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Site visit report

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Reference	SVR_RVO_Mesa H Environmental sites Assessments
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Geotechnical assessments – Potential diurnal Ghost Bat roost complexes at Robe Valley

1 Summary

The D3 Assurance and Systems team was requested to geotechnically assess the potential diurnal Ghost Bat roost complexes located at Robe Valley (Mesa H). The purpose of the assessments is to determine the level of blast control needed to be put in place to mitigate large scale damaged induced by mining, and to highlight any other possible geotechnical hazards within the sites that may present a risk for future access.

The geotechnical sensitivity (robustness) of the site was assessed in conjunction with the assessed environmental significance to determine the tolerable blast vibration range required to protect the integrity of the structure. Blast vibration thresholds were based on guidance that were developed for protection of heritage sites, specifically caves and shelters, based on discussions with the Explosive and Dangerous Goods team and referring to the Australian Standard AS2187.2 – Ground Vibration and Air blast Overexposure (Reference 1) as a guideline. The objective is to define vibration levels where routine mining activities (excavation and blasting) do not negatively impact on the integrity of the identified cave. However, natural weathering processes will continue to physically act on the cave and might eventually affect the integrity of the cave.

The tolerable vibration level for the sites has been assessed and are summarised in Figure 6. All the sites that were reviewed have recommended threshold Peak Particle Velocity (PPV) values of 50mm/s. The scaled distance method, as outlined in the AS2187.2:2006, should be used to determine the expected vibration levels at the sites. If the predicted PPV levels exceed the thresholds, more detailed blast management plans must be developed for the relevant sites.

2 Introduction

A list of sites to be assessed was provided by the Rio Tinto Environmental team. Some of the sites listed were previously also assessed for heritage purposes. The Geotechnical assessment of stability from a heritage perspective considers the possibility of any disturbance to the site, from a relative small rockfall to total collapse of the site. For the environmental assessment, smaller rockfalls were not evaluated. The main consideration is the permanent, large scale collapse of the site, preventing future Ghost Bat useof the site.

Development of a blast vibration threshold is based on a combination of the geotechnical sensitivity and the heritage / environmental value. All of the bat roost sites that are reported in this document are considered to have a high sensitivity. Where the environmental thresholds differed from the heritage thresholds, the more conservative threshold, i.e. the lower PPV number, was applied.

The sites that are reported in this document are listed in Table 1.

Cave/shelter ID	mE	mN
Mesa H		
Astron Cave 1	415815	7595655
MH16_35	415782	7595640
Astron Cave 4	417586	7594895

Table 1 List of sites that were assessed and reported in this document

3 Methodology

The level of required blast control depends on a combination of environmental significance and geotechnical sensitivity. These assessments are recorded on a matrix and the vibration thresholds, and other possible controls, determined depending on where it plots on the risk matrix (Figure 17). The Peak Particle Velocity (PPV) thresholds are based the Australian Standard AS2187.2 – Ground Vibration and Air blast Overexposure and discussions with the Explosive and Dangerous Goods team.

Some of the terminology used to describe the different areas of the caves or overhangs are explained in Figure 1.

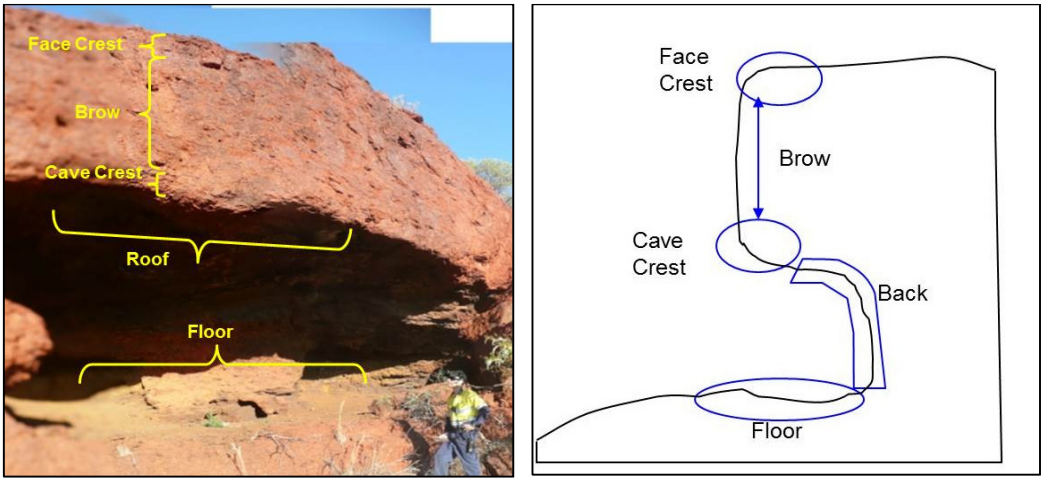

Figure 1 Explanation of terminology used in this report.

