THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LIMITED C/O
QUANTUMPLACE DEVELOPMENTS LIMITED

SUBDIVISION MINING IMPACT REPORT

THREE SISTERS VILLAGE - PHASE 1

NOVEMBER 2023

SUBDIVISION MINING IMPACT REPORT

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THREE SISTERS MOUNTAIN VILLAGE PROPERTIES LIMITED C/O QUANTUMPLACE DEVELOPMENTS

PROJECT NO.: CG09140
DATE: NOVEMBER 2023

WSP E&I Canada Limited
401, 1925 – 18 Avenue NE
Calgary, AB T2E 7T8

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WSP.com

"Effective September 21, 2022, Wood Environment & Infrastructure Solutions Canada Limited is now operating as WSP E&I Canada Limited. No other aspects of our legal entity, contractual terms or capabilities have changed in relation to this report submission."

November 10, 2023

Mr. Chris Ollenberger, P.Eng.
Three Sisters Mountain Village Properties Limited c/o QuantumPlace Development Limited
1026 16th Avenue NW, Suite 203
Calgary, AB T2M 0K6

Dear Mr. Ollenberger:

Subject: Subdivision Mining Impact Report, Three Sisters Village – Phase 1

This report is intended as an assessment of potential undermining hazards associated within the Three Sisters Village, Phase 1 project area and is the second report written under Alberta Regulation 34/2020 in this area. The report describes the following:

- The geological setting and mining history;
- The investigations undertaken in this assessment;
- WSP's understanding of the undermined areas, their current condition, and their potential impact on the roads and utilities;
- Mine subsidence hazards that could impact the roads and utilities; and
- Recommendations of areas for avoidance, for further investigation, or for potential mitigation for the potential hazards identified.

Should you have any questions or concerns, please contact the undersigned.

Yours sincerely,

Tod

James (Jim) Tod, M.Sc., P.Eng.
Principal Rock Mechanics Engineer

Blake Brodland

Blake Brodland, P.Eng.
Senior Geological Engineer

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Form 1
Compliance Certificate

Pursuant to the Canmore Undermining Review Regulation (AR 34/2020), a review of the land described in ***Subdivision Mining Impact Report for Three Sisters Village, Phase 1*** dated **10 November 2023** was carried out to determine whether the area is suitable for the intended development, ***Three Sisters Village, Phase 1***, having regard to undermining and related conditions. The review was made in accordance with the guidelines established by order of the Minister and accepted professional practice and accordingly includes the investigations considered necessary in the circumstances.

In my opinion, the land described in the above report is considered suitable for the intended development, subject to any mitigative measures outlined in the ***Subdivision Mining Impact Report for Three Sisters Village, Phase 1*** with respect to the undermining and related conditions.

JAMES TOD

Professional Seal

Municipality: Oakville, Ontario
Date: 10 November 2023

PERMIT TO PRACTICE
WSP E&I CANADA LIMITED
RM SIGNATURE:
RM APEGA ID #: 29016
DATE: 10 November 2023
PERMIT NUMBER: P004546
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Form 2

Compliance Review Certificate

Pursuant to the Canmore Undermining Review Regulation (AR 34/2020), I have made a review of the ***Subdivision Mining Impact Report for Three Sisters Village, Phase 1*** dated **10 November 2023** to determine whether the report complies with the guidelines established by order of the Minister and whether the review of the land described in the report was made in accordance with accepted professional practice and accordingly included the investigations necessary in the circumstances.

In my opinion, the ***Subdivision Mining Impact Report for Three Sisters Village, Phase 1*** complies with the guidelines established by order of the Minister.

In my opinion, the review of the land described in the ***Subdivision Mining Impact Report for Three Sisters Village, Phase 1*** was made in accordance with accepted professional practice and accordingly included the investigations necessary in the circumstances.

I certify that I did not assist in the preparation of the ***Subdivision Mining Impact Report for Three Sisters Village, Phase 1*** and I am not associated with or employed by the individuals or firm that prepared the undermining report.

DWAYNE TANNANT
ID 65075
November 11, 2023

Professional Seal

Municipality: Kelowna, British Columbia
Date: 10 November 2023

PERTMIT TO PRACTICE
GEOPACIFIC CONSULTANTS LTD
RM SIGNATURE:
RM APEGA ID #: 299522
DATE: NOV 11, 2023
PERMIT NUMBER: P010023
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Alberta Municipal Affairs

17th Floor, Commerce Place
10155 - 102 Street
Edmonton, Alberta T5J 4L4
Telephone 780-427-2225

AR113063

November 15, 2023

Chris Ollenberger, P. Eng.
Managing Principal
Quantum Place Developments Ltd.
Suite 203
1026 – 16 Avenue NW
Calgary, AB T2M 0K6

Dear Chris Ollenberger:

In accordance with Section 5(3) of the Canmore Undermining Review Regulation, this letter is to notify you of the receipt of the *Subdivision Mining Impact Report – Three Sisters Village Phase 1*, dated November 2023, together with the attendant compliance certificates as required by Section 5(2) of the Regulation.

We will also be implementing a streamlined process to accept reports. Any future submissions can be emailed to ma.updates@gov.ab.ca.

Please reach out to me at andrew.horton@gov.ab.ca if you have any questions or concerns.

Yours truly,

Andrew Horton
Executive Director
Municipal Policy and Engagement Branch

cc: James Tod, Senior Associate Rock Mechanics Engineer
WSP E & I Canada Ltd.

Sally Caudill, Chief Administrative Officer
Town of Canmore

EXECUTIVE SUMMARY

This Subdivision Mining Impact Report has been prepared by WSP E&I Canada Limited for Three Sisters Mountain Village Properties Limited (TSMVPL), care of QuantumPlace Developments Limited (QPD) as required by Alberta Regulation 34/2020. The work included assessing the proposed Three Sisters Village, Phase 1 for undermining considerations. The proposed Three Sisters Village, Phase 1 development is located in Canmore, Alberta.

To address the potential risks associated with development in proximity to the historic surface and underground coal mining in and around Canmore, the Province of Alberta had previously approved Alberta Regulation 114/97, the Canmore Undermining Review Regulation. As part of the review of the Municipal Government Act undertaken by the Province of Alberta between 2012 and 2020, TSMVPL had requested that the 114/97 Regulations and associated Guidelines be updated to reflect over 20 years of experience accumulated within the regulated area, and to better align the regulations with the stages of planning approvals to provide improved clarity of process to TSMVPL and the public. QPD, the Town of Canmore and the Province of Alberta worked together to prepare updated guidelines and regulations, which led to the Province of Alberta publishing the updated Alberta Regulation 34/2020 dated 17 March 2020 (the Regulations) concerning development on undermined lands so that risks from surface and underground mines can properly be considered and mitigated as appropriate. In addition to the Regulations, an updated set of guidelines entitled 2020 Guidelines to Evaluate Proposed Development Over Designated Undermined Lands in the Town of Canmore, Alberta dated 01 April 2020 (the Guidelines) was prepared that reflected current practice and modern risk considerations; the Guidelines were also approved by the Province for use.

An area hazard map was prepared for the entire Three Sisters Village (including Phase 1) and is presented in a report by WSP (previously known as Wood Environment & Infrastructure Solutions) titled Area Mining Impact Overview Report Resort Village Area Structure Plan_Rev2, dated 16 November 2020.

The present work included reviewing the following items: LiDAR, orthophotos, Canmore coal mine plans and boreholes in the Alberta Energy Regulator database, Canmore bedrock geology maps, proposed land uses and conceptual roads for Three Sisters Village, boreholes, downhole camera videos, multiple site walkthroughs, and existing undermining and inspection reports for the area written by others spanning back for over 20 years. Using various sources of data a three-dimensional model for the underground mine workings was created. This model allowed for specific sections to be cut through areas of interest. A total of two mines partially underly Three Sisters Village, Phase 1: Morris No. 1 and Stewart No.2 mine.

Confirmation dependant recommendations are provided to mitigate against undermining hazards in the following areas: the four portal locations, four gravel subcrop locations, areas where workings are shallower than 20 m deep, the four depillared panels. Subsequent investigation either prior to or as part of the mitigation process may provide opportunity to adjust the recommended mitigation areas.

Areas not impacted by undermining include blocks: 27, 28a, 28b, 30a and 30b, as well as the dry stormwater pond, various playgrounds, and bicycle pump track. These areas require no further investigation or work and this report satisfies Section 6(1) in AR34/2020, and represents a Project Undermining Assessment Report for these areas that are not impacted by undermining.

A compliance certificate in accordance with AR 34/2020 is enclosed within this report.

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APPENDICES

1 INTRODUCTION

WSP E&I Canada Limited (WSP) is pleased to submit this report to Three Sisters Mountain Village Properties Limited (TSMVPL), care of QuantumPlace Developments Limited (QPD). This work was completed in fulfillment of Work Order 004 signed on 26 February 2021, and contractually covered by the Master Services Agreement signed on 23 June 2020.

It is understood that TSMVPL will be developing the Three Sisters Village to the west of Three Sisters Parkway (Highway 742), across from the existing Cairns Landing development, utilizing a multi-year phased approach. Phase 1 is the first phase being developed, and an overview map of the proposed Phase 1 site in relation to Canmore and nearby surrounding development is shown in **Figure 1**. A closer view of the project area, including the 500 m Public Safety Assessment Area overlain on orthophoto and LiDAR backgrounds are shown on **Figure 2** and **Figure 3**, respectively. A close-up view of the Phase 1 development, including elevation contours is shown as **Figure 4**.

1.1 REGULATION OVERVIEW

To address the risks associated with development in proximity to the historic surface and underground coal mining in and around Canmore, the Province of Alberta had previously approved Alberta Regulation 114/97, the Canmore Undermining Review Regulation. As part of the review of the Municipal Government Act undertaken by the Province of Alberta between 2012 and 2020, TSMVPL had requested that the 114/97 regulations and associated guidelines be updated to reflect over 20 years of experience accumulated within the regulated area, and to better align the regulations with the stages of planning approvals to provide improved clarity of process to TSMVPL and the public. QPD, the Town of Canmore and the Province of Alberta worked together to prepare updated guidelines and regulations, which led to the Province of Alberta publishing the updated **Alberta Regulation 34/2020** dated **17 March 2020** (the Regulations) concerning development on undermined lands so that risks from surface and underground mines can properly be considered and mitigated as appropriate. In addition to the Regulations, an updated set of guidelines entitled **2020 Guidelines to Evaluate Proposed Development Over Designated Undermined Lands in the Town of Canmore, Alberta** dated **01 April 2020** (the Guidelines) was prepared that reflected current practice and modern risk considerations; the Guidelines were also approved by the Province for use.

This Subdivision Mining Impact Assessment Report is intended as an assessment of potential undermining hazards associated within the project area and is the second report written under Alberta Regulation 34/2020. The report describes the following:

- The geological setting and mining history;
- The investigations undertaken in this assessment;
- WSP's understanding of the undermined areas, their current condition, and their potential impact on the roads and utilities;
- Mine subsidence hazards that could impact the roads and utilities; and
- Recommendations of areas for avoidance, for further investigation, or for potential mitigation for the potential hazards identified.

This report has been prepared using the 2020 Regulations and Guidelines.

1.2 PROPOSED DEVELOPMENT

The proposed development for Phase 1 is shown on **Figure 5** and is expected to consist of:

- ten residential parcels for development, consisting of townhomes, apartments and semi-detached units expected to range from two to five stories in height;
- access roads and utilities;
- steep creek hazard diversion berms along the Three Sisters Creek; and
- a dry stormwater pond.

1.3 EXISTING HAZARD MAPPING WORK

An area hazard map was prepared for the entire Three Sisters Village (including Phase 1) and is presented in a report by WSP (previously known as Wood Environment & Infrastructure Solutions) titled *Area Mining Impact Overview Report Resort Village Area Structure Plan_Rev2*, dated 16 November 2020. The development hazard mapping of the entire Three Sisters Village, as determined from this earlier report, are shown in **Figure 6**, with Phase 1 outlined.

1.4 PRESENT SCOPE OF WORK

The purpose of this project is to develop a Subdivision Mining Impact Report for Three Sisters Village – Phase 1 according to the Guidelines.

The steps outlined in Sections B.2 and B.3 of the aforenamed document specify the technical evaluation process appropriate for a subdivision Mining Impact Overview Report, which is to consist of the following:

- Prepare site-specific maps and conduct field investigations;
- Identify mining features, map hazard zones and estimate ground deformations (where appropriate);
- Recommend mitigation of mining features as required; and
- Prepare subdivision mining impact assessment report.
- Identify blocks or areas that are not impacted by undermining such that this report will suffice as a Project Undermining Assessment Report for the identified areas under the Regulations.

2 GEOLOGICAL BACKGROUND

The bedrock geology, surficial geology, and groundwater considerations for the site are presented in the following sections.

2.1 BEDROCK GEOLOGY

The Canmore area is located in the northern portion of the Cascade Coal Basin, a northwest trending zone that extends approximately 80 km within the Front Ranges of the Rocky Mountains of Alberta. Bedrock at the site consists primarily of the Kootenay Group, a Lower Cretaceous to Upper Jurassic age coal-bearing formation.

Stratigraphically from the bottom up, the Kootenay Group consists of the Morrisey (Weary Ridge, Moose Mtn), Mist Mountain, and the Elk formations. These sedimentary units were deposited within a broad coastal plain environment associated with the Columbia Orogeny. The Mist Mountain Formation, which is up to 1000 m thick, underlies the study area, and is comprised of interbedded sandstone, siltstone, mudstone, and coal. These units are interpreted as deltaic and/or fluvial/alluvial/plain deposits. Economic coal seams are present throughout the stratigraphic sequence in seams up to 18 m thick (Mossop, 1994).

Within the Mist Mountain Formation, the bedrock units are folded into asymmetric syncline/anticline pairs with fold axes that plunge approximately 10° to the southeast. The northeast syncline limbs generally dip to the southwest at between 10° and 35°, while the southwest limbs of the synclines range from near vertical to overturned. These seams have been repeated by thrust faulting, shear faults, and late-stage extensional faulting. Extensive shearing, structural thinning and thickening have occurred within the core of the folds and acted as natural boundaries to the mineable reserves. The repeating coal seam sequence associated with the faulting has brought the coal units in the formation within mineable depths from the ground surface.

Within the study area, the stratigraphy generally dips shallowly to the south-southwest at between 8° and 20°, as illustrated in **Appendix C**.

The coal in the Mist Mountain Formation varies between medium and low volatile bituminous coal and a firm coherent coke. However, in the vicinity of Canmore, high geothermal conditions associated with intrusive activity resulted in high volatile bituminous and semi-anthracitic coals in this area (Mossop, 1994). The general geology of the Canmore area is shown in plan and section on **Figure 7**. A more detailed description of the bedrock geology is provided in **Appendix A**.

2.2 SURFICIAL GEOLOGY

Bedrock at the site is overlain by a mix of glacial, alluvial and colluvial deposits, with thicknesses ranging typically between 0 and 30 m. The lowermost layer at the site is glacial till, generally described as competent material consisting of a mixture of clay, silt, sand, gravel, cobbles, and boulders. This is overlain by colluvial materials at or near the base of natural slopes and consists of a mix of materials including till and other sediments, as well as rock debris. The alluvial deposits are typical fan-type highly permeable sands and gravels and are generally located adjacent to active mountain streams.

Both mines (Stewart Seam, No. 2 Mine and Morris No. 1 Seam, No. 2 Mine) within the footprint of the Phase 1 Development encountered gravel subcrops in portions of the upper easternmost limits of mining as discussed in subsequent sections of this report.

2.3 GROUNDWATER

The perched groundwater profile within the overburden generally follows the orientation of the ground surface towards the Bow River. The underground mine workings impact the deeper groundwater, with multiple studies indicating that the groundwater level typically fluctuates between 1310 and 1316 masl (Jacques Whitford, 2006). Historically, the surficial geology for parts of the site identified some areas as swamp; however, the groundwater regime was changed due to the underground mining, resulting in drainage of the swampy areas. From the LiDAR data and site walkthroughs, there is considerable evidence of local drainage ditches and wooden culverts, likely constructed during mining presumably to drain surface water and not allow it to enter the mines. This report does not include a hydrogeological study of the area and WSP does not recommend that one is completed. Further discussion is presented on groundwater levels as measured by WSP in subsequent sections of this report.

3 MINING BACKGROUND

Coal mining in the Canmore area began in the late 1800's to support the steam powered transcontinental Canadian Pacific Railway that ran through the Bow Valley. Semi-anthracite and bituminous coal were mined to produce steam for the trains and coke for smelting, respectively. The production of coal expanded through the First and Second World Wars. In the 1950's the railway began using diesel power instead of steam, lowering the local demand for coal. International demand kept the mines operating until 1979, when the price of coal dropped due to competition and reduced demand. This led to the closure of all coal mines in Canmore. Details of the mining history of the Canmore area are more fully described in **Appendix A**.

Two coal seams have been exploited beneath the project area, as summarized in **Table 3-1**. **Figures 8** and **9** show the layouts of each mine in plan view relative to the project area. Cross sections of the workings in relation to the project area can be seen in **Appendix C**.

Table 3-1 Mines Underlying the Phase 1 Development after Norwest 1994

SEAM NAME, MINE NAME	MINING DATES	AVERAGE SEAM THICKNESS (M)	AVERAGE MINED HEIGHT (M)	DEPTH RANGE BELOW PROJECT AREA (M)
Stewart Seam, No. 2 Mine	1914 - 1952	2.13	2.13	0 – 130
Morris No. 1, No. 2 Mine	1924 - 1941	2.0	2.0	0 – 55

Mining in the region was generally conducted via the room and pillar method, which typically consists of two phases:

- First is the development phase, in which a grid of tunnels is created (rooms) separated by a network of large pillars. During this phase, the extraction ratio (areal ratio of extracted coal to the initial in-situ coal in a seam) ranges from 20 to 40 percent and the pillars are large.
- Second is pillar recovery or the de-pillaring phase, which begins when the development has reached its ultimate mineable extent in the seam or area of interest. During this phase, the initial pillars are reduced in size to remove as much coal as practicable. The extent of de-pillaring is a function of the quality of the coal, the conditions of the ground around the coal (i.e., the mine roof, in particular), and general economics. De-pillaring can increase the overall extraction ratio to between 50 and 75% (Norris, 1953; **Appendix A**).

The mines within the study represent the westernmost mine workings for the overall No. 4 mining area, which from east to west, consists of the Wilson Mine, the No. 4 Mine – No. 4 Seam, the No. 2 Morris, and the No. 1 Morris. The Stewart Mine extends from the No. 4 Mine into the No.2 Mine seam and overlies the No. 1 Morris workings. The characteristics of each mining seam, as well as their mining histories are provided in the following subsections.

3.1 STEWART NO. 2

The Stewart No. 2 mine is stratigraphically the uppermost seam mined in the vicinity of the study area and is also the uppermost economic seam in the coal bearing sequence in the Canmore area. The average thickness for this mine is 2.13 m, which has a shallow dip to the southwest in the study area. The mine operated between 1914 and 1952. This mine in relation to the Phase 1 project area is shown on **Figure 8**.

The miners encountered two (2) subcrops on the eastern limit of this mine (northwestern corner and western edge of the Project Area) while following the contour of the coal. These two locations are marked on **Figure 8**. The presence of subcrop at this location increases the potential for surface subsidence due to the lack of bedrock cover.

Within the project area limits there is one (1) known portal to this mine. This location is marked on **Figure 8.** In addition, there are shafts and portals present within the 500 m public safety assessment area. These have been mitigated for public safety as discussed within the Area Structure Plan report (Wood's Area Mining Impact Report: Resort Village Area Structure Plan_Rev2, dated 16 November 2020). Visual inspection during the site reconnaissance for the preparation of the Area Structure Plan report indicated no evidence of changed conditions for these areas. Periodic inspections of these areas (which could be completed as part of overall land reviews) should be undertaken to verify ongoing stability.

3.2 NO. 1 MORRIS

The No. 1 Morris mine underlies the Stewart seam, and exploited the same seam as the Sedlock mine (located to the west / northwest). The average thickness of the seam is 1.83 m, although records indicated that in the vicinity of the Morris mine the mined thickness is on average 2 m. Within the study area, the seam dips shallowly to the southwest. The location of the No. 1 Morris mine workings in relation to the Phase 1 project area is shown on **Figure 9**.

The overlying rock mass between the Morris and the Stewart seam consists primarily of siltstone ranging between 10 and 90 m thick, but with an average thickness of 49m between the seams. The Morris seam is underlain by fine sandstone. The southeast portion of the Morris seam in the study area has been disrupted by a thrust fault, which displaced the seam to the east. This displaced seam underlies the No. 1 Morris and is referred to as the No. 2 Morris Seam. The Morris seams are part of the overall No. 4 Mine area.

The miners encountered the subcrop on the eastern limit of this mine (northern edge of the Project Area) and also on the southern edge of the Project Area) while following the contour of the coal. These two locations are marked on **Figure 9**. The presence of subcrop at these two locations increases the potential for surface subsidence due to the lack of bedrock cover.

Within the project area limits there are three (3) known portal to this mine. These three locations are marked on **Figure 9.** In addition, there are shafts and portals present within the 500 m Public Safety Assessment Area. These have been mitigated for public safety as discussed within the Area Structure Plan report (Wood's Area Mining Impact Report: Resort Village Area Structure Plan_Rev2, dated 16 November 2020). Visual inspection during the site reconnaissance for the preparation of the Area Structure Plan report did not indicate any evidence of changed conditions for these areas. Periodic inspections of these areas should be undertaken to verify ongoing stability. These inspections could be completed as part of overall land reviews, which have been previously undertaken by TSMVPL.

4 DESKTOP REVIEW

This report builds upon the earlier work presented by Wood in the Area Mining Impact Report Resort Village Area Structure Plan_rev2, dated 16 November 2020 (Wood, 2020).

The desktop portion of this assessment consisted of a review of numerous sources of data provided by QPD and acquired via public sources.

The following reviewed sources are within public domain or were purchased for this specific project:

- LiDAR and Orthophotos from the Town of Canmore, flown in June 2013;
- Canmore Coal Mine Plans from the Alberta Energy Regulator database;
- Canmore Boreholes from the Alberta Energy Regulator database;
- Canmore Bedrock Geology Map, Geological Survey of Canada, Map 1266A, Scale 1:50,000, dated 1970; and
- Canmore Museum Microfiche Records.

The following sources were provided by QPD from TSMVPL's database of previous work:

- Copies of coal mine line work and scans of mine plans from the Alberta Energy Regulator database and Canmore Museum;
- Line work of proposed land uses, conceptual road layouts, and potential building footprint areas;
- Borehole logs completed by others;
- Borehole videos and surveys by others; and
- Existing undermining and other relevant reports prepared by others for the current site and surrounding areas.

4.1 ALBERTA ENERGY REGULATOR BOREHOLE DATABASE

Boreholes in the Alberta Energy Regulator (AER) Library were drilled between 1967 and 1976 by private companies, often for exploration purposes, and later handed over to the AER library. A total of 18 AER boreholes exist within the 500 m public safety assessment area surrounding the Phase 1 Development, none of which are within the project area. The minimum, maximum and average length of these 18 boreholes was 35.0 m, 249.9 m and 99.3 m, respectively. The locations of the AER boreholes are shown on **Figure 10**.

4.2 OTHER EXISTING BOREHOLES

Another 377 boreholes were drilled within the 500 m public safety assessment area between 1998 and 2008 by others working for TSMVPL for the purposes of ground truthing the site, verifying the accuracy of the plans and the seam limits, clarifying the ground conditions associated with observed hazards, and to stabilize voids through the injection of paste or to observe the extent of paste migration performed as part of previous site mitigation work. Of these, 36 boreholes are located within the Phase 1 project area, and borehole logs have been provided to WSP.

The minimum, maximum and average borehole lengths of the 36 boreholes within the footprint of Phase 1 are 9.5 m, 62.5 m and 30.9 m, respectively. These borehole locations are also shown on **Figure 10**.

4.3 PREVIOUSLY MAPPED FEATURES AND LIDAR REVIEW

Please refer to Wood's Area Structure Plan report for details on previously mapped features, LiDAR and site walkthrough. A summary of historically identified features by others within the project area are presented in **Table 4-1** and shown on **Figure 11**. The feature type, feature description and mitigation details columns have not been modified from the original data provided by others. WSP visited all previously mapped features within the site, as well as other features based on LiDAR data and mine maps. LiDAR data from 2013, 2015 and 2023 were reviewed independently for features of interest, and also for changes using change detection methodology. There were no unexpected features of note identified within the Phase 1 site boundaries. GPS tracks from WSP's field inspection are shown as **Figure 12**. During the field inspection, no changes were noted in the surface features identified by others, and none were observed to explicitly require immediate mitigation within the development area.

During the site walkthrough, WSP noted a series of circular depressions approximately 0.5 to 1.0 m in diameter and approximately 0.5 m deep. These features are outside of the Phase 1 project area, but within the 500m Public Safety Zone. These features were noted approximately 60 m west of the Phase 1 boundary and outside of the known mined area. These features are labelled on **Figure 11**. A review of the mine scans shows two thrust faults and one strike-slip fault coalescing in this area; and WSP believes that these features are related to the faulting and not to undermining.

Table 4-1 Previously Mapped Features by Others Within Phase 1 Development

FEATURE ID	FEATURE TYPE	FEATURE DESCRIPTION BY OTHERS	MITIGATED (Y/N)	MITIGATION DETAILS AS PER OTHERS	WSP DISCUSSION
B99	Portal	Reclaimed portal - gravel pushed inside and over top.	Y	Backfilled portal. No movement as of last inspection	Previously mitigated. No concerns noted in field.
UMA9	Portal	Portal access to depillared area of No. 2, No. 1 Morris workings, 15° slope. Not over recorded workings.	Y	Reclaimed portal - gravel pushed inside and over top. Further mitigation not required. Previously excavated and backfilled with local materials (Norwest, 2001).	Previously mitigated. Air noted to be flowing from several small holes, approximately 0.05 m in diameter.
B38	Shaft	Site of No. 2 Stewart air shaft in gravel about 7 m deep to seam with 16° dip.	Y	Mitigated by Golder Associates Ltd. (2001) during Three Sisters Creek Subdivision 500 m Mitigation Program. Excavated to heading in seam. Heading plugged with 77 m^3 of concrete. Backfilled.	Previously mitigated. No concerns noted in field.
PR-54	Prospect	Probably prospect. Not over recorded workings. Possibly seeking No. 1 Morris Seam.	Y	Could not locate - probably opened up into portal (see B107) (Norwest, 2001).	Previously mitigated. No concerns noted in field.
PR-39	Prospect	Small hole into water filled prospect.	Y	Mitigated by Golder Associates (2001). Cleared of large vegetation, backfilled with 30 m3 of gravel pit run and graded. Mitigated together with PR-38.	Previously mitigated. No concerns noted in field.
PR-38	Prospect	Possibly seeking Morris Seam subcrop.	Y	Mitigated by Golder Associates (2001). Cleared of large vegetation, backfilled with 30 m^3 of gravel pit run and graded. Mitigated together with PR-39.	Previously mitigated. No concerns noted in field.
B101	Prospect	Probably prospect. Possibly portal to 15° slope. This feature has material built up on either side of it and looks like a channel without debris at the bottom of it. Numerous small depressions, 0.3 - 0.6 m deep. Remains of prospects PR38 and PR39.	Y	Opened up and temporarily backfilled with local materials during Parkway construction (Norwest, 2001).	Reportedly previously mitigated., however a depression approximately 10 m long, 0.5 m wide and 0.5 m deep noted in this location parallel to a slope. This is typical of prospects. No undermining concerns noted in field.
G317	Prospect	Shallow, square depression 0.8 m long, 0.5 m wide and 0.5 m deep. Notable rock present on sides.	N	Inspected by Golder Associates (2004). May regrade prior to development. Mitigation not required. Not considered hazardous at time of report.	Feature matching this description noted, but not "notable rock". No concerns noted in field.
B107	Portal	Portal access to depillared area of No. 2, No. 1 Morris workings, 15° slope. Possible location of reclaimed portal. Area wooded with small trees.	Y	Excavated and temporarily backfilled with local materials during Parkway construction (Norwest, 2001).	Previously mitigated. No concerns noted in field.

FEATURE ID	FEATURE TYPE	FEATURE DESCRIPTION BY OTHERS	MITIGATED (Y/N)	MITIGATION DETAILS AS PER OTHERS	WSP DISCUSSION
		No sign of subsidence, only some coal and shale, mining debris.			
B106	Water-course	Approx. 50 m long depression. Could be of natural origin. Narrow at the west and, 1 m wide and 1 m deep, progressively wider and deeper towards west where it is 10 m wide and 5 m deep. Some water seeping from the sides and floor at the west forming a stream. Possibly remains of borrow pits supplying gravel to block off adjacent to No. 1 Morris Portal.	N	Inspected. No mitigation required.	Erosion gulley noted in field. Water is being directed to this location through an upstream ditch, orientated approximately NE-SE as seen on the LiDAR.
B103	Surface Debris	Drainage ditch above shallow workings, 30 – 50 m long, 1 m wide, 0.5 - 0.7 m deep with flat bottom and vertical sides.	N	Inspected. No mitigation required.	Feature is parallel to a linear tree clearing and modern-day biking pathway, possibly originally cleared for construction access.
B102	Surface Debris	Trench like watercourse depression 20 m long, 1 m across and 0.7 m deep. Flat vertical sides. Possible surface excavation.	N	Inspected. No mitigation required.	Feature is parallel to a linear tree clearing and modern-day biking pathway, possibly originally cleared for construction access.
B37	Cave Subsidence	Square shaped depression, 15 m long, 7 m wide, 1 m deep, sharp edges, grass and small trees.	Y	Mitigated by Golder Associates Ltd. during Three Sisters Creek Subdivision 500 m Mitigation Program (2001). Feature was excavated and backfilled with approx. 100 m^3 of material.	Previously mitigated. No concerns noted in field.
B68	Subcrop Subsidence	3 m diameter hole, 1.5 m deep with steep edges along south and southwest sides. 8 m gravel cover over workings. Grass and trees. No recent movement. No danger.	Y	Regraded during Three Sisters Creek Golf Course (TSCGC) development, (2007). Mitigated by Golder Associates Ltd. (2001) during Three Sisters Creek Subdivision 500 m Mitigation Program. Feature was incorporated into feature B67.	Previously mitigated. No concerns noted in field. Modern access road exists in this location.
B67	Subcrop Subsidence	Irregular sink hole 5 m long and 10 m wide, with max depth of 1.2 m. There are two distinct holes inside this depression, 0.5 m diameter, 1 m deep with vertical sides. Grass and trees. 8 m gravel cover over workings.	Y	Regraded during TSCGC development (2007). Mitigated by Golder Associates Ltd. (2001) during Three Sisters Creek Subdivision 500 m Mitigation Program. Feature was excavated and backfilled with approx. 50 m^3 of material.	Previously mitigated. No concerns noted in field. Modern access road exists in this location.
B100	Portal	Small depression, 2 m diameter, 0.5 m deep. Small shrub and grass growing. Depression over slope from B99 portal.	N	Inspected. Indistinguishable from native ground	No concerns noted in field. Modern biking trail exists in this location.

FEATURE ID	FEATURE TYPE	FEATURE DESCRIPTION BY OTHERS	MITIGATED (Y/N)	MITIGATION DETAILS AS PER OTHERS	WSP DISCUSSION
B89	Non-mining Related	Small and shallow depressions above old U/G workings 0.5 m - 0.7 m deep. Suspected portal. No danger. Recognizable only because of mine plan showing U/G workings.	N	Mitigation not required.	No concerns noted in field.
B108	Watercourse	No subsidence. Some water seeping from ground forming a stream.	N	No Mitigation Required. Feature washed away by Three Sisters Creek.	Feature not undermining related, instead a waypoint for the creek. No concerns noted in field.
PR-04	Prospect	Prospect drivage as shown on mine plans. Drivage is approximately 5 m wide, 30 m long and 1.7 m high with a maximum dip of 47°.	Y	Excavated, concrete plug installed and backfilled during Parkway construction (Norwest, 2001).	Previously mitigated. No concerns noted in field. Modern pathway is adjacent to this location.
G315	Sinkhole	Potentially hazardous hole about 2m deep and 3m diameter. Appears partially dug-up by hoe. Close to dirt road and power lines	N	Inspected by Golder (2007). To be mitigated during TSCGC 500m zone mitigation	No concerns noted in field. This area is covered by stockpiles.
G314	Surface Debris	Large pile of logs and logging waste. Not mining related.	N	Inspected by Golder Associates (2004). General cleanup and disposal of debris is recommended. Mitigation not required. Not considered hazardous at time of report.	Significant felled logs noted. No undermining concern.
G316	Surface Debris	Wood structure, interpreted to be a drainage structure used during mining.	N	Inspected by Golder Associates (2004). May recover as an artifact. Mitigation not required. Not considered hazardous at time of report.	Not noted in this location, however two wooden culverts were noted approximately 100 m south near the drainage ditch and creek.
G405	Prospect shaft	Square shaped depression approx 1m square by 0.4m deep. Possible prospect into the No. 2 Morris seam. Steel anchors and guy wires surrounding the feature. Small trees growing in feature.	N	Inspected by Golder Associates (2007). Investigate and mitigate for TSCGC 500m safety zone.	Not observed or located during site walkthroughs on LiDAR data. Understood to have been mitigated.
MISC. MINE DEBRIS	Misc. Mine Debris	#N/A	#N/A	#N/A	Various mine debris noted, including railway track, wires, anchor points, wooden wire spool, steel pipes, etc. Also noted are historical drainage ditches in this area.
G389	Surface Debris	Trench 1.5 m wide by 1 m deep. Bearing 170/350 and is overgrown with spruce trees. Presumed to be a drainage trench.	N	May regrade prior to development.	Not an undermining concern. No concern noted in field.
G390	Surface Debris	Trench 1.5 m wide by 1 m deep. Bearing 40°/220°. Sides littered by old wooden culvert debris.	N	May regrade prior to development.	Not an undermining concern. No concern noted in field.

4.4 AREAS WITH EXISTING MITIGATION

As identified in the preceding table, there are features with the Phase 1 project area that are understood to have been previously mitigated for public safety, including all known mine portals and mine shafts. In addition to these features, additional mitigation was completed at specific locations partially located within Phase 1 and commensurate with the requirements of the originally proposed golf course, and not for development. It is understood that some mitigation works are not formally documented at this time. During the subsequent mitigation work at this site, the location and extent of earlier mitigation works for the proposed golf course will be confirmed to ensure the entire site is fit for development.

5 BOREHOLE INVESTIGATION PROGRAM

Prior to the field drilling, the Alberta One Call clearances were obtained for the site and a secondary locate sweep was conducted with a private utility locator. A pre-drilling hazard assessment and a toolbox safety meeting were conducted with the field crew before accessing the site and completing the borehole drilling.

The field drilling program at site consisted of a geotechnical soils investigation combined with an undermining investigation. The program was completed between 22 March and 03 April, 2021 and was supervised by a WSP geotechnical technician. The planned boreholes were advanced by Geotech Drilling of Prince George, British Columbia using a track mounted Fraste MDXL drill rig equipped with ODEX (for soils), air rotary (for bedrock) and wet rotary (for selected bedrock boreholes) equipment. A total of 16 boreholes were advanced for the investigation program, with seven (7) boreholes advanced for undermining assessment. All of the WSP borehole locations are indicated on the borehole location plan presented as **Figure 13**.

The borehole drilled depths are summarized in **Table 5-1** below.

Table 5-1 WSP Advanced Boreholes

BOREHOLE ID	GROUND ELEVATION (M)	BOREHOLE DEPTH (M)	BOREHOLE PURPOSE
BH21-RV-01	1323.59	6.4	Geotechnical
BH21-RV-03	1352.37	10.6	Geotechnical
BH21-RV-04	1344.43	15.0	Undermining
BH21-RV-05	1355.07	15.4	Undermining
BH21-RV-06	1355.46	63.0	Undermining
BH21-RV-07	1351.10	11.9	Undermining
BH21-RV-08	1323.72	4.3	Geotechnical
BH21-RV-09	1335.16	4.6	Geotechnical
BH21-RV-10	1348.13	4.7	Geotechnical
BH21-RV-G1	1347.99	50.3	Undermining
BH21-RV-G2	1351.59	48.5	Undermining
BH21-RV-G3	1328.85	6.1	Geotechnical
BH21-RV-G4	1356.18	38.4	Undermining
BH21-RV-G5	1342.31	4.4	Geotechnical
BH21-RV-G6	1324.06	6.1	Geotechnical
BH21-RV-G7	1350.22	5.8	Geotechnical
BH21-RV-G8	1340.92	6.3	Geotechnical

Upon completion, all boreholes were surveyed with a GyroMaster tool by Stockholm Precision Instruments. **Figure 14** shows the survey deviation versus depth as well as the azimuth versus depth from the GyroMaster survey. Typical resultant deviations were in the order of 1 to 1.5 m at 40 m depth; the deepest hole at 55 m depth deviated 1 m. The azimuth of the deviation did not trend together, likely because many of these boreholes are shallow and two are cored boreholes, which tend to be more vertical. At other sites, WSP has observed that for deeper boreholes, the deviation generally trends in the up-dip direction of the underlying strata.

Once survey was completed, for the air rotary boreholes a 114 mm (4-inch) inner diameter PVC pipe was installed from surface into bedrock approximately 1.5 m length past the depth of tri-cone drilling. A coupler with a slightly larger diameter than the tricone bit borehole was used to prevent the PVC from sliding deeper into the borehole. Steel casing protectors were installed at surface around all PVCs to prevent damage or tampering. The annulus around PVC was backfilled with bentonite chips and sand on surface.

Additional details on specific boreholes are provided in the borehole logs in **Appendix D**. Photo logs of the drill core are also presented in Appendix D. A summary of the Rock Quality Designation (RQD) and recovery from the cored boreholes is presented in **Table 5-2**.

Table 5-2 Summary of Cored Borehole Properties

Borehole ID	BH21-RV-05	BH21-RV-06
Average RQD %	57	64
Max RQD %	93	100
Min RQD %	21	0
Average RECOVERY %	86	86
Max Recovery %	100	103
Min Recovery %	58	0

The core properties in Table 5-2 indicate a *Fair* RQD value, and that the rock mass is characterized by zones of good quality rock with local zones of *Poor* to *Very Poor* quality rock, as indicated by the minimum RQD and recovery values. This observation is typical for coal-bearing sedimentary rock.

5.1 STRENGTH TESTING

Upon completion of the borehole program a series of laboratory tests were conducted on collected samples; the results are summarized in the following tables.

Table 5-3 Summary of Brazilian Disk Testing

Borehole ID	Sample ID	Rock Type	Sample Depth (m)	Average Tensile Strength (MPa)
BH21-RV-05	BR1	Siltstone	2.8-2.9	6.0
BH21-RV-05	BR2	Siltstone	8.65-9.0	7.4
BH21-RV-05	BR3	Siltstone	12.6-13.2	10.8
BH21-RV-06	BR1	Siltstone	13.9-14.0	7.6
BH21-RV-06	BR2	Siltstone	24.0-24.2	1.4
BH21-RV-06	BR3	Siltstone	33.9-34.0	11.2
BH21-RV-06	BR4	Siltstone	47.1-47.3	8.4
BH21-RV-06	BR5	Mudstone	56.4-56.6	7.1
Maximum				11.2
Minimum				1.4
Average				7.5

Table 5-4 Summary of Slake Durability Testing

Borehole ID	Sample ID	Rock Type	Sample Depth (m)	Slake Durability (%)
BH21-RV-05	SL1	Siltstone	3.8-3.9	98.3
BH21-RV-05	SL2	Siltstone	8.7-8.9	97.2
BH21-RV-05	SL3	Siltstone	12.6-13.2	99.2
BH21-RV-06	SL1	Siltstone	14.0-14.15	99.2
BH21-RV-06	SL2	Siltstone	24.4-24.5	91.8
BH21-RV-06	SL3	Siltstone	34.0-34.2	99.1
BH21-RV-06	SL4	Siltstone	46.9-47.1	99.3
BH21-RV-06	SL5	Mudstone	56.2-56.4	88.7
Maximum				99.3
Minimum				88.7
Average				96.6

Table 5-5 Summary of Unconfined Compressive Strength (UCS) Testing

Borehole ID	Sample ID	Rock Type	Sample Depth (m)	UCS (q_u) (MPa)	Strain at Failure (%)
BH21-RV-05	UCS1	Siltstone	3.3-3.5	143.2	2.58
BH21-RV-05	UCS1B	Siltstone	5.75-5.9	51.2	0.74
BH21-RV-05	UCS2	Siltstone	8.4-8.65	156.1	1.25
BH21-RV-05	UCS3	Siltstone	12.75-13.0	153.1	1.44
BH21-RV-06	UCS1	Siltstone	13.6-13.85	126.5	2.4
BH21-RV-06	UCS2	Siltstone	23.8-24.0	90.8	0.69
BH21-RV-06	UCS3	Siltstone	32.9-33.1	170.8	1.28
BH21-RV-06	UCS4	Siltstone	47.3-47.5	99.8	1.12
BH21-RV-06	UCS5	Mudstone	56.55-56.8	138.6	2.05
Maximum				170.8	2.58
Minimum				51.2	0.74
Average				125.6	1.5

Point load testing was also conducted on cored boreholes. A total of 191 valid tests were completed as presented in **Appendix D** with both a table summary and a photo of each test before breaking and after. The maximum, minimum and average Is50 was 16.9, 0.1 and 4.8, respectively. Using a K-value of 18, the maximum, minimum and average calculated Unconfined Compressive Strength (UCS) equivalent was 303.9, 2.6 and 86 MPa, respectively.

Based on the results of the laboratory testing, the rock mass at the site has an average UCS of 125 MPa, with a range between 51 and 171 MPa. The lowest UCS value is located close to ground surface and likely indicates localized near-surface weathering. The remainder of the tests indicate rock of moderate to high strength. Slake durability indicates materials are durable, with an average rating of high (98-95%) and a range from medium-high (95-85%) to very-high (100-98%).

5.2 ROCK MASS CLASSIFICATION

The Norwegian Geotechnical Institute (NGI) has established the Q-System (Barton et al. 1974) which WSP used for rock mass classification on all cores. The quantitative classification system is based on a numerical assessment using the following six parameters as given by the relation:

$$Q = \frac{RQD}{Jn} \times \frac{Jr}{Ja} \times \frac{Jw}{SRF}$$

Where:

- RQD - Rock quality designation
- Jn – Rating based on the number of joint sets
- Jr – Rating based on the roughness of the most unfavourable joint or discontinuity
- Ja – Rating based on the degree of alteration or filling along the weakest joint
- Jw – Rating based on water inflow
- SRF - Stress reduction factor applied based on the conditions and usage

The data for the two cored boreholes was used for the analysis. Input parameters and the resulting range of values for Q are shown in Table 5-6.

Table 5-6 Rock Mass Characteristics for Q from Core Boreholes

Parameter	Lower Bound	Average	Upper Bound
RQD	34	64	93
Jn	12	12	12
Jr	1	1.25	1.5
Ja	3[1]	2	1
Jw	1	1	1
SRF[2]	2.5	2.5	2.5
Q	**0.37**	**1.33**	**4.65**

*Notes:

[1] Ja of 4 used occasionally where soft infill observed on joint surfaces, but 3 is considered more representative overall.

[2] A value of 2.5 was used based on low stress, near surface, open joints

The average, minimum and maximum calculated Q-System values were 1.33, 0.37 and 4.65, respectively. The results of the analyses indicates that, based on the borehole data, the bedrock in the study area classifies as poor to very poor using the Q System. A lower Q value or rating correlates with a greater requirement for ground support for short term stability of underground excavations, and indicates that the rock mass above the excavations is likely to fail over time.

5.3 GROUNDWATER MONITORING

Groundwater levels were collected upon completion of all boreholes, and again on subsequent site visits. A single vibrating wire piezometer (VWP) was installed in BH21-RV-06 on 27 October 2022 to record the variation of the water levels with time. The manually recorded water levels are reported in **Table 5-7** and the VWP data is shown on **Figure 15**. Existing boreholes (completed by others) in the project area also had groundwater levels measured during the camera work. Those levels are reported in

Table 5-8.

Table 5-7 Measured Water Levels in WSP Boreholes

Borehole ID	Surface Elevation (m)[1]	Bottom of Borehole Elevation (m)	Water Elevation at Completion (m)	Water Elevation on 06 May 2021 (m)	Water Elevation on 27 Oct 2022 (m)
BH21-RV-04	1344.5	1329.5	dry	[2]	dry
BH21-RV-05	1355.0	1339.6	1341.0	[2]	dry
BH21-RV-06[3]	1355.4	1292.4	1310.5	[2]	1310.6
BH21-RV-07	1351.1	1339.2	dry	dry	dry
BH21-RV-G1	1346.8	1296.5	1296.5	1309.3	1310.6
BH21-RV-G2	1350.3	1301.9	1301.9	1315.8	1310.3
BH21-RV-G4	1356.1	1317.7	1317.7	1321.4	dry

Notes:
1. Elevation is based on 2015 LiDAR surface.
2. Depth is uncertain due to perched groundwater table trickling from borehole wall.
3. VWP installed in this borehole on 27 October 2022.

Table 5-8 Measured Water Levels in Boreholes by Others

Borehole ID	Surface Elevation (m)[1]	Bottom of Borehole Elevation (m)	Water Elevation on March/April 2021 (m)
GA02-35	1343.9	1314.1	dry to 1323.6
GA08-33	1346.1	1289.3	1308.9
GA03-66	1345.0	1316.5	dry to 1322.4
GA03-67	1346.9	1306.9	dry to 1311.1
GA03-68	1348.7	1286.2	1310.6
GA08-32	1351.2	1299.2	1311.4
GA08-31	1352.6	1329.6	dry to 1330.7
GA08-30	1355.0	1332	dry to 1335.1

Notes: 1. Elevation is based on data provided by TSMV

The water levels are generally consistent across the site and indicate that a significant portion of the undermining within Phase 1 is not flooded. The seepage observed in some of the boreholes, along with the geotechnical monitoring boreholes indicate that there is a perched water table within the overburden soils. The VWP data from BH-21-RV-06 shows relatively consistent groundwater elevations near 1310.6 m elevation, with slight fluctuations from day to day. A notable gap in the data exists during a period in late December 2022 when air temperatures were below -30°C. This is believed to have impacted the datalogger electronics and battery. VWP data from another site approximately one kilometer away has indicated seasonal variation in water elevations within the mine, generally with declining piezometric head through the fall and winter range of data and recharge in the spring and summer.

5.4 BOREHOLE CAMERA SURVEY

A downhole borehole camera program was completed at the site in boreholes from the WSP drilling programs, as well as in existing accessible boreholes drilled by others. The borehole camera used was either a GeoVision Deluxe, Dual Scan Camera or Well Vu Camera, depending on availability. The program served to confirm the findings of the borehole drilling and provide further details on the bedrock and mine conditions.

The boreholes that were camera surveyed and a summary of the findings are shown in **Table 5-9**.

Table 5-9 Borehole Camera Survey Results

Borehole ID	Summary Findings[1]	End of Camera Hole (m)	Seam Roof Depth in Model (m)	Borehole Depth (m)
BH21-RV-04	Void from 12.6 to 14 m, with cobble size rubble at bottom of void; no sign of cracking above the void.	14	12.6	15.0
GA03-66	Void from 21.1 – 22.6 m; rubble at bottom of void	22.6	20.9	28.5
GA03-67	Metallic object at 35.5 m (sharp edges); void at 33.2 – 35.8 m; water dripping into void from borehole; timbers visible on floor	35.8	31.7	40.0
GA08-33	Bed separation from 40.9 – 41.1 m, 41.9 – 42.1 m, 43.0 – 43.1 m, 44.5 – 44.6 m, 45.2 – 45.4 m; Rubble from 45.8 – 46.8 m.	46.8	46.4	56.8
BH21-RV-G1	Blocky 30.0 – 33.0 m but no bed separation; blocky 37.5 – 38.6 m; cracking 39.7 – 40.0 m; bed separation at 41.5 m; void at 41.7 – 42.1 m; rubble at bottom of hole; possible rockbolts in roof	42.1	48.1	50.3
GA03-68	Poor visibility – camera results inconclusive	57.3	57.3	62.5
BH21-RV-07	Void 8.4 – 9.8 ; sidewall of opening	11.7	8.4	11.9
BH21-RV-G2	Bed separation at 23.5 – 23.6 m with water flow; broken ground at 45 m; void at 46.2 – 47.7 m; fine rubble on floor	47.7	45.8	48.5
GA08-32	Water trickling in at 24.8 m; bed separation at 41.3 – 41.4 m; Bed separation from 42.0 – 42.3 m, 42.6 – 42.7 m, 43.4 – 43.5 m; void at 44.6 – 46.8 m; rubble at 46.8 m	46.8	48.6	52.0
GA08-31	Void at 19.7 – 22.0 m; very little rubble on floor	22.0	20.3	23.0
GA03-69	Pillar	n/a	n/a	35.2
GA08-30	Void at 19.8 – 21.5 m; rubble on floor	21.5	20.3	23.0
BH21-RV-G4	Bed separation at 27.9 m –possible fractured rock; bed separation at 29.5 m; void 31.6 – 33.1 m; rubble on floor	33.1	35.8	38.4
BH21-RV-05	Stewart Seam. Vertical cracking present from collar of hole to depth. Bed separation from 13.4 – 13.7 m, 13.8 – 4.0 m; void from 14.3 – 14.4 m; blocky rubble on floor.	14.4	12.0	15.4

Notes: 1. Void indicates the remains of the mined void; bed separation represents movement of strata above the mined void due to relaxation. The sum total of bed separation and void is considered in the assessment of subsidence and sinkhole formation potential.

In some cases the maximum camera depth was restricted by rubble and/or collapsed debris that blocked the borehole. For these holes, the borehole log was used to identify any additional voids below the maximum borehole camera depth achieved. It was important to use the information from both the core logs and the borehole camera. While the camera is much more reliable in detecting voids and bed separations, it is limited when the bottom of the hole is filled with rubble; for this condition, the logs rely on drill cuttings and feedback/rig response.

Where no camera data was available, existing borehole logs from previous investigations by others were used for subsequent assessment.

Additional details, along with exemplar screenshots from the camera work is provided in **Appendix E**.

5.5 GAS MEASUREMENTS

During borehole drilling, a gas detector was on site to monitor levels of methane (CH4), oxygen (OXY) and Lower Explosive Limit (LEL). An odour of hydrogen sulfide was detected while advancing BH21-RV-04 at 11.4 m, BH21-RV-G1 at 45.4 m depth, RV21-RV-G2 at 45.4 m depth and BH21-RV-G4 at 25.9 m depth. Following the PVC installation hydrogen sulfide levels were measured to be 11 PPM in BH21-RV-G4.

Previous work in Canmore has shown that gas can be generated when the coal is mined or disturbed by drilling, but that the levels of gas quickly dissipate thereafter. In some older areas within Canmore where there are underlying coal seams, the developer has installed a passive sub-slab ventilation system. Testing at the passive outlet vent was completed quarterly for the first year and semi-annually for a period of two-years thereafter. The testing results indicated that oxygen concentrations and methane levels were within reasonable limits (Stephenson and Van Den Bussche 1996).

Coal may be exposed during the construction work given the shallow coal seams with the project area. Gas is not expected to be a hazard to residential developments based on historical measurements. If during construction, in-situ coal is exposed, the exposure should be inspected by a qualified engineer for suitability prior to backfill or construction taking place.

6 ASSESSMENT

6.1 THREE-DIMENSIONAL MODELLING

WSP created a 3D model of the mine workings within the project area and surrounding 500 m buffer. The model was created using Deswik, a 3-D mine modeling package that permits export to various other software packages. The existing mine scans and mosaics were used to establish the mine linework and survey elevations, which was then carefully reviewed with Lidar topography and detailed borehole data to confirm the model, or to make minor adjustments as needed to account for current topography and mine conditions.

The mine scans were aligned and scaled to the Alberta Township System (ATS) Grid in Deswick. Linework was completed within the project area based on the historical mine scans and existing QPD data sources. Seam elevations were taken from the historic mine scans and adjusted to the elevation datum offset of 53 feet based on a note on scan "Carey_aban_vs2-3" dated 1935 and based on work undertaken by Norwest to verify the datum. Seam elevations were also determined from applicable borehole logs and combined with the seam elevations from the mine scans. Surfaces were generated using the elevations from the mine scans and borehole logs and re-limited to the outline of each mine's linework. The surfaces were then extruded to their corresponding seam thicknesses, resulting in 3D solids. The pillars for each mine were generated based on the linework created based on the above work and then cut from the solid of the applicable mine. The mine solids were then exported as dxf files for use in other packages.

A bedrock surface map was also created for the site using the digitized borehole logs that were provided by QPD and supplemented with WSP borehole data from the current undermining assessment. Using this data, an approximate isopach map showing overburden thickness was generated as shown in **Figure 16**. Overburden across the site is generally less than 10 m thick, and often less than 5 m thick.

The 3D model allows for locations of cross and long sections to be specified in plan view, with the software generating the sections automatically. **Appendix C** shows examples of various sections that have been cut through the model.

6.2 DEVELOPMENT OF SUBSIDENCE

The undermined areas in southeast Canmore are susceptible to two different types of subsidence: sinkhole development, and surface troughs or sags (panel subsidence). These mechanisms can be described as follows:

SINKHOLE DEVELOPMENT

Sinkhole development is possible where the underground workings approach the top of the bedrock surface (subcrop), and generally involve limited surface area. In these cases, the gradual collapse of the roof of the mine working causes the void to migrate upwards toward the ground surface. At the same time, the failed material increases in volume via bulking as it settles on the floor of the mine workings. These sinkholes can coalesce, forming steep sided troughs at the ground surface. Sinkhole development in the Canmore area is usually associated with shallow mining at or near the subcrop, or with shafts or portals for the underground workings.

To assess the potential for sinkhole formation, analysis on the stability of the roof of the existing tunnels was conducted using the Scaled Scan approach (Carter 2000). This approach determines the stability of the existing span by calculating the Scaled Span parameter based on the existing span, site geometry, the thickness of bedrock overlying the tunnel. This value is plotted against the Q rock mass quality value and compared to curves based on a database of stable and failed crowns in varying rock conditions. The value of the minimum stable span is then determined based on the Q value for the rock mass. This value compared to the Scaled Span value is used to determine the Factor of Safety (FoS) and the Probability of Failure (PoF). The details of the approach and analyses are described in **Appendix B**.

Historically, in Canmore, undermined areas with a bedrock cover less than 8 times the thickness of the mined seam (measured from the floor of the mined seam) have been considered to have potential for sinkhole formation. The analyses above indicate that this corresponds to a bulking factor of 1.10 to 1.15. This is considered conservative, however, as the average bulking factors observed for the site typically ranged from 40 to 50% (Golder, 2019).

A review of the literature and additional reports from site was conducted in 2023 as the observations from the surface expression above the workings and from the drilling programs did not support such a low bulking factor in the shallow-dipping portion of the seams. Based on this review, the details of which are provided in Appendix B, an adjustment to the lower bound value for bulking factor for shallow dipping seams was considered appropriate, bringing the analyses more in line with the observations from site.

The 15% bulking factor (1.15) should be retained for the more steeply dipping portions of the coal seams where the more friable coal present in remnant pillars makes up a larger proportion of the failed material. However, given the higher strength and competent materials of the strata overlying the coal seams, for the more shallow-dipping coal seams, a slightly less conservative but more representative bulking factor of 25% (1.25) is considered appropriate. This corresponds to potential surface influence where the bedrock cover is less than 5 times the mined seam thickness. The bulking factor for the overburden will remain at 2% (1.02).

PANEL SUBSIDENCE

Panel sags or troughs tend to form above wider mined panels with higher extraction ratios and can form due to mining at various depths. This process is described in detail in **Appendix B**.

In the study area, panel subsidence is associated primarily with three de-pillared areas of the No. 1 Morris Mine, which underlies the southwestern portion of the study area, and with two de-pillared areas of the Stewart Mine, located at the southwestern limit of the study area. There is also a de-pillared area associated with the No.2 Morris Mine, just beyond the southeastern limits of the study area.

The state of the ground conditions was determined based on available drillhole data within the small de-pillared portion of the seam. The holes that were used in the determination and their location are shown on **Figure 17**, and the data is summarized in **Table 6-1**. As can be seen from this Table, the drillholes hit a variety of different interpreted targets within the de-pillared seam. For assessment, only the holes that were interpreted to encounter the de-pillared zones were considered, as these holes best represent the development of potential subsidence above the seam.

Table 6-1 Key Borehole Parameters Within the De-Pillared Panels within the Study Area

Panel Mine[3]	Borehole ID	O/B Thickness (m)	Mine Roof Depth (m)	Cumulative Height of Voids, Hv (m)	Height of Loose Rubble, H1 (m)	Height of Blocky Rubble, H2 (m)	Depth to Uppermost Void/ Fracture[2] (m)	Termination Depth (m)
Panel 1 Morris	GA02-38[1]	7.8	30.4	1.6	0.3	4.9	27.4	32.4
Panel 2 Morris	GA08-33	4.8	46.4	0.8	0.3	7.0	40.9	56.8
	BH21-RV-G1	1.5	48.1	0.6	8.0	4.0	41.5	50.3
Panel 3 Morris	BH21-RV-G2	5.2	47.9	1.7	0.1	5.2	23.5	48.5
	GA08-32	7.5	48.6	0.8	3.8	3.3	24.5	52.0
Panel 4 Stewart	BH21-RV-05	1.1	13.3	0.6	0.8	0.8	13.4	15.4
Panel 5 Stewart	GA03-131[1]	1.0	6.9[4]	0.1	0	1.2	7.7	11.5
	GA03-129[1]	5.5	10.1[4]	0.8	0.9	0	10.4	17.9
	GA02-102[1]	2.9	47.4	1.7	0.4	6.7	40.8	54.6
	GA02-57[1]	0.5	20.9[4]	0.6	0.5	11.5	23.3	51.2
	GA02-106[1]	2.3	51.5	0.3	1.7	0.8	50	17.7
Panel 6 Morris	RDH98-15[1]	6.2	13.3	1.6	0.4	1.5	12.8	21.2

Notes:

1. No borehole camera data available – estimates based on drillhole logs.
2. This represents the depth of the uppermost ground relaxation, whether it is void, bed separation or fracture.
3. Morris Mine seam thickness is 2.0m on average; Stewart Mine seam thickness is 2.13 m on average
4. These values are based on the mine floor as encountered in borehole logs by others and adding the average seam thickness of the Stewart Mine

6.3 ESTIMATES OF SUBSIDENCE

There are six (6) de-pillared panels within or adjacent to the study area that warrant discussion. Three of these are small panels within the No. 1 Morris mine: Panel 1 is located just north of the study area limits, and Panels 2 and 3 are located within the study area boundaries. Panels 4 and 5 are larger panels within the Stewart Mine, and their up-dip limits lie within eastern limits of the study area, with the panels dipping off to the southwest. The final panel, Panel 6, is located within the Morris No. 2 Mine workings, just east of the southern limits of the study area. The panel locations are shown on **Figure 17**.

For areas where depillaring was not undertaken, analyses were performed to assess the stability of the remaining crown pillars above the workings and to determine the potential for sinkhole development above. For the de-pillared panels, assessment of panel subsidence was also conducted. These analyses and outcomes are discussed in the following sections.

SINKHOLE SUBSIDENCE

The development of sinkholes is generally a function of the height of the void, the quality of the rock above the tunnel, and the thickness of rock and soil above the void. To assess the stability of the rock above the tunnels of the No.1 Morris workings, the rock mass quality Q was determined from two core boreholes drilled in the study area: BH21-RV-05 and BH21-RV-06. The rock mass characteristics and input values are shown in **Table 5-6**.

Historically, the areas in and around the undermined parts of Canmore were generally considered susceptible to chimney failure and sinkhole development where the ground surface was less than eight times the thickness of the underground voids based on observations and data collected (Golder, 2019). This assessment considered all seams, regardless of the seam dip at the investigation area. However, WSP considers a bulking factor of 25% (1.25) to be more appropriate for the shallow dipping seams in the study area, corresponding to sinkhole potential for areas where the distance between the bedrock surface and the roof of the mine seam is less than five (5) times the seam thickness. For the case of the shallow-dipping No. 1 Morris mine in the study area where the mined thickness was 2 m on average, this corresponds to a minimum thickness of 10 m of bedrock above the excavations.

The stability of the crown pillars was assessed using the Scaled Span approach described in **Appendix B**. From this assessment, ground over the tunnels is assumed to require a minimum factor of safety of 2, with a corresponding Probability of Failure of 0.5 to 1.5%, a Class F or higher for long-term stability, suitable for long-term crowns with infrastructure. For the rock mass above the No. 1 Morris mine, a factor of safety of 2 is not achieved for crowns with a rock cover less than 25 m, 44 m, and 72 m for 4.2, 5.6, and 7.2 m spans, respectively. Consequently, the potential for chimney failure reaching the ground surface must be assessed.

Subsidence development for infrastructure will depend on the location of the infrastructure and the thickness of overburden at that location. Assuming a bulking factor of 1.25 (25% volume increase) for the rock and 1.02 (2% volume increase) for the overburden, the estimated surface deformation was determined for boreholes intersecting the tunnels in above the No.1 Morris Mine. These are summarized in **Table 6-2**.

Table 6-2 Estimated Sinkhole Formation by Borehole (assuming 25% bulking)

Borehole ID	Location[1]	Depth of Mine Roof (m)	Cumulative Height of Voids Hv (m)	Overburden Thickness (m)	Surface Deformation (m)
BH21-RV-04	Gangway adjacent to subcrop	10.3	2.5	2.2	0[2]
GA03-66	Adjacent to Gangway	17.3	1.6	4.0	0
GA03-67	Gangway	28.1	2.3	5.6	0
GA03-68	Adjacent to slope	51.9	2.0	5.4	0
BH21-RV-07	Small slope between horizontal rooms near subcrop	7.7	2.0	0.7	0.1
GA08-31	Main slope to surface	15.2	1.9	5.0	0
GA03-69	Pillar	n/a	0.0	11.5	0
GA08-30	Gangway (short)	15.7	1.7	4.5	0
GA08-29	Slope at intersection with gangway	15.4	1.8	9.0	0
GA08-28	Same slope as GA08-29 but down dip	17.0	1.7	16.5	0
BH21-RV-G4	Gangway	16.1	3.9	15.5	0[2]
GA03-70	Gangway	19.6	1.7	14.4	0

Notes:
1. Gangway here refers to mine openings running along the strike of the seam (i.e. horizontally); slopes run up-dip.
2. At a 25% bulking factor, the chimneying chokes off just at the top of rock for the holes indicated; there is still potential for overburden material to migrate into the interstitial space below, potentially resulting in surface deformation with time.

As shown in **Table 6-2**, one of the borehole locations (BH21-RV-07) has the potential to form sinkholes at the ground surface. Two additional boreholes (BH21-RV-04 and BH21-RV-G4) show that the caving chokes off just at or immediately below the bedrock surface, allowing the potential for overburden materials to migrate into the remaining interstitial voids in the caved material with potential for surface expression over time. The remainder of the holes choke off below the bedrock surface. However, any notable change in either rock cover or void height, or the removal of caved debris by water or downslope migration in the tunnels could lead to sinkhole formation. For most of the shallow workings at the No.1 Morris mine, the water table is at a depth of approximately 35 m below ground surface. Seepage and minor water flow may be present within the mine workings, which might increase the potential for the migration of fines and smaller caved debris downslope, removing some of the bulked material and creating more volume for the chimneying failure to progress.

At the 25% bulking factor discussed above, the potential surface influence based on bedrock cover less than 5 times the mined seam thickness is determined for each seam in the Phase 1 area. For the 2 m void height in the No. 1 Morris mine, this would mean that any bedrock cover less than 10 m is susceptible. For 2.13 m void height in the Stewart No. 2 mine, this would mean that any bedrock cover less than 10.65 m. To account for variability in the bedrock surface, mined height, and overburden thickness, WSP recommends that any voids with less than 15 m of bedrock cover be mitigated, which is also in agreement with the historical observations at site. **Figure 18** shows approximate bedrock cover over the mine workings in the Phase 1 development.

GENERAL PANEL SUBSIDENCE

For the six small de-pillared areas identified in **Figure 17**, the parameters for general panel subsidence were estimated. The first step in estimating general panel subsidence was to assess the stability of the pillars indicated on the mine plans using the relationships in **Appendix B**. A factor of safety below 1.5 was considered unstable. **Figure 17** shows the location of the pillars analyzed for the No. 1 Morris Seam in the study area.

In all cases, due to the shallow depth and low load, all pillars had a safety factor in excess of 1.5, so the panel dimensions were assessed based on the geometries indicated from the mine planes and model. The maximum subsidence (Smax) was calculated using the relationships in Appendix B for the boreholes in **Table 6-3** that were interpreted to be in the de-pillared portions of the mine, and only those that were considered to represent panel failure (and not voids associated with remnant pillars or rib pillars). Input parameters for assessment of the subsidence based on the drilling data above the panels is shown in **Table 6-3**. The extraction ratio for the calculation was assumed to be 100% and the void was conservatively assumed to extend across the entire panel.

Table 6-3 Input Parameters for Maximum Subsidence (Smax)

Panel & Mine	Borehole ID	Void Height H_v (m)	H_1[1] (m)	H_2[2] (m)	Depth to Void[3] (m)	Width: Depth Ratio[4]	Subsidence Factor	Smax (m)
Panel 1 Morris	GA02-38[1]	1.6	0.3	4.9	27.4	0.80	0.22[5]	0.37
Panel 2 Morris	GA08-33	0.8	0.3	7.0	40.9	1.27	0.81	0.66
	BH21-RV-G1	0.6	8.0	4.0	41.5	1.25	0.81	0.52
Panel 3 Morris	BH21-RV-G2	1.7	0.1	5.2	23.5	1.20	0.81	1.38
	GA08-32	0.8	3.8	3.3	24.5	1.15	0.81	0.66
Panel 4 Stewart	BH21-RV-05	0.6	0.8	0.8	13.4	4.18	0.81	0.49
Panel 5 Stewart	GA03-131	0.1	0.0	1.2	7.7	19.48	0.81	0.08
	GA03-129	0.8	0.9	0.0	10.4	14.42	0.81	0.65
	GA02-102	1.7	0.4	6.7	40.8	3.68	0.81	1.40
	GA02-57	0.6	0.5	11.5	23.3	6.44	0.81	0.52
	GA02-106	0.3	1.7	0.75	50	3.00	0.81	0.26
Panel 6 No. 2 Morris	RDH98-15	1.6	0.4	1.5	12.8	19.00	0.81	1.30

Notes:

1. H1 is the thickness of caved material.
2. H2 is the thickness of blocky material and sagging beds.
3. Depth to Void is the depth to the uppermost void observed in the borehole.
4. W:D Ratio is the ratio of the panel width to the depth.
5. Lower than others due to width to depth ratio

From the data in **Table 6-3**, for Panel 1, a maximum subsidence (Smax) of 0.37 m was assumed based on a single borehole, and no updated ground conditions could be obtained from the borehole camera work as debris in the hole prevented clear interpretation of the current conditions. This Smax value is considered conservative.

For Panel 2, the predicted Smax from the two boreholes was similar. Consequently, the higher value of 0.66 m was conservatively assumed for design.

For Panel 3, the data from borehole BH21-RV-G2 was excluded as the void for the borehole was close to the original mined height, suggesting that the hole was either adjacent to supported ground or to a pillar.

This observation is also reinforced as the second borehole in Panel 3 (GA08-32) shows a much smaller void, and both holes in the panel exhibit a similar degree of disturbance above the roof of the original excavation. The Smax value of 1.38 m was considered an outlier based on location. Consequently, a maximum subsidence value of 0.66 m for Panel 3 was considered most representative.

For Panels 4 and 5 in the Stewart Seam, the upper limits of the panels are very shallow, and the size of the de-pillared seams is quite large. Because the area of interest is at the edge of the shallow panel, the values for holes near the northwestern edge of the panels were used. For Panel 4, this corresponded to an Smax of 0.49 m (from borehole BH21-RV-05), and for Panel 5, an Smax of 0.65 m (from borehole GA03-129).

For Panel 6 in the No. 2 Morris seam, the values from the up-dip side of the panel were also used, as these will represent the closest impact to the study area to the northeast. The Smax for this panel, based on borehole RDH98-15, is 1.3 m.

The shape of the subsidence troughs was determined using the relationships described in Appendix B for subsidence, strain, tilt, and curvature. Using the maximum subsidence value above, the curves for each parameter are shown in **Figure 19** to **Figure 24** for Panels 1 to 6, respectively. The units for each curve are specified in the figure legend. From the subsidence curves, the maximum strain, tilt, and curvature could be determined for each panel. These are presented in **Table 6-4**.

Table 6-4 Estimated Subsidence Parameters and Locations from Edge of Panel

Parameter	Units	Panel 1	Panel 2	Panel 3	Panel 4	Panel 5	Panel 6
Maximum Subsidence, Smax (location from panel edge)	m	0.37 (19 m)	0.66 (29 m)	0.66 (18 m)	0.49 (10 m)	0.65 (6 m)	1.3 (10 m)
Maximum Strain (location from panel edge)	mm/m	20.3 (4m and 12 m)	25.0 (5m and 16 m)	41.7 (4 m and 9 m)	54.8 (2 m and 6 m)	123.1 (1 m and 4 m)	148.2 (2 m and 6 m)
Maximum Tilt (location from panel edge)	mm/m	40.5 (8 m)	48.3 (11 m)	82.5 (7 m)	109.7 (4 m)	243.7 (2 m)	299.9 (4 m)
Maximum Curvature (location from panel edge)	m	150 (4m and 12 m)	188 (5m and 16 m)	64 (4 m and 9 m)	27 (2 m and 6 m)	7 (1 m and 4 m)	10 (2 m and 6 m)

Notes:

1. The distances are measured from the edge of the panel, with positive values occurring within the panel boundary.
2. Maximum strain values are indicative of maximum tensile and compressive strain locations.
3. Maximum curvature values are indicative of maximum concave / convex curvature.

Note that for all panels, these are deterministic assessments and are not weighted based on probabilistic parameters. They are, however, based on the 95% determinant confidence interval for determination of the Subsidence Factor.

The strain, curvature and tilt values for the panels are high due to the shallow depths for the panels; the conditions worsen as the panel widths increase, as shown for panels 4 to 6. The threshold values for panel subsidence are shown in **Table 6-5**.

Table 6-5 Threshold Values for Panel Subsidence

Parameter	Threshold Value
Tensile / Compressive Strain	Wood frame and block structures: 1 mm/m Pavement cracking: 10 mm/m
Tilt	Gravity Pipelines: 2% (20 mm/m)
Curvature	Pipelines: 1000 x diameter[1] (200 mm dia pressure pipes: > 116 m; Gravity pipes 200 – 450 m: min 46 – 76 m)[2]

Notes:
1. 1000x diameter is a rule of thumb used by industry (Peng, 1992).
2. Minimum curvatures from product literature, assuming 4 m / 13 ft pipe sections (IPEX, 2009).

DISCUSSION

For development over the panels, the tensile strains exceed the allowable threshold values for wood frame and block structures, and for pavement cracking. Similarly, the tilt values exceed the allowable tilt threshold for gravity pipelines. The curvature values exceed the allowable values for pipelines, particularly for Panels 4, 5 and 6.

7 RECOMMENDATIONS

The following recommendations for the proposed Phase 1 Development are made. Many of the referenced locations are shown on **Figure 25**.

- Development with no undermining constraints can proceed on lots not identified on **Figure 25** as "Phase 1 Areas Recommended for Mitigation". Areas not impacted by undermining include blocks: 27, 28a, 28b, 30a and 30b, as well as the dry stormwater pond, various playgrounds, and the bicycle pump track. These areas require no further work and this report satisfies Section 6(1) in AR34/2020, and represents a Project Undermining Assessment Report for these areas not impacted by undermining.
- Block 31 includes minor undermining impact on the south corner as shown on **Figure 25**. The impact relates to Portal 99. Mitigation will need to take place on this corner before development can proceed.
- Portal Locations: the four (4) portal locations within the Phase 1 Development have been previously mitigated for public safety. Should development or modification be planned for at these locations (e.g. foundations, grade cuts, planting, recreation areas, etc.), it is recommended that the portals be excavated to expose the mine workings and more robust mitigation be implemented. Specific mitigation details can be provided once more detailed plans are known for these four (4) areas. Opening these portals will allow for a unique opportunity to further investigate the mine workings and their condition, particularly since these workings are primarily dry (*i.e.,* the water table is located at a depth of approximately 35 m below ground surface).
- Other Portal Locations within the 500 m Public Safety Zone: the various portal and shaft locations outside of the Phase 1 Development, but within the 500 m Public Safety Zone should be included in periodic inspections (which could be completed as part of overall land reviews) to verify ongoing stability, which historically have been undertaken periodically by TSMVPL.
- Gravel Subcrops: four (4) locations with the Phase 1 development where the historical mine plans identify gravel was encountered during mining. This is applicable to both the Stewart and Morris mines within the Phase 1 Development. These areas are more prone to subsidence given the limited to non-existent bedrock roof in these areas. Structural mitigation or pressurized paste mitigation is recommended in these areas, within the mine footprint and also slightly outside of the mine footprint in case voids have formed outside of the mine footprint in the overburden.
    - The subcrop adjacent to the Bicycle Pump Track does not require mitigation in the configuration shown. It is understood that landscaping and/or selective vegetation may be placed in this area to discourage foot traffic over the underground workings.
- Workings Shallower than 15 m Bedrock Cover: paste mitigation is recommend in areas where the mine roof is less than 15 m depth from bedrock surface or final construction surface (whichever is lower in elevation). This is applicable to both the Stewart and Morris mines within the Phase 1 Development. It is understood that final design grade is ongoing, so these extents have been estimated as approximately 18,600 m^3 within the Morris Mine and up to 5,000 m^3 with the Stewart Mine depending on extents. It is proposed that paste is injected via a series of boreholes (some existing and some to be advanced) to fill the void and prevent future subsidence. Note that there will be additional opportunities to further evaluate the conditions within the mines during the pasting program. This information will be used to verify the recommendations provided in this report and adjust the program, as necessary. The methodology for the pasting program procedure will include constructing berms within the mine with coarse granular material, to limit paste placement to relevant areas.

Once berms are in place, limited volume gravity paste injection should commence to reinforce the berms. Once reinforced, paste injection will continue in boreholes in an upgradient direction. Upgradient borehole adjacent to those having paste injected will be used for monitoring the paste progression, until they are also used to inject paste.

- Depillared panels: The four (4) panels which fully or partially fall within the assessed Phase 1 project area will require an engineering solution in order for development to proceed. The solution may include a combination of paste mitigation, structural mitigation or avoidance. The path forward for mitigation needs to be further discussed based on building locations on these Blocks (23a, 23b, 32a, 32b, 33b). Similarly, parts of these panels and additional panels adjacent to the Phase 1 project area may underlie future development Phases. Consideration could be given to efficiencies of pursuing mitigation work in these areas at the same time.
- Existing Mitigation: mitigation was completed in specific locations as part of the original plan to mitigate undermining hazards for use as a golf course. It is understood that some of the specific mitigation works that were completed are not formally documented at this time. During the subsequent mitigation works at this site, the location and extent of previous mitigation works will need to be confirmed.

8 CLOSURE

This report has been prepared for the exclusive use of Three Sisters Mountain Village Properties Limited and QuantumPlace Developments Limited. This memorandum is based on, and limited by, the interpretation of data, circumstances, and conditions available at the time of completion of the work as referenced throughout the memorandum. It has been prepared in accordance with generally accepted engineering practices and Alberta Regulation 34/2020 and applicable 2020 Undermining Guidelines approved by the Province of Alberta. No other warranty, express or implied, is made.

