Appendix E – Geomorphology Report
Bluestone Mines Tasmania Pty Ltd

D Dam Tailings Storage Facility
Geomorphic and Geoheritage Assessment

October 2013
Table of contents

1. Introduction ..................................................................................................................................... 4
   1.1 Background .......................................................................................................................... 4
   1.2 Objectives ............................................................................................................................ 4
   1.3 Scope of Works .................................................................................................................... 4

2. Site Characterisation ...................................................................................................................... 5
   2.1 Site Location ........................................................................................................................ 5
   2.2 Topography .......................................................................................................................... 5

3. Desktop Assessment ..................................................................................................................... 5
   3.1 Geology ................................................................................................................................ 5
   3.2 Glacial History ...................................................................................................................... 6
   3.3 Aerial Photographs .............................................................................................................. 7

4. Field Assessment ........................................................................................................................... 7
   4.1 Field Methodology ................................................................................................................ 7
   4.2 Site 1 .................................................................................................................................... 9
   4.3 Site 2 .................................................................................................................................. 11
   4.4 Site 3 .................................................................................................................................. 11
   4.5 Site 4 .................................................................................................................................. 13
   4.6 Site 5 .................................................................................................................................. 16
   4.7 Site 6 .................................................................................................................................. 17

5. Discussion and Geomorphic Interpretation .................................................................................. 21
   5.1 Impacts and Mitigation ....................................................................................................... 21

6. Conclusions .................................................................................................................................. 22

7. References ................................................................................................................................... 22

Figure index

Figure 1 Site Location Map ................................................................................................................ 8
Figure 2 Glacial sediments at Site 1 ............................................................................................... 9
Figure 3 Surface boulder at Site 1 ................................................................................................. 9
Figure 4 Detail of the glacial sediments at Site 1 ........................................................................... 10
Figure 5 Inferred lacustrine sediments at Site 1 ......................................................................... 10
Figure 6 Thin layer of glacial sediment at the surface at Site 3 .................................................... 12
Figure 7 Possible dolerite clast within harder, more weathered till at the northwestern margin of Site 3 .................................................................................................................. 12
Figure 8 Softer (possibly younger) glacial sediments at Site 3 .................................................... 12
Figure 9 More indurated sediments at Site 3 .............................................................................. 13
Figure 10  The indurated glacial sediments at Site 3 showing hill-slope. The less weathered glacial sediments were located further upslope ................................................................. 13
Figure 11  Sediment section at Site 4 showing lacustrine sediments overlain by glacial sediments .................................................................................................................................... 14
Figure 12  Sediment section at Site 4 showing laminar bedding present within the lacustrine sediments .............................................................................................................. 14
Figure 13  Glacial sediments overlying lacustrine deposits at Site 4 .................................................. 15
Figure 14  Highly weathered clast (possibly drop-stone) within the lacustrine unit ........................ 15
Figure 15  Close-up of Highly weathered clast (possibly drop-stone) within the lacustrine unit .................................................................................................................................. 15
Figure 16  Panoramic photograph of the southwestern cutting at site 5 ........................................... 16
Figure 17  Highly weathered clasts from within the fluvioglacial sediment which appear similar to dolerite ............................................................................................................. 17
Figure 18  Sands and gravels at Site 6 .................................................................................................. 18
Figure 19  Sands and gravels at Site 6 .................................................................................................. 18
Figure 20  Glacial sediments at the western margin of Site 6. The left hand photograph was taken on the top most bench in the right hand photograph ........................................ 19
Figure 21  Glacial erratic at Site 6 ..................................................................................................... 19
Figure 22  Smaller conglomerate erratic boulder at Site 6 .............................................................. 20
Figure 23  Possible granite boulder at Site 6 .................................................................................. 20
Figure 24  Lacustrine sediments at the eastern margin of Site 6 .................................................. 20
1. Introduction

1.1 Background

This document is intended to provide supporting information for the Development Proposal and Environmental Management Plan (DPEMP) for the proposed D-Dam tailings storage facility at Bluestone Tasmania’s Renison mine.