The size descriptions for the caves are based on the hydraulic radius measured in the field. In general cave sizes that are:

- Small caves – 1-50 m^2
- Medium caves – 51-100 m^2
- Large caves – 101 – 150 m^2
- Very Large caves >150 m^2

The size descriptions of historical rock-falls are based on size of particles in the rock-fall. In general the sizes are as follows:

- Very small rock-fall – very small size gravels and cobbles/slabs (< 0.1m)
- Small rock-fall – small size boulders/slabs (0.1 - 0.3m)
- Medium rock-fall – medium size boulders/slabs (0.3 – 0.6m)
- Large rock-fall – large size boulders/slabs (0.6 – 1.0m)
- Very large rock-fall – very large size boulders/slabs (> 1.0m)

4 Mesa H Assessments

The sites that were assessed for Mesa H are shown in Figure 2.

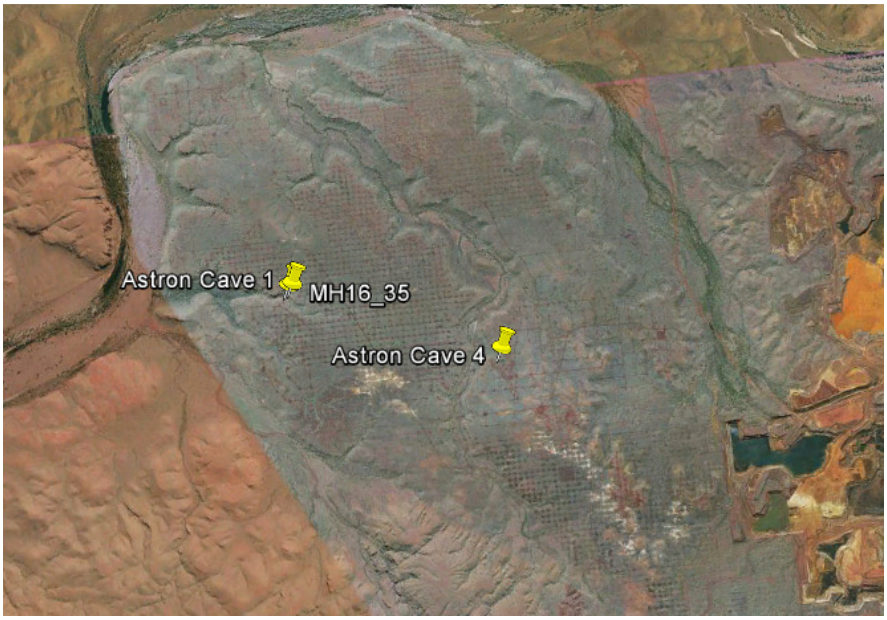

Figure 2 Location of environmental sites in Mesa H.

4.1 Astron Cave 1

Astron Cave 1 is a large (20 W x 3.5 H x 12 m D) cave developed in hydrated hardcap. There are three different entrances and two pillars. The roof is dome shaped. The floor is sloped towards the entrances and is covered in sediment and some historical rock falls. There is relic bedding which is tight, short, undulating and rough. There are no major joint sets in the cave. There are smaller random discontinuities throughout which are short and tight. Some roof slabs have developed along bedding planes and there are signs of spalling on the roof and walls of the cave. The pillar to the north appears sound with no defects. The south pillar has bedding and some random defects throughout with cracks opening up. The brow appears stable, with some minor spalling. There is a moderate rock fall potential at this site. The likelihood of a structural instability of the cave is rated as low.

Based on the absence of large continuous structures that could lead to collapse of the cave the geotechnical sensitivity of this site is rated as low.

The recommended PPV threshold is 50mm/s.

Figure 3: General view of Astron Cave 1

4.2 MH16_35

The site is a large (8 W x 4 H x 8 m D), wide cave developed in hydrated hardcap pisolite. It has a dome shaped roof, with a floor that inclines towards the rear with a large hump in the middle from historical rock falls, varying in size from medium to very large. These historical rock falls also partially obstruct the cave entrance. There is a secondary cavern at the western side of the cave and widely spaced relic bedding that disappears towards the rear of the cave where the structure becomes more massive. There is minor discontinuities near the entrance, however these are short and are not visible towards the rear of the cave. There is minor spalling around the centre pillar of the entrance, with potential for some smaller slabs to fail. These failures would not block the cave entrance. The roof and walls are stable inside the cave. The brow is stable with no signs of spalling or loose rocks above the brow. However the roof is a long unsupported span which increases the risk of failure. There is a moderate potential of rock fall in this cave but the likelihood of overall instability is rated as low.

