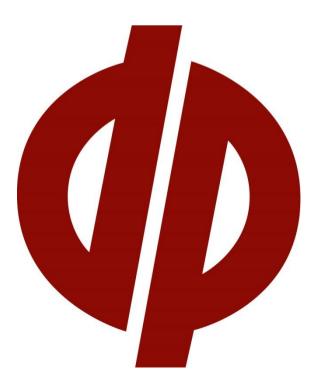


Report on Shaft Condition Assessment

Donnybrook Shaft Remediation Goodwood Road, Upper Capel

Prepared for Department of Mines, Industry Regulation & Safety

> Project 96721.02 April 2022



Douglas Partners Geotechnics | Environment | Groundwater

Document History

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author	Darlo	28 April 2022
Reviewer	F. L- y1.	28 April 2022



Douglas Partners Pty Ltd ABN 75 053 980 117 www.douglaspartners.com.au 36 O'Malley Street Osborne Park WA 6017 Phone (08) 9204 3511



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Report on Shaft Condition Assessment Donnybrook Shaft Remediation Goodwood Road, Upper Capel

1. Introduction

This report presents the results of a shaft condition assessment undertaken for the Donnybrook Mine Shaft Remediation Methodology project. The purpose of this report is to detail the site conditions and discuss the results and findings of the investigation of 15 features located within the Argyle Forest Block, approximately 2.6 km south of Donnybrook, WA. These features are generally grouped within an area known as "*First Mate Lease*" except one feature, known as the "*Dog Shaft*", that is outside this area.

The investigation was commissioned in a purchase order from the Department of Mines, Industry Regulation & Safety (DMIRS) dated 23 February 2022 and was undertaken in accordance with Douglas Partners' proposal 96721.01.P.001.Rev0 dated 14 February 2022.

Two reports have been produced:

- Shaft assessment report (this report) detailing the findings of the shaft assessment; and
- Shaft remediation report providing recommendations on suitable remediation options and budget estimates.

The aim of the investigation was to assess the condition of 15 mine features and provide an assessment of the following:

- Condition of the base of each feature and the presence of material or obstructions within the features;
- Stability of the features;
- Presence of fauna within the features; and
- Potential for noxious and/or flammable gases within the features.

The details of the investigation are presented in this report, together with comments and recommendations on the items listed above.

2. Field Work Methods

The field work was carried out under an Environmental and Safety Management Plan which incorporated measures to manage safety when working around the features, bush fire risk, dieback and limiting impact on the surrounding forest.



The field work was undertaken on 10 March 2022 and comprised:

- Inspection of the features from ground surface, by an experienced Geotechnical Engineer from Douglas Partners;
- Assessment of the condition of the base of the features less than 5 m deep using heavy steel rod with a cone tip either pushed by hand or where possible driven via multiple blows of a dropped 9 kg weight hammer.
- Photos of the features and where possible horizontal workings within approximately 5 m of the ground surface were visible, and video footage within the feature;
- LiDAR scanning of the features and their surrounds; and
- Monitoring for noxious or flammable gases within features.

The steel rod was pushed or driven to refusal in multiple points within each feature to assess the likelihood of the visible base of each feature comprising natural soil/rock or competent material (rather than a loose plug of debris).

The LiDAR scanning was undertaken using the Hovermap Platform, utilised Simultaneous Localisation and Mapping (SLAM) based LiDAR technology. Data collected using a combination of hand-held and winch mounted scanning methods was stitched together into a single, spatially correct model to provide accurate data on the spatial relationship between the features as well as dimensions and volumes of each feature. Douglas Partners engaged the services of specialist contractors, MineLiDAR to undertake this work. The LiDAR data was georeferenced using multiple points recorded by a decimetre GPS.

The gas monitoring was undertaken using a Ventis MX4 portable multi gas monitor with pump attachment capable of detecting carbon monoxide, hydrogen sulphide and oxygen concentrations and the lower explosives limit (LEL). The unit was lowered into the features and air was sampled directly into the unit.

3. Field Work Results

Comments on the observations made from the assessment of the features using LiDAR, hand tools and visual methods are provided in the table below. Photographs of the features at the time of the investigation are included in Appendix B.



Table 1: Descriptions of the Mine Feature

Feature	Description
101	Approximately 4.3 m deep and 3 m by 3 m in plan. Base of feature obscured by collapsed material. Probing the base of the feature indicates competent material at the base, approximately 0.3 m below the surface of the collapsed vegetation and branches. The volume of stockpiled material around this feature is estimated to exceed the excavated volume of the feature and therefore, is anticipated to comprise spoil from the excavation of multiple features in the vicinity. No evidence of lateral workings.
102	A roughly circular excavation, with a diameter of 3.3 m and approximately 1.5 m deep. Probing the base of the feature indicates competent material at the base, approximately 0.25 m below the surface of the fallen vegetation.
103	A trench, approximately 0.5 m to 1 m deep, 27 m long and 0.7 m wide with one notable feature near the mid-point of the trench alignment, measuring approximately 1.5 m deep and 3 m by 2 m in plan. Probing the base of the trench at regular intervals along the alignment, indicated that competent material was present within 0.3 m below the surface of the soil and fallen vegetation.
104	A trench, approximately 0.5 m to 1 m deep, 12 m long and 1.5 m wide with one notable feature near the mid-point measuring approximately 1.2 m deep and 2.5 m by 2.5 m in plan. Probing the base of the trench at regular intervals along the alignment indicated that competent material was present within 0.3 m below the surface of the soil and fallen vegetation.
105	Approximately 4 m deep and 1.5 m by 1.0 m in plan. Probing the base of the feature indicates competent material at the base, approximately 0.3 m below the surface of the fallen vegetation. No evidence of lateral workings.
106a	The southern-most feature of three closely grouped features. Approximately 1.5 m deep and 2.0 m by 1.3 m in plan. Probing the base of the feature indicates competent material at the base, approximately 0.5 m to 1.0 m below the surface of the fallen vegetation. No evidence of lateral workings.
106b	The central feature of three closely grouped features. This feature comprises a lateral working from surface, heading in a northwest direction (up-hill direction). The entrance to the working is approximately 0.7 m high and 2 m wide. Through this entrance, the working opens up to an excavated room approximately 1.5 m high, 3.5 m wide and 5 m long. A lateral working, approximately 1 m wide and less than 1 m high continues in a northwest direction, from the opposite side of the room. The working slopes downwards at a slope of approximately 1 horizontal:0.3 vertical. The total lateral extent of this working was beyond the reach of camera and lidar equipment, however it is estimated to be at least 12 m in horizontal length.
106c	The northern-most feature of three closely grouped features. Approximately 2 m deep and 1.8 m by 1.1 m in plan. Probing the base of the feature indicates competent material at the base, approximately 0.4 m below the surface of the fallen vegetation. No evidence of lateral workings.
107	Approximately 1.3 m deep and 2.0 m by 1.5 m in plan. Probing the base of the feature indicates competent material at the base, approximately 1.0 m below the surface of the fallen vegetation. A small lateral working, observed at the base, on the northern side of the feature. Lateral working is approximately 0.3 m in height and video footage from the base of the feature suggests the lateral extent of the working not more than 0.5 m.



Feature	Comments
108	Approximately 2.9 m deep and 2.5 m by 1.5 m in plan. Probing the base of the feature indicates competent material at the base, approximately 0.5 m below the surface of the fallen vegetation. No evidence of lateral workings.
109	Small depression, less than 0.3 m deep with evidence of manual excavation. Probing the base of the feature indicates competent material, approximately 0.5 m below the surface.
110	A vertical shaft, approximately 9.5 m deep and 1.5 m by 1.2 m in plan. Lateral workings extend in four directions (generally, north, east, south and west) from the base of the shaft. Based on the LiDAR data, the detected horizontal extent of the lateral workings is generally 1 m to 3 m. It is anticipated that the working heading in a southerly direction is longer than the detected extent. The extent of the workings in the north, east and west direction is uncertain however there is a possibility that they are only as long as their detected extent. The working in a southerly 1 horizontal:0.35 vertical and the other workings are roughly horizontal or angles downwards slightly.
111	An area of ground disturbance beside the forest access track measuring approximately 20 m by 8 m, where evidence of cutting into the slope is observed on the western edge, thereby creating a flatter area on the naturally slopping surface. Dynamic cone penetrometer testing within the footprint of the area indicated hard ground within 0.15 m of the surface level.
112	A roughly circular excavation at surface becoming rectangular, with side support (constructed from wood and sheet metal) near the base. The excavation is approximately 3.0 m in diameter at the surface and the rectangular part near the base is approximately 1.5 m by 1.0 m in plan. The feature has a total depth of approximately 2.0 m. Probing the base of the feature indicates competent material at the base, within 0.3 m below the surface of the fallen vegetation. No evidence of lateral workings.
113	Approximately 4.7 m deep and 2.5 m by 1.5 m in plan. Probing the base of the feature indicates competent material at the base, approximately 0.3 m below the surface of the fallen vegetation. No evidence of lateral workings.