The site of the proposed tailings dam and borrow pits is located within the Central Highlands Late Cainozoic Glacial Area Geo-conservation area.

Initially a site visit and standalone report was not considered warranted due to the high degree of modification that has previously occurred at the site. However discussions with the Department of Environment Parks Heritage and the Arts (DEPHA), indicated that the development of borrow pits and the cutting of tracks may have exposed sections that may be relevant to the geo-conservation areas. Hence, a site inspection was undertaken to examine these exposures.

This report has been updated for the 2014 DPEMP submission to cover an additional series of potential borrow areas outside the D Dam footprint (see areas outline in orange on Figure 1).

These will be subject to an intrusive investigation once permits have been obtained. Once investigations are complete a final refined borrow area or areas will be defined within them.

1.2 Objectives

The principal objectives of this report are outlined below:

- Describe the geologic and geomorphic history of the area
- Provide a description of features and any cuttings at the site
- Interpret possible geomorphic events and processes which have led to the current form of the site
- Describe potential impacts to geomorphic features identified at the site

1.3 Scope of Works

The scope of works for this geomorphic and geoheritage assessment includes the following components:

- Brief description of the project and the site
- Review of geological maps and relevant scientific papers
- Site inspection including the recording of cuttings and features of potential significance
- Interpretation of features into a geo chronological sequence of events

The following points are outside of the scope of this assessment:

- A statement of the significance of features on the site. Reporting will be limited to the description and implications of any features.
- Permanent recording of features at the site. The report is prepared to fulfil the general requirements for the preparation of the DPEMP and the project specific guidelines. Recommendations have been made regarding the recording of features within scientific literature or relevant departmental databases (e.g. Tasmanian Geo-conservation Database [TGD]).
2. Site Characterisation

The following information has been modified from the main DPEMP document, and has been included to ensure that this report contains all information necessary for the delivery of a standalone report.

2.1 Site Location

D-Dam is to be constructed at the Renison Bell mineral deposit, down gradient of the three existing tailings storage dams, approximately 10 km west of Rosebery. The location of D-Dam in relation to existing dams is shown in Figure 1. The proposed site is completely within the boundaries of the land title leased by Bluestone Mines.

2.2 Topography

The proposed dam site is located approximately 15 km northeast of Zeehan, 8 km to the west of Rosebery, and 2 km north of Renison Bell mine. The site is approximately 150m above Australian Height Datum (AHD), with the mine site itself rising to approximately 198 m AHD (Bluestone Mines Tasmania Pty Ltd, 2006).

Based on the Natural Values Atlas\(^1\) and observations on site the topography of the area can be described as moderately rugged, with dense timber and state reserves. Just to the south of the Murchison Highway are three hills that reach on average 350 m AHD (Dreadnought Hill, Stebbins Hill and Renison Bell Hill) (Tasmap 1986).

The low hills descend to the flooded valley of Lake Pieman to the north and are bounded to the east and west by the partially flooded valleys of the Ring and Argent Rivers.

The proposed location of D-Dam is approximately 300 m from the southern bank of Lake Pieman. At full supply level the waters of Lake Pieman are 97m AHD. The potential borrow areas lie between D Dam and the Lake.

3. Desktop Assessment

This section is based on a desktop review of the site, including information on the geology, glacial history and a review of current aerial photographs.

3.1 Geology

The Mineral Resources of Tasmania (MRT) maps of the area show the dam site as being within ‘fluvio-glacial and lacustrine deposits’ (Qpgl) and ‘dominantly mafic volcaniclastic lithicwacke and siltstone and carbonate beds’ of the Crimson Creek Formation (Pdv), which are predominantly exposed within cuttings and along surface water flow paths. This information is based on 1:50 000 scale mapping produced in 1994, that was revised and updated in 2003 (Mineral Resources of Tasmania, 2006). In the interests of a thorough review the following information has also been presented from previous investigations at the site.

