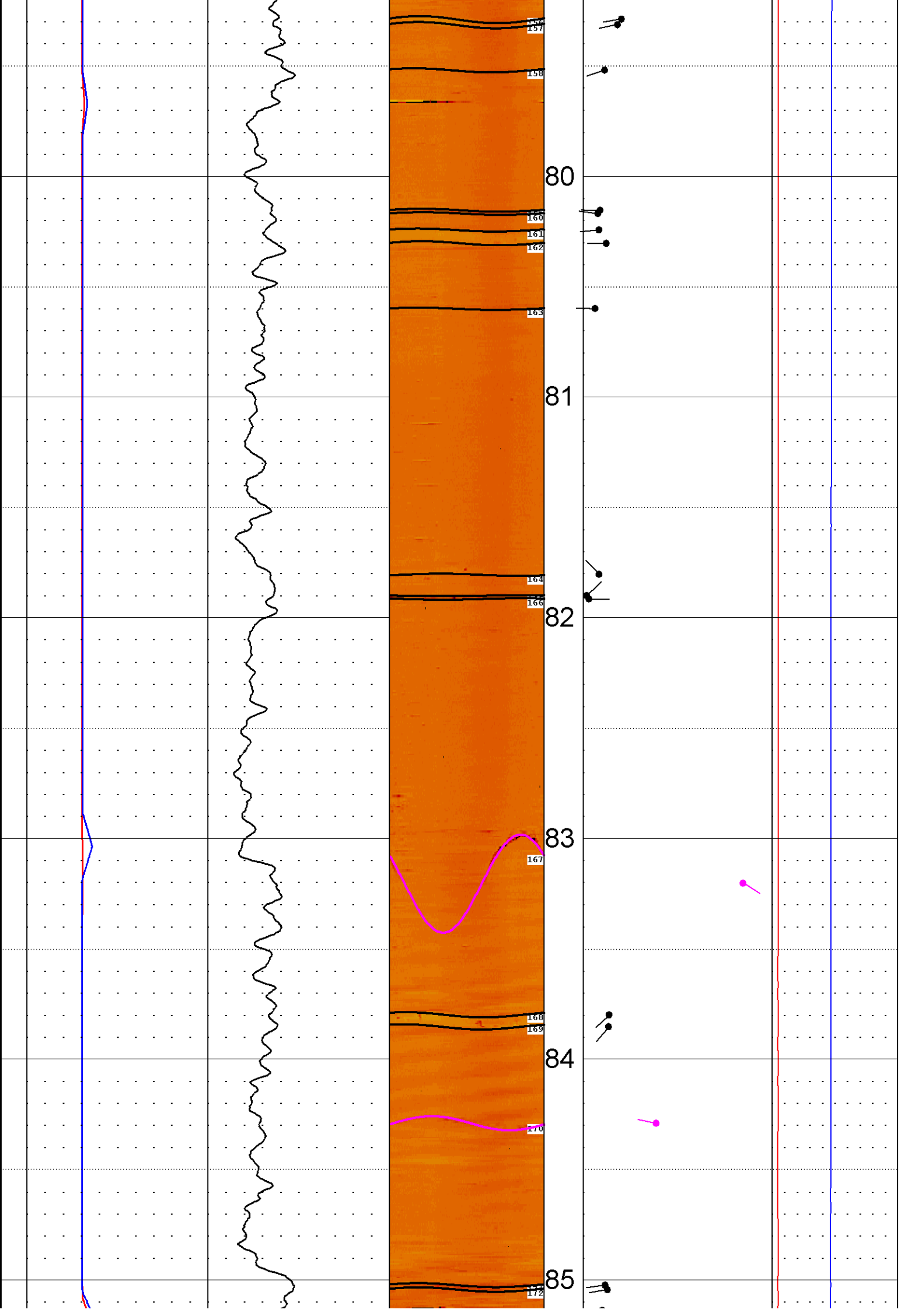

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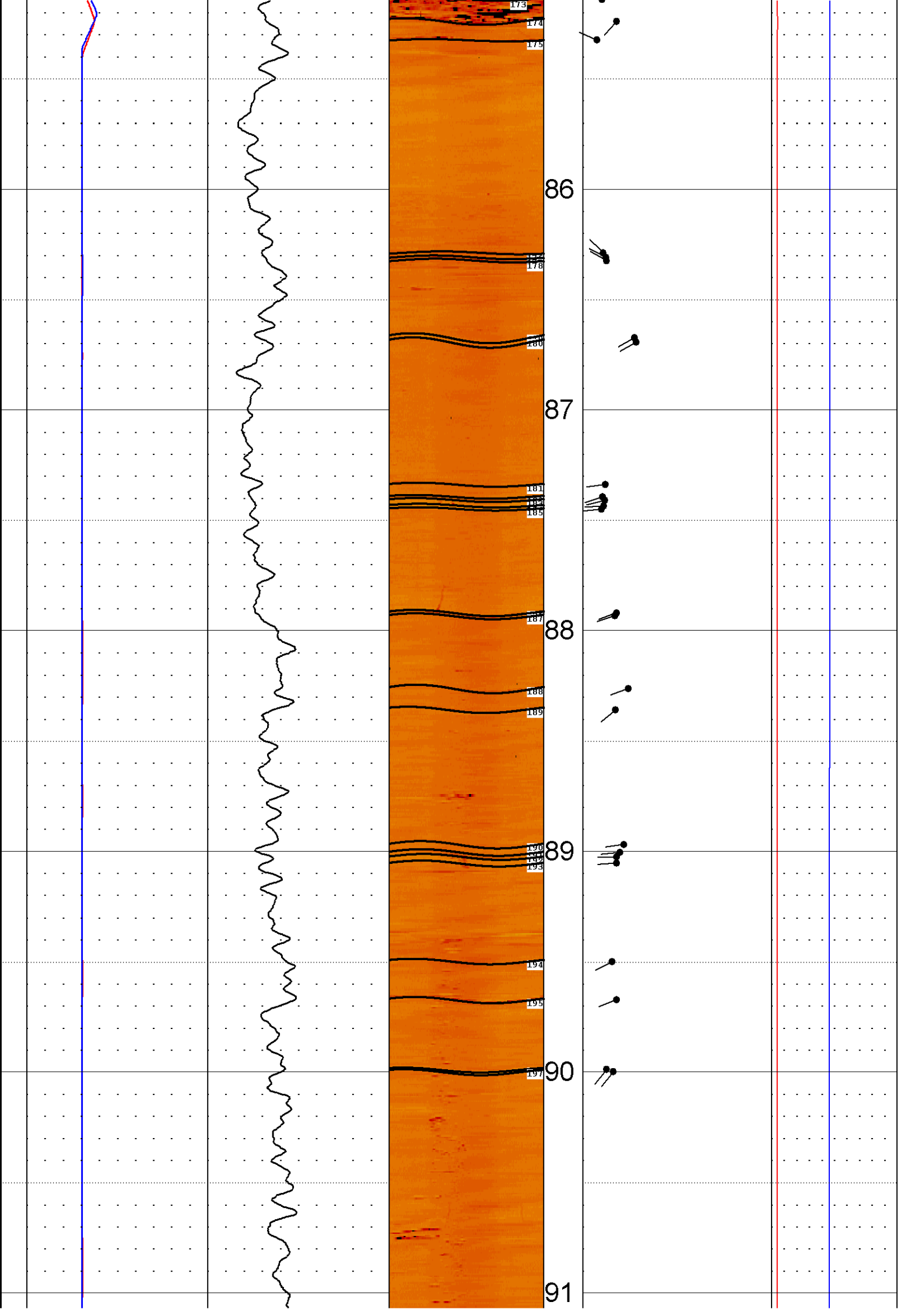

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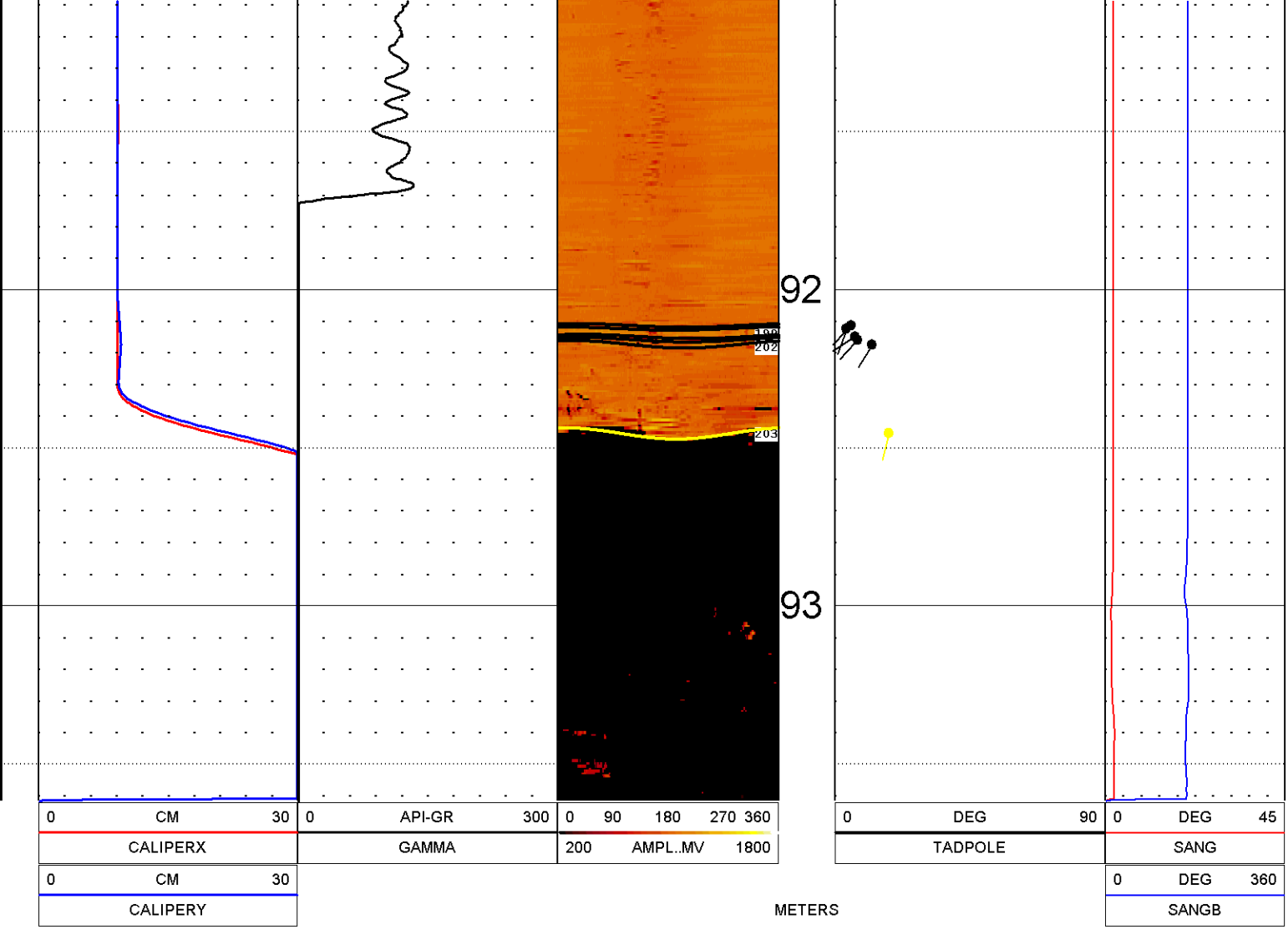

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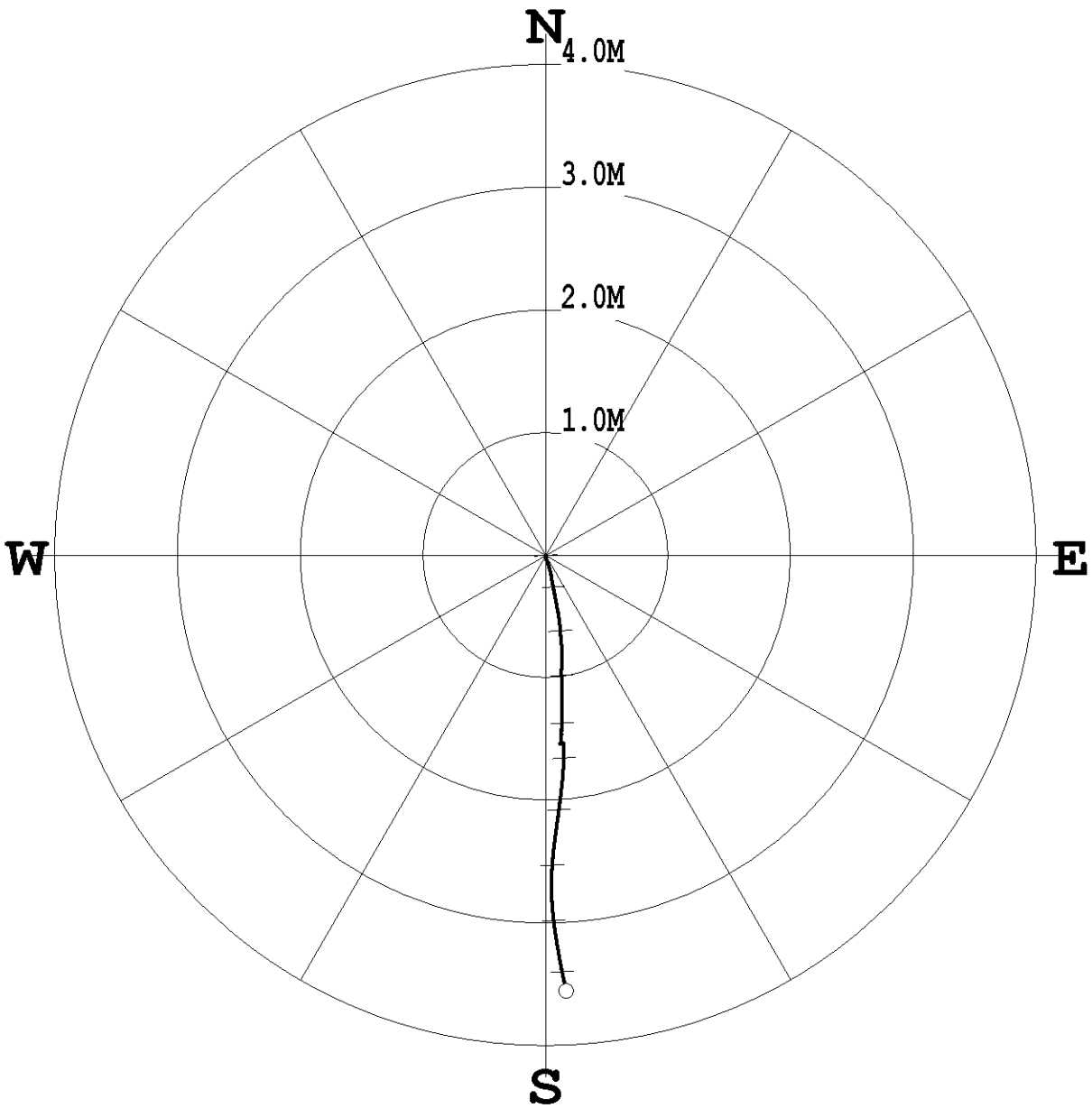

92
93
202
203
0 CM 30
CALIPERX
0 API-GR 300
GAMMA
0 90 180 270 360
200 AMPL..MV 1800
0 DEG 90
TADPOLE
0 DEG 45
SANG
0 CM 30
CALIPERY
METERS
0 DEG 360
SANGB

PLAN VIEW
COMPU-LOG DEVIATION

CLIENT: COFFEY GEOTECH
LOCATION: LINGARD
HOLE ID: BOREHOLE01#2 TELEVIEWER
DATE OF LOG: 09/14/18
PROBE: 9804A 4402

MAG DECL: 0.0

SCALE: 1 M/CM
TRUE DEPTH: 94.18 M
AZIMUTH: 177.3
DISTANCE: 3.6 M
+ = 10 M INCR
○ = BOTTOM OF HOLE



* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : COFFEY GEOTECH HOLE ID. : BOREHOLE01#2
FIELD OFFICE : RUTHERFORD DATE OF LOG : 09/14/18
DATA FROM : N/A PROBE : 9804A , 4402
MAG. DECL. : 0.000 DEPTH UNITS : METERS
LOG: BOREHOLE01#2TELEVIEWER_09-14-18_13-08_9804A_005_0.00_94.25_DEVI.log

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
0.00	-0.00	-0.00	0.00	0.0	177.5	0.3	177.5
10.00	10.00	-0.26	0.06	0.3	166.8	2.1	167.9
20.00	19.99	-0.61	0.11	0.6	169.4	1.8	180.2
30.00	29.98	-0.98	0.13	1.0	172.5	2.6	175.0
40.00	39.98	-1.37	0.13	1.4	174.5	2.2	181.8
50.00	49.97	-1.65	0.15	1.7	174.9	2.3	181.3
60.00	59.96	-2.07	0.11	2.1	177.0	2.6	187.9
70.00	69.95	-2.52	0.05	2.5	178.8	2.7	184.2
80.00	79.94	-2.97	0.06	3.0	178.8	2.5	173.8
90.00	89.93	-3.39	0.13	3.4	177.8	2.3	168.6
94.25	94.17	-3.55	0.17	3.6	177.3	2.5	165.4



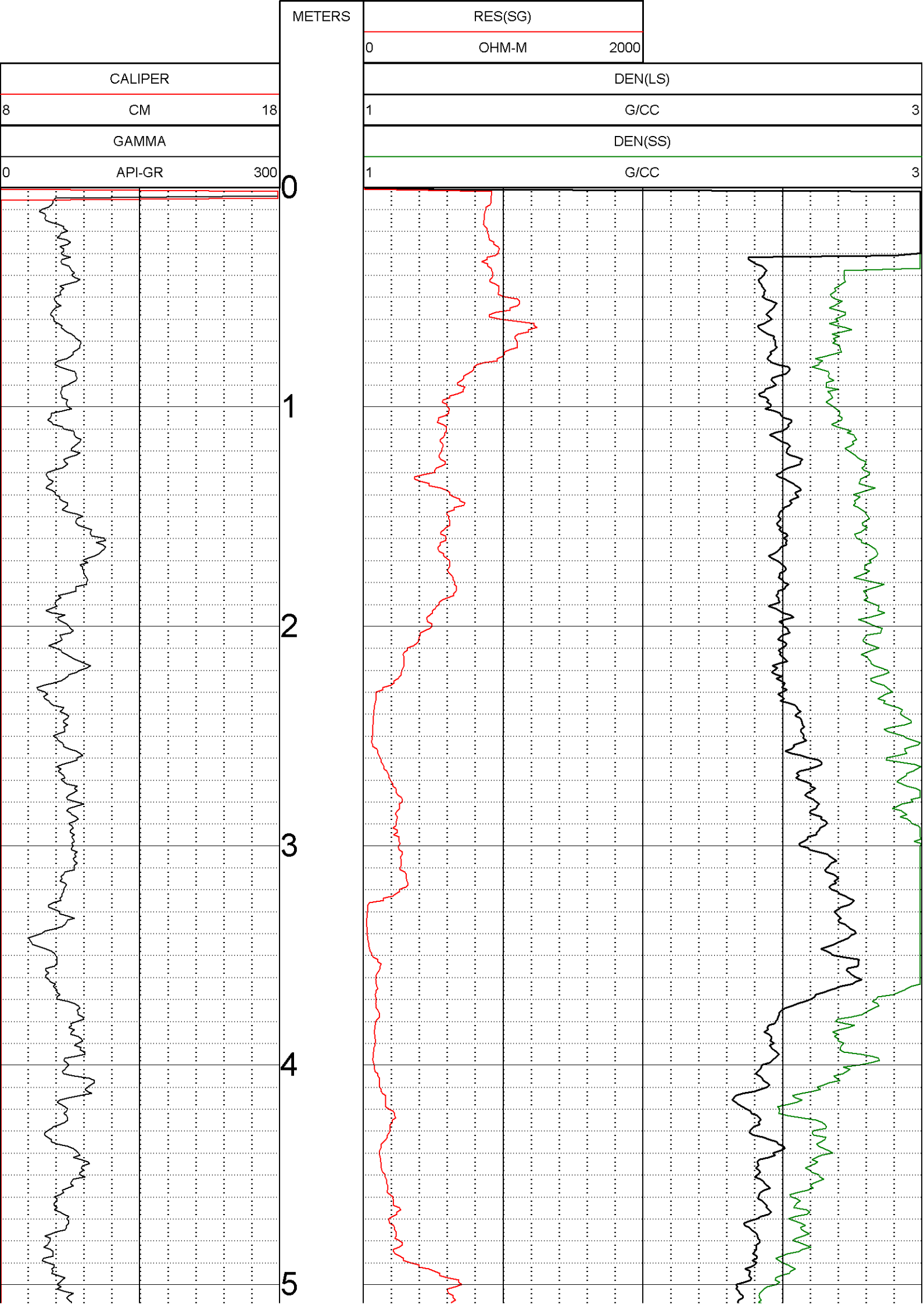
BH01DENSITY_C 1 20

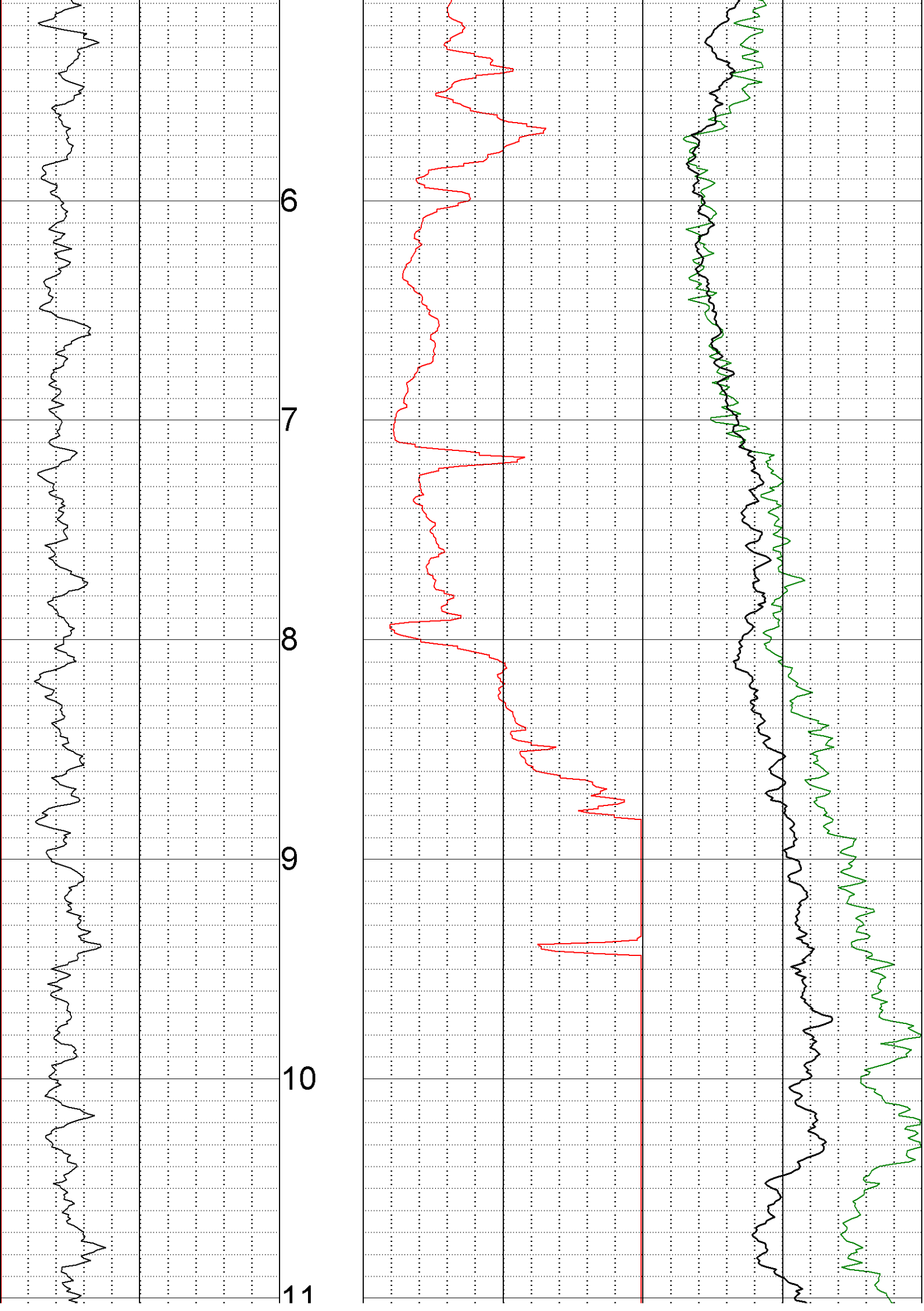
COMPANY	:	COFFEY GEOTECH					
WELL	:	BH01DENSITY_C 1 20					
LOCATION/FIELD	:	NBN DEV					
COUNTY	:						
LOCATION	:	NEWCASTLE					
SECTION	:	N/A	TOWNSHIP	:	N/A	RANGE	: N/A
DATE	:	09/07/18	PERMANENT DATUM	:	-1.2		
DEPTH DRILLER	:	102.1				KB	: N/A
LOG BOTTOM	:	100.91	LOG MEASURED FROM:		N/A	DF	: N/A
LOG TOP	:	0.00	DRL MEASURED FROM:		N/A	GL	: NA
CASING DIAMETER	:	10.	LOGGING UNIT	:	T107		
CASING TYPE	:	STEEL	FIELD OFFICE	:	RUTHERFORD		
CASING THICKNESS:		.5	RECORDED BY	:	A DAVIS		
BIT SIZE	:	9.60	BOREHOLE FLUID	:	0	FILE	: PROCESSED
MAGNETIC DECL.	:	0	RM	:	N/A	TYPE	: 9239B
MATRIX DENSITY	:	2.65	RM TEMPERATURE	:	N/A	LGDATE	: 09/07/18
NEUTRON MATRIX	:	SANDSTONE	MATRIX DELTA T	:	177	LGTIME	: 13:46:
						THRESH:	99999

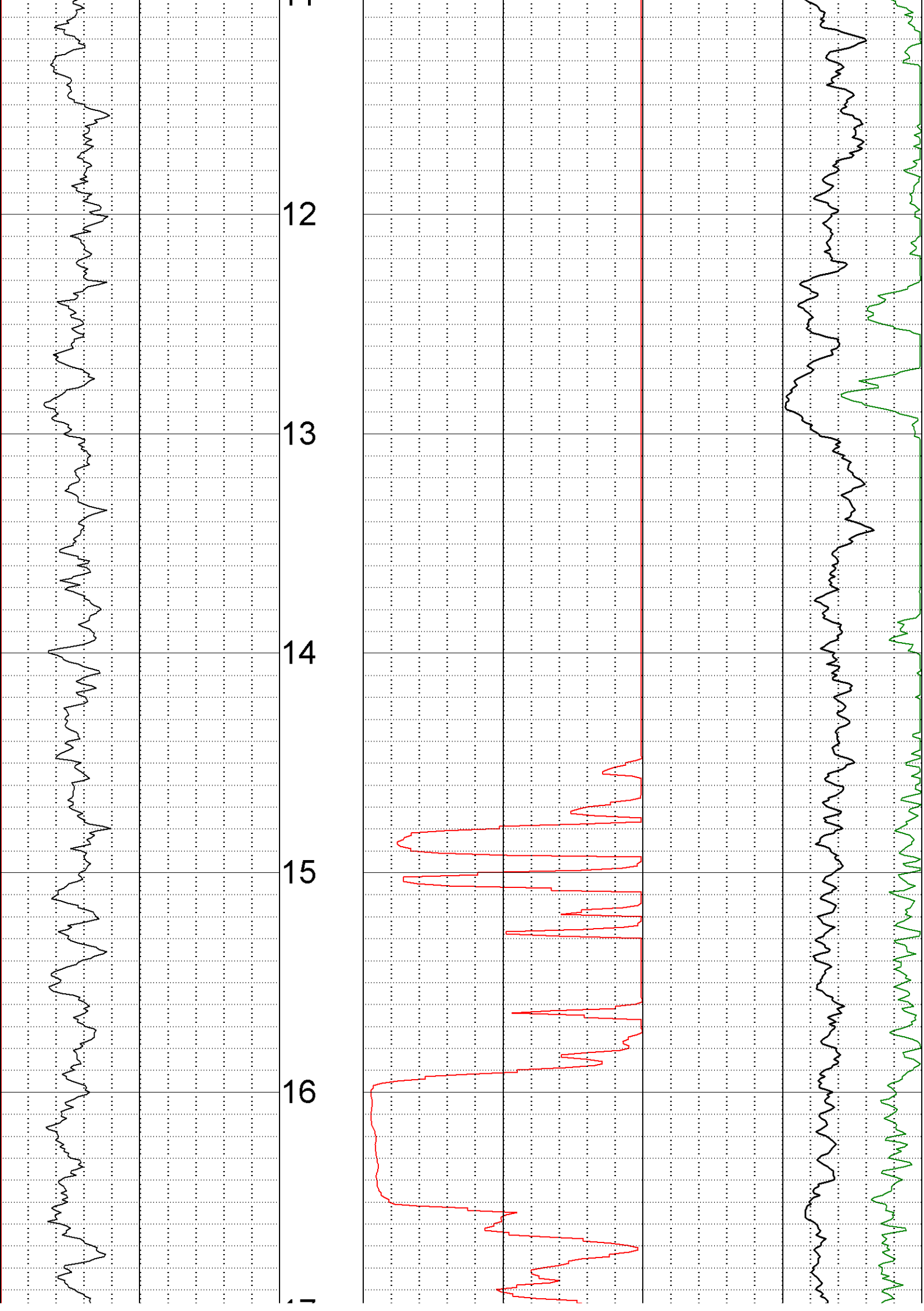
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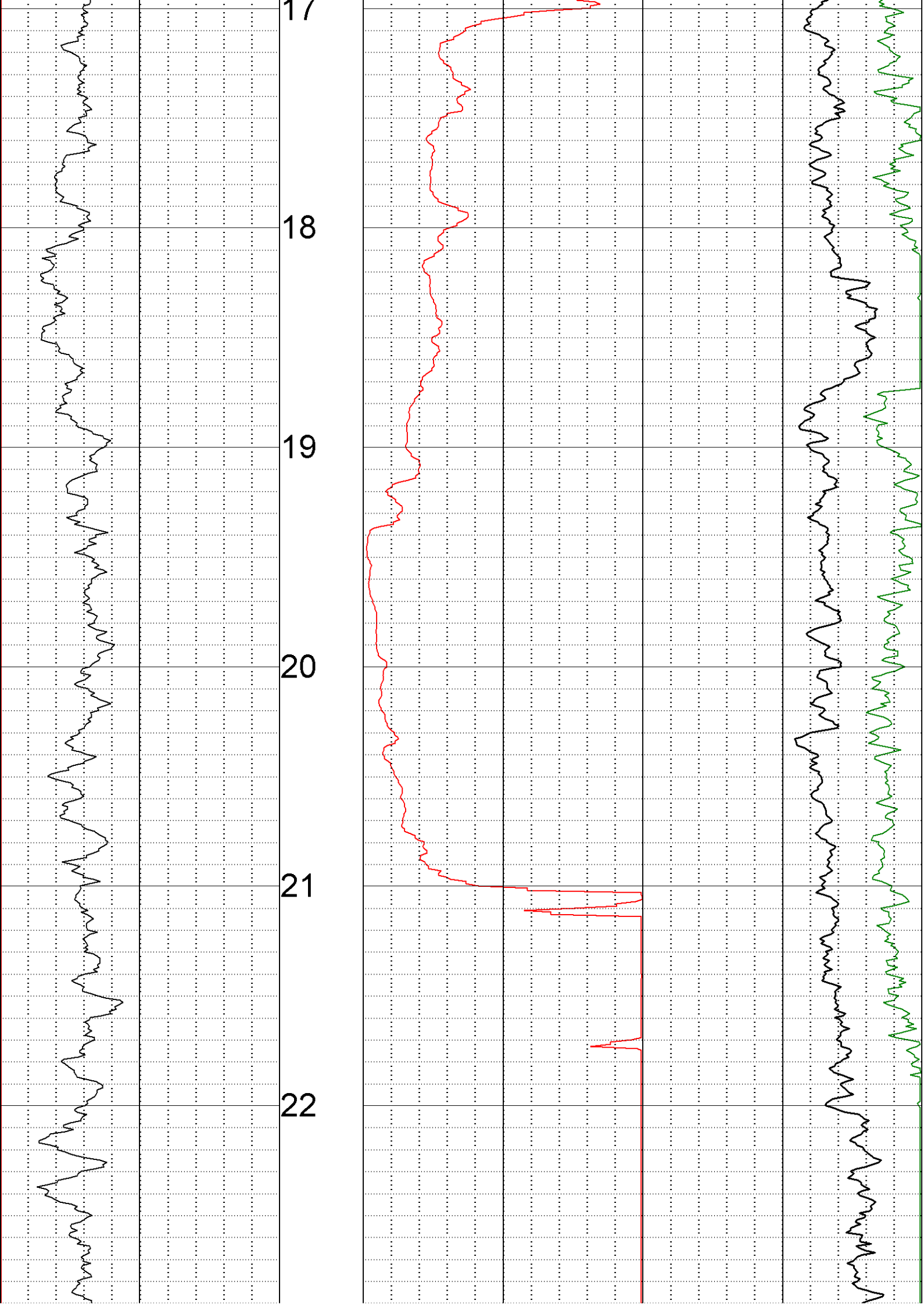
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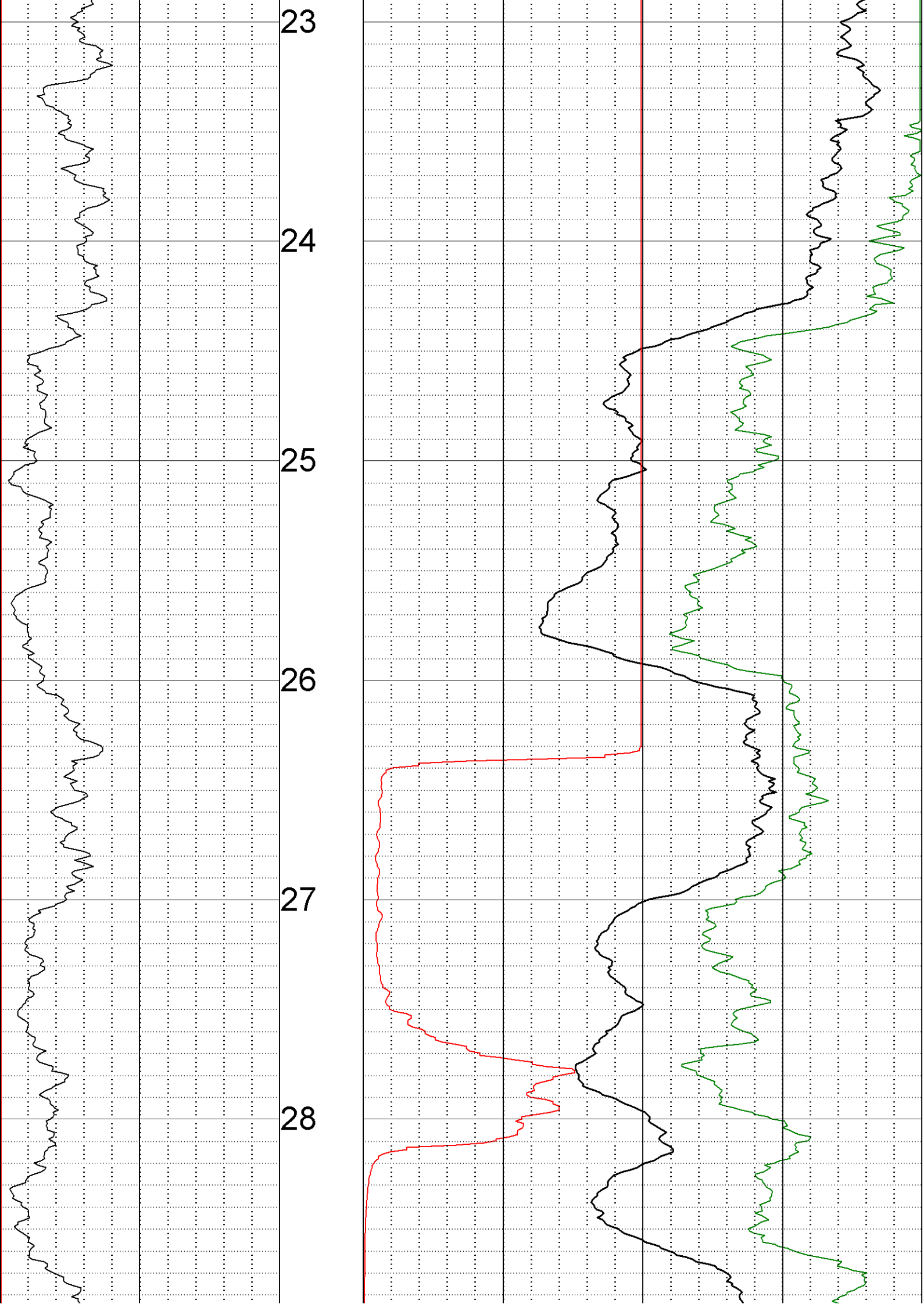
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

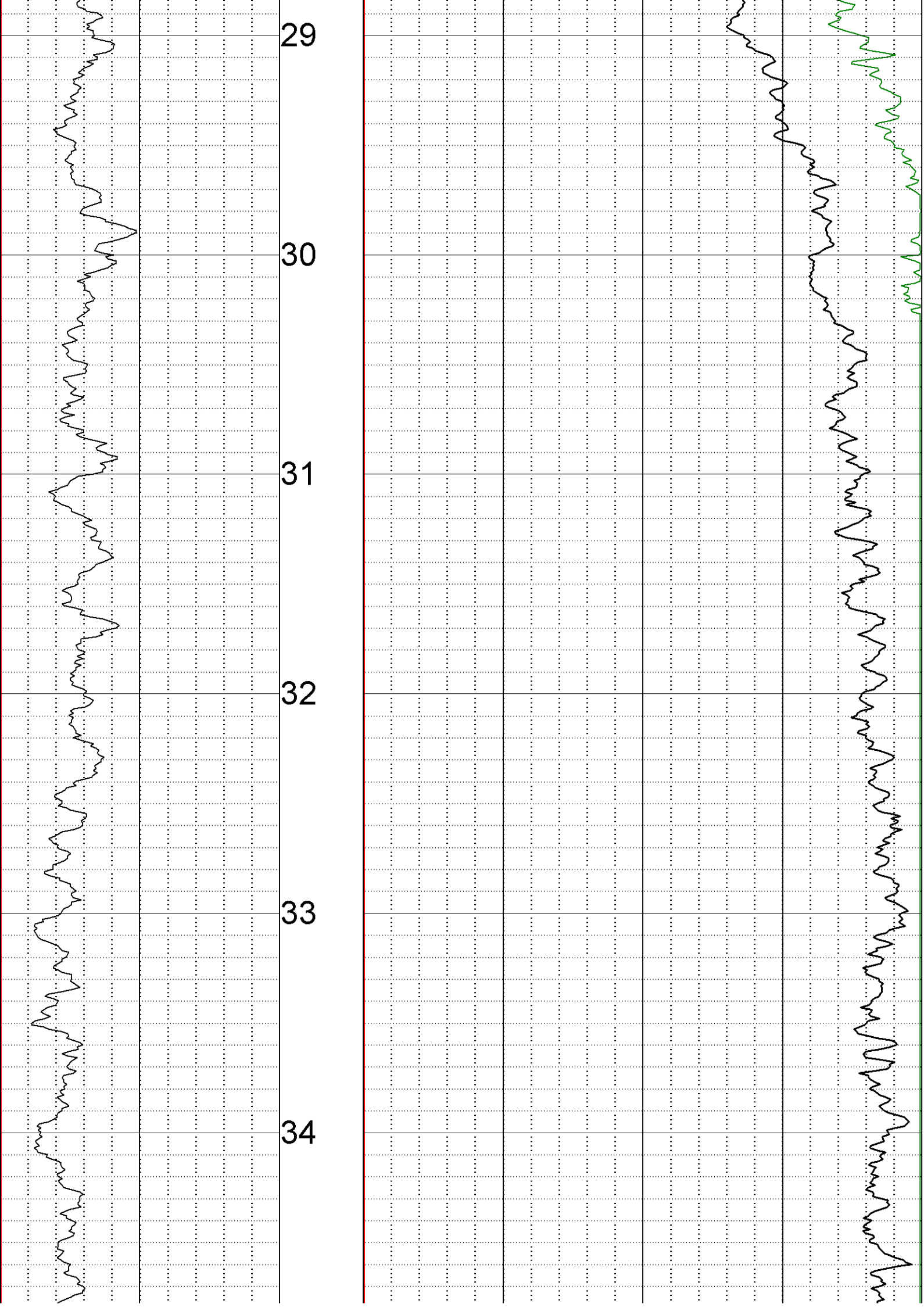

METERS
RES(SG)
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OHM-M
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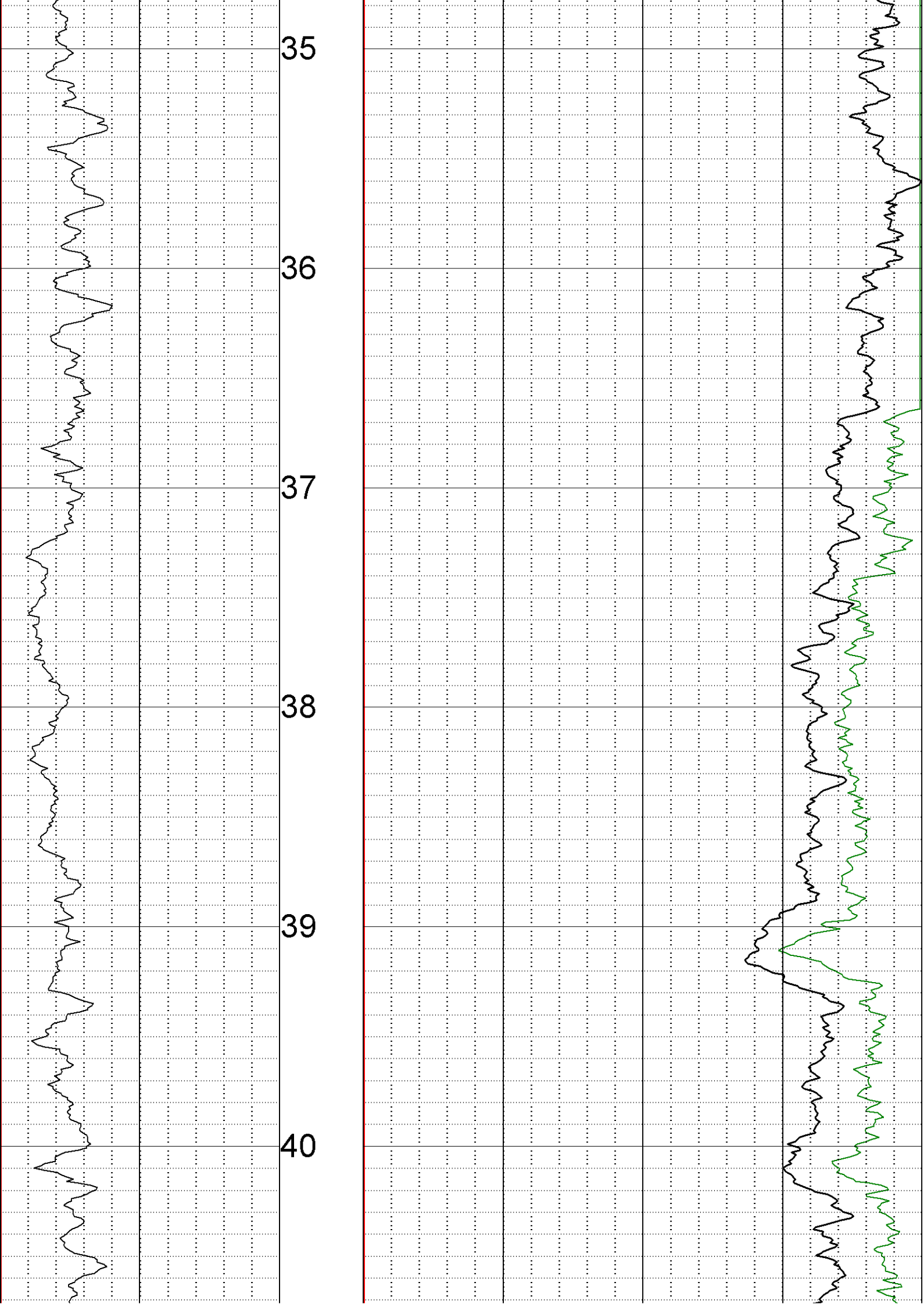

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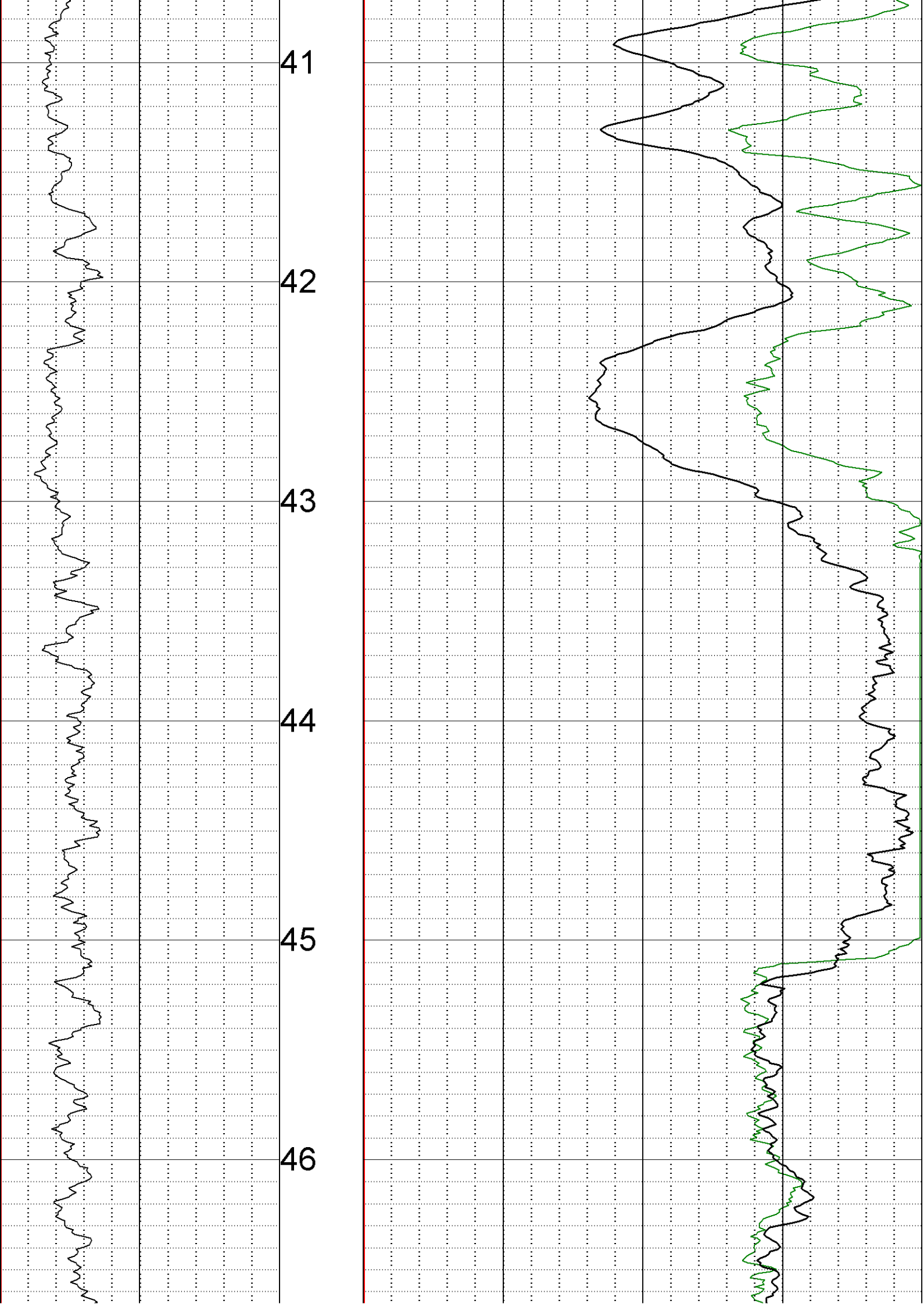

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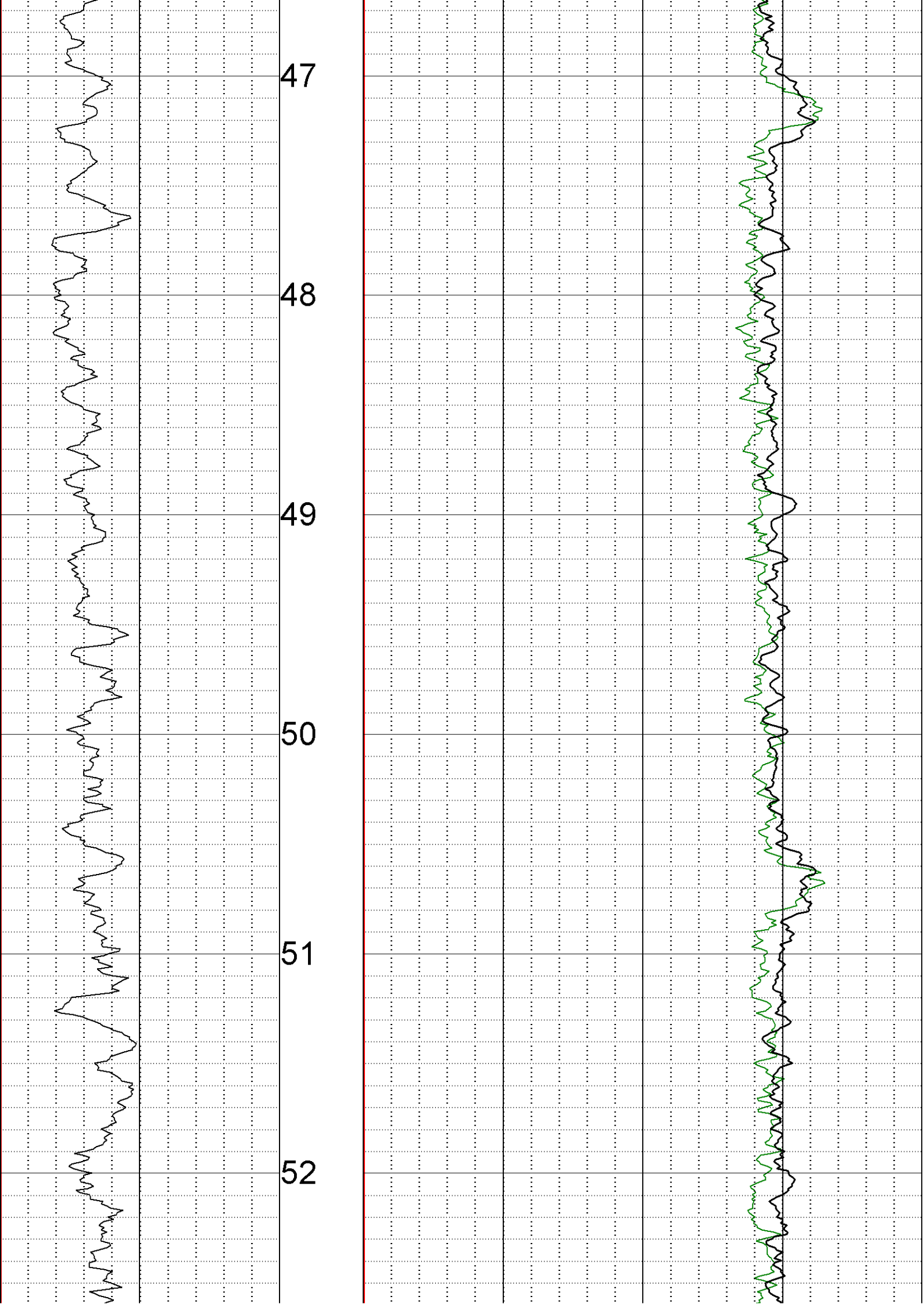

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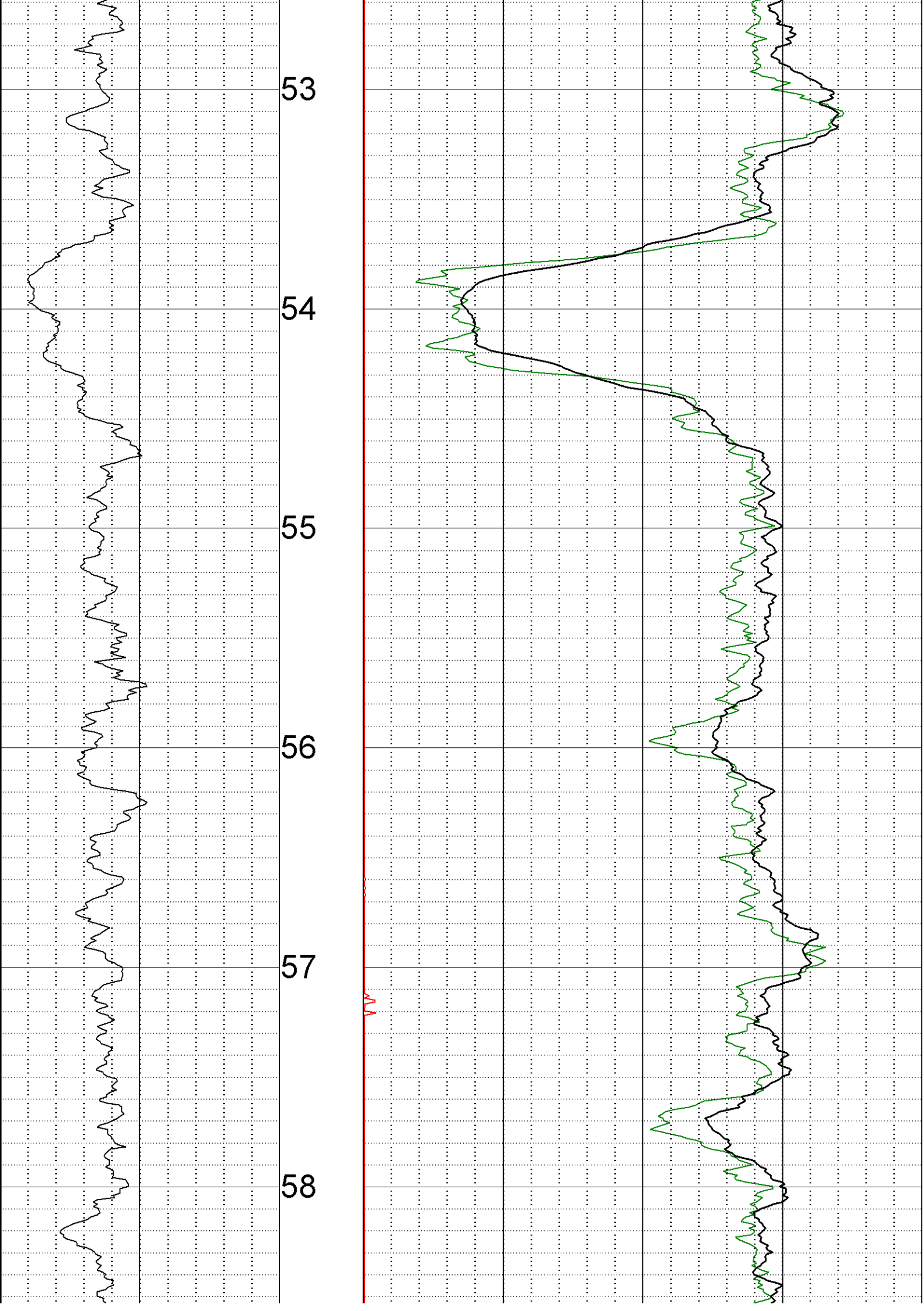

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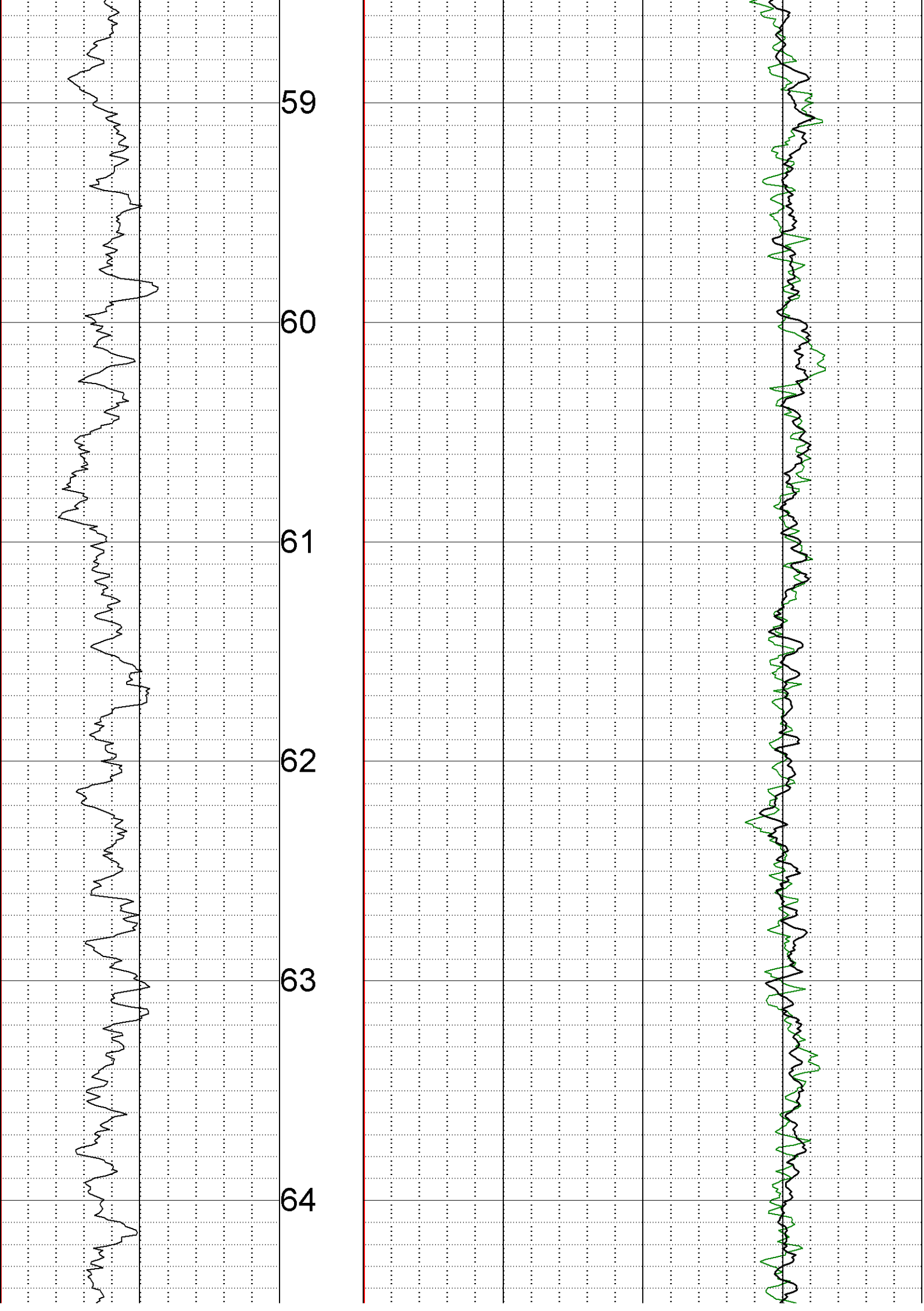

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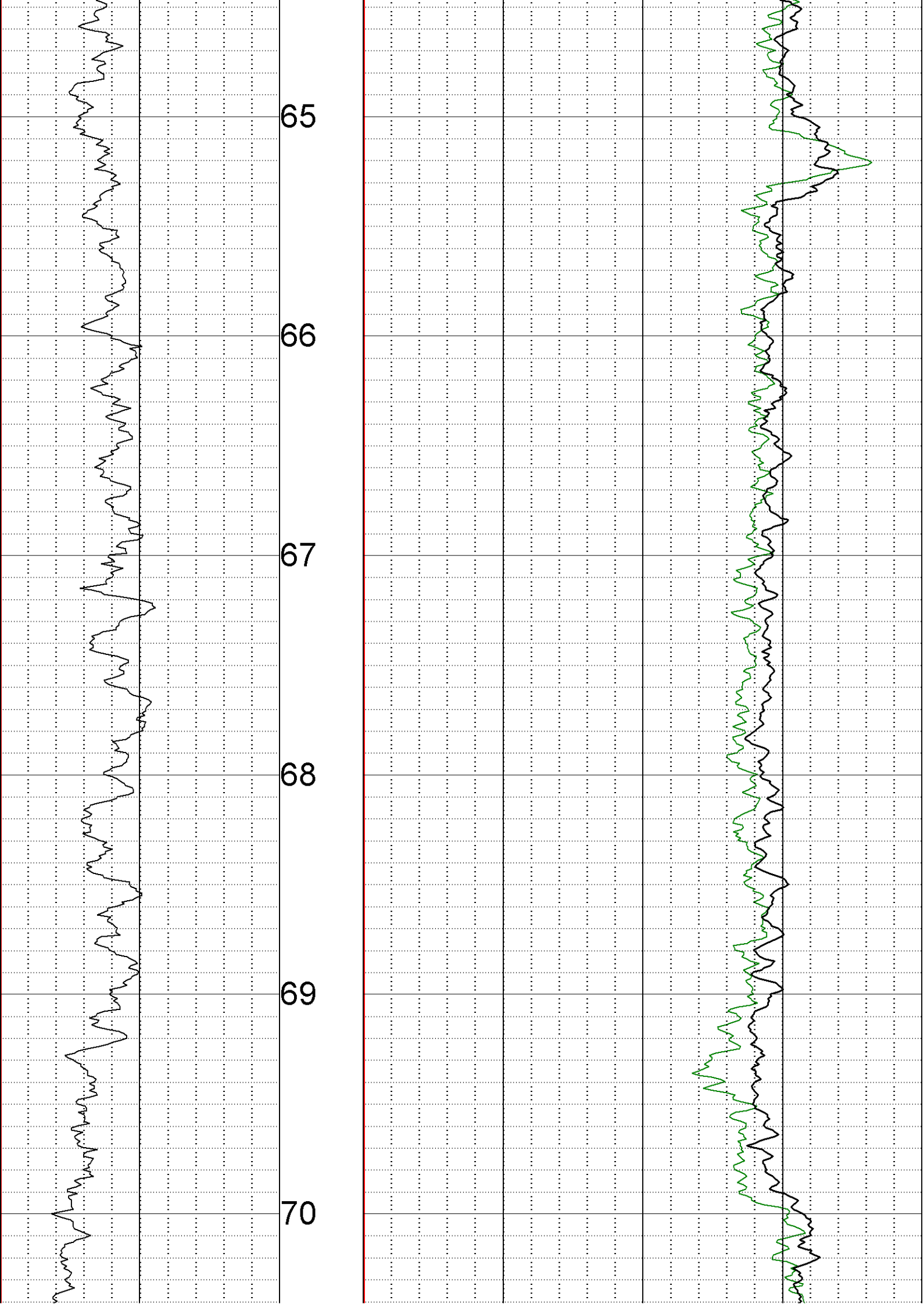

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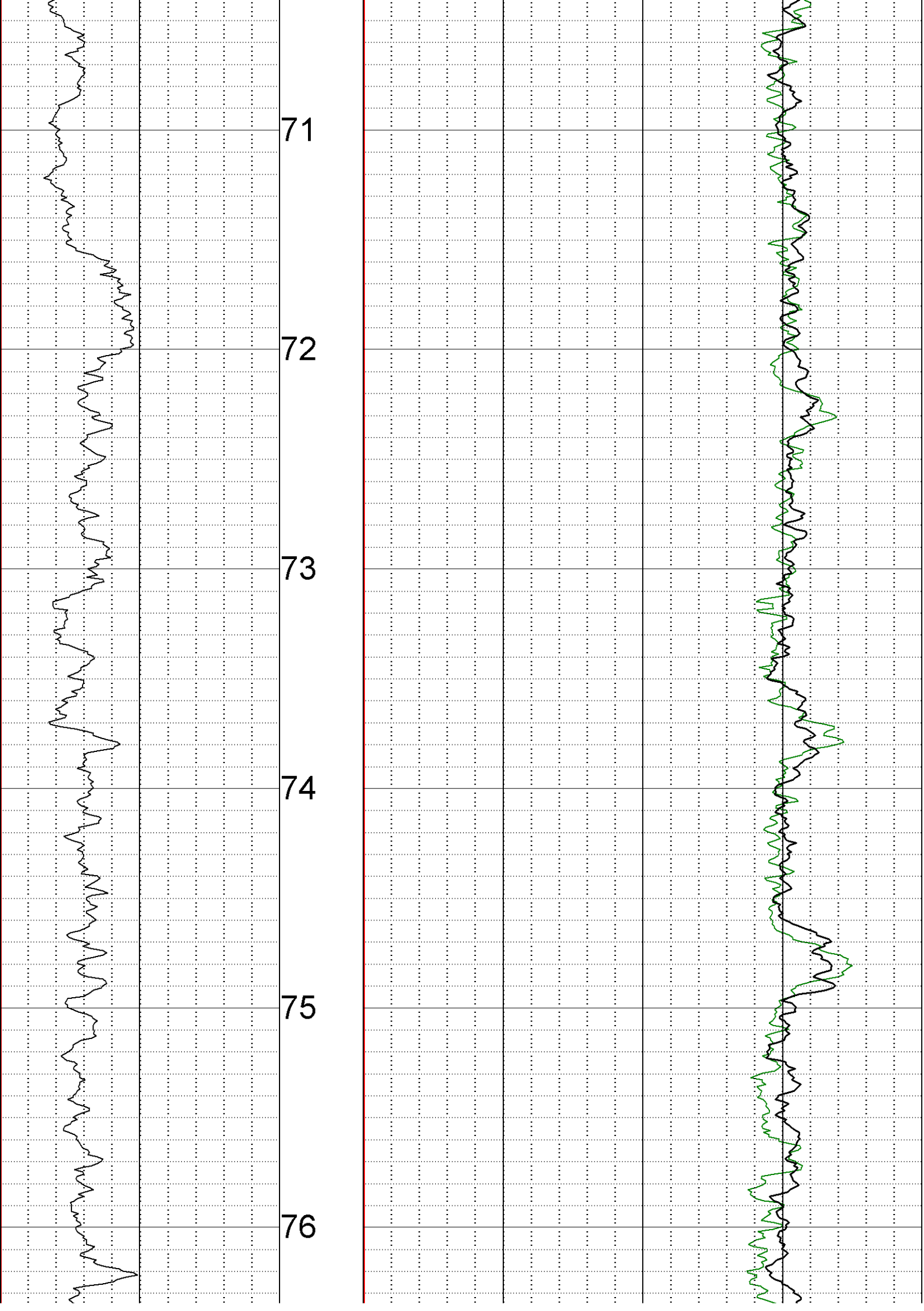

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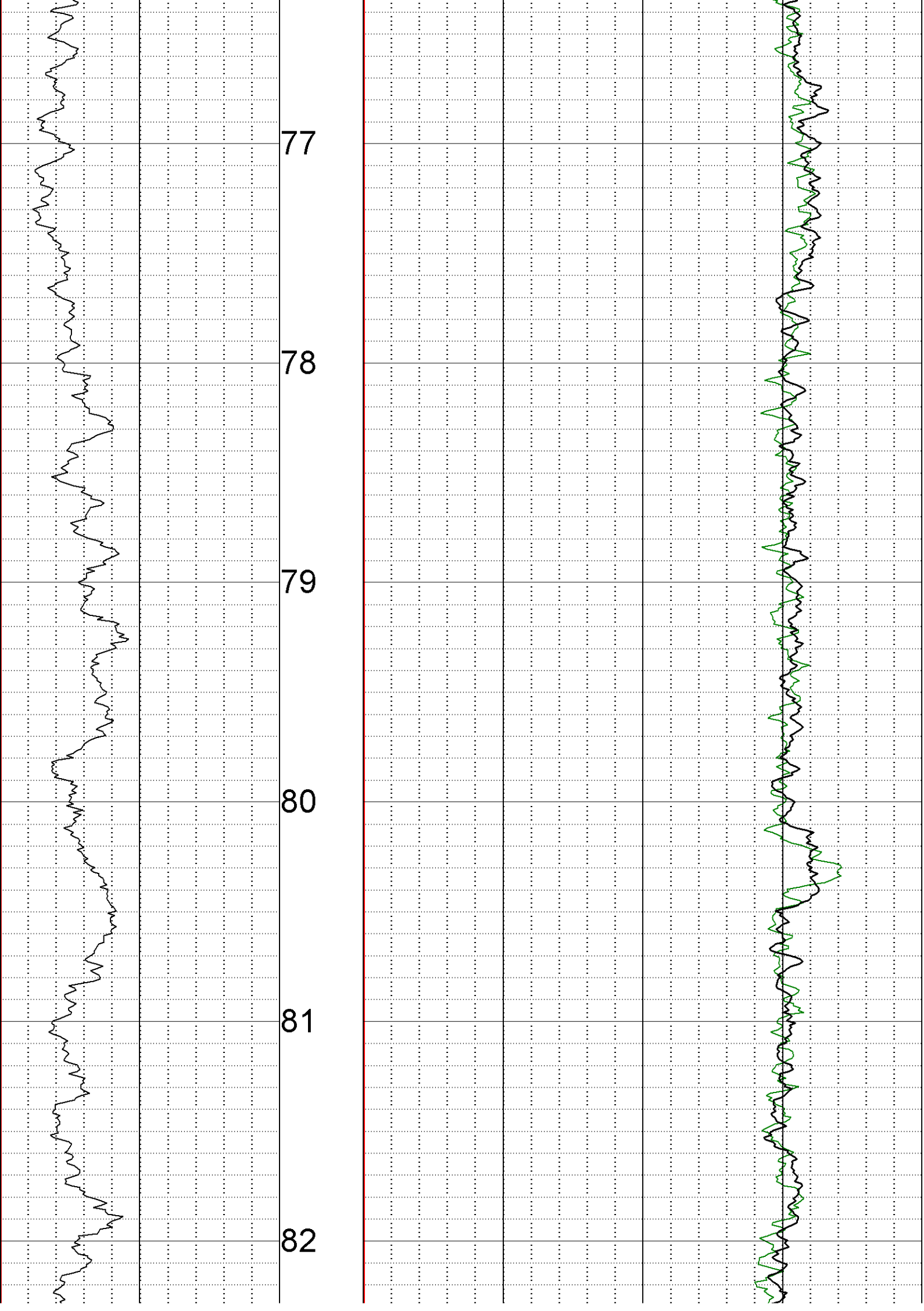

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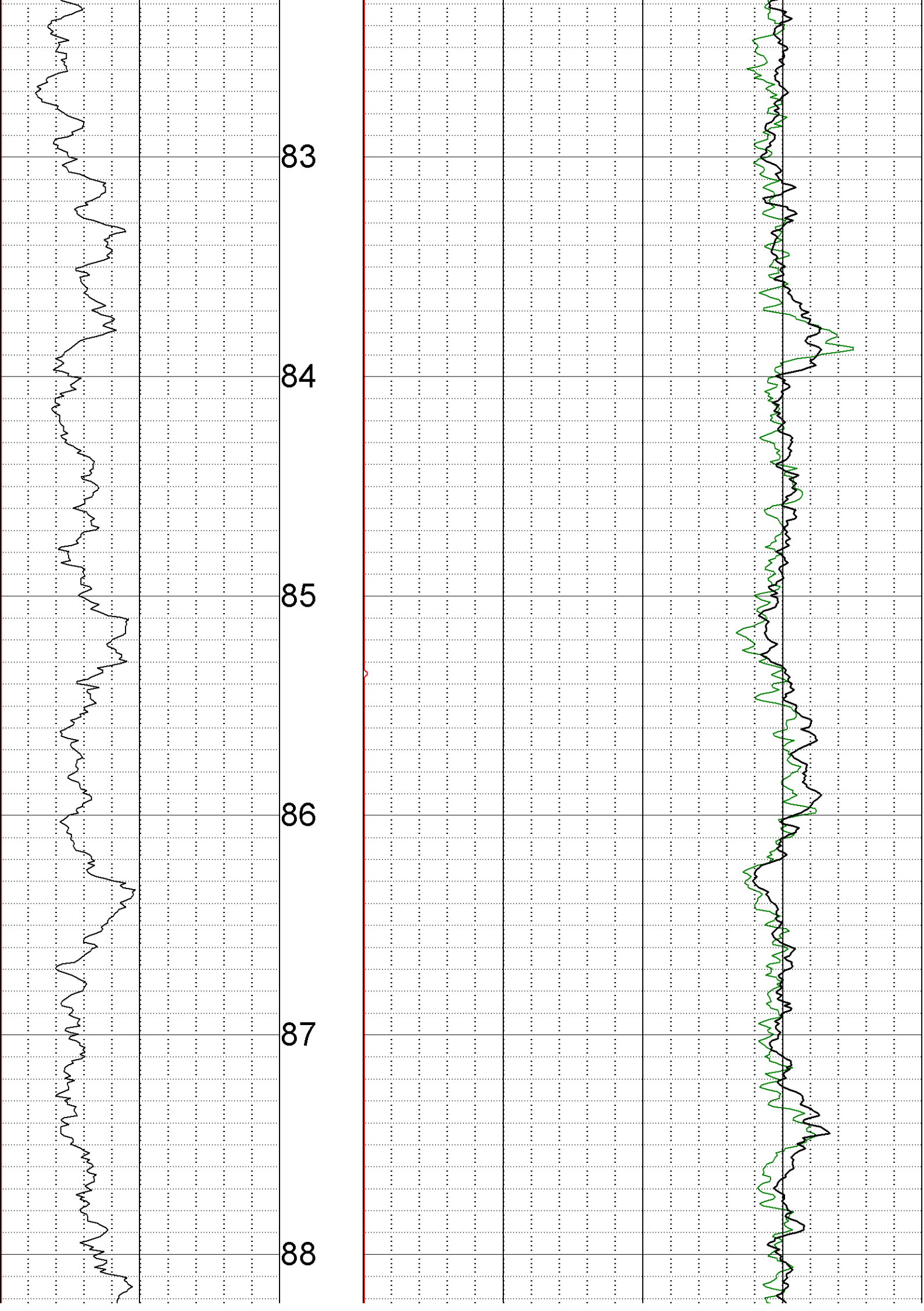

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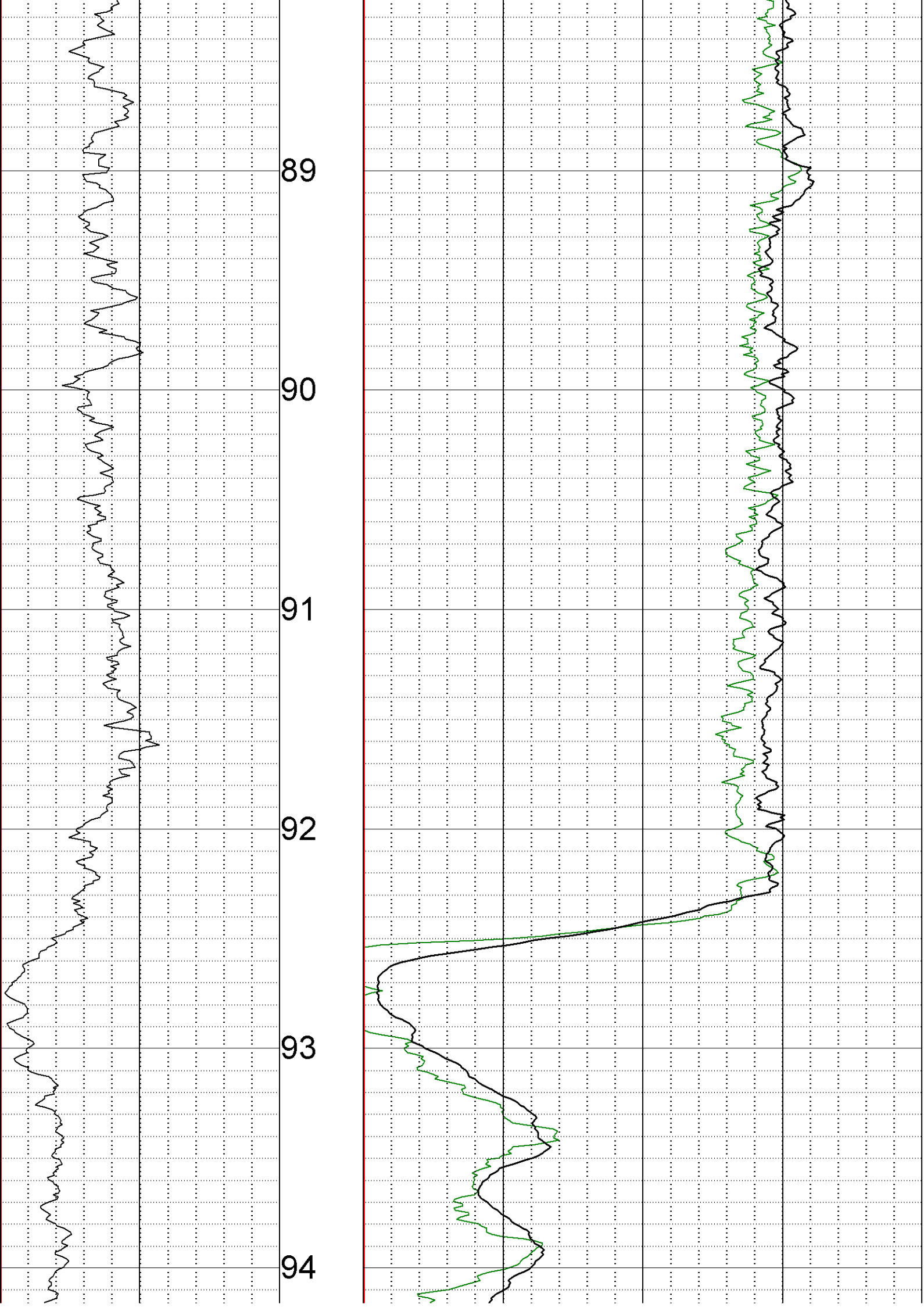

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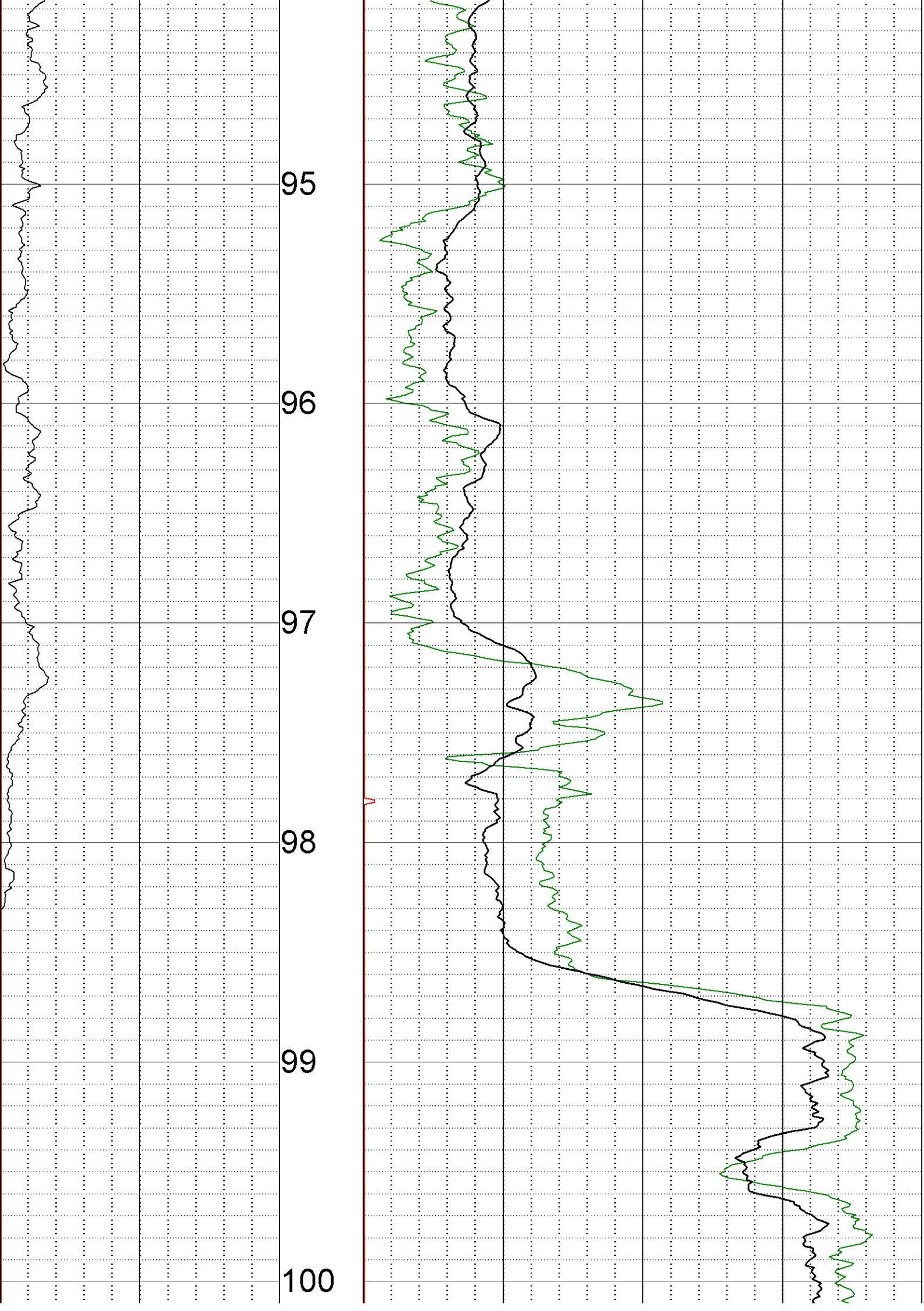

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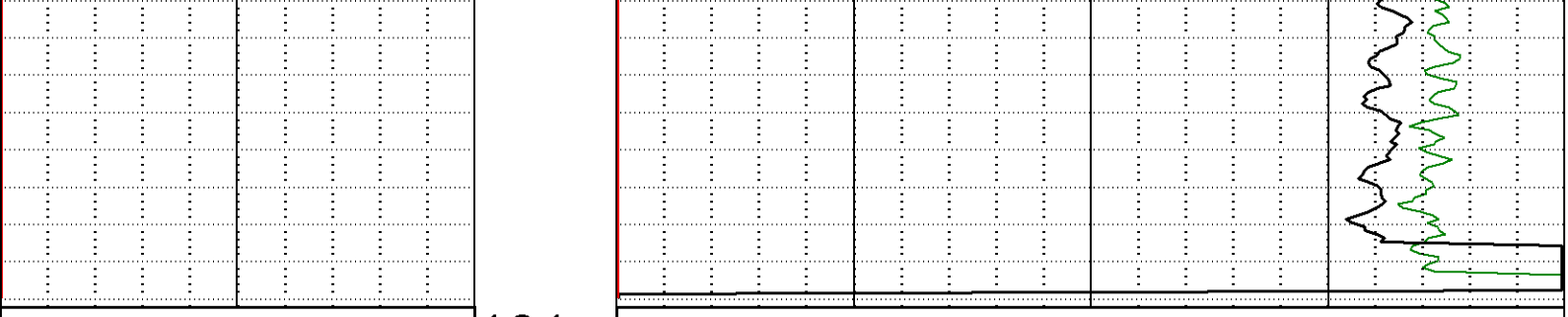

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0	API-GR	300	101	1	G/CC	3
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8	CM	18		1	G/CC	3
CALIPER				DEN(LS)		
				0	OHM-M	2000
			METERS	RES(SG)		

Coffey Geotechnics

Borehole BH02A

ACOUSTIC TELEVIEWER PETROPHYSICAL REPORT

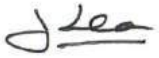
Groundsearch Australia Pty. Limited

3 October 2018

DISCLAIMER

The data used in this report were obtained using equipment manufactured by the Century Geophysical Corporation. The interpretations given in this report are based on judgement and experience of Groundsearch Australia's personnel. They are provided for Coffey Geotechnics sole use in accordance with a specified brief. As such, the interpretation outcomes do not necessarily address all aspects of ground conditions and behaviour on the subject site. The responsibility of Groundsearch Australia is solely to Coffey Geotechnics and it is not intended that any third party rely upon this report. This report shall not be reproduced either wholly or in part without the written permission of Groundsearch Australia Pty. Limited.

For and on behalf of Groundsearch Australia Pty. Limited



John Lea BSc (Hons) FAusIMM
Principal Geologist
Managing Director

Executive summary

The data contained in this report were obtained from one 9.6 cm diameter, vertical, cored borehole that was drilled as a component of the 2018 geotechnical exploration programme for Coffey Geotechnics at the NBN site Newcastle NSW.

Century Geophysical Corporation downhole 9804 acoustic televiewer and 9329 density tools were run to collect data in the field on 21 September 2018. This report is for data from 16.50 to 101.64 mbgl. The 9239 density tool was run inside steel casing and data were corrected for the steel. Therefore, there are no caliper or resistivity data.

The 305 identified features are interpreted as the SWL bedding, fractures and one washout. The bedding to fractures ratio is 7.3:1.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

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Appendix 1 1:20 Interpretation logs – 16.50 to 101.64 mbgl

1.0 Background technical information

The data contained in this report were obtained from one 9.6 cm diameter, vertical, cored borehole that was drilled as a component of the 2018 geotechnical exploration programme for Coffey Geotechnics at Lingard Street Newcastle NSW.

Century Geophysical Corporation downhole 9804 acoustic televiewer and 9329 density tools were run to collect data in the field on 21 September 2018. This report is for data from 16.50 to 101.64 mbgl. The 9239 density tool was run inside steel casing and data were corrected for the steel. Therefore, there are no caliper or resistivity data.

The 305 identified features are interpreted as the SWL bedding, fractures and one washout. The bedding to fractures ratio is 7.3:1.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

Subsequent processing and interpretation of data were carried out by Groundsearch.

The ATV takes an oriented image of the borehole using high-resolution sound waves. This acoustic image is displays amplitude variations. This information is used to detect bedding planes, fractures, and other borehole anomalies without the need to have clear fluid filling the boreholes. The tool works only in fluid-filled boreholes.

The televiewer digitises 256 measurements around the borehole at each high-resolution sample interval. These data can be oriented to North and displayed real-time while logging using the Visual Compu-Log System.

Analysis software includes colour adjustment, fracture dip and strike determination, and classification of features. It allows information to be displayed on the graphical screen, plot, and in report format.

2.0 Interpretation methodology

It should be noted that the ATV is a bowspring-type, centralised tool and is affected by poor wallrock conditions known as rugosity.

The ATV data interpretation procedure is based on the superposition of curves on feature logs directly onto the computer screen by using a subjective, manual; two-point definition of a feature's top and base to produce a sine curve. The sides of the time and amplitude plots represent magnetic north and magnetic south is in the centre of each plot. The low side, or trough, of the sine curve defines the dip direction of the feature.

The logging program automatically records the televiewer tool slant angle and bearing and corrects for any borehole deviations. The curves are automatically given an identification number for subsequent referencing in a report file.

There are possibly more bedding planes and structural fractures appearing in the televiewer logs that have not been included in this report due to their poor graphic definition or the inability to resolve their geometry by superposing a sine curve using the program's two point method.

This report contains a;

- Text summary of the interpreted features
- Circular representation of interpreted features
- Logs that show geological features with their subjective, numbered interpretation curves shown at 1:20 scale. The logs are in standard format whereby the optical image of the borehole wall is "flattened" onto the plot. The logs have the following additional features to enhance geological interpretations of the strata;
    - Amplitude image differentials
    - Time image differentials that indicate higher strength zones in **GREEN** and lower strength zones in **RED**
    - Tadpoles that represent feature dip and dip direction
    - Open fractures in **RED**
    - Partially open fractures in **MAGENTA**
    - Discontinuous fractures in **DARK BLUE**
    - Natural gamma
    - Slant (dip angle)
    - Slant angle bearing
    - Long and short space density
- Table containing feature curve ID, top, base, dip angle, dip azimuth, feature description and the generalised rock type that hosts the feature
- Graphical representations of the interpreted features

3.0 Borehole BH02Ainterpretation

The 305 identified features are interpreted as the SWL bedding, fractures and one washout. The bedding to fractures ratio is 7.3:1.

A description of each interpreted feature is presented in Table 1 and the log is presented in Appendix 1.

Table 1 Interpreted features report for BH02A

FEATURE ID	DIP (DEG)	AZIMUTH (DEG)	MIDPOINT (MBGL)	TOP (M)	BASE (M)	TYPE OF FEATURE	GENERALISED ROCK TYPE
1			17.05	17.05	17.05	SWL	Overburden
2	1	274	17.29	17.29	17.30	Bedding plane	Overburden
3	1	348	17.59	17.59	17.59	Bedding plane	Overburden
4	3	279	17.70	17.70	17.70	Bedding plane	Overburden
5	6	309	18.23	18.23	18.23	Bedding plane	Overburden
6	1	273	18.55	18.55	18.55	Bedding plane	Overburden
7	6	338	19.54	19.54	19.55	Bedding plane	Overburden
8	1	342	19.67	19.67	19.67	Bedding plane	Overburden
9	9	338	19.71	19.71	19.72	Bedding plane	Overburden
10	9	323	19.74	19.74	19.75	Bedding plane	Overburden
11	12	332	21.10	21.09	21.11	Bedding plane	Overburden
12	8	303	21.20	21.20	21.21	Bedding plane	Overburden
13	9	272	21.93	21.92	21.93	Bedding plane	Overburden
14	21	83	22.31	22.29	22.33	Bedding plane	Overburden
15	24	66	22.34	22.32	22.36	Bedding plane	Overburden
16	17	40	22.84	22.82	22.85	Bedding plane	Overburden
17	17	57	22.87	22.86	22.88	Bedding plane	Overburden
18	4	307	23.60	23.60	23.60	Bedding plane	Overburden
19	7	142	24.19	24.18	24.19	Bedding plane	Overburden
20	5	52	24.86	24.86	24.87	Bedding plane	Overburden
21	9	273	25.14	25.13	25.15	Bedding plane	Overburden
22	6	223	25.28	25.27	25.28	Bedding plane	Overburden
23	5	316	25.34	25.34	25.35	Bedding plane	Overburden
24	10	295	25.42	25.41	25.43	Bedding plane	Overburden
25	5	292	25.51	25.50	25.51	Bedding plane	Overburden
26	4	269	25.58	25.57	25.58	Bedding plane	Overburden
27	4	280	25.62	25.61	25.62	Bedding plane	Overburden
28	1	268	26.08	26.08	26.08	Bedding plane	Overburden
29	6	265	26.13	26.13	26.14	Top of coal unit	COAL SEAM
30	8	219	26.24	26.24	26.25	Bedding plane	COAL SEAM
31	4	269	26.31	26.31	26.31	Bedding plane	COAL SEAM
32	5	297	26.33	26.33	26.33	Bedding plane	COAL SEAM
33	5	294	26.35	26.34	26.35	Bedding plane	COAL SEAM
34	82	86	26.45	26.11	26.78	Fracture plane - partially open	COAL SEAM
35	4	232	26.55	26.55	26.55	Bedding plane	COAL SEAM
36	5	230	26.72	26.72	26.73	Bedding plane	COAL SEAM
37	2	326	26.82	26.82	26.83	Bedding plane	COAL SEAM
38	4	248	26.99	26.99	27.00	Bedding plane	COAL SEAM

39	83	220	27.00	26.56	27.43	Fracture plane - partially open	COAL SEAM
40	4	243	27.15	27.15	27.15	Bedding plane	COAL SEAM
41	2	330	27.16	27.16	27.16	Bedding plane	COAL SEAM
42	16	277	27.25	27.24	27.26	Bedding plane	COAL SEAM
43	4	231	27.69	27.68	27.69	Base of coal unit	COAL SEAM
44	17	228	27.98	27.97	28.00	Bedding plane	Interburden
45	6	284	28.07	28.06	28.07	Bedding plane	Interburden
46	3	277	28.22	28.22	28.22	Bedding plane	Interburden
47	4	272	28.30	28.29	28.30	Bedding plane	Interburden
48	1	295	28.52	28.52	28.52	Bedding plane	Interburden
49	7	271	28.61	28.60	28.61	Top of coal unit	COAL SEAM
50	3	283	28.75	28.74	28.75	Bedding plane	COAL SEAM
51	3	30	29.04	29.03	29.04	Bedding plane	COAL SEAM
52	6	30	29.07	29.07	29.08	Bedding plane	COAL SEAM
53	15	234	29.32	29.31	29.34	Base of coal unit	COAL SEAM
54	5	60	29.50	29.50	29.50	Bedding plane	Interburden
55	6	271	29.67	29.67	29.68	Bedding plane	Interburden
56	14	262	29.80	29.79	29.81	Top of coal unit	COAL SEAM
57	9	207	30.30	30.29	30.31	Bedding plane	COAL SEAM
58	6	201	30.32	30.31	30.33	Base of coal unit	COAL SEAM
59	6	299	30.49	30.48	30.49	Bedding plane	Interburden
60	8	298	30.56	30.55	30.56	Bedding plane	Interburden
61	5	242	30.61	30.60	30.61	Bedding plane	Interburden
62	7	235	31.23	31.23	31.24	Bedding plane	Interburden
63	1	11	31.33	31.33	31.33	Bedding plane	Interburden
64	2	47	31.45	31.45	31.45	Top of washout	Interburden
65	14	45	31.72	31.71	31.73	Base of washout	Interburden
66	9	45	31.83	31.82	31.83	Bedding plane	Interburden
67	4	267	32.06	32.06	32.07	Bedding plane	Interburden
68	7	56	32.43	32.43	32.44	Bedding plane	Interburden
69	2	49	32.48	32.48	32.48	Bedding plane	Interburden
70	4	37	32.54	32.54	32.55	Bedding plane	Interburden
71	5	70	32.59	32.59	32.60	Bedding plane	Interburden
72	2	328	32.64	32.64	32.64	Bedding plane	Interburden
73	3	91	32.99	32.99	33.00	Bedding plane	Interburden
74	5	65	33.11	33.10	33.11	Bedding plane	Interburden
75	16	33	33.15	33.14	33.16	Bedding plane	Interburden
76	12	354	33.21	33.20	33.22	Bedding plane	Interburden
77	24	115	33.53	33.51	33.55	Fracture plane - partially open	Interburden
78	13	348	33.60	33.59	33.61	Fracture plane - open	Interburden
79	3	360	33.73	33.73	33.73	Bedding plane	Interburden
80	5	333	33.80	33.80	33.81	Bedding plane	Interburden
81	25	281	33.85	33.82	33.87	Fracture plane - partially open	Interburden
82	12	84	33.97	33.96	33.98	Bedding plane	Interburden
83	17	78	34.13	34.12	34.15	Bedding plane	Interburden
84	19	109	34.17	34.15	34.19	Bedding plane	Interburden
85	13	38	35.81	35.80	35.82	Bedding plane	Interburden
86	5	319	36.64	36.64	36.65	Bedding plane	Interburden
87	2	331	36.80	36.80	36.80	Bedding plane	Interburden
88	1	21	36.99	36.99	36.99	Bedding plane	Interburden

89	4	284	37.23	37.23	37.23	Bedding plane	Interburden
90	2	231	37.28	37.27	37.28	Bedding plane	Interburden
91	5	217	37.29	37.29	37.30	Bedding plane	Interburden
92	1	21	37.53	37.53	37.53	Bedding plane	Interburden
93	3	308	37.76	37.76	37.76	Bedding plane	Interburden
94	7	324	38.05	38.04	38.05	Bedding plane	Interburden
95	7	319	38.64	38.63	38.64	Bedding plane	Interburden
96	7	137	39.25	39.24	39.25	Bedding plane	Interburden
97	2	265	42.72	42.72	42.72	Bedding plane	Interburden
98	69	129	43.06	42.93	43.19	Fracture plane - partially open	Interburden
99	59	144	43.48	43.40	43.57	Fracture plane - partially open	Interburden
100	6	294	43.85	43.84	43.85	Top of coal unit	COAL SEAM
101	72	78	43.89	43.75	44.04	Fracture plane - partially open	COAL SEAM
102	72	91	43.96	43.82	44.10	Fracture plane - partially open	COAL SEAM
103	7	357	44.02	44.01	44.02	Bedding plane	COAL SEAM
104	10	349	44.05	44.04	44.06	Bedding plane	COAL SEAM
105	3	290	44.42	44.41	44.42	Bedding plane	COAL SEAM
106	3	41	44.43	44.43	44.44	Bedding plane	COAL SEAM
107	6	279	44.92	44.92	44.93	Base of coal unit	COAL SEAM
108	17	296	45.13	45.12	45.15	Bedding plane	Interburden
109	10	271	45.25	45.24	45.26	Bedding plane	Interburden
110	13	22	47.92	47.91	47.93	Bedding plane	Interburden
111	5	71	48.25	48.25	48.25	Bedding plane	Interburden
112	2	331	49.76	49.76	49.76	Bedding plane	Interburden
113	11	257	49.85	49.84	49.86	Bedding plane	Interburden
114	4	99	51.32	51.31	51.32	Bedding plane	Interburden
115	75	175	53.27	53.06	53.49	Fracture plane - partially open	Interburden
116	70	240	54.00	53.86	54.15	Fracture plane - partially open	Interburden
117	75	241	54.19	53.99	54.39	Fracture plane - partially open	Interburden
118	19	335	54.58	54.56	54.60	Bedding plane	Interburden
119	77	232	54.98	54.75	55.20	Fracture plane - partially open	Interburden
120	76	232	55.02	54.83	55.21	Fracture plane - partially open	Interburden
121	5	286	55.26	55.26	55.26	Bedding plane	Interburden
122	4	263	55.30	55.29	55.30	Bedding plane	Interburden
123	12	313	55.53	55.52	55.54	Top of coal unit	COAL SEAM
124	6	263	55.59	55.58	55.59	Bedding plane	COAL SEAM
125	4	329	55.64	55.64	55.65	Bedding plane	COAL SEAM
126	3	272	55.70	55.70	55.70	Bedding plane	COAL SEAM
127	4	321	55.93	55.93	55.94	Bedding plane	COAL SEAM
128	7	325	56.09	56.08	56.09	Base of coal unit	COAL SEAM
129	79	233	56.46	56.19	56.73	Fracture plane - open	Interburden
130	71	241	56.69	56.55	56.83	Fracture plane - partially open	Interburden
131	71	242	56.77	56.64	56.91	Fracture plane - partially open	Interburden
132	74	226	56.91	56.73	57.08	Fracture plane - partially open	Interburden
133	74	228	57.01	56.84	57.18	Fracture plane - partially open	Interburden
134	76	223	57.15	56.93	57.37	Fracture plane - partially open	Interburden
135	10	59	57.40	57.39	57.40	Bedding plane	Interburden
136	14	52	57.56	57.54	57.57	Bedding plane	Interburden
137	9	20	57.58	57.57	57.58	Bedding plane	Interburden

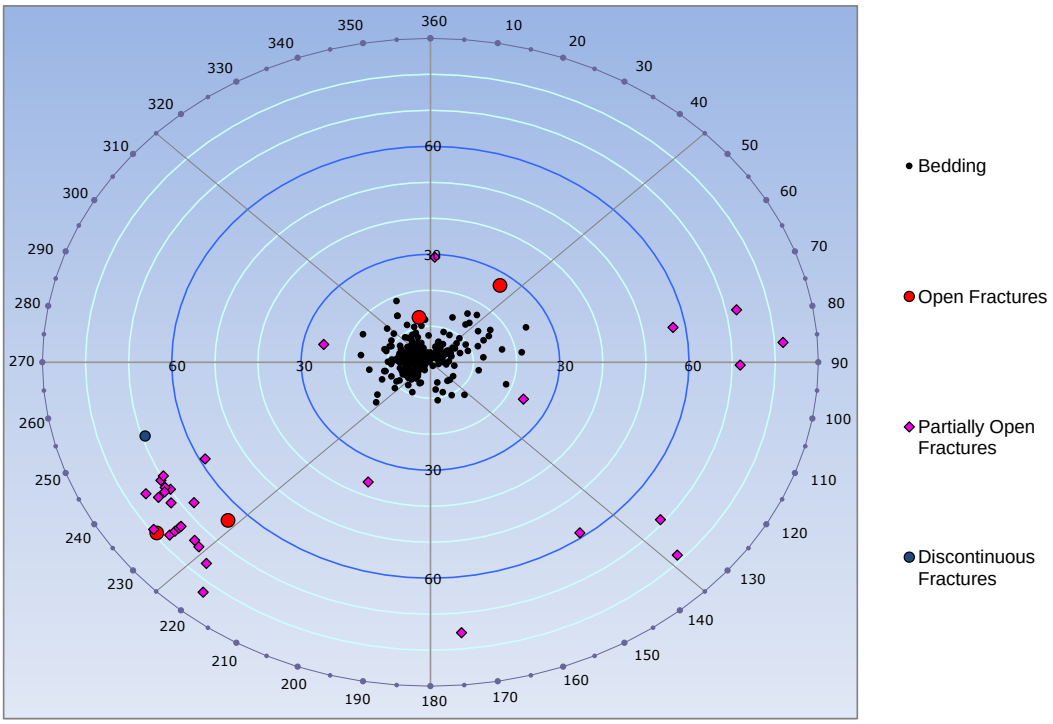
138	8	276	57.62	57.61	57.63	Bedding plane	Interburden
139	79	234	58.08	57.82	58.34	Fracture plane - partially open	Interburden
140	10	296	58.63	58.63	58.64	Bedding plane	Interburden
141	2	105	58.72	58.72	58.73	Bedding plane	Interburden
142	2	348	58.87	58.87	58.87	Bedding plane	Interburden
143	7	295	58.99	58.98	58.99	Bedding plane	Interburden
144	1	271	59.08	59.08	59.08	Bedding plane	Interburden
145	7	70	59.12	59.12	59.13	Bedding plane	Interburden
146	5	58	59.16	59.15	59.16	Bedding plane	Interburden
147	12	139	59.27	59.26	59.29	Bedding plane	Interburden
148	10	152	59.30	59.29	59.31	Bedding plane	Interburden
149	6	259	59.34	59.33	59.34	Bedding plane	Interburden
150	36	203	59.39	59.35	59.43	Fracture plane - partially open	Interburden
151	27	37	59.55	59.53	59.58	Fracture plane - open	Interburden
152	14	40	59.58	59.57	59.60	Bedding plane	Interburden
153	1	345	59.69	59.69	59.69	Bedding plane	Interburden
154	7	53	59.74	59.73	59.74	Bedding plane	Interburden
155	6	203	60.65	60.65	60.66	Bedding plane	Interburden
156	8	171	60.67	60.66	60.68	Bedding plane	Interburden
157	11	171	60.73	60.72	60.74	Bedding plane	Interburden
158	1	355	60.99	60.99	60.99	Bedding plane	Interburden
159	4	25	61.15	61.15	61.16	Bedding plane	Interburden
160	5	51	61.78	61.78	61.79	Bedding plane	Interburden
161	8	49	61.80	61.80	61.81	Bedding plane	Interburden
162	9	31	61.83	61.82	61.83	Bedding plane	Interburden
163	3	58	61.96	61.96	61.96	Bedding plane	Interburden
164	1	354	62.12	62.12	62.12	Bedding plane	Interburden
165	1	352	62.87	62.87	62.87	Bedding plane	Interburden
166	4	87	63.04	63.04	63.04	Bedding plane	Interburden
167	6	21	63.16	63.16	63.16	Bedding plane	Interburden
168	2	295	63.19	63.19	63.20	Bedding plane	Interburden
169	3	326	63.26	63.26	63.26	Bedding plane	Interburden
170	5	290	63.32	63.32	63.32	Bedding plane	Interburden
171	9	70	63.48	63.47	63.48	Bedding plane	Interburden
172	7	126	63.73	63.72	63.74	Bedding plane	Interburden
173	11	101	63.75	63.74	63.76	Bedding plane	Interburden
174	7	276	63.80	63.79	63.81	Bedding plane	Interburden
175	11	229	63.86	63.85	63.87	Bedding plane	Interburden
176	9	275	64.05	64.04	64.05	Bedding plane	Interburden
177	9	331	64.88	64.88	64.89	Bedding plane	Interburden
178	6	100	65.24	65.23	65.24	Bedding plane	Interburden
179	6	223	65.51	65.50	65.51	Bedding plane	Interburden
180	3	276	65.87	65.87	65.87	Bedding plane	Interburden
181	5	307	66.03	66.02	66.03	Bedding plane	Interburden
182	5	296	66.42	66.41	66.42	Bedding plane	Interburden
183	5	305	67.49	67.48	67.49	Bedding plane	Interburden
184	3	344	67.69	67.69	67.69	Bedding plane	Interburden
185	2	51	69.17	69.17	69.17	Bedding plane	Interburden
186	7	308	69.90	69.89	69.90	Bedding plane	Interburden

187	6	327	69.97	69.97	69.97	Bedding plane	Interburden
188	4	338	69.98	69.98	69.99	Bedding plane	Interburden
189	2	7	70.10	70.10	70.10	Bedding plane	Interburden
190	2	8	70.23	70.23	70.23	Bedding plane	Interburden
191	5	31	70.74	70.74	70.74	Bedding plane	Interburden
192	8	289	71.69	71.68	71.70	Bedding plane	Interburden
193	6	328	71.94	71.94	71.94	Bedding plane	Interburden
194	2	9	72.10	72.10	72.10	Bedding plane	Interburden
195	9	161	72.57	72.56	72.58	Bedding plane	Interburden
196	78	133	72.85	72.58	73.11	Fracture plane - partially open	Interburden
197	4	326	73.21	73.21	73.21	Bedding plane	Interburden
198	5	312	75.38	75.37	75.38	Bedding plane	Interburden
199	4	325	75.45	75.45	75.45	Bedding plane	Interburden
200	4	317	76.29	76.29	76.29	Bedding plane	Interburden
201	6	233	76.38	76.38	76.39	Bedding plane	Interburden
202	4	310	76.52	76.52	76.53	Bedding plane	Interburden
203	4	272	76.56	76.55	76.56	Bedding plane	Interburden
204	7	270	76.67	76.66	76.68	Bedding plane	Interburden
205	2	312	76.77	76.77	76.77	Bedding plane	Interburden
206	3	210	77.55	77.55	77.56	Bedding plane	Interburden
207	6	320	77.76	77.75	77.76	Bedding plane	Interburden
208	70	243	78.15	78.01	78.29	Fracture plane - partially open	Interburden
209	57	80	78.22	78.14	78.30	Fracture plane - partially open	Interburden
210	59	243	78.39	78.31	78.47	Fracture plane - partially open	Interburden
211	71	240	78.54	78.39	78.68	Fracture plane - partially open	Interburden
212	73	239	78.64	78.47	78.81	Fracture plane - partially open	Interburden
213	15	62	79.00	78.99	79.01	Bedding plane	Interburden
214	14	64	79.18	79.17	79.20	Bedding plane	Interburden
215	12	68	80.10	80.09	80.11	Bedding plane	Interburden
216	7	295	80.29	80.28	80.29	Bedding plane	Interburden
217	6	256	80.50	80.49	80.50	Bedding plane	Interburden
218	1	298	80.56	80.56	80.56	Bedding plane	Interburden
219	5	336	81.04	81.04	81.05	Bedding plane	Interburden
220	2	300	81.25	81.24	81.25	Bedding plane	Interburden
221	4	293	81.59	81.59	81.59	Bedding plane	Interburden
222	7	250	81.75	81.75	81.76	Bedding plane	Interburden
223	4	285	81.87	81.86	81.87	Bedding plane	Interburden
224	7	239	82.28	82.28	82.29	Bedding plane	Interburden
225	6	331	82.37	82.37	82.38	Bedding plane	Interburden
226	9	236	82.98	82.97	82.99	Bedding plane	Interburden
227	10	246	83.02	83.01	83.03	Bedding plane	Interburden
228	10	339	83.10	83.09	83.11	Bedding plane	Interburden
229	7	242	84.25	84.25	84.26	Bedding plane	Interburden
230	4	58	84.37	84.36	84.37	Bedding plane	Interburden
231	6	164	84.69	84.68	84.69	Bedding plane	Interburden
232	5	282	84.82	84.81	84.82	Bedding plane	Interburden
233	2	278	84.94	84.94	84.94	Bedding plane	Interburden
234	2	325	85.11	85.11	85.11	Bedding plane	Interburden
235	4	274	85.83	85.83	85.84	Bedding plane	Interburden
236	12	247	86.12	86.11	86.13	Bedding plane	Interburden

237	7	230	86.15	86.14	86.16	Bedding plane	Interburden
238	5	67	86.81	86.81	86.82	Bedding plane	Interburden
239	7	249	87.23	87.22	87.23	Bedding plane	Interburden
240	7	337	88.72	88.71	88.72	Bedding plane	Interburden
241	9	235	88.92	88.92	88.93	Bedding plane	Interburden
242	3	279	89.37	89.37	89.37	Bedding plane	Interburden
243	3	34	89.45	89.45	89.45	Bedding plane	Interburden
244	2	60	89.62	89.62	89.63	Bedding plane	Interburden
245	69	253	89.73	89.61	89.85	Fracture plane - discontinuous	Interburden
246	6	215	89.81	89.81	89.82	Bedding plane	Interburden
247	7	283	90.01	90.00	90.01	Bedding plane	Interburden
248	1	1	90.04	90.04	90.04	Bedding plane	Interburden
249	7	283	90.24	90.24	90.25	Bedding plane	Interburden
250	7	246	90.53	90.53	90.54	Bedding plane	Interburden
251	3	295	90.66	90.66	90.66	Bedding plane	Interburden
252	64	227	90.72	90.62	90.82	Fracture plane - open	Interburden
253	3	281	90.73	90.73	90.74	Bedding plane	Interburden
254	5	296	90.93	90.92	90.93	Bedding plane	Interburden
255	3	55	91.04	91.03	91.04	Bedding plane	Interburden
256	11	304	91.35	91.34	91.35	Bedding plane	Interburden
257	5	247	91.47	91.46	91.47	Bedding plane	Interburden
258	2	347	91.70	91.70	91.70	Bedding plane	Interburden
259	3	283	91.82	91.82	91.82	Bedding plane	Interburden
260	3	281	91.93	91.93	91.93	Bedding plane	Interburden
261	2	259	92.07	92.07	92.07	Bedding plane	Interburden
262	72	237	92.15	92.02	92.29	Fracture plane - partially open	Interburden
263	2	299	92.43	92.43	92.43	Bedding plane	Interburden
264	5	284	92.59	92.58	92.59	Bedding plane	Interburden
265	74	232	92.66	92.50	92.82	Fracture plane - partially open	Interburden
266	74	232	92.78	92.62	92.93	Fracture plane - partially open	Interburden
267	5	309	93.09	93.09	93.10	Bedding plane	Interburden
268	5	299	93.22	93.21	93.22	Bedding plane	Interburden
269	7	257	93.61	93.61	93.62	Bedding plane	Interburden
270	29	2	93.67	93.64	93.70	Fracture plane - partially open	Interburden
271	5	298	93.76	93.76	93.77	Bedding plane	Interburden
272	5	277	94.06	94.06	94.06	Bedding plane	Interburden
273	5	286	94.17	94.16	94.17	Bedding plane	Interburden
274	3	21	94.21	94.21	94.22	Bedding plane	Interburden
275	2	297	94.31	94.31	94.31	Bedding plane	Interburden
276	4	221	94.34	94.34	94.35	Bedding plane	Interburden
277	67	235	94.36	94.24	94.47	Fracture plane - partially open	Interburden
278	3	230	94.36	94.36	94.36	Bedding plane	Interburden
279	4	17	94.47	94.47	94.48	Bedding plane	Interburden
280	5	297	94.62	94.61	94.62	Bedding plane	Interburden
281	15	329	94.70	94.69	94.71	Bedding plane	Interburden
282	14	313	94.80	94.79	94.81	Top of coal unit	COAL SEAM
283	6	323	95.20	95.19	95.20	Bedding plane	COAL SEAM
284	15	329	95.34	95.33	95.35	Bedding plane	COAL SEAM
285	5	15	95.37	95.37	95.38	Bedding plane	COAL SEAM
286	6	18	95.41	95.40	95.41	Bedding plane	COAL SEAM

287	6	18	95.71	95.70	95.71	Bedding plane	COAL SEAM
288	2	34	95.73	95.73	95.73	Bedding plane	COAL SEAM
289	2	289	97.38	97.38	97.38	Bedding plane	COAL SEAM
290	11	287	97.97	97.97	97.98	Bedding plane	COAL SEAM
291	0	311	98.09	98.09	98.09	Bedding plane	COAL SEAM
292	0	290	98.12	98.12	98.12	Bedding plane	COAL SEAM
293	9	320	98.19	98.18	98.20	Bedding plane	COAL SEAM
294	3	278	98.52	98.51	98.52	Bedding plane	COAL SEAM
295	6	271	98.53	98.53	98.53	Bedding plane	COAL SEAM
296	2	40	99.01	99.01	99.01	Bedding plane	COAL SEAM
297	4	25	99.14	99.14	99.15	Bedding plane	COAL SEAM
298	3	70	99.20	99.20	99.20	Bedding plane	COAL SEAM
299	6	312	99.31	99.30	99.31	Bedding plane	COAL SEAM
300	11	257	100.41	100.40	100.42	Base of coal unit	COAL SEAM
301	7	281	100.67	100.67	100.67	Bedding plane	Interburden
302	9	267	100.72	100.71	100.72	Bedding plane	Interburden
303	6	244	100.76	100.76	100.76	Bedding plane	Interburden
304	11	289	101.22	101.21	101.23	Bedding plane	Interburden
305	1	151	101.32	101.31	101.32	Bedding plane	Interburden
FEATURE ID	**DIP (DEG)**	**AZIMUTH (DEG)**	**MIDPOINT (MBGL)**	**TOP (M)**	**BASE (M)**	**TYPE OF FEATURE**	**GENERALISED ROCK TYPE**

Figure 1 BH02A circular plan representation of interpreted features



The 266 identified sedimentary features are predominantly bedding planes that appear to range in dip from flat-lying to 24^0. Figures 2 and 3 show the distribution of the planes' dip angles and dip direction with depth.