No carbon monoxide or hydrogen sulphide were detected by the gas monitor lowered to the base of all vertical features generally deeper than 1.5 m or to a distance of 5 m into the lateral working at 106b. Gas readings within all features are summarised in the table below:

Feature	Lower Explosives Limit (%)	Oxygen (%)	Carbon Monoxide (%)	Hydrogen Sulphide (%)	
101	1	20.9			
105	3	20.9			
106a	1	20.9			
106b	3	18.9	0	0	
106c	2	20.9			
107	2	20.9			
108	3	20.9			

Table 2: Gas Meter Reading Summary



Feature	Lower Explosives Limit (%)	Oxygen (%)	Carbon Monoxide (%)	Hydrogen Sulphide (%)	
110	3	18.2	0	0	
113	1	20.9	0	0	

Drawings 1 to 5 in Appendix B detail the feature locations, results of the LiDAR scanning, including below ground views of the digital models.

Digital mesh models of a features were produced by MineLIDAR and are included in Appendix C. Models of Features 109 and 111 were not created due to the expectation that no remediation or further attention will be required in these areas. The volumes of each mesh (i.e. the volume of all areas visible to the LiDAR scanning equipment) are summarised in the table below.

Feature	Volume (m3)
101	41
102	11
103	19
104	17
105	7
106a	3
106b	17
106c	3
107	5
108	7
110	29
112	7
113	11

Table 3: Feature Volumes

The observations and findings of the field work are summarised in Table 4 on the following page.



Table 4: Summarised Results of the Field Work

Feature Dimensio	Approximate	MaximumVolumeDimensions [1](m³) [5]	num Volume Lateral ions ^[1] (m³) ^[5] Detected?			Estimated Dimensions of Lateral Working		Bearing of	al Comment	Harmful	Fauna Detected?
	Dimensions ^[1] (LxWxD) (m)			Height (m)	Width (m)	Below Ground Surface (m) ^[4]	the Lateral Working	Gas Detected?			
101	3.0 x 3.0 x 4.3	40.6	No	-	-	-	-				
102	3.3 dia x 1.5	11.1	No	-	-	-	-	Base of feature,	No		
103	27 x 0.7 x 1.0	18.8	No	-	-	-	-	underlying fallen vegetation and possibly			
104	12 x 1.5 x 1.0	16.7	No	-	-	-	-	some loose soil, assessed to be competent.			
105	1.5 x 1.0 x 4.0	6.9	No	-	-	-	-				
106a	2.0 x 1.3 x 1.5	2.7	No	-	-	-	-				
106b	>12 x 1.0-3.5 x 1.0	17.2	Yes	<1	1	1.1 m to 3.8 ^[5]	300°	No notable collapse of roof. Feature appears stable. Minimum clearance of 1.1 m between ground surface and top of lateral working occurs near the entrance to the working.	No, albeit low oxygen levels 5 m into lateral working	No ^[2]	
106c	1.8 x 1.1 x 2.0	2.4	No	-	-	-	-	Base of feature,			
107	2.0 x 1.5 x 1.3	4.8	No	-	-	-	-	underlying fallen vegetation and possibly	No		
108	2.5 x 1.5 x 2.9	7.2	No	-	-	-	-	some loose soil, assessed to be competent.			



	Approximate Maximum	Volume	Lateral		imensions of Working	Depth of Lateral Working	Bearing of		Harmful	Gas Fauna
Feature	Dimensions ^[1] (LxWxD) (m)	(m ³) ^[5]	Workings Detected?	Height (m)	Width (m)	Below Ground Surface (m) ^[4]	the Lateral Working	Comment	Gas Detected?	
109	3.2 x 2.4 x <0.3	<1	No	-	-	-	-	Base of feature, underlying approx. 0.5 m of loose soil assessed to be competent.	No	
110	1.5 x 1.2 x 9.5	29.0	Yes	4 directions ranging from 0.4 m to 1.1 m	4 directions ranging from 0.4 m to 0.9 m	≥6.6 ^[5]	20°/110°/ 185°/300°	No evidence of collapse from photographs or LiDAR models. Scanned geometry at the base of the feature indicative of the extent of excavation and therefore, considered likely to be competent.	No, albeit Iow oxygen Ievels at base	No ^[2]
111	20 x 8 x <1	NA	No	-	-	-	-	Base of feature, assessed to be competent.		
112	3.0 dia x 2.0	6.4	No	-	-	-	-	Base of feature,		
113	2.5 x 1.5 x 4.7	10.4	No	-	-	-	-	underlying fallen vegetation and possibly some loose soil, assessed to be competent.	No	

Notes [1]: Length and width dimensions taken at ground surface.

[2]: Based on visual assessment of photos and video of the features and ground surface observations during the field work.

[3]: Based on recorded LiDAR data and include total volume including horizontal workings, if applicable.

[4] Depth to the roof of the opening beneath the ground surface.

[5]: Derived from LiDAR data

Shaft Condition Assessment, Donnybrook Shaft Remediation Goodwood Road, Upper Capel



4. Discussion

Some discussions in this section use the terminology regarding risk proposed by the Australian Geomechanics Society (AGS, 2007). This terminology, albeit originally derived for landslide risk management, is considered suitable to assist with the description of risks associated with the collapse of features at this site. A relevant extract of AGS (2007) is included in Appendix D.

The 15 mine features assessed are generally in good condition and considered overall stable. Some limited collapse of the walls of some features (e.g. 101, 102, 106a, 112) is evident, essentially from shallow depth, i.e. where the ground profile comprises soil rather than rock surrounding the features.

It is considered that the risk of sudden collapse of the features, specifically those that could be described as vertical shafts (e.g. 101, 105, 108, 110 and 113) or their lateral extensions is very low. This risk allocation considers the following:

- the generally hard ground conditions apparent from visual assessment of the feature walls;
- results of limited dynamic cone penetrometer tests indicating greater than 20 blows for 150 mm of rod penetration at the base of the features;
- the overall stability of the features noting that they are likely more than 100 years old;
- the relatively small size of the lateral openings, and
- the depth below ground surface to the openings, relative to their size.

Other than Features 106b and 110, results of the investigation suggest that most of the features terminate at relatively shallow depths not greater than 5 m with no significant horizontal workings.

The assessment of the total lateral extent of Feature 106b was beyond the maximum range of the equipment. It does however progress at a dip and direction that would only increase the thickness of ground cover above the lateral working and therefore, the section of 106b that was beyond inspection range is not considered to pose any risk of collapse that would warrant further investigation. It is noted that the bearing of Feature 106b heads towards Feature 104 in plan view, however, the difference of level between the two features appears to discard any connection between these features (refer to Drawing 7, Appendix B). It is considered that the portion of 106b posing the greatest risk for collapse is the opening of the feature, immediately west of its entrance as this section is where it is widest and with the least amount of cover to the surface. This section however, is also considered to be low risk to pedestrians and other similar light loads other than vehicles and heavier equipment.

Feature 110 contains lateral workings, including one heading in a southerly direction towards Feature 103 located about 10 m away. The limited LiDAR data collected on the southerly working and the lack of evidence of any lateral continuation from Features 103 however make it difficult to extrapolate the significance of the south-heading lateral working from Feature 110 past its investigated length. Regardless, owing to the depth of the lateral workings from Feature 110, they are not considered to be a risk.

A volume assessment of the stockpiled material in the vicinity of Feature 101 indicated approximately 60 m³ to 100 m³ of material above the anticipated natural surface level. It is therefore considered possible that this stockpile contains material from nearby features, which would be consistent with a lack of waste surrounding some of the features. It should also be noted that the apparent lack of significant collapse of the feature itself above its current base is inconsistent with a scenario where



Feature 101 would be a deep vertical shaft plugged at shallow depth, therefore most likely discarding a scenario where Feature 101 would be a deep shaft from which 100 m³ of spoil would have been extracted.

Gas monitoring did not detect any harmful gases within the features and the slightly decreased oxygen levels encountered in Features 106b and 110 are not a concern in the context of the likely work to occur around the features. For comparison, the levels detected are approximately equivalent to levels typically expected at approximately 1,000 m above sea level (e.g. Bluff Knoll, Stirling Ranges, WA).

No evidence of fauna was detected in the features during the field investigation.

5. References

AS 1726. (2017). Geotechnical Site Investigations. Standards Australia.

Australian Geomechanics Society. (2007, March). A National Landslide Risk Management Framework for Australia". *Journal and News of the Australian Geomechanics Society*, 64-113.