As described in previous geotechnical and hydrogeological reports (including GHD 2008), Renison Bell is the largest of three major, stratabound, carbonate - replacement, pyrrhotite-cassiterite deposits found in western Tasmania (Bluestone Mines Tasmania Pty Ltd, 2006).

The site geology comprises steeply dipping, weakly metamorphosed sedimentary rocks, mostly comprising alternating beds of greywacke and argillite of Cambrian age (Coffey, 1990). These

\(^1\) [https://www.naturalvaluesatlas.dpiw.tas.gov.au](https://www.naturalvaluesatlas.dpiw.tas.gov.au)
are overlain by fluvioglacial Pleistocene-age sediments and more recent deposits of gravel, colluvium, alluvium and peat, deposited where surface water features have eroded Pleistocene deposits.

The local geo-chronological units are described below:

- **Holocene** deposits include lag gravels, colluvium, alluvium and peat
- **Pleistocene** deposits include fluvioglacial gravels and sands, and lacustrine silts and clays
- **Cambrian** – Argillite and greywacke including extremely weathered and altered argillite. The full progression from extremely weathered to slightly weathered is only preserved beneath the protective cap of the younger fluvioglacial and lacustrine deposits (Coffey, 1989)

The Cambrian bedrock geology has been eroded during several phases of glaciation.

**3.2 Glacial History**

The Central Highlands Cainozoic Glacial area is a geo-conservation area that is used to indicate the likely presence of glacial features. This means that rather than identifying specific sites or features of geo-conservation significance, it indicates that features of geo-conservation significance are possibly encompassed within that area. As such a detailed desktop assessment was conducted to determine the likelihood of any significant features occurring within the footprint of the proposed tailing dam.

There have been several scientific papers published on the glacial history of the Pieman River and the surrounding area (Augustinus and Nichol, 1999; Augustinus et al 1995; Augustinus et al 1994; Augustinus and Colhoun, 1986).

The area surrounding the proposed dam site has been influenced by up to four glaciations (termed the Que, Bulgobac, Boco I and Boco II glaciations in order of decreasing age) (Augustinus and Colhoun, 1986). While the area was probably influenced by the Que glaciation, evidence of this glaciation is only preserved to the north and east of the Boco Valley, in areas that were not affected by the more recent glacial events.

Deeply weathered glacial drift is exposed in the upper Marianoak valley and is correlated to the Bulgobac glaciation (the most extensive well preserved glaciation in the area). The end moraines of this glaciation are located approximately 1.5 km to the west of the Pieman Road Bridge, crossing the Huskisson River (Augustinus and Colhoun 1986). It is likely that there is glacial till within the site area deposited during the Bulgobac Glaciation, especially in lower lying areas such as the proposed dam site and the southern pipeline route.

The Boco I glaciation extends to a point approximately 0.5-1 km west of the Marianoak River (Augustinus and Colhoun 1986). This indicates that the site of the proposed D-Dam is located outside the ice limit inferred by Augustinus et al (1994).

All the glaciations identified above have been shown to precede the Last Glacial Maximum (LGM), through relative dating and radiocarbon dating (Sansom 1978 in Augustinus and Colhoun, 1986). Magnetostratigraphic dating indicates that the Bulgobac Glaciation occurred over 783 000 years ago (Augustinus et al 1995).

The Pieman River Valley has experienced at least five glaciations during the late Cainozoic (Augustinus et al 1995). Several studies indicate that glaciations may have extended over the proposed dam site during the mid-Pleistocene (Augustinus and Nichol 1999, Augustinus et al 1995, Augustinus et al 1994, Augustinus and Colhoun 1986). This indicates that there is a high likelihood of glacial landforms and deposits being present at the proposed dam site.
3.3 Aerial Photographs

The aerial photographs (see Figure 1) do not show a great deal of detail of the site. The principal features that can be identified are several areas of past and current mining related disturbance.