Table 2 details the variation in the dip angle and dip direction data. Figure 4 shows the dip direction data in a rose diagram with the bedding planes' dip angle and dip direction data shown as histograms in Figures 5 and 6.

The 36 fractures are identified as open (11%), partially open (86%) and discontinuous (3%). The fracture dip angles range from 13 to 83^0.

Table 3 details the variation in the fractures' dip angle and dip direction data. Figure 7 shows the dip direction data in a rose diagram with the fractures' plane dip angle and dip direction data as histograms in Figures 8 and 9.

Figure 2 BH02A feature dip angle data distribution

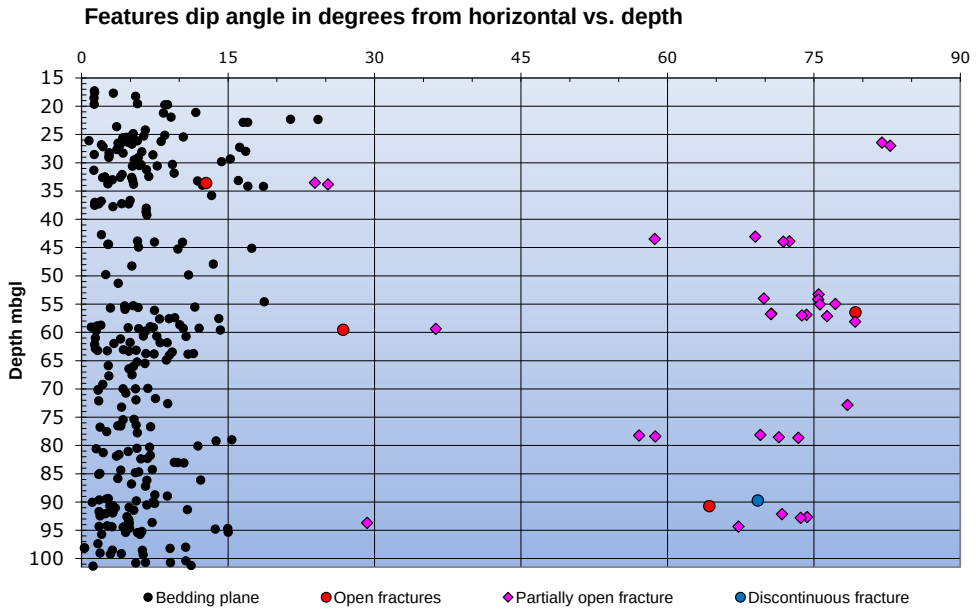


Figure 3 BH02A feature dip direction data distribution

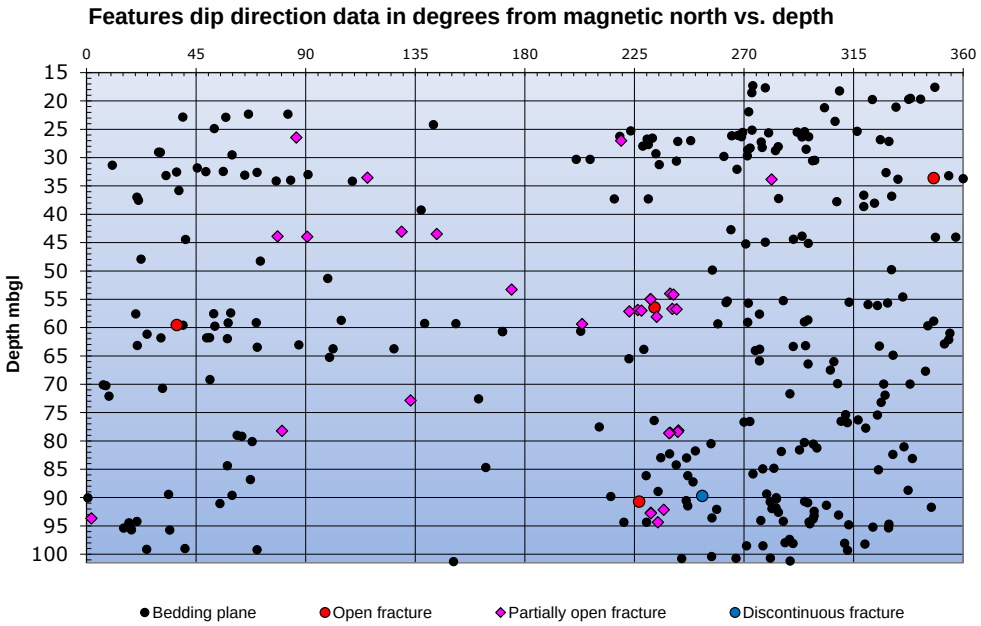


Table 2 BH02A bedding histogram data

Dip Distribution Total: 266			Orientation Distribution Total: 266		
Dip Range	Count	%	Bearing Range	Count	%
0 to 10	224	84.2	0 to 10	4	1.5
10 to 20	40	15.0	10 to 20	5	1.9
20 to 30	2	0.8	20 to 30	9	3.4
30 to 40	0	0.0	30 to 40	10	3.8
40 to 50	0	0.0	40 to 50	5	1.9
50 to 60	0	0.0	50 to 60	14	5.3
60 to 70	0	0.0	60 to 70	8	3.0
70 to 80	0	0.0	70 to 80	4	1.5
80 to 90	0	0.0	80 to 90	3	1.1
			90 to 100	3	1.1
			100 to 110	3	1.1
			110 to 120	0	0.0
			120 to 130	1	0.4
			130 to 140	2	0.8
			140 to 150	1	0.4
			150 to 160	2	0.8
			160 to 170	2	0.8
			170 to 180	2	0.8
			180 to 190	0	0.0
			190 to 200	0	0.0
			200 to 210	3	1.1
			210 to 220	4	1.5
			220 to 230	7	2.6
			230 to 240	10	3.8
			240 to 250	11	4.1
			250 to 260	6	2.3
			260 to 270	11	4.1
			270 to 280	25	9.4
			280 to 290	19	7.1
			290 to 300	27	10.2
			300 to 310	10	3.8
			310 to 320	12	4.5
			320 to 330	17	6.4
			330 to 340	13	4.9
			340 to 350	7	2.6
			350 to 360	6	2.3

Figure 5 BH02A bedding dip angles histogram

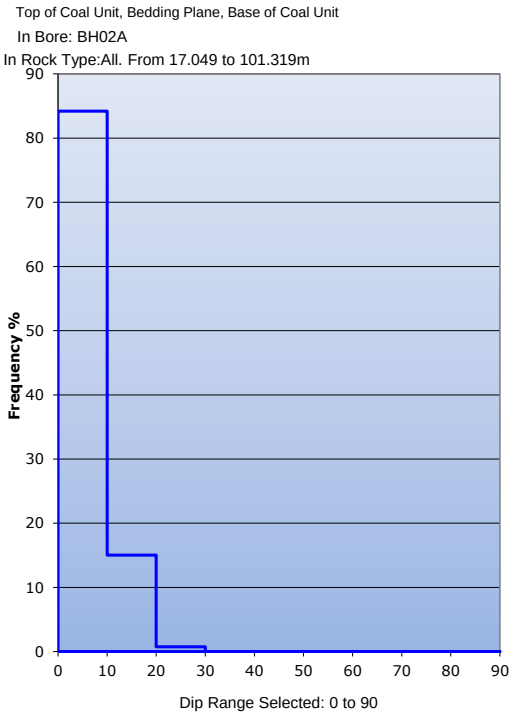


Figure 4 BH02A bedding dip direction data rose diagram

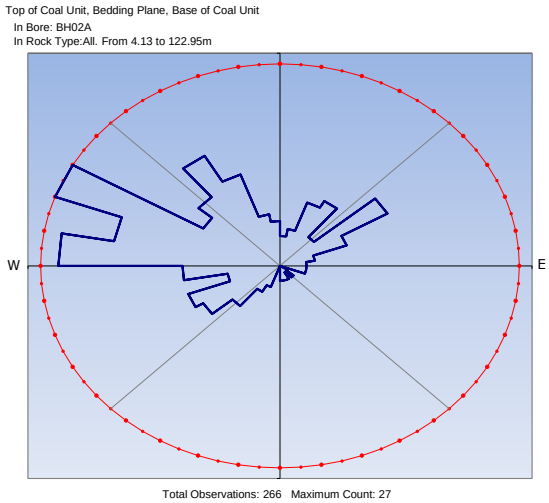


Figure 6 BH02A bedding dip directions histogram

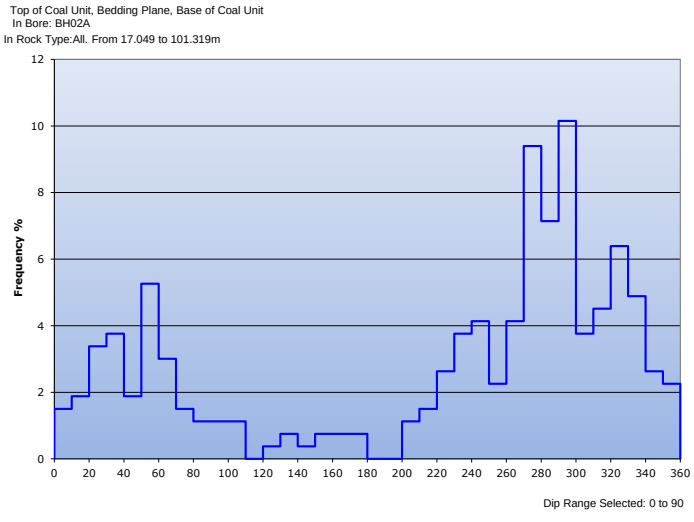


Table 3 BH02A fractures histogram data

Dip Distribution Total: 36			Orientation Distribution Total: 36		
Dip Range	Count	%	Bearing Range	Count	%
0 to 10	0	0.0	0 to 10	1	2.8
10 to 20	1	2.8	10 to 20	0	0.0
20 to 30	4	11.1	20 to 30	0	0.0
30 to 40	1	2.8	30 to 40	1	2.8
40 to 50	0	0.0	40 to 50	0	0.0
50 to 60	3	8.3	50 to 60	0	0.0
60 to 70	6	16.7	60 to 70	0	0.0
70 to 80	19	52.8	70 to 80	1	2.8
80 to 90	2	5.6	80 to 90	2	5.6
			90 to 100	1	2.8
			100 to 110	0	0.0
			110 to 120	1	2.8
			120 to 130	1	2.8
			130 to 140	1	2.8
			140 to 150	1	2.8
			150 to 160	0	0.0
			160 to 170	0	0.0
			170 to 180	1	2.8
			180 to 190	0	0.0
			190 to 200	0	0.0
			200 to 210	1	2.8
			210 to 220	1	2.8
			220 to 230	4	11.1
			230 to 240	11	30.6
			240 to 250	5	13.9
			250 to 260	1	2.8
			260 to 270	0	0.0
			270 to 280	0	0.0
			280 to 290	1	2.8
			290 to 300	0	0.0
			300 to 310	0	0.0
			310 to 320	0	0.0
			320 to 330	0	0.0
			330 to 340	0	0.0
			340 to 350	1	2.8
			350 to 360	0	0.0

Figure 8 BH02A fractures dip angles histogram

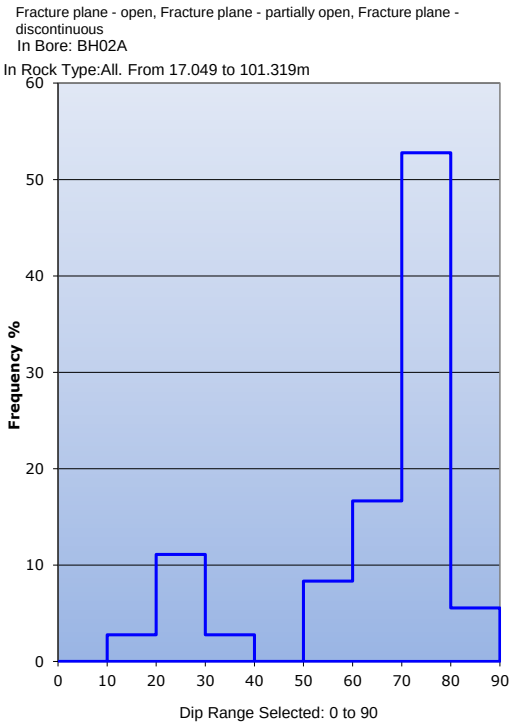


Figure 7 BH02A fractures dip direction data rose diagram

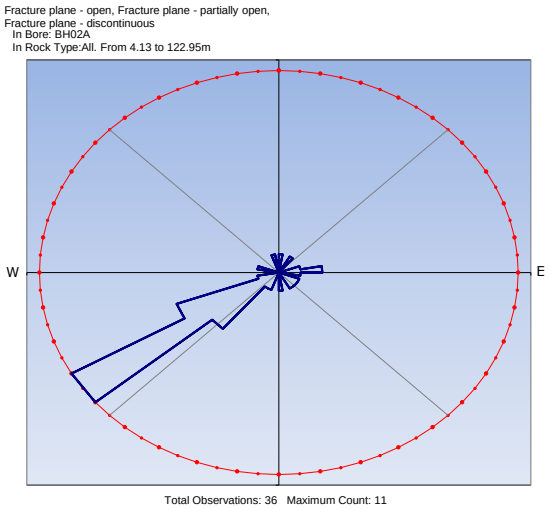
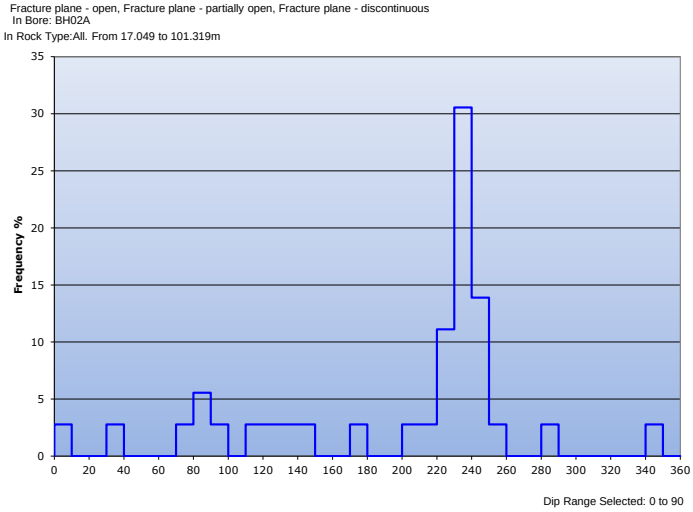


Figure 9 BH02A fractures dip directions histogram



Appendix 1

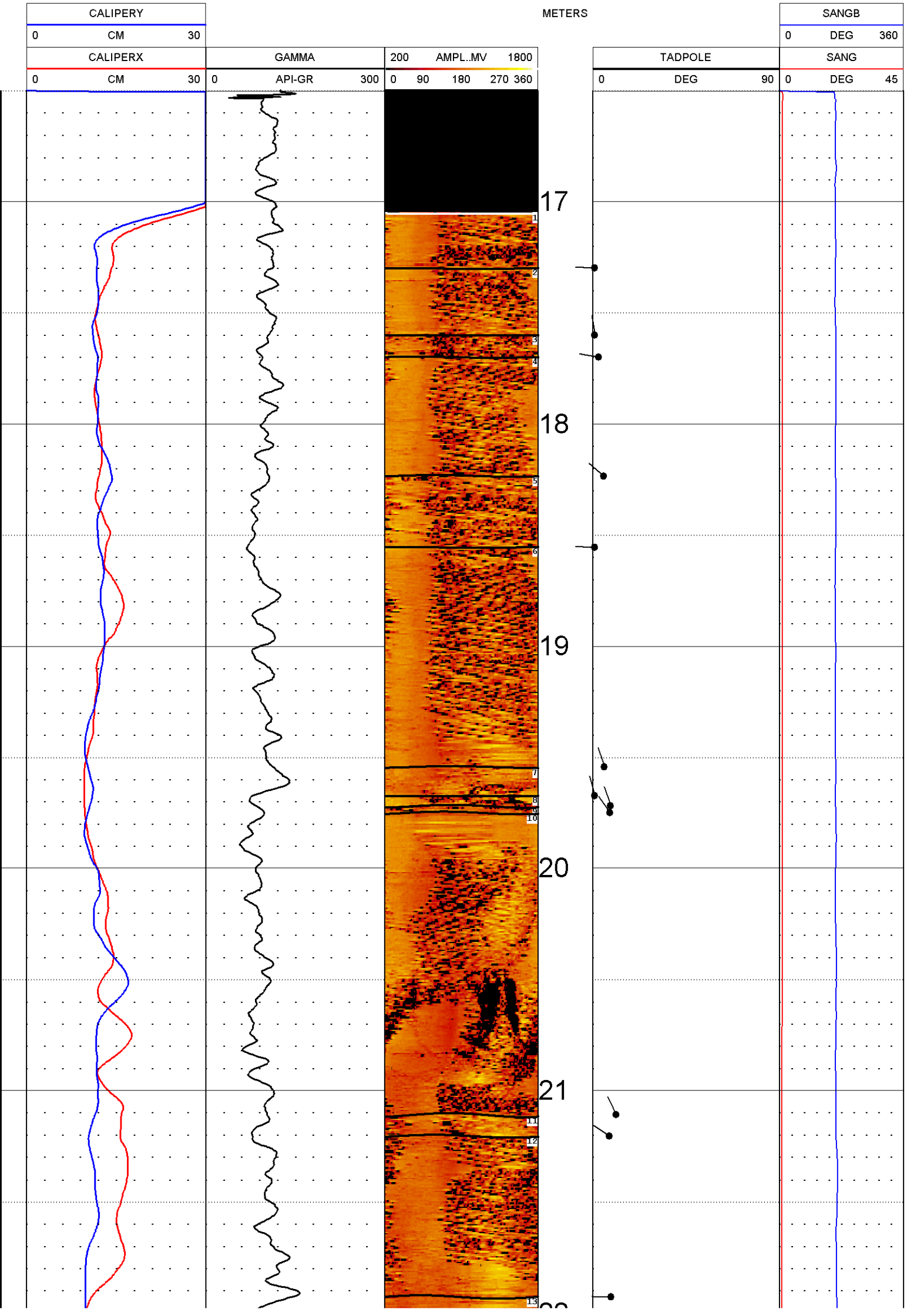
Appendix 1 ***1:20 Interpretation logs – 16.50 to 101.64 mbgl***

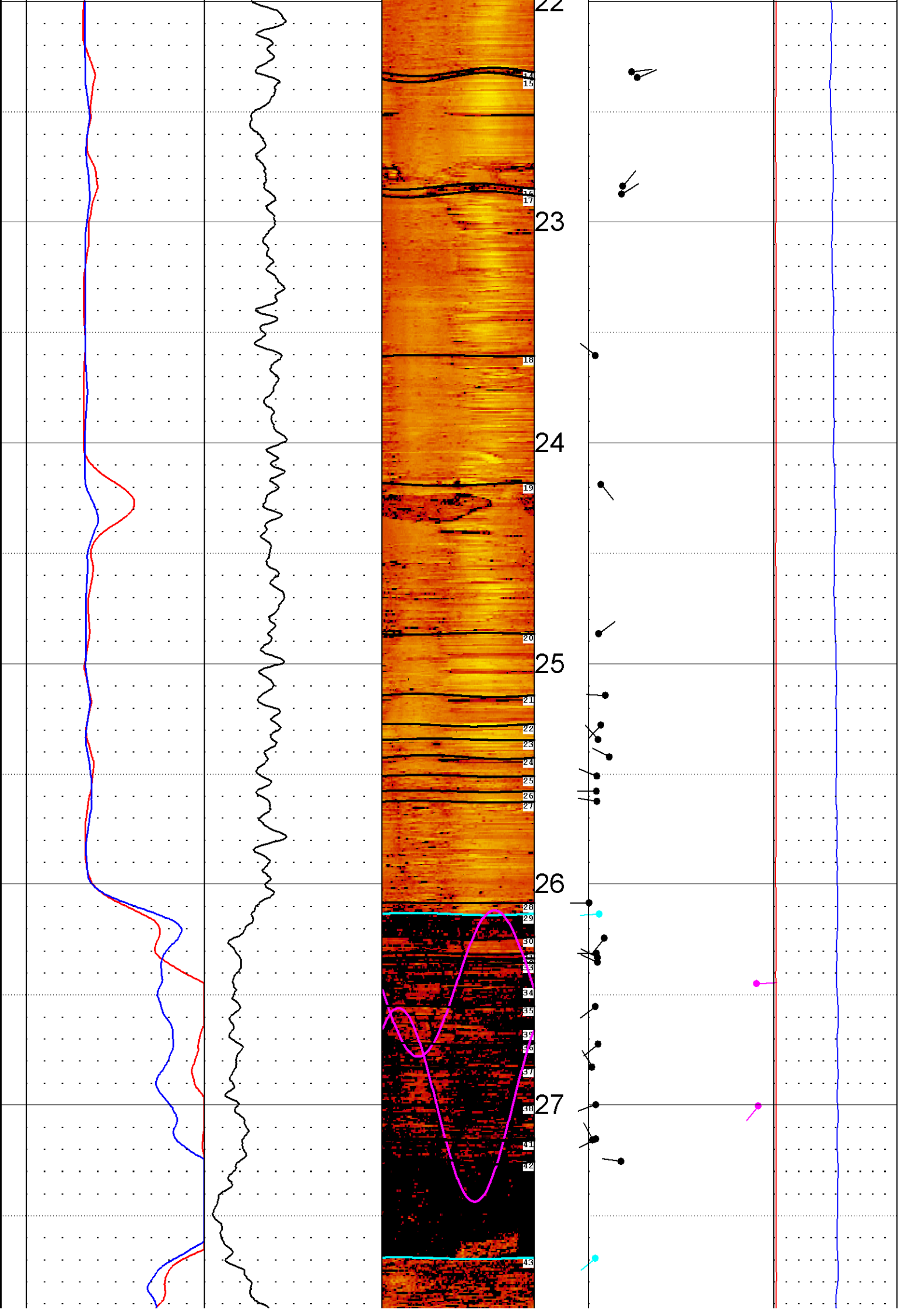


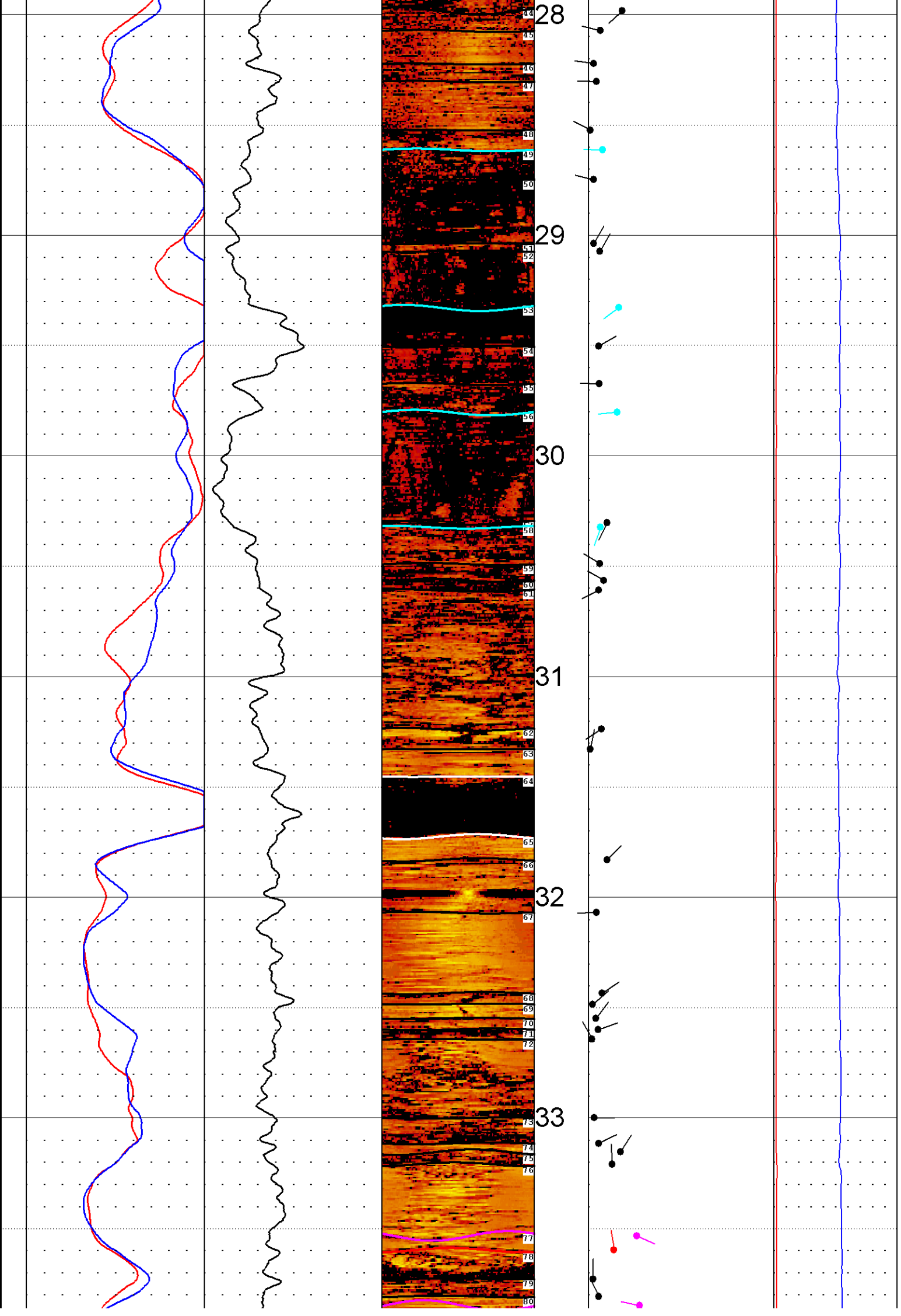
BH2A ATV 1:20

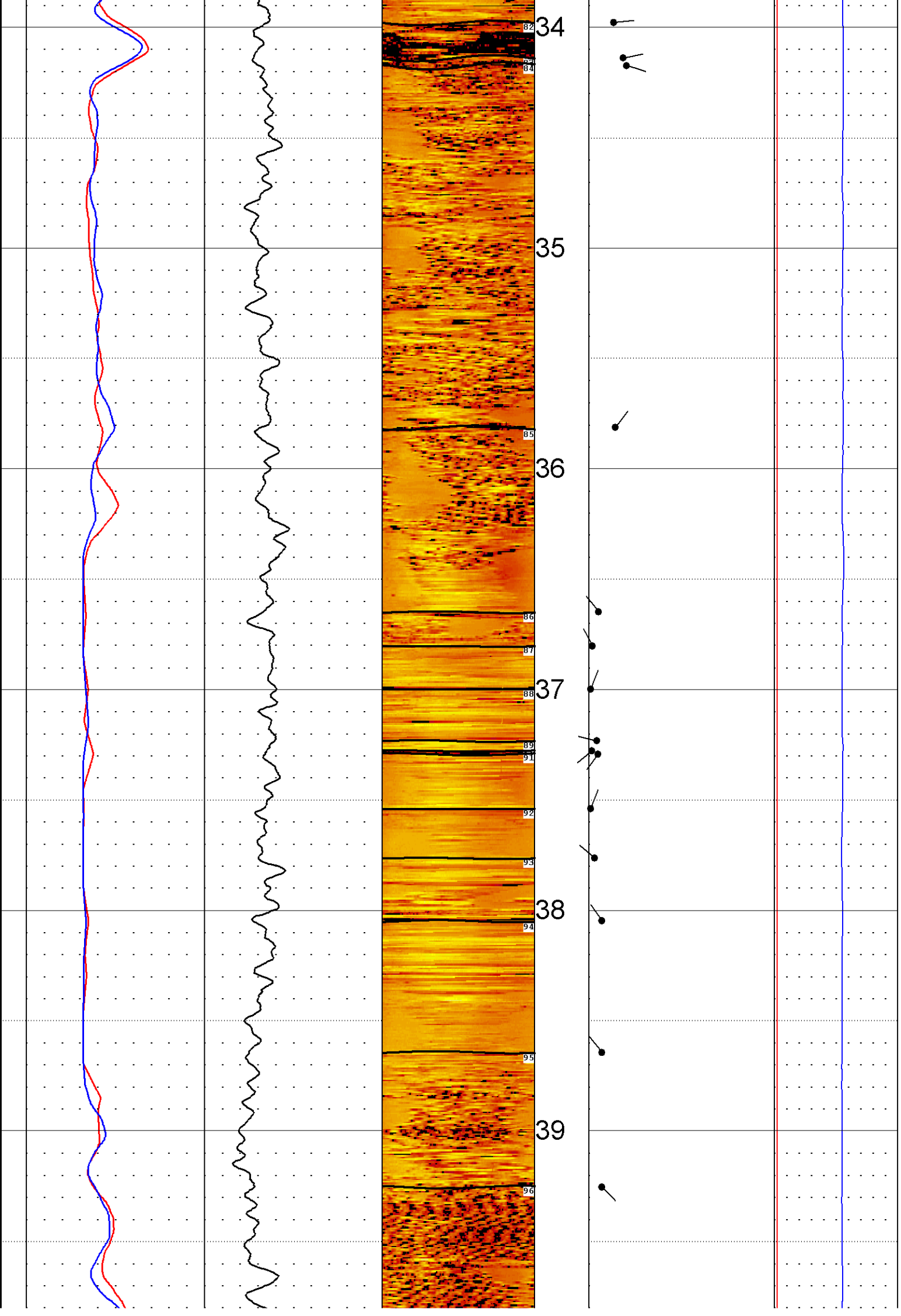
COMPANY	:	COFFEY GEOTECHNICS			OTHER SERVICES:	UTM-E	: NA
WELL	:	BH2A ATV 1:20			TV	UTM-N	: NA
LOCATION/FIELD	:	NBN			ON TV		
COUNTY	:				TV		
LOCATION	:	NSW					
SECTION	:	NA	TOWNSHIP	: NA		RANGE	: NA
DATE	:	09/21/18	PERMANENT DATUM	:			
DEPTH DRILLER	:	101				KB	: NA
LOG BOTTOM	:	101.640	LOG MEASURED FROM:	GL		DF	: NA
LOG TOP	:	16.500	DRL MEASURED FROM:	GL		GL	: 0
CASING DIAMETER	:	10.	LOGGING UNIT	: 121			
CASING TYPE	:	HWT	FIELD OFFICE	: RUTHERFORD			
CASING THICKNESS:		.5	RECORDED BY	: M CRANE			
BIT SIZE	:	9.6	BOREHOLE FLUID	: 0		FILE	: PROCESSED
MAGNETIC DECL.	:	0	RM	: 0		TYPE	: 9804A
MATRIX DENSITY	:	2.65	RM TEMPERATURE	: 0		LGDATE	: 09/21/18
NEUTRON MATRIX	:	SANDSTONE	MATRIX DELTA T	: 177		LGTIME	: 12:10
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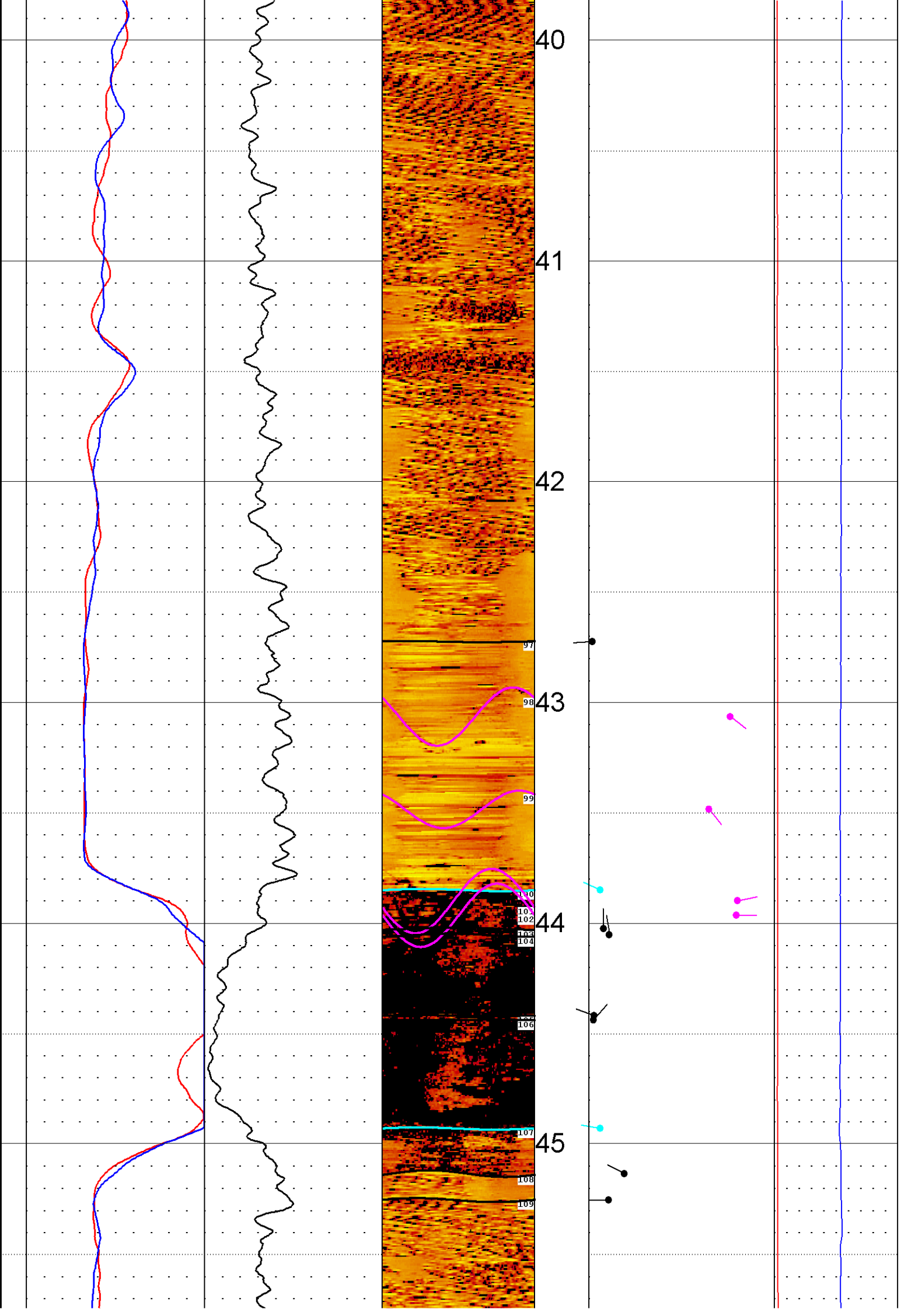
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

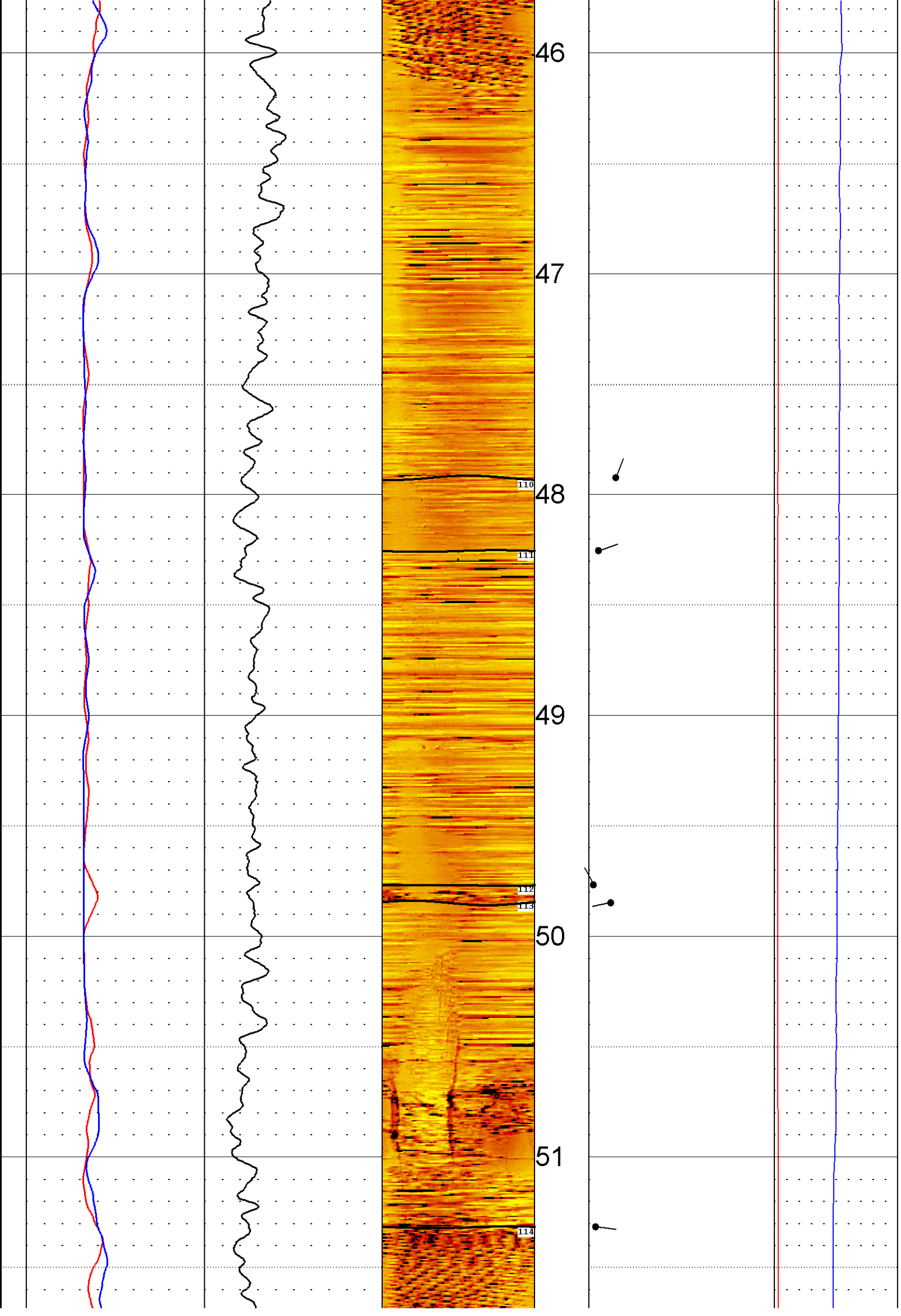

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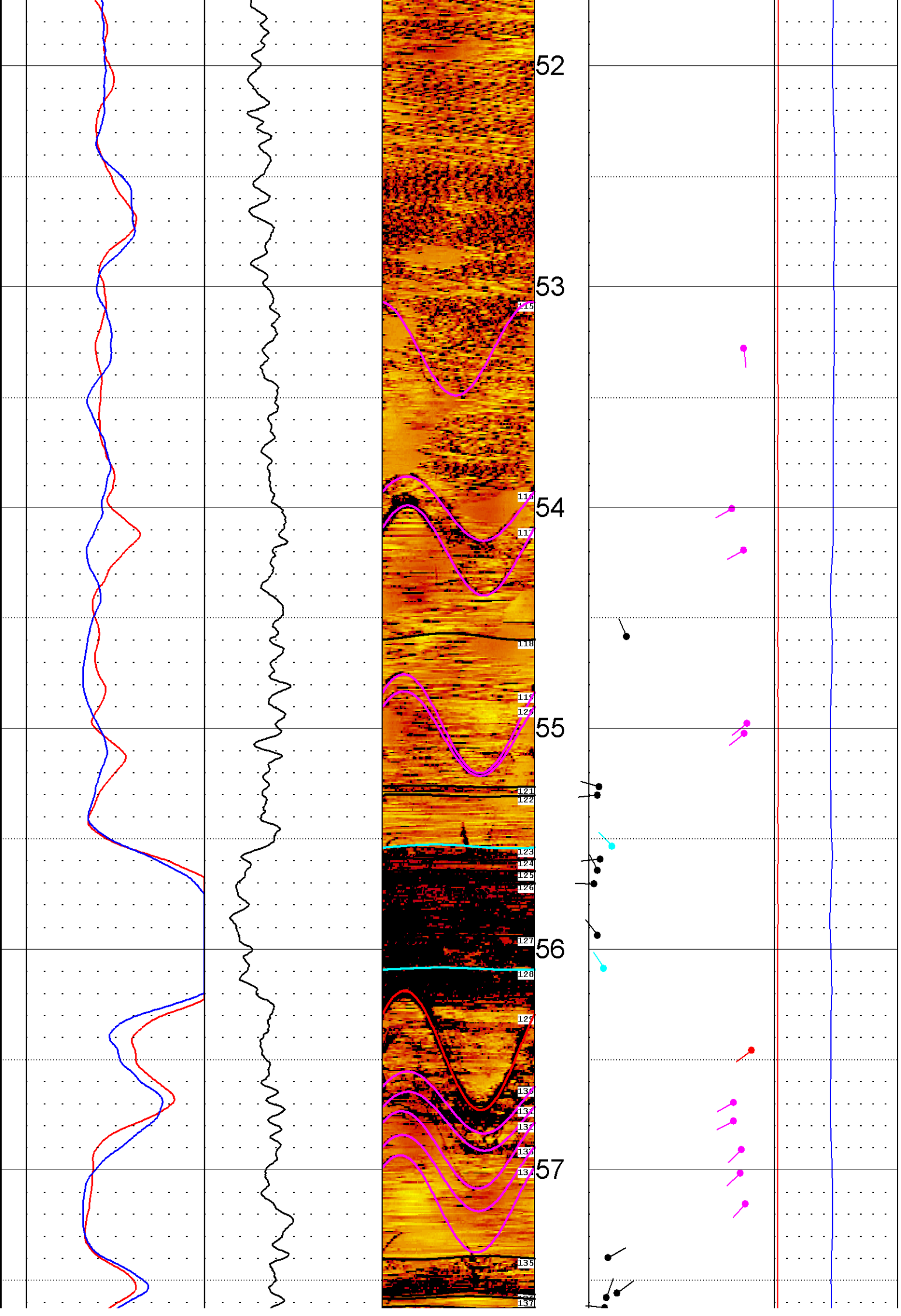

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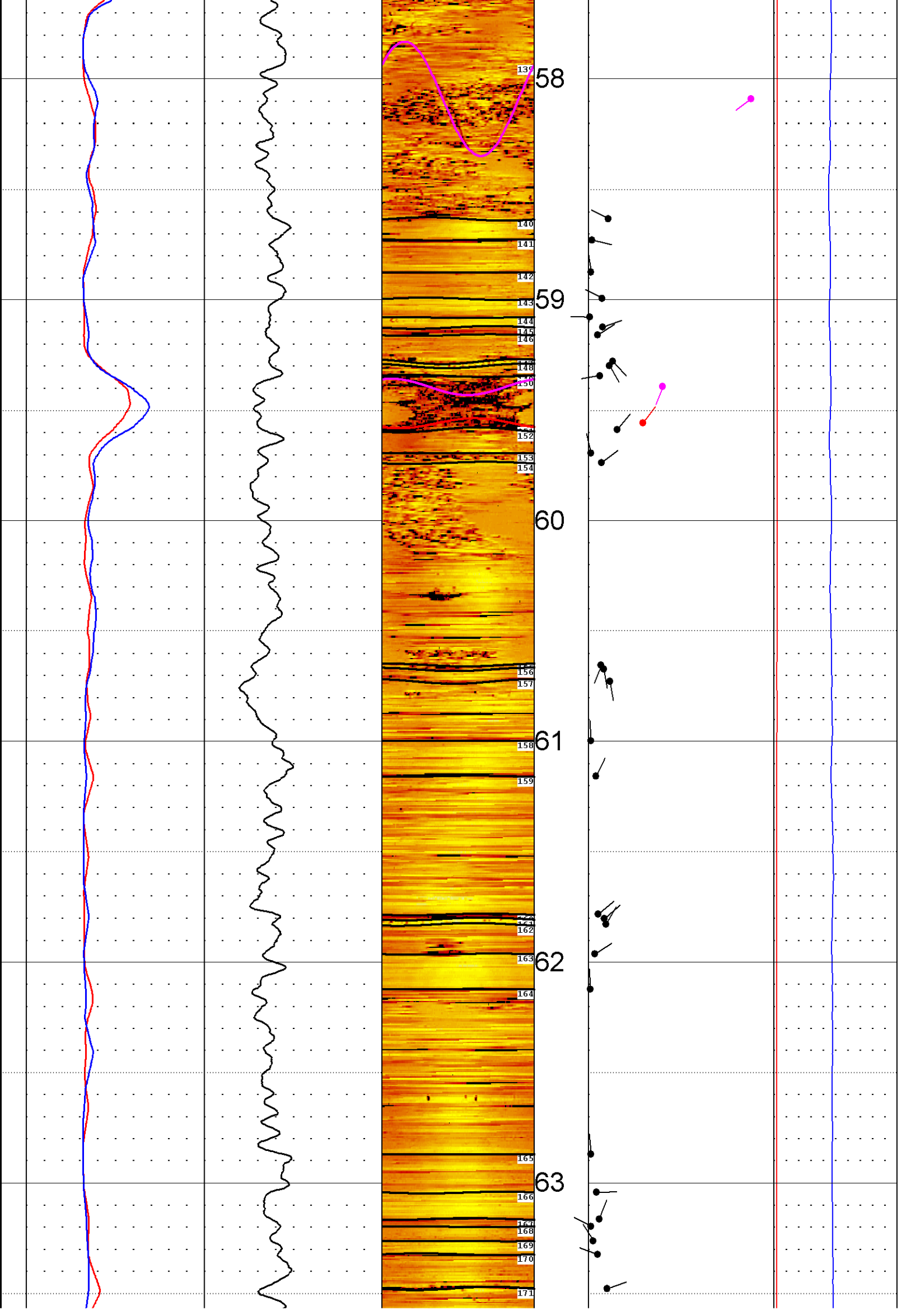

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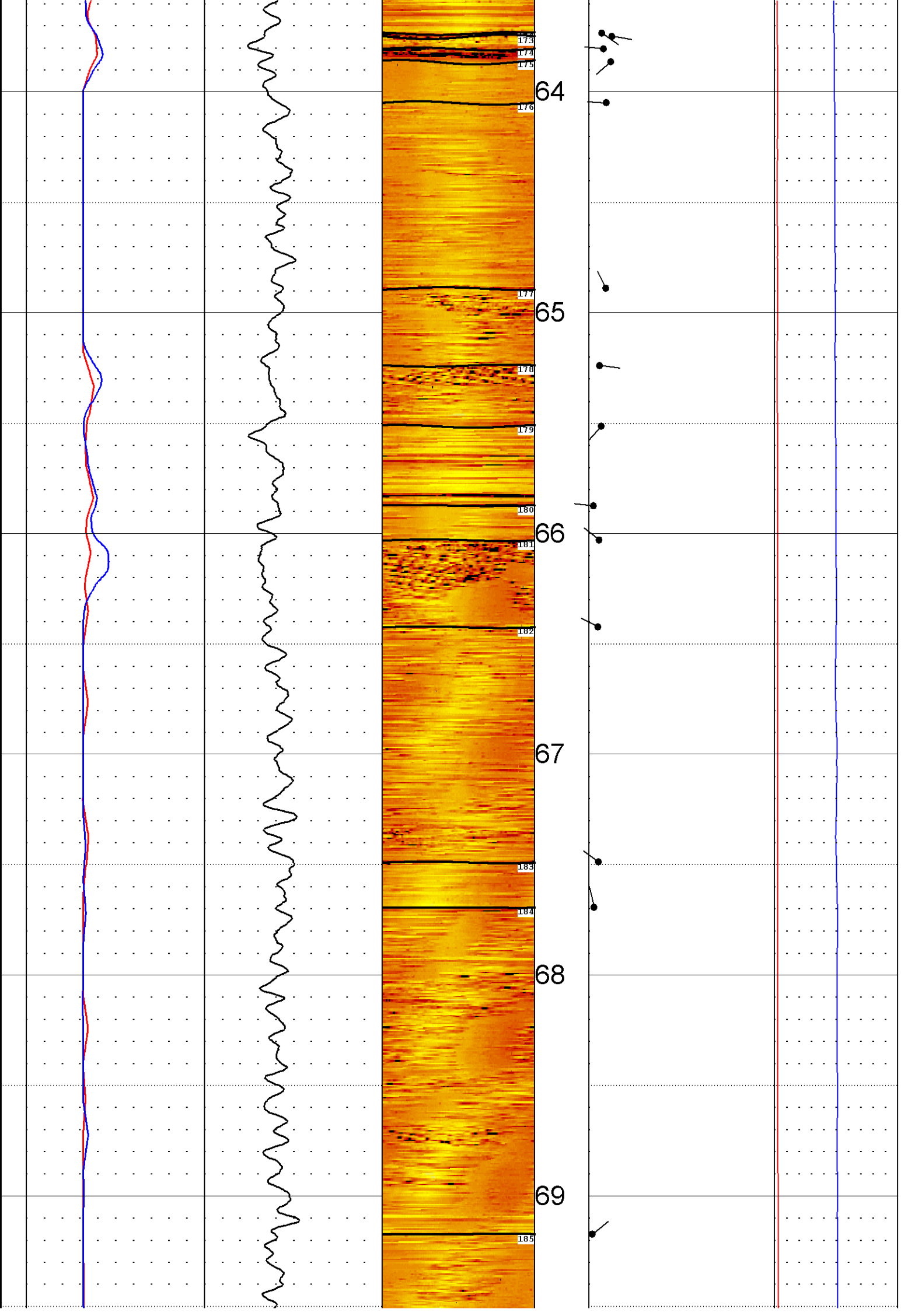

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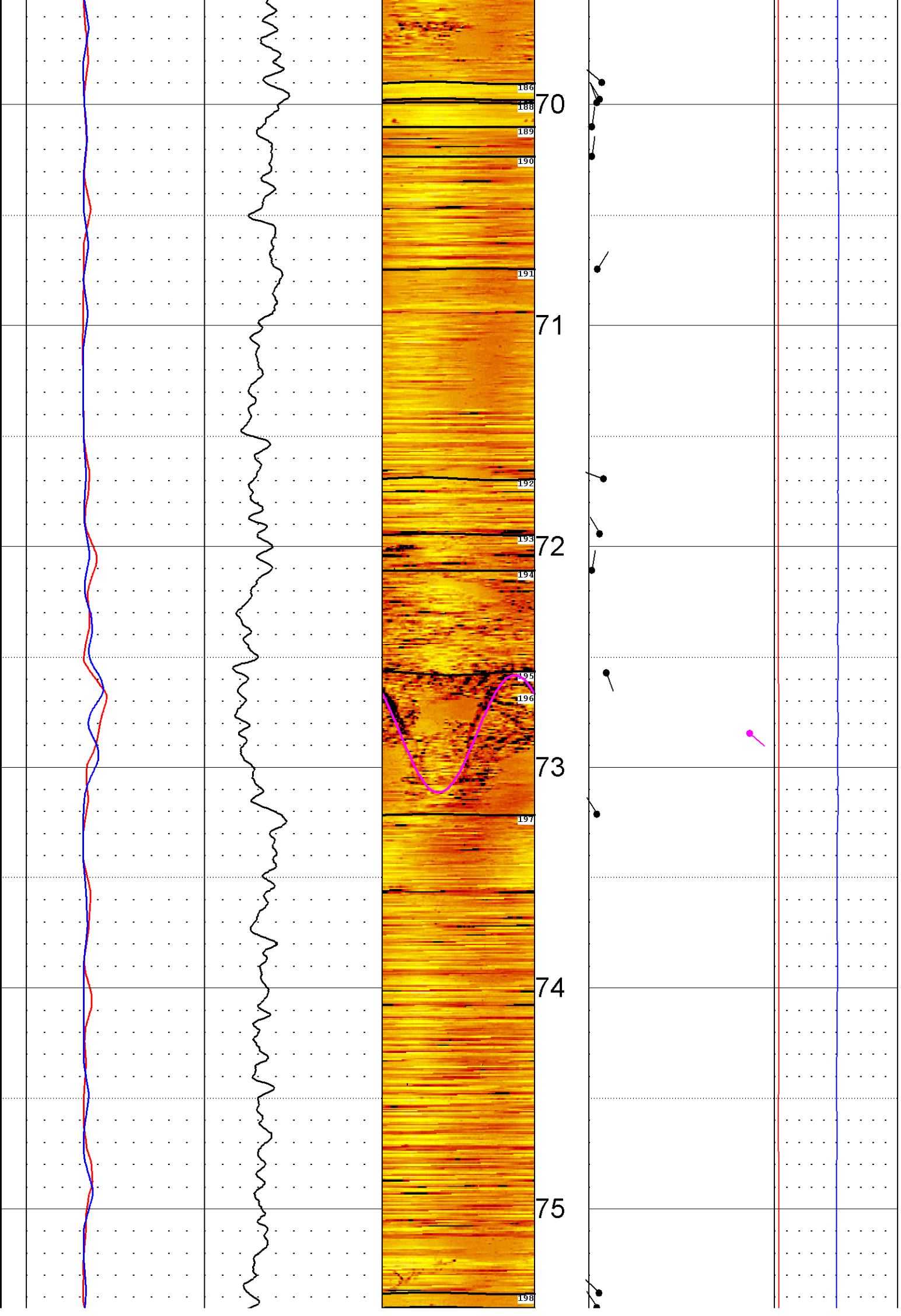

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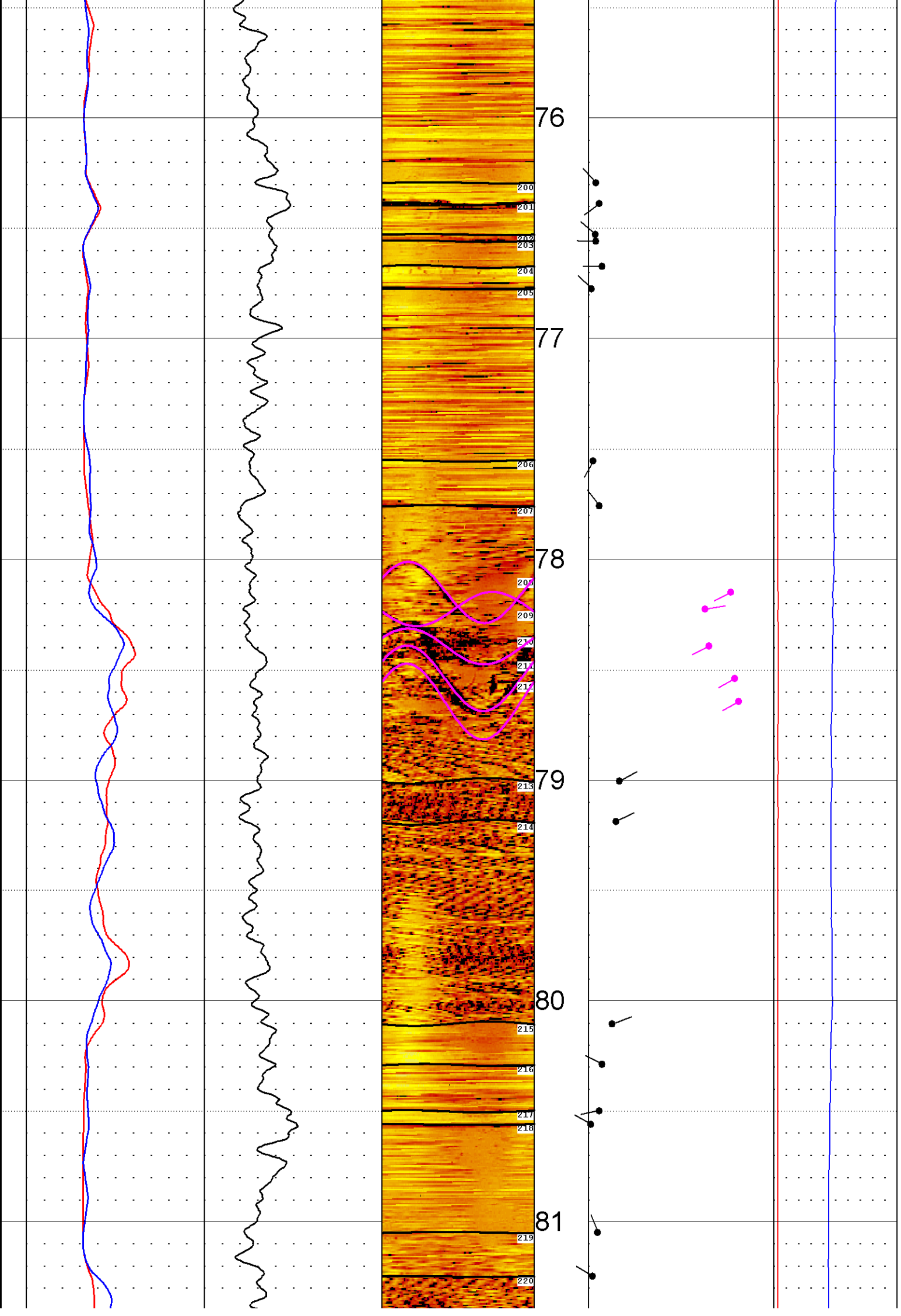

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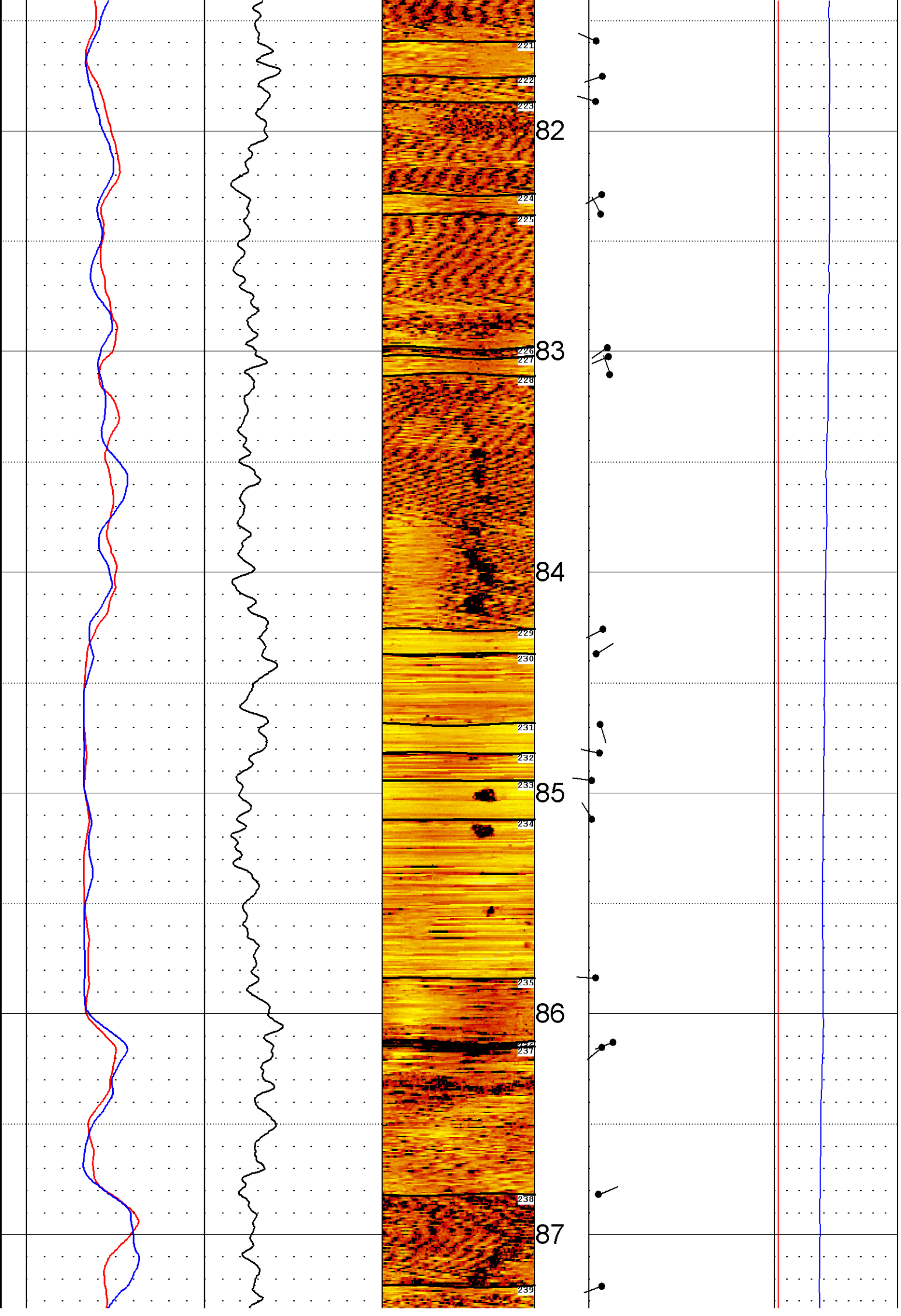

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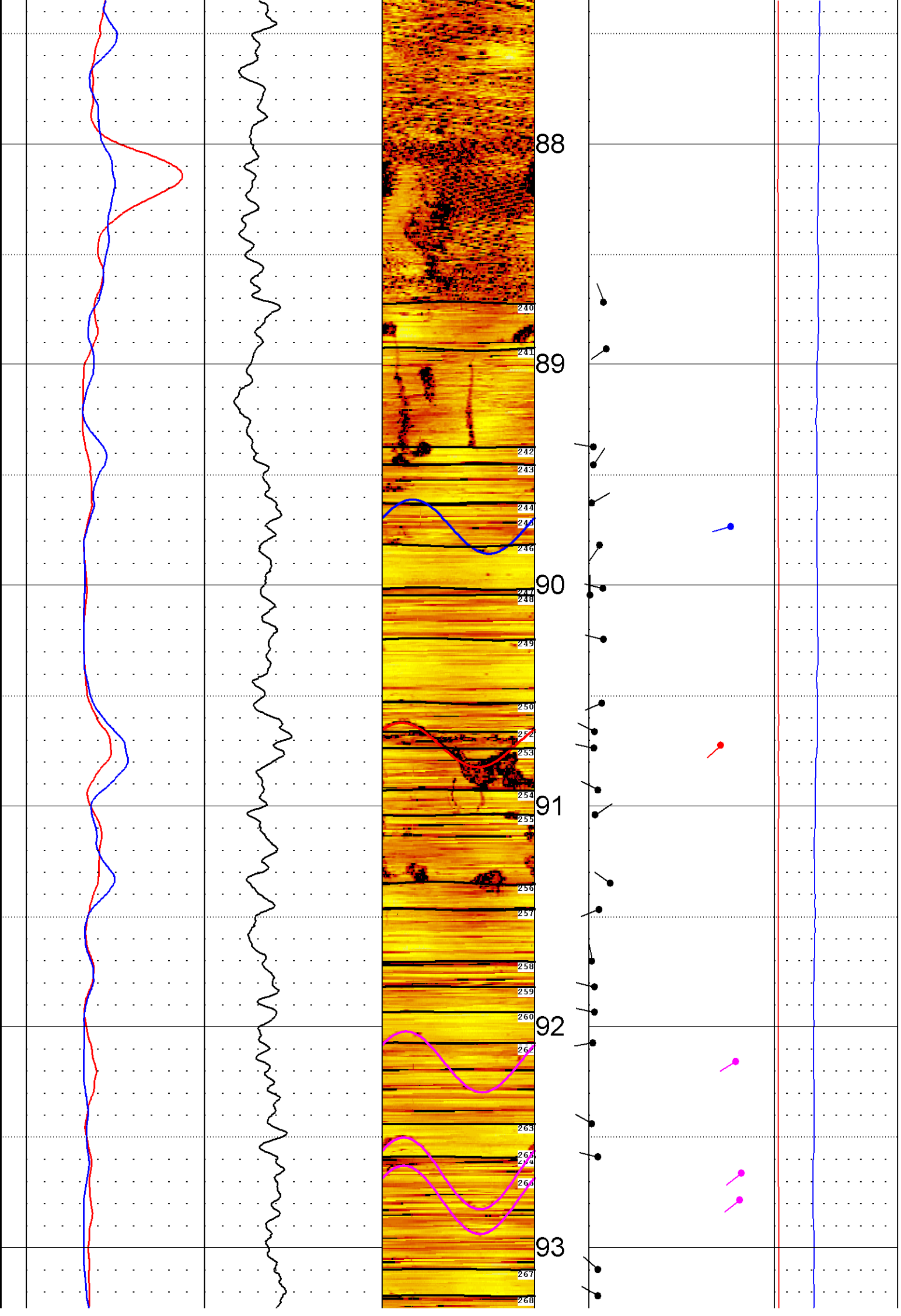

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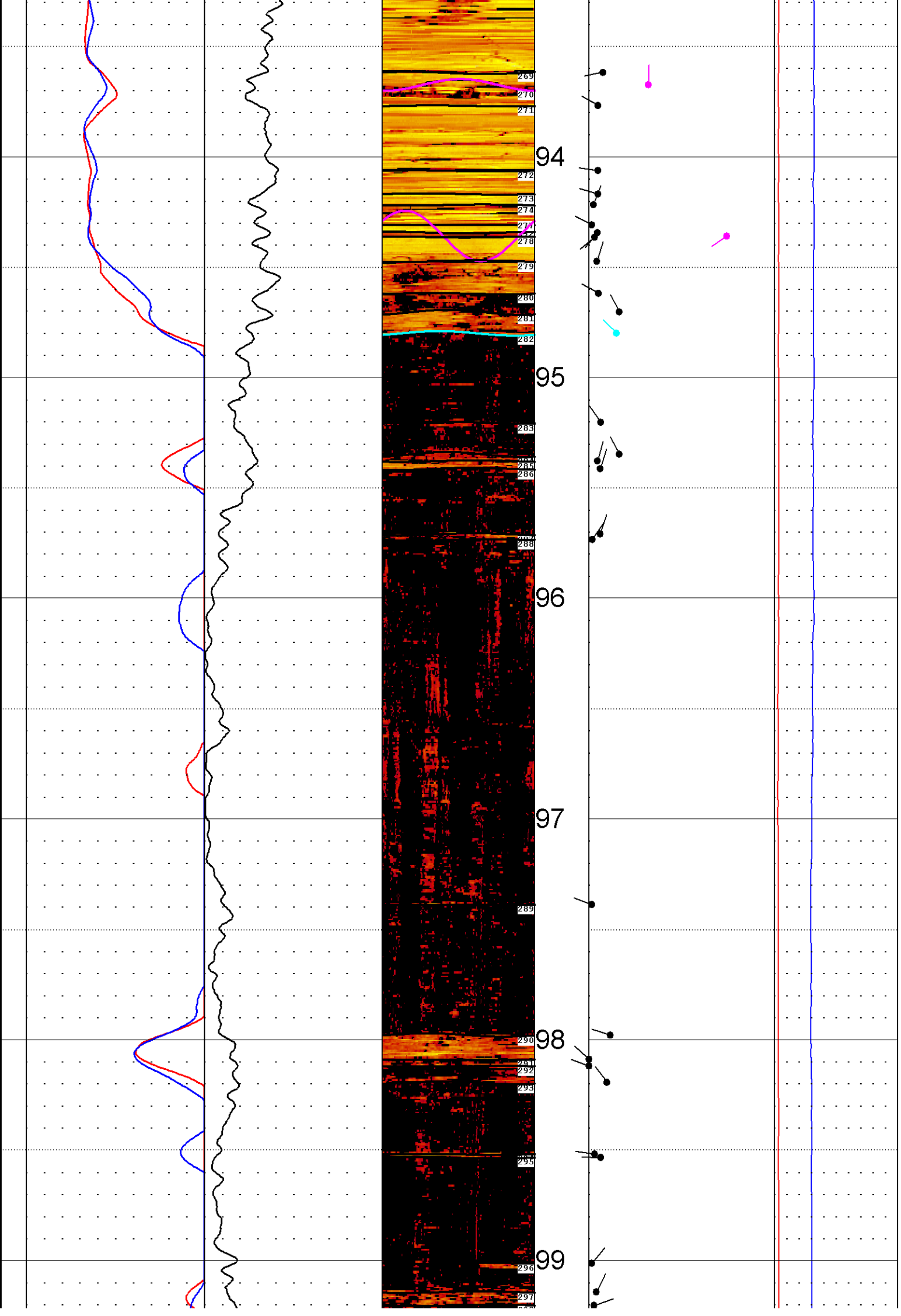

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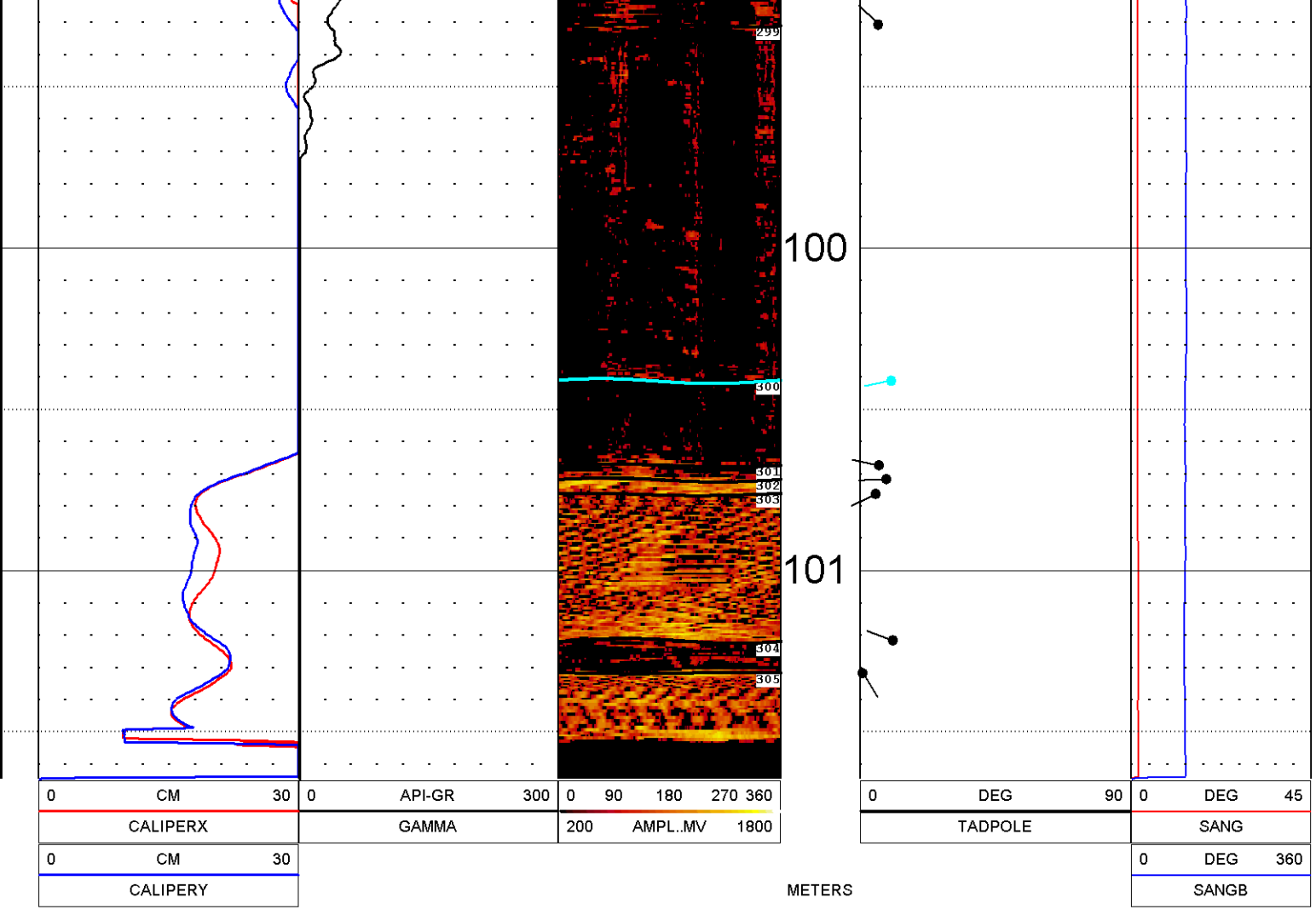

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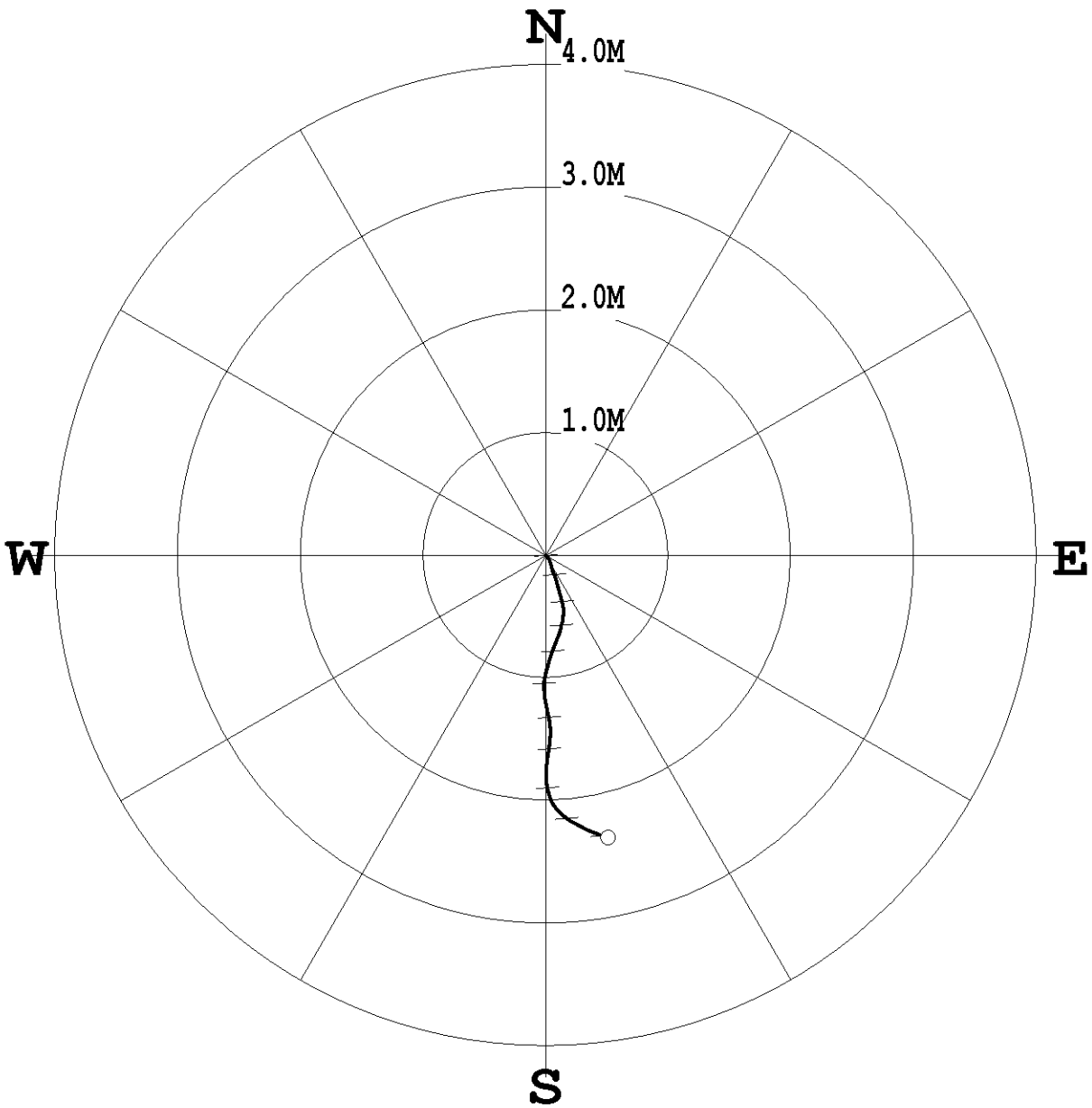

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0 API-GR 300
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0 90 180 270 360
200 AMPL..MV 1800
0 DEG 90
TADPOLE
0 DEG 45
SANG
0 DEG 360
SANGB
METERS

PLAN VIEW
COMPU-LOG DEVIATION

CLIENT: COFFEY
LOCATION: NBN
HOLE ID: BH2A TELEVIEWER
DATE OF LOG: 09/21/18
PROBE: 9804A 4402

MAG DECL: 0.0

SCALE: 1 M/CM
TRUE DEPTH: 101.60 M
AZIMUTH: 167.5
DISTANCE: 2.4 M
+ = 10 M INCR
○ = BOTTOM OF HOLE



* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : COFFEY HOLE ID. : BH2A TELEVIEW
FIELD OFFICE : RUTHERFORD DATE OF LOG : 09/21/18
DATA FROM : NA PROBE : 9804A , 4402
MAG. DECL. : 0.000 DEPTH UNITS : METERS
LOG: BH2ATELEVIEWER_09-21-18_12-10_9804A_.01_-0.73_101.64_DEVI.log

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
0.00	-0.00	-0.00	0.00	0.0	132.2	0.7	132.2
10.00	10.00	-0.16	0.07	0.2	156.2	1.4	158.0
20.00	20.00	-0.37	0.13	0.4	160.7	1.3	164.5
30.00	29.99	-0.57	0.13	0.6	167.3	1.2	196.9
40.00	39.99	-0.78	0.05	0.8	176.0	1.4	199.0
50.00	49.99	-1.04	-0.01	1.0	180.8	1.6	186.3
60.00	59.98	-1.32	0.02	1.3	178.9	1.5	171.3
70.00	69.98	-1.58	0.03	1.6	179.1	1.7	189.4
80.00	79.98	-1.89	0.01	1.9	179.6	1.8	174.4
90.00	89.97	-2.14	0.17	2.1	175.4	1.9	128.2
100.00	99.97	-2.28	0.46	2.3	168.7	2.0	111.6
101.64	101.58	-2.30	0.51	2.4	167.5	2.1	111.7

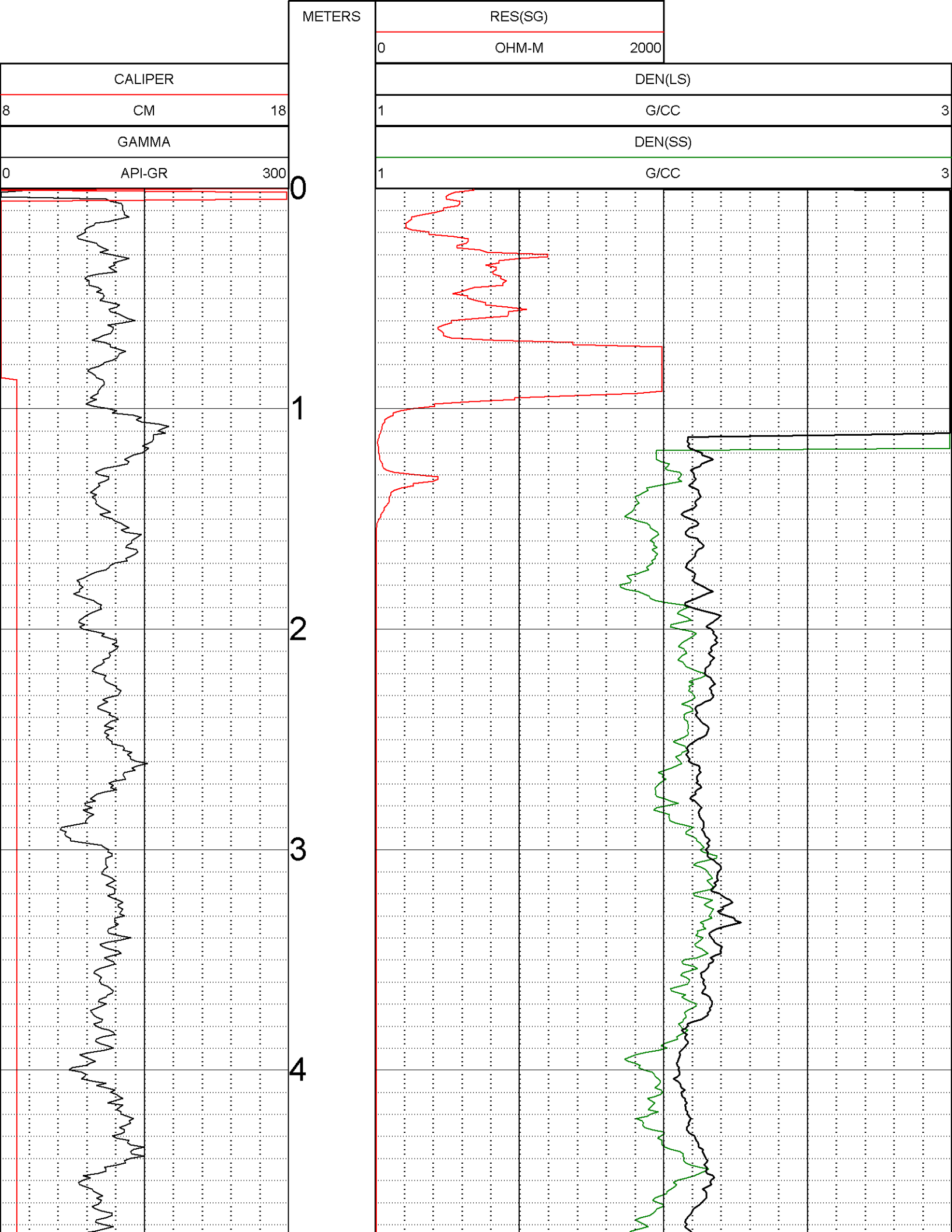


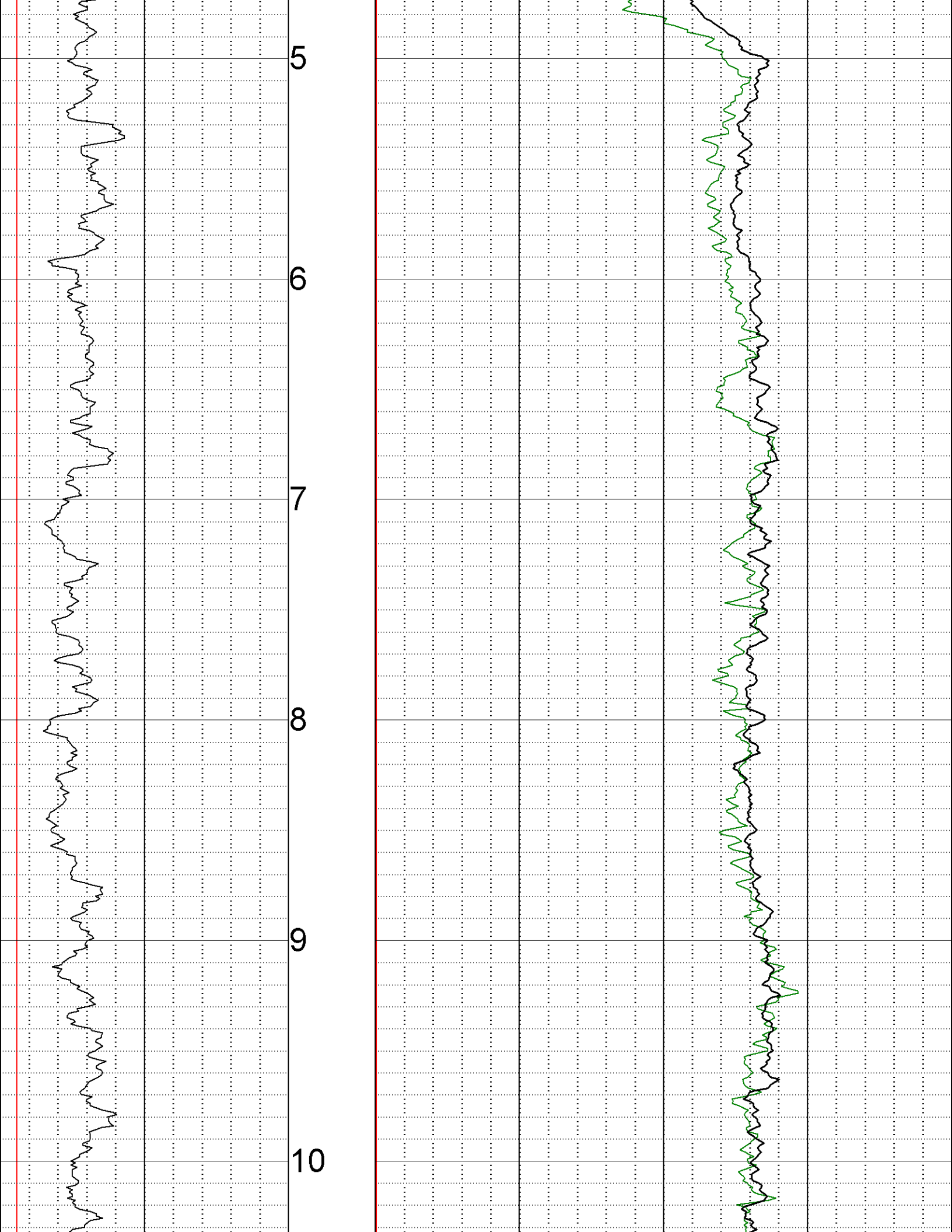
BH2A DENSITYC 1:20

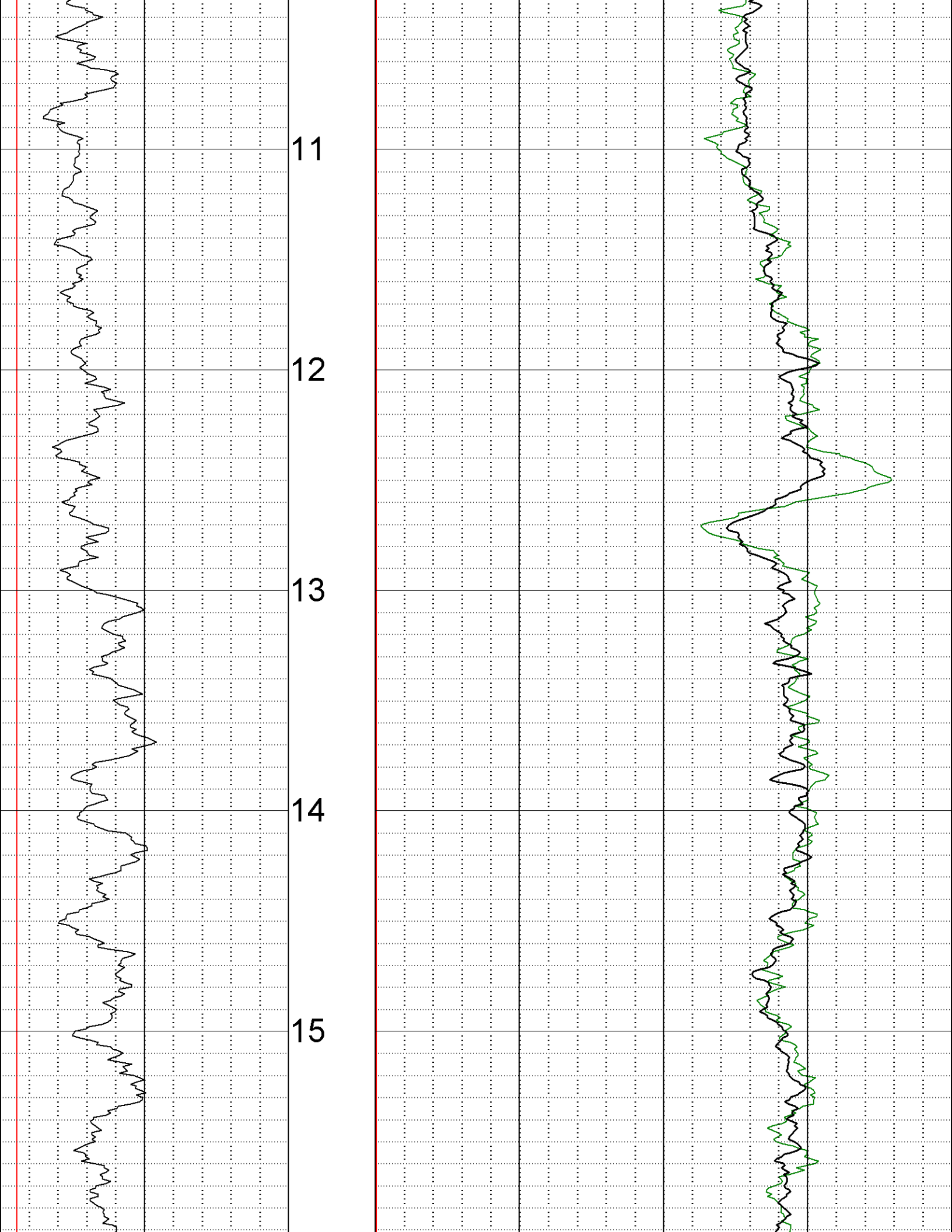
COMPANY	:	COFFEY				OTHER SERVICES:	
WELL	:	BH2A DENSITYC 1:20				DEN TV	
LOCATION/FIELD	:	NBN					
COUNTRY	:	AUST					
LOCATION	:	NSW					
SECTION	:	NA	TOWNSHIP	:	NA	RANGE	: NA
DATE	:	09/21/18	PERMANENT DATUM	:	-1.5		
DEPTH DRILLER	:	102				KB	: NA
LOG BOTTOM	:	100.55	LOG MEASURED FROM:		GL	DF	: NA
LOG TOP	:	-1.28	DRL MEASURED FROM:		GL	GL	: 0
CASING DIAMETER	:	10.	LOGGING UNIT	:	121		
CASING TYPE	:	HWT	FIELD OFFICE	:	RUTHERFORD		
CASING THICKNESS:		.5	RECORDED BY	:	M CRANE		
BIT SIZE	:	9.60	BOREHOLE FLUID	:	0	FILE	: PROCESSED
MAGNETIC DECL.	:	0	RM	:	0	TYPE	: 9239B
MATRIX DENSITY	:	2.65	RM TEMPERATURE	:	0	LGDATE	: 09/21/18
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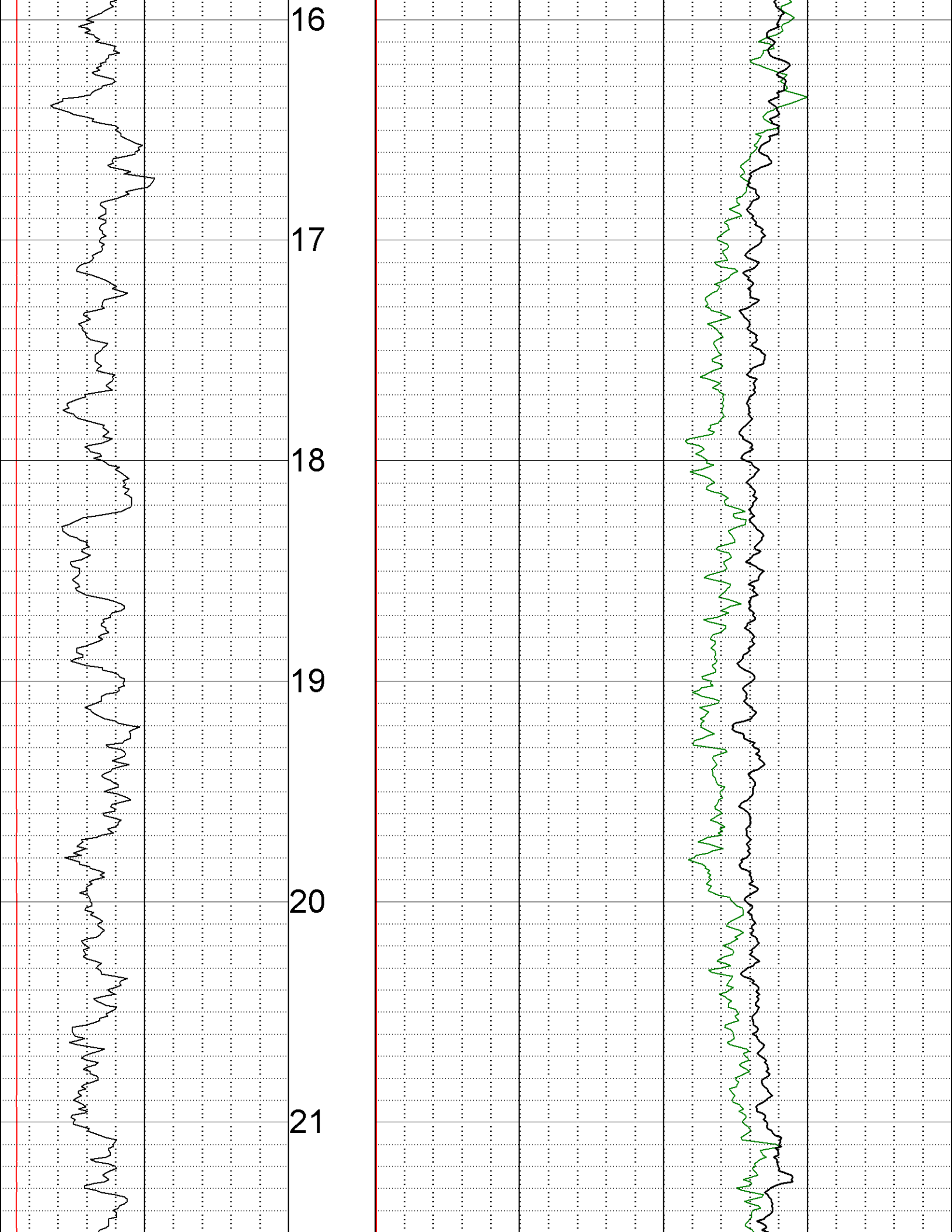
CORRECTED FOR STEEL