6. Limitations

Douglas Partners (DP) has prepared this report for this project at Lot F27 Goodwood Road, Upper Capel in accordance with DP's proposal dated 14 February 2022 and acceptance received from Ben Darby dated 23 February 2022. The work was carried out under DMIRS General Conditions of Contract dated August 2019. This report is provided for the exclusive use of Department of Mines, Industry Regulation & Safety for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the (geotechnical / environmental / groundwater) components set out in this report and based on known project conditions



and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

Douglas Partners Pty Ltd

Appendix A

About This Report



Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

 In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;

- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

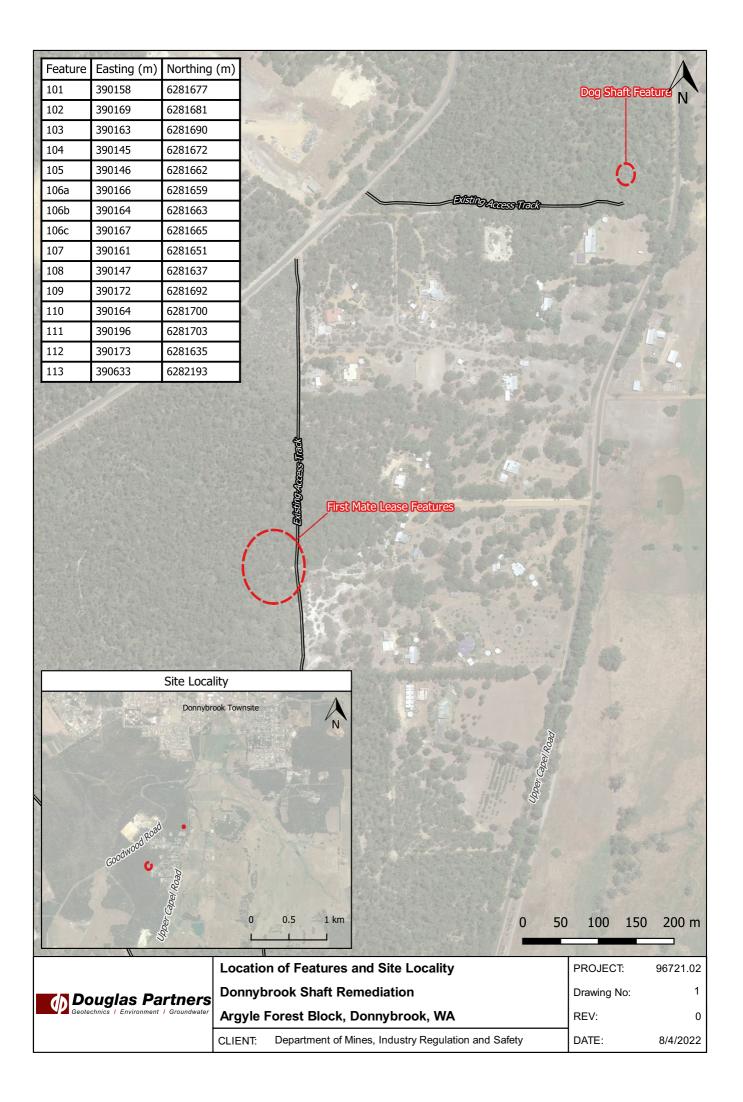
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

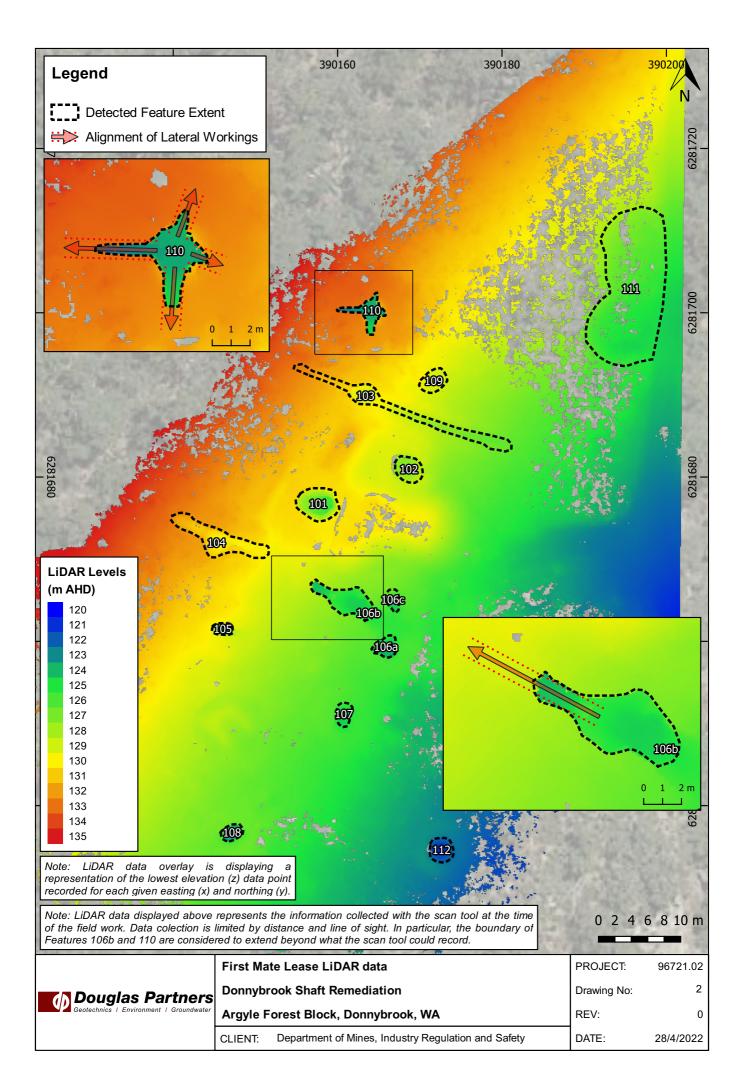
Site Inspection

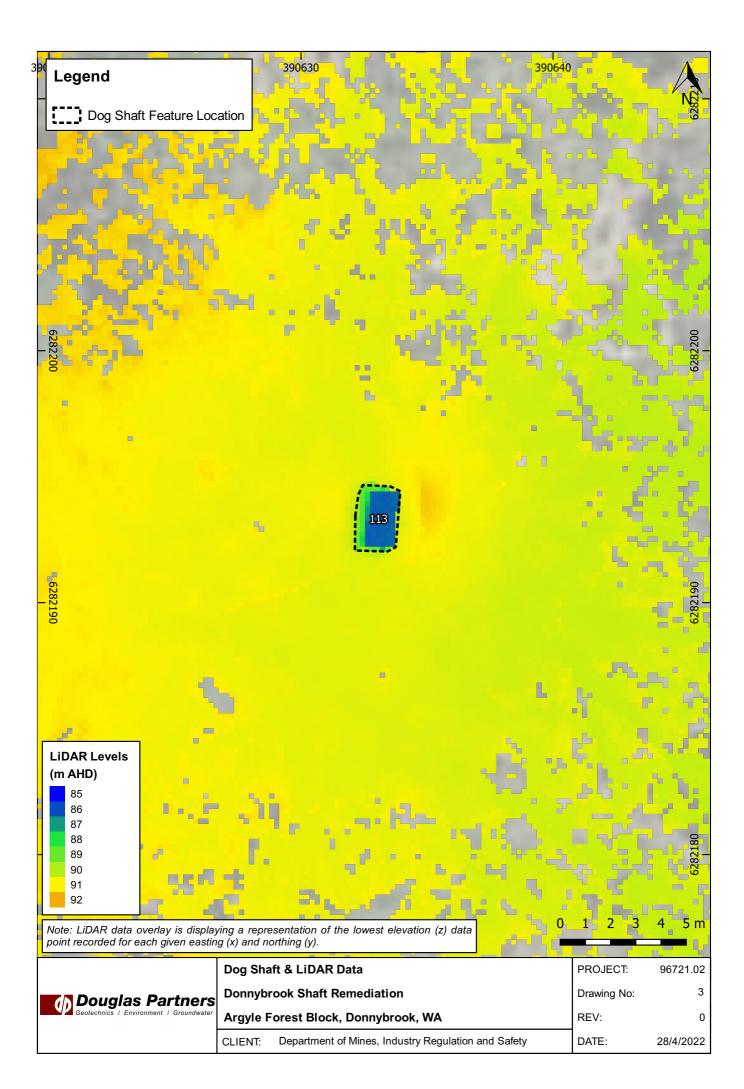
The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