Yours sincerely,

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RM APEGA ID #: 29016
DATE: 10 November 2023
PERMIT NUMBER: P004546
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

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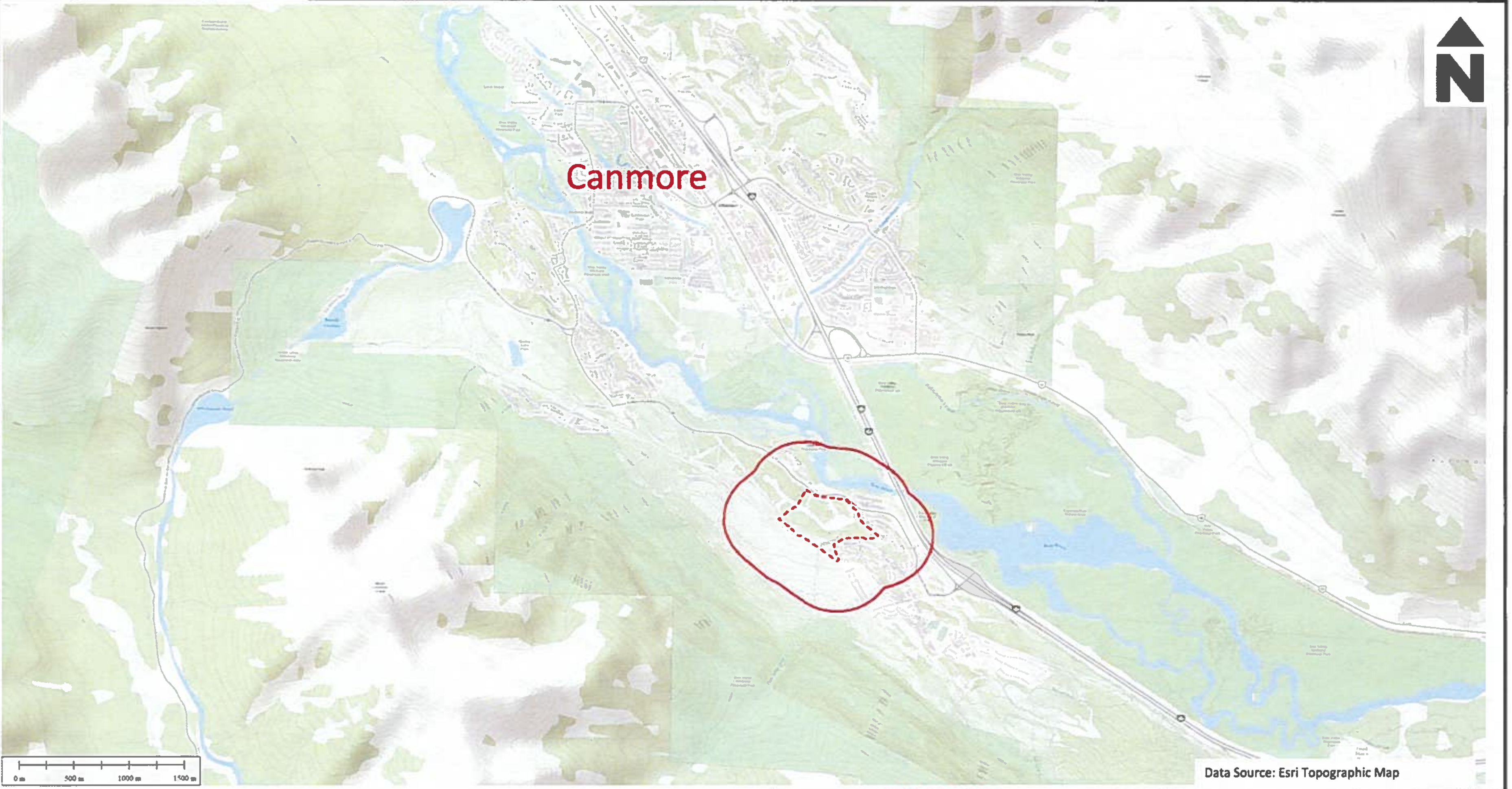
Figures



Data Source: Esri Topographic Map

Legend

⋰ Project Area

／ 500m Public Safety Zone

wsp

THREE SISTERS mountain village

PROJECT NAME
Resort Village - Phase 1 Undermining

SHEET TITLE
Site Location

PROJECT NUMBER
CG09140

FIGURE NUMBER
1

ISSUE/REVISION
0

Legend

Project Area

500m Public Safety Zone

wsp

THREE SISTERS mountainvillage

PROJECT NAME
Resort Village - Phase 1 Undermining

SHEET TITLE
Site Overview with Orthophoto

PROJECT NUMBER
CG09140

FIGURE NUMBER
2

ISSUE/REVISION
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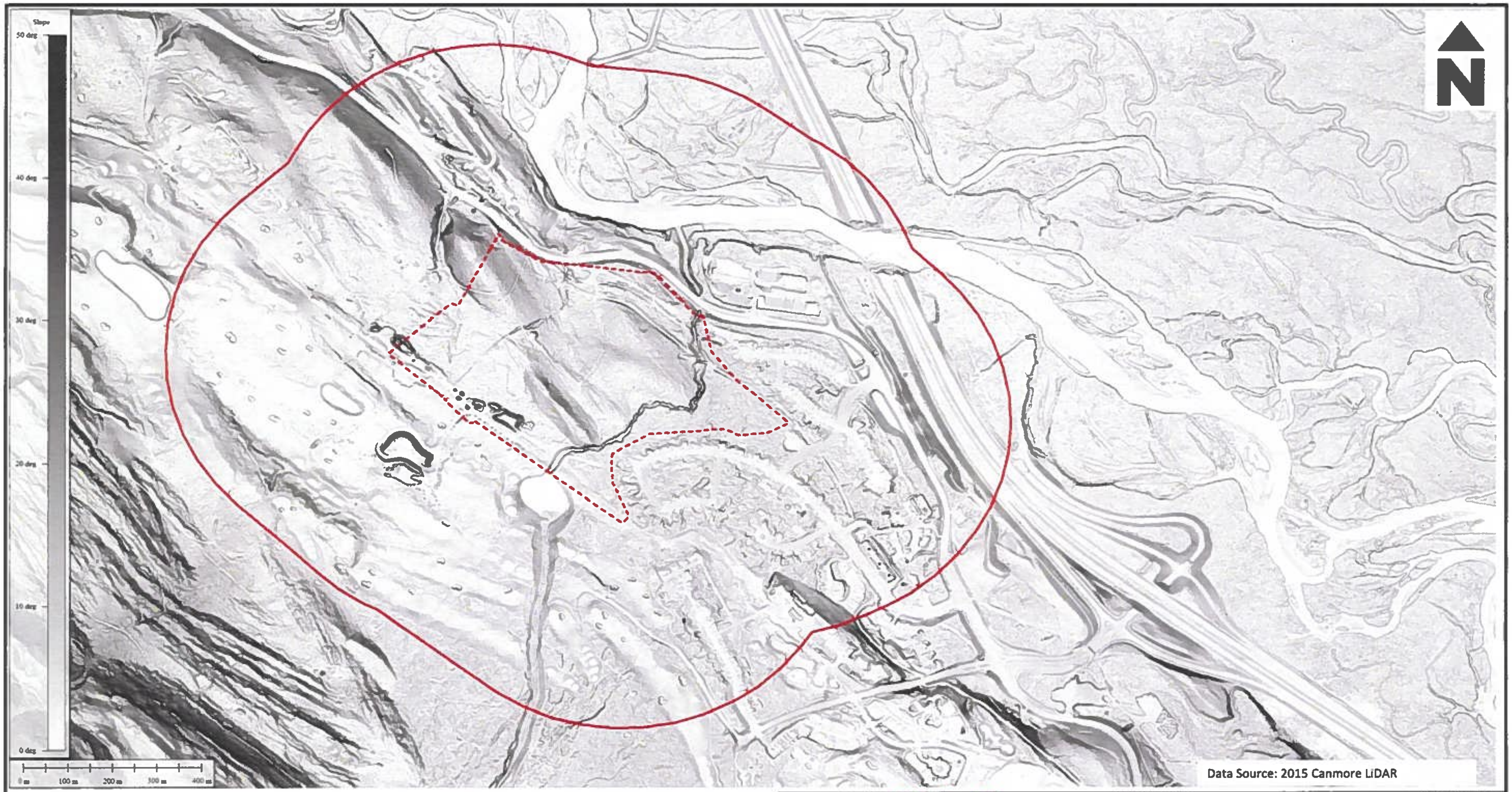

Data Source: 2015 Canmore LiDAR

Legend

- ⋰ Project Area
- ⁄ 500m Public Safety Zone

wsp

THREE SISTERS mountain village

PROJECT NAME
Resort Village - Phase 1 Undermining

SHEET TITLE
Site Overview with LiDAR

PROJECT NUMBER
CG09140

FIGURE NUMBER
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ISSUE/REVISION
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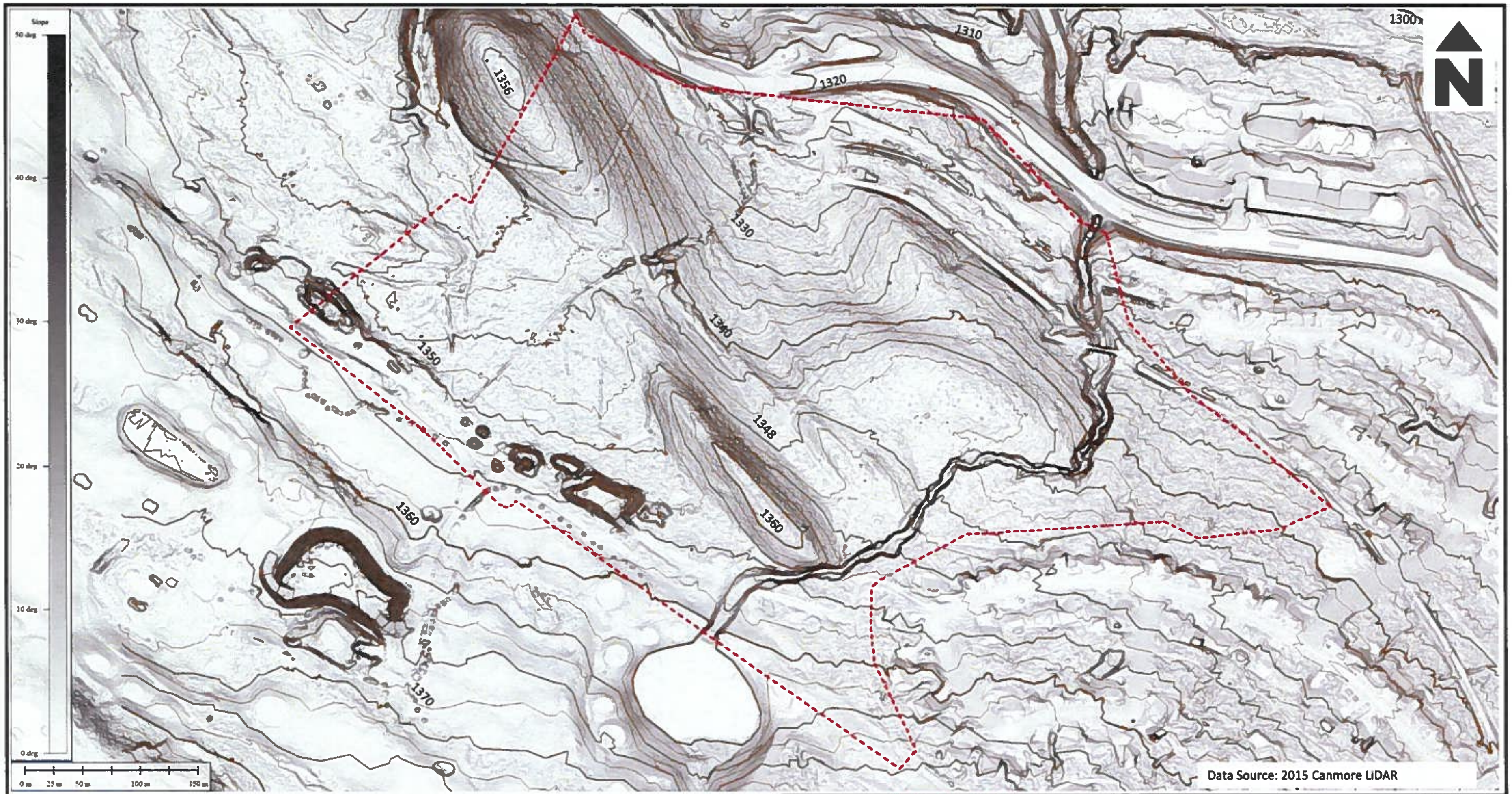

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Project Area

2m Elevation Contours

wsp

THREE SISTERS mountain village

PROJECT NAME
Resort Village - Phase 1
Undermining

SHEET TITLE
Phase 1 Elevation Contours

PROJECT NUMBER
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FIGURE NUMBER
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ISSUE/REVISION
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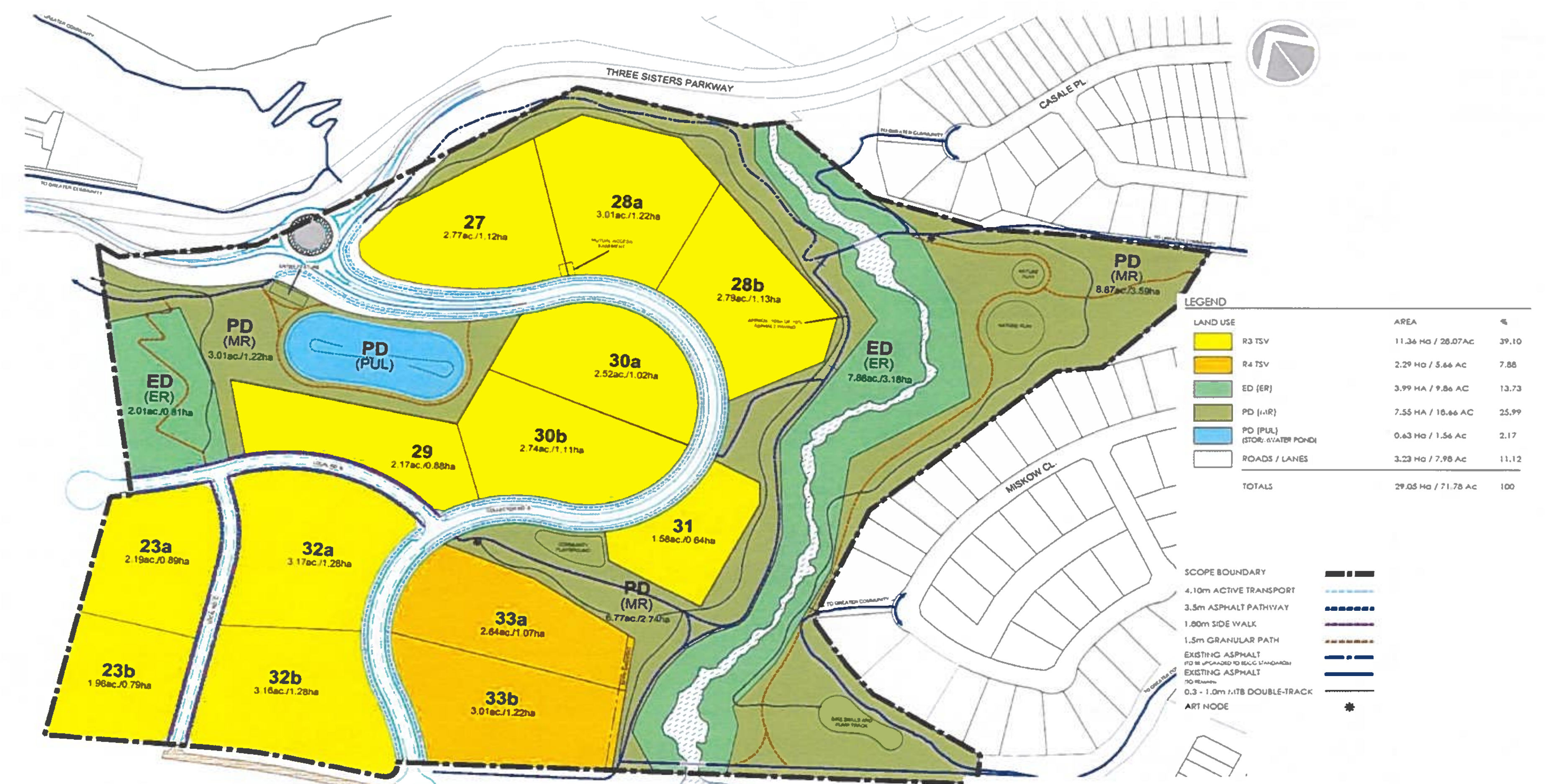

Data Source: NAK Design Strategies, Drawing # Fig 25, Rev 10, dated 2023-04-25

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Project Area

PROJECT NAME
Resort Village - Phase 1
Undermining

SHEET TITLE
Proposed Development

PROJECT NUMBER
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FIGURE NUMBER
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ISSUE/REVISION
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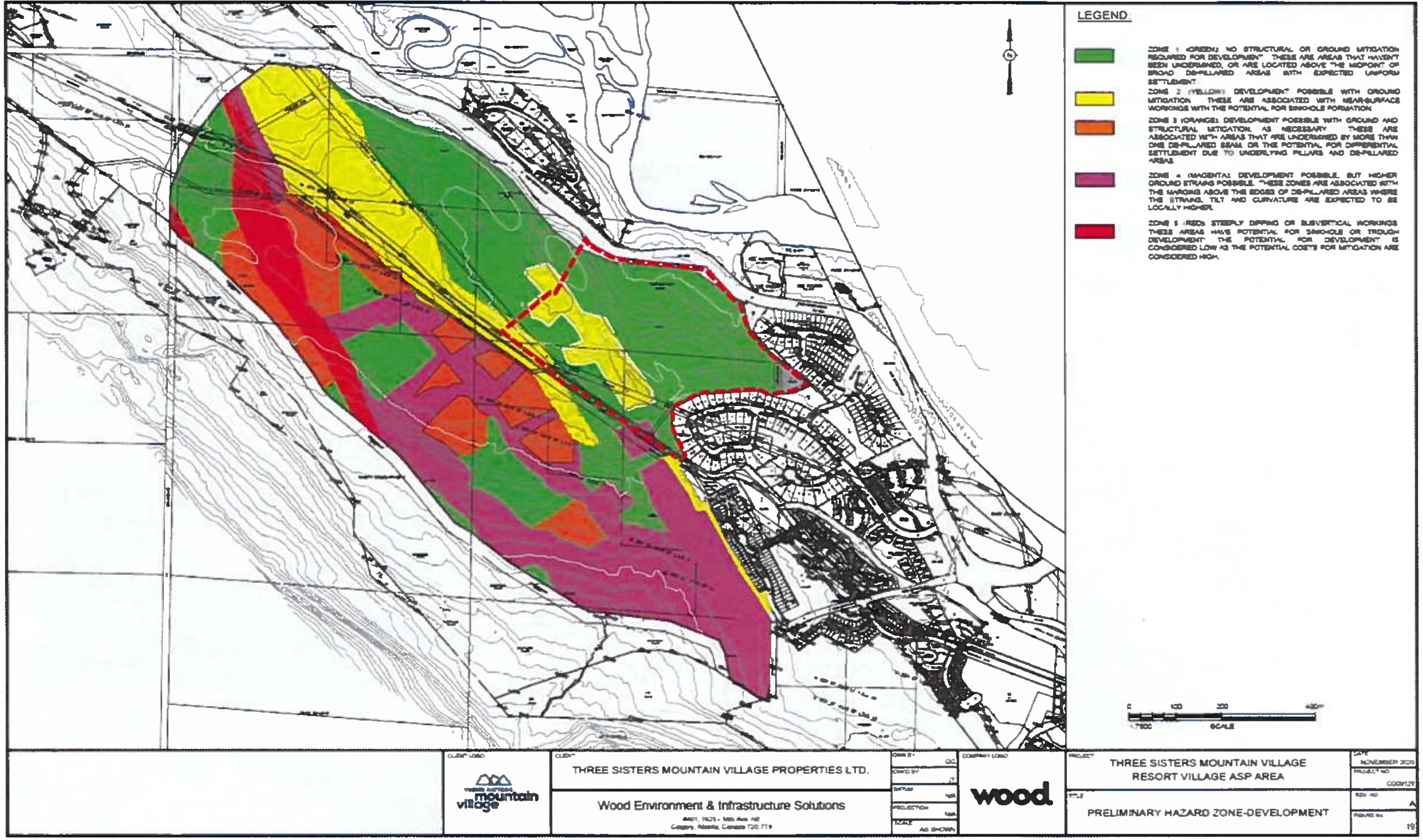

Source: WSP E&I Canada Limited, Area Mining Impact Overview Report Resort Village Area Structure Plan_Rev2, dated 16 November 2020

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🟥 Project Area

PROJECT NAME
Resort Village - Phase 1 Undermining

SHEET TITLE
Existing Hazard Mapping for Development

PROJECT NUMBER
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FIGURE NUMBER
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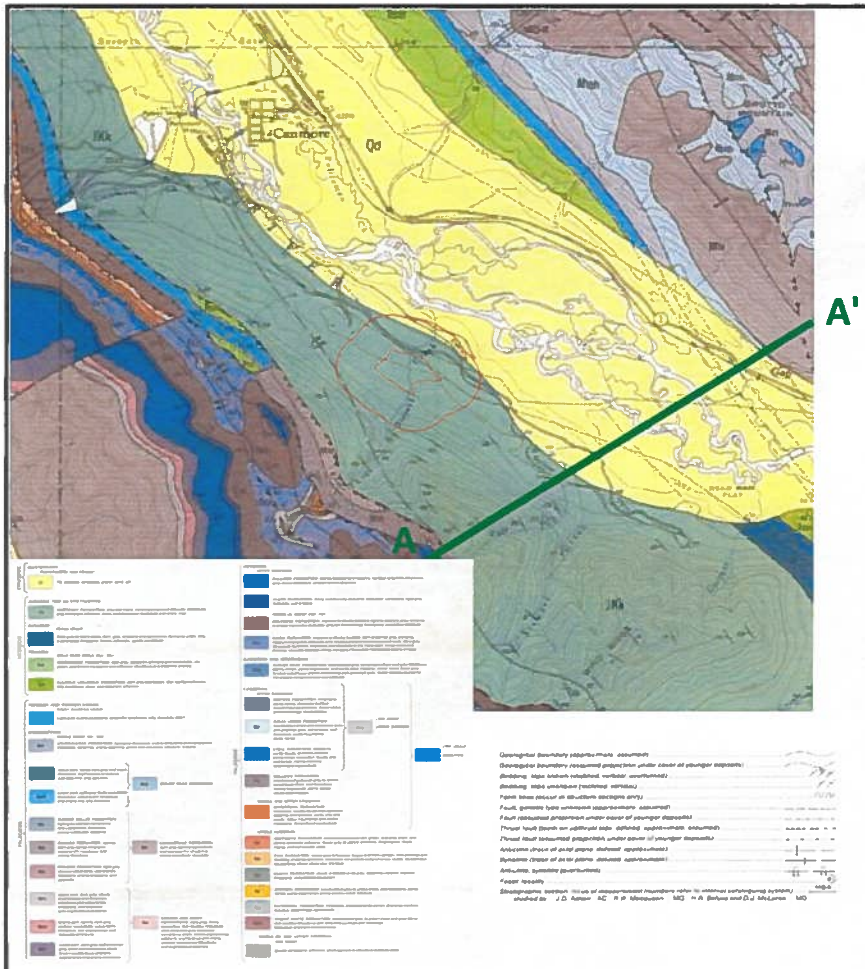

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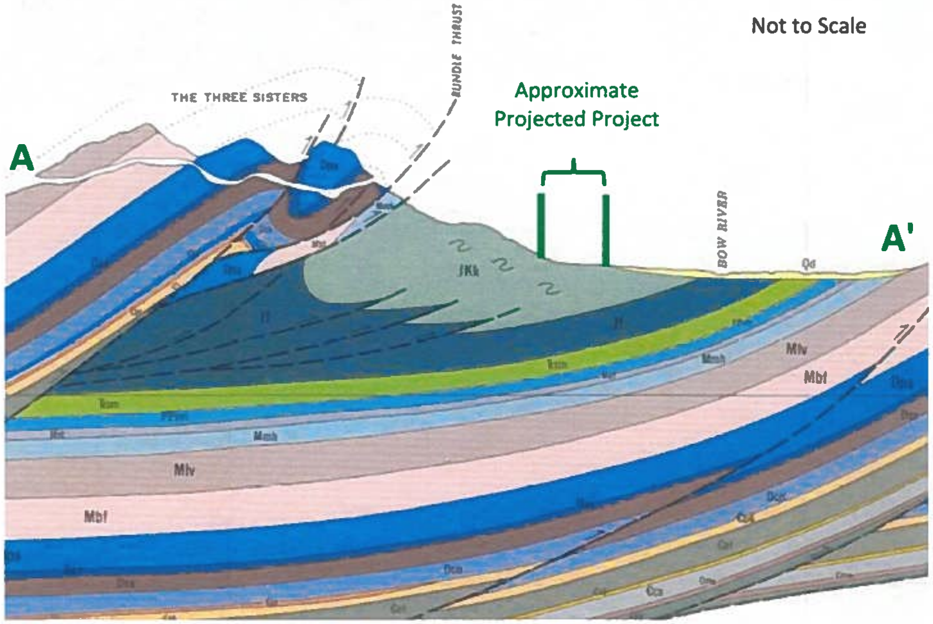
Project Area

500m Public Safety Zone



Map and Section Modified from: Geological Survey of Canada, Map 1266A, Canmore, Scale 1:50,000, Published 1970

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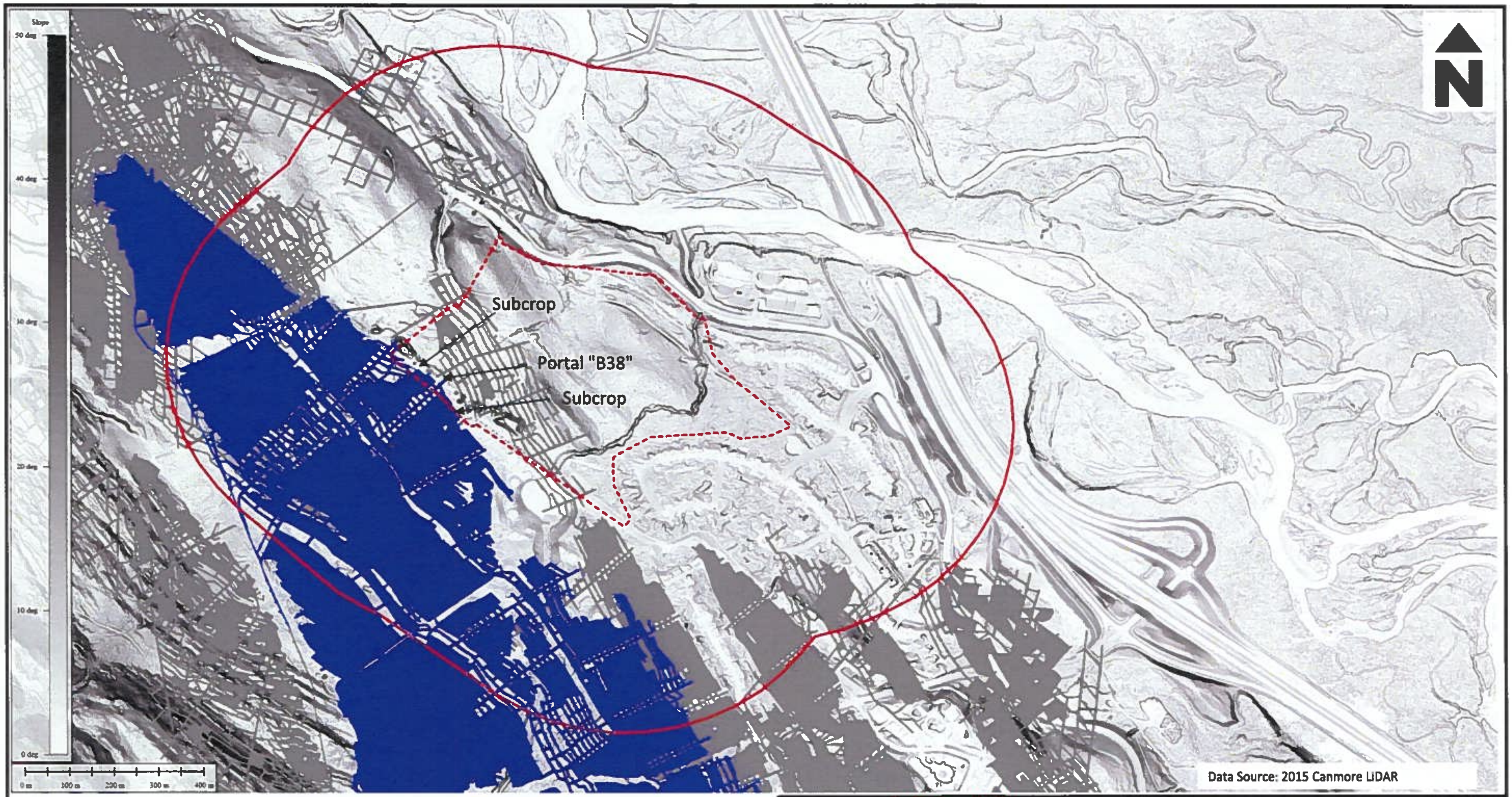
THREE SISTERS mountain village	SHEET TITLE Bedrock Geology	ISSUE/REVISION 0



Data Source: 2015 Canmore LiDAR

Legend

Project Area

500m Public Safety Zone

🟦 Stewart Mine

⬜ Other Mines

wsp

THREE SISTERS mountain village

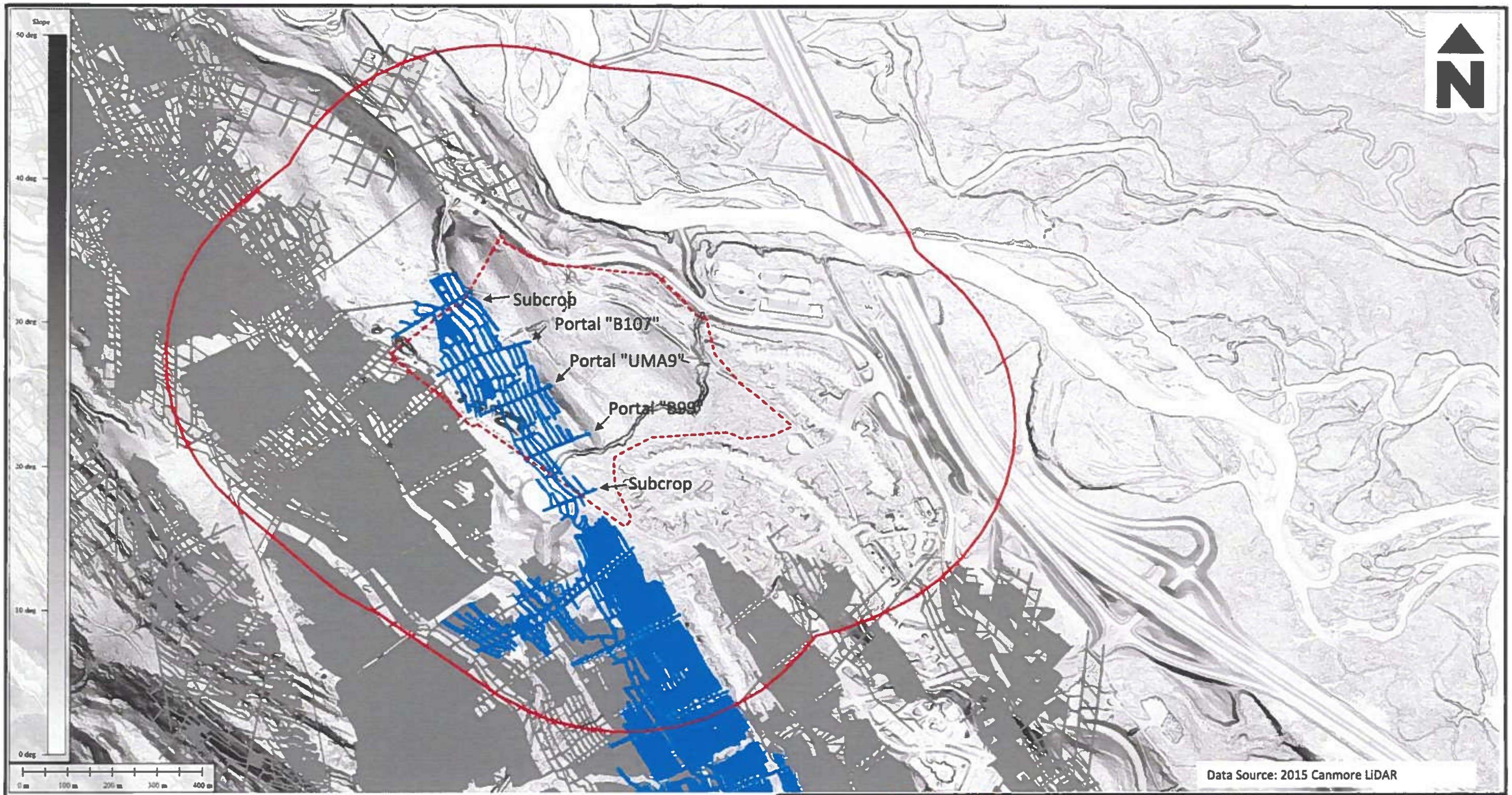
PROJECT NAME
Resort Village - Phase 1
Undermining

SHEET TITLE
Stewart Mine

PROJECT NUMBER
CG09140

FIGURE NUMBER
8

ISSUE/REVISION
0



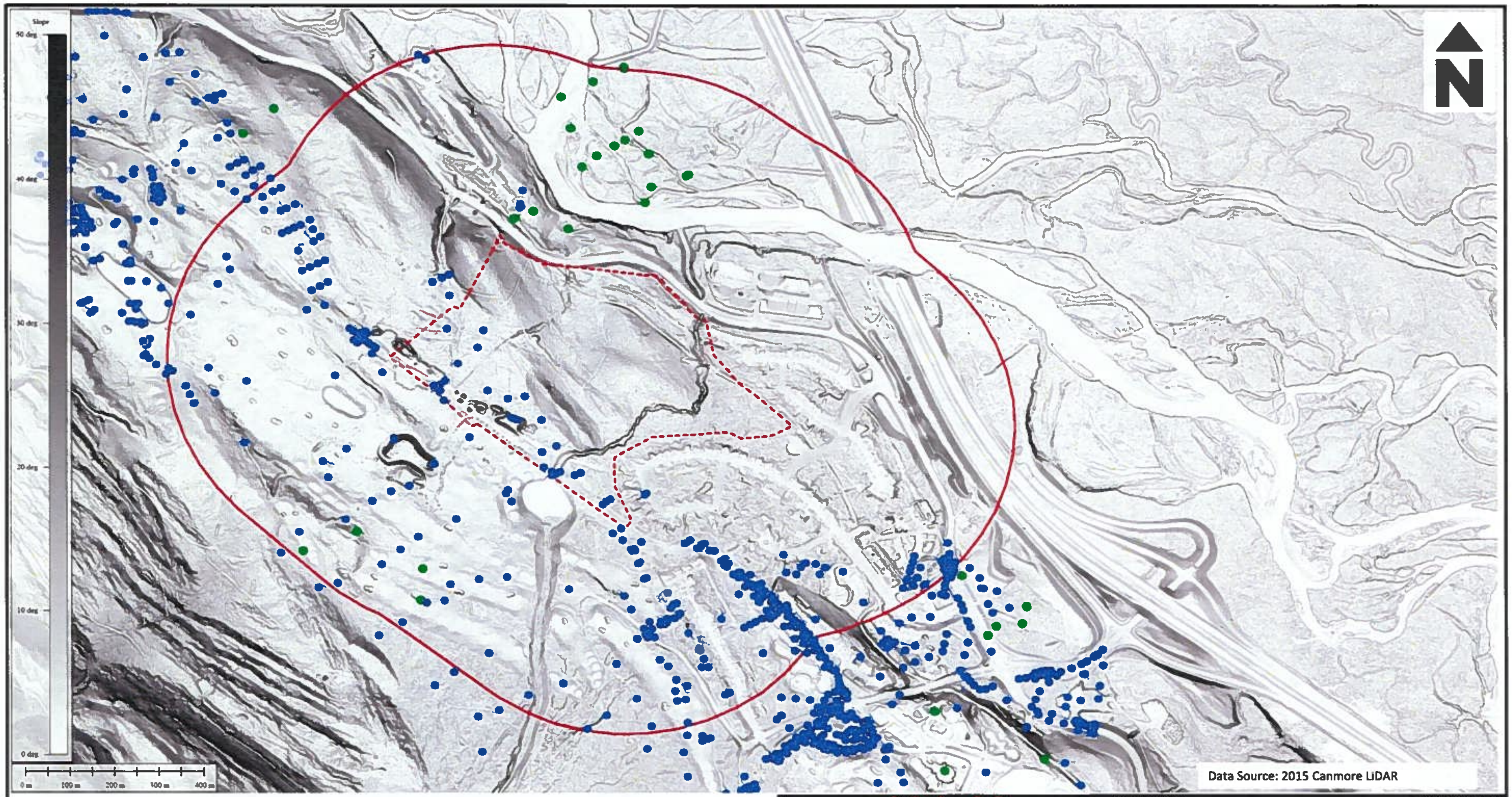
Data Source: 2015 Canmore LiDAR

Legend
- Project Area
- 500m Public Safety Zone
- 🟦 Morris Mine
- ⬜ Other Mines

wsp

THREE SISTERS mountain village

PROJECT NAME Resort Village - Phase 1 Undermining	PROJECT NUMBER CG09140	FIGURE NUMBER 9
SHEET TITLE Morris Mine	ISSUE/REVISION 0	



Legend

- ⋯ Project Area
- ╱ 500m Public Safety Zone
- ● AER Boreholes
- ● Boreholes by Others

wsp

THREE SISTERS mountain village

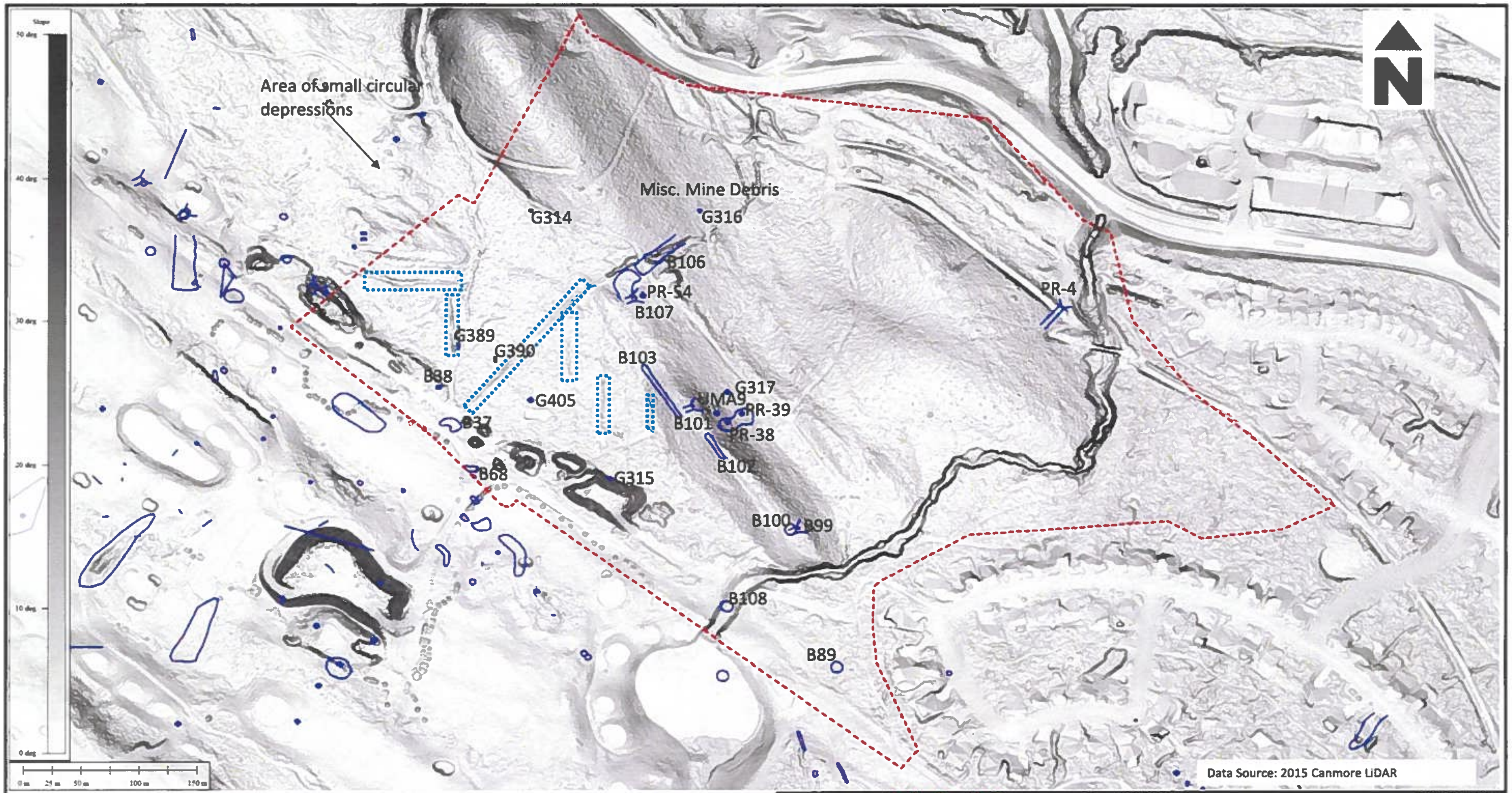
PROJECT NAME
Resort Village - Phase 1
Undermining

SHEET TITLE
Existing Boreholes

PROJECT NUMBER
CG09140

FIGURE NUMBER
10

ISSUE/REVISION
0

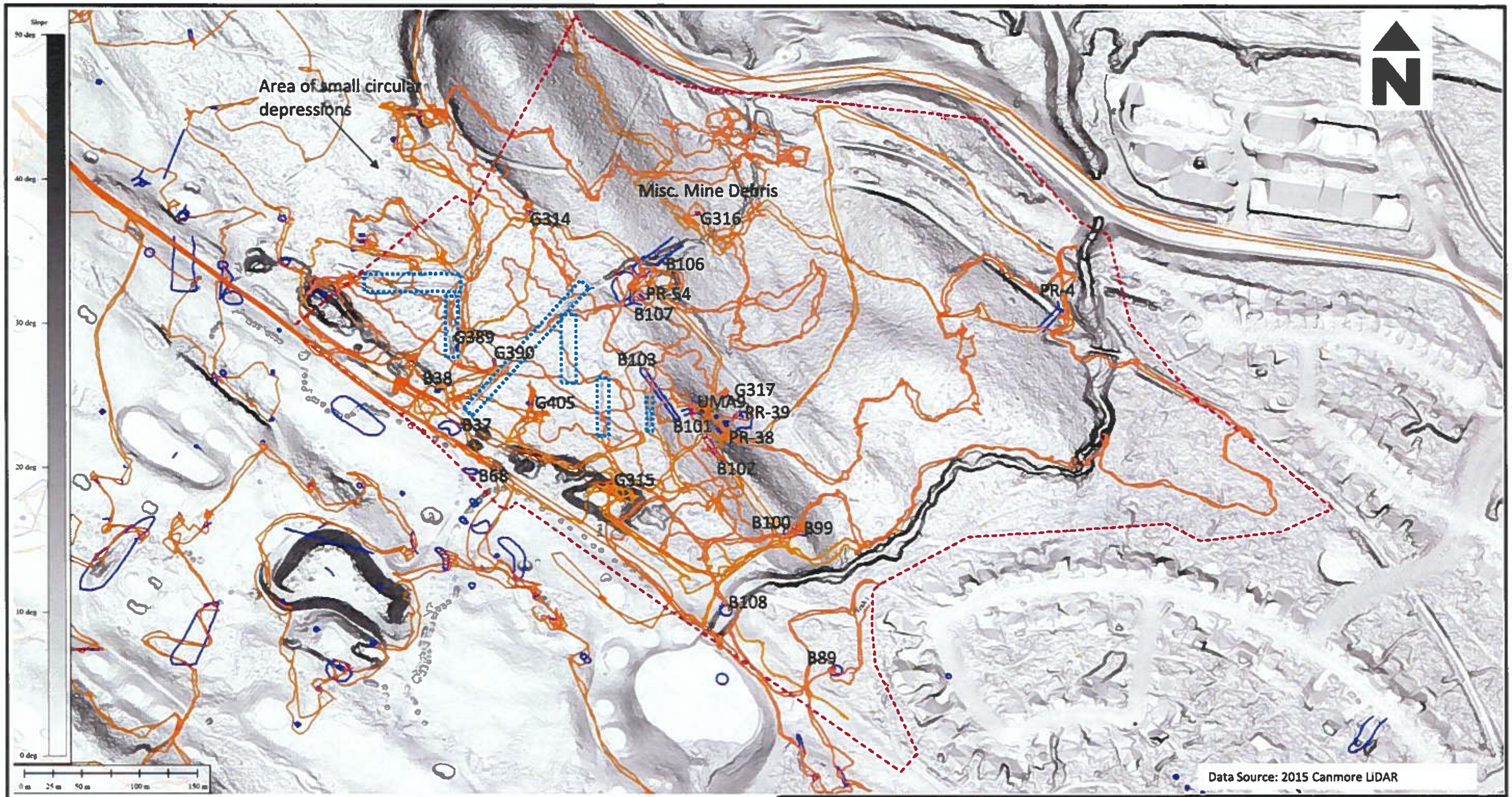


Data Source: 2015 Canmore LiDAR

Legend

- Project Area
- Previously Identified Feature
- Drainage Ditch

wsp THREE SISTERS mountain village	PROJECT NAME Resort Village - Phase 1 Undermining	PROJECT NUMBER CG09140
	SHEET TITLE Existing Features	FIGURE NUMBER 11
		ISSUE/REVISION 0



Data Source: 2015 Canmore LiDAR

Legend

Project Area

Previously Identified Feature

WSP Tracks via GPS

wsp

THREE SISTERS mountain village

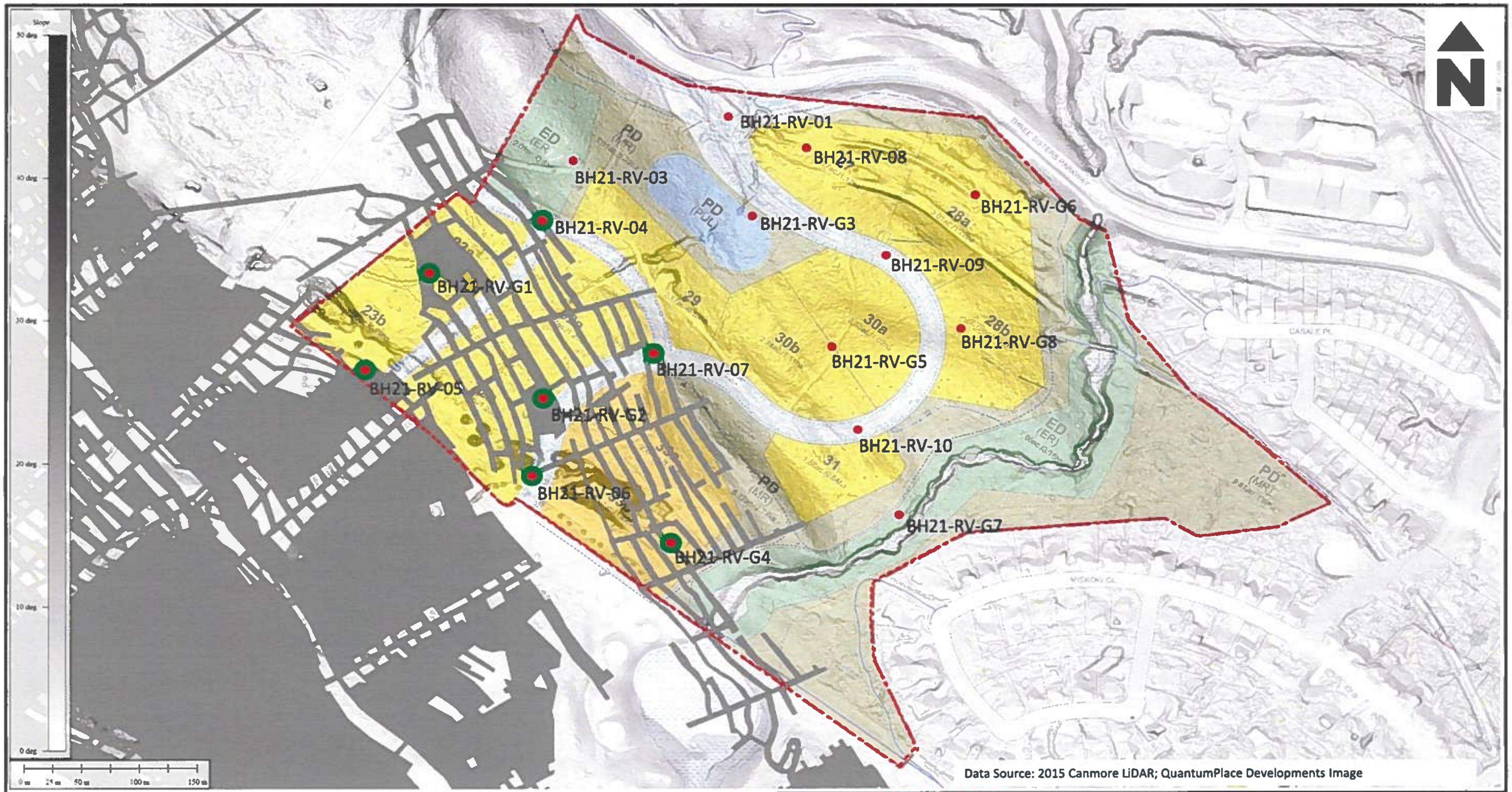
PROJECT NAME
Resort Village - Phase 1
Undermining

SHEET TITLE
Existing Features with WSP Tracks

PROJECT NUMBER
CG09140

FIGURE NUMBER
12

ISSUE/REVISION
0



Data Source: 2015 Canmore LiDAR; QuantumPlace Developments Image

Legend

- Project Area
- Mine Extents
- ● Geotechnical Boreholes Advanced by WSP
- ● Undermining Boreholes Advanced by WSP

wsp

THREE SISTERS mountain village

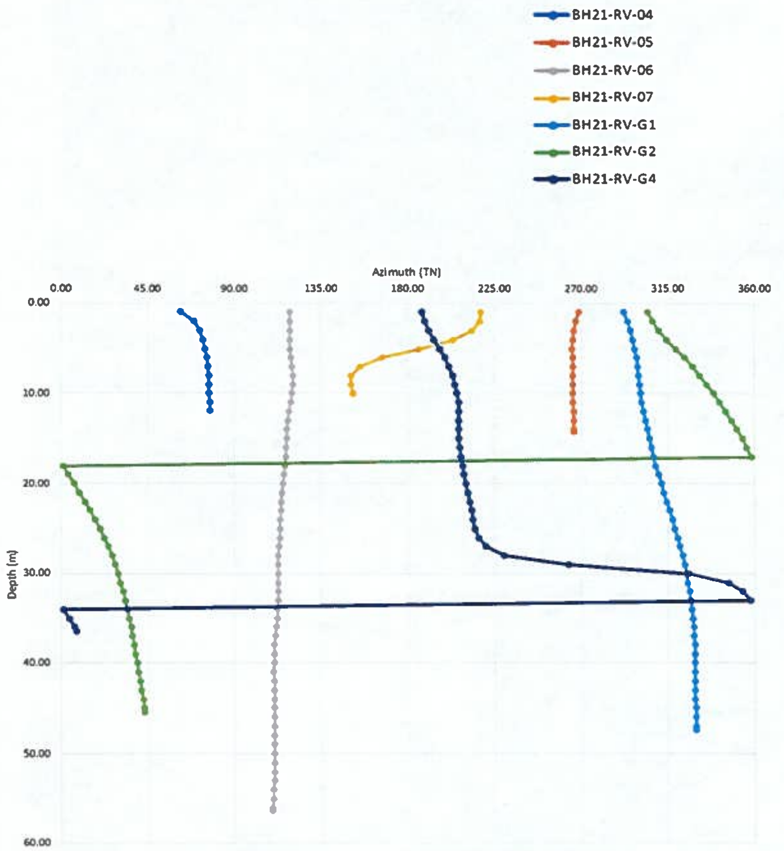
PROJECT NAME
Resort Village - Phase 1
Undermining

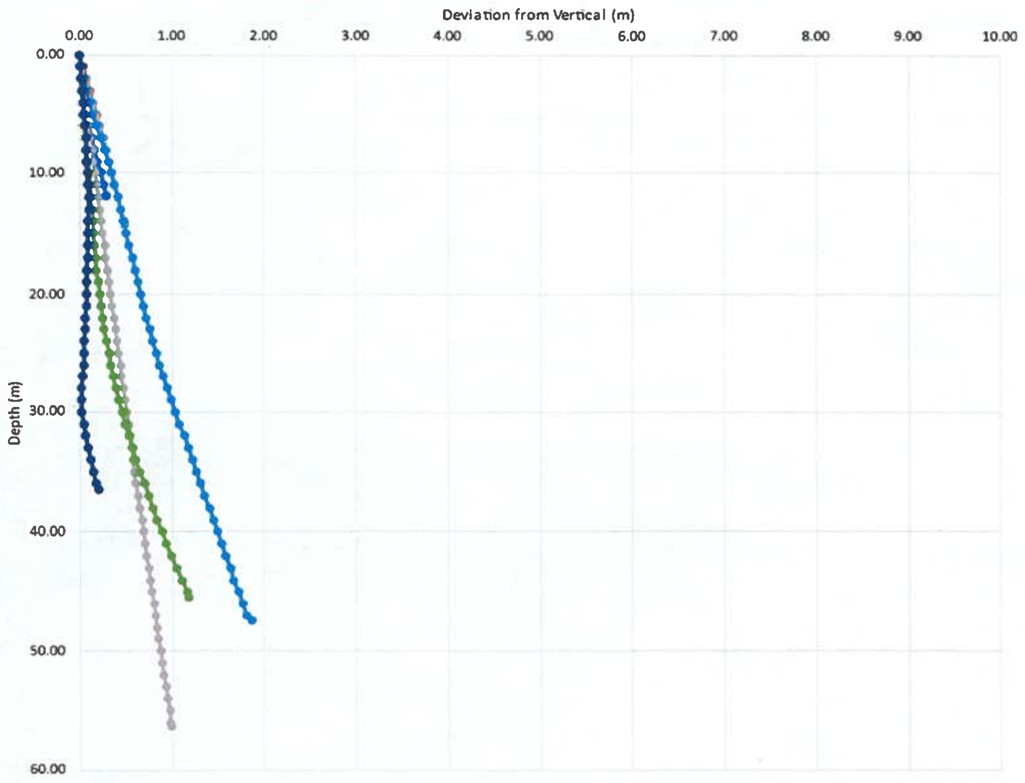
SHEET TITLE
WSP Advanced Boreholes

PROJECT NUMBER
CG09140

FIGURE NUMBER
13

ISSUE/REVISION
0





Data Source: 2015 Canmore LiDAR

wsp	PROJECT NAME Resort Village - Phase 1 Undermining	PROJECT NUMBER CG09140 FIGURE NUMBER 14
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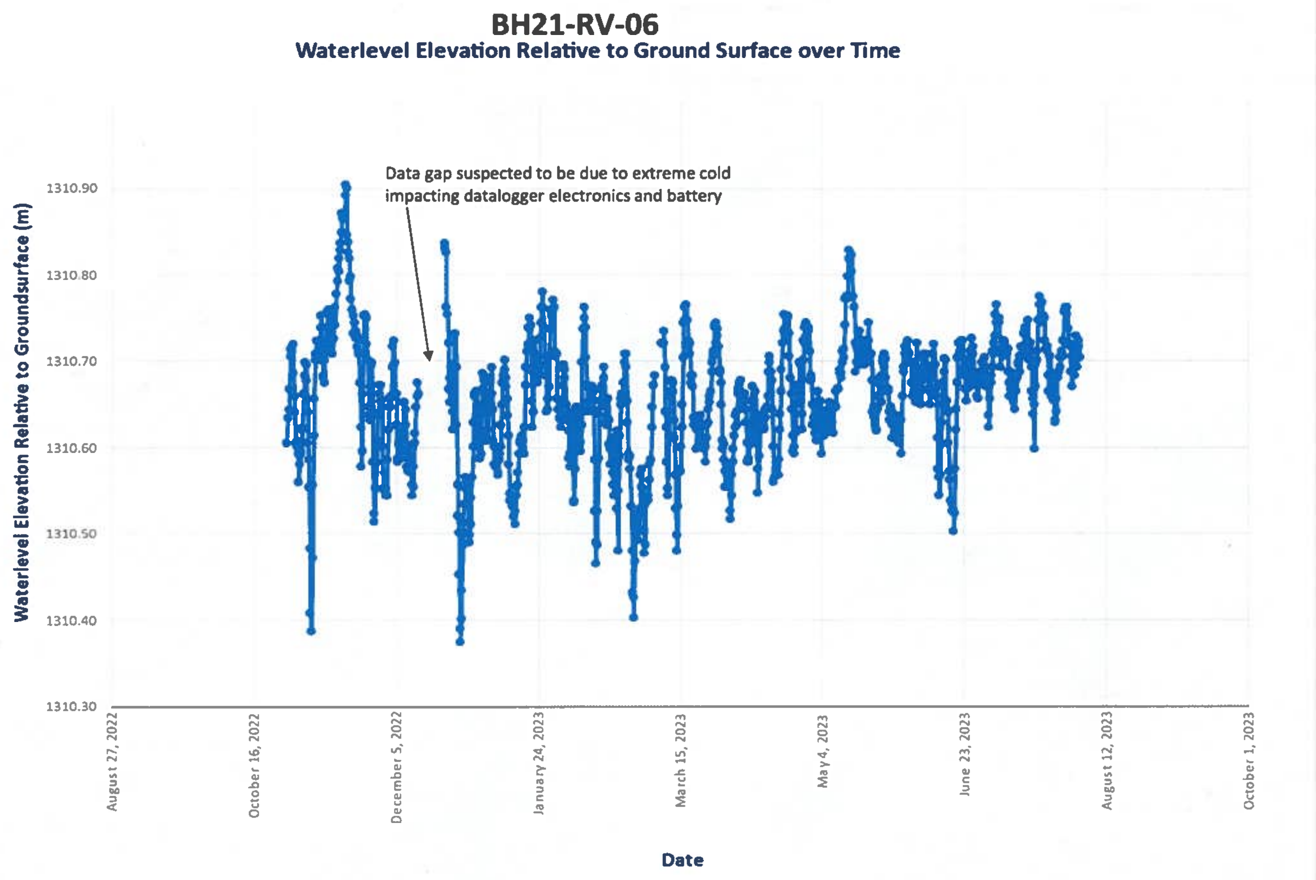
BH21-RV-06

Waterlevel Elevation Relative to Ground Surface over Time

Data gap suspected to be due to extreme cold impacting datalogger electronics and battery

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		FIGURE NUMBER 15
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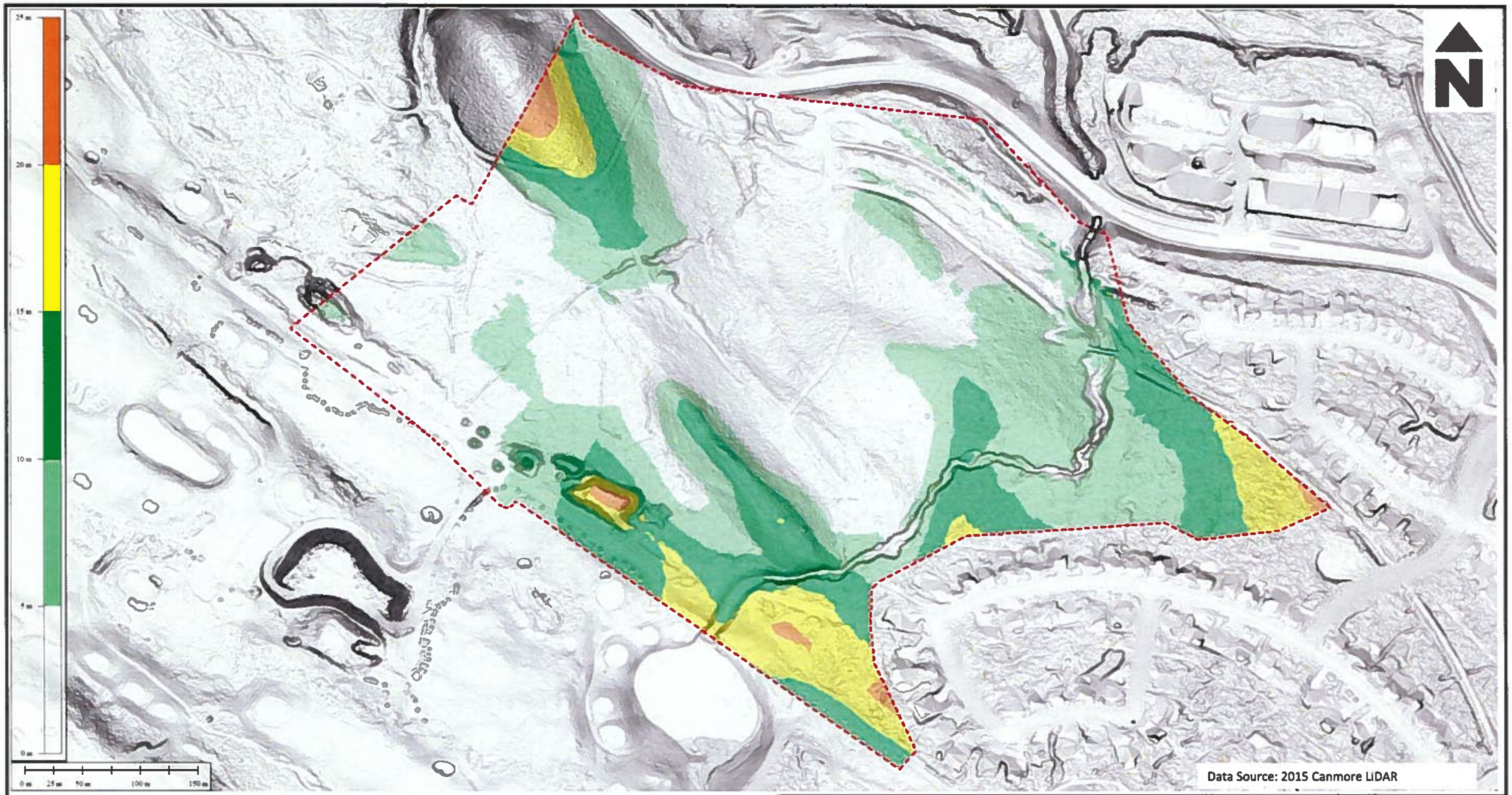

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Project Area

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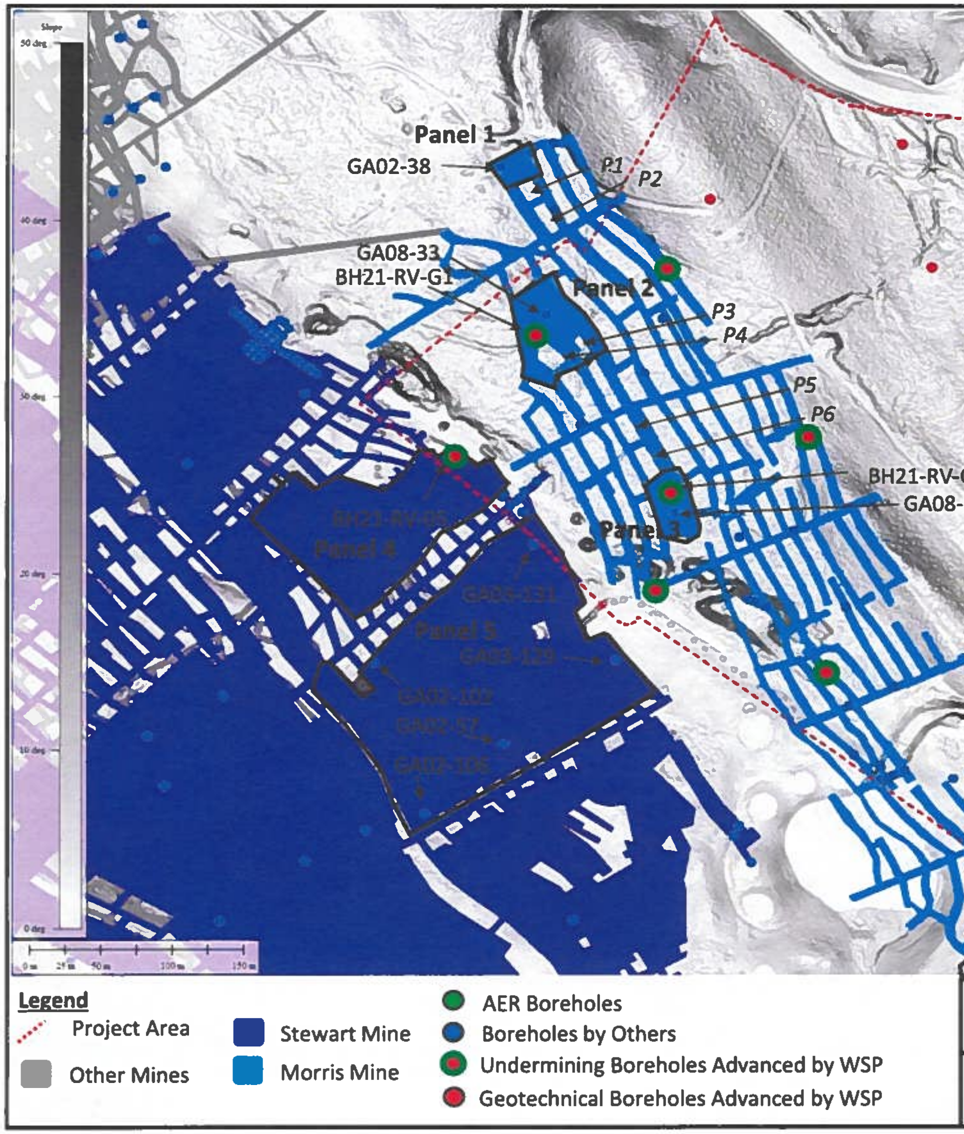
THREE SISTERS mountain village

PROJECT NAME	Resort Village - Phase 1 Undermining
SHEET TITLE	Overburden Isopach Map
PROJECT NUMBER	CG09140
FIGURE NUMBER	16
ISSUE/REVISION	0



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THREE SISTERS mountainvillage

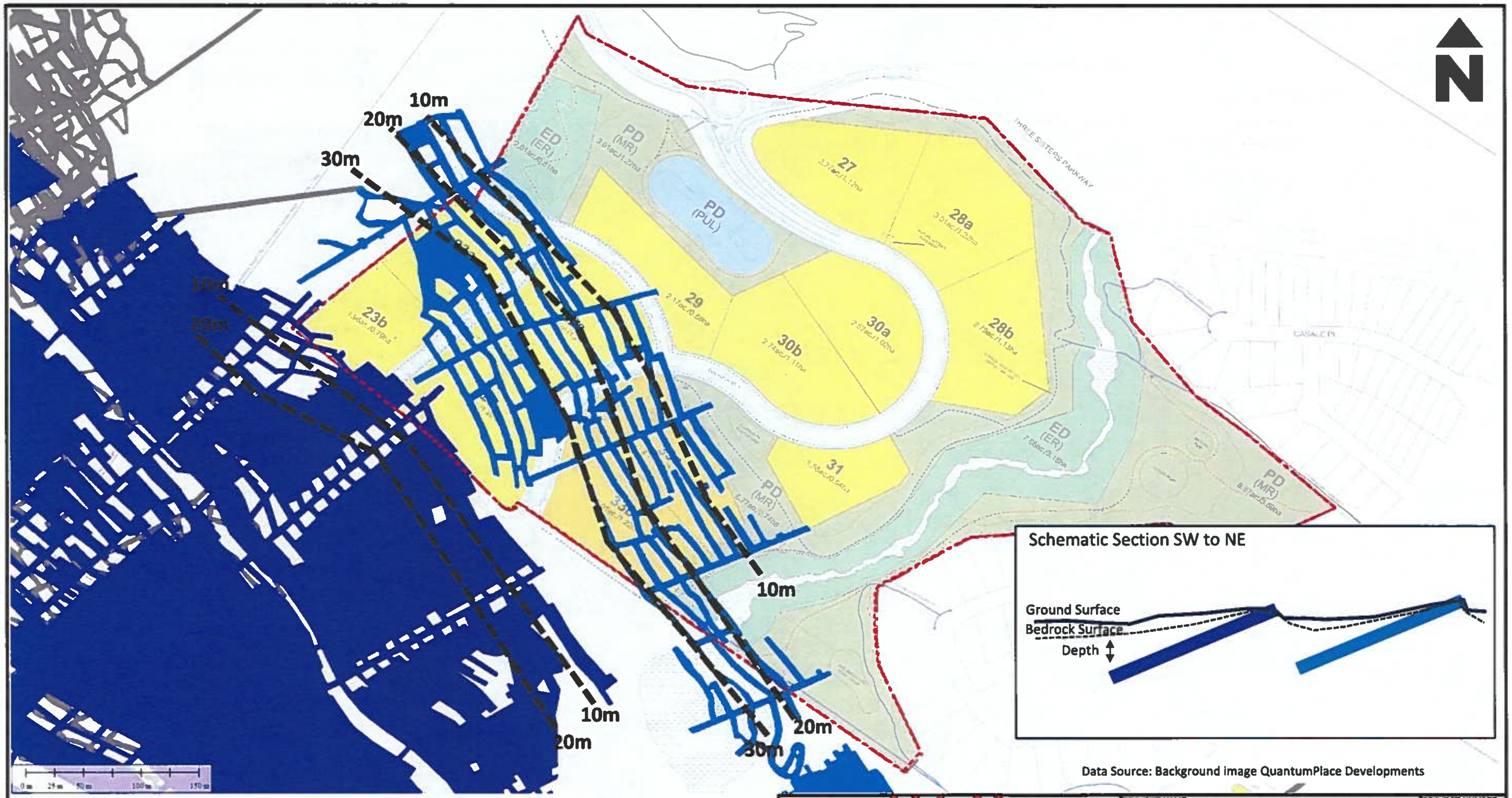
PROJECT NAME
Resort Village - Phase 1
Undermining

SHEET TITLE
Assessment of Panels

PROJECT NUMBER
CG09140

FIGURE NUMBER
17

ISSUE/REVISION
0



Data Source: Background image QuantumPlace Developments

Legend

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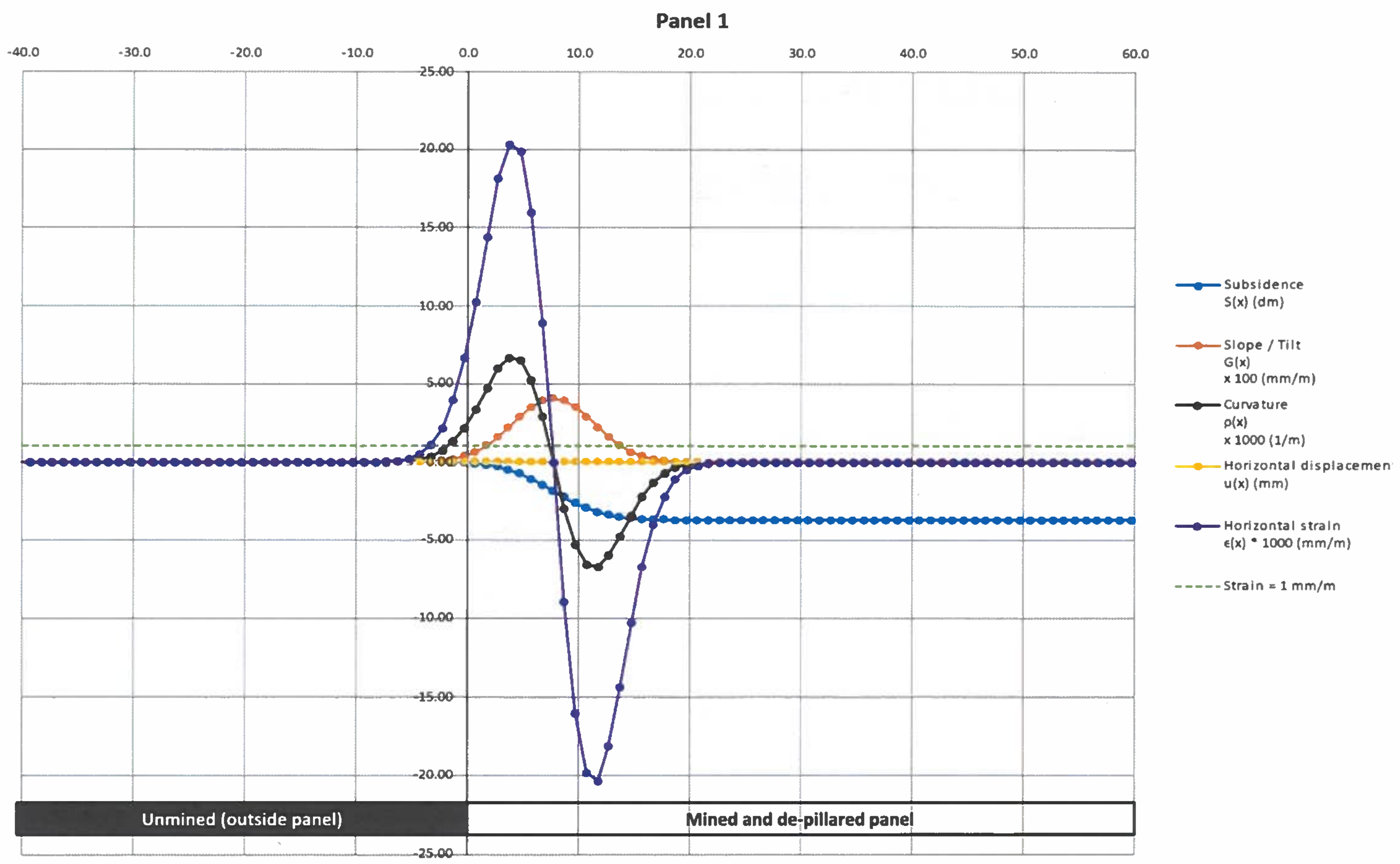
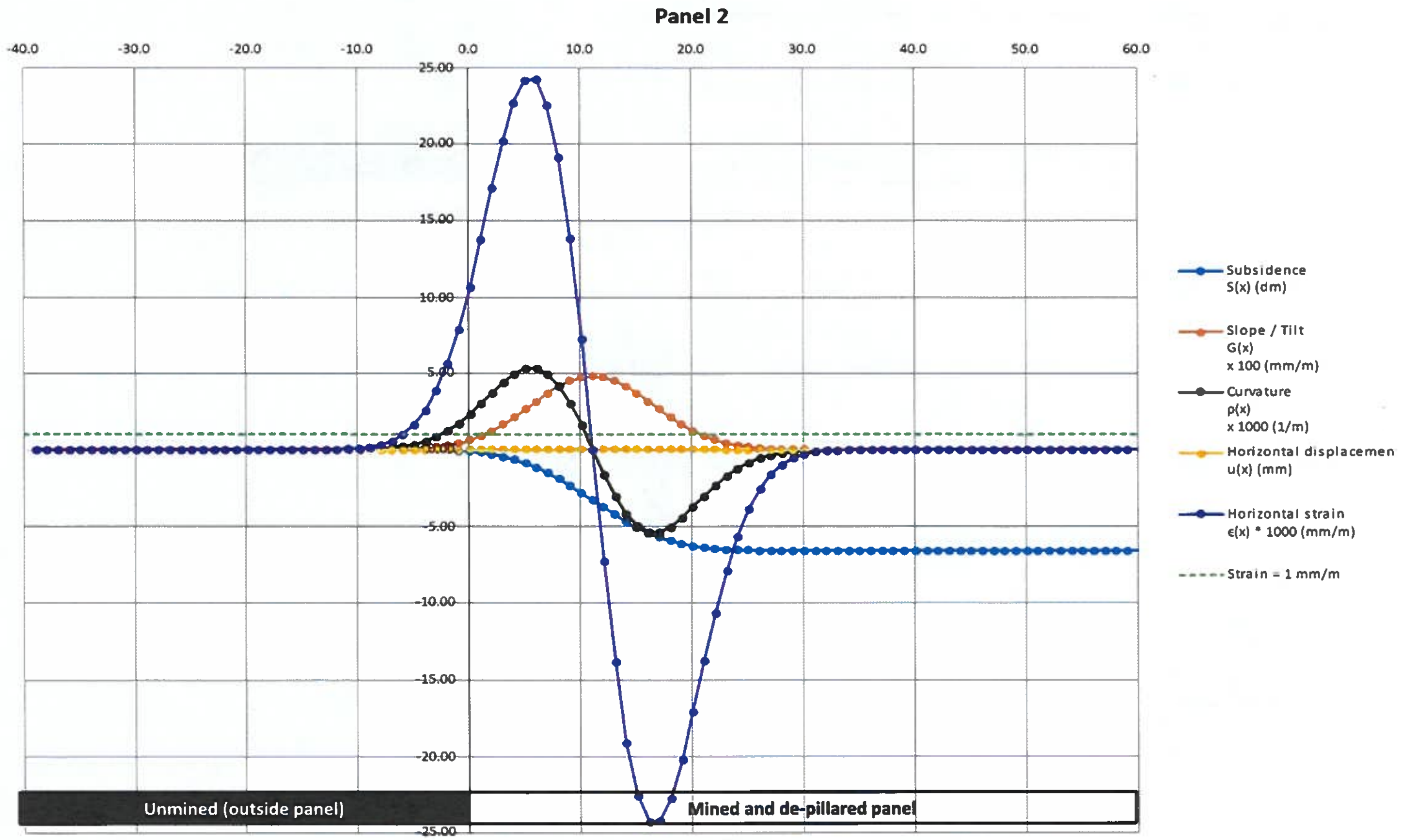
THREE SISTERS mountain village

PROJECT NAME Resort Village - Phase 1 Undermining	PROJECT NUMBER CG09140
	FIGURE NUMBER 18
SHEET TITLE Approximate Bedrock Cover Contours	ISSUE/REVISION 0



wsp THREE SISTERS mountain village	PROJECT NAME Resort Village - Phase 1 Undermining	PROJECT NUMBER CG09140
		FIGURE NUMBER 19
	SHEET TITLE Panel 1 - Morris Mine	ISSUE/REVISION 0



PROJECT NAME
Resort Village - Phase 1 Undermining

SHEET TITLE
Panel 2 - Morris Mine

PROJECT NUMBER
CG09140

FIGURE NUMBER
20

ISSUE/REVISION
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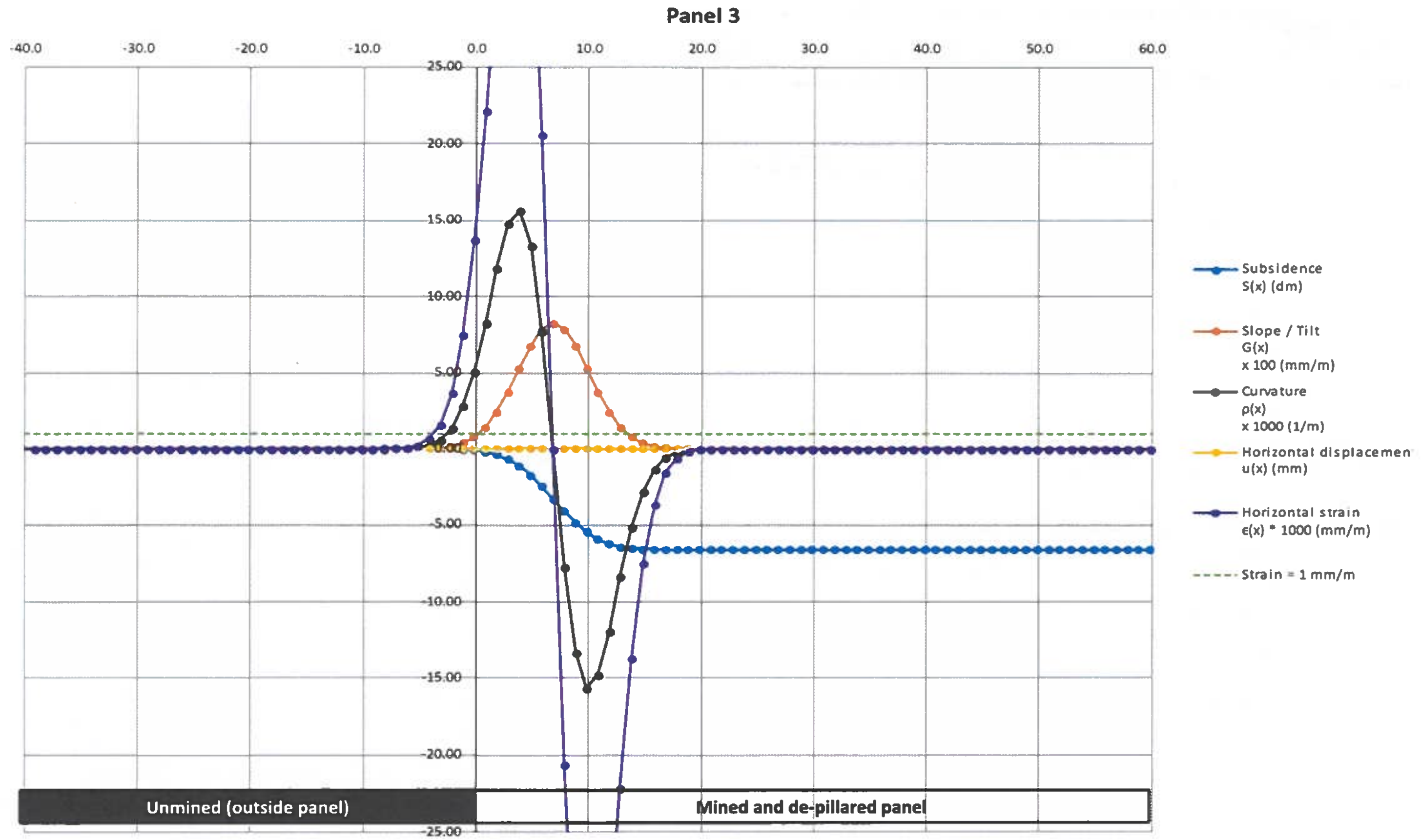

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Resort Village - Phase 1 Undermining

SHEET TITLE
Panel 3 - Morris Mine

PROJECT NUMBER
CG09140

FIGURE NUMBER
21

ISSUE/REVISION
0

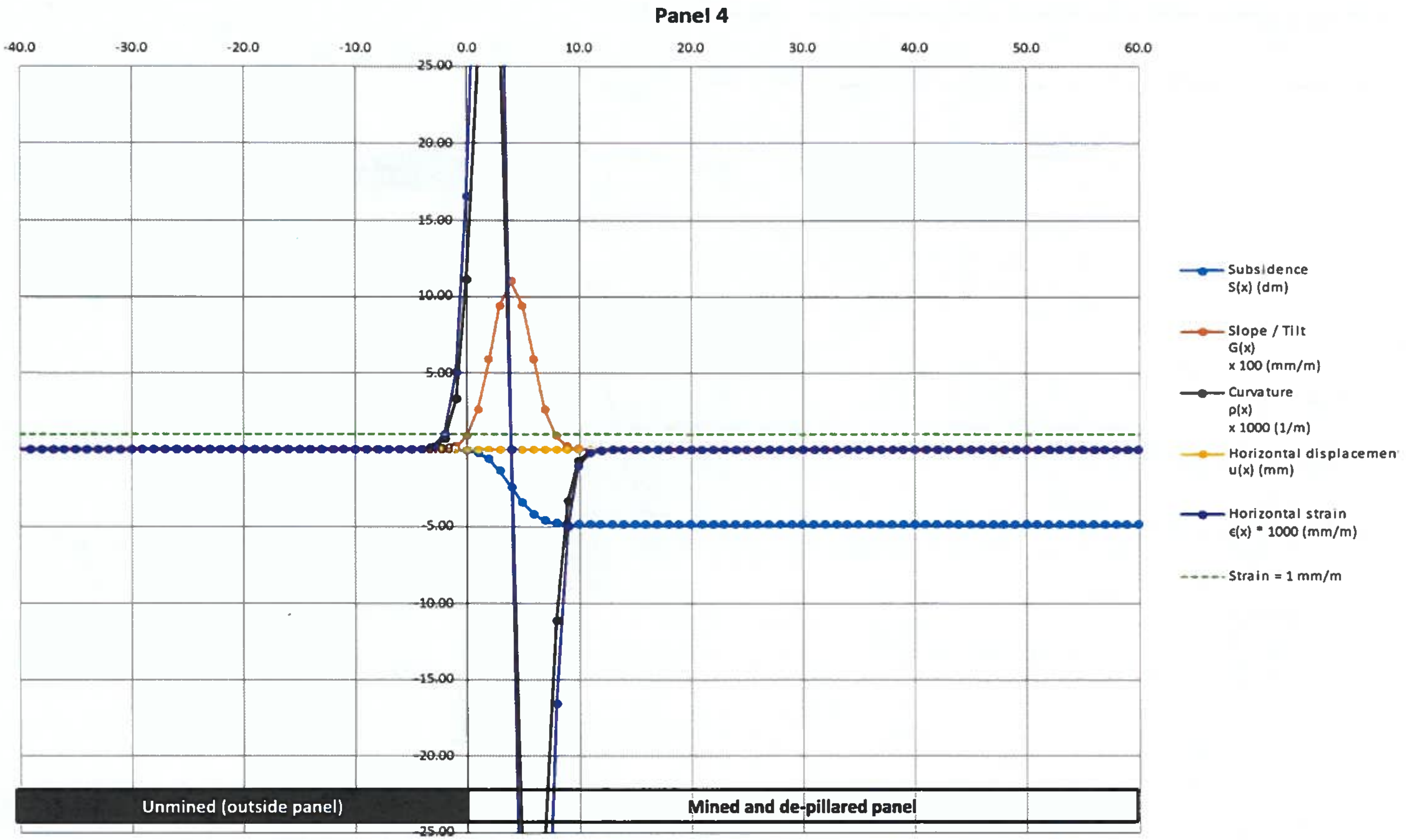

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		FIGURE NUMBER 22
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Panel 5

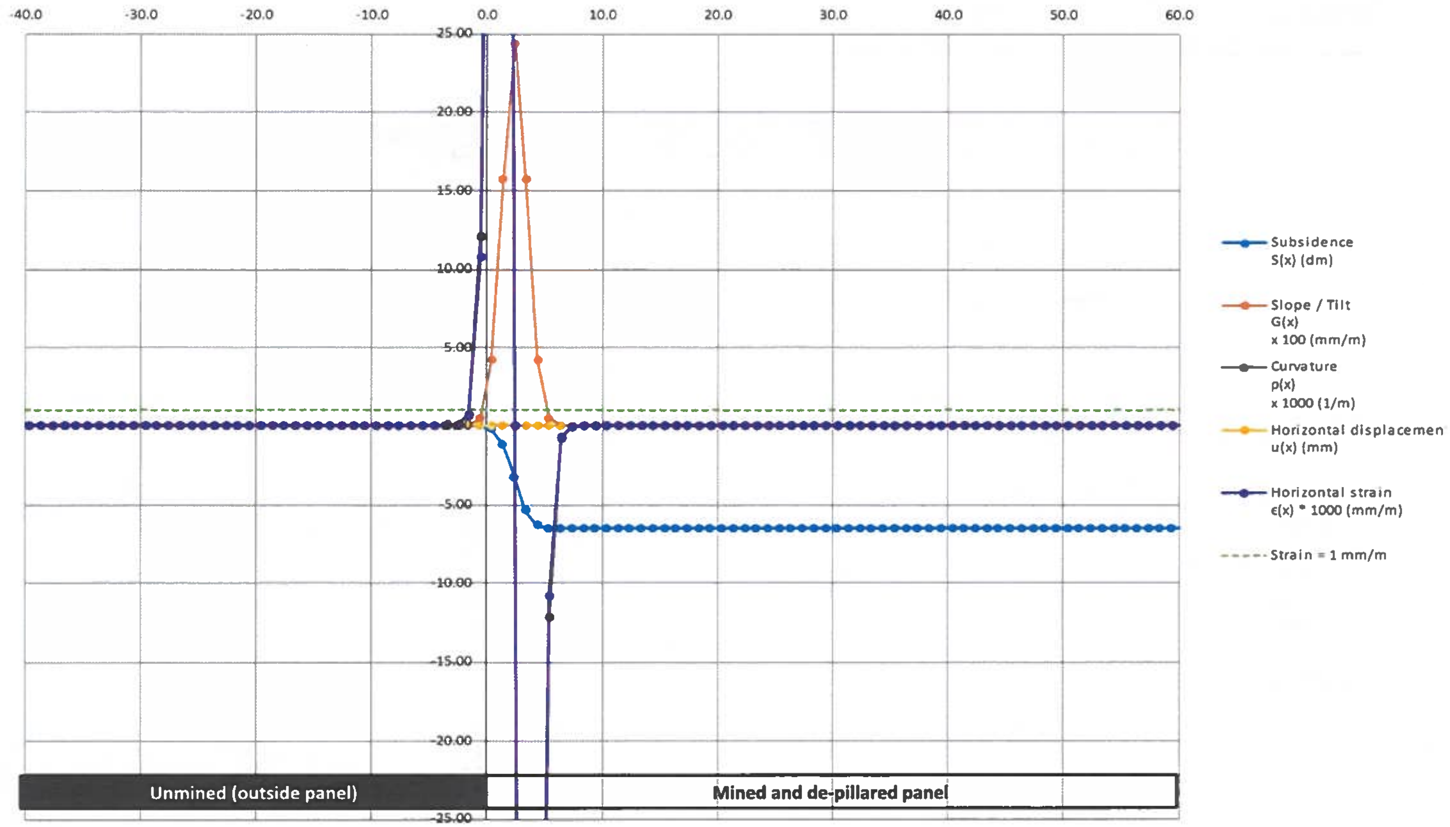

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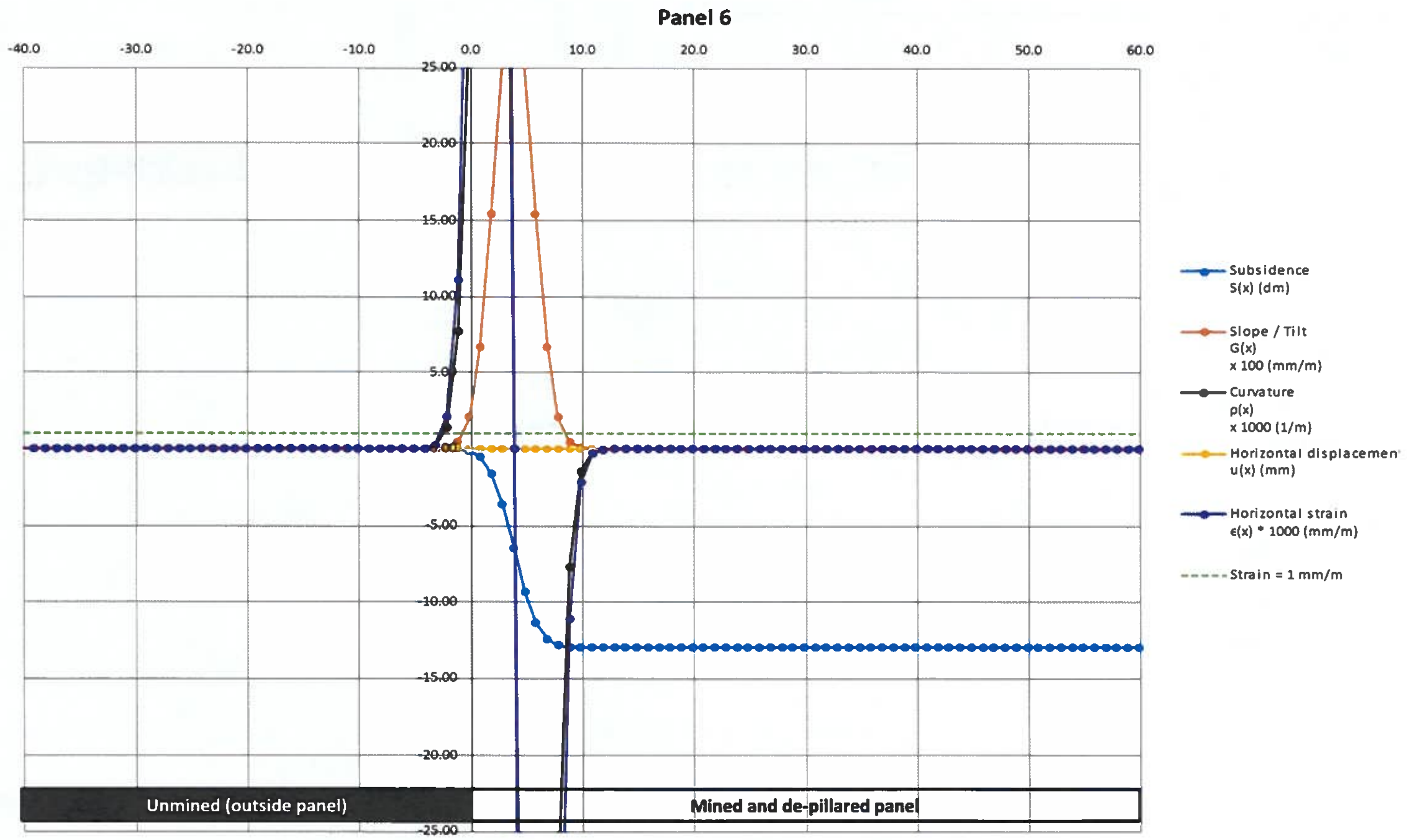
		FIGURE NUMBER 23
	SHEET TITLE Panel 5 - Stewart Mine	ISSUE/REVISION 0



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THREE SISTERS mountain village

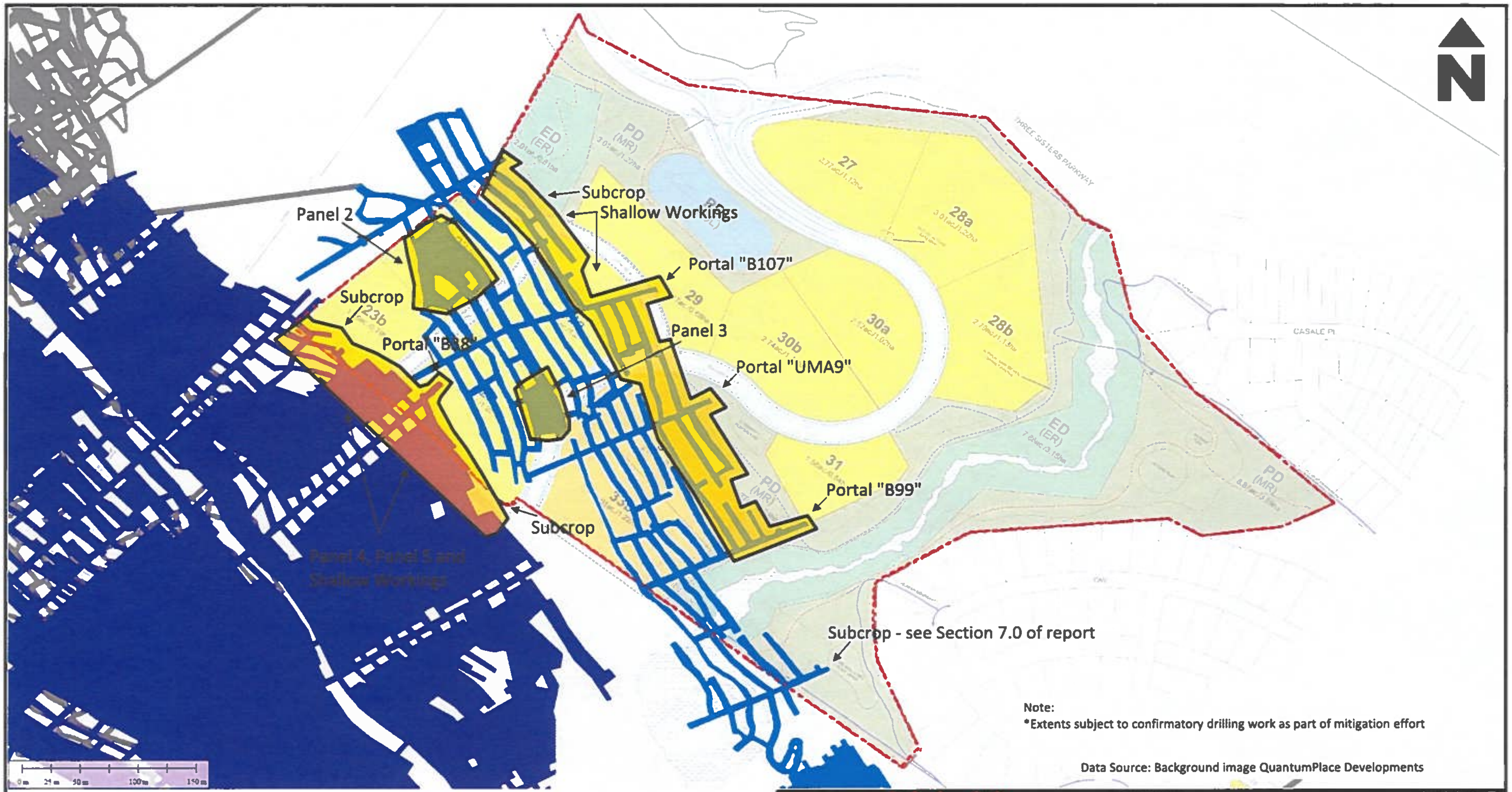
PROJECT NAME
Resort Village - Phase 1
Undermining

SHEET TITLE
Panel 6 - Morris Mine

PROJECT NUMBER
CG09140

FIGURE NUMBER
24

ISSUE/REVISION
0



Note:
*Extents subject to confirmatory drilling work as part of mitigation effort

Data Source: Background image QuantumPlace Developments

Legend

- Project Area
- ■ Other Mines
- ■ Stewart Mine
- ■ Morris Mine
- 🟨 Phase 1 Areas Recommended for Mitigation*

wsp

THREE SISTERS mountain village

PROJECT NAME
Resort Village - Phase 1
Undermining

SHEET TITLE
Areas Recommended for Mitigation

PROJECT NUMBER
CG09140

FIGURE NUMBER
25

ISSUE/REVISION
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Appendix A

Mining History

Appendix A – Mining History and Geology

1.0 INTRODCTION

Coal mining in the Canmore area began in the late 1800's to support the steam powered transcontinental Canadian Pacific Railway that ran through the Bow Valley. The anthracite and low volatile bituminous coal found in the Canmore area was ideal for use with steam engines, and was burned from Kamloops, BC to Medicine Hat, AB. Production expanded through the First and Second World Wars but declined in the 1950's as the railway converted to diesel power. This transition was completed by 1957, resulting in a steep decline in demand. A second market for Canmore coal was found in supplying metallurgical coal for Japanese steel mills. Production continued until 1979, when competition and reduced demand led to a drop in the price of coal and subsequent closure of the Canmore mines.