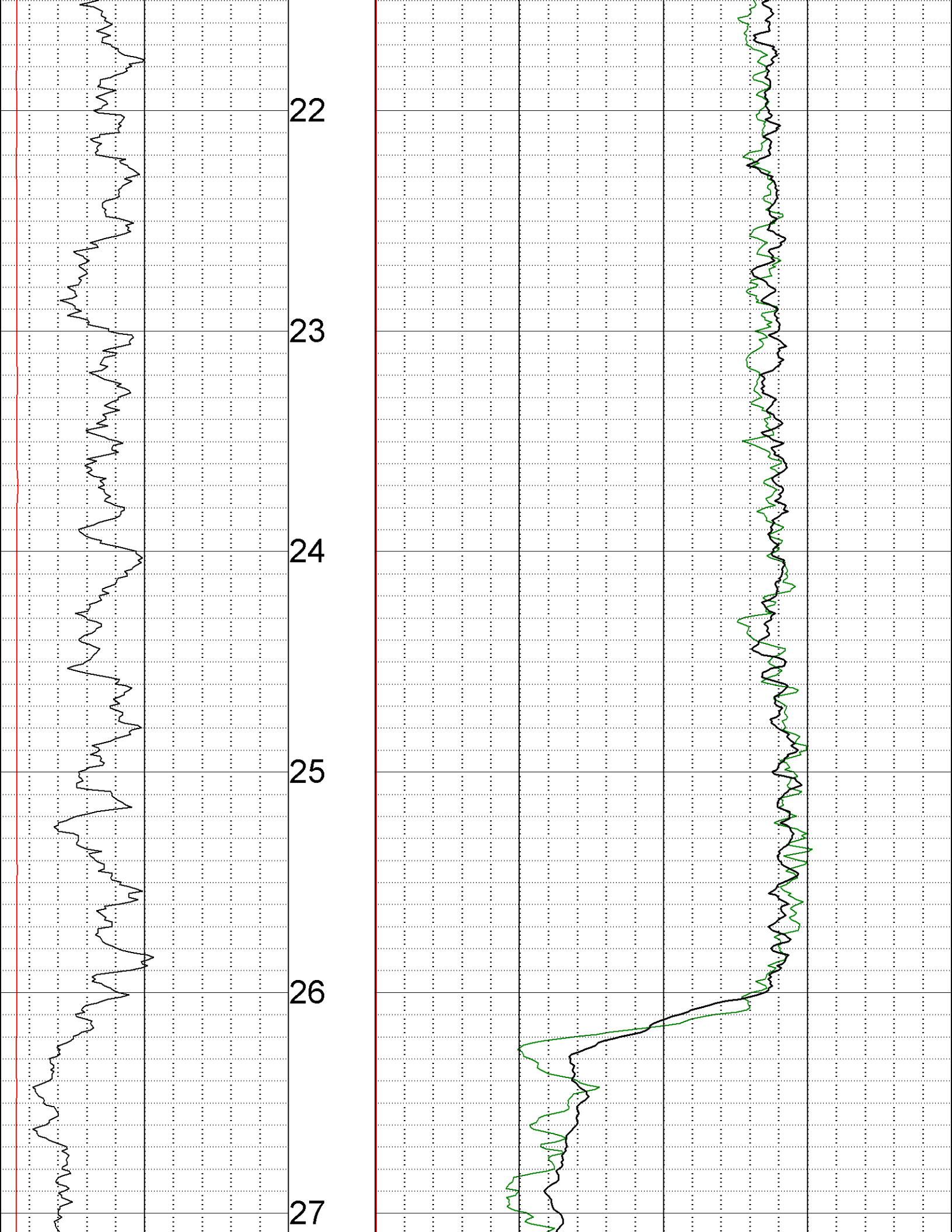
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

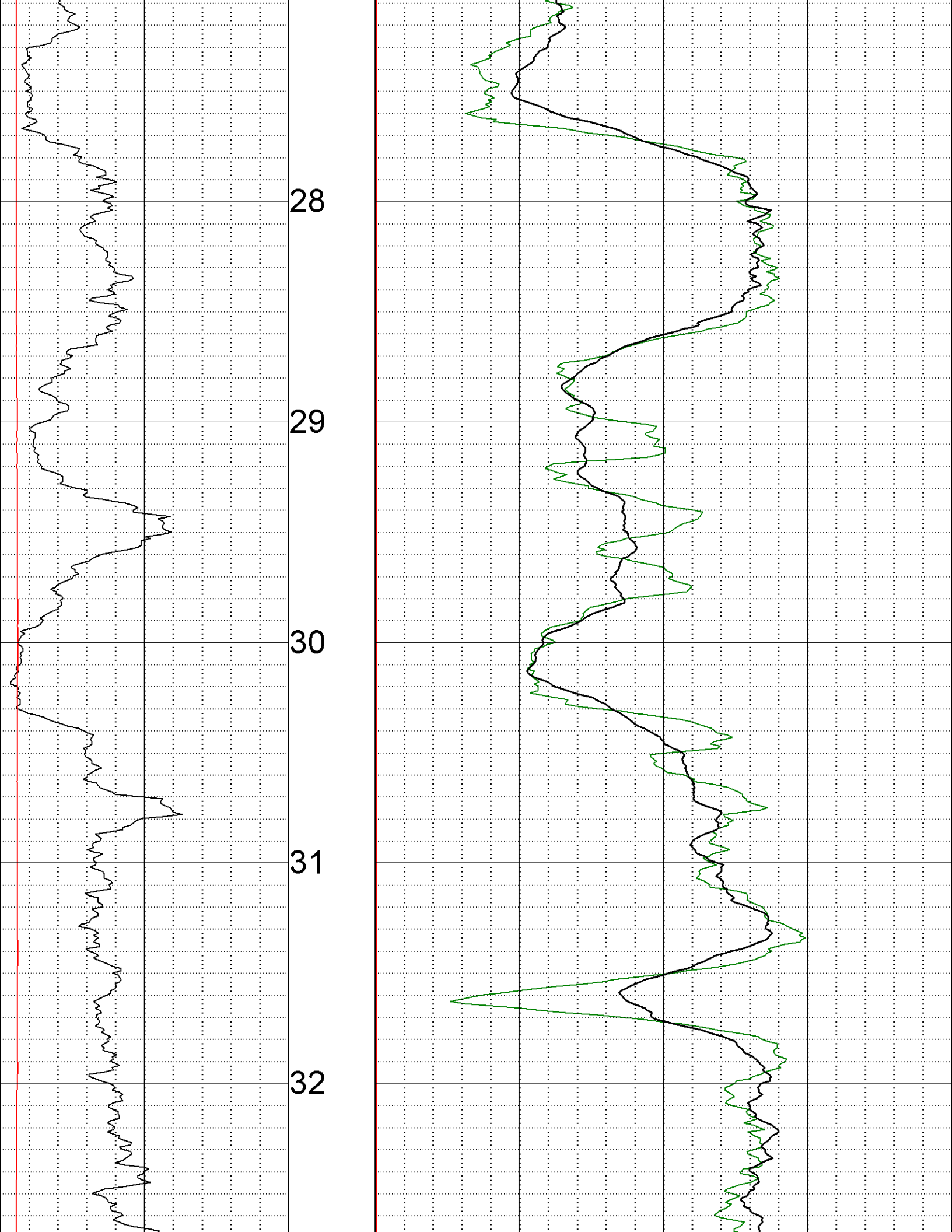

METERS
RES(SG)
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OHM-M
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CALIPER
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CM
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DEN(LS)
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G/CC
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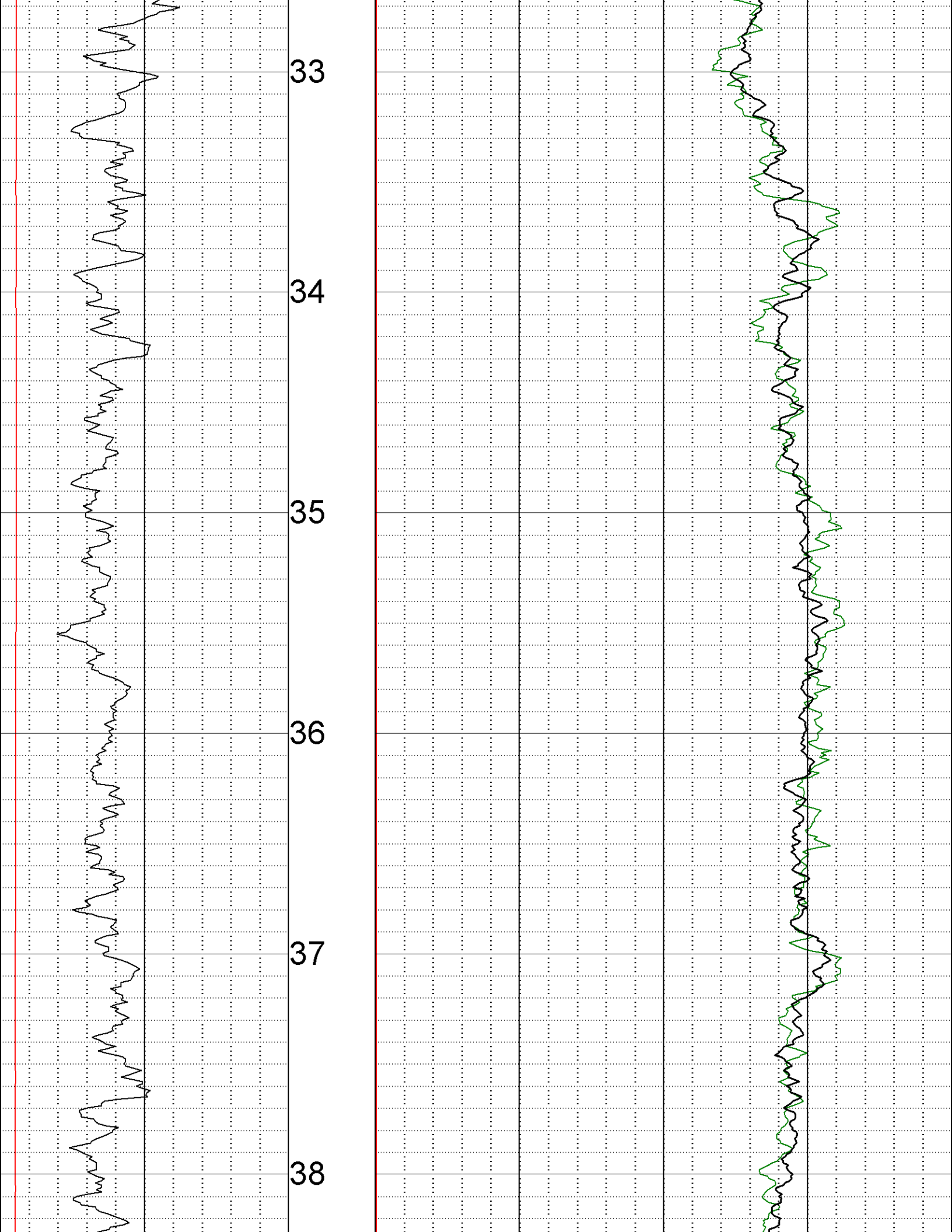

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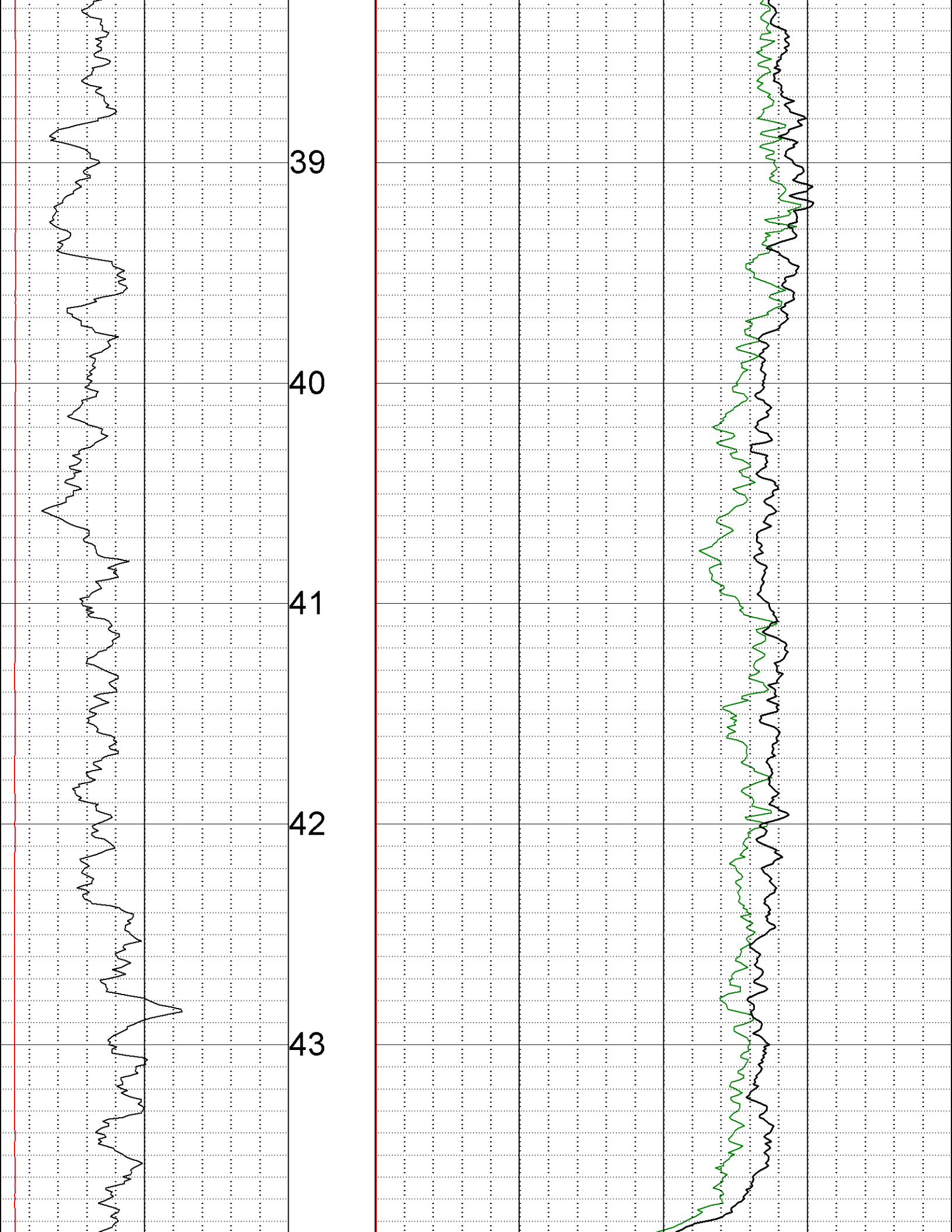

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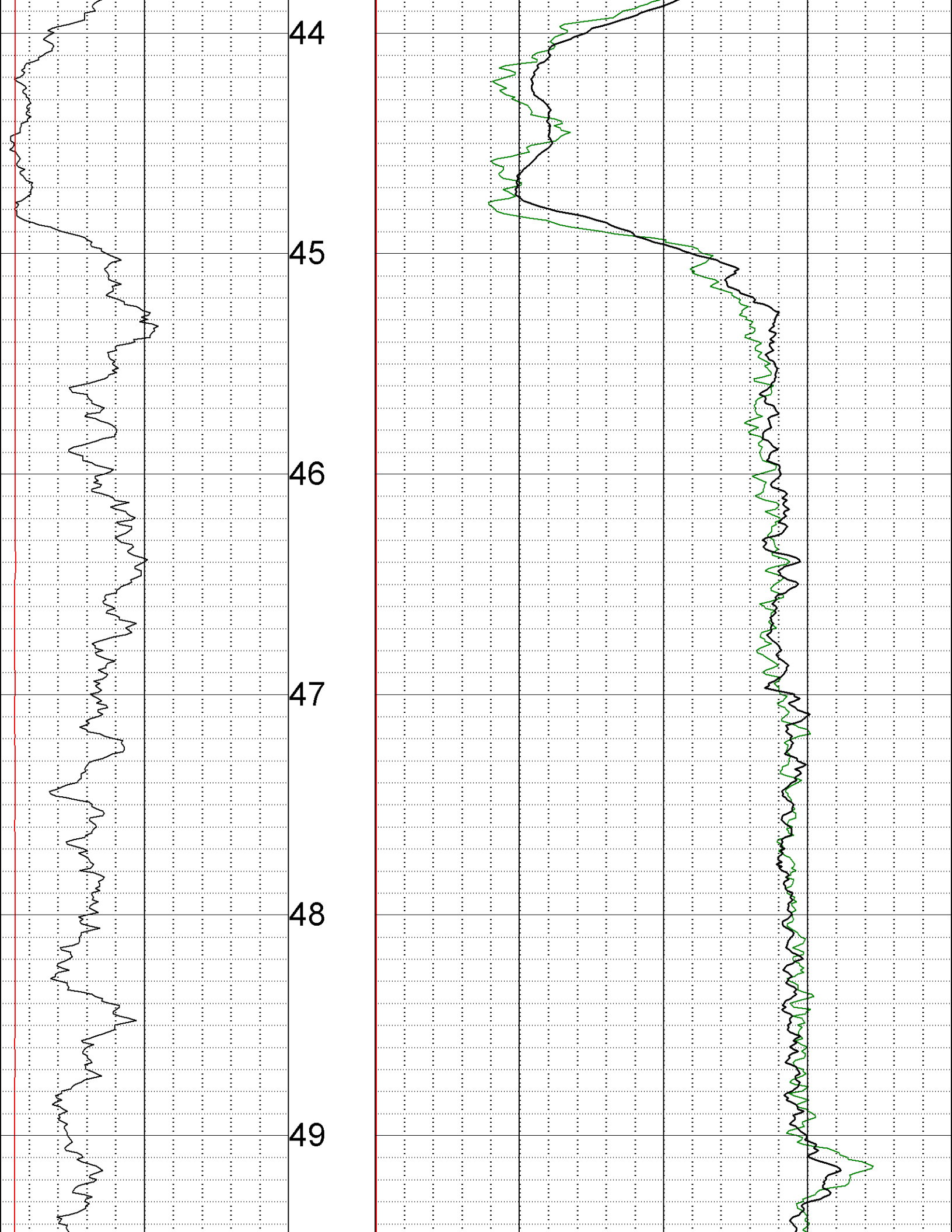

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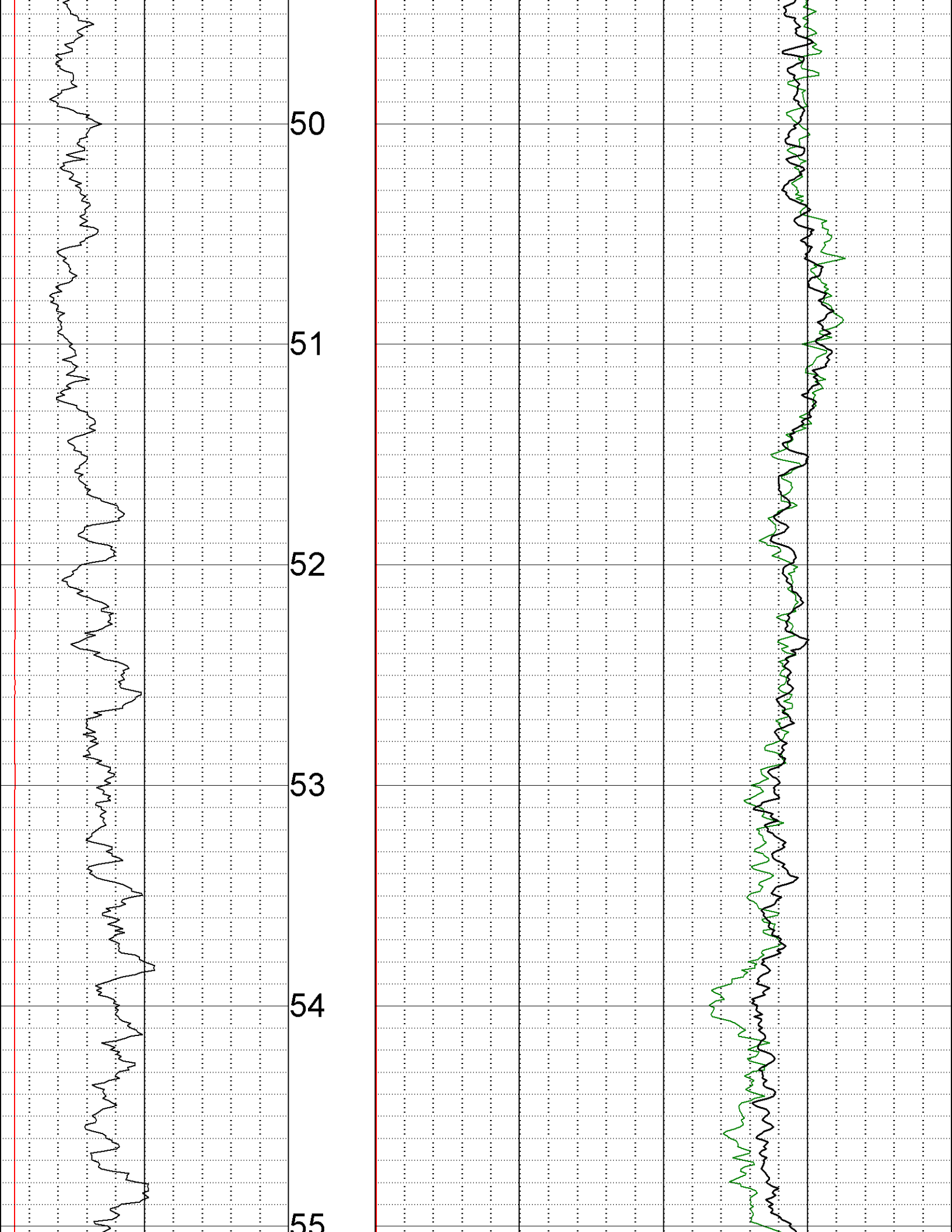

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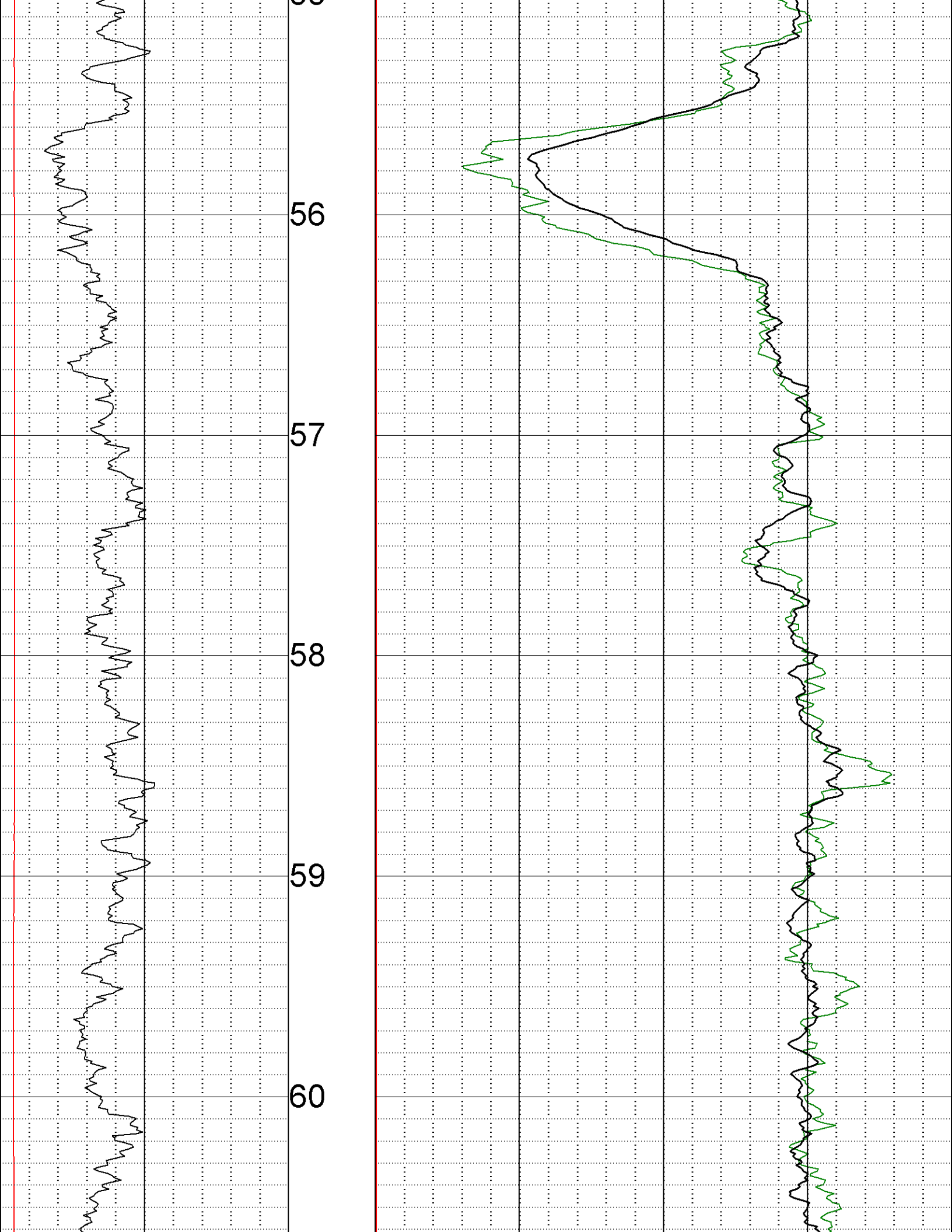

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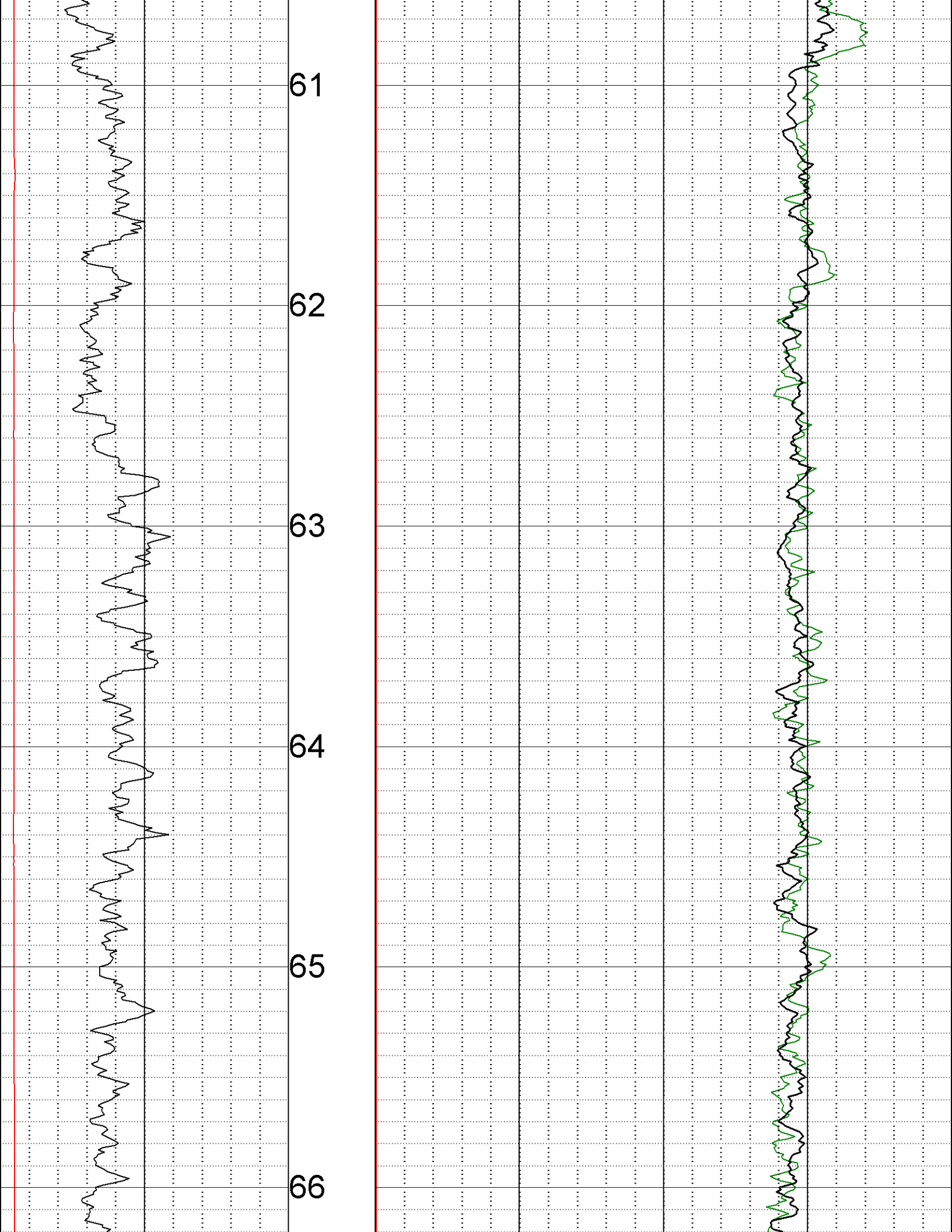

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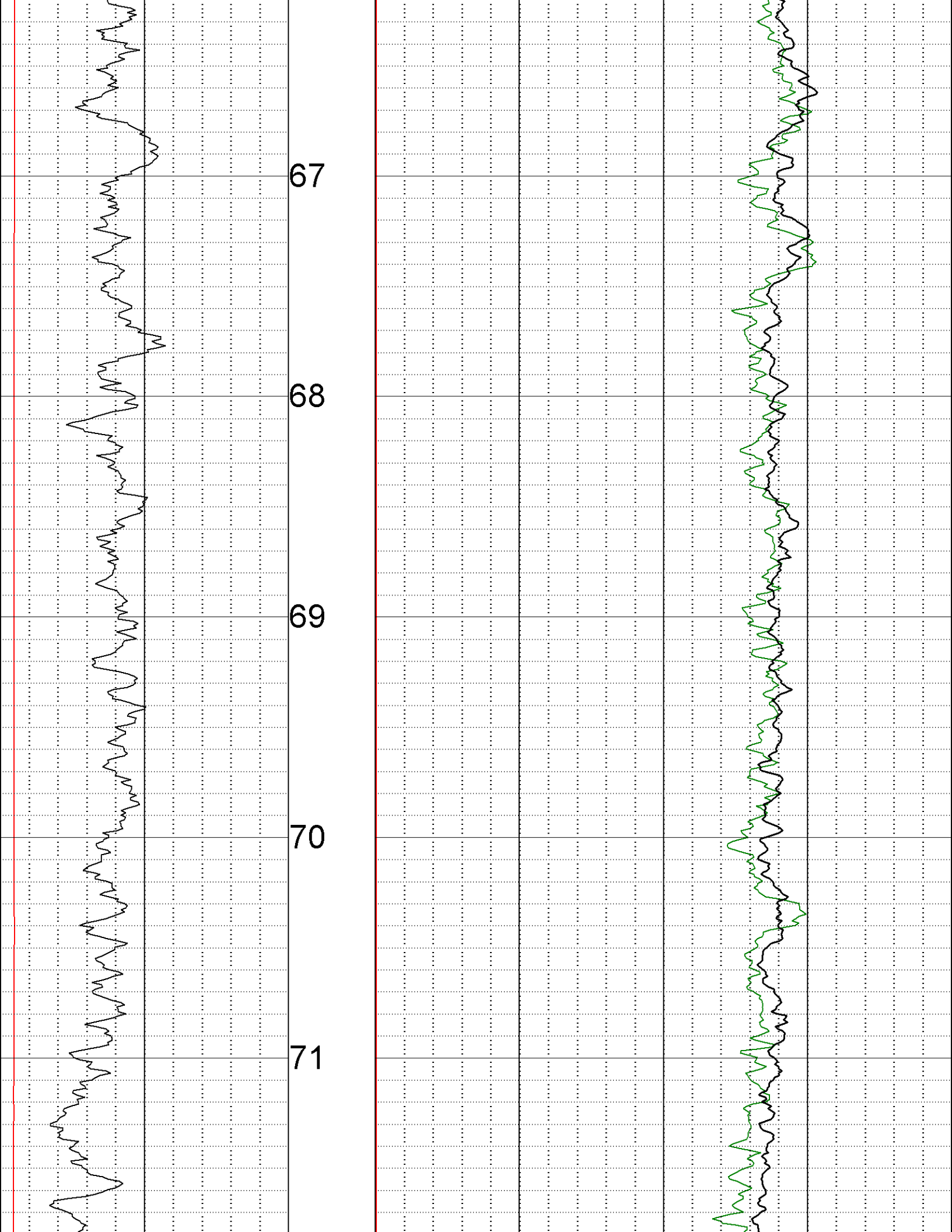

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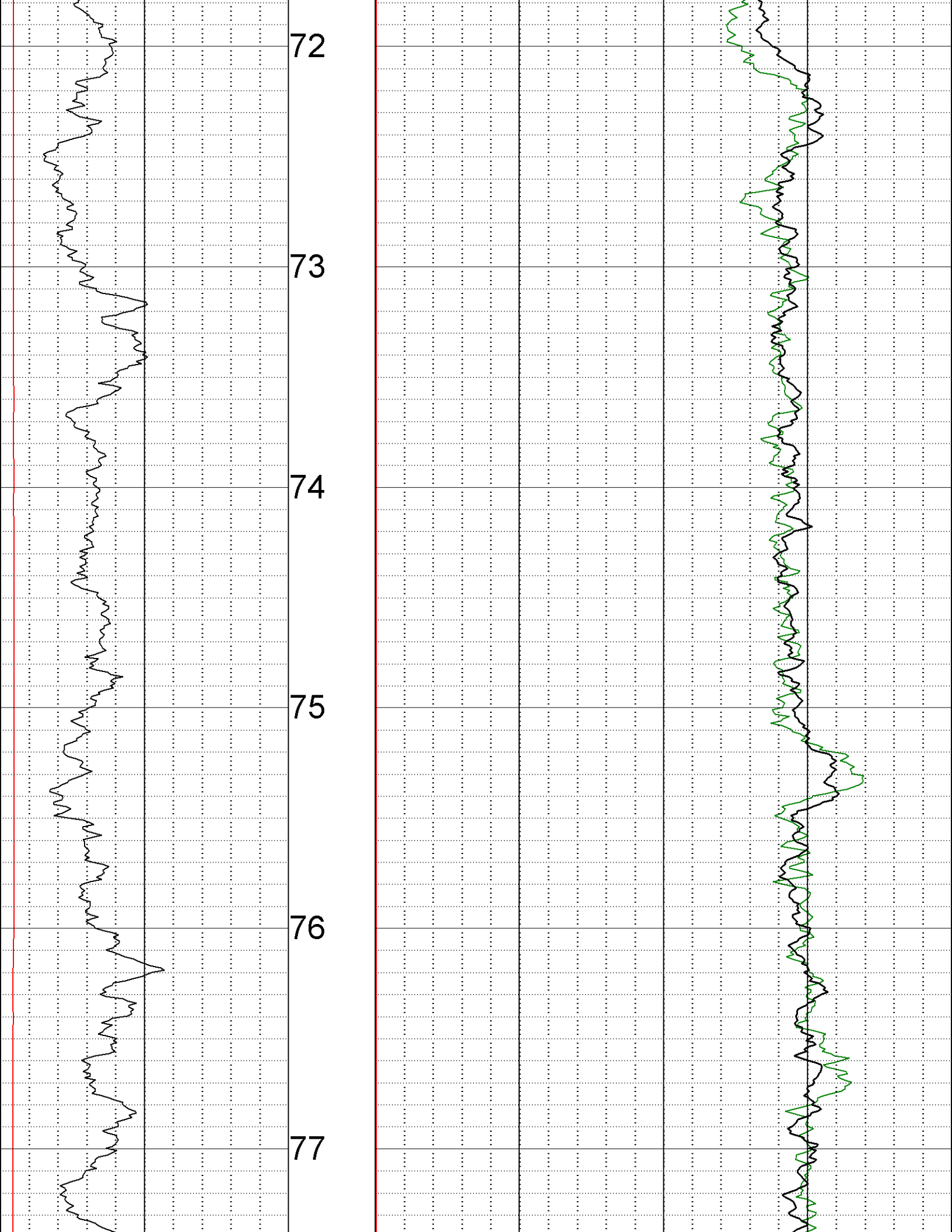

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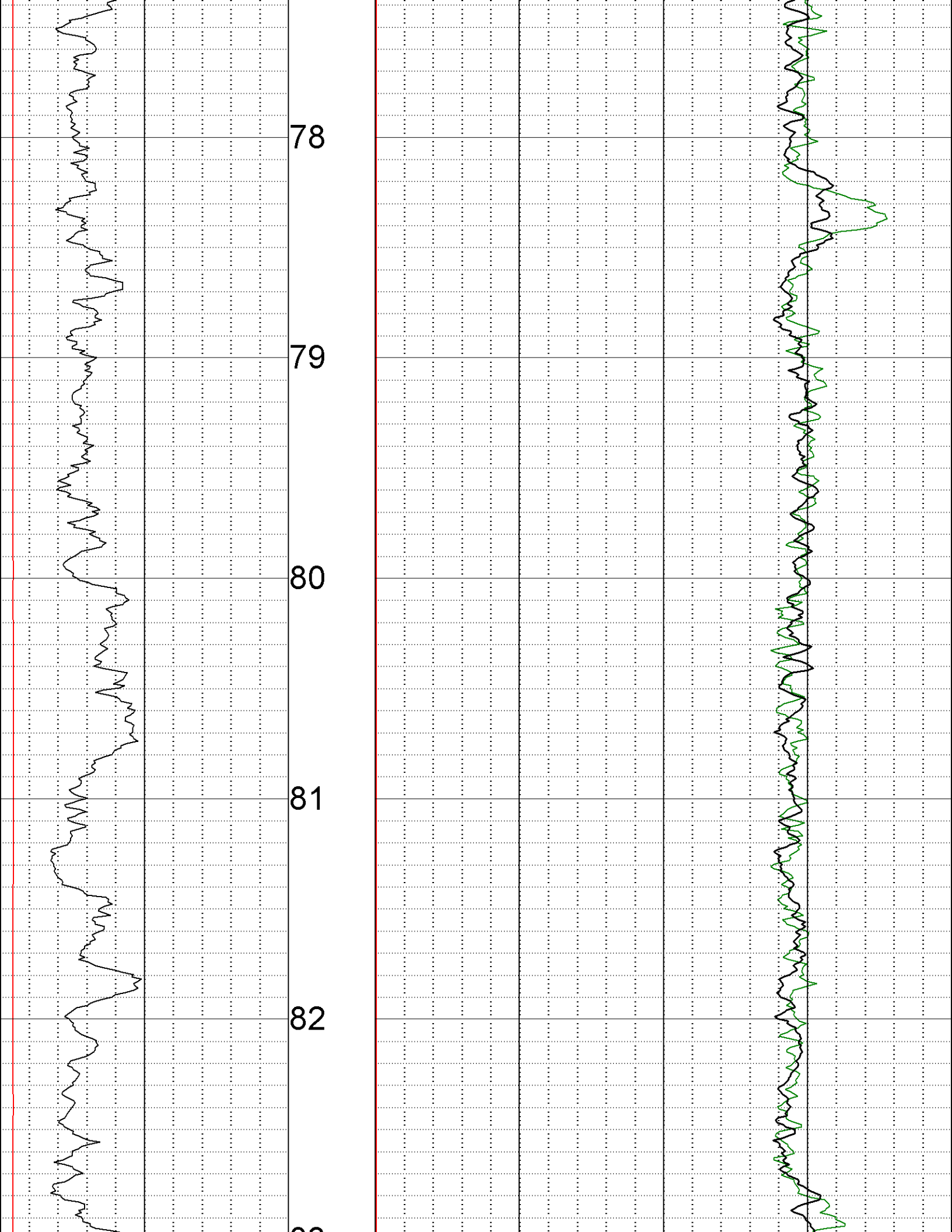

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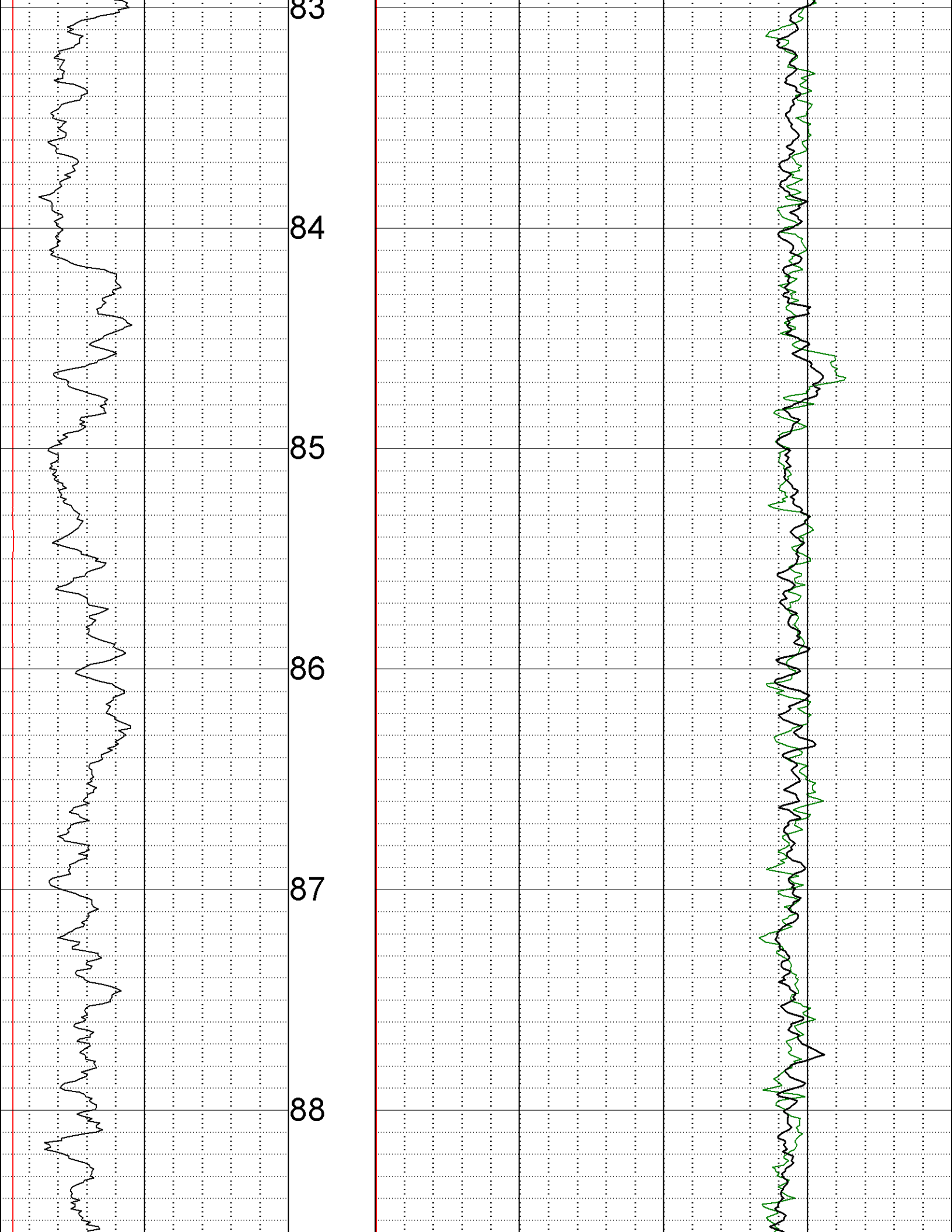

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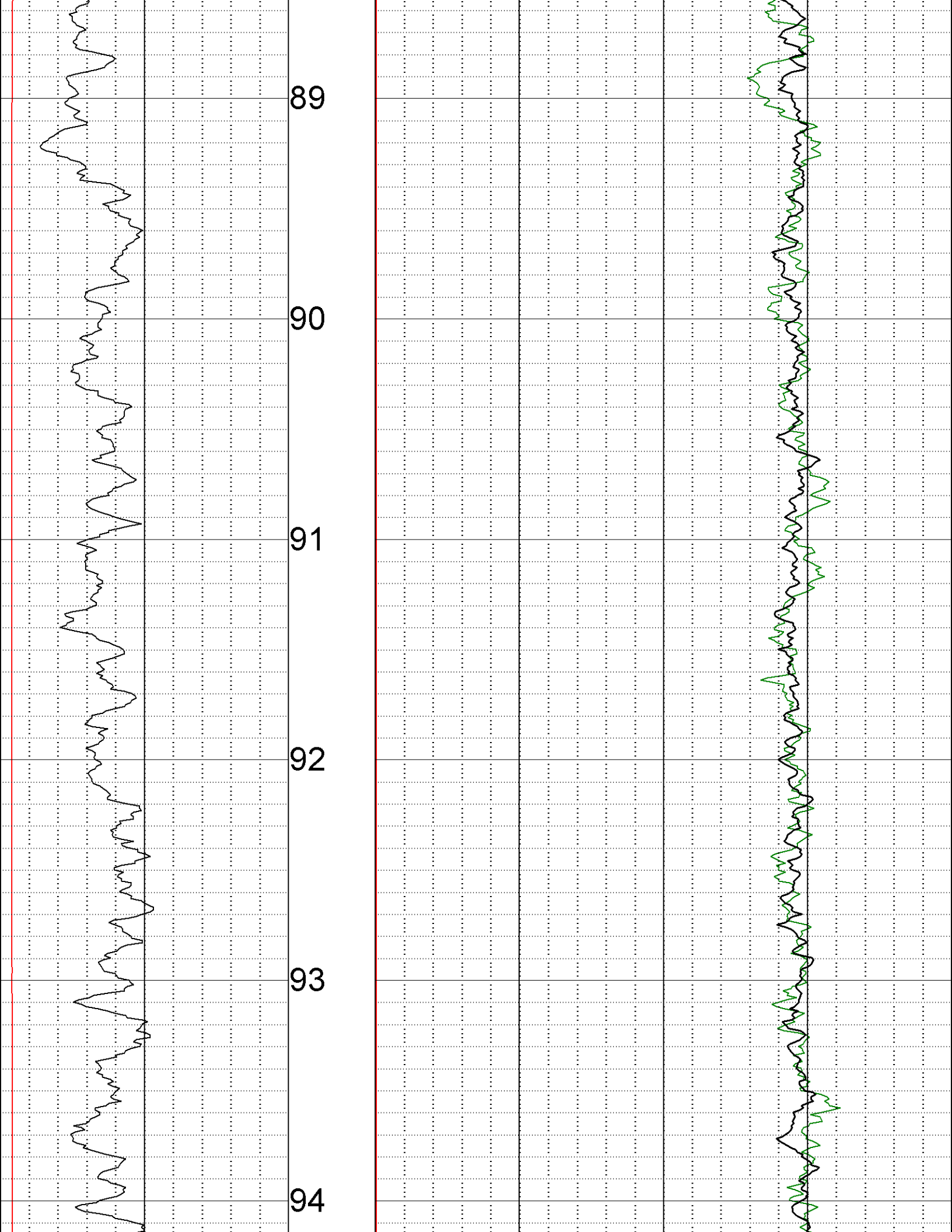

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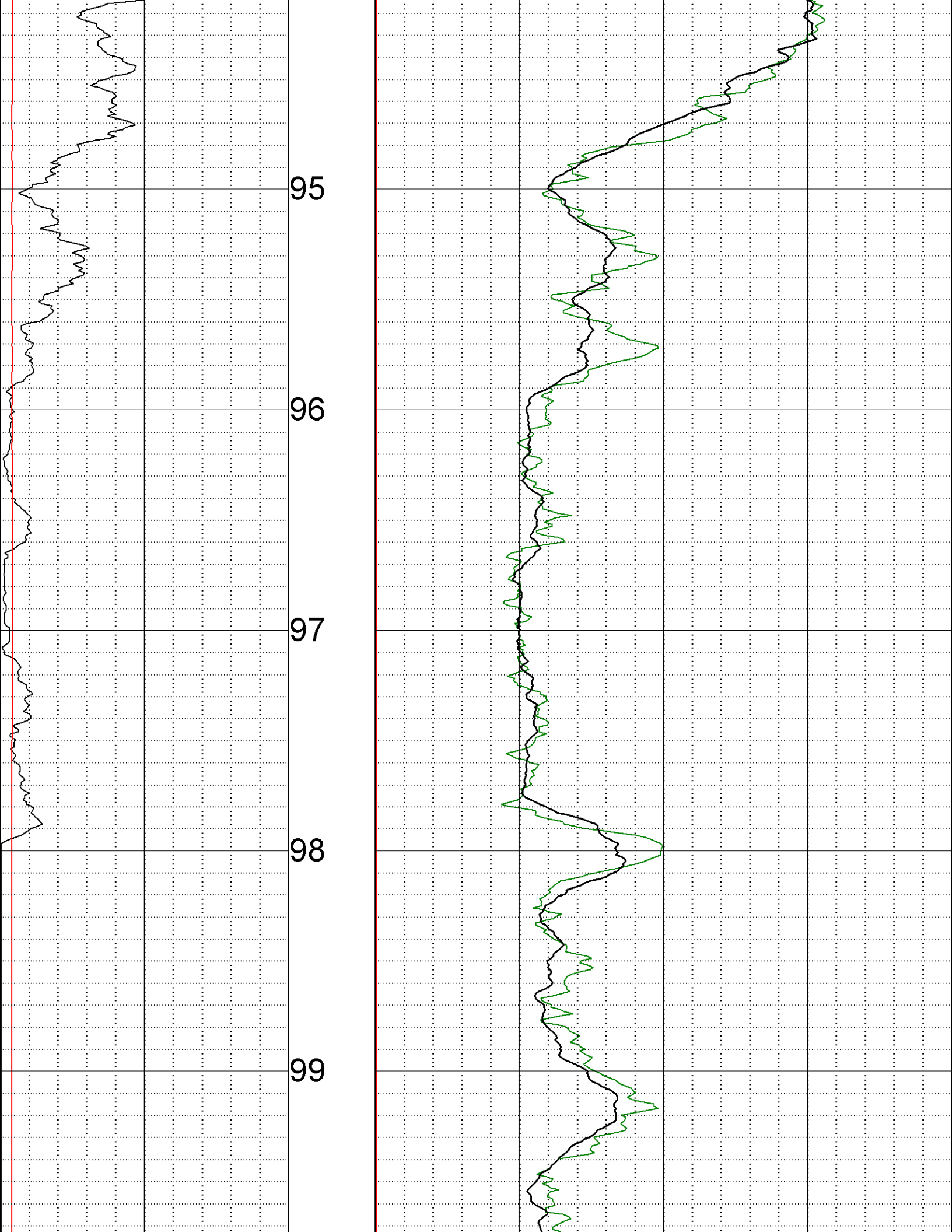

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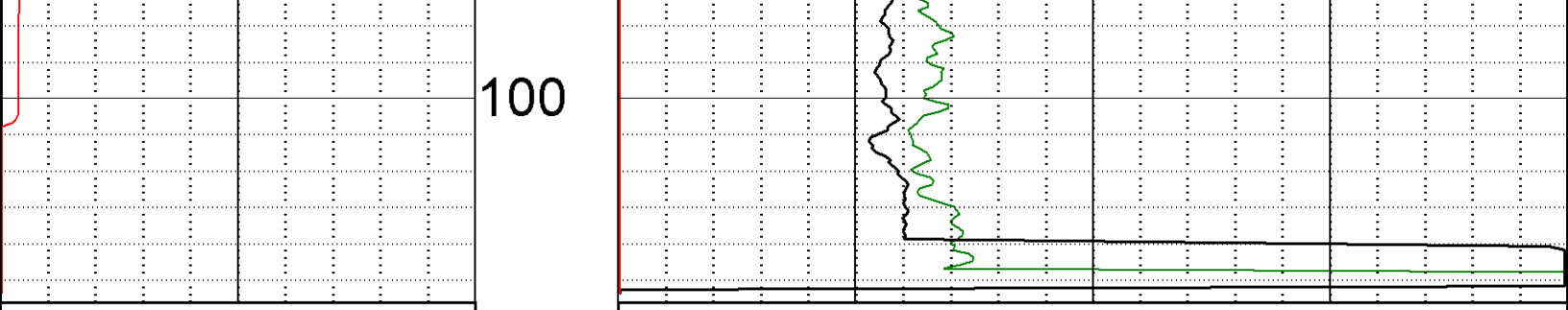

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8	CM	18
CALIPER		

1	G/CC	3
DEN(SS)		
1	G/CC	3
DEN(LS)		
0	OHM-M	2000
METERS	RES(SG)	

Coffey Geotechnics

Borehole BH03

ACOUSTIC TELEVIEWER PETROPHYSICAL REPORT

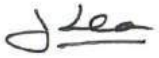
Groundsearch Australia Pty. Limited

3 October 2018

DISCLAIMER

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For and on behalf of Groundsearch Australia Pty. Limited



John Lea BSc (Hons) FAusIMM
Principal Geologist
Managing Director

Executive summary

The data contained in this report were obtained from one 9.6 cm diameter, vertical, cored borehole that was drilled as a component of the 2018 geotechnical exploration programme for Coffey Geotechnics at the NBN site Newcastle NSW.

Century Geophysical Corporation downhole 9804 acoustic televiewer and 9329 density tools were run to collect data in the field on 21 September 2018. This report is for data from 29.50 to 40.27 mbgl. The 9239 density tool was run inside steel casing and data were corrected for the steel. Therefore, there are no caliper or resistivity data.

The 80 identified features are interpreted as the SWL bedding, and fractures. The bedding to fractures ratio is 7:1.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

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Appendix 1 1:20 Interpretation logs – 29.50 to 40.27 mbgl

1.0 Background technical information

The data contained in this report were obtained from one 9.6 cm diameter, vertical, cored borehole that was drilled as a component of the 2018 geotechnical exploration programme for Coffey Geotechnics at the NBN site Newcastle NSW.

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Subsequent processing and interpretation of data were carried out by Groundsearch.

The ATV takes an oriented image of the borehole using high-resolution sound waves. This acoustic image is displays amplitude variations. This information is used to detect bedding planes, fractures, and other borehole anomalies without the need to have clear fluid filling the boreholes. The tool works only in fluid-filled boreholes.

The televiewer digitises 256 measurements around the borehole at each high-resolution sample interval. These data can be oriented to North and displayed real-time while logging using the Visual Compu-Log System.

Analysis software includes colour adjustment, fracture dip and strike determination, and classification of features. It allows information to be displayed on the graphical screen, plot, and in report format.

2.0 Interpretation methodology

It should be noted that the ATV is a bowspring-type, centralised tool and is affected by poor wallrock conditions known as rugosity.

The ATV data interpretation procedure is based on the superposition of curves on feature logs directly onto the computer screen by using a subjective, manual; two-point definition of a feature's top and base to produce a sine curve. The sides of the time and amplitude plots represent magnetic north and magnetic south is in the centre of each plot. The low side, or trough, of the sine curve defines the dip direction of the feature.

The logging program automatically records the televiewer tool slant angle and bearing and corrects for any borehole deviations. The curves are automatically given an identification number for subsequent referencing in a report file.

There are possibly more bedding planes and structural fractures appearing in the televiewer logs that have not been included in this report due to their poor graphic definition or the inability to resolve their geometry by superposing a sine curve using the program's two point method.

This report contains a;

- Text summary of the interpreted features
- Circular representation of interpreted features
- Logs that show geological features with their subjective, numbered interpretation curves shown at 1:20 scale. The logs are in standard format whereby the optical image of the borehole wall is "flattened" onto the plot. The logs have the following additional features to enhance geological interpretations of the strata;
    - Amplitude image differentials
    - Time image differentials that indicate higher strength zones in **GREEN** and lower strength zones in **RED**
    - Tadpoles that represent feature dip and dip direction
    - Open fractures in **RED**
    - Partially open fractures in **MAGENTA**
    - Discontinuous fractures in **DARK BLUE**
    - Natural gamma
    - Slant (dip angle)
    - Slant angle bearing
    - Long and short space density
- Table containing feature curve ID, top, base, dip angle, dip azimuth, feature description and the generalised rock type that hosts the feature
- Graphical representations of the interpreted features

3.0 Borehole BH03interpretation

The 80 identified features are interpreted as the SWL bedding, and fractures. The bedding to fractures ratio is 7:1.

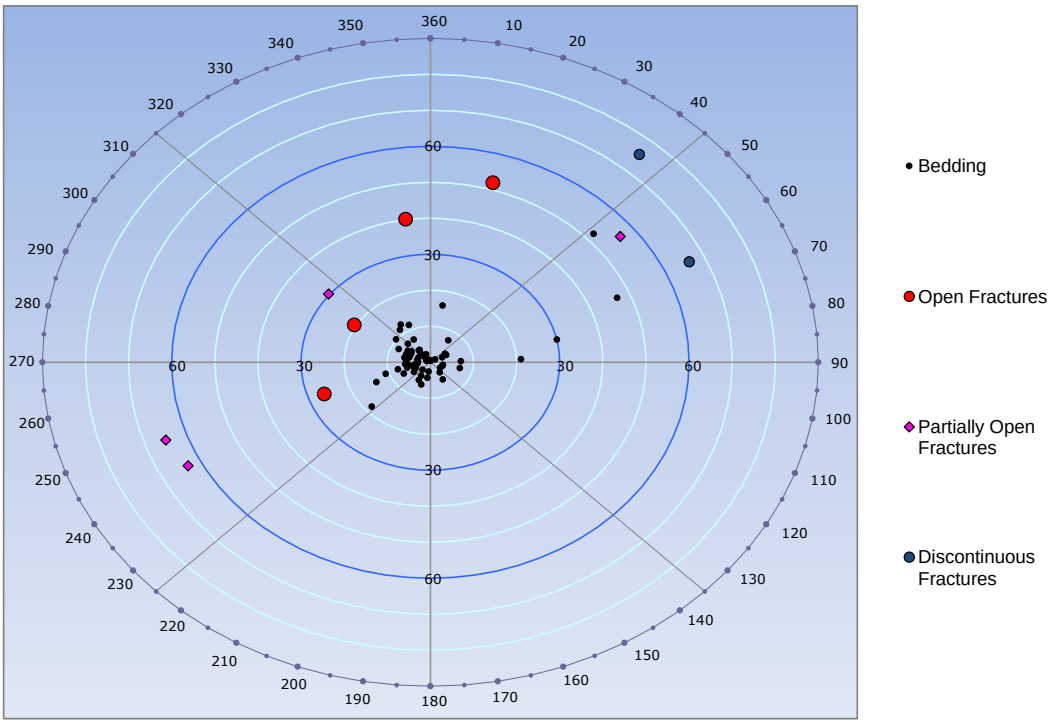
A description of each interpreted feature is presented in Table 1 and the log is presented in Appendix 1.

Table 1 Interpreted features report for BH03

FEATURE ID	DIP (DEG)	AZIMUTH (DEG)	MIDPOINT (MBGL)	TOP (M)	BASE (M)	TYPE OF FEATURE	GENERALISED ROCK TYPE
1			29.92	29.92	29.92	SWL	Overburden
2	52	16	30.08	30.02	30.14	Fracture plane - open	Overburden
3	6	274	30.71	30.71	30.72	Bedding plane	Overburden
4	6	254	30.88	30.88	30.89	Bedding plane	Overburden
5	4	210	30.90	30.90	30.90	Bedding plane	Overburden
6	4	189	31.05	31.04	31.05	Bedding plane	Overburden
7	3	295	31.16	31.16	31.16	Bedding plane	Overburden
8	30	309	31.23	31.20	31.26	Fracture plane - partially open	Overburden
9	12	334	31.33	31.32	31.34	Bedding plane	Overburden
10	11	322	31.47	31.47	31.48	Bedding plane	Overburden
11	12	327	31.51	31.50	31.52	Bedding plane	Overburden
12	4	253	31.67	31.67	31.67	Bedding plane	Overburden
13	40	352	31.89	31.85	31.93	Fracture plane - open	Overburden
14	63	243	31.95	31.85	32.04	Fracture plane - partially open	Overburden
15	3	63	31.98	31.98	31.98	Bedding plane	Overburden
16	4	244	32.11	32.10	32.11	Bedding plane	Overburden
17	4	62	32.37	32.36	32.37	Bedding plane	Overburden
18	3	282	32.49	32.49	32.49	Bedding plane	Overburden
19	0	16	32.82	32.82	32.82	Bedding plane	Overburden
20	6	302	32.83	32.82	32.83	Bedding plane	Overburden
21	5	235	32.94	32.93	32.94	Bedding plane	Overburden
22	8	255	33.04	33.03	33.05	Bedding plane	Overburden
23	5	297	33.21	33.21	33.21	Bedding plane	Overburden
24	1	54	33.31	33.31	33.31	Bedding plane	Overburden
25	4	259	33.40	33.40	33.40	Bedding plane	Overburden
26	6	264	33.43	33.43	33.44	Bedding plane	Overburden
27	4	324	33.52	33.52	33.52	Bedding plane	Overburden
28	4	320	33.54	33.53	33.54	Bedding plane	Overburden
29	65	251	33.59	33.49	33.70	Fracture plane - partially open	Overburden
30	3	274	33.61	33.61	33.61	Bedding plane	Overburden
31	3	104	33.66	33.66	33.66	Bedding plane	Overburden
32	3	110	33.68	33.68	33.68	Bedding plane	Overburden
33	1	321	33.75	33.75	33.75	Bedding plane	Overburden
34	2	336	33.86	33.86	33.86	Bedding plane	Overburden
35	2	319	33.88	33.88	33.88	Bedding plane	Overburden
36	4	142	33.93	33.93	33.93	Bedding plane	Overburden
37	7	88	34.07	34.07	34.08	Bedding plane	Overburden
38	7	103	34.11	34.11	34.12	Bedding plane	Overburden

39	2	323	34.24	34.23	34.24	Bedding plane	Overburden
40	1	310	34.51	34.51	34.51	Bedding plane	Overburden
41	2	328	34.82	34.82	34.82	Bedding plane	Overburden
42	1	292	34.84	34.84	34.84	Bedding plane	Overburden
43	5	287	34.86	34.86	34.87	Bedding plane	Overburden
44	56	52	34.98	34.91	35.05	Fracture plane - partially open	Overburden
45	2	326	35.07	35.07	35.07	Bedding plane	Overburden
46	0	11	35.18	35.18	35.18	Bedding plane	Overburden
47	6	292	35.32	35.31	35.32	Bedding plane	Overburden
48	7	329	35.40	35.39	35.40	Bedding plane	Overburden
49	5	285	35.63	35.63	35.64	Bedding plane	Overburden
50	6	149	35.85	35.85	35.86	Bedding plane	Overburden
51	3	123	35.88	35.88	35.88	Bedding plane	Overburden
52	6	208	35.98	35.97	35.98	Bedding plane	Overburden
53	7	199	36.01	36.00	36.01	Bedding plane	Overburden
54	3	189	36.04	36.04	36.04	Bedding plane	Overburden
55	7	34	36.07	36.06	36.07	Bedding plane	Overburden
56	11	253	36.13	36.12	36.14	Bedding plane	Overburden
57	10	309	36.69	36.68	36.70	Bedding plane	Overburden
58	66	65	36.71	36.61	36.82	Fracture plane - discontinuous	Overburden
59	16	10	36.73	36.71	36.74	Bedding plane	Overburden
60	5	303	37.00	37.00	37.01	Bedding plane	Overburden
61	3	264	37.21	37.21	37.21	Bedding plane	Overburden
62	4	55	37.42	37.42	37.42	Bedding plane	Overburden
63	3	317	37.67	37.67	37.67	Bedding plane	Overburden
64	7	243	37.99	37.98	37.99	Bedding plane	Overburden
65	21	301	38.34	38.33	38.36	Fracture plane - open	Overburden
66	21	88	38.49	38.47	38.51	Bedding plane	Overburden
67	30	78	38.52	38.50	38.55	Bedding plane	Overburden
68	26	250	38.60	38.58	38.63	Fracture plane - open	Overburden
69	4	249	38.69	38.68	38.69	Bedding plane	Overburden
70	5	304	38.77	38.77	38.78	Bedding plane	Overburden
71	75	40	38.82	38.64	39.00	Fracture plane - discontinuous	Overburden
72	5	261	38.85	38.84	38.85	Bedding plane	Overburden
73	8	296	39.16	39.15	39.17	Bedding plane	Overburden
74	7	314	39.19	39.19	39.20	Bedding plane	Overburden
75	52	47	39.44	39.38	39.51	Bedding plane	Overburden
76	47	68	39.54	39.49	39.59	Bedding plane	Overburden
77	3	221	39.79	39.79	39.79	Bedding plane	Overburden
78	6	282	39.95	39.95	39.96	Bedding plane	Overburden
79	18	228	40.09	40.07	40.10	Bedding plane	Overburden
80	14	246	40.18	40.17	40.19	Bedding plane	Overburden
FEATURE ID	**DIP (DEG)**	**AZIMUTH (DEG)**	**MIDPOINT (MBGL)**	**TOP (M)**	**BASE (M)**	**TYPE OF FEATURE**	**GENERALISED ROCK TYPE**

Figure 1 BH03 circular plan representation of interpreted features



The 69 identified sedimentary features are predominantly bedding planes that appear to range in dip from flat-lying to 52^0. Figures 2 and 3 show the distribution of the planes' dip angles and dip direction with depth.

Table 2 details the variation in the dip angle and dip direction data. Figure 4 shows the dip direction data in a rose diagram with the bedding planes' dip angle and dip direction data shown as histograms in Figures 5 and 6.

The 10 fractures are identified as open (4), partially open (4) and discontinuous (2). The fracture dip angles range from 21 to 75^0.

Table 3 details the variation in the fractures' dip angle and dip direction data. Figure 7 shows the dip direction data in a rose diagram with the fractures' plane dip angle and dip direction data as histograms in Figures 8 and 9.

Figure 2 BH03 feature dip angle data distribution

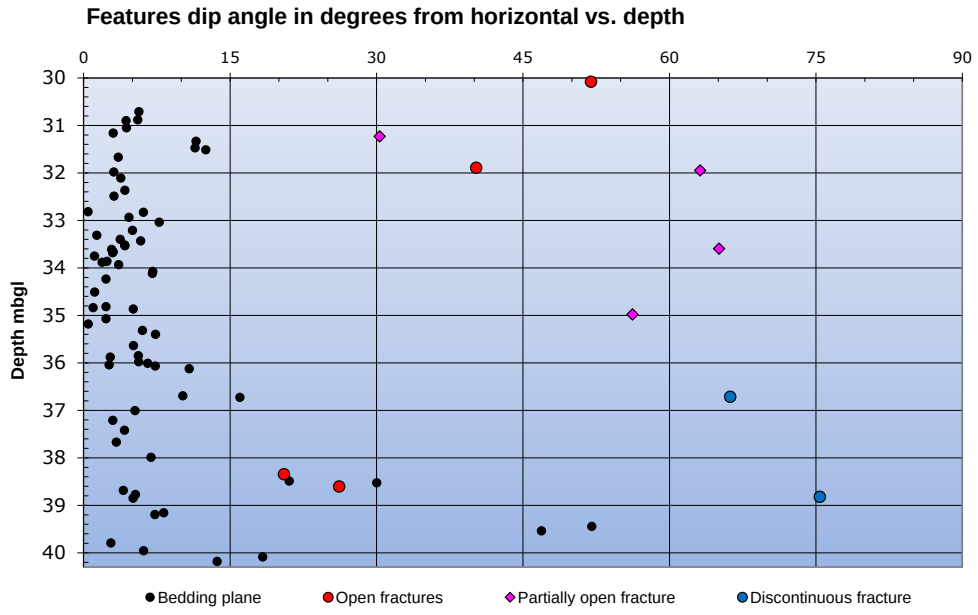


Figure 3 BH03 feature dip direction data distribution

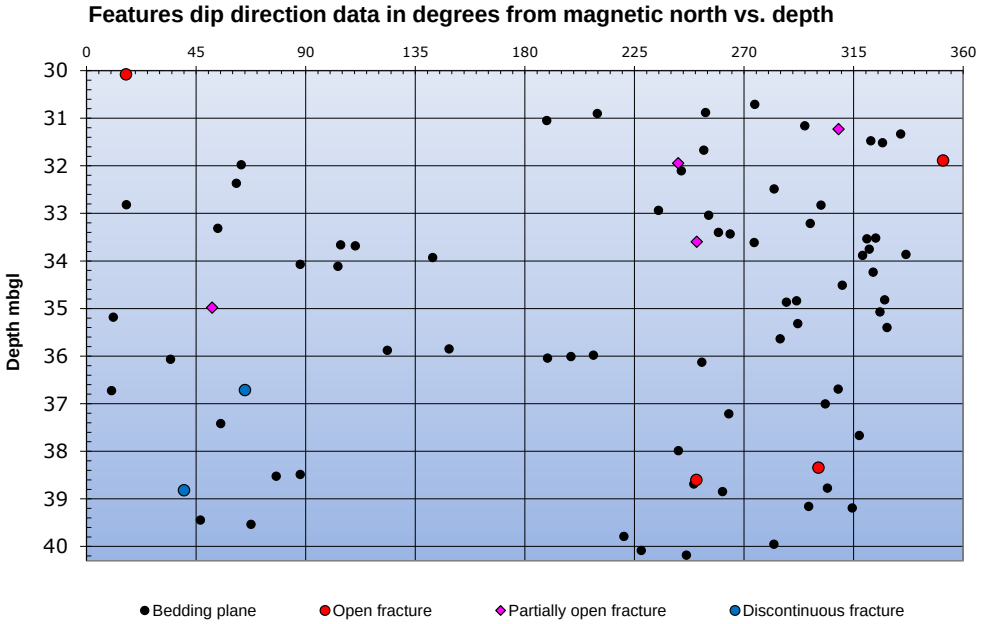


Table 2 BH03 bedding histogram data

Dip Distribution Total: 69			Orientation Distribution Total: 69		
Dip Range	Count	%	Bearing Range	Count	%
0 to 10	57	82.6	0 to 10	0	0.0
10 to 20	8	11.6	10 to 20	3	4.3
20 to 30	1	1.4	20 to 30	0	0.0
30 to 40	1	1.4	30 to 40	1	1.4
40 to 50	1	1.4	40 to 50	1	1.4
50 to 60	1	1.4	50 to 60	2	2.9
60 to 70	0	0.0	60 to 70	3	4.3
70 to 80	0	0.0	70 to 80	1	1.4
80 to 90	0	0.0	80 to 90	2	2.9
			90 to 100	0	0.0
			100 to 110	2	2.9
			110 to 120	1	1.4
			120 to 130	1	1.4
			130 to 140	0	0.0
			140 to 150	2	2.9
			150 to 160	0	0.0
			160 to 170	0	0.0
			170 to 180	0	0.0
			180 to 190	2	2.9
			190 to 200	1	1.4
			200 to 210	2	2.9
			210 to 220	0	0.0
			220 to 230	2	2.9
			230 to 240	1	1.4
			240 to 250	4	5.8
			250 to 260	5	7.2
			260 to 270	3	4.3
			270 to 280	2	2.9
			280 to 290	4	5.8
			290 to 300	5	7.2
			300 to 310	4	5.8
			310 to 320	4	5.8
			320 to 330	9	13.0
			330 to 340	2	2.9
			340 to 350	0	0.0
			350 to 360	0	0.0

Figure 5 BH03 bedding dip angles histogram

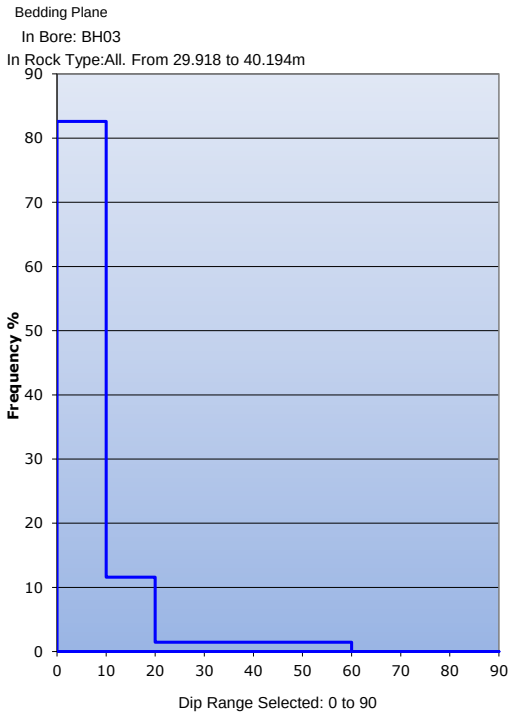


Figure 4 BH03 bedding dip direction data rose diagram

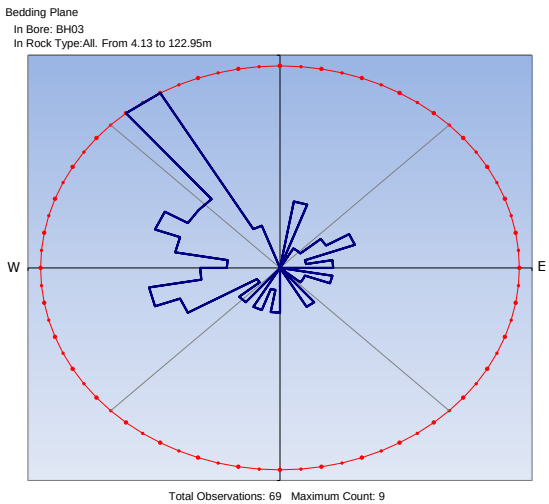


Figure 6 BH03 bedding dip directions histogram

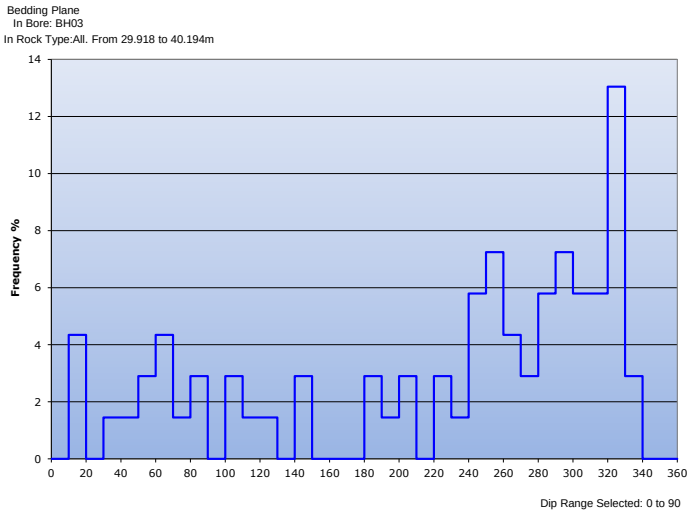


Table 3 BH03 fractures histogram data

Dip Distribution Total: 10			Orientation Distribution Total: 10		
Dip Range	Count	%	Bearing Range	Count	%
0 to 10	0	0.0	0 to 10	0	0.0
10 to 20	0	0.0	10 to 20	1	10.0
20 to 30	2	20.0	20 to 30	0	0.0
30 to 40	1	10.0	30 to 40	0	0.0
40 to 50	1	10.0	40 to 50	1	10.0
50 to 60	2	20.0	50 to 60	1	10.0
60 to 70	3	30.0	60 to 70	1	10.0
70 to 80	1	10.0	70 to 80	0	0.0
80 to 90	0	0.0	80 to 90	0	0.0
			90 to 100	0	0.0
			100 to 110	0	0.0
			110 to 120	0	0.0
			120 to 130	0	0.0
			130 to 140	0	0.0
			140 to 150	0	0.0
			150 to 160	0	0.0
			160 to 170	0	0.0
			170 to 180	0	0.0
			180 to 190	0	0.0
			190 to 200	0	0.0
			200 to 210	0	0.0
			210 to 220	0	0.0
			220 to 230	0	0.0
			230 to 240	0	0.0
			240 to 250	1	10.0
			250 to 260	2	20.0
			260 to 270	0	0.0
			270 to 280	0	0.0
			280 to 290	0	0.0
			290 to 300	0	0.0
			300 to 310	2	20.0
			310 to 320	0	0.0
			320 to 330	0	0.0
			330 to 340	0	0.0
			340 to 350	0	0.0
			350 to 360	1	10.0

Figure 8 BH03 fractures dip angles histogram

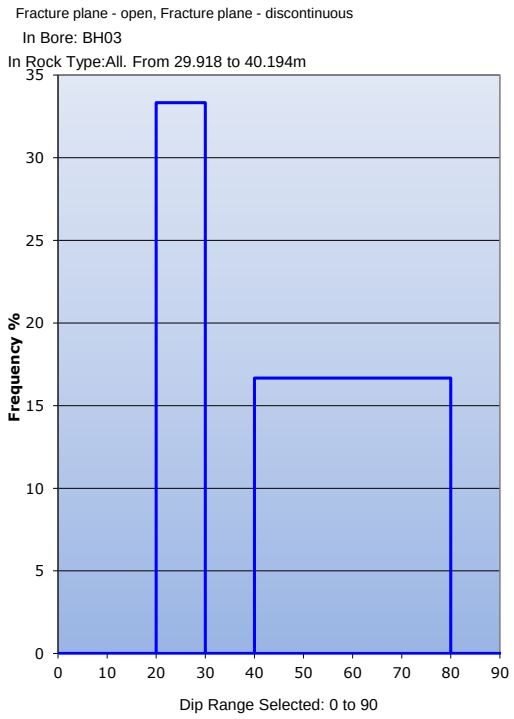


Figure 7 BH03 fractures dip direction data rose diagram

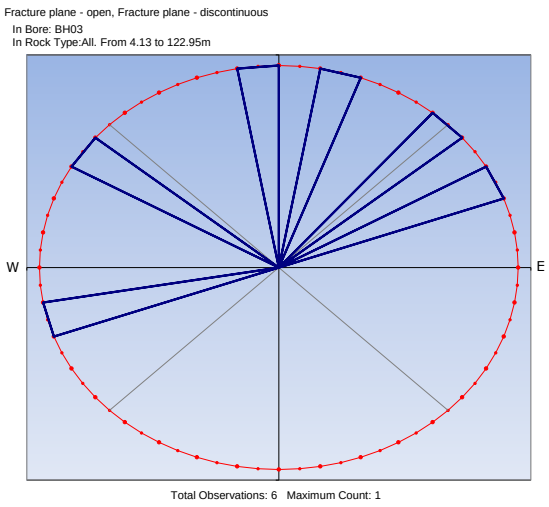
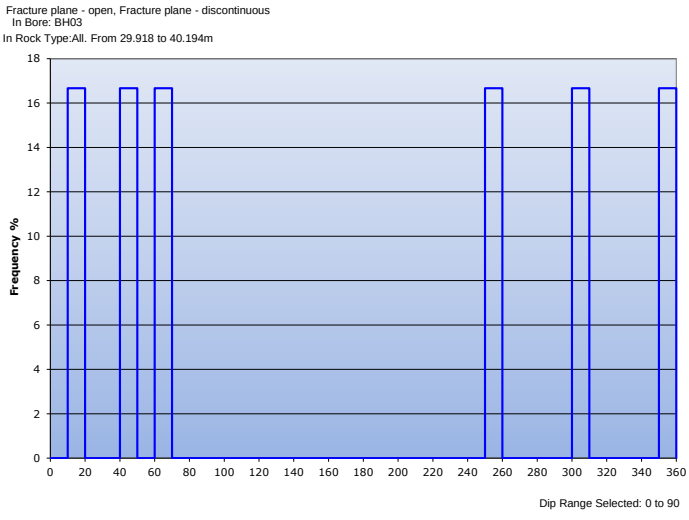


Figure 9 BH03 fractures dip directions histogram



Appendix 1

Appendix 1 ***1:20 Interpretation logs – 29.50 to 40.27 mbgl***

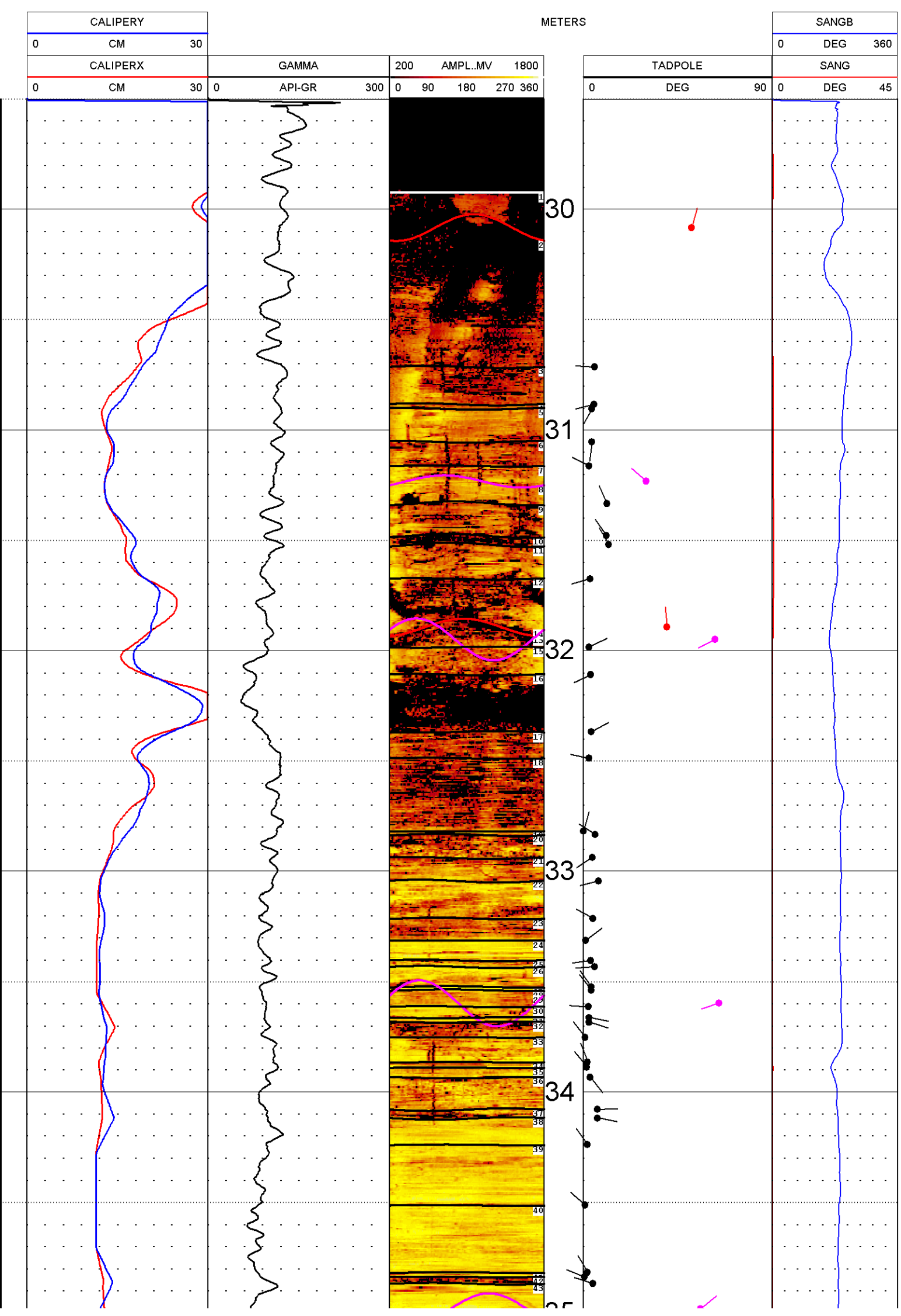
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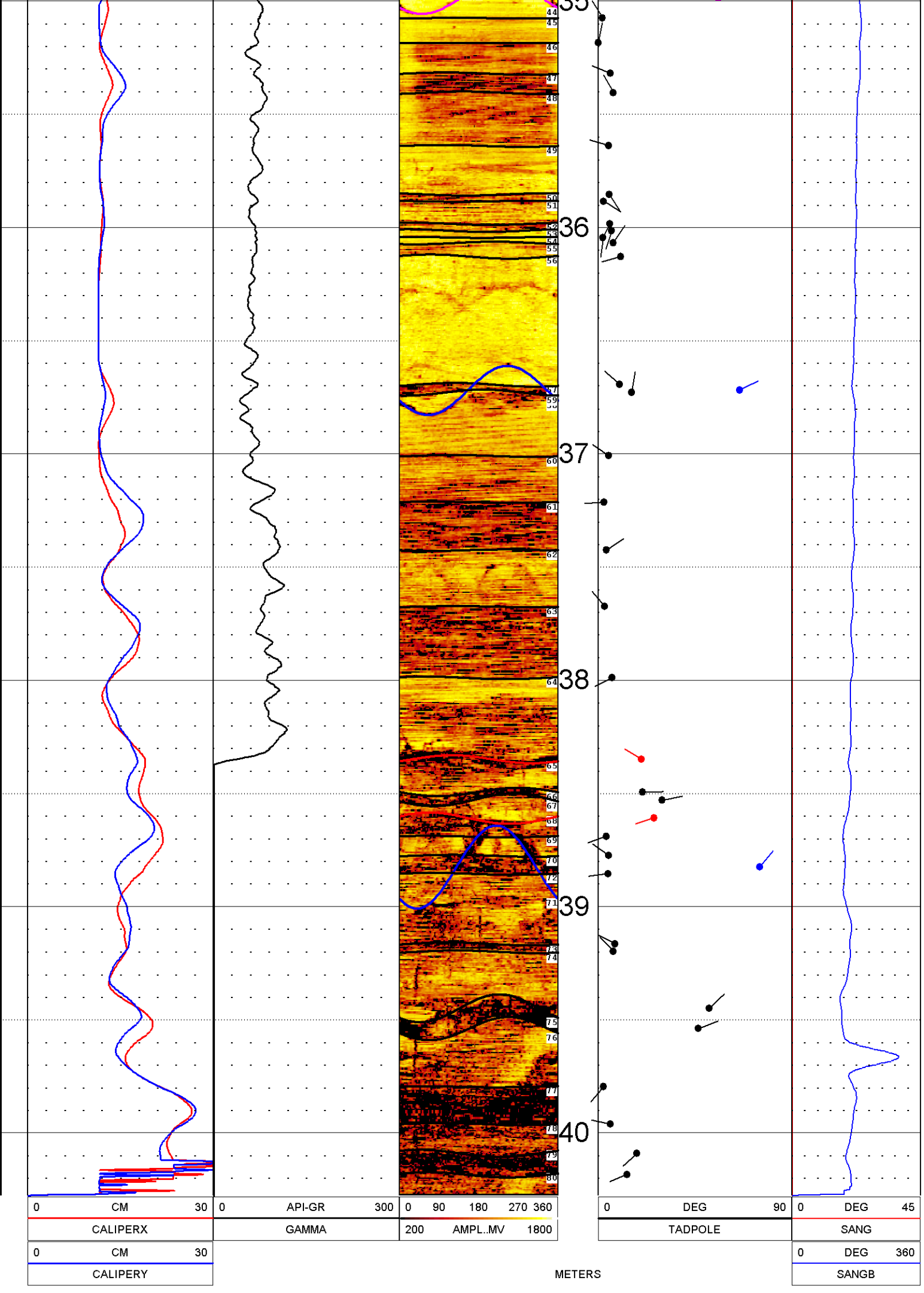
BH03 ATV 1:20

COMPANY	:	COFFEY GEOTECHNICS			OTHER SERVICES:	UTM-E	: NA
WELL	:	BH03 ATV 1:20			TV	UTM-N	: NA
LOCATION/FIELD	:	NBN			ON TV		
COUNTY	:				TV		
LOCATION	:	NSW					
SECTION	:	NA	TOWNSHIP	: NA		RANGE	: NA
DATE	:	09/21/18	PERMANENT DATUM	: 0			
DEPTH DRILLER	:	102.1				KB	: NA
LOG BOTTOM	:	40.270	LOG MEASURED FROM:	GL		DF	: NA
LOG TOP	:	29.500	DRL MEASURED FROM:	GL		GL	: 0
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CASING TYPE	:	PVC	FIELD OFFICE	: RUTHERFORD			
CASING THICKNESS:		.5	RECORDED BY	: M CRANE			
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MATRIX DENSITY	:	2.65	RM TEMPERATURE	: 0		LGDATE	: 09/21/18
NEUTRON MATRIX	:	SANDSTONE	MATRIX DELTA T	: 177		LGTIME	: 11:38
						THRESH:	99999

VOID AROUND 40M 41M

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


CALIPERY
0 CM 30
CALIPERX
0 CM 30
GAMMA
0 API-GR 300
METERS
200 AMPL..MV 1800
0 90 180 270 360
TADPOLE
0 DEG 90
SANGB
0 DEG 360
SANG
0 DEG 45
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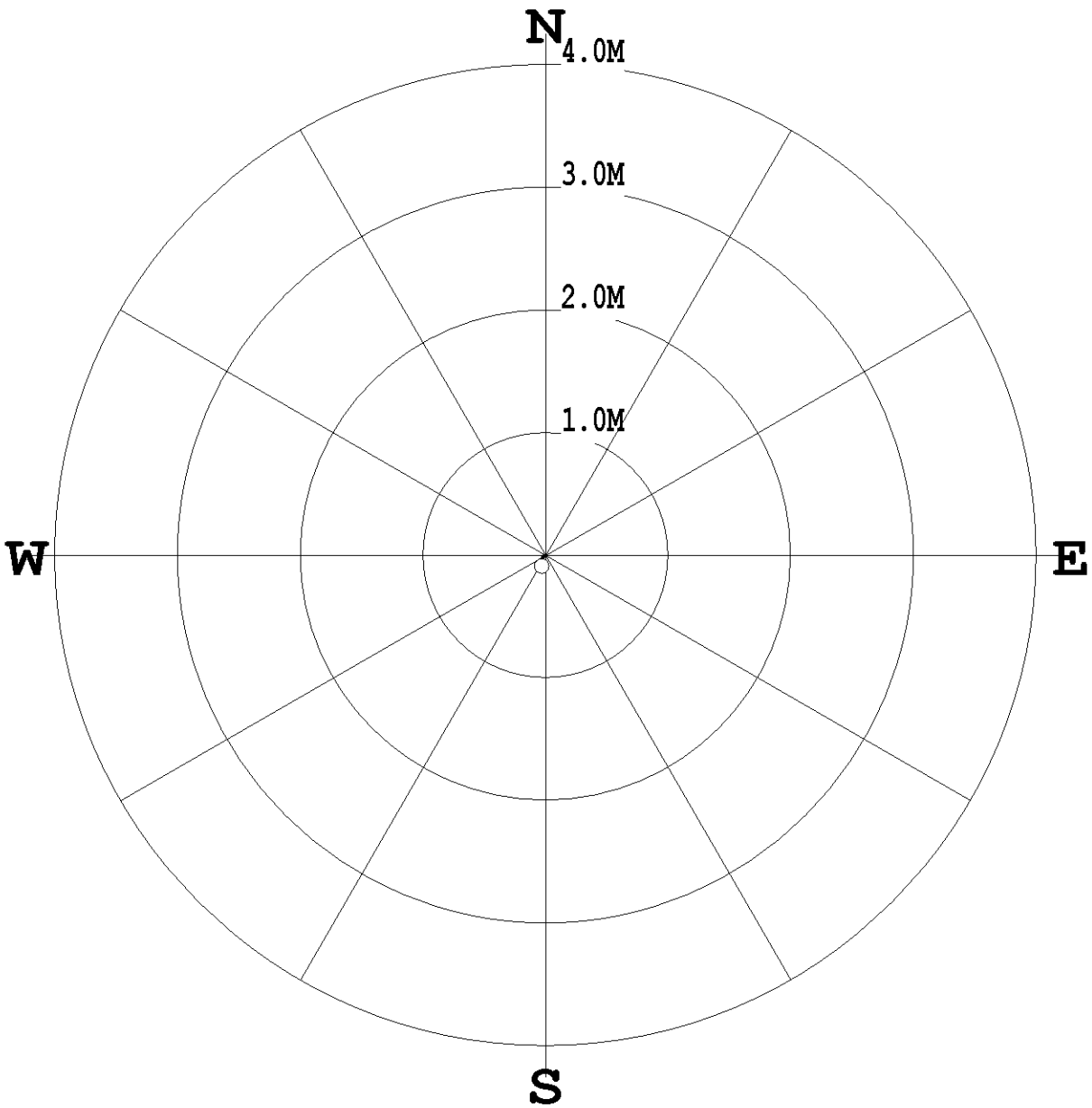

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0 CM 30
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GAMMA
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200 AMPL..MV 1800
0 DEG 90
TADPOLE
0 DEG 45
SANG
0 DEG 360
SANGB
METERS

PLAN VIEW
COMPU-LOG DEVIATION

CLIENT: COFFEY
LOCATION: NBN
HOLE ID: BH03 TELEVIEWER
DATE OF LOG: 09/21/18
PROBE: 9804A 4402

MAG DECL: 0.0

SCALE: 1 M/CM
TRUE DEPTH: 40.27 M
AZIMUTH: 197.6
DISTANCE: 0.1 M
+ = 50 M INCR
○ = BOTTOM OF HOLE



* * * * * * * COMPU-LOG - VERTICAL DEVIATION * * * * * * *

CLIENT : COFFEY HOLE ID. : BH03 TELEVIEW
FIELD OFFICE : RUTHERFORD DATE OF LOG : 09/21/18
DATA FROM : NA PROBE : 9804A , 4402
MAG. DECL. : 0.000 DEPTH UNITS : METERS
LOG: BH03TELEVIEWER_09-21-18_11-38_9804A_.01_26.6_40.27_DEVI.log

CABLE DEPTH	TRUE DEPTH	NORTH DEV.	EAST DEV.	DISTANCE	AZIMUTH	SANG	SANGB
26.60	26.60	-0.00	-0.00	0.0	246.5	0.6	246.5
36.60	36.60	-0.07	-0.04	0.1	205.3	0.4	173.6
40.27	40.26	-0.09	-0.03	0.1	197.7	0.3	165.2



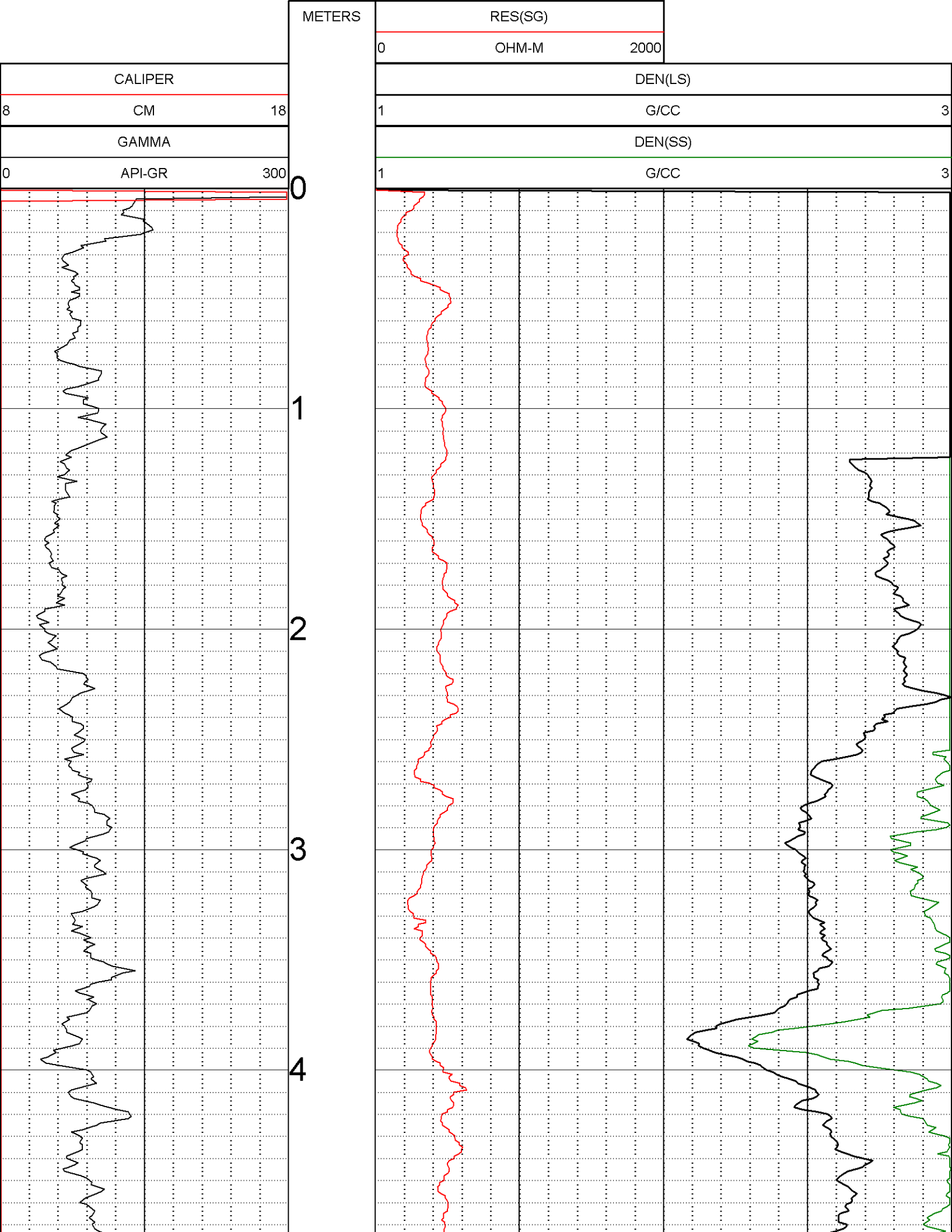
BH03 DENSITY C 1:20

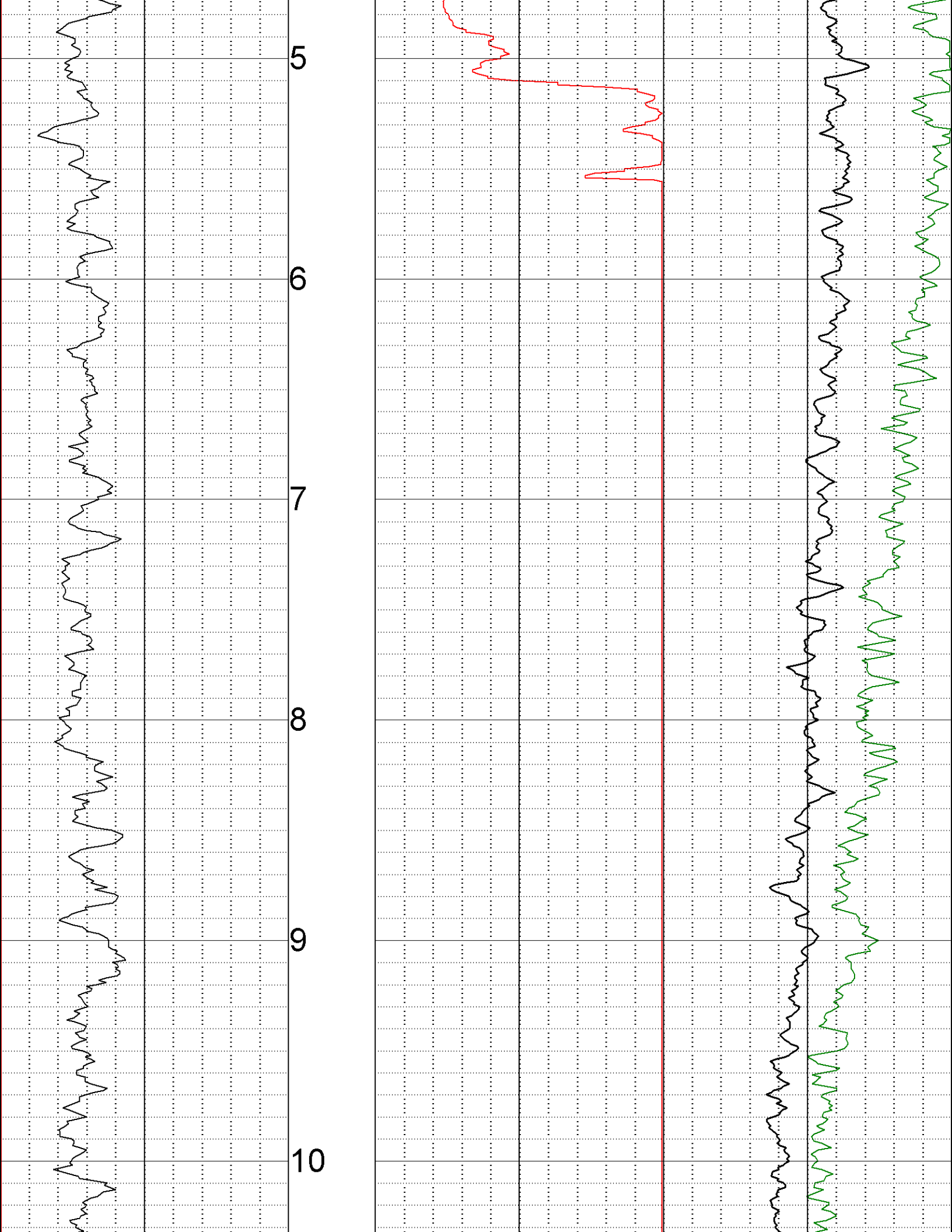
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WELL	:	BH03 DENSITY C 1:20					
LOCATION/FIELD	:						
COUNTRY	:	AUST					
LOCATION	:	MOSBRI CRES					
SECTION	:	NA	TOWNSHIP	:	NA	RANGE	: NA
DATE	:	09/19/18	PERMANENT DATUM	:	0		
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BIT SIZE	:	9.60	BOREHOLE FLUID	:	0	FILE	: PROCESSED
MAGNETIC DECL.	:	0	RM	:	0	TYPE	: 9239B
MATRIX DENSITY	:	2.65	RM TEMPERATURE	:	0	LGDATE	: 09/19/18
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						THRESH:	99999