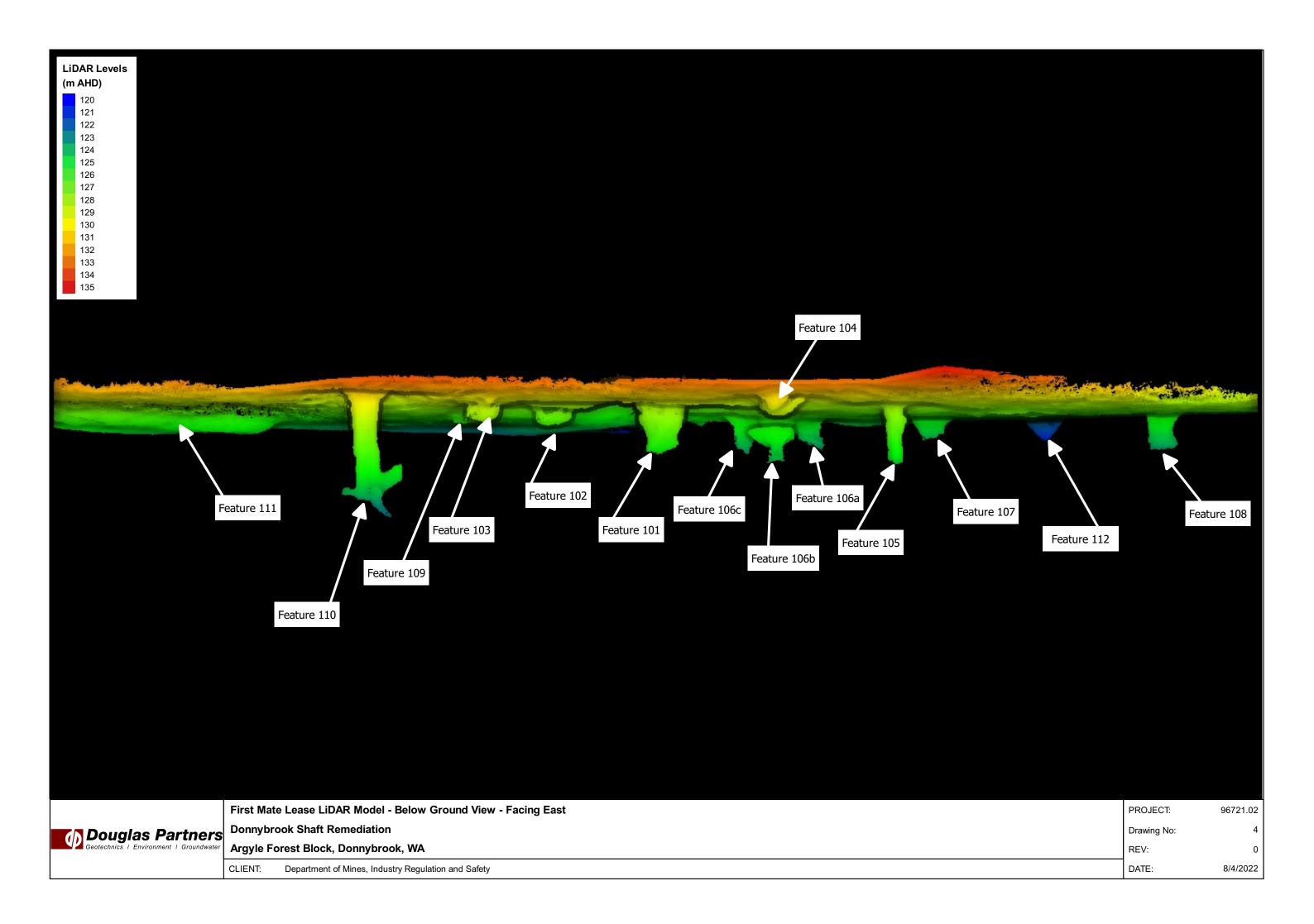
Appendix B

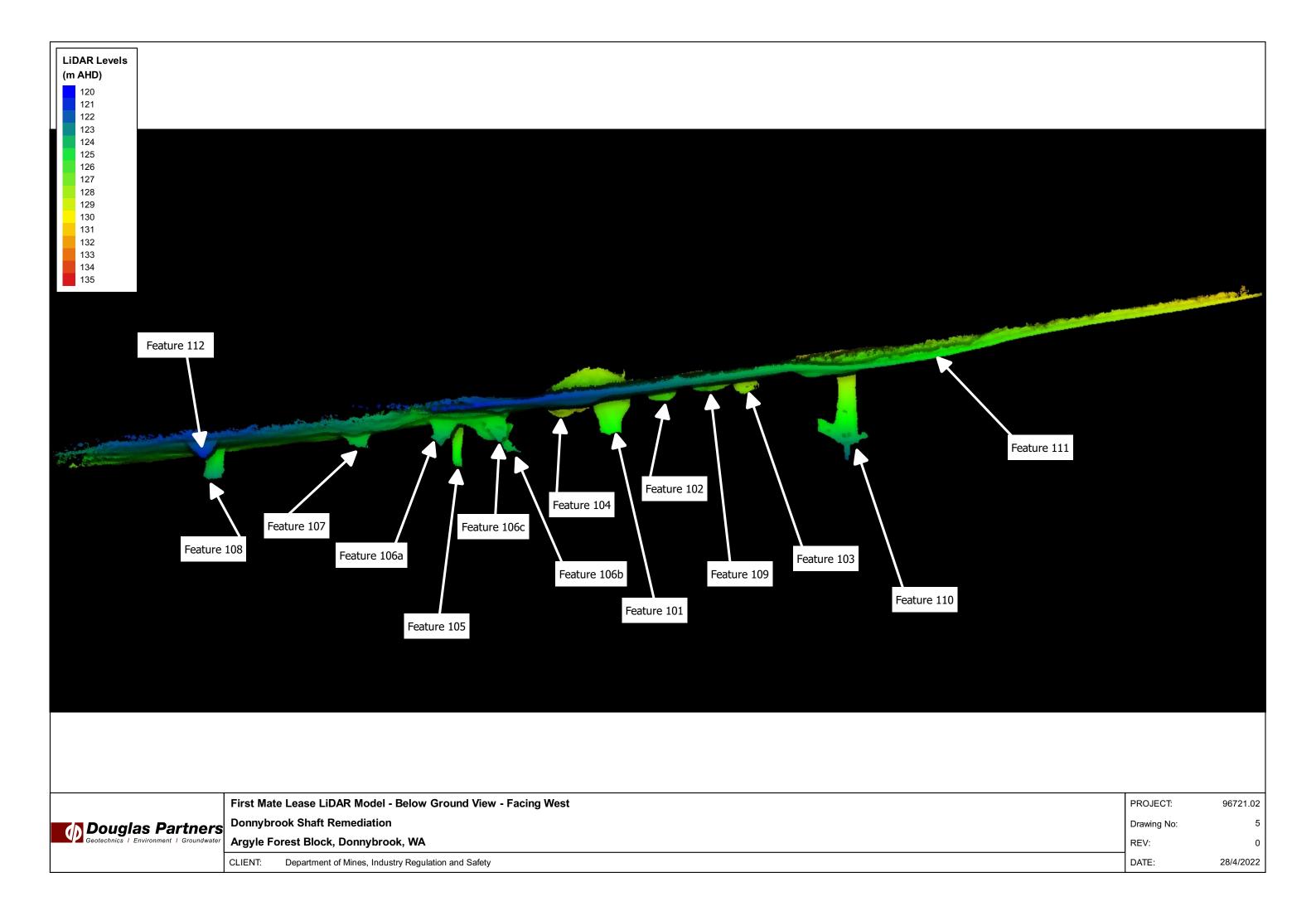
Drawings 1 to 8 Feature Photos





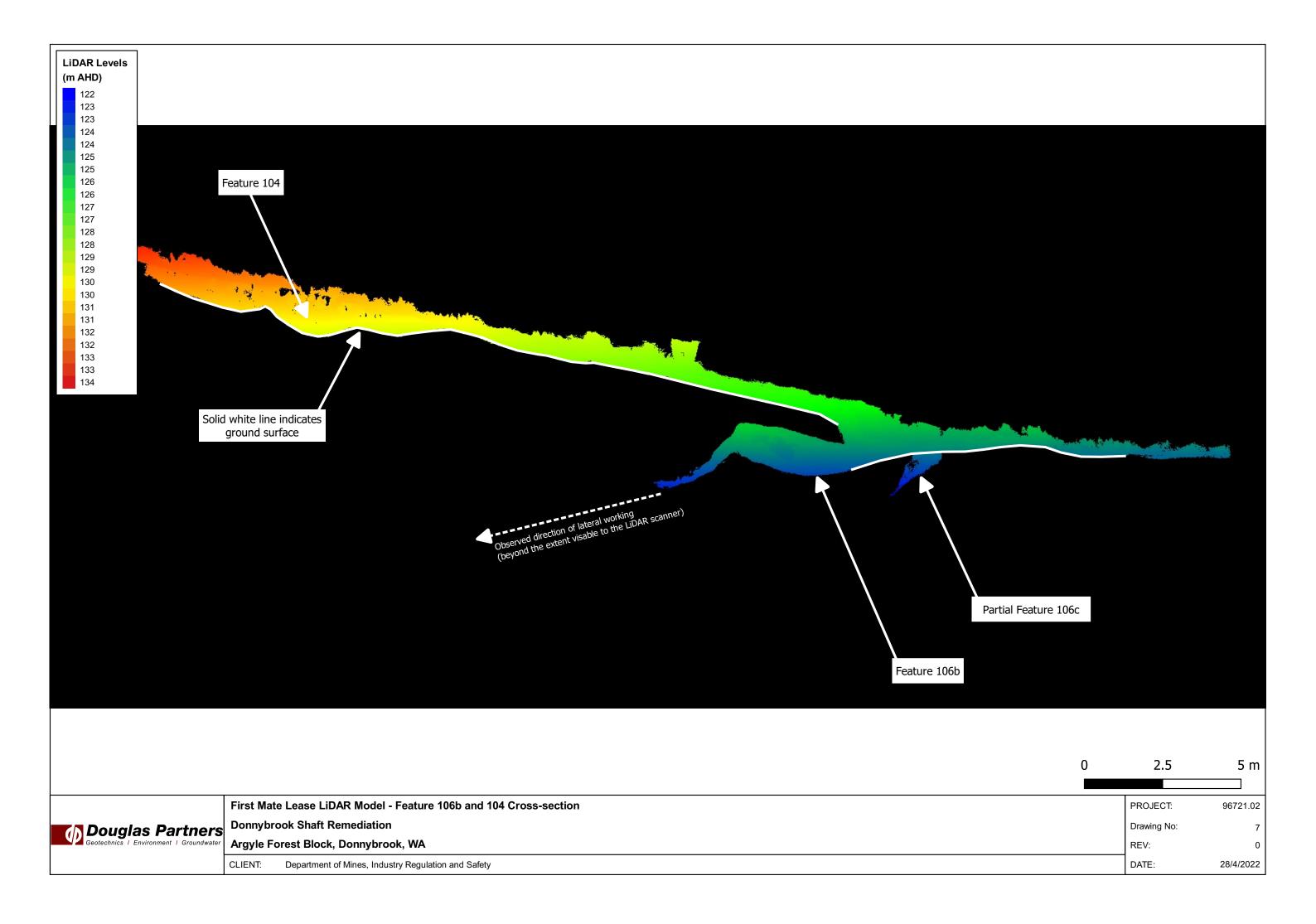


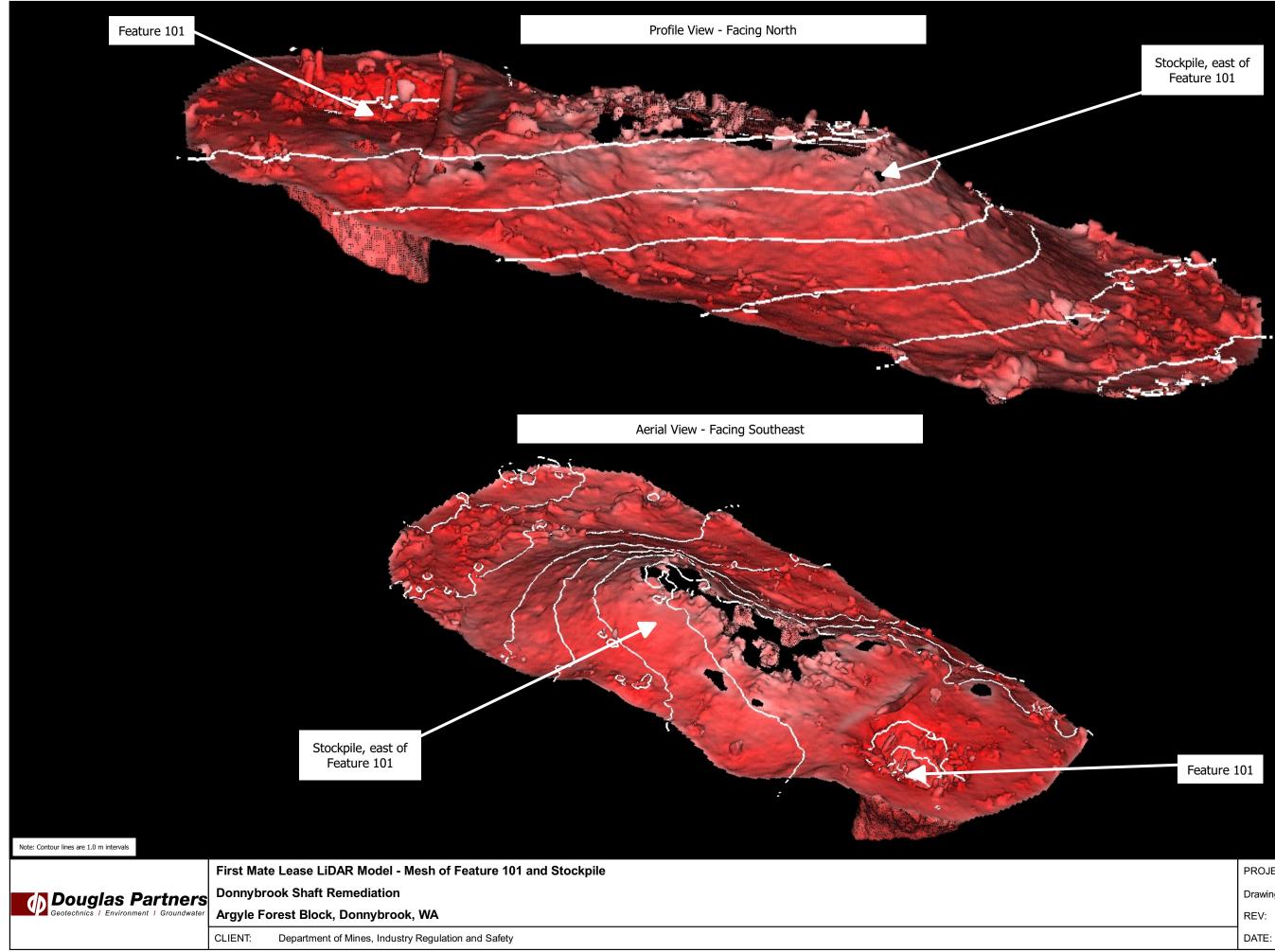


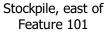


LiDAR Levels (m AHD) 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135	
Douglas Partners Geotechnics Environment Groundwater	Feature 106a Feature 106c First Mate Lease LiDAR Model - Below Ground View - Facing Southwest - Feature 106 Donnybrook Shaft Remediation Argyle Forest Block, Donnybrook, WA CLIENT: Department of Mines, Industry Regulation and Safety

PROJECT:	96721.02
Drawing No:	6
REV:	0
DATE:	11/4/2022







PROJECT: 96721.02 Drawing No: 7 0 DATE: 28/4/2022



Photograph 1: Feature 101



Photograph 2: Feature 102

Douglas Partners Geotechnics Environment Groundwater	Photographs - Features 101 & 102	Project No.:	96721.02
	Donnybrook Mine Shaft Condition	Photo Plate No.:	1
	Lot F27, Argyle Forest Block, Upper Capel	Revision:	0
	CLIENT: Department of Mines, Industry	Date:	Apr-22
	Regulation and Safety	Date.	λρι-22



Photograph 3: Feature 103- central excavation



Photograph 4: Feature 104 - central excavation

A Douglas Partners	Photographs - Features 103 & 104	Project No.:	96721.02
	Donnybrook Mine Shaft Condition	Photo Plate No.:	2
	Lot F27, Argyle Forest Block, Upper Capel	Revision:	0
	CLIENT: Department of Mines, Industry Regulation and Safety	Date:	Apr-22



Photograph 5: Feature 105



Photograph 6: Feature 105 - base

	Photographs - Feature 105	Project No.:	96721.02
	Donnybrook Mine Shaft Condition	Photo Plate No.:	3
	Lot F27, Argyle Forest Block, Upper Capel	Revision:	0
	CLIENT: Department of Mines, Industry Regulation and Safety	Date:	Apr-22



Photograph 7: Features 106a, 106b & 106c



Photograph 8: Feature 106a

Douglas Partners Geotechnics Environment Groundwater	Photographs - Feature 106	Project No.:	96721.02