Coal production in the Canmore area came from multiple mines and seams. These are listed in chronological order of start date in Table A1. The mined areas are shown in plan in Figure A1, and a simplified schematic of the stratigraphic relationship of the mines and seams is presented in Figure A2.

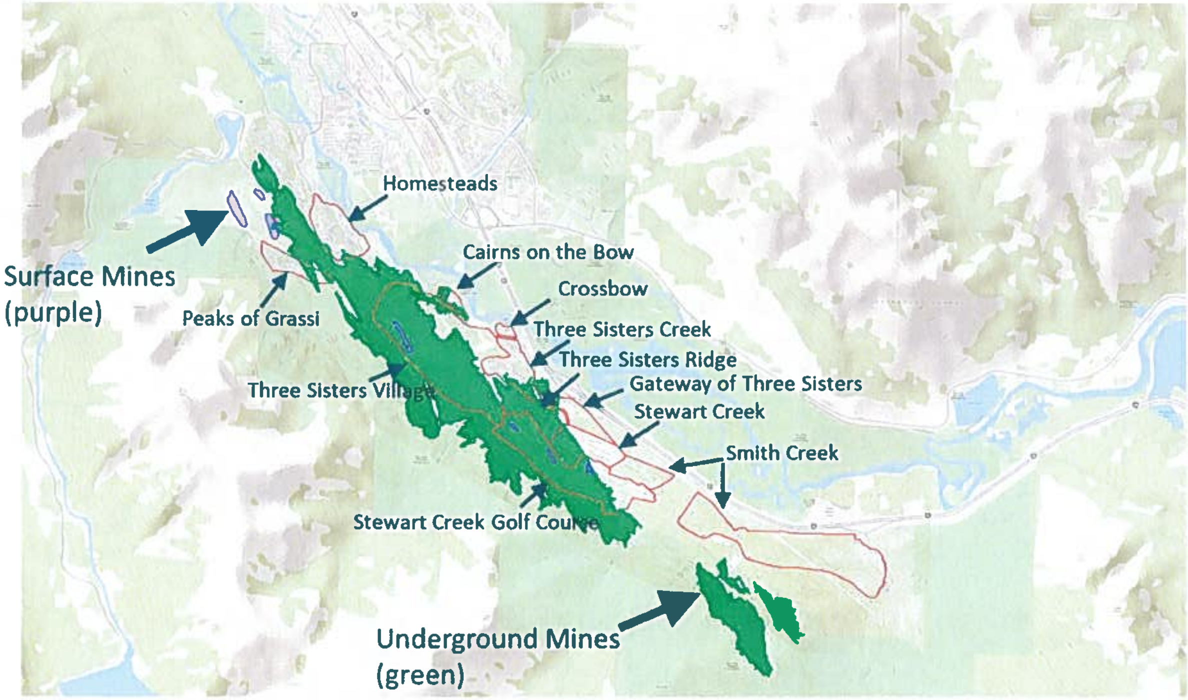


Figure A1. Plan Overview of Mining in the Canmore Area

Table A1: Underground Mines in the Canmore Area after Norwest 1994

Seam	Mine	Thickness (m)	Mining Date (planned)
No. 2 Seam	No. 1	2.13	1886 - 1907
No 1 Seam	No. 1	1.72	1891 - 1916
No. 4 seam	No. 1	0.9	1892 - 1911
No. 3 Seam	No. 1	1.52	1892 - 1916
Sedlock Seam	No. 2	1.8	1903 - 1915
Carey Seam	No. 1	2.75	1906 - 1916
Stewart Seam	No. 2	2.13	1914 - 1952
Carey Seam	No. 2	2.75	1916 - 1934
Morris No. 1 Seam	No. 2	2.0	1924 - 1941
Morris No. 2 Seam	No. 2	2.0	1929 - 1940
No. 4 Seam	No. 4	1.8	1937 - 1949
No. 2 Seam (?)	Wilson	3.8	1969 - 1979
Stewart Seam	No. 5	1.8	1965 - 1974
No. 4 Seam	No. 4B	1.8	1972 - 1979
No. 4 Seam	Riverside	1.8	1976 - 1979

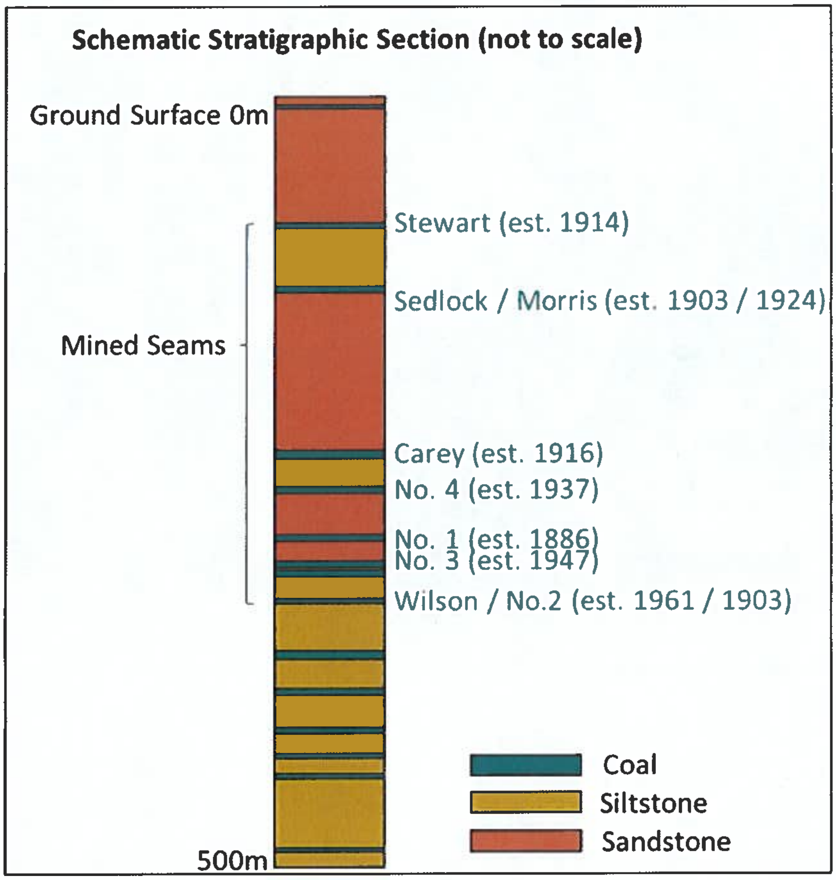


Figure A2. Schematic Stratigraphic Section for the Canmore Area (after Norwest 1994.)

2.0 REGIONAL AND LOCAL GEOLOGY

The geology of the Canmore area is well-described by Norwest Mining Consultants (2000); the discussion from that report is summarized in the remainder of this section.

Canmore is situated in the Cascade Coal Basin, which trends in a northwesterly direction for a distance of approximately 80 km within the front ranges of the Rocky Mountains. The Canmore area is located in the northern part of the basin, on the southwest side of the Bow River Valley. The stratum in this area belongs to the Lower Cretaceous Kootenay Group, which are exposed in northwest trending ridges and associated depressions (Figure A3).

The Mist Mountain Formation is the coal-bearing unit within the Kootenay Group, consisting of fine-grained sediments including siltstone, fine sandstone, shale, and coal seams in a sequence up to 400 m thick. The depositional environment is interpreted to correspond to continental, near-shore lagoonal and fluvial deltaic facies, with coal forming back swamps. This coal-bearing section is overlain be the Elk Formation, a 600 m thick unit of fine-grained sediments. In the Cascade Coal Basin, the contact between the units is gradational, coarsening upwards. While there are thin coal seams in the lower part of the Elk Formation, mineable thicknesses are not present.

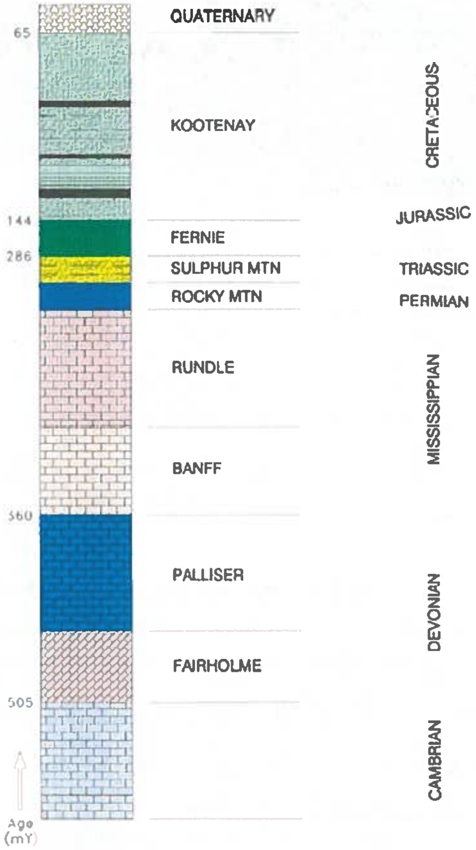
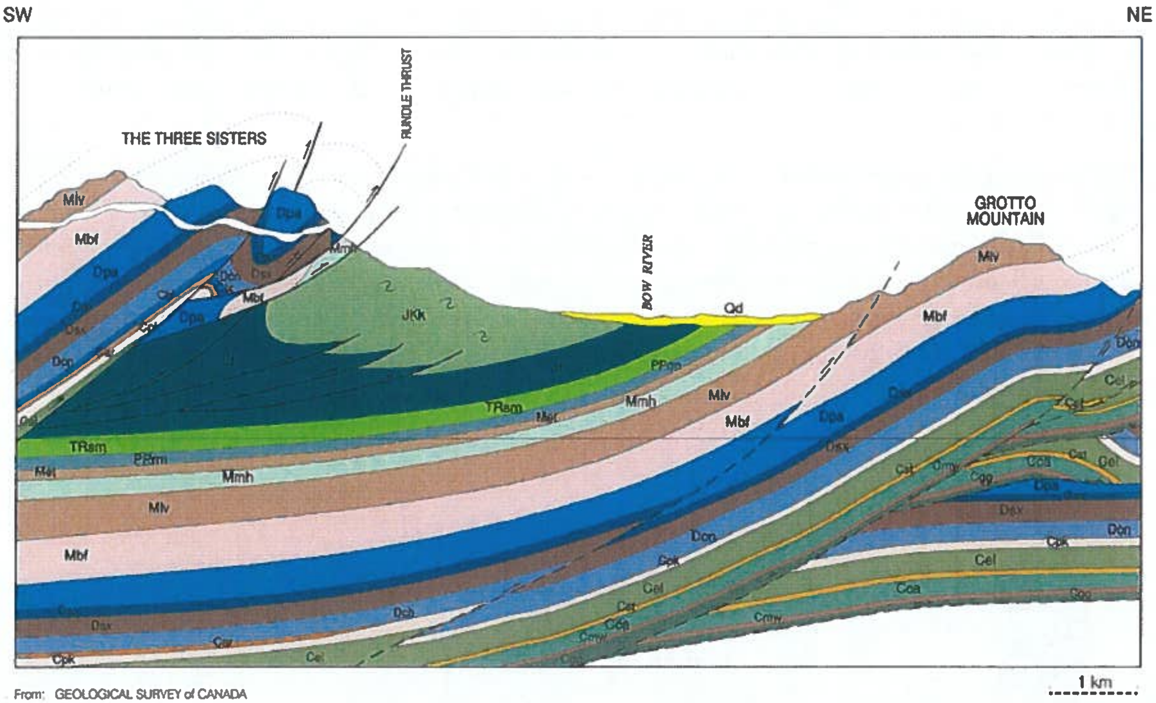


Figure A3. Stratigraphic Sequence of the Cascade Coal Basin (Norwest, 2000).

Locally, the Cascade Coal Basin (Figure A4) is bound to the west by the Rundle Thrust Fault, which has overthrust older beds over the younger Kootenay Formation. Folding and thrusting have also created repetitions in the strata in the area. To the northeast, the basin is bounded by the Paleozoic carbonate rock rocks of the Fairholme Range.



From: GEOLOGICAL SURVEY of CANADA
Diagrammatic Structure Section 2 (in part)
Accompanying Maps 1265A and 1266A,
Canmore

Figure A4. Cross Section through the Cascade Coal Basin at Canmore (after Geological Survey of Canada).

As noted in the earlier section, there are at least 13 coal seams of mineable thickness, ranging from 1 to 4 m. These seams are not continuous, and only a few were mineable based on structure and coal quality.

Coal quality ranged from low volatile bituminuous to semi-anthracitic in rank. The higher rank in this area relative to adjacent areas is thought to be due to local thermal upgrading associated with the Laramide Orogeny. The coal rank increases with stratigraphic depth.

The seams mined are shown in Figure A2, with interseam strata of calcareous dark grey to black thinly bedded siltstone and shale, as well as very fine-grained sandstone. Localized coarse-grained sandstone and minor congolomerate are also present. Carbonaceous mudstone occurs directly with the coal, usually at the contacts.

Surficial deposits range in thickness between 2 and 28 m, consisting of glacial till, sand, gravel, and colluvium.

The Late Cretaceous to Early Tertiary Laramide Orogeny is also associated with deformation of the sedimentary strata in the region. Major fault blocks are separated by southwest dipping thrust faults, with further deformation through folding and smaller scale thrust, normal, and wrench faults. The coal-bearing strata within the basin lie within the Lac des Arc Thrust plate and have been deformed into a northwest-trending overturned fold referred to as the Mound Allan Syncline. The axial plane of the syncline dips to the southwest parallel to the major faults. The northeast limb of the faults dip gently to the southwest at between 10° and

40°, whereas the strata in the southwest limb are vertical to overturned. The fold plunges gently to the southeast.

The coal-bearing strata within the core of the Mount Allan Syncline are buckled into a series of similarly trending folds, and some are recumbent. Thrust faulting is common, with the fault planes oriented to the northwest, in line with the general fabric of the southern Canadian Cordillera. Normal and wrench faults are often oriented perpendicular to the trend of the thrust faults, and smaller scale folding is observed associated with these smaller normal and wrench faults. The strains associated with folding and the mountain building process manifest as bedding slip surfaces, cleat and joint systems, and in the faults.

The coal seams are more incompetent, and so were more readily deformed than the host rock. Seams tend to thin on the flanks of folds and thicken in the cores. Shearing at the top and bottom contacts has often destroyed the depositional fabric of the seams, and slickensides are present within the seams. Cross jointing perpendicular to bedding is pervasive, with spacing ranging from a few centimetres to over 1 m.

Displacement on normal faults is on the order of 1 to 2 m, although offsets can be as high as 20 m. These faults usually cut the coal at about 60° dip, in contrast to the thrust faults that cut the seam at about 30°. The thrust faults also exhibit much larger displacements, with measurement up to 80 m.

Mining limits were usually defined by geologic structure and/or coal seam quality. Structurally, limits could be induced by severe folding, faulting, and the depth of the seam. At the outer limits of the seam, the subcrop defined the mining limits. Large faults often caused such deformation to the seam and the surrounding strata that economic mining was not possible, limiting the extents of the mine development.

Below 220 m depth, "blowouts" associated with excessive ground pressure and low-strength coal were encountered. These resulted in expulsion of methane and coal fines from the coal face. The maximum mining depth in the region is approximately 350 m.

3.0 COAL MINING IN THE CANMORE AREA

3.1 GENERAL

To better understand the potential for subsidence, it is important to understand the configuration of the mines and the extraction sequence. A good description was provided by Norris (1953) for his Ph.D. dissertation and is paraphrased herein. For reference, a sketch of a typical coal mine in Western Canada is shown in Figure A5.

The *main slope* (main ramp / decline) was the principal haulage artery for each operation. This haulage was well protected with large pillars to ensure that it remained open during operations. From the slopes, *levels* were driven at regular intervals along the strike of the seam; in the Canmore area the main levels are referred to as *Gangways*, which followed the strike of the coal seam and were used for haulage.

For ventilation at the working face, a counter level (counter) had to be developed approximately 80 to 100 ft (28 – 30 m) up dip from the level. The counter and the level were connected by *rooms* that were also typically 100 ft (30 m) apart. Rooms were driven from one level to the next and driving cross cuts parallel to the counter at regular intervals, creating large pillars. Any of the four sides of a pillar was known as a *rib*.

The roof of the rooms were supported by *posts* fitted against the ribs with a *boom* connecting the top of the posts. When the roof could not support its own weight, it was said to be *heavy*, and the sets were placed closer together. Timber slabs (*lagging*) were inserted between the booms and the overlying roof strata.

For the extraction of pillars, a systematic *pillar line* or *extraction line* was maintained. A *skip* was a successive strip taken off each pillar. For control of the roof slab into the *gob* or extracted seam, *props* were placed tightly to the roof and floor close to the working face. To prevent overall rapid collapse of the roof into the gob, *sacrifice pillars* or stumps were left behind. These stumps yielded slowly and allowed a gentler convergence of the roof into the gob.

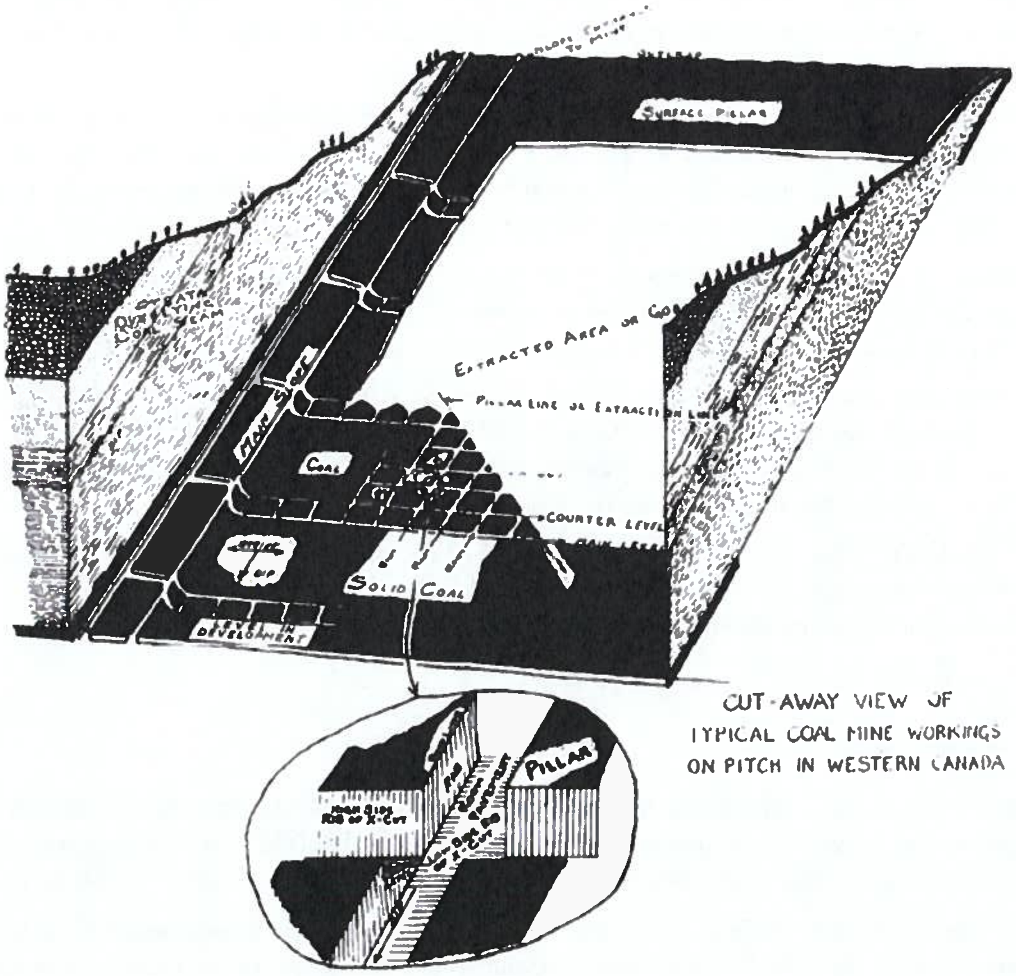


Figure A5. Sketch showing typical mine layout for Western Canada (Norris, 1953)

As almost all the development occurred within the coal seam, the development process typically resulted in a recovery of between 20 and 40% of the coal. With de-pillaring, the recovery could increase up to 100% over small local areas, but generally was in the range of 50 to 75% over a mined area. The geological conditions for coal mining in Canmore were quite complex. In some cases, only mining of development and rooms was completed; de-pillaring was not attempted in these cases due to a combination of factors including poor ground conditions, poor coal quality, and general economics at the time of mining.

Using the dip of the coal seams, blasted coal was transported to the haulage level by chutes and loaded into mine cars that were hauled to surface initially by rope haulages and later by compressed air locomotives.

Continuous miners were introduced at the Wilson Mine in the mid 1960's; however, steeper seam gradients caused issues for the equipment, and the mine switched to the use of slushers (cable-controlled scraper). This switch was effective at the mine and was particularly useful when de-pillaring (Stephenson *et al*, 1996).

3.2 STRESS REDISTRIBUTION

To understand how subsidence can occur, it is important to understand the state of stress in the rock and its response to the extraction and void creation associated with mining. Prior to the commencement of underground mining, the stress state in the rock mass is in equilibrium. The creation of voids within the rock mass disturbs the equilibrium of the stress state, and the stresses are required to re-adjust. For mines in Canmore, the main stress is typically the load of overlying materials on the coal seam, but there may be some locked in tectonic forces or compression associated with prior glaciation. In the initial development and excavation of the rooms, the openings are small, and the load from the overlying material spans the small opening and is transferred to the sidewalls, aided by the posts/booms and any ground support (i.e. rock bolts) installed into the roof.

With the commencement of de-pillaring, the width of the roof span increases beyond the limit that is stable without support. The rock from the roof begins to relax and, if not supported, will collapse. In the short term, this collapse is prevented by ground support in the form of bolting and/or props, but after extensive de-pillaring, the roof will eventually yield. At first, this expansion is elastic, but with time the deformation becomes plastic as the roof material fails into the opening. The remaining stress is carried by the stump pillars, which yield slowly, and to the abutments, which are sized to remain stable. Often the failure of the immediate roof was encouraged in the de-pillared areas as it reduced the degree of load increase onto the adjacent abutment pillars, allowing them to remain stable.

Most of the plastic failure was assumed to come from the roof of the deposit. However, in some operations where precise leveling surveys were used, it was possible to measure the change in position of both the floor and the roof. In the No 4 mine (which overlies the Wilson seam), at deeper portions of the mine (between 225 and 350 m bgs) where only sacrifice pillars remained, the observed mining void height of 10 ft (3 m) was found to close to a residual void of 1 ft. Based on the leveling surveys, only 3 feet (1 m) of the failed material was found to come from the roof. The remaining 6 feet (2 m) of closure came from uplift of the floor of the depillared area (Norris, 1953). Given the glacial history of the Canmore area and the locked-in stresses that occur elsewhere due to glaciation, the description of floor uplift is not surprising.

4.0 REFERENCES

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Stephenson, H.G., B. Van Den Bussche, and P. Curry. 1979. Reclamation, rehabilitation, and development of abandoned mine land at Canmore, Alberta. CIM Bulletin, pp. 57-64. April.

Stephenson, H.G, C.W. Gregory, and W.J. Riva. 1972. Pillar extraction in thick coal at Canmore, Alberta, on gradients between 5 and 30 degrees. CIM Bulletin, pp. 55 -62. November.

Appendix B

Ground Deformation

Appendix B – Ground Movement and Deformation

1.0 INTRODUCTION

In this appendix, the deterministic methodologies behind the calculations for the ground movement and deformation for the undermined areas around Canmore are presented. These methodologies include determining sinkhole development potential and the degree of ground movement and deformations associated with panel sag over the mining panels.

Undermining assessment of the Three Sisters properties have been ongoing since 1997, with work initially done by Norwest Consultants and later by Golder Associates Ltd. (Golder) Over time, the understanding of site conditions has evolved based on observations and investigations. The methodologies and approaches used by Golder have been evaluated and are considered appropriate for application to the current site, with occasional modification based on the experiences of WSP engineers and the site understanding from Norwest reports and analyses. These methodologies are described in the following sections.

2.0 CAVING AND SINKHOLE FORMATION

Sinkhole development is associated with the chimneying failure of the rock mass above a void below the ground surface. This type of failure is often circular in nature in the rock; however, the shape of the surface expression of the failure can change in the overlying soils, depending on their nature. Assessment of the potential for development of sinkholes considers both the stability of the rock above an underground excavation, and the bulking associated with failure into the void.

2.1 STABILITY ASSESSMENT OF THE ROOF

Initiation of a roof failure depends on the stability of the material above the excavation, known as the crown pillar. The Scaled Span crown pillar assessment is an approach developed in the 1990's to assess the stability of active and historic crown pillars with consideration to populated areas or with public access (Carter et al., 1995; Carter et al., 2000; Carter, 2014). The approach is an empirical assessment based on a database of stable and failed crown pillars in a variety of rock types and range of rock quality. An assessment of intact and failed crown pillars discovered that increased stability is associated with an increase in crown pillar thickness (in rock), horizontal (clamping) stress, and dip of the sides of the underlying walls. By contrast, crown stability is reduced by increases in crown pillar span, overall length of the opening, mass (specific gravity) of the overlying material, and increases in groundwater pressure. In assessing the stability of the near-surface tunnels (slopes and accesses) in the Canmore area, the opening sides are typically vertical, the span is the width of the tunnel, and the length is long relative to the width.

The Scaled Span for an excavation is determined by normalizing the series of parameters using the relation:

The Scaled Span for an excavation is determined by normalizing the series of parameters using the relation:

$$C_s = S\left\{\frac{\gamma}{t(1+S_R)(1\ -0.4\cos\theta)}\right\}$$

Where:

C_s = the Scaled Span
γ = specific gravity of the rock mass
t = thickness of the crown pillar
S_R = Span Ratio = Span/Strike Length
θ = dip of the orebody (90° for a tunnel)

When the strike length exceeds the span by a large amount, the Cs expression devolves into a 2D case, suitable for use for tunnels. The normalized scaled span,Cs (m) is plotted against NGI's rock mass quality, Q, as shown on Figure B1. This gives an indication of the potential stability of the current crown configuration based on a comparison of failed versus stable cases.

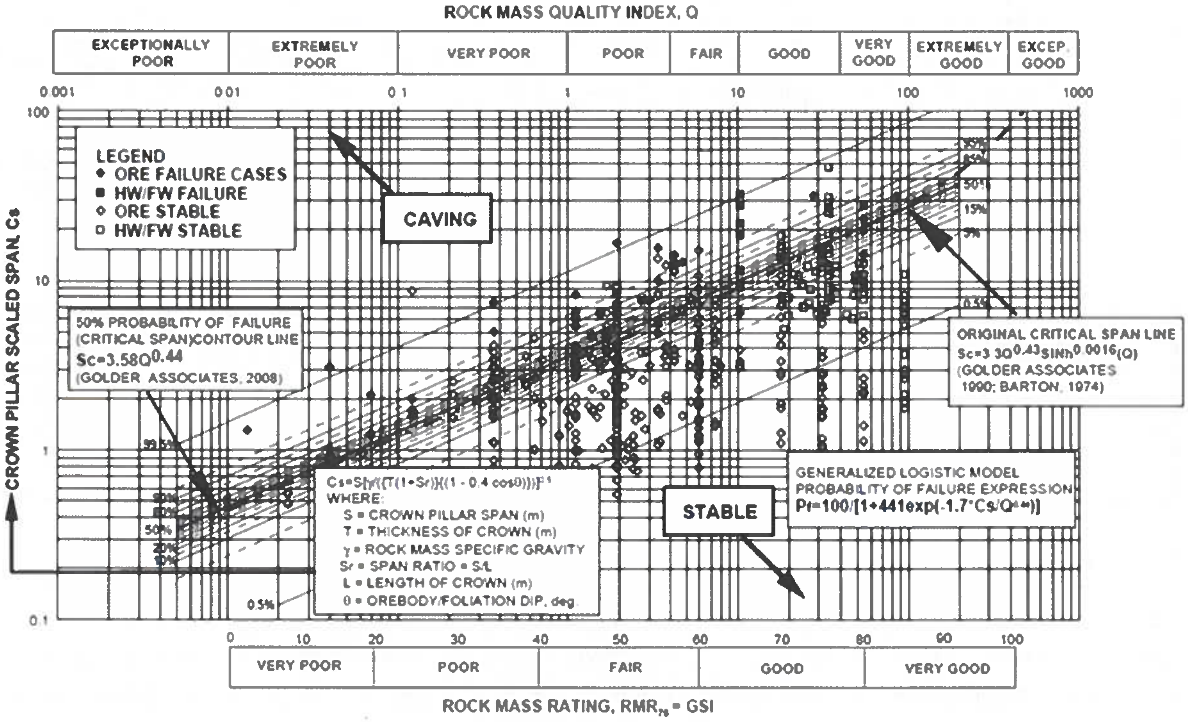


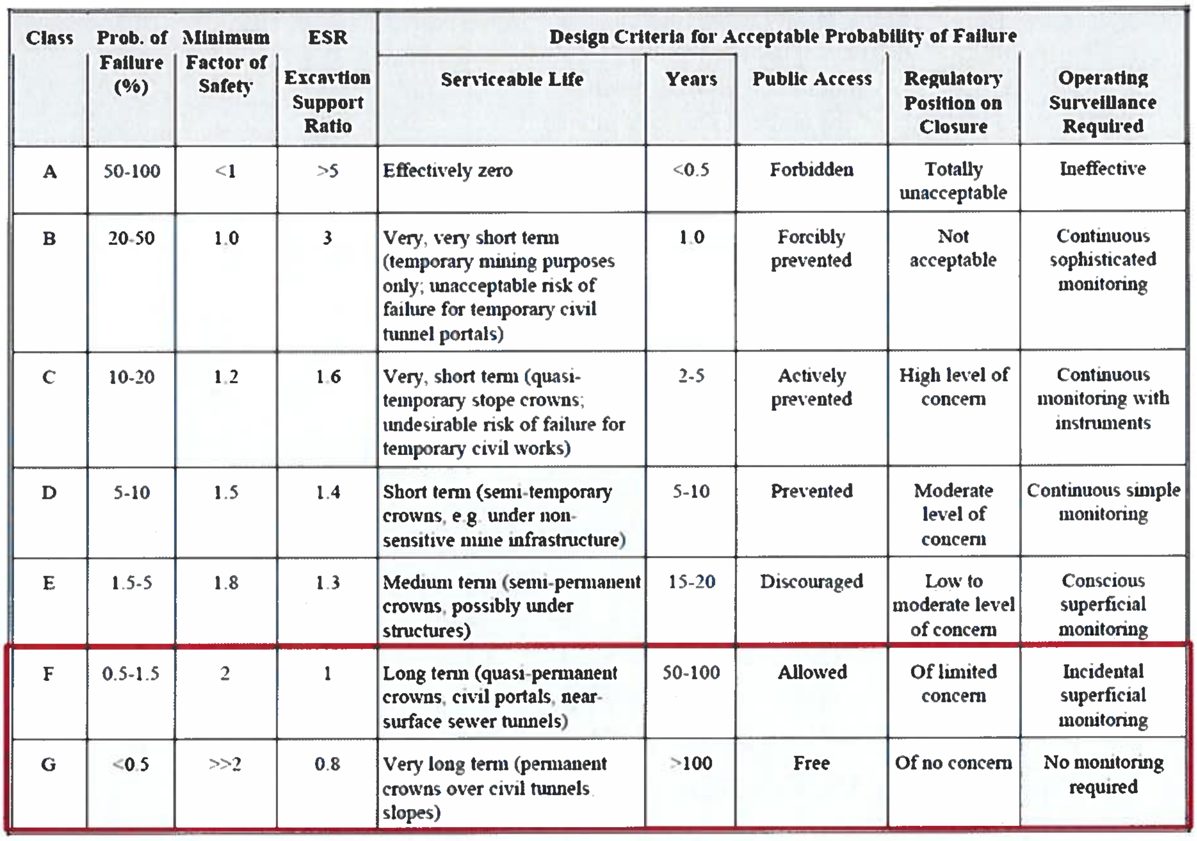
Figure B1. Scaled Span Chart showing Probability of Failure Contour Intervals (Carter, 2000)

Using the Q value for the rock mass, it's possible to determine the widest critical span Sc (m) via the relation:

$$S_c = 3.3 * Q^{0.043} * (\sinh Q)^{0.0016}$$

When the Scaled Span (Cs) is less than the critical span (Sc), the crown pillar is considered stable. The ratio of the scaled span to critical span gives the factor of safety for the crown. Determinant regression of case histories has also been used to determine the Probability of Failure, and a classification system based on use and risk, as shown in Table B1. From this table, for long term public access, the crown pillar above an existing tunnel should have a rating that fits into Class F or G, shown in the red box, with a Probability of Failure of 1.5 % or less. Crowns with a class lower than this are susceptible to chimney failure, and can be assessed using the methods in the next section.

Table B1. Significance of Crown Pillar Failure (Carter & Miller, 1995)



Class	**Prob. of Failure (%)**	**Minimum Factor of Safety**	**ESR Excavtion Support Ratio**	**Design Criteria for Acceptable Probability of Failure**				
				Serviceable Life	**Years**	**Public Access**	**Regulatory Position on Closure**	**Operating Surveillance Required**
A	50-100	<1	>5	Effectively zero	<0.5	Forbidden	Totally unacceptable	Ineffective
B	20-50	1.0	3	Very, very short term (temporary mining purposes only; unacceptable risk of failure for temporary civil tunnel portals)	1.0	Forcibly prevented	Not acceptable	Continuous sophisticated monitoring
C	10-20	1.2	1.6	Very, short term (quasi-temporary stope crowns; undesirable risk of failure for temporary civil works)	2-5	Actively prevented	High level of concern	Continuous monitoring with instruments
D	5-10	1.5	1.4	Short term (semi-temporary crowns, e.g. under non-sensitive mine infrastructure)	5-10	Prevented	Moderate level of concern	Continuous simple monitoring
E	1.5-5	1.8	1.3	Medium term (semi-permanent crowns, possibly under structures)	15-20	Discouraged	Low to moderate level of concern	Conscious superficial monitoring
F	0.5-1.5	2	1	Long term (quasi-permanent crowns, civil portals, near-surface sewer tunnels)	50-100	Allowed	Of limited concern	Incidental superficial monitoring
G	<0.5	>>2	0.8	Very long term (permanent crowns over civil tunnels, slopes)	>100	Free	Of no concern	No monitoring required

2.2 STABILITY ASSESSMENT OF THE ROOF

In chimney failure, the roof or back of the void begins to deteriorate and fail into the void, chimneying upwards towards the surface. As the material fails, there is an increase in volume as the failed material takes up more space than in the intact form. Depending on the degree of bulking, the height of the void, and the amount of rock above the initial void, the material can expand completely to fill the void, eventually choking off and stopping the progress of the chimney failure. The bulking factor for more competent rocks is generally higher, as the rubble is in a more disorderly arrangement due to less breakage from falling than for weaker materials (Ofoegbu *et al*, 2008).

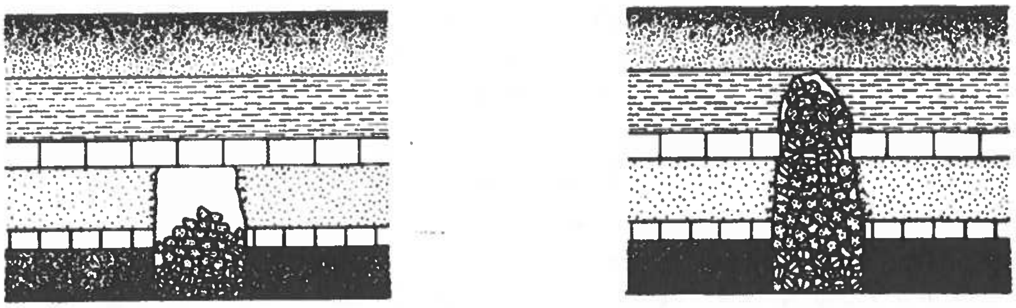


Figure 5a. Caving Arrested by a More Competent.

Figure 5b. Caving Arrested by Bulking of Roof Debris.

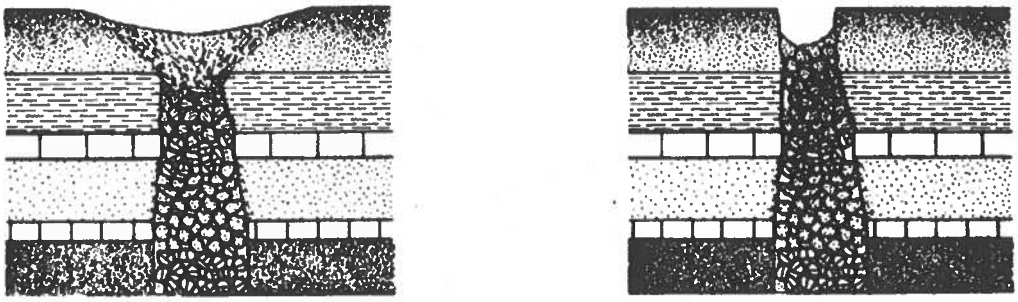


Figure 5c. Formation of a Trough Subsidence of the Surface.

Figure 5d. Formation of a Sinkhole at the Surface.

Figure B2. Chimney caving and sinkhole formation (Karfakis, 1987)

For determining the maximum height that a cave can progress above a void, WSP uses an iterative process that incrementally progresses the cave in small increments (typically 0.3 m or 1 ft), while allowing the failed material to increase in volume by the bulking factor. Both the caved height and the void height position relative to the initial void floor are tracked with each increment, and if the caved height equals or exceeds the void height, the cave is considered choked. If the caved height doesn't equal or exceed the void height before the original rock thickness is reached, the remaining unfilled void height is used to estimate the resulting surface depression based on the collapse of the overburden into the void.

Bulking factors tend to be region-specific and dependent on a variety of factors, including rock type and strength, shape, size and arrangement of fragments, and the pressure exerted by overlying materials. Previous work performed investigating undermining in Canmore has identified that the mean bulking factor for the Canmore area between 1.4 and 1.5 (i.e., a volume increase of between 40 and 50%), with a minimum of 1.14 (i.e., a volume increase of 14%). Less than 10% of the data was found to have a bulking factor less than 1.25 (Golder, 2019). Using a minimum value of 1.15 to assess caving and sinkhole development means chimney failure is not expected to propagate to surface if the bedrock thickness above the void is 8 times the mined or void height; this has been used as a rule of thumb previously (Golder, 2019).

To determine the potential for sinkhole formation at surface, a series of assessments were conduced at varying crown pillar (i.e. bedrock) thicknesses and bulking factors. In the current example, the surface soils (overburden) were assumed to have a thickness of 14 m and a bulking factor of 1.02 (i.e., a volume increase of 2%). If a void did develop at surface, the final void height and hazard limit (lateral offset using a draw angle in the overburden), are calculated from the chimney edge in bedrock to ground surface). The results are shown in Table B2 for bulking factors of a.) a 10%, b.) 15%, c.) 20%, and d.) 25%. Surface deformations for various crown pillar thicknesses and bulking factors are also plotted in Figure B3.

Table B2. Example Void heights and hazard limits for various crown pillar thicknesses and Bulking Factors (BF)

a.) 2 % BF_{OVB}; 10 % BF_{rock}

Crown pillar thickness (m)	Initial Void Height (m)	Ovberburden Thickness (m)	Void Height at Surface after Caving (m)	Final Void Height at Surface (m)	Medium Hazard Limit (m)*
2	3.5	14.0	3.0	1.5	3.2
12	3.5	14.0	2.0	1.0	2.0
22	3.5	14.0	1.0	0.3	0.5
32	3.5	14.0	0.1	-	-
42	3.5	14.0	Choked	-	-
56	3.5	14.0	Choked	-	-

b.) 2 % BF_{OVB}; 15 % BF_{rock}

Crown pillar thickness (m)	Initial Void Height (m)	Ovberburden Thickness (m)	Void Height at Surface after Caving (m)	Final Void Height at Surface (m)	Medium Hazard Limit (m)*
2	3.5	14.0	3.0	1.45	3.11
12	3.5	14.0	1.4	0.60	1.29
22	3.5	14.0	Choked	-	-
32	3.5	14.0	Choked	-	-
42	3.5	14.0	Choked	-	-
56	3.5	14.0	Choked	-	-

c.) 2 % BF_{OVB}; 20 % BF_{rock}

Crown pillar thickness (m)	Initial Void Height (m)	Ovberburden Thickness (m)	Void Height at Surface after Caving (m)	Final Void Height at Surface (m)	Medium Hazard Limit (m)*
2	3.5	14	2.9	1.40	3.00
12	3.5	14	0.8	0.10	0.32
22	3.5	14	Choked	-	-
32	3.5	14	Choked	-	-
42	3.5	14	Choked	-	-
56	3.5	14	Choked	-	-

d.) 2 % BF_{OVB}; 25 % BF_{rock}

Crown pillar thickness (m)	Initial Void Height (m)	Ovberburden Thickness (m)	Void Height at Surface after Caving (m)	Final Void Height at Surface (m)	Medium Hazard Limit (m)*
2	3.5	14	2.8	1.35	2.9
12	3.5	14	0.3	-	-
22	3.5	14	Choked	-	-
32	3.5	14	Choked	-	-
42	3.5	14	Choked	-	-
56	3.5	14	Choked	-	-

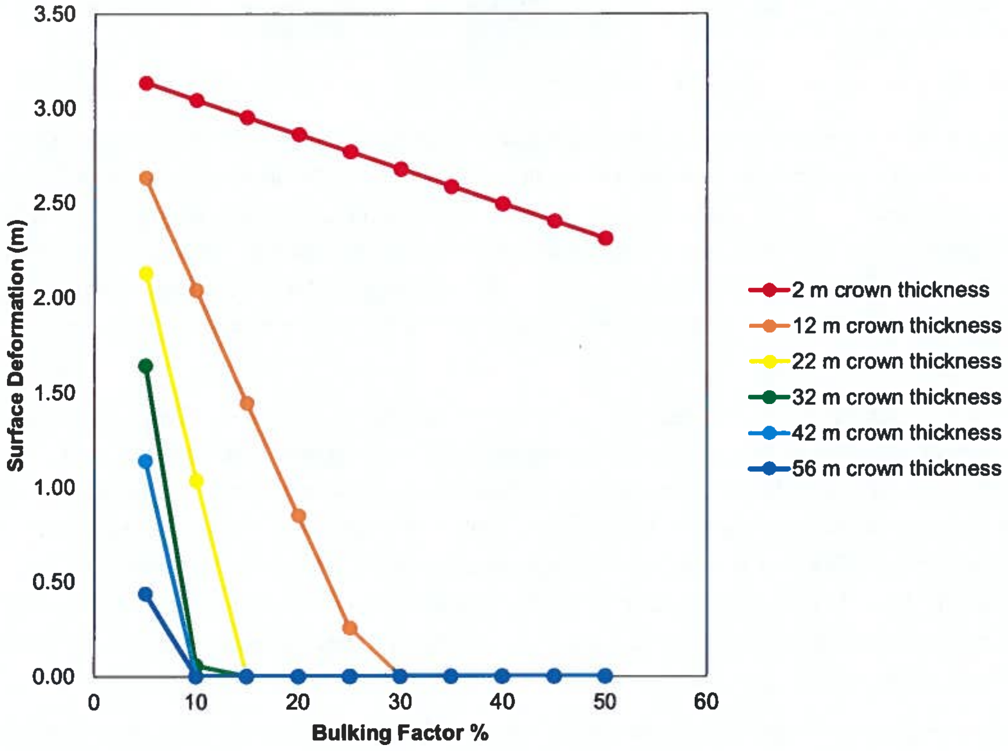


Figure B3. Surface deformation of different crown pillar thickness with respect to bulking factor and 14m of overburden.

Historically, in Canmore, undermined areas with a bedrock cover less than 8 times the thickness of the mined seam (measured from the floor of the mined seam) have been considered to have potential for sinkhole formation. The analyses above indicate that this corresponds to a bulking factor of 1.10 to 1.15.

A review of the literature and additional reports from site was conducted in 2023 as the observations from the surface expression above the workings and from the drilling programs did not support such a low bulking factor in the shallow-dipping portion of the seams. From a study looking at bulking factors for various underground openings (Ofoegbu *et al*, 2008), the bulking factor of caved rock is affected by multiple factors, including the rock strength, shape, and particle size distribution. One of the studies mentioned in the reference above looked at the influence of rock strength and shape, as well as overburden stress (load) on the bulking factor for coal mines for shale, and for weak and strong sandstones. The results from the study are shown in Figure B4.

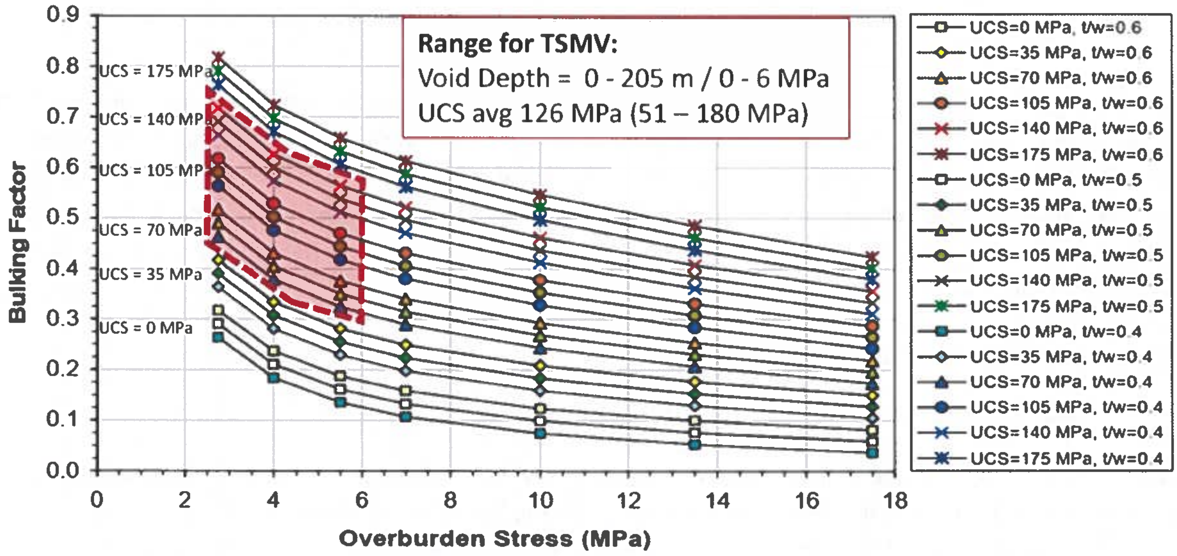


Figure B4. Relation between Overburden Stress and Bulking Factor for a Range of UCS and Thickness to Width (t/w) ratios (after Pappas and Mark, 1983)

The range of values corresponding to the study area are indicated by the red shaded area, corresponding to a UCS ranging from 51 to 180 MPa with an average of 126 MPa. The maximum depth of mine workings in the study area is about 200 m, which corresponds to an overburden pressure of 6 MPa (assuming 0.027 MPa/m of depth). According to this figure, the minimum bulking factor corresponds to 30%, with an average of around 50%.

Prior to the first development at the site in the 1990's, assessment of sinkhole subsidence features observed at the site shows that the majority were associated with bedrock cover of less than 15 m above the mine workings. From observations in drillholes at the site during early investigations, the average bulking factor was 40%, with the lowest observed value of 15%. These observations are shown in Figure B5 a.) and b.), respectively.

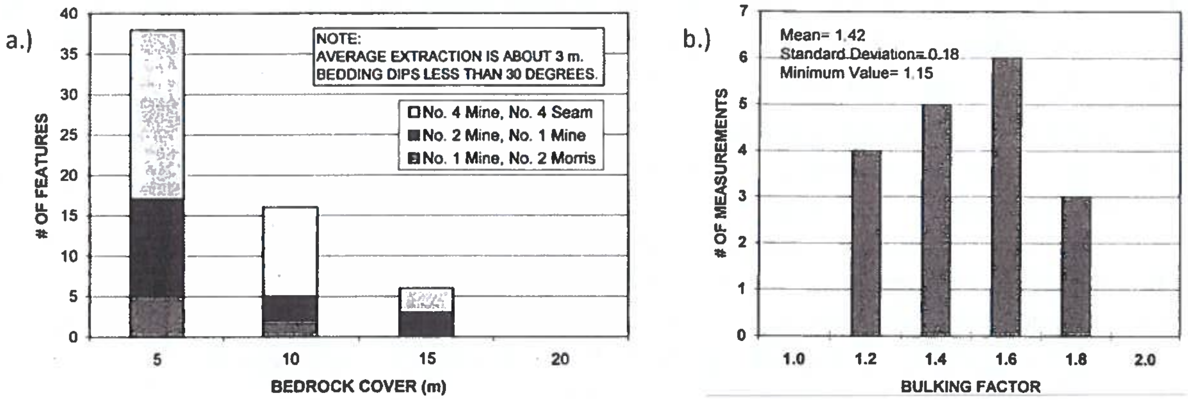


Figure B5. Observations of a.) subsidence features relative to bedrock cover, and b.) bulking factors observed in boreholes (Norwest, 1998).

While the 15% bulking factor should be retained for the more steeply dipping portions of the coal seams where the more friable coal pillars can continue to rill downslope within the seams. However, given the higher strength and competent materials of the overlying strata, for the more shallow-dipping coal seams, a slightly less conservative but more representative bulking factor of 25% is considered appropriate. This corresponds to potential surface influence where the bedrock cover is less than 5 times the mined seam thickness. Note that this only considers the bedrock, not the thickness of overburden, which remains at a 2% bulking factor.

3.0 PANEL SUBSIDENCE

3.1 BACKGROUND

Surface deformations over de-pillared coal panels are generally region or site specific, and can vary depending on multiple factors, including seam height, residual pillar size, mine (panel) width and depth, type of rock above the mine, etc.). These deformations can range between insignificant/imperceptible to severe. For deep mines, the land above can often be developed with no restrictions. However, thick seams in shallow mines can require restrictions for development of surface structures.

In general, assessment of panel subsidence makes the following assumptions:

- The overlying materials above the void remain essentially intact;
- This intact material sags onto an area of total extraction, or
- Moves downward as crushing of yielding pillars occurs.

The sagging process is assumed to begin immediately following mining, and the initial void is equal to the height of the extracted seam.

Panel subsidence generally forms a broad dish or trough shaped depression on the ground surface. While the maximum subsidence occurs in the middle of the panel, the most marked impact on the surface occurs near the edge of the trough where the strains (compressive and tensile), tilt, and curvature are highest.

3.2 PILLAR STABILITY

The first step in assessing the potential for panel subsidence is to determine the area that has been effectively de-pillared. Often pillars are left near slopes and levels or gangways, and the stability of these pillars must be assessed to determine if they are still providing support, or if they have failed and can be considered part of the mining panel under consideration. In considering pillar stability, the pillar loading, and pillar strength must both be analyzed to determine the factor of safety.

For pillar loading, there are two main methods for calculating loads: Tributary Area Theory (TAT), and Pressure Area Theory (PAT). TAT is generally applicable for situations where the roof is intact and the mine is large in size. PAT is more applicable for pillars near caving roofs, barrier pillars in room and pillar mines, strip pillars, and longwall pillars. As most of the pillars under consideration in Canmore undermining are barrier pillars in room and pillar mines, PAT is used. The relation to calculate the load is as follows (Yu et al, 2018):

$$P = \frac{P_{T}\_P_{C}}{\omega_p L_p^a} = \gamma H \frac{(\omega_P - \omega_c)\left(L_p + \omega_C\right)^a}{\omega_P L_P^a} - b\gamma \left[\frac{\omega_C^2 (\omega_P + L_P)^a}{4\omega_P L_P^a \tan\beta} - \left(\frac{\omega_C^3}{24\omega_P L_P \tan\beta} \right)^a \right]$$

Where:

P = average pillar stress (MPa)
ωP = pillar width (m)
LP = pillar length (m)
ωC = mining width (m), capped at 10 m, reflecting the maximum credible long-term roof span in current conditions
γ = unit weight of overburden (N/m3)
H = mining depth (m)
β = abutment angle (°), assumed to be 21°
a and b = Cooefficients, for small rectangular pillars, a and b are both 1

Pillar strength is a function of both pillar volume and shape. A number of equations exist for assessing the strength of coal pillars. These are usually derived empirically and are most applicable to the region for which they were developed. A comparative study of empirical methods to estimate coal pillar strength and factor of safety was conducted by Verma (2014) looking at pillar failures from two different regions in India. From this analysis, it was determined that Salamon & Munro (1967) predicted failed cases correctly, and that Bieniawski (1975) and Mark-Bieniawski (1997) gave the highest predicted factor of safety. Based on this assessment, these relations were selected for assessing the strength of relict pillars for the current study; the formulation for Salamon & Wagner (1985) was included to maintain continuity with the previous studies and for comparison.

Multiple methods were used to give a range for the potential pillar strength and related Factor of Safety (FoS) for comparative purposes. The relations used are summarized in Table B3.

Table B3: Empirical Pillar Strength Formulae

Method	Formula	Constants	Comments
Salamon & Munro (1967)	$C_P = k_{SM} h_P^{\alpha} w_P^{\beta}$	k_{SM} = strength of 30 cm coal cube (MPa) h_P, w_P =Pillar height, width α, β = constants	Developed for S. African room and pillar mines; K to be evaluated by testing a specimen size of 30 cm
Bieniawski (1975)	$C_P = k_B \left[0.64 + 0.34\left(\frac{w_P}{h_P}\right)\right]$	k_B = compressive strength of 30 cm coal cube (MPa) h_P, w_P =Pillar height, width	Specimen should be 30 cm cube pillar
Salamon & Wagner 1985	$C_P = KV^a R_0^b \left\{\frac{b}{\varepsilon}\left[\left(\frac{R}{R_0}\right)^{\varepsilon} - 1\right] + 1\right\}$	R_0 =4 (squat pillars) ε = strength increase when R>R_0	ε taken as 2.5
Mark & Bieniawski 1985	$C_P = S_I \left[0.64 + \left(0.54\left(\frac{w_P}{h_P}\right) - 0.18\left(\frac{w_P^2}{h_P L_P}\right)\right)\right]$	S_I = in-situ coal strength; L_P= pillar length	

It should be noted that in most cases, the strength of the coal is to be based on the strength of a sample block size of 30 cm. The purpose for this specification is that there is a scale effect associated with intact strength versus the size of sample, where smaller samples are considered to have a lower number of imperfections or fractures and, consequently, are stronger. However, for the Canmore situation, it has been reported that 70% of the coal recovered across the mines was 6 mm or smaller in size (Norwest, 2000). Due to the friable nature of the coal, there is no associated decrease in strength with increasing sample size.

Earlier analyses assumed an unconfined strength for the coal of 5 MPa (Golder, 2006); this value is considered reasonable and conservative, and this has been adopted for the analyses described herein. In all cases, pillars with a Factor of Safety less than 1.5 were considered failed. This assumption is also considered conservative.

The risk of pillar punching into the floor or roof material is not considered, as the coal is a weaker unit than the surrounding rock, The lowest unconfined compressive strength measured the rock mass during recent testing is 18 MPa, with an average value of 58 MPa and a maximum of 106 MPa.

3.3 DETERMINATION OF MAXIMUM SUBSIDENCE, SMAX

The National Coal Board (NCB) of the United Kingdom published the 2nd edition of the Subsidence Engineers' Handbook in 1975, which related observed subsidence to the width and depth of longwall workings in the UK (NCB, 1975). However, application of the NCB parameters to other locations and geologic environments has been found to be less reliable due to the differing geological conditions at each mining location (Abel and Lee, 1983). Nevertheless, this work influenced others working on subsidence related research.

The Marino method was used to correlate observed subsidence with the width and depth of the underlying mined seams for room and pillar mines in Illinois (Marino, 1998). The data from Marino is plotted on Figure B6, which shows a significant spread in the data for each width: depth ratio, Marino defined upper and lower limits for the potential subsidence based on the shape of the data set as shown on Figure B6, with the following limits:

W:D < 0.8	SF' = 0.22
0.8 < W:D < 1.11	SF' = 1.88* W:D -1.28
1.11 < W:D	SF' = 0.81

Where Smax = SF'*H*e

H = initial mining height (m)

e = extraction ratio (%)

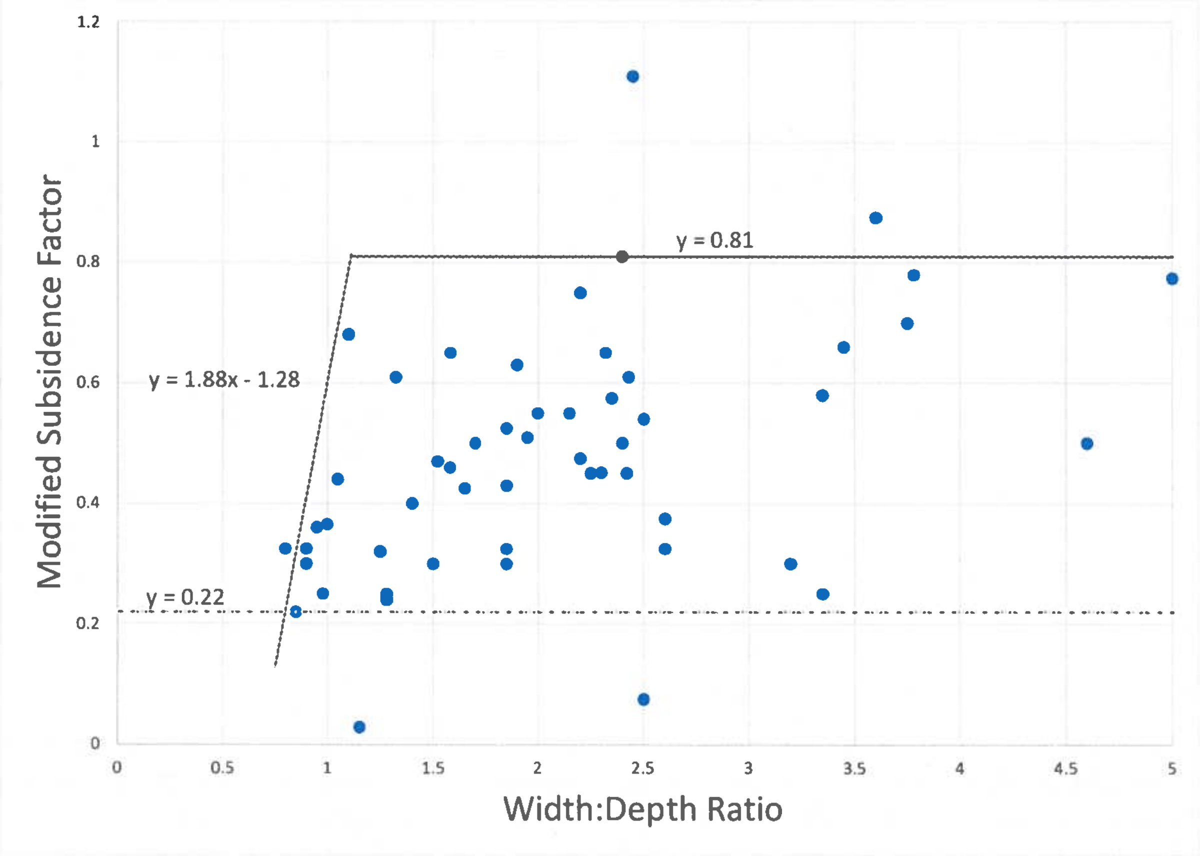


Figure B6. Modified Subsidence Factor, SF' (after Marino, 1988)

This method and was adopted by both Norwest and Golder for use in Canmore. Golder used the raw data and guidelines from Marino; however, Norwest applied the guidelines to additional data from measured subsidence over room and pillar mines in Pennsylvania. Based on this additional data, Norwest found a good fit below a width to depth ratio (W:D) of 0.9 and above a W:D ratio of 2.0 but modified the upper bound curve in between this range (Norwest, 2000). WSP applied a best-fit curve to the data from the Pennsylvania sites within the ranges identified above. This modified curve is presented in Figure B7 and was used in the present analysis. The distribution is as follows:

$W:D < 0.8$	$SF' = 0.22$
$0.8 < W:D < 0.9$	$SF' = 1.88 * W:D - 1.28$
$0.9 < W:D < 2.0$	$SF' = 0.327 * W:D + 0.0645$
$2.0 < W:D$	$SF' = 0.81$

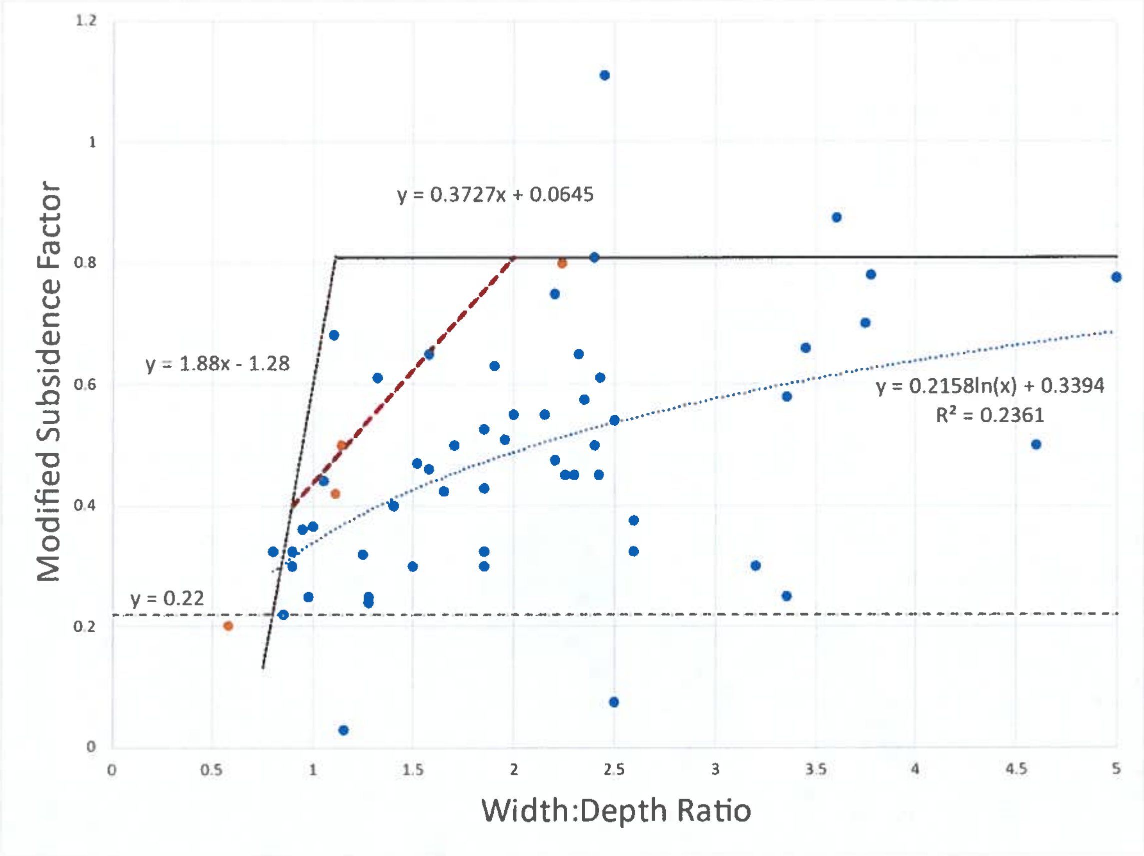


Figure B7. Norwest Modified Subsidence Factor, SF’

A log-normal best fit curve has also been applied to the data, as shown by the dashed line and underlying equation on the right side of Figure B5. This curve corresponds to a confidence interval of approximately 50%. A review of the data distribution shows that the upper limits on the curve correspond to a confidence interval of approximately 95%, so these upper bounds were used for determination of the subsidence factor in the analysis conducted.

3.4 ASSESSMENT OF MINING HEIGHT

Assessments of mined height or initial void for the empirical analyses often assumes that the void to be analyzed is the mined height of the coal seam. This value gives a starting point or an upper bound, but it does not necessarily reflect the failure mechanisms that are occurring in the rock mass above the mined-out seam. From observations made underground in the Wilson Seam during mining, it was reported that following de-pillaring, the immediate roof would fail into the void with a bulking factor of 1.30 to 1.35. The upward migration of the caving was halted by a stronger unit located approximately 8 m above the original roof position. Norwest estimated the height of the residual void at between 0.8 and 1.2 m based on the bulking factor and used these values for the mined height (Norwest, 2000). The void height at the time of reporting was confirmed by drilling to the base of the original coal seam depth.

The validity of this approach was confirmed by Cullen et al (1995), who reported that the maximum subsidence observed above a shallow mining horizon can be reduced by caving of the roof strata prior to the occurrence of general collapse.

Golder (2019) followed a similar approach, but their analysis considered a multi-stage failure process and accounted for compression of the caved materials due to the ultimate settlement of the overlying arched materials. The stages of failure are as follows:

- Initial collapse of the immediate roof into the mined void. This collapse is truncated at approximately 5 to 8 times the initial void height depending on the assumed bulking factors (25 to 15% bulking factors, respectively). This failed material is loose to unconsolidated and was free to rotate during failure into the void.
- Secondary collapse occurs above this initial failure, incorporating some of the overlying beds. These beds separate from the overlying beds and sag onto the initial rubble pile, compressing the rubble to some degree. However, this material is generally blockier and more constrained than the original rubble pile and is consequently less compressible. For simplicity, this bed separation is considered continuous across the panel, although it is more likely that this void thins towards the ends of the panel, and there may be multiple narrower arches formed over the panel due to the presence of rib and barrier pillars in the panel, or incomplete yielding of some of the stump pillars left within the de-pillared areas, or a combination thereof.
- Finally, any remaining arches fail, and the remaining rock settles down onto the already-failed materials, compressing the failed materials based on the weight of the rock in the final failure. Infilling of the remaining voids combined with compression of failed materials is then transmitted to surface, where subsidence is observed.

The failure process is shown schematically in Figure B8.

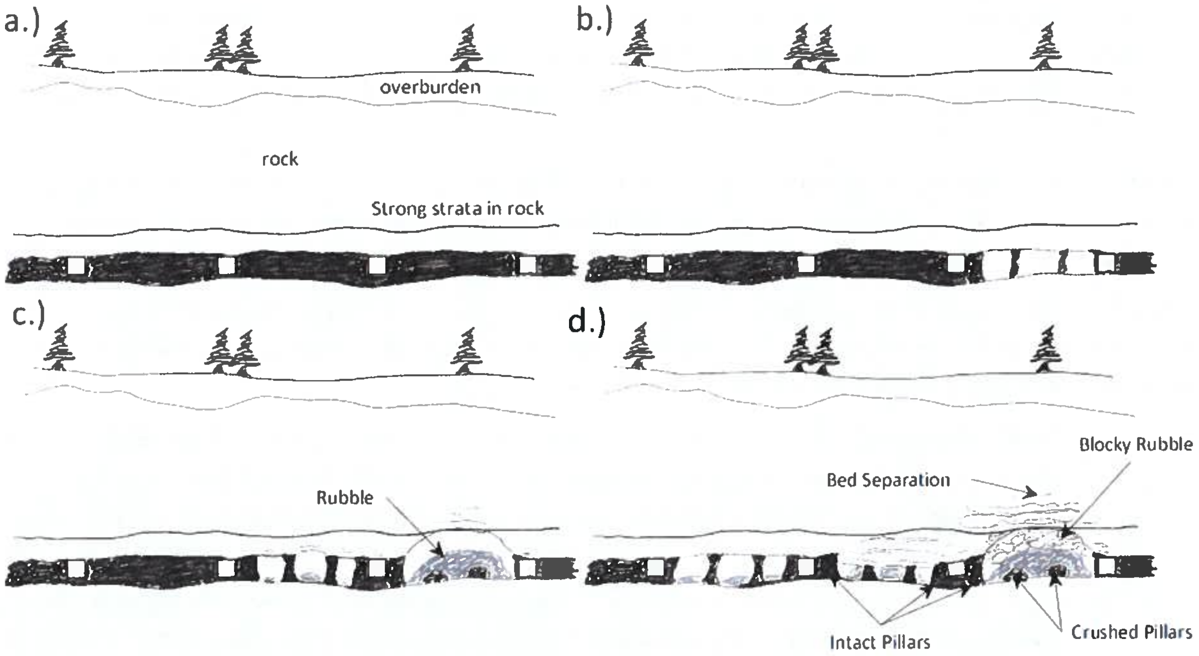


Figure B8. Schematic showing extraction process and ground response. a.) initial room development; b.) depillaring process on right hand side; c.) material caves up to strong strata; d.) blocky rubble fails onto caved rubble, bed separation begins

The approach used by Golder (2009, 2019) to determine Smax as described above is considered reasonable and is adopted for this project with slight modification for the determination of the subsidence factor as noted in Section 3.3.

Based on this approach, the determination of Smax is given as follows:

$$S_{max} = F_s * H_v + H_{r1}\frac{S_r}{Y_{r1}} + H_{r2}\frac{S_r}{Y_{r2}}$$

Where:

F_s = SF', The subsidence factor from the modified Marino chart in Figure B5, and which considers the potential for overlying material to settle into the remaining void, Hv

Hv = The height of the remaining voids, including bed separation and remaining void at the mine level (m).

H_{r1} = The height of caved rubble (maximum 8 x the thickness of the original void) (m)

Y_{r1} = Deformation modulus for the caved rubble (200 MPa assumed) (Golder 2006)

H_{r2} = The height of block failure or sagged material overlying the caved rubble (m)

Y_{r2} = Deformation modulus for the block failure / sagged rubble (m) (500 MPa assumed) (Golder 2006)

S_r = The stress applied to the top of the rubble piles due to the collapse of the remaining intact rock above the sagged beds (MPa).

The thicknesses of void, caved rubble and sagged / block failure rubble are determined by drilling, targeting de-pillared areas of the seam based on the mine plans. It should be noted that the interpretation of drilling data can be difficult for multiple reasons. In identifying the various types of debris or the presence of voids, the use of a borehole camera is recommended as it can help prevent misinterpretation based on drill returns, cuttings, or the response of the drill string. Note that if no drill data is available, the Smax can be estimated using upper bound identified in the modified Marino method in Figure B7 to determine the value of SF' and multiplying that value by the original mined height and the extraction ratio (as a decimal fraction).

The presence of pillars and support in de-pillared zones can delay or halt the failure in de-pillared zones. To illustrate this point, Figure B9 shows some observations of closure in a Pennsylvania longwall coal mine. Photo a.) shows cribbing and rockbolts used to support the roof, with material failing around the bolts but support still being provided by the cribbing. Photo b.) shows bulking and caving around props. Photo c.) shows props supporting a panel next to a rib or barrier pillar. Photo d.) shows props retaining the roof, but caved material on the floor and bagging in the screen attached to the roof (note screen was not used in Canmore, to WSP's knowledge). Drilling into any one of these scenarios in a de-pillared panel would indicate a much greater initial void than is present where supports have decayed/failed, and pillars have yielded. The latter scenario is considered more representative for future surface settlement determinations as the remaining support may create multiple smaller panels rather than a single large panel.

Figure B9. Examples of underground closure in a Pennsylvania longwall coal mine

The height of void encountered in a de-pillared area can vary depending on what part of the depillared seam the drill hits. As an example to illustrate, in Figure B10 the drillhole with the void height of 0.6 m which also encounters caved material and blocky debris, can be considered most representative of the ground response and subsidence potential for the area. The other boreholes either encounter still-supported workings, or voids adjacent to intact pillars, or intact barrier pillars, which are less useful for the determination of the ground response to subsidence.

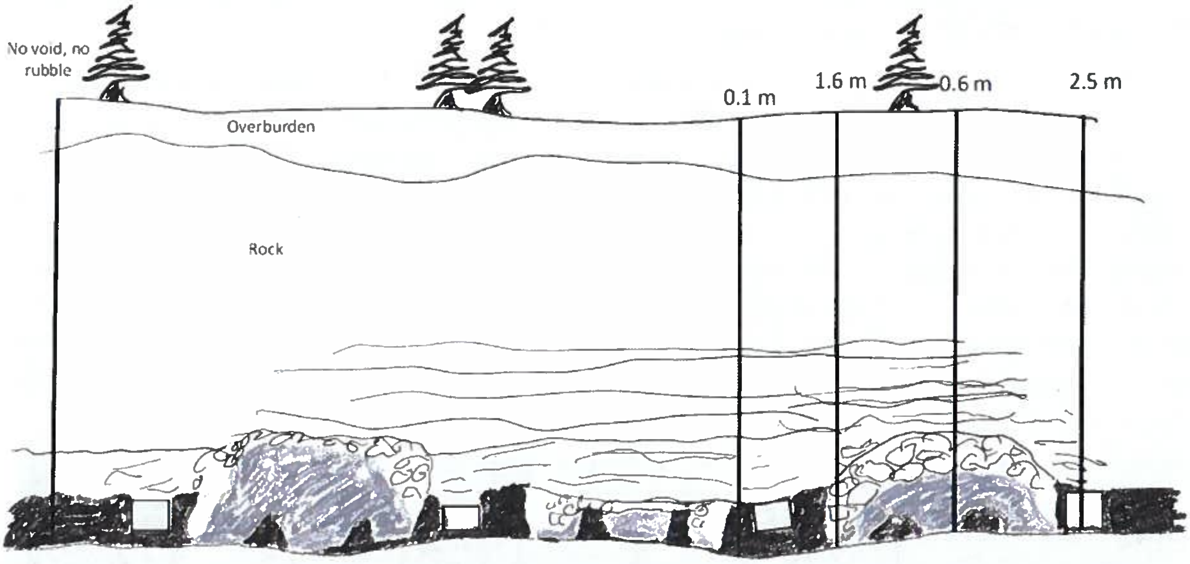


Figure B10. Schematic showing potential void heights based on drillhole locations

3.5 SHAPE OF THE SUBSIDENCE TROUGH

Once the maximum magnitude of subsidence is determined, it is important to determine the shape of the subsidence trough on the ground surface. Subsidence related damage is not generally related to the vertical and horizontal displacements encountered; rather, the damage is related to the slope, strain and curvature related to the ground subsidence (Peng et al., 1994). These values are highest near the margins of the de-pillared areas.

For irregular or complex mine geometries, influence functions have been found to be most suitable for subsidence predictions over underground workings (Hartman, 1992). Subsidence profiles were developed using the Budryk-Knothe influence function (Knothe, 1957) as provided in Hartman (1992). Use of this influence function permits determination of the distance relative to the edge of the seam at which the strain, tilt and curvature values using the following relations:

For surface profile: $$S'(x) = \frac{S_{max}}{R} * e^{-\pi\frac{x^2}{R^2}}$$

For horizontal strain: $$E(x) = \frac{-2\pi x}{Rh} * S_{max} * e^{-\pi\frac{x^2}{R^2}}$$

For Tilt: $$G(x) = \frac{S_{max}}{R} * e^{-\pi\frac{x^2}{R^2}}$$

For Curvature: $$k(x) = \frac{-2\pi x}{R^3} * S_{max} * e^{-\pi\frac{x^2}{R^2}}$$

Where:

S_{max} = The maximum subsidence (m)
R = Radius of influence (m)
x = The horizontal distance from the inflection point on the subsidence curve (m)
h = The depth from the surface to the top of mined void.