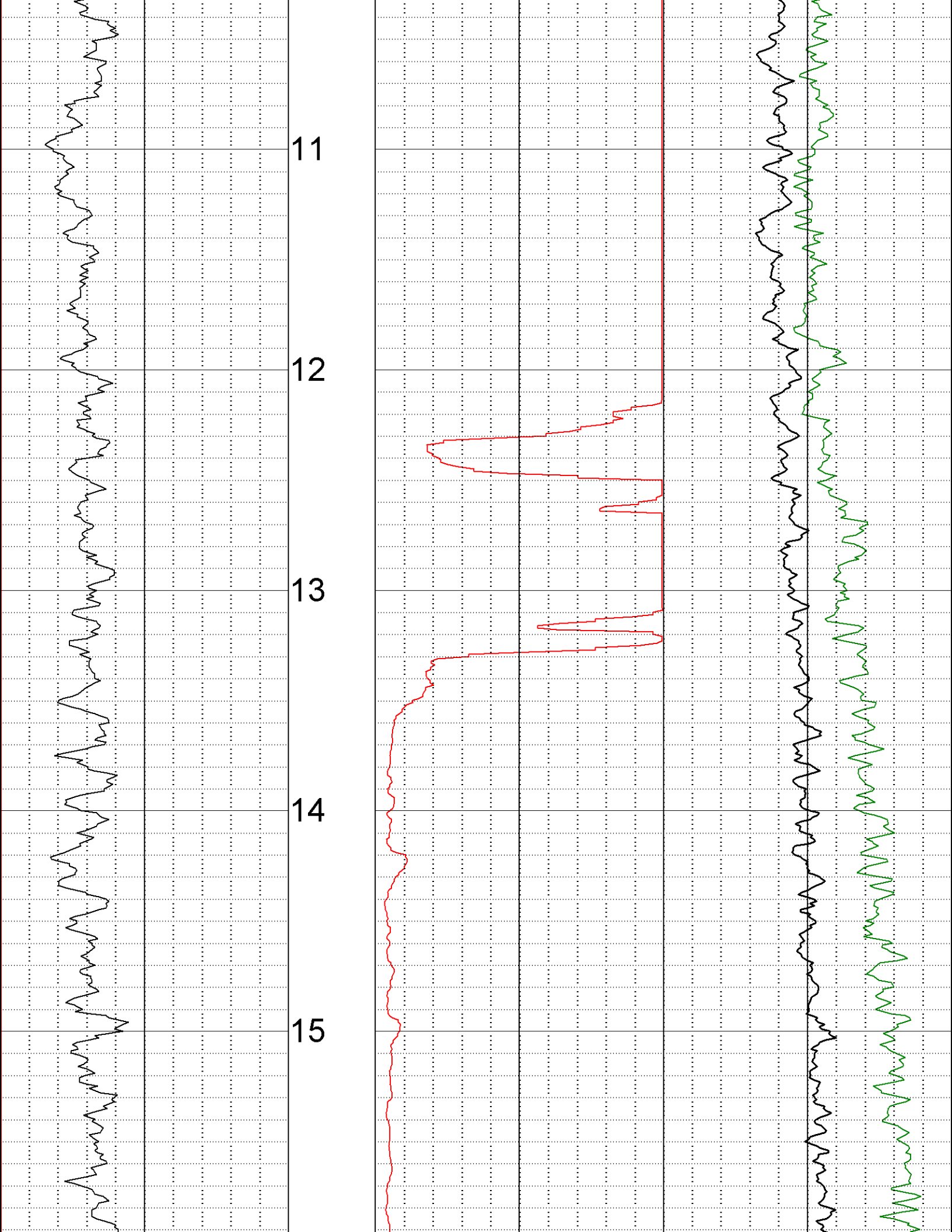
OTHER SERVICES:
DEN

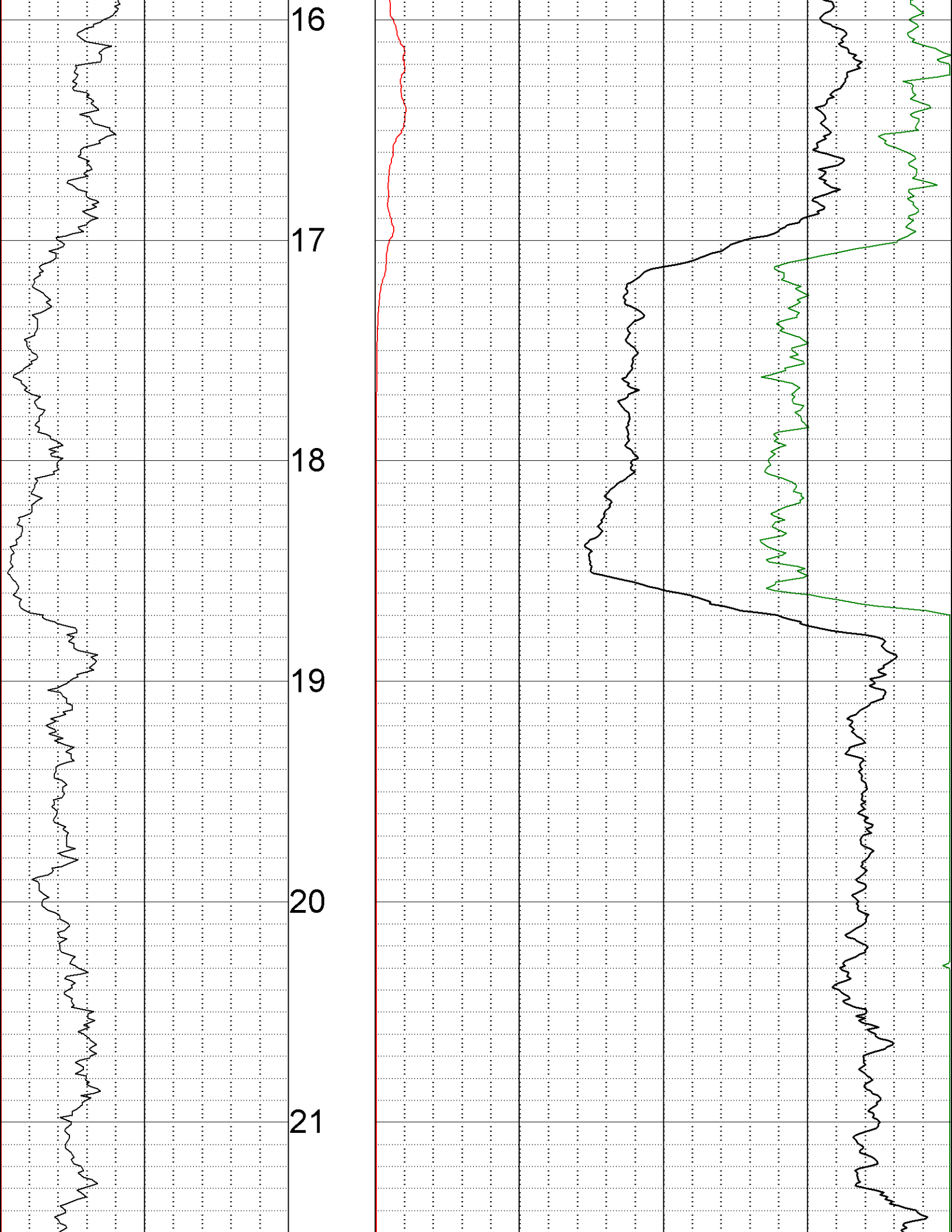
LOGGED THROUGH THE RODS
CORRECTED FOR STEEL

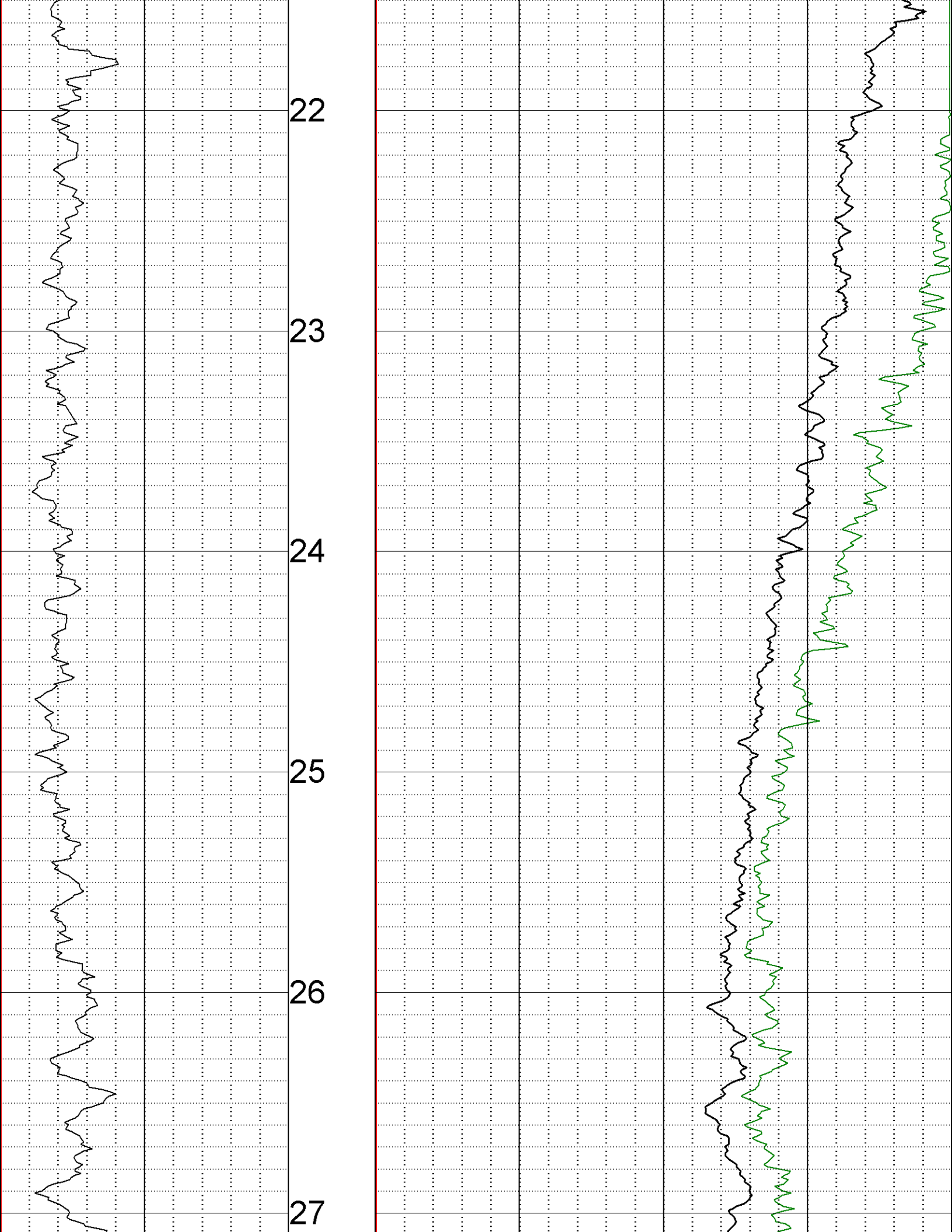
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

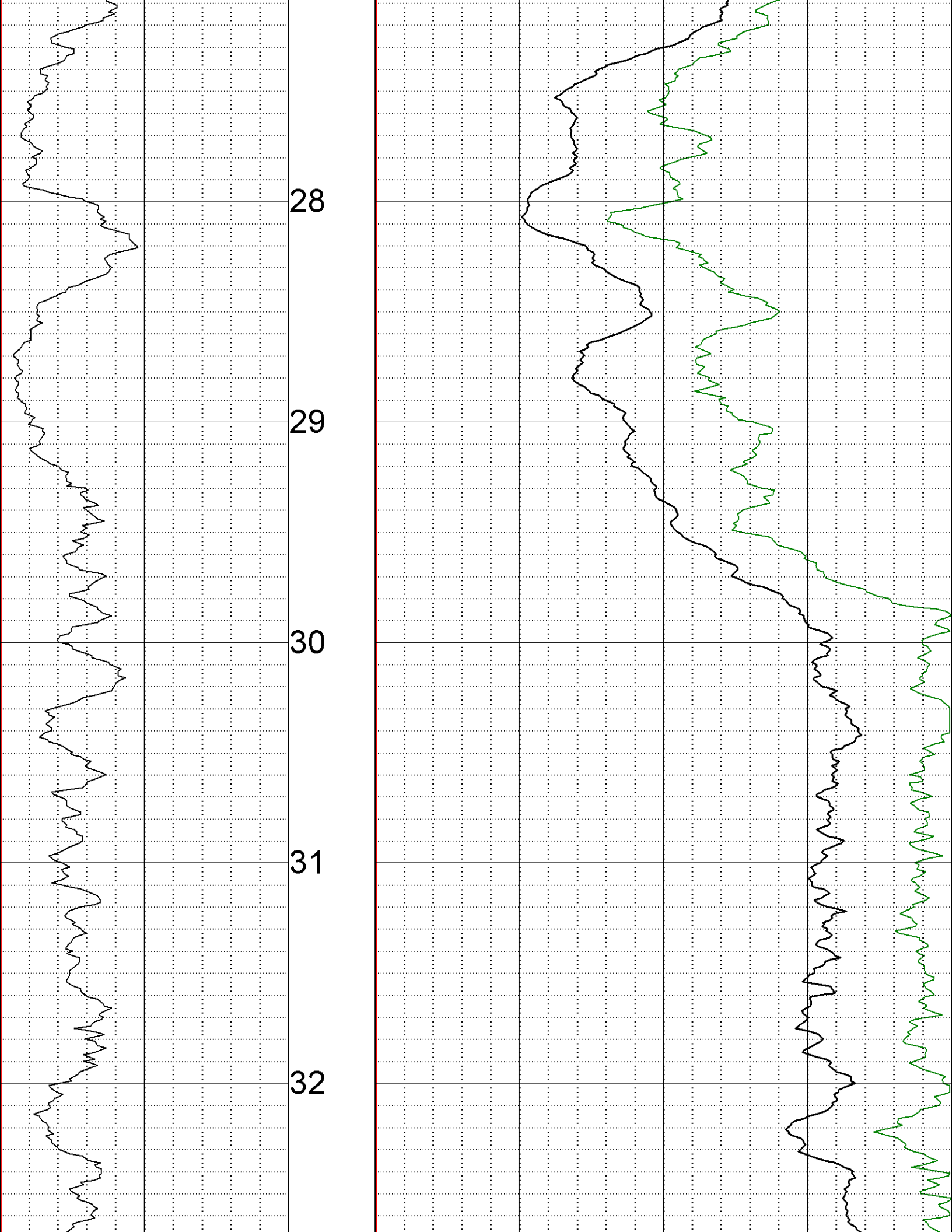

METERS
RES(SG)
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OHM-M
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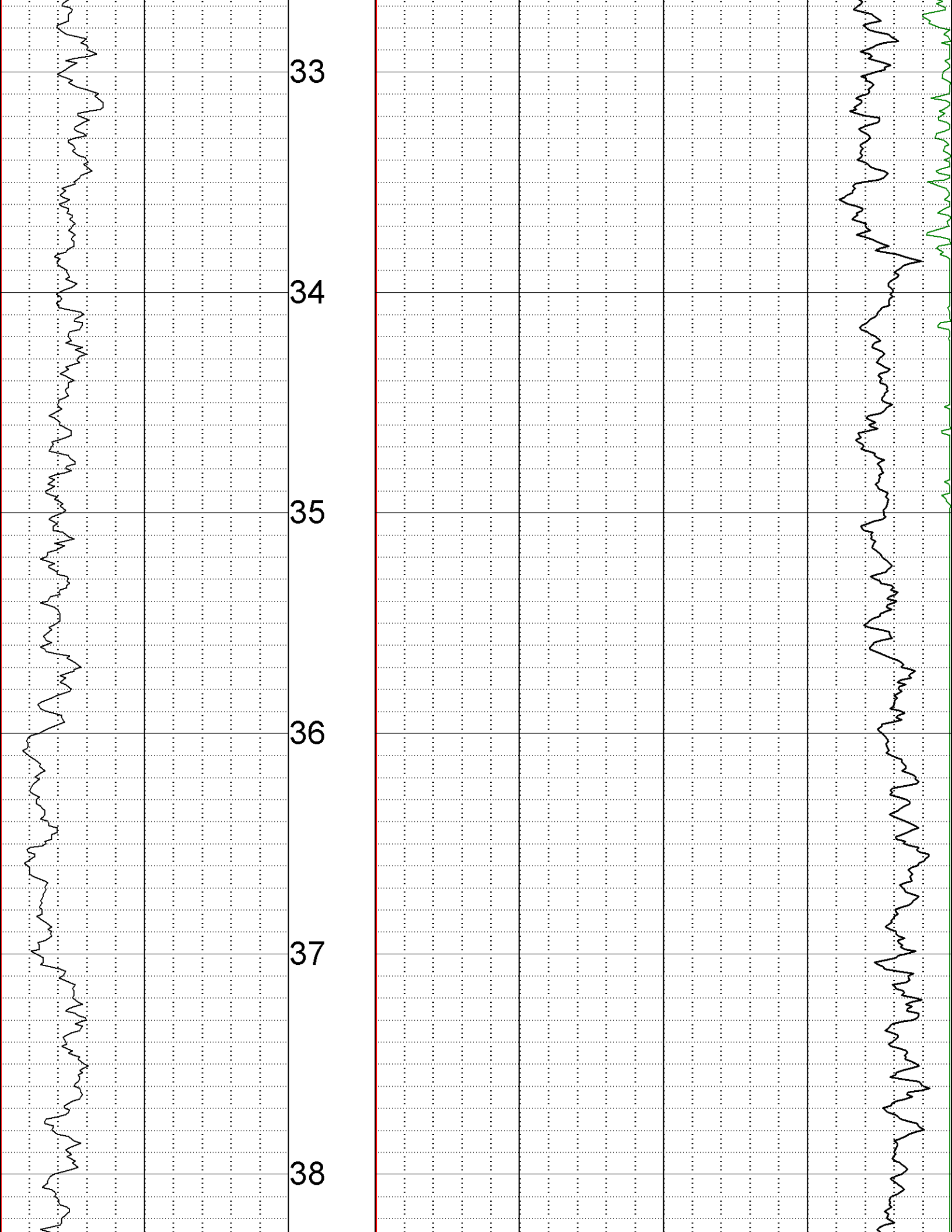

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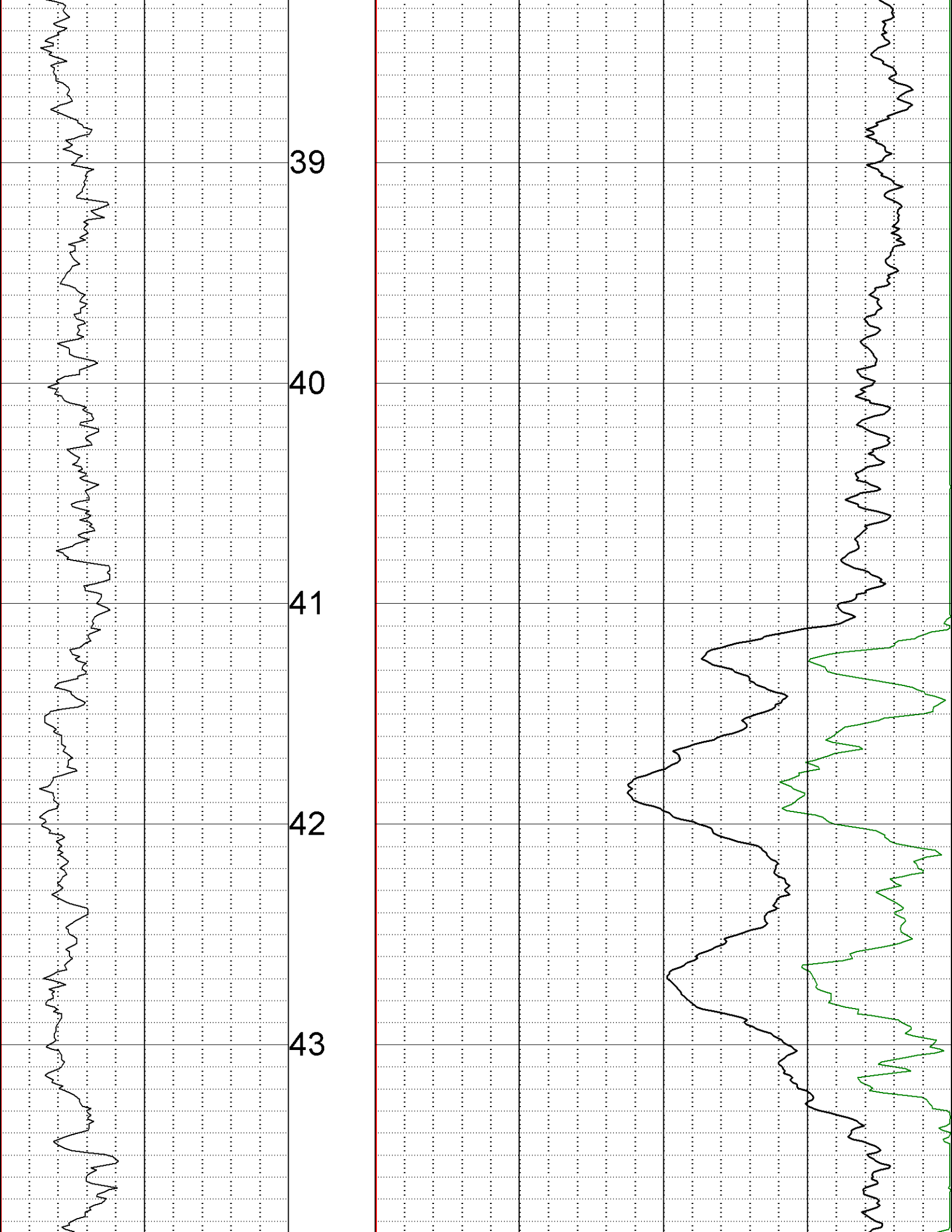

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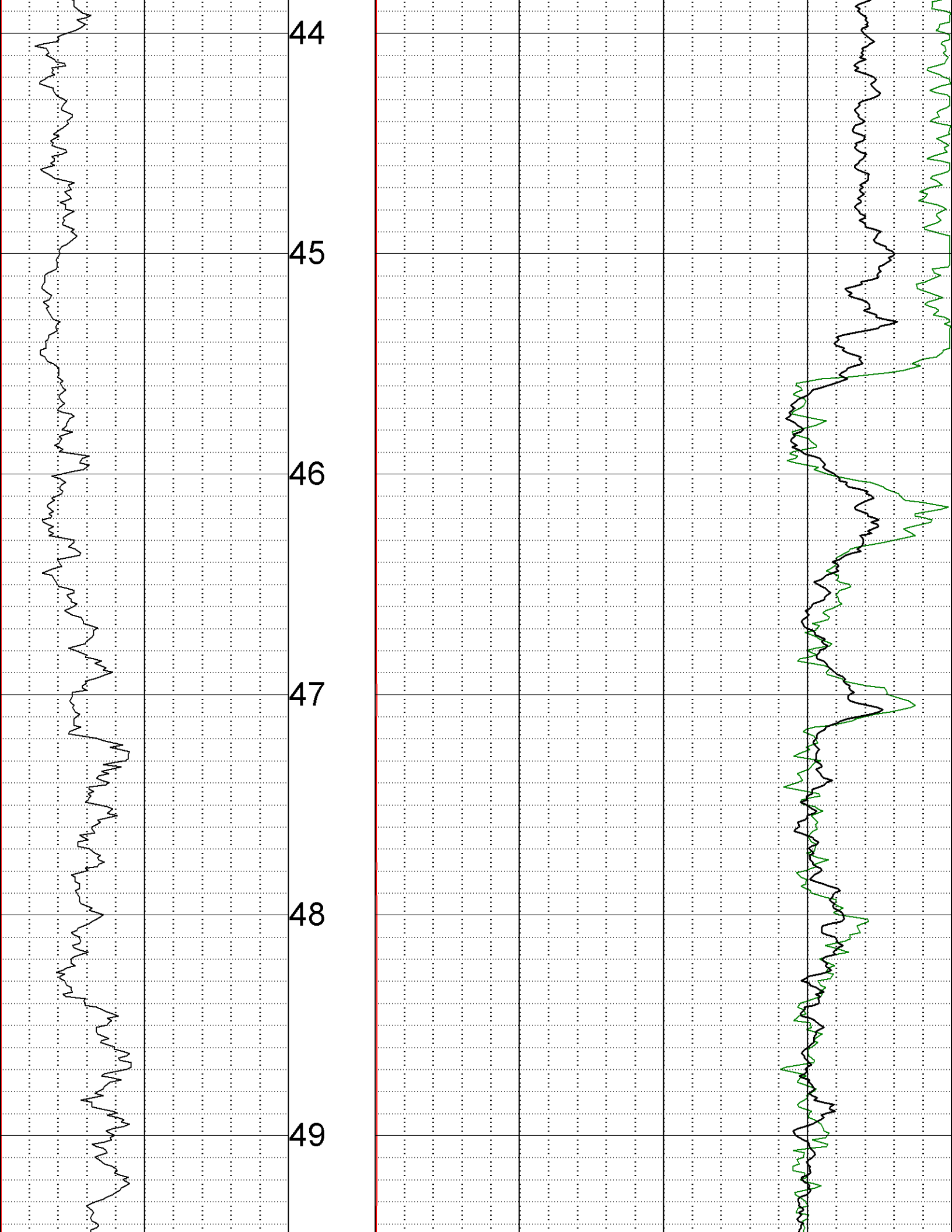

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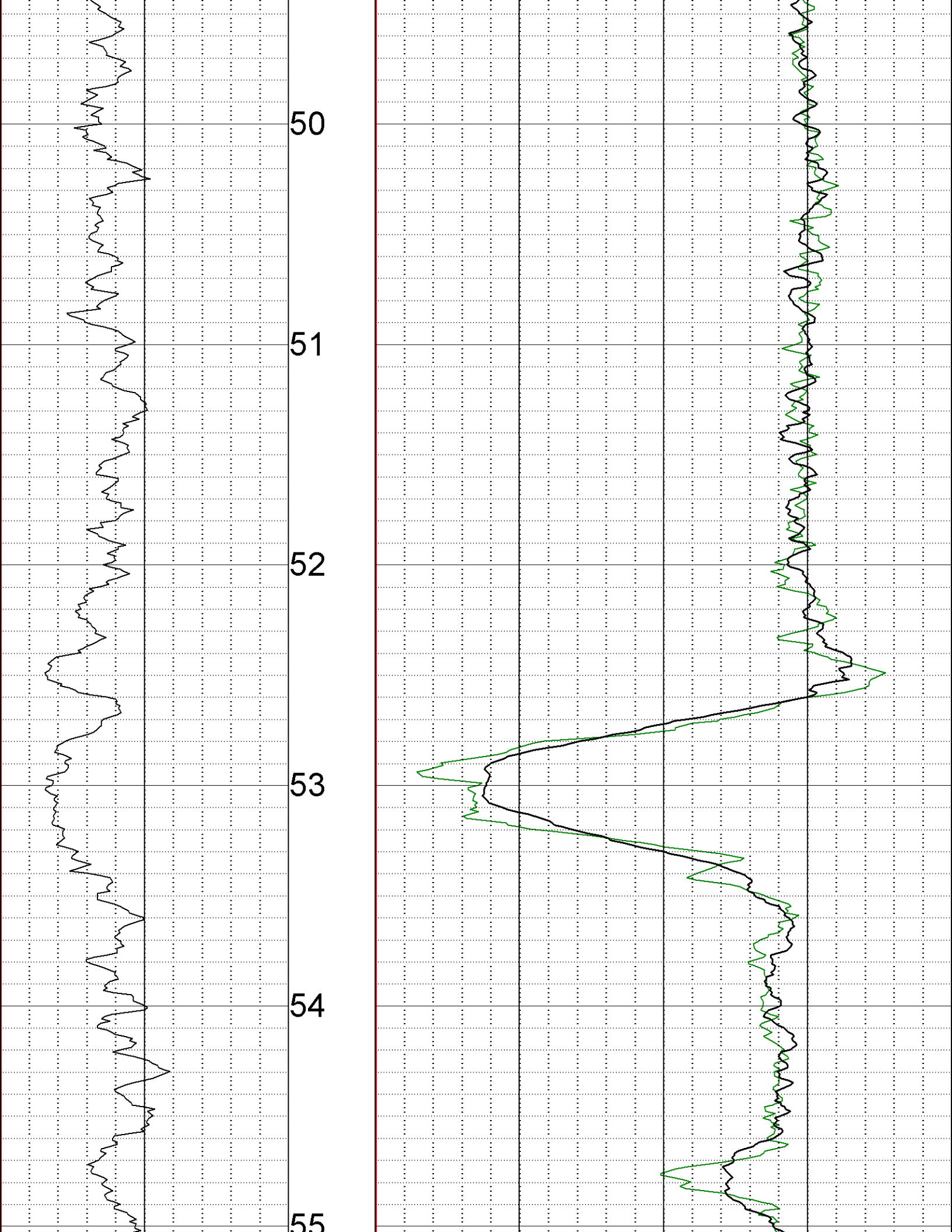

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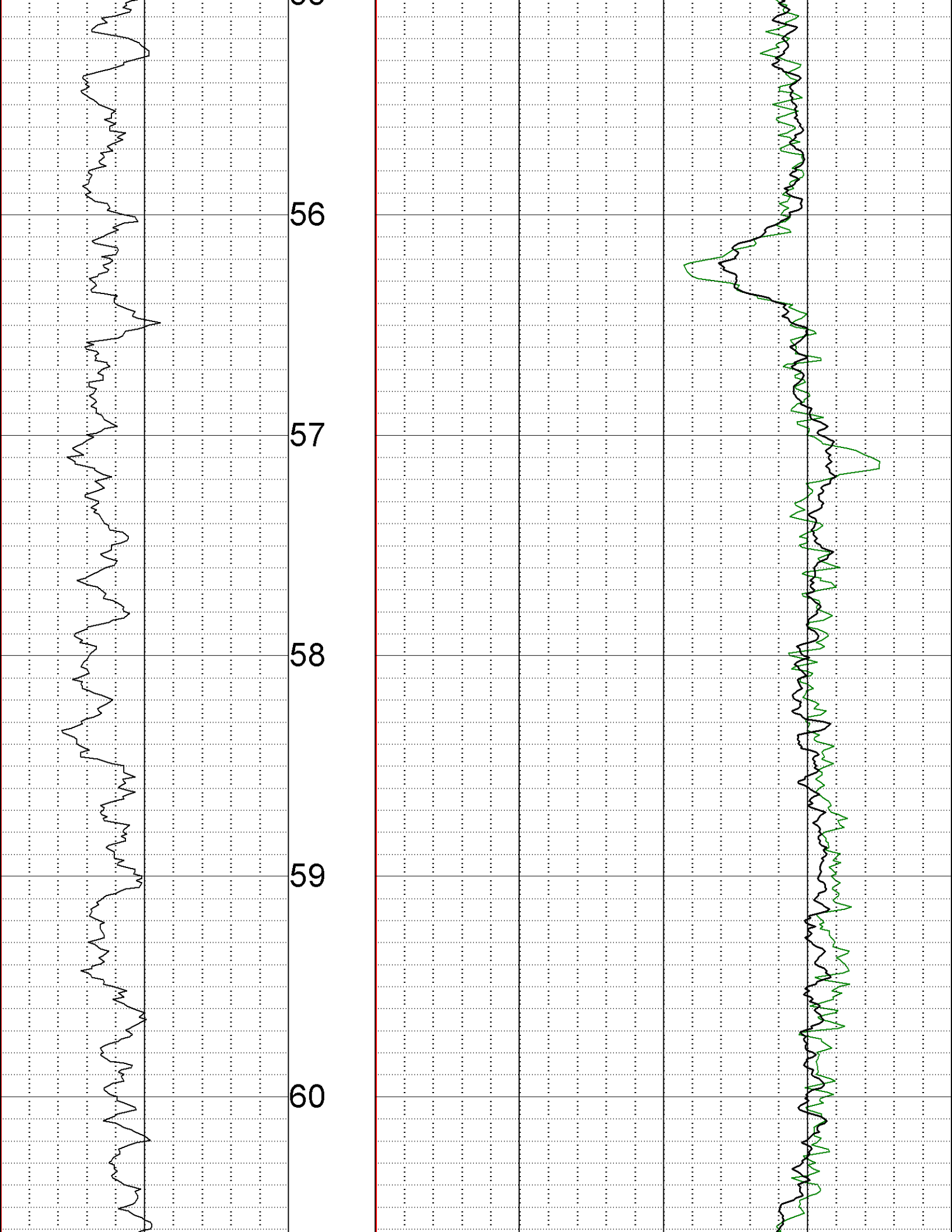

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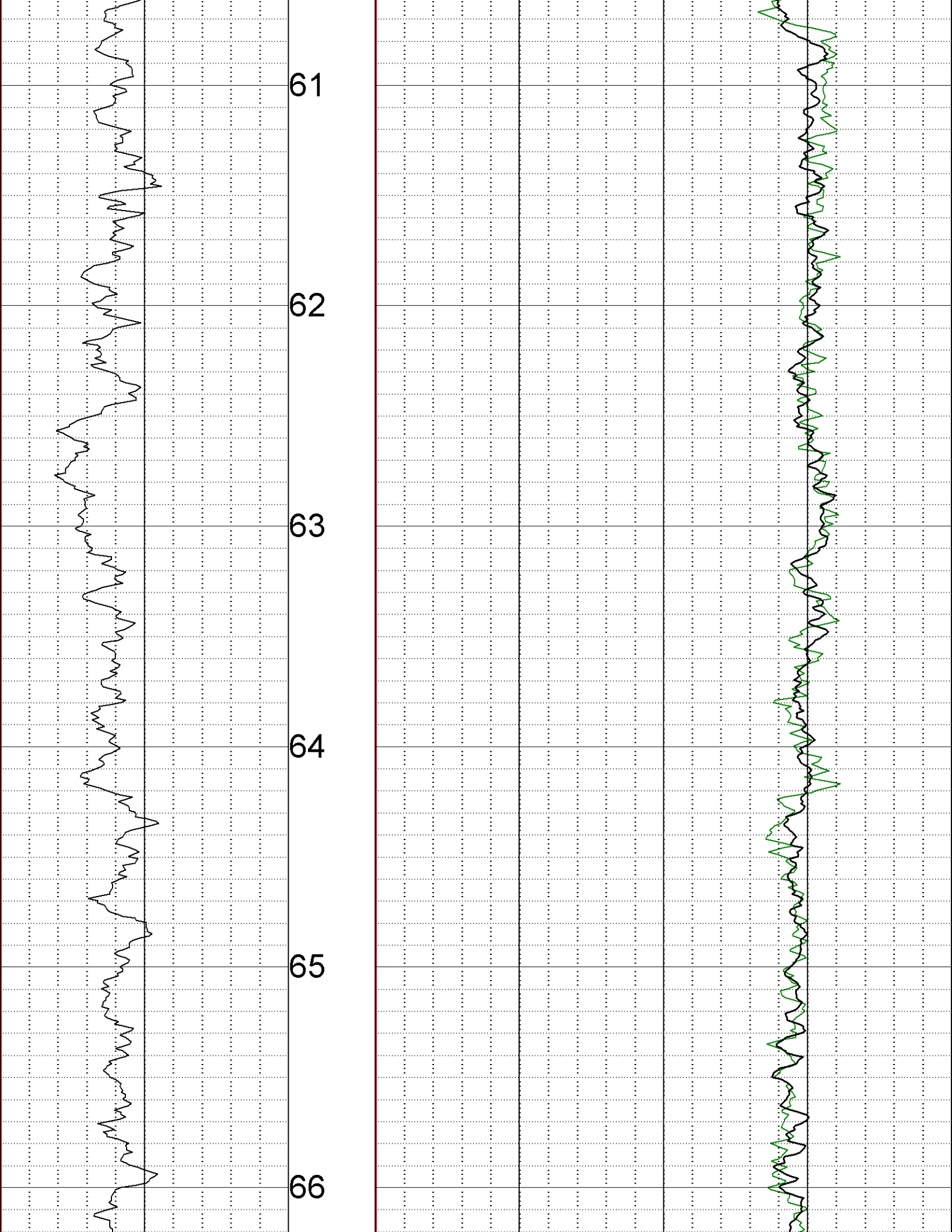

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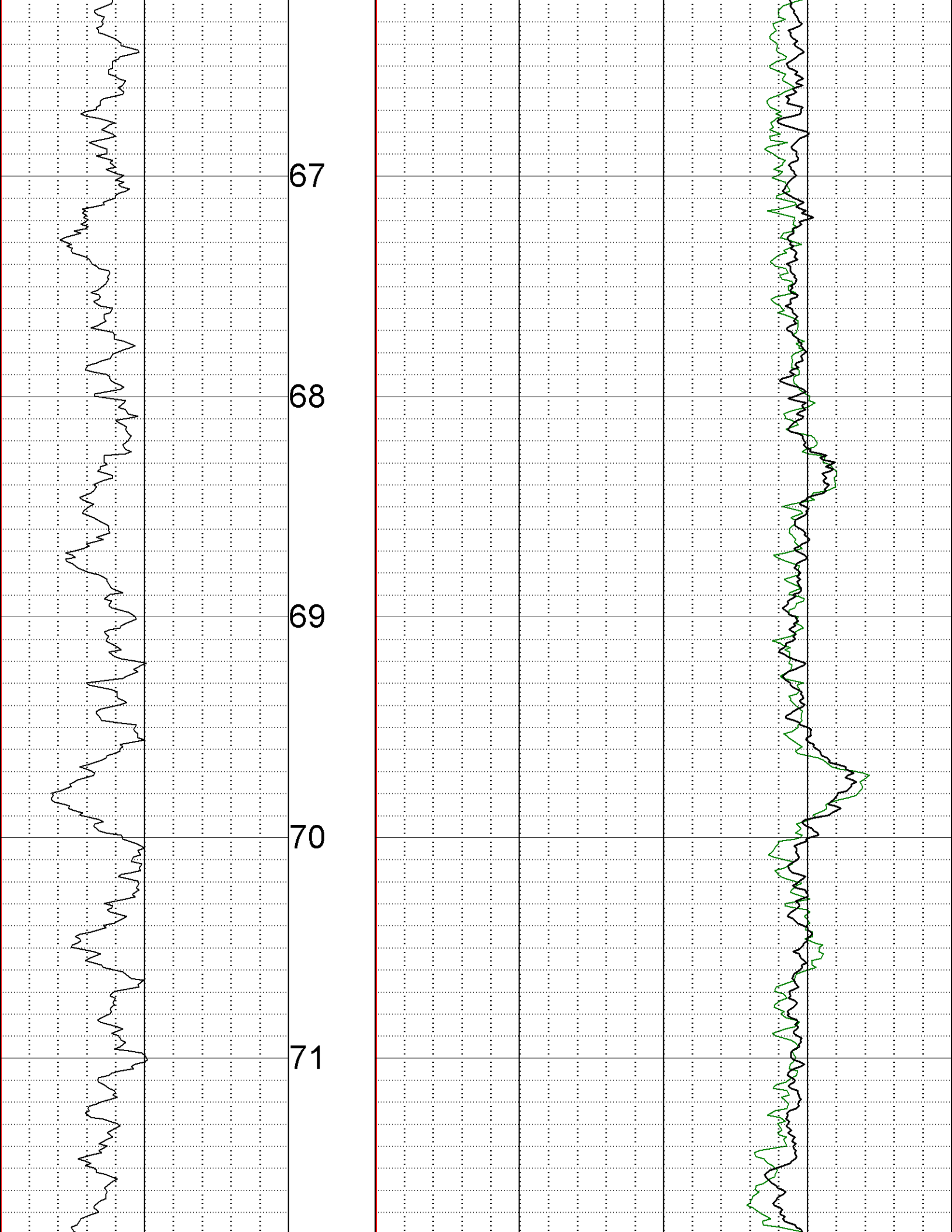

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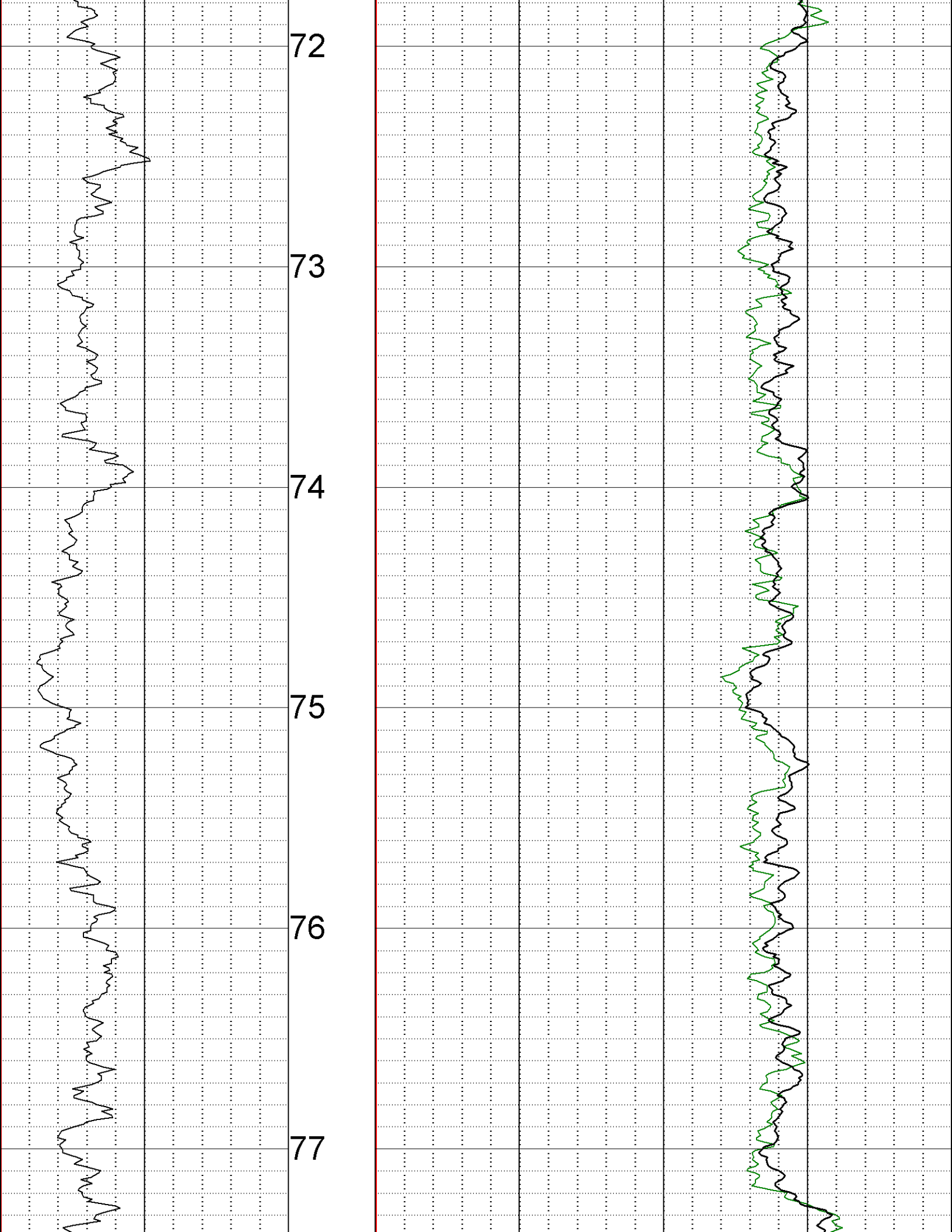

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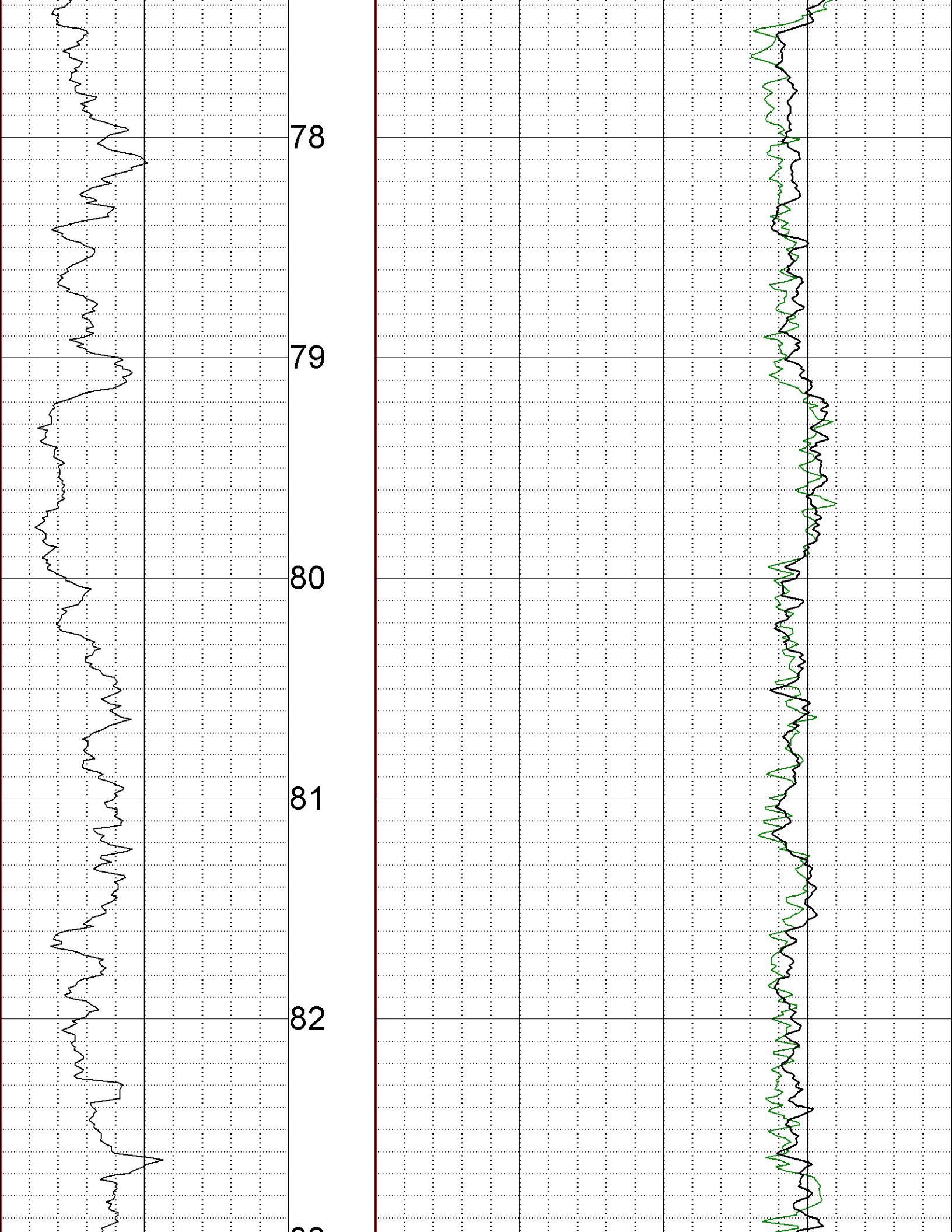

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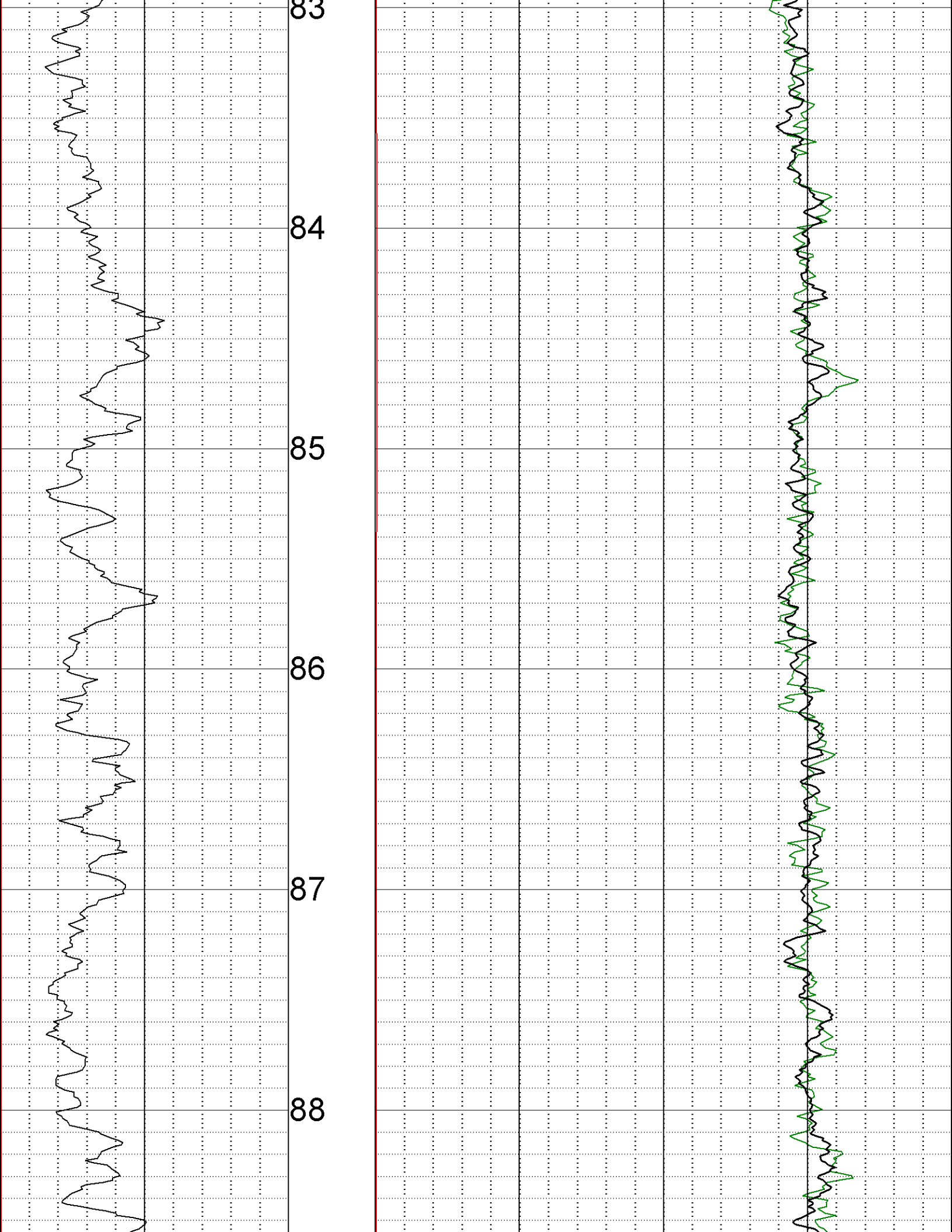

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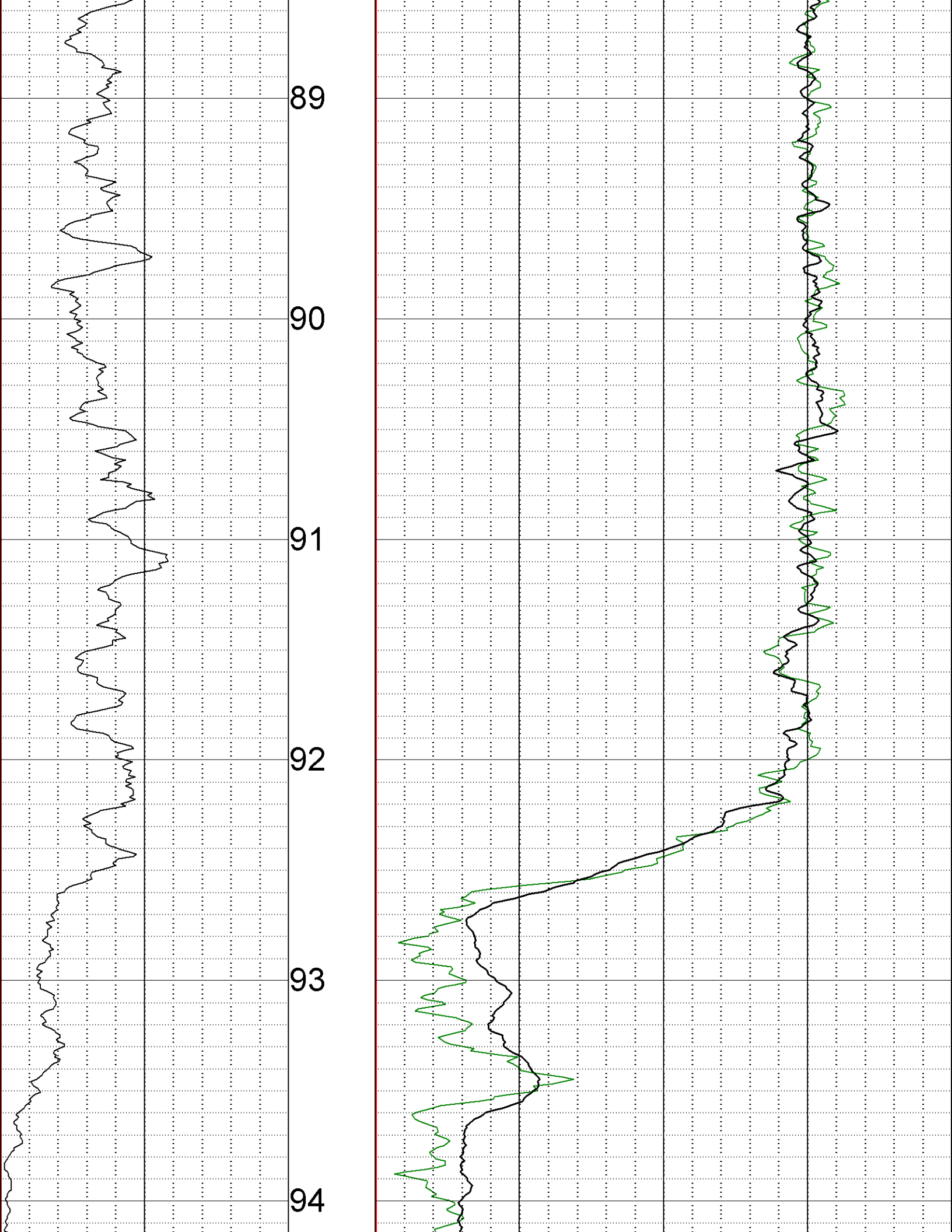

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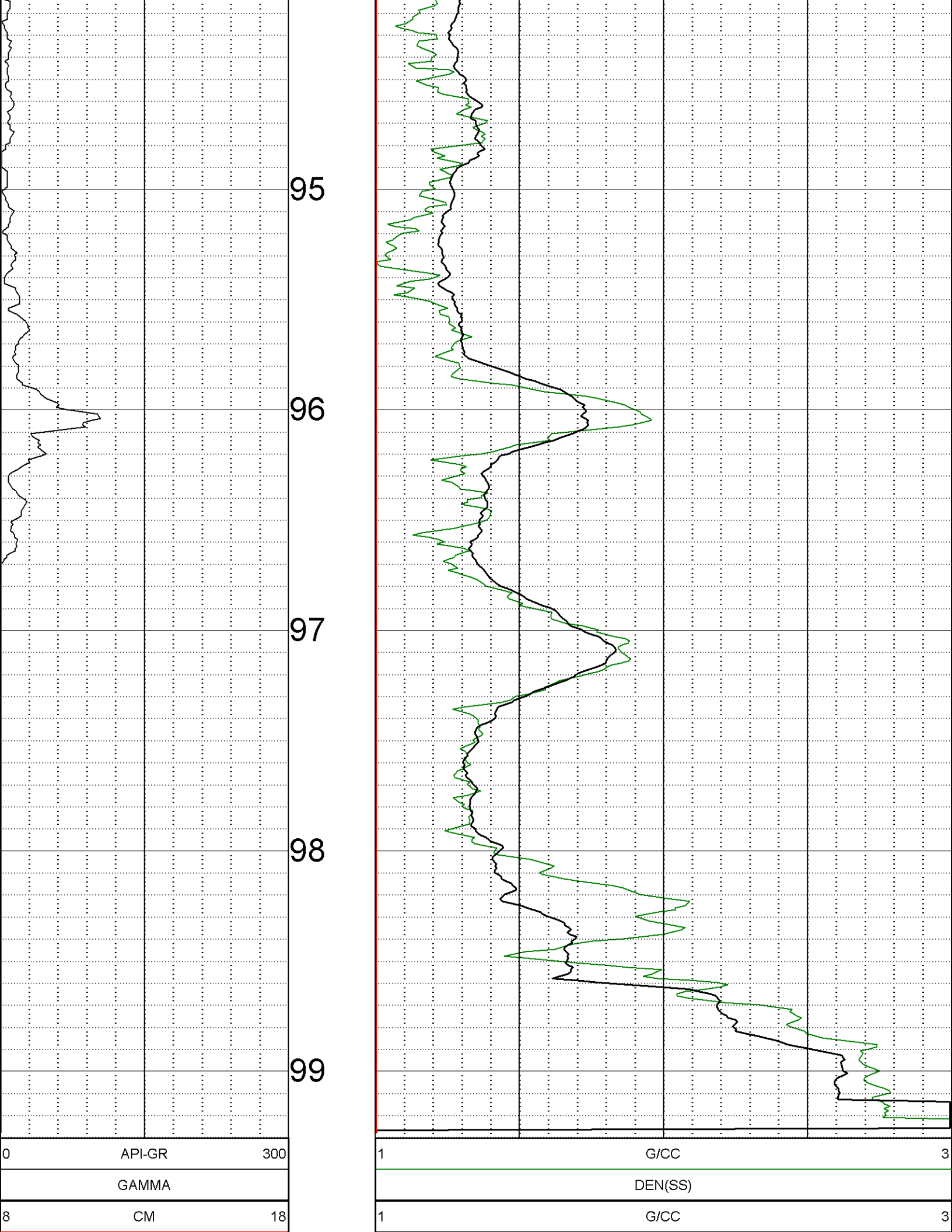

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API-GR
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GAMMA
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CM
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1
G/CC
3
DEN(SS)
1
G/CC
3

CALIPER		DEN(LS)		
		0	OHM-M	2000
	METERS	RES(SG)		

Coffey Geotechnics

Borehole BH04 TOP

ACOUSTIC TELEVIEWER PETROPHYSICAL REPORT

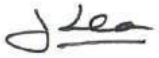
Groundsearch Australia Pty. Limited

2 October 2018

DISCLAIMER

The data used in this report were obtained using equipment manufactured by the Century Geophysical Corporation. The interpretations given in this report are based on judgement and experience of Groundsearch Australia's personnel. They are provided for Coffey Geotechnics sole use in accordance with a specified brief. As such, the interpretation outcomes do not necessarily address all aspects of ground conditions and behaviour on the subject site. The responsibility of Groundsearch Australia is solely to Coffey Geotechnics and it is not intended that any third party rely upon this report. This report shall not be reproduced either wholly or in part without the written permission of Groundsearch Australia Pty. Limited.

For and on behalf of Groundsearch Australia Pty. Limited



John Lea BSc (Hons) FAusIMM
Principal Geologist
Managing Director

Executive summary

The data contained in this report were obtained from one 9.6 cm diameter, vertical, cored borehole that was drilled as a component of the 2018 geotechnical exploration programme for Coffey Geotechnics at Lingard Street Newcastle NSW.

Century Geophysical Corporation downhole 9804 acoustic televiewer and 9329 density tools were run to collect data in the field on 14 September 2018. This report is for data from 30.00 to 41.32 mbgl. The 9239 density tool was run inside steel casing and data were corrected for the steel. Therefore, there are no caliper or resistivity data.

The 67 identified features are interpreted as the SWL bedding and fractures. The bedding to fractures ratio is 5:1.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

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Figure 6 BH04 TOP bedding dip directions histogram 11
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Appendix 1 1:20 Interpretation logs – 30.00 to 41.32 mbgl

1.0 Background technical information

The data contained in this report were obtained from one 9.6 cm diameter, vertical, cored borehole that was drilled as a component of the 2018 geotechnical exploration programme for Coffey Geotechnics at Lingard Street Newcastle NSW.

Century Geophysical Corporation downhole 9804 acoustic televiewer and 9329 density tools were run to collect data in the field on 14 September 2018. This report is for data from 30.00 to 41.32 mbgl. The 9239 density tool was run inside steel casing and data were corrected for the steel. Therefore, there are no caliper or resistivity data.

The 67 identified features are interpreted as the SWL bedding and fractures. The bedding to fractures ratio is 5:1.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

Subsequent processing and interpretation of data were carried out by Groundsearch.

The ATV takes an oriented image of the borehole using high-resolution sound waves. This acoustic image is displays amplitude variations. This information is used to detect bedding planes, fractures, and other borehole anomalies without the need to have clear fluid filling the boreholes. The tool works only in fluid-filled boreholes.

The televiewer digitises 256 measurements around the borehole at each high-resolution sample interval. These data can be oriented to North and displayed real-time while logging using the Visual Compu-Log System.

Analysis software includes colour adjustment, fracture dip and strike determination, and classification of features. It allows information to be displayed on the graphical screen, plot, and in report format.

2.0 Interpretation methodology

It should be noted that the ATV is a bowspring-type, centralised tool and is affected by poor wallrock conditions known as rugosity.

The ATV data interpretation procedure is based on the superposition of curves on feature logs directly onto the computer screen by using a subjective, manual; two-point definition of a feature's top and base to produce a sine curve. The sides of the time and amplitude plots represent magnetic north and magnetic south is in the centre of each plot. The low side, or trough, of the sine curve defines the dip direction of the feature.

The logging program automatically records the televiewer tool slant angle and bearing and corrects for any borehole deviations. The curves are automatically given an identification number for subsequent referencing in a report file.

There are possibly more bedding planes and structural fractures appearing in the televiewer logs that have not been included in this report due to their poor graphic definition or the inability to resolve their geometry by superposing a sine curve using the program's two point method.

This report contains a;

- Text summary of the interpreted features
- Circular representation of interpreted features
- Logs that show geological features with their subjective, numbered interpretation curves shown at 1:20 scale. The logs are in standard format whereby the optical image of the borehole wall is "flattened" onto the plot. The logs have the following additional features to enhance geological interpretations of the strata;
    - Amplitude image differentials
    - Time image differentials that indicate higher strength zones in **GREEN** and lower strength zones in **RED**
    - Tadpoles that represent feature dip and dip direction
    - Open fractures in **RED**
    - Partially open fractures in **MAGENTA**
    - Natural gamma
    - Slant (dip angle)
    - Slant angle bearing
    - Long and short space density
- Table containing feature curve ID, top, base, dip angle, dip azimuth, feature description and the generalised rock type that hosts the feature
- Graphical representations of the interpreted features

3.0 Borehole BH04 TOP interpretation

The 67 identified features are interpreted as the SWL bedding and fractures. The bedding to fractures ratio is 5:1.

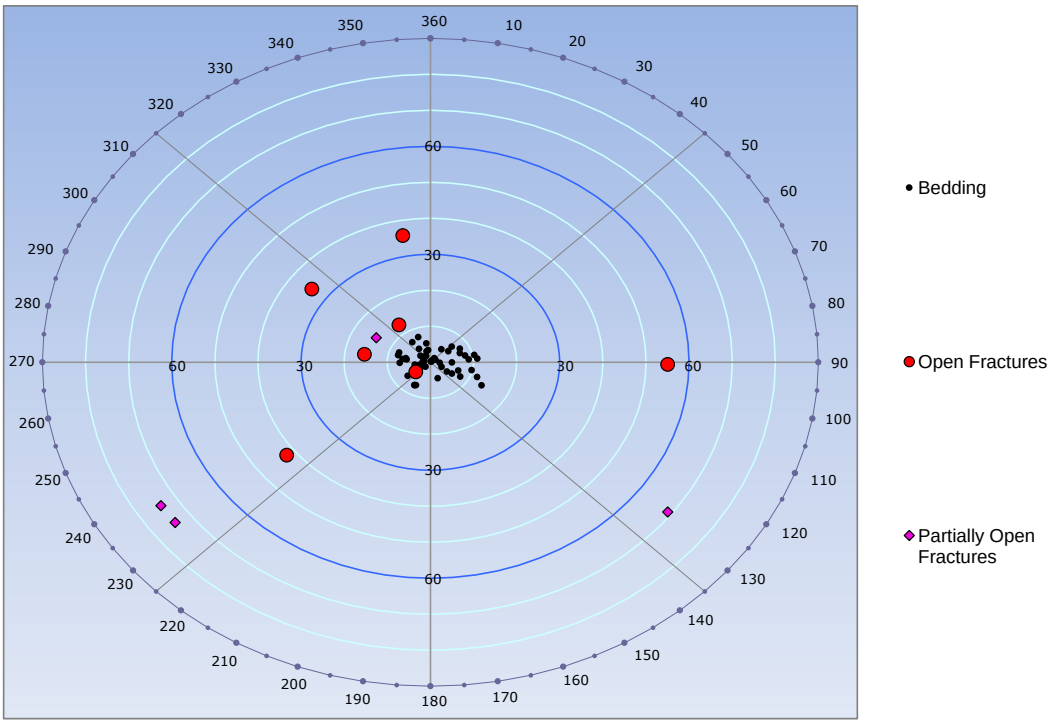
A description of each interpreted feature is presented in Table 1 and the log is presented in Appendix 1.

Table 1 Interpreted features report for BH04 TOP

FEATURE ID	DIP (DEG)	AZIMUTH (DEG)	MIDPOINT (MBGL)	TOP (M)	BASE (M)	TYPE OF FEATURE	GENERALISED ROCK TYPE
1			30.17	30.17	30.17	SWL	Overburden
2	2	319	30.48	30.48	30.48	Bedding plane	Overburden
3	0	44	30.96	30.96	30.96	Bedding plane	Overburden
4	15	278	31.19	31.18	31.21	Fracture plane - open	Overburden
5	14	298	31.29	31.28	31.30	Fracture plane - partially open	Overburden
6	8	338	31.33	31.32	31.33	Bedding plane	Overburden
7	8	61	31.56	31.56	31.57	Bedding plane	Overburden
8	7	70	31.77	31.76	31.77	Bedding plane	Overburden
9	8	77	31.83	31.83	31.84	Bedding plane	Overburden
10	12	111	31.92	31.91	31.93	Bedding plane	Overburden
11	7	208	32.39	32.38	32.39	Bedding plane	Overburden
12	7	323	32.53	32.52	32.53	Bedding plane	Overburden
13	8	120	32.70	32.70	32.71	Bedding plane	Overburden
14	69	127	32.78	32.65	32.91	Fracture plane - partially open	Overburden
15	2	312	32.93	32.93	32.94	Bedding plane	Overburden
16	2	94	33.16	33.15	33.16	Bedding plane	Overburden
17	5	238	34.48	34.47	34.48	Bedding plane	Overburden
18	2	255	34.65	34.65	34.65	Bedding plane	Overburden
19	3	117	34.72	34.71	34.72	Bedding plane	Overburden
20	3	254	34.79	34.79	34.80	Bedding plane	Overburden
21	7	49	34.83	34.83	34.84	Bedding plane	Overburden
22	3	352	35.09	35.09	35.09	Bedding plane	Overburden
23	5	350	35.13	35.13	35.14	Bedding plane	Overburden
24	0	47	35.62	35.62	35.62	Bedding plane	Overburden
25	4	232	35.67	35.66	35.67	Fracture plane - open	Overburden
26	1	38	35.72	35.72	35.72	Bedding plane	Overburden
27	2	282	35.77	35.77	35.77	Bedding plane	Overburden
28	7	269	35.84	35.84	35.85	Bedding plane	Overburden
29	4	35	35.95	35.95	35.95	Bedding plane	Overburden
30	2	222	36.15	36.15	36.15	Bedding plane	Overburden
31	8	290	36.25	36.24	36.25	Bedding plane	Overburden
32	6	122	36.37	36.37	36.38	Bedding plane	Overburden
33	6	281	36.56	36.56	36.57	Bedding plane	Overburden
34	55	91	36.74	36.67	36.82	Fracture plane - open	Overburden
35	13	325	36.90	36.89	36.91	Fracture plane - open	Overburden
36	6	278	37.06	37.06	37.07	Bedding plane	Overburden
37	0	26	37.15	37.15	37.15	Bedding plane	Overburden
38	3	308	37.18	37.18	37.18	Bedding plane	Overburden

FEATURE ID	DIP (DEG)	AZIMUTH (DEG)	MIDPOINT (MBGL)	TOP (M)	BASE (M)	TYPE OF FEATURE	GENERALISED ROCK TYPE
39	2	266	37.28	37.27	37.28	Bedding plane	Overburden
40	6	278	37.51	37.50	37.52	Bedding plane	Overburden
41	1	285	37.53	37.53	37.54	Bedding plane	Overburden
42	2	239	37.60	37.60	37.60	Bedding plane	Overburden
43	6	235	37.63	37.63	37.64	Bedding plane	Overburden
44	8	285	37.69	37.68	37.70	Bedding plane	Overburden
45	36	350	38.33	38.30	38.37	Fracture plane - open	Overburden
46	3	344	38.34	38.34	38.34	Bedding plane	Overburden
47	7	110	38.39	38.38	38.39	Bedding plane	Overburden
48	5	325	38.68	38.67	38.68	Bedding plane	Overburden
49	7	210	38.82	38.82	38.83	Bedding plane	Overburden
50	7	210	38.84	38.84	38.85	Bedding plane	Overburden
51	5	159	38.96	38.96	38.96	Bedding plane	Overburden
52	1	61	39.00	39.00	39.00	Bedding plane	Overburden
53	10	103	39.02	39.01	39.02	Bedding plane	Overburden
54	13	118	39.07	39.06	39.09	Bedding plane	Overburden
55	9	85	39.12	39.11	39.13	Bedding plane	Overburden
56	11	85	39.17	39.16	39.18	Bedding plane	Overburden
57	34	307	39.49	39.45	39.52	Fracture plane - open	Overburden
58	42	232	39.59	39.55	39.64	Fracture plane - open	Overburden
59	4	260	39.73	39.72	39.73	Bedding plane	Overburden
60	0	45	40.15	40.15	40.14	Bedding plane	Overburden
61	2	331	40.25	40.25	40.25	Bedding plane	Overburden
62	10	79	40.57	40.56	40.58	Bedding plane	Overburden
63	5	124	40.69	40.68	40.69	Bedding plane	Overburden
64	74	237	40.69	40.51	40.87	Fracture plane - partially open	Overburden
65	5	91	40.73	40.72	40.73	Bedding plane	Overburden
66	74	233	40.74	40.56	40.92	Fracture plane - partially open	Overburden
67	5	54	40.75	40.74	40.75	Bedding plane	Overburden

Figure 1 BH04 TOP circular plan representation of interpreted features



The 55 identified sedimentary features are predominantly bedding planes that appear to range in dip from flat-lying to 13^0. Figures 2 and 3 show the distribution of the planes' dip angles and dip direction with depth.

Table 2 details the variation in the dip angle and dip direction data. Figure 4 shows the dip direction data in a rose diagram with the bedding planes' dip angle and dip direction data shown as histograms in Figures 5 and 6.

The 11 fractures are identified as open (64%) and partially open (36%). The fracture dip angles range from 4 to 74^0.

Table 3 details the variation in the fractures' dip angle and dip direction data. Figure 7 shows the dip direction data in a rose diagram with the fractures' plane dip angle and dip direction data as histograms in Figures 8 and 9.

Figure 2 BH04 TOP feature dip angle data distribution

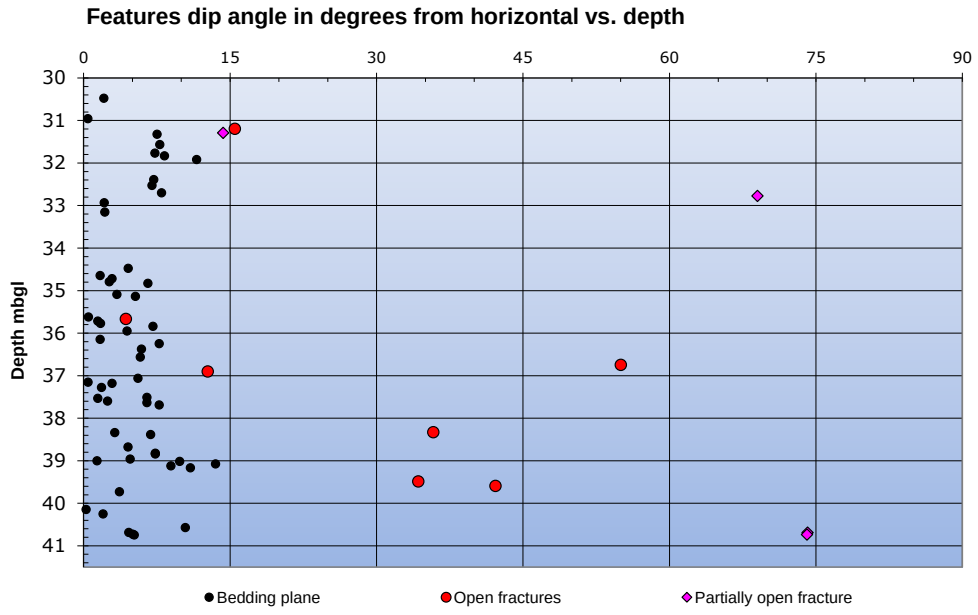


Figure 3 BH04 TOP feature dip direction data distribution

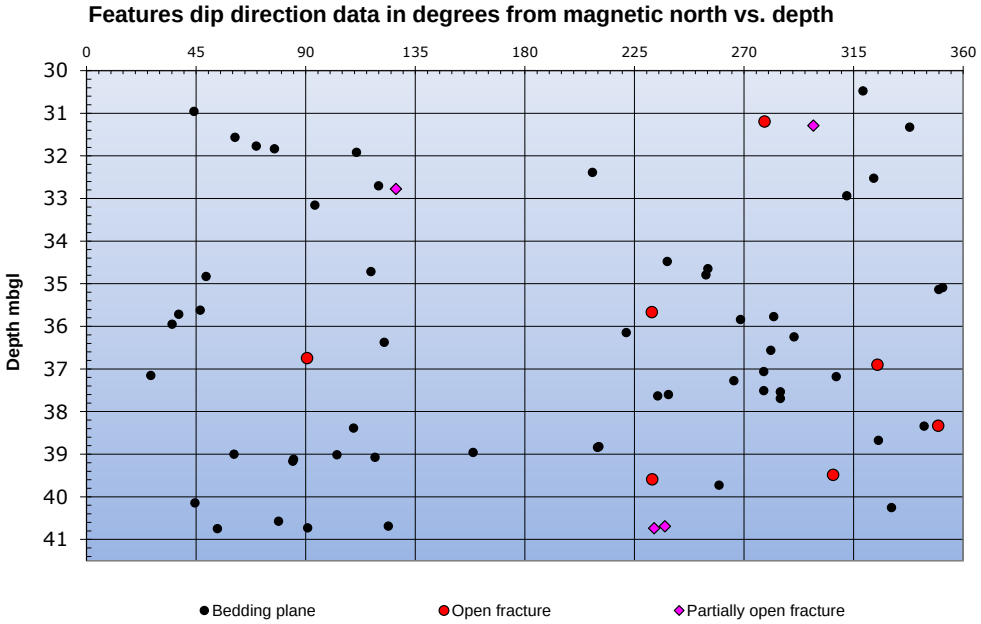


Table 2 BH04 TOP bedding histogram data

Dip Distribution Total: 55			Orientation Distribution Total: 55		
Dip Range	Count	%	Bearing Range	Count	%
0 to 10	51	92.7	0 to 10	0	0.0
10 to 20	4	7.3	10 to 20	0	0.0
20 to 30	0	0.0	20 to 30	1	1.8
30 to 40	0	0.0	30 to 40	2	3.6
40 to 50	0	0.0	40 to 50	4	7.3
50 to 60	0	0.0	50 to 60	1	1.8
60 to 70	0	0.0	60 to 70	3	5.5
70 to 80	0	0.0	70 to 80	2	3.6
80 to 90	0	0.0	80 to 90	2	3.6
			90 to 100	2	3.6
			100 to 110	2	3.6
			110 to 120	4	7.3
			120 to 130	2	3.6
			130 to 140	0	0.0
			140 to 150	0	0.0
			150 to 160	1	1.8
			160 to 170	0	0.0
			170 to 180	0	0.0
			180 to 190	0	0.0
			190 to 200	0	0.0
			200 to 210	2	3.6
			210 to 220	1	1.8
			220 to 230	1	1.8
			230 to 240	3	5.5
			240 to 250	0	0.0
			250 to 260	3	5.5
			260 to 270	2	3.6
			270 to 280	2	3.6
			280 to 290	4	7.3
			290 to 300	1	1.8
			300 to 310	1	1.8
			310 to 320	2	3.6
			320 to 330	2	3.6
			330 to 340	2	3.6
			340 to 350	2	3.6
			350 to 360	1	1.8

Figure 5 BH04 TOP bedding dip angles histogram

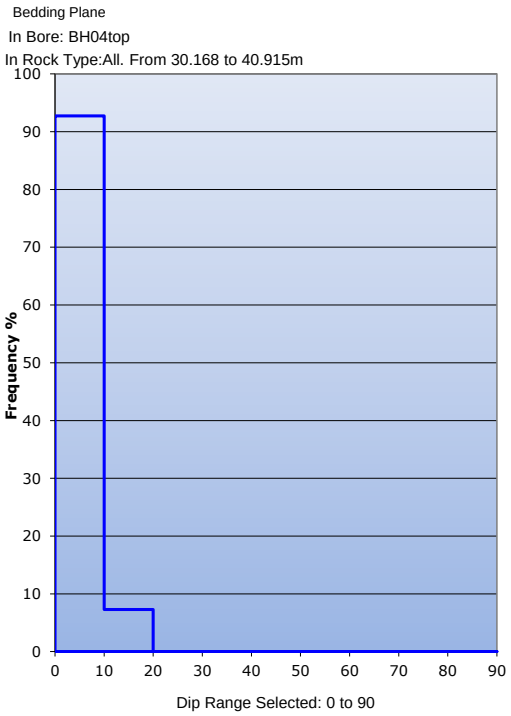


Figure 4 BH04 TOP bedding dip direction data rose diagram

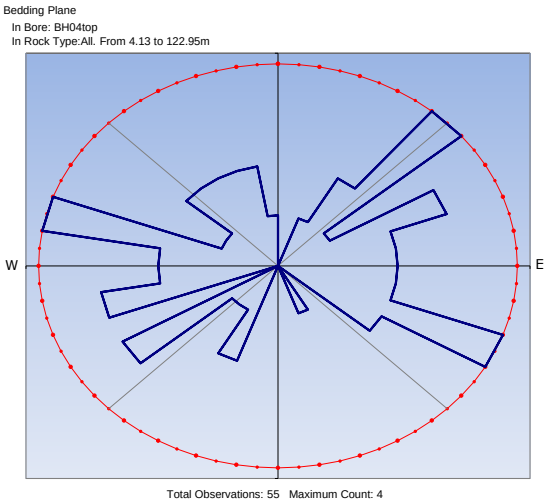


Figure 6 BH04 TOP bedding dip directions histogram

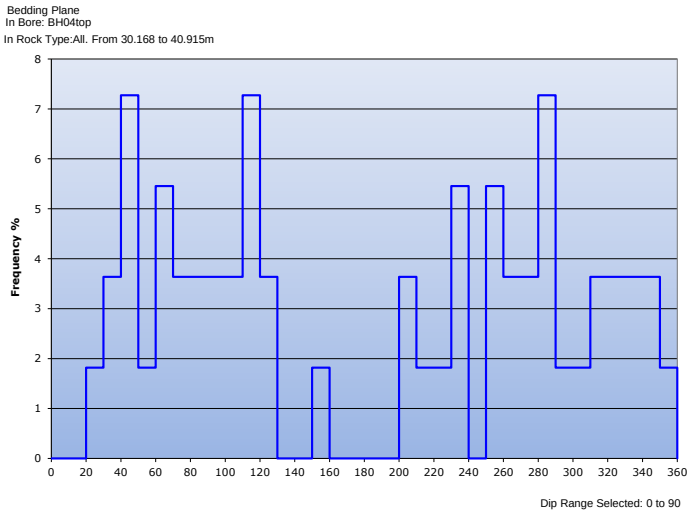


Table 3 BH04 TOP fractures histogram data

Dip Distribution Total: 11			Orientation Distribution Total: 11		
Dip Range	Count	%	Bearing Range	Count	%
0 to 10	1	9.1	0 to 10	0	0.0
10 to 20	3	27.3	10 to 20	0	0.0
20 to 30	0	0.0	20 to 30	0	0.0
30 to 40	2	18.2	30 to 40	0	0.0
40 to 50	1	9.1	40 to 50	0	0.0
50 to 60	1	9.1	50 to 60	0	0.0
60 to 70	1	9.1	60 to 70	0	0.0
70 to 80	2	18.2	70 to 80	0	0.0
80 to 90	0	0.0	80 to 90	0	0.0
			90 to 100	1	9.1
			100 to 110	0	0.0
			110 to 120	0	0.0
			120 to 130	1	9.1
			130 to 140	0	0.0
			140 to 150	0	0.0
			150 to 160	0	0.0
			160 to 170	0	0.0
			170 to 180	0	0.0
			180 to 190	0	0.0
			190 to 200	0	0.0
			200 to 210	0	0.0
			210 to 220	0	0.0
			220 to 230	0	0.0
			230 to 240	4	36.4
			240 to 250	0	0.0
			250 to 260	0	0.0
			260 to 270	0	0.0
			270 to 280	1	9.1
			280 to 290	0	0.0
			290 to 300	1	9.1
			300 to 310	1	9.1
			310 to 320	0	0.0
			320 to 330	1	9.1
			330 to 340	0	0.0
			340 to 350	1	9.1
			350 to 360	0	0.0

Figure 8 BH04 TOP fractures dip angles histogram

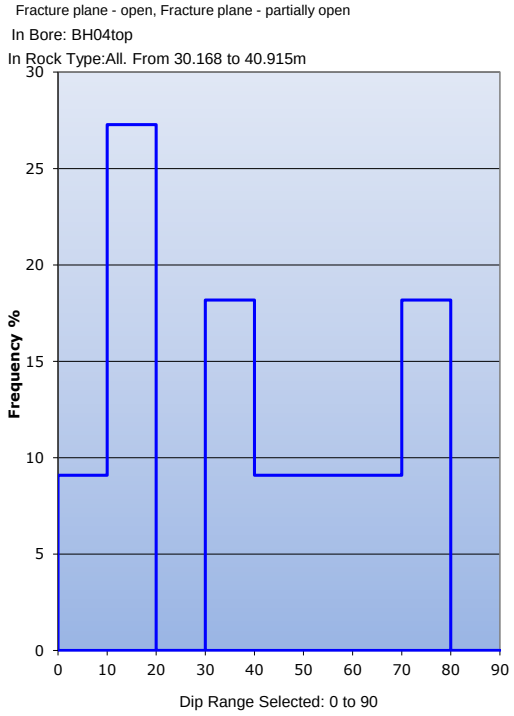


Figure 7 BH04 TOP fractures dip direction data rose diagram

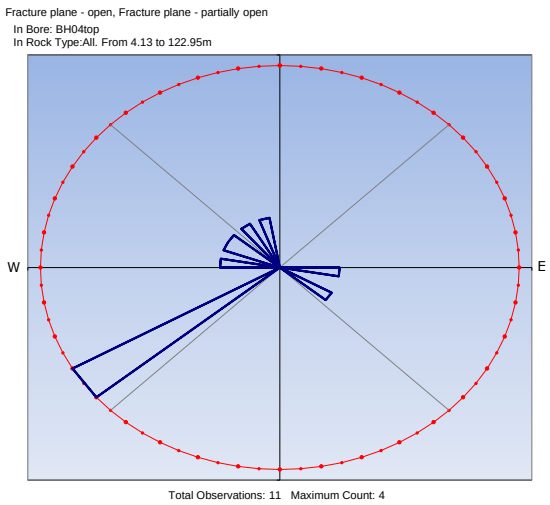
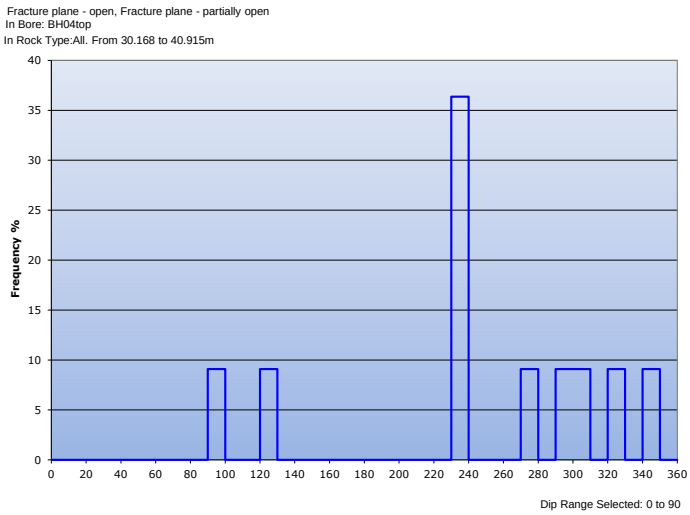


Figure 9 BH04 TOP fractures dip directions histogram



Appendix 1

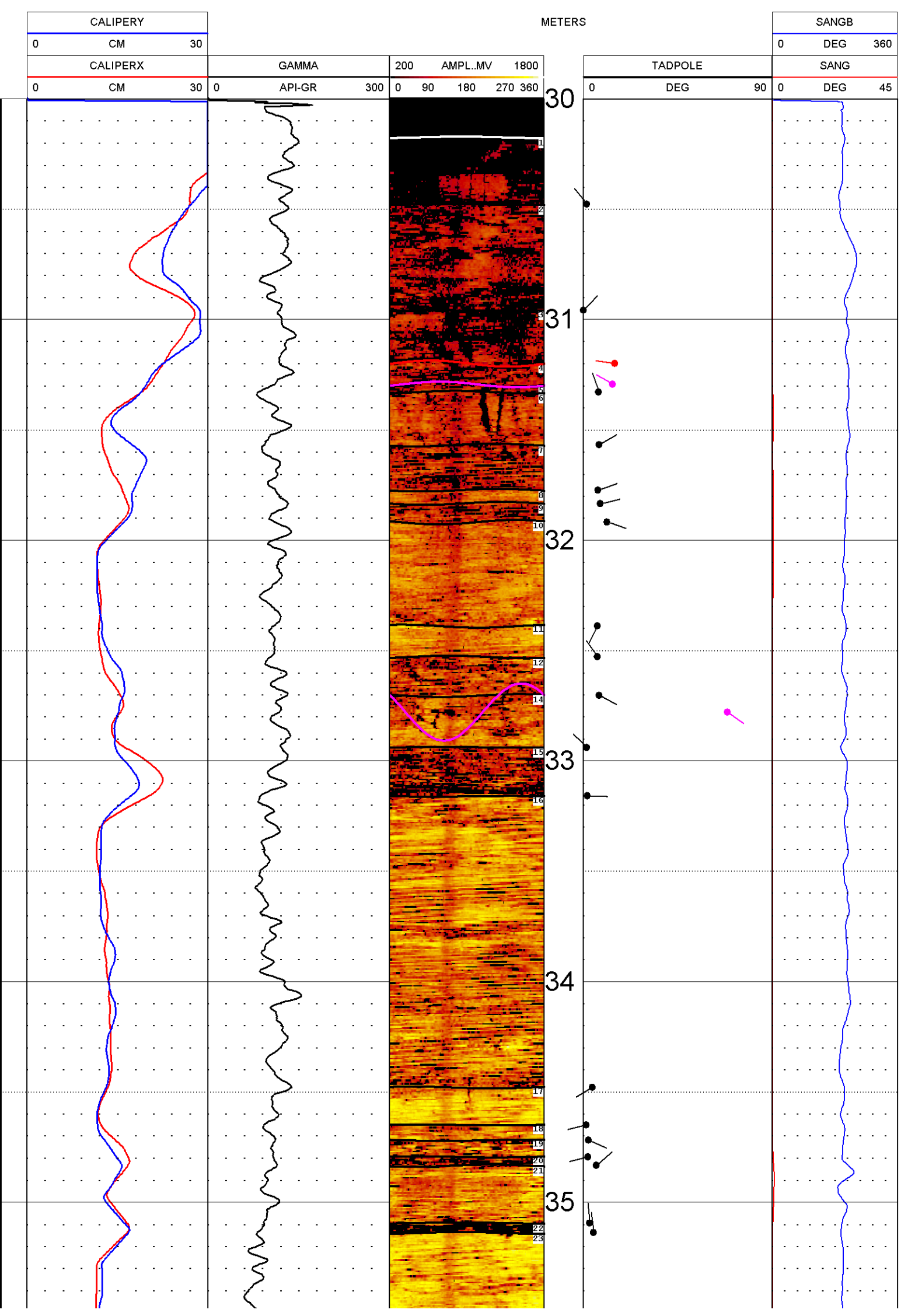
Appendix 1 ***1:20 Interpretation logs – 30.00 to 41.32 mbgl***

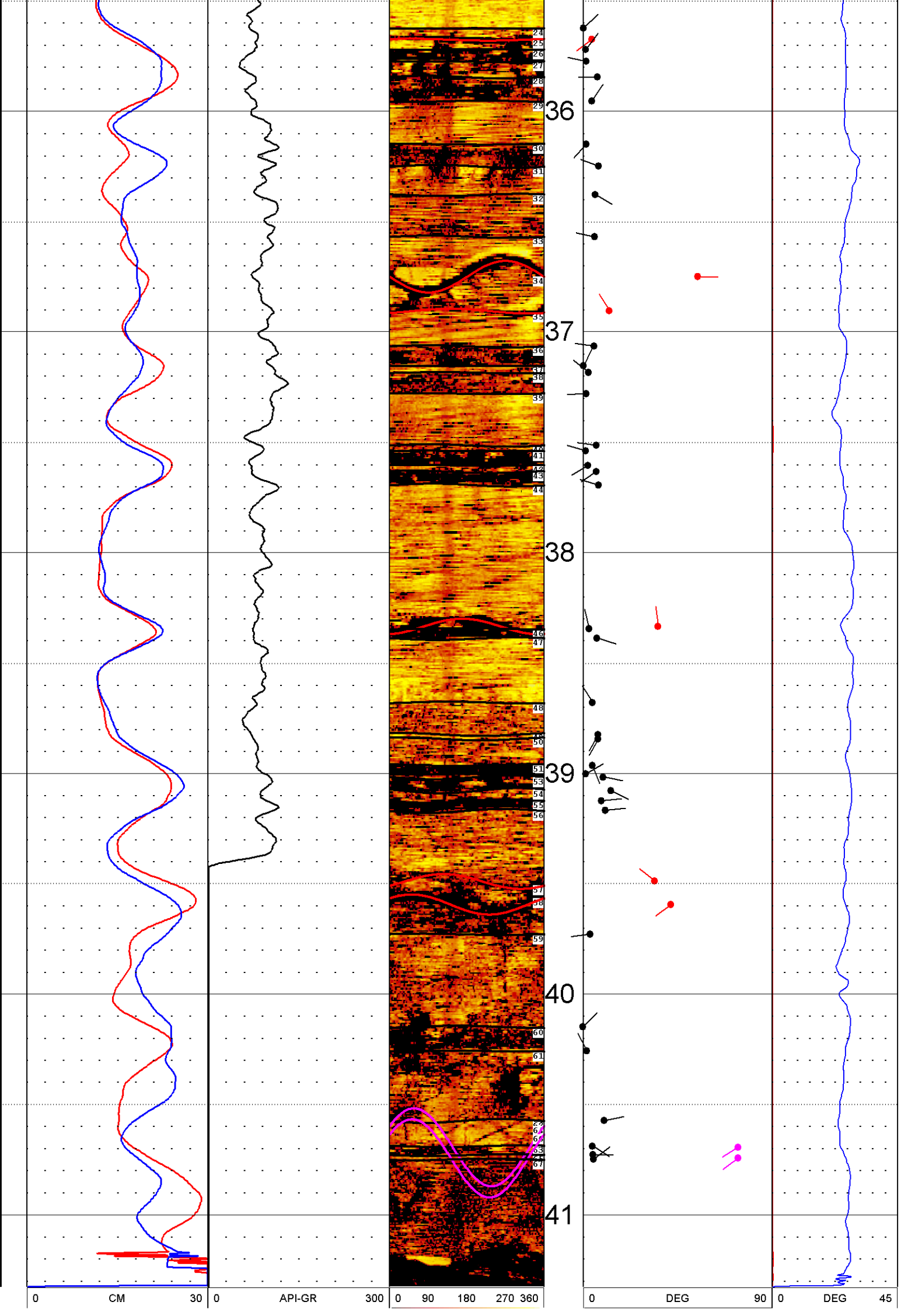


BOREHOLE04 TOP ATV 1:20

COMPANY	:	COFFEY GEOTECHNICS			OTHER SERVICES:	UTM-E	: N/A
WELL	:	BOREHOLE04 TOP ATV 1:20			DEN ATV	UTM-N	: N/A
LOCATION/FIELD	:	LINGARD			ON,TV		
COUNTY	:						
LOCATION	:	NEWCASTLE					
SECTION	:	N/A	TOWNSHIP	: N/A		RANGE	: N/A
DATE	:	09/14/18	PERMANENT DATUM	:			
DEPTH DRILLER	:	101.6				KB	: N/A
LOG BOTTOM	:	41.320	LOG MEASURED FROM:	N/A		DF	: N/A
LOG TOP	:	30.000	DRL MEASURED FROM:	N/A		GL	: NA
CASING DIAMETER	:	10.	LOGGING UNIT	: T107			
CASING TYPE	:	STEEL	FIELD OFFICE	: RUTHERFORD			
CASING THICKNESS:		.5	RECORDED BY	: P WOODWARD			
BIT SIZE	:	9.9	BOREHOLE FLUID	: 0		FILE	: PROCESSED
MAGNETIC DECL.	:	0	RM	: N/A		TYPE	: 9804A
MATRIX DENSITY	:	2.65	RM TEMPERATURE	: N/A		LGDATE	: 09/14/18
NEUTRON MATRIX	:	SANDSTONE	MATRIX DELTA T	: 177		LGTIME	: 12:20
						THRESH:	99999

ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS


CALIPERY
0 CM 30
CALIPERX
0 CM 30
METERS
GAMMA
0 API-GR 300
200 AMPL..MV 1800
0 90 180 270 360
TADPOLE
0 DEG 90
SANGB
0 DEG 360
SANG
0 DEG 45
30
31
32
33
34
35


36
37
38
39
40
41
0
CM
30
0
API-GR
300
0
90
180
270
360
0
DEG
90
0
DEG
45

Coffey Geotechnics

Borehole BH04

ACOUSTIC TELEVIEWER PETROPHYSICAL REPORT

Groundsearch Australia Pty. Limited

24 September 2018

DISCLAIMER

The data used in this report were obtained using equipment manufactured by the Century Geophysical Corporation. The interpretations given in this report are based on judgement and experience of Groundsearch Australia's personnel. They are provided for Coffey Geotechnics sole use in accordance with a specified brief. As such, the interpretation outcomes do not necessarily address all aspects of ground conditions and behaviour on the subject site. The responsibility of Groundsearch Australia is solely to Coffey Geotechnics and it is not intended that any third party rely upon this report. This report shall not be reproduced either wholly or in part without the written permission of Groundsearch Australia Pty. Limited.

For and on behalf of Groundsearch Australia Pty. Limited



John Lea BSc (Hons) FAusIMM
Principal Geologist
Managing Director

Executive summary

The data contained in this report were obtained from one 9.6 cm diameter, vertical, cored borehole that was drilled as a component of the 2018 geotechnical exploration programme for Coffey Geotechnics at Lingard Street Newcastle NSW.

Century Geophysical Corporation downhole 9804 acoustic televiewer and 9329 density tools were run to collect data in the field on 14 September 2018. This report is for data from 44.50 to 93.26 mbgl. The 9239 density tool was run inside steel casing and data were corrected for the steel. Therefore, there are no caliper or resistivity data.

The 212 identified features are interpreted as bedding, fractures, the SWL and a void at the base of the log. The bedding to fractures ratio is 6.8:1.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

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Appendix 1 1:20 Interpretation logs – 44.50 to 93.26 mbgl

1.0 Background technical information

The data contained in this report were obtained from one 9.6 cm diameter, vertical, cored borehole that was drilled as a component of the 2018 geotechnical exploration programme for Coffey Geotechnics at Lingard Street Newcastle NSW.

Century Geophysical Corporation downhole 9804 acoustic televiewer and 9329 density tools were run to collect data in the field on 14 September 2018. This report is for data from 44.50 to 93.26 mbgl. The 9239 density tool was run inside steel casing and data were corrected for the steel. Therefore, there are no caliper or resistivity data.

The 212 identified features are interpreted as bedding, fractures, the SWL and a void at the base of the log. The bedding to fractures ratio is 6.8:1.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

The Century Display program has automatically recalculated the dip angle data to represent the borehole in the vertical position and the dip direction data is referenced to magnetic north.

Subsequent processing and interpretation of data were carried out by Groundsearch.

The ATV takes an oriented image of the borehole using high-resolution sound waves. This acoustic image is displays amplitude variations. This information is used to detect bedding planes, fractures, and other borehole anomalies without the need to have clear fluid filling the boreholes. The tool works only in fluid-filled boreholes.

The televiewer digitises 256 measurements around the borehole at each high-resolution sample interval. These data can be oriented to North and displayed real-time while logging using the Visual Compu-Log System.

Analysis software includes colour adjustment, fracture dip and strike determination, and classification of features. It allows information to be displayed on the graphical screen, plot, and in report format.

2.0 Interpretation methodology

It should be noted that the ATV is a bowspring-type, centralised tool and is affected by poor wallrock conditions known as rugosity.

The ATV data interpretation procedure is based on the superposition of curves on feature logs directly onto the computer screen by using a subjective, manual; two-point definition of a feature's top and base to produce a sine curve. The sides of the time and amplitude plots represent magnetic north and magnetic south is in the centre of each plot. The low side, or trough, of the sine curve defines the dip direction of the feature.

The logging program automatically records the televiewer tool slant angle and bearing and corrects for any borehole deviations. The curves are automatically given an identification number for subsequent referencing in a report file.

There are possibly more bedding planes and structural fractures appearing in the televiewer logs that have not been included in this report due to their poor graphic definition or the inability to resolve their geometry by superposing a sine curve using the program's two point method.

This report contains a;

- Text summary of the interpreted features
- Circular representation of interpreted features
- Logs that show geological features with their subjective, numbered interpretation curves shown at 1:20 scale. The logs are in standard format whereby the optical image of the borehole wall is "flattened" onto the plot. The logs have the following additional features to enhance geological interpretations of the strata;
    - Amplitude image differentials
    - Time image differentials that indicate higher strength zones in **GREEN** and lower strength zones in **RED**
    - Tadpoles that represent feature dip and dip direction
    - Open fractures in **RED**
    - Partially open fractures in **MAGENTA**
    - Discontinuous fractures in **DARK BLUE**
    - Natural gamma
    - Slant (dip angle)
    - Slant angle bearing
    - Long and short space density
- Table containing feature curve ID, top, base, dip angle, dip azimuth, feature description and the generalised rock type that hosts the feature
- Graphical representations of the interpreted features

3.0 Borehole BH04interpretation

The 212 identified features are interpreted as bedding, fractures, the SWL and a void at the base of the log. The bedding to fractures ratio is 6.8:1.

A description of each interpreted feature is presented in Table 1 and the log is presented in Appendix 1.