	Donnybrook Mine Shaft Condition	Photo Plate No.:	4
	Lot F27, Argyle Forest Block, Upper Capel	Revision:	0
	CLIENT: Department of Mines, Industry Regulation and Safety	Date:	Apr-22



Photograph 9: Feature 106b - entrance



Photograph 10: Feature 106b - view from entrance

	Photographs - Feature 106	Project No.:	96721.02
N Douglas Partners	Donnybrook Mine Shaft Condition	Photo Plate No.:	5
Geotechnics / Environment / Groundwater	Lot F27, Argyle Forest Block, Upper Capel	Revision:	0
	CLIENT: Department of Mines, Industry Regulation and Safety	Date:	Apr-22



Photograph 11: Feature 106c



Photograph 12: Feature 107

Douglas Partners	Photographs - Features 106 & 107	Project No.:	96721.02
	Donnybrook Mine Shaft Condition	Photo Plate No.:	6
	Lot F27, Argyle Forest Block, Upper Capel	Revision:	0
	CLIENT: Department of Mines, Industry Regulation and Safety	Date:	Apr-22



Photograph 13: Feature 108



Photograph 14: Feature 109

Douglas Partners Geotechnics Environment Groundwater	Photographs - Features 108 & 109	Project No.:	96721.02
	Donnybrook Mine Shaft Condition	Photo Plate No.:	7
	Lot F27, Argyle Forest Block, Upper Capel	Revision:	0
	CLIENT: Department of Mines, Industry Regulation and Safety	Date:	Apr-22



Photograph 15: Feature 110



Photograph 16: Feature 110 - lateral working visible from surface

	Photographs - Feature 7	Project No.:	96721.02
	Donnybrook Mine Shaft Condition	Photo Plate No.:	8
	Lot F27, Argyle Forest Block, Upper Capel	Revision:	0
	CLIENT: Department of Mines, Industry Regulation and Safety	Date:	Apr-22



Photograph 17: Feature 111



Photograph 18: Feature 112

Douglas Partners Geotechnics Environment Groundwater	Photographs - Features 111 & 112	Project No.:	96721.02
	Donnybrook Mine Shaft Condition	Photo Plate No.:	9
	Lot F27, Argyle Forest Block, Upper Capel	Revision:	0
	CLIENT: Department of Mines, Industry Regulation and Safety	Date:	Apr-22