Generally the area appears heavily vegetated. Older aerial photographs show more numerous and extensive areas of disturbance. More recent aerial imagery shows that most tracks are now colonised by vegetation and that many of the smaller clearings are no longer visible.

4. Field Assessment

A site visit was conducted by a GHD Geomorphologist on the 25th and 26th of August 2008. The Geomorphologist was accompanied by an Environmental Officer from Bluestone Mines Tasmania Pty Ltd.

The topography of the site has been significantly modified through human activity. Much of the Pleistocene and Holocene sediment has been stripped for use in the construction of dam walls and to gain access to the underlying argillite bedrock for similar construction purposes. The large-scale removal of material has modified the topography to the extent that it is difficult to identify larger scale glacial landforms such as moraines.

A number of cuttings and sections were visited during the site assessment. Several of these did not provide any evidence of glacial sediments or were of insufficient size to be able to make any clear determination of their significance or mode of emplacement. As a result, these exposures will not be discussed further. A total of six sites were investigated in detail, including three within the footprint of the proposed D-Dam (Sites 1, 2 and 3), one just outside this footprint (Site 4) and two others within approximately 600 m of the site (Site 5 and 6) (see Figure 1).

These sites are discussed below, as they contain sections that are most relevant to the objectives of this investigation.

4.1 Field Methodology

The primary purpose of this investigation is to provide a more detailed understanding of the nature of the geomorphology of the site and to determine if there are any features on the site of potential geo-conservation significance. It was the intention of this investigation to document and describe features that had been exposed as a result of excavation and as such the field assessment was limited to the description of these disturbed sites.

The site investigation inspected the majority of access tracks and borrow pits within the footprint of the proposed tailings impoundment. Where features such as glacial erratics were encountered these were photographed and their location was recorded by GPS and by positioning on a hardcopy map.

Not all exposures of fluvioglacial sediments can be described in text, as the deposits are extensive and were exposed along many of the access tracks. Sites described in Section 4 are generally located within the largest areas of disturbance, providing more extensive areas of sediment exposure. These sites have been described and photographs are provided where appropriate.
4.2 Site 1

Altitude – 165m Approx

Site 1 is located within a small borrow pit and is the western most of the sites within the footprint of the proposed D-Dam. Significant revegetation and recolonisation has taken place since the cessation of past excavation activities.

Site 1 consists of two small cleared areas that were identified in the more recent aerial photographs. The western most of these clearings displays a section exposing the Cambrian weathered argillite bedrock. The other clearing displays a section containing some fluvioglacial sediment overlying the argillite.

At the top of the northern most part of this borrow pit glaciogenic sediments are exposed to a depth of approximately 1.8 m (Figure 2). Clasts are up to 800 mm in diameter (Figure 3), though are generally approximately 70 mm in diameter, within a matrix of clay and silt. These sediments are determined to be of glacial origin due to the large variation in clast size and the negligible sorting that has taken place. The glacial sediments were, in some places overlain by fine silts and clays, which are likely to be lacustrine in origin (Figure 5). Although highly irregular, a contact between the glacial sediments and the overlying lacustrine sediments could be discerned.

Figure 2 Glacial sediments at Site 1

Figure 3 Surface boulder at Site 1
Figure 4  Detail of the glacial sediments at Site 1

Figure 5  Inferred lacustrine sediments at Site 1
4.3 Site 2

*Altitude – 160m approx*

Site 2 is the eastern most site within the footprint of the proposed dam. It is a large borrow pit that appears to have been used relatively recently. This site is dominated by the Cambrian bedrock geology and, although rounded cobbles were noted at the surface, no sections of glacial sediments were identified.

