Dubbo Quarry

Ground Control Management Plan

Prepared for:
Holcim Australia

Effective Date: November 2017

INITIAL INVESTIGATION INTO SLOPE STABILITY AT THE HOLCIM DUBBO QUARRY.

THIS DOCUMENT IDENTIFIED POTENTIAL FOR LANDSLIDE ON THE EAST WALL IF THE LOWER BENCH WAS EXTRACTED.

Alastair Well

XstractGroup.com

Xstract - Excellence from the outset
Project Manager:
Patrick Walker
BSc(Hons), MSc, DIC, PhD
Principal Consultant - Geotechnical
Xstract Mining Consultants, Perth

Contributing authors:
P Walker

Peer review of technical work by:
M Heap

Report reviewed by:
M Heap

Xstract Mining Consultants Pty Ltd has prepared this report on behalf of Holcim Australia. Public disclosure, publication, or presentation of any information contained in this document must be accompanied by written consent from Xstract Mining Consultants Pty Ltd.

© Xstract Mining Consultants Pty Ltd 21/11/2017

Document information:

Project reference: P17039
Reporting standard/s: NA
Effective date: November 2017
Status: Published
File: P17039_FINAL_HOLCIM_DubboGCMP_20171117

Principal Consultant – Geotechnical, Perth
Principal Consultant – Geotechnical, Perth
Xstract Mining Consultants Pty Ltd
ABN: 62 129 791 279

Brisbane, Australia
Ground Level, 545 Queen Street
BRISBANE QLD 4000
PO Box 10312
BRISBANE ADELAIDE STREET QLD 4000
T +61 7 3221 2366 | F +61 7 3221 2225

Perth, Australia
Level 10, 50 St Georges Terrace
PERTH WA 6000
PO Box Z5426
PERTH WA 6821
T +61 8 9327 9500 | F +61 8 9481 8700

XstractGroup.com
Xstract - Excellence from the outset
# Table of Contents

**Executive Summary**  
4

1. **What is a Ground Control Management Plan**  
1.1 Why is this Plan needed  
1.2 What is in this Plan  
1.3 Controlling Geotechnical Risks in an Operating Quarry  
1.4 Who Prepared this Plan  
1.5 Sources of Information  
1.6 How often should this Plan be reviewed?  
1.7 Other useful Training Material  
5

2. **Who is Responsible for this Plan?**  
2.1 Cell Manager/General Manager  
2.2 Quarry Manager  
2.3 Reserves Manager  
2.4 Quarry Supervisor  
2.5 Safety Manager  
2.6 All Quarry Personnel  
2.7 Who can help implement this Plan?  
9

3. **Hazard and Risk Management Process**  
3.1 Process Overview  
3.2 Risk Levels in the INX System  
3.3 Risk Management Steps  
3.4 Hazard Identification and Reporting  
3.5 Generic Hazard Types  
3.6 Geotechnical Hazard Database  
3.7 Mapping of Geological Structure  
3.8 Hierarchy of Risk Controls  
3.9 Types of Risk Control  
12

4. **Geotechnical Hazards at Dubbo Quarry**  
4.1 Hazard Maps  
4.2 Rock Falls and Batter Instability  
4.3 Stockpiles  
4.4 What if new hazards are identified?  
18

5. **Risk Management at Dubbo Quarry**  
5.1 Risk Levels  
5.2 Risk Register  
21
5.3 Risk Controls

6 Inspections and Monitoring
  6.1 Routine Inspections of Active Working Areas
  6.2 Blast Risk Assessments and Wall Sign-Off
  6.3 Site Wide Inspections
  6.4 Inspection Schedule
  6.5 Instrumentation

7 Hazard Reporting and Communication

8 Emergency Procedures

9 Review and Audit Process

10 Design Parameters
  10.1 Pit Wall
  10.2 Waste/Overburden Dumps
  10.3 Stockpiles

Background

Site Geology

Geotechnical Environment

Blasting Checklist

Tables

Table 1: Key Personnel – as at October 2017
Table 2: Geotechnical Hazard Indicators
Table 3: Types of Controls at Quarries
Table 4: Schedule of Inspections
Table 5: Pit slope design parameters