The surface profile forms an elongated S-shape with the lower end trending toward the bottom of the subsidence trough, and the upper end trending towards the original ground surface. The inflection point is the point along this curve where the strains change from tensional at the top to compressional at the bottom of the curve. From Peng et al (1994), the inflection point generally locates inside the trough, and is offset from the edge of the mined panel by distance d, given by:

$$d(h) = h(0.305069 * 0.999104^{3.28h})$$

where: the value for R (radius of influence) is given by h/3, corresponding to an angle of influence of 71.56° (Peng et al, 1994).

Using these values, it is possible to estimate the distance from the edge of the mined panel to the point at which strain, tilt, or curvature values exceed the critical limits for the structure under consideration. To locate structures outside of the critical limits, an offset of 5 m is applied to the calculated location to account for any discrepancy in the location of the mining limits used in the analysis.

3.6 DEFORMATION LIMITS FOR DEVELOPMENT

In determining the deformation limits for development, WSP reviewed the substantial body of work that has been performed for development over the undermined areas of the Three Sisters site. To this end, the following limits have been determined based on the work by Golder (2006):

Table B4: Design Limits for Structures

Deformation Type[1]	Upper bound Value
Strain (compression and extension)	1 mm / m
Tilt	5 mm / m (0.5%)
Curvature	0.2 / km

Notes:

1. Applies to timber frame and brick/block low rise structures.

Critical guidelines for other infrastructure vary depending on the type of infrastructure. The values described herein have been used historically for the Canmore area (Golder, 2005). The infrastructure limits are as follows:

Strain:

- For roads, cracking can occur at strains of 10 mm/m. Pavement also has about a 10-year life so a probabilistic assessment is recommended.
- For gravity and pressure pipes, material can be selected based on the expected strain, which is provided to the designers.

Slope:

- For gravity pipes: a change in slope of less than 2% (i.e, 20 mm/m) will have little impact over short distances.
- For pressure pipes, tilt should have no impact.

Curvature:

- For pipelines, the maximum allowable curvature from the literature is 1000 x the pipe diameter (DN) (Peng, 1992). For gravity pipes 200 to 450 mm diameter, the allowable curvature ranges from 46 to 76 m (230 x DN and 170 x DN respectively); for 210 mm diameter pressure pipes, the curvature can be up to 116 m (550 x DN). These values correspond to a deflection of up to 1.5° and 3° for pressure and gravity pipes, respectively.

3.7 UNCERTAINTY

In determining the potential for surface deformations at the area of study due to undermining, any assumptions made regarding material properties, loading and deformation have been conservative in nature. In addition, there are many areas of uncertainty related to estimating the current conditions. These can be described as follows:

- No surface subsidence measurements: while there have been many recorded incidents of sinkhole development where underground workings were near to the subcrop, there are no recorded measurements of surface deformation at site, including changes in surface structures or infrastructure. Anecdotally, references are made regarding limited surface deformations, including:
- the narrow-gauge railroad that crossed the site, including over multiple de-pillared mine seams, did not experience any settlement-related issues,
- there were no recorded issues with leaning or movement of power poles installed across the site or impacts to the power lines, and
- there were no observations of tilting trees associated with high strain above the edge of seams.
- Models used for estimating the subsidence factor: the models of Marino (1998) and Peng (1994) are based on observations made in Illinois and Pennsylvania, respectively, and display a wide range of observations with no discussion of uncertainties. To compensate, conservative upper limit bounds were used in the estimations herein.
- Geological uncertainty: each geologic regime has its own unique signature for ground behaviour. The National Coal Board (NCB) estimates were not used for Canmore due to significant differences in ground conditions. The North American experiences from Peng and Marino were used with modification for Canmore as they were less conservative than the NCB example; however, differences still exist. Canmore mines consist of friable mountain coal that is weaker than the surrounding rock mass. Geologically, the strata in Pennsylvania is closer to that in Canmore, but the coal is stronger than the immediate surrounding strata (the opposite of the Canmore experience). This allows the pillars to potentially punch into the beds above and below the seam, whereas in Canmore, they will yield due to the loading. The strata in Illinois is much softer, and consequently the deformations would be higher than the Canmore experience.
- Incomplete mine plans: while the record keeping for the Canmore mines was exemplary in most cases, there are still cases where the mine plans may be incomplete or inexact, due to

- Damage or distortion associated with aging and storage of the plans
- Incomplete survey pickup of mined areas, particularly at the outer limits of the mine areas, and at late stages of the extraction.
- Issues with interpretation of the drillhole data: interpretation of the drilling data requires an understanding or estimation of the portion or layout of the workings encountered by each drillhole. In some cases the age of the boreholes may not reflect the current conditions, and so interpretation must be made with caution. Borehole interpretation has been enhanced by the use of down-hole camera surveys, which can be more accurate in assessing the presence and location of voids, fractures, rubble, and caved debris. In addition, some holes from earlier programs are still accessible, and re-surveying with the borehole camera can help to update conditions in the rock mass above the hole. Comparison with the historic logs can also give an estimate for rate-of-change for migration of fractures towards surface.

In handling the uncertainties described above, care has been taken to err on the side of caution while trying to avoid compounding of conservatism from multiple assumptions. It is anticipated that as more work is done across the sites, including additional drilling campaigns, the understanding of the unique conditions in Canmore will improve, which will correspondingly improve the understanding of the potential surface impacts.

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Appendix C

3D Model Plans and Sections

Client Logo

THREE SISTERS
mountain village

Client :
THREE SISTERS MOUNTAIN VILLAGE

WSP Wood E&I Solutions
#401,1925 - 18th Ave NE
Calgary, Alberta, Canada T2E 7T8

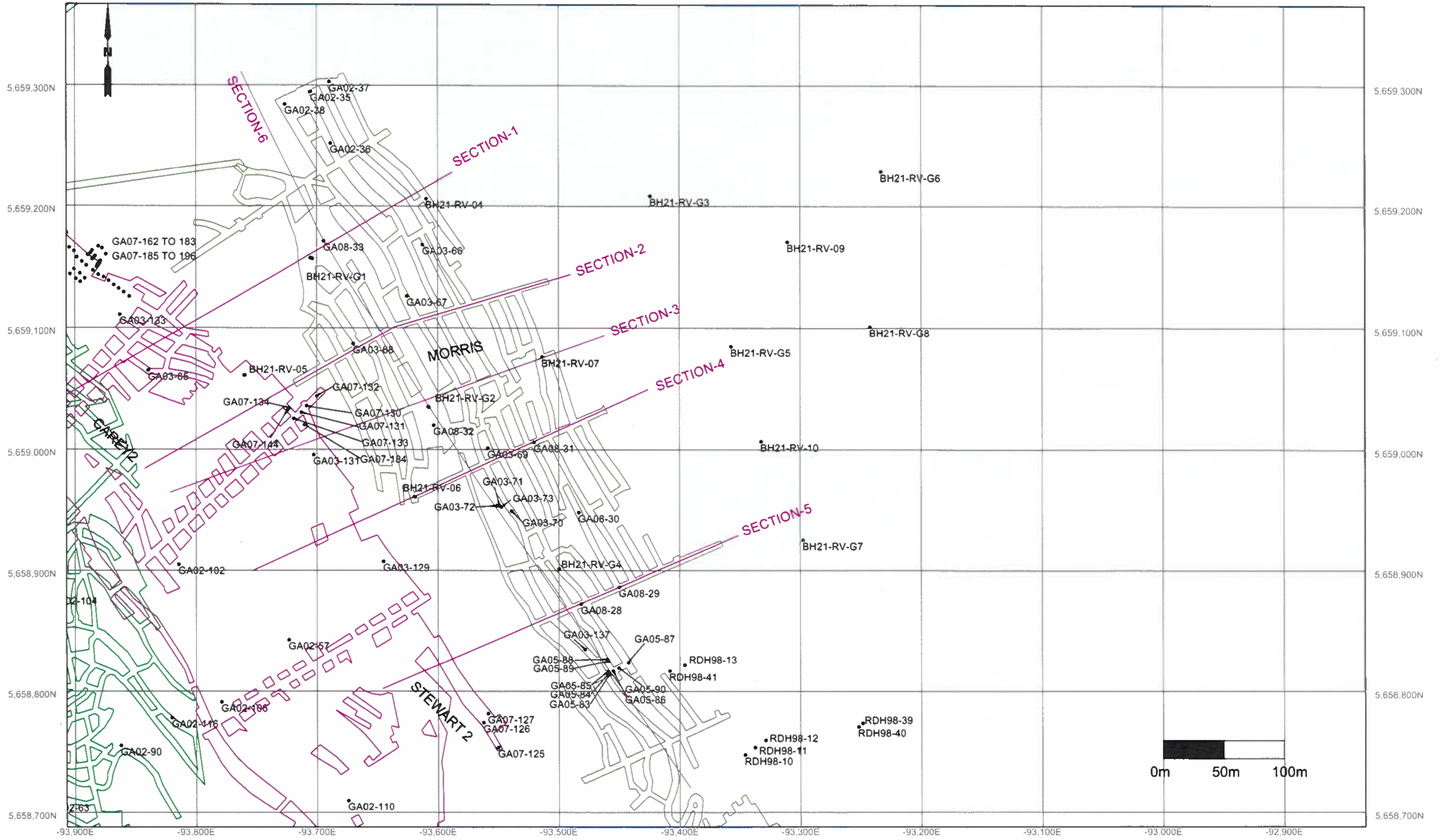
wsp

DRAWN BY	S L
DESIGNED BY	
CHECKED BY	B B
REVIEWED BY	J T
APPROVED BY	P P

PROJECT :
THREE SISTERS VILLAGE-PHASE1

DRAWING TITLE :
PLAN VIEW

PROJECT NO CG09140
REVISION:0
DATE: OCTOBER 2023
SCALE AS SHOWN
DRAWING NO C-7



Client Logo

THREE SISTERS mountain village

Client :
THREE SISTERS MOUNTAIN VILLAGE

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wsp

DRAWN BY : S L
DESIGNED BY:
CHECKED BY : B B
REVIEWED BY : J.T
APPROVED BY : P P

PROJECT :
THREE SISTERS VILLAGE-PHASE1

DRAWING TITLE :
PLAN VIEW WITH BOREHOLES

PROJECT NO.: CG09140
REVISION:0
DATE: OCTOBER 2023
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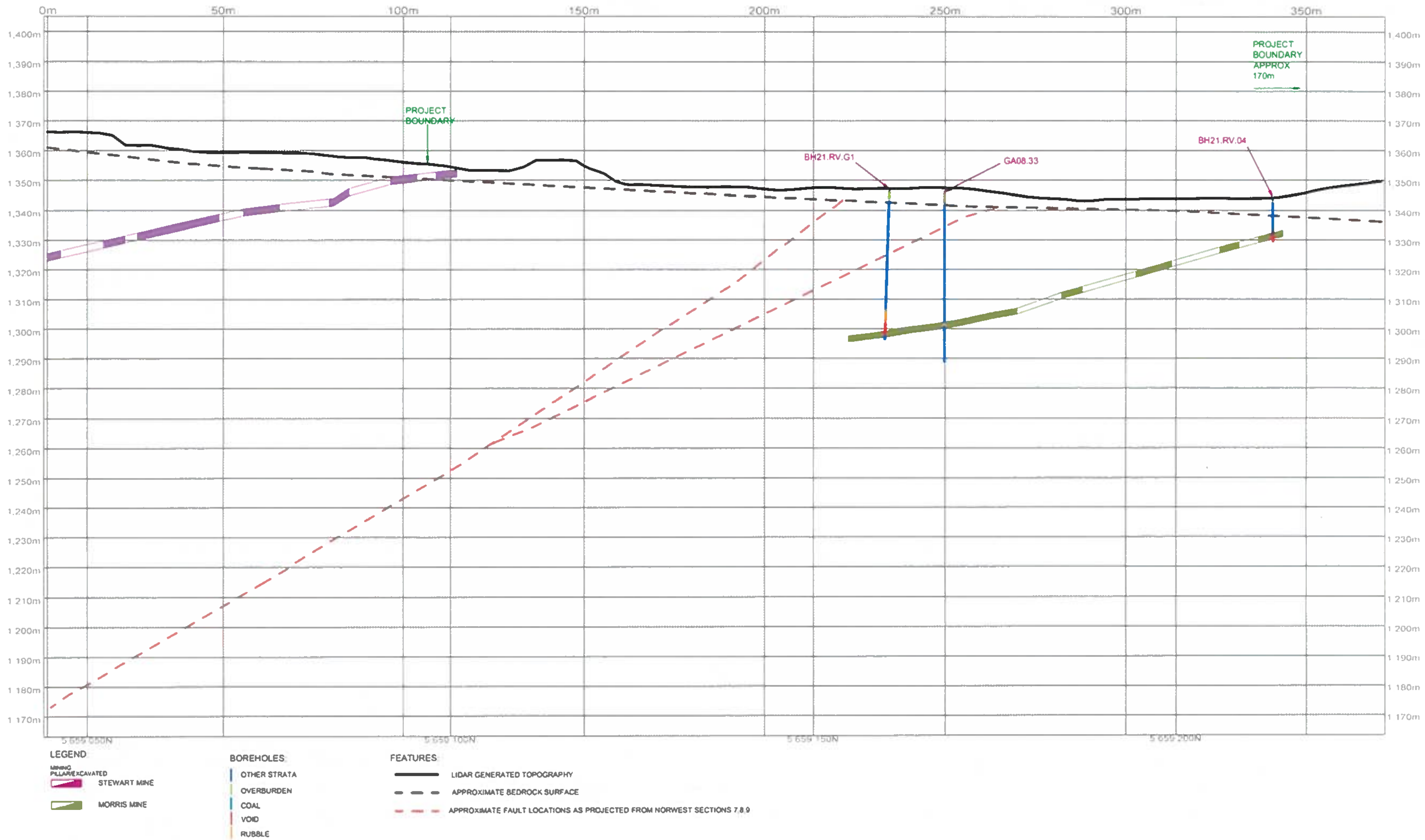
DRAWING NO.: C-8



NOTE:ONLY SELECT BOREHOLES SHOWN. BOREHOLES PROJECTED ONTO SECTION WITHIN+/- 10m OF SECTION LINES.

Client Logo

THREE SISTERS mountain village

Client :
THREE SISTERS MOUNTAIN VILLAGE

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Calgary, Alberta, Canada T2E 7T8

wsp

DRAWN BY : S.L
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CHECKED BY : B.B
REVIEWED BY : J.T
APPROVED BY : P.P

PROJECT :
RESORT VILLAGE-PHASE1 UNDERMINING

DRAWING TITLE :
SECTION-1

PROJECT NO : CG09140
REVISION 0
DATE: OCTOBER 2023
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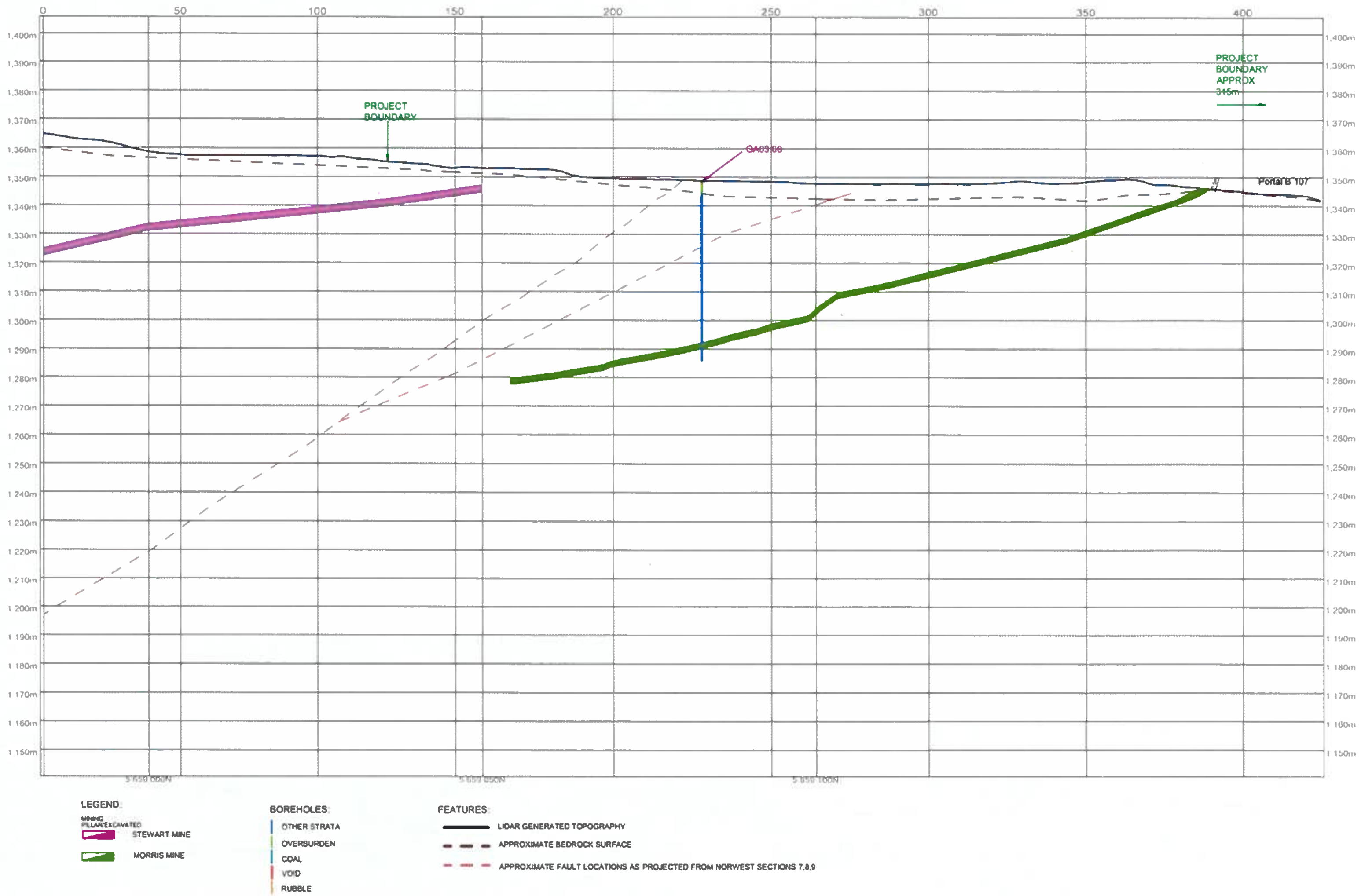

NOTE:ONLY SELECT BOREHOLES SHOWN. BOREHOLES PROJECTED ONTO SECTION WITHIN+/- 10m OF SECTION LINES.

Client Logo

THREE SISTERS mountain village

Client :
THREE SISTERS MOUNTAIN VILLAGE

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Calgary, Alberta, Canada T2E 7T8

wsp

DRAWN BY : S L
DESIGNED BY :
CHECKED BY : B B
REVIEWED BY : J T
APPROVED BY : P P

PROJECT :
RESORT VILLAGE-PHASE1 UNDERMINING

DRAWING TITLE :
SECTION-2

PROJECT NO : CG09140
REVISION:0
DATE: OCTOBER 2023
SCALE : AS SHOWN
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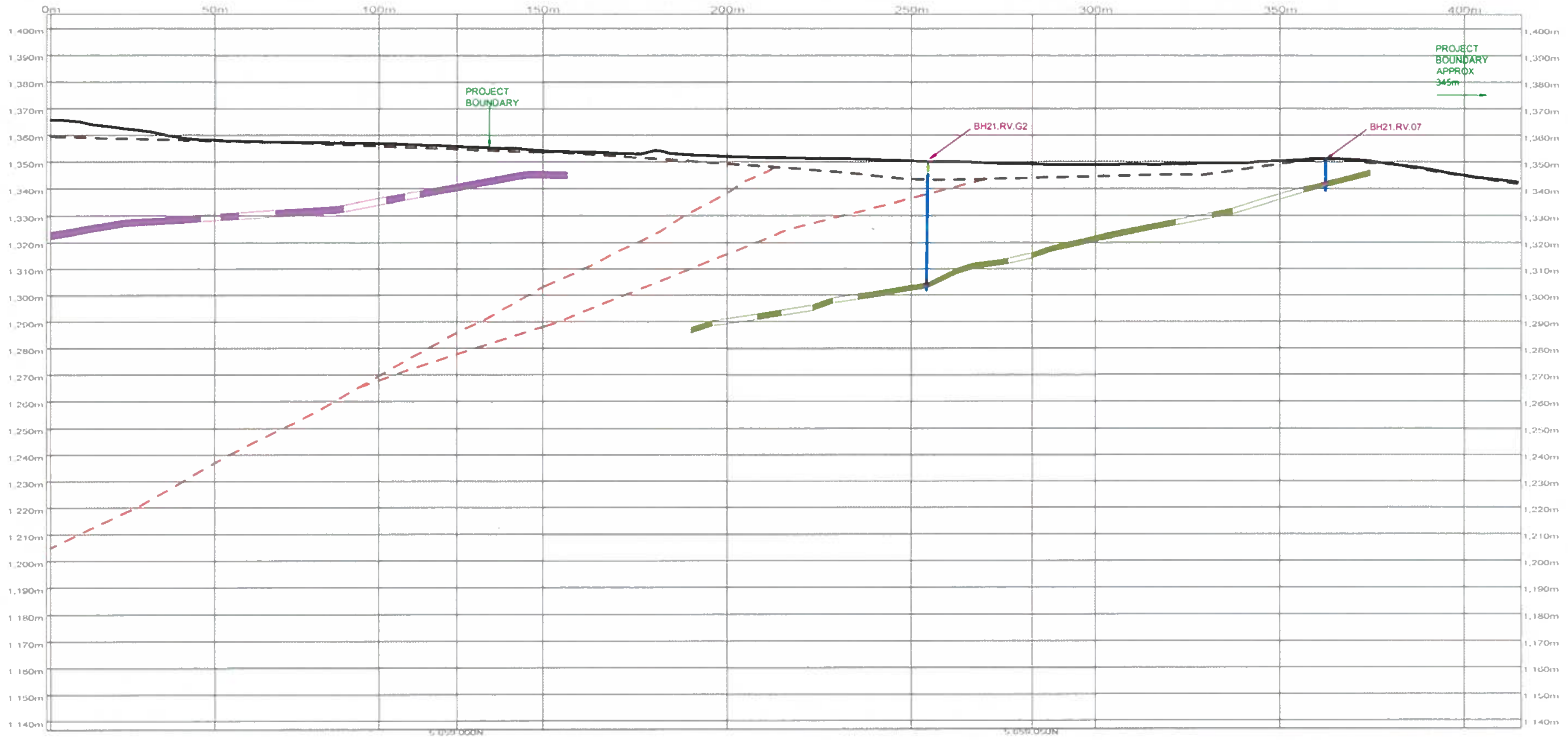

LEGEND:

MINING PILLAR/EXCAVATED

🟥 STEWART MINE

🟩 MORRIS MINE

BOREHOLES:

- OTHER STRATA
- OVERBURDEN
- COAL
- VOID
- RUBBLE

FEATURES:

- LIDAR GENERATED TOPOGRAPHY
- APPROXIMATE BEDROCK SURFACE
- APPROXIMATE FAULT LOCATIONS AS PROJECTED FROM NORWEST SECTIONS 7,8,9

NOTE: ONLY SELECT BOREHOLES SHOWN. BOREHOLES PROJECTED ONTO SECTION WITHIN+/- 10m OF SECTION LINES

Client Logo

THREE SISTERS mountain village

Client :
THREE SISTERS MOUNTAIN VILLAGE

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#401,1925 - 18th Ave NE
Calgary, Alberta, Canada T2E 7T8

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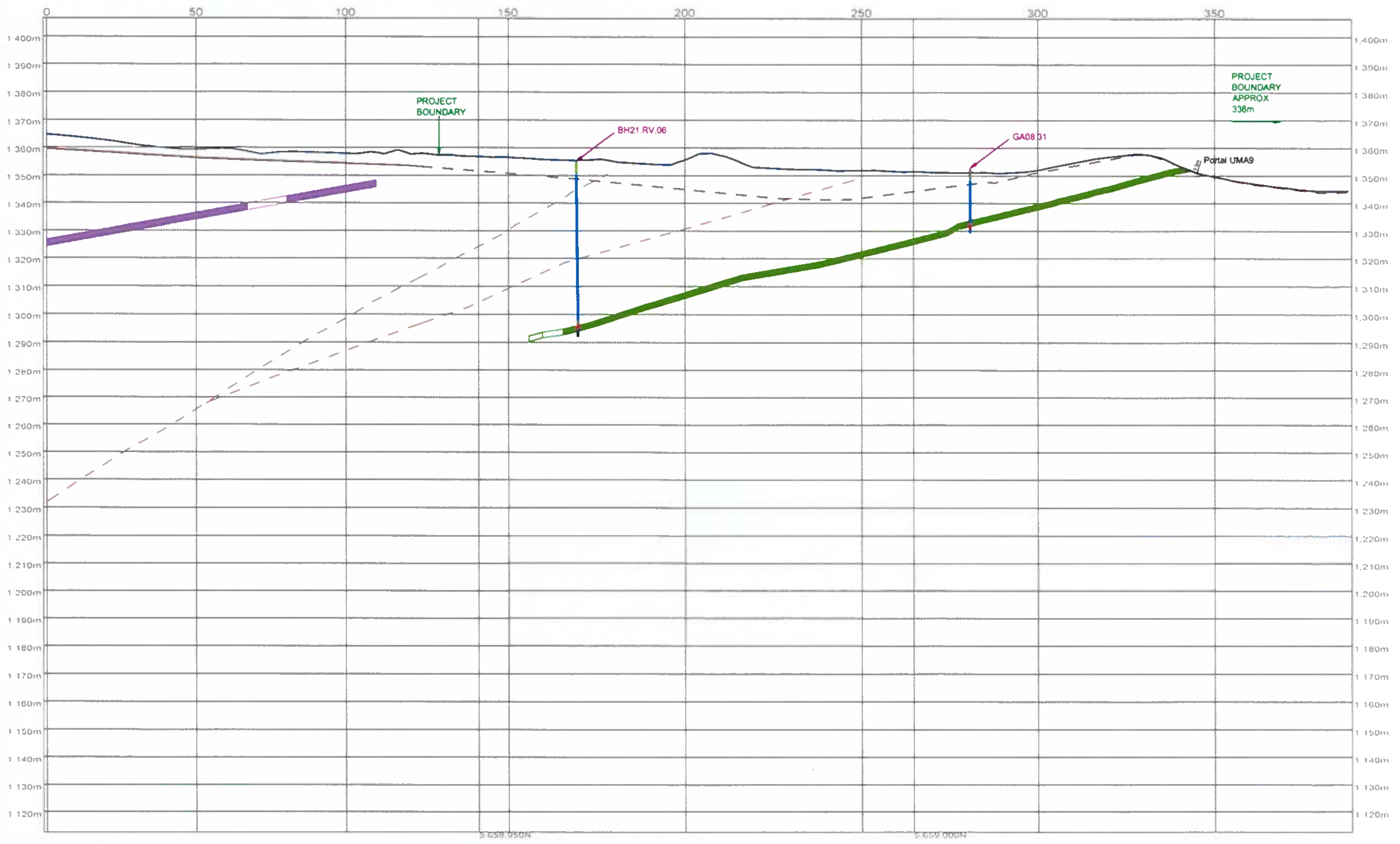
DESIGNED BY
CHECKED BY B B
REVIEWED BY J T
APPROVED BY P P

PROJECT :
RESORT VILLAGE-PHASE1 UNDERMINING

DRAWING TITLE :
SECTION-3

PROJECT NO CG09140
REVISION:0
DATE: OCTOBER 2023
SCALE AS SHOWN
DRAWING NO C-3



LEGEND:

MINING PILLAR/EXCAVATED

🟪 STEWART MINE

🟩 MORRIS MINE

BOREHOLES:

- OTHER STRATA
- OVERBURDEN
- COAL
- VOID
- RUBBLE

FEATURES:

- LIDAR GENERATED TOPOGRAPHY
- APPROXIMATE BEDROCK SURFACE
- APPROXIMATE FAULT LOCATIONS AS PROJECTED FROM NORWEST SECTIONS 7,8,9

NOTE:ONLY SELECT BOREHOLES SHOWN. BOREHOLES PROJECTED ONTO SECTION WITHIN+/- 10m OF SECTION LINES.

Client Logo

THREE SISTERS mountain village

Client :
THREE SISTERS MOUNTAIN VILLAGE

WSP Wood E&I Solutions
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wsp

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DESIGNED BY :
CHECKED BY : B B
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PROJECT :
RESORT VILLAGE-PHASE1 UNDERMINING

DRAWING TITLE :
SECTION-4

PROJECT NO : CG09140
REVISION 0
DATE: OCTOBER 2023
SCALE : AS SHOWN
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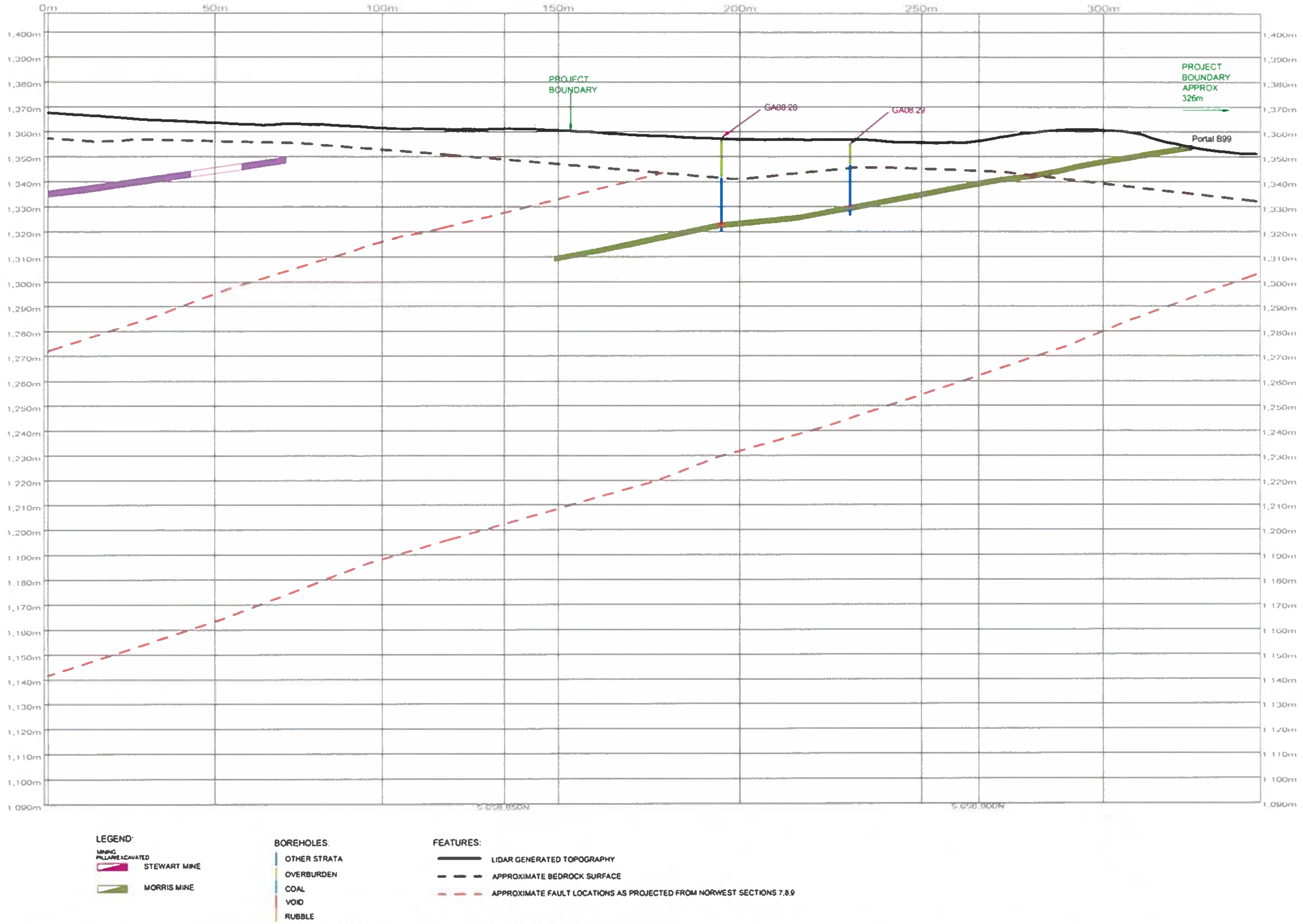

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Client Logo

THREE SISTERS mountain village

Client :
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Calgary, Alberta, Canada T2E 7T8

wsp

DRAWN BY S.L	PROJECT : RESORT VILLAGE-PHASE1 UNDERMINING
DESIGNED BY	
CHECKED BY B.B	DRAWING TITLE : SECTION-5
REVIEWED BY J.T	
APPROVED BY P.P	

PROJECT NO CG09140
REVISION:0
DATE: OCTOBER 2023
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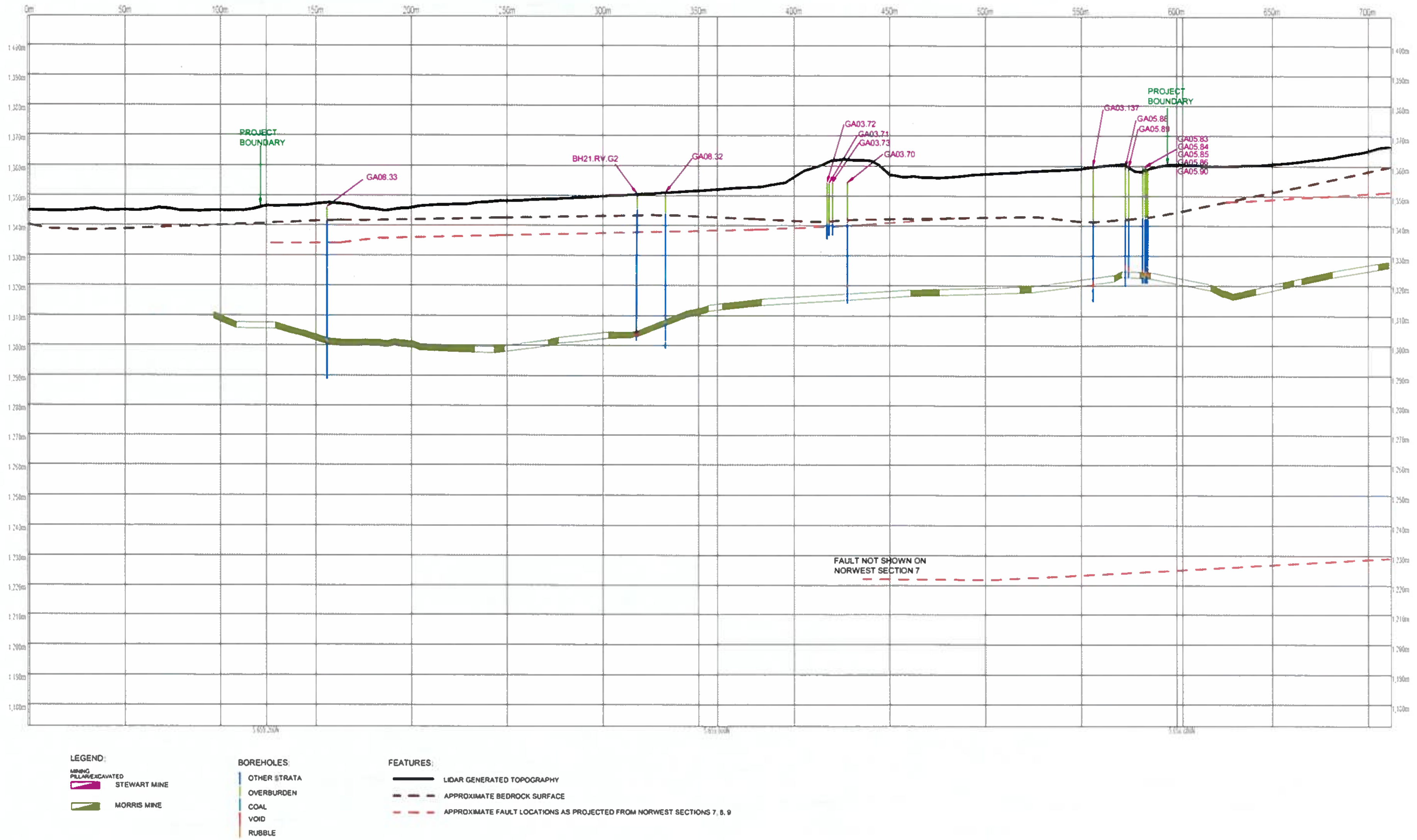

NOTE:ONLY SELECT BOREHOLES SHOWN. BOREHOLES PROJECTED ONTO SECTION WITHIN+/- 10m OF SECTION LINES.

Client Logo

THREE SISTERS mountain village

Client:
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Calgary, Alberta, Canada T2E 7T8

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DRAWN BY: S L	PROJECT: RESORT VILLAGE-PHASE1 UNDERMINING
DESIGNED BY	
CHECKED BY: B B	DRAWING TITLE: SECTION-6
REVIEWED BY: J T	
APPROVED BY: P P	

PROJECT NO: CG09140
REVISION:0
DATE: OCTOBER 2023
SCALE: AS SHOWN
DRAWING NO: C-6

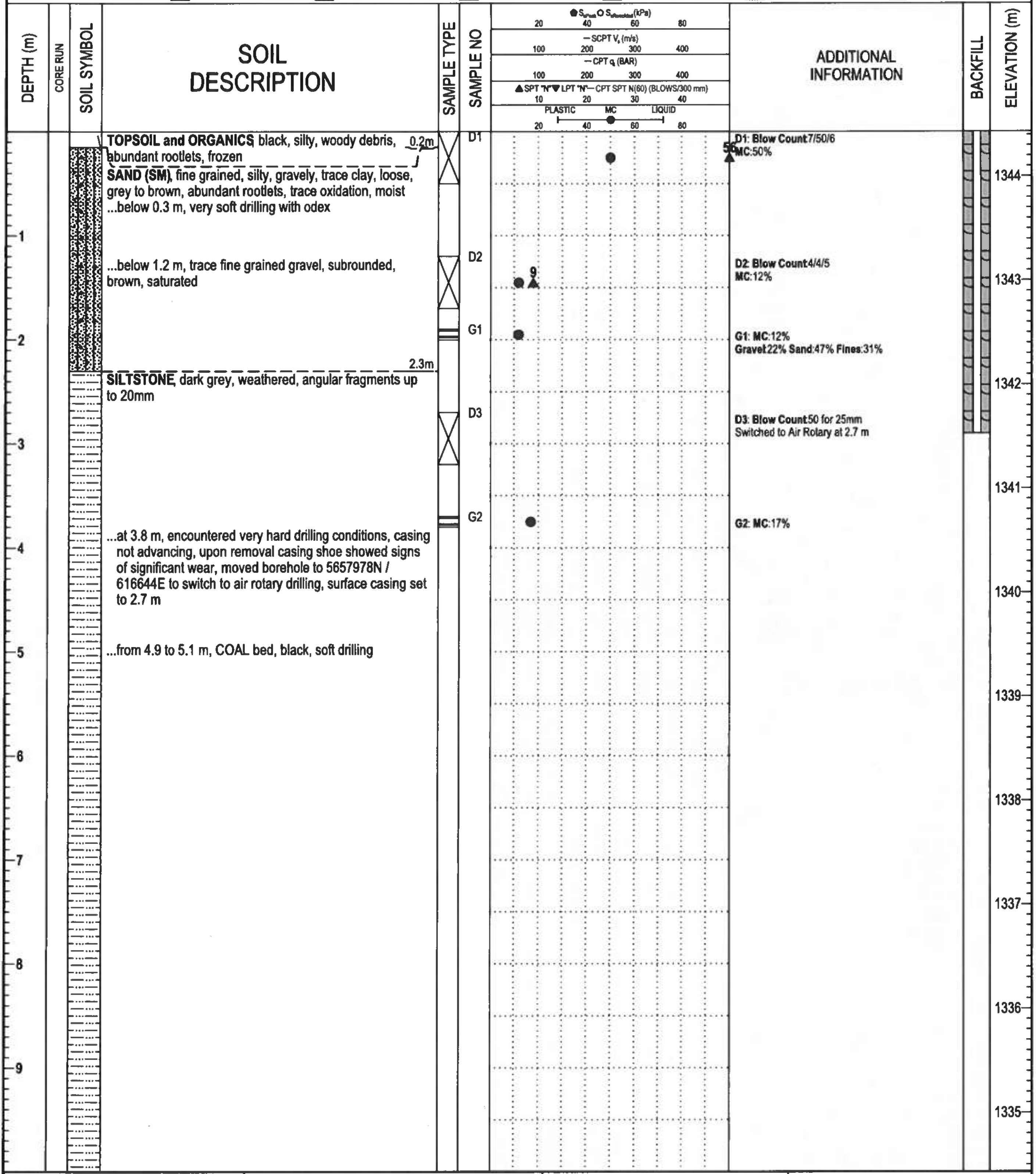
Appendix D

WSP Borehole Logs and Point Load Test Data

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-04-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659205.87 EASTING: -93607.44	ELEVATION: 1344.4 m

SAMPLE TYPE ■ TUBE ◪ NO RECOVERY ☒ SPT ☰ GRAB ⁙ LPT ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ⁙ GROUT ▮ PIEZOMETER HEAD ⁙ SAND



SOIL DESCRIPTION

TOPSOIL and ORGANICS, black, silty, woody debris, abundant rootlets, frozen 0.2m

SAND (SM), fine grained, silty, gravely, trace clay, loose, grey to brown, abundant rootlets, trace oxidation, moist
...below 0.3 m, very soft drilling with odex

...below 1.2 m, trace fine grained gravel, subrounded, brown, saturated

2.3m

SILTSTONE, dark grey, weathered, angular fragments up to 20mm

...at 3.8 m, encountered very hard drilling conditions, casing not advancing, upon removal casing shoe showed signs of significant wear, moved borehole to 5657978N / 616644E to switch to air rotary drilling, surface casing set to 2.7 m

...from 4.9 to 5.1 m, COAL bed, black, soft drilling

ADDITIONAL INFORMATION

D1: Blow Count7/50/6
MC:50%

D2: Blow Count4/4/5
MC:12%

G1: MC:12%
Gravel:22% **Sand:**47% **Fines:**31%

D3: Blow Count50 for 25mm
Switched to Air Rotary at 2.7 m

G2: MC:17%

SOIL LOG CG09140 BOREHOLES.GPJ 5/7/21

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW	COMPLETION DEPTH: 15.0 m
		ENTERED BY: JR	COMPLETION DATE: 3/30/2021
		REVIEWED BY: MP	Page 1 of 2

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-04-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659205.87 EASTING: -93607.44	ELEVATION: 1344.4 m

SAMPLE TYPE	■ TUBE	▨ NO RECOVERY	☒ SPT	☰ GRAB	☐ LPT	▯ CORE
BACKFILL TYPE	▩ BENTONITE	▨ BENTONITE CHIPS	▩ BENTONITE PELLETS	▨ GROUT	▮ PIEZOMETER HEAD	⁘ SAND

DEPTH (m)	CORE RUN	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	● $S_{u(field)}$ ○ $S_{u(remoulded)}$ (kPa) 20 40 60 80 — SCPT V_s (m/s) 100 200 300 400 — CPT q_t (BAR) 100 200 300 400 ▲ SPT "N" ▼ LPT "N" — CPT SPT N(60) (BLOWS/300 mm) 10 20 30 40 PLASTIC MC LIQUID 20 40 60 80	ADDITIONAL INFORMATION	BACKFILL	ELEVATION (m)
									1334
11									
			...at 11.4 m, strong sulphur odour				Could hear water trickling. Water level probe beeped on and off most of the hole, water depth is approximate		▽ 1333
12			12.2m						
			VOID						1332
13									
									1331
14									
									1330
15			15.0m						
			END OF BOREHOLE AT 15.0 m 4.5" ID PVC installed from surface to 2.9 m with 1.4 m stick-up Annulus around PVC backfilled with bentonite chips from surface to 2.9 m A square steel casing protector 155mm wide was installed around the PVC stick-up						1329
16									
									1328
17									
									1327
18									
									1326
19									
									1325

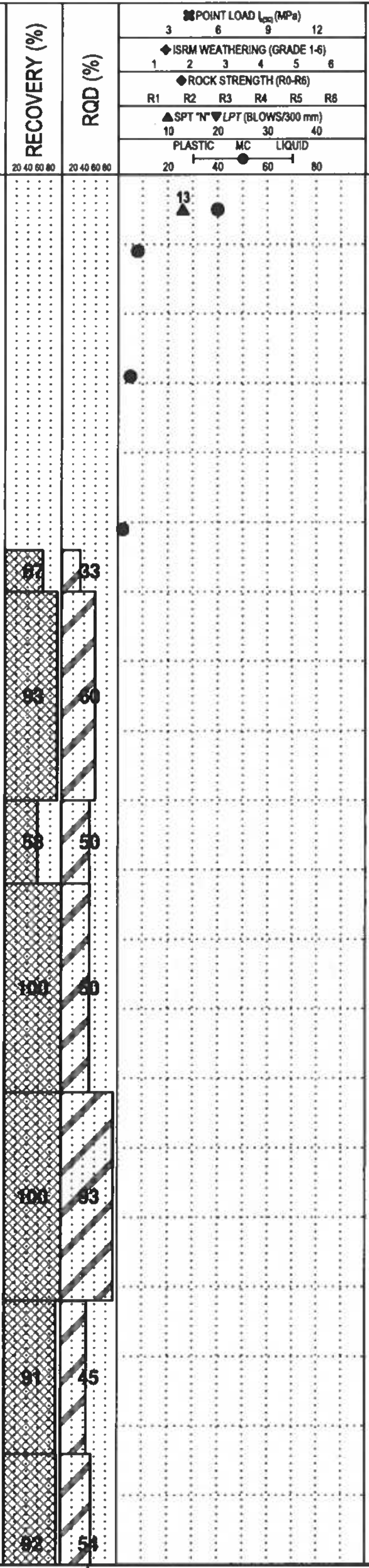
wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW	COMPLETION DEPTH: 15.0 m
		ENTERED BY: JR	COMPLETION DATE: 3/30/2021
		REVIEWED BY: MP	Page 2 of 2

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-05-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Wet Rotary	NORTHING: 5659062.19 EASTING: -93760.11	ELEVATION: 1355.1 m AZIMUTH/DIP:

SAMPLE TYPE ■ TUBE ☒ NO RECOVERY ☒ SPT ☰ GRAB ⁙ LPT ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ⁙ GROUT ▮ PIEZOMETER HEAD ⁙ SAND

DEPTH (m)	CORE RUN	SOIL SYMBOL	ROCK & SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	RQD (%)		ADDITIONAL INFORMATION	BACKFILL	ELEVATION (m)



TOPSOIL and ORGANICS, silty, clayey, stiff, brown, abundant rootlets, forest debris, wet — 0.2m (D1)

SAND and GRAVEL (SW), fine to coarse grained, compact, grey, wet
...below 0.5 m, some siltstone fragments, highly weathered — 1.1m (G1)

SILTSTONE, grey, highly weathered, fragments up to 10mm, dry (D2, G2)
...from 3.6 to 3.65 m, highly fractured with soft fracture infill
...below 3.65 m, occasional fractures at 45 to core axis
...at 4.4 m, COAL bed, black, possible core loss
...below 4.9 m, fracture parallel to core axis
...at 6.5 m, fracture at 45 to core axis, calcite on fracture surface
...at 8.7 m, lost circulation/core barrel plugged

Core runs: C1, C2, C3, C4, C5, C6, C7

Depth (m): 1, 2, 3, 4, 5, 6, 7, 8, 9

Elevation (m): 1355, 1354, 1353, 1352, 1351, 1350, 1349, 1348, 1347, 1346

D1: **Blow Count** 1/6/7
MC:40%

G1: **MC**:8%

D2: **Blow Count** 50 for 150mm
MC:5%

G2: **MC**:2%

C1: **REC**:0.2/0.30 m **RQD**:0.1/0.30 m
Set Casing and Switched to Wet Rotary at 2.7 m

C2: **REC**:1.4/1.50 m **RQD**:0.9/1.50 m

C3: **REC**:0.35/0.60 m **RQD**:0.3/0.60 m

C4: **REC**:1.5/1.50 m **RQD**:0.75/1.50 m

C5: **REC**:1.5/1.50 m **RQD**:1.4/1.50 m

C6: **REC**:1/1.10 m **RQD**:0.5/1.10 m

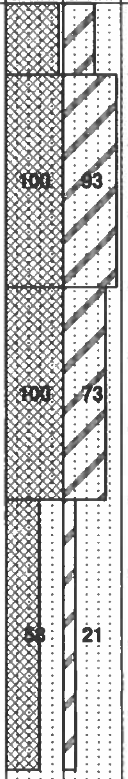
C7: **REC**:1.2/1.30 m **RQD**:0.7/1.30 m

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW	COMPLETION DEPTH: 15.4 m
		ENTERED BY: JR	COMPLETION DATE: 4/4/2021
		REVIEWED BY: MP	Page 1 of 2

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-05-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Wet Rotary	NORTHING: 5659062.19 EASTING: -93760.11	ELEVATION: 1355.1 m AZIMUTH/DIP:

SAMPLE TYPE	■ TUBE	▨ NO RECOVERY	☒ SPT	☰ GRAB	⁙ LPT	▮ CORE
BACKFILL TYPE	▩ BENTONITE	▨ BENTONITE CHIPS	☒ BENTONITE PELLETS	⁙ GROUT	▮ PIEZOMETER HEAD	⁙ SAND

DEPTH (m) | CORE RUN | SOIL SYMBOL | **ROCK & SOIL DESCRIPTION** | SAMPLE TYPE | SAMPLE NO | RECOVERY (%) 20 40 60 80 | RQD (%) 20 40 60 80 | ✖ POINT LOAD $I_{s(50)}$ (MPa) 3 6 9 12 / ◆ ISRM WEATHERING (GRADE 1-6) 1 2 3 4 5 6 / ◆ ROCK STRENGTH (R0-R6) R1 R2 R3 R4 R5 R6 / ▲ SPT "N" ▼ *LPT* (BLOWS/300 mm) 10 20 30 40 / PLASTIC MC LIQUID 20 40 60 80 | ADDITIONAL INFORMATION | BACKFILL | ELEVATION (m)



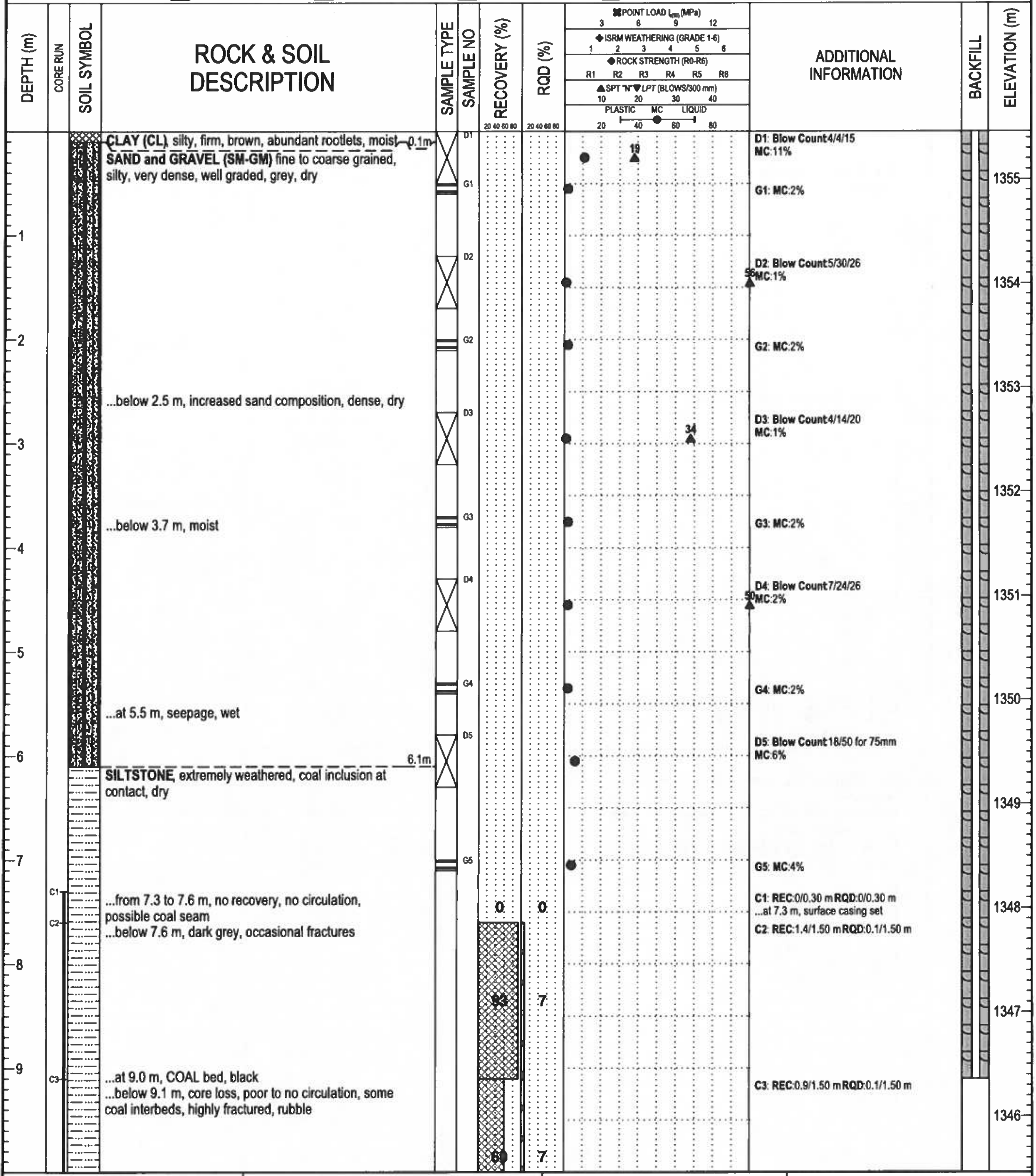
DEPTH (m)	CORE RUN	ROCK & SOIL DESCRIPTION	ADDITIONAL INFORMATION	ELEVATION (m)
				1345
	C8	...at 10.3 m, some oxidation staining on fracture surfaces	**C8**: **REC**:1.5/1.50 m**RQD**:1.4/1.50 m	
11				1344
12	C9		**C9**: **REC**:1.5/1.50 m**RQD**:1.1/1.50 m	1343
		...below 12.5 m, trace pyrite inclusions		
13				1342
	C10		**C10**: **REC**:1.1/1.90 m**RQD**:0.4/1.90 m	
14				1341
		...at 14.4 m, drill rods dropped to 14.7 m, possible rubble below		
15		...at 15.0 m, drill rods dropped to 15.4 m		1340 ▽
		...at 15.4 m, hard, competent, no return or circulation 15.4m		
		END OF BOREHOLE AT 15.4 m Borehole open to 14.2 m upon completion Water level at 14.0 m upon completion		
16		4.5" ID PVC installed from surface to 2.9 m with 1.3 m stick-up Annulus around PVC backfilled with bentonite chips from surface to 2.9 m A square steel casing protector 155mm wide was installed around the PVC stick-up		1339
17				1338
18				1337
19				1336

wood.	LOGGED BY: BW	COMPLETION DEPTH: 15.4 m
Environment & Infrastructure Solutions **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	ENTERED BY: JR	COMPLETION DATE: 4/4/2021
	REVIEWED BY: MP	Page 2 of 2

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-06-4"**	
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140	
METHOD: Odex/Wet Rotary	NORTHING: 5658961.51 EASTING: -93618.34	ELEVATION: 1355.5 m	AZIMUTH/DIP:

SAMPLE TYPE ■ TUBE ◩ NO RECOVERY ☒ SPT ☰ GRAB ⬚ LPT ▥ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ▨ BENTONITE PELLETS ▨ GROUT ▨ PIEZOMETER HEAD ⬚ SAND



CLAY (CL), silty, firm, brown, abundant rootlets, moist 0.1m

SAND and GRAVEL (SM-GM) fine to coarse grained, silty, very dense, well graded, grey, dry

...below 2.5 m, increased sand composition, dense, dry

...below 3.7 m, moist

...at 5.5 m, seepage, wet

6.1m

SILTSTONE, extremely weathered, coal inclusion at contact, dry

...from 7.3 to 7.6 m, no recovery, no circulation, possible coal seam

...below 7.6 m, dark grey, occasional fractures

...at 9.0 m, COAL bed, black

...below 9.1 m, core loss, poor to no circulation, some coal interbeds, highly fractured, rubble

D1: **Blow Count**4/4/15
MC:11%

G1: **MC**:2%

D2: **Blow Count**5/30/26
MC:1%

G2: **MC**:2%

D3: **Blow Count**4/14/20
MC:1%

G3: **MC**:2%

D4: **Blow Count**7/24/26
MC:2%

G4: **MC**:2%

D5: **Blow Count**18/50 for 75mm
MC:6%

G5: **MC**:4%

C1: **REC**:0/0.30 m **RQD**:0/0.30 m
...at 7.3 m, surface casing set

C2: **REC**:1.4/1.50 m **RQD**:0.1/1.50 m

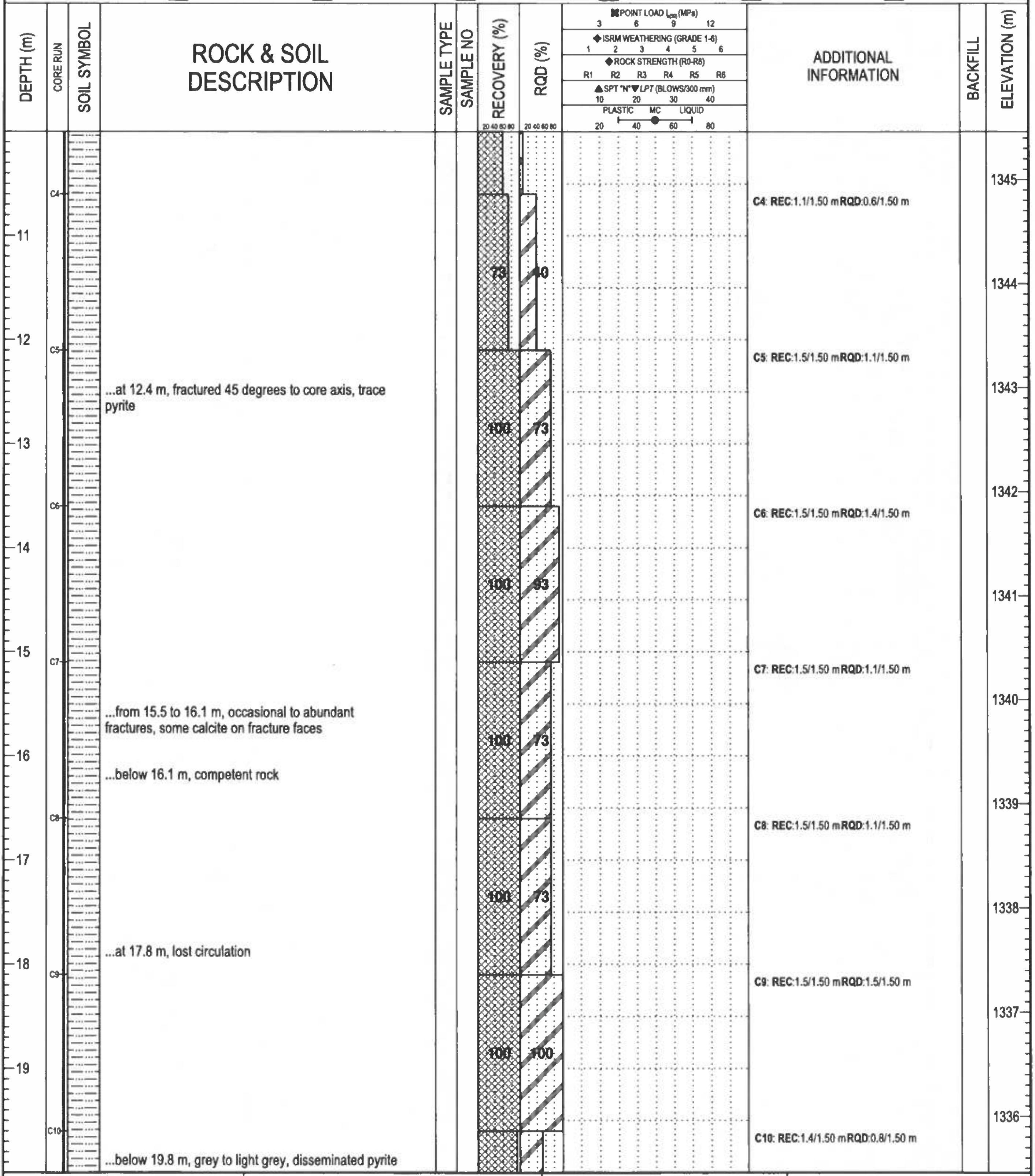
C3: **REC**:0.9/1.50 m **RQD**:0.1/1.50 m

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW	COMPLETION DEPTH: 63.0 m
		ENTERED BY: JR	COMPLETION DATE: 4/6/2021
		REVIEWED BY: MP	

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-06-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Wet Rotary	NORTHING: 5658961.51 EASTING: -93618.34	ELEVATION: 1355.5 m AZIMUTH/DIP:

SAMPLE TYPE ■ TUBE ◪ NO RECOVERY ☒ SPT ☰ GRAB ⛶ LPT ▯ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ▨ GROUT ▮ PIEZOMETER HEAD ⛶ SAND



...at 12.4 m, fractured 45 degrees to core axis, trace pyrite

...from 15.5 to 16.1 m, occasional to abundant fractures, some calcite on fracture faces

...below 16.1 m, competent rock

...at 17.8 m, lost circulation

...below 19.8 m, grey to light grey, disseminated pyrite

C4: **REC**:1.1/1.50 m**RQD**:0.6/1.50 m

C5: **REC**:1.5/1.50 m**RQD**:1.1/1.50 m

C6: **REC**:1.5/1.50 m**RQD**:1.4/1.50 m

C7: **REC**:1.5/1.50 m**RQD**:1.1/1.50 m

C8: **REC**:1.5/1.50 m**RQD**:1.1/1.50 m

C9: **REC**:1.5/1.50 m**RQD**:1.5/1.50 m

C10: **REC**:1.4/1.50 m**RQD**:0.8/1.50 m

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW	COMPLETION DEPTH: 63.0 m
		ENTERED BY: JR	COMPLETION DATE: 4/6/2021
		REVIEWED BY: MP	Page 2 of 7

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-06-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Wet Rotary	NORTHING: 5658961.51 EASTING: -93618.34	ELEVATION: 1355.5 m AZIMUTH/DIP:

SAMPLE TYPE ■ TUBE ▨ NO RECOVERY ☒ SPT ▤ GRAB ⬚ LPT ▮ CORE

BACKFILL TYPE ▩ BENTONITE ▧ BENTONITE CHIPS ☒ BENTONITE PELLETS ⁘ GROUT ▮ PIEZOMETER HEAD ⬚ SAND

DEPTH (m)	CORE RUN	ROCK & SOIL DESCRIPTION	RECOVERY (%)	RQD (%)	ADDITIONAL INFORMATION	ELEVATION (m)
		throughout ...at 20.1 m, regained circulation ...from 20.4 to 20.6 m, COAL seams, highly fractured, 50mm thick	93	53		1335
21	C11	...from 21.5 to 21.9 m, some mm to 40mm thick COAL seams	100	73	**C11**: **REC**:1.5/1.50 m**RQD**:1.1/1.50 m	1334
22	C12		100	93	**C12**: **REC**:1.5/1.50 m**RQD**:1.4/1.50 m	1333 1332
23						
24	C13	...below 24.9 m, trace mm thick calcite inclusions, some calcite on fracture faces	87	53	**C13**: **REC**:1.3/1.50 m**RQD**:0.8/1.50 m	1331 1330
25	C14		100	93	**C14**: **REC**:1.5/1.50 m**RQD**:1.4/1.50 m	1329
26						
27	C15	...below 27.1 m, some mm thick calcite veins, parallel to core axis	100	93	**C15**: **REC**:1.5/1.50 m**RQD**:1.4/1.50 m	1328 1327
28	C16		93	93	**C16**: **REC**:1.4/1.50 m**RQD**:1.4/1.50 m	1326
29						

Column headings: SOIL SYMBOL, SAMPLE TYPE, SAMPLE NO, BACKFILL; ✖ POINT LOAD $I_{s(50)}$ (MPa) 3 6 9 12; ◆ ISRM WEATHERING (GRADE 1-6) 1 2 3 4 5 6; ◆ ROCK STRENGTH (R0-R6) R1 R2 R3 R4 R5 R6; ▲ SPT "N" ▼ LPT (BLOWS/300 mm) 10 20 30 40; PLASTIC MC LIQUID 20 40 60 80

ROCK LOG CG09140 BOREHOLES.GPJ 5/7/21

wood.

Environment & Infrastructure Solutions
401 - 1925 18th Avenue NE
Calgary, AB T2E 7T8

LOGGED BY: BW	COMPLETION DEPTH: 63.0 m
ENTERED BY: JR	COMPLETION DATE: 4/6/2021
REVIEWED BY: MP	Page 3 of 7

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-06-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Wet Rotary	NORTHING: 5658961.51 EASTING: -93618.34	ELEVATION: 1355.5 m AZIMUTH/DIP:

SAMPLE TYPE	■ TUBE	◺ NO RECOVERY	☒ SPT	☰ GRAB	⛶ LPT	▯ CORE
BACKFILL TYPE	▨ BENTONITE	◪ BENTONITE CHIPS	⊠ BENTONITE PELLETS	⛶ GROUT	▮ PIEZOMETER HEAD	⛶ SAND

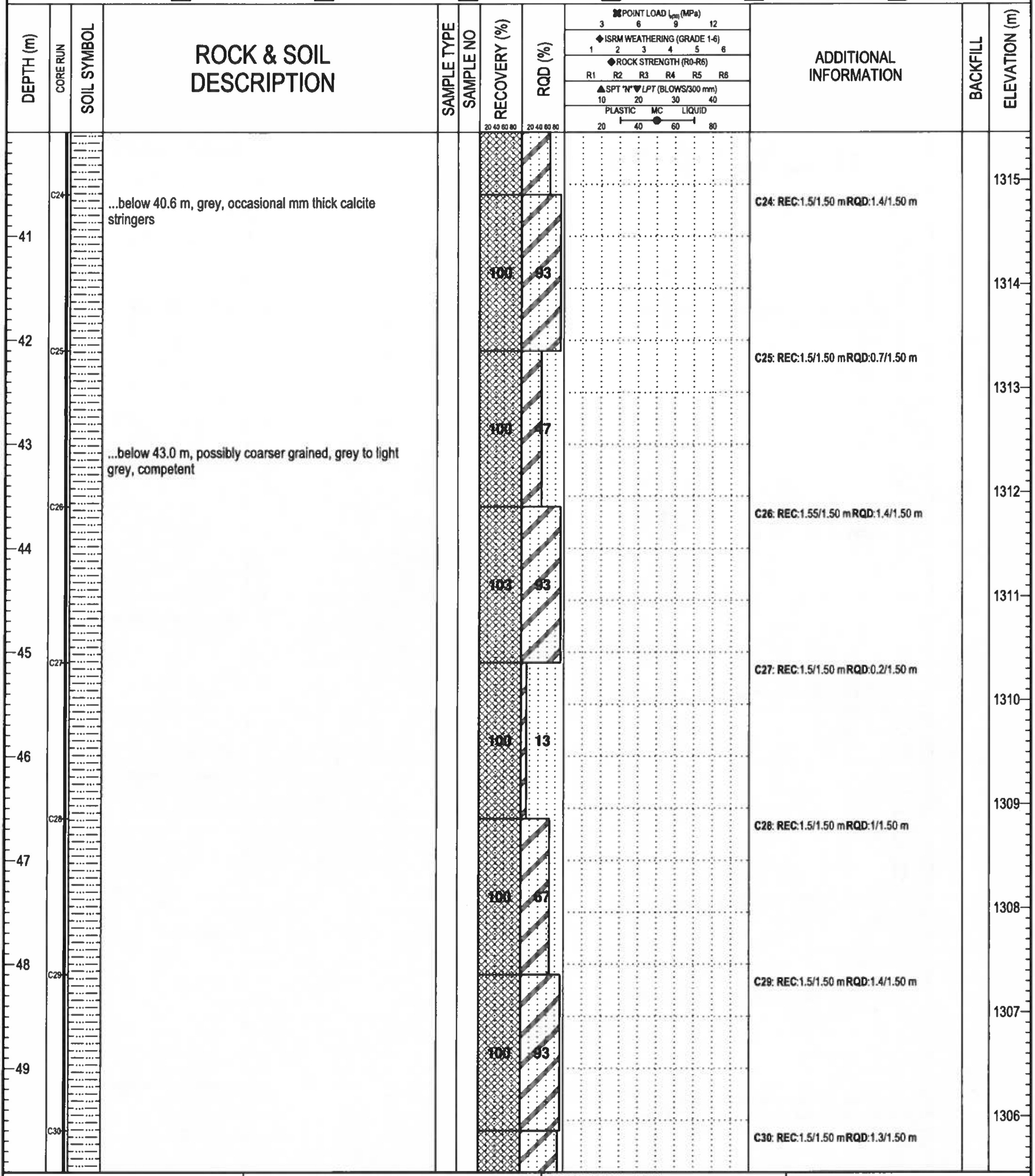
Test scales: ✖ POINT LOAD $I_{s(50)}$ (MPa) 3 6 9 12; ◆ ISRM WEATHERING (GRADE 1-6) 1 2 3 4 5 6; ◆ ROCK STRENGTH (R0-R6) R1 R2 R3 R4 R5 R6; ▲ SPT "N" ▼ LPT (BLOWS/300 mm) 10 20 30 40; PLASTIC MC LIQUID 20 40 60 80

DEPTH (m)	CORE RUN	SOIL SYMBOL	ROCK & SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	RQD (%)	ADDITIONAL INFORMATION	BACKFILL	ELEVATION (m)
31	C17		...below 30.1 m, C17 core loss at possible coal seam, returns water turned black during coring			47	27	**C17**: **REC**:0.7/1.50 m **RQD**:0.4/1.50 m		1325 1324
32 33	C18		...below 31.6 m, poor recovery, core recovered is extremely fractured			40	7	**C18**: **REC**:0.6/1.50 m **RQD**:0.1/1.50 m		1323
34	C19		...at 33.6 m, 45 degree calcite filled joint/fracture approximately 30mm thick			100	100	**C19**: **REC**:1.5/1.50 m **RQD**:1.5/1.50 m		1322 1321
35 36	C20		...at 35.3 m, highly fractured, possible wash out of coal laminae			67	40	**C20**: **REC**:1/1.50 m **RQD**:0.6/1.50 m		1320
37	C21		...at 37.3 m, COAL, highly fractured, possible core loss zone			87	80	**C21**: **REC**:1.3/1.50 m **RQD**:1.2/1.50 m		1319 1318
38 39	C22		...from 38.2 to 38.6 m, coal, highly fractured, possible core loss			73	53	**C22**: **REC**:1.1/1.50 m **RQD**:0.8/1.50 m		1317
	C23		...from 39.2 to 39.5 m, abundant fractures at 45 degrees to core axis, some fractured coal infill			100	67	**C23**: **REC**:1.5/1.50 m **RQD**:1/1.50 m		1316

LOGGED BY: BW	COMPLETION DEPTH: 63.0 m
ENTERED BY: JR	COMPLETION DATE: 4/6/2021
REVIEWED BY: MP	

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-06-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Wet Rotary	NORTHING: 5658961.51 EASTING: -93618.34	ELEVATION: 1355.5 m AZIMUTH/DIP:

SAMPLE TYPE	■ TUBE	▨ NO RECOVERY	☒ SPT	☰ GRAB	⬚ LPT	▮ CORE
BACKFILL TYPE	▩ BENTONITE	◺ BENTONITE CHIPS	⊠ BENTONITE PELLETS	⁘ GROUT	▮ PIEZOMETER HEAD	⁘ SAND



...below 40.6 m, grey, occasional mm thick calcite stringers

...below 43.0 m, possibly coarser grained, grey to light grey, competent

C24: **REC**:1.5/1.50 m **RQD**:1.4/1.50 m

C25: **REC**:1.5/1.50 m **RQD**:0.7/1.50 m

C26: **REC**:1.55/1.50 m **RQD**:1.4/1.50 m

C27: **REC**:1.5/1.50 m **RQD**:0.2/1.50 m

C28: **REC**:1.5/1.50 m **RQD**:1/1.50 m

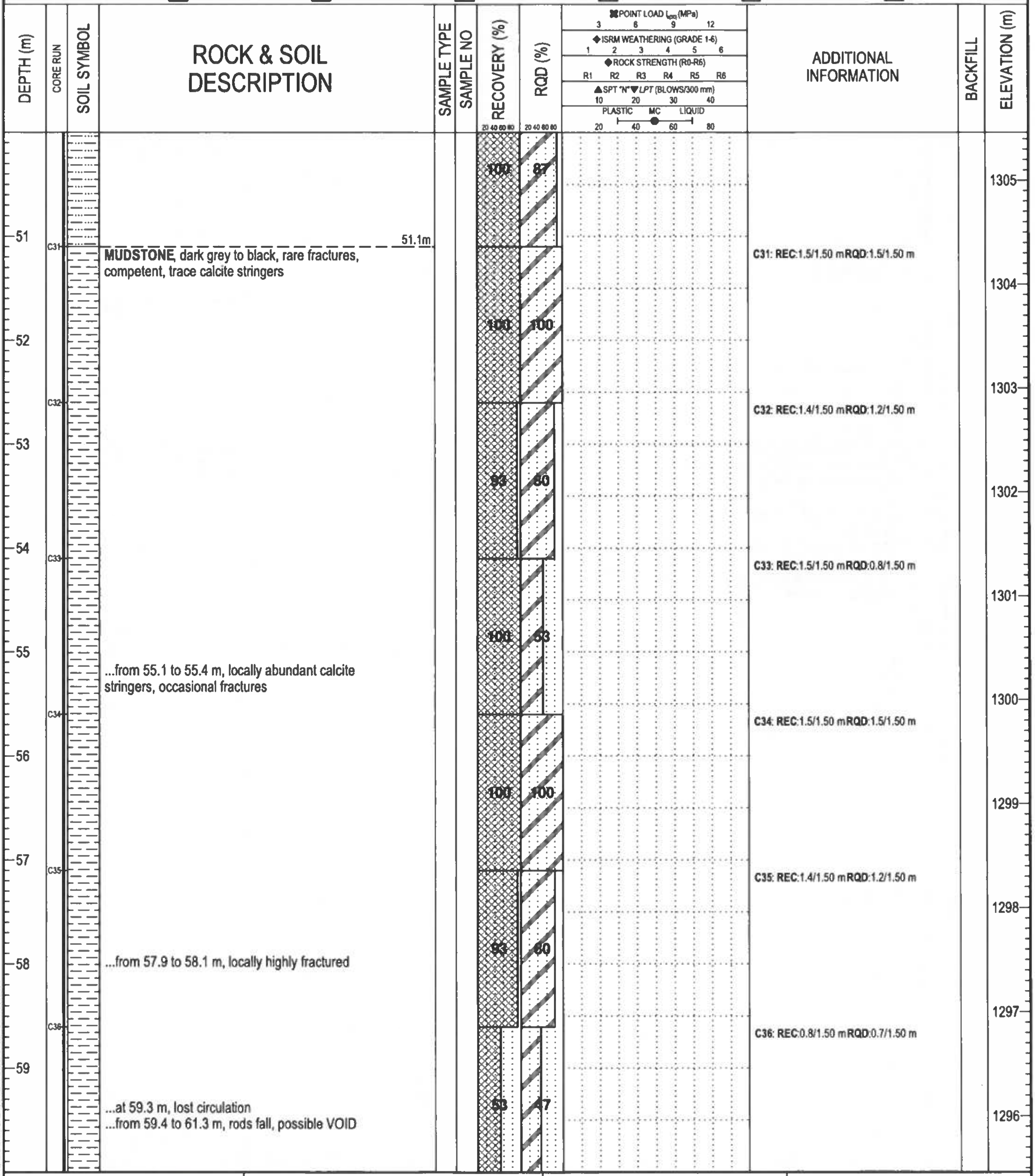
C29: **REC**:1.5/1.50 m **RQD**:1.4/1.50 m

C30: **REC**:1.5/1.50 m **RQD**:1.3/1.50 m

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW	COMPLETION DEPTH: 63.0 m
		ENTERED BY: JR	COMPLETION DATE: 4/6/2021
		REVIEWED BY: MP	Page 5 of 7

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-06-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Wet Rotary	NORTHING: 5658961.51 EASTING: -93618.34	ELEVATION: 1355.5 m AZIMUTH/DIP:

SAMPLE TYPE	■ TUBE	◸ NO RECOVERY	☒ SPT	☰ GRAB	⁙ LPT	▥ CORE
BACKFILL TYPE	▨ BENTONITE	BENTONITE CHIPS	BENTONITE PELLETS	GROUT	PIEZOMETER HEAD	⁙ SAND



51.1m

MUDSTONE, dark grey to black, rare fractures, competent, trace calcite stringers

...from 55.1 to 55.4 m, locally abundant calcite stringers, occasional fractures

...from 57.9 to 58.1 m, locally highly fractured

...at 59.3 m, lost circulation
...from 59.4 to 61.3 m, rods fall, possible VOID

C31: **REC**:1.5/1.50 m**RQD**:1.5/1.50 m

C32: **REC**:1.4/1.50 m**RQD**:1.2/1.50 m

C33: **REC**:1.5/1.50 m**RQD**:0.8/1.50 m

C34: **REC**:1.5/1.50 m**RQD**:1.5/1.50 m

C35: **REC**:1.4/1.50 m**RQD**:1.2/1.50 m

C36: **REC**:0.8/1.50 m**RQD**:0.7/1.50 m

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW ENTERED BY: JR REVIEWED BY: MP	COMPLETION DEPTH: 63.0 m COMPLETION DATE: 4/6/2021 Page 6 of 7

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-06-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Wet Rotary	NORTHING: 5658961.51 EASTING: -93618.34	ELEVATION: 1355.5 m AZIMUTH/DIP:

SAMPLE TYPE: ■ TUBE ▨ NO RECOVERY ☒ SPT ☰ GRAB ⁙ LPT ▮ CORE

BACKFILL TYPE: ▩ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ⁘ GROUT ▮ PIEZOMETER HEAD ⁖ SAND

✖POINT LOAD $I_{s(50)}$ (MPa) 3 6 9 12
◆ISRM WEATHERING (GRADE 1-6) 1 2 3 4 5 6
◆ROCK STRENGTH (R0-R6) R1 R2 R3 R4 R5 R6
▲SPT "N" ▼LPT (BLOWS/300 mm) 10 20 30 40
PLASTIC MC LIQUID 20 40 60 80

DEPTH (m)	CORE RUN	ROCK & SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	RECOVERY (%)	RQD (%)	ADDITIONAL INFORMATION	BACKFILL	ELEVATION (m)
	C37				20	0	**C37**: **REC**:0.3/1.50 m**RQD**:0/1.50 m		1295
61		...from 61.3 to 61.6 m, rubble							1294
	C38				100	71	**C38**: **REC**:1.4/1.40 m**RQD**:1/1.40 m		
62		...from 62.2 to 62.3 m, clay (competent rock above and below)							1293
63		63.0m **END OF BOREHOLE AT 63.0 m** Borehole open to 63.0 m upon completion Water level at 44.9 m upon completion 4.5" ID PVC installed from surface to 9.1 m with 1.25 m stick-up Annulus around PVC backfilled with bentonite chips from surface to 9.1 m. A square steel casing protector 155mm wide was installed around the PVC stick-up					Could hear water trickling. Water level probe beeped on and off most of the hole, unable to determine water level	▽	1292
64									1291
65									1290
66									1289
67									1288
68									1287
69									1286

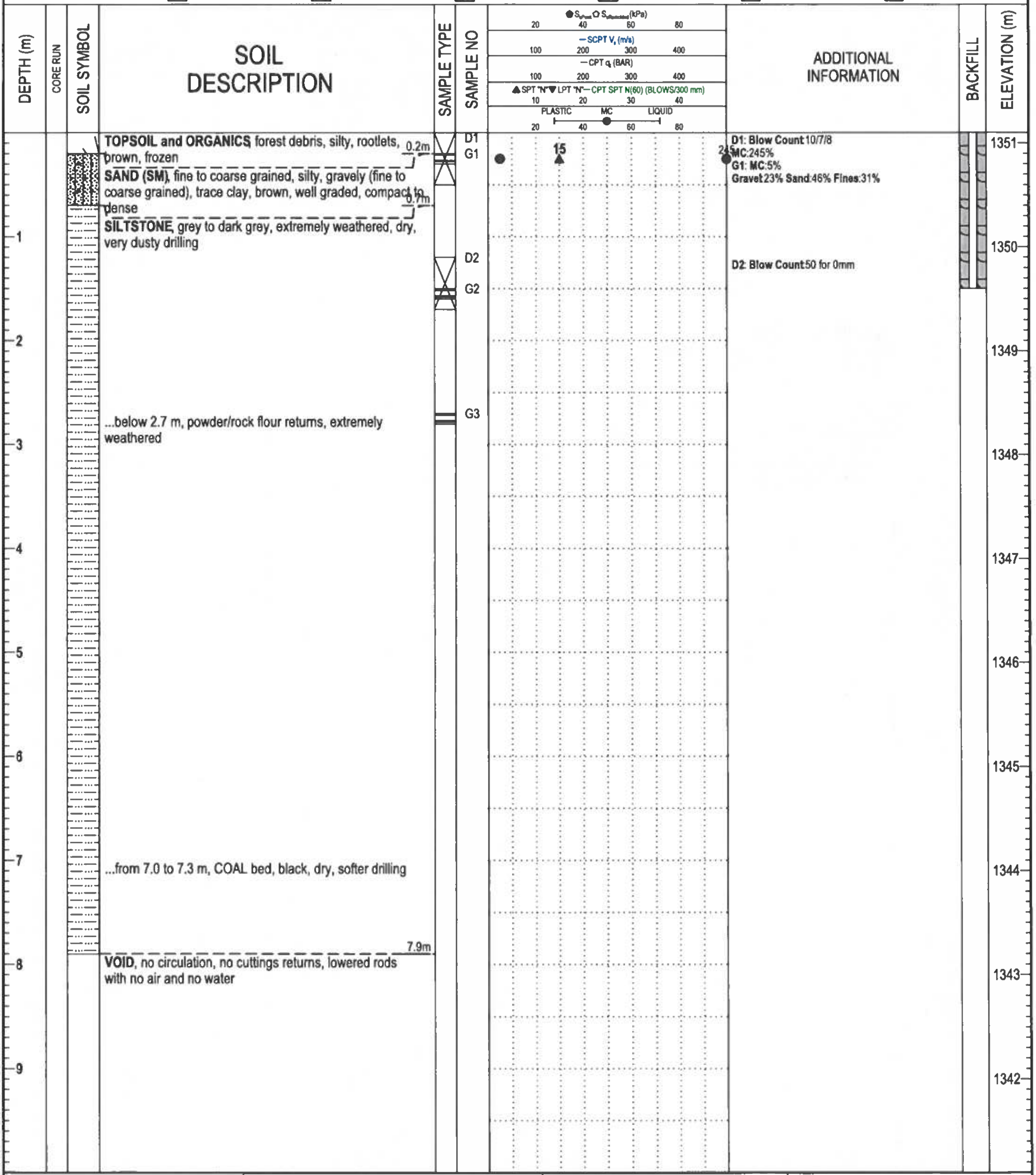
ROCK LOG CG09140 BOREHOLES.GPJ 5/7/21

wood.	LOGGED BY: BW	COMPLETION DEPTH: 63.0 m
Environment & Infrastructure Solutions **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	ENTERED BY: JR	COMPLETION DATE: 4/6/2021
	REVIEWED BY: MP	Page 7 of 7

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-07-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659077 EASTING: -93510.21	ELEVATION: 1351.1 m

SAMPLE TYPE ■ TUBE ◩ NO RECOVERY ☒ SPT ☰ GRAB ⬚ LPT ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ▨ BENTONITE PELLETS ▨ GROUT ▮ PIEZOMETER HEAD ⬚ SAND



TOPSOIL and ORGANICS, forest debris, silty, rootlets, brown, frozen — 0.2m

SAND (SM), fine to coarse grained, silty, gravely (fine to coarse grained), trace clay, brown, well graded, compact to dense — 0.7m

SILTSTONE, grey to dark grey, extremely weathered, dry, very dusty drilling

...below 2.7 m, powder/rock flour returns, extremely weathered

...from 7.0 to 7.3 m, COAL bed, black, dry, softer drilling — 7.9m

VOID, no circulation, no cuttings returns, lowered rods with no air and no water

D1: Blow Count 10/7/8
MC:245%
G1: MC:5%
Gravel:23% **Sand:**46% **Fines:**31%

D2: Blow Count 50 for 0mm

Environment & Infrastructure Solutions
401 - 1925 18th Avenue NE
Calgary, AB T2E 7T8

LOGGED BY: BW	COMPLETION DEPTH: 11.9 m
ENTERED BY: JR	COMPLETION DATE: 4/2/2021
REVIEWED BY: MP	

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-07-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659077 EASTING: -93510.21	ELEVATION: 1351.1 m

SAMPLE TYPE ■ TUBE ◸ NO RECOVERY ☒ SPT ☰ GRAB ⁝ LPT ▯ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ⧗ BENTONITE PELLETS ⁙ GROUT ▮ PIEZOMETER HEAD ⁝ SAND

DEPTH (m)	CORE RUN	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	● S_{uPeak} ○ $S_{uRemolded}$ (kPa) 20 40 60 80 — SCPT V_s (m/s) 100 200 300 400 — CPT q_t (BAR) 100 200 300 400 ▲SPT "N" ▼ LPT "N" — CPT SPT N(60) (BLOWS/300 mm) 10 20 30 40 PLASTIC MC LIQUID 20 40 60 80	ADDITIONAL INFORMATION	BACKFILL	ELEVATION (m)
									1341
			10.4m **BEDROCK**, competent material, hard drilling, no circulation, no cuttings returns, hammer engaging						
11									1340
			11.9m						
12			**END OF BOREHOLE AT 11.9 m** Borehole open to 11.9 m upon completion Borehole dry upon completion 4.5" ID PVC installed from surface to 1.5 m with 1.35 m stick-up Annulus around PVC backfilled with bentonite chips from surface to 1.5 m. A square steel casing protector 155mm wide was installed around the PVC stick-up						1339
13									1338
14									1337
15									1336
16									1335
17									1334
18									1333
19									1332

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW	COMPLETION DEPTH: 11.9 m
		ENTERED BY: JR	COMPLETION DATE: 4/2/2021
		REVIEWED BY: MP	Page 2 of 2

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G1-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659157.49 EASTING: -93701.84	ELEVATION: 1348.0 m

SAMPLE TYPE ■ TUBE ◻ NO RECOVERY ☒ SPT ☰ GRAB ⬚ LPT ▯ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ⬚ GROUT ▮ PIEZOMETER HEAD ⬚ SAND

DEPTH (m) | CORE RUN | SOIL SYMBOL | SOIL DESCRIPTION | SAMPLE TYPE | SAMPLE NO | ADDITIONAL INFORMATION | BACKFILL | ELEVATION (m)

TOPSOIL and ORGANICS, forest debris, abundant rootlets, dark brown, frozen — 0.3m

SILT and CLAY (ML-CL) sandy (fine to coarse grained), gravelly (fine grained), brown, dense (possibly frozen), well graded, possible boulders, dry — 1.9m

CLAY TILL (CL), silty, sandy, fine grained, some gravel (fine to coarse grained), very stiff, low plastic, dark grey to black, possible coal inclusions, moist

...at 3.5 m, seepage observed, locally strong H2S odour, abundant coal debris — 4.1m

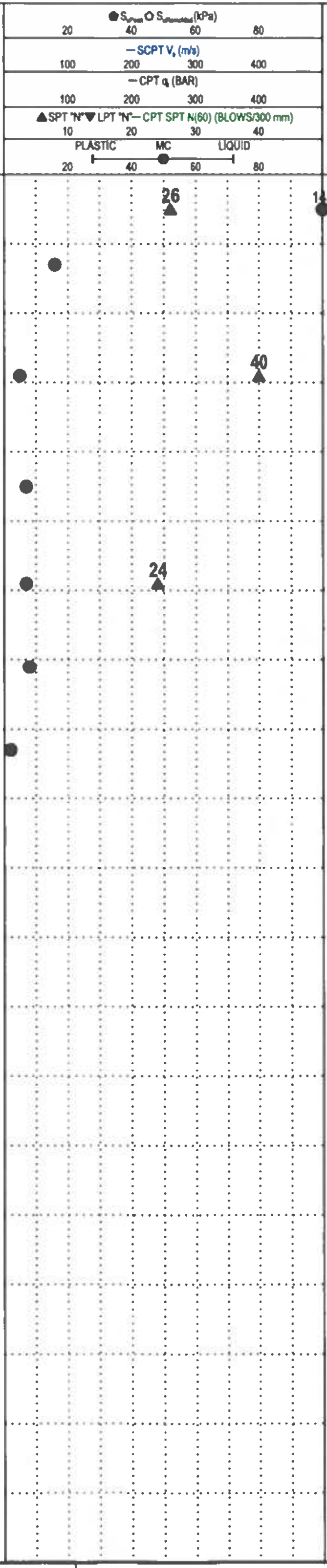
SILTSTONE, dark grey, mm sized angular fragments/rock flour, dry, dusty drilling — 6.1m

COAL, black, some interbedded mudstone, dry — 7.3m

SILTSTONE, dark grey, mm sized angular fragments/rock flour, dry, dusty drilling

...below 7.6 m, weathered, brown to grey cuttings, dry

...from 8.2 to 8.5 m, COAL bed



Sample No	Additional Information
D1	D1: Blow Count 2/1/25 MC:145%
G1	G1: MC:16% Gravel:25% Sand:22% Fines:53%
D2	D2: Blow Count 11/18/22 MC:5%
G2	G2: MC:7% ...G2 at 2.2 m, Sulphate = 0.056 % SQ
D3	D3: Blow Count 6/12/12 MC:7%
G3	G3: MC:8%
G4	G4: MC:2%
D4	D4: Blow Count 50 for 0mm REC:0/0.50 m

Depth (m)	Elevation (m)
1	1347
2	1346
3	1345
4	1344
5	1343
6	1342
7	1341
8	1340
9	1339

SOIL LOG CG09140 BOREHOLES.GPJ 5/7/21

wood.