A much older borrow pit which is known to contain fluvioglacial sediments is located approximately 50 m from the southern margin of the visible borrow pit at Site 2. However the main part of this pit has subsequently filled with water and exposed sections could not be observed.

Although no fluvioglacial sediments were identified at this site it was included in this discussion as it is the second largest of the borrow pits within the dam footprint and is obvious in aerial photography.

4.4 Site 3

*Altitude – 165m Approx*

Site 3 is the northern most site within the proposed dam footprint. It is also the largest borrow pit located within the dam site and appears to be currently used.

A thin layer of fluvioglacial sediments (up to 1m depth) is exposed along the western margin of this pit, overlying the Cambrian bedrock geology. It is inferred that the fluvioglacial layer once covered much of the borrow pit area (Figure 6).

The northern end of the borrow pit provides exposures of two areas of different glacial sediments. An upslope area displays deposits similar to that seen at Site 1 (and other sites) (Figure 6), while the down slope deposits are more indurated, with an orange stained matrix. Clast and matrix composition of the two different sedimentary layers appears similar. It is likely that the staining in the indurated sediment is a result of more extensive weathering than the overlying layer. Hence, these two deposits are possibly the result of two separate glaciations (Figure 8 and Figure 9).
Figure 6  Thin layer of glacial sediment at the surface at Site 3

Figure 7  Possible dolerite clast within harder, more weathered till at the northwestern margin of Site 3

Figure 8  Softer (possibly younger) glacial sediments at Site 3
In the indurated deposit, all clasts are weathered to clay, with the exception of the quartzite clasts. Some of the clasts within the indurated deposit appear similar to dolerite clasts found in other areas of Tasmania (Figure 7). Augustinus and Colhoun (1986) indicate that dolerite clasts are present in other glacial deposits in the Pieman Valley.

1. These sediments are located on the northern slope of the hill at Site 3 (Figure 10) and are possibly morainal material deposited by ice flowing down the Pieman Valley during two separate glaciations. The depth of the deposits could not be determined in this investigation.

Exposed sections at the site indicate that fluvioglacial and lacustrine sediments at this site are up to 5m in thickness (Figure 11).

The stratigraphy consists of fluvioglacial sediments overlain by lacustrine sediments, which are then overlain by more fluvioglacial sediments (Figure 13). The lowest, and therefore oldest,
fluvio-glacial unit appears similar to those seen at Site 1 and Site 3, being poorly mixed with a relatively large percentage of finer material. Clasts are generally less than 100 mm in diameter.

The lacustrine deposits display laminar beds (5-10 mm in thickness) and are consistently clayey silt, with no grading within those beds (Figure 12). These sediments reach a thickness varying from 1-1.5m. In some places the silts include what appear to be drop-stones (Figure 14), indicating that the lacustrine unit possibly developed through a moraine damming of the valley and subsequent formation of a melt-water lake during glacial retreat.
Figure 13  Glacial sediments overlying lacustrine deposits at Site 4

Figure 14  Highly weathered clast (possibly drop-stone) within the lacustrine unit

Figure 15  Close-up of Highly weathered clast (possibly drop-stone) within the lacustrine unit
The upper fluvioglacial sediments are approximately 500 mm thick and, although clast sizes are similar, appears to contain less fine material within its matrix than the lower fluvioglacial unit. It is possible that this is a result of the preferential removal of finer sediment, leading to the classification of these upper units as lag gravels. However, it is also possible that they were deposited in a higher energy fluvial environment. Although if this were the case, it is likely that the lacustrine sediments would have been eroded prior to the deposition of the coarser cobbles. Hence, this unit is presumed to be a gravel lag deposit.

4.6 Site 5

Altitude – 180m approx

Site 5 was located well outside of the proposed dam site, on the southeastern corner of B-Dam. Again this was a borrow pit that has recently been excavated.

The cuttings at this site are dominated by fluvioglacial sediments. Although the base of these deposits could not be located the exposures are up to 5m in height (Figure 16).