Figures

Figure 1: Generic Slope Instability Hazards
Figure 2: Hierarchy of Controls
Figure 3: Working platform configuration (after Holcim 2014)
Figure 4: Dubbo Geotechnical Domain Map – Current Pit
Figure 5: Dubbo Geotechnical Domain Map – Ultimate Pit
Figure 6: Overburden/waste storage area
Appendices

Appendix A: Geotechnical Documentation Register
Appendix B: Legislative Requirements
Appendix C: Geotechnical Hazard Map
Appendix D: Geotechnical Conditions
Appendix E: Holcim INX Risk Matrix
Appendix F: Dubbo TARP
Appendix G: Dubbo Inspection Forms
Appendix H: Geotechnical Hazard Database

Key abbreviations

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holcim</td>
<td>Holcim Australia</td>
</tr>
<tr>
<td>Xtract</td>
<td>Xtract Mining Consultants Pty Ltd</td>
</tr>
<tr>
<td>GCMP</td>
<td>Ground Control Management Plan</td>
</tr>
</tbody>
</table>
Executive Summary

This Ground Control Management Plan ("GCMP") describes how geotechnical hazards at Dubbo Quarry are managed.

Geotechnical hazards at Dubbo include:

- Rockfalls that can occur anywhere within the quarry pit, as a result of fracturing and jointing of the rock mass.
- Batter/bench scale failure as a result of structurally controlled instability such as planar sliding and toppling failure.
  - In particular on slopes oriented subparallel to the well developed and persistent NW-SE joint set
- Multi-bench instability as a result of the interaction of continuous geological structures (i.e. basalt-basement contact) with the pit wall geometry.
  - In particular on the east wall where the contact may dip at moderate angles towards the pit void.
- Stockpile slope instability.
- Overburden dump instability.

These hazards have the potential to cause harm to people and the environment and disrupt quarrying operations. This plan gives guidance to the Quarry Manager on how to manage these hazards to limit impacts. Implementation of the Plan is required to meet regulatory requirements.

The Plan includes maps and illustrations that the Quarry Manager can use to locate and identify geotechnical hazards. Known geotechnical hazards are shown on the maps and illustrations, as are locations where different types of hazards could occur in the future. The maps contain advice about the actions to be taken by the Quarry Manager to limit the risks from geotechnical hazards, for example, by constructing bunds (rock traps) at the base of pit walls to contain rock fall debris.

The Plan includes guidance on actions to be taken by the Quarry Manager if there are emergencies because of incidents caused by geotechnical hazards or if the response to another type of emergency could impact geotechnical hazards.

This Plan contains design information about how the Quarry Manager should construct interim and final pit walls to limit the risk of geotechnical hazards, in particular rock falls and slides.

The Quarry Manager is responsible for implementing this Plan and can seek assistance from the Reserves Manager and specialist geotechnical engineers, particularly if there are incidents due to geotechnical hazards. This Plan requires that the Quarry Manager inspects the quarry operations for geotechnical hazards on a regular basis. Hazards must be reported in Holcim's INX risk management system. Every year, a geotechnical specialist will need to be engaged to review the hazards at the site and the adequacy of the Plan.
Background

Holcim Australia currently wins quality hard rock from its Dubbo quarry, about 6 kilometres south east of Dubbo CBD. The existing quarry operation at Dubbo comprises a single pit and a crushing and processing area as presented in Figure D.

Figure D1: Site layout.

Dams, inundation and inrush

Quarrying commenced in 1980 and is undertaken using a typical truck and loader/excavator operation. The pit is up to 25 m deep in the north east area but typically 20 m deep. Batters are typically between 10 m and 15 m high and developed at 75° to 80°.
Current planning for the quarry includes extending the pit to the north west and south east, which will require the processing and stockpile area to be re-located. The currently proposed final pit geometry is shown in Figure D2.