Table 1 Interpreted features report for BH04

FEATURE ID	DIP (DEG)	AZIMUTH (DEG)	MIDPOINT (MBGL)	TOP (M)	BASE (M)	TYPE OF FEATURE	GENERALISED ROCK TYPE
1			44.81	44.81	44.81	SWL	Overburden
2	2	288	46.31	46.30	46.31	Bedding plane	Overburden
3	5	214	46.42	46.41	46.42	Bedding plane	Overburden
4	3	315	47.58	47.58	47.58	Bedding plane	Overburden
5	4	306	47.80	47.79	47.80	Bedding plane	Overburden
6	7	278	47.93	47.92	47.94	Bedding plane	Overburden
7	9	293	48.00	48.00	48.01	Bedding plane	Overburden
8	9	293	48.09	48.08	48.09	Bedding plane	Overburden
9	2	267	48.62	48.62	48.63	Bedding plane	Overburden
10	7	155	49.07	49.07	49.08	Bedding plane	Overburden
11	3	284	51.99	51.99	51.99	Bedding plane	Overburden
12	3	278	52.10	52.09	52.10	Bedding plane	Overburden
13	60	117	52.10	52.01	52.18	Fracture plane - partially open	Overburden
14	64	122	52.17	52.07	52.26	Fracture plane - open	Overburden
15	5	340	52.32	52.31	52.32	Bedding plane	Overburden
16	7	278	52.48	52.48	52.49	Bedding plane	Overburden
17	11	70	52.65	52.64	52.66	Bedding plane	Overburden
18	11	51	52.97	52.97	52.98	Bedding plane	Overburden
19	3	299	53.02	53.02	53.03	Bedding plane	Overburden
20	1	95	53.30	53.30	53.30	Bedding plane	Overburden
21	14	72	53.39	53.38	53.40	Bedding plane	Overburden
22	8	113	53.44	53.43	53.45	Bedding plane	Overburden
23	7	291	53.51	53.50	53.51	Bedding plane	Overburden
24	61	238	53.65	53.56	53.75	Fracture plane - partially open	Overburden
25	2	214	53.76	53.75	53.76	Bedding plane	Overburden
26	2	321	53.87	53.87	53.87	Bedding plane	Overburden
27	4	245	53.90	53.90	53.91	Bedding plane	Overburden
28	2	330	54.21	54.21	54.22	Bedding plane	Overburden
29	4	90	54.41	54.41	54.42	Bedding plane	Overburden
30	4	256	54.56	54.55	54.56	Bedding plane	Overburden
31	4	268	54.60	54.60	54.61	Bedding plane	Overburden
32	1	296	54.71	54.71	54.71	Bedding plane	Overburden
33	3	299	54.74	54.74	54.75	Bedding plane	Overburden
34	5	249	54.80	54.80	54.81	Bedding plane	Overburden
35	1	70	54.89	54.89	54.89	Bedding plane	Overburden
36	7	327	54.96	54.96	54.97	Bedding plane	Overburden
37	2	276	55.07	55.07	55.08	Bedding plane	Overburden
38	3	272	55.20	55.20	55.20	Bedding plane	Overburden

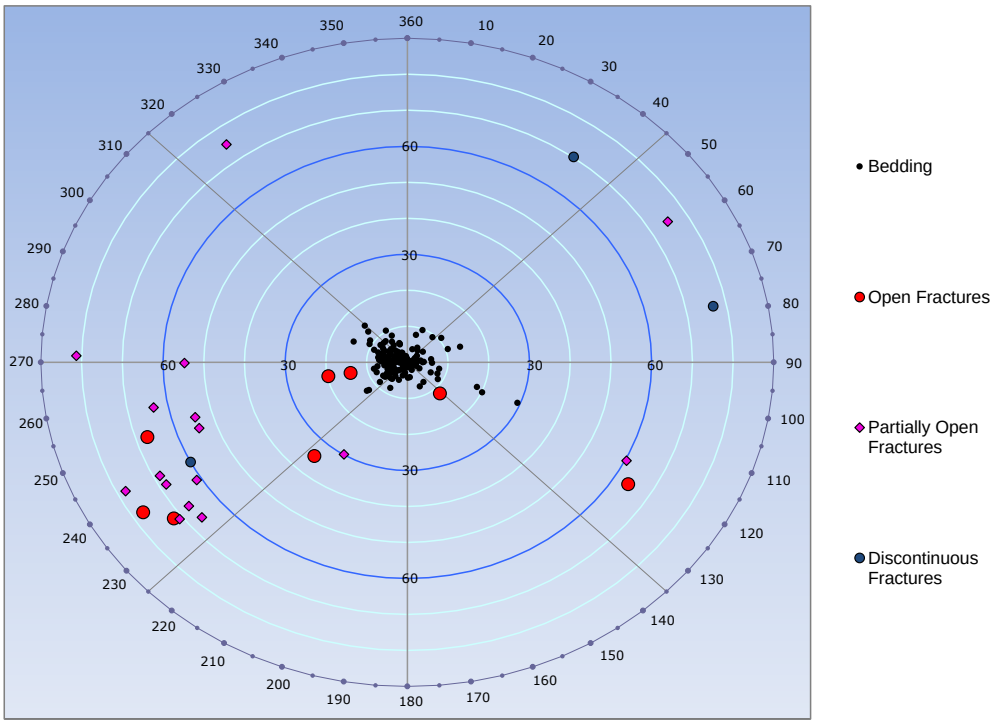
39	9	42	55.30	55.29	55.30	Bedding plane	Overburden
40	6	277	56.12	56.11	56.12	Bedding plane	Overburden
41	2	312	56.33	56.33	56.33	Bedding plane	Overburden
42	2	123	56.43	56.42	56.43	Bedding plane	Overburden
43	55	270	56.53	56.46	56.60	Fracture plane - partially open	Overburden
44	1	185	56.69	56.69	56.69	Bedding plane	Overburden
45	2	62	56.89	56.89	56.89	Bedding plane	Overburden
46	4	258	57.19	57.19	57.20	Bedding plane	Overburden
47	7	275	57.33	57.33	57.34	Bedding plane	Overburden
48	13	312	57.91	57.90	57.92	Bedding plane	Overburden
49	8	333	58.00	57.99	58.01	Bedding plane	Overburden
50	6	91	58.13	58.13	58.14	Bedding plane	Overburden
51	3	335	58.49	58.49	58.49	Bedding plane	Overburden
52	6	219	58.59	58.58	58.59	Bedding plane	Overburden
53	3	304	58.78	58.78	58.78	Bedding plane	Overburden
54	4	259	58.84	58.84	58.84	Bedding plane	Overburden
55	3	275	58.99	58.99	58.99	Bedding plane	Overburden
56	4	293	59.01	59.01	59.01	Bedding plane	Overburden
57	7	233	59.11	59.11	59.12	Bedding plane	Overburden
58	4	239	59.17	59.16	59.17	Bedding plane	Overburden
59	3	285	59.28	59.28	59.28	Bedding plane	Overburden
60	9	231	59.60	59.59	59.60	Bedding plane	Overburden
61	7	238	59.95	59.94	59.96	Bedding plane	Overburden
62	3	82	60.05	60.05	60.06	Bedding plane	Overburden
63	4	259	60.22	60.21	60.22	Bedding plane	Overburden
64	1	306	60.44	60.44	60.44	Bedding plane	Overburden
65	20	114	60.49	60.48	60.51	Bedding plane	Overburden
66	18	112	60.52	60.51	60.54	Bedding plane	Overburden
67	1	246	60.64	60.64	60.65	Bedding plane	Overburden
68	2	332	60.77	60.77	60.77	Bedding plane	Overburden
69	8	16	60.93	60.93	60.94	Bedding plane	Overburden
70	7	280	61.65	61.64	61.65	Bedding plane	Overburden
71	2	303	61.78	61.77	61.78	Bedding plane	Overburden
72	1	74	62.84	62.84	62.84	Bedding plane	Overburden
73	5	203	63.00	62.99	63.00	Bedding plane	Overburden
74	4	172	63.14	63.13	63.14	Bedding plane	Overburden
75	4	225	63.19	63.19	63.20	Bedding plane	Overburden
76	8	210	63.23	63.22	63.24	Bedding plane	Overburden
77	11	304	63.54	63.53	63.55	Bedding plane	Overburden
78	11	299	63.57	63.56	63.58	Bedding plane	Overburden
79	75	324	63.60	63.41	63.80	Fracture plane - partially open	Overburden
80	13	231	64.37	64.36	64.38	Bedding plane	Overburden
81	64	259	67.21	67.11	67.31	Fracture plane - partially open	Overburden
82	1	195	68.70	68.70	68.70	Bedding plane	Overburden
83	7	234	69.05	69.04	69.06	Bedding plane	Overburden
84	54	254	69.56	69.50	69.63	Fracture plane - partially open	Overburden
85	66	230	69.82	69.70	69.93	Fracture plane - partially open	Overburden
86	67	233	69.86	69.74	69.98	Fracture plane - partially open	Overburden
87	7	262	70.12	70.11	70.12	Bedding plane	Overburden
88	3	323	70.20	70.20	70.20	Bedding plane	Overburden

89	72	233	70.30	70.15	70.46	Fracture plane - open	Overburden
90	68	243	70.40	70.27	70.53	Fracture plane - partially open	Overburden
91	71	232	70.45	70.30	70.60	Fracture plane - partially open	Overburden
92	5	256	70.70	70.70	70.70	Bedding plane	Overburden
93	5	268	70.85	70.84	70.85	Bedding plane	Overburden
94	4	322	70.87	70.87	70.87	Bedding plane	Overburden
95	7	281	70.94	70.93	70.94	Bedding plane	Overburden
96	70	36	70.95	70.82	71.08	Fracture plane - discontinuous	Overburden
97	2	304	71.03	71.02	71.03	Bedding plane	Overburden
98	2	282	71.07	71.07	71.07	Bedding plane	Overburden
99	68	240	71.08	70.95	71.20	Fracture plane - partially open	Overburden
100	1	86	71.46	71.46	71.46	Bedding plane	Overburden
101	60	243	71.63	71.54	71.72	Fracture plane - discontinuous	Overburden
102	1	77	71.65	71.65	71.65	Bedding plane	Overburden
103	1	269	71.74	71.74	71.74	Bedding plane	Overburden
104	5	340	71.83	71.83	71.84	Bedding plane	Overburden
105	5	235	71.86	71.86	71.87	Bedding plane	Overburden
106	1	320	71.91	71.91	71.91	Bedding plane	Overburden
107	20	259	72.00	71.99	72.02	Fracture plane - open	Overburden
108	4	274	72.03	72.03	72.04	Bedding plane	Overburden
109	3	315	72.15	72.15	72.15	Bedding plane	Overburden
110	2	336	72.29	72.29	72.29	Bedding plane	Overburden
111	3	265	72.47	72.46	72.47	Bedding plane	Overburden
112	1	71	72.52	72.52	72.52	Bedding plane	Overburden
113	1	357	72.56	72.56	72.56	Bedding plane	Overburden
114	78	243	74.08	73.83	74.33	Fracture plane - partially open	Overburden
115	5	300	74.25	74.25	74.25	Bedding plane	Overburden
116	30	211	74.36	74.33	74.38	Fracture plane - partially open	Overburden
117	67	252	74.38	74.26	74.50	Fracture plane - open	Overburden
118	35	221	74.39	74.35	74.42	Fracture plane - open	Overburden
119	54	250	74.58	74.50	74.65	Fracture plane - partially open	Overburden
120	5	248	74.60	74.60	74.61	Bedding plane	Overburden
121	3	274	74.62	74.62	74.62	Bedding plane	Overburden
122	15	314	74.67	74.66	74.68	Bedding plane	Overburden
123	6	82	74.98	74.97	74.98	Bedding plane	Overburden
124	7	303	75.06	75.06	75.07	Bedding plane	Overburden
125	4	265	75.75	75.75	75.76	Bedding plane	Overburden
126	5	280	76.04	76.03	76.04	Bedding plane	Overburden
127	5	52	76.13	76.12	76.13	Bedding plane	Overburden
128	5	236	76.25	76.25	76.26	Bedding plane	Overburden
129	8	318	77.14	77.13	77.15	Bedding plane	Overburden
130	2	297	77.17	77.17	77.17	Bedding plane	Overburden
131	4	260	78.06	78.06	78.06	Bedding plane	Overburden
132	12	137	78.11	78.10	78.12	Fracture plane - open	Overburden
133	1	165	78.67	78.67	78.67	Bedding plane	Overburden
134	3	190	78.72	78.71	78.72	Bedding plane	Overburden
135	9	122	79.31	79.30	79.32	Bedding plane	Overburden
136	6	239	79.69	79.69	79.70	Bedding plane	Overburden
137	6	232	79.93	79.92	79.93	Bedding plane	Overburden

138	3	193	81.79	81.79	81.79	Bedding plane	Overburden
139	4	266	81.93	81.93	81.94	Bedding plane	Overburden
140	8	257	82.02	82.02	82.03	Bedding plane	Overburden
141	5	217	82.06	82.05	82.06	Bedding plane	Overburden
142	14	294	82.17	82.16	82.19	Bedding plane	Overburden
143	12	231	82.22	82.21	82.23	Bedding plane	Overburden
144	10	23	82.31	82.30	82.31	Bedding plane	Overburden
145	8	291	83.61	83.60	83.61	Bedding plane	Overburden
146	2	286	83.79	83.78	83.79	Bedding plane	Overburden
147	4	318	83.84	83.84	83.85	Bedding plane	Overburden
148	6	340	84.14	84.13	84.14	Bedding plane	Overburden
149	0	253	84.30	84.30	84.30	Bedding plane	Overburden
150	3	83	84.37	84.37	84.37	Bedding plane	Overburden
151	3	301	84.48	84.48	84.49	Bedding plane	Overburden
152	1	103	84.55	84.55	84.55	Bedding plane	Overburden
153	14	258	84.90	84.89	84.92	Fracture plane - open	Overburden
154	3	120	85.03	85.03	85.03	Bedding plane	Overburden
155	2	114	85.12	85.12	85.12	Bedding plane	Overburden
156	2	280	85.20	85.20	85.20	Bedding plane	Overburden
157	1	242	85.49	85.49	85.49	Bedding plane	Overburden
158	77	78	85.53	85.31	85.74	Fracture plane - discontinuous	Overburden
159	5	285	85.89	85.89	85.90	Bedding plane	Overburden
160	6	223	86.02	86.02	86.03	Bedding plane	Overburden
161	1	102	86.13	86.13	86.13	Bedding plane	Overburden
162	2	152	86.20	86.20	86.20	Bedding plane	Overburden
163	2	216	86.32	86.32	86.33	Bedding plane	Overburden
164	2	58	86.35	86.34	86.35	Bedding plane	Overburden
165	75	59	86.43	86.23	86.62	Fracture plane - partially open	Overburden
166	4	274	86.47	86.46	86.47	Bedding plane	Overburden
167	5	283	86.49	86.49	86.50	Bedding plane	Overburden
168	3	53	86.58	86.57	86.58	Bedding plane	Overburden
169	1	267	86.60	86.60	86.60	Bedding plane	Overburden
170	4	88	86.73	86.73	86.73	Bedding plane	Overburden
171	4	178	87.06	87.06	87.07	Bedding plane	Overburden
172	4	233	87.25	87.25	87.25	Bedding plane	Overburden
173	4	298	87.49	87.49	87.49	Bedding plane	Overburden
174	1	269	87.62	87.62	87.62	Bedding plane	Overburden
175	8	103	87.98	87.97	87.98	Bedding plane	Overburden
176	5	305	88.04	88.04	88.05	Bedding plane	Overburden
177	8	306	88.14	88.14	88.15	Bedding plane	Overburden
178	8	250	88.28	88.27	88.28	Bedding plane	Overburden
179	7	278	88.55	88.55	88.56	Bedding plane	Overburden
180	3	223	88.81	88.81	88.81	Bedding plane	Overburden
181	3	224	88.84	88.84	88.84	Bedding plane	Overburden
182	4	37	88.94	88.93	88.94	Bedding plane	Overburden
183	7	144	88.97	88.96	88.97	Bedding plane	Overburden
184	5	304	89.10	89.10	89.11	Bedding plane	Overburden
185	5	274	89.18	89.18	89.18	Bedding plane	Overburden
186	8	313	89.31	89.31	89.32	Bedding plane	Overburden

FEATURE ID	DIP (DEG)	AZIMUTH (DEG)	MIDPOINT (MBGL)	TOP (M)	BASE (M)	TYPE OF FEATURE	GENERALISED ROCK TYPE
187	6	272	89.37	89.36	89.37	Bedding plane	Overburden
188	2	153	89.46	89.46	89.46	Bedding plane	Overburden
189	81	271	89.75	89.46	90.04	Fracture plane - partially open	Overburden
190	77	237	89.95	89.75	90.15	Fracture plane - open	Overburden
191	6	116	90.08	90.07	90.08	Bedding plane	Overburden
192	2	282	90.16	90.16	90.16	Bedding plane	Overburden
193	5	251	90.19	90.19	90.20	Bedding plane	Overburden
194	5	296	90.40	90.39	90.40	Bedding plane	Overburden
195	6	325	90.41	90.41	90.42	Bedding plane	Overburden
196	5	290	90.52	90.52	90.53	Bedding plane	Overburden
197	3	276	90.55	90.55	90.55	Bedding plane	Overburden
198	6	291	90.60	90.59	90.60	Bedding plane	Overburden
199	5	237	90.67	90.67	90.67	Bedding plane	Overburden
200	29	113	90.77	90.74	90.81	Bedding plane	Overburden
201	6	300	90.95	90.95	90.96	Bedding plane	Overburden
202	4	197	91.07	91.07	91.08	Bedding plane	Overburden
203	6	262	91.10	91.10	91.11	Bedding plane	Overburden
204	5	312	91.33	91.33	91.34	Bedding plane	Overburden
205	4	19	91.37	91.37	91.37	Bedding plane	Overburden
206	3	333	91.39	91.39	91.39	Bedding plane	Overburden
207	2	99	91.55	91.55	91.55	Bedding plane	Overburden
208	2	350	91.74	91.74	91.75	Bedding plane	Overburden
209	1	43	91.85	91.85	91.85	Bedding plane	Overburden
210	5	31	91.93	91.92	91.93	Bedding plane	Overburden
211	10	329	91.99	91.98	92.00	Bedding plane	Overburden
212	4	114	92.18	92.18	92.19	Top of void	VOID

Figure 1 BH04 circular plan representation of interpreted features



The 183 identified sedimentary features are predominantly bedding planes that appear to range in dip from flat-lying to 29^0. Figures 2 and 3 show the distribution of the planes' dip angles and dip direction with depth.

Table 2 details the variation in the dip angle and dip direction data. Figure 4 shows the dip direction data in a rose diagram with the bedding planes' dip angle and dip direction data shown as histograms in Figures 5 and 6.

The 27 fractures are identified as open (30%), partially open (59%) and discontinuous (11%). The fracture dip angles range from 12 to 81^0.

Table 3 details the variation in the fractures' dip angle and dip direction data. Figure 7 shows the dip direction data in a rose diagram with the fractures' plane dip angle and dip direction data as histograms in Figures 8 and 9.

Figure 2 BH04 feature dip angle data distribution

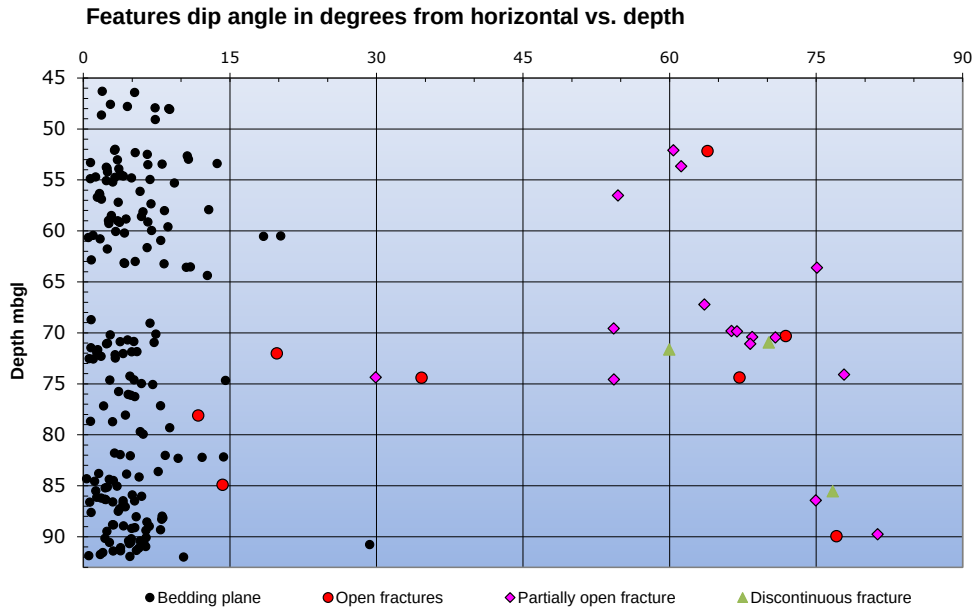


Figure 3 BH04 feature dip direction data distribution

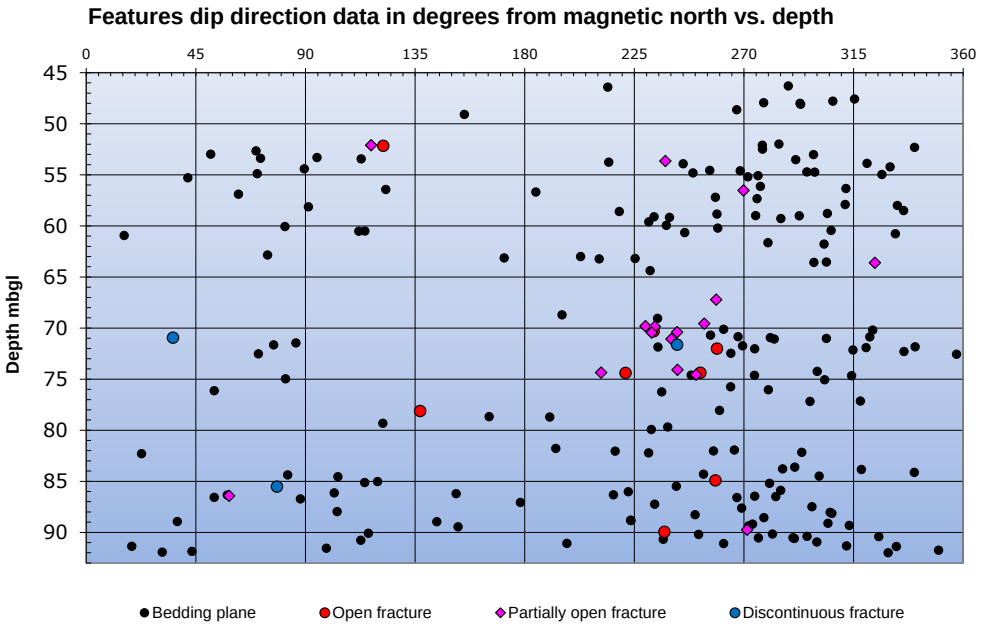


Table 2 BH04 bedding histogram data

Dip Distribution Total: 183			Orientation Distribution Total: 183		
Dip Range	Count	%	Bearing Range	Count	%
0 to 10	169	92.3	0 to 10	0	0.0
10 to 20	12	6.6	10 to 20	2	1.1
20 to 30	2	1.1	20 to 30	1	0.5
30 to 40	0	0.0	30 to 40	2	1.1
40 to 50	0	0.0	40 to 50	2	1.1
50 to 60	0	0.0	50 to 60	4	2.2
60 to 70	0	0.0	60 to 70	2	1.1
70 to 80	0	0.0	70 to 80	5	2.7
80 to 90	0	0.0	80 to 90	6	3.3
			90 to 100	3	1.6
			100 to 110	3	1.6
			110 to 120	7	3.8
			120 to 130	2	1.1
			130 to 140	0	0.0
			140 to 150	1	0.5
			150 to 160	3	1.6
			160 to 170	1	0.5
			170 to 180	2	1.1
			180 to 190	1	0.5
			190 to 200	4	2.2
			200 to 210	1	0.5
			210 to 220	6	3.3
			220 to 230	4	2.2
			230 to 240	13	7.1
			240 to 250	6	3.3
			250 to 260	9	4.9
			260 to 270	11	6.0
			270 to 280	16	8.7
			280 to 290	11	6.0
			290 to 300	16	8.7
			300 to 310	12	6.6
			310 to 320	9	4.9
			320 to 330	8	4.4
			330 to 340	6	3.3
			340 to 350	3	1.6
			350 to 360	1	0.5

Figure 5 BH04 bedding dip angles histogram

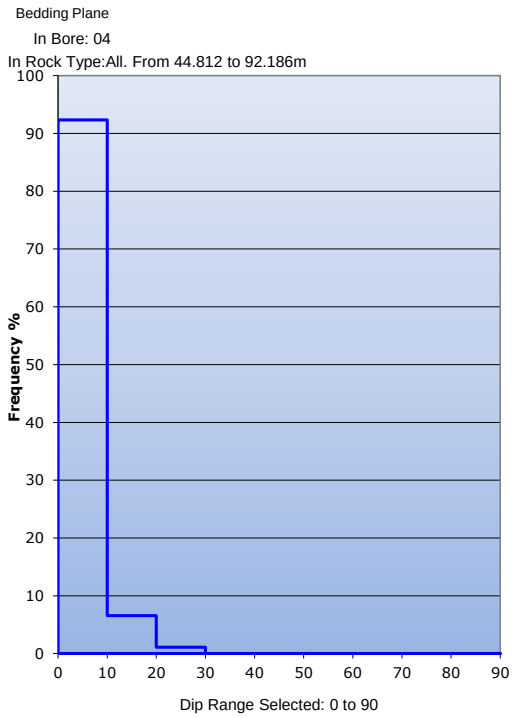


Figure 4 BH04 bedding dip direction data rose diagram

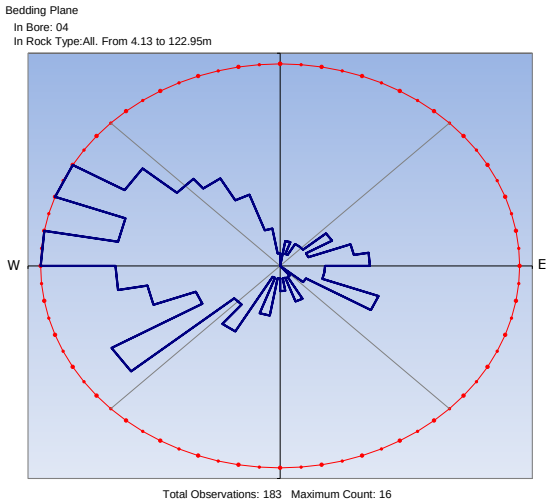


Figure 6 BH04 bedding dip directions histogram

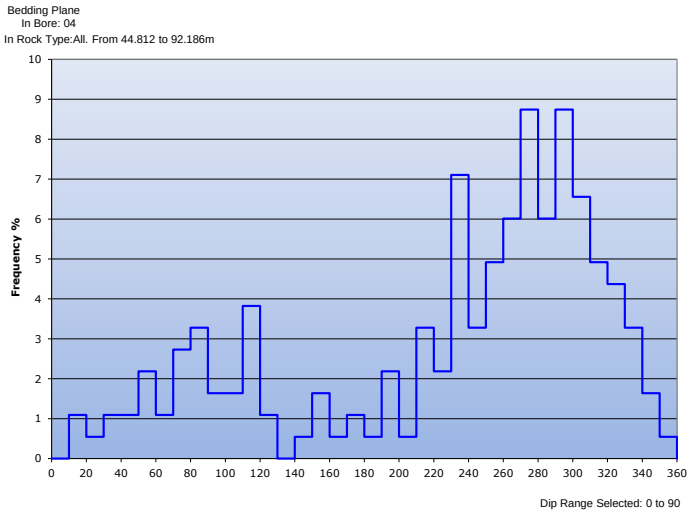


Table 3 BH04 fractures histogram data

Dip Distribution Total: 27			Orientation Distribution Total: 27		
Dip Range	Count	%	Bearing Range	Count	%
0 to 10	0	0.0	0 to 10	0	0.0
10 to 20	3	11.1	10 to 20	0	0.0
20 to 30	1	3.7	20 to 30	0	0.0
30 to 40	1	3.7	30 to 40	1	3.7
40 to 50	0	0.0	40 to 50	0	0.0
50 to 60	4	14.8	50 to 60	1	3.7
60 to 70	9	33.3	60 to 70	0	0.0
70 to 80	8	29.6	70 to 80	1	3.7
80 to 90	1	3.7	80 to 90	0	0.0
			90 to 100	0	0.0
			100 to 110	0	0.0
			110 to 120	1	3.7
			120 to 130	1	3.7
			130 to 140	1	3.7
			140 to 150	0	0.0
			150 to 160	0	0.0
			160 to 170	0	0.0
			170 to 180	0	0.0
			180 to 190	0	0.0
			190 to 200	0	0.0
			200 to 210	0	0.0
			210 to 220	1	3.7
			220 to 230	2	7.4
			230 to 240	5	18.5
			240 to 250	4	14.8
			250 to 260	6	22.2
			260 to 270	1	3.7
			270 to 280	1	3.7
			280 to 290	0	0.0
			290 to 300	0	0.0
			300 to 310	0	0.0
			310 to 320	0	0.0
			320 to 330	1	3.7
			330 to 340	0	0.0
			340 to 350	0	0.0
			350 to 360	0	0.0

Figure 8 BH04 fractures dip angles histogram

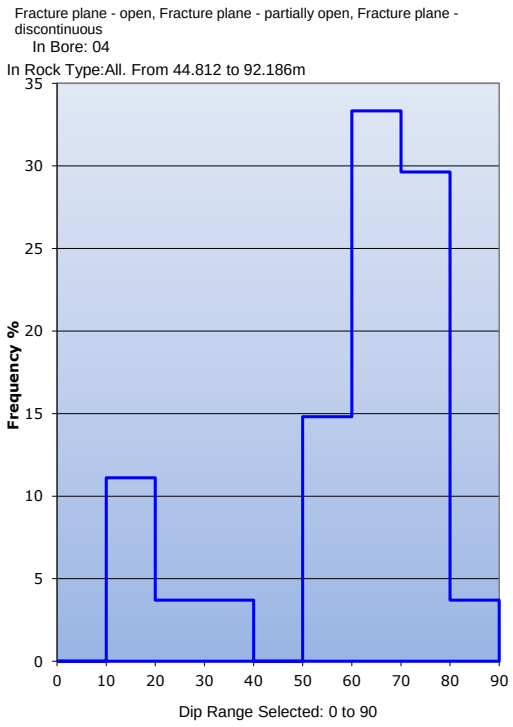


Figure 7 BH04 fractures dip direction data rose diagram

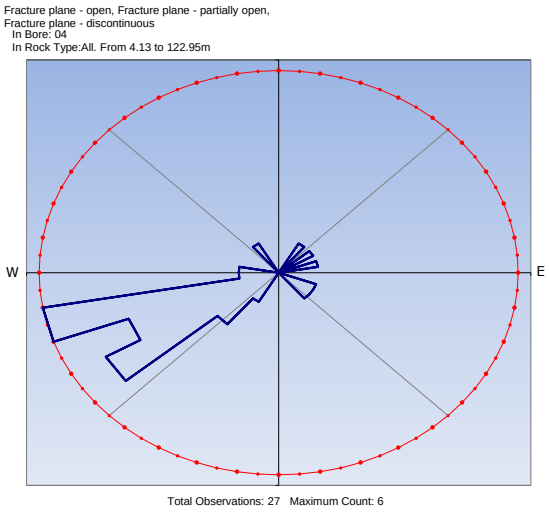
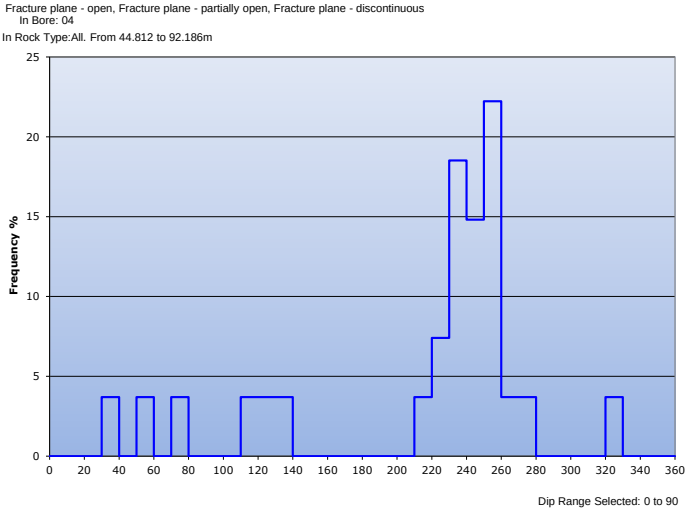


Figure 9 BH04 fractures dip directions histogram



Appendix 1

Appendix 1 ***1:20 Interpretation logs – 44.50 to 93.26 mbgl***

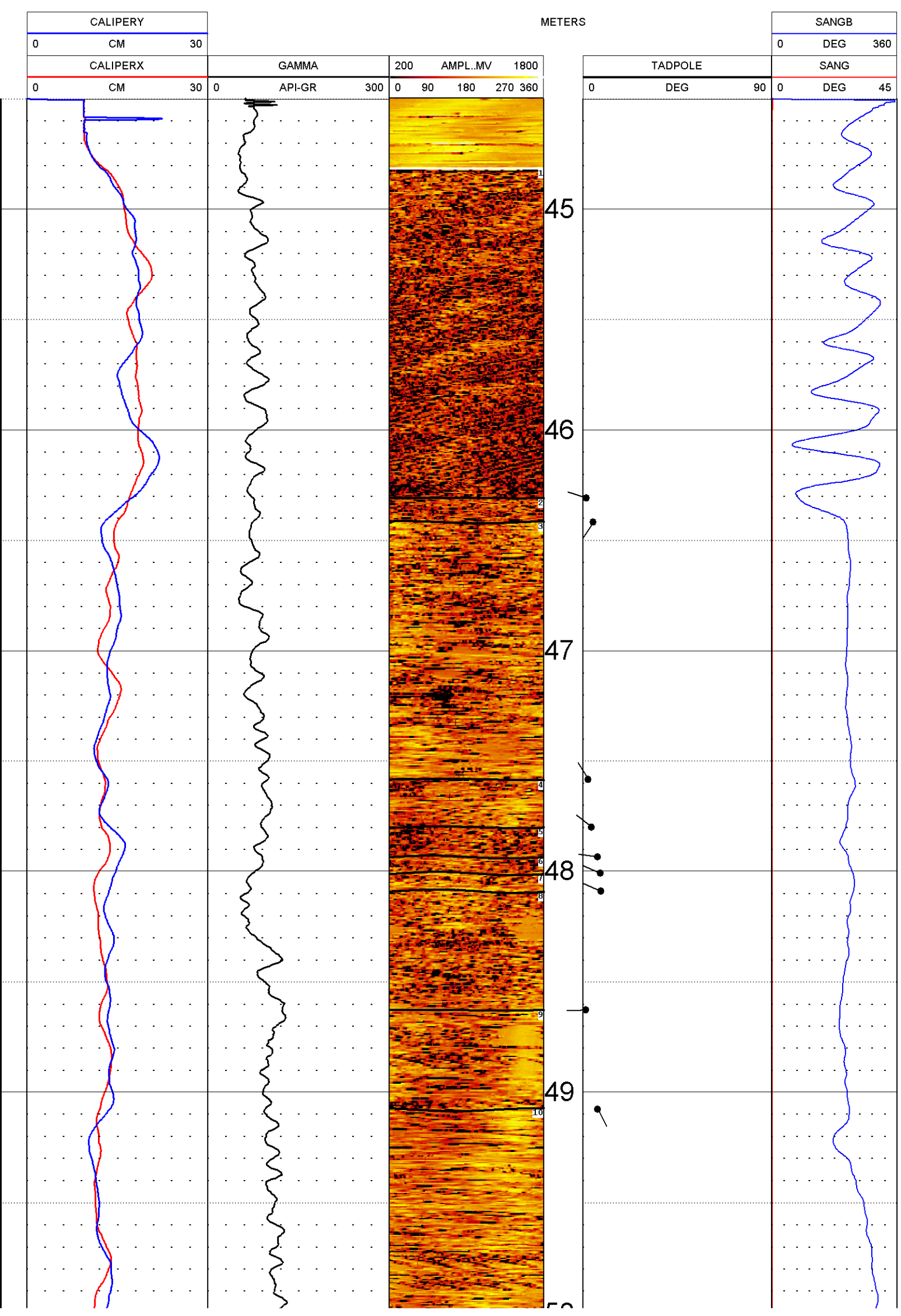


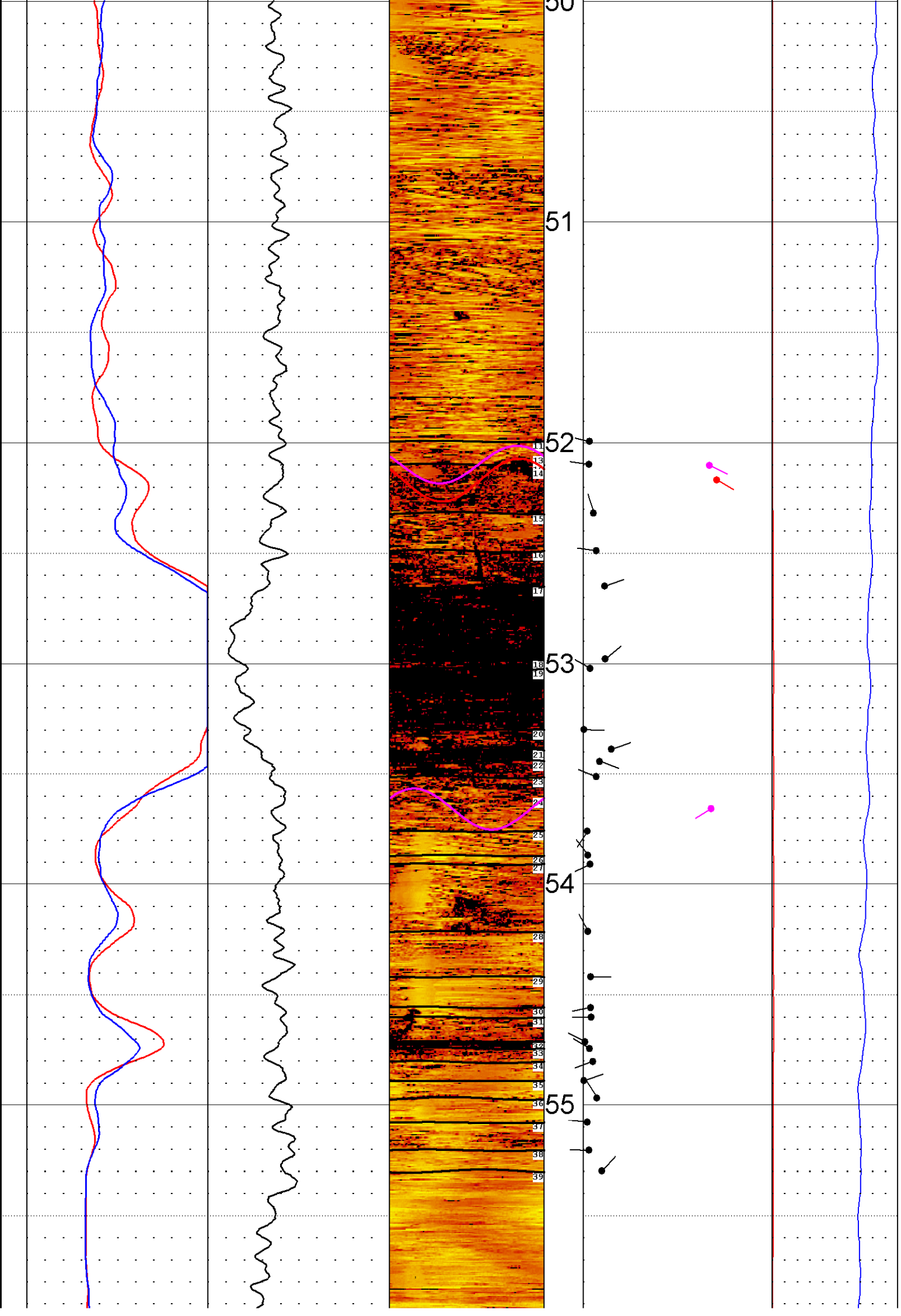
BH04 ATV 1:20

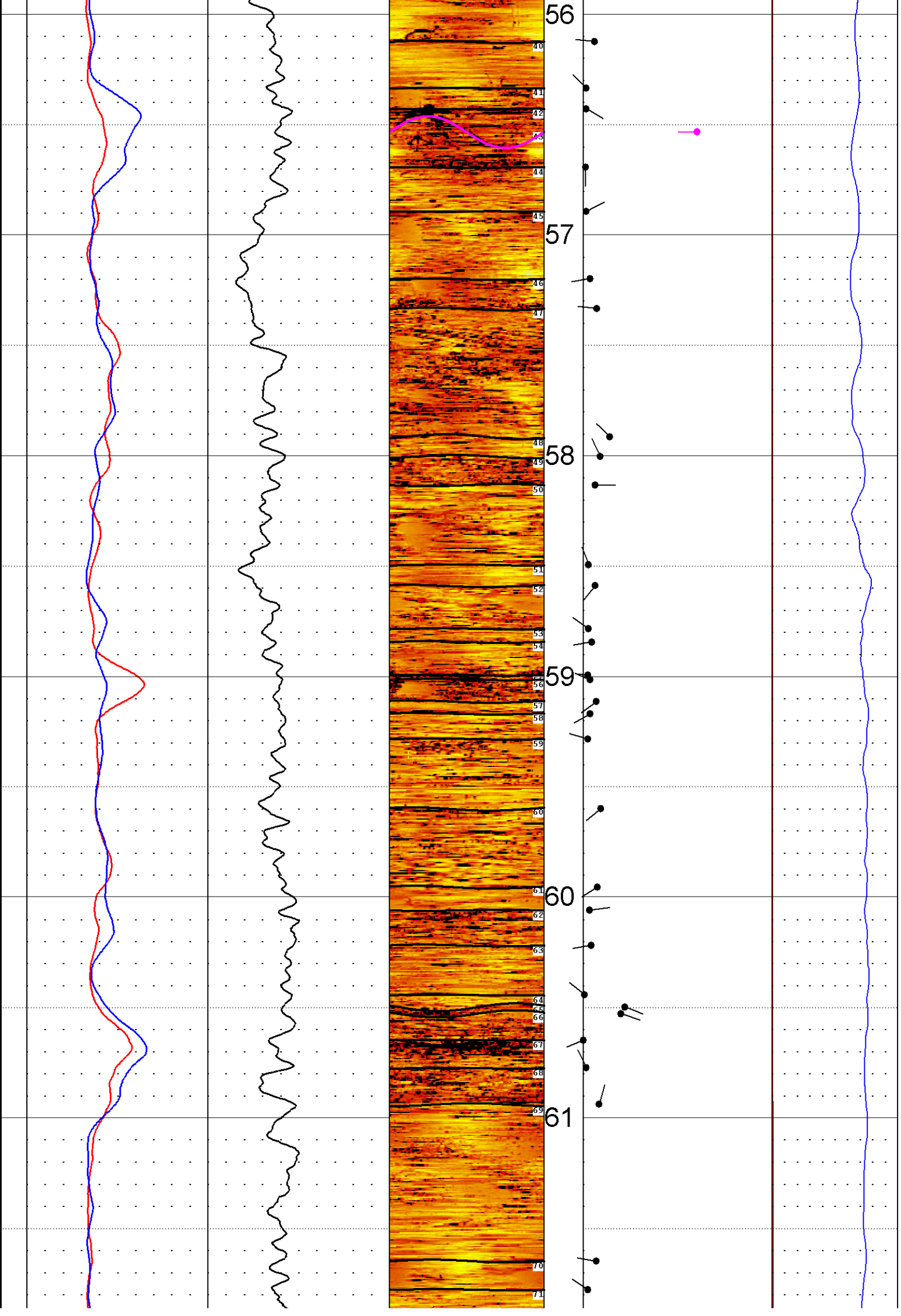
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COUNTY	:				ne		
LOCATION	:	NEWCASTLE					
SECTION	:	N/A	TOWNSHIP	: N/A		RANGE	: N/A
DATE	:	09/14/18	PERMANENT DATUM	:			
DEPTH DRILLER	:	101.6				KB	: N/A
LOG BOTTOM	:	93.260	LOG MEASURED FROM:	N/A		DF	: N/A
LOG TOP	:	44.500	DRL MEASURED FROM:	N/A		GL	: NA
CASING DIAMETER	:	10.	LOGGING UNIT	: T107			
CASING TYPE	:	STEEL	FIELD OFFICE	: RUTHERFORD			
CASING THICKNESS:		.5	RECORDED BY	: P WOODWARD			
BIT SIZE	:	9.9	BOREHOLE FLUID	: 0		FILE	: PROCESSED
MAGNETIC DECL.	:	0	RM	: N/A		TYPE	: 9804A
MATRIX DENSITY	:	2.65	RM TEMPERATURE	: N/A		LGDATE	: 09/14/18
NEUTRON MATRIX	:	SANDSTONE	MATRIX DELTA T	: 177		LGTIME	: 08:50
						THRESH:	99999

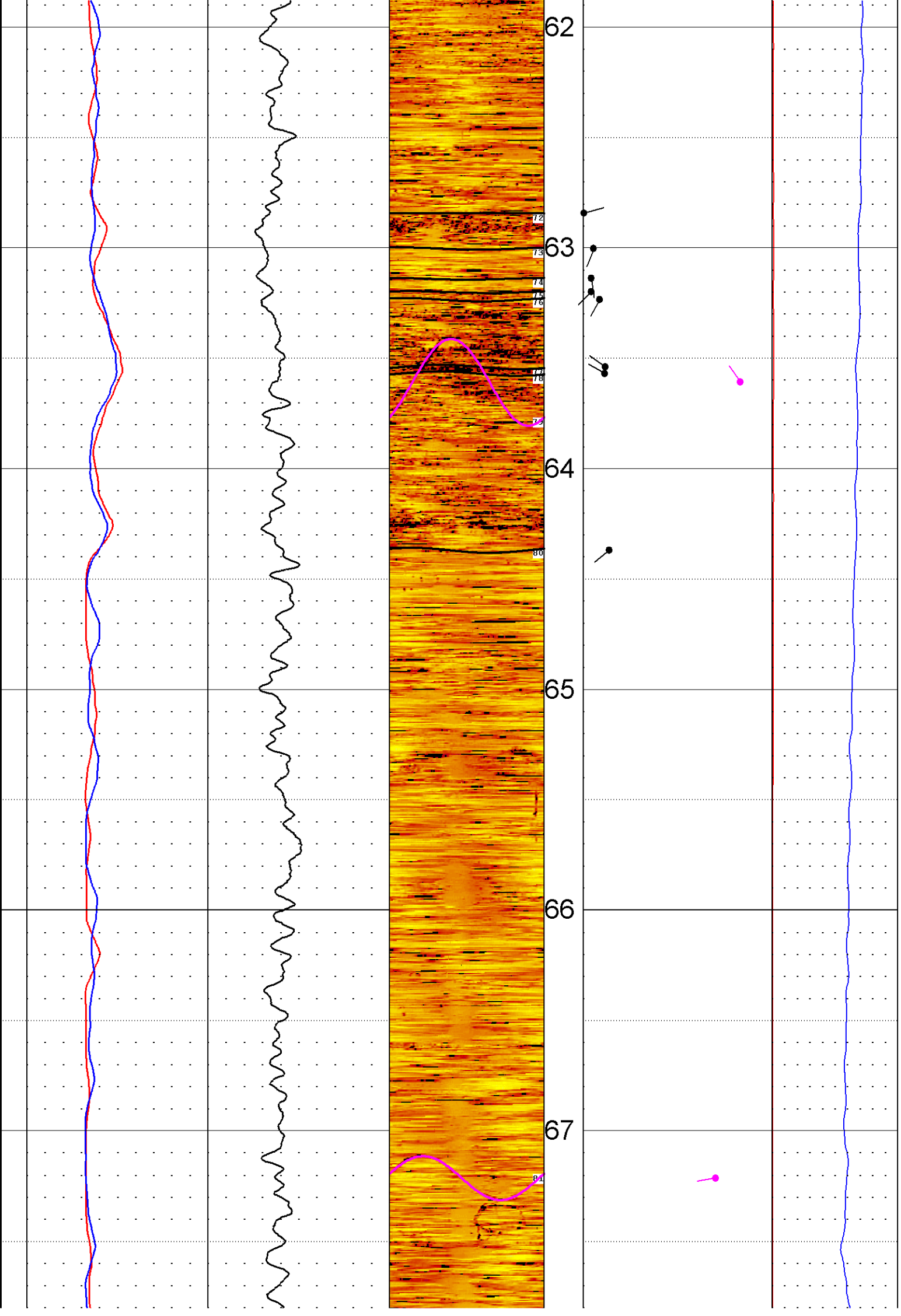
NE, 743'FNL, 661'FEL

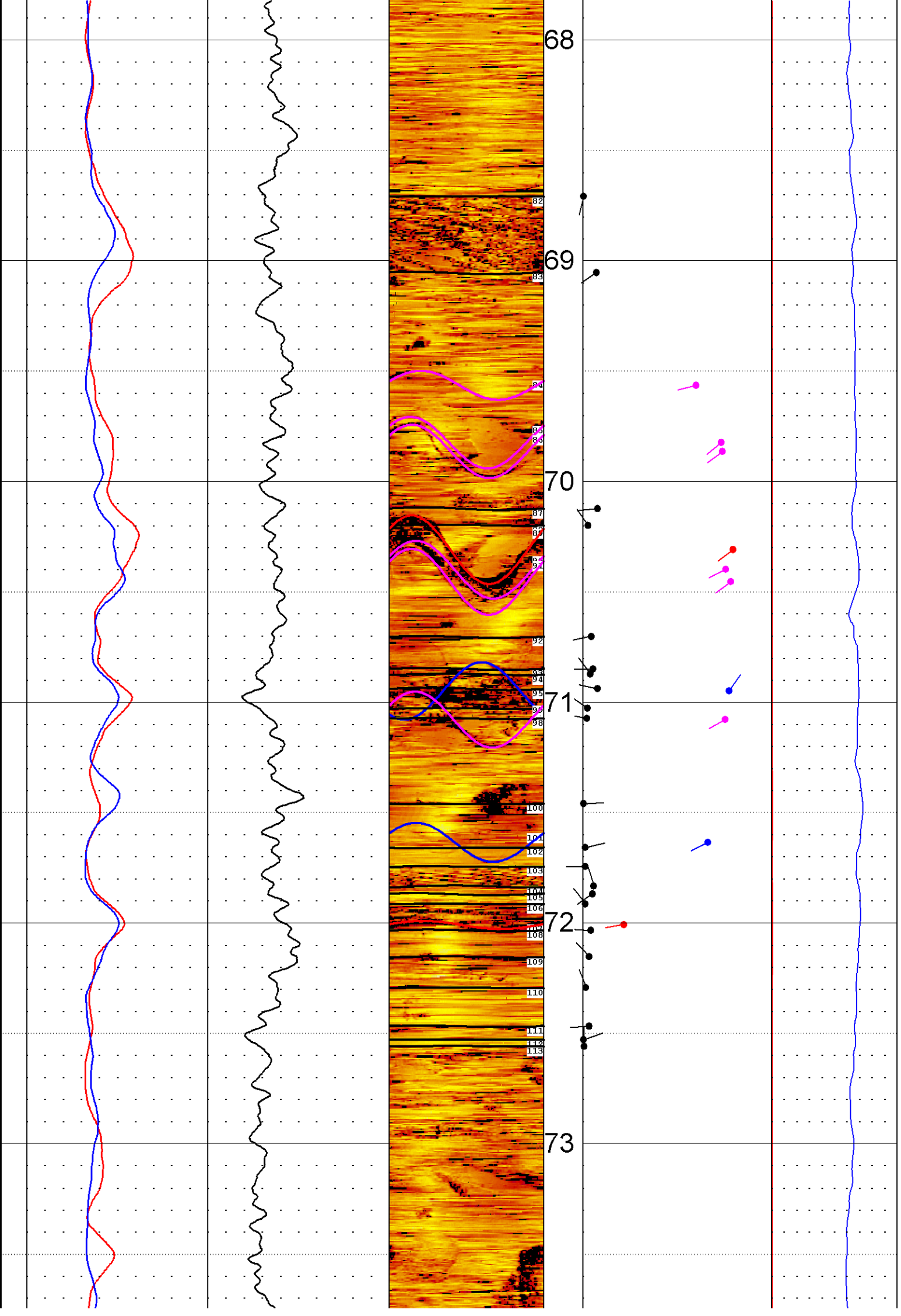
ALL SERVICES PROVIDED SUBJECT TO STANDARD TERMS AND CONDITIONS

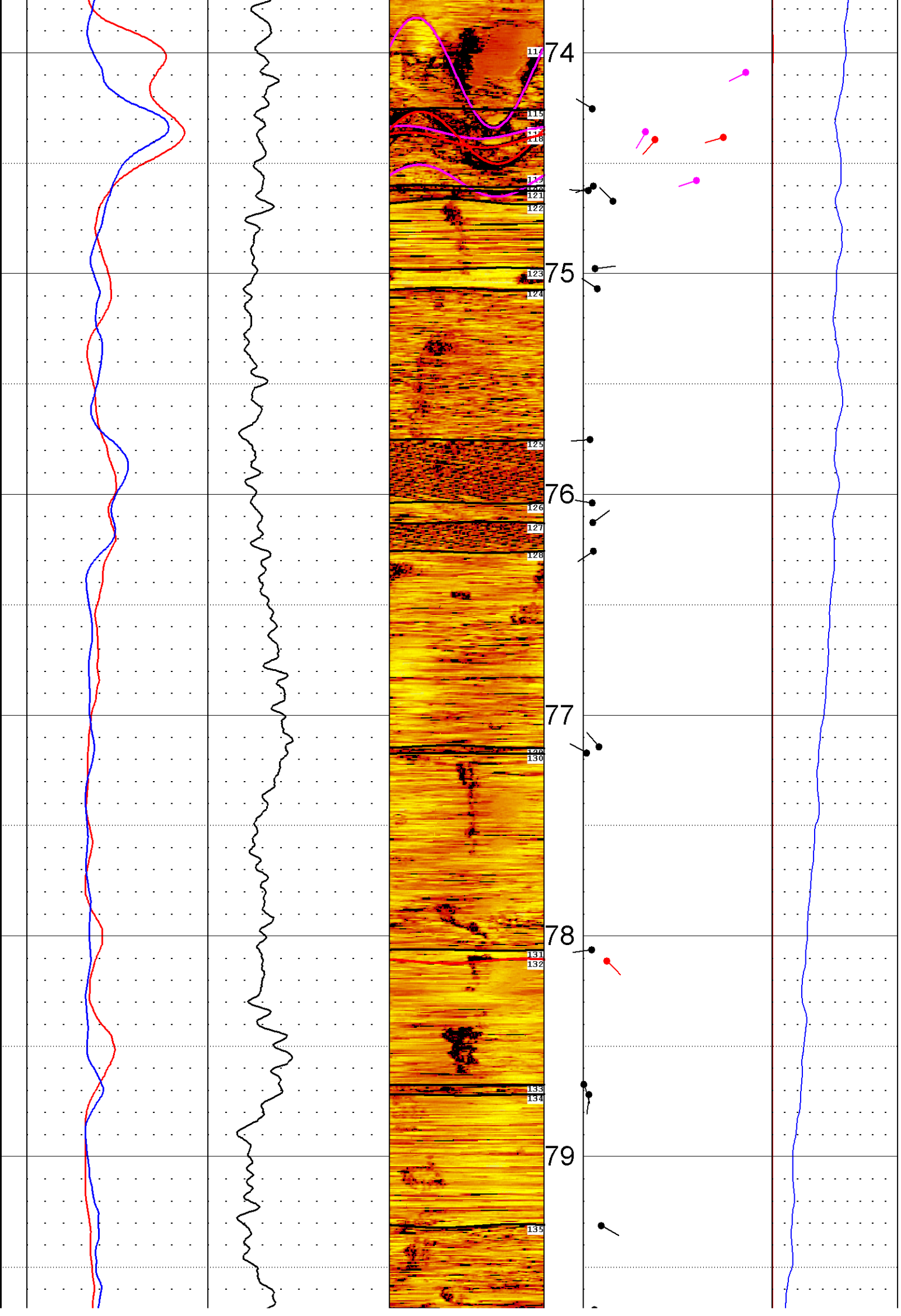

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CALIPERX
0 CM 30
GAMMA
0 API-GR 300
METERS
200 AMPL..MV 1800
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TADPOLE
0 DEG 90
SANGB
0 DEG 360
SANG
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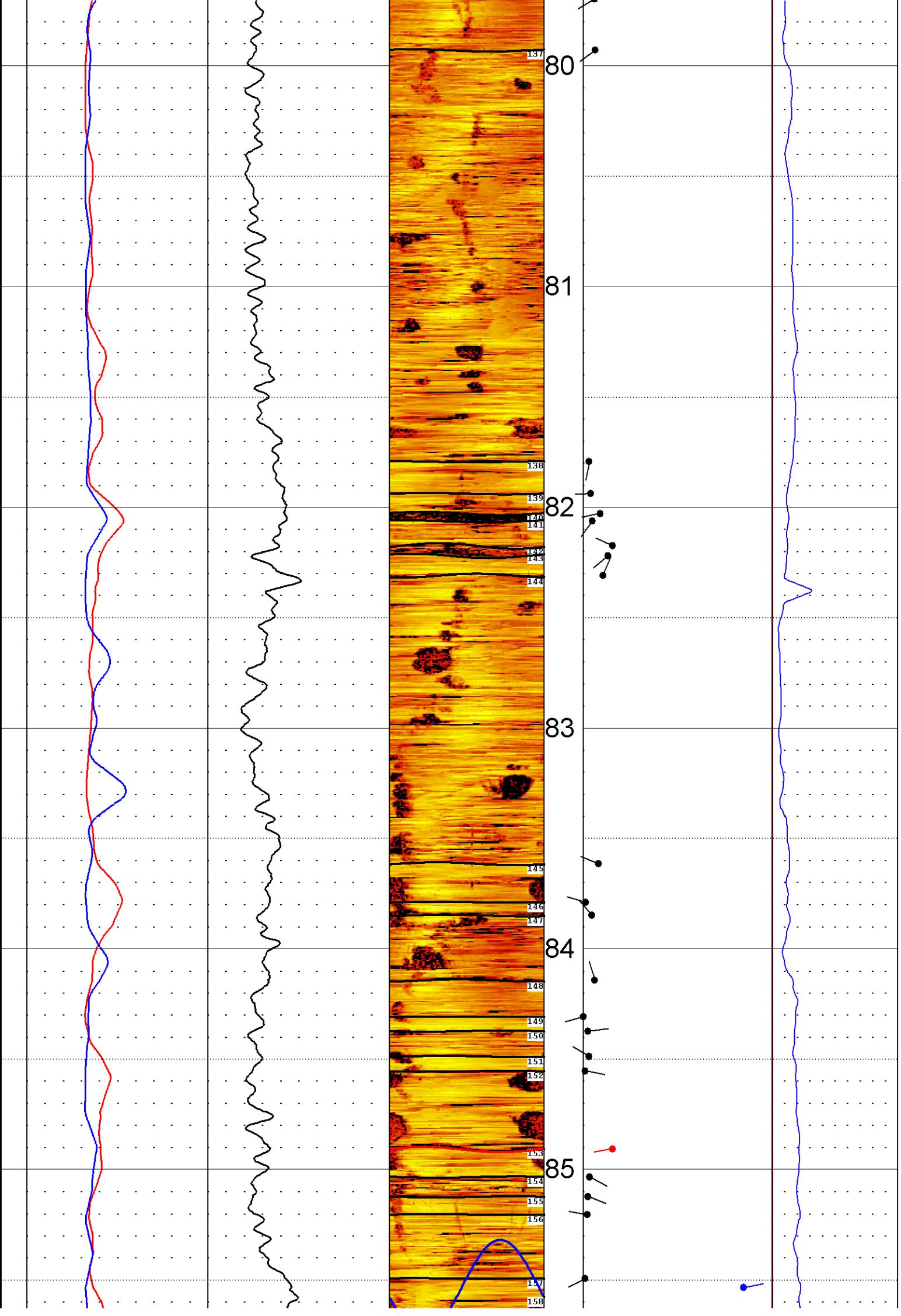

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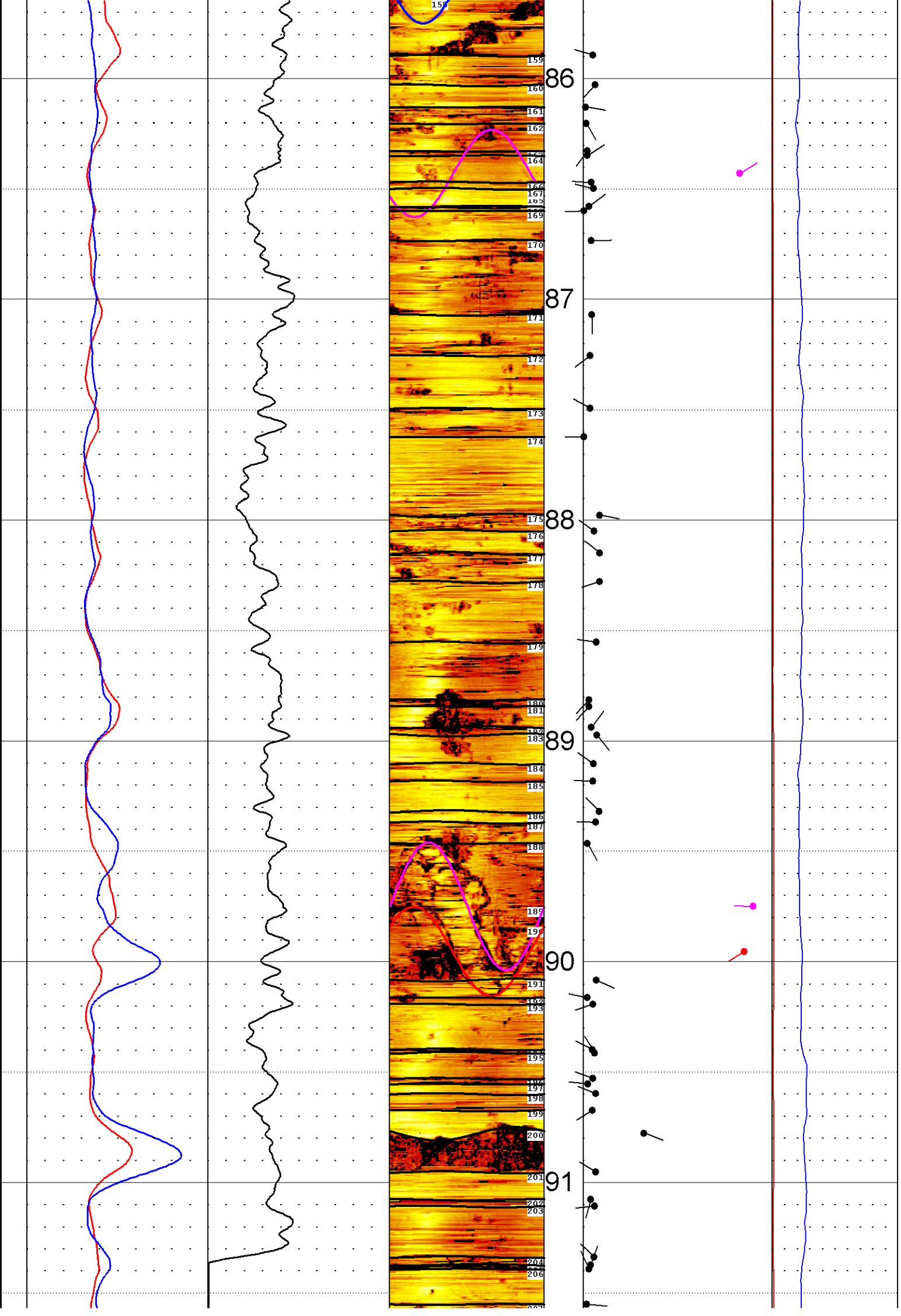

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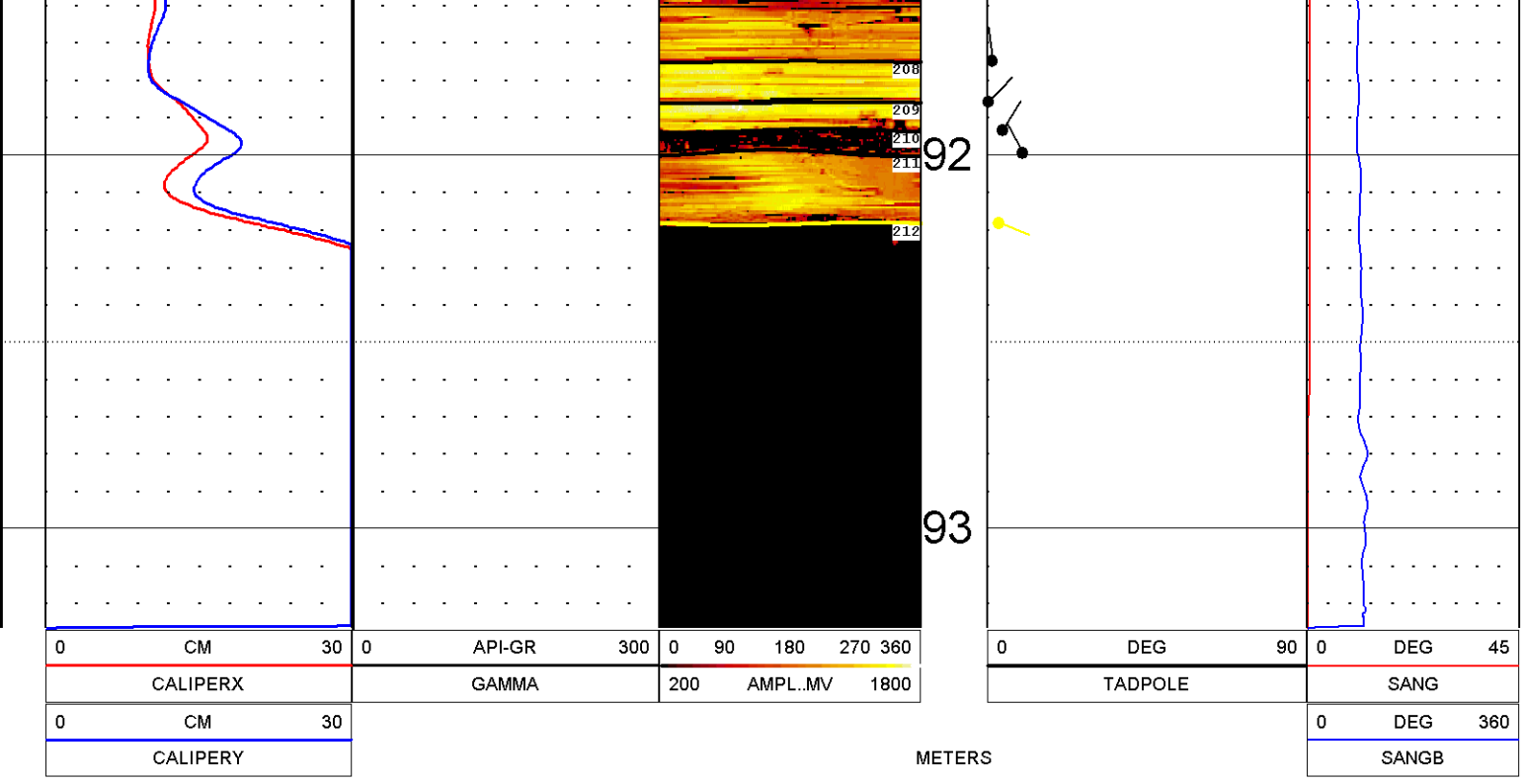

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0 CM 30	0 API-GR 300	0 90 180 270 360	0 DEG 90	0 DEG 45
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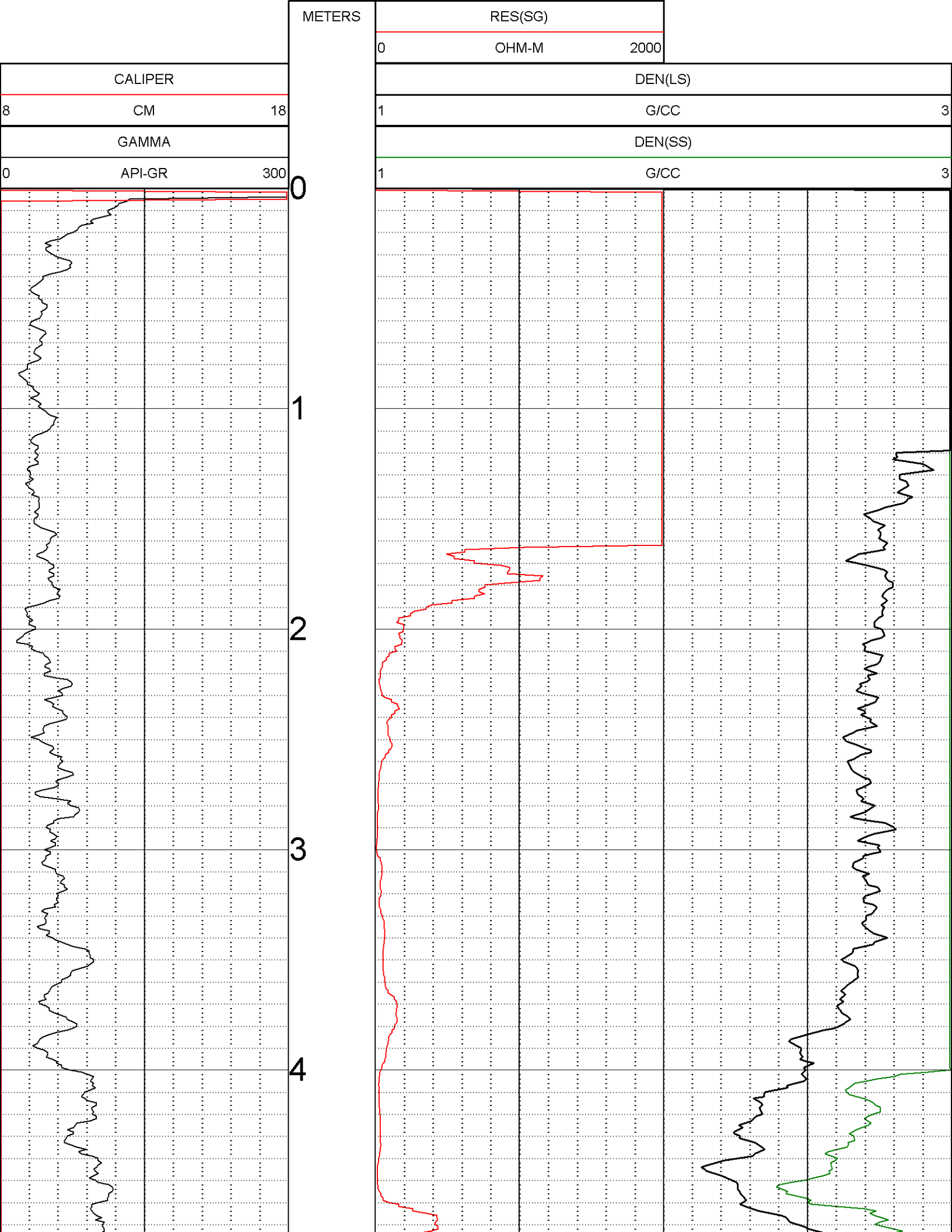


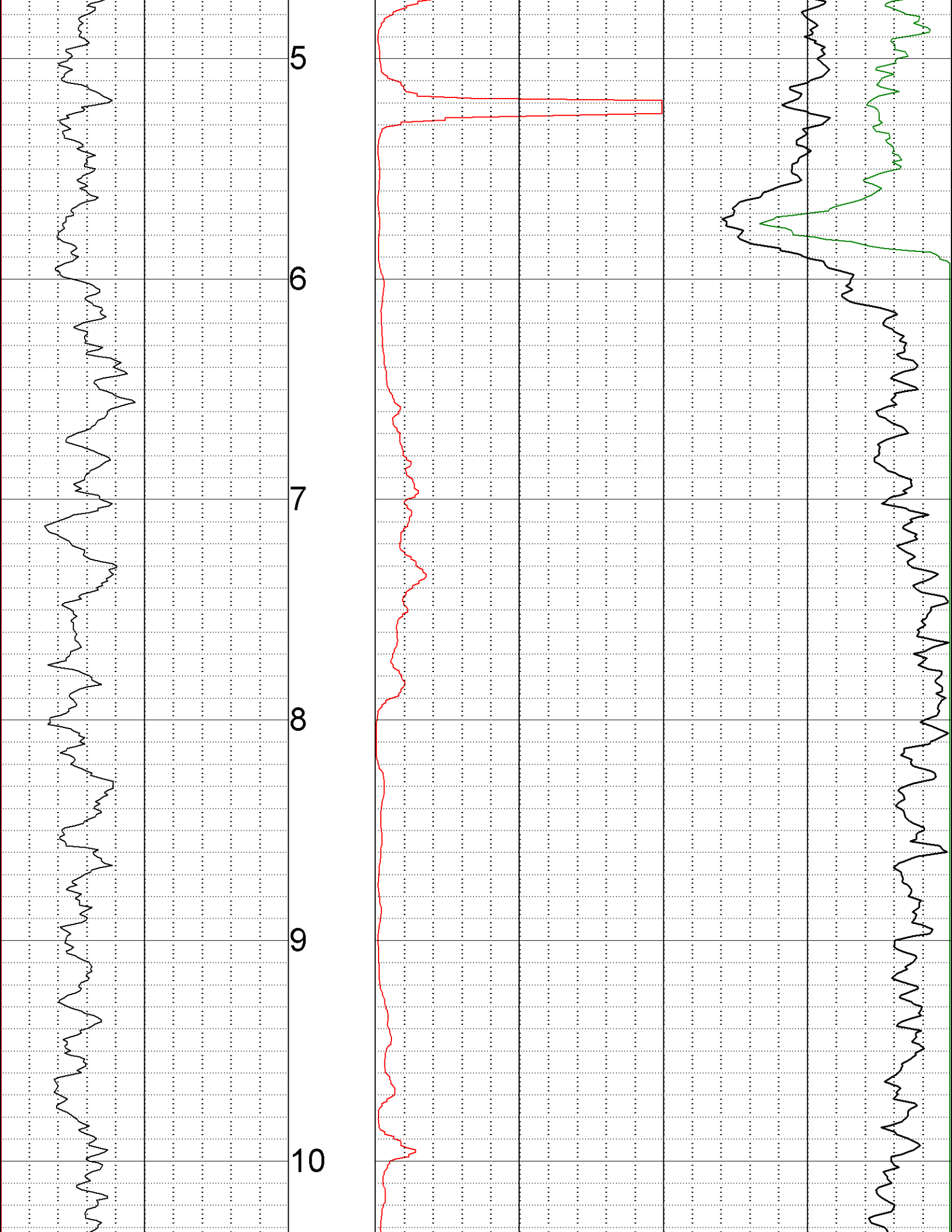
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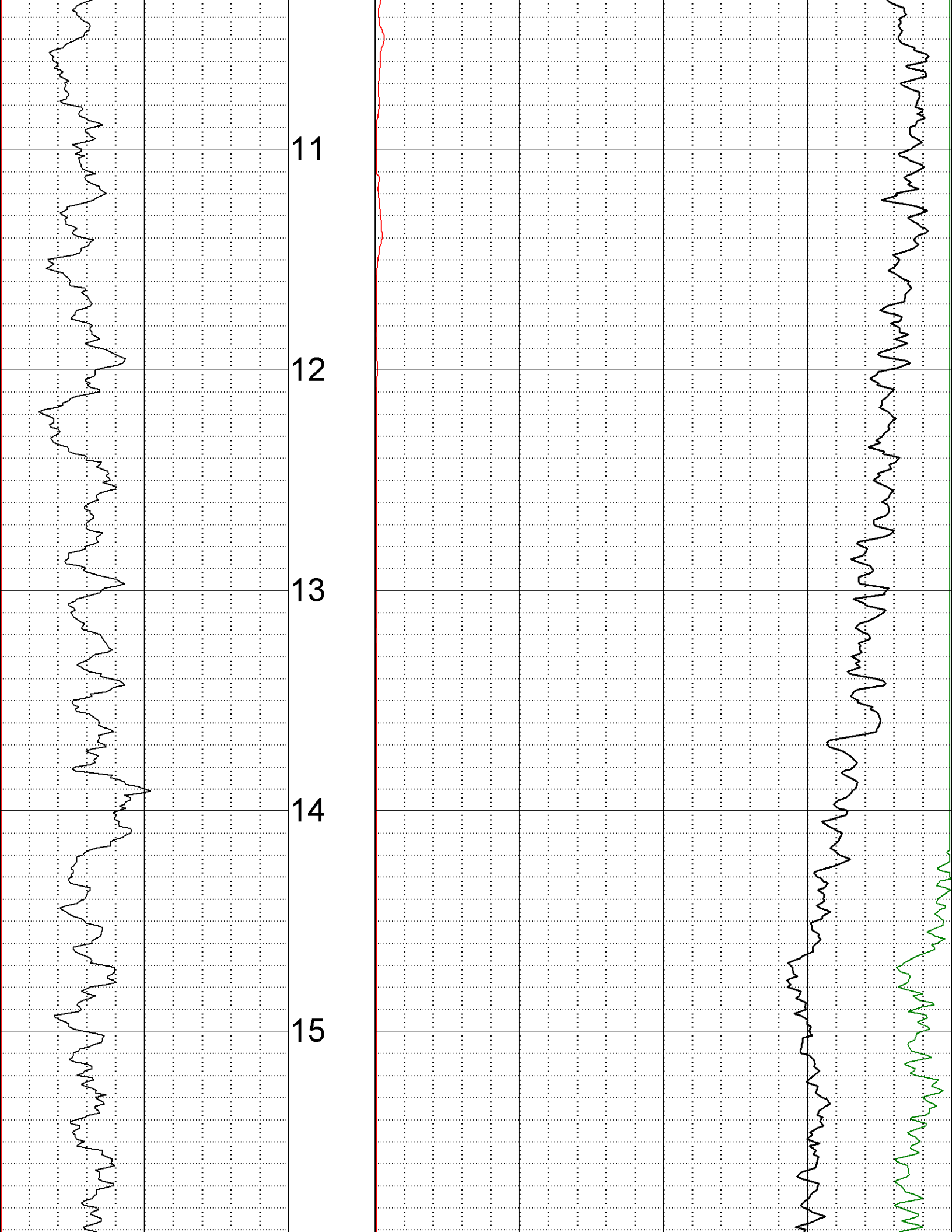
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WELL	: BOREHOLE04 DENSITY c 1:20					
LOCATION/FIELD	: LINGARD					
COUNTRY	: AUST					
LOCATION	: NEWCASTLE					
SECTION	: N/A	TOWNSHIP	: N/A		RANGE	: N/A
DATE	: 09/14/18	PERMANENT DATUM	: -0.9			
DEPTH DRILLER	: 101.6				KB	: N/A
LOG BOTTOM	: 100.81	LOG MEASURED FROM:	N/A		DF	: N/A
LOG TOP	: 0.00	DRL MEASURED FROM:	N/A		GL	: NA
CASING DIAMETER	: 10.	LOGGING UNIT	: T107			
CASING TYPE	: STEEL	FIELD OFFICE	: RUTHERFORD			
CASING THICKNESS:	.5	RECORDED BY	: P WOODWARD			
BIT SIZE	: 9.90	BOREHOLE FLUID	: 0		FILE	: PROCESSED
MAGNETIC DECL.	: 0	RM	: N/A		TYPE	: 9239B
MATRIX DENSITY	: 2.65	RM TEMPERATURE	: N/A		LGDATE	: 09/14/18
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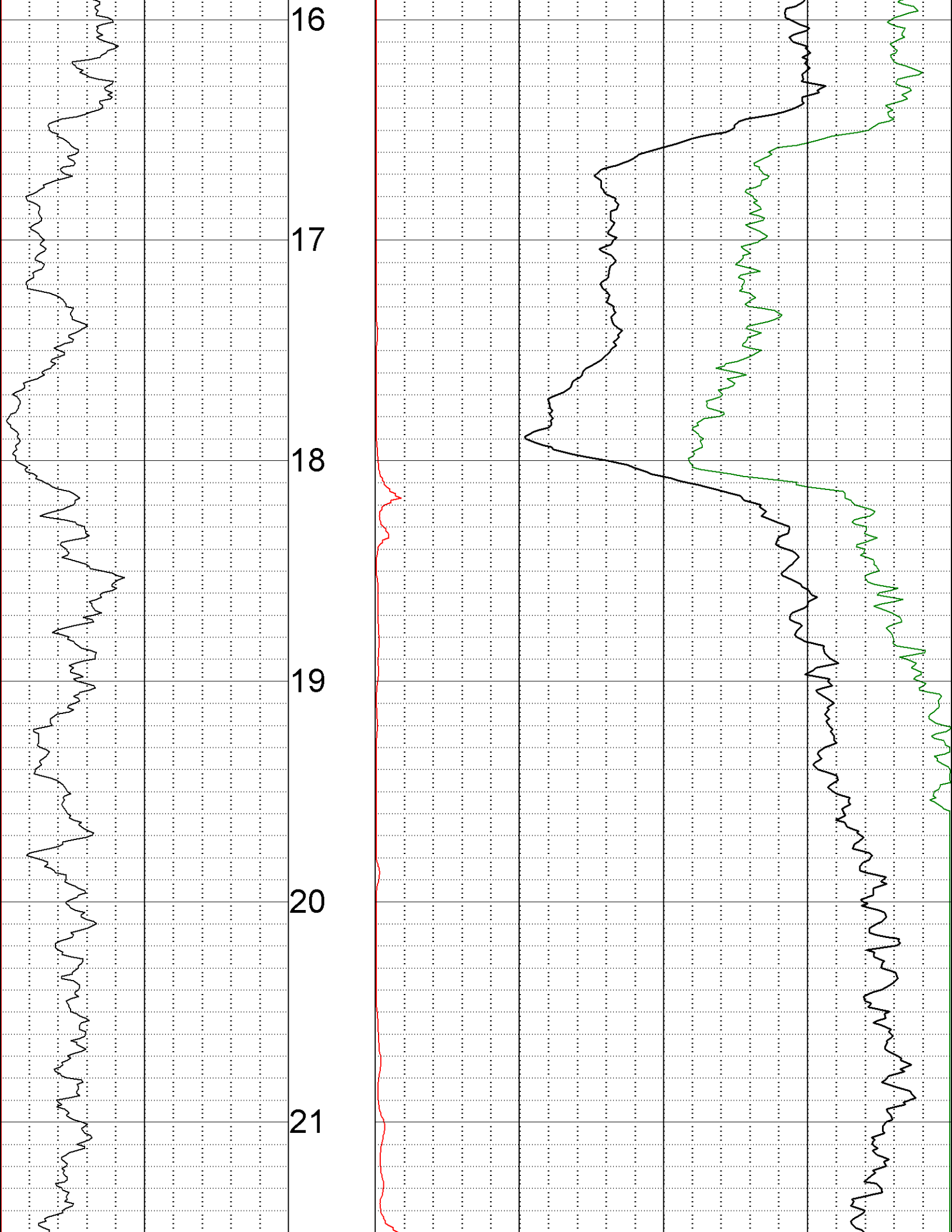
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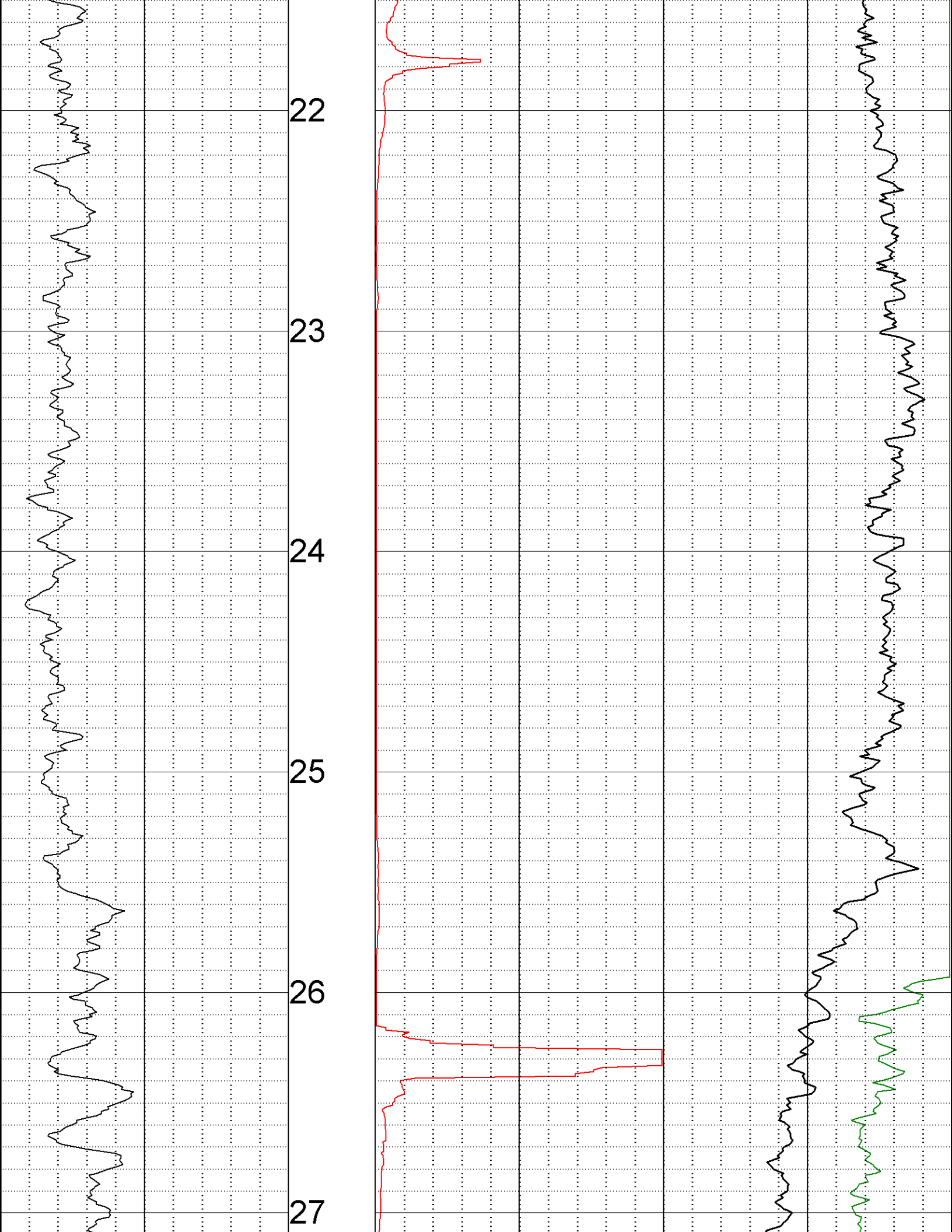
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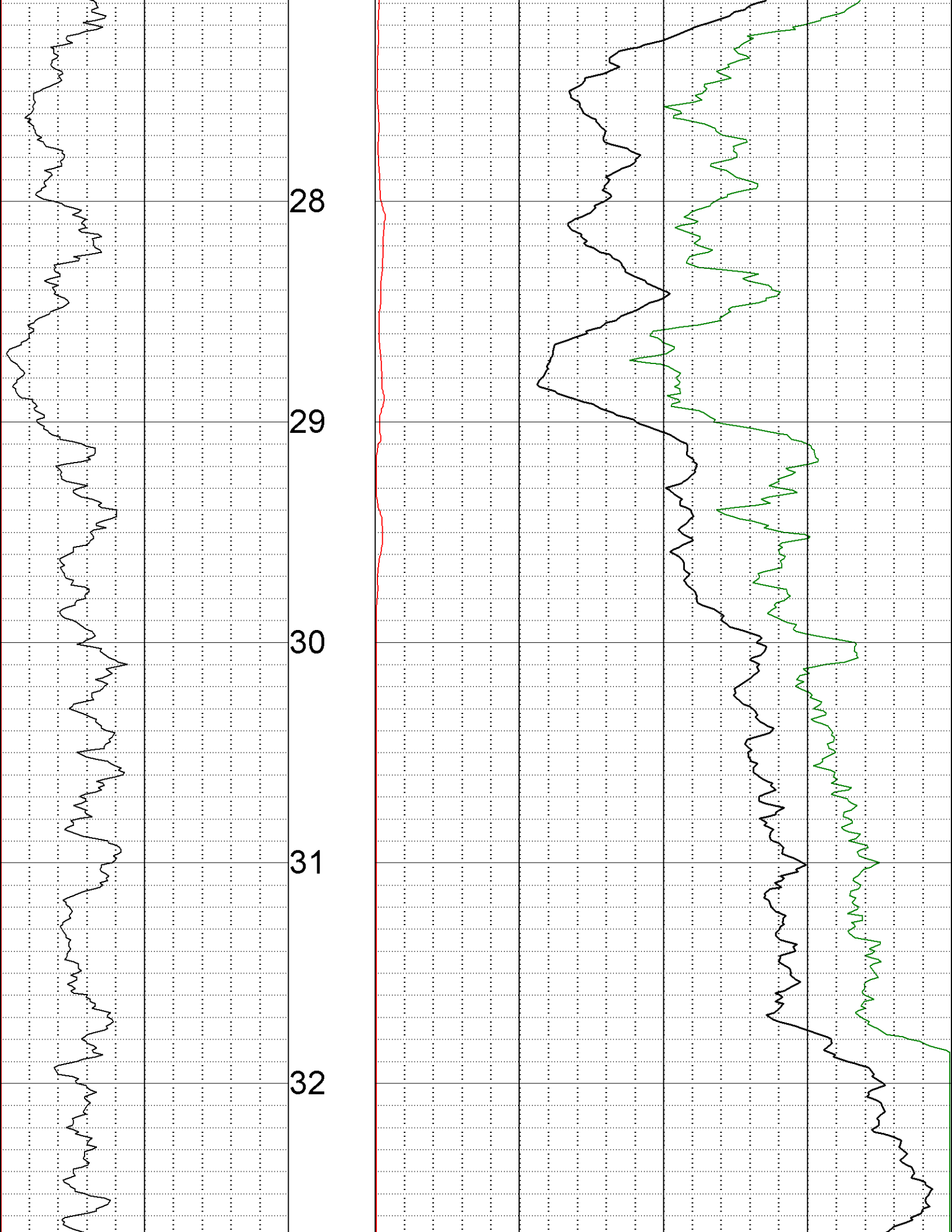

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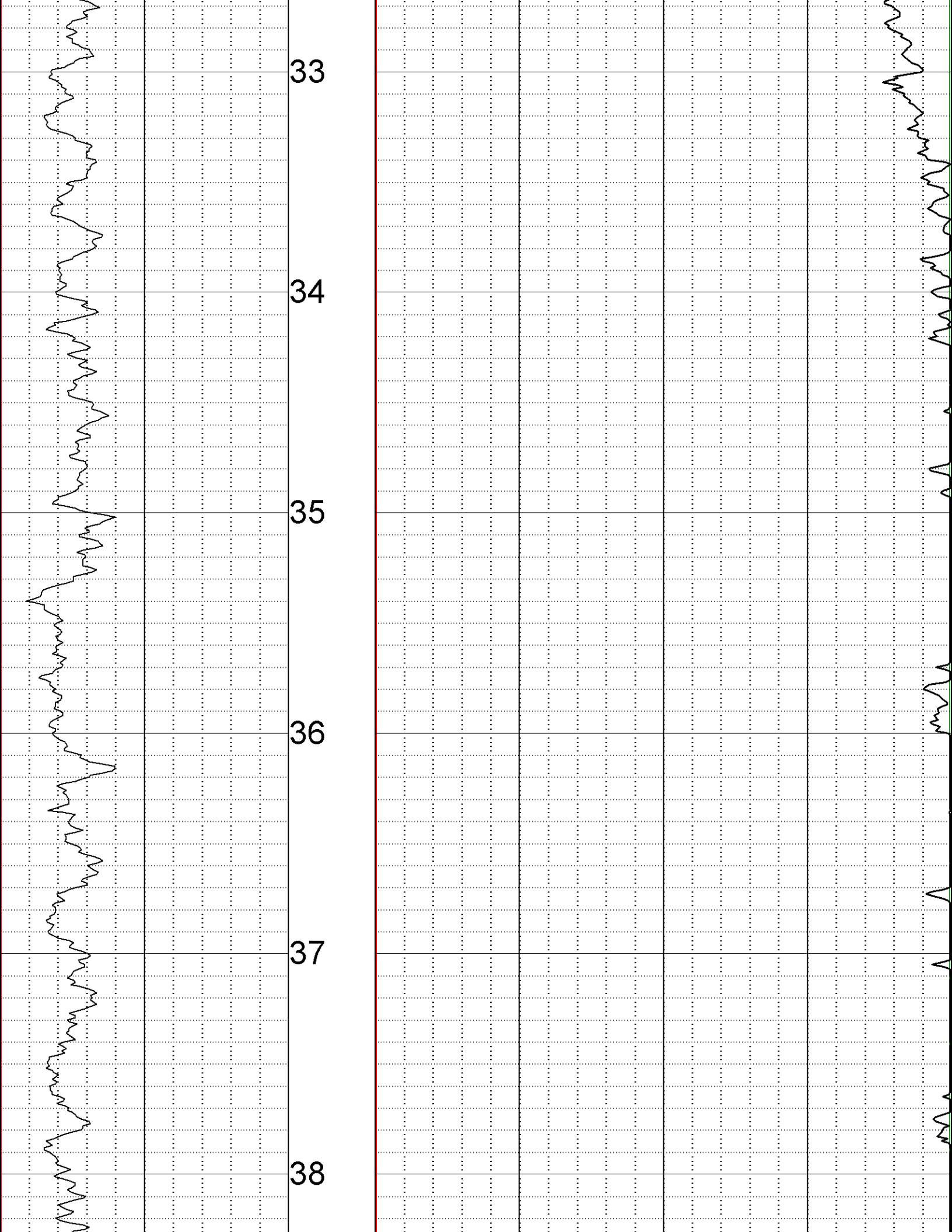

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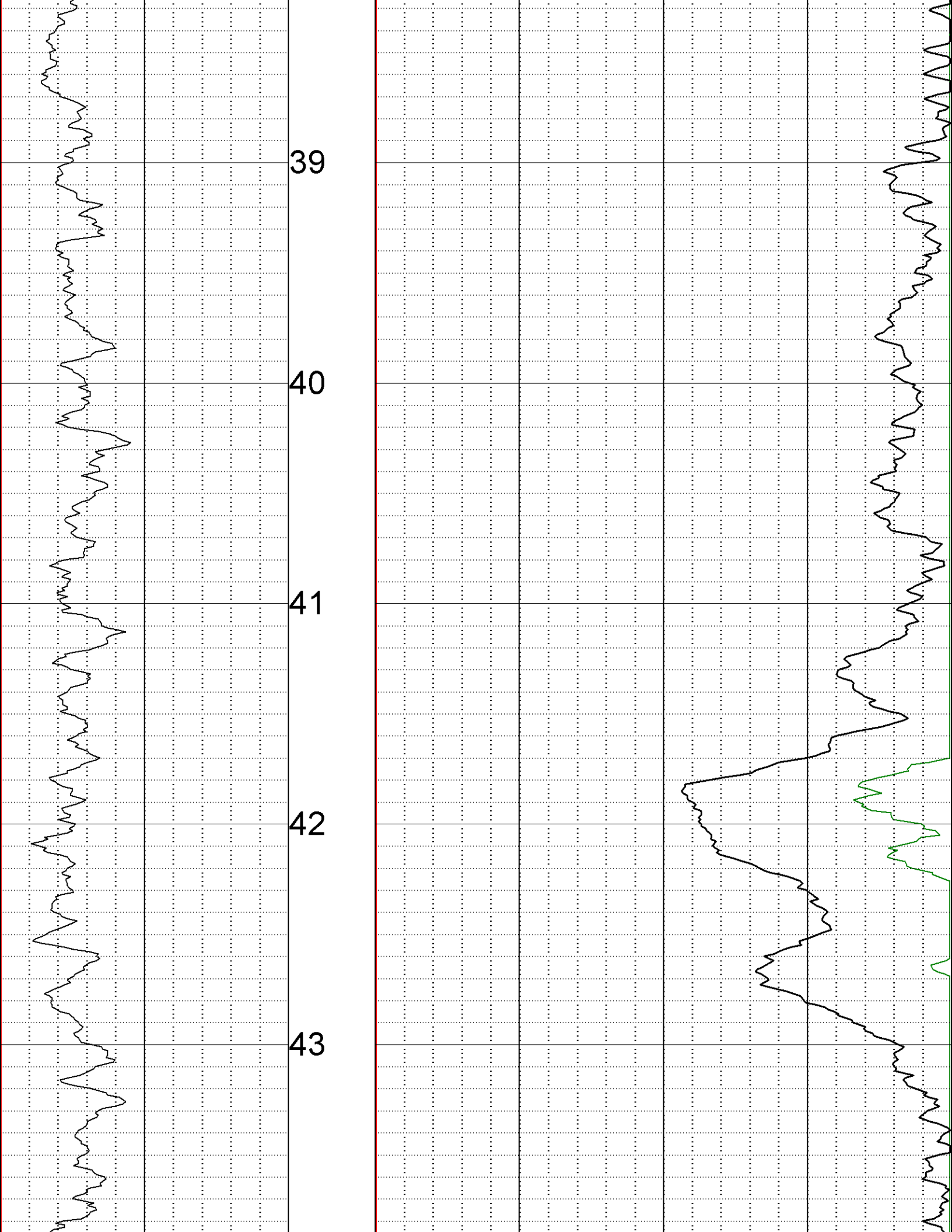

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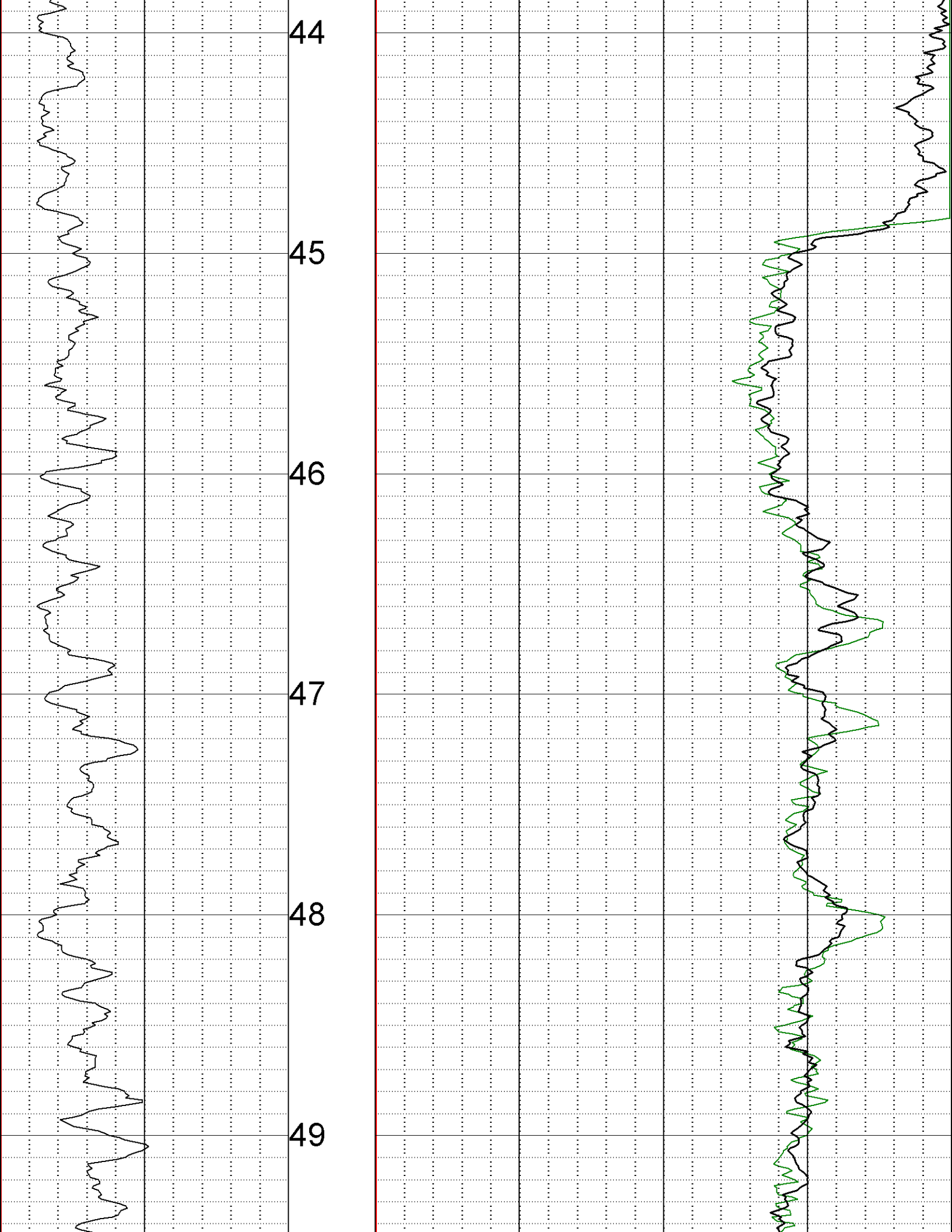

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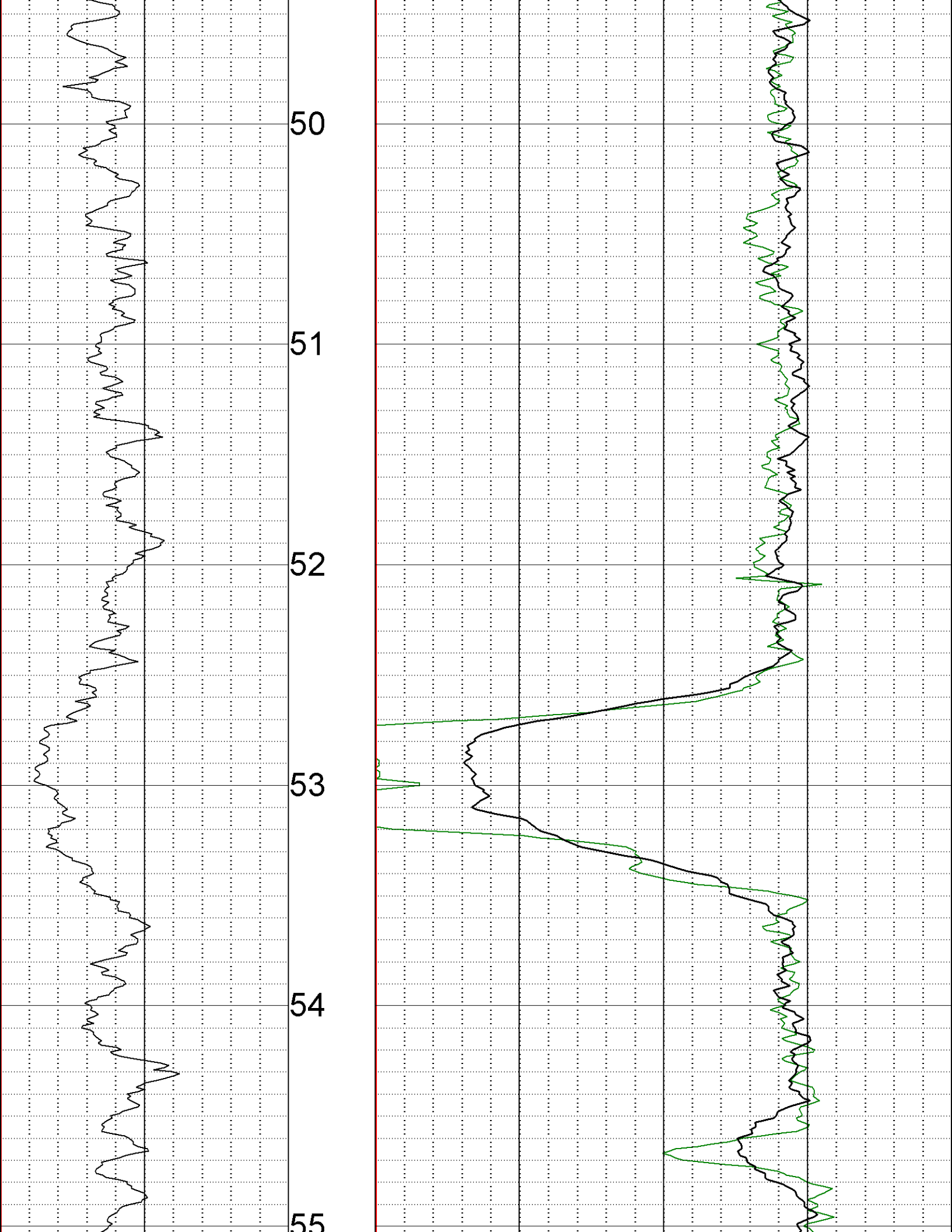