Environment & Infrastructure Solutions
401 - 1925 18th Avenue NE
Calgary, AB T2E 7T8

LOGGED BY: BW	COMPLETION DEPTH: 50.3 m
ENTERED BY: JR	COMPLETION DATE: 3/31/2021
REVIEWED BY: MP	Page 1 of 6

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G1-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659157.49 EASTING: -93701.84	ELEVATION: 1348.0 m

SAMPLE TYPE ■ TUBE ◪ NO RECOVERY ☒ SPT ☰ GRAB ⬚ LPT ▯ CORE

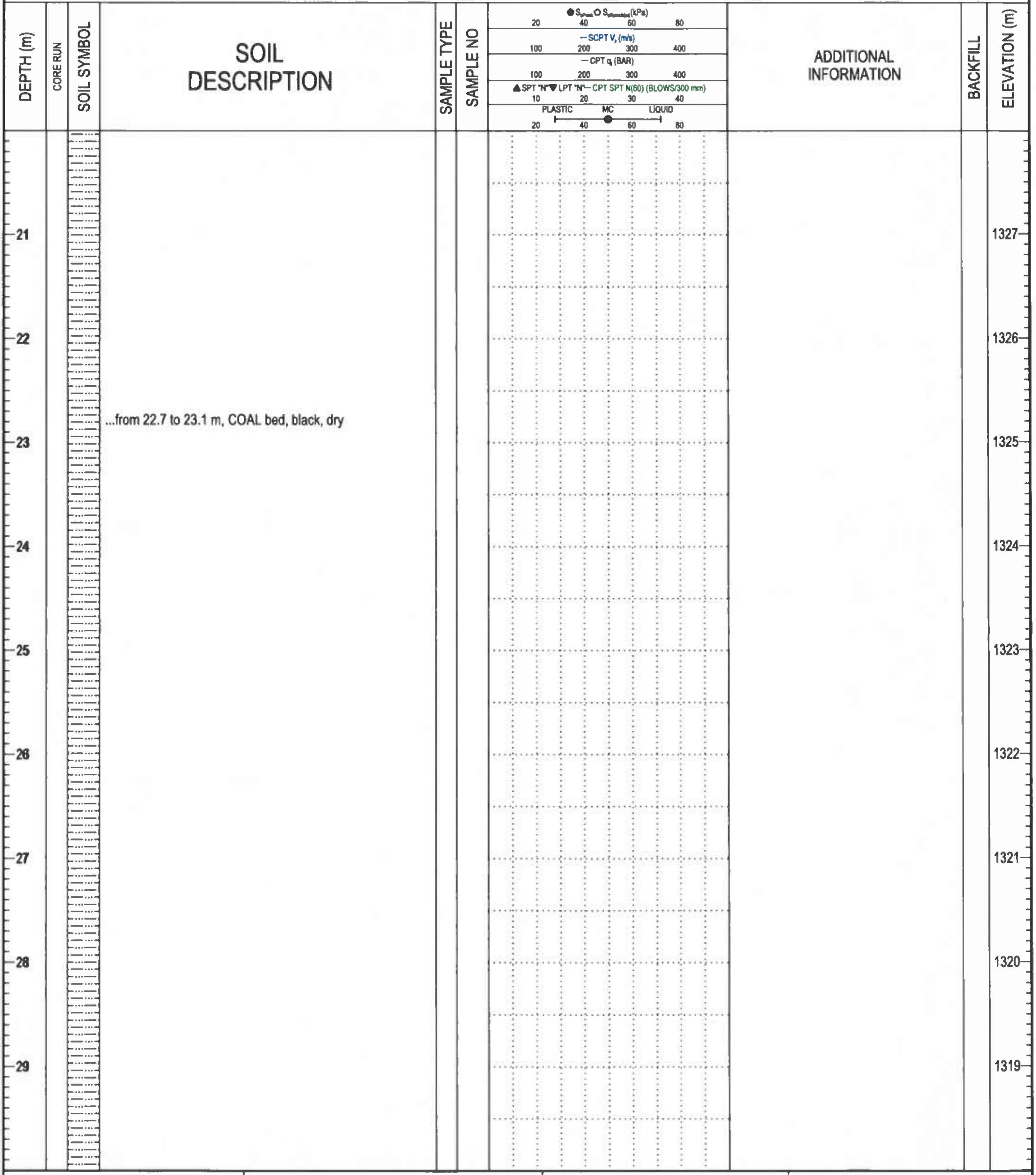
BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ▨ GROUT ▮ PIEZOMETER HEAD ⬚ SAND

DEPTH (m)	CORE RUN	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	● $S_{u(Peak)}$ ○ $S_{u(Remoulded)}$ (kPa) 20 40 60 80 — SCPT V_s (m/s) 100 200 300 400 — CPT q_c (BAR) 100 200 300 400 ▲SPT "N" ▼ LPT "N" — CPT SPT N(60) (BLOWS/300 mm) 10 20 30 40 PLASTIC MC LIQUID 20 40 60 80	ADDITIONAL INFORMATION	BACKFILL	ELEVATION (m)
			...below 10.4 m, extremely weathered, dark grey, possible seepage						
11									1337
12									1336
13									1335
			13.3m **COAL**, black, some interbedded mudstone, dry						
14									1334
			14.6m **SILTSTONE**, dark grey, mm sized angular fragments/rock flour, dry, dusty drilling						
15									1333
16									1332
17									1331
18									1330
19									1329

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW	COMPLETION DEPTH: 50.3 m
		ENTERED BY: JR	COMPLETION DATE: 3/31/2021
		REVIEWED BY: MP	Page 2 of 6

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G1-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659157.49 EASTING: -93701.84	ELEVATION: 1348.0 m

SAMPLE TYPE	■ TUBE	◩ NO RECOVERY	☒ SPT	☰ GRAB	⬚ LPT	▥ CORE
BACKFILL TYPE	▨ BENTONITE	▧ BENTONITE CHIPS	▩ BENTONITE PELLETS	⛶ GROUT	▮ PIEZOMETER HEAD	⬚ SAND



...from 22.7 to 23.1 m, COAL bed, black, dry

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW ENTERED BY: JR REVIEWED BY: MP	COMPLETION DEPTH: 50.3 m COMPLETION DATE: 3/31/2021 Page 3 of 6

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G1-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659157.49 EASTING: -93701.84	ELEVATION: 1348.0 m

SAMPLE TYPE ■ TUBE ◿ NO RECOVERY ☒ SPT ☰ GRAB ⁙ LPT ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ⁙ GROUT ▮ PIEZOMETER HEAD ⁙ SAND

DEPTH (m)	CORE RUN	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	● S_u(Peak) ○ S_u(Remolded) (kPa) 20 40 60 80 — SCPT V_s (m/s) 100 200 300 400 — CPT q_t (BAR) 100 200 300 400 ▲SPT "N" ▼ LPT "N" — CPT SPT N(60) (BLOWS/300 mm) 10 20 30 40 PLASTIC MC LIQUID 20 40 60 80	ADDITIONAL INFORMATION	BACKFILL	ELEVATION (m)
31									1317
32			...below 31.8 m, some larger fragments (up to 10mm), wet, possibly fractured						1316
33									1315
34			...below 34.4 m, interbedded coal seams, easy drilling						1314
35									1313
36							Water level probe beeped on and off most of the hole, water depth is approximate		1312 ∇
37									1311
38									1310
39									1309

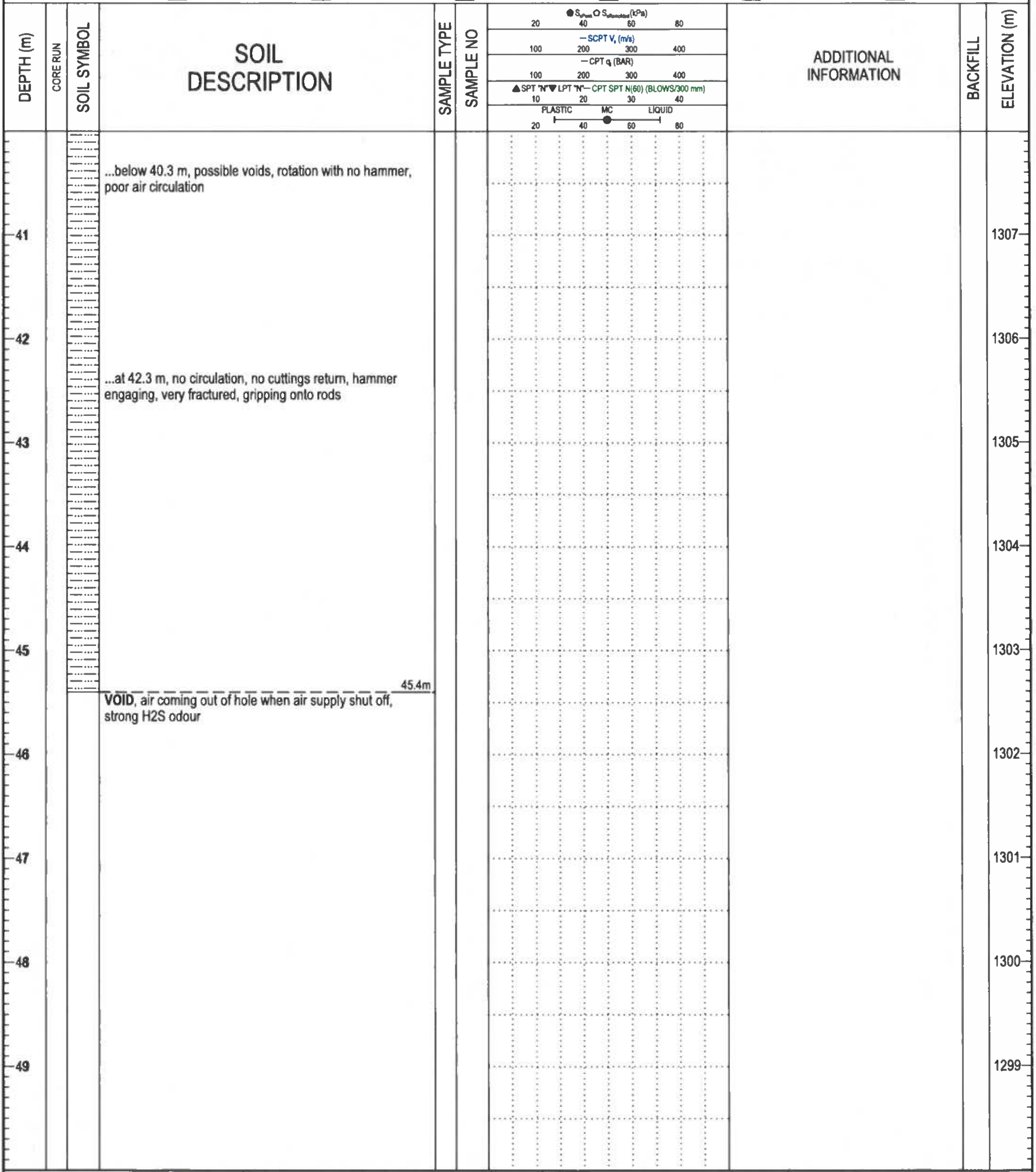
wood.

Environment & Infrastructure Solutions
401 - 1925 18th Avenue NE
Calgary, AB T2E 7T8

LOGGED BY: BW	COMPLETION DEPTH: 50.3 m
ENTERED BY: JR	COMPLETION DATE: 3/31/2021
REVIEWED BY: MP	

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G1-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659157.49 EASTING: -93701.84	ELEVATION: 1348.0 m

SAMPLE TYPE	■ TUBE	◿ NO RECOVERY	☒ SPT	☰ GRAB	⁙ LPT	◫ CORE
BACKFILL TYPE	▨ BENTONITE	▨ BENTONITE CHIPS	⊠ BENTONITE PELLETS	⁘ GROUT	▮ PIEZOMETER HEAD	⁘ SAND



...below 40.3 m, possible voids, rotation with no hammer, poor air circulation

...at 42.3 m, no circulation, no cuttings return, hammer engaging, very fractured, gripping onto rods

45.4m

VOID, air coming out of hole when air supply shut off, strong H2S odour

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW ENTERED BY: JR REVIEWED BY: MP	COMPLETION DEPTH: 50.3 m COMPLETION DATE: 3/31/2021 Page 5 of 6

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G1-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659157.49 EASTING: -93701.84	ELEVATION: 1348.0 m

SAMPLE TYPE	■ TUBE	◺ NO RECOVERY	☒ SPT	☰ GRAB	⁘ LPT	▯ CORE
BACKFILL TYPE	▨ BENTONITE	◪ BENTONITE CHIPS	⧗ BENTONITE PELLETS	⁛ GROUT	▮ PIEZOMETER HEAD	⁘ SAND

DEPTH (m)	CORE RUN	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	● $S_{u\,Peak}$ ○ $S_{u\,Remolded}$ (kPa) 20 40 60 80 — SCPT V_s (m/s) 100 200 300 400 — CPT q_t (BAR) 100 200 300 400 ▲ SPT "N" ▼ LPT "N" — CPT SPT N(60) (BLOWS/300 mm) 10 20 30 40 PLASTIC MC LIQUID 20 40 60 80	ADDITIONAL INFORMATION	BACKFILL	ELEVATION (m)
			...from 50.1 to 50.3 m, hard drilling, no cuttings returns 50.1m 50.3m **END OF BOREHOLE AT 50.3 m** Borehole open to 49.6 m upon completion Borehole dry upon completion 4.5" ID PVC installed from surface to 4.6 m with 1.3 m stick-up Annulus around PVC backfilled with bentonite chips from surface to 4.6 m. A square steel casing protector 155mm wide was installed around the PVC stick-up						
51									1297
52									1296
53									1295
54									1294
55									1293
56									1292
57									1291
58									1290
59									1289

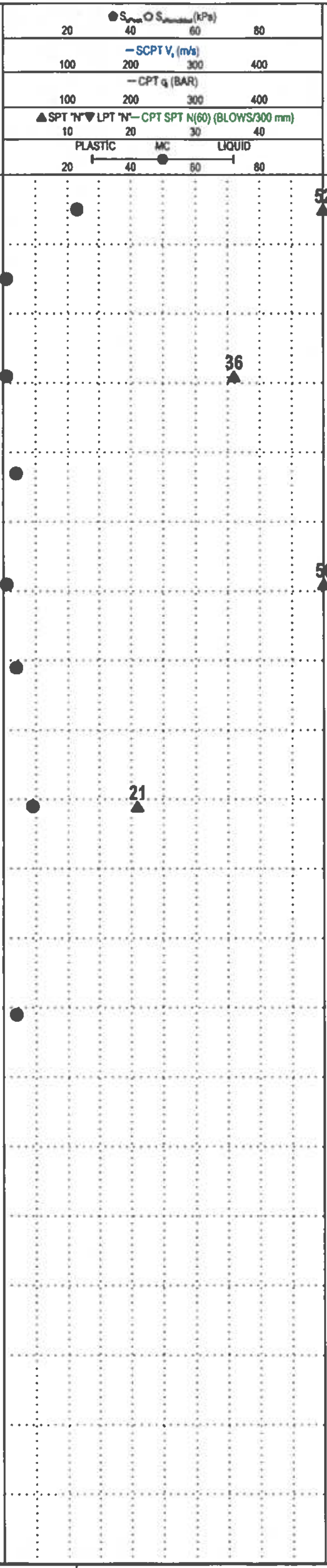
Environment & Infrastructure Solutions **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW	COMPLETION DEPTH: 50.3 m
	ENTERED BY: JR	COMPLETION DATE: 3/31/2021
	REVIEWED BY: MP	Page 6 of 6

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G2-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659033.31 EASTING: -93603.95	ELEVATION: 1351.6 m

SAMPLE TYPE ■ TUBE ⊘ NO RECOVERY ☒ SPT ☰ GRAB ⁚ LPT ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ⁘ GROUT ▮ PIEZOMETER HEAD ⁘ SAND

DEPTH (m)	SOIL DESCRIPTION	SAMPLE NO	ADDITIONAL INFORMATION
0	**TOPSOIL and ORGANICS**, forest debris, abundant rootlets, brown, dry	D1	D1: Blow Count6/19/33 MC:23%
0.2m	**SAND and GRAVEL (SM-GM)** fine to coarse grained, silty, brown, dense, well graded, possible cobbles, dry	G1	G1: MC:1%
		D2	D2: Blow Count2/12/24 MC:1%
2	...below 2.0 m, increased fine to coarse grained sand composition, some silt, moist	G2	G2: MC:4% Gravel35% Sand:51% Fines:14%
		D3	D3: Blow Count6/19/37 MC:1%
3.5	...below 3.5 m, moist to wet/seepage	G3	G3: MC:4% ...G3 at 3.5 m, Sulphate = 0.005 % SQ
4.3	...below 4.3 m, some to abundant silt pockets, dark grey, saturated/freewater	D4	D4: Blow Count4/7/14 MC:9%
5.2m	**SILTSTONE**, grey, mm sized angular fragments, dry, harder drilling	D5	D5: Blow Count50 for 0mm
		G4	G4: MC:4%
7.9	...from 7.9 to 8.0 m, COAL bed, black, dry		



DEPTH (m): 1 2 3 4 5 6 7 8 9

ELEVATION (m): 1351 1350 1349 1348 1347 1346 1345 1344 1343 1342

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW ENTERED BY: JR REVIEWED BY: MP
		COMPLETION DEPTH: 48.5 m COMPLETION DATE: 4/2/2021 Page 1 of 5

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G2-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659033.31 EASTING: -93603.95	ELEVATION: 1351.6 m

SAMPLE TYPE ■ TUBE ▨ NO RECOVERY ☒ SPT ☰ GRAB ⁚ LPT ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ▨ BENTONITE PELLETS ▨ GROUT ▮ PIEZOMETER HEAD ⁚ SAND

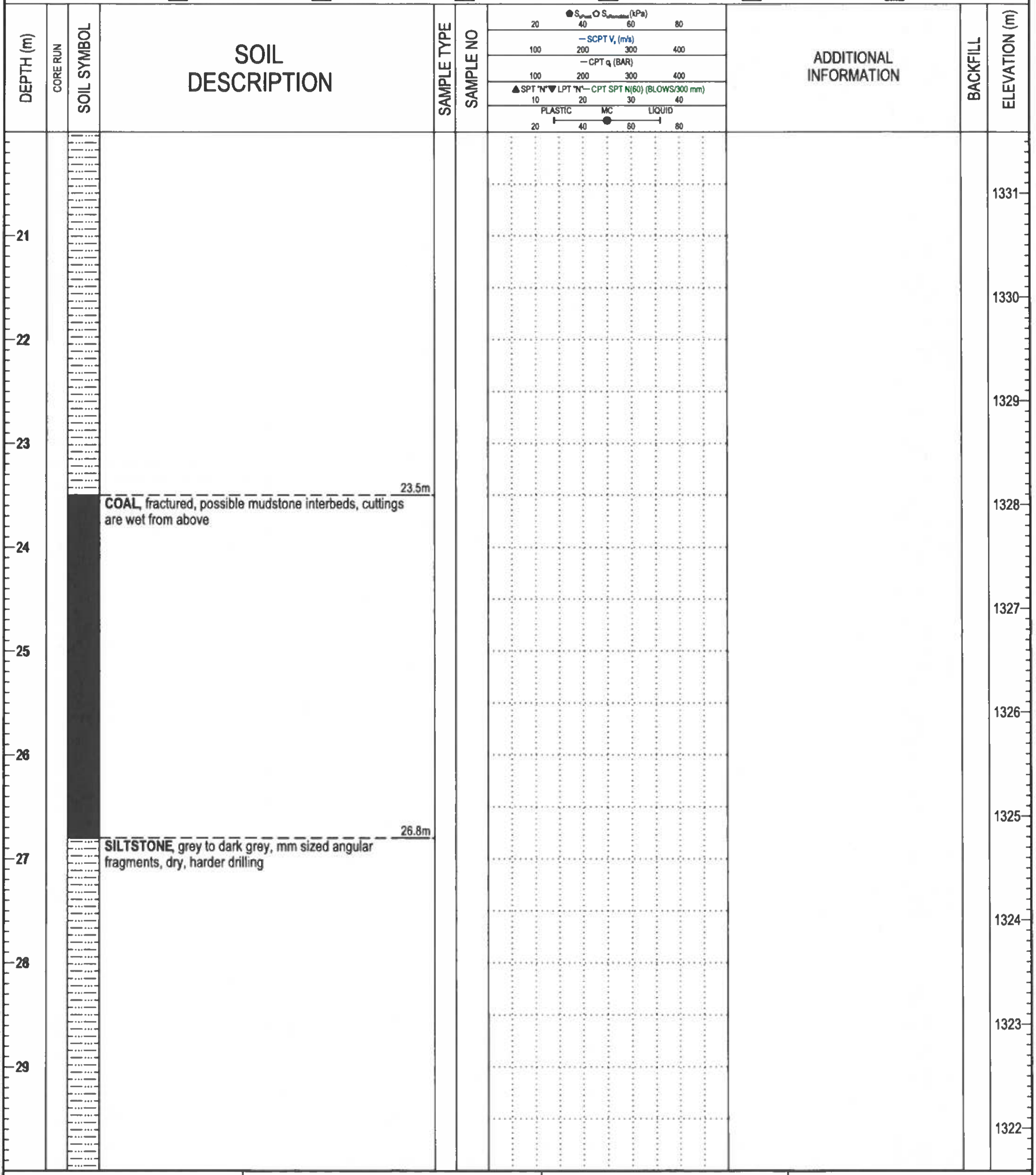
DEPTH (m)	CORE RUN	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	● SPeak ○ S Remoulded (kPa) 20 40 60 80 — SCPT Vs (m/s) 100 200 300 400 — CPT q (BAR) 100 200 300 400 ▲ SPT "N" ▼ LPT "N" — CPT SPT N(60) (BLOWS/300 mm) 10 20 30 40 PLASTIC MC LIQUID 20 40 60 80	ADDITIONAL INFORMATION	BACKFILL	ELEVATION (m)
									1341
11									1340
12									1339
13									1338
14			...below 14.3 m, weathered, grey to dark grey						1337
15									1336
16									1335
17									1334
18									1333
19									1332

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW	COMPLETION DEPTH: 48.5 m
		ENTERED BY: JR	COMPLETION DATE: 4/2/2021
		REVIEWED BY: MP	Page 2 of 5

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G2-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659033.31 EASTING: -93603.95	ELEVATION: 1351.6 m

SAMPLE TYPE ■ TUBE ▨ NO RECOVERY ☒ SPT ▤ GRAB ⬚ LPT ▮ CORE

BACKFILL TYPE ▩ BENTONITE ▨ BENTONITE CHIPS ▩ BENTONITE PELLETS ▩ GROUT ▮ PIEZOMETER HEAD ⬚ SAND



23.5m
COAL, fractured, possible mudstone interbeds, cuttings are wet from above

26.8m
SILTSTONE, grey to dark grey, mm sized angular fragments, dry, harder drilling

wood.

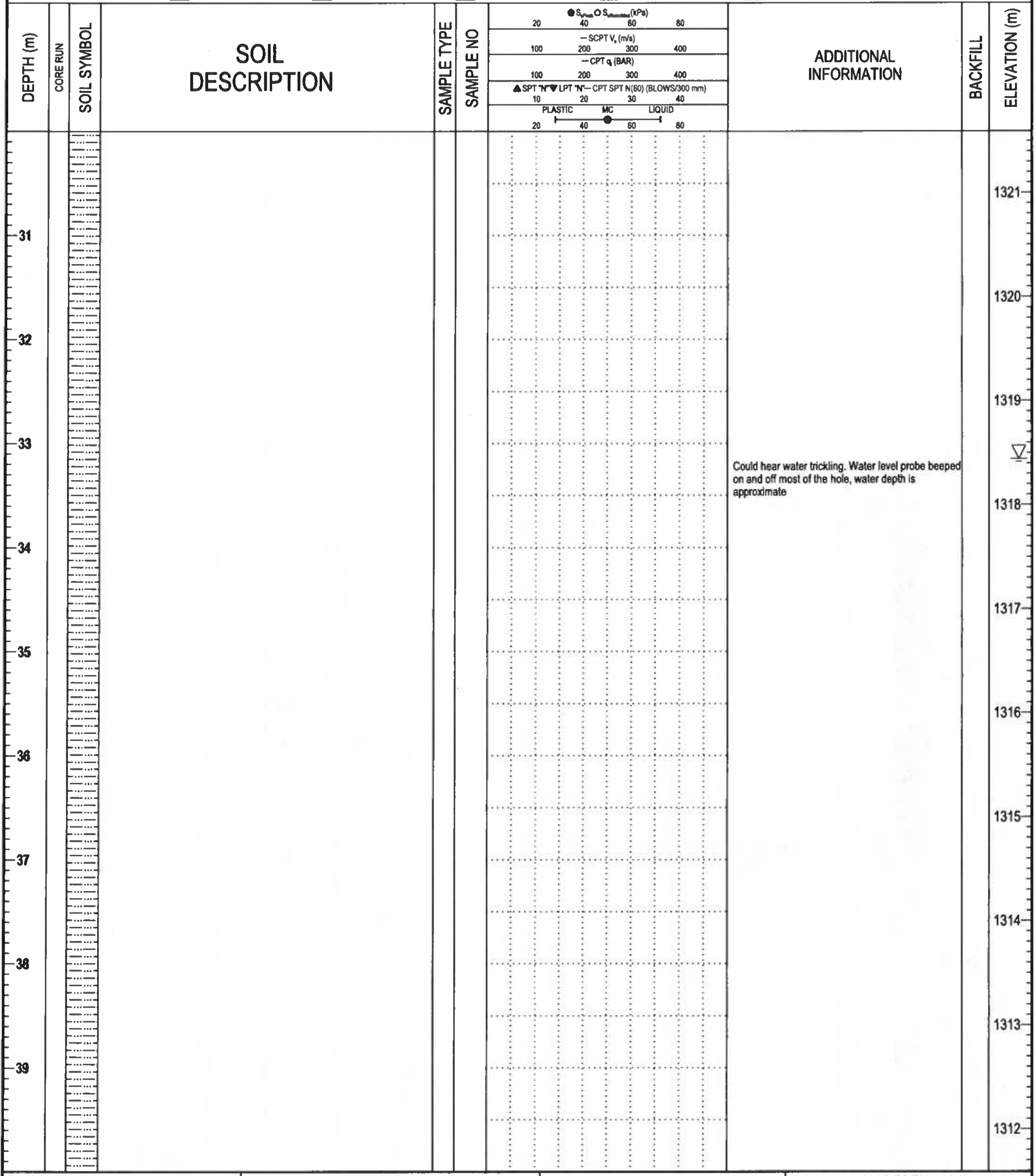
Environment & Infrastructure Solutions
401 - 1925 18th Avenue NE
Calgary, AB T2E 7T8

LOGGED BY: BW	COMPLETION DEPTH: 48.5 m
ENTERED BY: JR	COMPLETION DATE: 4/2/2021
REVIEWED BY: MP	

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G2-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659033.31 EASTING: -93603.95	ELEVATION: 1351.6 m

SAMPLE TYPE ■ TUBE ◸ NO RECOVERY ☒ SPT ▤ GRAB ⁚ LPT ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ⁘ GROUT ▮ PIEZOMETER HEAD ⁚ SAND



Could hear water trickling. Water level probe beeped on and off most of the hole, water depth is approximate

wood.

Environment & Infrastructure Solutions
401 - 1925 18th Avenue NE
Calgary, AB T2E 7T8

LOGGED BY: BW	COMPLETION DEPTH: 48.5 m
ENTERED BY: JR	COMPLETION DATE: 4/2/2021
REVIEWED BY: MP	Page 4 of 5

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G2-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5659033.31 EASTING: -93603.95	ELEVATION: 1351.6 m

SAMPLE TYPE ■ TUBE ◪ NO RECOVERY ☒ SPT ☰ GRAB ⬚ LPT ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ⬚ GROUT ▮ PIEZOMETER HEAD ⬚ SAND

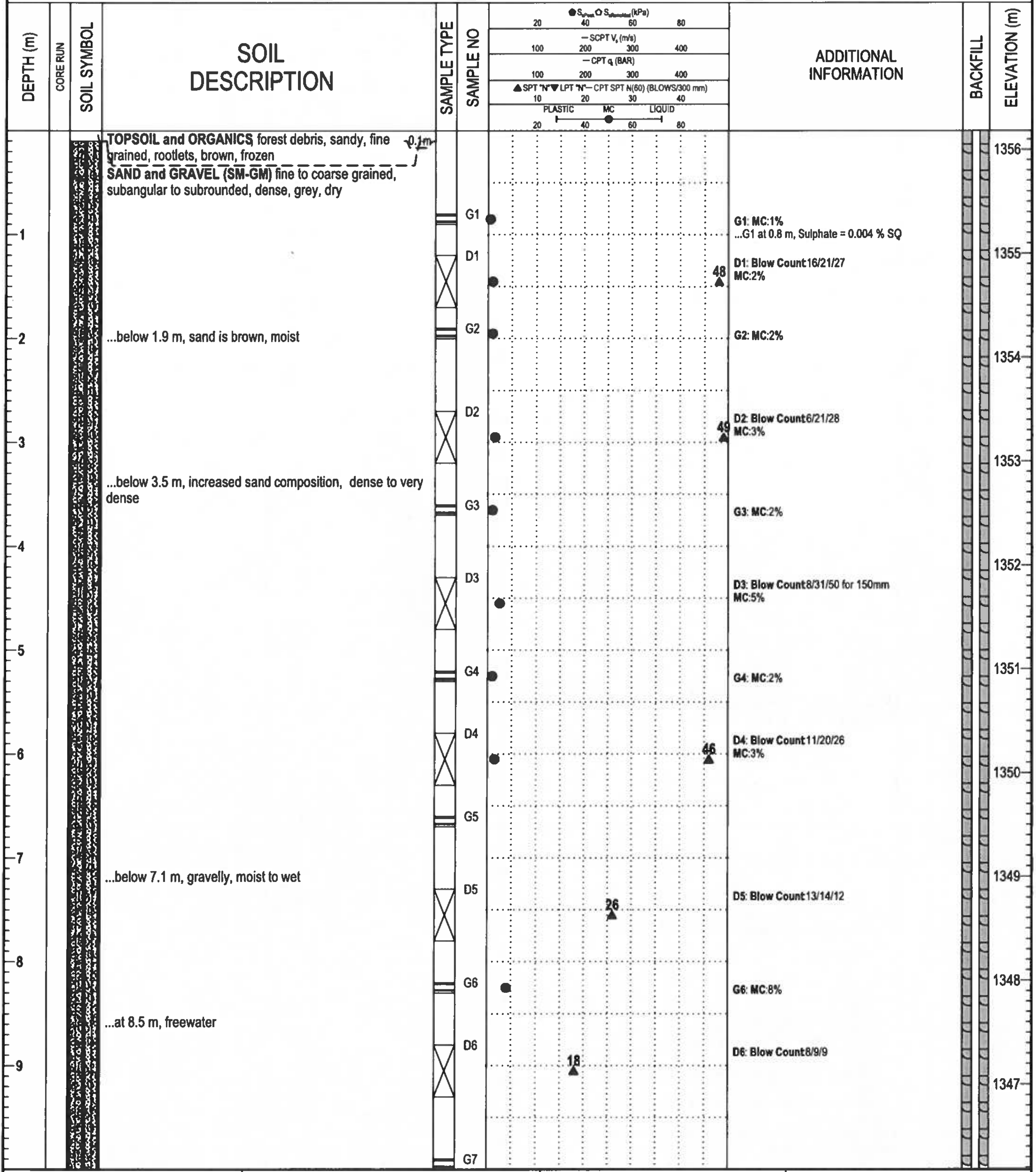
DEPTH (m)	CORE RUN	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	● S_u(Peak) ○ S_u(Remoulded) (kPa) 20 40 60 80 — SCPT V_s (m/s) 100 200 300 400 — CPT q (BAR) 100 200 300 400 ▲ SPT "N" ▼ LPT "N" — CPT SPT N(60) (BLOWS/300 mm) 10 20 30 40 PLASTIC MC LIQUID 20 40 60 80	ADDITIONAL INFORMATION	BACKFILL	ELEVATION (m)
									1311
41									1310
42									1309
43									1308
44									1307
45			45.4m						
			VOID, lowered rods with air supply turned off, total loss of circulation, strong H2S odour						1306
46									1305
47			47.6m						1304
			...at 47.6 m, hard competent drilling						
48			48.5m						1303
			END OF BOREHOLE AT 48.5 m Borehole open to 48.4 m upon completion 4.5" ID PVC installed from surface to 6.0 m with 1.35 m stick-up Annulus around PVC backfilled with bentonite chips from surface to 6.0 m. A square steel casing protector 155mm wide was installed around the PVC stick-up						
49									1302

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW ENTERED BY: JR REVIEWED BY: MP	COMPLETION DEPTH: 48.5 m COMPLETION DATE: 4/2/2021

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G4-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5658898.16 EASTING: -93497.94	ELEVATION: 1356.2 m

SAMPLE TYPE ■ TUBE ▨ NO RECOVERY ☒ SPT ☰ GRAB ⁝ LPT ▮ CORE

BACKFILL TYPE ▩ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ⁘ GROUT ▮ PIEZOMETER HEAD ⁘ SAND



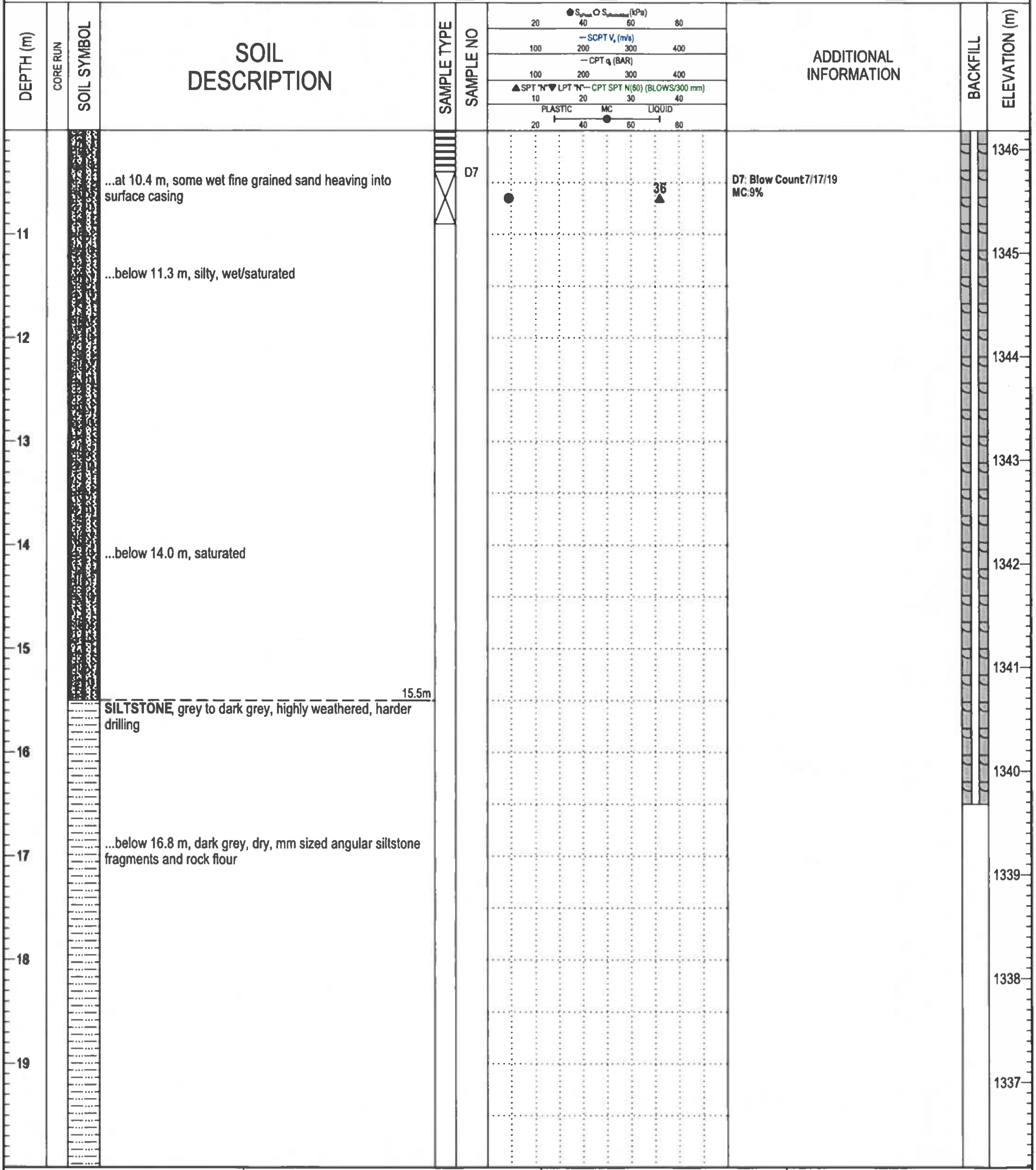
SOIL DESCRIPTION	SAMPLE NO	ADDITIONAL INFORMATION
TOPSOIL and ORGANICS forest debris, sandy, fine grained, rootlets, brown, frozen		
SAND and GRAVEL (SM-GM) fine to coarse grained, subangular to subrounded, dense, grey, dry		
	G1	**G1: MC:1%** ...G1 at 0.8 m, Sulphate = 0.004 % SQ
	D1	**D1: Blow Count 16/21/27** **MC:2%**
...below 1.9 m, sand is brown, moist	G2	**G2: MC:2%**
	D2	**D2: Blow Count 6/21/28** **MC:3%**
...below 3.5 m, increased sand composition, dense to very dense	G3	**G3: MC:2%**
	D3	**D3: Blow Count 8/31/50** for 150mm **MC:5%**
	G4	**G4: MC:2%**
	D4	**D4: Blow Count 11/20/26** **MC:3%**
	G5	
...below 7.1 m, gravelly, moist to wet	D5	**D5: Blow Count 13/14/12**
	G6	**G6: MC:8%**
...at 8.5 m, freewater	D6	**D6: Blow Count 8/9/9**
	G7	

Environment & Infrastructure Solutions **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW	COMPLETION DEPTH: 38.4 m
	ENTERED BY: JR	COMPLETION DATE: 3/22/2021
	REVIEWED BY: MP	Page 1 of 4

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G4-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5658898.16 EASTING: -93497.94	ELEVATION: 1356.2 m

SAMPLE TYPE ■ TUBE ◪ NO RECOVERY ☒ SPT ☰ GRAB ⬚ LPT ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ▨ GROUT ▮ PIEZOMETER HEAD ⬚ SAND



...at 10.4 m, some wet fine grained sand heaving into surface casing

...below 11.3 m, silty, wet/saturated

...below 14.0 m, saturated

15.5m

SILTSTONE, grey to dark grey, highly weathered, harder drilling

...below 16.8 m, dark grey, dry, mm sized angular siltstone fragments and rock flour

D7: Blow Count7/17/19
MC:9%

SOIL LOG CG09140 BOREHOLES.GPJ 5/7/21

wood.

Environment & Infrastructure Solutions
401 - 1925 18th Avenue NE
Calgary, AB T2E 7T8

LOGGED BY: BW	COMPLETION DEPTH: 38.4 m
ENTERED BY: JR	COMPLETION DATE: 3/22/2021
REVIEWED BY: MP	

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G4-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5658898.16 EASTING: -93497.94	ELEVATION: 1356.2 m

SAMPLE TYPE ■ TUBE ◿ NO RECOVERY ☒ SPT ☰ GRAB ⬚ LPT ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ▨ GROUT ▮ PIEZOMETER HEAD ⬚ SAND

DEPTH (m)	CORE RUN	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	● $S_{u(peak)}$ ○ $S_{u(remolded)}$ (kPa) 20 40 60 80 — SCPT V_s (m/s) 100 200 300 400 — CPT q_t (BAR) 100 200 300 400 ▲ SPT "N" ▼ LPT "N" — CPT SPT N(60) (BLOWS/300 mm) 10 20 30 40 PLASTIC MC LIQUID 20 40 60 80	ADDITIONAL INFORMATION	BACKFILL	ELEVATION (m)
									1336
21									1335
22									1334
23									1333
24									1332
25									1331
26			...below 25.9 m, possibly fractured, easier drilling, moderate H2S odour, seepage						1330
27									1329
28									1328
29									1327
			...from 29.3 to 29.6 m, possible COAL bed, easy drilling						

wood.	**Environment & Infrastructure Solutions** **401 - 1925 18th Avenue NE** **Calgary, AB T2E 7T8**	LOGGED BY: BW ENTERED BY: JR REVIEWED BY: MP	COMPLETION DEPTH: 38.4 m COMPLETION DATE: 3/22/2021 Page 3 of 4

CLIENT: Three Sisters Mountain Village Properties Ltd.	PROJECT: Resort Village Phase 1 - Geotechnical	BOREHOLE NO: **BH21-RV-G4-4"**
DRILLER/DRILL: Geotech Drilling/Fraste DR 257	Canmore, AB	PROJECT NO: CG09140
METHOD: Odex/Air Rotary	NORTHING: 5658898.16 EASTING: -93497.94	ELEVATION: 1356.2 m

SAMPLE TYPE ■ TUBE ▨ NO RECOVERY ☒ SPT ☰ GRAB ⬚ LPT ◨ CORE

BACKFILL TYPE ▩ BENTONITE ▨ BENTONITE CHIPS ☒ BENTONITE PELLETS ⬚ GROUT ▮ PIEZOMETER HEAD ⬚ SAND

DEPTH (m)	CORE RUN	SOIL SYMBOL	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NO	● S_{uPeak} ○ $S_{uRemolded}$ (kPa) 20 40 60 80 — SCPT V_s (m/s) 100 200 300 400 — CPT q_t (BAR) 100 200 300 400 ▲ SPT "N" ▼ LPT "N" — CPT SPT N(60) (BLOWS/300 mm) 10 20 30 40 PLASTIC MC LIQUID 20 40 60 80	ADDITIONAL INFORMATION	BACKFILL	ELEVATION (m)
									1326
31			...from 30.8 to 31.1 m, COAL bed, black, easy drilling						1325
			31.7m						
32			**VOID**, lowered rods with air supply turned off, total loss of circulation, strong H2S odour						1324
33			...below 33.2 m, possible collapse material, hammer engaged intermittently, no circulation						1323 ▽
34									1322
35									1321
36									1320
37			...at 37.7 m, hammer engaged intermittently 37.8m						1319
38			...below 37.8 m, hard competent drilling, no circulation, no returns 38.4m						1318
39			**END OF BOREHOLE AT 38.4 m** Borehole open to 38.4 m upon completion Water level at 32.3 m upon completion 4.5" ID PVC installed from surface to 16.5 m with 1.3 m stick-up Annulus around PVC backfilled with bentonite chips from surface to 16.5 m. A square steel casing protector 155mm wide was installed around the PVC stick-up						1317

Run #1: 2.7 – 3.0 m
Rec: 67%
RQD: 33%

Run #2: 3.0 – 4.5 m
Rec: 93%
RQD: 60%

CLIENT:

THREE SISTERS mountain village

Stewart Creek Core Photos

BH22-RV-05

CG09140

February 2023

Run #3: 4.5 – 5.1 m
Rec: 58%
RQD: 50%

Run #4: 5.1 – 6.6 m
Rec: 100%
RQD: 50%

CLIENT:

THREE SISTERS mountain village

Stewart Creek Core Photos

BH21-RV-05

CG09140

February 2023

Run #5: 6.6 – 8.1 m
Rec: 100%
RQD: 93%

Run #6: 8.1 – 9.2 m
Rec: 91%
RQD: 45%

wood.

CLIENT:
THREE SISTERS mountainvillage

Stewart Creek Core Photos

BH21-RV-05

CG09140
February 2023

Run #7: 9.2 – 10.5 m
Rec: 92%
RQD: 54%

Run #8: 10.5 – 12.0 m
Rec: 100%
RQD: 93%

wood.

CLIENT:

THREE SISTERS mountain village

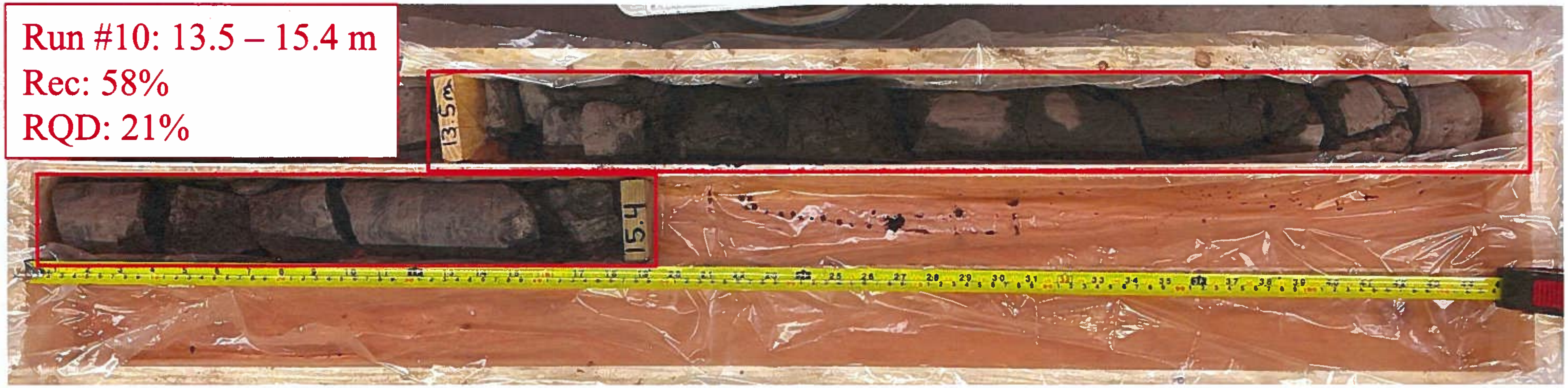
Stewart Creek Core Photos

BH21-RV-05

CG09140

February 2023


Run #9: 12.0 – 13.5 m
Rec: 100%
RQD: 73%


Run #10: 13.5 – 15.4 m
Rec: 58%
RQD: 21%

wood.	CLIENT: THREE SISTERS mountainvillage	Stewart Creek Core Photos	
		BH21-RV-05	CG09140 February 2023

Run #1: 7.3 – 7.6 m
Rec: 0%
RQD: 0%

No recovery therefore no image available.

Run #2: 7.6 – 9.1 m
Rec: 93%
RQD: 7%

wood.

CLIENT:

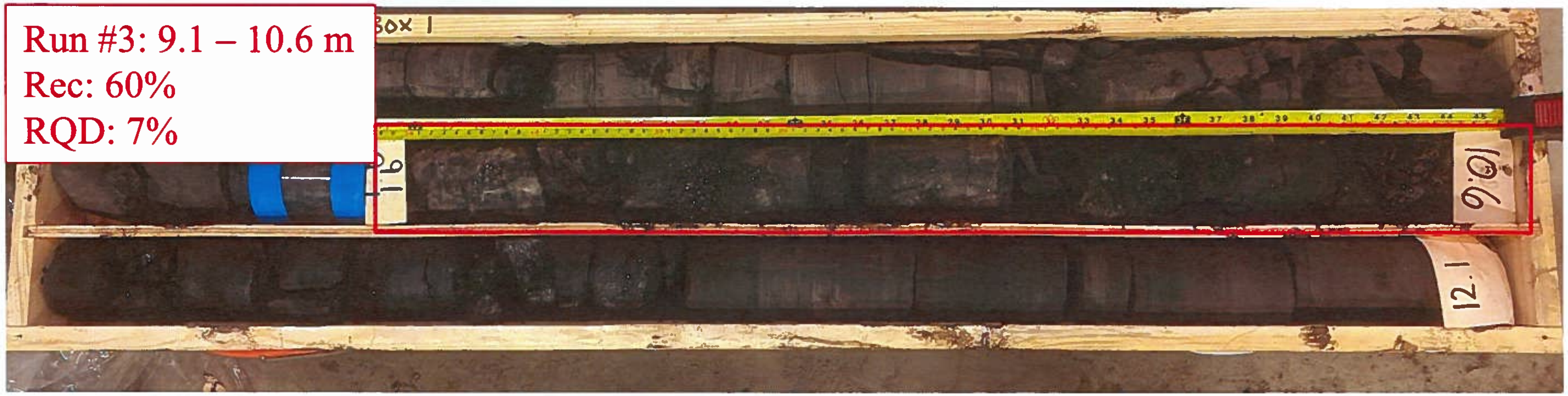
THREE SISTERS mountainvillage

Stewart Creek Core Photos

BH21-RV-06

CG09140

February 2023



Run #3: 9.1 – 10.6 m
Rec: 60%
RQD: 7%

Run #4: 10.6 – 12.1 m
Rec: 73%
RQD: 40%

wood.

CLIENT:
THREE SISTERS mountain village

Stewart Creek Core Photos

BH21-RV-06

CG09140

February 2023

Run #5: 12.1 – 13.6 m
Rec: 100%
RQD: 73%

Run #6: 13.6 – 15.1 m
Rec: 100%
RQD: 93%

wood.

CLIENT:
THREE SISTERS mountainvillage

Stewart Creek Core Photos

BH21-RV-06

CG09140

February 2023

Run #7: 15.1 – 16.6 m
Rec: 100%
RQD: 73%

Run #8: 16.6 – 18.1 m
Rec: 100%
RQD: 73%

wood.

CLIENT:

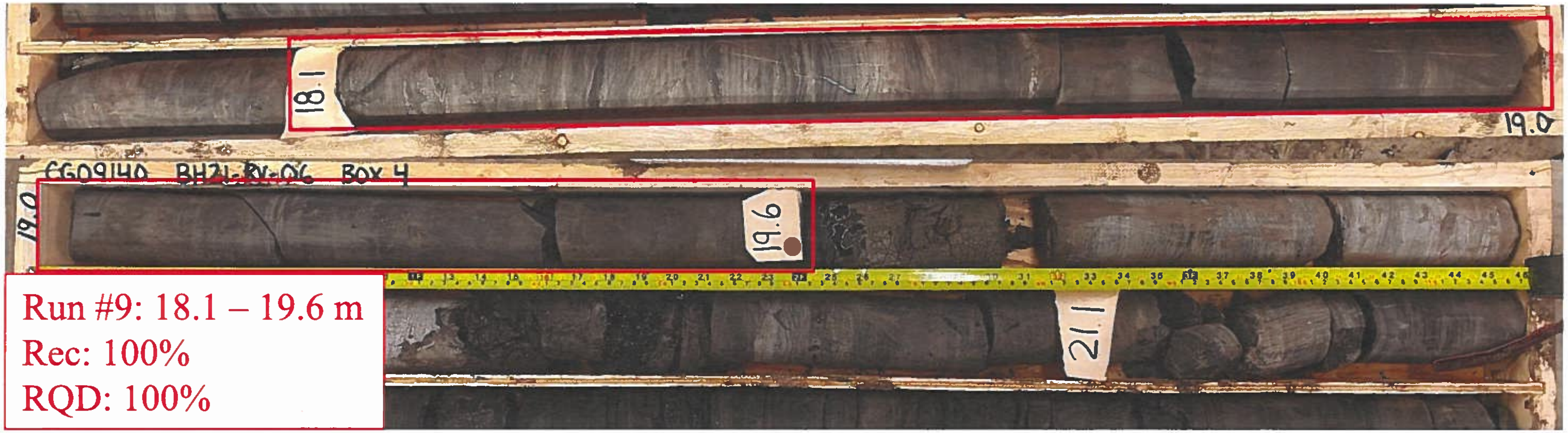
THREE SISTERS mountain village

Stewart Creek Core Photos

BH21-RV-06

CG09140

February 2023



Run #9: 18.1 – 19.6 m
Rec: 100%
RQD: 100%

Run #10: 19.6 – 21.1 m
Rec: 93%
RQD: 53%

wood.

CLIENT:
THREE SISTERS mountain village

Stewart Creek Core Photos

BH21-RV-06

CG09140
February 2023


Run #11: 21.1 – 22.6 m
Rec: 100%
RQD: 73%


Run #12: 22.6 – 24.1 m
Rec: 100%
RQD: 93%

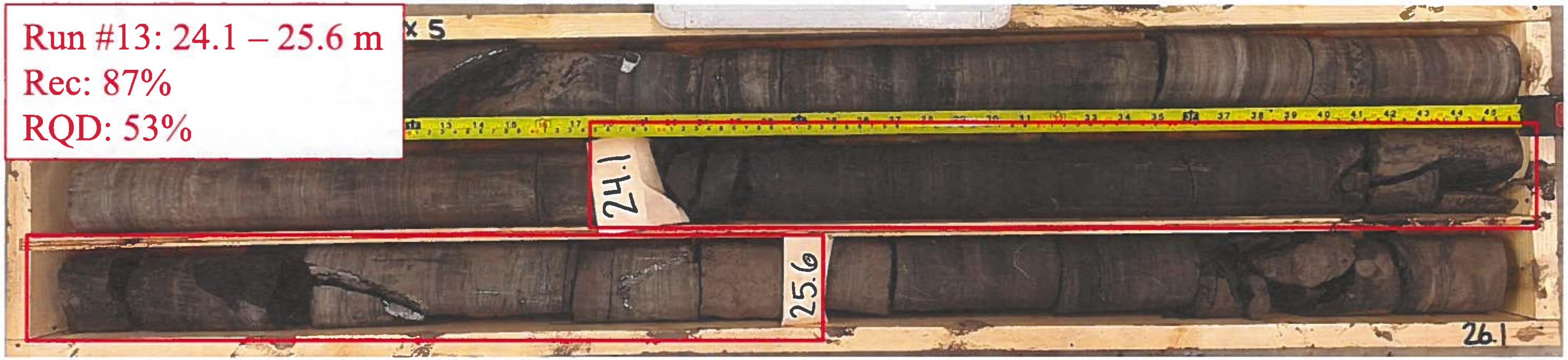
wood.

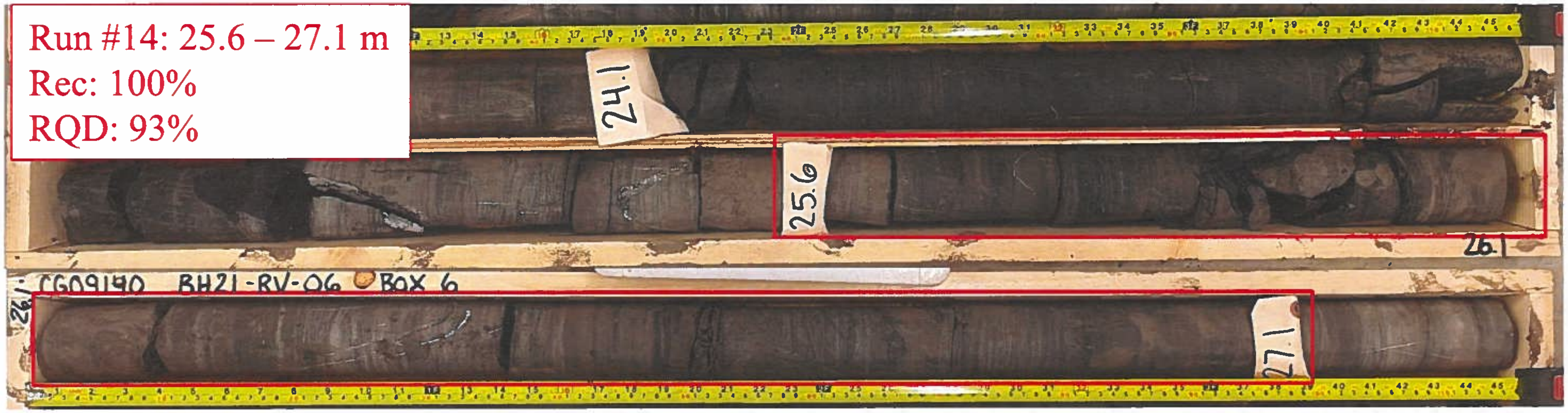
CLIENT:
THREE SISTERS
mountain village

Stewart Creek Core Photos

BH21-RV-06

CG09140
February 2023


Run #13: 24.1 – 25.6 m
Rec: 87%
RQD: 53%


Run #14: 25.6 – 27.1 m
Rec: 100%
RQD: 93%

wood.

CLIENT:
THREE SISTERS mountain village

Stewart Creek Core Photos

BH21-RV-06

CG09140

February 2023

Run #15: 27.1 – 28.6 m
Rec: 100%
RQD: 93%

Run #16: 28.6 – 30.1 m
Rec: 93%
RQD: 93%

wood.

CLIENT:
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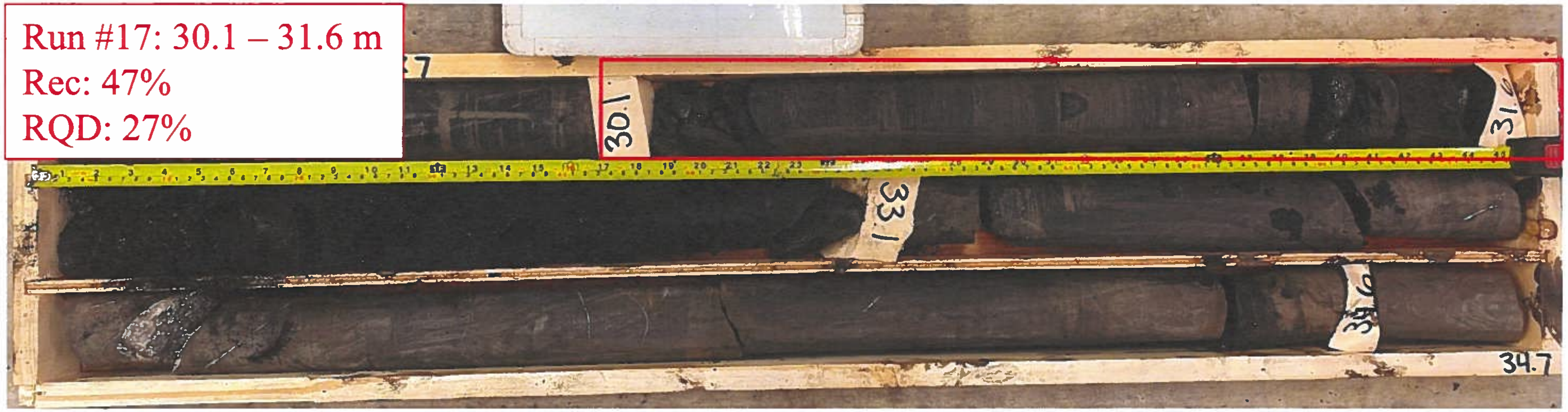
CG09140
February 2023



Run #17: 30.1 – 31.6 m
Rec: 47%
RQD: 27%

Run #18: 31.6 – 33.1 m
Rec: 40%
RQD: 7%

wood.

CLIENT:
THREE SISTERS mountain village

Stewart Creek Core Photos

BH21-RV-06

CG09140

February 2023

Run #19: 33.1 – 34.6 m
Rec: 100%
RQD: 100%

Run #20: 34.6 – 36.1 m
Rec: 67%
RQD: 40%

wood.

CLIENT:

THREE SISTERS mountainvillage

Stewart Creek Core Photos

BH21-RV-06

CG09140

February 2023


Run #21: 36.1 – 37.6 m
Rec: 87%
RQD: 80%


Run #22: 37.6 – 39.1 m
Rec: 73%
RQD: 53%

wood.

CLIENT:
THREE SISTERS mountain village

Stewart Creek Core Photos

BH21-RV-06

CG09140

February 2023

Run #23: 39.1 – 40.6 m
Rec: 100%
RQD: 67%

Run #24: 40.6 – 42.1 m
Rec: 100%
RQD: 93%

wood.	CLIENT: THREE SISTERS mountainvillage	Stewart Creek Core Photos	
		BH21-RV-06	CG09140 February 2023

Run #25: 42.1 – 43.6 m
Rec: 100%
RQD: 47%

Run #26: 43.6 – 45.1 m
Rec: 103%
RQD: 93%

CLIENT:

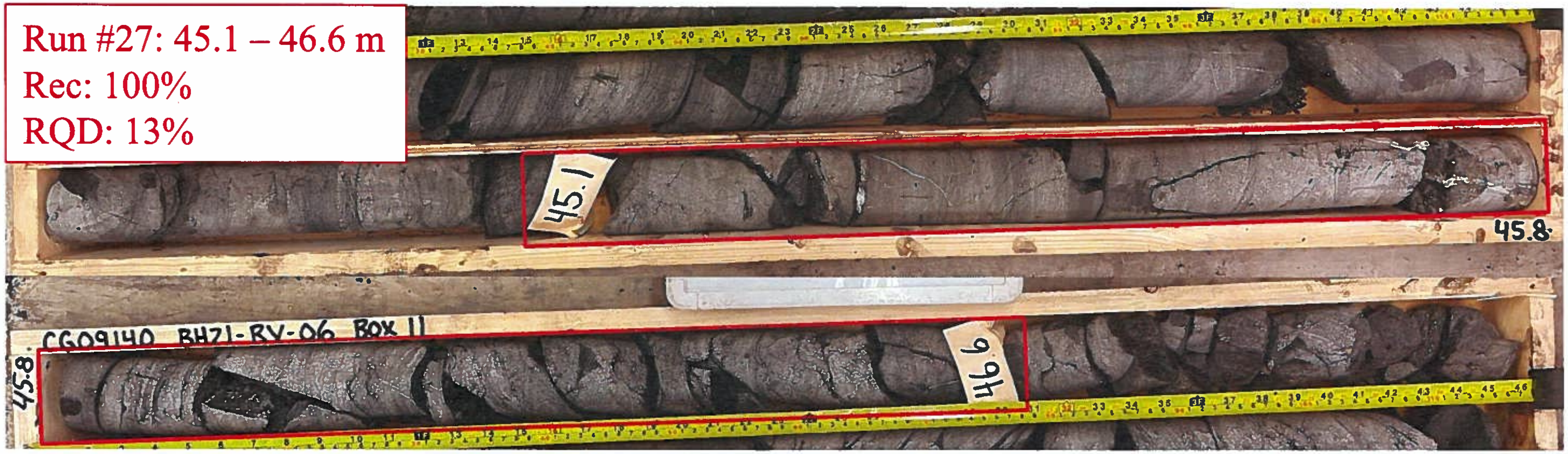
THREE SISTERS mountain village

Stewart Creek Core Photos

BH21-RV-06

CG09140

February 2023


Run #27: 45.1 – 46.6 m
Rec: 100%
RQD: 13%


Run #28: 46.6 – 48.1 m
Rec: 100%
RQD: 67%

wood.

CLIENT:

THREE SISTERS mountainvillage

Stewart Creek Core Photos

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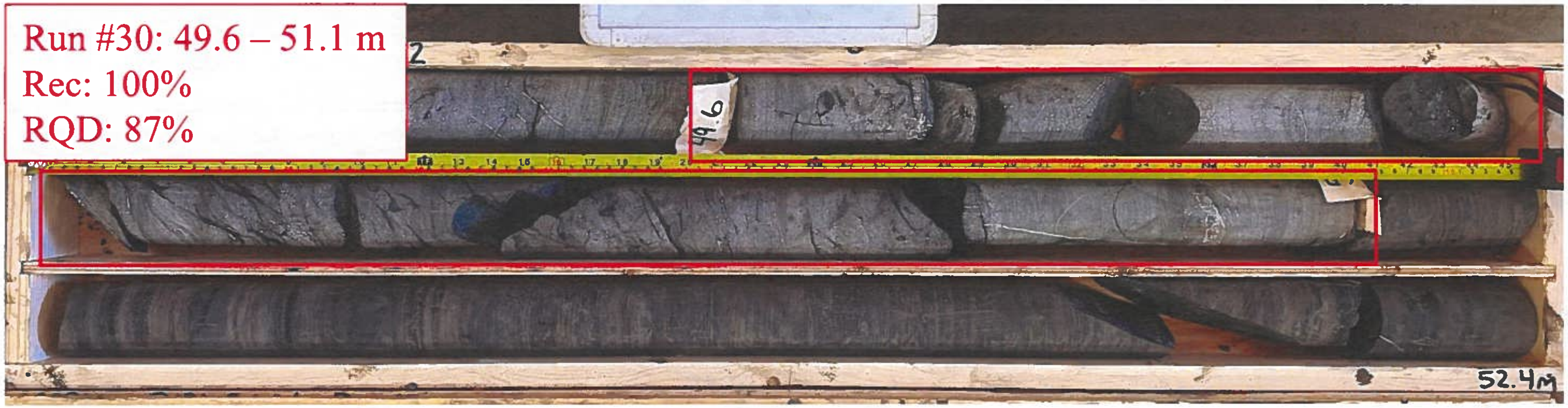
February 2023

Run #29: 48.1 – 49.6 m
Rec: 100%
RQD: 93%



Run #30: 49.6 – 51.1 m
Rec: 100%
RQD: 87%

wood.

CLIENT:
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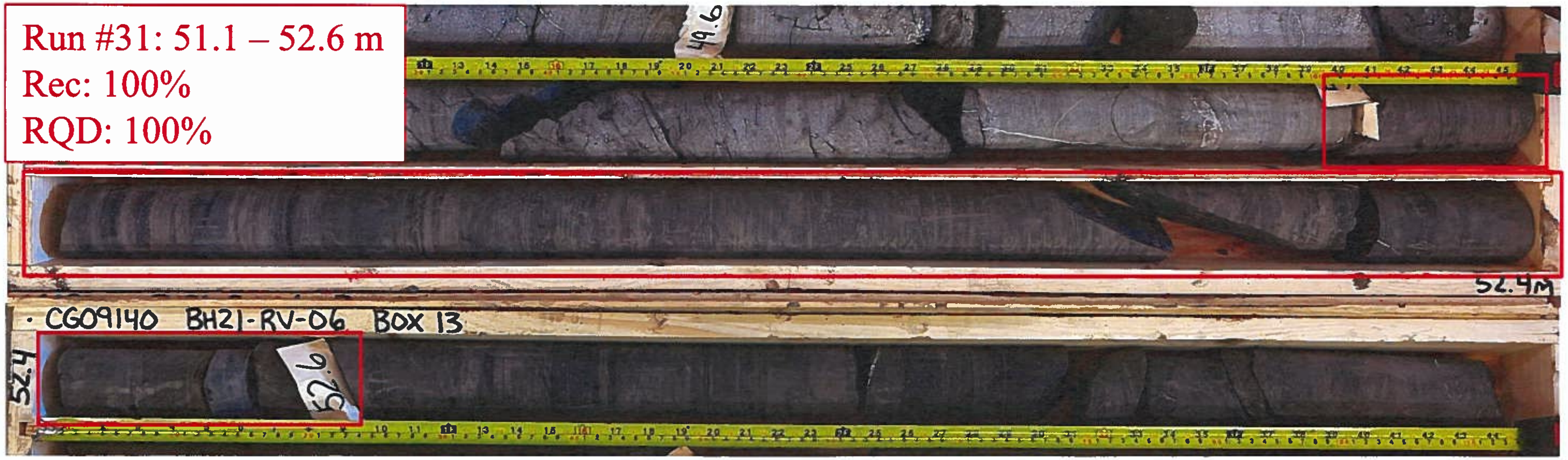
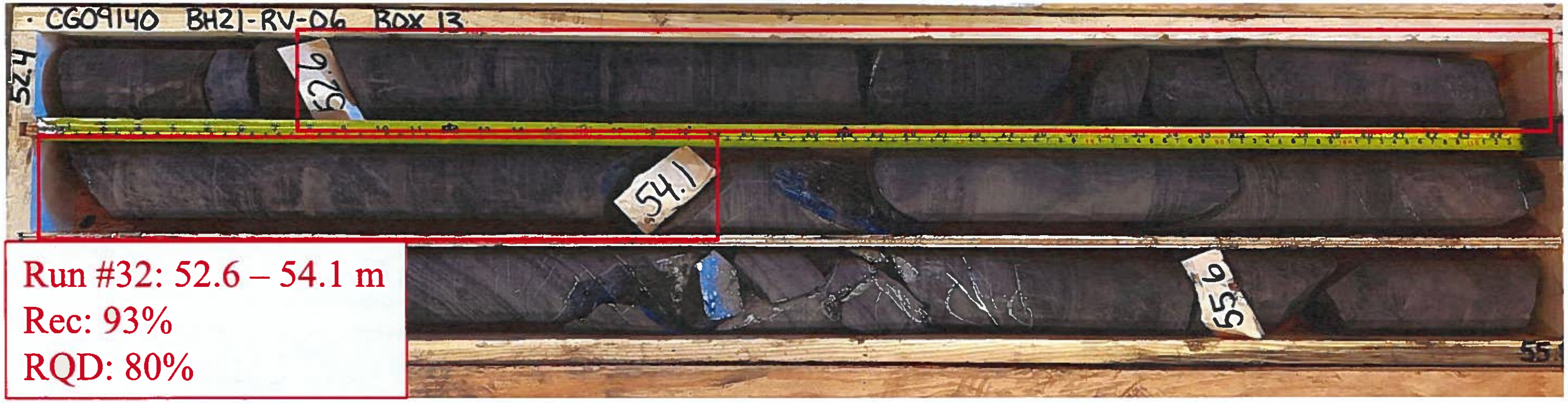

Run #31: 51.1 – 52.6 m
Rec: 100%
RQD: 100%


Run #32: 52.6 – 54.1 m
Rec: 93%
RQD: 80%

wood.

CLIENT:
THREE SISTERS mountain village

Stewart Creek Core Photos

BH21-RV-06

CG09140
February 2023

Run #33: 54.1 – 55.6 m
Rec: 100%
RQD: 53%

Run #34: 55.6 – 57.1 m
Rec: 100%
RQD: 100%

wood.

CLIENT:

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Stewart Creek Core Photos

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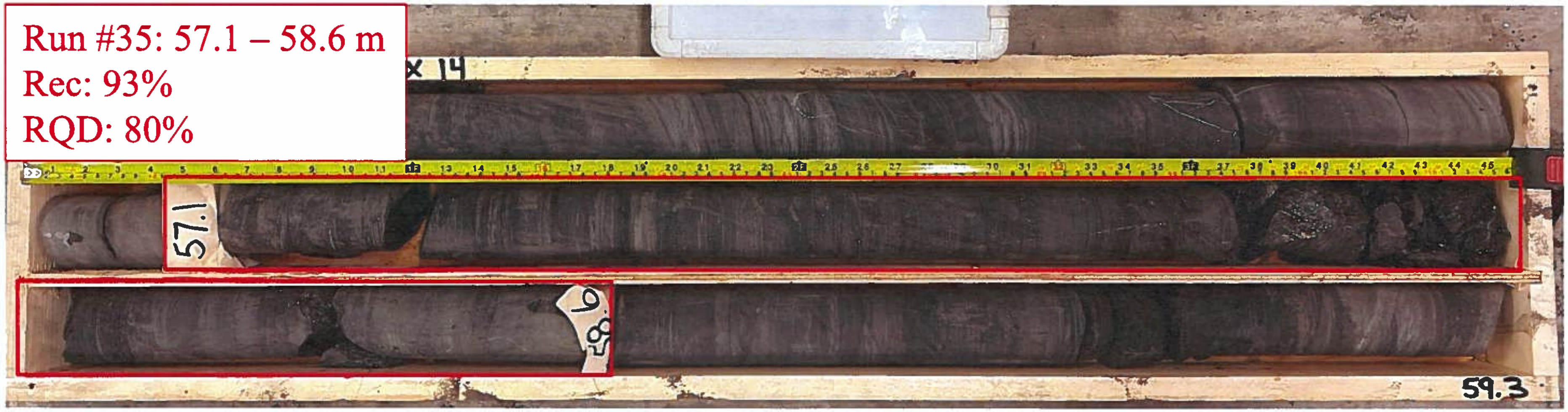
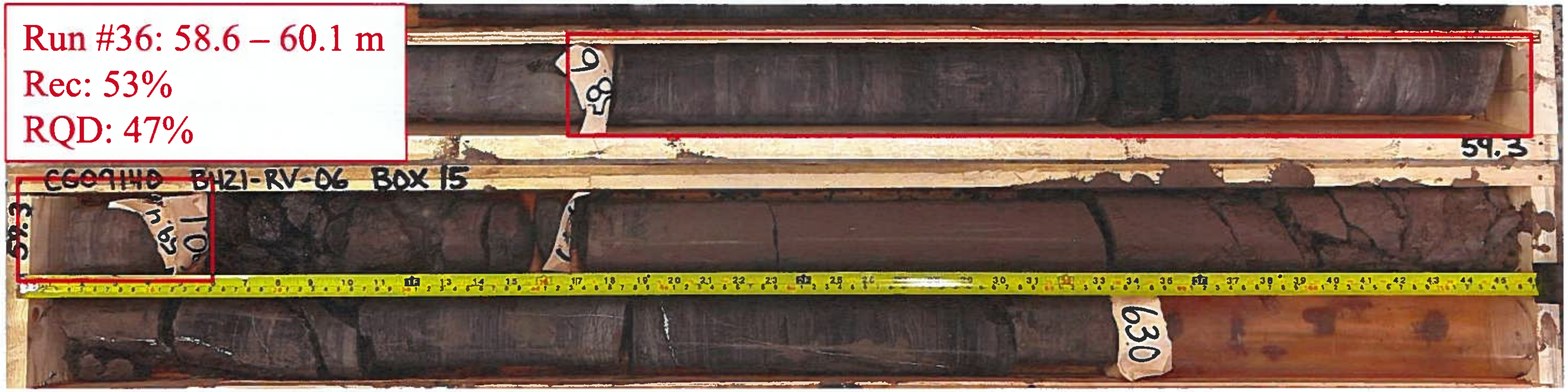
February 2023


Run #35: 57.1 – 58.6 m
Rec: 93%
RQD: 80%


Run #36: 58.6 – 60.1 m
Rec: 53%
RQD: 47%

wood.

CLIENT:
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Stewart Creek Core Photos

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CG09140
February 2023

Run #37: 60.1 – 61.6 m
Rec: 20%
RQD: 0%

Run #38: 61.6 – 63.0 m
Rec: 100%
RQD: 71%

wood.

