Birla Mount Gordon Mine

Esperanza Pit

Hydraulic Performance Criteria and Spillway Assessment

July 2013
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1. **Introduction**

1.1 **Purpose for Revision**

The purpose of this revised report is to assist in addressing the comments received from the Department of Environment and Heritage Protection (DEHP) on 25 June 2013. The items specifically being addressed as part of this report are items 43 to 55 inclusive.

1.2 **Background**

In October 2012, BMG’s Esperanza Pit Mine was confirmed to have a “significant hazard” classification as outlined in GHD’s document 109973/4217564 and in accordance with the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (DERM 2012). As shown in Table 4 of this same manual, regulated dams with a hazard category of “significant” are required to have a spillway with a minimum capacity to accommodate a 1 in 1,000 AEP flood. Esperanza pit does not have a “constructed” spillway per say; however there are various levels of control for outflow from the Esperanza Pit that facilitates compliance with the intent of the spillway requirements of the Manual of Assessing Hazard Categories and Hydraulic Performance of Dams. These are shown in Attachment A and include:

- **Rock Bar at RL 222 m** - above this level minor seepage could occur into the TSF access ramp pond area and subsequently into the downstream Mill Creek Dam. This level has been set as the maximum desirable water level to limit seepage from the Esperanza Pit.
- **Hydraulic Divide at RL 225** – significant seepage is prevented by a hydraulic divide within the site groundwater system between Esperanza Pit and Mill Creek Dam at RL 225.
- **Access Ramp at approximate RL 229 m** - unrestricted flow would cause a significant amount of water to back up against the TSF access ramp, which is likely to increase seepage into the downstream Mill Creek Dam.
- **Haul Road at RL 240 m** - ultimate uncontrolled discharge from the Esperanza Pit, which would flow to Mill Creek Dam.

In summary, if Esperanza Pit ‘overflowed’ above the RL 222 m Rock Bar, seepage could report to Mill Creek Dam via the TSF ramp. If the water level rose above RL 229 water could be in direct contact with the ramp with increase in seepage rate. Further rainfall could cause this area to truly overflow down the haul road and into Mill Creek Dam. Of the levels noted above, the Rock Bar is considered to be the most important as, when this level is exceeded; seepage out of the Esperanza Pit is likely to occur.

The original purpose of this assessment was, therefore, to evaluate the increase in the Esperanza Pit water level resulting from a 1 in 1,000 AEP storm event assuming an initial water level at the Rock Bar. This is a very conservative point of measure, and adds a large element of contingency to this planning exercise.

1.3 **Response from DEHP**

DEHP raised concern that the catchment area adopted for the Esperanza Pit excluded the Esperanza TSF and the Upper Esperanza Catchment (below the Upper Esperanza Diversion Dam). These two catchments rely on pumping to control overflow to the Esperanza Pit. GHD had previously determined that the existing diversion infrastructure would be adequate to reduce inflow to the Esperanza Pit from the Esperanza TSF and the Upper Esperanza catchment areas. However DEHP’s review comments recommend that these catchments be added to the assessment of the spillway, the Design Storage Allowance (DSA) and the
Mandatory Reporting Level (MRL), for strict compliance with the Departments Manual for Assessing Hazard Categories and Hydraulic Performance of Dams, February 2012.

1.4 Response from GHD

GHD has revised the October 2012 report “Esperanza Pit Spillway Assessment” and included recalculation of the DSA, MRL and spillway performance taking into account the assumption that pumped diversions are ineffective. This increases the potential catchment area
2. **Limitations and Assumptions**

The following limitations and assumptions were adopted in order to perform this assessment:

- The catchment area contributing to the Esperanza Pit during a 1 in 1,000 AEP includes the Esperanza Pit itself, Mid Esperanza, Mammoth Waste Dump, Upper Esperanza and the Esperanza TSF totalling a catchment area of 264.4 ha.
- The maximum allowable operating level of the Esperanza Pit is RL 222.
- A runoff coefficient of 1 for the storm event.
- The storage volume of the Esperanza Pit was estimated by using existing LiDAR survey data.
3. **Data Collection**

The following data was sourced in order to undertake this assessment:

- The deciles method was used to estimate the DSA requirements for the 2 month wet season events in accordance with the DERM Guidelines for Assessing the Hazard Categories and Hydraulic Performance of Dams (DERM, 2012). The deciles method fits the available rainfall data to a Log Pearson III (LPIII) distribution to determine the rainfall depth of the required criteria. The LPIII distribution describes the probability of occurrence of a given event, which in this case is the predicted rainfall depth.

- Intensity Frequency Duration data for the 1 in 1,000 AEP storm event was derived by applying AR&R ratios to the CRC-FORGE 24 hour AEP (1 in 50) value (Attachment B).

- LiDar contour survey.

- Stage storage data provided by BMG and extrapolated by GHD (Attachment C).