Clast size regularly reached in excess of 300 mm in diameter and, as with Site 3, some appeared similar to dolerite (Figure 17). These clasts had developed significant weathering rinds, to the extent that the clasts are entirely decomposed to clay. If these weathering rind thicknesses are compared to weathering rinds in other deposits in the Pieman Valley the deposits are likely to be the result of either the Que or Bulgbac glaciations (Augustinus and Colhoun 1986).

Figure 16 Panoramic photograph of the southwestern cutting at site 5
Figure 17  Highly weathered clasts from within the fluvialglacial sediment which appear similar to dolerite

4.7  Site 6

Altitude – 170m to 190m approx

Site 6 is the largest borrow pit visited during the site visit. As with Site 5, it is located well outside the proposed dam footprint, to the west of C-Dam. The site displays several different sedimentary units indicating a variety of past depositional environments. Overlying the Cambrian argillite bedrock is a deposit of indurated silts, sands and fine gravels that are inferred to be of fluvial origin (Figure 18). The exact nature of the contact between the sediments and the bedrock could not be determined due to minor land slippage. These fluvial sediments were estimated to be approximately 10m thick.
Overlying the fluvial sediments are glacial and/or fluvioglacial deposits that also reached at least 10 m thickness (Figure 20) in places. Cobbles are generally less than 20 mm in diameter, though clasts up to 400 mm were also found.

Several clasts of interest were found on the floor of the borrow pit, indicating that they had been moved from their original location. This suggests that much of this borrow pit area was covered by glacial sediments, which have subsequently been excavated.

A quartzite erratic was found which was partially covered with sediment (not insitu), which was estimated to be up to 2 m in diameter. Another clast (approximately 400 mm in diameter) of Owen Conglomerate was also found nearby. It is unlikely that this was transported from outside this borrow pit during excavation. A highly weathered clast, similar in texture to granite was also identified. It is noted that there was no residual quartz, which may be expected considering the prevalence of quartzite clasts within deposits at other sites in the vicinity.

The most undisturbed exposures on the eastern margin of this borrow pit display glacial material overlain by a layer of lacustrine sediment of at least 400 mm thickness.
Figure 20  Glacial sediments at the western margin of Site 6. The left hand photograph was taken on the top most bench in the right hand photograph

Figure 21  Glacial erratic at Site 6
Figure 22  Smaller conglomerate erratic boulder at Site 6

Figure 23  Possible granite boulder at Site 6

Figure 24  Lacustrine sediments at the eastern margin of Site 6
5. **Discussion and Geomorphic Interpretation**

It is likely that prior to mining activities in the area, deposits of fluvioglacial and lacustrine sediments covered the site. The deposits described above are likely to be incomplete due to the high level of human disturbance, and as such interpretation of the depositional history of the area is difficult. Boulder erratics at Site 6 indicate that the area surrounding D-Dam has been glaciated at some point, although the timing and extent of the glaciation is unknown as these erratics are no longer insitu. Most exposures indicate that there have been several phases of sedimentary deposition at the site under a variety of environments including fluvial, glacial and lacustrine.

As much of the site area has been stripped of its surface sediments it is probable that only an incomplete record of sedimentary deposition at the site remains. Site 4 exhibits the most complete sedimentary record. Most other sites display a glacial or fluvioglacial deposit overlain by lacustrine silts. However, Site 4 shows an additional deposit of fluvioglacial sediments overlying lacustrine units.

The sedimentary profile at Site 4 indicates a glacial event was followed by a period of inundation (indicated by the lacustrine sediments) followed by a period of higher energy deposition (either glacial or fluvial). The latter deposit has subsequently had the finer sediments washed out, leaving lag gravels.

Assuming that Augustinus and Colhoun (1986) are correct in their determination of ice limits during the Boco glaciations, the proposed D-Dam site was not glaciated during that time. This would suggest that the most recent glaciation of the proposed D-Dam site was during the Bulgobac glaciation. This is supported by the thickness of weathering rinds on possible dolerite clasts witnessed in Site 5.