CLIENT:

THREE SISTERS mountain village

Stewart Creek Core Photos

BH21-RV-06

CG09140

February 2023

Project	[illegible] Village Phase 1 Undermining
Job No.	CO29148
Date	26-27 May 2021
Test Device	Matest Point Load Tester
Tests Performed by	N. Khan

wsp

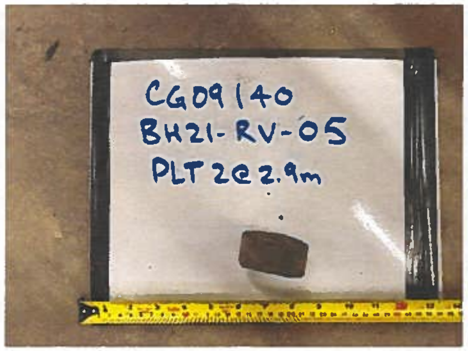
Borehole	Sample ID	Sample Depth (m)	Rock Type	Test Type	Diametral Parameters		Axial Parameters		Ratio D/W	Ratio L/D	Sample Dimension Validity	Reported Load (P), kN	Sample Break Validity	Comments	Calculations						
					L: Length between contact points and nearest free face (mm)	D: Core Diameter (mm)	W: Core width (mm)	D: Distance between load points (mm)							D_e^2 (mm²)	D_e (mm)	Uncorrected Point Load Strength Index I_s, MPa	Size Correction Factor (F)	Corrected Point Load Strength Index (Is(50)) Mpa	Index to Strength Conversion Factor (K)	Estimated Uniaxial Compressive Strength (σc), Mpa
BH21-RY-05	PLT1	2.50		Diametral	31	60			N/A	0.5	Valid	25,646	Valid		3600	60.0	8.21	1.09	8.91	18	160.4
	PLT2	2.80		Axial			60	30	0.4	N/A	Valid	17,480	Valid		1986	44.6	8.80	0.95	8.36	18	150.4
	PLT3	3.20		Diametral	56	60			N/A	0.9	Valid	30,672	Valid		3600	60.0	8.34	1.09	9.07	18	163.2
	PLT4	3.80		Axial			60	29	0.5	N/A	Valid	12,836	Valid		2215	47.1	5.79	0.97	5.56	18	98.8
	PLT5	4.00		Diametral	35	60			N/A	0.6	Valid	14,070	Valid		3600	60.0	3.91	1.09	4.24	18	76.4
	PLT6	4.10		Axial			60	30	0.5	N/A	Valid	6,058	Valid		2292	47.8	2.64	0.98	2.60	18	46.9
	PLT9	4.65		Diametral	52	60			N/A	0.9	Valid	56,000	Valid		3600	60.0	15.56	1.09	16.88	18	303.8
	P.T10	4.75		Axial			60	30	0.5	N/A	Valid	20,812	Valid		2292	47.8	9.08	0.98	8.91	18	160.3
	PLT11	5.20		Diametral	57	60			N/A	0.9	Valid	37,032	Valid		3600	60.0	10.29	1.09	11.17	18	201.0
	PLT12	5.30		Diametral	40	60			N/A	0.7	Valid	23,676	Valid		3600	60.0	6.58	1.09	7.14	18	128.5
	P.T13	5.35		Axial			60	23	0.4	N/A	Valid	14,314	Valid		1757	41.9	8.15	0.92	7.53	18	135.5
	P.T14	5.50		Axial			60	32	0.5	N/A	Valid	9,888	Valid		2445	49.4	4.04	0.99	4.02	18	72.4
	PLT15	5.60		Diametral	38	60			N/A	0.6	Valid	32,308	Valid		3600	60.0	8.98	1.09	9.71	18	174.8
	PLT18	7.20		Diametral	40	60			N/A	0.7	Valid	28,502	Valid		3600	60.0	7.86	1.09	8.62	18	155.2
	PLT19	7.30		Diametral	59	60			N/A	1.0	Valid	15,388	Valid		3600	60.0	4.27	1.09	4.64	18	83.5
	P.T20	7.40		Axial			60	27	0.5	N/A	Valid	16,842	Valid		2063	45.4	8.17	0.96	7.82	18	140.8
	P.T21	7.70		Axial			60	21	0.4	N/A	Valid	11,474	Valid		1604	40.1	7.15	0.91	6.47	18	116.5
	PLT22	7.80		Diametral	44	60			N/A	0.7	Valid	12,828	Valid		3600	60.0	3.56	1.09	3.87	18	69.6
	PLT23	7.90		Diametral	54	60			N/A	0.9	Valid	25,194	Valid		3600	60.0	7.00	1.09	7.60	18	136.7
	PLT24	8.00		Diametral	35	60			N/A	0.6	Valid	6,318	Valid		3600	60.0	1.76	1.09	1.91	18	34.3
	PLT25	8.05		Diametral	32	60			N/A	0.5	Valid	13,412	Valid		3600	60.0	3.73	1.09	4.04	18	72.8
	PLT26	8.20		Diametral	73	60			N/A	1.2	Valid	26,812	Valid		3600	60.0	7.45	1.09	8.08	18	145.5
	PLT27	8.35		Diametral	68	60			N/A	1.1	Valid	20,816	Valid		3600	60.0	5.78	1.09	6.28	18	113.0
	PLT28	8.60		Diametral	34	60			N/A	0.6	Valid	11,220	Valid		3600	60.0	3.12	1.09	3.38	18	60.9
	PLT29	8.75		Diametral	53	60			N/A	0.9	Valid	18,074	Valid		3600	60.0	5.02	1.09	5.45	18	98.1
	PLT30	8.80		Diametral	94	60			N/A	1.6	Valid	1,878	Valid		3600	60.0	0.66	1.09	0.80	18	13.7
	PLT31	8.95		Diametral	61	60			N/A	1.0	Valid	13,258	Valid		3600	60.0	3.68	1.09	4.00	18	72.0
	PLT32	9.45		Diametral	46	60			N/A	0.8	Valid	16,896	Valid		3600	60.0	4.71	1.09	5.11	18	92.0
	PLT33	9.80		Diametral	41	60			N/A	0.7	Valid	14,862	Valid		3600	60.0	4.13	1.09	4.51	18	81.2
	P.T35	10.13		Diametral	63	60			N/A	1.1	Valid	18,770	Valid		3600	60.0	5.22	1.09	5.66	18	101.9
	P.T36	10.15		Axial			60	32	0.5	N/A	Valid	9,856	Valid		2445	49.4	4.07	0.99	4.05	18	72.9
	P.T37	10.55		Axial			60	26	0.4	N/A	Valid	7,992	Valid		1986	44.6	4.02	0.95	3.82	18	68.7
	P.T38	10.65		Axial			60	38	0.6	N/A	Valid	15,280	Valid		2903	53.9	5.26	1.03	5.44	18	98.0
	P.T39	10.80		Diametral	91	60			N/A	1.5	Valid	11,140	Valid		3600	60.0	3.10	1.09	3.36	18	60.5
	P.T40	11.00		Diametral	90	60			N/A	1.5	Valid	37,626	Valid		3600	60.0	10.42	1.09	11.32	18	203.7
	P.T41	11.10		Axial			60	23	0.4	N/A	Valid	9,084	Valid		1757	41.9	5.17	0.92	4.76	18	85.7
	P.T42	11.30		Diametral	142	60			N/A	2.4	Valid	30,774	Valid		3600	60.0	8.55	1.09	9.28	18	167.0
	P.T43	11.80		Diametral	139	60			N/A	2.2	Valid	41,476	Valid		3600	60.0	11.52	1.09	12.51	18	225.1
	P.T44	11.90		Diametral	134	60			N/A	2.2	Valid	18,076	Valid		3600	60.0	5.02	1.09	5.45	18	98.1
	P.T46	12.10		Axial			60	28	0.5	N/A	Valid	14,736	Valid		2139	46.2	6.89	0.97	6.66	18	119.7
	P.T47	12.15		Diametral	42	60			N/A	0.7	Valid	11,082	Valid		3600	60.0	3.08	1.09	3.34	18	60.2
	P.T48	12.25		Diametral	86	60			N/A	1.4	Valid	30,686	Valid		3600	60.0	8.53	1.09	9.26	18	166.8
	P.T49	12.40		Diametral	99	60			N/A	1.7	Valid	21,270	Valid		3600	60.0	5.91	1.09	6.41	18	115.4
	P.T50	12.60		Diametral	37	60			N/A	0.6	Valid	15,408	Valid		3600	60.0	4.28	1.09	4.65	18	83.6
	P.T51	12.70		Diametral	51	60			N/A	0.9	Valid	9,666	Valid		3600	60.0	2.68	1.09	2.91	18	52.5
	P.T52	13.05		Diametral	36	60			N/A	0.6	Valid	0,564	Valid		3600	60.0	0.16	1.09	0.17	18	3.1
	P.T53	13.40		Diametral	55	60			N/A	0.9	Valid	21,476	Valid		3600	60.0	5.97	1.09	6.48	18	116.6
	P.T54	13.65		Diametral	39	60			N/A	0.7	Valid	2,892	Valid		3600	60.0	0.80	1.09	0.87	18	15.7
	P.T55	13.75		Diametral	63	60			N/A	1.0	Valid	10,712	Valid		3600	60.0	2.98	1.09	3.23	18	58.1
BH21-RY-06	PLT1	7.85		Axial			60	42	0.7	N/A	Valid	22,380	Valid		3208	56.6	6.98	1.05	7.38	18	132.9
	PLT2	8.00		Axial			60	32	0.5	N/A	Valid	19,826	Valid		2445	49.4	8.11	0.99	8.07	18	145.3
	PLT3	8.15		Axial			60	32	0.5	N/A	Valid	9,008	Valid		2445	49.4	3.68	0.99	3.67	18	66.0
	PLT4	8.40		Axial			60	22	0.4	N/A	Valid	3,164	Valid		1681	41.0	1.88	0.91	1.72	18	31.0
	PLT5	9.80		Diametral	41	60			N/A	0.7	Valid	0,478	Valid		3600	60.0	0.13	1.09	0.14	18	2.6
	PLT6	10.05		Axial			60	45	0.8	N/A	Valid	2,518	Valid		3438	58.6	0.73	1.07	0.78	18	14.2
	P.T10	11.05		Axial			60	50	0.8	N/A	Valid	1,252	Valid	Coal	3821	61.8	0.33	1.10	0.36	18	6.6
	P.T11	12.05		Diametral	90	60			N/A	1.5	Valid	12,300	Valid		3600	60.0	3.43	1.09	3.72	18	67.0
	P.T12	12.75		Axial			60	40	0.7	N/A	Valid	6,034	Valid		3056	55.3	2.02	1.05	2.11	18	38.1
	P.T13	12.90		Diametral	61	60			N/A	1.0	Valid	4,000	Valid		3600	60.0	1.11	1.09	1.21	18	21.7
	P.T14	12.42		Axial			60	30	0.5	N/A	Valid	12,816	Valid		2292	47.8	5.59	0.98	5.48	18	98.7
	P.T15	12.95		Axial			60	35	0.6	N/A	Valid	6,002	Valid		2674	51.7	2.24	1.02	2.28	18	41.0
	P.T16	12.96		Diametral	34	60			N/A	0.6	Valid	2,538	Valid		3600	60.0	0.65	1.09	0.71	18	12.7
	P.T17	13.20		Diametral	86	60			N/A	1.4	Valid	18,270	Valid		3600	60.0	5.08	1.09	5.51	18	99.2
	P.T18	13.30		Diametral	60	60			N/A	1.0	Valid	14,290	Valid		3600	60.0	3.97	1.09	4.31	18	77.6
	P.T19	13.80		Diametral	56	60			N/A	0.9	Valid	15,612	Valid		3600	60.0	4.34	1.09	4.71	18	84.7
	P.T20	14.20		Diametral	71	60			N/A	1.2	Valid	5,870	Valid		3600	60.0	1.63	1.09	1.77	18	31.9
	P.T21	14.40		Diametral	72	60			N/A	1.2	Valid	27,980	Valid		3600	60.0	7.77	1.09	8.43	18	151.8
	P.T23	15.00		Diametral	68	60			N/A	1.1	Valid	12,536	Valid		3600	60.0	3.48	1.09	3.78	18	68.0
	P.T24	15.45		Axial			60	24	0.4	N/A	Valid	2,120	Valid		1833	42.8	1.16	0.93	1.08	18	19.4
	P.T25	15.70		Diametral	34	60			N/A	0.6	Valid	2,688	Valid		3600	60.0	0.75	1.09	0.81	18	14.6
	P.T27	16.20		Diametral	58	60			N/A	1.0	Valid	18,528	Valid		3600	60.0	5.14	1.09	5.58	18	100.5
	P.T28	16.50		Diametral	68	60			N/A	1.1	Valid	6,862	Valid		3600	60.0	1.91	1.09	2.07	18	37.2
	P.T29	16.60		Axial			60	35	0.6	N/A	Valid	11,076	Valid		2674	51.7	4.14	1.02	4.21	18	75.7
	P.T30	16.80		Diametral	62	60			N/A	1.0	Valid	10,394	Valid		3600	60.0	2.88	1.09	3.13	18	56.3
	P.T31	17.10		Diametral	75	60			N/A	1.2	Valid	11,572	Valid		3600	60.0	3.21	1.09	3.49	18	62.8
	P.T32	17.30		Diametral	73	60			N/A	1.2	Valid	26,180	Valid		3600	60.0	7.27	1.09	7.89	18	142.1
	P.T33	17.75		Diametral	33	60			N/A	0.5	Valid	32,144	Valid		3600	60.0	8.93	1.09	9.69	18	174.6
	P.T34	18.00		Diametral	87	60			N/A	1.4	Valid	18,574	Valid		3600	60.0	5.16	1.09	5.60	18	100.8
	P.T35	18.65		Axial			60	54	0.9	N/A	Valid	20,370	Valid		4125	64.2	4.94	1.12	5.53	18	99.5
	P.T36	18.75		Diametral	46	60			N/A	0.7	Valid	8,904	Valid		3600	60.0	2.42	1.09	2.63	18	47.3
	P.T37	18.95		Axial			60	26	0.4	N/A	Valid	10,064	Valid		1986	44.6	5.06	0.95	4.81	18	86.5
	P.T38	19.10		Diametral	79	60			N/A	1.3	Valid	21,602	Valid		3600	60.0	6.00	1.09	6.51	18	117.2
	P.T39	19.45		Diametral	80	60			N/A	1.3	Valid	21,314	Valid		3600	60.0	5.92	1.09	6.43	18	115.7
	P.T41	20.10		Diametral	70	60			N/A	1.2	Valid	24,666	Valid		3600	60.0	6.85	1.09	7.44	18	133.8
	P.T42	20.40		Diametral	63	60			N/A	1.1	Valid	22,936	Valid		3600	60.0	6.37	1.09	6.92	18	124.5
	P.T43	20.80		Axial			60	44	0.7	N/A	Valid	18,190	Valid		3361	58.0	5.41	1.07	5.78	18	104.0
	P.T45	21.30		Axial			60	24	0.4	N/A	Valid	17,096	Valid		1833	42.8	9.33	0.93	9.00	18	161.9
	P.T46	21.35		Diametral	53	60			N/A	0.9	Valid	11,300	Valid		3600	60.0	3.15	1.09	3.42	18	61.6
	P.T47	21.60		Axial			60	38	0.6	N/A	Valid	8,046	Valid		2903	53.9	2.77	1.03	2.87	18	51.6
	P.T48	21.80		Axial			60	40	0.7	N/A	Valid	6,890	Valid		3056	55.3	2.25	1.05	2.36	18	42.5
	P.T51	22.40		Diametral	33	60			N/A	0.6	Valid	10,638	Valid		3600	60.0	2.96	1.09	3.21	18	57.7
	P.T52	22.55		Diametral	60	60			N/A	1.0	Valid	9,982	Valid		3600	60.0	2.77	1.09	3.00	18	54.1
	P.T53	23.12		Diametral	63	60			N/A	1.1	Valid	35,970	Valid		3600	60.0	9.99	1.09	10.85	18	195.2
	P.T54	23.40		Diametral	57	60			N/A	1.0	Valid	25,294	Valid		3600	60.0	7.02	1.09	7.62	18	137.1
	P.T56	23.80		Axial			60	46	0.8	N/A	Valid	5,640	Valid		3514	59.3	1.60	1.08	1.73	18	31.1
	P.T57	24.05		Diametral	41	60			N/A	0.7	Valid	2,720	Valid		3600	60.0	0.76	1.09	0.82	18	14.8
	P.T58	24.40		Diametral	48	60			N/A	0.8	Valid	2,840	Valid		3600	60.0	0.79	1.09	0.86	18	15.4
	P.T59	24.45		Axial			60	31	0.5	N/A	Valid	4,090	Valid		2368	48.7	1.72	0.99	1.70	18	30.5
	P.T60	25.30		Diametral	78	60			N/A	1.3	Valid	16,494	Valid		3600	60.0	4.58	1.09	4.97	18	89.5
	P.T62	25.70		Diametral	66	60			N/A	1.1	Valid	9,134	Valid		3600	60.0	2.54	1.09	2.75	18	49.6
	P.T63	26.05		Diametral	41	60			N/A	0.7	Valid	6,964	Valid		3600	60.0	1.93	1.09	2.10	18	37.7
	P.T64	26.55		Diametral	72	60			N/A	1.2	Valid	1,276	Valid		3600	60.0	0.35	1.09	0.38	18	6.9
	P.T66	26.90		Diametral	68	60			N/A	1.1	Valid	26,860	Valid		3600	60.0	7.21	1.09	7.82	18	140.8
	P.T67	27.15		Diametral	58	60			N/A	0.9	Valid	20,946	Valid		3600	60.0	5.82	1.09	6.32	18	113.7
	P.T69	27.65		Axial			60	26	0.4	N/A	Valid	24,508	Valid		1986	44.6	12.34	0.95	11.62	18	209.2
	P.T70	27.75		Diametral	60	60			N/A	1.0	Valid	12,088	Valid		3600	60.0	3.36	1.09	3.64	18	65.6
	P.T71	28.13		Diametral	60	60			N/A	1.0	Valid	2,090	Valid		3600	60.0	0.58	1.09	0.63	18	11.3
	P.T72	28.60		Diametral	56	60			N/A	0.9	Valid	11,946	Valid		3600	60.0	3.32	1.09	3.60	18	64.8
	P.T73	29.00		Diametral	54	60			N/A	0.9	Valid	27,116	Valid		3600	60.0	7.53	1.09	8.18	18	147.2
	P.T74	29.40		Axial			60	44	0.7	N/A	Valid	22,846	Valid		3361	58.0	6.74	1.07	7.21	18	129.7
	P.T75	29.55		Diametral	54	60			N/A	0.9	Valid	15,516	Valid		3600	60.0	4.31	1.09	4.68	18	84.2
	P.T76	29.65		Axial			60	35	0.6	N/A	Valid	11,804	Valid		2674	51.7	3.90	1.02	4.15	18	74.8
	P.T77	29.75		Diametral	66	60			N/A	1.1	Valid	9,308	Valid		3600	60.0	2.59	1.09	2.81	18	50.5
	P.T78	31.30		Diametral	78	60			N/A	1.3	Valid	7,016	Valid		3600	60.0	1.95	1.09	2.12	18	38.1
	P.T82	33.60		Axial			60	38	0.6	N/A	Valid	8,405	Valid		2903	53.9	2.94	1.03	3.36	18	60.3
	P.T84	34.00		Diametral	35	60			N/A	0.6	Valid	14,140	Valid		3600	60.0	3.93	1.09	4.27	18	76.8
	P.T85	34.20		Diametral	48	60			N/A	0.8	Valid	18,664	Valid		3600	60.0	5.18	1.09	5.62	18	101.2
	P.T86	34.50		Diametral	59	60			N/A	1.0	Valid	21,880	Valid		3600	60.0	6.11	1.09	6.63	18	119.3
	P.T88	34.80		Axial			60	40	0.7	N/A	Valid	17,440	Valid		3056	55.3	5.71	1.05	5.99	18	107.8
	P.T89	35.45		Diametral	53	60			N/A	0.9	Valid	26,000	Valid		3600	60.0	7.86	1.09	8.53	18	153.5
	P.T92	37.22		Diametral	59	60			N/A	0.9	Valid	12,480	Valid		3600	60.0	3.47	1.09	3.76	18	67.7
	P.T94	37.40		Diametral	55	60			N/A	0.9	Valid	2,236	Valid		3600	60.0	0.62	1.09	0.67	18	12.1
	P.T95	37.80		Diametral	90	60			N/A	1.5	Valid	12,700	Valid		3600	60.0	3.53	1.09	3.83	18	68.9
	P.T96	38.00		Diametral	46	60			N/A	0.8	Valid	7,609	Valid		3600	60.0	2.09	1.09	2.27	18	40.7
	P.T98	38.15		Diametral	43	60			N/A	0.7	Valid	5,082	Valid		3600	60.0	1.41	1.09	1.53	18	27.6
	PLT100	38.85		Axial			60	23	0.4	N/A	Valid	19,516	Valid		1757	41.9	13.27	0.89	9.67	18	174.0
	PLT101	40.00		Diametral	43	60			N/A	0.7	Valid	20,072	Valid		3600	60.0	5.58	1.09	6.05	18	108.8
	PLT102	40.80		Axial			60	30	0.5	N/A	Valid	8,456	Valid		2292	47.8	3.69	0.98	3.62	18	65.1
	PLT105	41.15		Axial			60	42	0.7	N/A	Valid	10,864	Valid		3209	56.6	3.39	1.05	3.56	18	64.2
	PLT106	41.55		Diametral	39	60			N/A	0.6	Valid	32,574	Valid		3600	60.0	9.05	1.09	9.82	18	176.8
	PLT107	42.00		Diametral	70	60			N/A	1.2	Valid	28,104	Valid		3600	60.0	7.81	1.09	8.47	18	152.5
	PLT108	42.20		Diametral	42	60			N/A	0.7	Valid	16,430	Valid		3600	60.0	4.56	1.09	4.95	18	89.1
	PLT109	42.60		Diametral	34	60			N/A	0.6	Valid	23,838	Valid		3600	60.0	6.62	1.09	7.19	18	129.4
	PLT110	43.00		Diametral	32	60			N/A	0.5	Valid	8,778	Valid		3600	60.0	2.44	1.09	2.65	18	47.6
	PLT111	43.50		Axial			60	28	0.5	N/A	Valid	12,134	Valid		2139	46.2	5.67	0.97	5.49	18	98.8
	PLT112	43.75		Axial			60	26	0.4	N/A	Valid	3,082	Valid		1986	44.6	1.55	0.95	1.48	18	26.6
	PLT113	43.85		Diametral	68	60			N/A	1.1	Valid	2,890	Valid		3600	60.0	0.81	1.09	0.87	18	15.7
	PLT114	44.00		Diametral	35	60			N/A	0.6	Valid	34,038	Valid		3600	60.0	9.46	1.09	10.26	18	184.7
	PLT115	44.70		Diametral	68	60			N/A	1.2	Valid	15,740	Valid		3600	60.0	4.38	1.09	4.75	18	85.5
	PLT116	44.95		Diametral	57	60			N/A	1.0	Valid	25,152	Valid		3600	60.0	6.99	1.09	7.58	18	136.5
	PLT117	45.40		Diametral	82	60			N/A	1.4	Valid	18,684	Valid		3600	60.0	5.19	1.09	5.64	18	101.5
	PLT119	45.80		Diametral	39	60			N/A	0.7	Valid	5,476	Valid		3600	60.0	1.52	1.09	1.64	18	29.4
	PLT120	46.40		Diametral	46	60			N/A	0.8	Valid	14,954	Valid		3600	60.0	4.15	1.09	4.51	18	81.2
	PLT121	47.20		Diametral	89	60			N/A	1.5	Valid	6,928	Valid		3600	60.0	1.92	1.09	2.09	18	37.6
	PLT122	48.00		Diametral	59	60			N/A	1.0	Valid	5,078	Valid		3600	60.0	1.41	1.09	1.53	18	27.6
	PLT123	48.30		Diametral	74	60			N/A	1.2	Valid	15,148	Valid		3600	60.0	4.21	1.09	4.57	18	82.2
	PLT124	48.50		Diametral	82	60			N/A	1.4	Valid	26,558	Valid		3600	60.0	7.38	1.09	8.02	18	144.4
	PLT125	48.70		Diametral	35	60			N/A	0.6	Valid	7,627	Valid		3600	60.0	[illegible]	1.09	[illegible]	18	[illegible]
	PLT126	48.85		Diametral	66	60			N/A	1.1	Valid	7,880	Valid		3600	60.0	2.19	1.09	2.38	18	42.8
	PLT127	49.35		Diametral	40	60			N/A	0.7	Valid	8,442	Valid		3600	60.0	2.35	1.09	2.55	18	45.8
	PLT128	49.65		Diametral	70	60			N/A	1.2	Valid	10,516	Valid		3600	60.0	2.92	1.09	3.17	18	57.1
	PLT129	50.00		Diametral	66	60			N/A	1.1	Valid	51,799	Valid		3600	60.0	14.39	1.09	15.61	18	280.9
	PLT130	50.25		Diametral	36	60			N/A	0.6	Valid	3,652	Valid		3600	60.0	1.01	1.09	1.10	18	19.8
	PLT131	50.75		Diametral	90	60			N/A	1.5	Valid	6,175	Valid		3600	60.0	1.72	1.09	1.86	18	33.5
	PLT132	51.00		Diametral	81	60			N/A	0.9	Valid	41,602	Valid		3600	60.0	11.53	1.09	12.51	18	225.3
	PLT133	51.15		Diametral	56	60			N/A	0.9	Valid	1,169	Valid		3600	60.0	0.32	1.09	0.35	18	6.3
	PLT134	51.25		Axial			60	30	0.5	N/A	Valid	8,704	Valid		2292	47.8	3.80	0.98	3.72	18	67.0
	PLT135	51.50		Diametral	112	60			N/A	1.9	Valid	14,782	Valid		3600	60.0	4.11	1.09	4.46	18	80.2
	PLT136	51.60		Axial			60	26	0.4	N/A	Valid	6,058	Valid		1986	44.6	3.05	0.95	2.90	18	52.2
	PLT137	51.85		Diametral	75	60			N/A	1.3	Valid	14,514	Valid		3600	60.0	4.03	1.09	4.38	18	78.8
	PLT138	52.20		Diametral	68	60			N/A	1.1	Valid	23,630	Valid		3600	60.0	6.56	1.09	7.13	18	128.3
	PLT139	52.45		Diametral	57	60			N/A	1.0	Valid	20,642	Valid		3600	60.0	5.73	1.09	6.20	18	111.6
	PLT140	52.80		Axial			60	26	0.4	N/A	Valid	11,474	Valid		1986	44.6	5.78	0.95	5.68	18	102.2
	PLT141	53.10		Diametral	63	60			N/A	1.1	Valid	7,378	Valid		3600	60.0	2.05	1.09	2.22	18	39.9
	PLT142	53.25		Axial			60	40	0.7	N/A	Valid	12,484	Valid		3056	55.3	4.09	1.05	4.28	18	77.1
	PLT143	53.50		Diametral	66	60			N/A	1.1	Valid	6,148	Valid		3600	60.0	1.71	1.09	1.86	18	33.4
	PLT145	54.20		Diametral	70	60			N/A	1.2	Valid	25,438	Valid		3600	60.0	7.07	1.09	7.67	18	138.1
	PLT146	54.60		Axial			60	35	0.6	N/A	Valid	7,818	Valid		2674	51.7	2.92	1.02	2.97	18	53.4
	PLT150	55.10		Diametral	61	60			N/A	1.0	Valid	11,180	Valid		3600	60.0	3.11	1.09	3.37	18	60.7
	PLT151	55.60		Diametral	54	60			N/A	0.9	Valid	17,102	Valid		3600	60.0	4.75	1.09	5.16	18	92.8
	PLT153	56.10		Diametral	75	60			N/A	1.3	Valid	14,252	Valid		3600	60.0	3.96	1.09	4.30	18	77.3
	PLT154	56.85		Diametral	57	60			N/A	1.0	Valid	13,014	Valid		3600	60.0	3.62	1.09	3.92	18	[illegible]
	PLT155	57.20		Diametral	65	60			N/A	1.1	Valid	6,284	Valid		3600	60.0	1.75	1.09	1.89	18	34.2
	PLT156	57.45		Axial			60	46	0.8	N/A	Valid	12,688	Valid		3514	59.3	3.61	1.08	3.90	18	70.2
	PLT157	57.80		Diametral	66	60			N/A	1.0	Valid	2,020	Valid		3600	60.0	0.56	1.09	0.61	18	11.0
	PLT158	58.20		Diametral	75	60			N/A	1.3	Valid	13,930	Valid		3600	60.0	3.87	1.09	4.21	18	75.7
	PLT159	58.45		Diametral	74	60			N/A	1.2	Valid	4,625	Valid		3600	60.0	1.28	1.09	1.39	18	25.1
	PLT160	58.80		Axial			60	20	0.3	N/A	Valid	4,255	Valid		1528	39.1	2.78	0.90	2.50	18	45.0
	PLT161	59.00		Axial			60	35	0.6	N/A	Valid	7,485	Valid		2674	51.7	2.80	1.02	2.85	18	51.3
	PLT162	59.20		Diametral	75	60			N/A	1.3	Valid	15,534	Valid		3600	60.0	4.32	1.09	4.68	18	84.3
	PLT163	59.35		Diametral	32	60			N/A	0.5	Valid	20,400	Valid		3600	60.0	5.67	1.09	6.15	18	110.7
	PLT164	60.10		Axial			60	28	0.5	N/A	Valid	4,095	Valid		2139	46.2	1.91	0.97	1.86	18	33.5
	PLT165	60.25		Axial			60	30	0.5	N/A	Valid	3,846	Valid		2292	47.8	1.68	0.98	1.65	18	29.6
	PLT167	61.00		Axial			60	42	0.7	N/A	Valid	[illegible]	Valid		3208	56.6	6.19	1.05	6.47	18	116.5
	PLT168	61.80		Diametral	73	60			N/A	1.2	Valid	23,128	Valid		3600	60.0	6.42	1.09	6.97	18	125.5
	PLT170	62.40		Diametral	59	60			N/A	1.0	Valid	22,852	Valid		3600	60.0	6.35	1.09	6.91	18	124.3
	PLT171	62.60		Axial			60	42	0.7	N/A	Valid	14,062	Valid		3209	56.6	4.38	1.05	4.60	18	82.8
	PLT172	62.70		Diametral	52	60			N/A	0.9	Valid	3,679	Valid		3600	60.0	1.02	1.09	1.11	18	20.0
	PLT173	62.80		Axial			60	35	0.6	N/A	Valid	6,940	Valid		2674	51.7	2.48	1.02	2.52	18	45.4
	PLT174	62.95		Diametral	31	60			N/A	0.5	Valid	4,448	Valid		3600	60.0	1.24	1.09	1.34	18	24.1

Point Load Test	PLT 1
Depth (m)	2.80

Point Load Test Type	Diametral
Failure Validity	Valid

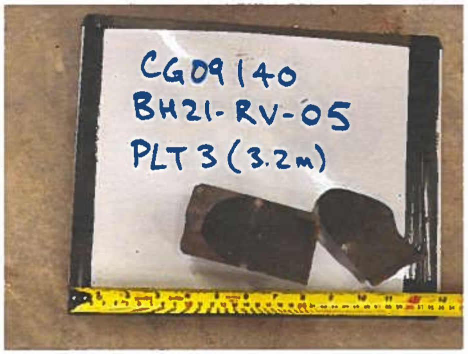
Point Load Test	PLT 2
Depth (m)	2.90

Point Load Test Type	Axial
Failure Validity	Valid



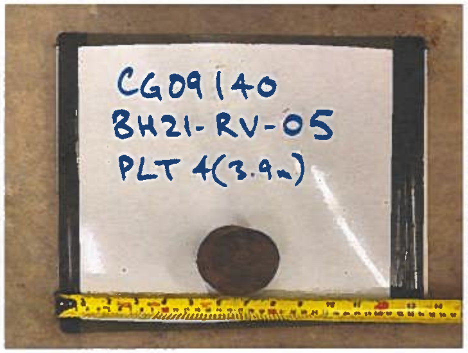
Point Load Test	PLT 3
Depth (m)	3.20

Point Load Test Type	Diametral
Failure Validity	Valid



Point Load Test	PLT 4
Depth (m)	3.90

Point Load Test Type	Axial
Failure Validity	Valid



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Point Load Test	PLT 5
Depth (m)	4.00

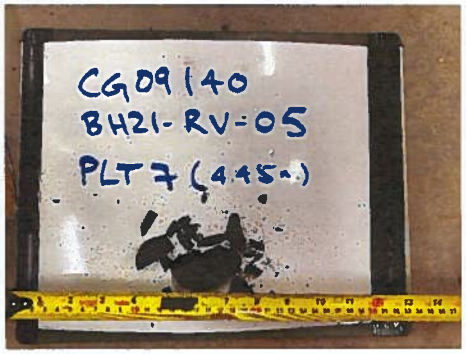
Point Load Test Type	Diametral
Failure Validity	Valid

Point Load Test	PLT 6
Depth (m)	4.10

Point Load Test Type	Axial
Failure Validity	Valid

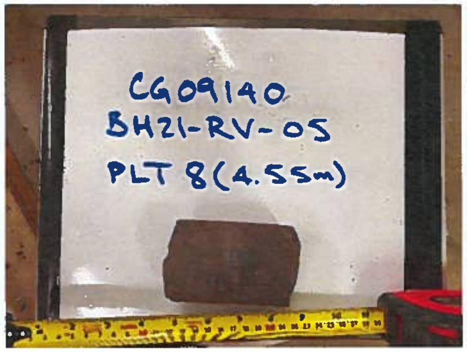
Point Load Test	PLT 7
Depth (m)	4.45

Point Load Test Type	Axial
Failure Validity	Valid



Point Load Test	PLT 8
Depth (m)	4.55

Point Load Test Type	Diametral
Failure Validity	Invalid



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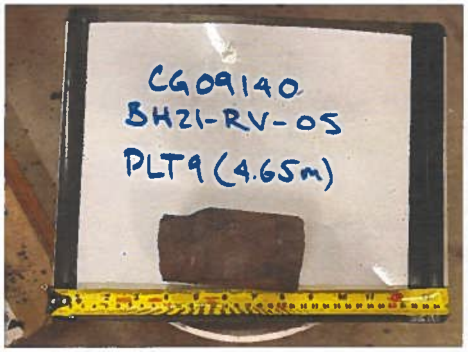
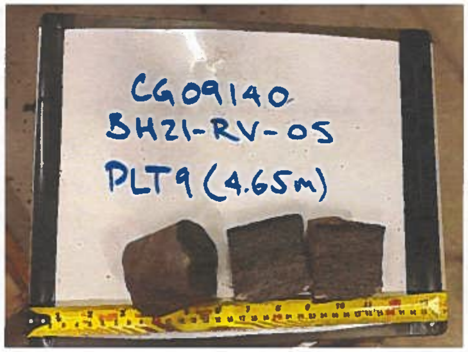
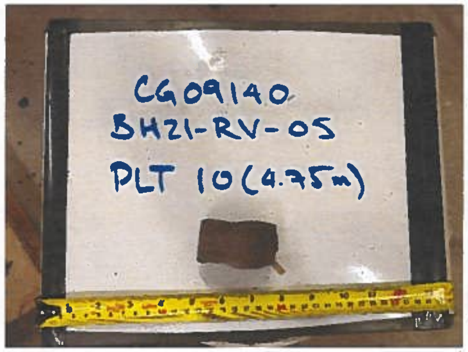
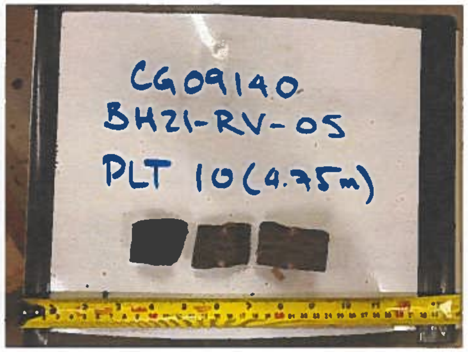
Point Load Test	PLT 9	**Point Load Test Type**	Diametral
Depth (m)	4.65	**Failure Validity**	Valid



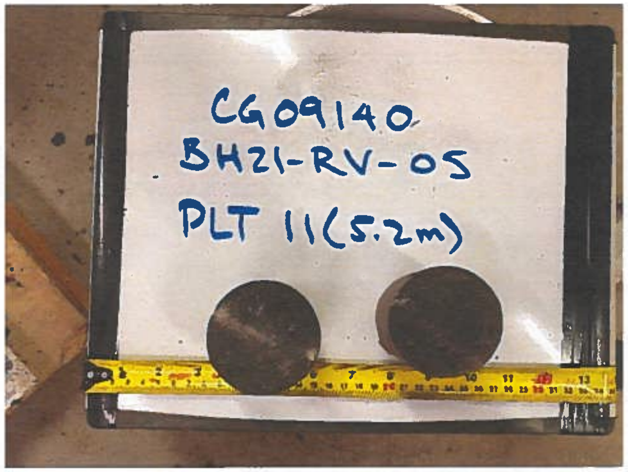


Point Load Test	PLT 10	**Point Load Test Type**	Axial
Depth (m)	4.75	**Failure Validity**	Valid

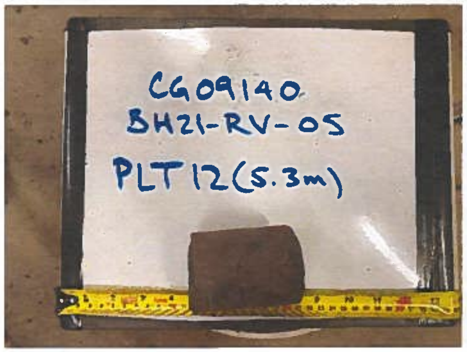




Point Load Test	PLT 11	**Point Load Test Type**	Diametral
Depth (m)	5.20	**Failure Validity**	Valid



Point Load Test	PLT 12	**Point Load Test Type**	Diametral
Depth (m)	5.30	**Failure Validity**	Valid



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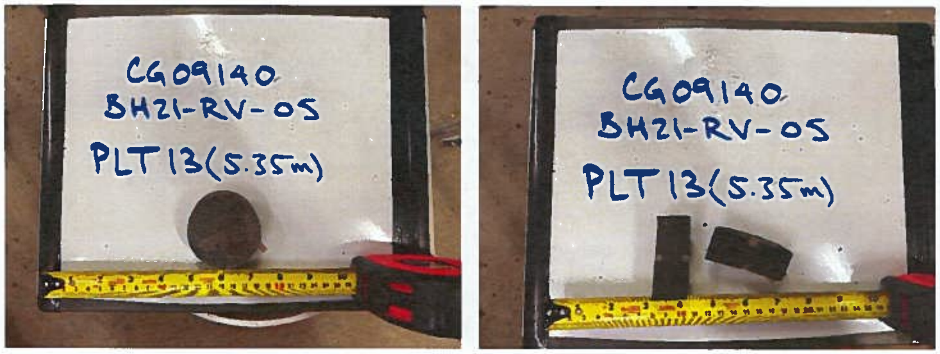
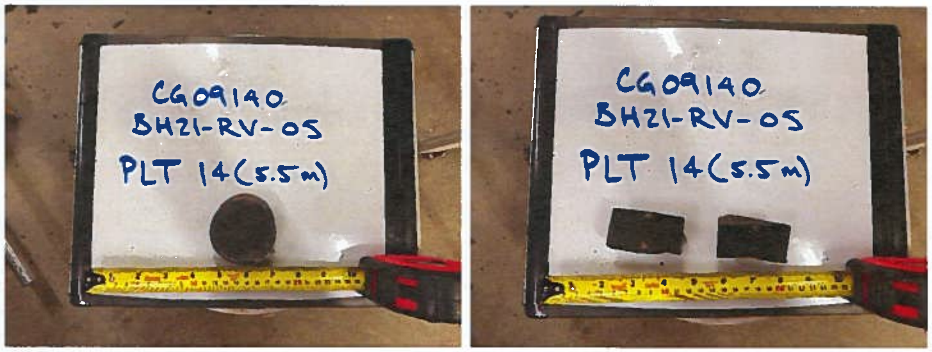
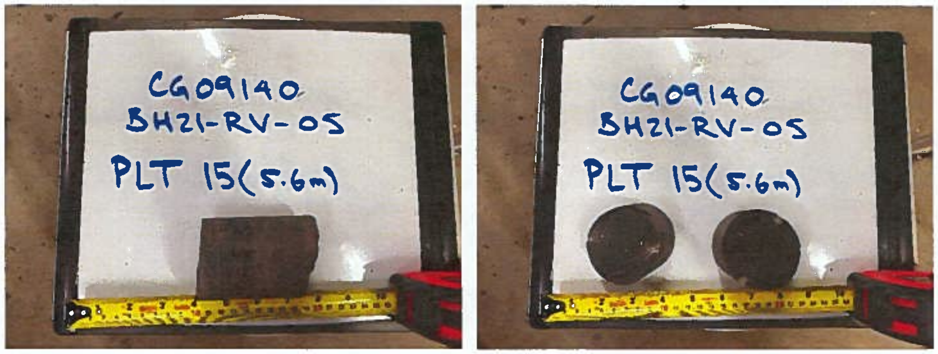
Point Load Test	PLT 13	**Point Load Test Type**	Axial
Depth (m)	5.35	**Failure Validity**	Valid



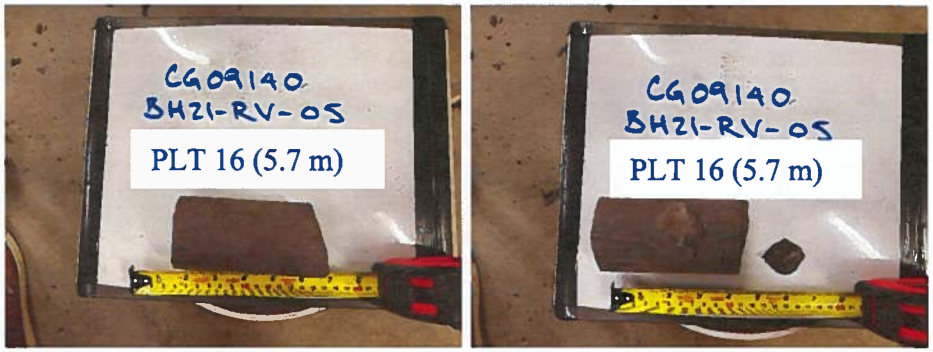
Point Load Test	PLT 14	**Point Load Test Type**	Axial
Depth (m)	5.50	**Failure Validity**	Valid



Point Load Test	PLT 15	**Point Load Test Type**	Diametral
Depth (m)	5.60	**Failure Validity**	Valid



Point Load Test	PLT 16	**Point Load Test Type**	Diametral
Depth (m)	5.70	**Failure Validity**	Invalid



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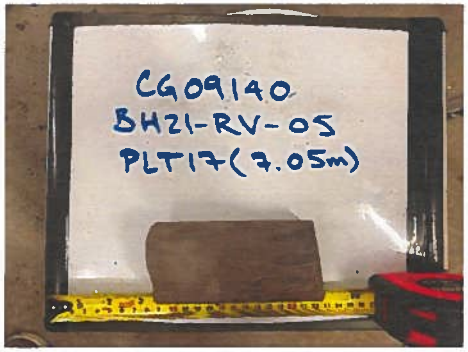
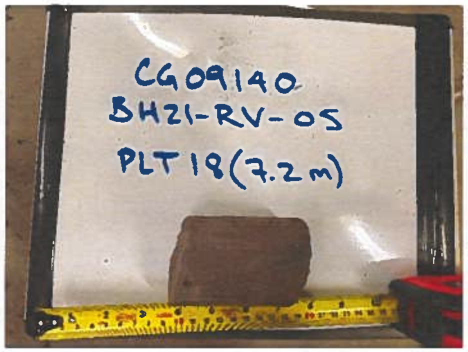
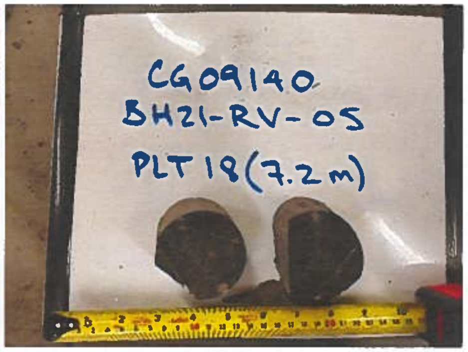
Point Load Test	PLT 17		**Point Load Test Type**	Diametral
Depth (m)	7.05		**Failure Validity**	Invalid

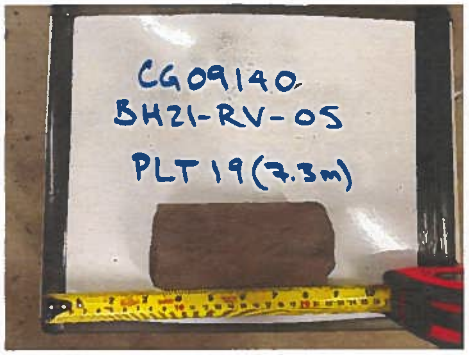


Point Load Test	PLT 18		**Point Load Test Type**	Diametral
Depth (m)	7.20		**Failure Validity**	Valid

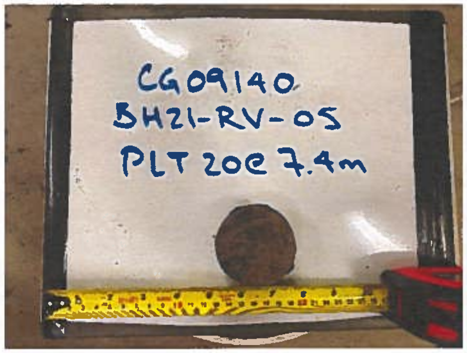




Point Load Test	PLT 19		**Point Load Test Type**	Diametral
Depth (m)	7.30		**Failure Validity**	Valid



Point Load Test	PLT 20		**Point Load Test Type**	Axial
Depth (m)	7.40		**Failure Validity**	Valid



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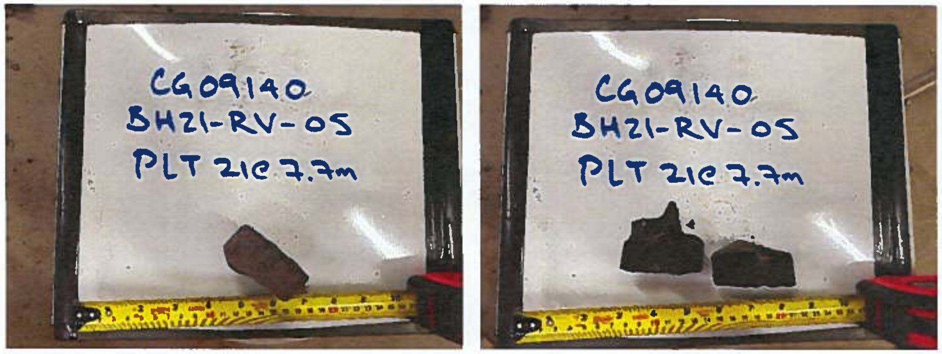
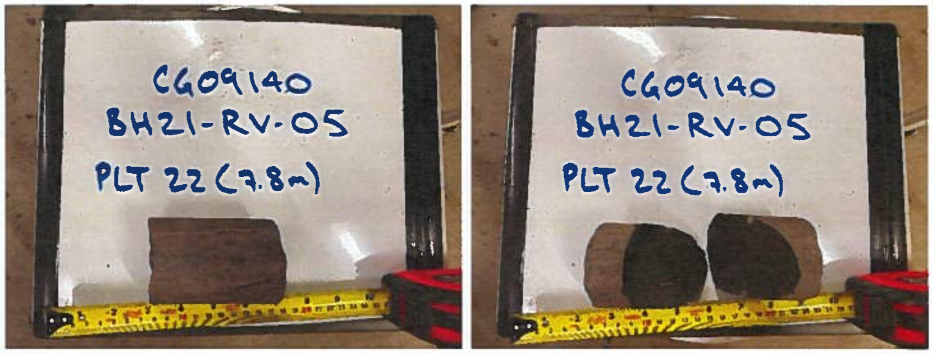
Point Load Test	PLT 21	**Point Load Test Type**	Axial
Depth (m)	7.70	**Failure Validity**	Valid

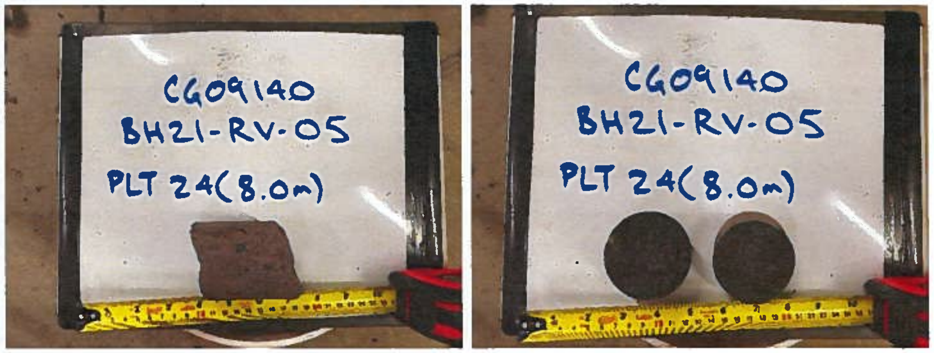


Point Load Test	PLT 22	**Point Load Test Type**	Diametral
Depth (m)	7.80	**Failure Validity**	Valid



Point Load Test	PLT 23	**Point Load Test Type**	Diametral
Depth (m)	7.90	**Failure Validity**	Valid

Point Load Test	PLT 24	**Point Load Test Type**	Diametral
Depth (m)	8.00	**Failure Validity**	Valid



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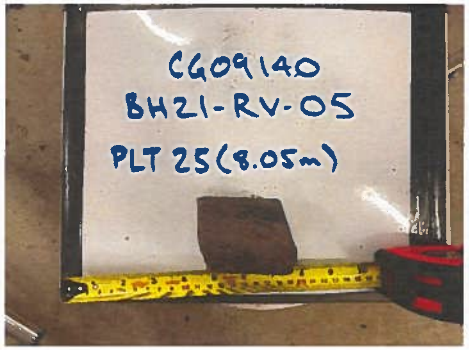
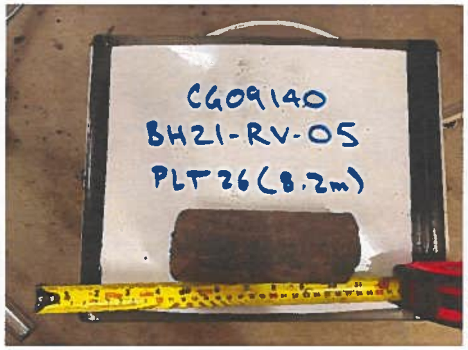
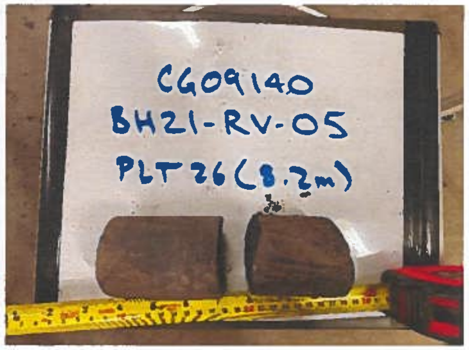
Point Load Test	PLT 25	**Point Load Test Type**	Diametral
Depth (m)	8.05	**Failure Validity**	Valid

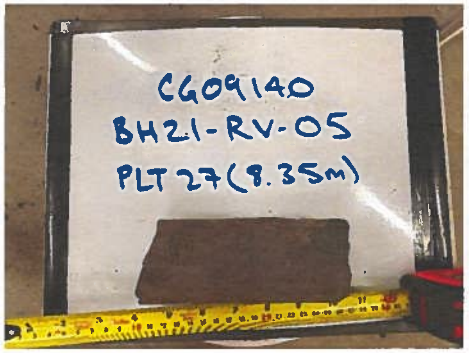


Point Load Test	PLT 26	**Point Load Test Type**	Diametral
Depth (m)	8.20	**Failure Validity**	Valid

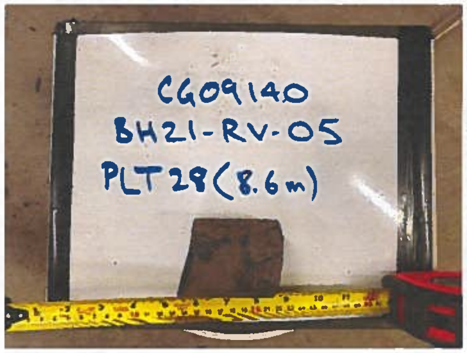




Point Load Test	PLT 27	**Point Load Test Type**	Diametral
Depth (m)	8.35	**Failure Validity**	Valid



Point Load Test	PLT 28	**Point Load Test Type**	Diametral
Depth (m)	8.60	**Failure Validity**	Valid



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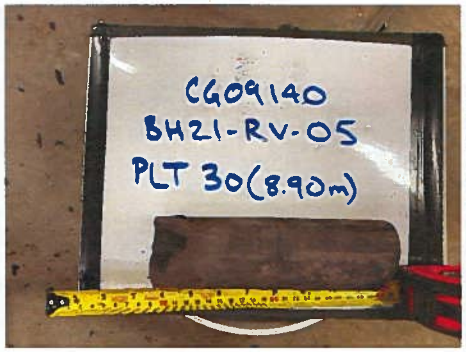
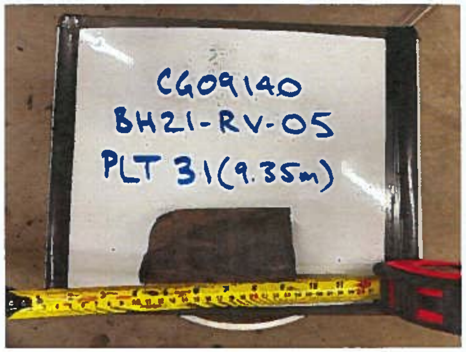
Point Load Test	PLT 29	**Point Load Test Type**	Diametral
Depth (m)	8.75	**Failure Validity**	Valid

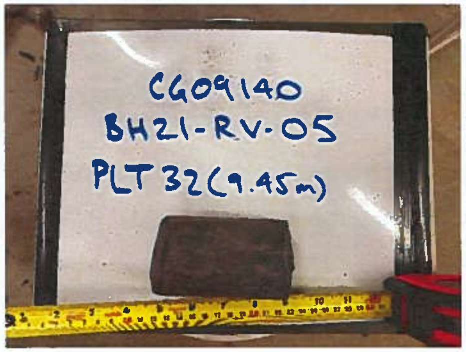
Point Load Test	PLT 30	**Point Load Test Type**	Diametral
Depth (m)	8.90	**Failure Validity**	Valid

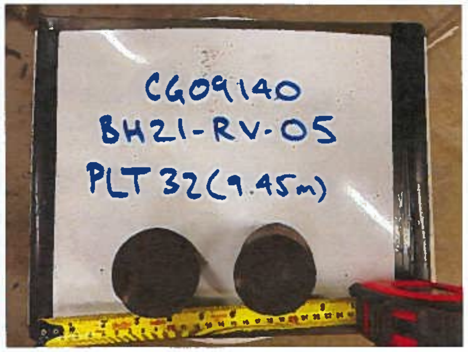


Point Load Test	PLT 31	**Point Load Test Type**	Diametral
Depth (m)	9.35	**Failure Validity**	Valid



Point Load Test	PLT 32	**Point Load Test Type**	Diametral
Depth (m)	9.45	**Failure Validity**	Valid





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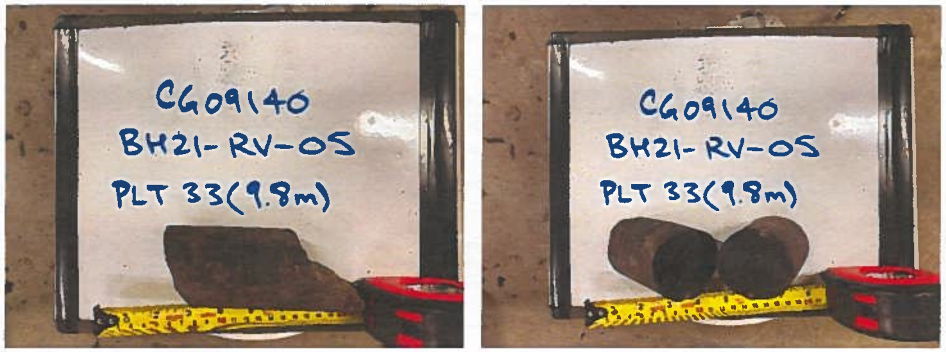
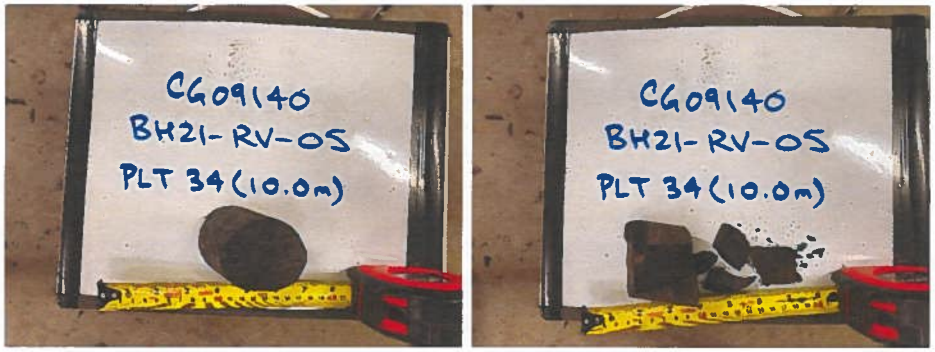
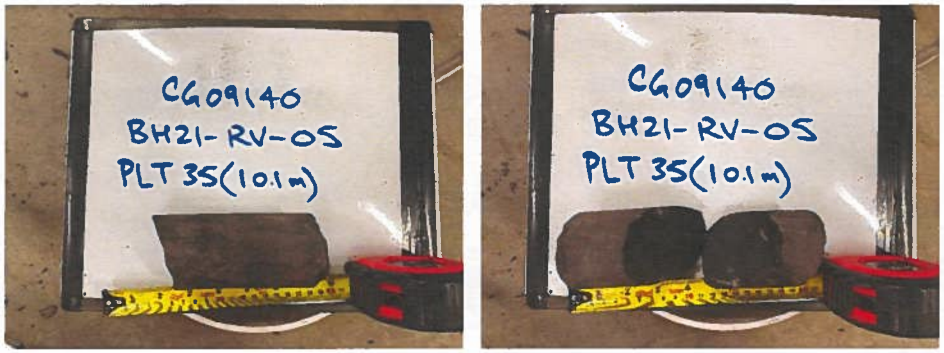
Point Load Test	PLT 33	**Point Load Test Type**	Diametral
Depth (m)	9.80	**Failure Validity**	Valid



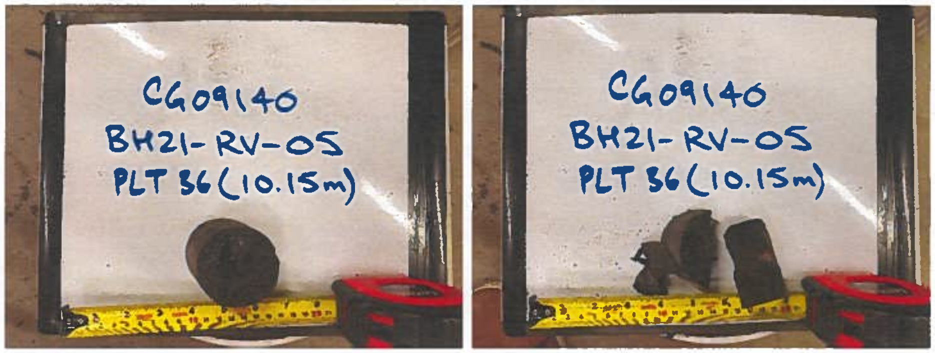
Point Load Test	PLT 34	**Point Load Test Type**	Axial
Depth (m)	10.00	**Failure Validity**	Invalid



Point Load Test	PLT 35	**Point Load Test Type**	Diametral
Depth (m)	10.10	**Failure Validity**	Valid



Point Load Test	PLT 36	**Point Load Test Type**	Axial
Depth (m)	10.15	**Failure Validity**	Valid



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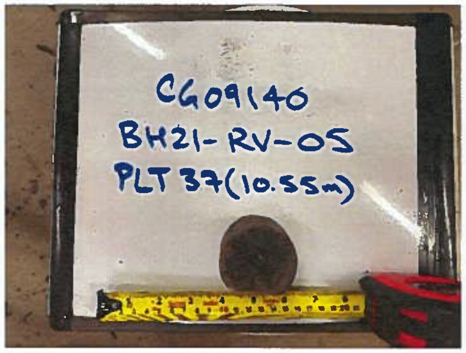
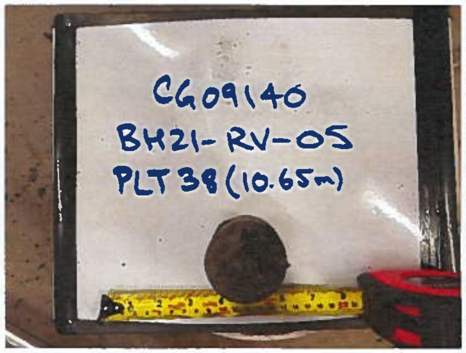
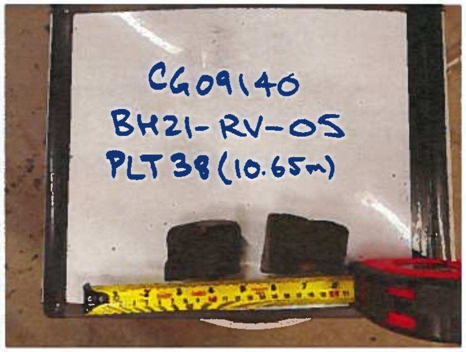
Point Load Test	PLT 37	**Point Load Test Type**	Axial
Depth (m)	10.55	**Failure Validity**	Valid

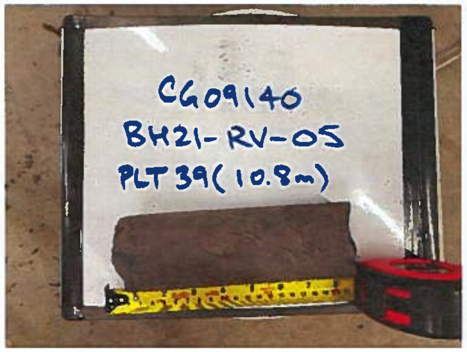


Point Load Test	PLT 38	**Point Load Test Type**	Axial
Depth (m)	10.65	**Failure Validity**	Valid

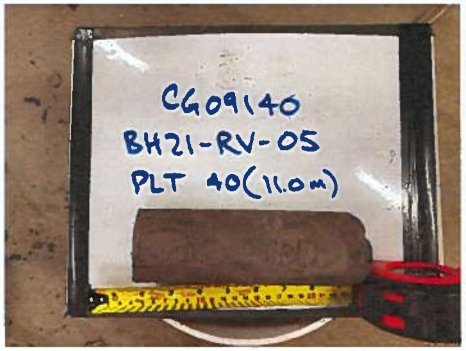




Point Load Test	PLT 39	**Point Load Test Type**	Diametral
Depth (m)	10.80	**Failure Validity**	Valid



Point Load Test	PLT 40	**Point Load Test Type**	Diametral
Depth (m)	11.00	**Failure Validity**	Valid



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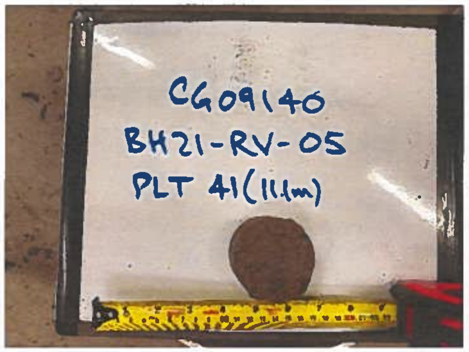
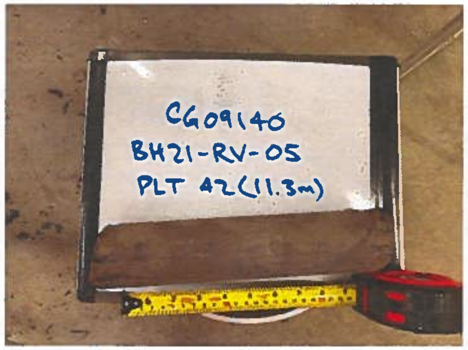
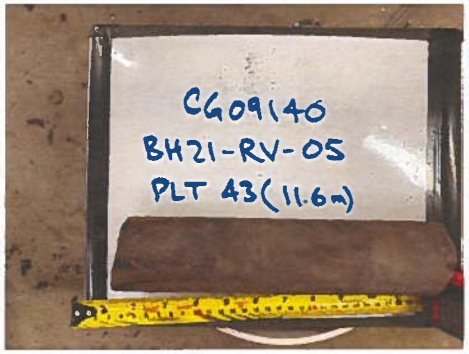
Point Load Test	PLT 41	**Point Load Test Type**	Axial
Depth (m)	11.10	**Failure Validity**	Valid

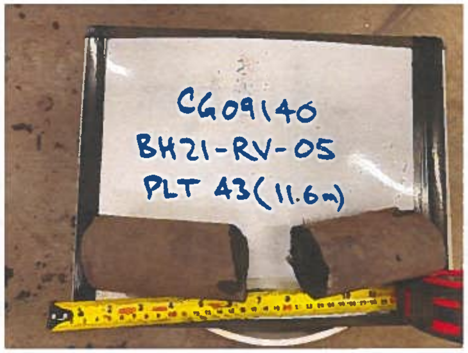


Point Load Test	PLT 42	**Point Load Test Type**	Diametral
Depth (m)	11.30	**Failure Validity**	Valid

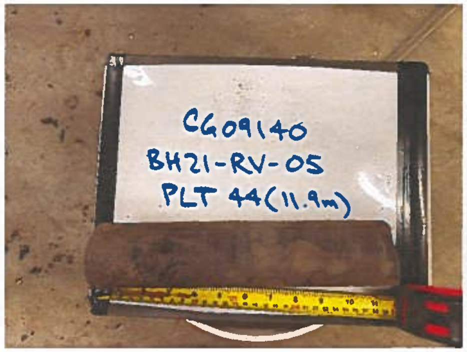


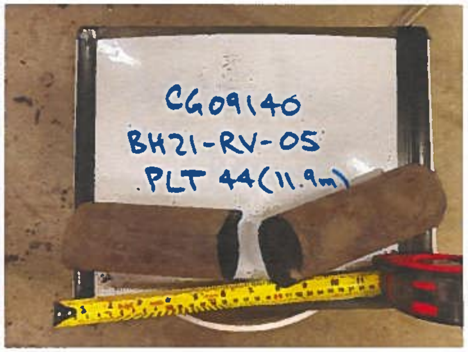
Point Load Test	PLT 43	**Point Load Test Type**	Diametral
Depth (m)	11.60	**Failure Validity**	Valid





Point Load Test	PLT 44	**Point Load Test Type**	Diametral
Depth (m)	11.90	**Failure Validity**	Valid





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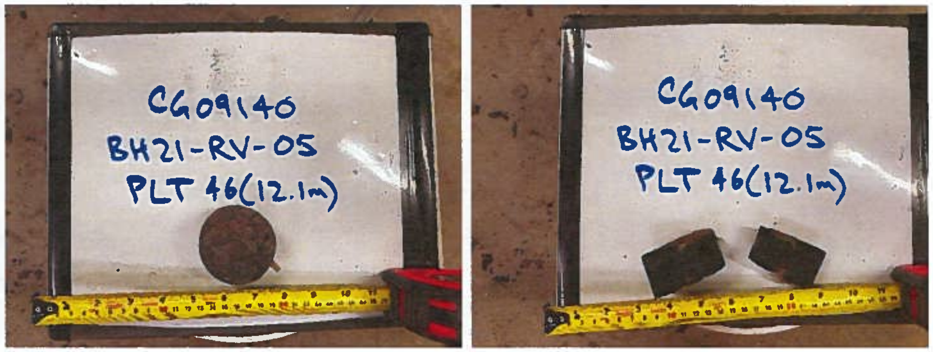
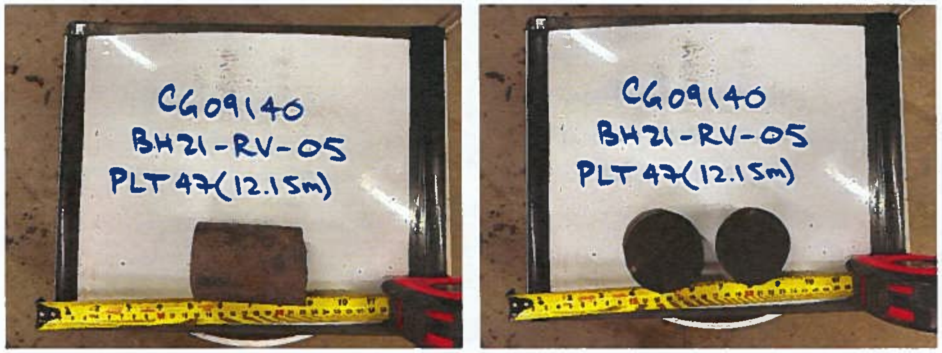
Point Load Test	PLT 45	**Point Load Test Type**	Axial
Depth (m)	12.05	**Failure Validity**	Invalid

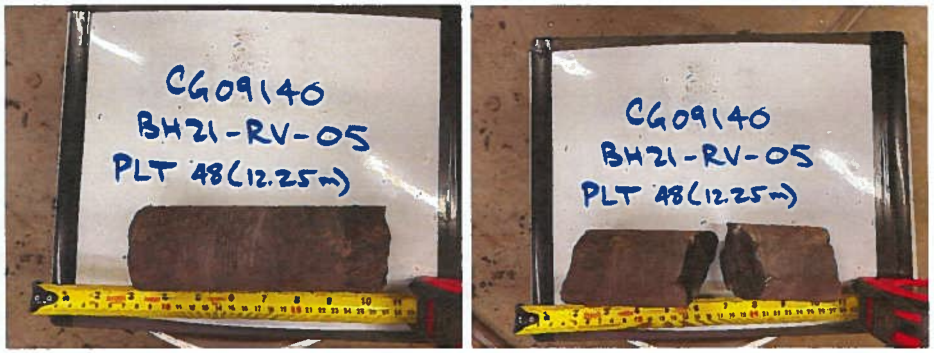
Point Load Test	PLT 46	**Point Load Test Type**	Axial
Depth (m)	12.10	**Failure Validity**	Valid



Point Load Test	PLT 47	**Point Load Test Type**	Diametral
Depth (m)	12.15	**Failure Validity**	Valid



Point Load Test	PLT 48	**Point Load Test Type**	Diametral
Depth (m)	12.25	**Failure Validity**	Valid



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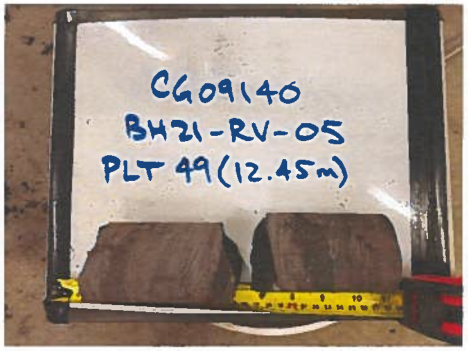
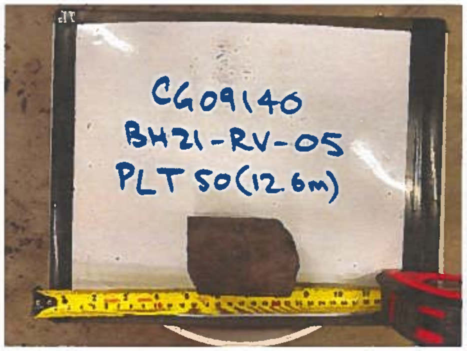
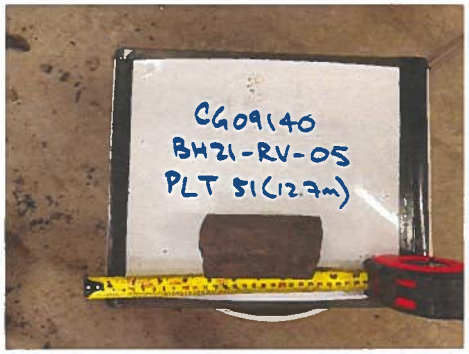
Point Load Test	PLT 49	**Point Load Test Type**	Diametral
Depth (m)	12.45	**Failure Validity**	Valid

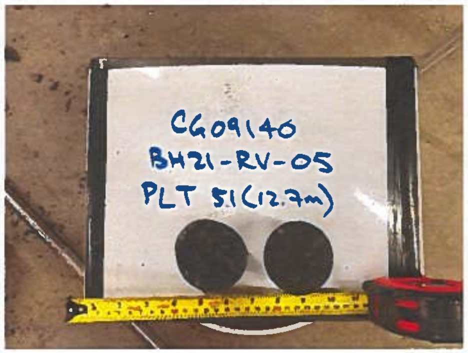


Point Load Test	PLT 50	**Point Load Test Type**	Diametral
Depth (m)	12.60	**Failure Validity**	Valid

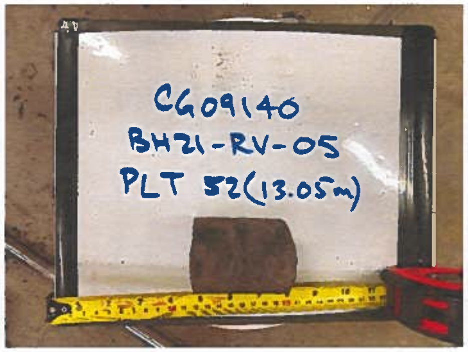


Point Load Test	PLT 51	**Point Load Test Type**	Diametral
Depth (m)	12.70	**Failure Validity**	Valid





Point Load Test	PLT 52	**Point Load Test Type**	Diametral
Depth (m)	13.05	**Failure Validity**	Valid



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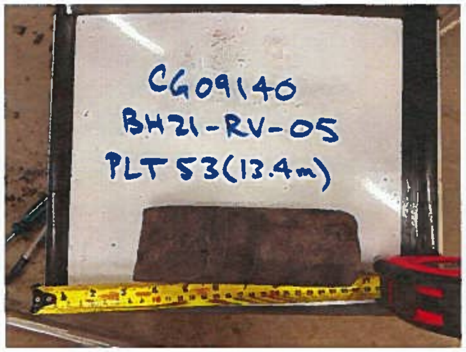
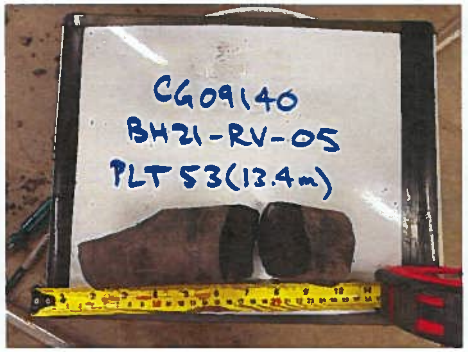
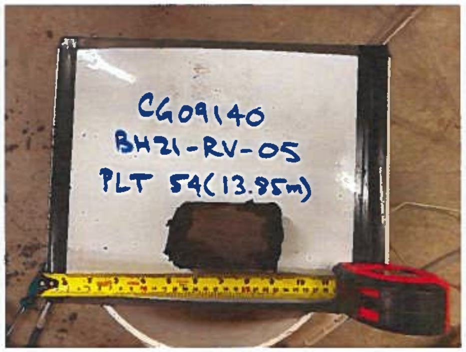
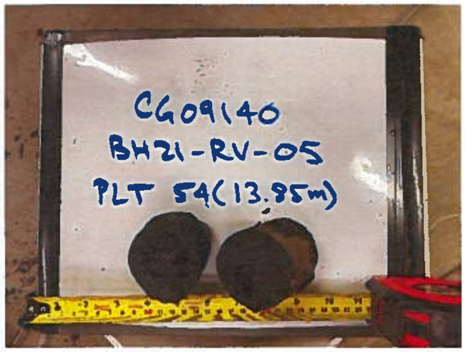
Point Load Test	PLT 53		**Point Load Test Type**	Diametral
Depth (m)	13.40		**Failure Validity**	Valid



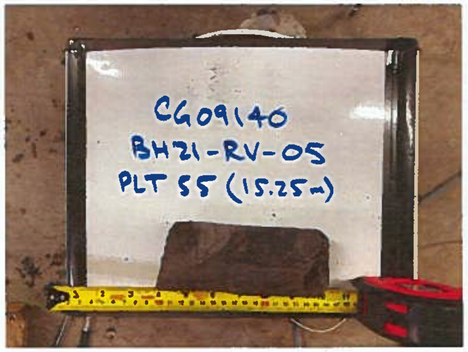


Point Load Test	PLT 54		**Point Load Test Type**	Diametral
Depth (m)	13.85		**Failure Validity**	Valid





Point Load Test	PLT 55		**Point Load Test Type**	Diametral
Depth (m)	15.25		**Failure Validity**	Valid



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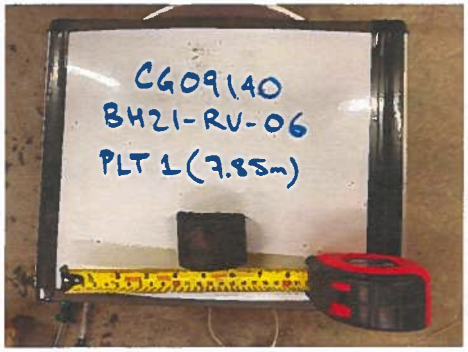
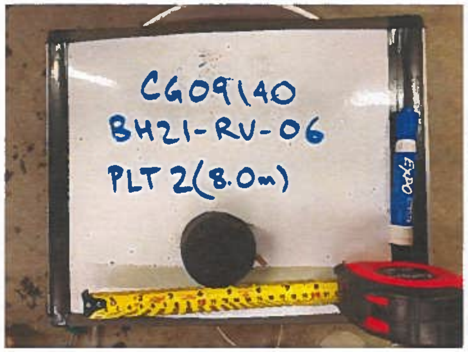
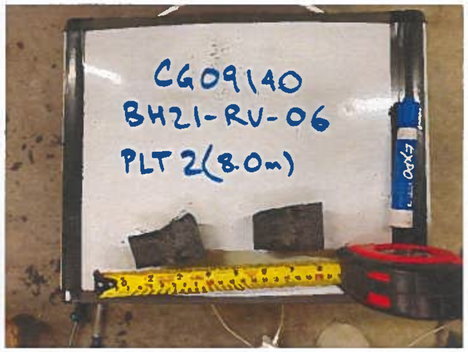
Point Load Test	PLT 1	**Point Load Test Type**	Axial
Depth (m)	7.85	**Failure Validity**	Valid

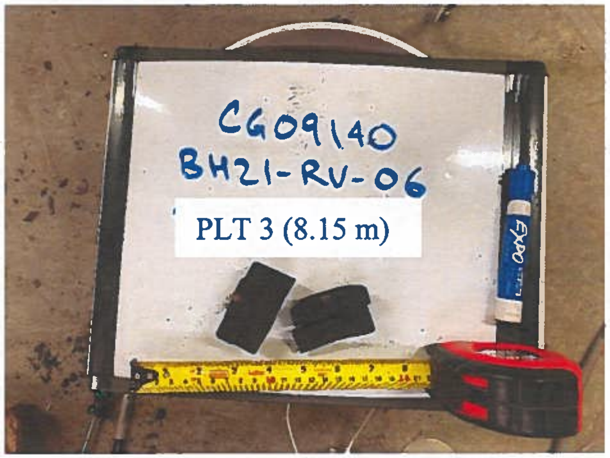


Point Load Test	PLT 2	**Point Load Test Type**	Axial
Depth (m)	8.00	**Failure Validity**	Valid

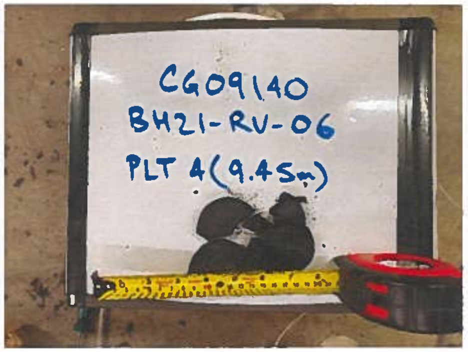




Point Load Test	PLT 3	**Point Load Test Type**	Axial
Depth (m)	8.15	**Failure Validity**	Valid



Point Load Test	PLT 4	**Point Load Test Type**	Axial
Depth (m)	9.45	**Failure Validity**	Valid



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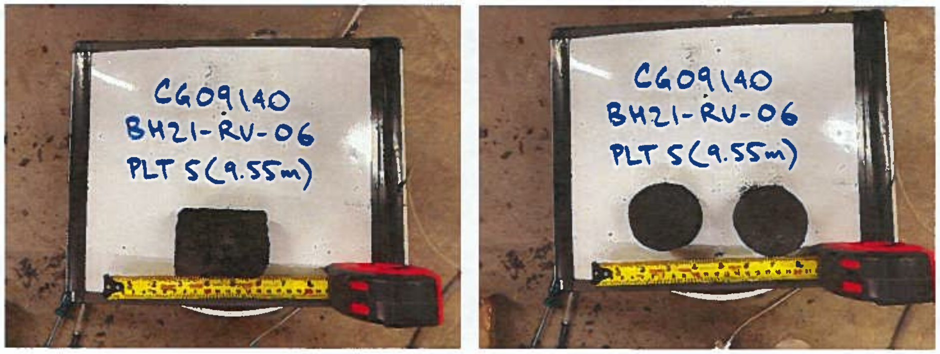
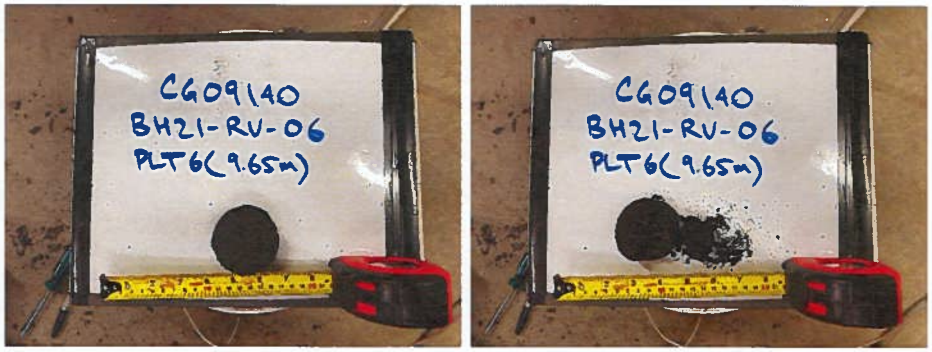
Point Load Test	PLT 5		**Point Load Test Type**	Diametral
Depth (m)	9.55		**Failure Validity**	Valid

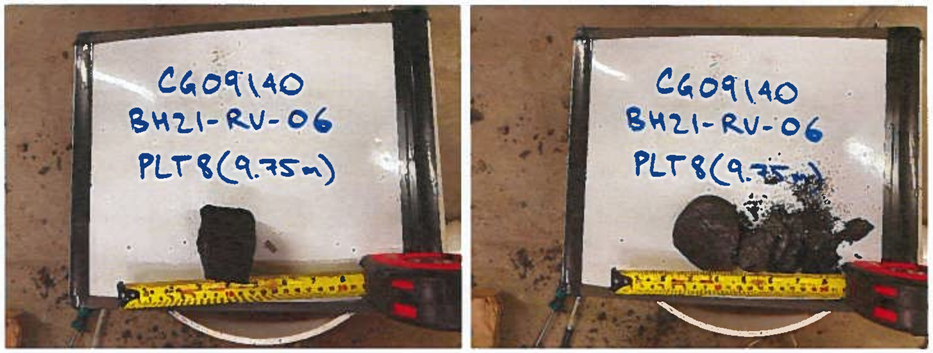


Point Load Test	PLT 6		**Point Load Test Type**	Axial
Depth (m)	9.65		**Failure Validity**	Invalid



Point Load Test	PLT 7		**Point Load Test Type**	Axial
Depth (m)	9.70		**Failure Validity**	Invalid

Point Load Test	PLT 8		**Point Load Test Type**	Axial
Depth (m)	9.75		**Failure Validity**	Invalid