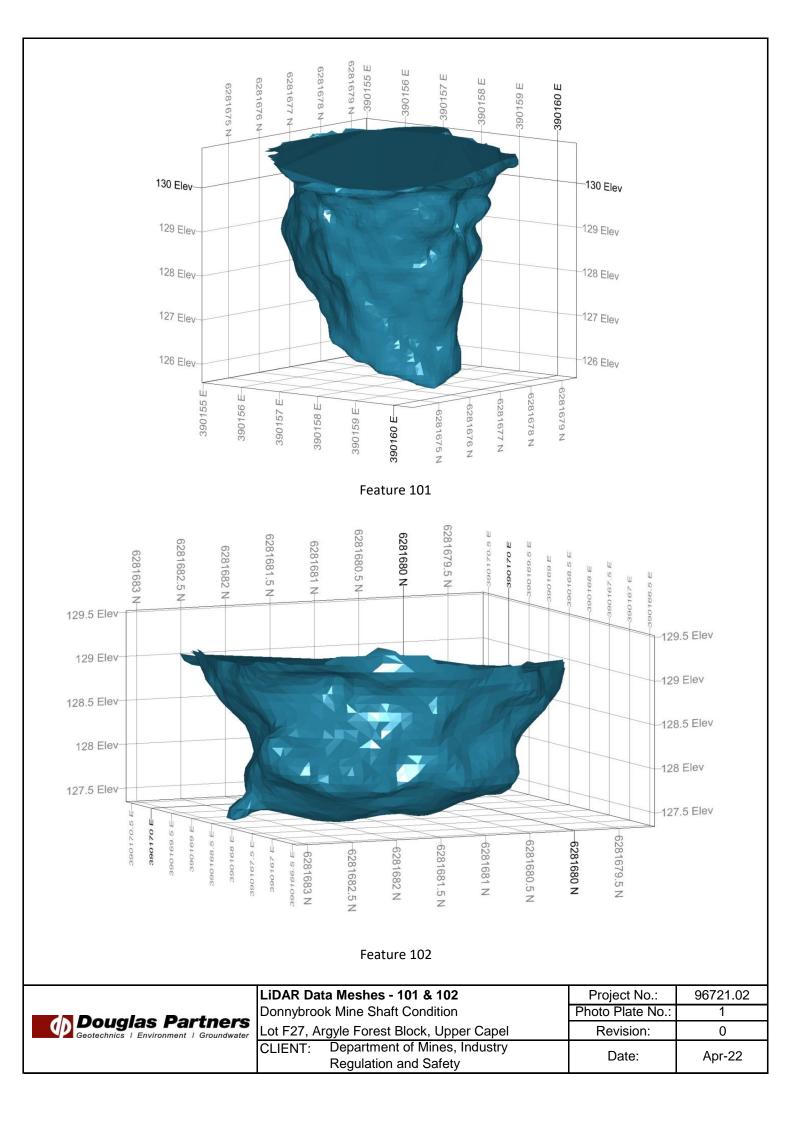


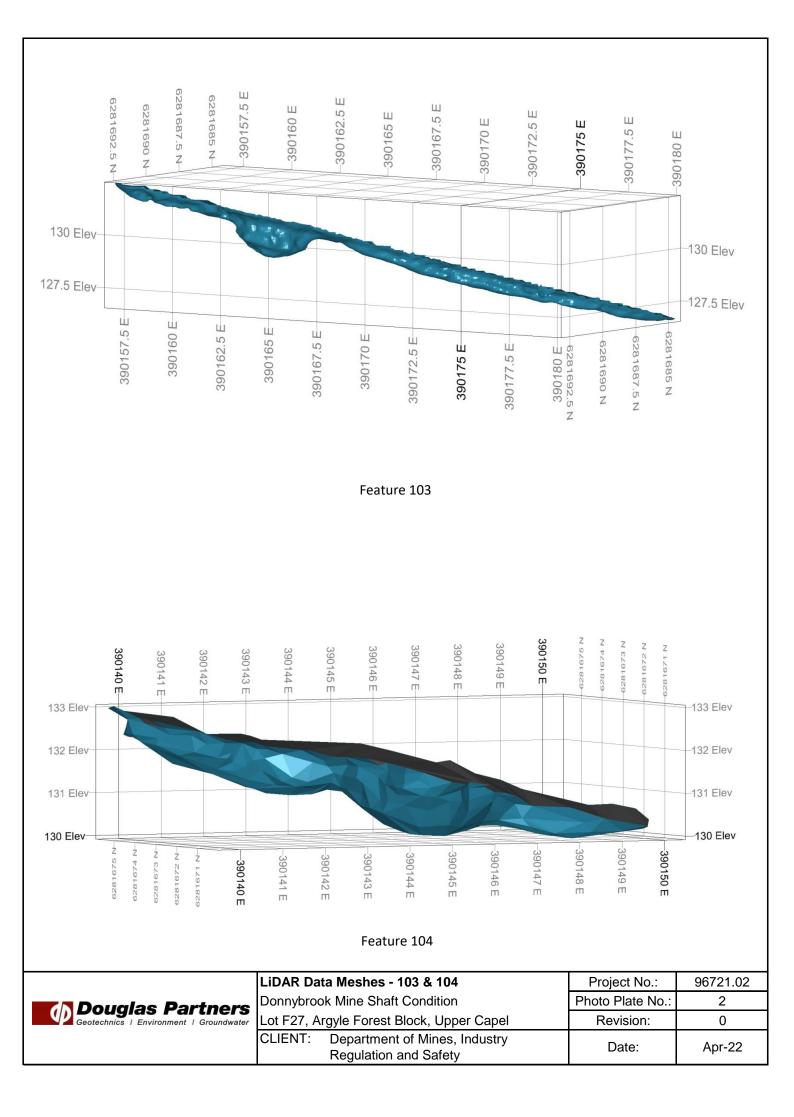
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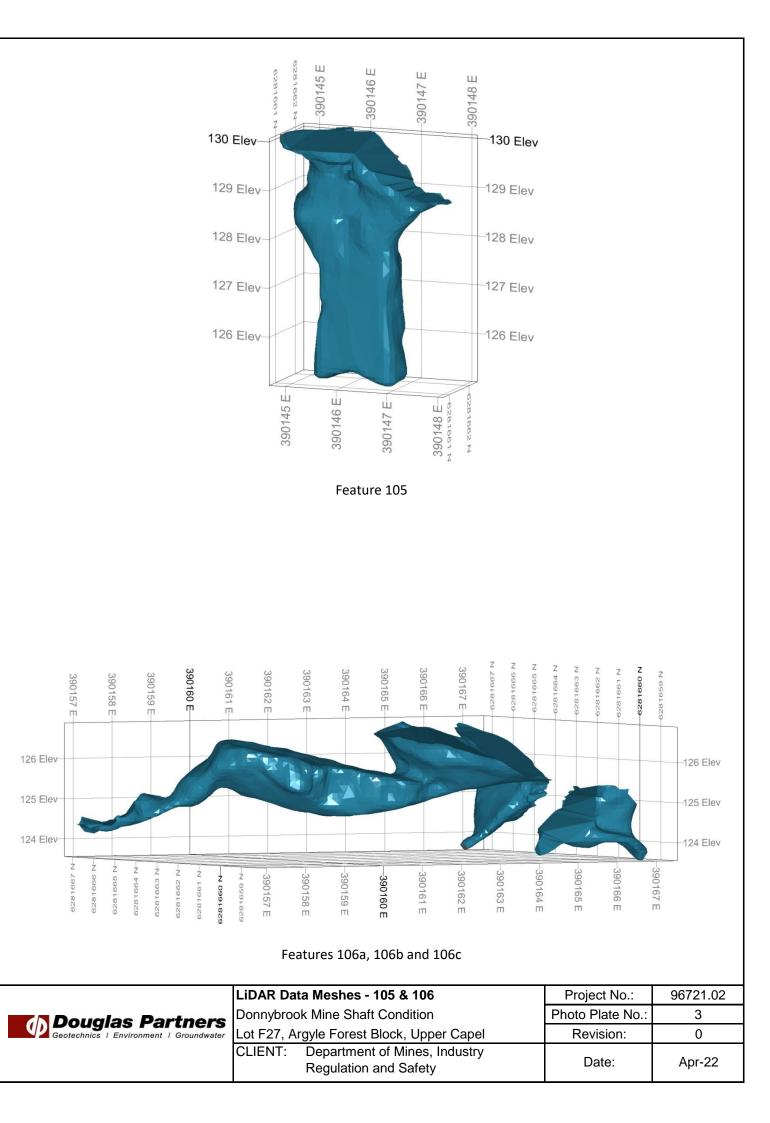
Douglas Partners Geotechnics Environment Groundwater	Photographs - Feature 113	Project No.:	96721.02
	Donnybrook Mine Shaft Condition	Photo Plate No.:	10
	Lot F27, Argyle Forest Block, Upper Capel	Revision:	0
	CLIENT: Department of Mines, Industry Regulation and Safety	Date:	Apr-22