The most likely scenario resulting in the deposition of these features is that the oldest glacial deposits at Site 4 (and the indurated glacial deposit at Site 3) were deposited during the Que Glaciation. With retreat of the Que glaciation, a terminal moraine may have dammed the valley resulting in the formation of a melt-water lake (explaining both the drop-stones and lacustrine sediments). It is possible that when the area was reglaciated during the Bulgobac glaciation, the more recent glacial deposits as displayed at Site 4, and the less indurated glacial sediment at Site 3, were deposited. The high annual rainfall of the area could then have contributed to the washing away of the fine sediments resulting in a hybrid lag and glacial deposit.

Other possible scenarios include the eventual removal of the moraine dam and subsequent deposition of the lag gravels in a fluvial environment. It is also possible that ice limits for the Boco glaciation extend beyond the limits previously thought, and the surface gravels at Site 4 correspond to that glaciation rather than the Bulgobac glaciation as suggested above.

5.1 **Impacts and Mitigation**

Much of the site of the proposed D-Dam, and the westernmost of the potential borrow areas, has been stripped of the majority of the surface sediment and consequently has retained little natural value. The exceptions to this statement are Sites 3 and 4, which appear to show a relatively complete record of the glacial history of the site.

Apart from the westernmost potential borrow area which has been subject to previous quarrying, the zones being investigated for borrow areas are likely to be have experienced less historical disturbance than the footprint of the TSF. Removal of glacial deposits in the footprint of the final borrow will be complete and hence mitigation will not be possible.
However, the Central Highlands Late Cenozoic Glacial geo-conservation area covers hundreds of square kilometres of which the footprint is a small, peripheral part. Hence it is not anticipated that their removal will have a significant impact on the geo-heritage area as a whole.

6. **Conclusions**

The dam site has been highly modified through the cutting of tracks and the excavation of surface sediments and bedrock for construction of tracks and dam walls. This makes the identification of glacial landforms (such as moraines) difficult, and has left the site with little natural conservation value.

However, the disturbance of the site has allowed the relatively recent exposure of sections that are able to provide some insight into the glacial history of the area.

Although the borrow area footprint is likely to be less disturbed than that of the TSF, the impact to the geo-conservation area as a whole will be minimal and additional information on the glacial geology and geo-morphology will be recorded during the excavation.

Sections are generally exposed in borrow pit excavations, with much smaller sections of sediments exposed in the cuttings adjacent to some tracks. The sections visited during this investigation show that, prior to mining activities, much of the site was likely covered by fluvio-glacial and lacustrine deposits up to at least 20m in thickness (Site 6).

Due to the exposure of sediments during excavation for construction materials, some areas of the site potentially provide a level of detail to the glacial history of the Pieman Valley that has not previously been attainable.

7. **References**


GHD
2 Salamanca Square Hobart 7000
GPO Box 667 Hobart 7001
T: 03 6210 0600  F: 03 6210 0601  E: hbamail@ghd.com

© GHD 2014

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Z:\Deliverables\06 Appendix E Geomorphology report\superseded\60320 client amendments.docx

Document Status

<table>
<thead>
<tr>
<th>Rev No.</th>
<th>Author</th>
<th>Reviewer</th>
<th>Approved for Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Name</td>
<td>Signature</td>
<td>Name</td>
</tr>
<tr>
<td>0</td>
<td>M. McMinn</td>
<td>G. Lampert</td>
<td>A. Jungalwalla</td>
</tr>
<tr>
<td>1</td>
<td>M. McMinn</td>
<td>A. Jungalwalla</td>
<td>A. Jungalwalla</td>
</tr>
<tr>
<td>2</td>
<td>H.Kerr</td>
<td>P. Topliss</td>
<td>On File</td>
</tr>
</tbody>
</table>