- Catchment areas provided and field verified by BMG (Attachment D).
4. **Hydrology**

4.1 **Overview**

In the event of the Esperanza Pit water level rising, it is understood that stormwater will initially seep to the ramp area over the Rock Bar and pond against the TSF Ramp. If water reached approximately RL 229 m, increased seepage from the Esperanza Pit into Mill Creek Dam will occur. If the water level continued to rise, LiDar survey indicates that uncontrolled release from the Esperanza Pit would not occur until the water reached RL 240 m on the Haul Road.

4.2 **Methodology**

For a Significant Hazard “Dam” the required hydraulic performance criteria are:

- A Wet Season Containment (DSA) of 1:20 AEP wet season
- A Storm Containment (MRL) of 1:10 AEP, 72 hr. storm, and
- A spillway capacity of 1:1000 AEP storm

These parameters have been assessed as follows using available CRC Forge rainfall data:

- The 1:20 AEP wet season rainfall is 630 mm
- The 1:10 AEP 72 hr. storm rainfall is 218 mm
- As there is not a spillway at the adopted maximum operating level (rock bar RL 222) a simplified hydrology methodology was adopted for assessing the total volume of stormwater to arrive at the Esperanza Pit during a 1 in 1,000 AEP storm event. A duration of 120 hours was adopted as it was the longest duration available and results in the largest volume of runoff. This storm has an average intensity of 4.95 mm/hr.

The runoff volume was calculated by multiplying the rainfall depth by the Esperanza Pit’s catchment areas and the estimated water level was determined using the stage storage curve, which was extrapolated for the Esperanza Pit from the supplied data. The stage storage curve adopted for this assessment is shown in Attachment C.

4.3 **Data and Results**

The assessed hydraulic performance Criteria and spillway capacity results are presented in Table 1.
### Table 1  Data and Results

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in 1,000 AEP, 120 hr. Duration Rainfall Depth (m)</td>
<td>0.59</td>
</tr>
<tr>
<td>Esperanza Pit Catchment Area (m²)</td>
<td>2,644,000</td>
</tr>
<tr>
<td>1 in 1,000 AEP, 120 hr. Duration Runoff Volume (m³)</td>
<td>1,568,950</td>
</tr>
<tr>
<td>1:20 wet season runoff - DSA (m³)</td>
<td>1,665,720</td>
</tr>
<tr>
<td>1:10 AEP, 72 hr. inflow – MRL (m³)</td>
<td>576,392</td>
</tr>
<tr>
<td>MRL (RL m)</td>
<td>216.5</td>
</tr>
<tr>
<td>DSA (RL m)</td>
<td>204.5</td>
</tr>
<tr>
<td>Rock Bar Level (initial water level) (RL m)</td>
<td>222</td>
</tr>
<tr>
<td>Estimated Water Level post 1 in 1,000 AEP Storm Event (RL m)</td>
<td>237</td>
</tr>
</tbody>
</table>

Based on the assessment undertaken and summarised in Table 1 a 1 in 1,000 AEP storm event will result in a water level increase to RL 237 m. This water level is below the uncontrolled discharge level to the Haul Road (RL 240 m), and therefore the 1 in 1,000 AEP storm event will not lead to significant outflow from the Esperanza Pit and no formal spillway is required.

Nevertheless the existing haul Road excavation provides a spillway capacity for more extreme events.

In addition, the increased catchment area resulted in revised MRL and DSA storage volumes equivalent to levels of RL 216.5 m and RL 204.5 m respectively.
5. Conclusion

This revised report was developed due to the DEHP responses to the original assessments undertaken by GHD. DEHP requested that additional catchment areas be added to the Esperanza Pit due to the assumption that the existing diversion structures relying on pumping could not be relied on for the events being assessed.

The results from this assessment indicate that the Esperanza Pit may reach an estimated water level of RL 237 m after a 1 in 1,000 AEP storm event. This level is a conservative estimate based on zero outflows and estimated storage volumes. This level is below the uncontrolled release level at the low point on the Haul Road. Therefore, no formal spillway is required for Esperanza Pit. No further earthworks are required to comply with this aspect of the EA or the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams (DERM 2012).

The required design flood event would not raise the water level to the existing natural overflow that has been excavated to a level of approximately 240 m AHD through a ridgeline of hard natural rock, comprising the Esperanza Haul Road. Nevertheless this excavation would act as an emergency “spillway” for more severe events. Being 26 m wide and approximately 8 to 10 m deep below the crest of the Esperanza TSF Ramp this comprises a conservatively wide rockfill structure. This “spillway” does provide an emergency outlet if it was required.

Of importance to note, the assessment of an appropriate Mandatory Reporting Level for Esperanza Pit has been based on a spillway RL level of 222m, and not on its true overflow point of approximately 240 m AHD. In GHD’s professional opinion, this is a conservative approach. Similarly the assumption of diversions being ineffective results in a conservative DSA.
Appendices
Appendix A – Spillway Level Locations
Appendix B – IFD Data
DESIGN RAINFALL ESTIMATES

Entries are mm of rainfall per hour.
Row Heading - Duration of event
Column Headings - AEP (1 in X)
Above 24 hours duration and events rarer than AEP (1 in 50) entries are derived from CRCFORGE estimates only.
Other entries have been derived by applying AR&R ratios to the CRCFORGE 24 hour AEP (1 in 50) value.
Areal Reduction Factors (ARFs) have already been applied and are as shown in the companion output file: '* Data Summary.txt'.
Below 24 hours duration the relevant 24 hour ARF has been conservatively applied.