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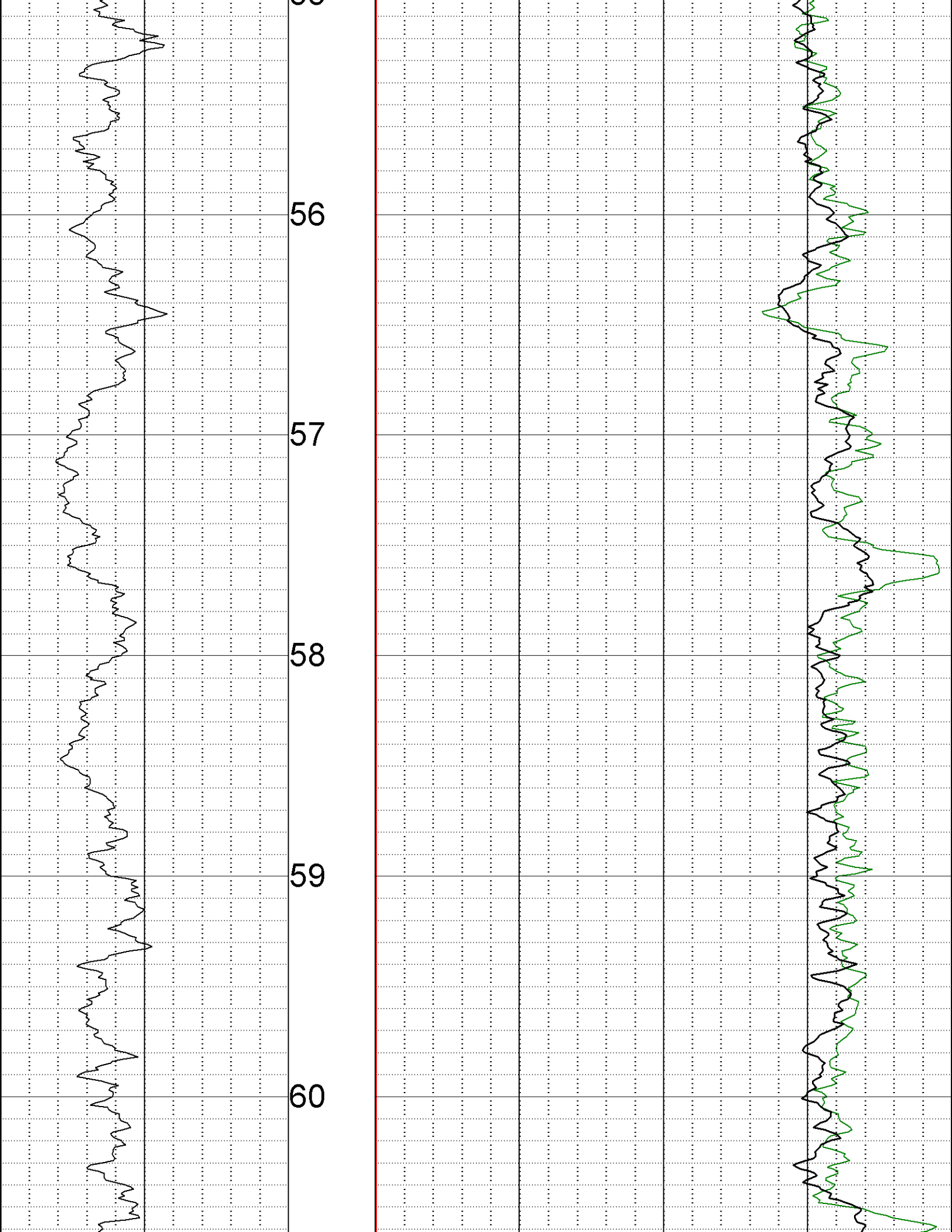

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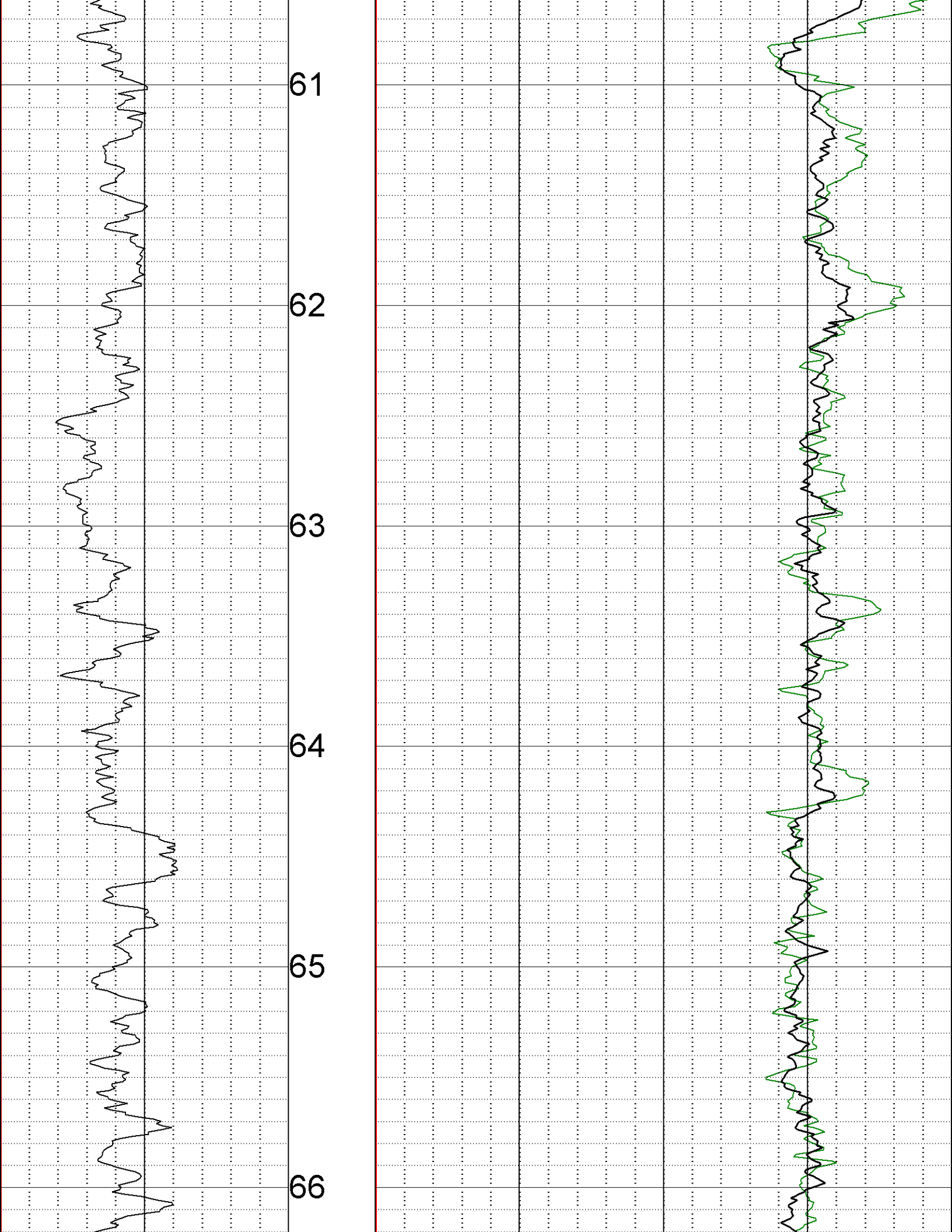

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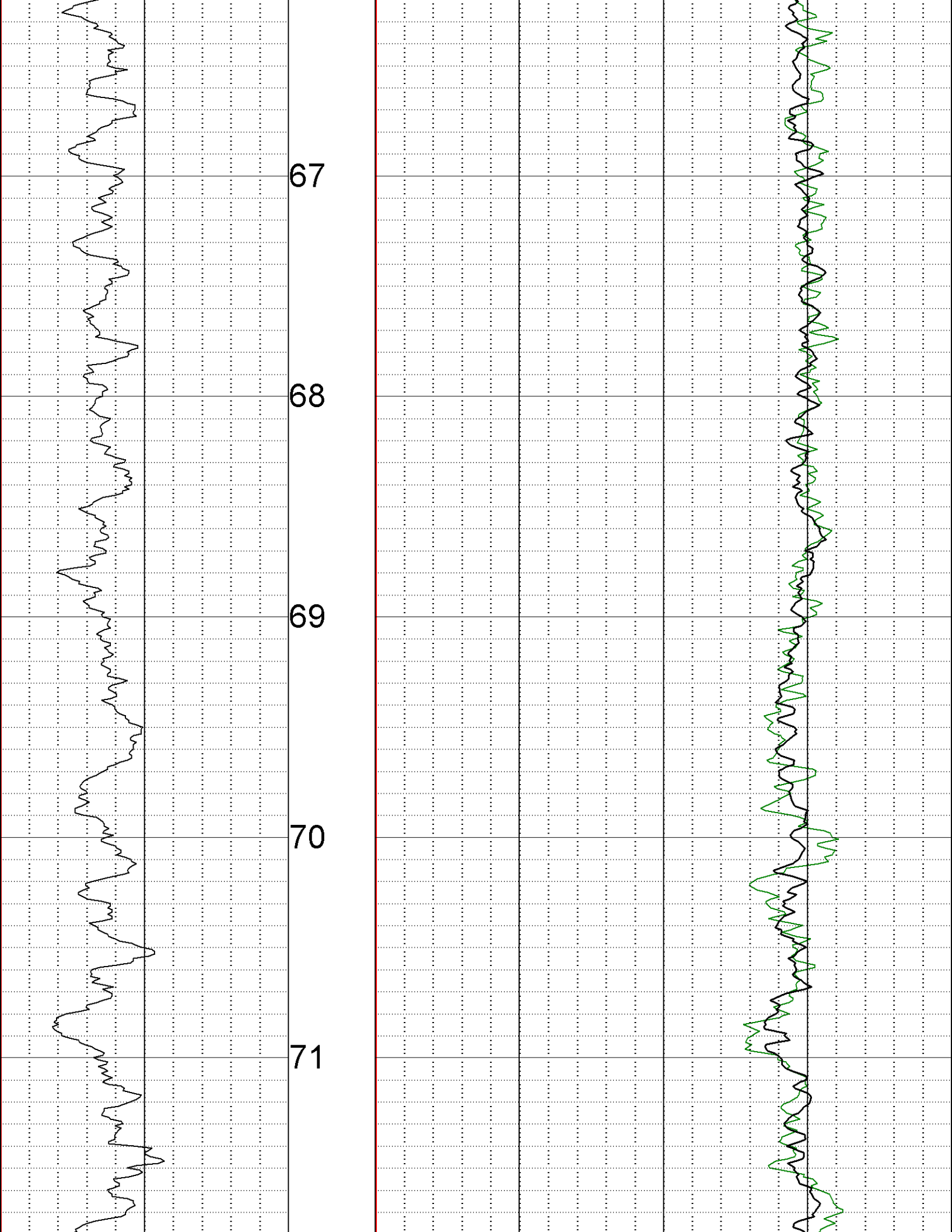

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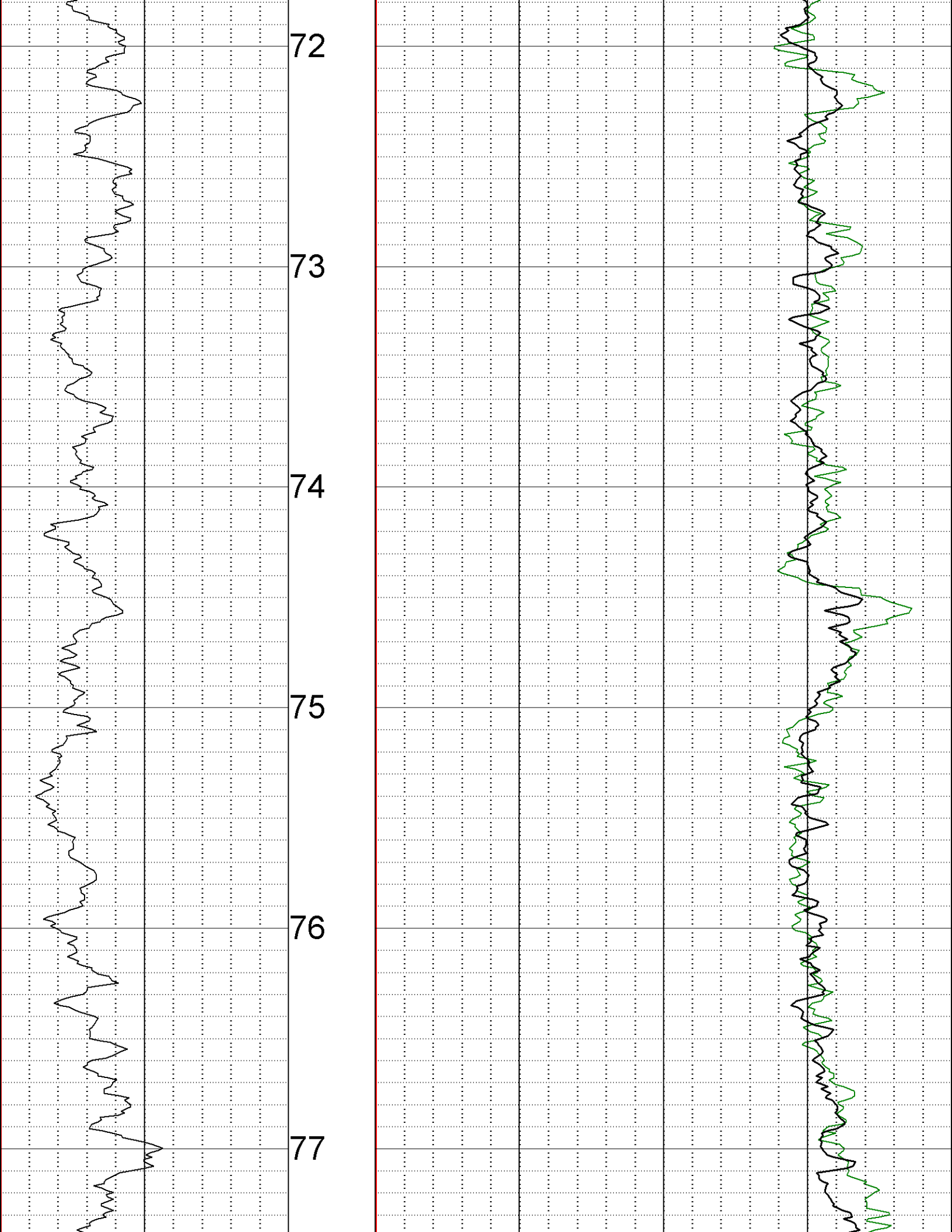

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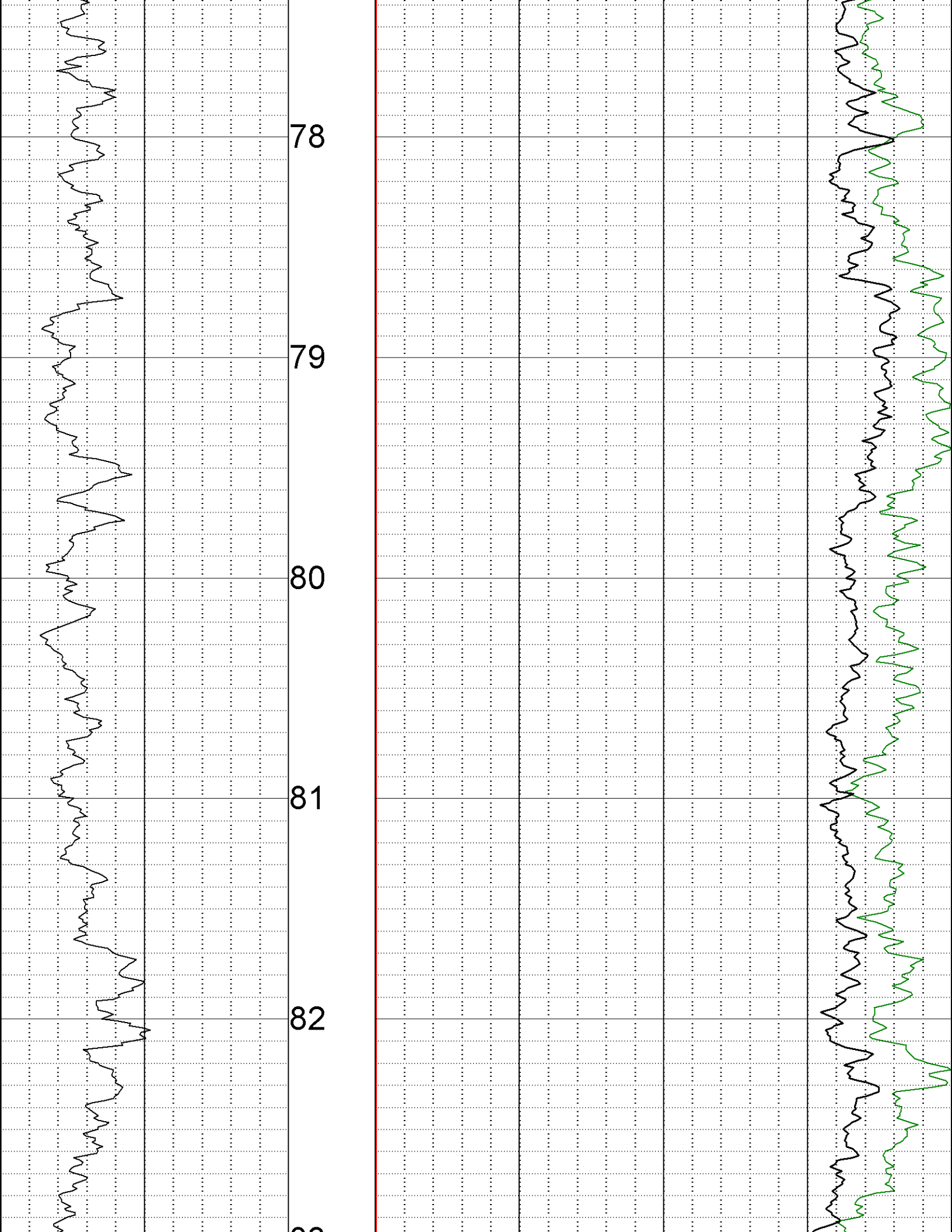

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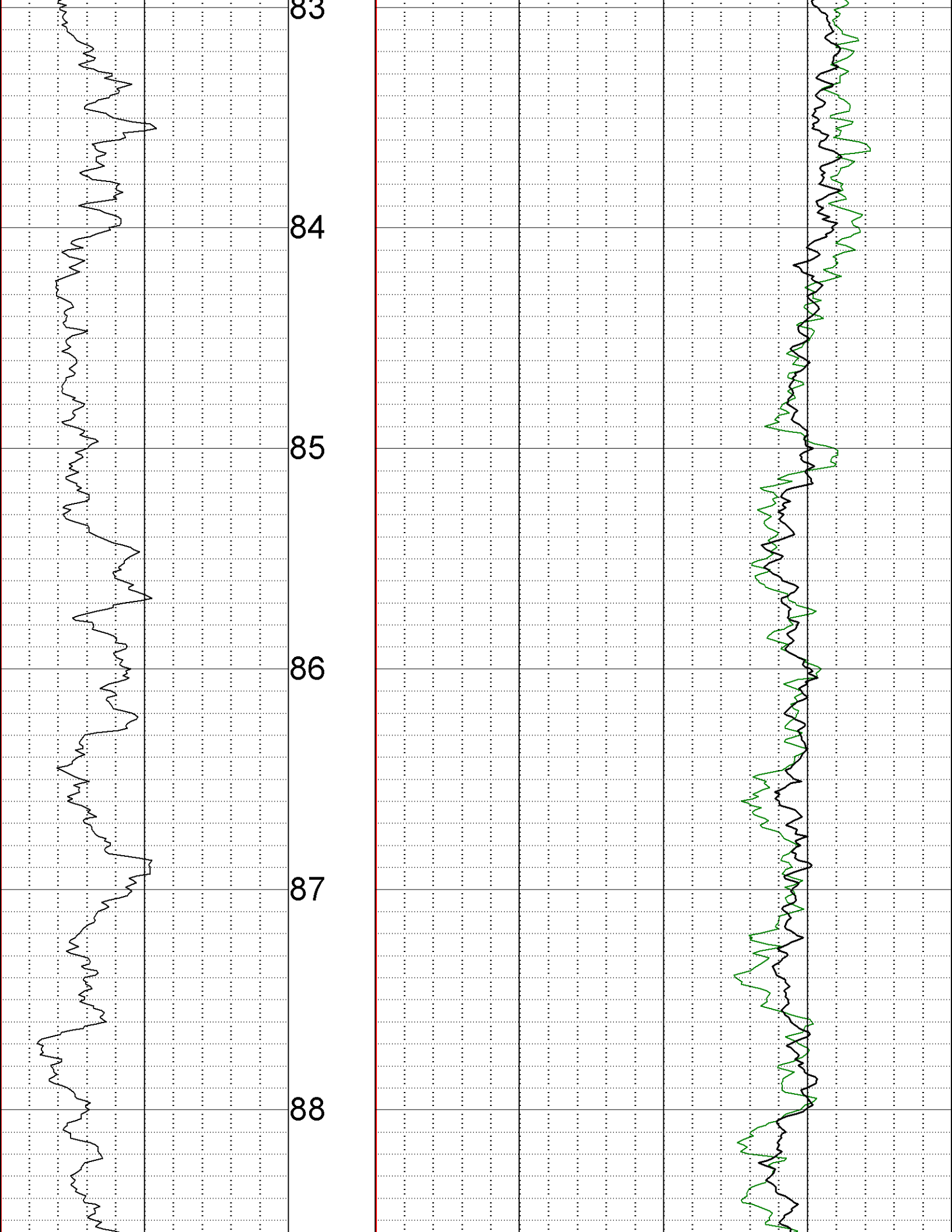

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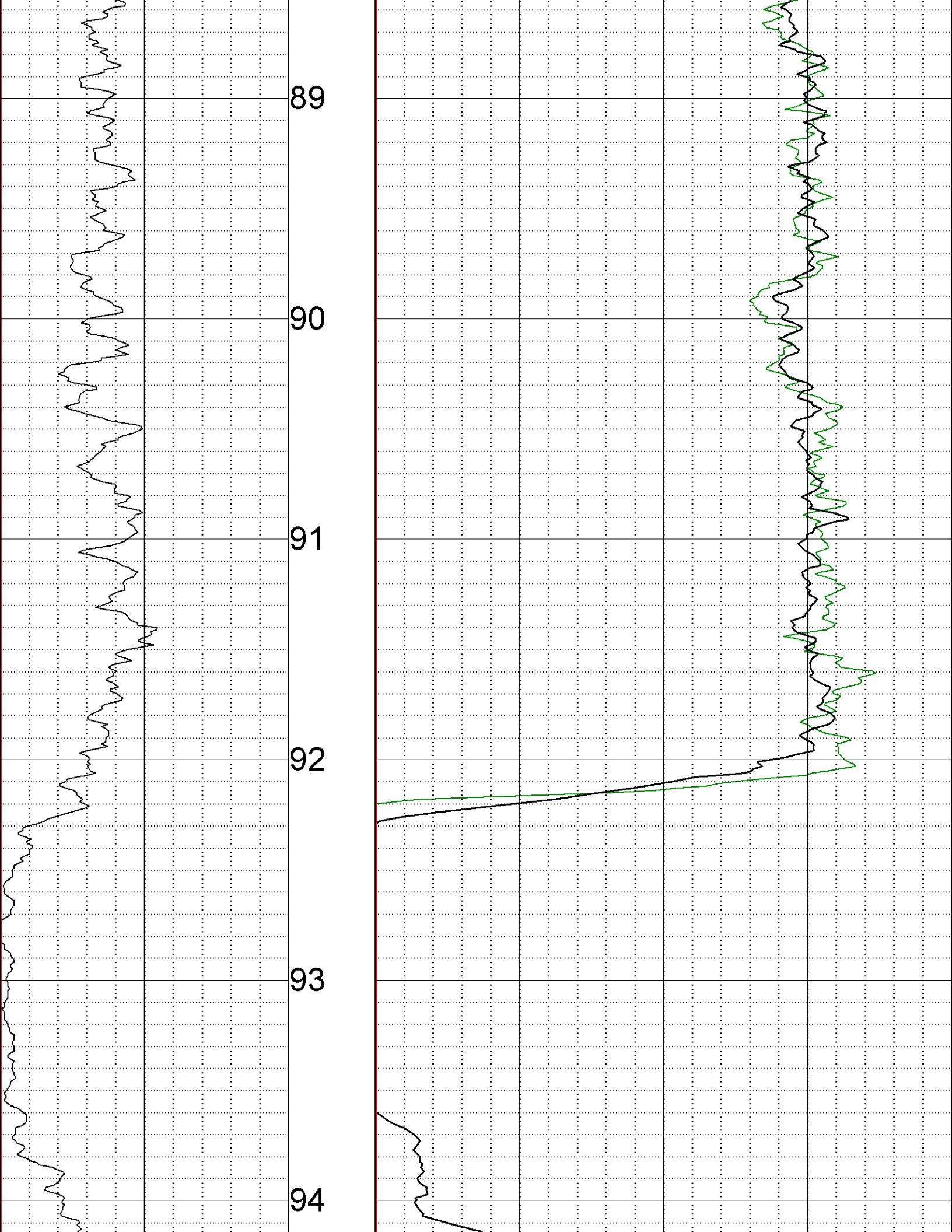

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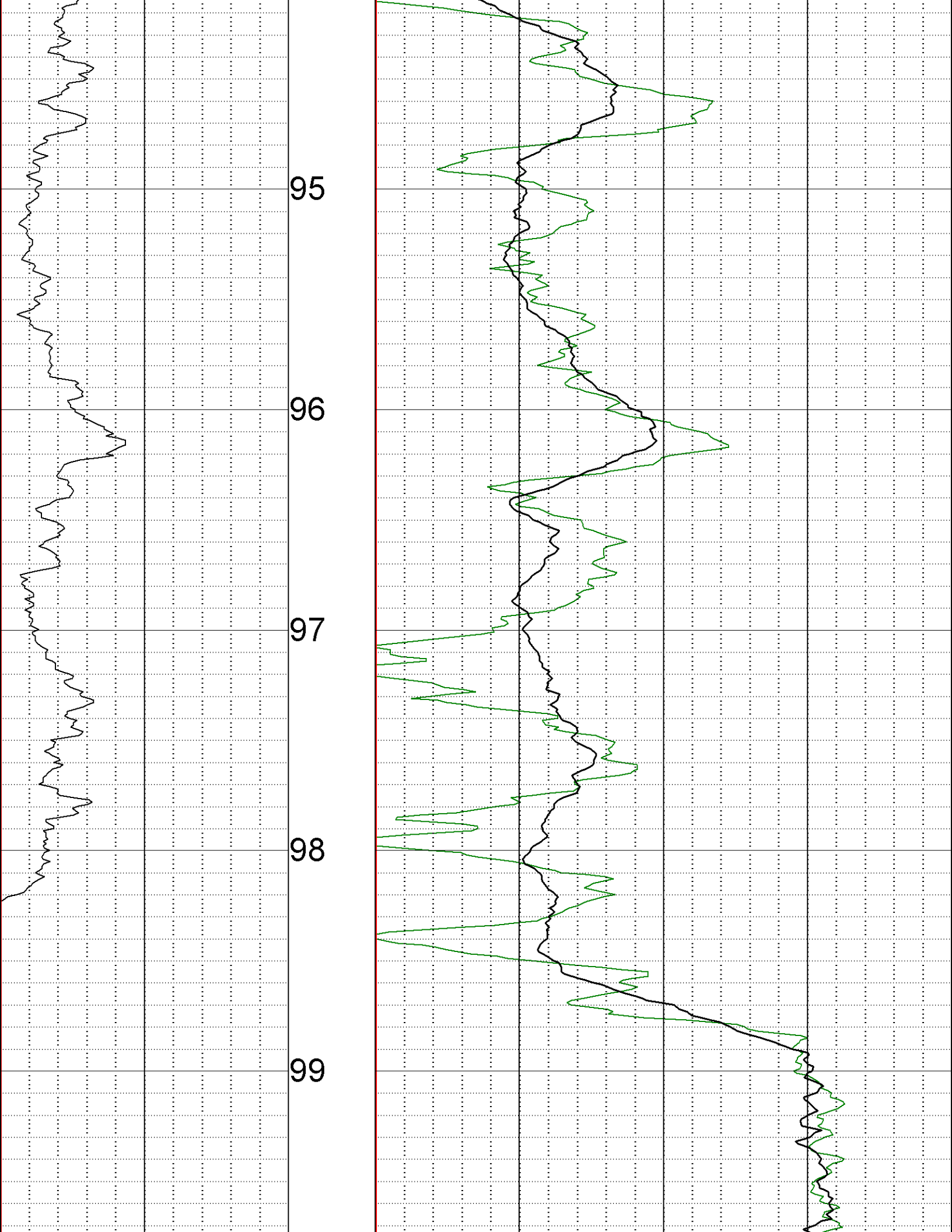

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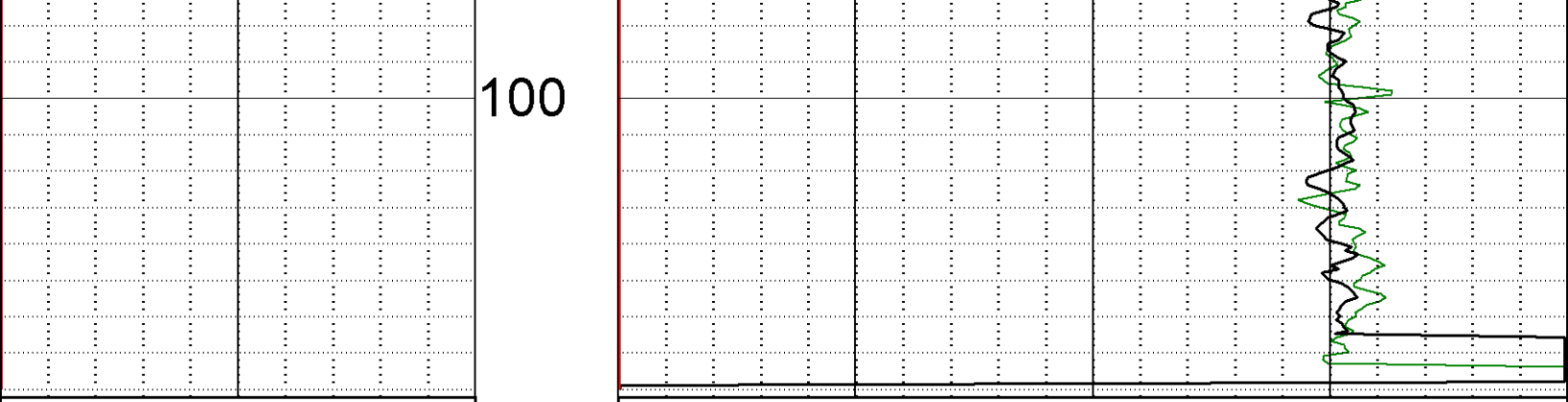

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0	API-GR	300
GAMMA		
8	CM	18
CALIPER		

1	G/CC	3
DEN(SS)		
1	G/CC	3
DEN(LS)		
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RES(SG)		

METERS

Appendix C – Downhole camera

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BH01 CCTV Yard Seam



Roof of void

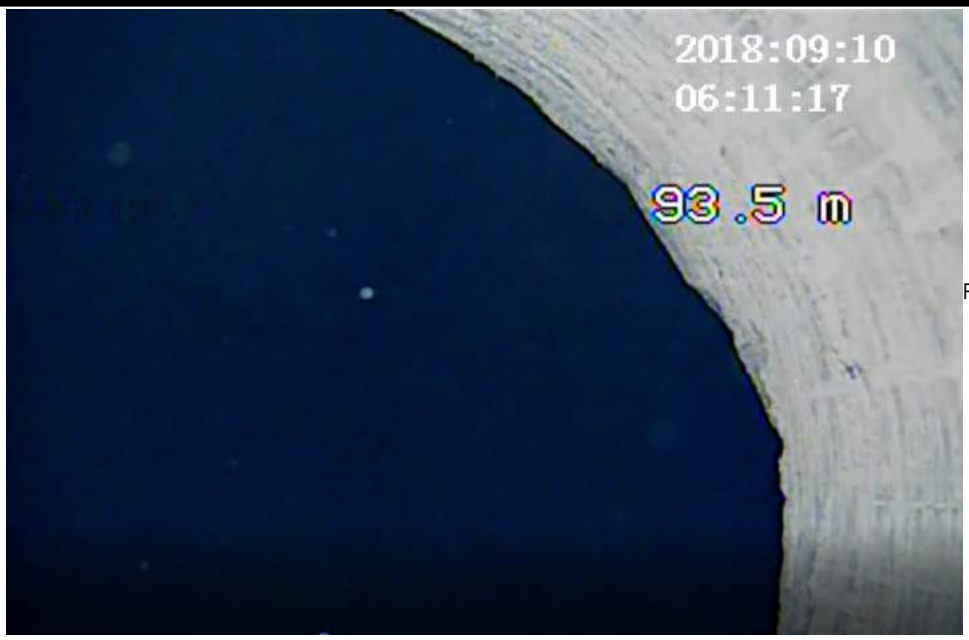


Floor of void

Note depths are approximate only

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approved	JD		project:	PROPOSED RESIDENTIAL DEVELOPMENT 11-17 MOSBRI CRESCENT THE HILL
date	2/11/2018			
scale	N/A		title:	CCTV SNAPSHOTS BH01 YARD SEAM
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BH01 CCTV Borehole Seam



Roof of void



Floor of void

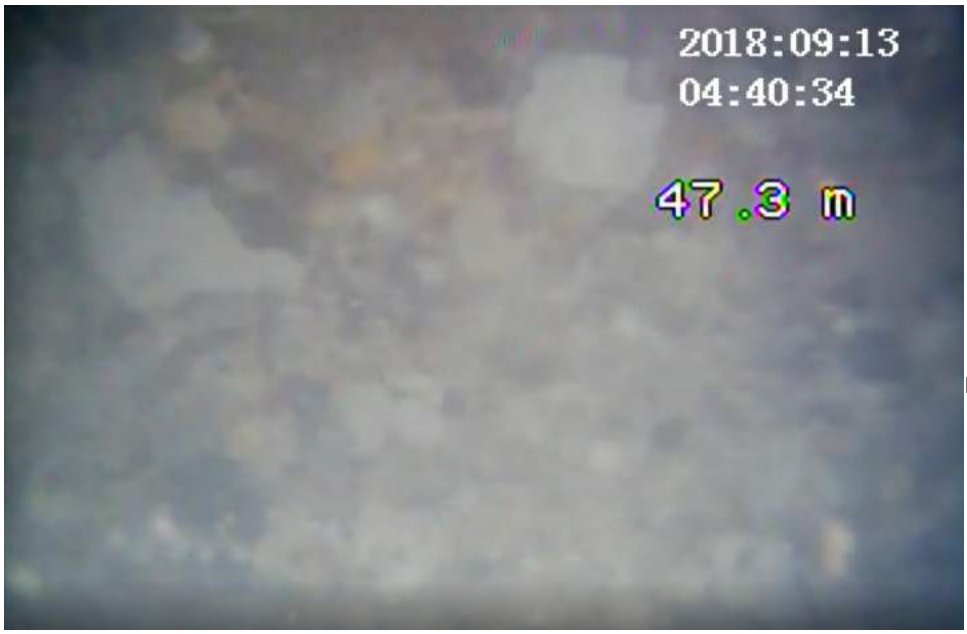
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original size	A4			

BH03 CCTV Yard Seam



Roof of void



Floor of void

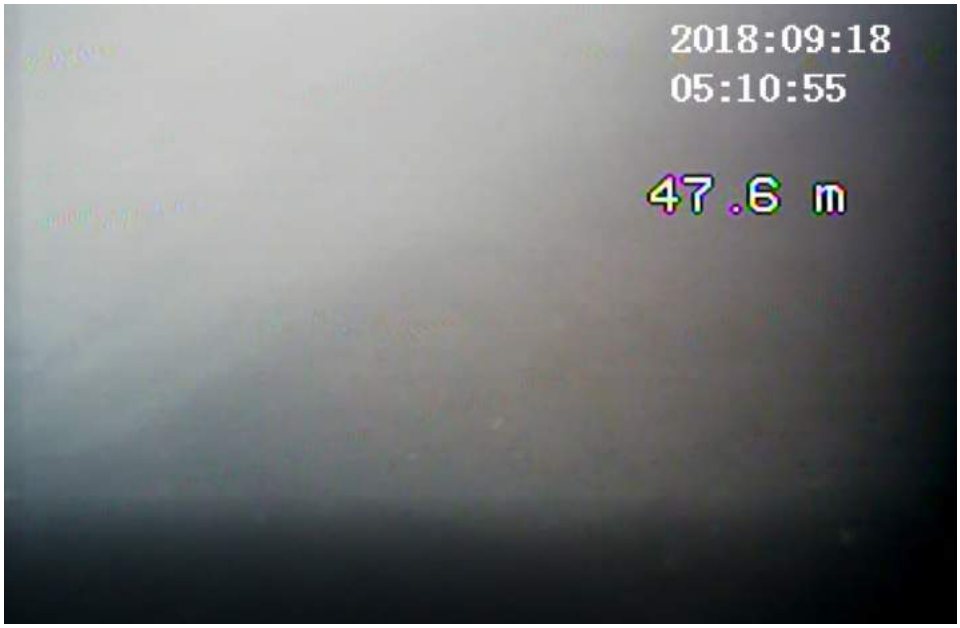
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BH04 CCTV Yard Seam



Roof of void

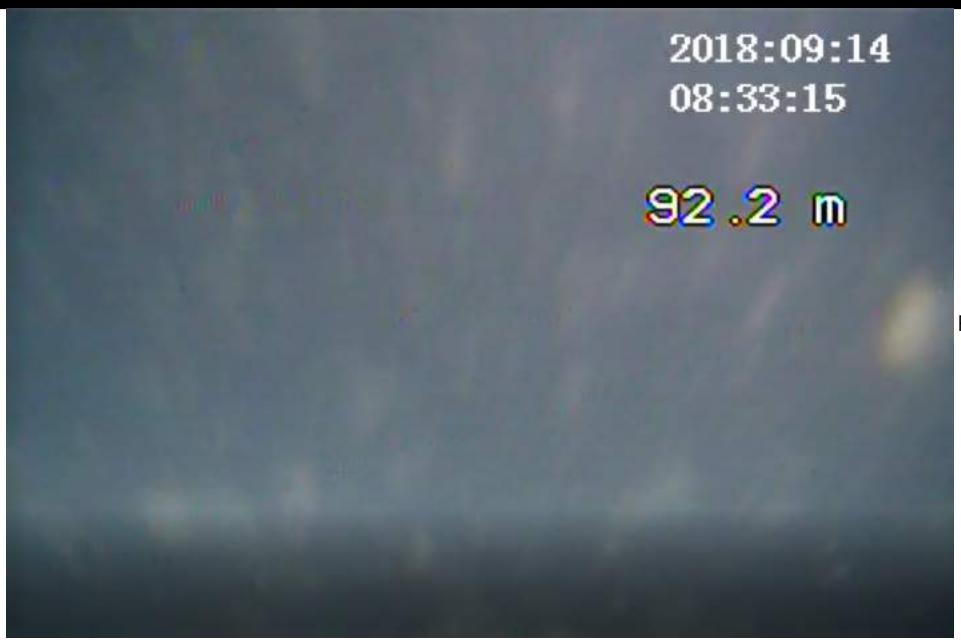


Floor of void

Note depths are approximate only

drawn	SJB	coffey A TETRA TECH COMPANY	client:	CRESCENT NEWCASTLE PTY LTD
approved	JD		project:	PROPOSED RESIDENTIAL DEVELOPMENT
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BH04 CCTV Yard Seam



Roof of void



Floor of void

Note depths are approximate only

drawn	SJB		client:	CRESCENT NEWCASTLE PTY LTD
approved	JD	coffey A TETRA TECH COMPANY	project:	PROPOSED RESIDENTIAL DEVELOPMENT 11-17 MOSBRI CRESCENT THE HILL
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scale	N/A		project no: 754-NTLGE220504	figure no: C-BH04 -02
original size	A4			

Appendix B – DgS Report COF-009/2a

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Ditton Geotechnical Services Pty Ltd
80 Roslyn Avenue Charlestown NSW 2290
PO Box 5100 Kahibah NSW 2290

22 August 2020

Attention: Mr Mark Purdy
Assistant Development Manager
Crescent Newcastle Pty Ltd
Po Box 292 Wickham NSW 2293

DgS Report No. COF-009/2a

Dear Mark,

Subject: Further Addendum to Worst-Case Mine Subsidence and Grouting Plan Assessment for the Proposed Multi-Storey Building Re-Development at 11 - 17 Mosbri Crescent, The Hill

1.0 Introduction

This letter provides the numerical modelling results for the proposed amendment to the approved grouting strategy presented in DgS Report No. COF-009/2 (5/12/19).

The proposed revision of the grouting strategy, as approved by SA NSW, was requested by Crescent Newcastle Pty Ltd. The purpose of the review was to assess the impact of the modified DA plans and where possible, negate the need for directional drilling and grouting under adjoining private properties without compromising the compliance with SA NSW Merit-based criteria.

This alternate strategy will allow some relaxation of the previous design recommendation to extend grout beyond the site boundaries by 20 m or 0.15 x cover depth (whichever is greater) (**DgS, 2019a**). The purpose of this recommendation was intended to provide an adequate buffer between the limits of future mine workings instability and subsequent surface cracking that may develop in the vicinity of the proposed structures. Additional grout has also been added to provide full pillar length confinement where the lot boundary restrictions or mine pillar geometry have reduced or limited confinement at key locations below the site boundaries and high rise towers.

In summary, the amended grouting strategy has resulted in minor increases to the subsidence effect predictions with no change to the predicted 'negligible' impacts to the structures.

It is understood that Northrop Consulting Engineers Pty Ltd, as the structural engineer for the project, will provide a separate review of the revised subsidence contour parameters and the potential 'cracking hazard' zones presented in this document as part of the modified DA package.

ABN 43 113 858 910 ACN 124 206 962
Ph: 02 4920 9798 Mob: 0413 094074
Email: steve.dgs@westnet.com.au

2.0 Method

The assessment has applied the methodology described in **DgS, 2019a** for the original preferred grouting strategy using 5 MPa UCS grout. The approved grouting strategy was modified by removing all grout previously shown below adjacent private properties and extending it elsewhere to obtain a similar outcome to the approved strategy.

The limits of grouting is governed by the SA NSW Merit Based Guidelines criteria for limiting subsidence effects for multi-story development over old mine workings.

The modelling included the following steps:

(i) Modify grouting and check subsidence effects meet design criteria for structures with the SDPS 3-D Influence Function Model

(ii) Check pillar stability for revised grouting arrangement with Lamodel (boundary element numerical model).

(iii) Up-date cracking hazard zones for the site.

3.0 SDPS Modelling Results

The credible worst-case subsidence effect contours for the proposed (preferred) Option 2 grouting strategy have been assessed using SDPS (3D-Influence Function model).

The following SDPS model input parameters were again used to estimate the CWC Subsidence effects due to full pillar crush events in the Borehole Seam workings below the Mosbri Crescent site:

- Maximum supercritical subsidence/effective mining height ratio, $S_{max}/he = 0.4$
- Maximum subsidence of 0.6 m or 16% of 3.75 m without grout.
- Supercritical inflexion point distance from mining limits/cover depth ratio, d/H = 0.32 (d = 32 m)[1]
- Tangent of the Influence Angle, tan(β) = 1.5 to 1.8 (likely range)
- Horizontal Displacement (mm) = 25 x Tilt (mm/m)
- Horizontal Strain (mm/m) = 20 x Curvature (1/km)

[1] The inflexion point represents the distance to maximum tilt from the limits affected by pillar instability or mine subsidence in general. The d/H value is taken as the average for a solid barrier of 0.384 (21° abutment angle) and a relatively soft boundary at the surface due to deep sands of 0.25. Note: The design d/H was incorrectly given as 0.25H in **DgS, 2019**, although a d/H of 0.32 was used.

The subsidence effect contours are shown in **Figures 1a** to **1e** for a tanB = 1.5 with **Figures 2a** to **2e** based on a tanB = 1.8. It is predicted that the subsidence effects will range somewhere between the two cases, with tanB = 1.5 giving the worst-case values for the site.

The maximum subsidence effect parameters for the site with the amended grouting design is presented in **Table 1**.

Table 1 - Predicted Subsidence Effects for the Site Structures and Proposed Modified Grout Design

Parameter	**Approved Design**		**Proposed Modified Design**		**SSR Limits (Structures)**
	Townhouses	High-Rise Buildings	Townhouses	High-Rise Buildings	
Subsidence (m)	< 0.02	< 0.02	**< 0.03**	< 0.02	N/A
Tilt (mm/m)	< 2	< 2	**< 3**	< 2	<3
Curvature (1/km)	< 0.15	< 0.15	< 0.15	< 0.15	<0.15
Horizontal Strain (mm/m)	< 3	< 3	< 3	< 3	<3
Horizontal Displacement (mm)	<30	<30	**< 65**	**< 50**	N/A

bold - value greater than indicated for approved grouting strategy.

The results indicate that the Proposed Modification will still be within the Safe, Serviceable and Practically Repairable (SSR) limits assumed for the proposed structures. The increase in horizontal displacement is due to a minor increase in tilt, which is now estimated to be up to 2 mm/m at the high rise buildings (previously 1.2 mm/m) and up to 2.6 mm/m at the townhouses (previously 1.2 mm/m).

The amended grouting strategy has resulted in minor increases to the subsidence effect predictions with no change to the predicted 'negligible' impacts to the structures.

4.0 Lamodel Results

The Lamodel results for the proposed grouting strategy modification are presented in **Figures 3a** and **3b**.

A summary of the assumed input parameters and applied abutment stresses for the proposed Grouting Modification is summarised in **Table 2**.

Table 2 - Pillar Stability v. Seam Convergence Summary for Approved & Proposed Modified Grouting Options (2 - 3)

Option	Description	Average Pillar Strength @ Seam Convergence Magnitude^ (MPa)	Applied Abutment Stress Range (maximum core stress) (MPa)	Residual Pillar FoS @ 100 mm of seam convergence^	Maximum Seam Convergence Range Below Site (subsidence) (mm)	Comment
2	Approved	8.32 - 8.01 (20mm) 16.76 - 14.55 (100mm)	6.18 - 7.4) (7.72 - 10.0)	2.71 - 1.97	<100 (<50 mm)	Grouting pattern encroaches beneath Private Properties
3	Proposed Modification (this Study)	8.32 - 8.01 (20mm) 16.76 - 14.55 (100mm)	6.24 - 7.7) (7.8 - 10.7)	2.82 - 1.95	<100 (<50 mm)	No Private Property Encroachment

^ - Range for Pillars P1 to P6 shown in **Figure 3b**.

The results indicate that the difference between the approved and proposed modification to the grouting strategy is marginal with no significant increase in the risk of SSR criteria being exceeded after a pillar run.

5.0 Crack Hazard Zoning

The revised tensile cracking and compressive strain hazard zoning for the site is shown in **Figure 4**.

The figure shows revised grouting modification is likely to have reduced the exposure of the townhouses to subsidence cracking (i.e. < 3 mm/m strain). It is recommended however, that the previous design criteria for crack development protection for the structures on the property should remain unchanged.

It is recommended that the structural engineer to review the revised subsidence contour parameters and the potential 'cracking hazard' zones presented in this document.

There are no changes to the non-conventional subsidence parameters recommended in **DgS, 2019b** for valley closure effects.

The proposed grouting strategy is shown relative the adjacent lot boundaries in **Figure 5**.

For and on behalf of
Ditton Geotechnical Services Pty Ltd



Steven Ditton

Principal Engineer and Director
BE(Civil/Hons), C.P.Eng(Civil), M.I.E.(Aust) MAusI.M.M.
N.P.E.R. 342140

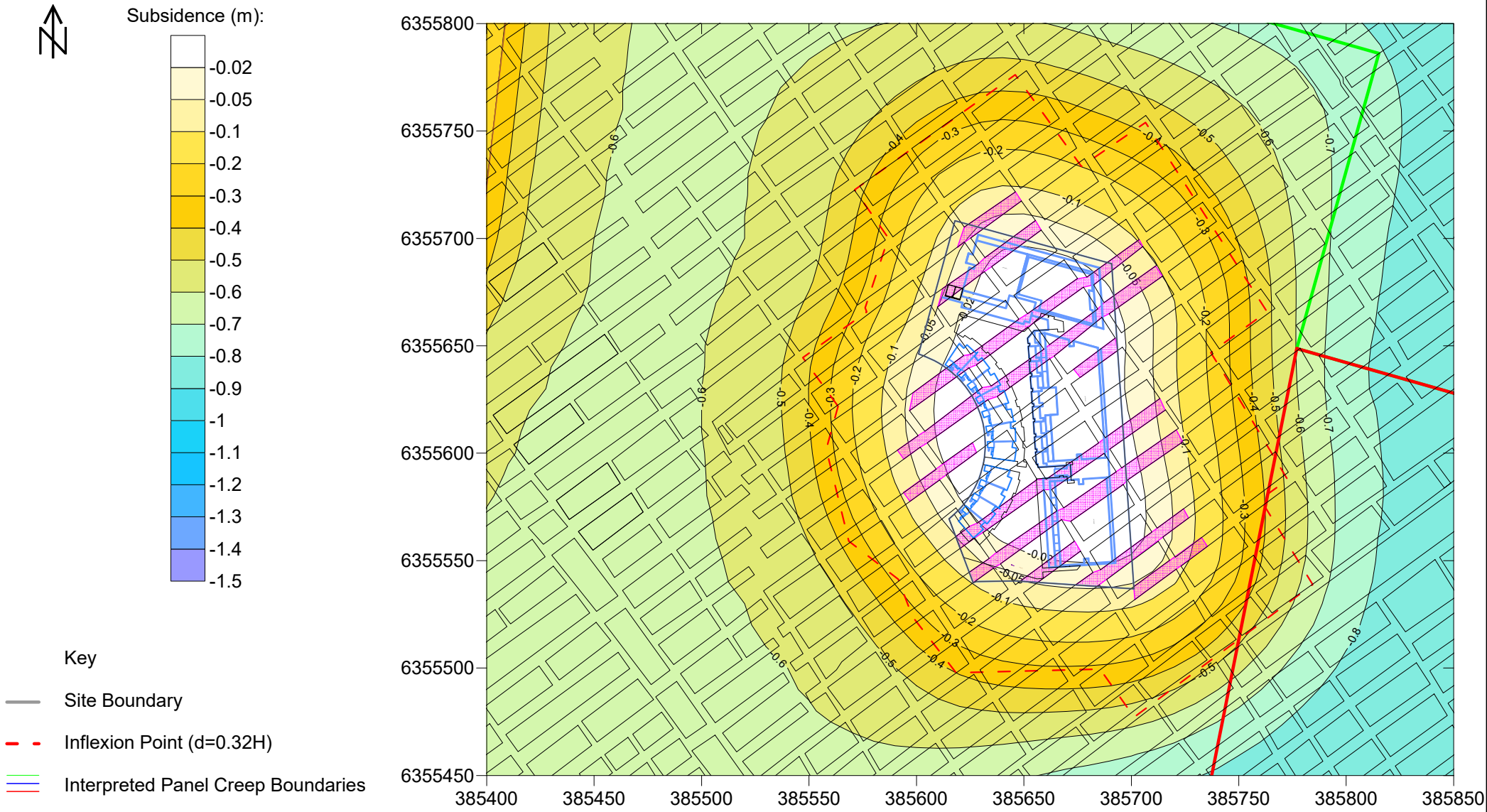
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Figures 1 to 5

References:

DgS (2019a). **Addendum to the Independent Review of the Worst-Case Mine Subsidence and Grouting Plan Assessment for the Proposed Multi-Storey Building Re-Development at 11 - 17 Mosbri Close, The Hill** DgS Report No. COF-009/2 (5 December).

DgS (2019b). **Updated Response to Galvin and Associates Letter to SA NSW (29/08/19) regarding the Worst-Case Mine Subsidence and Grouting Plan Assessment for 11 - 17 Mosbri Crescent, The Hill**. DgS Report No. COF-009/3 (October).

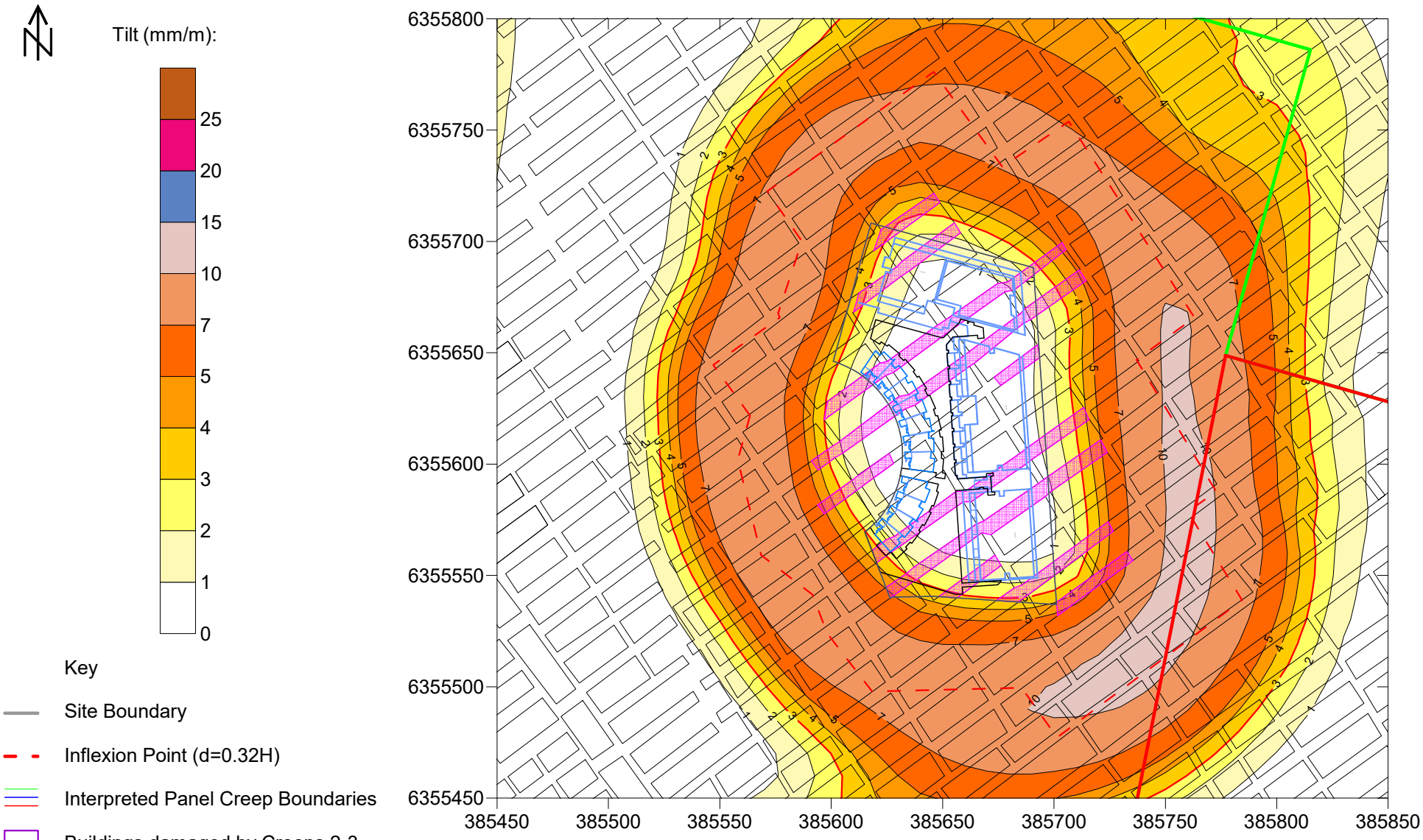


DgS

Ditton Geotechnical Services Pty Ltd

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Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Predicted Final Subsidence Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.5)
Scale:	1:2,500 (A4)
Figure No:	1a

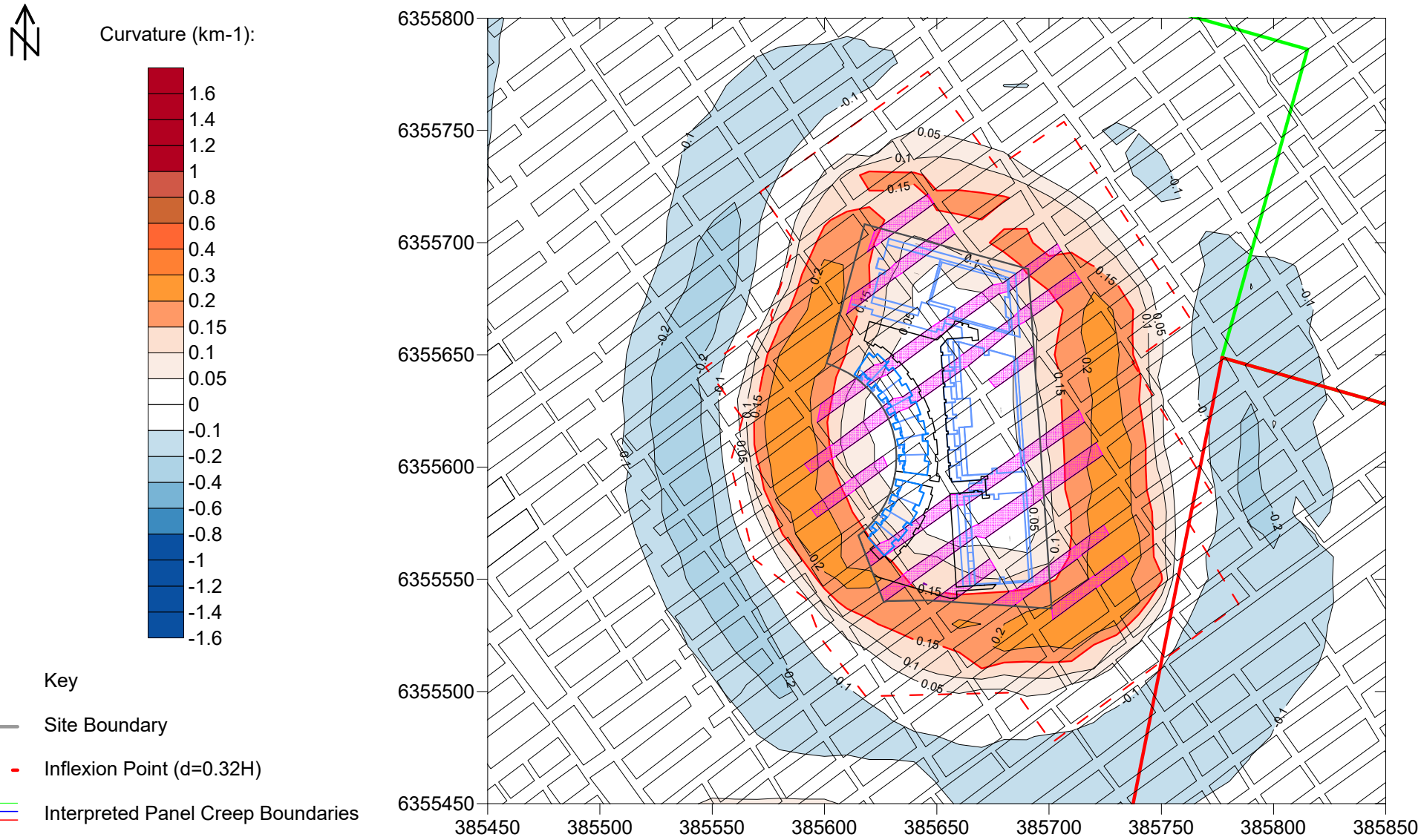


DgS

Ditton Geotechnical Services Pty Ltd

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Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Predicted Final Tilt Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.5)
Scale:	1:2,500 (A4)
Figure No:	1b



Key

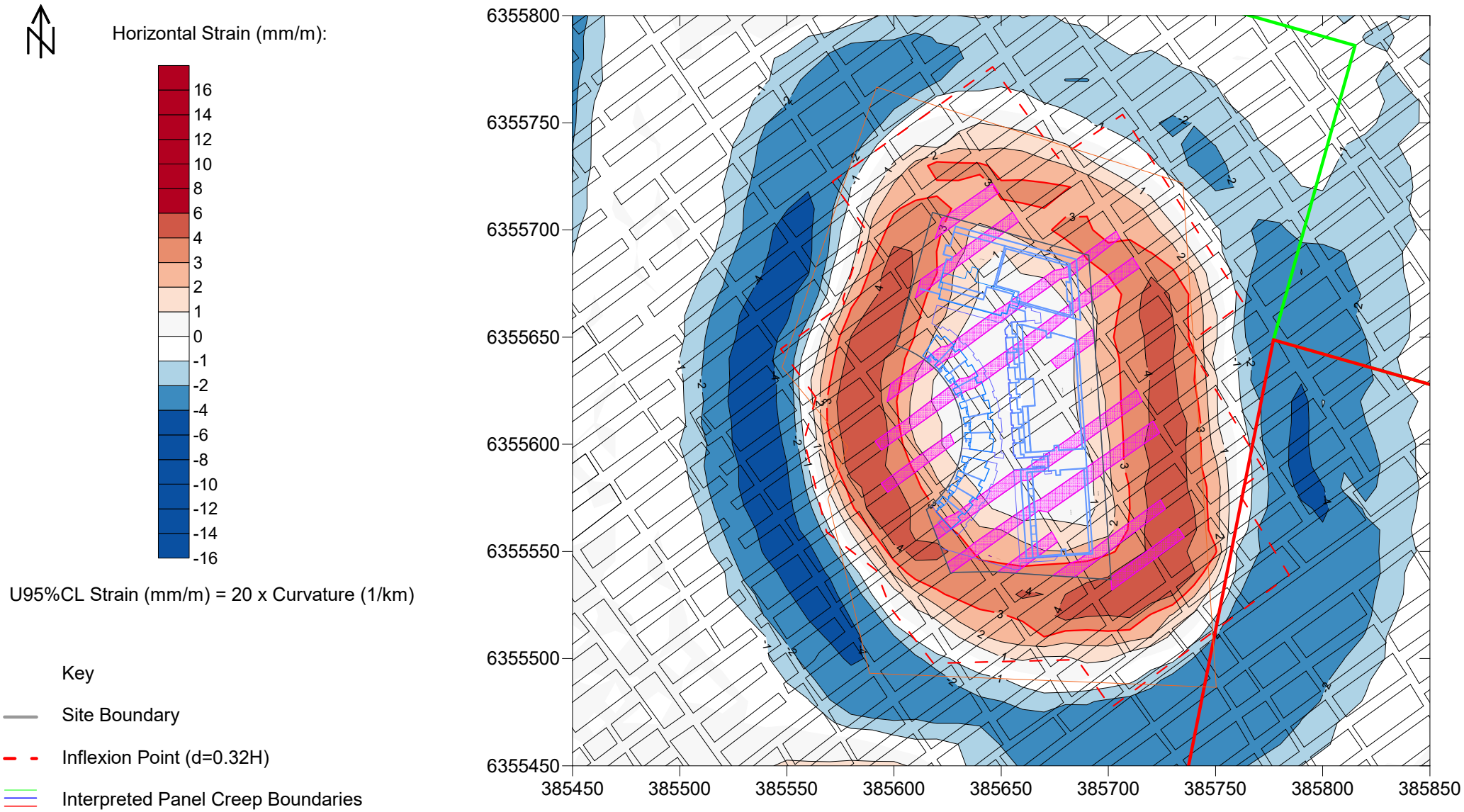
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- Inflexion Point (d=0.32H)
- Interpreted Panel Creep Boundaries
- Buildings damaged by Creeps 2-3
- AAC Mine Workings Pillars in Borehole Seam
- Grout

DgS

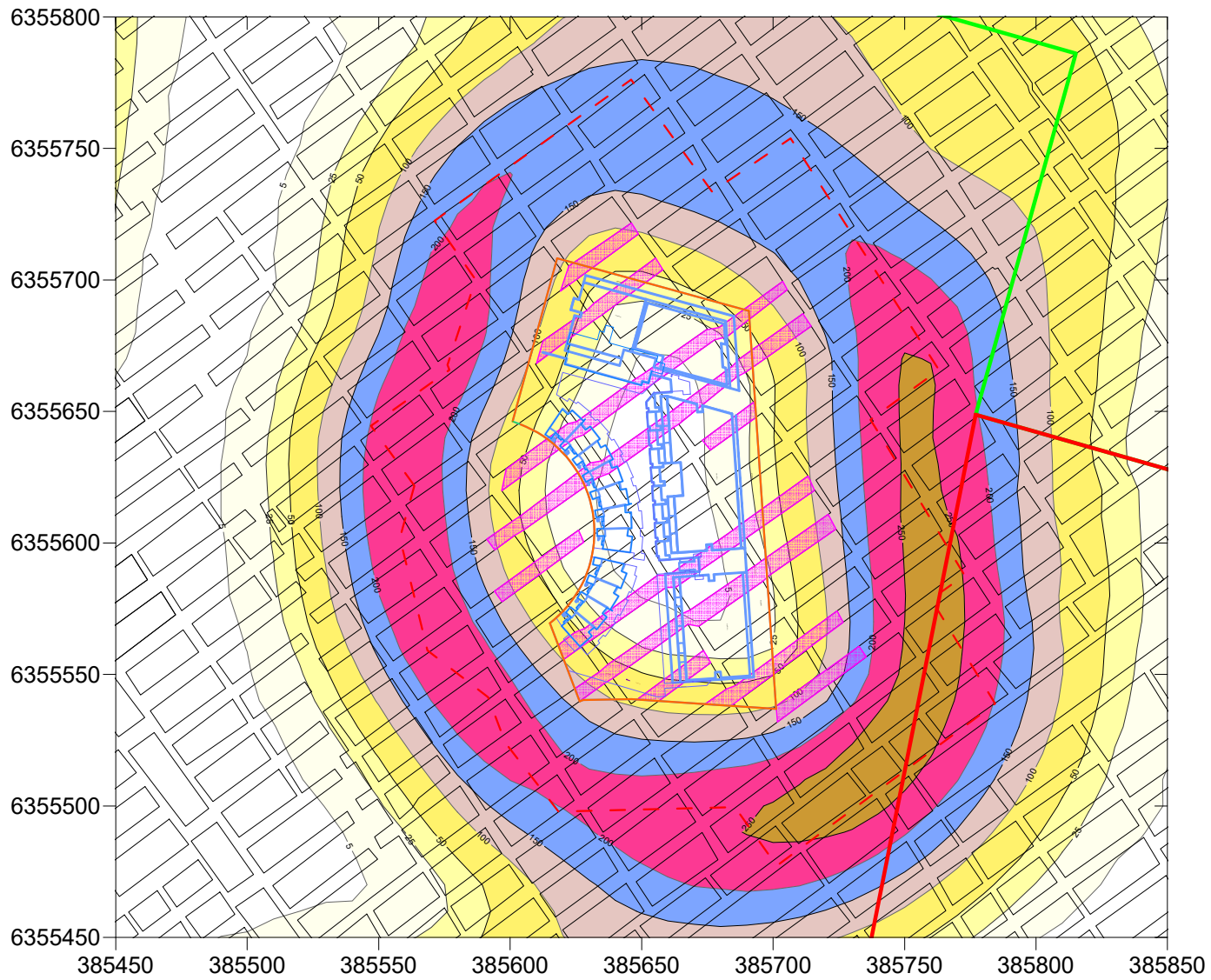
Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

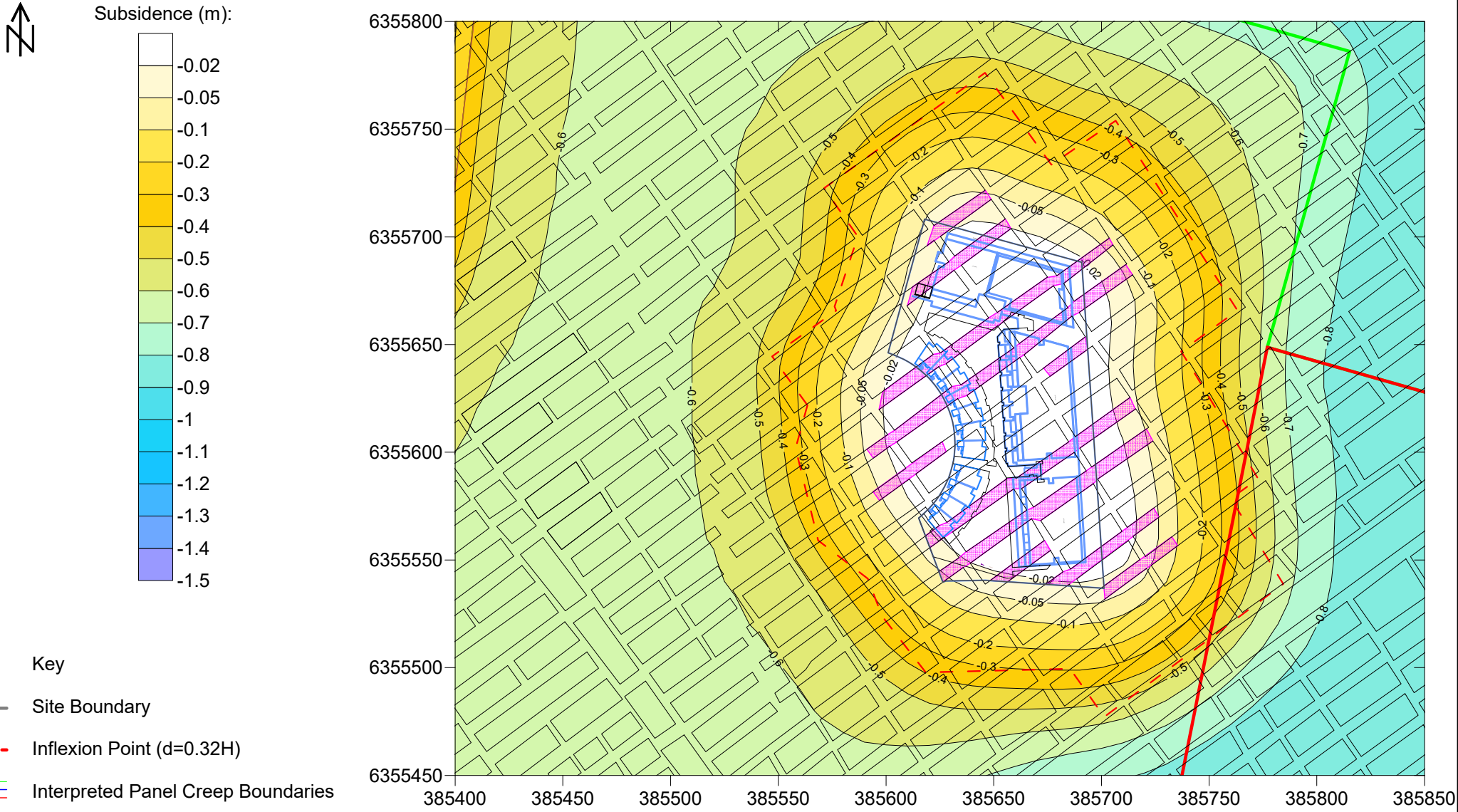
Client:	Coffey COF-009/2a
Title:	Predicted Final Curvature Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam:Preferred Option 2 (tanb=1.5)
Scale:	1:2,500 (A4)
Figure No:	1c



DgS Ditton Geotechnical Services Pty Ltd	Engineer: S.Ditton	Client:	Coffey COF-009/2a
	Drawn: S.Ditton	Title:	Predicted Final Horizontal Strain Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.5)
	Date: 14.08.20	Scale:	1:10,000 (A4) — Figure No: 1d



DgS Ditton Geotechnical Services Pty Ltd	Engineer: S.Ditton	Client:	Coffey COF-009/2a
	Drawn: S.Ditton	Title:	Predicted Final Horizontal Displacement Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option (tanb=1.5)
	Date: 20.02.19	Scale:	1:10,000 (A4) — Figure No: 1e

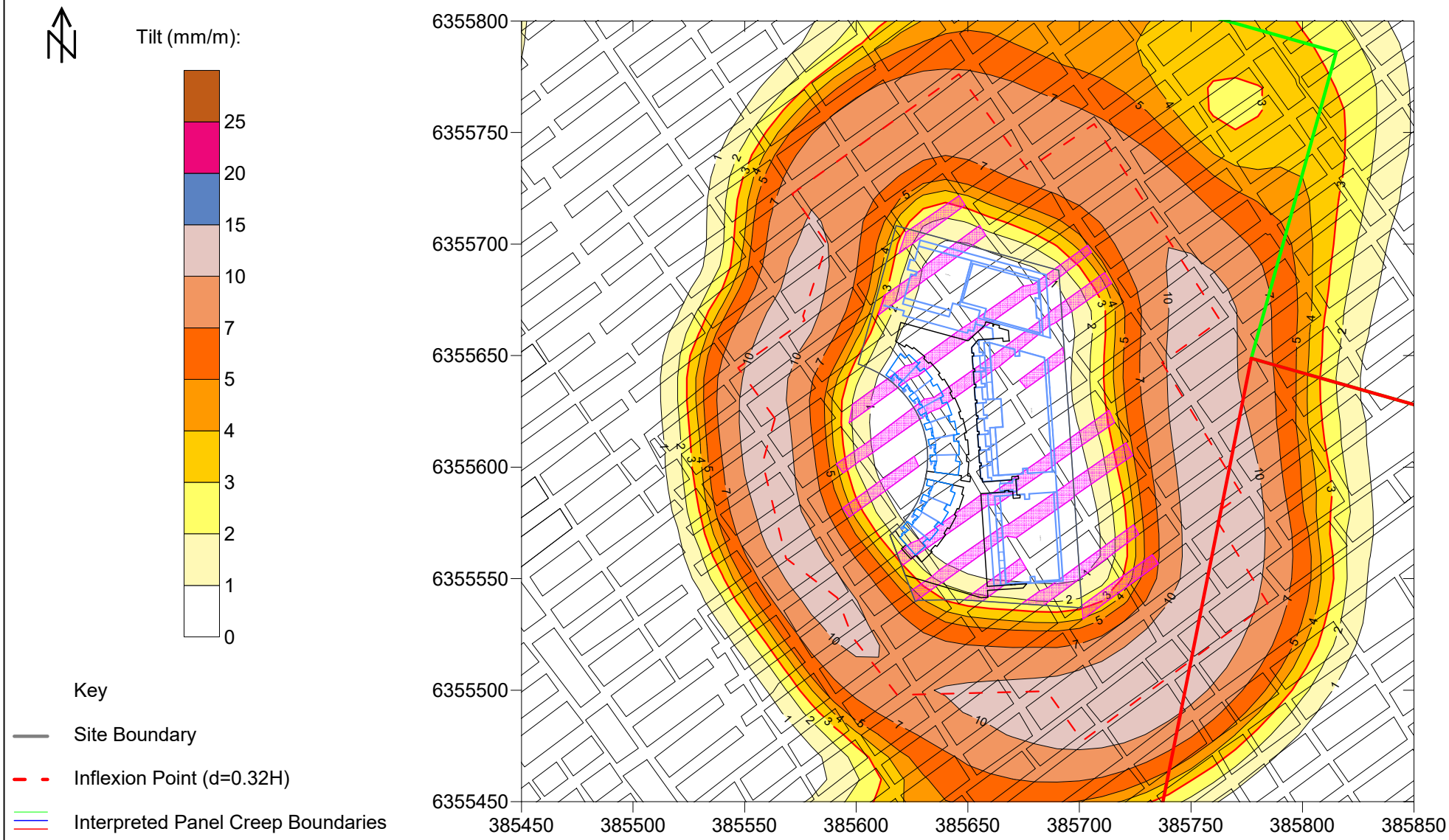


DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Predicted Final Subsidence Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2: (tan(B) = 1.8)
Scale:	1:2,500 (A4)
Figure No:	2a

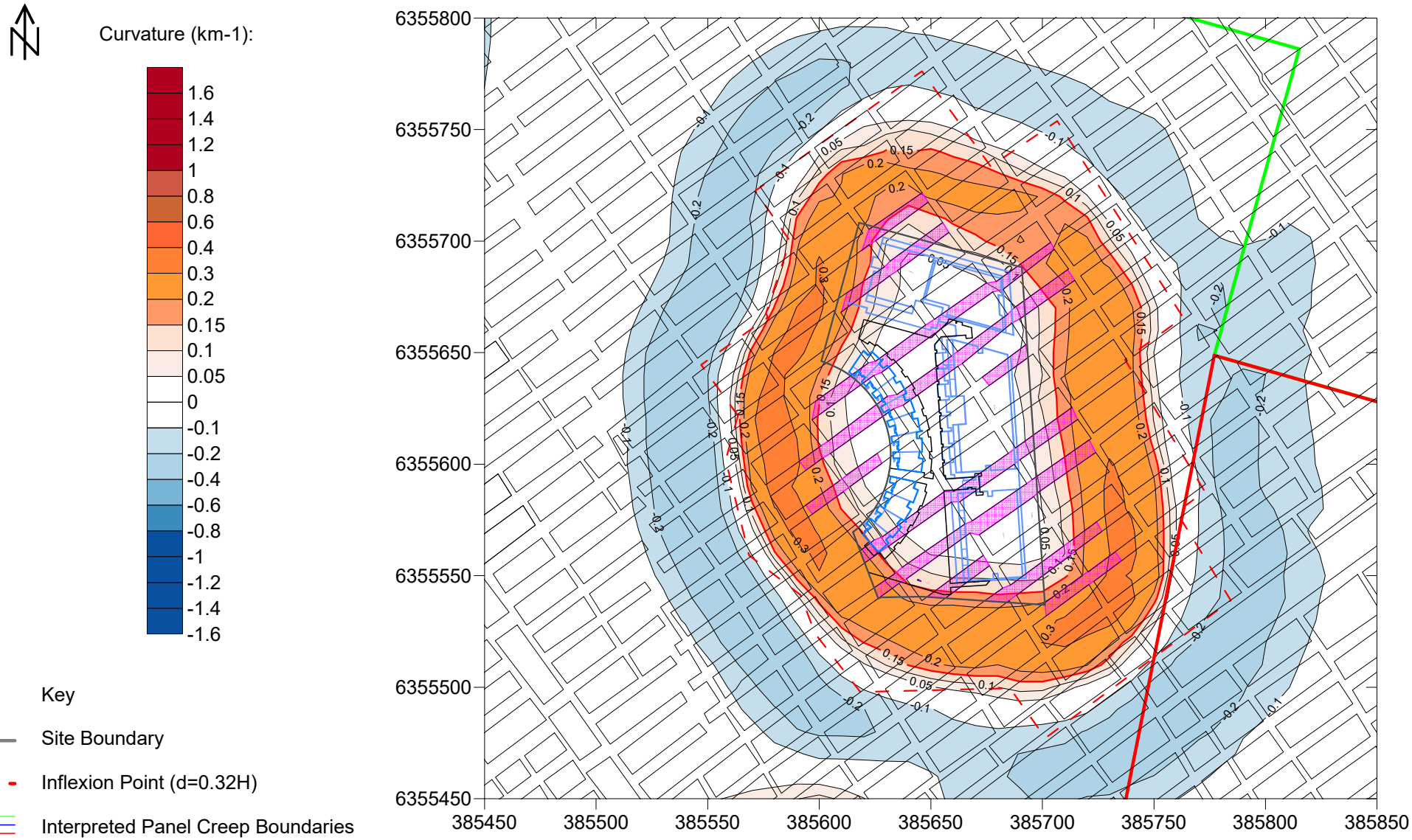


DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Predicted Final Tilt Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanB = 1.8)
Scale:	1:2,500 (A4)
Figure No:	2b



Key

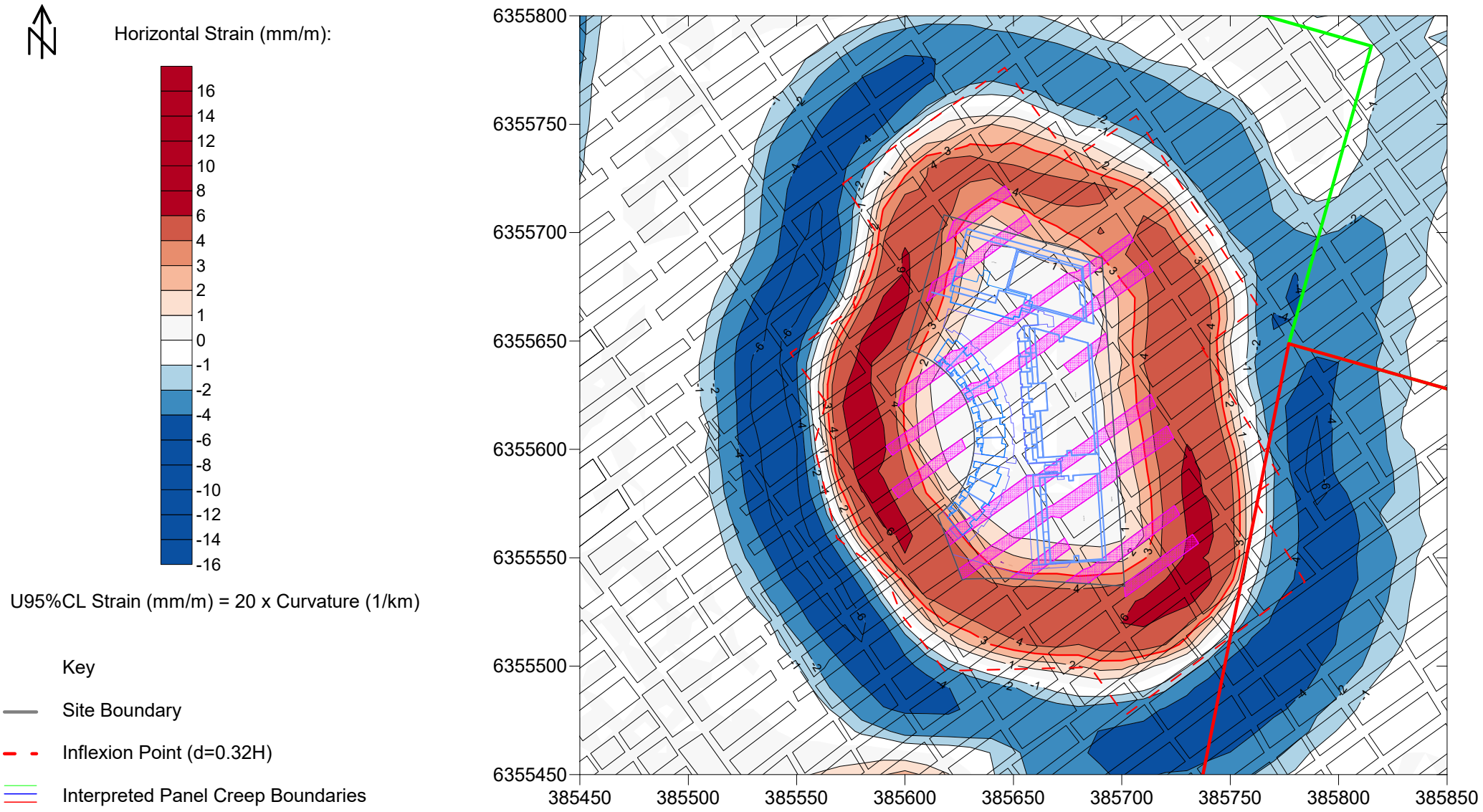
- Site Boundary
- Inflexion Point (d=0.32H)
- Interpreted Panel Creep Boundaries
- Buildings damaged by Creeps 2-3
- AAC Mine Workings Pillars in Borehole Seam
- Grout

DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a		
Title:	Predicted Final Curvature Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam:Preferred Option 2 (tanb=1.8)		
Scale:	1:2,500 (A4)	Figure No:	2c



DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Predicted Final Horizontal Strain Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.8)
Scale:	1:10,000 (A4)
Figure No:	2d

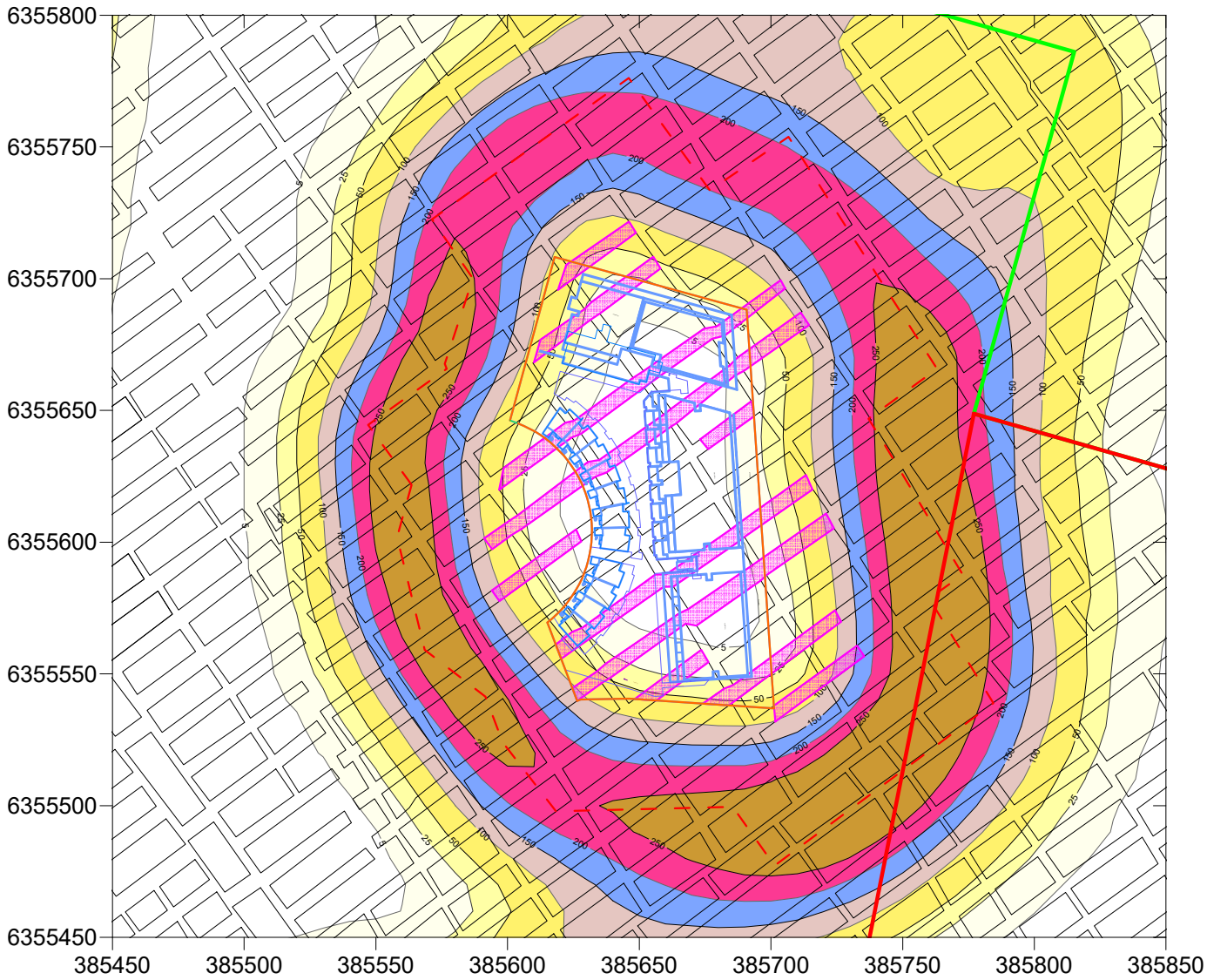
Horizontal Displacement (mm):

250
200
150
100
50
25
5

U95%CL Displacement (mm) = 25 x Tilt (mm/m)

Key

- Site Boundary
- Inflexion Point (d=0.32H)
- Interpreted Panel Creep Boundaries
- Buildings damaged by Creeps 2-3
- AAC Mine Workings Pillars in Borehole Seam
- Grout

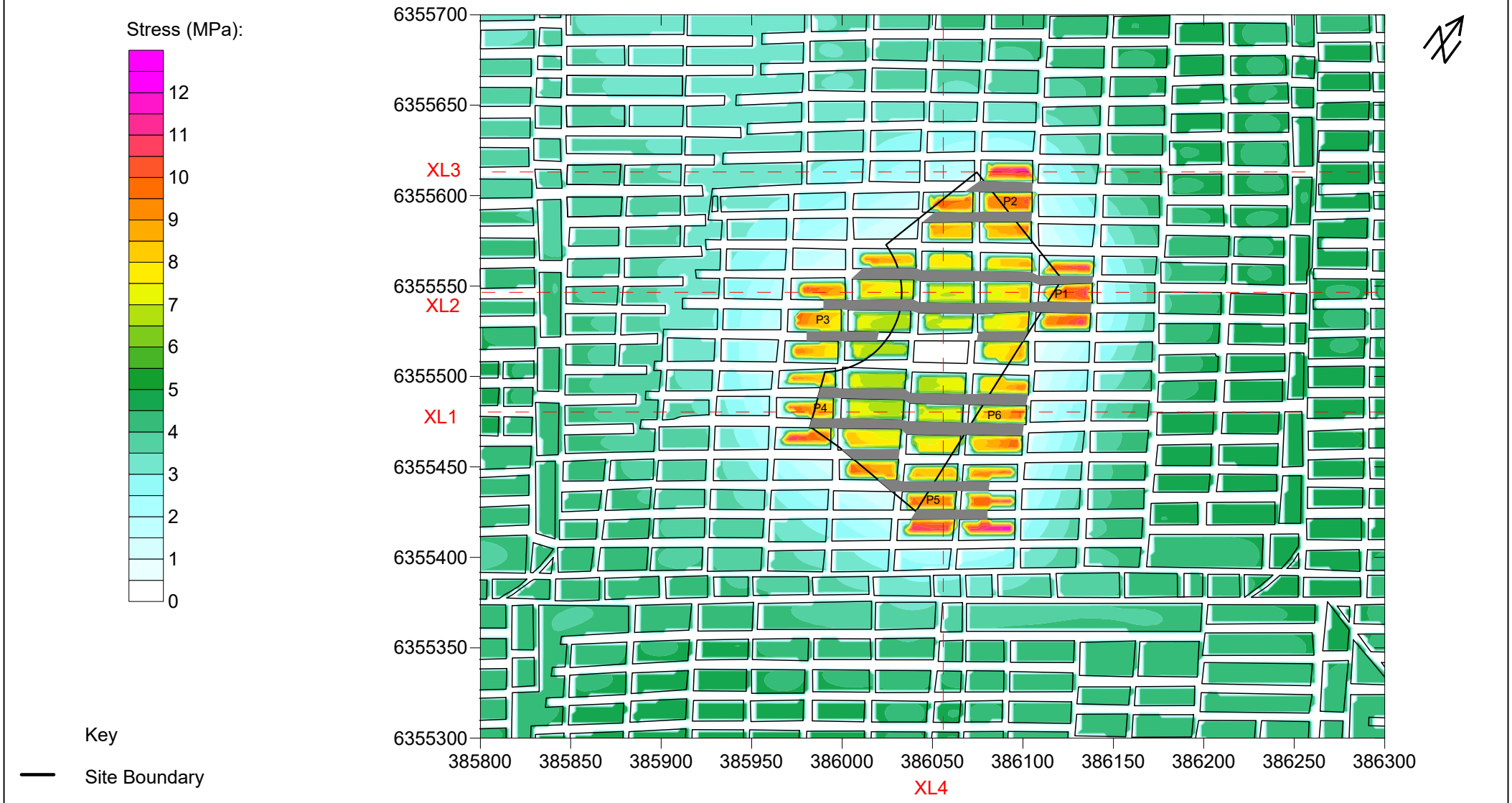


DgS

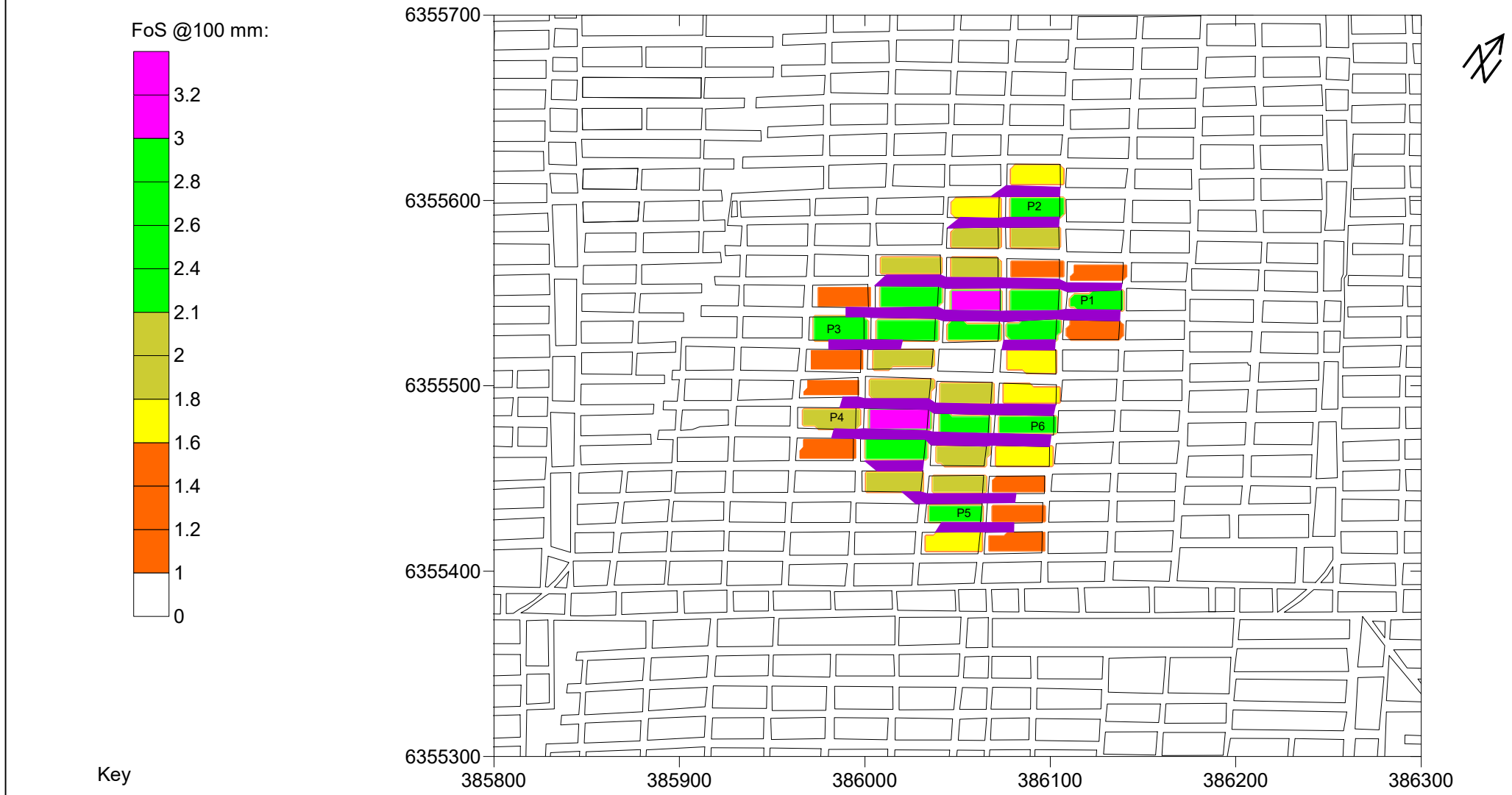
Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

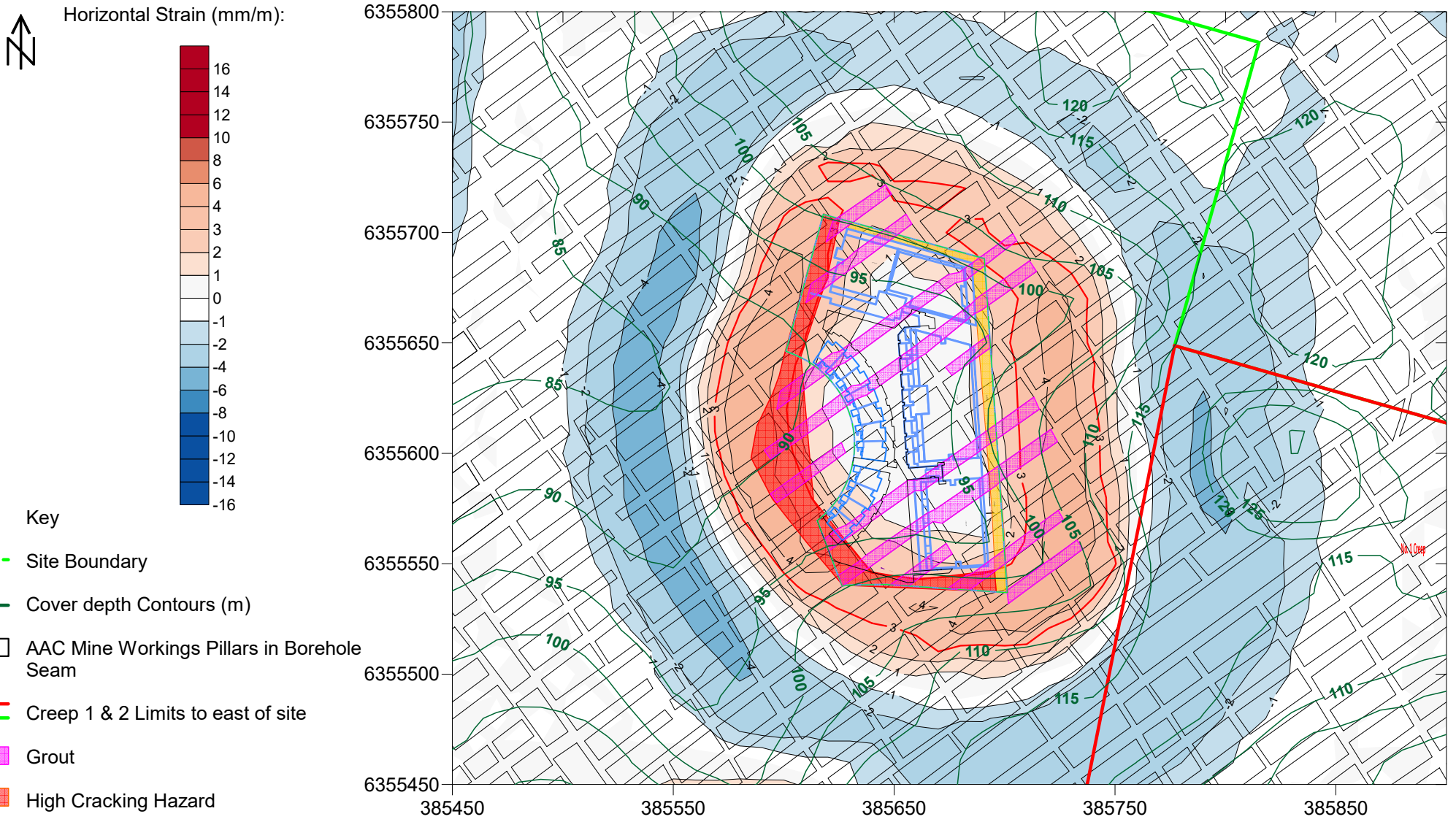
Client:	Coffey COF-009/2a
Title:	Predicted Final Horizontal Displacement Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.8)
Scale:	1:10,000 (A4)
Figure No:	2e



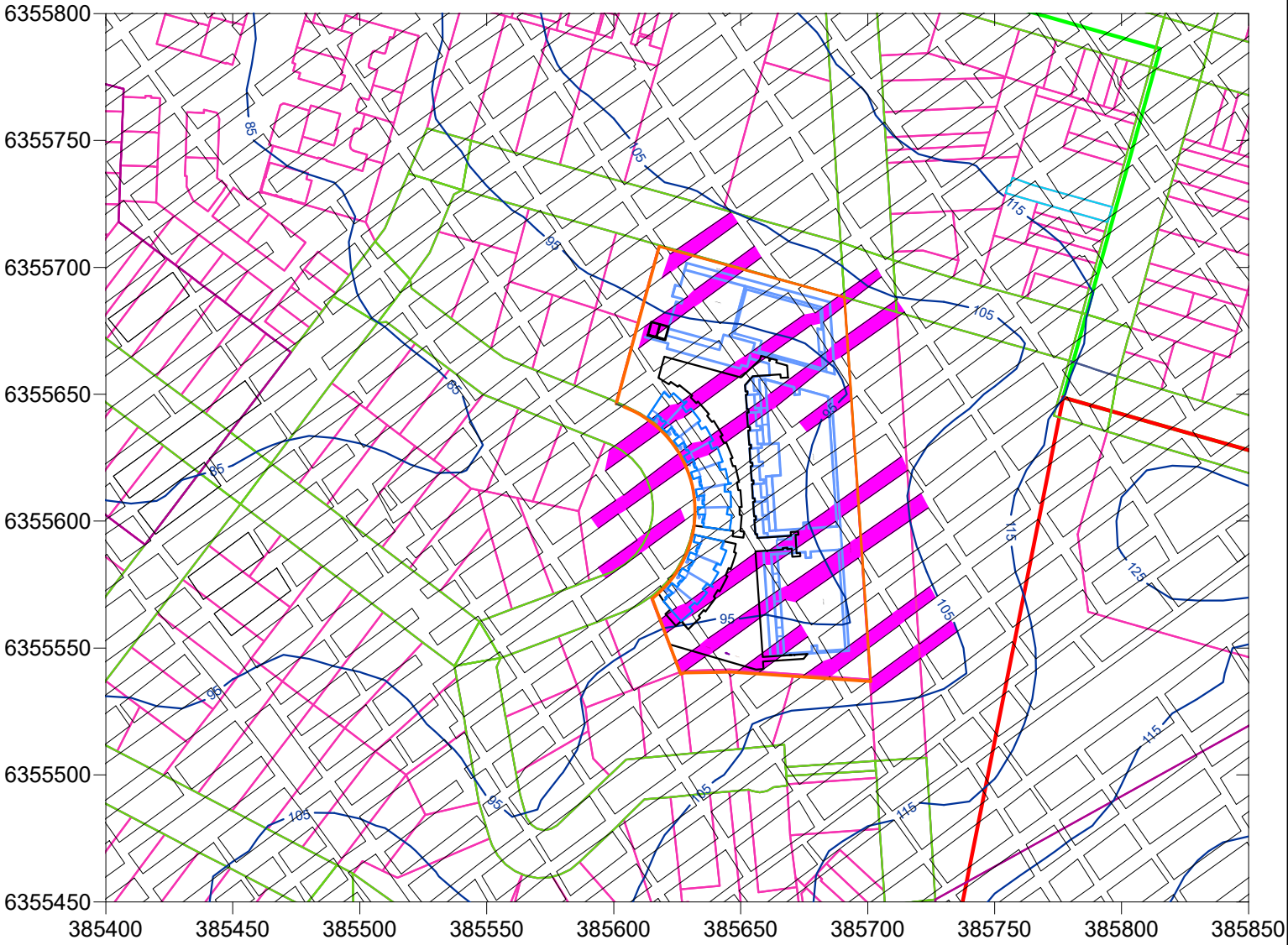
DgS	Engineer: S.Ditton	Client:	Stronach Property COF-009/2a
	Drawn: S.Ditton		
	Date: 25.10.19	Title:	Pillar Stress for Proposed Strategic Grouting with 5 MPa UCS in the BH Seam to satisfy Internal and External Pillar Instability Control for the Mosbri Crescent Site: Preferred Grouting Solution 2
Ditton Geotechnical Services Pty Ltd		Scale:	1:10,000 (A4) Figure No: 3a



DgS Ditton Geotechnical Services Pty Ltd	Engineer:	S.Ditton	
	Drawn:	S.Ditton	
	Date:	14.08.20	
	Client:	Stronach Property COF-009/2a	
	Title:	Pillar FoS for Proposed Strategic Grout in the BH Seam (with 5 MPa UCS) to satisfy Internal and External Pillar Instability Control for the Mosbri Crescent Site: Preferred Grouting Solution 2	
	Scale:	1:10,000 (A4)	Figure No: 3b



DgS Ditton Geotechnical Services Pty Ltd	Engineer: S.Ditton	Client:	Coffey COF-009/2a
	Drawn: S.Ditton	Title:	Horizontal Strain Cracking Hazard Zones Due to Topographic Effects during Subsidence development with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanB=1.5)
	Date: 14.08.20	Scale:	1:2,500 (A4) — Figure No: 4



Key

- Site Boundary
- Interpreted Panel Creep Boundaries
- Buildings damaged by Creeps 2-3
- AAC Mine Workings Pillars in Borehole Seam
- Grout
- Cover Depth Contours (m)

DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Lot Boundaries and Proposed Grout in the Borehole Seam: Preferred Option 2
Scale:	1:2,500 (A4)
Figure No:	5

Appendix C – SANSW Conditions Met Letter

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Subsidence Advisory

117 Bull Street, Newcastle West, NSW, 2302
T: (02) 4908 4300 | **24 Hour Emergency Service:** 1800 248 083 (Free Call)

Newcastle City Council
ATTN: William Toose & Leah Lindsay
Via Email: mail@ncc.nsw.gov.au

Our ref: TBA19-04135 & TSUB19-00543

Dear William & Leah

DA 2019/00061 - 11-17 MOSBRI CRESCENT THE HILL; LOT 1 DP 204077

I am writing regarding the proposed development at 11-17 Mosbri Crescent, The Hill, ref. FN93-00355N0.