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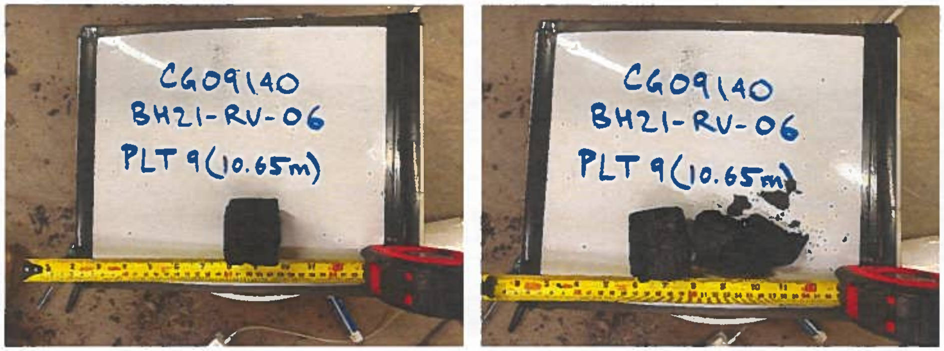
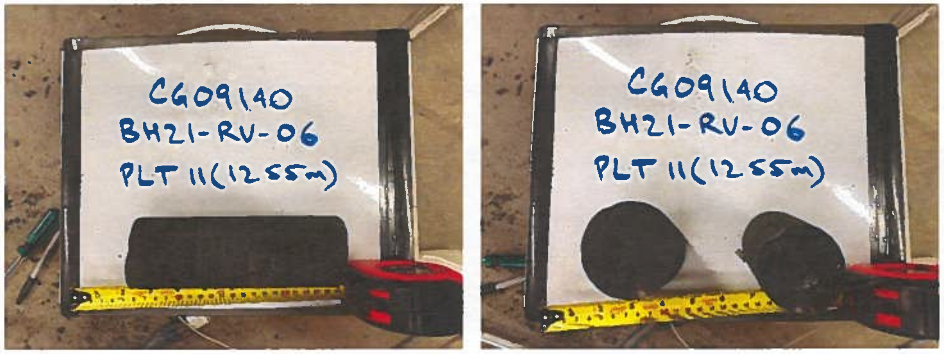
Point Load Test	PLT 9	**Point Load Test Type**	Axial
Depth (m)	10.65	**Failure Validity**	Valid

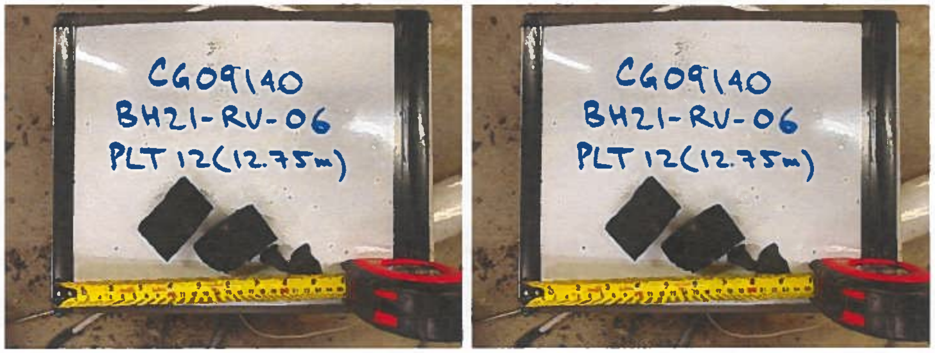


Point Load Test	PLT 10	**Point Load Test Type**	Axial
Depth (m)	11.05	**Failure Validity**	Valid

Point Load Test	PLT 11	**Point Load Test Type**	Diametral
Depth (m)	12.55	**Failure Validity**	Valid



Point Load Test	PLT 12	**Point Load Test Type**	Axial
Depth (m)	12.75	**Failure Validity**	Valid



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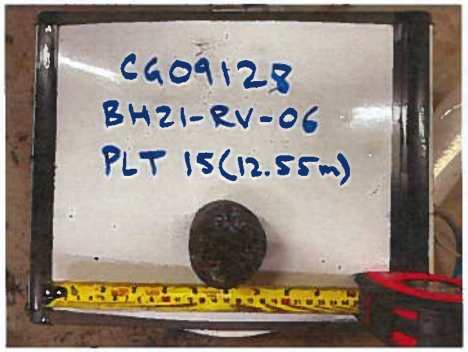
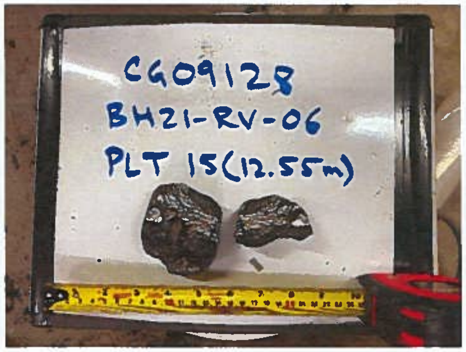
Point Load Test	PLT 13	Point Load Test Type	Diametral
Depth (m)	12.90	**Failure Validity**	Valid

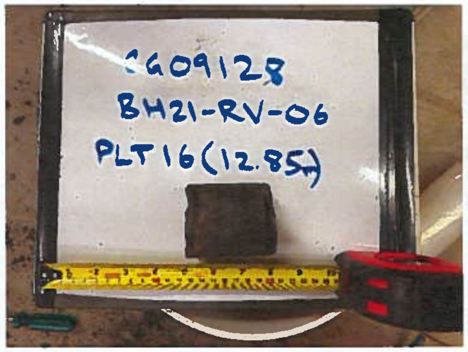
Point Load Test	PLT 14	Point Load Test Type	Axial
Depth (m)	12.40	**Failure Validity**	Valid

Point Load Test	PLT 15	Point Load Test Type	Axial
Depth (m)	12.55	**Failure Validity**	Valid





Point Load Test	PLT 16	Point Load Test Type	Diametral
Depth (m)	12.85	**Failure Validity**	Valid



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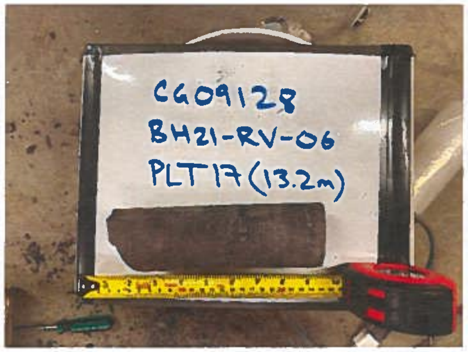
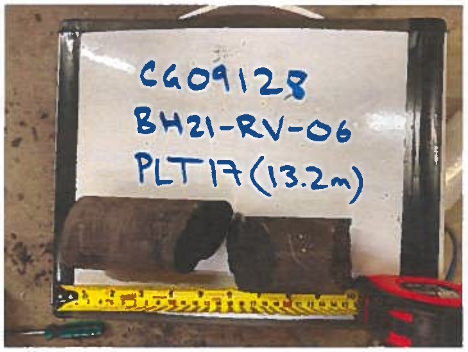
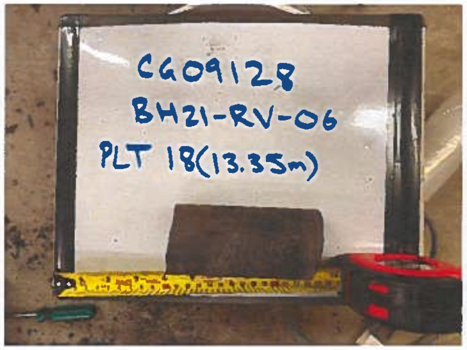
Point Load Test	PLT 17	**Point Load Test Type**	Diametral
Depth (m)	13.20	**Failure Validity**	Valid

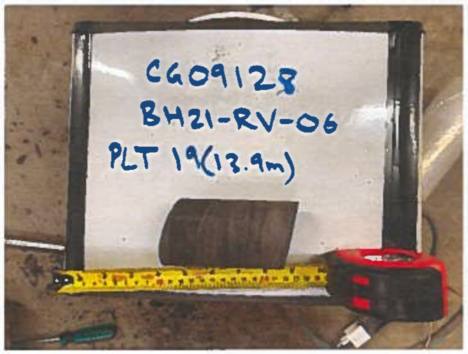




Point Load Test	PLT 18	**Point Load Test Type**	Diametral
Depth (m)	13.35	**Failure Validity**	Valid



Point Load Test	PLT 19	**Point Load Test Type**	Diametral
Depth (m)	13.90	**Failure Validity**	Valid



Point Load Test	PLT 20	**Point Load Test Type**	Diametral
Depth (m)	14.25	**Failure Validity**	Valid

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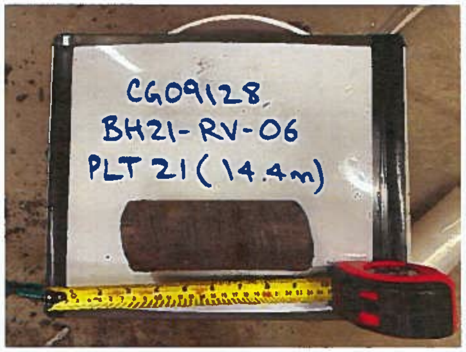
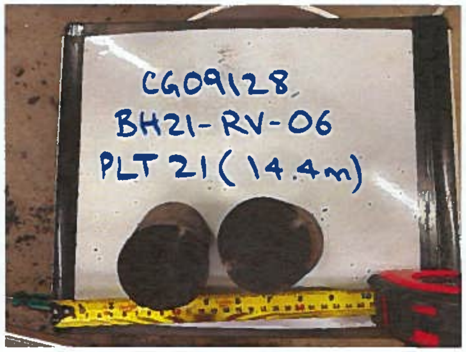
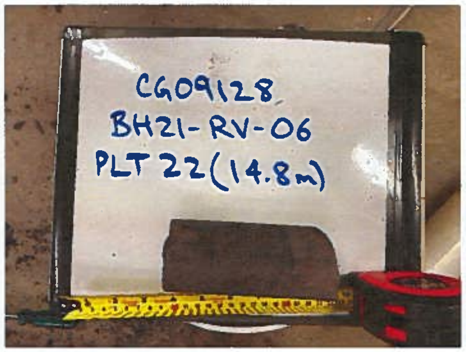
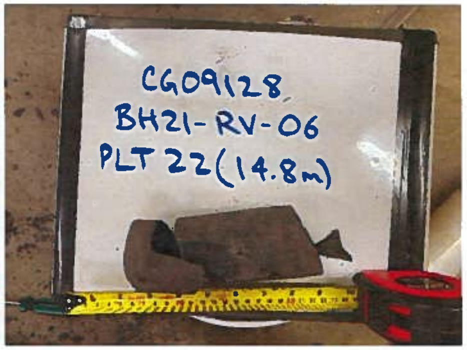
Point Load Test	PLT 21	**Point Load Test Type**	Diametral
Depth (m)	14.40	**Failure Validity**	Valid



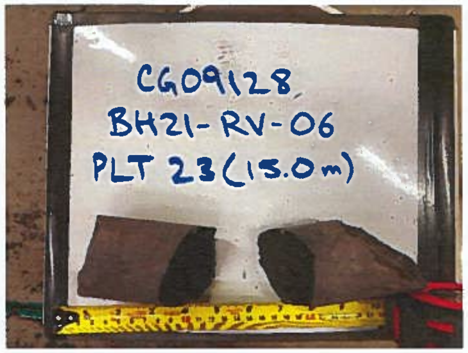


Point Load Test	PLT 22	**Point Load Test Type**	Diametral
Depth (m)	14.80	**Failure Validity**	Invalid





Point Load Test	PLT 23	**Point Load Test Type**	Diametral
Depth (m)	15.00	**Failure Validity**	Valid



Point Load Test	PLT 24	**Point Load Test Type**	Axial
Depth (m)	15.45	**Failure Validity**	Valid

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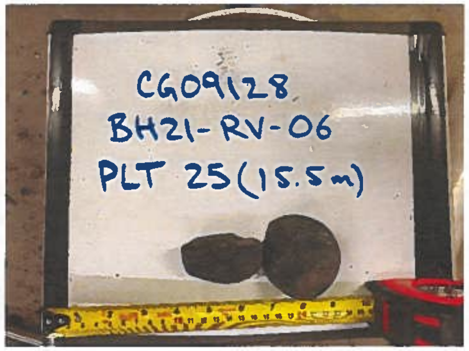
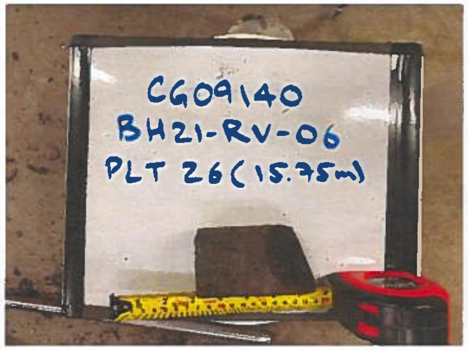
Point Load Test	PLT 25
Depth (m)	15.50

Point Load Test Type	Axial
Failure Validity	Invalid



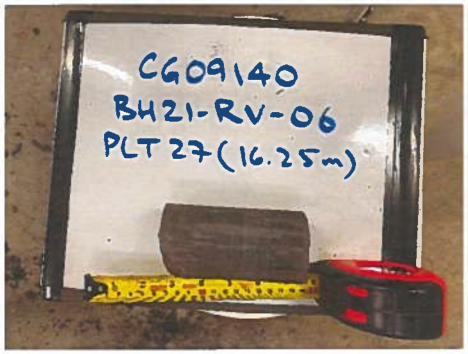
Point Load Test	PLT 26
Depth (m)	15.75

Point Load Test Type	Diametral
Failure Validity	Valid



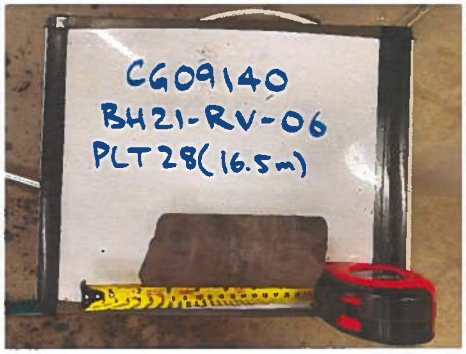
Point Load Test	PLT 27
Depth (m)	16.25

Point Load Test Type	Diametral
Failure Validity	Valid



Point Load Test	PLT 28
Depth (m)	16.50

Point Load Test Type	Diametral
Failure Validity	Valid



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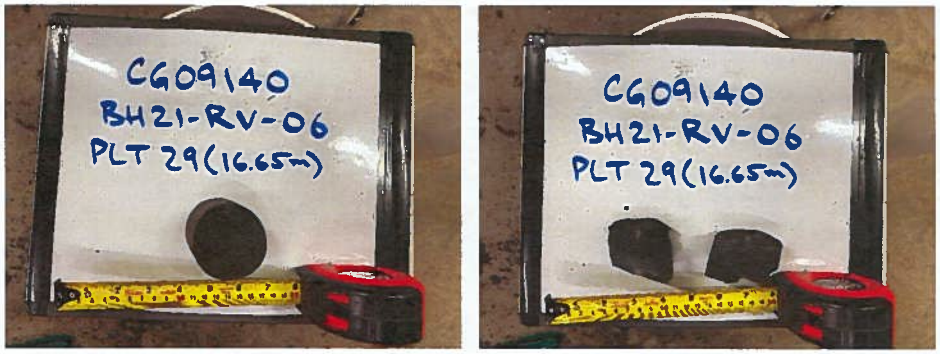
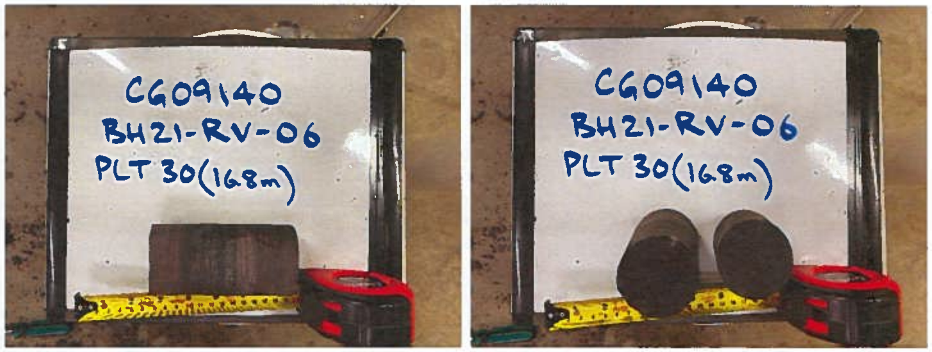
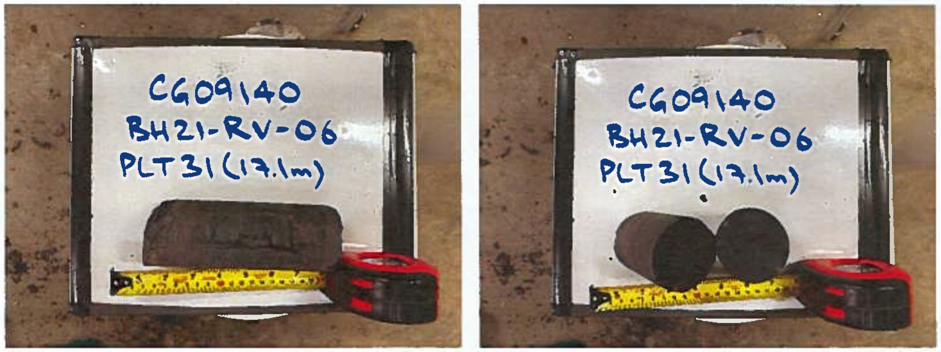
Point Load Test	PLT 29	**Point Load Test Type**	Axial
Depth (m)	16.65	**Failure Validity**	Valid



Point Load Test	PLT 30	**Point Load Test Type**	Diametral
Depth (m)	16.80	**Failure Validity**	Valid



Point Load Test	PLT 31	**Point Load Test Type**	Diametral
Depth (m)	17.10	**Failure Validity**	Valid



Point Load Test	PLT 32	**Point Load Test Type**	Diametral
Depth (m)	17.30	**Failure Validity**	Valid

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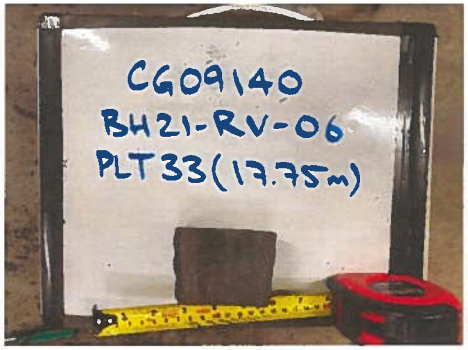
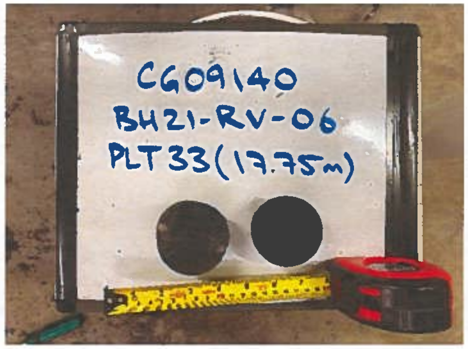
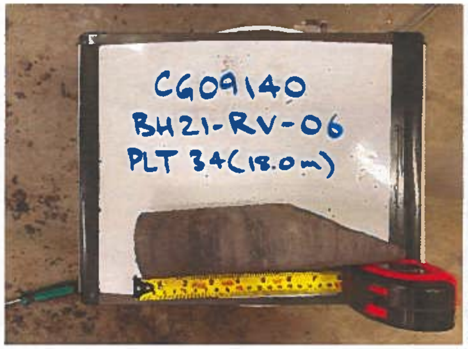
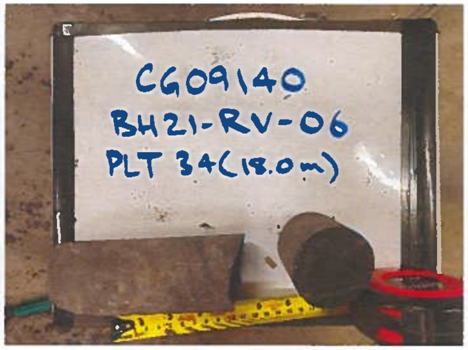
Point Load Test	PLT 33	**Point Load Test Type**	Diametral
Depth (m)	17.75	**Failure Validity**	Valid



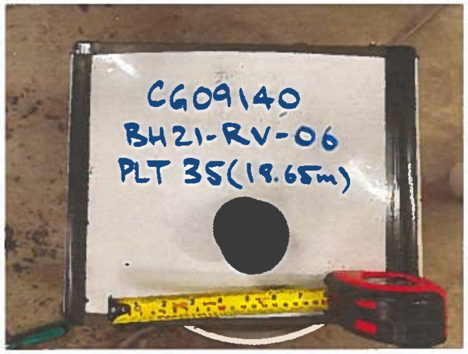


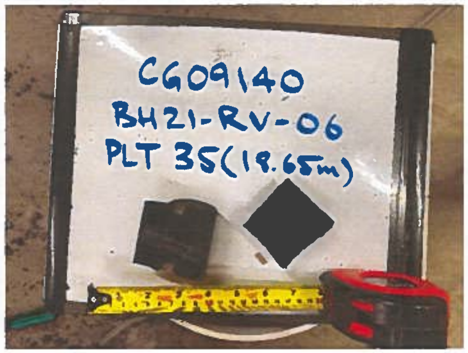
Point Load Test	PLT 34	**Point Load Test Type**	Diametral
Depth (m)	18.00	**Failure Validity**	Valid



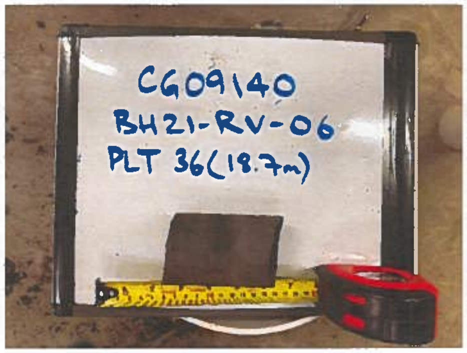


Point Load Test	PLT 35	**Point Load Test Type**	Axial
Depth (m)	18.65	**Failure Validity**	Valid





Point Load Test	PLT 36	**Point Load Test Type**	Diametral
Depth (m)	18.70	**Failure Validity**	Valid



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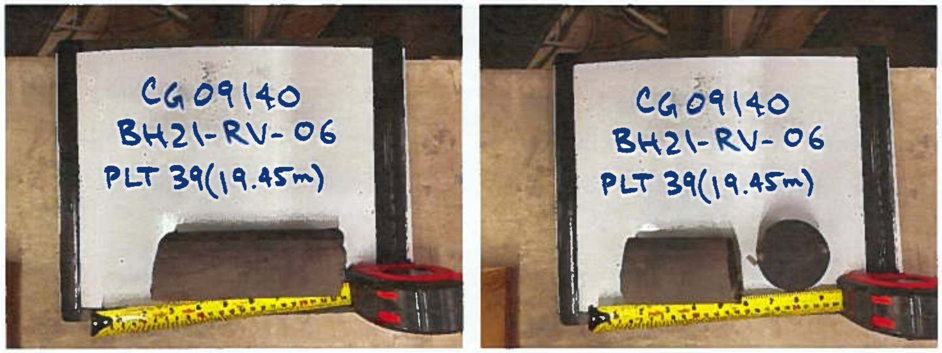
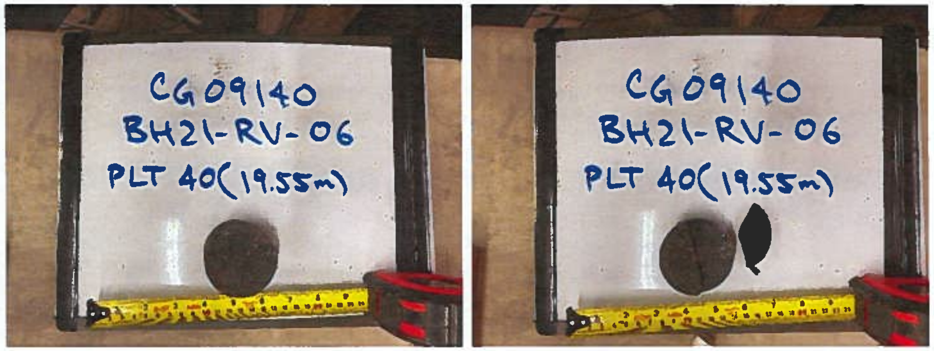
Point Load Test	PLT 37	**Point Load Test Type**	Axial
Depth (m)	18.95	**Failure Validity**	Valid

Point Load Test	PLT 38	**Point Load Test Type**	Diametral
Depth (m)	19.10	**Failure Validity**	Valid

Point Load Test	PLT 39	**Point Load Test Type**	Diametral
Depth (m)	19.45	**Failure Validity**	Valid



Point Load Test	PLT 40	**Point Load Test Type**	Axial
Depth (m)	19.55	**Failure Validity**	Invalid



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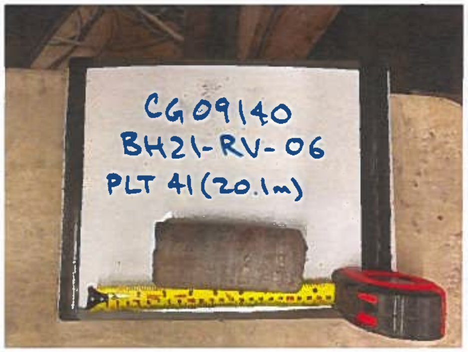
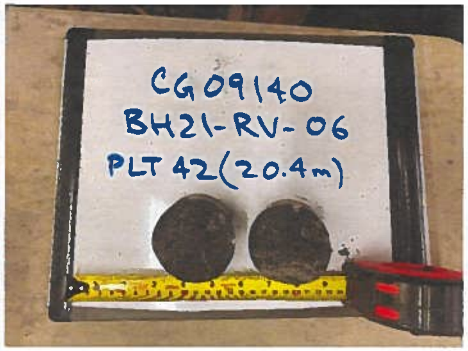
Point Load Test	PLT 41	**Point Load Test Type**	Diametral
Depth (m)	20.10	**Failure Validity**	Valid

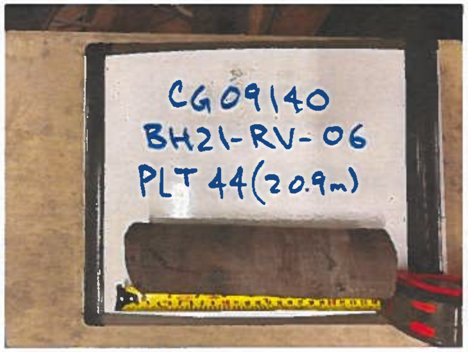


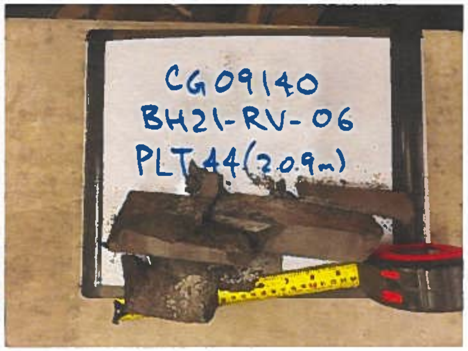
Point Load Test	PLT 42	**Point Load Test Type**	Diametral
Depth (m)	20.40	**Failure Validity**	Valid



Point Load Test	PLT 43	**Point Load Test Type**	Axial
Depth (m)	20.55	**Failure Validity**	Valid

Point Load Test	PLT 44	**Point Load Test Type**	Diametral
Depth (m)	20.90	**Failure Validity**	Invalid





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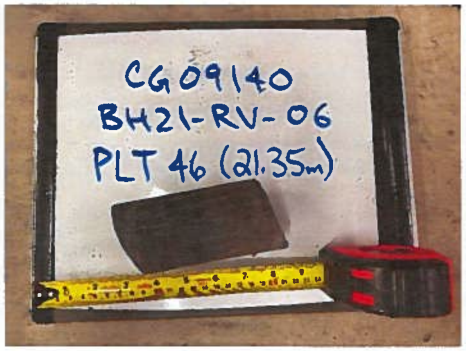
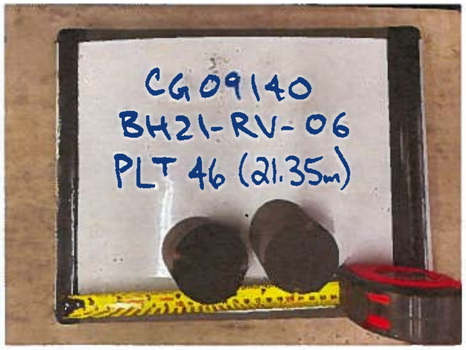
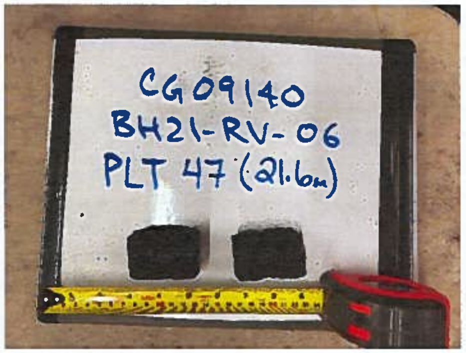
Point Load Test	PLT 45	**Point Load Test Type**	Axial
Depth (m)	21.30	**Failure Validity**	Valid

Point Load Test	PLT 46	**Point Load Test Type**	Diametral
Depth (m)	21.35	**Failure Validity**	Valid





Point Load Test	PLT 47	**Point Load Test Type**	Axial
Depth (m)	21.60	**Failure Validity**	Valid



Point Load Test	PLT 48	**Point Load Test Type**	Axial
Depth (m)	21.80	**Failure Validity**	Invalid

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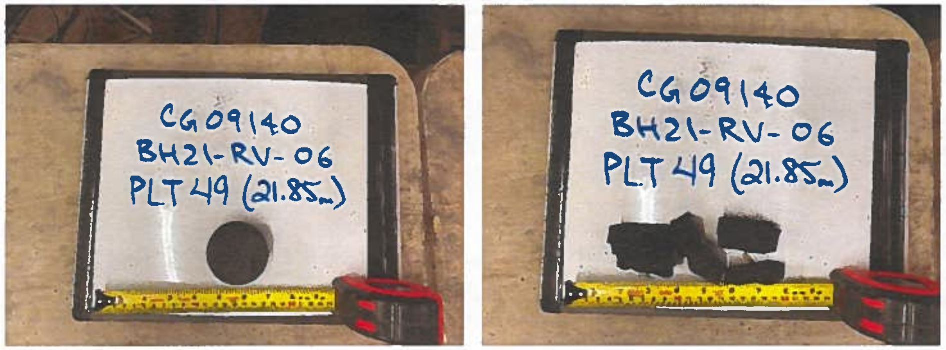
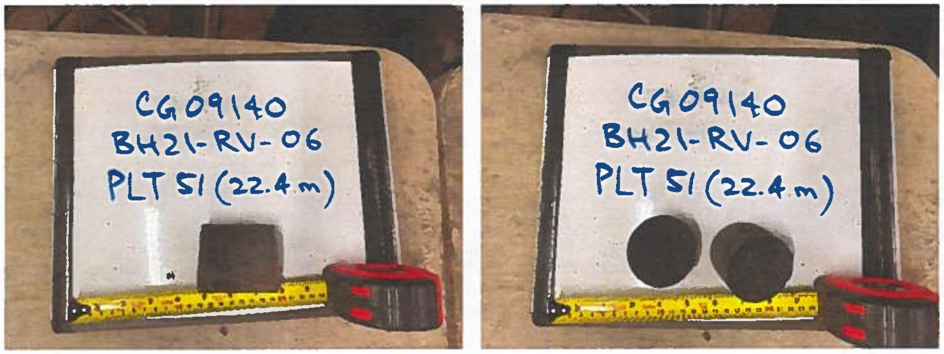
Point Load Test	PLT 49	**Point Load Test Type**	Axial
Depth (m)	21.85	**Failure Validity**	Valid

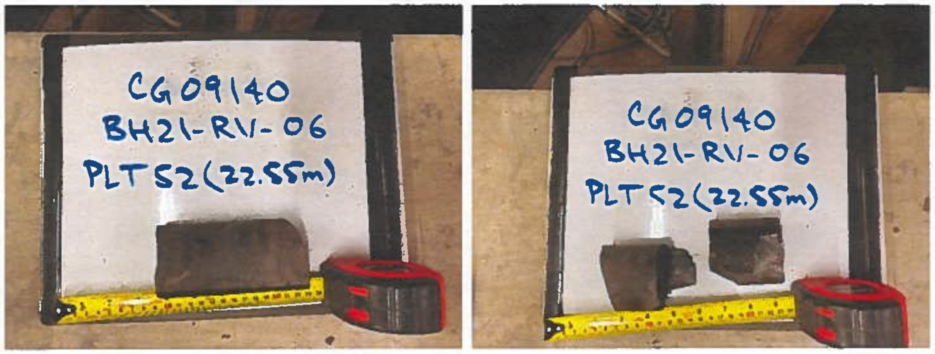


Point Load Test	PLT 50	**Point Load Test Type**	Axial
Depth (m)	22.20	**Failure Validity**	Invalid

Point Load Test	PLT 51	**Point Load Test Type**	Diametral
Depth (m)	22.40	**Failure Validity**	Valid



Point Load Test	PLT 52	**Point Load Test Type**	Diametral
Depth (m)	22.55	**Failure Validity**	Valid



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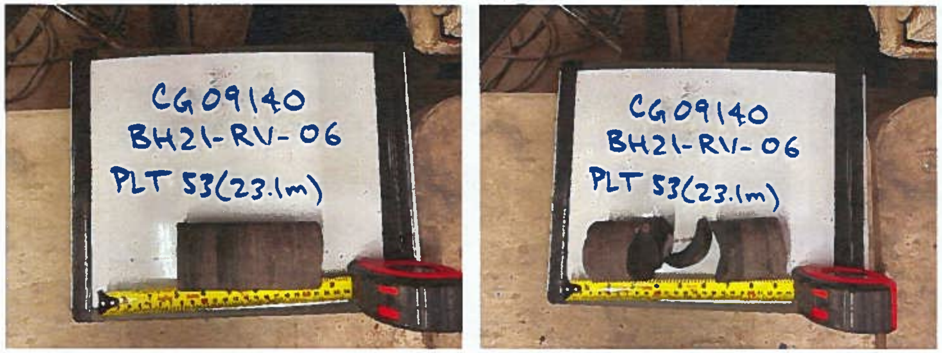
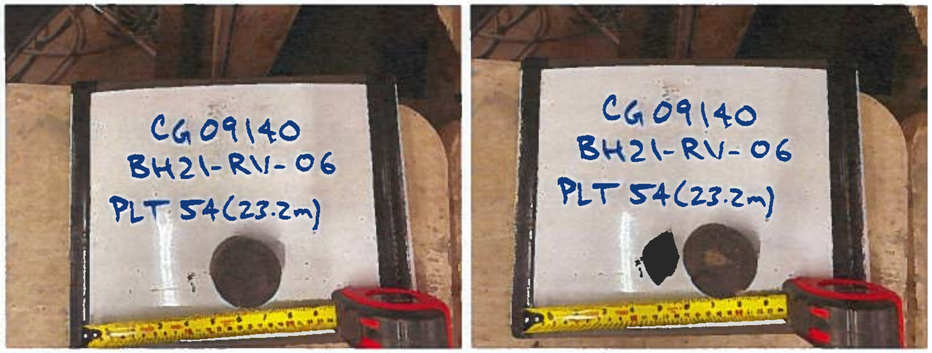
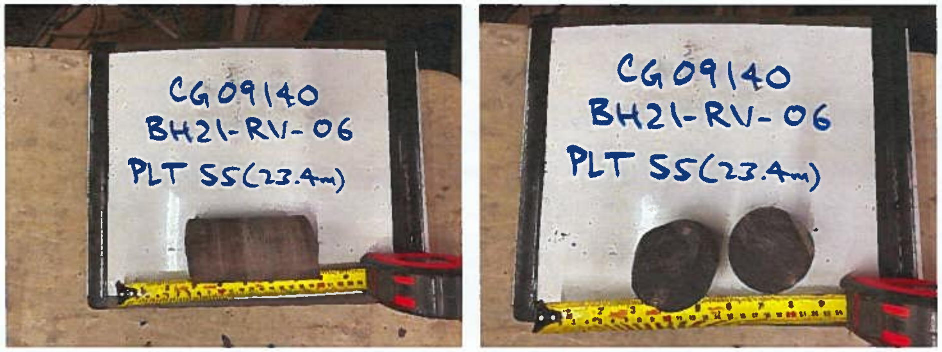
Point Load Test	PLT 53	**Point Load Test Type**	Diametral
Depth (m)	23.10	**Failure Validity**	Valid



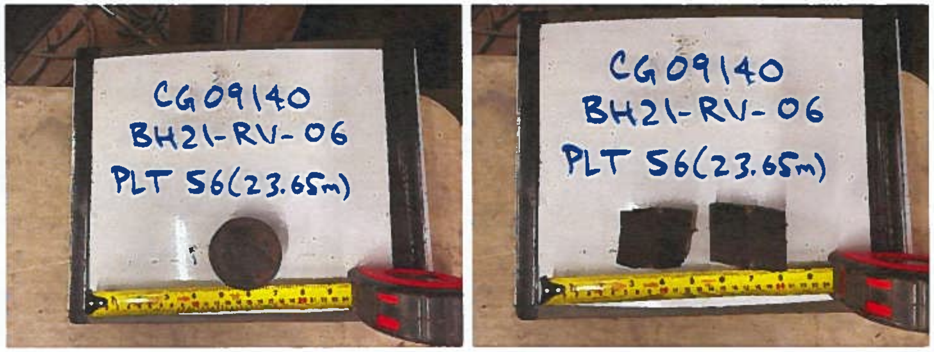
Point Load Test	PLT 54	**Point Load Test Type**	Axial
Depth (m)	23.20	**Failure Validity**	Invalid



Point Load Test	PLT 55	**Point Load Test Type**	Diametral
Depth (m)	23.40	**Failure Validity**	Valid



Point Load Test	PLT 56	**Point Load Test Type**	Axial
Depth (m)	23.65	**Failure Validity**	Valid



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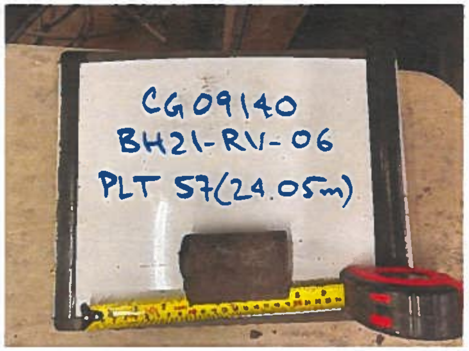
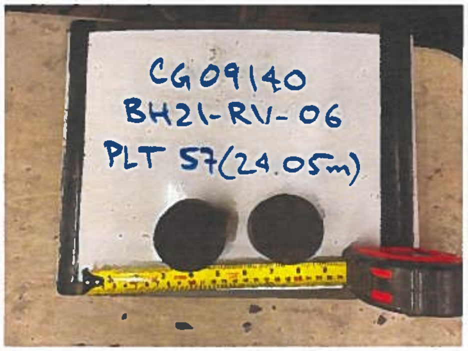
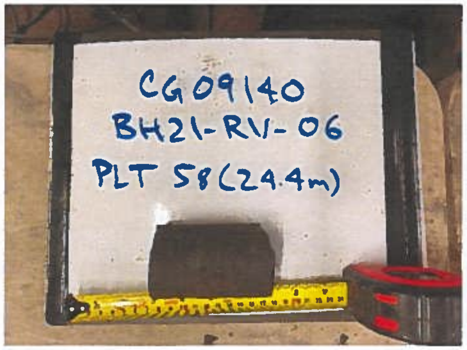
Point Load Test	PLT 57	**Point Load Test Type**	Diametral
Depth (m)	24.05	**Failure Validity**	Valid

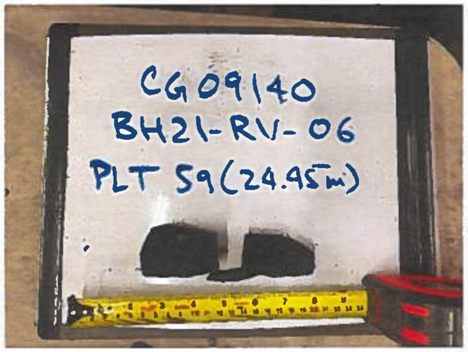




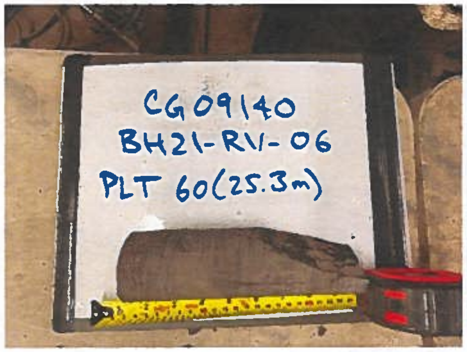
Point Load Test	PLT 58	**Point Load Test Type**	Diametral
Depth (m)	24.40	**Failure Validity**	Valid

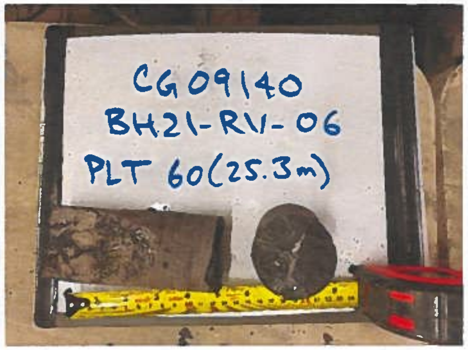


Point Load Test	PLT 59	**Point Load Test Type**	Axial
Depth (m)	24.45	**Failure Validity**	Valid



Point Load Test	PLT 60	**Point Load Test Type**	Diametral
Depth (m)	25.30	**Failure Validity**	Valid





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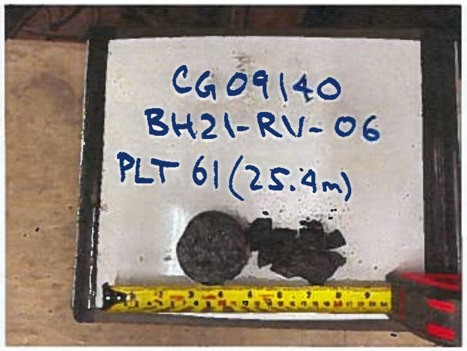
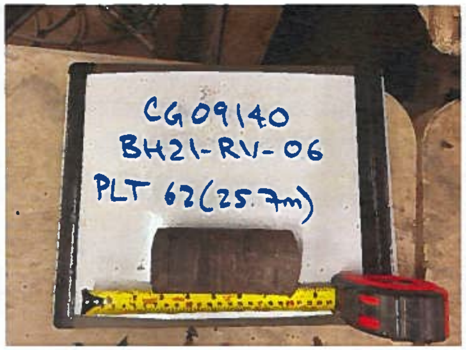
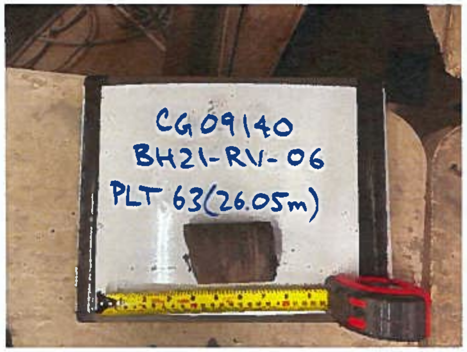
Point Load Test	PLT 61	**Point Load Test Type**	Axial
Depth (m)	25.40	**Failure Validity**	Invalid



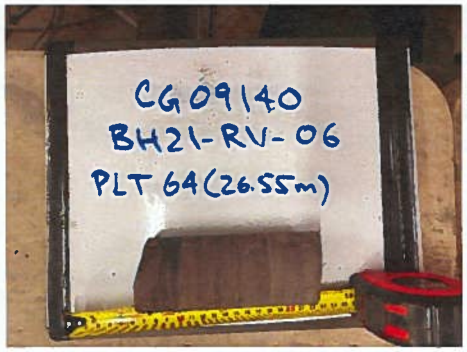
Point Load Test	PLT 62	**Point Load Test Type**	Diametral
Depth (m)	25.70	**Failure Validity**	Valid



Point Load Test	PLT 63	**Point Load Test Type**	Diametral
Depth (m)	26.05	**Failure Validity**	Valid



Point Load Test	PLT 64	**Point Load Test Type**	Diametral
Depth (m)	26.55	**Failure Validity**	Valid



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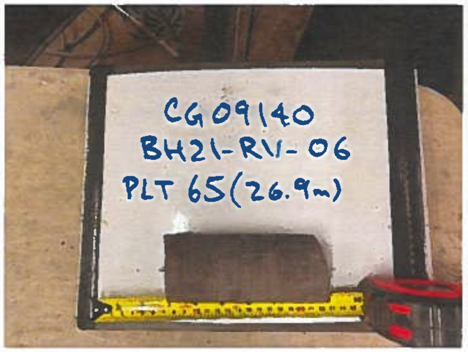
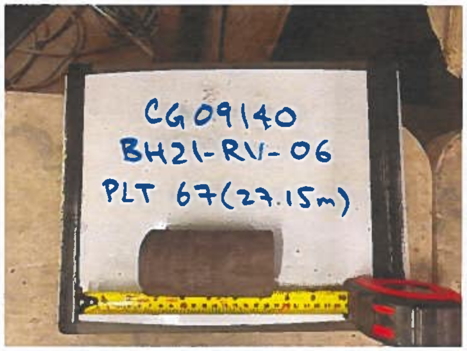
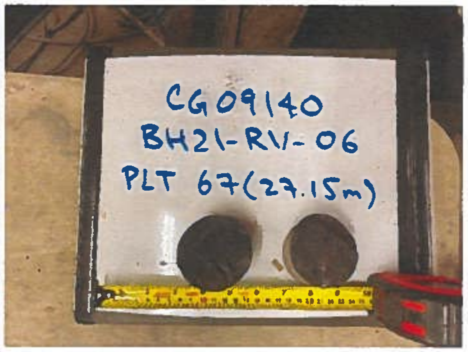
Point Load Test	PLT 65	**Point Load Test Type**	Diametral
Depth (m)	26.90	**Failure Validity**	Valid

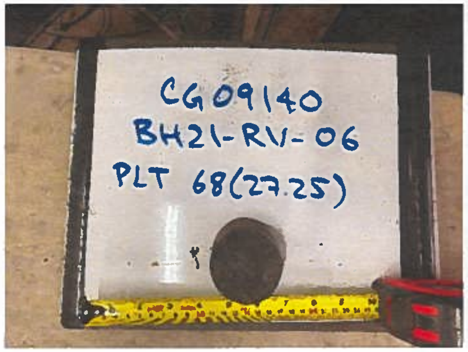


Point Load Test	PLT 67	**Point Load Test Type**	Diametral
Depth (m)	27.15	**Failure Validity**	Valid

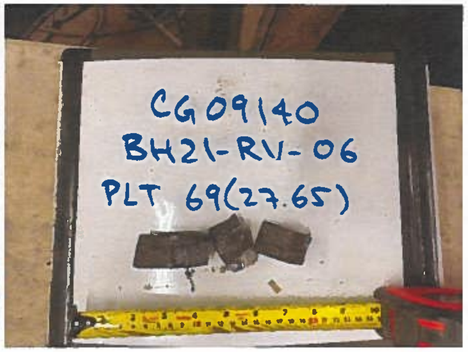




Point Load Test	PLT 68	**Point Load Test Type**	Axial
Depth (m)	27.25	**Failure Validity**	Invalid



Point Load Test	PLT 69	**Point Load Test Type**	Axial
Depth (m)	27.65	**Failure Validity**	Valid



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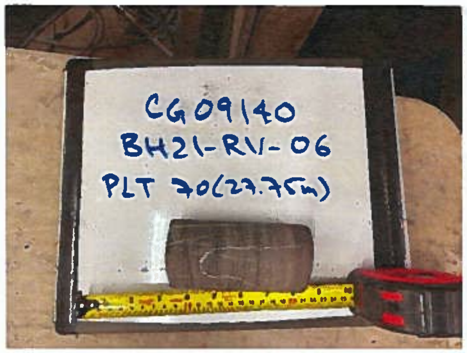
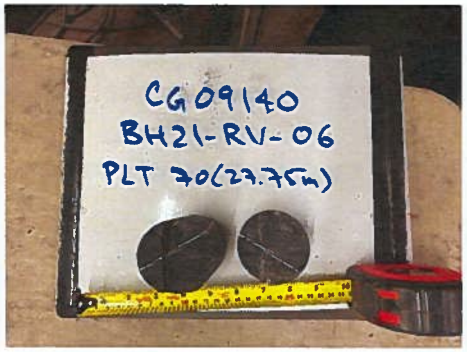
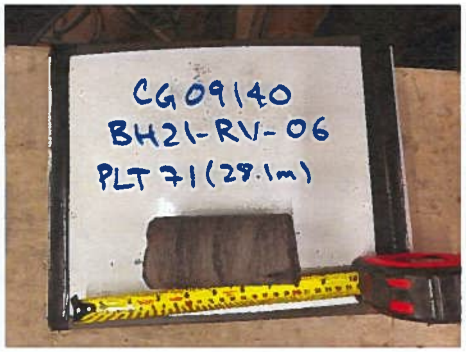
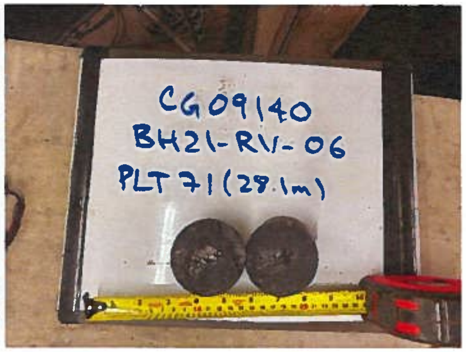
Point Load Test	PLT 70	**Point Load Test Type**	Diametral
Depth (m)	27.75	**Failure Validity**	Valid



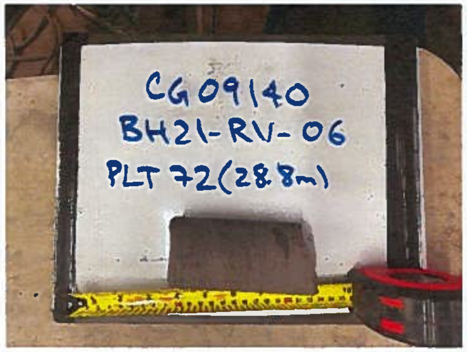


Point Load Test	PLT 71	**Point Load Test Type**	Diametral
Depth (m)	28.10	**Failure Validity**	Valid





Point Load Test	PLT 72	**Point Load Test Type**	Diametral
Depth (m)	28.80	**Failure Validity**	Valid



Point Load Test	PLT 73	**Point Load Test Type**	Diametral
Depth (m)	29.00	**Failure Validity**	Valid

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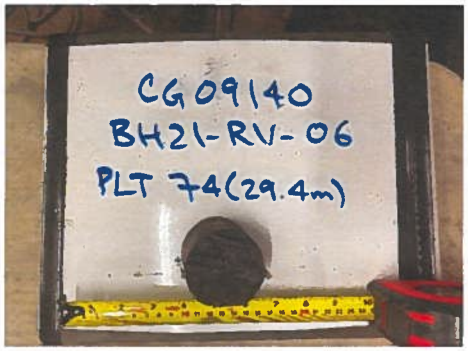
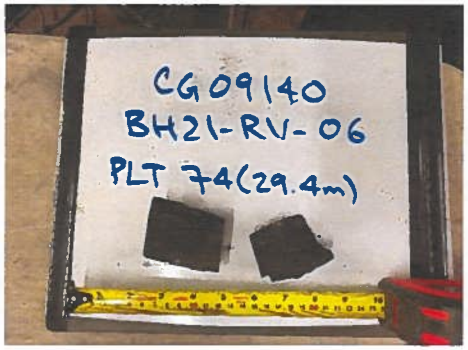
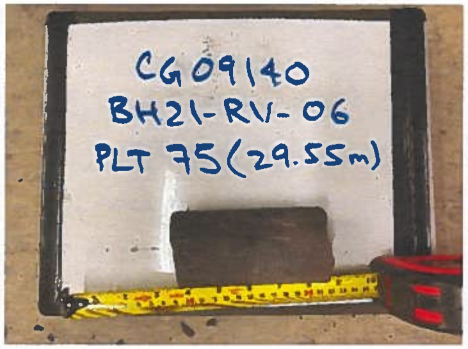
Point Load Test	PLT 74	**Point Load Test Type**	Axial
Depth (m)	29.40	**Failure Validity**	Valid

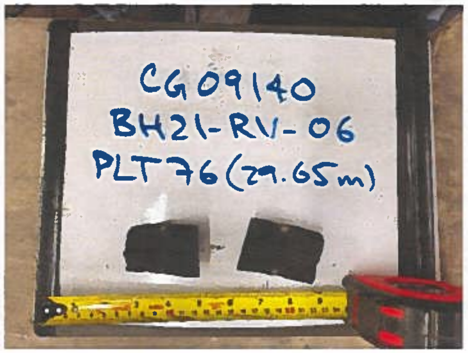




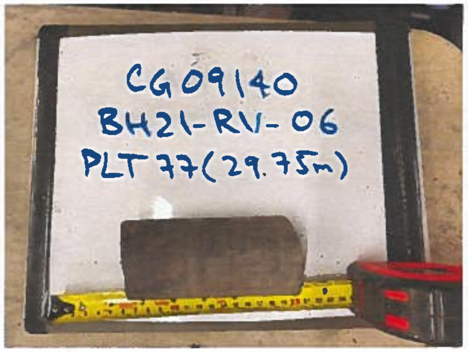
Point Load Test	PLT 75	**Point Load Test Type**	Diametral
Depth (m)	29.55	**Failure Validity**	Valid



Point Load Test	PLT 76	**Point Load Test Type**	Axial
Depth (m)	29.65	**Failure Validity**	Valid



Point Load Test	PLT 77	**Point Load Test Type**	Diametral
Depth (m)	29.75	**Failure Validity**	Valid



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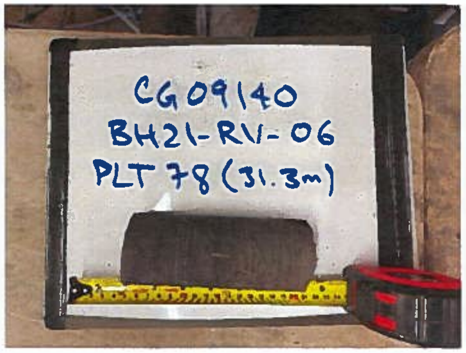
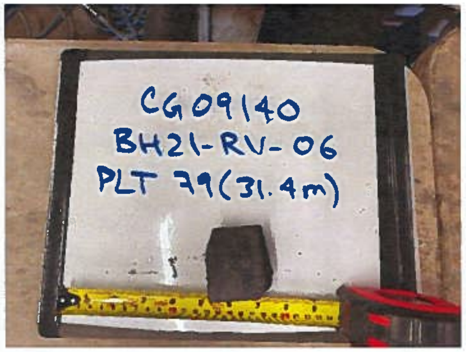
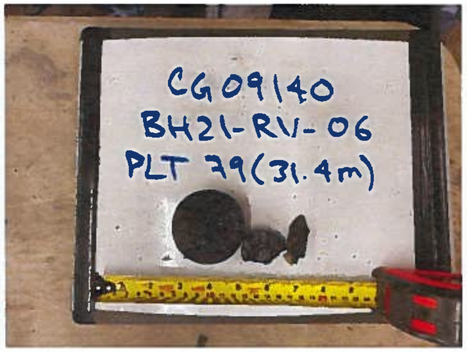
Point Load Test	PLT 78	**Point Load Test Type**	Diametral
Depth (m)	31.30	**Failure Validity**	Valid



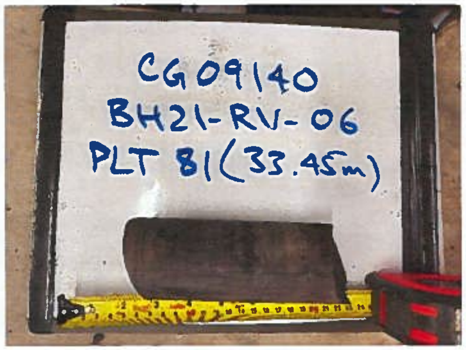
Point Load Test	PLT 79	**Point Load Test Type**	Axial
Depth (m)	31.40	**Failure Validity**	Invalid

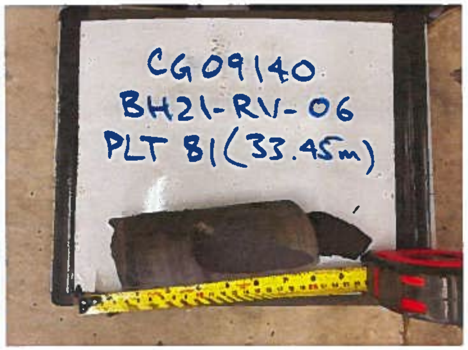




Point Load Test	PLT 80	**Point Load Test Type**	Axial
Depth (m)	31.75	**Failure Validity**	Invalid

Point Load Test	PLT 81	**Point Load Test Type**	Diametral
Depth (m)	33.45	**Failure Validity**	Invalid





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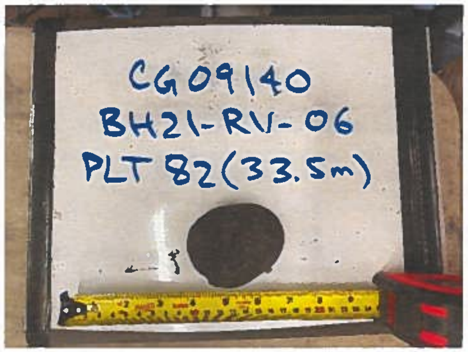
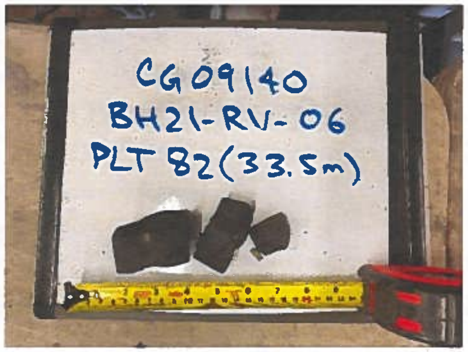
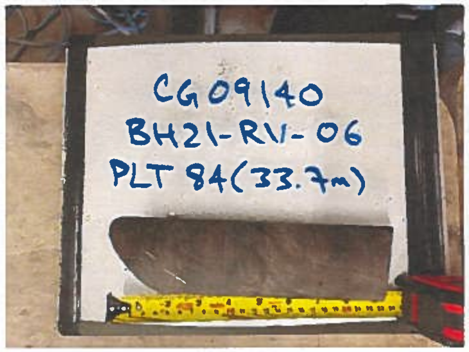
Point Load Test	PLT 82	**Point Load Test Type**	Axial
Depth (m)	33.50	**Failure Validity**	Valid

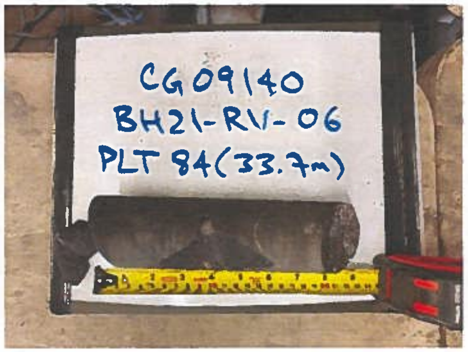




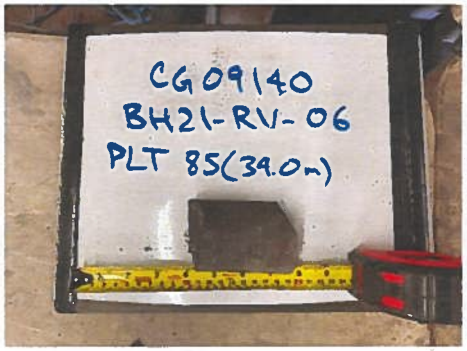
Point Load Test	PLT 83	**Point Load Test Type**	Diametral
Depth (m)	33.60	**Failure Validity**	Invalid

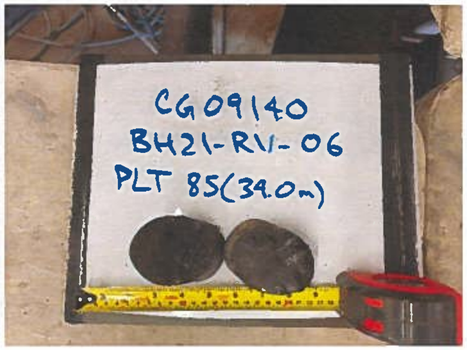
Point Load Test	PLT 84	**Point Load Test Type**	Diametral
Depth (m)	33.70	**Failure Validity**	Invalid





Point Load Test	PLT 85	**Point Load Test Type**	Diametral
Depth (m)	34.00	**Failure Validity**	Valid





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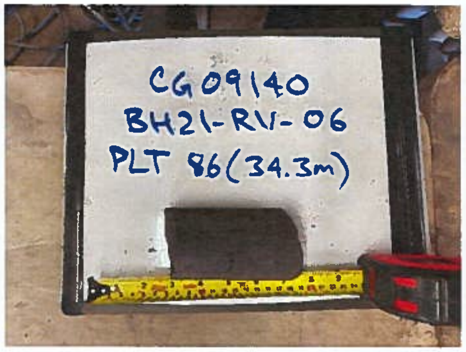
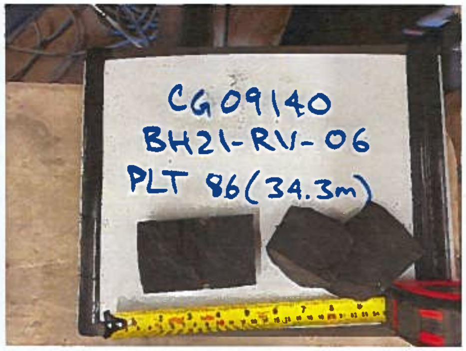
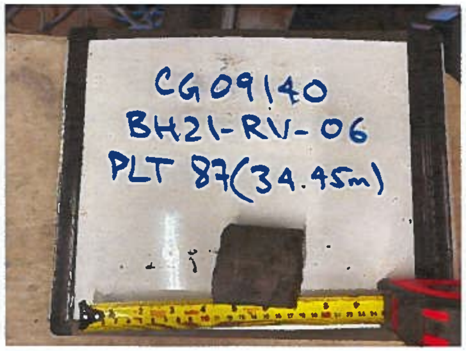
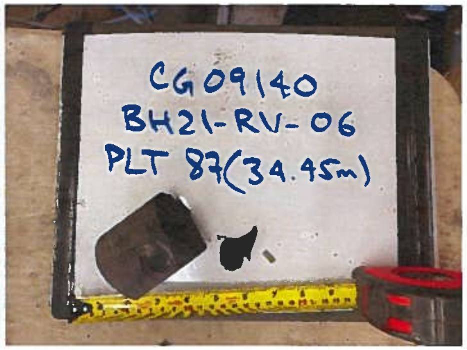
Point Load Test	PLT 86	**Point Load Test Type**	Diametral
Depth (m)	34.30	**Failure Validity**	Valid



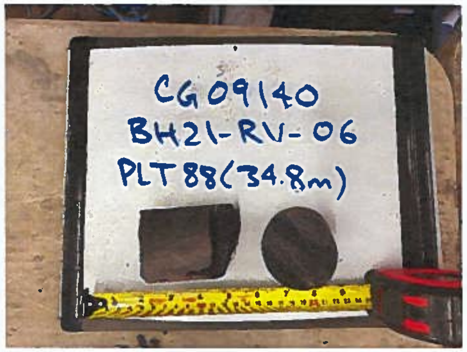


Point Load Test	PLT 87	**Point Load Test Type**	Diametral
Depth (m)	34.45	**Failure Validity**	Invalid

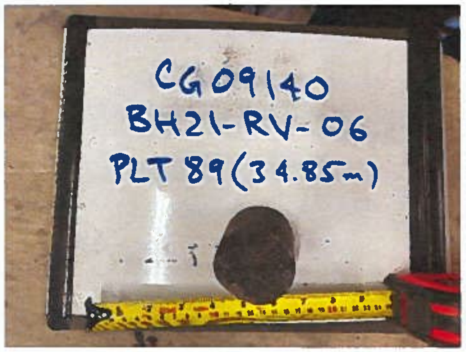




Point Load Test	PLT 88	**Point Load Test Type**	Diametral
Depth (m)	34.80	**Failure Validity**	Valid



Point Load Test	PLT 89	**Point Load Test Type**	Axial
Depth (m)	34.85	**Failure Validity**	Valid



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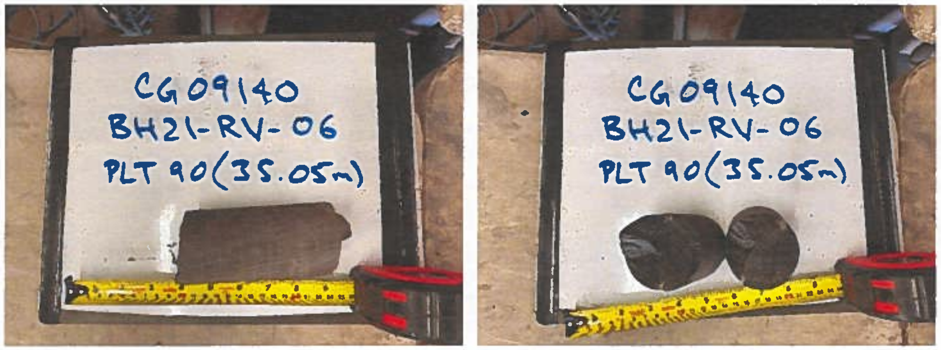
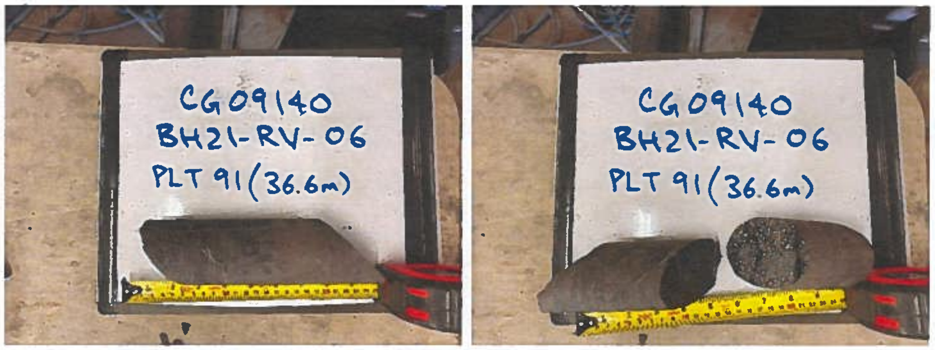
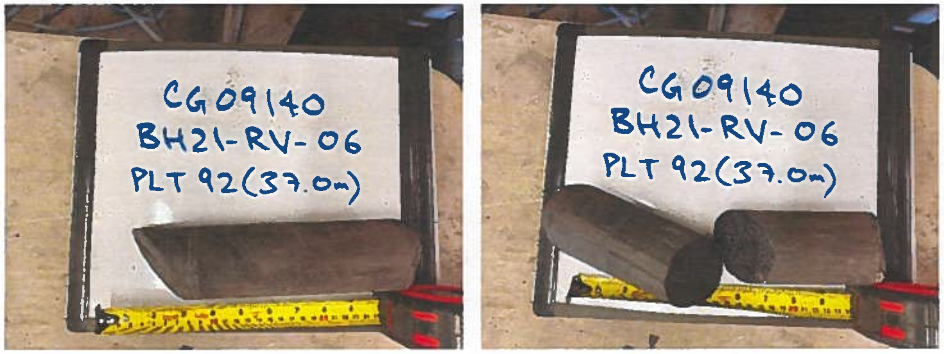
Point Load Test	PLT 90	**Point Load Test Type**	Diametral
Depth (m)	35.05	**Failure Validity**	Valid



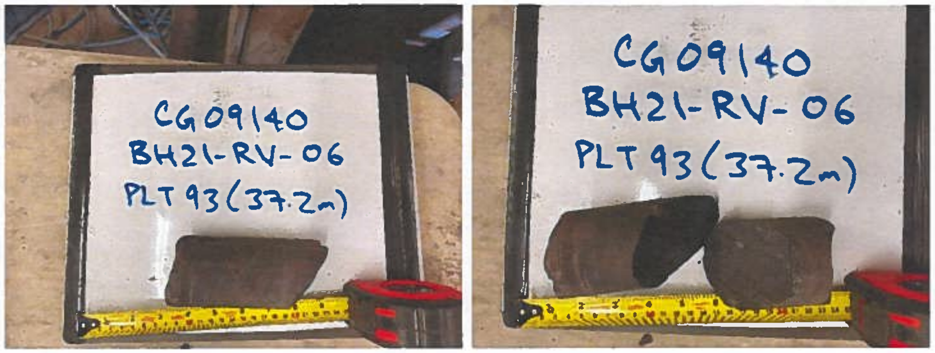
Point Load Test	PLT 91	**Point Load Test Type**	Diametral
Depth (m)	36.60	**Failure Validity**	Invalid



Point Load Test	PLT 92	**Point Load Test Type**	Diametral
Depth (m)	37.00	**Failure Validity**	Invalid



Point Load Test	PLT 93	**Point Load Test Type**	Diametral
Depth (m)	37.20	**Failure Validity**	Valid



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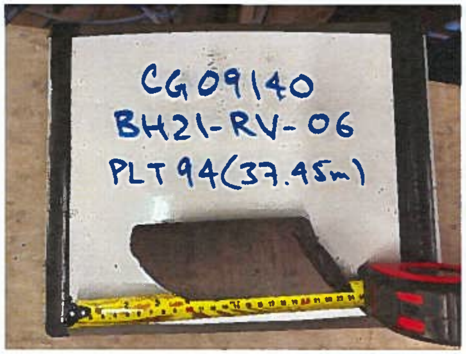
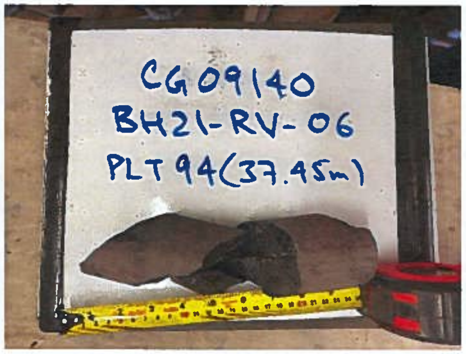
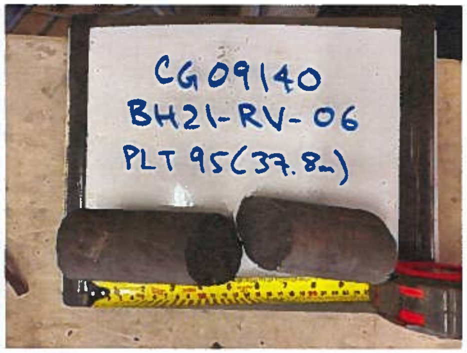
Point Load Test	PLT 94	**Point Load Test Type**	Diametral
Depth (m)	37.45	**Failure Validity**	Valid

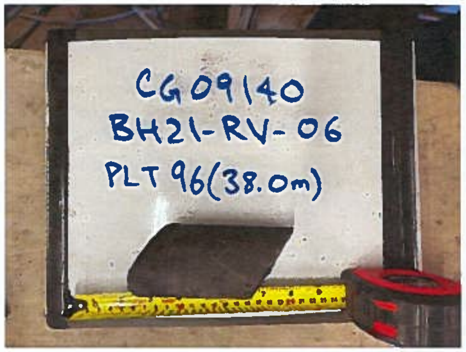


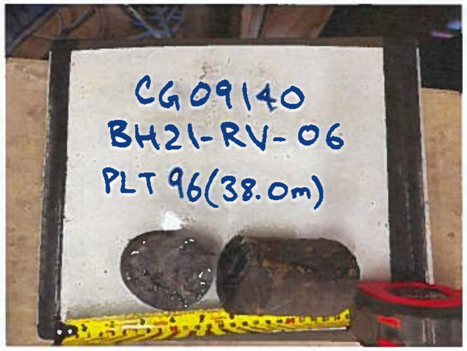


Point Load Test	PLT 95	**Point Load Test Type**	Diametral
Depth (m)	37.80	**Failure Validity**	Valid

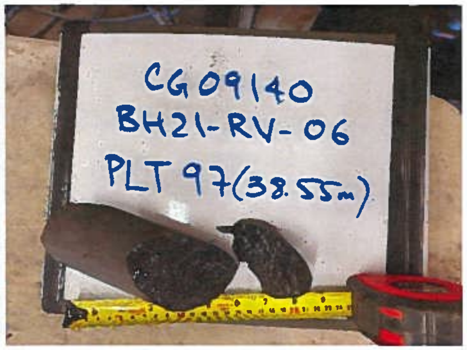


Point Load Test	PLT 96	**Point Load Test Type**	Diametral
Depth (m)	38.00	**Failure Validity**	Valid





Point Load Test	PLT 97	**Point Load Test Type**	Diametral
Depth (m)	38.55	**Failure Validity**	Invalid



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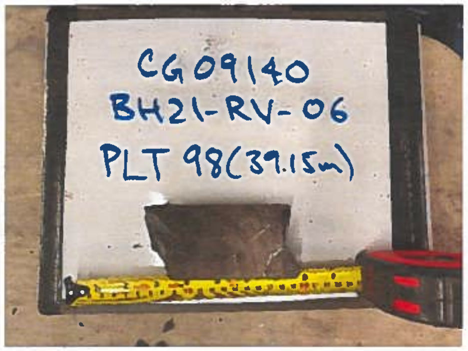
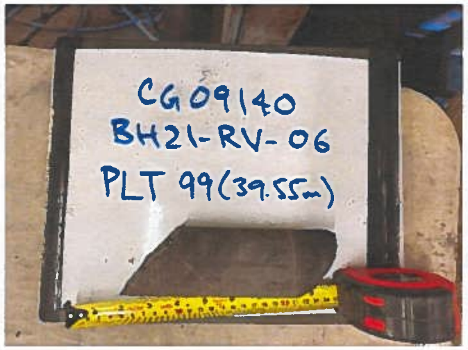
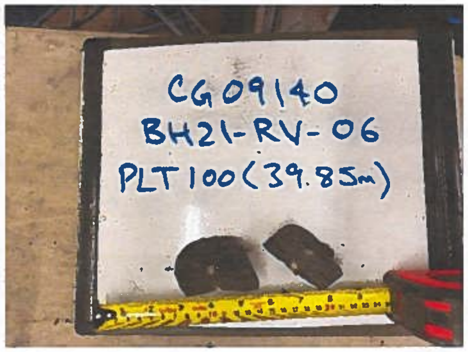
Point Load Test	PLT 98	**Point Load Test Type**	Diametral
Depth (m)	39.15	**Failure Validity**	Valid



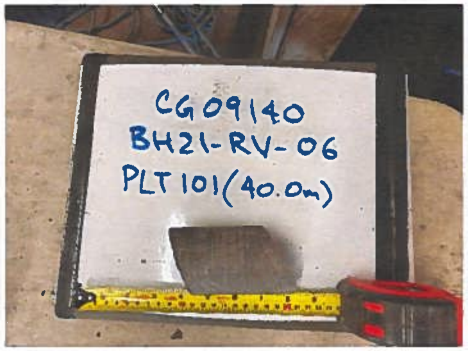
Point Load Test	PLT 99	**Point Load Test Type**	Diametral
Depth (m)	39.55	**Failure Validity**	Invalid

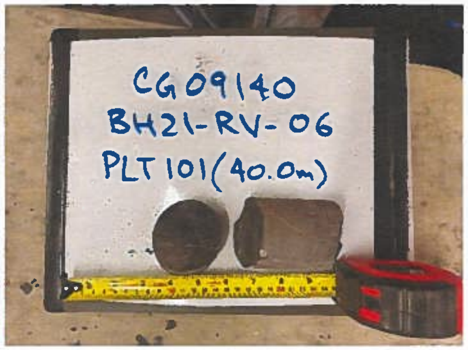


Point Load Test	PLT 100	**Point Load Test Type**	Axial
Depth (m)	39.85	**Failure Validity**	Valid



Point Load Test	PLT 101	**Point Load Test Type**	Diametral
Depth (m)	40.00	**Failure Validity**	Valid





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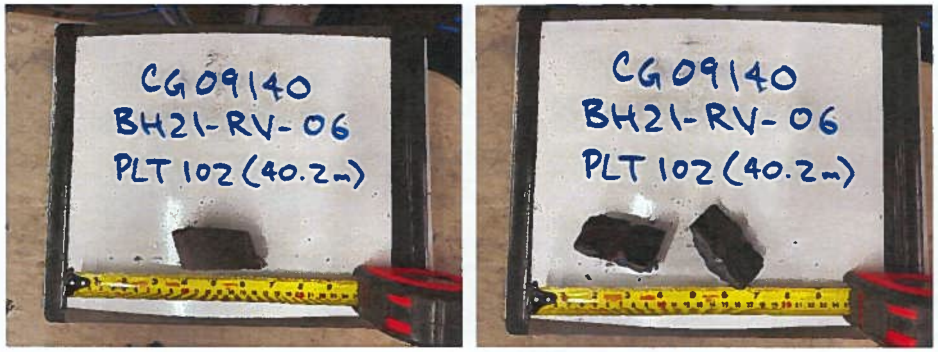
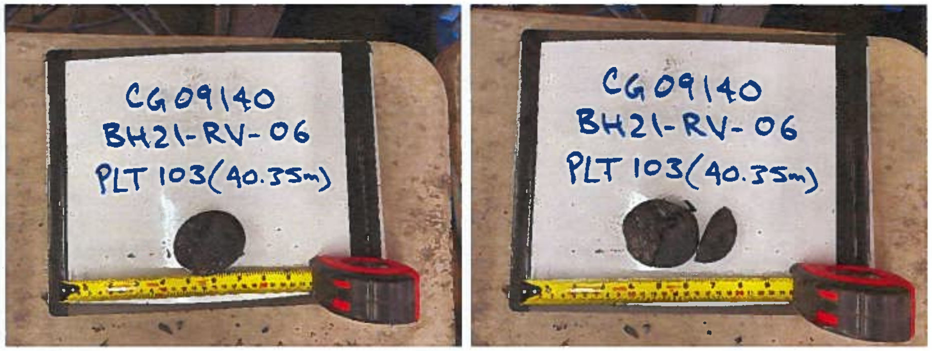
Point Load Test	PLT 102	**Point Load Test Type**	Axial
Depth (m)	40.20	**Failure Validity**	Valid

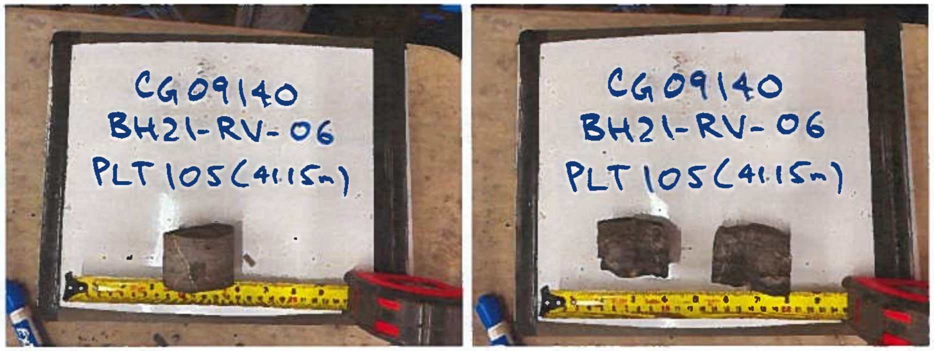


Point Load Test	PLT 103	**Point Load Test Type**	Axial
Depth (m)	40.35	**Failure Validity**	Invalid



Point Load Test	PLT 104	**Point Load Test Type**	Axial
Depth (m)	40.90	**Failure Validity**	Invalid

Point Load Test	PLT 105	**Point Load Test Type**	Axial
Depth (m)	41.15	**Failure Validity**	Valid



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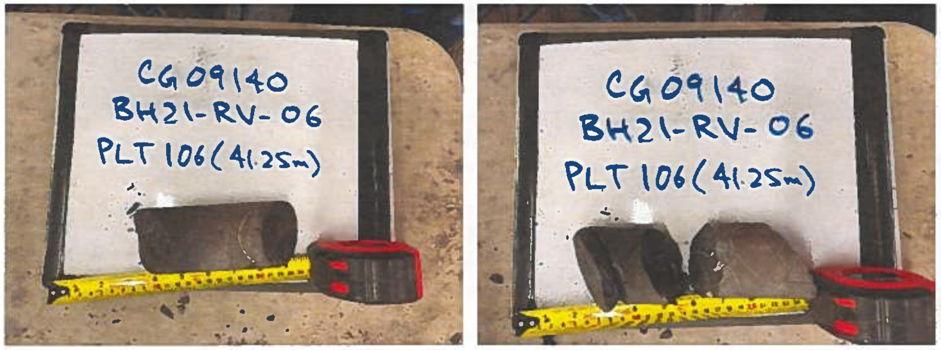
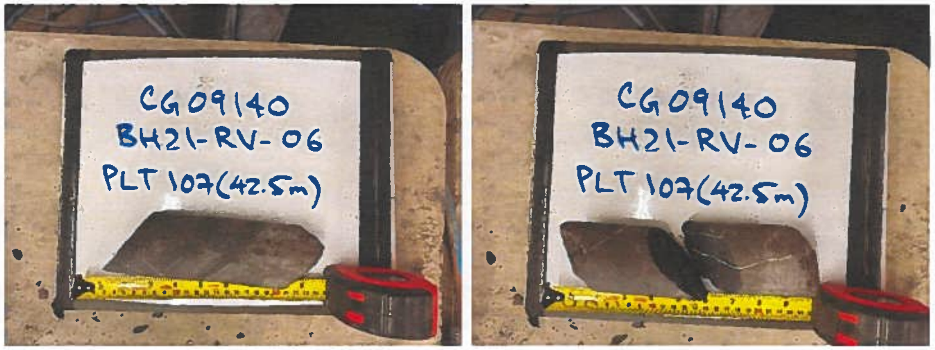
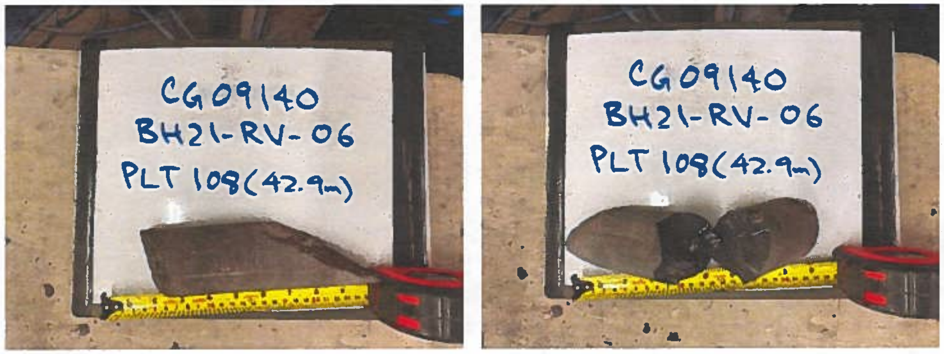
Point Load Test	PLT 106	**Point Load Test Type**	Diametral
Depth (m)	41.25	**Failure Validity**	Valid



Point Load Test	PLT 107	**Point Load Test Type**	Diametral
Depth (m)	42.50	**Failure Validity**	Valid



Point Load Test	PLT 108	**Point Load Test Type**	Diametral
Depth (m)	42.90	**Failure Validity**	Valid



Point Load Test	PLT 109	**Point Load Test Type**	Diametral
Depth (m)	42.65	**Failure Validity**	Valid