<table>
<thead>
<tr>
<th></th>
<th>5</th>
<th>10</th>
<th>20</th>
<th>50</th>
<th>100</th>
<th>200</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
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<tr>
<td>15 min</td>
<td>88.67</td>
<td>101.3</td>
<td>117.7</td>
<td>139.4</td>
<td>159.7</td>
<td>180.9</td>
<td>211.0</td>
<td>235.6</td>
<td>261.3</td>
</tr>
<tr>
<td>30 min</td>
<td>66.07</td>
<td>75.49</td>
<td>87.75</td>
<td>103.9</td>
<td>119.1</td>
<td>134.9</td>
<td>157.3</td>
<td>175.7</td>
<td>194.9</td>
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<tr>
<td>1 hour</td>
<td>47.62</td>
<td>54.43</td>
<td>63.27</td>
<td>74.95</td>
<td>85.86</td>
<td>97.27</td>
<td>113.5</td>
<td>126.7</td>
<td>140.5</td>
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<tr>
<td>3 hours</td>
<td>22.18</td>
<td>25.81</td>
<td>30.45</td>
<td>36.68</td>
<td>42.02</td>
<td>47.60</td>
<td>55.52</td>
<td>62.01</td>
<td>68.77</td>
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<tr>
<td>6 hours</td>
<td>13.58</td>
<td>15.98</td>
<td>19.03</td>
<td>23.17</td>
<td>26.54</td>
<td>30.07</td>
<td>35.07</td>
<td>39.17</td>
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<td>12 hours</td>
<td>8.327</td>
<td>9.913</td>
<td>11.92</td>
<td>14.67</td>
<td>16.80</td>
<td>19.03</td>
<td>22.20</td>
<td>24.79</td>
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<td>18 hours</td>
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<td>7.537</td>
<td>9.049</td>
<td>11.12</td>
<td>12.73</td>
<td>14.43</td>
<td>16.83</td>
<td>18.79</td>
<td>20.84</td>
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<tr>
<td>24 hours</td>
<td>5.215</td>
<td>6.189</td>
<td>7.423</td>
<td>9.108</td>
<td>10.43</td>
<td>11.82</td>
<td>13.79</td>
<td>15.40</td>
<td>17.08</td>
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<tr>
<td>96 hours</td>
<td>2.014</td>
<td>2.391</td>
<td>2.867</td>
<td>3.518</td>
<td>4.037</td>
<td>4.580</td>
<td>5.343</td>
<td>5.950</td>
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<tr>
<td>120 hours</td>
<td>1.682</td>
<td>1.996</td>
<td>2.394</td>
<td>2.938</td>
<td>3.364</td>
<td>3.813</td>
<td>4.443</td>
<td>4.945</td>
<td>5.478</td>
</tr>
</tbody>
</table>
Appendix C – Stage Storage Graph
Appendix D – Catchment Plan
Appendix E – Certification
Form of Certification

Birla Mount Gordon – Report on Hydraulic Performance Criteria and Spillway Assessment

Name: David Maxwell Brett, FIE Aust, NPER 3, RPEQ 8002
Address: GHD Pty Ltd, PO Box 667, Hobart, Tasmania 7001

Statement of Relevant Experience
I, David Brett, have over 30 years’ experience as a civil/geotechnical engineer involved in the design and construction of dams and water management systems including assessment of Hydraulic Performance in accordance with DEPH Manual for Assessing Hazard Categories and Hydraulic Performance of Dams, February 2012.

Qualifications and Affiliations
- ME University of Tasmania
- BE University of Tasmania
- Fellow Engineers Australia, registered NPER-3, Civil Category
- RPEQ 8002
- Member, The Australian Geomechanics Society
- Associate Member, Australian National Committee on Large Dams (ANCOLD)

I hereby state that I am a Registered Professional Engineer of Queensland and meet the requirements of the definition of ‘suitably qualified and experienced person’. My address is GHD Pty Ltd, PO Box 667, Hobart, Tasmania 7001.

Statement of Certification
I hereby certify that the report Birla Mount Gordon – Hydraulic Performance Criteria and Spillway Assessment:

Has been carried out in accordance with good engineering practice and is consistent with the standards required for assessment of hazard category and hydraulic performance as set out in the Manual for Assessing Hazard Categories and Hydraulic Performance of Dams published by the administering authority.

I, David Maxwell Brett, declare that the information provided as part of this certification is true to the best of my knowledge. I acknowledge that it is an offence under section 480 of the Environmental Protection Act 1994 to give the administering authority a document containing information that I know is false, misleading or incomplete in a material particular.

Signed

David Maxwell Brett, FIE Aust, CP Eng, NPER3, RPEQ 8002

Dated 26 July 2013