Following a recent meeting with the applicant, Subsidence Advisory NSW has issued General Terms of Approval (GTA) for the development of land as detailed above. Please note conditions are detailed under Schedule 2. The stamped approved plans are attached.

The conditions of approval require the mine subsidence risk to be effectively eliminated prior to the commencement of construction. This will require, but not necessarily be limited to, the emplacement of grout into the mine voids.

Please note a construction certificate will not be issued for the proposed development until the relevant conditions have been met and SA NSW receives certification confirming that any works required by SA NSW have occurred in accordance with the attached conditions of approval.

Once relevant documentation to meet the conditions in Schedule 2 is available, please submit via email to SA-Risk@customerservice.nsw.gov.au quoting reference **TBA19-04135 & TSUB19-00543**.

This satisfies the approval of Subsidence Advisory NSW under *section 22 of the Coal Mine Subsidence Compensation Act 2017*.

Please contact me on (02) 4908 4300 or at SA-Risk@customerservice.nsw.gov.au if you have any questions or wish to discuss.

Yours faithfully,

Kieran Black
Technical Manager
16 October 2019

GENERAL TERMS OF APPROVAL

Issued in accordance with Section 4.46 of the *Environmental Planning & Assessment Act* 1979 for the subdivision / development of land.

As delegate for Subsidence Advisory NSW under delegation executed 3 October 2019, general terms of approval are granted for the development described in Schedule 1, subject to the conditions attached in Schedule 2.

SCHEDULE 1

Ref**:**	**TBA19-04135 & TSUB19-00543**
DA:	**2019/00061**
Site Address:	**11-17 MOSBRI CRESCENT THE HILL**
Lot and DP:	**LOT 1 DP 204077**
Proposal:	**152 X 2-3 BEDROOM APARTMENTS AND 20 X 3 BEDROOM TERRACE HOUSES ACROSS 4 BUILDINGS UP TO 9 STOREYS AND STRATA SUBDIVISION**
Mine Subsidence District:	**NEWCASTLE**

SCHEDULE 2

GENERAL TERMS OF APPROVAL

GENERAL	
Plans, Standards and Guidelines	
1.	These General Terms of Approval (GTAs) only apply to the development described in the plans and associated documentation relating to **DA2019/00061** and provided to Subsidence Advisory NSW. Any amendments or subsequent modifications to the development may render these GTAs invalid. If the proposed development is amended or the development consent modified, Subsidence Advisory NSW must be notified to determine if any variations to these GTAs are required.
2.	This approval expires 5 years after the date the approval was granted if construction work has not physically commenced.
3.	Subsidence Advisory NSW is to be notified of any changes to lot numbering and the registered DP number.
PRIOR TO COMMENCEMENT OF CONSTRUCTION	
4.	SA NSW requires any potential mine subsidence risk to be effectively eliminated. Submit a proposal for SA NSW acceptance limit the risk of subsidence such that any improvements will be safe, serviceable and any damage from mine subsidence limited to very slight (in accordance with AS2870 -Damage Classification). This assessment shall consider the potential for non-conventional subsidence given the sites topography. The proposal shall include, but not necessarily be limited to, grouting of the mine voids. "Bulk" grouting of mine voids and any other measure that SA NSW deems necessary may be required to satisfy this condition.
5a.	**Prescribed Design Parameters** By geotechnical investigation and analysis, recommend mine subsidence parameters where it can be demonstrated to the satisfaction of SA NSW that the proposed structure(s) can be designed to be "*safe, serviceable and any damage from mine subsidence shall be limited to 'very slight' damage in accordance with AS2870 (Damage Classification), and readily repairable*". Any ancillary structures or services identified in the subdivision plan shall be designed with flexible joints and remain safe, serviceable and repairable using mine subsidence design parameters acceptable to Subsidence Advisory NSW. Subdivision roadworks identified in the identified in the subdivision plan shall be designed as a flexible pavement with a bitumen or asphalt treated surface over one or more unbound base courses in accordance with the relevant Australian Standards and Codes of Practice. If a concrete surface course is required, it shall be designed to include expansion and crack control joints or sacrificial sections to minimise the risk of damage from mining

	subsidence.
5b.	Submit an Engineering Impact Statement prior to commencement of detailed design for acceptance by SA NSW, which shall identify the: a. Mine subsidence parameters used for the design. b. Main building elements and materials. c. Risk of damage due to mine subsidence d. Design measures proposed to control the risks. e. Comment on the: • likely building damage in the event of mine subsidence. • sensitivity of the design to greater levels of mine subsidence.
6a.	SA NSW requires any subsidence risk due to a potential collapse in the Yard seam workings to be effectively eliminated. Submit a proposal acceptable to SA NSW to remove the risk of subsidence that could cause damage that would exceed the threshold of safety, serviceability and very slight damage (in accordance with AS2870 -Damage Classification). The proposal shall include, but not necessarily be limited to grouting of the mine voids. Any other measures that SA NSW deem necessary may also be included in the proposal.
6b.	SA NSW requires that the risk of subsidence in the Borehole seam be limited to the extent that the proposed development will remain safe, serviceable and any damage will be limited to "very slight" (in accordance with AS2870 -Damage Classification). Submit a proposal acceptable to SA NSW that satisfies this requirement. The proposal shall include, but not necessarily be limited to grouting of the mine voids and structural engineered design. Any other measures that SA NSW deem necessary may also be included in the proposal.
7.	Submit a final design incorporating the design methodology contained in the Engineering Impact Statement, for acceptance by Subsidence Advisory NSW prior to commencement of construction. It shall include certification by a qualified structural engineer including a statement to the effect that the improvements will remain "*safe, serviceable and any damage from mine subsidence shall be limited to 'very slight' damage in accordance with AS2870 (Damage Classification), and readily repairable*" taking into consideration the mine subsidence parameters accepted by SA NSW.

Dispute Resolution

If you are dissatisfied with the determination of this application an appeal may be formally submitted with the Chief Executive Officer for an independent internal review. The application must be made in writing and must provide reasons why the determination should be changed.

Appendix D – Summary Table of Reports

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Mines Reports Chronology	Report	Date
1. Coffey DA Reports	Geotechnical	
	754-NTLGE220504-AG.Rev3	14-Jan-19
	Mine Subsidence Investigation Report	
	754-NTLGE220504-AH.Rev4	9-Nov-21
	Mine Subsidence Assessment Report	
	754-NTLGE220504-AI	18-Jan-19
2. DGS initial Peer Review	COF-009/1	14-Mar-19
3. CG Mine Subsidence Assessment Report Rev	754-NTLGE220504-AI.Rev1	12-Mar-19
4. GAPL Expert Review for SA NSW	2019-1b	1-Aug-19
5. CG Letter Response to GAPL	54-NTLGE220504-AK.Rev1	20-Sep-19
6. DGS Response to GAPL	COF-009/2 - Addendum to peer review	18-Sep-19
	COF-009/3 - Letter responding to GAPL	19-Sep-19
7. SA NSW Minutes & GTAs	7. SA NSW Minutes & GTAs	Oct-19
8. DGS Revisions post GAPL Meeting	COF-009/3 - update to letter to GAPl	25-Oct-19
	COF-002/2- update Addendum to peer review	22-Nov-19
	COF-009/3 (Rev 1) -update to letter to GAPl	31-Dec-19
	COF-002/2- update Addendum to peer review	31-Dec-19
9. Northrop Mines Impact Statement	NL180367	13-Jan-20
10. CG - review of DgS Reports after meeting with GAPL	754-NTLGE220504-AM.Rev1	13-Feb-20
11. GAPL final Report	Report No. 2020-2a	Mar-20
12. Mine subsidence Engineering Consultants Peer Review for SA NSW of all above	MSCE Peer Review for SA NSW of all above	7-Apr-20
13. SA NSW conditions met letter	SA NSW Letter	7-May-20
14. DGS Report amended grout layout	COF-009-2a	22-Aug-20
15. Northrop amended impact statement	NL180367E01 Revision C	23-Aug-20

Appendix E – Updated DA Plans

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Appendix B – DgS Report COF-009/2a

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Ditton Geotechnical Services Pty Ltd
80 Roslyn Avenue Charlestown NSW 2290
PO Box 5100 Kahibah NSW 2290

22 August 2020

Attention: Mr Mark Purdy
Assistant Development Manager
Crescent Newcastle Pty Ltd
Po Box 292 Wickham NSW 2293

DgS Report No. COF-009/2a

Dear Mark,

Subject: Further Addendum to Worst-Case Mine Subsidence and Grouting Plan Assessment for the Proposed Multi-Storey Building Re-Development at 11 - 17 Mosbri Crescent, The Hill

1.0 Introduction

This letter provides the numerical modelling results for the proposed amendment to the approved grouting strategy presented in DgS Report No. COF-009/2 (5/12/19).

The proposed revision of the grouting strategy, as approved by SA NSW, was requested by Crescent Newcastle Pty Ltd. The purpose of the review was to assess the impact of the modified DA plans and where possible, negate the need for directional drilling and grouting under adjoining private properties without compromising the compliance with SA NSW Merit-based criteria.

This alternate strategy will allow some relaxation of the previous design recommendation to extend grout beyond the site boundaries by 20 m or 0.15 x cover depth (whichever is greater) (**DgS, 2019a**). The purpose of this recommendation was intended to provide an adequate buffer between the limits of future mine workings instability and subsequent surface cracking that may develop in the vicinity of the proposed structures. Additional grout has also been added to provide full pillar length confinement where the lot boundary restrictions or mine pillar geometry have reduced or limited confinement at key locations below the site boundaries and high rise towers.

In summary, the amended grouting strategy has resulted in minor increases to the subsidence effect predictions with no change to the predicted 'negligible' impacts to the structures.

It is understood that Northrop Consulting Engineers Pty Ltd, as the structural engineer for the project, will provide a separate review of the revised subsidence contour parameters and the potential 'cracking hazard' zones presented in this document as part of the modified DA package.

ABN 43 113 858 910 ACN 124 206 962
Ph: 02 4920 9798 Mob: 0413 094074
Email: steve.dgs@westnet.com.au

2.0 Method

The assessment has applied the methodology described in **DgS, 2019a** for the original preferred grouting strategy using 5 MPa UCS grout. The approved grouting strategy was modified by removing all grout previously shown below adjacent private properties and extending it elsewhere to obtain a similar outcome to the approved strategy.

The limits of grouting is governed by the SA NSW Merit Based Guidelines criteria for limiting subsidence effects for multi-story development over old mine workings.

The modelling included the following steps:

(i) Modify grouting and check subsidence effects meet design criteria for structures with the SDPS 3-D Influence Function Model

(ii) Check pillar stability for revised grouting arrangement with Lamodel (boundary element numerical model).

(iii) Up-date cracking hazard zones for the site.

3.0 SDPS Modelling Results

The credible worst-case subsidence effect contours for the proposed (preferred) Option 2 grouting strategy have been assessed using SDPS (3D-Influence Function model).

The following SDPS model input parameters were again used to estimate the CWC Subsidence effects due to full pillar crush events in the Borehole Seam workings below the Mosbri Crescent site:

- Maximum supercritical subsidence/effective mining height ratio, $S_{max}/he = 0.4$
- Maximum subsidence of 0.6 m or 16% of 3.75 m without grout.
- Supercritical inflexion point distance from mining limits/cover depth ratio, d/H = 0.32 (d = 32 m)[1]
- Tangent of the Influence Angle, tan(β) = 1.5 to 1.8 (likely range)
- Horizontal Displacement (mm) = 25 x Tilt (mm/m)
- Horizontal Strain (mm/m) = 20 x Curvature (1/km)

[1] The inflexion point represents the distance to maximum tilt from the limits affected by pillar instability or mine subsidence in general. The d/H value is taken as the average for a solid barrier of 0.384 (21° abutment angle) and a relatively soft boundary at the surface due to deep sands of 0.25. Note: The design d/H was incorrectly given as 0.25H in **DgS, 2019**, although a d/H of 0.32 was used.

The subsidence effect contours are shown in **Figures 1a** to **1e** for a tanB = 1.5 with **Figures 2a** to **2e** based on a tanB = 1.8. It is predicted that the subsidence effects will range somewhere between the two cases, with tanB = 1.5 giving the worst-case values for the site.

The maximum subsidence effect parameters for the site with the amended grouting design is presented in **Table 1**.

Table 1 - Predicted Subsidence Effects for the Site Structures and Proposed Modified Grout Design

Parameter	**Approved Design**		**Proposed Modified Design**		**SSR Limits (Structures)**
	Townhouses	High-Rise Buildings	Townhouses	High-Rise Buildings	
Subsidence (m)	< 0.02	< 0.02	**< 0.03**	< 0.02	N/A
Tilt (mm/m)	< 2	< 2	**< 3**	< 2	<3
Curvature (1/km)	< 0.15	< 0.15	< 0.15	< 0.15	<0.15
Horizontal Strain (mm/m)	< 3	< 3	< 3	< 3	<3
Horizontal Displacement (mm)	<30	<30	**< 65**	**< 50**	N/A

bold - value greater than indicated for approved grouting strategy.

The results indicate that the Proposed Modification will still be within the Safe, Serviceable and Practically Repairable (SSR) limits assumed for the proposed structures. The increase in horizontal displacement is due to a minor increase in tilt, which is now estimated to be up to 2 mm/m at the high rise buildings (previously 1.2 mm/m) and up to 2.6 mm/m at the townhouses (previously 1.2 mm/m).

The amended grouting strategy has resulted in minor increases to the subsidence effect predictions with no change to the predicted 'negligible' impacts to the structures.

4.0 Lamodel Results

The Lamodel results for the proposed grouting strategy modification are presented in **Figures 3a** and **3b**.

A summary of the assumed input parameters and applied abutment stresses for the proposed Grouting Modification is summarised in **Table 2**.

Table 2 - Pillar Stability v. Seam Convergence Summary for Approved & Proposed Modified Grouting Options (2 - 3)

Option	Description	Average Pillar Strength @ Seam Convergence Magnitude^ (MPa)	Applied Abutment Stress Range (maximum core stress) (MPa)	Residual Pillar FoS @ 100 mm of seam convergence^	Maximum Seam Convergence Range Below Site (subsidence) (mm)	Comment
2	Approved	8.32 - 8.01 (20mm) 16.76 - 14.55 (100mm)	6.18 - 7.4) (7.72 - 10.0)	2.71 - 1.97	<100 (<50 mm)	Grouting pattern encroaches beneath Private Properties
3	Proposed Modification (this Study)	8.32 - 8.01 (20mm) 16.76 - 14.55 (100mm)	6.24 - 7.7) (7.8 - 10.7)	2.82 - 1.95	<100 (<50 mm)	No Private Property Encroachment

^ - Range for Pillars P1 to P6 shown in **Figure 3b**.

The results indicate that the difference between the approved and proposed modification to the grouting strategy is marginal with no significant increase in the risk of SSR criteria being exceeded after a pillar run.

5.0 Crack Hazard Zoning

The revised tensile cracking and compressive strain hazard zoning for the site is shown in **Figure 4**.

The figure shows revised grouting modification is likely to have reduced the exposure of the townhouses to subsidence cracking (i.e. < 3 mm/m strain). It is recommended however, that the previous design criteria for crack development protection for the structures on the property should remain unchanged.

It is recommended that the structural engineer to review the revised subsidence contour parameters and the potential 'cracking hazard' zones presented in this document.

There are no changes to the non-conventional subsidence parameters recommended in **DgS, 2019b** for valley closure effects.

The proposed grouting strategy is shown relative the adjacent lot boundaries in **Figure 5**.

For and on behalf of
Ditton Geotechnical Services Pty Ltd



Steven Ditton

Principal Engineer and Director
BE(Civil/Hons), C.P.Eng(Civil), M.I.E.(Aust) MAusI.M.M.
N.P.E.R. 342140

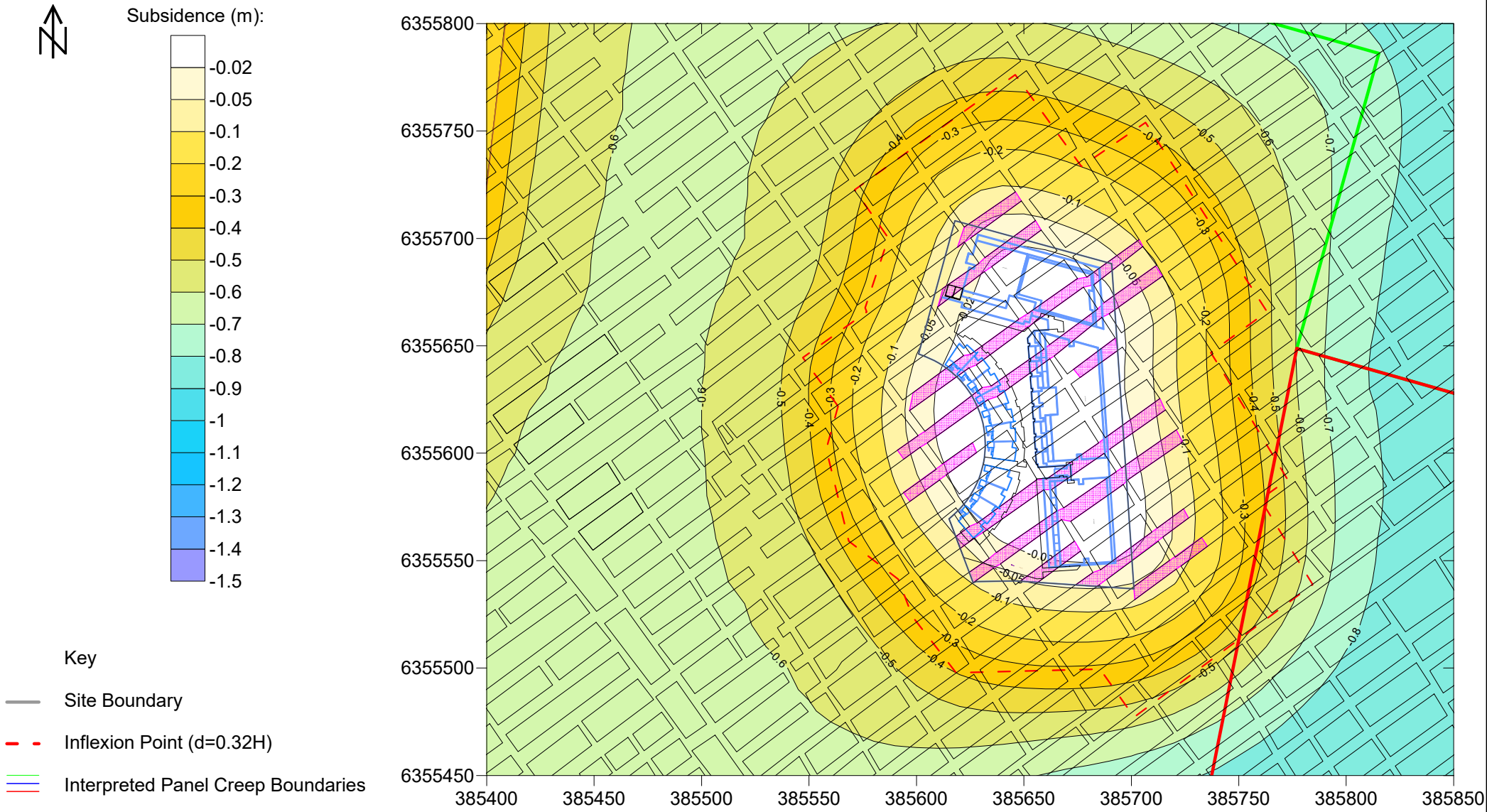
Attachments:

Figures 1 to 5

References:

DgS (2019a). **Addendum to the Independent Review of the Worst-Case Mine Subsidence and Grouting Plan Assessment for the Proposed Multi-Storey Building Re-Development at 11 - 17 Mosbri Close, The Hill** DgS Report No. COF-009/2 (5 December).

DgS (2019b). **Updated Response to Galvin and Associates Letter to SA NSW (29/08/19) regarding the Worst-Case Mine Subsidence and Grouting Plan Assessment for 11 - 17 Mosbri Crescent, The Hill**. DgS Report No. COF-009/3 (October).

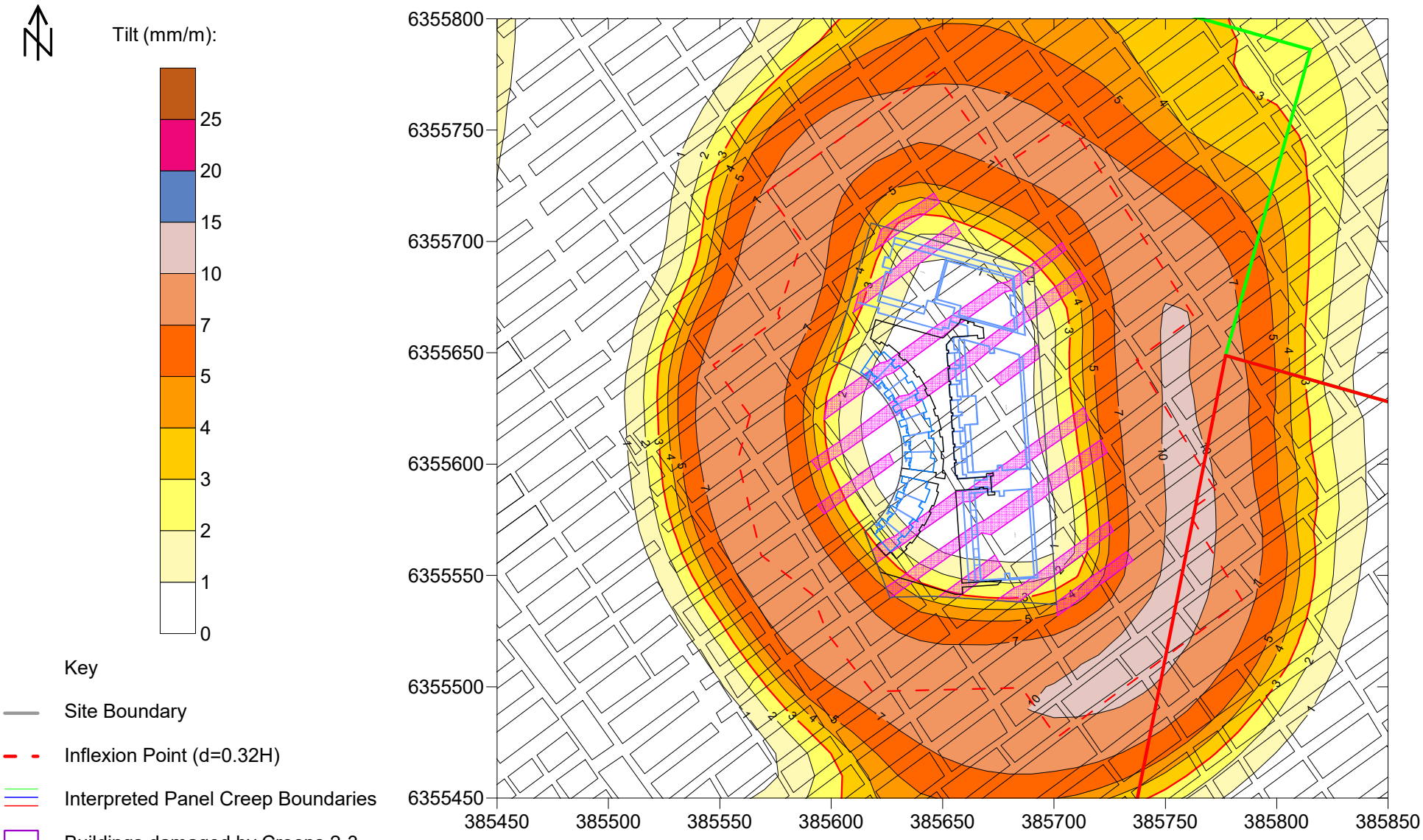


DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Predicted Final Subsidence Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.5)
Scale:	1:2,500 (A4)
Figure No:	1a

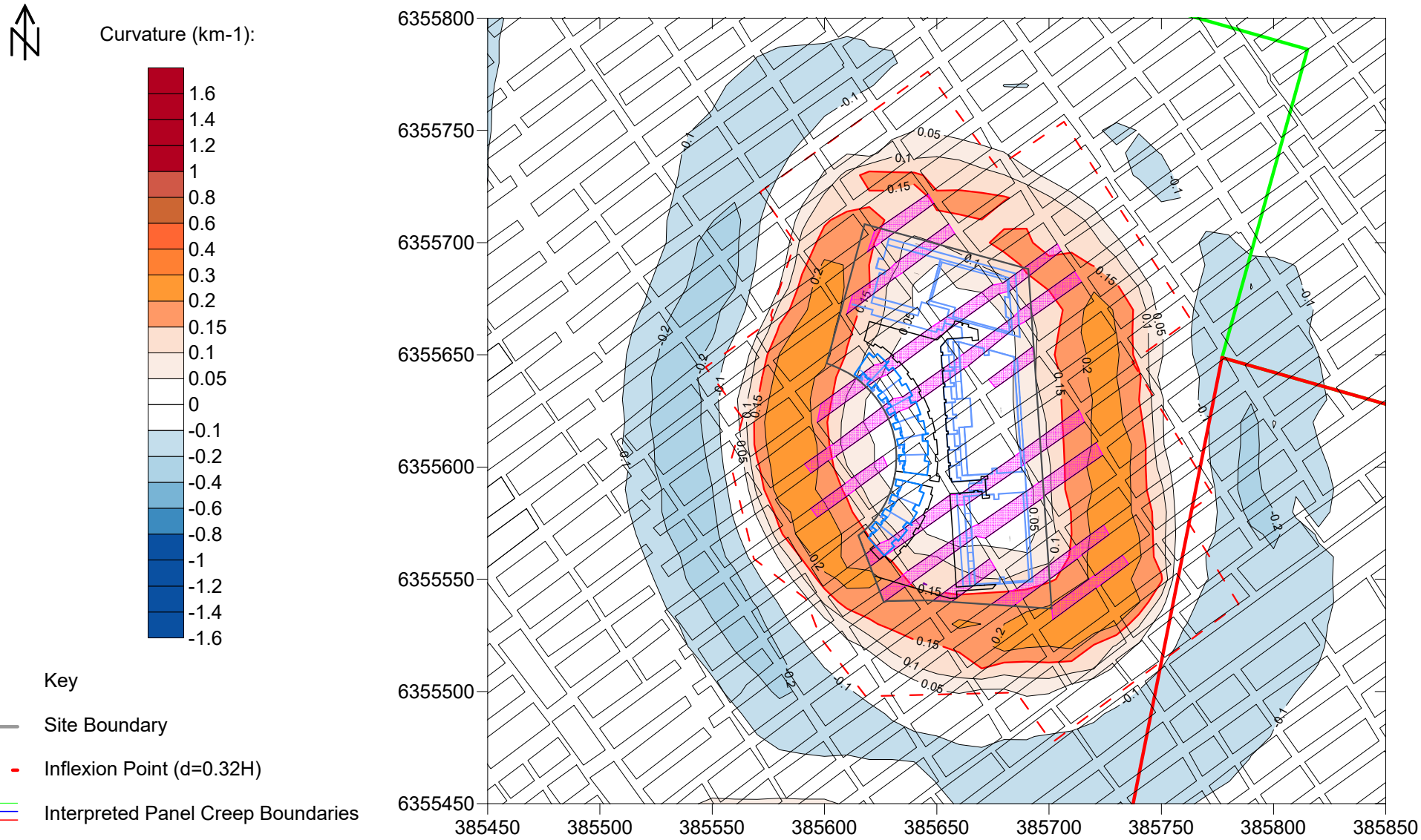


DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Predicted Final Tilt Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.5)
Scale:	1:2,500 (A4)
Figure No:	1b



Key

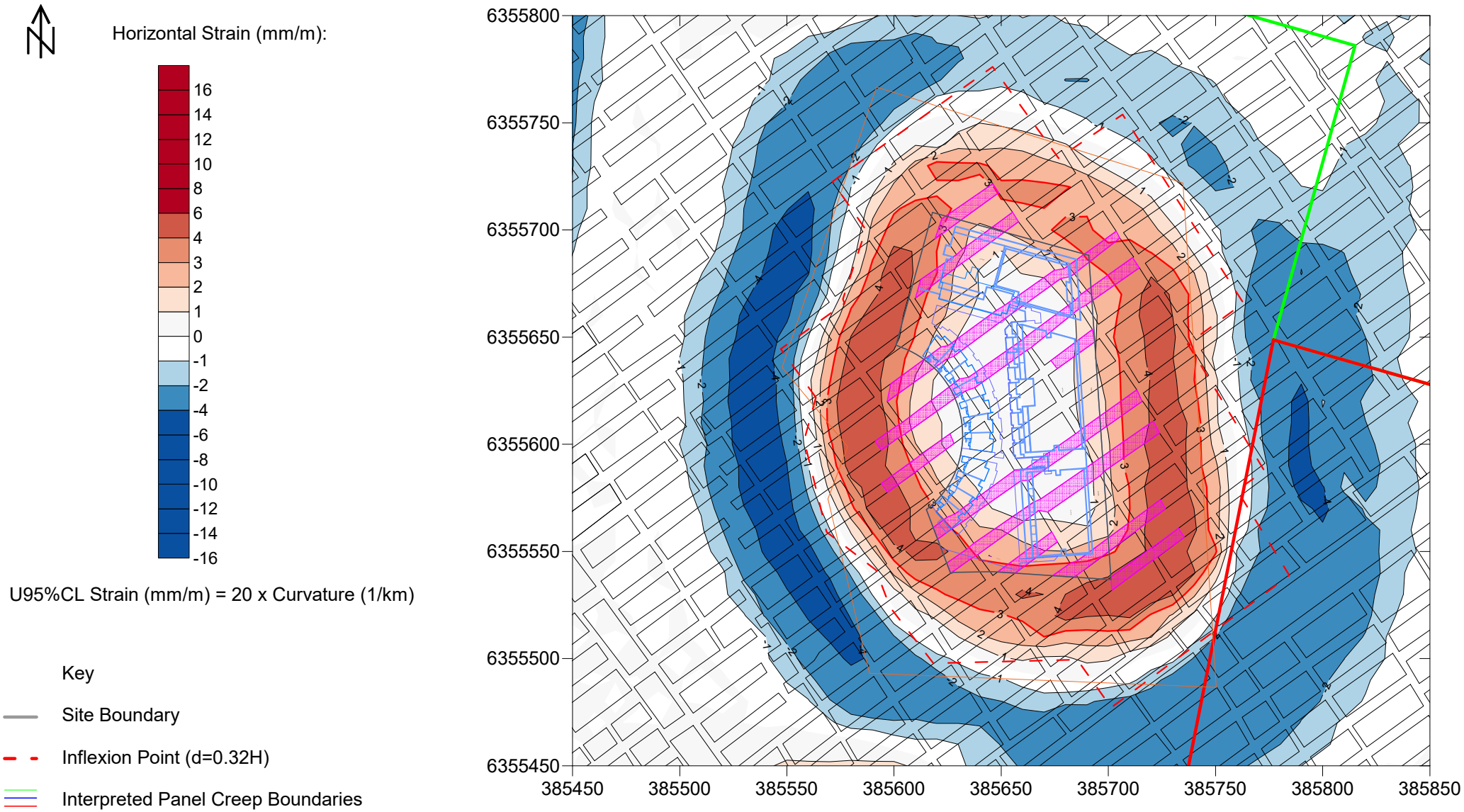
- Site Boundary
- Inflexion Point (d=0.32H)
- Interpreted Panel Creep Boundaries
- Buildings damaged by Creeps 2-3
- AAC Mine Workings Pillars in Borehole Seam
- Grout

DgS

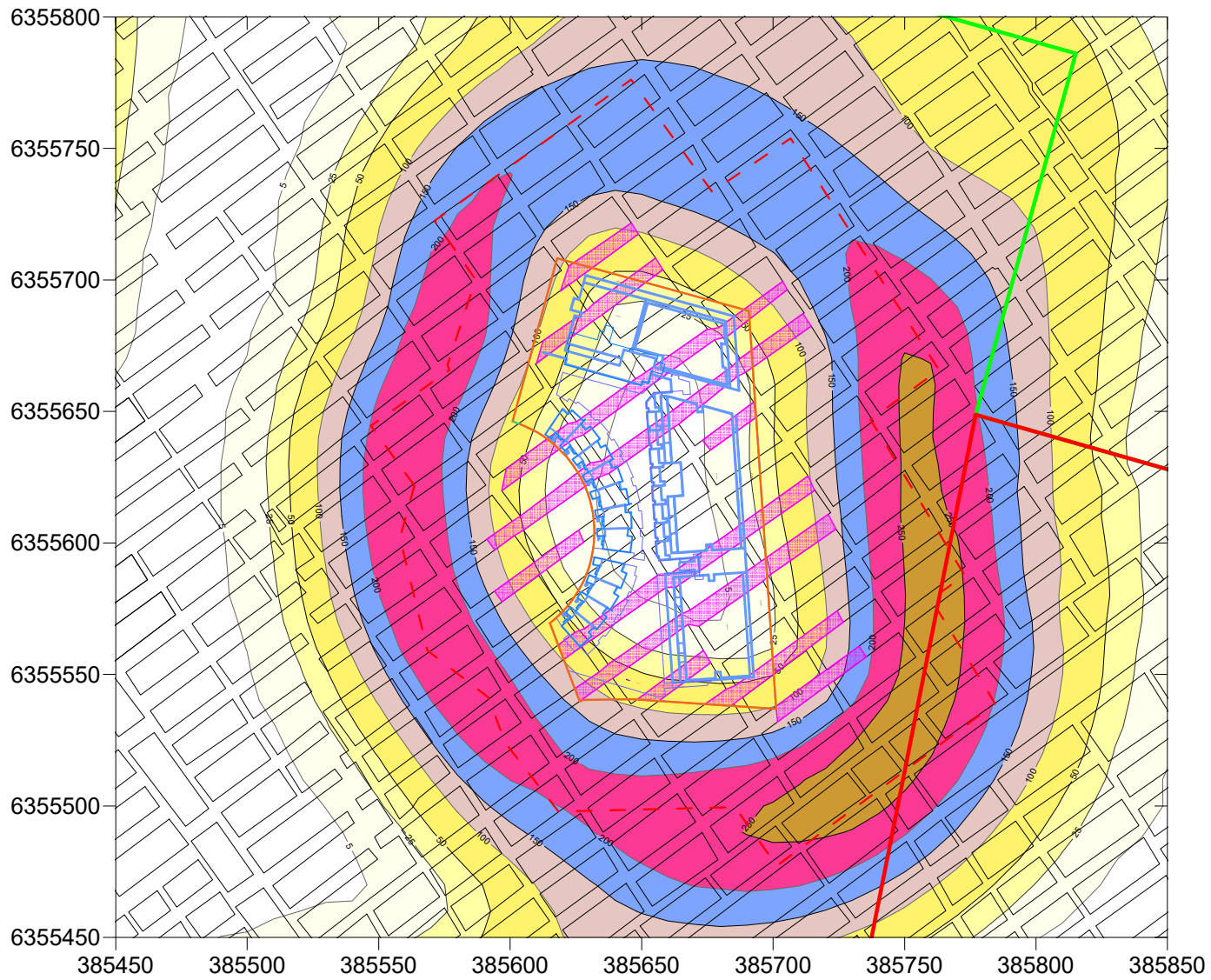
Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

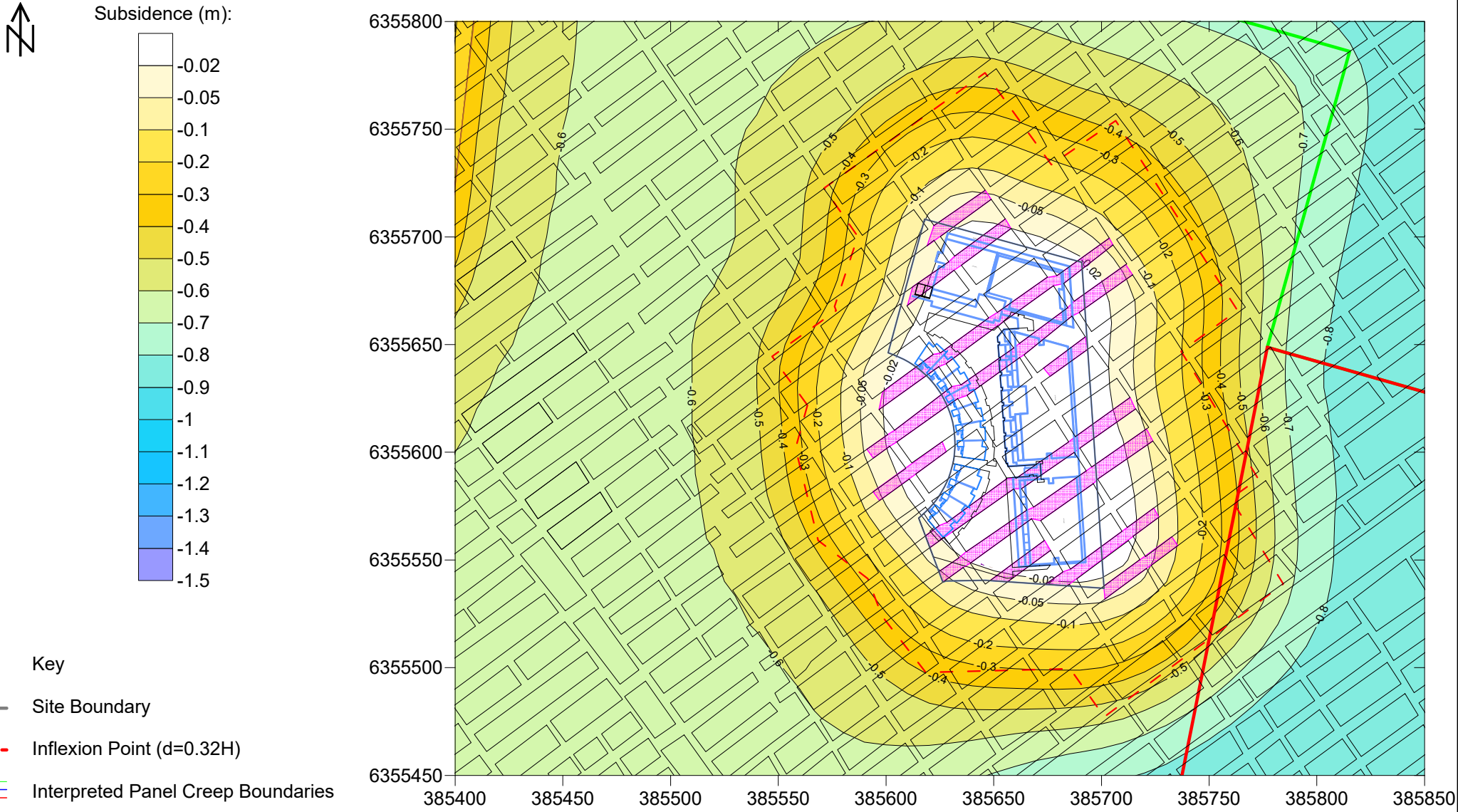
Client:	Coffey COF-009/2a
Title:	Predicted Final Curvature Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam:Preferred Option 2 (tanb=1.5)
Scale:	1:2,500 (A4)
Figure No:	1c



DgS Ditton Geotechnical Services Pty Ltd	Engineer: S.Ditton	Client:	Coffey COF-009/2a
	Drawn: S.Ditton	Title:	Predicted Final Horizontal Strain Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.5)
	Date: 14.08.20	Scale:	1:10,000 (A4) — Figure No: 1d



DgS Ditton Geotechnical Services Pty Ltd	Engineer: S.Ditton	Client:	Coffey COF-009/2a
	Drawn: S.Ditton	Title:	Predicted Final Horizontal Displacement Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option (tanb=1.5)
	Date: 20.02.19	Scale:	1:10,000 (A4) — Figure No: 1e

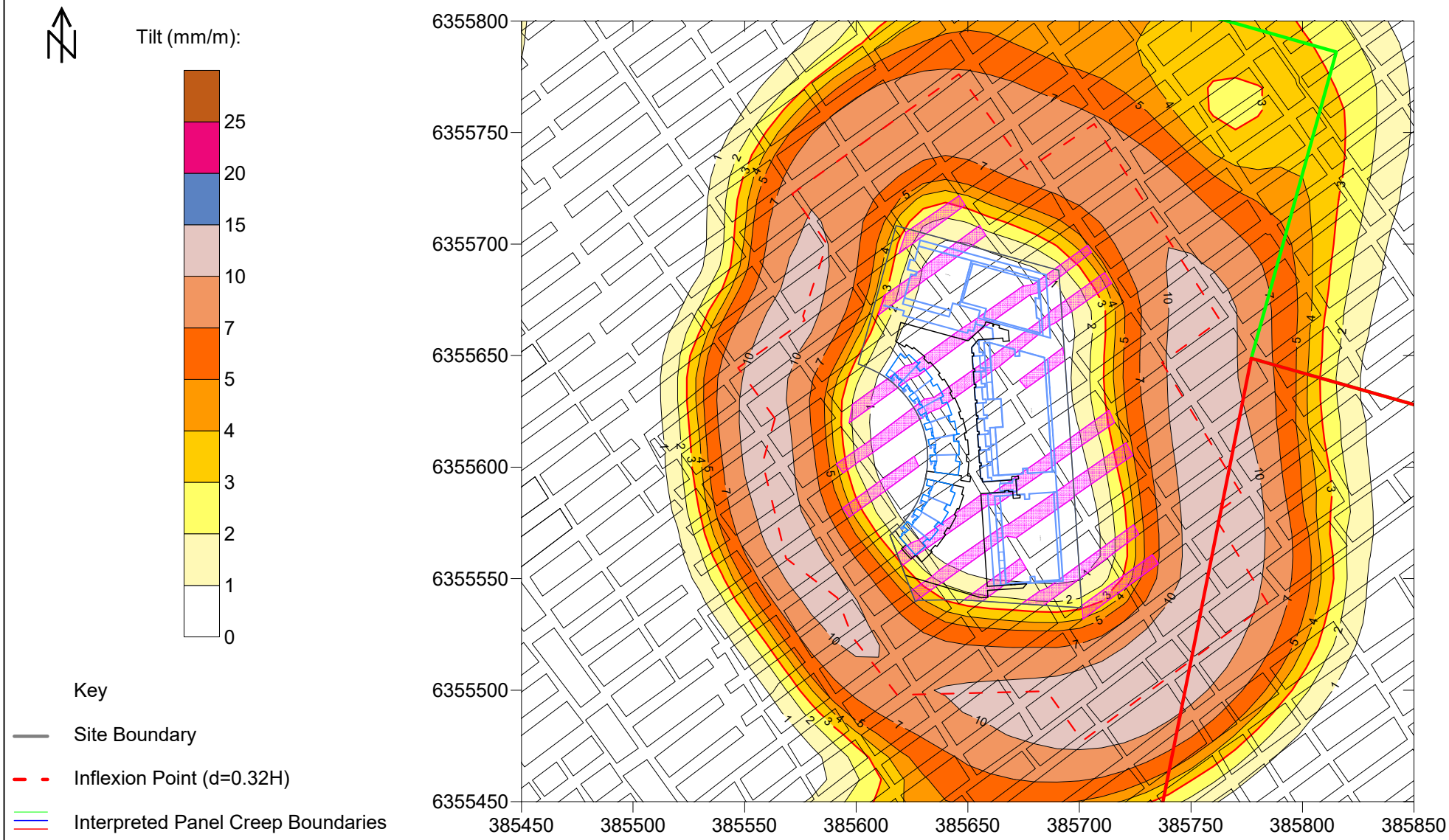


DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Predicted Final Subsidence Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2: (tan(B) = 1.8)
Scale:	1:2,500 (A4)
Figure No:	2a

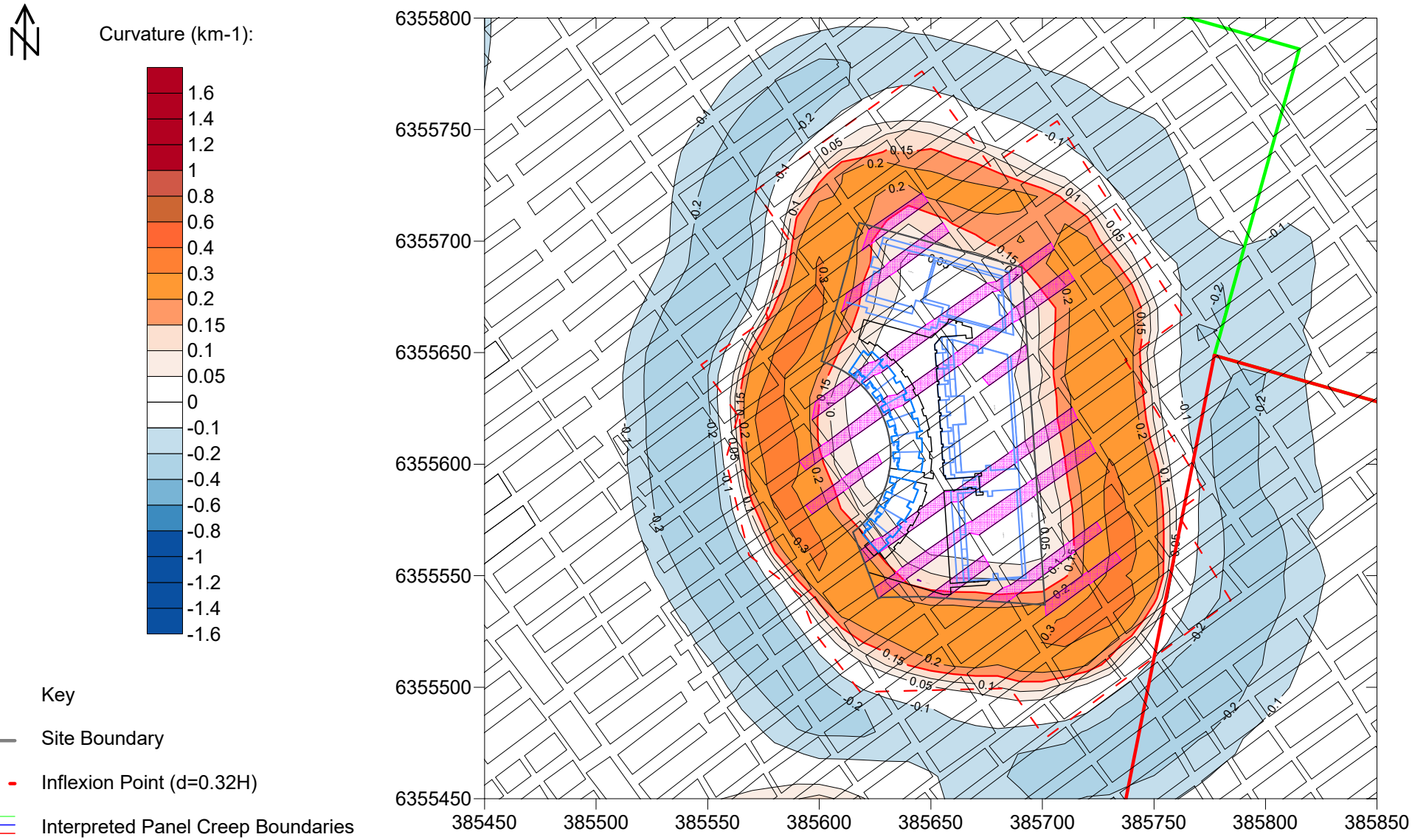


DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Predicted Final Tilt Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanB = 1.8)
Scale:	1:2,500 (A4)
Figure No:	2b



Key

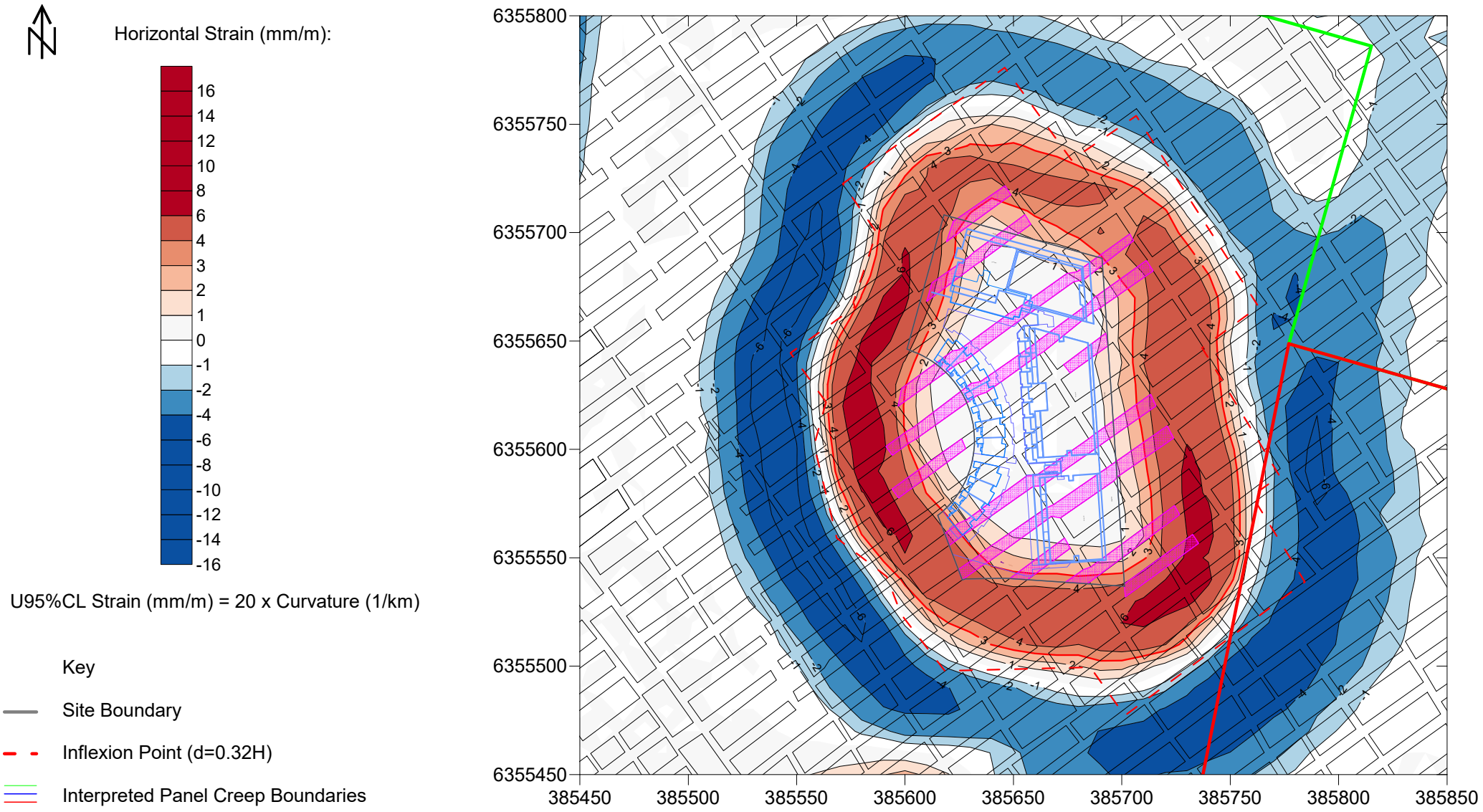
- Site Boundary
- Inflexion Point (d=0.32H)
- Interpreted Panel Creep Boundaries
- Buildings damaged by Creeps 2-3
- AAC Mine Workings Pillars in Borehole Seam
- Grout

DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a		
Title:	Predicted Final Curvature Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam:Preferred Option 2 (tanb=1.8)		
Scale:	1:2,500 (A4)	Figure No:	2c



DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Predicted Final Horizontal Strain Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.8)
Scale:	1:10,000 (A4)
Figure No:	2d

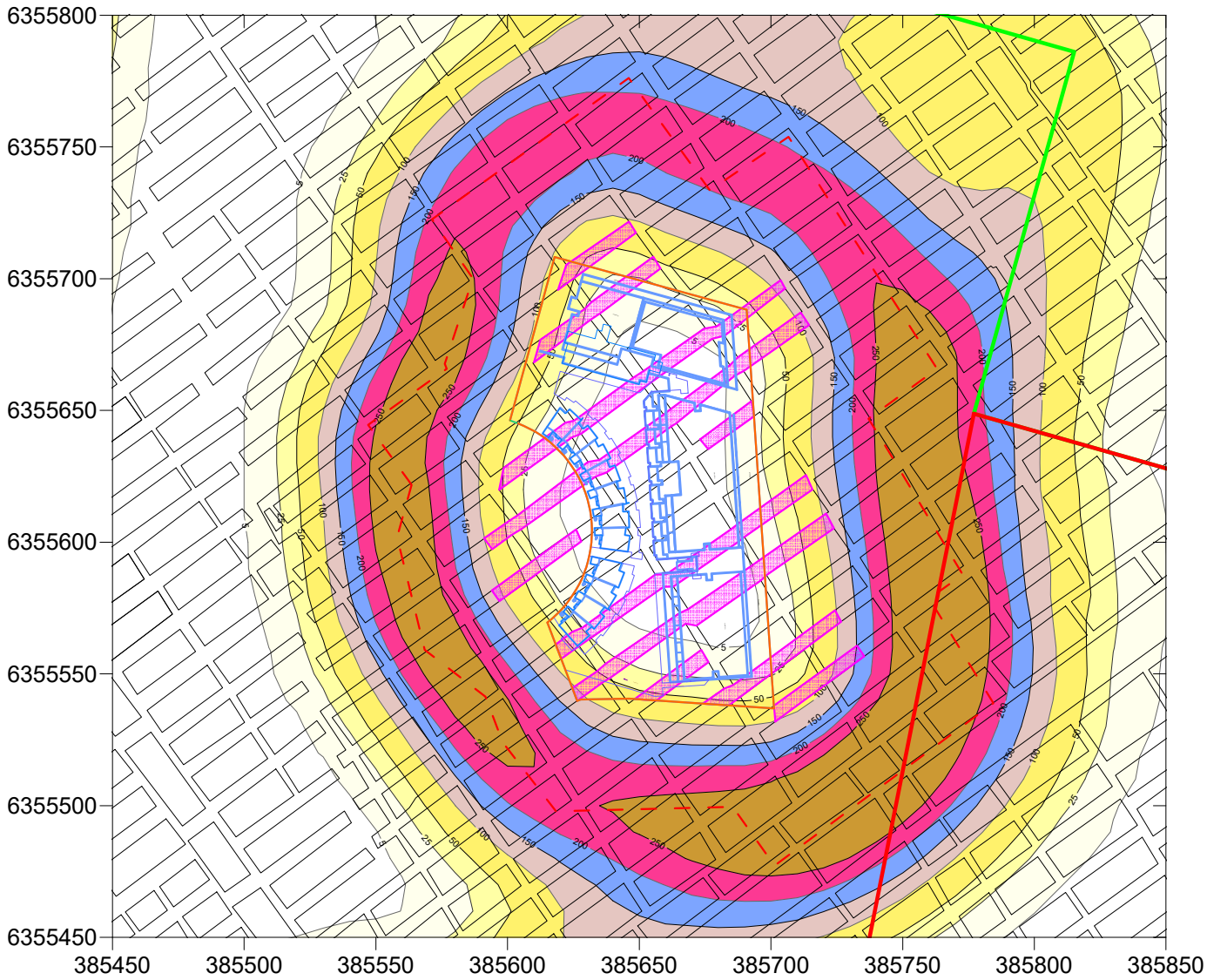
Horizontal Displacement (mm):

250
200
150
100
50
25
5

U95%CL Displacement (mm) = 25 x Tilt (mm/m)

Key

- Site Boundary
- Inflexion Point (d=0.32H)
- Interpreted Panel Creep Boundaries
- Buildings damaged by Creeps 2-3
- AAC Mine Workings Pillars in Borehole Seam
- Grout

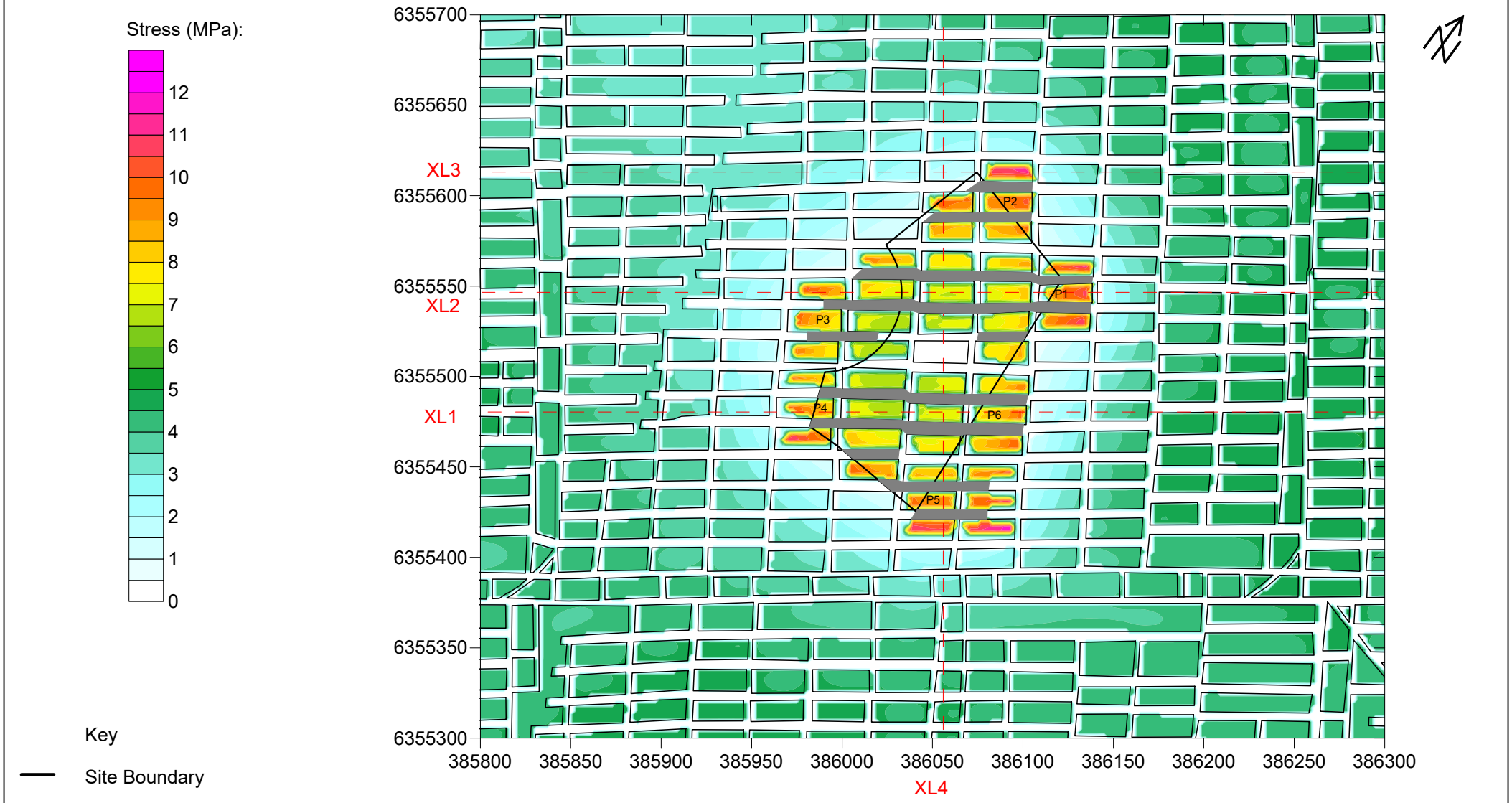


DgS

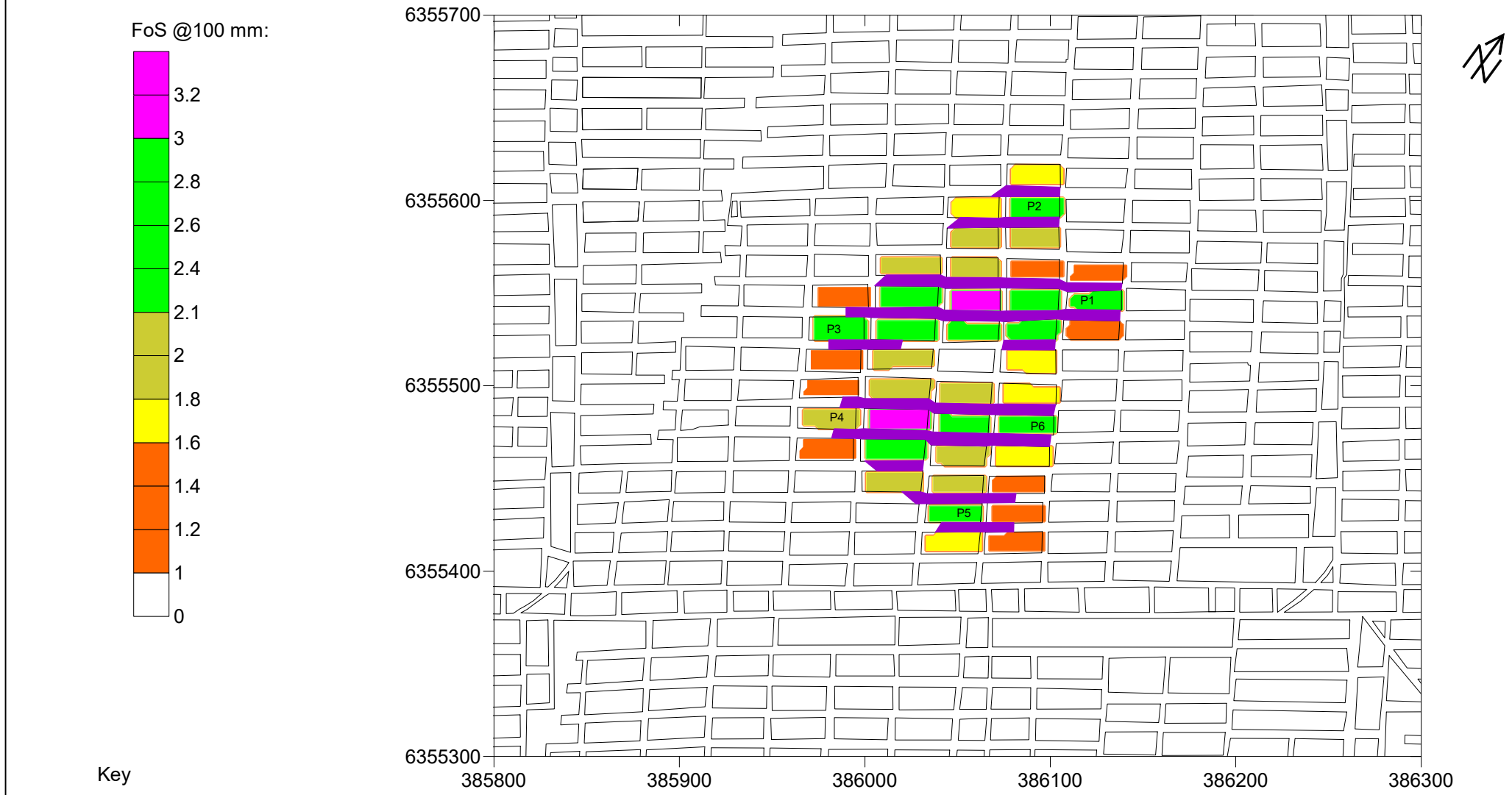
Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

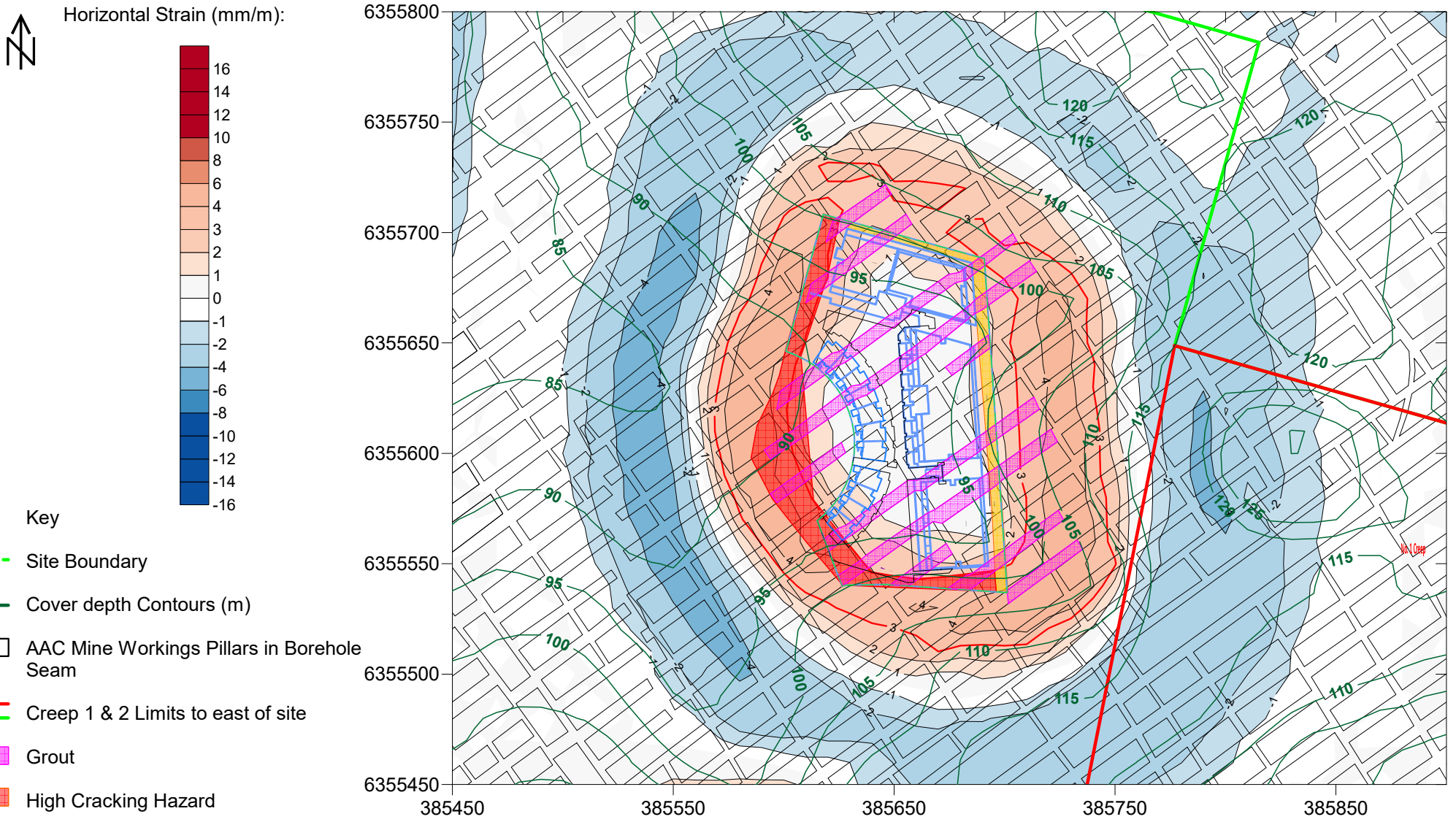
Client:	Coffey COF-009/2a
Title:	Predicted Final Horizontal Displacement Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.8)
Scale:	1:10,000 (A4)
Figure No:	2e



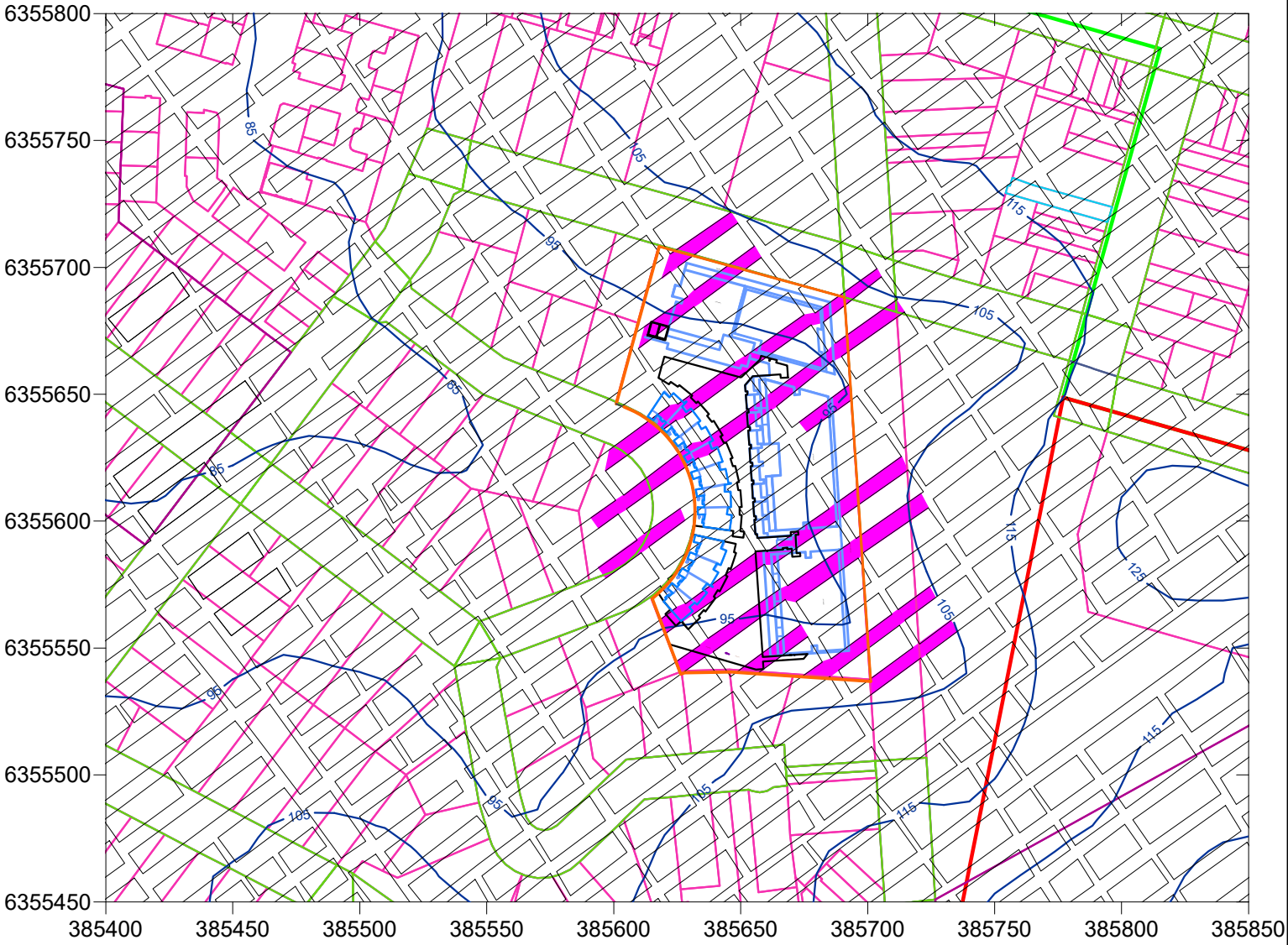
DgS	Engineer: S.Ditton	Client:	Stronach Property COF-009/2a
	Drawn: S.Ditton		
	Date: 25.10.19	Title:	Pillar Stress for Proposed Strategic Grouting with 5 MPa UCS in the BH Seam to satisfy Internal and External Pillar Instability Control for the Mosbri Crescent Site: Preferred Grouting Solution 2
Ditton Geotechnical Services Pty Ltd		Scale:	1:10,000 (A4) Figure No: 3a



DgS Ditton Geotechnical Services Pty Ltd	Engineer:	S.Ditton	
	Drawn:	S.Ditton	
	Date:	14.08.20	
	Client:	Stronach Property COF-009/2a	
	Title:	Pillar FoS for Proposed Strategic Grout in the BH Seam (with 5 MPa UCS) to satisfy Internal and External Pillar Instability Control for the Mosbri Crescent Site: Preferred Grouting Solution 2	
	Scale:	1:10,000 (A4)	Figure No: 3b



DgS Ditton Geotechnical Services Pty Ltd	Engineer: S.Ditton	Client:	Coffey COF-009/2a
	Drawn: S.Ditton	Title:	Horizontal Strain Cracking Hazard Zones Due to Topographic Effects during Subsidence development with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanB=1.5)
	Date: 14.08.20	Scale:	1:2,500 (A4) — Figure No: 4



Key

- Site Boundary
- Interpreted Panel Creep Boundaries
- Buildings damaged by Creeps 2-3
- AAC Mine Workings Pillars in Borehole Seam
- Grout
- Cover Depth Contours (m)

DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Lot Boundaries and Proposed Grout in the Borehole Seam: Preferred Option 2
Scale:	1:2,500 (A4)
Figure No:	5

Appendix C – SANSW Conditions Met Letter

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Appendix D – Summary Table of Reports

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Mines Reports Chronology	Report	Date
1. Coffey DA Reports	Geotechnical	
	754-NTLGE220504-AG.Rev3	14-Jan-19
	Mine Subsidence Investigation Report	
	754-NTLGE220504-AH.Rev3	14-Jan-19
	Mine Subsidence Assessment Report	
	754-NTLGE220504-AI	18-Jan-19
2. DGS initial Peer Review	COF-009/1	14-Mar-19
3. CG Mine Subsidence Assessment Report Rev	754-NTLGE220504-AI.Rev1	12-Mar-19
4. GAPL Expert Review for SA NSW	2019-1b	1-Aug-19
5. CG Letter Response to GAPL	54-NTLGE220504-AK.Rev1	20-Sep-19
6. DGS Response to GAPL	COF-009/2 - Addendum to peer review	18-Sep-19
	COF-009/3 - Letter responding to GAPL	19-Sep-19
7. SA NSW Minutes & GTAs	7. SA NSW Minutes & GTAs	Oct-19
8. DGS Revisions post GAPL Meeting	COF-009/3 - update to letter to GAPl	25-Oct-19
	COF-002/2- update Addendum to peer review	22-Nov-19
	COF-009/3 (Rev 1) -update to letter to GAPl	31-Dec-19
	COF-002/2- update Addendum to peer review	31-Dec-19
9. Northrop Mines Impact Statement	NL180367	13-Jan-20
10. CG - review of DgS Reports after meeting with GAPL	754-NTLGE220504-AM.Rev1	13-Feb-20
11. GAPL final Report	Report No. 2020-2a	Mar-20
12. Mine subsidence Engineering Consultants Peer Review for SA NSW of all above	MSCE Peer Review for SA NSW of all above	7-Apr-20
13. SA NSW conditions met letter	SA NSW Letter	7-May-20
14. DGS Report amended grout layout	COF-009-2a	22-Aug-20
15. Northrop amended impact statement	NL180367E01 Revision C	23-Aug-20

Appendix E – Updated DA Plans

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DEVELOPMENT APPLICATION - PROPOSED RESIDENTIAL FLAT BUILDINGS & TOWNHOUSES
11 - 17 MOSBRI CRESCENT, THE HILL

JUN 2021 | JUL 2020 | OCT 2019 | JAN 2019

DRAWING SCHEDULE

DRAWING NO.	TITLE	SCALE AT A1
DA0.00 PRELIMINARIES		
DA0.00	COVER SHEET	NTS
DA0.10	DATA SHEET	NTS
DA1.00 SITE PLANS		
DA1.01	SURVEY	1:250@A1
DA1.02	EXISTING SITE PLAN	1:250@A1
DA1.03	SITE PLAN	1:250@A1
DA1.04	SITE ANALYSIS	1:250@A1
DA2.00 FLOOR PLANS		
DA2.01	LOWER GROUND FLOOR PLAN	1:250@A1
DA2.02	GROUND FLOOR PLAN	1:250@A1
DA2.03	LEVEL 1 FLOOR PLAN	1:250@A1
DA2.04	LEVEL 2 FLOOR PLAN	1:250@A1
DA2.05	LEVEL 3 FLOOR PLAN	1:250@A1
DA2.06	LEVEL 4 FLOOR PLAN	1:250@A1
DA2.07	LEVEL 5 FLOOR PLAN	1:250@A1
DA2.08	LEVEL 6 FLOOR PLAN	1:250@A1
DA2.09	LEVEL 7 FLOOR PLAN	1:250@A1
DA2.10	LEVEL 8 FLOOR PLAN	1:250@A1
DA2.11	ROOF FLOOR PLAN	1:250@A1
DA3.00 SECTIONS & ELEVATIONS		
DA3.01	SITE SECTIONS & ELEVATIONS 01 - MOSBRI CRE TOWN HOUSES	1:200@A1
DA3.02	SITE SECTIONS & ELEVATIONS 02	1:200@A1
DA3.03	SITE ELEVATION & ELEVATIONS 03	1:200@A1
DA3.04	SITE SECTIONS & ELEVATIONS 04	1:200@A1
DA3.05	SITE SECTIONS & ELEVATIONS 05	1:200@A1
DA3.06	SITE SECTIONS & ELEVATIONS 06	1:200@A1
DA3.07	SECTION AA	1:200@A1
DA4.00 DETAILS		
DA4.01	COMMUNITY PAVILION	1:250@A1
DA5.00 DIAGRAMS		
DA5.11	GFA DIAGRAMS 01	1:750@A1
DA5.12	GFA DIAGRAMS 02	1:750@A1
DA5.21	CROSS VENTILATION DIAGRAMS 01	1:750@A1
DA5.22	CROSS VENTILATION DIAGRAMS 02	1:750@A1
DA5.31	SOLAR ACCESS DIAGRAMS 01	1:750@A1
DA5.32	SOLAR ACCESS DIAGRAMS 02	1:750@A1
DA5.33	SOLAR ACCESS DIAGRAM VIEWS FROM THE SUN	1:250@A1
DA5.41A - DA5.43e	SHADOW ANALYSIS - MID WINTER	NTS
DA5.51	STORAGE DIAGRAMS 01	1:750@A1
DA5.52	STORAGE DIAGRAMS 02	1:750@A1
DA5.61	HEIGHT ANALYSIS	1:250@A1
DA5.62	BUILDING A HEIGHT DIAGRAM	1:200@A1
DA5.71	TOPOGRAPHY CUT DIAGRAM 01	NTS
DA5.72	TOPOGRAPHY CUT DIAGRAM 02	NTS
DA6.100 - DA6.113	VIEW ANALYSIS	NTS
DA7.00 VIEWS AND MATERIAL BOARD		
DA7.20	EXTERIOR FINISHES - BUILDING A	1:300@A1
DA7.21	EXTERIOR FINISHES - MOSBRI CRE TOWN HOUSES	1:200@A1
DA7.23	EXTERIOR FINISHES - BUILDING B & C	1:300@A1

SITE LOCATION N.T.S.



DEVELOPMENT DATA

BUILDING A									
	UNIT MIX								
LEVEL	ONE BED	ONE BED + STUDY	TWO BED	TWO BED + STUDY	THREE BED	TWO BED T.H.	THREE BED T.H.	SUB TOTAL	GFA
G	3	-	1	-	-	-	-	4	386
1	3	-	1	-	-	-	-	4	325
2	1	1	2	5	2	0	0	11	1,067
3	1	1	2	5	2	0	0	11	1,067
4	1	1	2	5	2	0	0	11	1,067
5	1	1	2	5	2	0	0	11	1,067
6	1	1	1	1	2	0	0	6	583
7	1	1	1	1	2	0	0	6	583
8	1	0	0	0	3	0	0	4	511
TOTAL	**13**	**6**	**12**	**22**	**15**	**0**	**0**	**68**	**6,656**
	19%	**9%**	**18%**	**32%**	**22%**	**0%**	**0%**		

BUILDING B									
	UNIT MIX								
LEVEL	ONE BED	ONE BED + STUDY	TWO BED	TWO BED + STUDY	THREE BED	TWO BED T.H.	THREE BED T.H.	SUB TOTAL	GFA
G	0	0	0	0	0	0	9	9	826
1	-	-	-	-	-	-	-	0	561
2	0	1	3	5	1	0	0	10	995
3	0	1	3	5	1	0	0	10	995
4	0	1	3	5	1	0	0	10	995
5	0	1	3	5	1	0	0	10	995
6	0	1	3	5	1	0	0	10	995
TOTAL	**0**	**5**	**15**	**25**	**5**	**0**	**9**	**59**	**6,362**
	0%	**8%**	**25%**	**42%**	**8%**	**0%**	**15%**		

BUILDING C									
	UNIT MIX								
LEVEL	ONE BED	ONE BED + STUDY	TWO BED	TWO BED + STUDY	THREE BED	TWO BED T.H.	THREE BED T.H.	SUB TOTAL	GFA
G	2	0	2	1	0	0	0	5	463
1	2	0	2	1	0	0	0	5	447
2	0	2	3	3	0	0	0	8	757
3	0	2	3	3	0	0	0	8	757
4	0	2	3	3	0	0	0	8	757
TOTAL	**4**	**6**	**13**	**11**	**0**	**0**	**0**	**34**	**3,181**
	12%	**18%**	**38%**	**32%**	**0%**	**0%**	**0%**		

MOSBRI CRESCENT TERRACE HOUSES									
	UNIT MIX								
LEVEL	ONE BED	ONE BED + STUDY	TWO BED	TWO BED + STUDY	THREE BED	TWO BED T.H.	THREE BED T.H.	SUB TOTAL	GFA
LG	-	-	-	-	-	-	-		
G	**0**	**0**	**0**	**0**	**0**	**0**	**11**	**11**	**1,626**
1	-	-	-	-	-	-	-		
TOTAL	**0**	**0**	**0**	**0**	**0**	**0**	**11**	**11**	**1,626**
	0%	**0%**	**0%**	**0%**	**0%**	**0%**	**100%**		

COMMUNAL AREAS		
LEVEL		**GFA**
G	GROUND PAVILION	32
7	LEVEL 7 POOL DECK	8
TOTAL		**40**

GRAND TOTAL												
	UNIT MIX									SEPP65		
LEVEL	ONE BED	ONE BED + STUDY	TWO BED	TWO BED + STUDY	THREE BED	TWO BED T.H.	THREE BED T.H.	SUB TOTAL	GFA	CROSS VENT.	SOLAR ACCESS	NO DIRECT SOLAR BETWEEN 9am & 3pm
TOTAL	**17**	**17**	**40**	**58**	**20**	**0**	**20**	**172**	**17,865**	**97**	**121**	**24**
	10%	**10%**	**23%**	**34%**	**12%**	**0%**	**12%**			**60.2%**	**75.2%**	**14.9%**

NOTE : SEPP65 not applicable to Mosbri Crescent Town Houses. Cross Ventilation and Solar calculations do not include Townhouses i.e. Exempt from ADG

	CURRENT ALLOWABLE FSR UNDER LEP		PROPOSED FSR	
SITE m²	GFA m²	FSR X:1	GFA m²	FSR X:1
12,235	18,353	1.50	17,865	1.46

SITE CALCULATIONS

COMMON OPEN SPACE			LANDSCAPE			DEEP SOIL		
MINIMUM % OF SITE	PROPOSED m²	PROPOSED % OF SITE	MINIMUM % OF SITE	PROPOSED m²	PROPOSED % OF SITE	MINIMUM % OF SITE	PROPOSED m²	PROPOSED % OF SITE
25%	3,087	25.2%	25%	4,100	33.5%	12%	1,800	14.7%

CAR PARKING DATA

		CAR PARKING			MOTORCYCLE			BICYCLE		
PARKING TYPE	UNIT MIX	DCP RATE	DCP REQ.	PROPOSED SPACES	RATE	REQUIRED SPACES	PROPOSED SPACES	RATE	REQUIRED SPACES	PROPOSED SPACES
1 BED DWELLING	34	1	34							
2 BED DWELLING	98	1	98							
3 BED DWELLING	40	1	40							
RESIDENTIAL SUBTOTAL	**172**		**172**	**207**	1 PER 20 CAR SPACES	**10.4**	**12**	1	**172.0**	**172**
VISITOR		1 SPACE FOR THE FIRST 5 DWELLINGS PLUS 1 PER 5 THEREAFTER	34.4	35				1 PER 10 UNITS	17.2	18
TOTAL			**206.4**	**242**		**10.4**	**12**		**189.2**	**190**

ADDITIONAL INFORMATION FOR BASIX

BUILDING STRUCTURE:

FLOOR CONSTRUCTION GF:	Post tension concrete slab, nominal 220mm
CONSTRUCTION UPPER FLOORS:	Post tension concrete slab, nominal 220mm
EXTERNAL WALL CONSTRUCTION:	Precast concrete panels with plasterboard internal lining
INTERNAL WALL CONSTRUCTION:	90mm steel framed plasterboard
PARTY WALL CONSTRUCTION:	250mm steel hebel and plasterboard lining
INTERNAL CEILING CONSTRUCTION:	13mm suspended plasterboard ceiling
CEILING UNDER THE ROOF CONSTRUCTION	13mm suspended plasterboard ceiling with insulation **Suspended ceiling under concrete roof provided for insulation.*
ROOF CONSTRUCTION:	Concrete roof slab with insulation and gravel/ landscaping
ROOF COLOUR:	As required to pass BASIX

RESIDENTIAL LIGHTING:
SEALED Recessed 50mm diameter LED downlights will be installed in ALL ROOMS at a rate of 1 per every 5 sq metres of ceiling area.

RESIDENTIAL EXHAUST VENTS:
All kitchen, bathroom and laundry vents are sealed.

IMPORTANT NOTES:

Do not scale from drawings. All dimensions shall be checked on site before commencement of work. All discrepancies shall be brought to the attention of the Architect. Larger scale drawings and written dimensions take precedence. This drawing is copyright and the property of the author, and must not be retained, copied or used without the express authority of MARCHESE PARTNERS INTERNATIONAL PTY. LTD.

FOR APPROVAL
NOT FOR CONSTRUCTION

REVISION	DATE	DESCRIPTION	BY
A	2018.12.21	ISSUED FOR DEVELOPMENT APPLICATION	LH
B	2019.01.16	ISSUED FOR DEVELOPMENT APPLICATION	LH
C	2019.01.17	ISSUED FOR DEVELOPMENT APPLICATION	LH
D	2020.07.20	ISSUED FOR PLANNING SUBMISSION	LP
E	2021.06.23	ISSUED FOR DEVELOPMENT APPLICATION	LP

marchesepartners
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Kuala Lumpur · Auckland · Christchurch · London · Madrid
ABN 20 098 552 151

CLIENT
CRESCENT NEWCASTLE PTY LTD
PO BOX 292
WICKHAM, NSW, 2293

PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
DATA SHEET

SCALE	DATE	DRAWN	CHECKED
NTS NTS	2019	LP	PS
JOB	DRAWING		REVISION
17114	DA0.10		E

DRAWN BY:

Monteath & Powys Pty Ltd
PLANNING · SURVEYING · PROJECT MANAGEMENT
ENGINEERING DESIGN · UAV · GIS & MAPPING
NEWCASTLE · SYDNEY · GUNNEDAH · MUSWELLBROOK
MonteathPowys.com.au

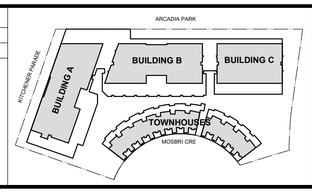
HEAD OFFICE
Suite 13, Tonella Commercial centre
125 Bull Street, Newcastle West 2302
PO Box 2270, Dangar NSW 2309
P. (02) 4926 1388

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NOT FOR CONSTRUCTION

REVISION	DATE	DESCRIPTION	BY
A	2018.12.21	ISSUED FOR DEVELOPMENT APPLICATION	LH
B	2019.01.16	ISSUED FOR DEVELOPMENT APPLICATION	LH



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CLIENT
CRESCENT NEWCASTLE PTY LTD
PO BOX 292
WICKHAM, NSW, 2293

PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
SURVEY

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	-	KI

JOB	DRAWING	REVISION
17114	DA1.01	B

ARCADIA PARK

ERL40.00

ERL39.00

BUILDING B

BUILDING C

ERL39.00

ERL39.00

17 HILLVIEW CRESCENT

NEWCASTLE EAST PUBLIC SCHOOL

K I T C H E N E R P A R A D E

BUILDING A

ERL38.00

13 HILLVIEW CRESCENT

ERL38.00

11 HILLVIEW CRESCENT

ERL38.00

ERL37.00

ERL36.00

ERL35.00

ERL34.00

ERL33.00

ERL32.00

ERL31.00

ERL30.00

ERL29.00

ERL28.00

ERL27.00

ERL26.00

M O S B R I C R E S C E N T

9 HILLVIEW CRESCENT

41 KITCHENER PARADE

3 STOREY UNITS

9 MOSBRI CRESCENT

2 STOREY DWELLING

MOSBRI CRESCENT RESERVE

19 MOSBRI CRESCENT

2 STOREY DWELLING

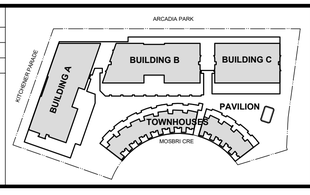
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PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
EXISTING SITE PLAN

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	LP	RDM
JOB	DRAWING		REVISION
17114	DA1.02		C

ARCADIA PARK

BB DA3.08

ERL40.00

ERL39.00

6m SETBACK

9m SETBACK

AA DA3.07

NEWCASTLE EAST PUBLIC SCHOOL

KITCHENER PARADE

ERL39.00

ERL38.00

BUILDING B TOWER LEVELS 2 - 8

RL56.90

BUILDING B TOWER LEVELS 2 - 5

RL47.50

BUILDING B PODIUM LEVELS G - 1

PROPOSED EASEMENT

BUILDING B TOWER LEVELS 2 -7

LANDSCAPED COMMUNAL OPEN SPACE

REFER TO LANDSCAPE ARCHITECT'S DETAILS

RL50.70

RL52.05

RL50.70

BUILDING B PODIUM LEVELS G - 1

BUILDING C TOWER LEVELS 2 - 4

RL44.50

BUILDING C PODIUM LEVELS G - 1

EASEMENT

ERL39.00

AA DA3.07

17 HILLVIEW CRESCENT

13 HILLVIEW CRESCENT

11 HILLVIEW CRESCENT

9 HILLVIEW CRESCENT

19 MOSBRI CRESCENT

2 STOREY DWELLING

ERL38.00

ERL38.00

ERL37.00

ERL36.00

ERL35.00

ERL34.00

ERL33.00

ERL32.00

ERL31.00

ERL30.00

ERL29.00

ERL28.00

ERL27.00

ERL26.00

10m SETBACK

6m SETBACK

4m SETBACK

41 KITCHENER PARADE

3 STOREY UNITS

9 MOSBRI CRESCENT

2 STOREY DWELLING

MOSBRI CRE TOWNHOUSES

MOSBRI CRESCENT

MOSBRI CRESCENT RESERVE

BB DA3.08

PROPOSED OVERLAND FLOW

350ø

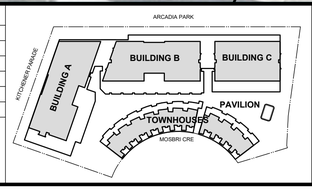
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E	2020.07.20	ISSUED FOR PLANNING SUBMISSION	LP
F	2021.07.23	ISSUED FOR DEVELOPMENT APPLICATION	LP



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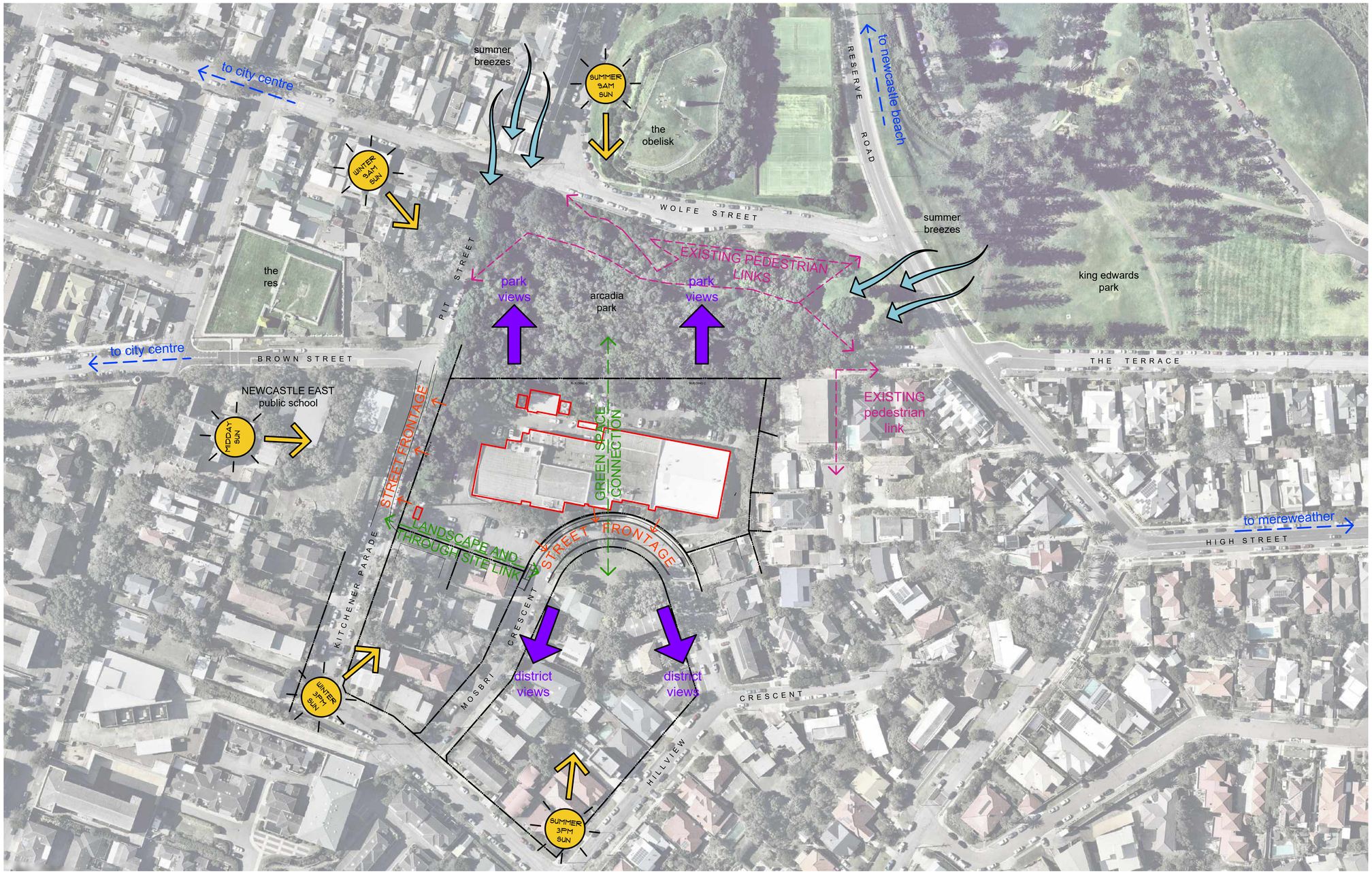
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PO BOX 292
WICKHAM, NSW, 2293

PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
SITE PLAN

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	LP	PS

JOB	DRAWING	REVISION
17114	DA1.03	F



A EXISTING SITE ANALYSIS
1:1000



ARCADIA PARK - PUBLIC PARK
ADJACENT TO SITE (EAST BOUNDARY)



THE OBELISK - HISTORICAL NAVIGATIONAL MARKER
APPROX. 850m FROM SITE (EASTWARD)



THE RES - HISTORICAL LANDMARK IN THE HILL
APPROX. 450m FROM SITE (NORTH EASTWARD)



MARKETTOWN - SHOPPING CENTER & URBAN
PRECINCT. APPROX. 2km FROM SITE (WESTWARD)



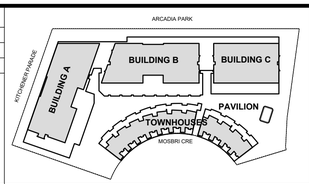
BOGEY HOLE - TIDAL SWIMMING POOL
APPROX. 1.8km FROM SITE (SOUTH EASTWARD)

\- PHOTOS OF SITE SURROUNDS
NTS

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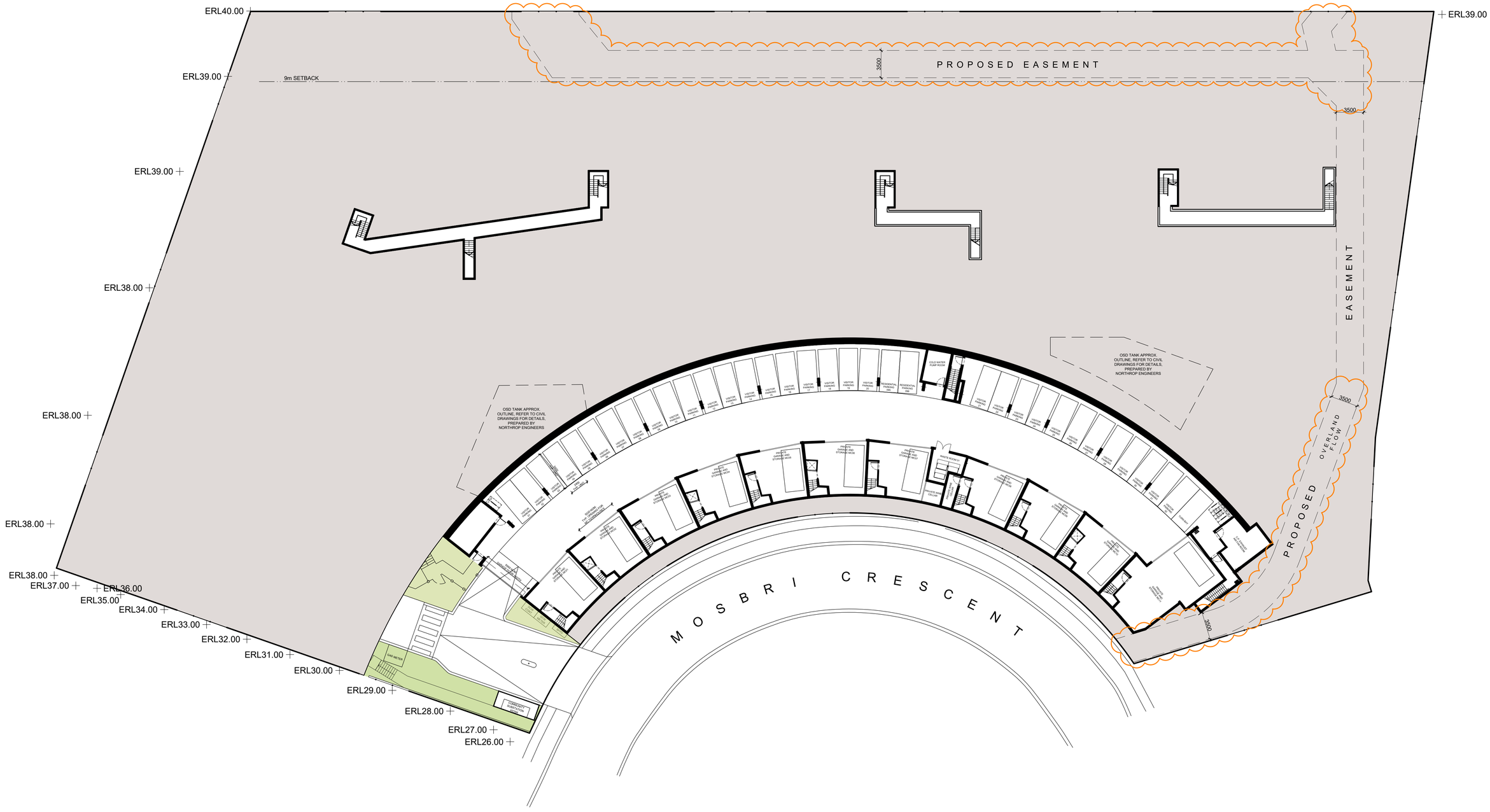
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PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
SITE ANALYSIS

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	LP	RDM
JOB	DRAWING		REVISION
17114	DA1.04		C


ERL40.00
ERL39.00
ERL39.00
ERL38.00
ERL38.00
ERL38.00
ERL37.00
ERL36.00
ERL35.00
ERL34.00
ERL33.00
ERL32.00
ERL31.00
ERL30.00
ERL29.00
ERL28.00
ERL27.00
ERL26.00
ERL39.00
9m SETBACK
3500
PROPOSED EASEMENT
3500
EASEMENT
3500
PROPOSED OVERLAND FLOW
3500
OSD TANK APPROX. OUTLINE, REFER TO CIVIL DRAWINGS FOR DETAILS, PREPARED BY NORTHROP ENGINEERS
OSD TANK APPROX. OUTLINE, REFER TO CIVIL DRAWINGS FOR DETAILS, PREPARED BY NORTHROP ENGINEERS
MOSBRI CRESCENT
VISITOR PARKING 1
VISITOR PARKING 2
VISITOR PARKING 3
VISITOR PARKING 4
VISITOR PARKING 5
VISITOR PARKING 6
VISITOR PARKING 7
VISITOR PARKING 8
VISITOR PARKING 9
VISITOR PARKING 10
VISITOR PARKING 11
VISITOR PARKING 12
VISITOR PARKING 13
VISITOR PARKING

ARCADIA PARK

BB DA3.08

ERL40.00

ERL39.00

BUILDING B

BUILDING C

PROPOSED EASEMENT

3500

AA DA3.07

CAR PARKING RL29.00

CAR PARKING

5600

6200

3500

ERL39.00

NEWCASTLE EAST PUBLIC SCHOOL

KITCHENER PARADE

BUILDING A

ERL38.00

CAR PARKING

8100

5800

RAMP 14.65m AT 14

RAMP 26m AT 8

RAMP 19.9m AT 8

RAMP 15.8m AT 15.8

RAMP @1%

ERL38.00

ERL37.00

ERL36.00

ERL35.00

ERL34.00

ERL33.00

ERL32.00

ERL31.00

ERL30.00

ERL29.00

ERL28.00

ERL27.00

ERL26.00

RL26.085

RL28.085

RL26.13

RL29.93

41 KITCHENER PARADE

3 STOREY UNITS

9 MOSBRI CRESCENT

2 STOREY DWELLING

BUILDING B & C ENTRY LOBBY

WASTE 4x1100L

STORAGE CAGES

CG05 3B
INTERNAL AREA 126m²
COURTYARD 17m²

CG06 3B
INTERNAL AREA 126m²
COURTYARD 22m²

CG07 3B
INTERNAL AREA 176m²
COURTYARD 22m²

CG08 3B
INTERNAL AREA 126m²
COURTYARD 22m²

CG09 3B
INTERNAL AREA 145m²
COURTYARD 22m²
BALCONY 7m²

DG10 3B
INTERNAL AREA 145m²
COURTYARD 22m²
BALCONY 7m²

DG11 3B
INTERNAL AREA 126m²
COURTYARD 22m²

DG12 3B
INTERNAL AREA 126m²
COURTYARD 22m²

DG13 3B
INTERNAL AREA 145m²
COURTYARD 22m²

EG14 2B
INTERNAL AREA 80m²
COURTYARD 35m²

EG15 1B
INTERNAL AREA 55m²
COURTYARD 30m²

EG16 2B+S
INTERNAL AREA 93m²
COURTYARD 49m²

EG17 1B
INTERNAL AREA 55m²
COURTYARD 30m²

EG18 2B
INTERNAL AREA 80m²
COURTYARD 35m²

EASEMENT

RL30.80

RL30.60

RL29.80

RL29.80

17 HILLVIEW CRESCENT

13 HILLVIEW CRESCENT

11 HILLVIEW CRESCENT

9 HILLVIEW CRESCENT

COMMUNAL PAVILION
INTERNAL AREA 35m²
EXTERNAL AREA 25m²

OVERLAND FLOW

PROPOSED

RL30.45

RL30.30

RL29.90

RL29.90

RL29.90

RL29.20

RL29.20

RL28.50

RL28.50

RL28.50

RL29.75

MC01 3B
INTERNAL AREA 151m²
COURTYARD 38m²
FRONT YARD 5m²
BALCONY 5m²

MC02 3B
INTERNAL AREA 143m²
COURTYARD 36m²
FRONT YARD 11m²
BALCONY 5m²

MC03 3B
INTERNAL AREA 154m²
COURTYARD 38m²
FRONT YARD 11m²
BALCONY 5m²

MC04 3B
INTERNAL AREA 146m²
COURTYARD 38m²
FRONT YARD 11m²
BALCONY 5m²

MC05 3B
INTERNAL AREA 151m²
COURTYARD 38m²
FRONT YARD 11m²
BALCONY 5m²

MC06 3B
INTERNAL AREA 148m²
COURTYARD 39m²
FRONT YARD 19m²
BALCONY 5m²

MC07 3B
INTERNAL AREA 154m²
COURTYARD 39m²
FRONT YARD 11m²
BALCONY 4m²

MC08 3A
INTERNAL AREA 146m²
COURTYARD 38m²
FRONT YARD 11m²
BALCONY 5m²

MC09 3B
INTERNAL AREA 151m²
COURTYARD 38m²
FRONT YARD 11m²
BALCONY 5m²

MC10 3B
INTERNAL AREA 148m²
COURTYARD 38m²
FRONT YARD 11m²
BALCONY 5m²

MC11 3B
INTERNAL AREA 154m²
COURTYARD 39m²
FRONT YARD 9m²
BALCONY 4m²

MOSBRI CRESCENT

BB DA3.08

MOSBRI CRESCENT RESERVE

19 MOSBRI CRESCENT

2 STOREY DWELLING

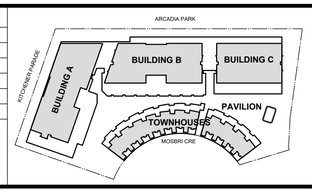
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D	2019.10.11	ISSUED FOR DEVELOPMENT APPLICATION	CA
E	2020.07.20	ISSUED FOR PLANNING SUBMISSION	LP
F	2021.07.23	ISSUED FOR DEVELOPMENT APPLICATION	LP



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WICKHAM, NSW, 2293

PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
GROUND FLOOR PLAN

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	LP	PS

JOB	DRAWING	REVISION
17114	DA2.02	F

ARCADIA PARK

BB DA3.08

ERL40.00

BUILDING B

BUILDING C

ERL39.00

6m SETBACK

PROPOSED EASEMENT

3500

AA DA3.07

ERL39.00

CAR PARKING

RL32.10

CAR PARKING

17 HILLVIEW CRESCENT

NEWCASTLE EAST PUBLIC SCHOOL

K I T C H E N E R P A R A D E

BUILDING A

ERL38.00

CAR PARKING

EASEMENT

13 HILLVIEW CRESCENT

E114 2B
INTERNAL AREA 80m²
BALCONY 10m²

E115 1B
INTERNAL AREA 55m²
BALCONY 8m²

E116 2B+S
INTERNAL AREA 93m²
BALCONY 16m²

E117 1B
INTERNAL AREA 55m²
BALCONY 8m²

E118 2B
INTERNAL AREA 80m²
BALCONY 10m²

B104 2B
INTERNAL AREA 73m²
BALCONY 10m²

B103 1B
INTERNAL AREA 55m²
BALCONY 10m²

A102 1B
INTERNAL AREA 55m²
BALCONY 10m²

A101 1B
INTERNAL AREA 55m²
BALCONY 10m²

RAMP 14.6m AT 1:8

RAMP 14.6m AT 1:8

RAMP 14.6m AT 1:4

6m SETBACK

4m SETBACK

ERL38.00

ERL37.00

ERL36.00

ERL35.00

ERL34.00

ERL33.00

ERL32.00

ERL31.00

ERL30.00

ERL29.00

ERL28.00

ERL27.00

ERL26.00

RL37.80

RL37.60

RL37.00

RL36.80

RL36.60

RL36.00

RL35.80

RL35.60

RL35.00

RL34.80

RL34.60

RL34.00

RL33.80

RL33.60

RL33.00

RL32.80

RL32.60

RL32.00

RL31.80

RL31.60

RL31.00

PROPOSED OVERLAND FLOW

3500

11 HILLVIEW CRESCENT

9 HILLVIEW CRESCENT

19 MOSBRI CRESCENT

2 STOREY DWELLING

M O S B R I C R E S C E N T

MOSBRI CRESCENT RESERVE

41 KITCHENER PARADE

3 STOREY UNITS

9 MOSBRI CRESCENT

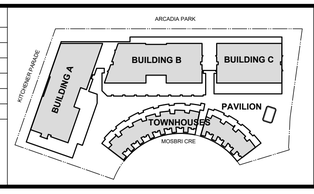
2 STOREY DWELLING

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PO BOX 292
WICKHAM, NSW, 2293

PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
LEVEL 1 FLOOR PLAN

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	LP	PS
JOB	DRAWING		REVISION
17114	DA2.03		F

ARCADIA PARK

ERL40.00

ERL39.00

ERL39.00

ERL38.00

ERL38.00

ERL38.00

ERL37.00

ERL36.00

ERL35.00

ERL34.00

ERL33.00

ERL32.00

ERL31.00

ERL30.00

ERL29.00

ERL28.00

ERL27.00

ERL26.00

ERL39.00

NEWCASTLE EAST PUBLIC SCHOOL

KITCHENER PARADE

BUILDING A

BUILDING B

BUILDING C

TERRACED LANDSCAPING
REFER TO LANDSCAPE ARCHITECT'S DETAIL'S

6m SETBACK

B210 3B
INTERNAL AREA 108m²
BALCONY 25m²

B211 2B
INTERNAL AREA 90m²
BALCONY 13m²

RL35.20

B208 2B+S
INTERNAL AREA 90m²
BALCONY 13m²

B209 2B+S
INTERNAL AREA 90m²
BALCONY 13m²

A202 2B+S
INTERNAL AREA 90m²
BALCONY 13m²

A203 2B+S
INTERNAL AREA 90m²
BALCONY 13m²

A204 2B+S
INTERNAL AREA 90m²
BALCONY 13m²

A205 2B+S
INTERNAL AREA 90m²
BALCONY 13m²

A206 2B+S
INTERNAL AREA 90m²
BALCONY 13m²

A207 2B+S
INTERNAL AREA 90m²
BALCONY 13m²

10m SETBACK

6m SETBACK

4m SETBACK

LANDSCAPE
REFER TO LANDSCAPE ARCHITECTS DETAILS.