The absence of large scale structures and low likelihood of overall instability results in a low geotechnical sensitivity rating of overall instability. The geotechnical sensitivity to rockfalls is also rated as low..

The recommended PPV threshold is 50mm/s.

Figure 4: General view (MH16_31) Blue arrow indicates central pillar; red oval is historical rock falls.

4.3 Astron Cave 4

Astron 4 is a large (7 W x 3.5 H x 25 m D), deep cave developed in hydrated hardcap pisolite. The cave is square shaped, with a flat roof controlled by relic bedding. There are large historical rock falls on the floor. The main structures in the cave are relic bedding planes spaced ±1 m, tight, cemented and persistent through the whole cave. The floor rises towards the rear of the cave where the internal height is around 1.5 m. There are a number of additional random joint sets all widely spaced which are vertical to sub-vertical dipping which define side walls of the cave. The main structural concerns are the well-defined large blocks in the roof, similar to the historical rock falls on the floor of the cave. There is a moderate potential for rockfall in this cave. Due to the tabular shape and size of these rocks, it is not expected to impact on cave entrance, in the event of a rock fall. No large scale instabilities are expected.

The sensitivity for overall structural collapse is rated as low. Due to the large blocks in the roof which have potential to fall as well as historical rock fall evidence, the geotechnical rock fall sensitivity of the site is rated as medium.

The environmental PPV threshold of 50mm/s.should apply to this location.

Figure 5 Entrance to Astron Cave 4.

5 Recommendations

The recommended blast vibration thresholds are based on a combination of the environmental significance and the geotechnical sensitivity. The results are summarised in Table 2 and Figure 6. All the sites assessed have a recommended PPV threshold of 50mm/s.

The scaled distance method as outlined in the Australian Standard AS2187.2:2006 should be used to determine the expected vibration levels at the sites. In the absence of site specific data, use of proxy constants K = 1140 and b = -1.6 can be used as a starting point. Should the calculated vibration levels exceed the recommended thresholds, the Drill and Blast team can:

- develop site specific K and b values, or
- modify the blast design to reduce the maximum charge weight.

Cave/shelter ID	Environmental Rating	Geotechnical Rating	Recommended PPV
Mesa H			
Astron Cave 1	High	Low	50
MH16_35	High	Low	50
Astron Cave 4	High	Low	50

Table 2 Summary of recommended blast vibration thresholds

Should the predicted estimated thresholds levels still be exceeded following these modifications, a more detailed blast management plan should be developed.

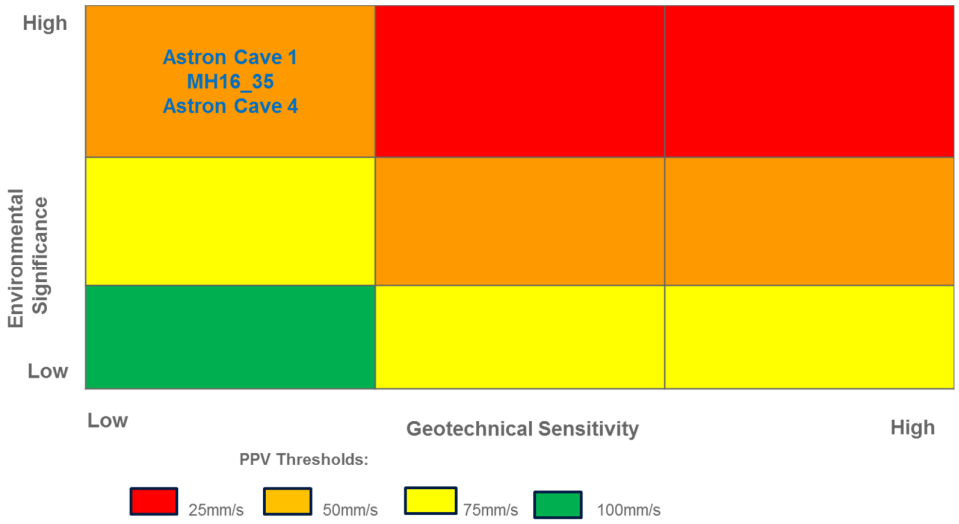

Figure 6 PPV recommendations based on environmental geotechnical assessments. All the environmental thresholds are 50mm/s.

Should you have any queries, don't hesitate to contact me at any time.

Regards

Fanie Wessels
Geotechnical Superintendent – Orebody Knowledge and Risk Management

References

1. Australian Standard AS 2187.2. 2006. Appendix J. *Ground Vibration and Air blast overexposure.*