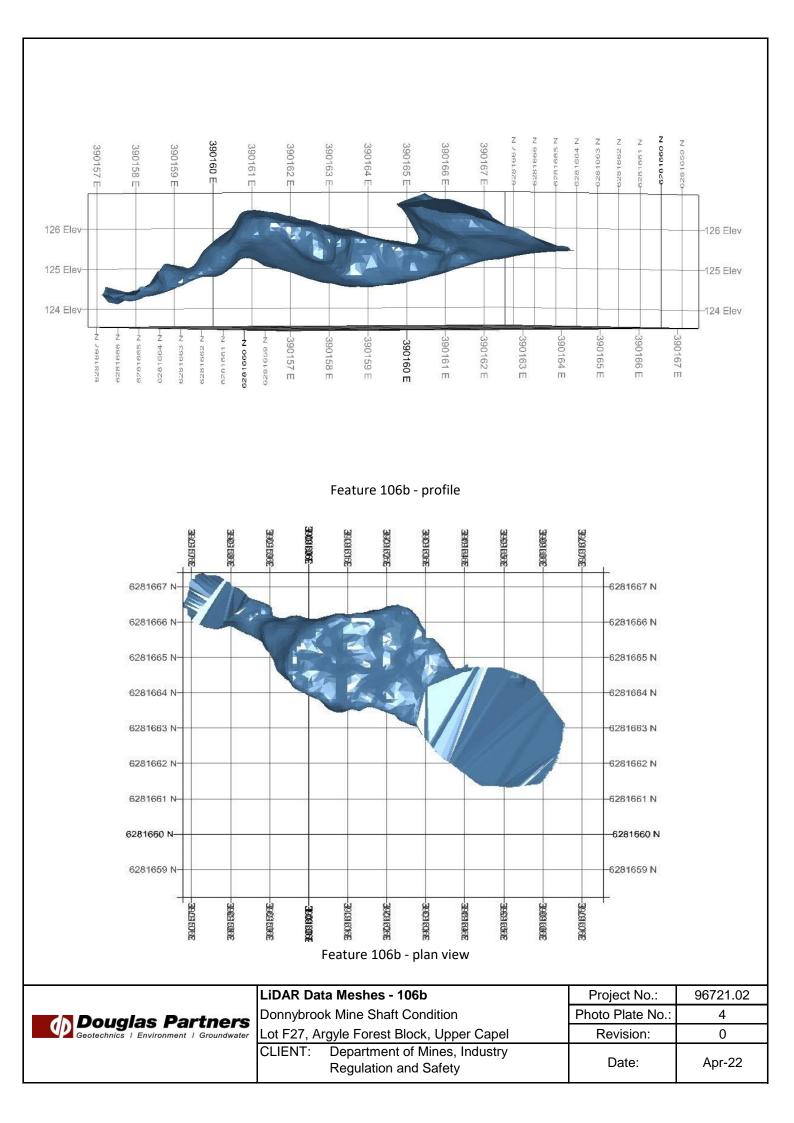
Appendix C

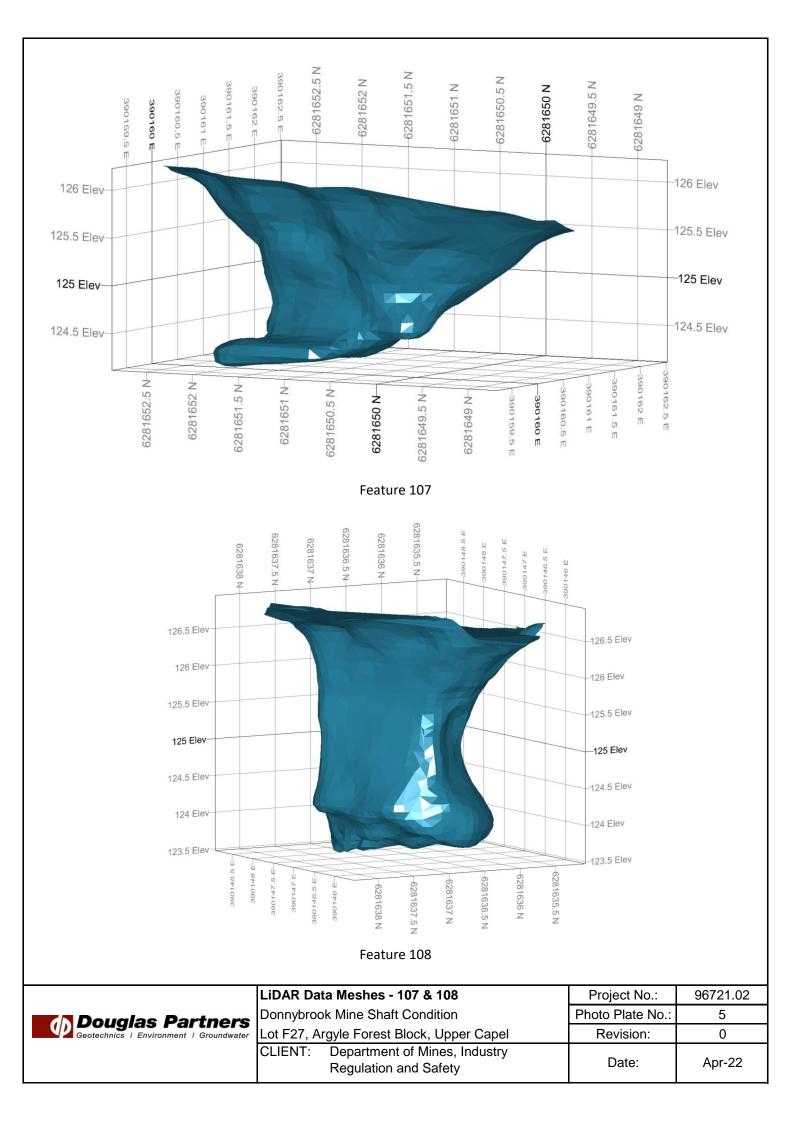
LiDAR Mesh Models of Features

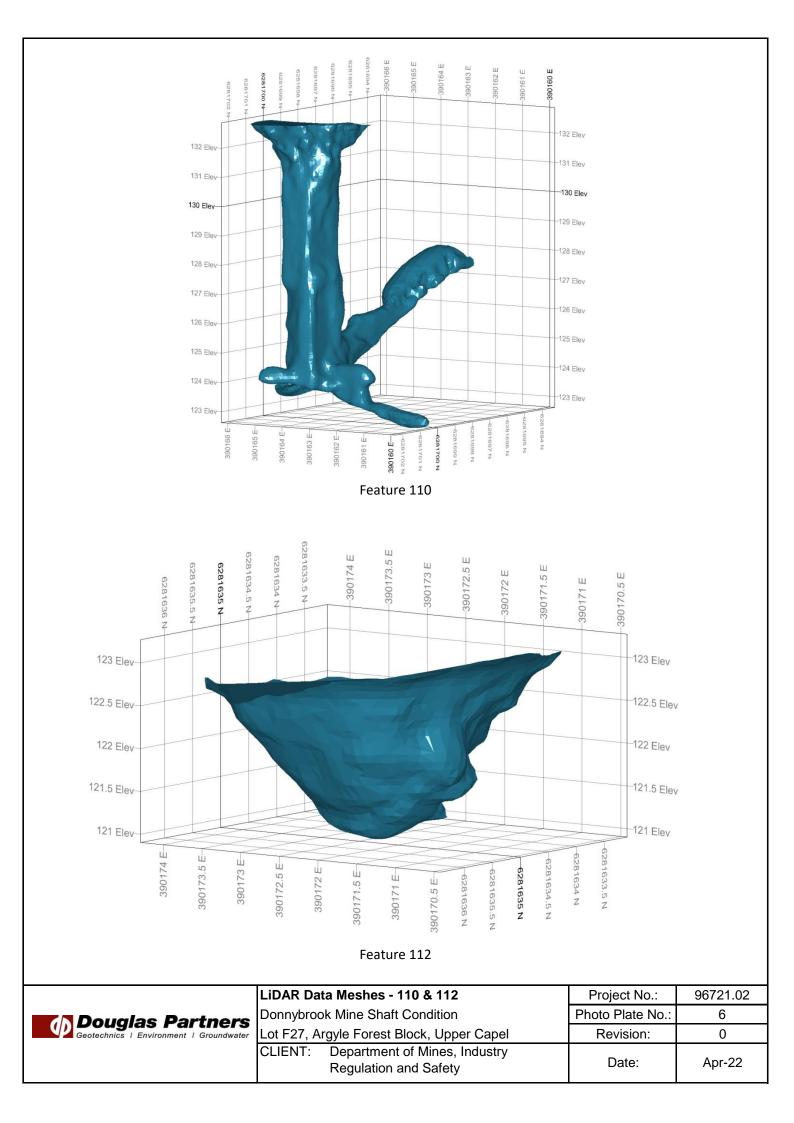


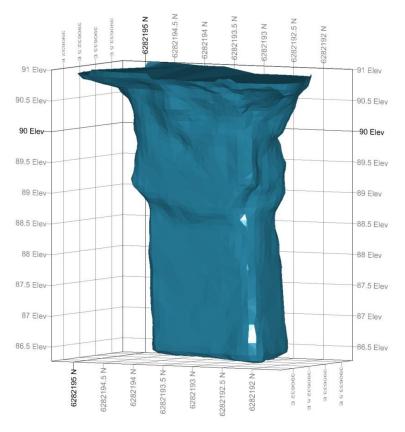












Feature 113

	LiDAR Data Meshes - 113	Project No.:	96721.02
Douglas Partners	Donnybrook Mine Shaft Condition	Photo Plate No.:	7
Geotechnics Environment Groundwater	Lot F27, Argyle Forest Block, Upper Capel	Revision:	0
	CLIENT: Department of Mines, Industry Regulation and Safety	Date:	Apr-22