OVAL RACING TRACK

LANDSCAPED PEDESTRIAN LINK
REFER TO LANDSCAPE ARCHITECT'S DETAILS.

41 KITCHENER PARADE

3 STOREY UNITS

9 MOSBRI CRESCENT

2 STOREY DWELLING

C212 3B
INTERNAL AREA 108m²
BALCONY 28m²

C214 1B+S
INTERNAL AREA 50m²
BALCONY 20m²

C216 2B+S
INTERNAL AREA 97m²
BALCONY 31m²

D218 2B+S
INTERNAL AREA 97m²
BALCONY 31m²

D219 2B+S
INTERNAL AREA 92m²
BALCONY 32m²

D220 2B+S
INTERNAL AREA 92m²
BALCONY 32m²

F222 2B+S
INTERNAL AREA 95m²
BALCONY 33m²

F224 2B+S
INTERNAL AREA 95m²
BALCONY 33m²

F226 1B+S
INTERNAL AREA 54m²
BALCONY 20m²

E228 2B+S
INTERNAL AREA 95m²
BALCONY 33m²

2575

PROPOSED EASEMENT

3500

RECREATION OUTDOOR AREA

RECREATION OUTDOOR AREA

RL35.20

RL35.20

RL35.20

C213 2B+S
INTERNAL AREA 92m²
BALCONY 57m²

C215 2B+S
INTERNAL AREA 93m²
BALCONY 41m²

D217 2B+S
INTERNAL AREA 93m²
BALCONY 41m²

D221 2B+S
INTERNAL AREA 93m²
BALCONY 41m²

E223 2B+S
INTERNAL AREA 95m²
BALCONY 40m²

E225 2B+S
INTERNAL AREA 95m²
BALCONY 39m²

E227 1B
INTERNAL AREA 54m²
BALCONY 28 m²

E229 2B
INTERNAL AREA 100m²
BALCONY 38m²

COVERED PERGOLA OVER

EASEMENT

17 HILLVIEW CRESCENT

13 HILLVIEW CRESCENT

11 HILLVIEW CRESCENT

9 HILLVIEW CRESCENT

19 MOSBRI CRESCENT

2 STOREY DWELLING

ROOF RL34.70

ROOF RL34.70

ROOF RL35.40

ROOF RL35.40

ROOF RL36.10

ROOF RL36.10

ROOF RL36.10

ROOF RL36.80

ROOF RL36.80

ROOF RL37.50

MOSBRI CRESCENT

MOSBRI CRESCENT RESERVE

3500

OVERLAND FLOW

PROPOSED

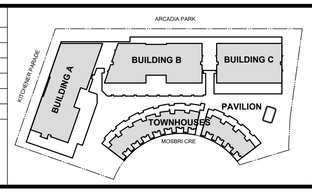
3500

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C	2019.01.17	ISSUED FOR DEVELOPMENT APPLICATION	LH
D	2019.10.11	ISSUED FOR DEVELOPMENT APPLICATION	CA
E	2020.07.20	ISSUED FOR PLANNING SUBMISSION	LP
F	2021.07.23	ISSUED FOR DEVELOPMENT APPLICATION	LP



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CLIENT
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PO BOX 292
WICKHAM, NSW, 2293

PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
LEVEL 2 FLOOR PLAN

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	LP	PS

JOB	DRAWING	REVISION
17114	DA2.04	F

ARCADIA PARK

BB DA3.08

BUILDING B

BUILDING C

AA DA3.07

NEWCASTLE EAST PUBLIC SCHOOL

K I T C H E N E R P A R A D E

17 HILLVIEW CRESCENT

13 HILLVIEW CRESCENT

11 HILLVIEW CRESCENT

9 HILLVIEW CRESCENT

6m SETBACK

B310 3B
INTERNAL AREA 108m²
BALCONY 22m²

B311 2B
INTERNAL AREA 89m²
BALCONY 24m²

C312 3B
INTERNAL AREA 103m²
BALCONY 16m²

C314 1B+S
INTERNAL AREA 66m²
BALCONY 11m²

C316 2B+S
INTERNAL AREA 97m²
BALCONY 24m²

D318 2B+S
INTERNAL AREA 97m²
BALCONY 24m²

D319 2B+S
INTERNAL AREA 96m²
BALCONY 18m²

D320 2B+S
INTERNAL AREA 95m²
BALCONY 18m²

E322 2B+S
INTERNAL AREA 95m²
BALCONY 18m²

E324 2B+S
INTERNAL AREA 92m²
BALCONY 18m²

E326 1B+S
INTERNAL AREA 60m²
BALCONY 10m²

E328 2B+S
INTERNAL AREA 95m²
BALCONY 18m²

B308 2B+S
INTERNAL AREA 96m²
BALCONY 18m²

B306 2B+S
INTERNAL AREA 83m²
BALCONY 24m²

A305 2B+S
INTERNAL AREA 97m²
BALCONY 24m²

B309 1B
INTERNAL AREA 60m²
BALCONY 10m²

B307 1B+S
INTERNAL AREA 66m²
BALCONY 20m²

BUILDING A

RL38.30

A304 2B+S
INTERNAL AREA 83m²
BALCONY 18m²

A302 2B
INTERNAL AREA 100m²
BALCONY 16m²

A303 2B+S
INTERNAL AREA 83m²
BALCONY 11m²

A301 2B+S
INTERNAL AREA 83m²
BALCONY 11m²

10m SETBACK

6m SETBACK

4m SETBACK

C313 2B+S
INTERNAL AREA 92m²
BALCONY 20m²

C315 2B+S
INTERNAL AREA 83m²
BALCONY 11m²

D317 2B+S
INTERNAL AREA 83m²
BALCONY 11m²

D321 2B+S
INTERNAL AREA 83m²
BALCONY 11m²

E323 2B+S
INTERNAL AREA 83m²
BALCONY 11m²

E325 2B+S
INTERNAL AREA 81m²
BALCONY 10m²

E327 1B
INTERNAL AREA 54m²
BALCONY 11 m²

E329 2B
INTERNAL AREA 100m²
BALCONY 13m²

COVERED PERGOLA

41 KITCHENER PARADE

3 STOREY UNITS

9 MOSBRI CRESCENT

2 STOREY DWELLING

M O S B R I C R E S C E N T

MOSBRI CRESCENT RESERVE

19 MOSBRI CRESCENT

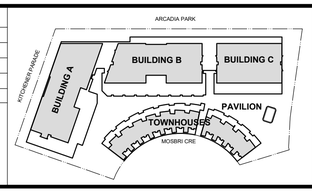
2 STOREY DWELLING

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PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
LEVEL 3 FLOOR PLAN

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	LP	PS

JOB	DRAWING	REVISION
17114	DA2.05	E

ARCADIA PARK

BB DA3.08

BUILDING B

BUILDING C

AA DA3.07

AA DA3.07

NEWCASTLE EAST PUBLIC SCHOOL

K I T C H E N E R P A R A D E

17 HILLVIEW CRESCENT

13 HILLVIEW CRESCENT

11 HILLVIEW CRESCENT

9 HILLVIEW CRESCENT

6m SETBACK

10m SETBACK

6m SETBACK

4m SETBACK

BUILDING A

RL41.40

RL41.40

RL41.40

RL41.40

RL41.40

B410 3B INTERNAL AREA 108m² BALCONY 22m²

B411 2B INTERNAL AREA 89m² BALCONY 24m²

B408 2B+S INTERNAL AREA 96m² BALCONY 16m²

B409 1B INTERNAL AREA 50m² BALCONY 20m²

B406 2B+S INTERNAL AREA 97m² BALCONY 24m²

B407 1B+S INTERNAL AREA 58m² BALCONY 20m²

A404 2B+S INTERNAL AREA 97m² BALCONY 24m²

A405 2B+S INTERNAL AREA 97m² BALCONY 24m²

A402 2B INTERNAL AREA 100m² BALCONY 16m²

A403 2B+S INTERNAL AREA 96m² BALCONY 11m²

A401 2B+S INTERNAL AREA 95m² BALCONY 11m²

A406 2B+S INTERNAL AREA 83m² BALCONY 11m²

C412 3B INTERNAL AREA 103m² BALCONY 16m²

C414 1B+S INTERNAL AREA 66m² BALCONY 11m²

C416 2B+S INTERNAL AREA 97m² BALCONY 24m²

D418 2B+S INTERNAL AREA 97m² BALCONY 24m²

D419 2B+S INTERNAL AREA 96m² BALCONY 16m²

D420 2B+S INTERNAL AREA 95m² BALCONY 16m²

C413 2B+S INTERNAL AREA 92m² BALCONY 20m²

C415 2B+S INTERNAL AREA 83m² BALCONY 11m²

D417 2B+S INTERNAL AREA 83m² BALCONY 11m²

D421 2B+S INTERNAL AREA 83m² BALCONY 11m²

E422 2B+S INTERNAL AREA 95m² BALCONY 16m²

E424 2B+S INTERNAL AREA 92m² BALCONY 16m²

E426 1B+S INTERNAL AREA 60m² BALCONY 10m²

E428 2B+S INTERNAL AREA 95m² BALCONY 16m²

E423 2B+S INTERNAL AREA 83m² BALCONY 11m²

E425 2B+S INTERNAL AREA 81m² BALCONY 10m²

E427 1B INTERNAL AREA 54m² BALCONY 11 m²

E429 2B INTERNAL AREA 100m² BALCONY 13m²

41 KITCHENER PARADE

3 STOREY UNITS

9 MOSBRI CRESCENT

2 STOREY DWELLING

M O S B R I C R E S C E N T

BB DA3.08

MOSBRI CRESCENT RESERVE

19 MOSBRI CRESCENT

2 STOREY DWELLING

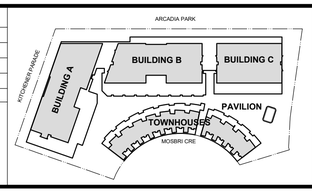
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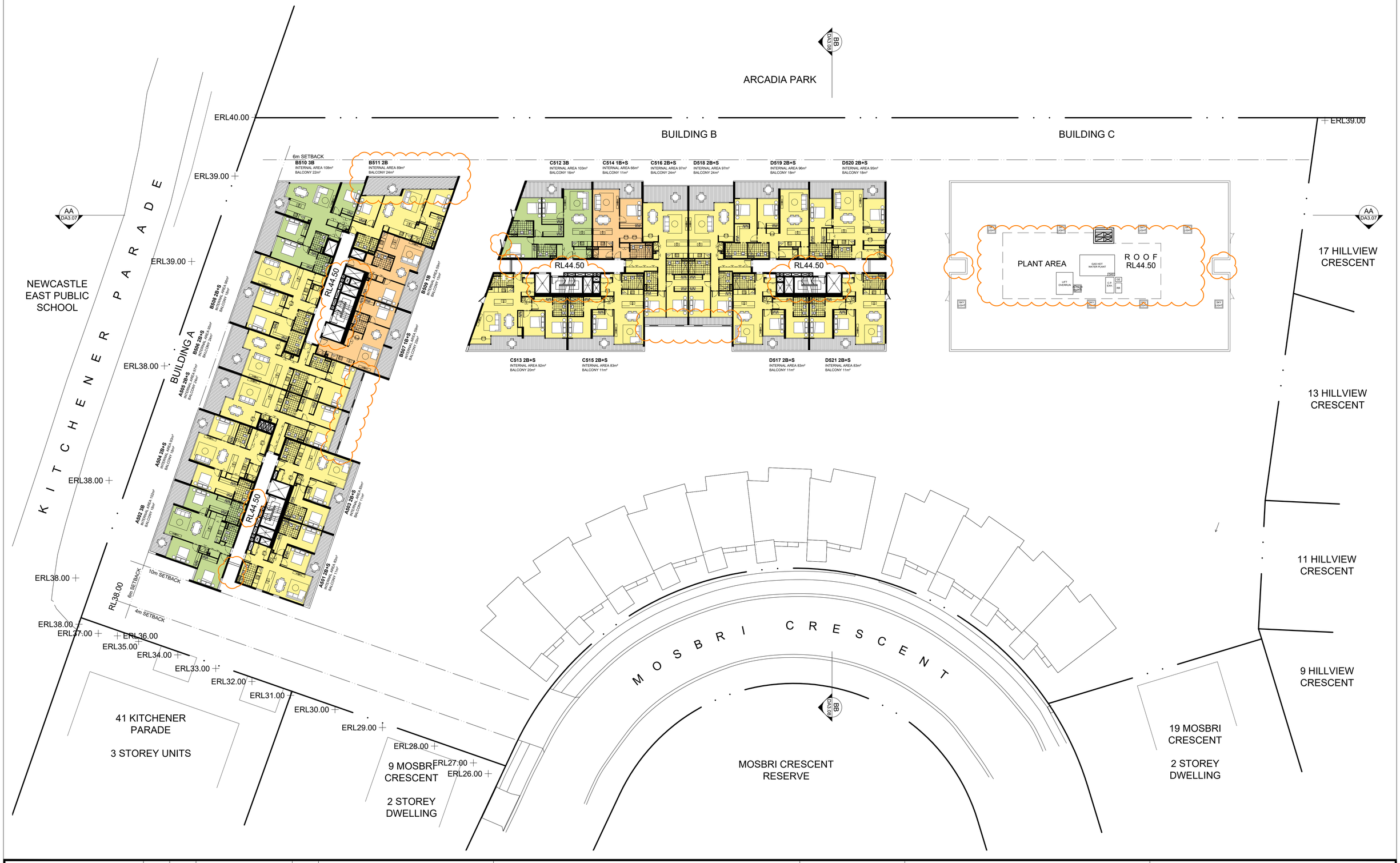
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WICKHAM, NSW, 2293

PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
LEVEL 4 FLOOR PLAN

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	LP	PS

JOB	DRAWING	REVISION
17114	DA2.06	E

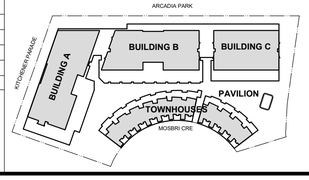


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E	2021.07.23	ISSUED FOR DEVELOPMENT APPLICATION	LP



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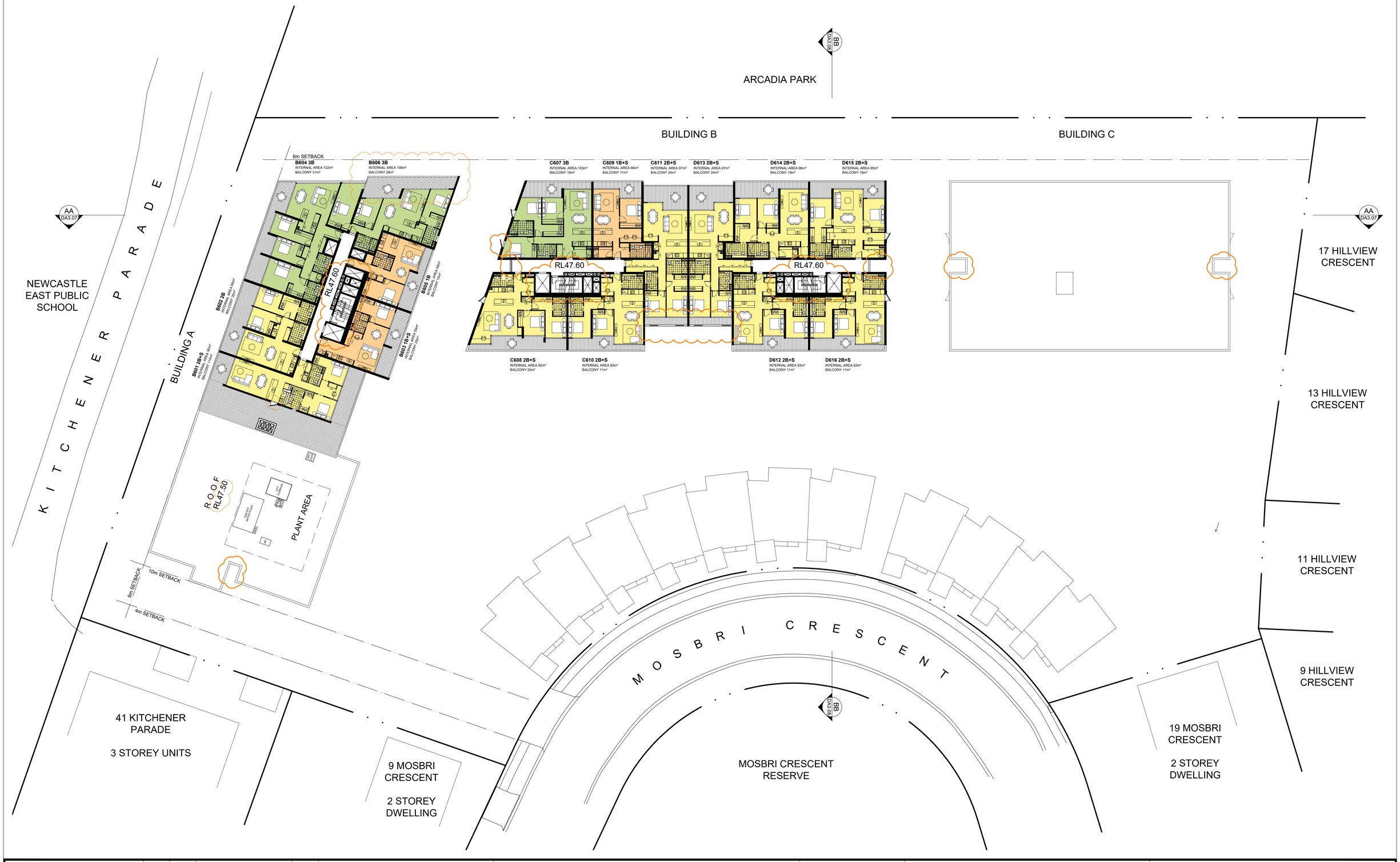
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PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
LEVEL 5 FLOOR PLAN

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	LP	PS

JOB	DRAWING	REVISION
17114	DA2.07	E

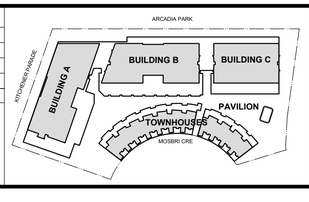


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E	2021.07.23	ISSUED FOR DEVELOPMENT APPLICATION	LP



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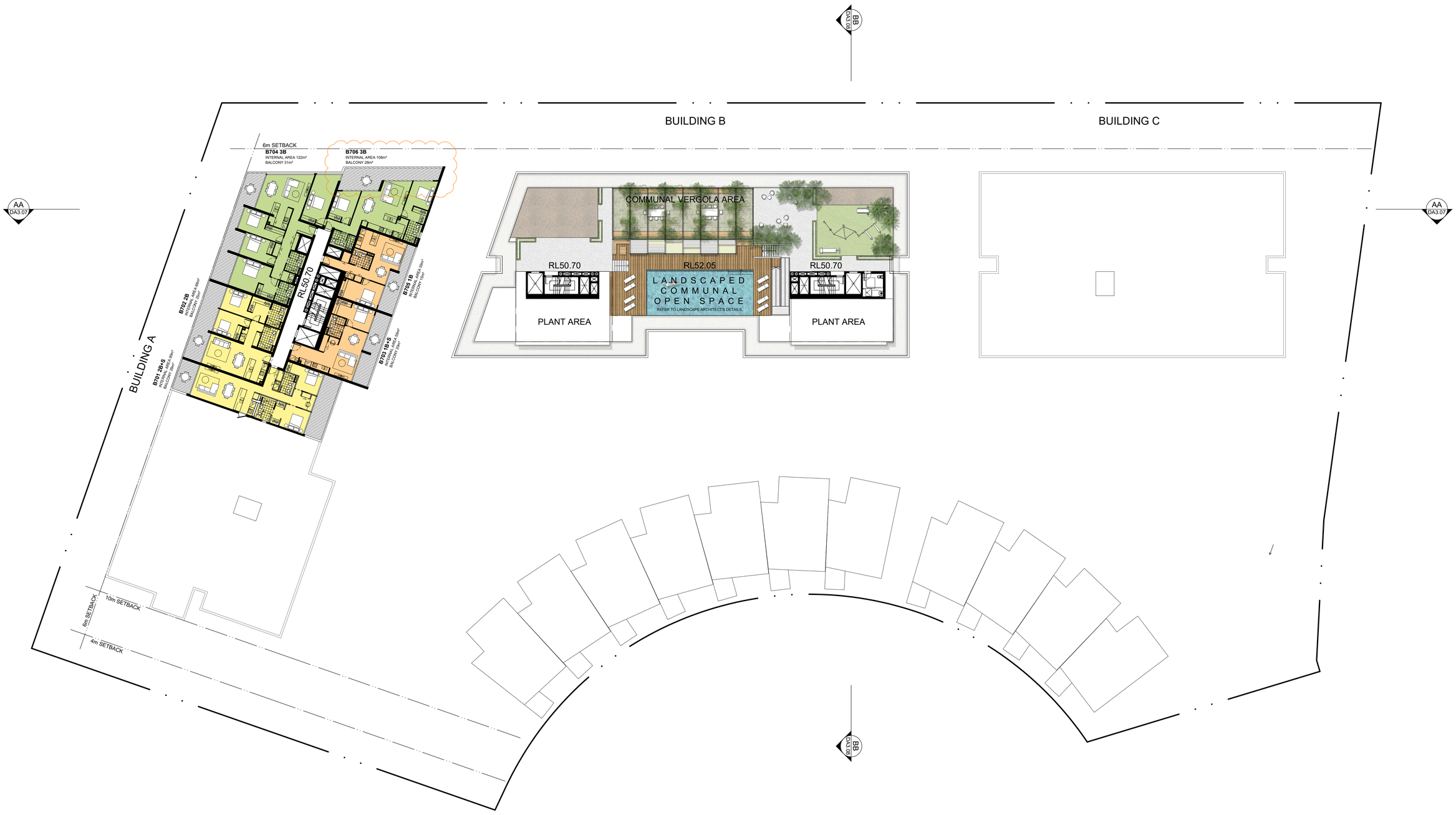
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PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
LEVEL 6 FLOOR PLAN

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	LP	PS

JOB	DRAWING	REVISION
17114	DA2.08	E

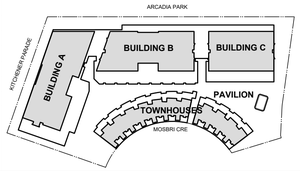


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D	2019.03.13	ISSUED FOR DEVELOPMENT APPLICATION	CA
E	2020.07.20	ISSUED FOR PLANNING SUBMISSION	LP
F	2021.06.23	ISSUED FOR DEVELOPMENT APPLICATION	LP



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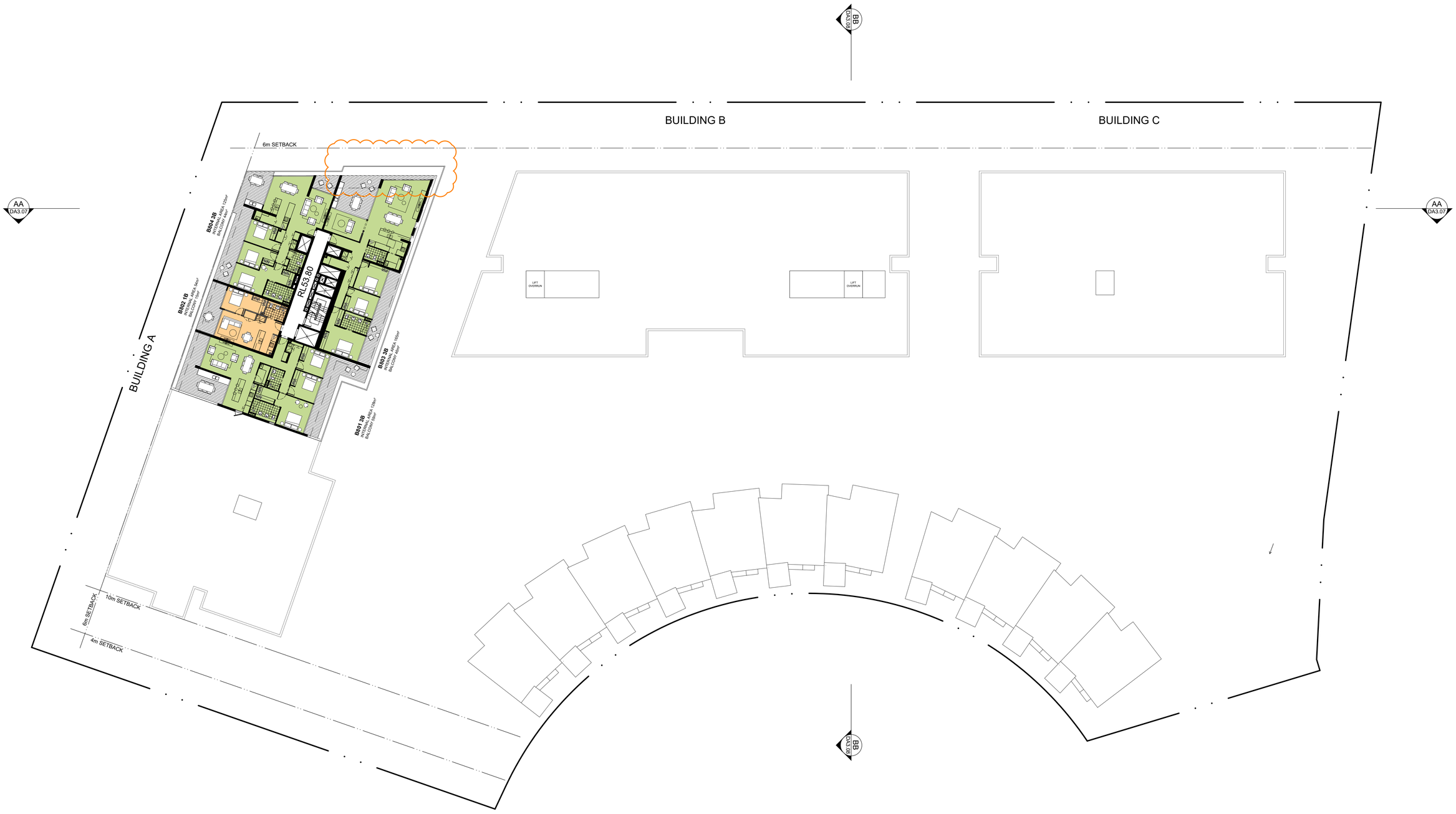
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PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
LEVEL 7 FLOOR PLAN

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	LP	PS

JOB	DRAWING	REVISION
17114	DA2.09	F

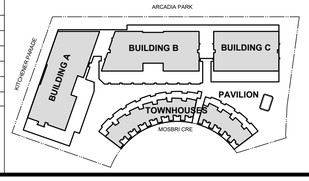


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F	2021.06.23	ISSUED FOR DEVELOPMENT APPLICATION	LP



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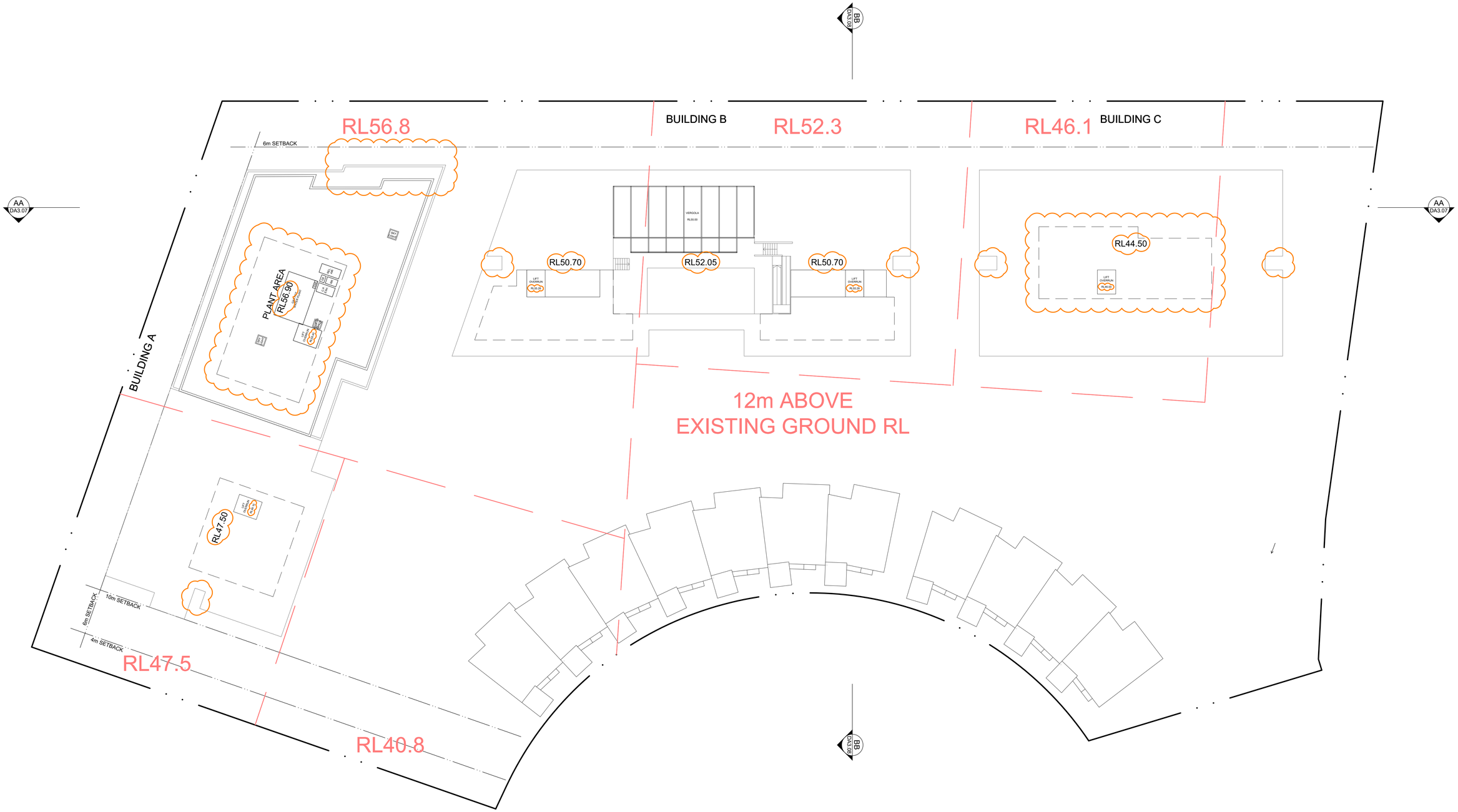
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WICKHAM, NSW, 2293

PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
LEVEL 8 FLOOR PLAN

SCALE	DATE	DRAWN	CHECKED
1:250@A1 1:500@A3	2019	LP	PS

JOB	DRAWING	REVISION
17114	DA2.10	F

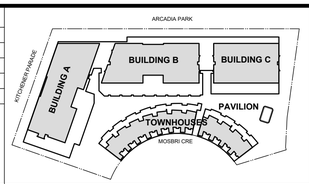


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PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
ROOF FLOOR PLAN

SCALE	DATE	DRAWN	CHECKED
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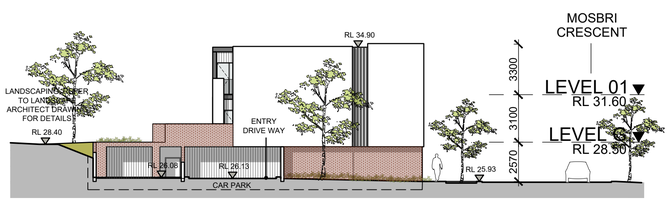
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17114	DA2.11	E



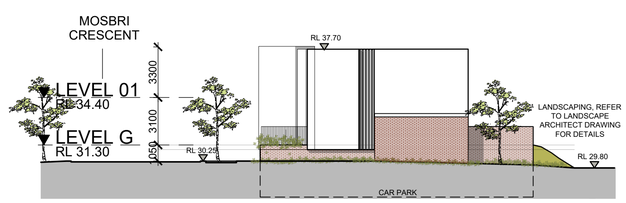
A MOSBRI CRESCENT TOWN HOUSE WEST ELEVATION
1:200



B MOSBRI CRESCENT TOWN HOUSES EAST ELEVATION
1:200



C MOSBRI CRESCENT NORTH ELEVATION
1:200

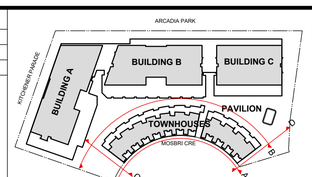


D MOSBRI CRESCENT SOUTH ELEVATION
1:200

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PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

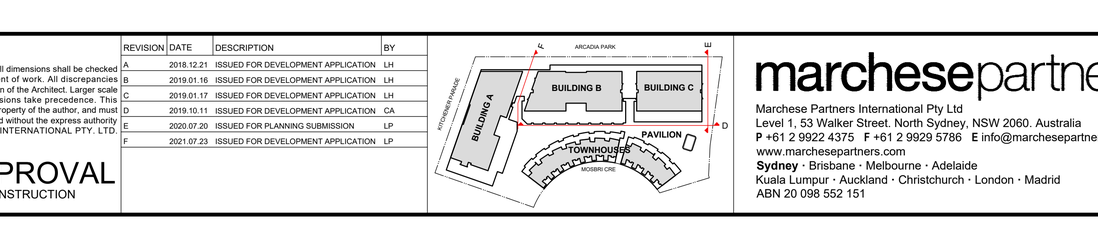
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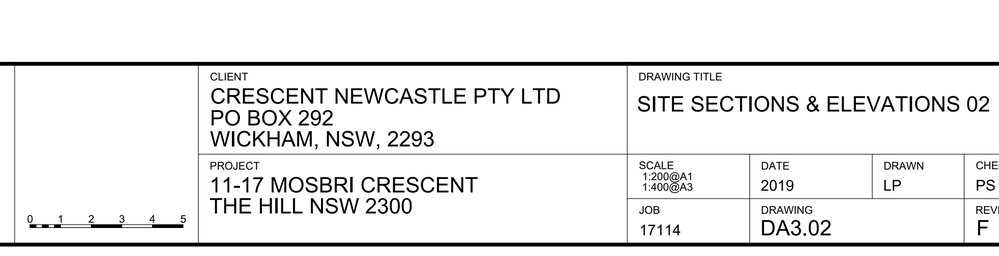
JOB	DRAWING	REVISION
17114	DA3.01	C



D BUILDING B AND C WEST ELEVATIONS
1:200



E BUILDING C SOUTH ELEVATION
1:200



F BUILDING B NORTH ELEVATION
1:200

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D	2019.10.11	ISSUED FOR DEVELOPMENT APPLICATION	CA
E	2020.07.20	ISSUED FOR PLANNING SUBMISSION	LP
F	2021.07.23	ISSUED FOR DEVELOPMENT APPLICATION	LP

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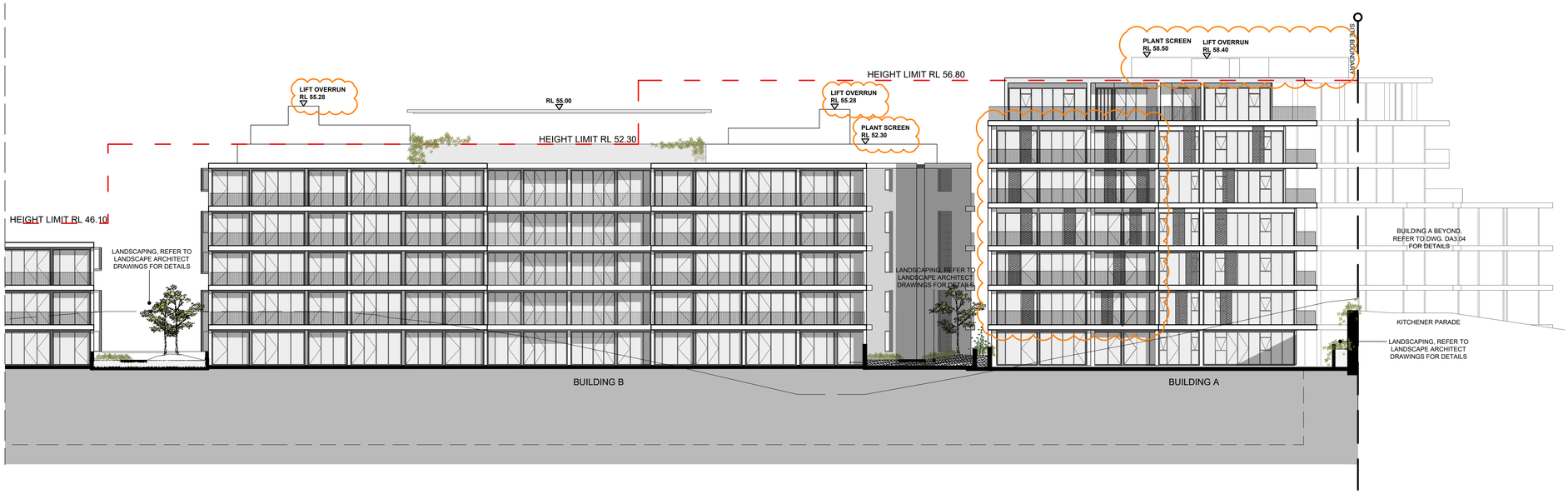
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SITE SECTIONS & ELEVATIONS 02

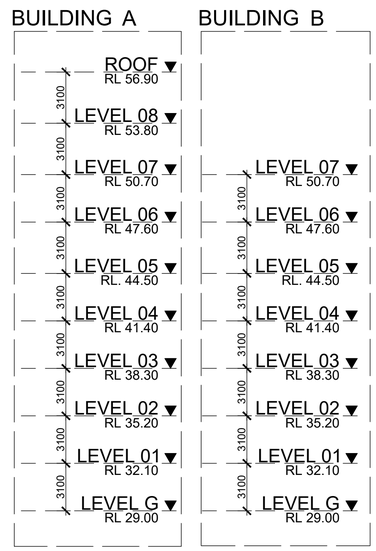
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JOB	DRAWING	REVISION
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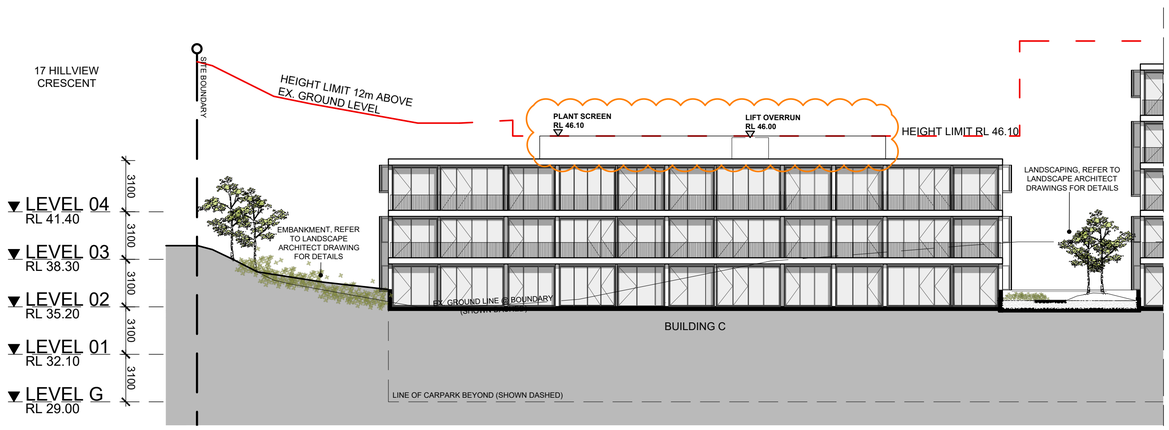


G EAST ELEVATION
1:500





G.01 EAST ELEVATION BUILDING B & A
1:200

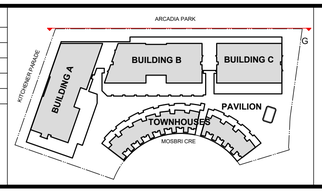


G.02 EAST ELEVATION BUILDING C
1:200

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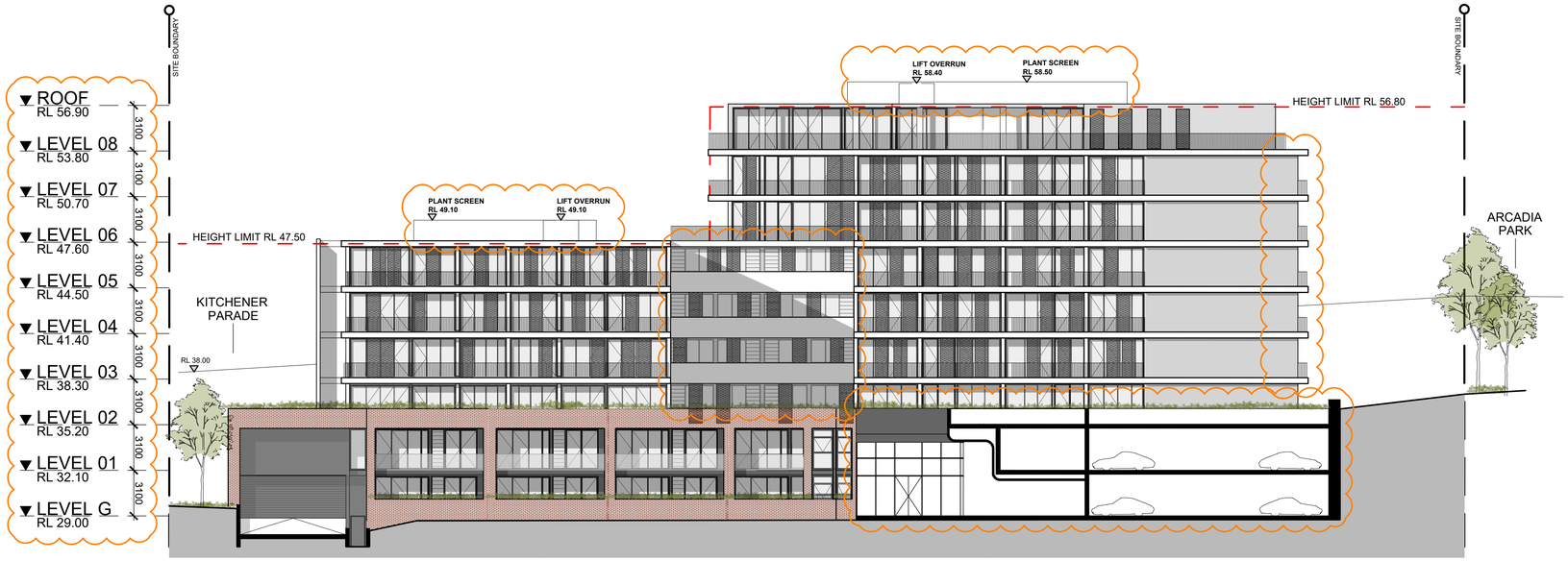
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DRAWING TITLE
SITE ELEVATION & ELEVATIONS 03

SCALE	DATE	DRAWN	CHECKED
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JOB	DRAWING		REVISION
17114	DA3.03		E



I BUILDING A SOUTH ELEVATION
NTS

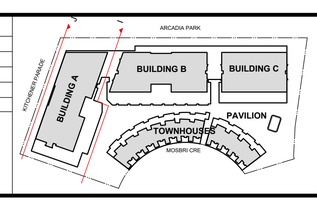


J BUILDING A NORTH ELEVATION
NTS

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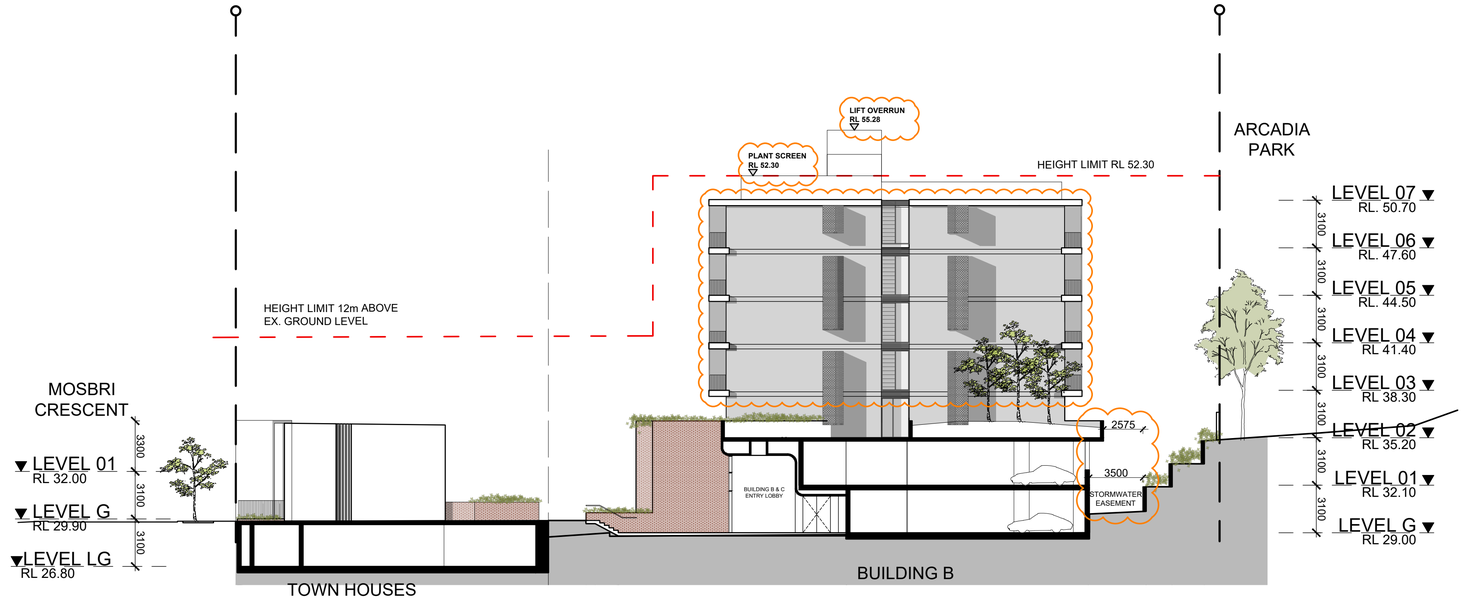
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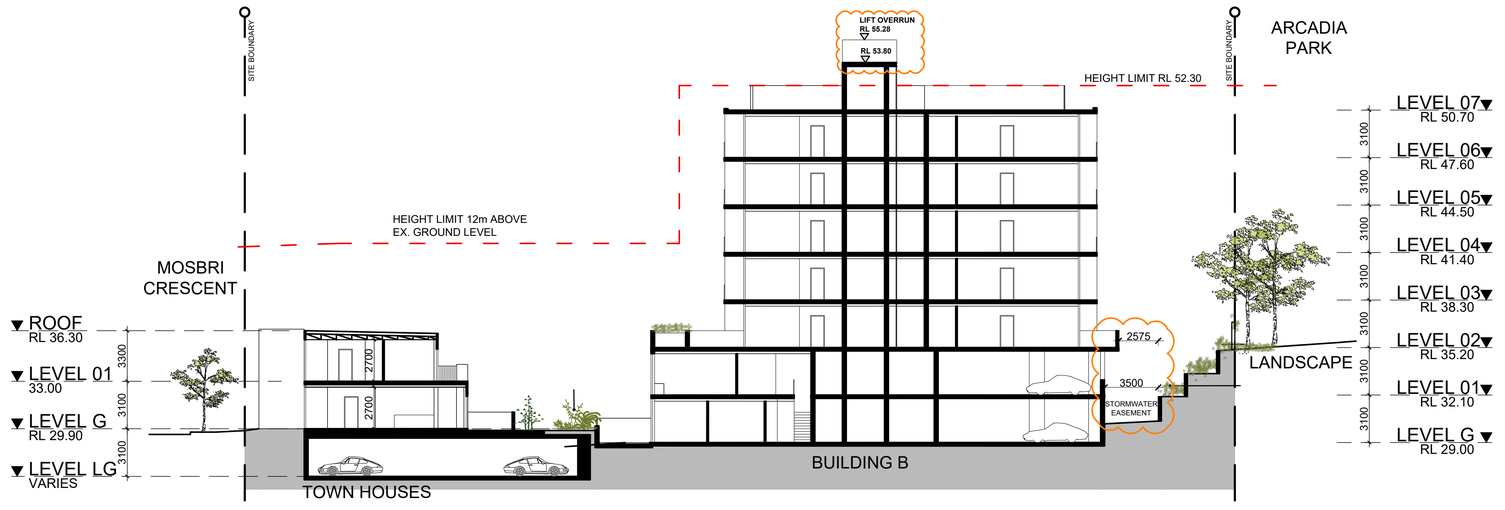
PROJECT
11-17 MOSBRI CRESCENT
THE HILL NSW 2300

DRAWING TITLE
SITE SECTIONS & ELEVATIONS 04

SCALE	DATE	DRAWN	CHECKED
NTS -	2019	LP	PS
JOB	DRAWING		REVISION
17114	DA 3.04		E



M BUILDING B SOUTH ELEVATION
NTS

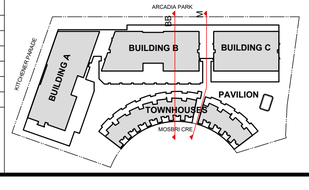


BB SECTION
NTS

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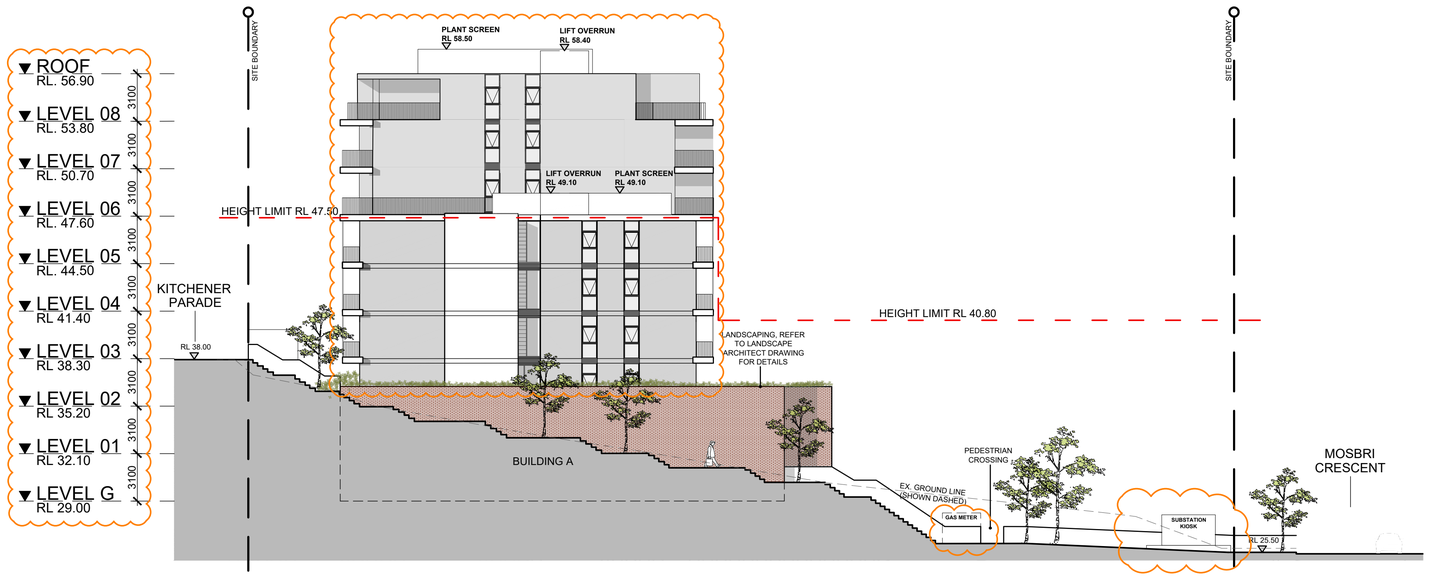
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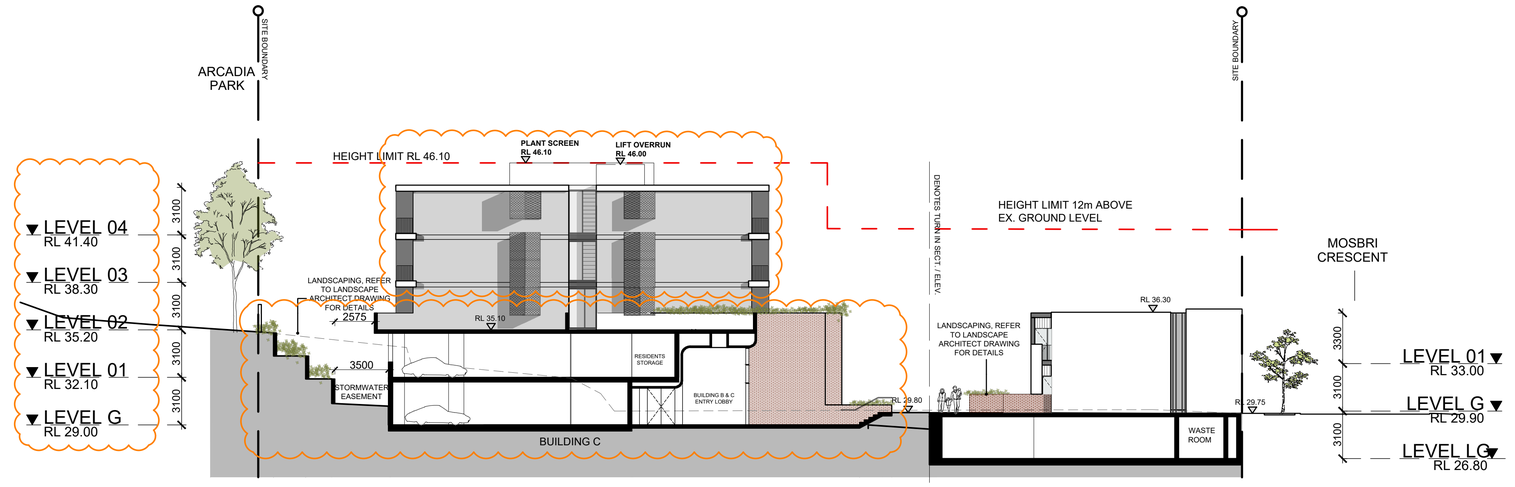
PROJECT
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THE HILL NSW 2300

DRAWING TITLE
SITE SECTIONS & ELEVATIONS 05

SCALE	DATE	DRAWN	CHECKED
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JOB	DRAWING		REVISION
17114	DA3.05		F



K BUILDING A WEST ELEVATION
1:200

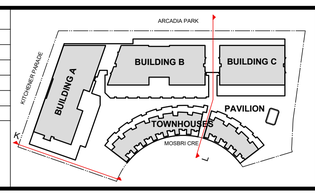


L BUILDING C NORTH ELEVATION
1:200

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C	2019.01.17	ISSUED FOR DEVELOPMENT APPLICATION	LH
D	2019.03.13	ISSUED FOR DEVELOPMENT APPLICATION	CA
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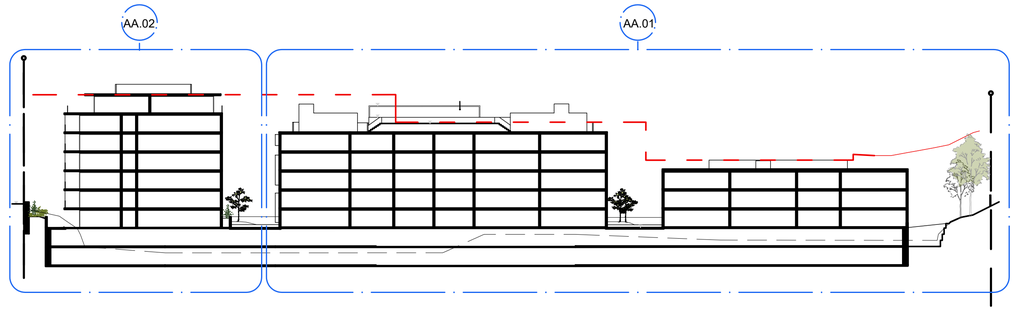
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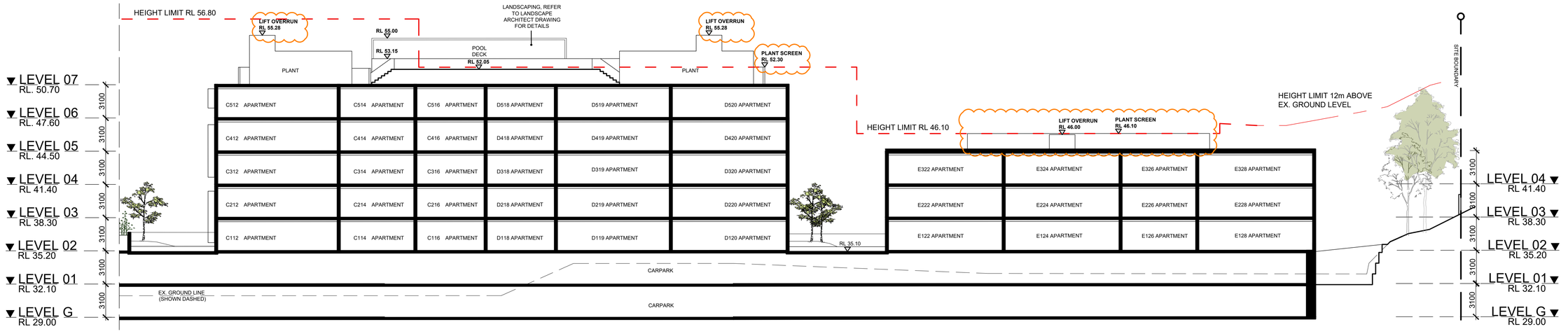
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SITE SECTIONS & ELEVATIONS 06

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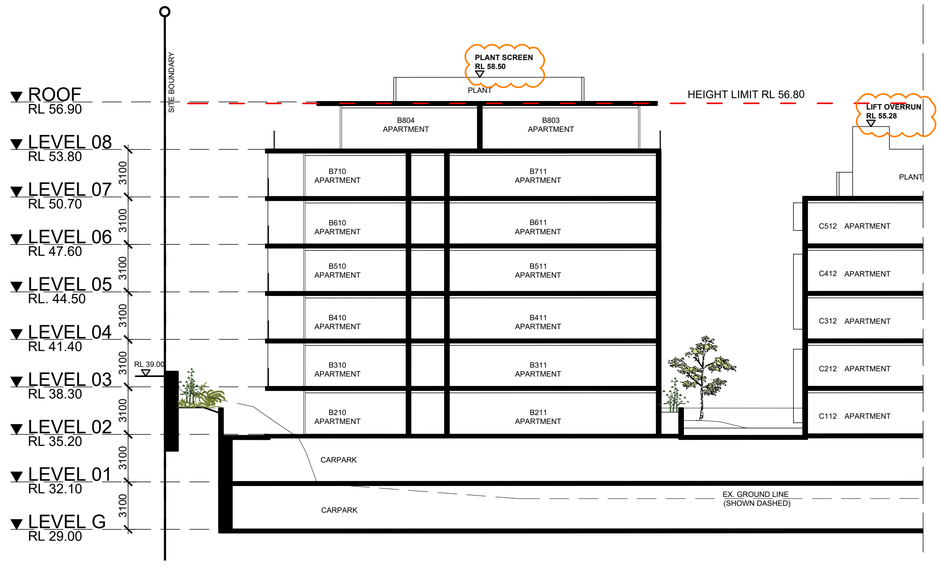
JOB	DRAWING	REVISION
17114	DA3.06	F



AA SECTION
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AA.01 SECTION
1:200

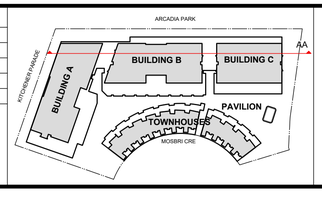


AA.02 SECTION
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DRAWING TITLE
SECTION AA

SCALE	DATE	DRAWN	CHECKED
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JOB	DRAWING		REVISION
17114	DA3.07		E

Appendix F - NL180367E01 Revision C

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newcastle@northrop.com.au
ABN 81 094 433 100

23 August 2020

NL180367_E01

Subsidence Advisory NSW
Kieran Black
PO Box 488
Newcastle NSW 2300

Dear Kieran,

Re: 11 – 17 Mosbri Crescent, The Hill – Mine Subsidence Impact Statement

Project Overview

It is proposed to demolish the existing building on the site.

The development proposal for the site consists of a series of town houses fronting Mosbri Crescent to the west of the site. This section of the development has a single level reinforced concrete basement structure with two storey lightweight framed residential townhouse apartments constructed over.

The eastern and northern part of the site has a separate two level reinforced concrete basement with three levels of apartments over the south eastern end and seven levels of apartments over the north eastern end of the basement i.e. ranging from five to nine levels in total. The residential apartments are located in three separate towers located over a podium that is located over the basement car park.

Mine Subsidence Design Parameters

Mine subsidence design parameters for the site following grouting have been prepared for the site by Coffey Geosciences and a peer review has been undertaken by Ditton Geotechnical and Professor Jim Galvin. Following meetings with SA NSW additional modelling work has been carried out and we understand that the agreed subsidence parameters for the preferred grouting option are those contained in the Ditton report No. COF 009/2a dated 22nd August 2020. The mine subsidence parameters are those outlined in Fig 1a-1e and Fig 4 enclosed in Appendix A.

- Maximum Vertical Subsidence = 20 - 50mm.
- Maximum Horizontal Tensile Strain of up to 3mm/m although these appear to only impact a small area around the perimeter of the site. Predicted strains across the remainder of the site are generally less than 1mm/m.
- Up to 60mm of Compressive Strain across the length of the basement in a north south direction due to valley closure.
- A maximum localised crack width of 30mm in an east west direction due to downhill slope movement as identified in Fig 4.

		Date
Prepared by	NP	23/08/2020
Checked by	MS	23/08/2020
Admin	BM	23/08/2020

- Maximum Tilt = <2mm/m under the apartment building footprint, <2.6mm/m under the townhouses.
- Maximum Curvature = 0.15km^{-1}.

The parameters will be subject to successful verification and grouting of mine workings.

Details of Proposed Development

The development proposal for the site consists of a series of town houses fronting Mosbri Crescent to the west of the site. This section of the development has a single level reinforced concrete basement structure with eleven two storey lightweight framed residential townhouse apartments constructed over.

The eastern and northern part of the site has a separate two level reinforced concrete basement with three levels of apartments over the south eastern end, seven levels of apartments over the north eastern end and four levels of apartments over the north west end of the basement i.e. ranging from five to nine levels in total. In total there are 169 residential apartments located in three separate towers over a podium that is located over the basement car park.

Externally there is a mixture of brick veneer and lightweight cladding and precast concrete, all being fully articulated to cope with the expected movements.

Mine Subsidence Risk Assessment and Design Mitigation Measures

The following measures will be incorporated into the design to minimise the impacts on the building, in the unlikely case of a mine subsidence event following grouting of the underlying mine workings.

For the residential townhouses we propose to use a waffle pod slab for the basement with pad footings incorporated into the overall depth of the waffle pod slab. Beneath the waffle pod slab, we will be providing a 100mm sand blinding layer over a layer of geotextile and two layers of polythene to provide a slip plane. This slip plane will tolerate a crack of 30mm opening-up under the basement slab. There are no compressive strains in this area so accordingly we will not need separation of the basement walls from the surrounding ground. Basement walls will be articulated at a maximum of 10m centres to allow for differential settlement and any tensile strains that the basement is subjected to. The upper floors being lightweight construction are inherently flexible and unlikely to require any further articulation other than that required by Australian Standards and product specifications.

All gravity services in this area will be documented with an additional 0.3% grade over that required by design to ensure minimum grades are maintained following a mine subsidence event and, wherever services enter the building from the ground, flexible connections will be documented to minimise or eliminate any damage to these services.

The residential apartments to the east and north of the site will be constructed as a reinforced concrete framed structure using isolated columns and discrete lift and stair shafts. The use of loadbearing wall structures will be avoided. Pad and piled footings will be isolated from the pile caps and columns to minimise the transfer of ground strains into the building superstructure and to cope with localised cracking of the ground although we note that there is only a moderate risk of cracking and/ or thrusting in this part of the site. The shoring structure will be separated from the main building structure so that the building only provides lateral support to the shoring/ retaining walls. Between the shoring/ retaining walls and the new concrete floor slabs we intend to utilise 100mm Styroboard XPS the same product that we specified on the Newcastle Private Hospital project. The Styroboard XPS will allow for the 60mm of compression in the north south direction to be isolated from the structure. Additionally, a number of movement joints will be provided in the basement and podium slabs that will have the ability to close up if any residual compressive or tensile strains are transferred into the structure.

The most difficult structural element to isolate from ground strains is the shoring wall itself. At this stage it is proposed that the shoring will be a contiguous pile wall with isolated piles and concrete infill sections. For 60mm of compression strain over the length of the site this equates to 0.4mm/m. The infill concrete sections are generally no more that 1800mm long and not physically connected to the piles but rather bear on the back of the piles so if the infill areas are subject to compression forces, they can slide around the back of the pile. Having said this it would be worth providing 10mm of Ableflex at one end of the concrete infill to ensure that this movement can take place. For tensile strains the piles will simply separate by less than a millimetre which will have no detrimental impact on the adequacy of capacity of the shoring. Importantly the wall is drained and not required to be watertight.

At the interface between the post tensioned floor slabs and the shoring we will be documenting Styroboard XPS that has sufficient compressive capacity to provide horizontal support to the shoring wall but will compress if subject to high compressive ground strains.

The entire structure will be analysed using a 3D finite element model (ETABS) with mine subsidence run as an additional load case to identify any additional forces imposed on the structure due to the predicted subsidence parameters. Additional reinforcement will be provided wherever the forces imposed from the mine subsidence load case exceed the forces imposed by other more traditional load cases.

Appropriate articulation will be documented to any brittle elements of the façade or internal finishes as required. For the subsidence parameters provided for this site this would generally be achieved by complying with the articulation requirements outlined in the relevant materials standards. However, anywhere we believe this is insufficient we will close-up the joint spacings.

All gravity services in this area will be documented with an additional 0.25% grade over that required by design to ensure minimum grades are maintained following a mine subsidence event and, wherever services enter the building from the ground, flexible connections will be documented to minimise or eliminate any damage to these services.

Other than the basement structure itself, the only inground structures are two very small stormwater pump out pits that will be isolated from the ground by founding them on a sand blinding layer and providing compressible material around the outside of the pits.

The only roadway on the site is an internal driveway from Mosbri Crescent to the basement entrance. We would suggest that this driveway is constructed using segmental pavers or asphalt both being flexible surfaces. Any concrete kerbs will be provided with joints at 3m maximum centres.

These details will be incorporated into the final construction documents and submitted to Subsidence Advisory NSW prior to construction of that part of the works.

Expected Impact of Mine Subsidence on Building Elements

Based on the facts outlined above, we would expect only minimal impact to the proposed building structure, façade and associated infrastructure as a result of the mine subsidence parameters outlined above.

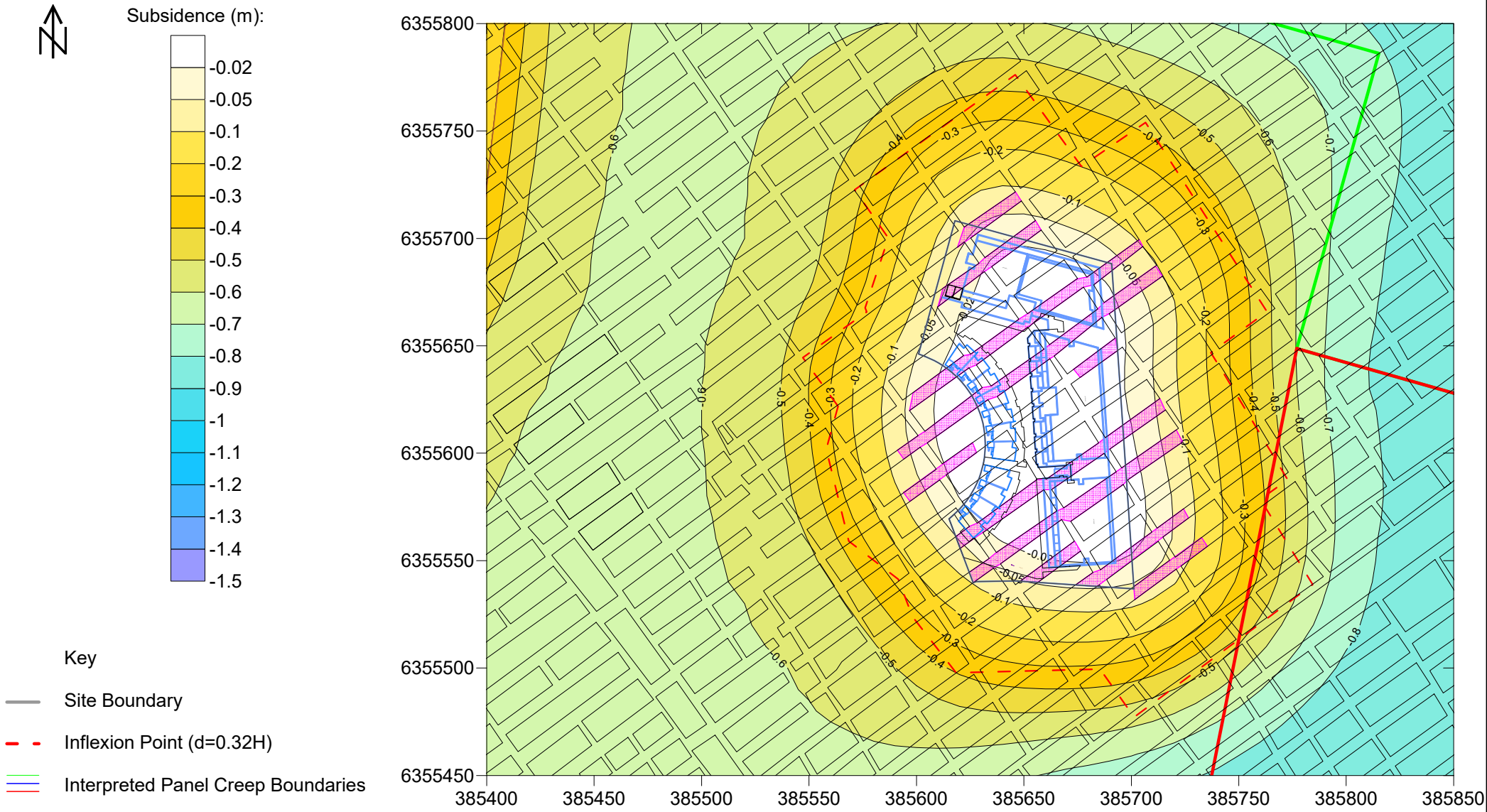
We trust this meets your requirements, however, should you require anything further, please do not hesitate to contact the undersigned.

Yours sincerely,



Neil Petherbridge
Northern NSW Business Manager | Principal
BEng (Civil), Grad Dip (Struct) FIEAust CPEng NER (Civil)

Appendix A

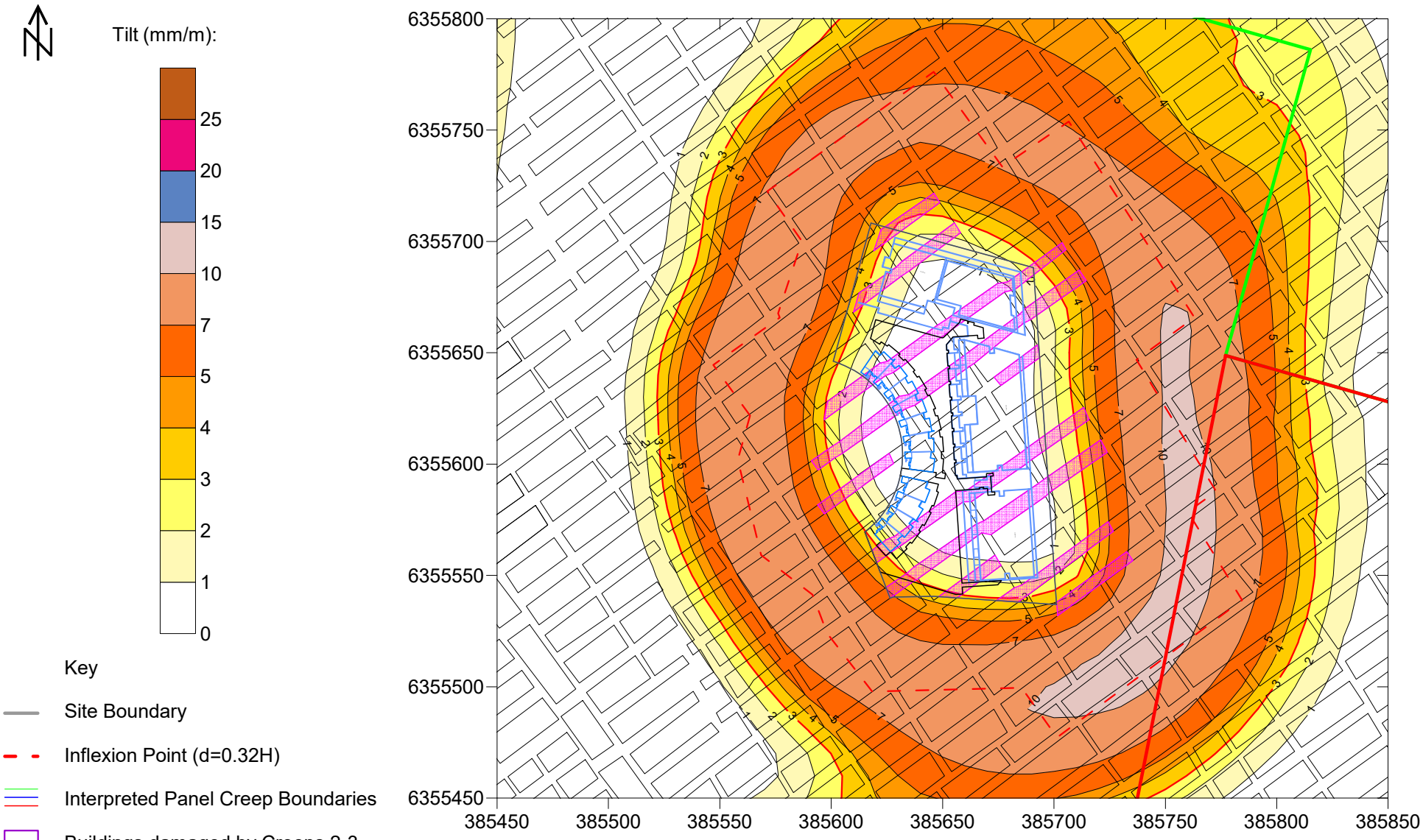


DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Predicted Final Subsidence Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.5)
Scale:	1:2,500 (A4)
Figure No:	1a

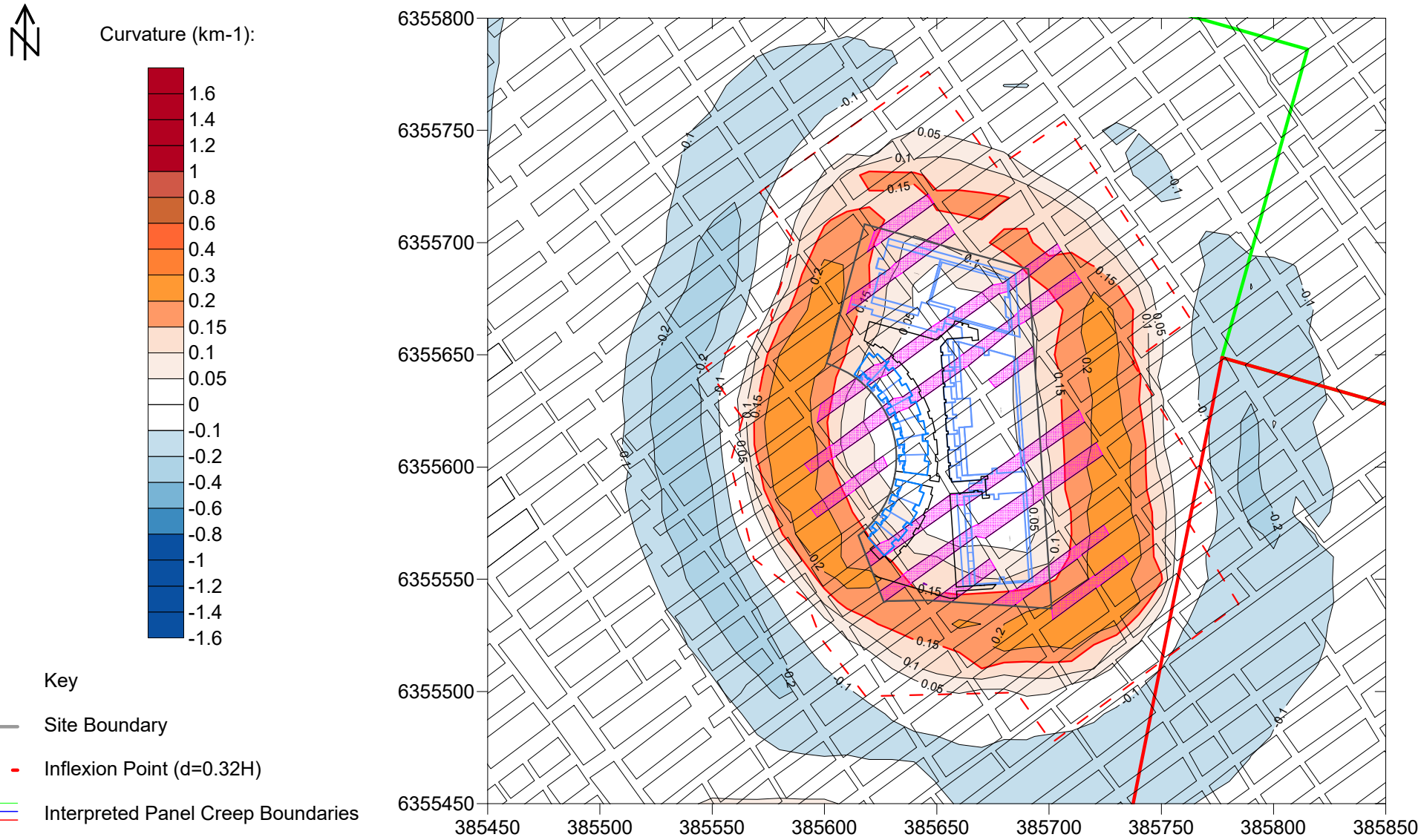


DgS

Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

Client:	Coffey COF-009/2a
Title:	Predicted Final Tilt Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.5)
Scale:	1:2,500 (A4)
Figure No:	1b



Key

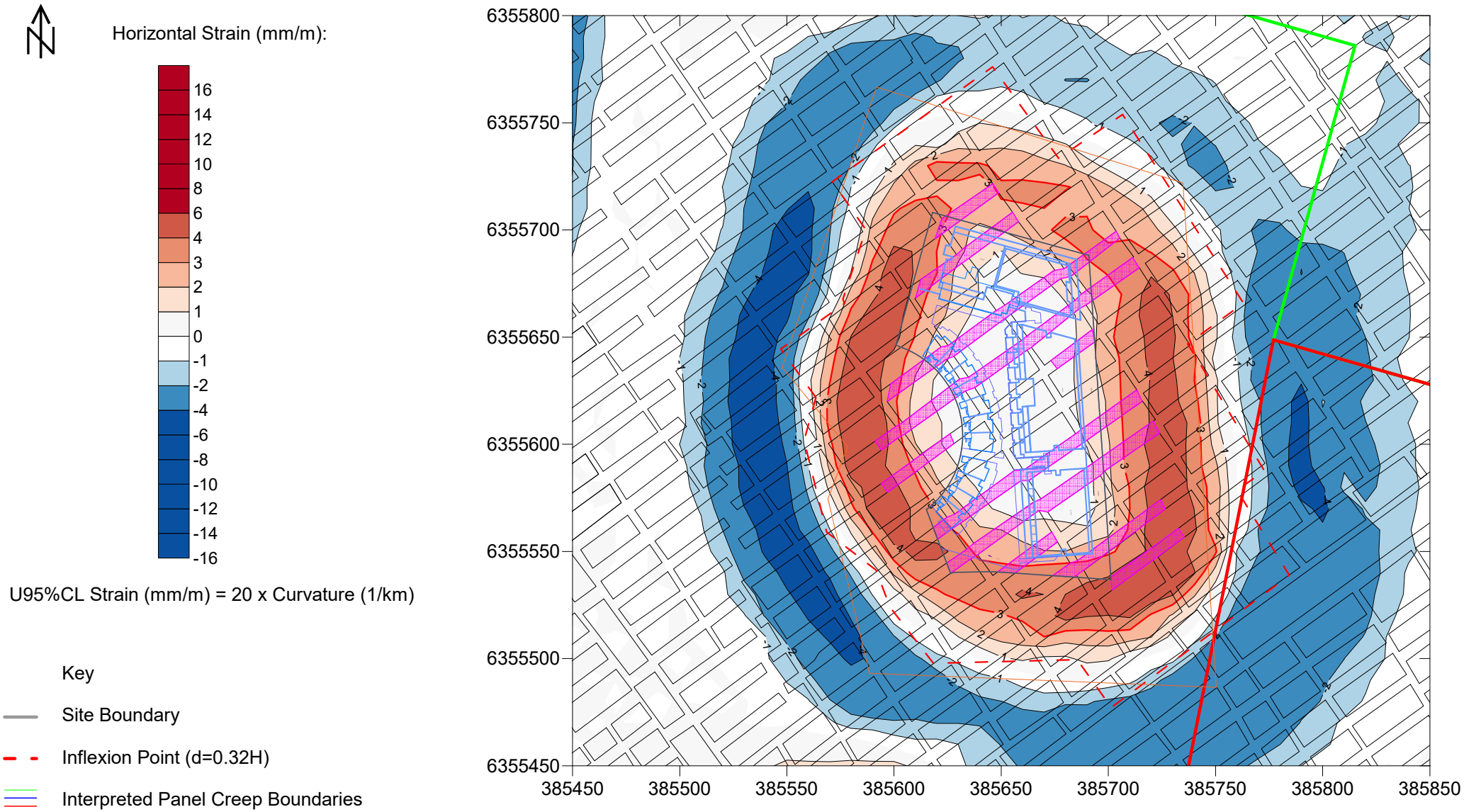
- Site Boundary
- Inflexion Point (d=0.32H)
- Interpreted Panel Creep Boundaries
- Buildings damaged by Creeps 2-3
- AAC Mine Workings Pillars in Borehole Seam
- Grout

DgS

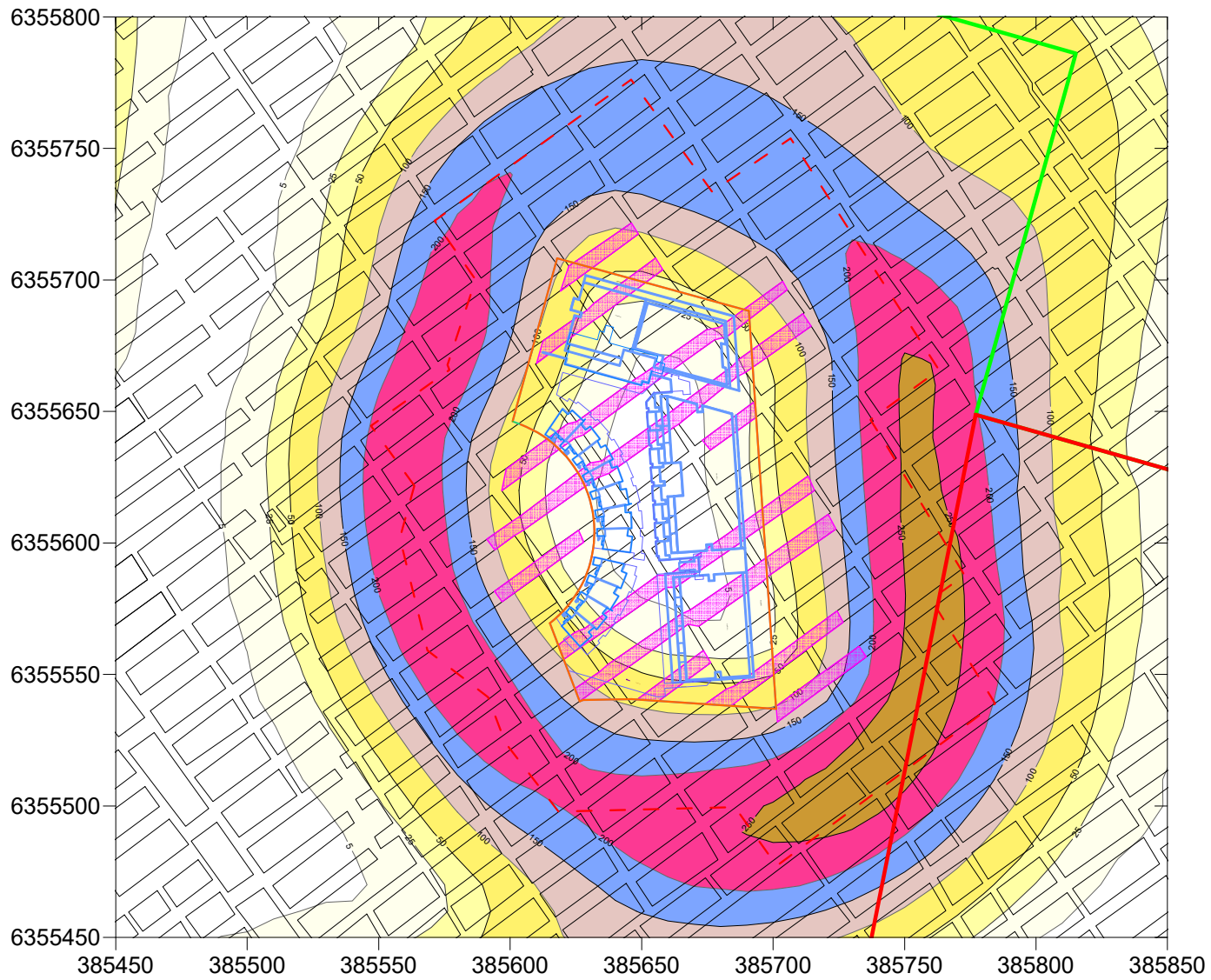
Ditton Geotechnical Services Pty Ltd

Engineer:	S.Ditton
Drawn:	S.Ditton
Date:	14.08.20

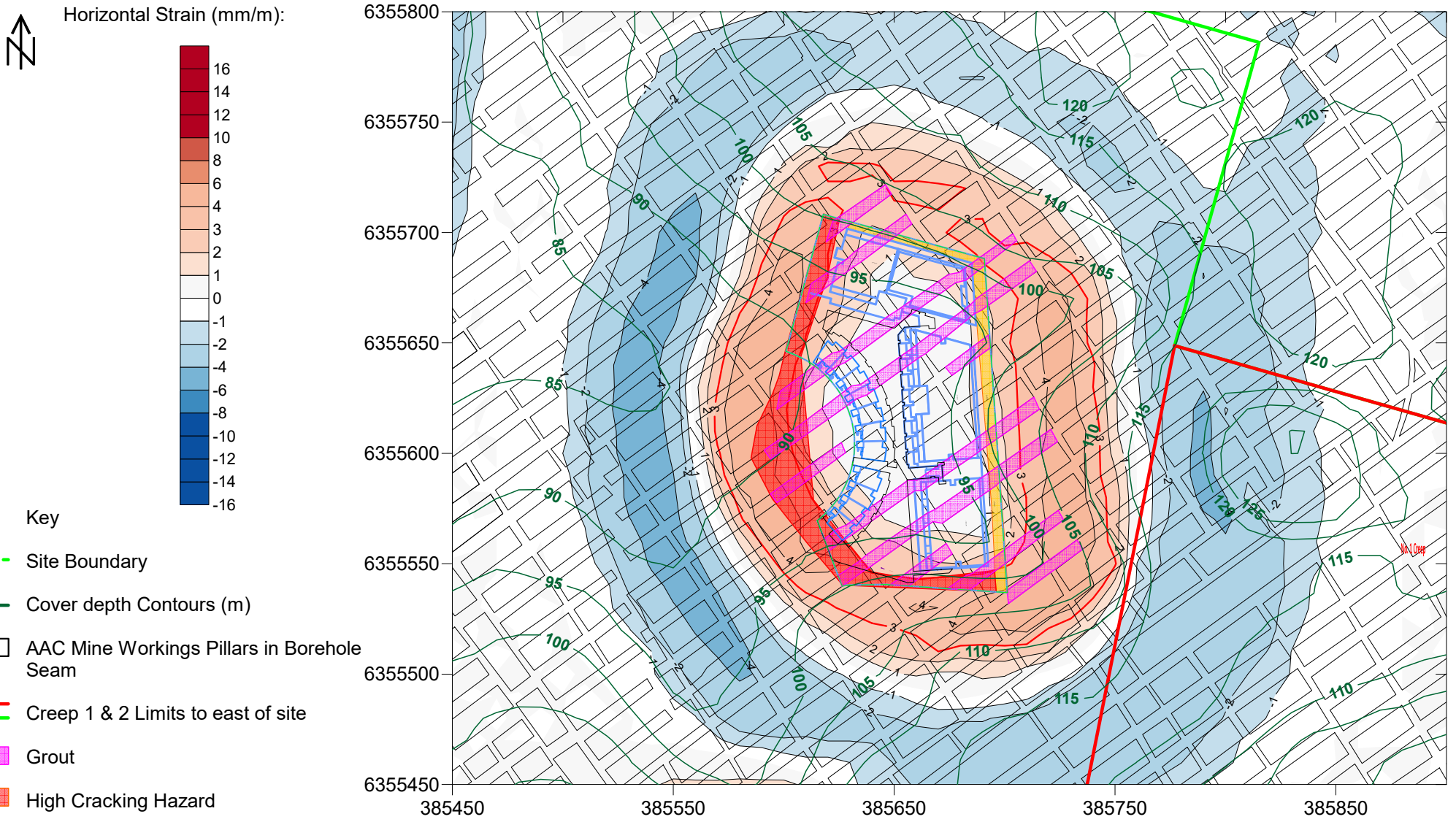
Client:	Coffey COF-009/2a
Title:	Predicted Final Curvature Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam:Preferred Option 2 (tanb=1.5)
Scale:	1:2,500 (A4)
Figure No:	1c



DgS Ditton Geotechnical Services Pty Ltd	Engineer: S.Ditton	Client:	Coffey COF-009/2a
	Drawn: S.Ditton	Title:	Predicted Final Horizontal Strain Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanb=1.5)
	Date: 14.08.20	Scale:	1:10,000 (A4) — Figure No: 1d



DgS Ditton Geotechnical Services Pty Ltd	Engineer: S.Ditton	Client:	Coffey COF-009/2a
	Drawn: S.Ditton	Title:	Predicted Final Horizontal Displacement Contours (Credible Worst Case) with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option (tanb=1.5)
	Date: 20.02.19	Scale:	1:10,000 (A4) — Figure No: 1e



DgS Ditton Geotechnical Services Pty Ltd	Engineer: S.Ditton	Client:	Coffey COF-009/2a
	Drawn: S.Ditton	Title:	Horizontal Strain Cracking Hazard Zones Due to Topographic Effects during Subsidence development with 5 MPa Strategic Grout in the Borehole Seam: Preferred Option 2 (tanB=1.5)
	Date: 14.08.20	Scale:	1:2,500 (A4) — Figure No: 4