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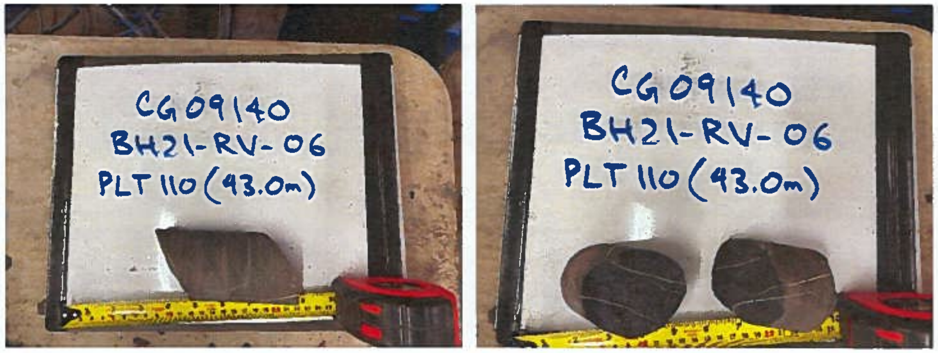
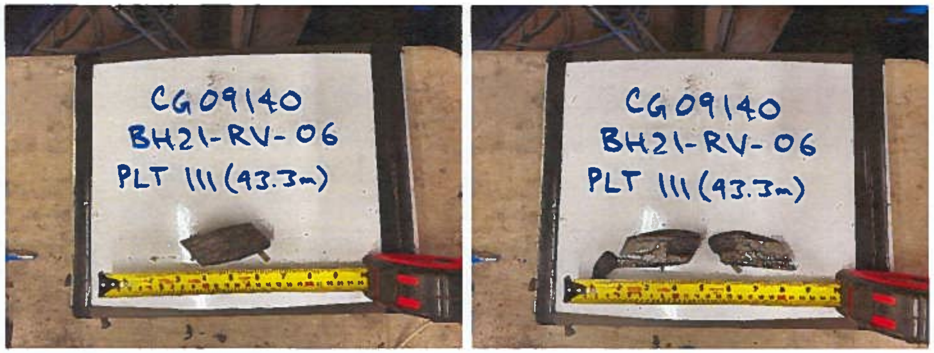
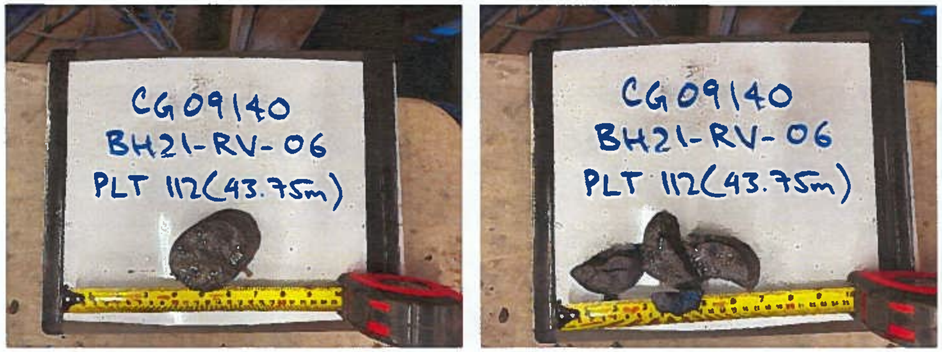
Point Load Test	PLT 110	**Point Load Test Type**	Diametral
Depth (m)	43.00	**Failure Validity**	Valid



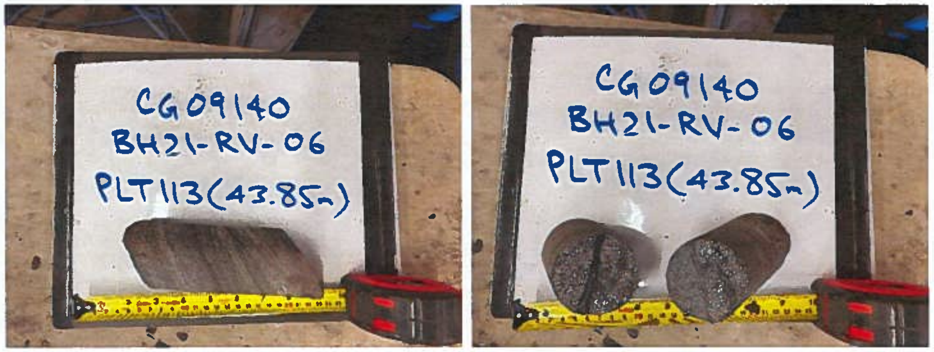
Point Load Test	PLT 111	**Point Load Test Type**	Axial
Depth (m)	43.30	**Failure Validity**	Valid



Point Load Test	PLT 112	**Point Load Test Type**	Axial
Depth (m)	43.75	**Failure Validity**	Valid



Point Load Test	PLT 113	**Point Load Test Type**	Diametral
Depth (m)	43.85	**Failure Validity**	Valid



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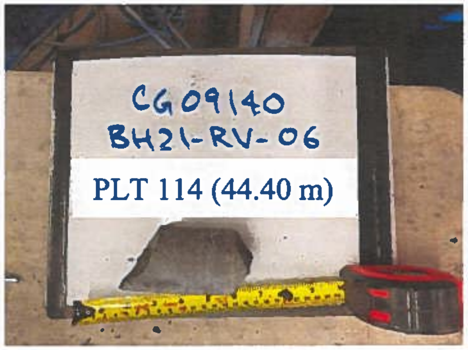
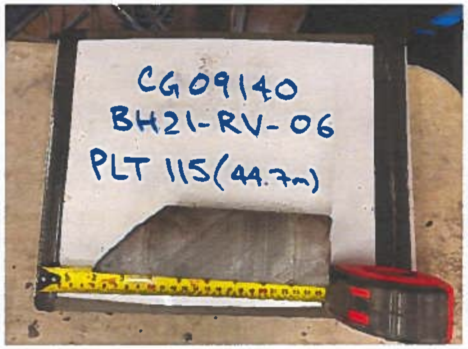
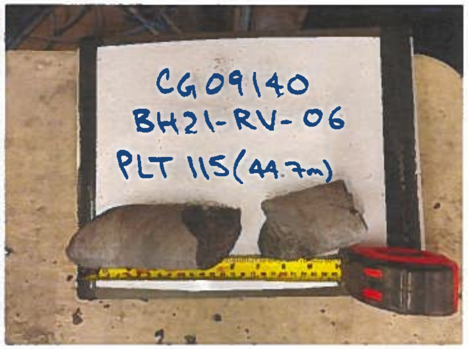
Point Load Test	PLT 114	**Point Load Test Type**	Diametral
Depth (m)	44.40	**Failure Validity**	Valid

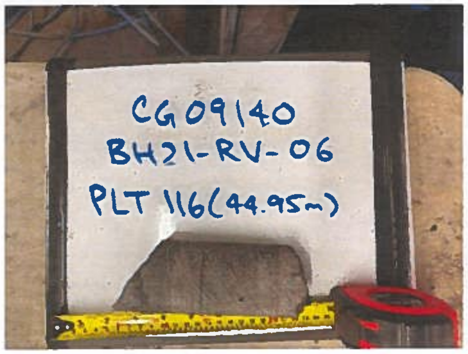


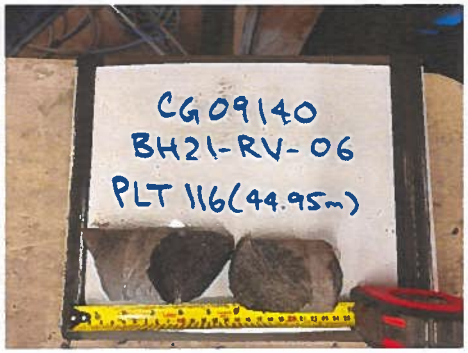
Point Load Test	PLT 115	**Point Load Test Type**	Diametral
Depth (m)	44.70	**Failure Validity**	Valid



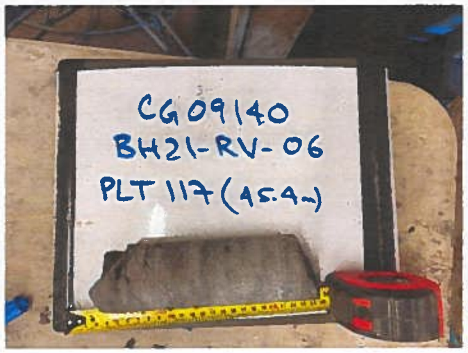


Point Load Test	PLT 116	**Point Load Test Type**	Diametral
Depth (m)	44.95	**Failure Validity**	Valid





Point Load Test	PLT 117	**Point Load Test Type**	Diametral
Depth (m)	45.40	**Failure Validity**	Valid



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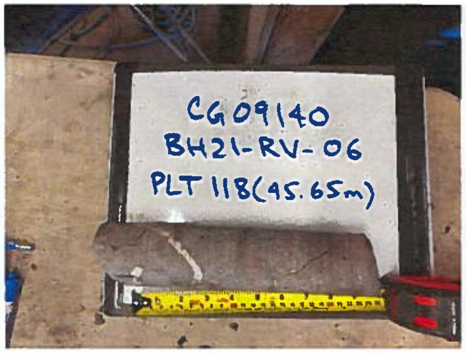
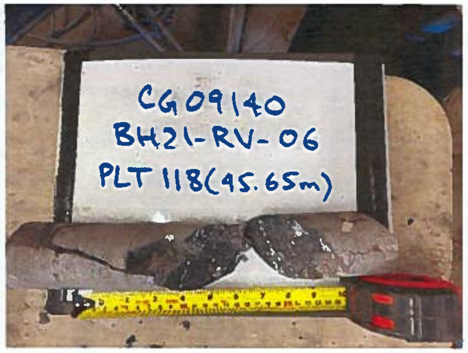
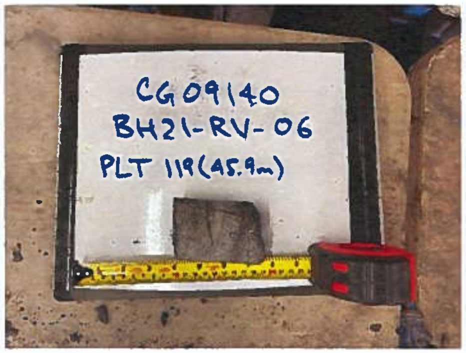
Point Load Test	PLT 118	**Point Load Test Type**	Diametral
Depth (m)	45.65	**Failure Validity**	Invalid

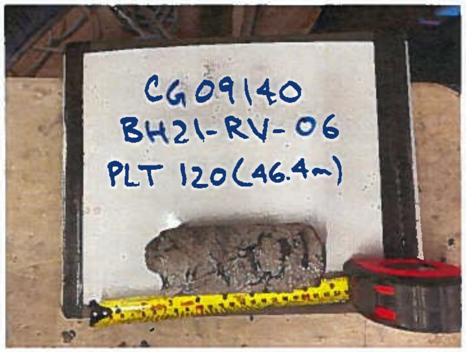




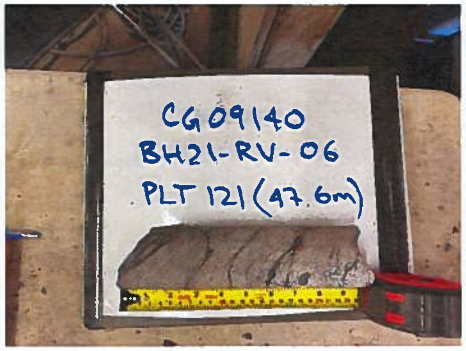
Point Load Test	PLT 119	**Point Load Test Type**	Diametral
Depth (m)	45.90	**Failure Validity**	Valid

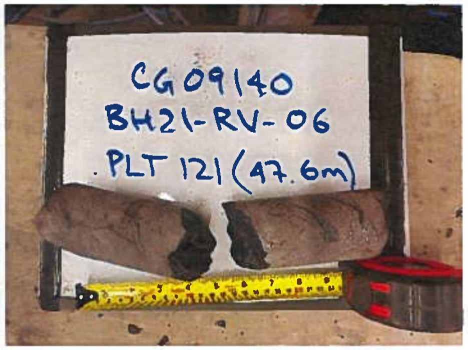


Point Load Test	PLT 120	**Point Load Test Type**	Diametral
Depth (m)	46.40	**Failure Validity**	Valid



Point Load Test	PLT 121	**Point Load Test Type**	Diametral
Depth (m)	47.60	**Failure Validity**	Valid





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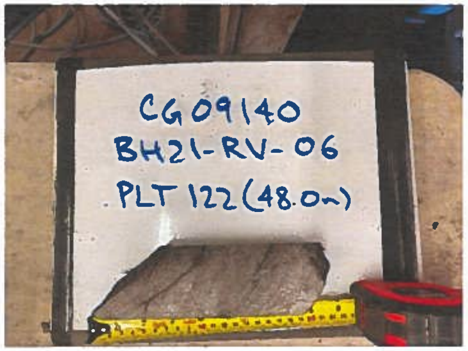
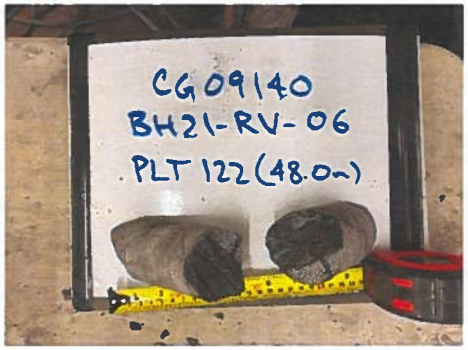
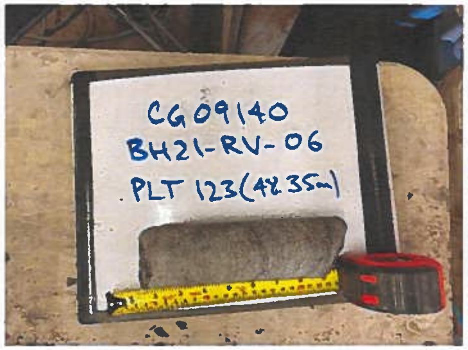
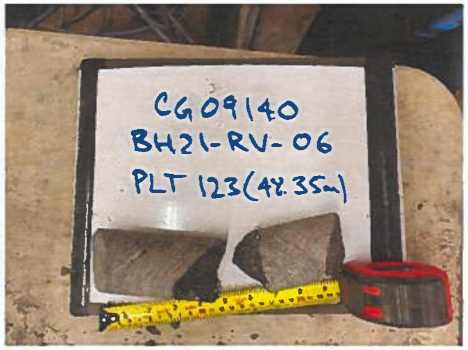
Point Load Test	PLT 122	**Point Load Test Type**	Diametral
Depth (m)	48.00	**Failure Validity**	Valid



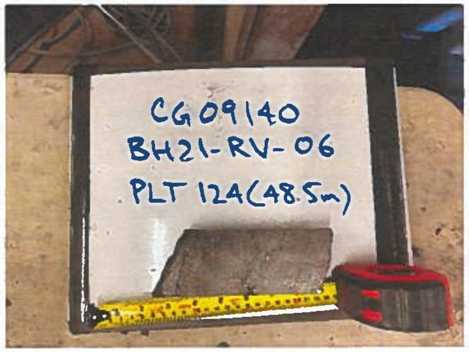


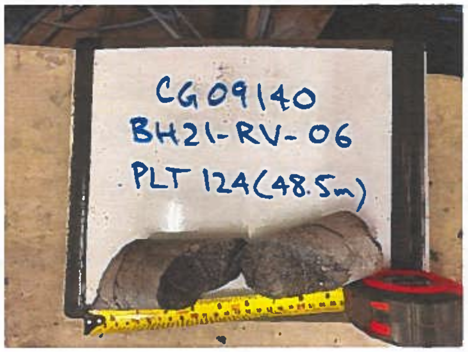
Point Load Test	PLT 123	**Point Load Test Type**	Diametral
Depth (m)	48.35	**Failure Validity**	Valid



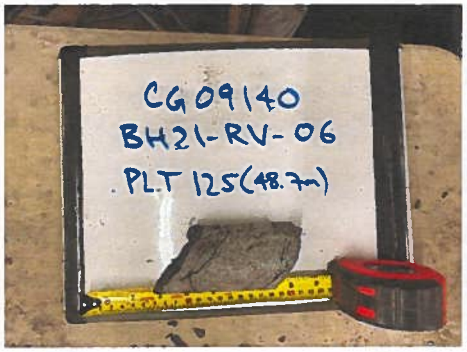


Point Load Test	PLT 124	**Point Load Test Type**	Diametral
Depth (m)	48.50	**Failure Validity**	Valid





Point Load Test	PLT 125	**Point Load Test Type**	Diametral
Depth (m)	48.70	**Failure Validity**	Valid



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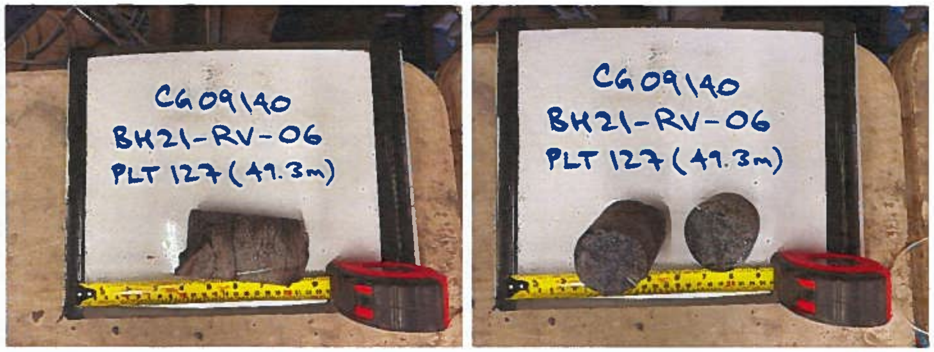
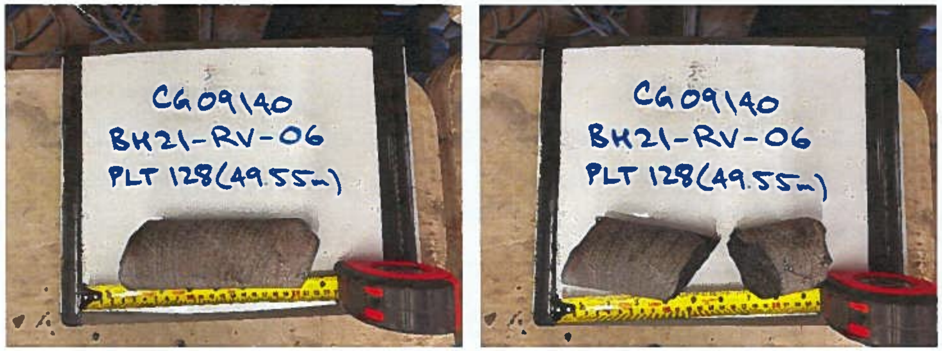
Point Load Test	PLT 126	**Point Load Test Type**	Diametral
Depth (m)	48.85	**Failure Validity**	Valid

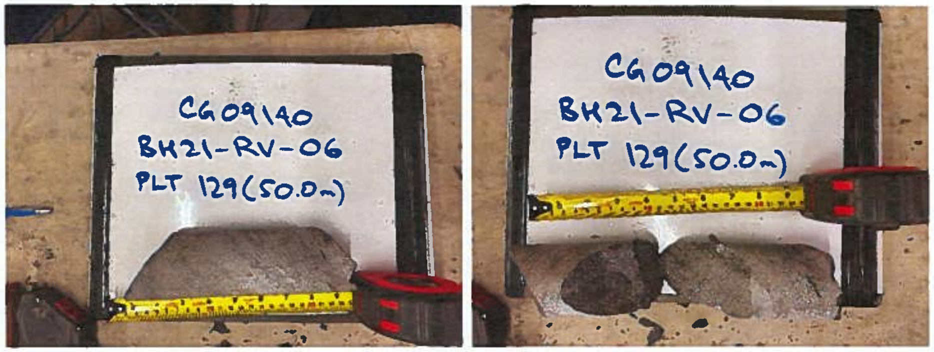
Point Load Test	PLT 127	**Point Load Test Type**	Diametral
Depth (m)	49.30	**Failure Validity**	Valid



Point Load Test	PLT 128	**Point Load Test Type**	Diametral
Depth (m)	49.55	**Failure Validity**	Valid



Point Load Test	PLT 129	**Point Load Test Type**	Diametral
Depth (m)	50.00	**Failure Validity**	Valid



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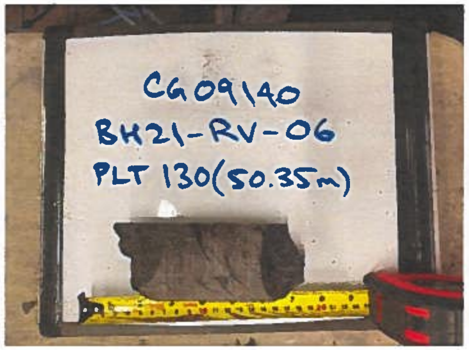
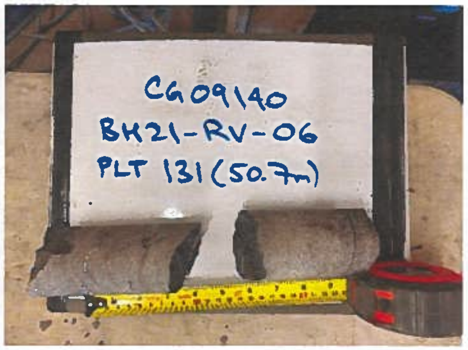
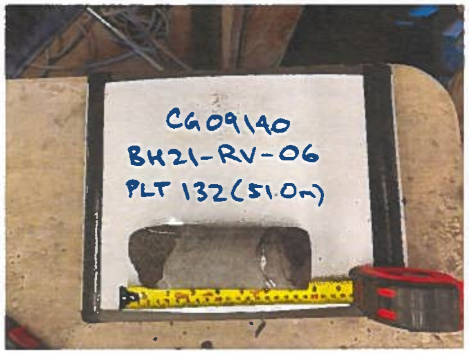
Point Load Test	PLT 130	**Point Load Test Type**	Diametral
Depth (m)	50.35	**Failure Validity**	Valid



Point Load Test	PLT 131	**Point Load Test Type**	Diametral
Depth (m)	50.70	**Failure Validity**	Valid



Point Load Test	PLT 132	**Point Load Test Type**	Diametral
Depth (m)	51.00	**Failure Validity**	Valid



Point Load Test	PLT 133	**Point Load Test Type**	Diametral
Depth (m)	51.15	**Failure Validity**	Valid

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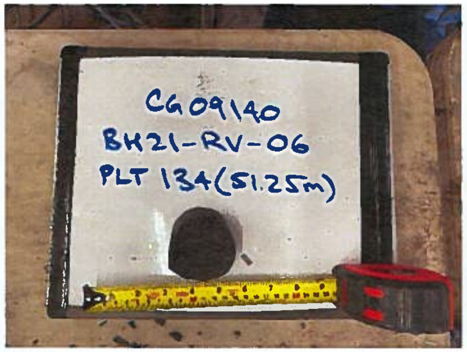
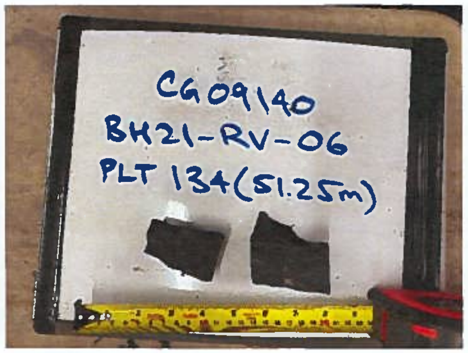
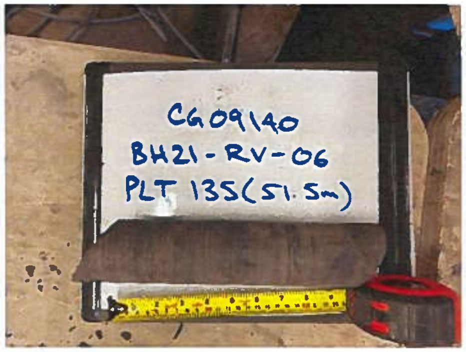
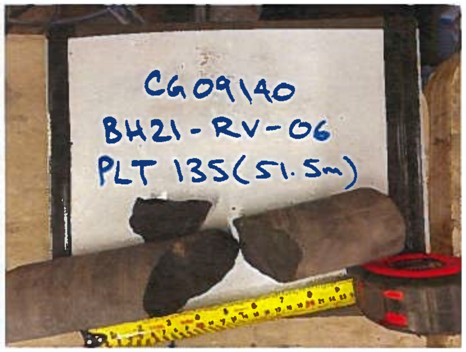
Point Load Test	PLT 134	**Point Load Test Type**	Axial
Depth (m)	51.25	**Failure Validity**	Valid



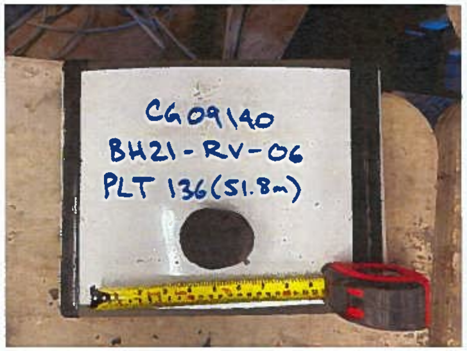


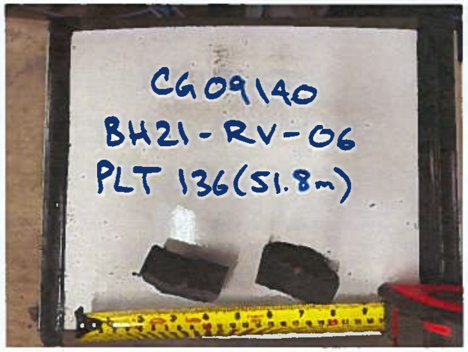
Point Load Test	PLT 135	**Point Load Test Type**	Diametral
Depth (m)	51.50	**Failure Validity**	Valid



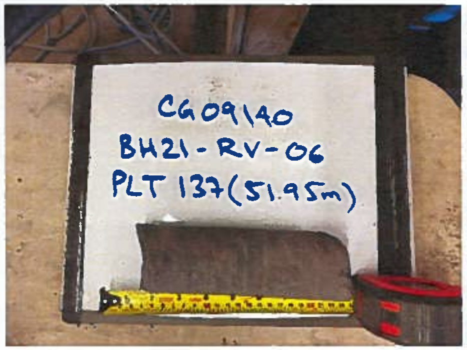


Point Load Test	PLT 136	**Point Load Test Type**	Axial
Depth (m)	51.80	**Failure Validity**	Valid





Point Load Test	PLT 137	**Point Load Test Type**	Diametral
Depth (m)	51.95	**Failure Validity**	Valid



CLIENT:

THREE SISTERS mountain village

Resort Village Phase 1 Undermining PLTs

BH21-RV-06

CG09140

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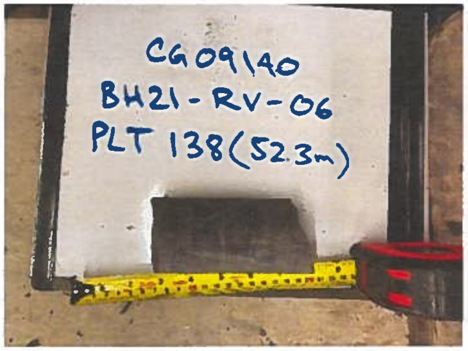
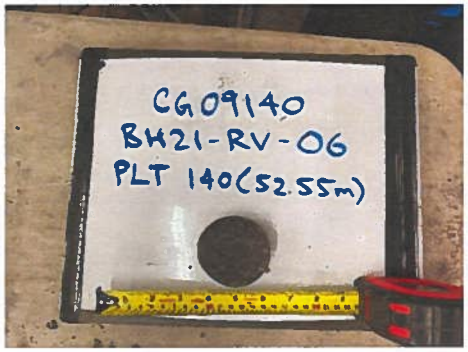
Point Load Test	PLT 138	**Point Load Test Type**	Diametral
Depth (m)	52.30	**Failure Validity**	Valid



Point Load Test	PLT 139	**Point Load Test Type**	Diametral
Depth (m)	52.45	**Failure Validity**	Valid

Point Load Test	PLT 140	**Point Load Test Type**	Axial
Depth (m)	52.55	**Failure Validity**	Valid



Point Load Test	PLT 141	**Point Load Test Type**	Diametral
Depth (m)	53.10	**Failure Validity**	Valid

CLIENT:

THREE SISTERS mountain village

Resort Village Phase 1 Undermining PLTs

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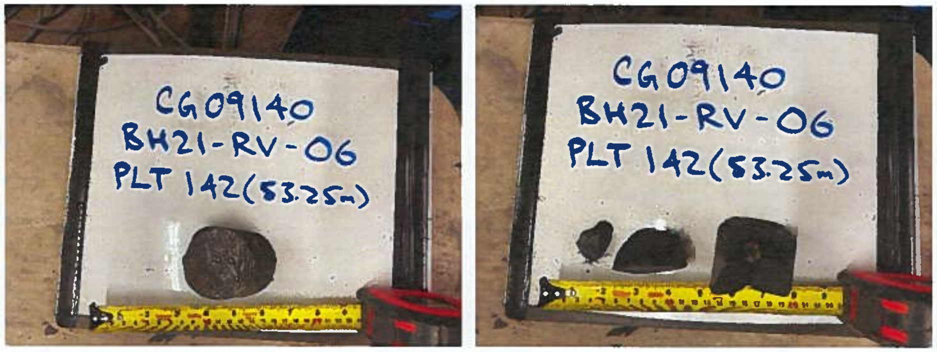
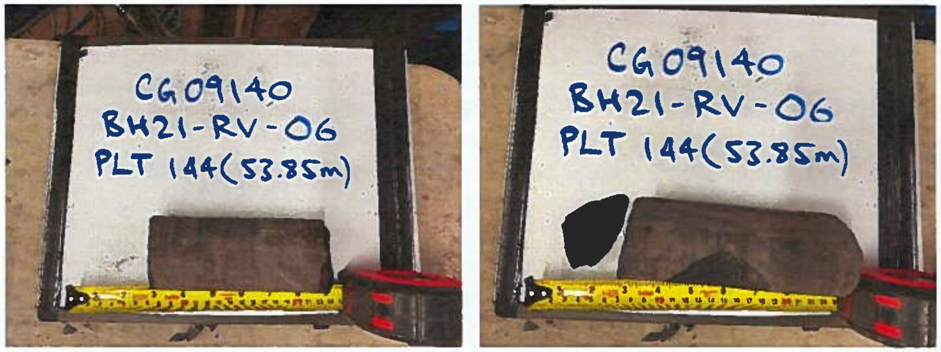
Point Load Test	PLT 142	**Point Load Test Type**	Axial
Depth (m)	53.25	**Failure Validity**	Valid

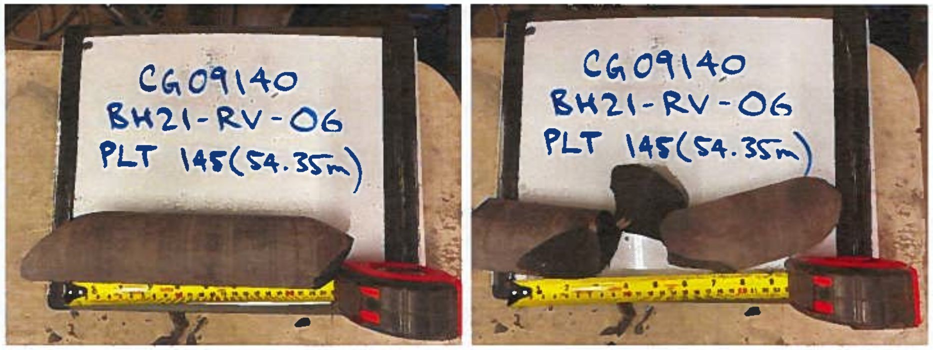


Point Load Test	PLT 143	**Point Load Test Type**	Diametral
Depth (m)	53.30	**Failure Validity**	Valid

Point Load Test	PLT 144	**Point Load Test Type**	Diametral
Depth (m)	53.85	**Failure Validity**	Invalid



Point Load Test	PLT 145	**Point Load Test Type**	Diametral
Depth (m)	54.35	**Failure Validity**	Valid



CLIENT:

THREE SISTERS mountain village

Resort Village Phase 1 Undermining PLTs

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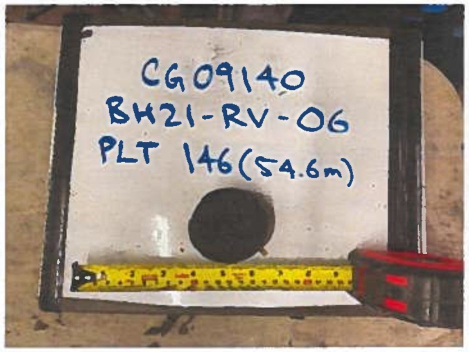
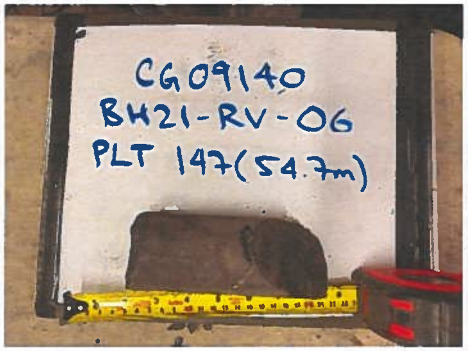
CG09140

February 2022

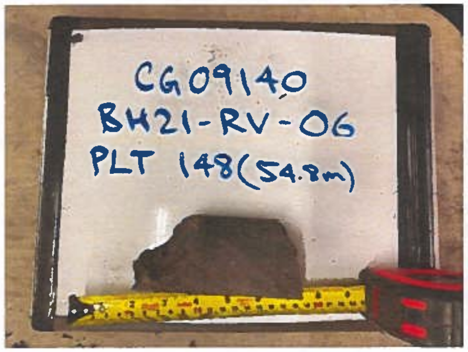
Point Load Test	PLT 146	**Point Load Test Type**	Axial
Depth (m)	54.60	**Failure Validity**	Valid

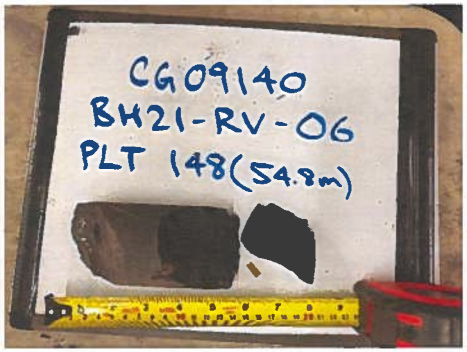


Point Load Test	PLT 147	**Point Load Test Type**	Diametral
Depth (m)	54.70	**Failure Validity**	Invalid

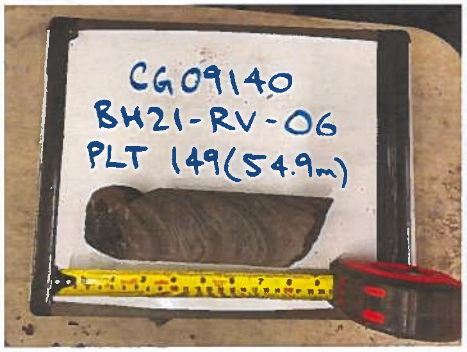


Point Load Test	PLT 148	**Point Load Test Type**	Diametral
Depth (m)	54.80	**Failure Validity**	Invalid





Point Load Test	PLT 149	**Point Load Test Type**	Diametral
Depth (m)	54.90	**Failure Validity**	Invalid



CLIENT:

THREE SISTERS
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Resort Village Phase 1 Undermining PLTs

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CG09140

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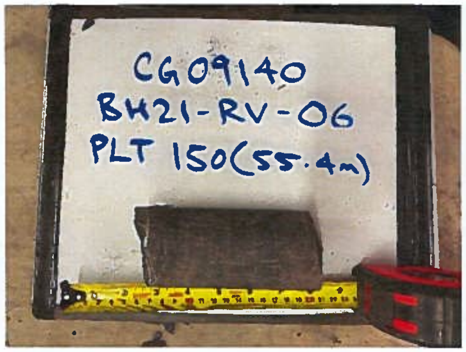
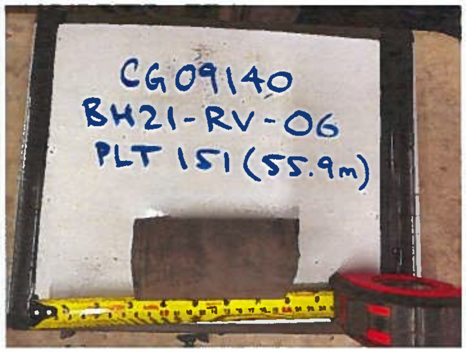
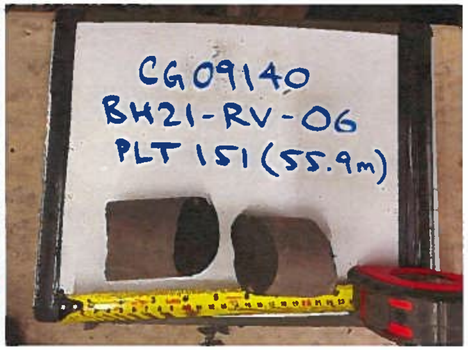
Point Load Test	PLT 150		**Point Load Test Type**	Diametral
Depth (m)	55.40		**Failure Validity**	Valid

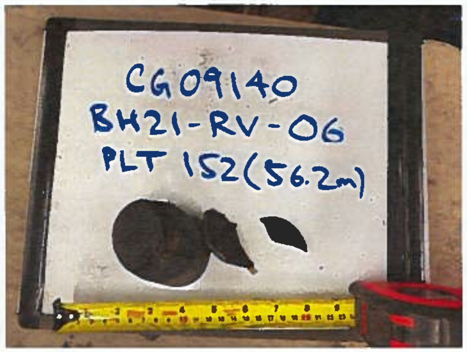


Point Load Test	PLT 151		**Point Load Test Type**	Diametral
Depth (m)	55.90		**Failure Validity**	Valid

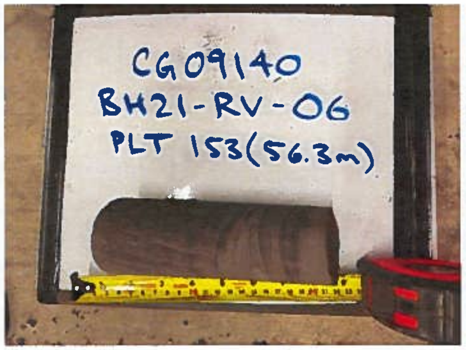




Point Load Test	PLT 152		**Point Load Test Type**	Axial
Depth (m)	56.20		**Failure Validity**	Invalid



Point Load Test	PLT 153		**Point Load Test Type**	Diametral
Depth (m)	56.30		**Failure Validity**	Valid



CLIENT:

THREE SISTERS mountainvillage

Resort Village Phase 1 Undermining PLTs

BH21-RV-06

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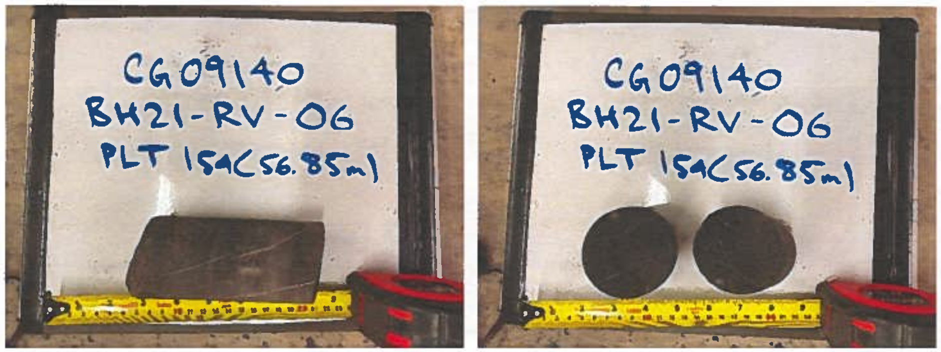
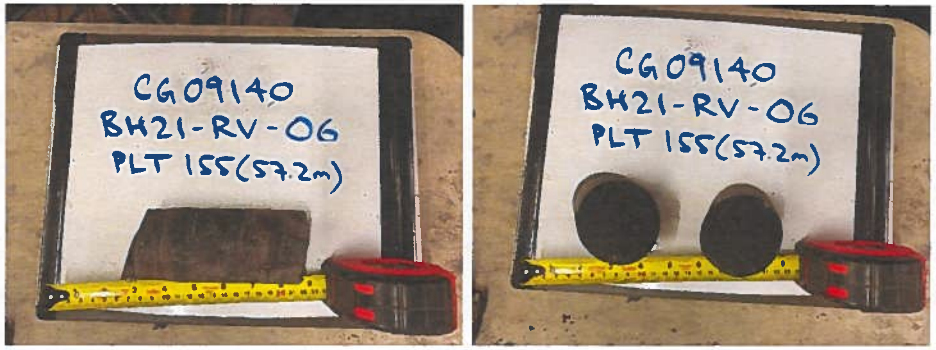
February 2022

Point Load Test	PLT 154	**Point Load Test Type**	Diametral
Depth (m)	56.85	**Failure Validity**	Valid

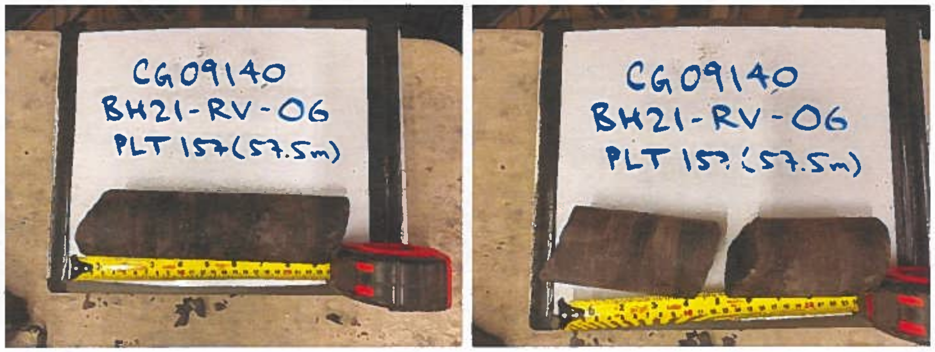


Point Load Test	PLT 155	**Point Load Test Type**	Diametral
Depth (m)	57.20	**Failure Validity**	Valid



Point Load Test	PLT 156	**Point Load Test Type**	Axial
Depth (m)	57.35	**Failure Validity**	Valid

Point Load Test	PLT 157	**Point Load Test Type**	Diametral
Depth (m)	57.50	**Failure Validity**	Valid



wsp

CLIENT:

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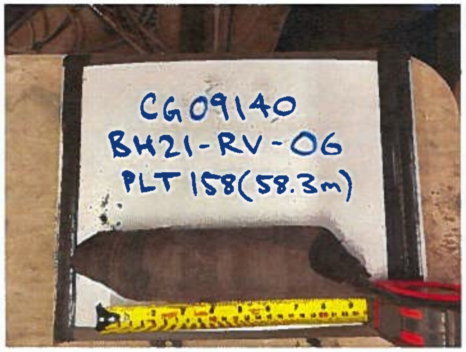
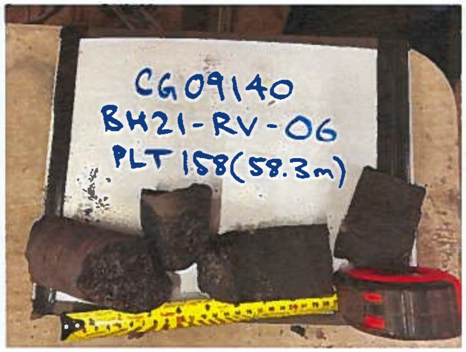
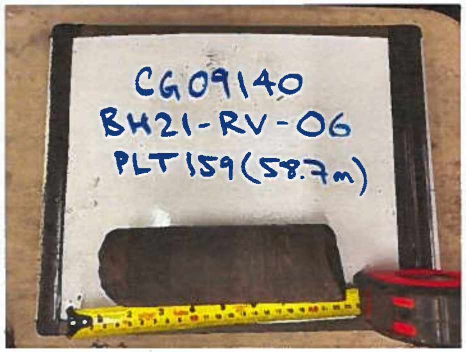
February 2022

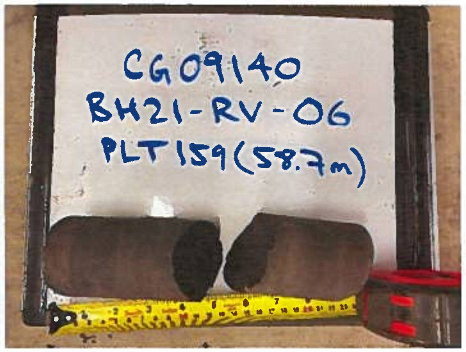
Point Load Test	PLT 158	**Point Load Test Type**	Diametral
Depth (m)	58.30	**Failure Validity**	Valid





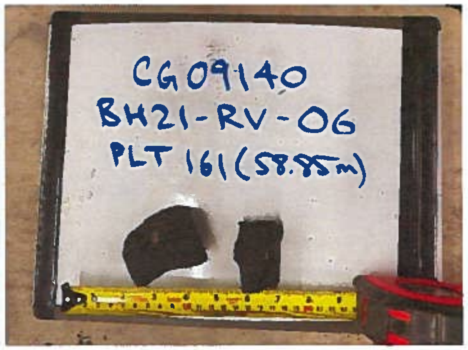
Point Load Test	PLT 159	**Point Load Test Type**	Diametral
Depth (m)	58.70	**Failure Validity**	Valid





Point Load Test	PLT 160	**Point Load Test Type**	Axial
Depth (m)	58.80	**Failure Validity**	Valid

Point Load Test	PLT 161	**Point Load Test Type**	Axial
Depth (m)	58.85	**Failure Validity**	Valid



wsp

CLIENT:

THREE SISTERS
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Resort Village Phase 1 Undermining PLTs

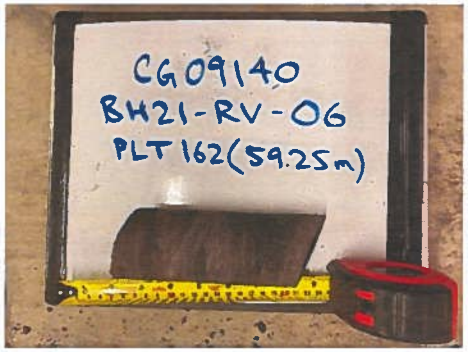
BH21-RV-06

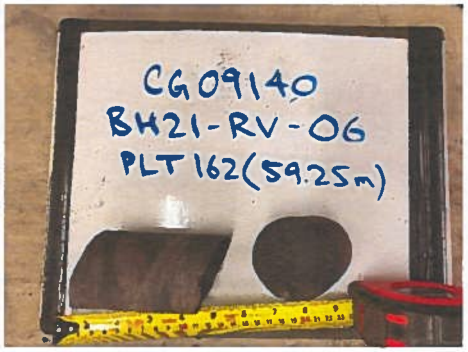
CG09140

February 2022

Point Load Test	PLT 162
Depth (m)	59.25

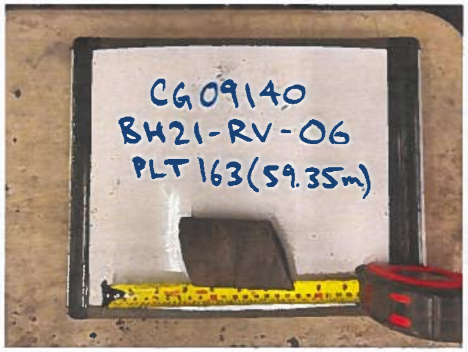
Point Load Test Type	Diametral
Failure Validity	Valid

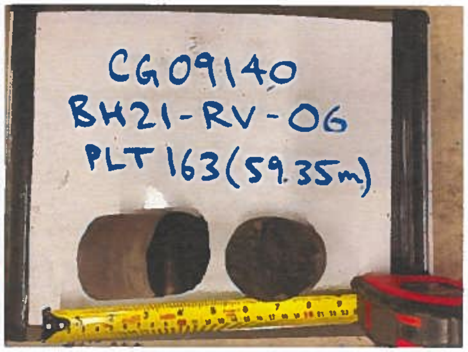




Point Load Test	PLT 163
Depth (m)	59.35

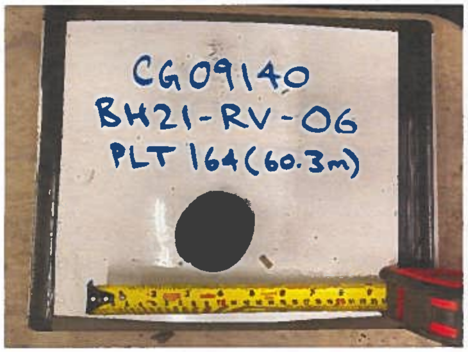
Point Load Test Type	Diametral
Failure Validity	Valid

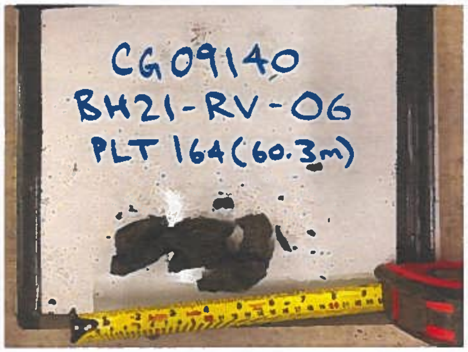




Point Load Test	PLT 164
Depth (m)	60.30

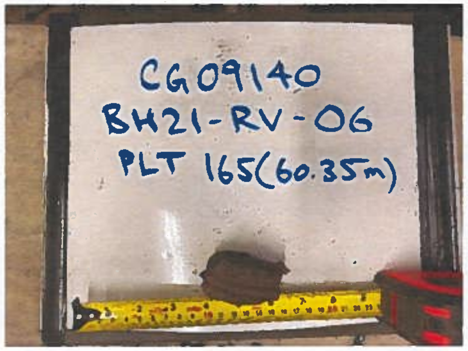
Point Load Test Type	Axial
Failure Validity	Valid





Point Load Test	PLT 165
Depth (m)	60.35

Point Load Test Type	Axial
Failure Validity	Valid



wsp

CLIENT:

THREE SISTERS mountain village

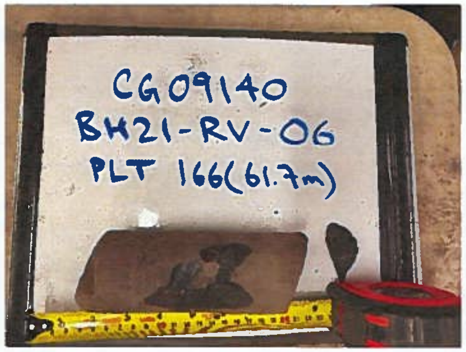
Resort Village Phase 1 Undermining PLTs

BH21-RV-06

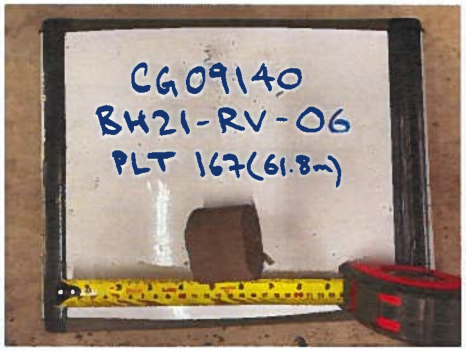
CG09140

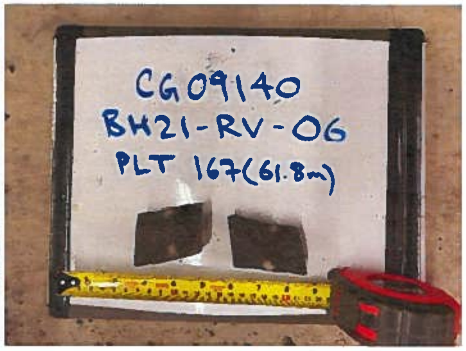
February 2022

Point Load Test	PLT 166	**Point Load Test Type**	Diametral
Depth (m)	61.70	**Failure Validity**	Invalid

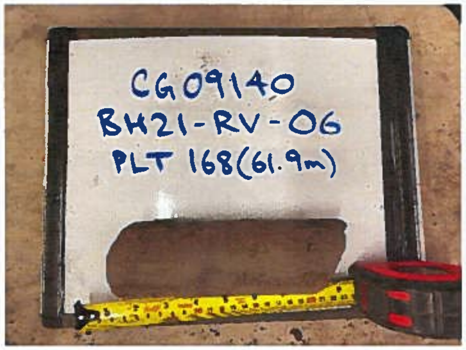


Point Load Test	PLT 167	**Point Load Test Type**	Axial
Depth (m)	61.80	**Failure Validity**	Valid

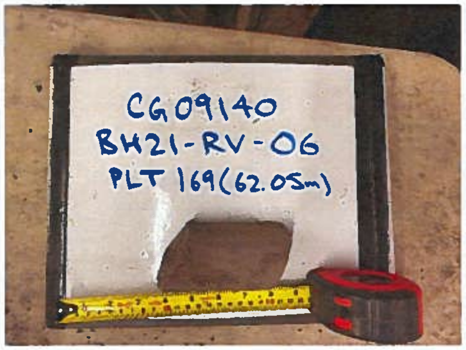




Point Load Test	PLT 168	**Point Load Test Type**	Diametral
Depth (m)	61.90	**Failure Validity**	Valid



Point Load Test	PLT 169	**Point Load Test Type**	Diametral
Depth (m)	62.05	**Failure Validity**	Invalid



CLIENT:

THREE SISTERS mountain village

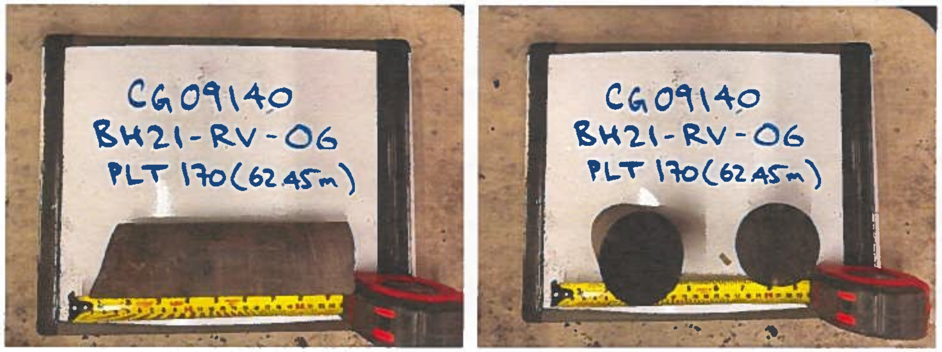
Resort Village Phase 1 Undermining PLTs

BH21-RV-06

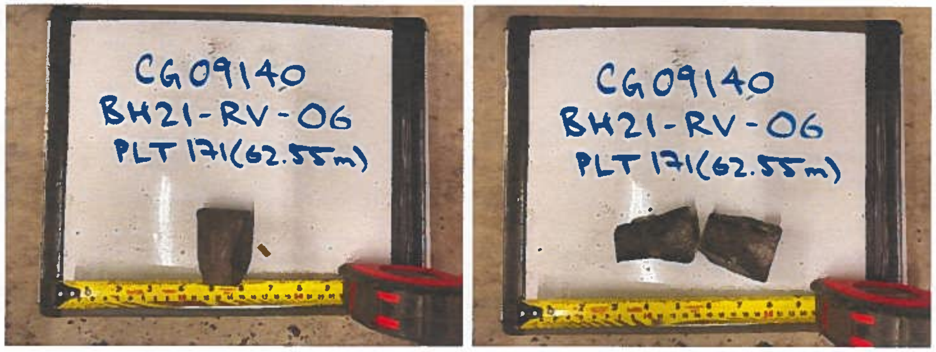
CG09140

February 2022

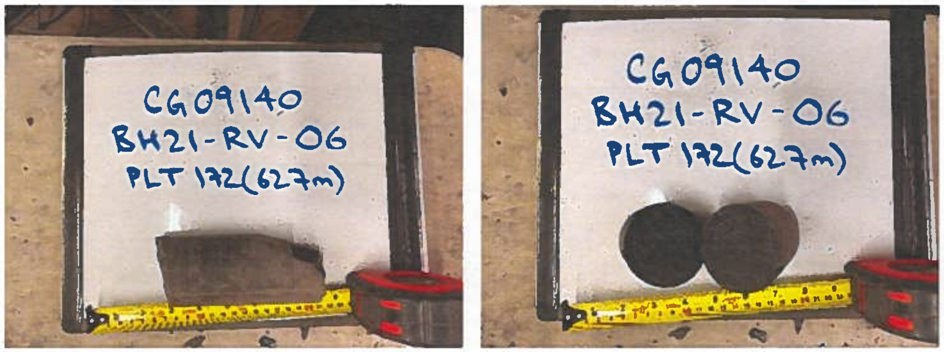
Point Load Test	PLT 170	**Point Load Test Type**	Diametral
Depth (m)	62.45	**Failure Validity**	Valid



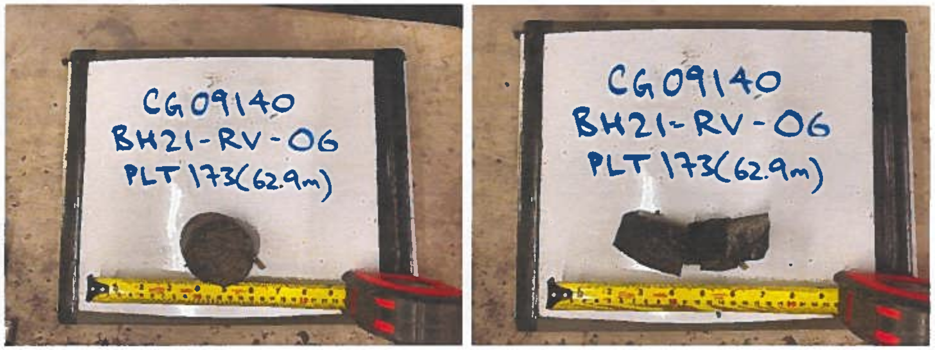
Point Load Test	PLT 171	**Point Load Test Type**	Axial
Depth (m)	62.55	**Failure Validity**	Valid



Point Load Test	PLT 172	**Point Load Test Type**	Diametral
Depth (m)	62.70	**Failure Validity**	Valid



Point Load Test	PLT 173	**Point Load Test Type**	Axial
Depth (m)	62.90	**Failure Validity**	Valid



CLIENT:

THREE SISTERS mountainvillage

Resort Village Phase 1 Undermining PLTs

BH21-RV-06

CG09140

February 2022

Point Load Test	PLT 174
Depth (m)	62.95

Point Load Test Type	Diametral
Failure Validity	Valid

CLIENT:

THREE SISTERS mountain village

Resort Village Phase 1 Undermining PLTs

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February 2022

Appendix E

Camera Survey

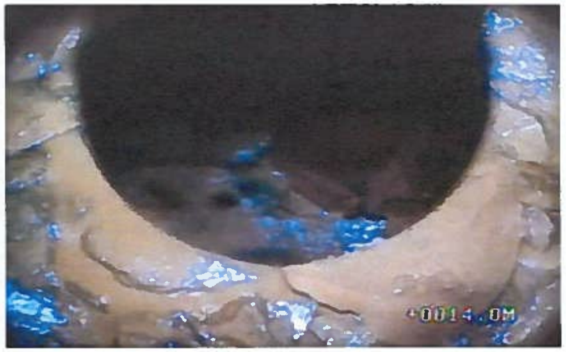
End of PVC at 2.9 m

Typical borehole view at 8.9 m

Top of void at 12.5 m

Side view of the void at 12.9 m

Rubble at the bottom of the borehole



Maximum camera depth at 14.1 m

wsp

CLIENT: THREE SISTERS mountain village

PROJECT:	Three Sisters Village			
TITLE:	Downhole Camera Survey BH21-RV-04			
DATE: October 2023	JOB No.: CG09140	FILE:	FIGURE No.: E-1	REV.: 0


End of PVC at 3.0 m


Vertical cracking noted at 3.4 m

Void at 13.4 to 13.7 m

Void at 13.8 to 14.0 m

Void at 14.2 to 14.4 m


Blocky rubble noted at 14.4 m

wsp

CLIENT:
THREE SISTERS mountain village

PROJECT: Three Sisters Village

TITLE: Downhole Camera Survey
BH21-RV-05

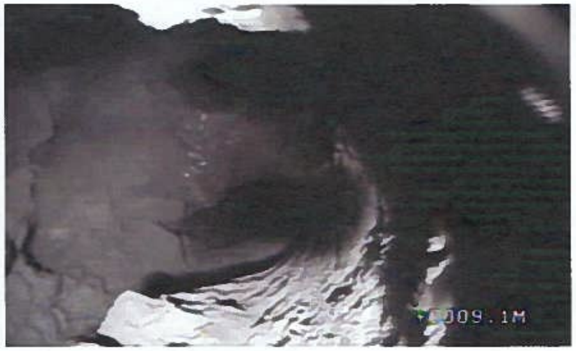
DATE	JOB No.	FILE	FIGURE No.	REV.
October 2023	CG09140		E-2	0

Typical borehole wall at 1.5 m

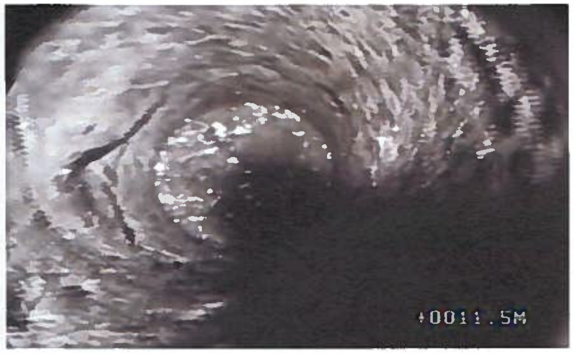
Start of void at 8.4 m

End of Void at 9.6

Side view of the void at 8.7 m



Widening of void at 9.1 m



End of borehole at 11.7 m

wsp

CLIENT:
THREE SISTERS mountain village

PROJECT:	Three Sisters Village
TITLE:	Downhole Camera Survey BH21-RV-07

DATE:	JOB No.:	FILE:	FIGURE No.:	REV.:
October 2023	CG09140		E-3	0

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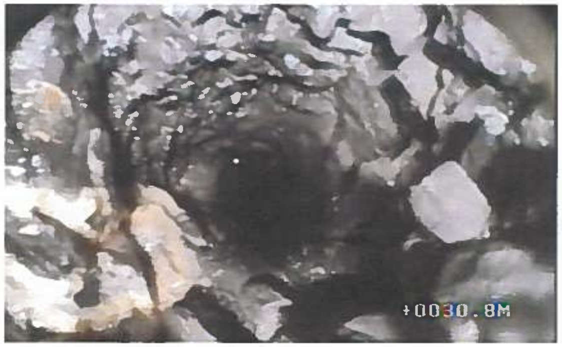
End of PVC at 4.6 m

Typical borehole wall at 23.1 m



Rough borehole wall from 30.0 to 33.0 m


Water noted at 36.0 m


Rubble at 37.5 to 38.6 m


End of borehole at 42.1 m

wsp

CLIENT

THREE SISTERS mountain village

PROJECT:	Three Sisters Village
TITLE:	Downhole Camera Survey BH21-RV-G1

DATE	JOB No.:	FILE:	FIGURE No.	REV.
October 2023	CG09140		E-4	0

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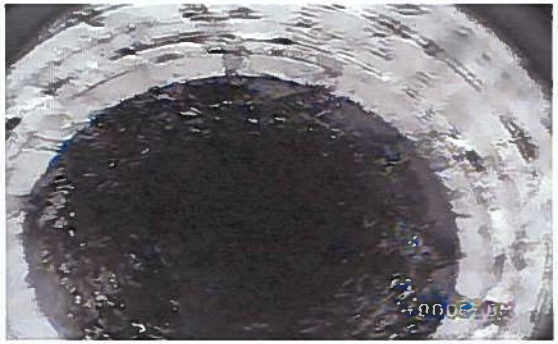
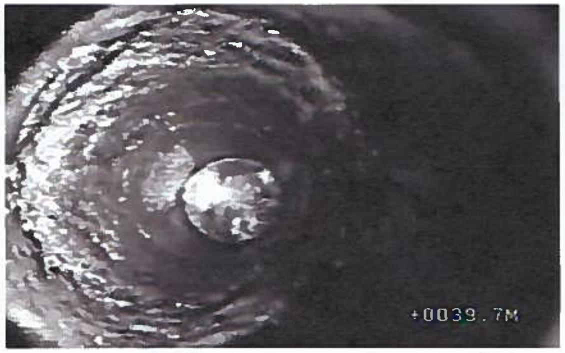


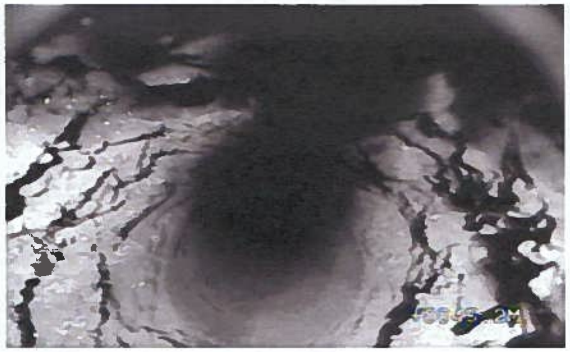
End of PVC at 6.0 m

Void at 23.5 m

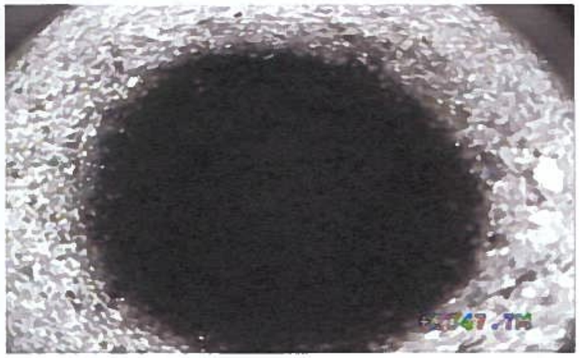
End of void at 23. 6 m



Water noted at 40.0 m



Fractured borehole wall from 45.0 to 47.7 m



End of Borehole at 47.7

CLIENT: Three Sisters mountain village	PROJECT:	Three Sisters Village			
	TITLE:	Downhole Camera Survey BH21-RV-G2			
	DATE: October 2023	JOB No.: CG09140	FILE:	FIGURE No.: E-5	REV: 0

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Printed: 10/20/23 05:15 PM

End of PVC at 16.7 m

Start of void noted at 27.9 m extending to 29.0 m

Fractures noted at 29.6 m

Start of void at 31.7 m

End of void and water noted at 33.1 m

End of borehole at 33.4 m

CLIENT:
THREE SISTERS mountain village

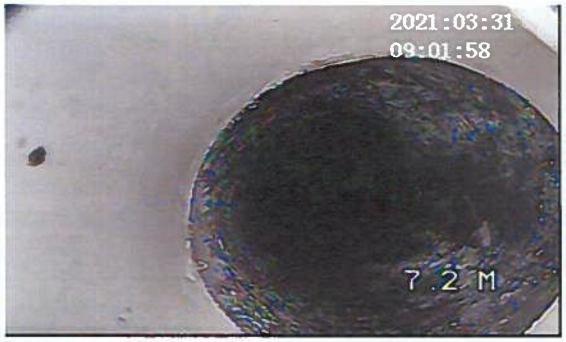
PROJECT: Three Sisters Village

TITLE:
Downhole Camera Survey
BH21-RV-G4

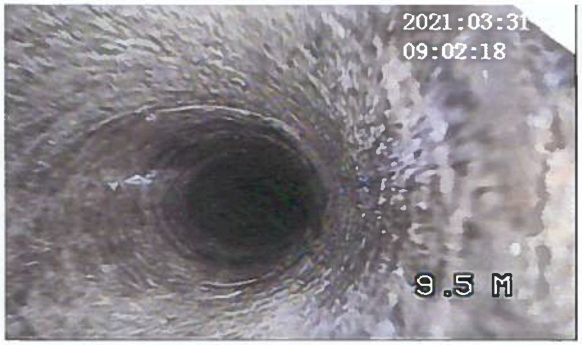
DATE:	JOB No.:	FILE:	FIGURE No.:	REV.
October 2023	CG09140		E-6	0

X:\CAD\CCAN100-CAL1\CAL1-EE-GEO\Projects\Calgary Geo\CG09140 - Resort Village Phase 1 Undermining\05 - Undermining Data\05 - Rep

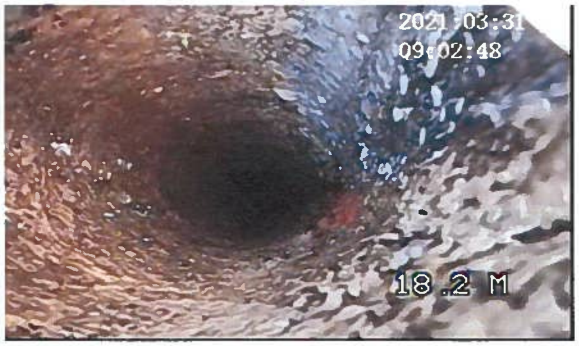
Printed: 10/20/23 05:15 PM



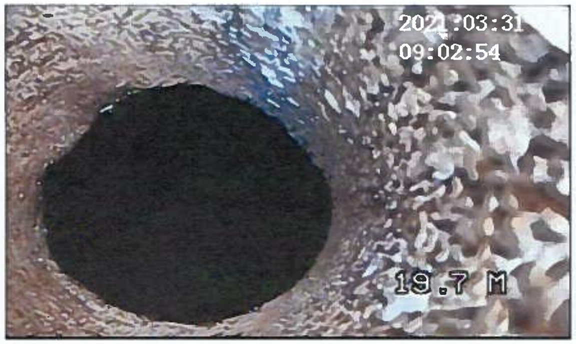
End of PVC at 7.2 m



Typical borehole view at 9.5 m



Typical borehole view at 18.2 m



Start of void at 19.8 m

End of void at 21.5

End of borehole at 21.8 m

wsp

CLIENT:
THREE SISTERS mountain village

PROJECT: Three Sisters Village

TITLE: Downhole Camera Survey
GA08-30

DATE:	JOB No.:	FILE:	FIGURE No.:	REV:
October 2023	CG09140		E-7	0

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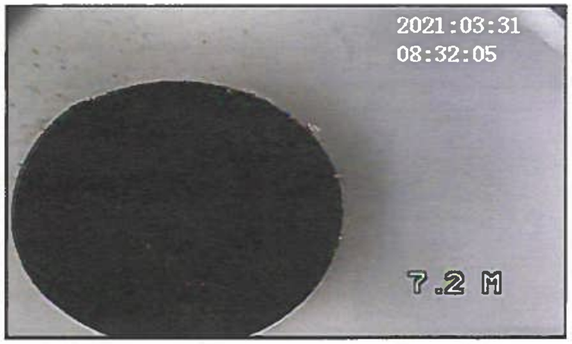
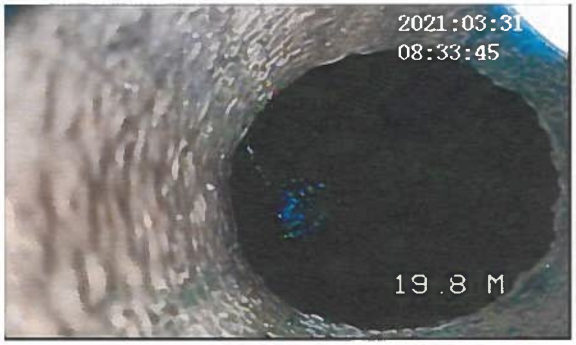


End of PVC at 7.2 m

Typical borehole view at 8.6 m

Typical borehole view at 18.1 m



Start of void at 19.8 m

End of void (top of rock at botton) at 21.4 m

Water at 21.7 m

CLIENT: Three Sisters mountain village

PROJECT: Three Sisters Village

TITLE: Downhole Camera Survey
GA08-31

DATE	JOB No.	FILE	FIGURE No.	REV
October 2023	CG09140		E-8	0

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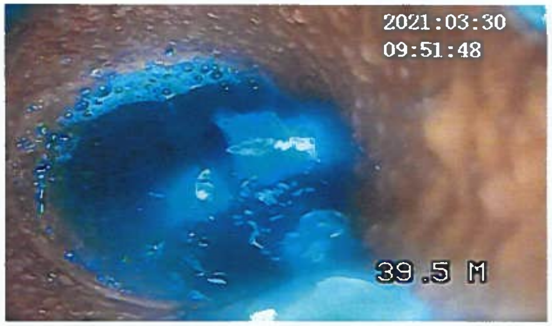
End of PVC at 10.2 m

Potential bed separation at 24.3 m

Typical borehole view at 28.8 m



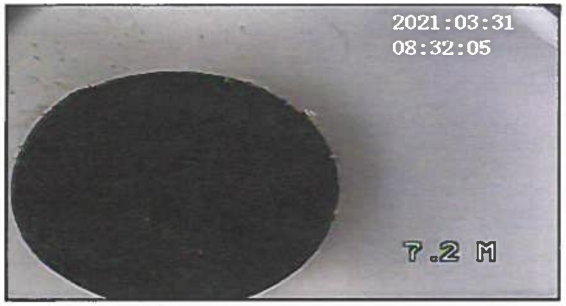
Water noted at 39.6 m

Start of Void at 41.4 m extending to 43.1 m

Void at 44.6 m; rubble noted on the borehole floor

PROJECT:	Three Sisters Village				
TITLE:	Downhole Camera Survey GA08-32				
CLIENT: THREE SISTERS mountain village	DATE: October 2023	JOB No.: CG09140	FILE:	FIGURE No.: E-9	REV: 0

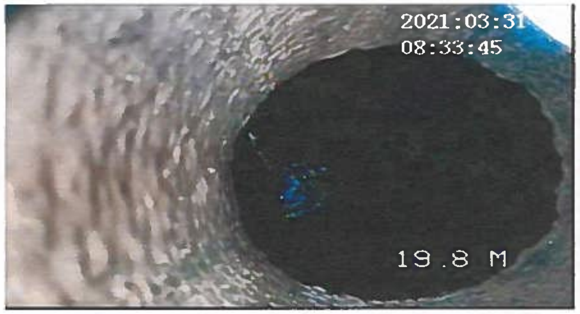
X:\CA\DCCAN100-CAL1\CAL1-EE-GEO\Projects\Calgary Geo\CG09140 - Resort Village Phase 1 Undermining\05 - Undermining Data\05 - Rep



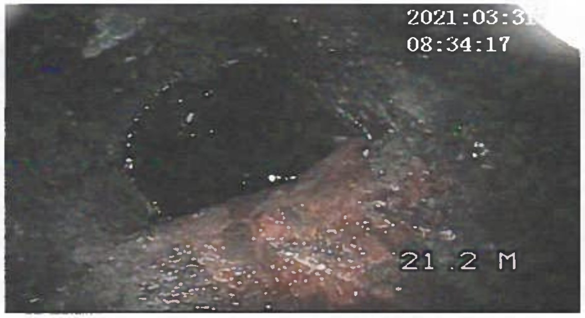
End of PVC at 7.2 m

Typical borehole view at 8.6 m

Typical borehole view at 18.1 m



Start of void at 19.8 m



End of void at 21.4 m

Water at 21.7 m

wsp

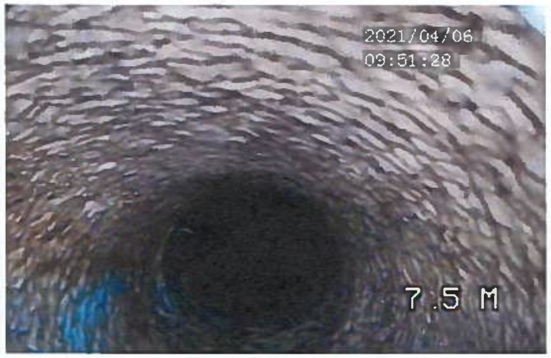
CLIENT:
THREE SISTERS mountainvillage

PROJECT: Three Sisters Village

TITLE:
Downhole Camera Survey
GA08-33

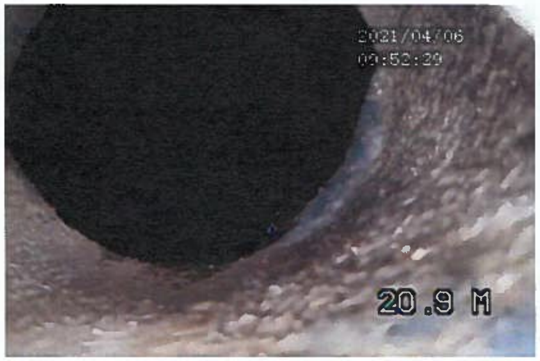
DATE	JOB No.	FILE	FIGURE No.	REV.
October 2023	CG09140		E-10	0

Bottom of PVC at 6.0 m



Typical borehole section at 7.5 m

Typical borehole section at 14.7 m



Start of void at 21.1 m

Rubble noted on the floor

End of borehole at 22.5 m

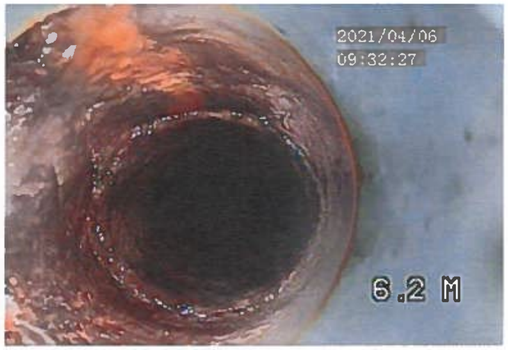
wsp

CLIENT:
THREE SISTERS
mountain village

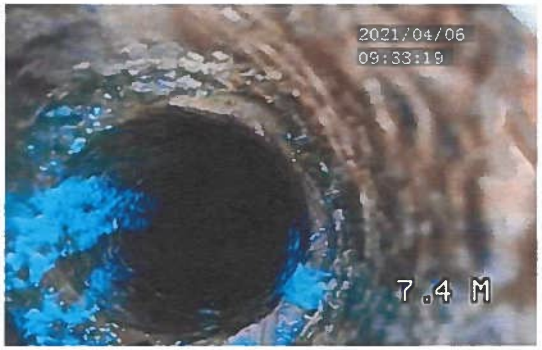
PROJECT: Three Sisters Village

TITLE: Downhole Camera Survey
GA03-66

DATE:	JOB No.:	FILE:	FIGURE No.:	REV.:
October 2023	CG09140		E-11	0



End of PVC at 6.2 m



Potential bed seperation at 7.5 m

Typical borehole section at 18.7 m

Void at 33.2 to 35.8 m

Timber logs noted at the bottom around 35.0 m

End of borehole at 35.8 m

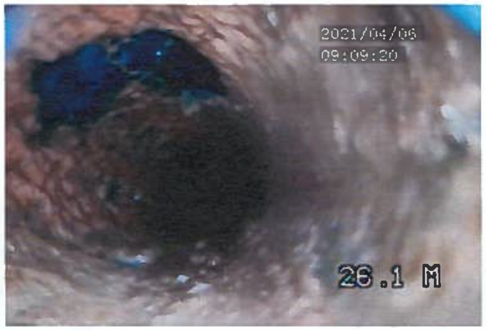
CLIENT: THREE SISTERS mountain village

PROJECT: Three Sisters Village

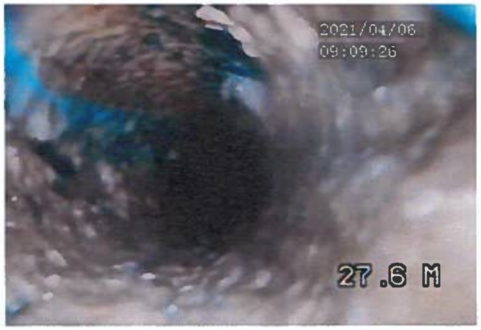
TITLE: Downhole Camera Survey
GA03-67

DATE:	JOB No.:	FILE:	FIGURE No.:	REV.:
October 2023	CG09140		E-12	0

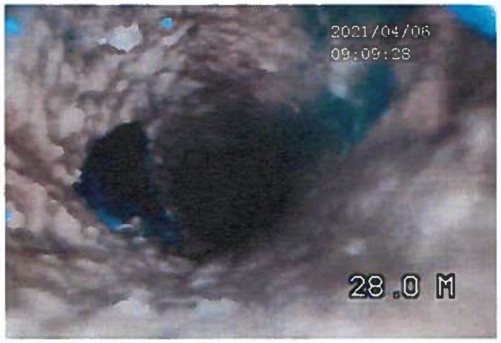
End of PVC at 6.6 m



Black deposits noted at the borehole wall at 26.1 m



Typical borehole at 27.6 m



Black deposits noted at the borehole wall at 28.0 m

Water Noted at 38.0 m

End of borehole at 57.7 m; poor visibility of the floor

wsp

CLIENT:
THREE SISTERS mountain village

PROJECT: Three Sisters Village

TITLE: Downhole Camera Survey
GA03-68

DATE:	JOB No.:	FILE:	FIGURE No.:	REV.
October 2023	CG09140		E-13	0

Appendix F

Limitations

Limitations

1. The work performed in the preparation of this report and the conclusions presented are subject to the following:
    a. The Standard Terms and Conditions which form a part of our Professional Services Contract;
    b. The Scope of Services;
    c. Time and Budgetary limitations as described in our Contract; and
    d. The Limitations stated herein.
2. No other warranties or representations, either expressed or implied, are made as to the professional services provided under the terms of our Contract, or the conclusions presented.
3. The conclusions presented in this report were based, in part, on visual observations of the Site and attendant structures. Our conclusions cannot and are not extended to include those portions of the Site or structures, which are not reasonably available, in WSP's opinion, for direct observation.
4. The environmental conditions at the Site were assessed, within the limitations set out above, having due regard for applicable environmental regulations as of the date of the inspection. A review of compliance by past owners or occupants of the Site with any applicable local, provincial or federal bylaws, orders-in-council, legislative enactments and regulations was not performed.
5. The Site history research included obtaining information from third parties and employees or agents of the owner. No attempt has been made to verify the accuracy of any information provided, unless specifically noted in our report.
6. Where testing was performed, it was carried out in accordance with the terms of our contract providing for testing. Other substances, or different quantities of substances testing for, may be present on-site and may be revealed by different or other testing not provided for in our contract.
7. Because of the limitations referred to above, different environmental conditions from those stated in our report may exist. Should such different conditions be encountered, WSP must be notified in order that it may determine if modifications to the conclusions in the report are necessary.
8. The utilization of WSP's services during the implementation of any remedial measures will allow WSP to observe compliance with the conclusions and recommendations contained in the report. WSP's involvement will also allow for changes to be made as necessary to suit field conditions as they are encountered.
9. This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or contract. Any use which any third party makes of the report, in whole or the part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. WSP accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on the report or anything set out therein.
10. This report is not to be given over to any third party for any purpose whatsoever without the written permission of WSP.
11. Provided that the report is still reliable, and less than 12 months old, WSP will issue a third-party reliance letter to parties that the client identifies in writing, upon payment of the then current fee for such letters. All third parties relying on WSP's report, by such reliance agree to be bound by our proposal and WSP's standard reliance letter. WSP's standard reliance letter indicates that in no event shall WSP be liable for

any damages, howsoever arising, relating to third-party reliance on WSP's report. No reliance by any party is permitted without such agreement.