Appendix D

Practice Note Guidelines for Landslide Risk Management (2007)

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007 APPENDIX C: LANDSLIDE RISK ASSESSMENT QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

	nual Probability	Implied Indicat		Description	Descriptor	Level
Indicative Value	Notional Boundary	Recurrence Interval			2	
10-1	5x10 ⁻²	10 years		The event is expected to occur over the design life.	ALMOST CERTAIN	А
10-2	5x10 ⁻³	100 years	20 years	The event will probably occur under adverse conditions over the design life.	LIKELY	В
10 ⁻³	100020202020204*	1000 years	200 years	The event could occur under adverse conditions over the design life.	POSSIBLE	С
10 ⁻⁴	5x10 ⁻⁴ 5x10 ⁻⁵	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10 ⁻⁵	5x10 ⁻⁶	100,000 years		The event is conceivable but only under exceptional circumstances over the design life.	RARE	Е
10-6	5710	1,000,000 years	200,000 years	The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not vice versa.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage				
Indicative Value	Notional Boundary	- Description	Descriptor	Level
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	40%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%	170	Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

LIKELIH	CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)					
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A – ALMOST CERTAIN	10-1	VH	VH	VH	Н	M or L (5)
B - LIKELY	10-2	VH	VH	Н	М	L
C - POSSIBLE	10-3	VH	H	М	М	VL
D - UNLIKELY	10-4	Н	М	L	L	VL
E - RARE	10-5	М	L	L	VL	VL
F - BARELY CREDIBLE	10-6	L	VL	VL	VL	VL

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.

(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

	Risk Level	Example Implications (7)	
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.	
۶Ħ	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.	
М	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.	
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.	
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.	

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

AUSTRALIAN GEOGUIDE LR7 (LANDSLIDE RISK)

LANDSLIDE RISK

Concept of Risk

Risk is a familiar term, but what does it really mean? It can be defined as "a measure of the probability and severity of an adverse effect to health, property, or the environment." This definition may seem a bit complicated. In relation to landslides, geotechnical practitioners (GeoGuide LR1) are required to assess risk in terms of the likelihood that a particular landslide will occur and the possible consequences. This is called landslide risk assessment. The consequences of a landslide are many and varied, but our concerns normally focus on loss of, or damage to, property and loss of life.

Landslide Risk Assessment

Some local councils in Australia are aware of the potential for landslides within their jurisdiction and have responded by designating specific "landslide hazard zones". Development in these areas is often covered by special regulations. If you are contemplating building, or buying an existing house, particularly in a hilly area, or near cliffs, go first for information to your local council.

Landslide risk assessment must be undertaken by a geotechnical practitioner. It may involve visual inspection, geological mapping, geotechnical investigation and monitoring to identify:

- potential landslides (there may be more than one that could impact on your site)
- · the likelihood that they will occur
- the damage that could result
- the cost of disruption and repairs and
- the extent to which lives could be lost.

Risk assessment is a predictive exercise, but since the ground and the processes involved are complex, prediction tends to lack precision. If you commission a landslide risk assessment for a particular site you should expect to receive a report prepared in accordance with current professional guidelines and in a form that is acceptable to your local council, or planning authority.

Risk to Property

Table 1 indicates the terms used to describe risk to property. Each risk level depends on an assessment of how likely a landslide is to occur and its consequences in dollar terms. "Likelihood" is the chance of it happening in any one year, as indicated in Table 2. "Consequences" are related to the cost of repairs and temporary loss of use if a landslide occurs. These two factors are combined by the geotechnical practitioner to determine the Qualitative Risk.

TABLE 2: LIK	ELIHOOD
--------------	---------

Likelihood	Annual Probability
Almost Certain	1:10
Likely	1:100
Possible	1:1,000
Unlikely	1:10,000
Rare	1:100,000
Barely credible	1:1,000,000

The terms "unacceptable", "may be tolerated", etc. in Table 1 indicate how most people react to an assessed risk level. However, some people will always be more prepared, or better able, to tolerate a higher risk level than others.

Some local councils and planning authorities stipulate a maximum tolerable level of risk to property for developments within their jurisdictions. In these situations the risk must be assessed by a geotechnical practitioner. If stabilisation works are needed to meet the stipulated requirements these will normally have to be carried out as part of the development, or consent will be withheld.

a data		TABLE 1: RISK TO PROPERTY		
Qualitative Risk		Significance - Geotechnical engineering requirements		
Very high	VH	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low. May be too expensive and not practical. Work likely to cost more than the value of the property.		
High	Н	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to acceptable level. Work would cost a substantial sum in relation to the value of the property.		
Moderate	М	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as possible.		
Low	L	Usually acceptable to regulators. Where treatment has been needed to reduce the risk to this level, ongoing maintenance is required.		
Very Low	VL	Acceptable. Manage by normal slope maintenance procedures.		

AUSTRALIAN GEOGUIDE LR7 (LANDSLIDE RISK)

Risk to Life

Most of us have some difficulty grappling with the concept of risk and deciding whether, or not, we are prepared to accept it. However, without doing any sort of analysis, or commissioning a report from an "expert", we all take risks every day. One of them is the risk of being killed in an accident. This is worth thinking about, because it tells us a lot about ourselves and can help to put an assessed risk into a meaningful context. By identifying activities that we either are, or are not, prepared to engage in we can get some indication of the maximum level of risk that we are prepared to take. This knowledge can help us to decide whether we really are able to accept a particular risk, or to tolerate a particular likelihood of loss, or damage, to our property (Table 2).

In Table 3, data from NSW for the years 1998 to 2002, and other sources, is presented. A risk of 1 in 100,000 means that, in any one year, 1 person is killed for every 100,000 people undertaking that particular activity. The NSW data assumes that the whole population undertakes the activity. That is, we are all at risk of being killed in a fire, or of choking on our food, but it is reasonable to assume that only people who go deep sea fishing run a risk of being killed while doing it.

It can be seen that the risks of dying as a result of falling, using a motor vehicle, or engaging in waterrelated activities (including bathing) are all greater than 1:100,000 and yet few people actively avoid situations where these risks are present. Some people are averse to flying and yet it represents a lower risk than choking to death on food. Importantly, the data also indicate that, even when the risk of dying as a consequence of a particular event is very small, it could still happen to any one of us any day. If this were not so, no one would ever be struck by lightning.

Most local councils and planning authorities that stipulate a tolerable risk to property also stipulate a tolerable risk to life. The AGS Practice Note Guideline recommends that 1:100,000 is tolerable in newly

GeoGuide LR5 - Water & Drainage

developed areas, where works can be carried out as part of the development to limit risk. The tolerable level is raised to 1:10,000 in established areas, where specific landslide hazards may have existed for many years. The distinction is deliberate and intended to prevent the concept of landslide risk management, for its own sake, becoming an unreasonable financial burden on existing communities. Acceptable risk is usually taken to be one tenth of the tolerable risk (1:1,000,000 for new developments and 1:100,000 for established areas) and efforts should be made to attain these where it is practicable and financially realistic to do so.

TABLE 3: RI	SK TO LIFE
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Risk (deaths per participant per year)	Activity/Event Leading to Death (NSW data unless noted)
1:1,000	Deep sea fishing (UK)
1:1,000 to 1:10,000	Motor cycling, horse riding , ultra-light flying (Canada)
1:23,000	Motor vehicle use
1:30,000	Fall
1:70,000	Drowning
1:180,000	Fire/burn
1:660,000	Choking on food
1:1,000,000	Scheduled airlines (Canada)
1:2,300,000	Train travel
1:32,000,000	Lightning strike

Retaining Walls Hillside Construction

Effluent & Surface Water Disposal

More information relevant to your particular situation may be found in other AUSTRALIAN GEOGUIDES:

-	GeoGuide LR1	Introduction	•	GeoGuide LR6	-
			•	GeoGuide LR8	- 1
	GeoGuide LR2	- Landslides		GeoGuide LR9	
•	GeoGuide LR3	 Landslides in Soil 			
•	GeoGuide LR4	 Landslides in Rock 		GeoGuide LR10	

GeoGuide LR10 - Coastal Landslides
GeoGuide LR11 - Record Keeping

ian GeoGuides (LR series) are a set of publications intended for property owners: local o

The Australian GeoGuides (LR series) are a set of publications intended for property owners; local councils; planning authorities; developers; insurers; lawyers and, in fact, anyone who lives with, or has an interest in, a natural or engineered slope, a cutting, or an excavation. They are intended to help you understand why slopes and retaining structures can be a hazard and what can be done with appropriate professional advice and local council approval (if required) to remove, reduce, or minimise the risk they represent. The GeoGuides have been prepared by the <u>Australian Geomechanics Society</u>, a specialist technical society within Engineers Australia, the national peak body for all engineering disciplines in Australia, whose members are professional geotechnical engineers and engineering geologists with a particular interest in ground engineering. The GeoGuides have been funded under the Australian governments' National Disaster Mitigation Program.