Figure D2: Ultimate pit geometry

Site Geology

Dubbo quarry wins quality aggregate material from a hard basalt rock unit. The basalt unit represents a Tertiary volcanic flow occupying low lying areas in the basement Piliga Sandstone which forms the floor of the deposit. An altered zone, at the base of the basalt flow, known as ‘floor’ rock, forms the base of the hard basalt. The natural groundwater table is at approximately 277mRL with only the deepest, north east corner area of the pit below this RL.

The depth of weathering at the site is minimal and up to approximately 2 m (from visual inspection).
Geotechnical Hazard Map A1

HOLLIM DUBBO QUARRY

Quarry Pit Slopes (general)
Rockfall and batter scale failure striking personnel or machinery working near batter toe. Back break of bench crest leading to destabilisation of personnel or machinery working on bench.

Volcanic Vents
Rockfall and ravelling in altered basalt in vent area

Ravelling in Vent zones

Toppling and rockfall

East Wall
Toppling and rockfall on NW-SE joint set

Water Storage Ponds
Breach and sudden release of water into quarry pit

East Wall
Batter and multi batter sliding and instability on undercut basalt-basement contact (Floor rock)

Geotechnical Risk rating
Low
Increasing
Moderate
High

Potential landslides on geological contact was identified early.

Southern Wall
Rockfall from loose material on batter face and overhangs

Stockpile areas
Sudden slumping of a stockpile leading to engulfment of machinery at toe or destabilisation of machinery at crest
Appendix D: Geotechnical Conditions
Throughout the general body of the rock mass, defect orientation and continuity is such that the potential for structurally controlled failure mechanisms is limited with the exception of slopes oriented sub-parallel to the NN-SE trending joint set identified. Blast damage to final batter faces is generally well controlled using post-split blasting techniques. However, use of decking and uncharged hole collars have resulted in overhangs in some areas (refer Figure D5).

Figure D5: Overhangs along south wall of quarry pit

The Pilliga sandstone rocks forming the basement, below the floor rock range from grey to orange/yellow in colour and are relatively weak (compared to the basalt units) but appear
generally to not be clay weathered or altered. However, one localised area in the floor of the south east sector of the pit contains dark grey/black (carbonaceous?), high plasticity clay.

The east wall of the quarry pit is close to the eastern margin of the flow channel, which is interpreted to dip at moderate to steep angles to the west. A conceptual section through the east wall has been constructed from the available contoured pit plan and is presented in Figure D6. Xstract understand that short term production requirements and current resource availability mean that taking the lower bench on the east wall back to limits is being considered in the short term. Cutting back the lower bench as currently proposed does have potential to result in slope instability along the undercut floor rock, depending on the geometry of the basalt-basement contact. The results of conceptual stability assessments (Figure D7) suggest that factors of safety will be significantly reduced, perhaps sufficiently to result in instability, if the basalt-basement contact steepens towards the natural ground surface as indicated in Figure D7b.

Figure D6: Conceptual section through east wall of quarry pit

285mRL

277mRL

Potential floor rock – basement contact geometries
Figure D7: Stability of East Wall

- FoS=1.75
  - a) Steeper contact, current geometry

- FoS=1.49
  - b) Steeper contact, cutback geometry

- FoS=2.38
  - c) Flatter contact, current geometry

- FoS=2.21
  - d) Flatter contact, cutback geometry
The principal geotechnical risks in the operating pit at the site are associated with the rock fall hazard and small to bench scale structural controlled failures in certain wall sectors (i.e. sub-parallel to persistent joints and around vents).

The likelihood of multi-batter scale instability is considered to be low, with the exception of the east wall which undercuts the west dipping floor rock, given the high strength of the rock materials present and condition of the few pervasive structures present.