From
Sections N1 to N4
Quarry Resources Investigation Report
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HUME HIGHWAY DUPLICATION
STURT HIGHWAY TO HOLBROOK
NORTHERN HUME ALLIANCE

Exec Summary
N1 - Quarry – Blyth Merino
Blyth Merino is a small, former granite quarry which operated some 15 years ago for the production of concrete sub-base aggregate for a Hume Highway upgrade. The investigation results indicate the rock is of high strength but contains many microfractures that cause the granitic rock, when crushed, to have a lower aggregate strength, more sand production and higher water absorption and would present limitations for use as concrete aggregate. The material, when correctly blended with finer material should satisfy the requirements for selected material and DGB20. The rock strength is adequate for the use of the material as drainage rock.

The reserve area is estimated to be over 18,750m3 (approximately 28,200 tonnes) of moderately weathered material and over 108,000m3 (approximately 162,000 tonnes) of slightly weathered material.

3.0 BLYTH MERINO QUARRY (N1)

3.1 Site Description
Blyth Merino Quarry is located approximately 1.5km east of the Hume Highway and about 8km north of N1. The quarry exposes granite rock that has been identified by the NHA as a location where the granite can be quarried and crushed to produce selected material zone, verge and drainage rock for the N1 section of the project. The existing quarry development (operational some 10 years previous) is located on the eastern side of the hill, with the quarry floor at a level of approximately 296m AHD. A single roughly north-south trending quarry face exists, attaining a height of approximately 11-12m. A relatively flat stockpiling area is located upslope and to the north of the quarry working area. Present down slope approximately 550m to the north of the quarry site are old settling lagoons used as part of the previous quarrying activities. The quarry site is surrounded on all sides by grazing farmland. Access to the quarry is gained through a gate off the Hume Highway and via a farm track through the adjacent farmland. The quarry itself is located upon a north-south trending hill with an approximate height of 325m AHD. The hill slopes down markedly to the north, east and west with a creek present approximately 150m to the east at a level of approximately 275m AHD. A site location plan showing site features, approximate spot heights and the locations of investigation boreholes and lines of section is shown in Appendix A, Figure BM1.

3.2 Geology of the Site
Geological mapping was carried out at Blyth Merino on the 20th June 2007. A geological map for the site is presented in Appendix A, Figure BM2. The location of photographs referenced in the text are shown on this figure.

3.2.1 Rock Type (Lithology)
The rock exposed within Blyth Merino Quarry is a medium grained, fairly even grained (although occasional plagioclase feldspar phenocrysts were noted), pale grey coloured granodiorite. The rock mass contains infrequent quartz-tourmaline veins up to 200mm thick noted within the rock mass contain subhedral and euhedral quartz crystals and needles of black tourmaline.

The petrographic examination of the previously blasted rock boulders lying in the quarry, The petrographic examination of the previously blasted rock boulders lying in the quarry, indicates the mineralogy is dominated by quartz, plagioclase and orthoclase feldspars with subordinate biotite and muscovite mica (refer to Plate BM5). The quartz and feldspar crystals are 1mm to 4mm in size. No fabric was observed within the rock and it may therefore be described as massive or isotropic. However, the petrographic analysis identified significant microfractures within the quartz crystals and extending to some feldspar crystals. These microfractures are postulated as a result of earthquake damage (this could be possibly related to quarry blasting) and are inferred to reduce the strength of the rock, increase water absorption and produce more sands during crushing.

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The rock in close proximity to the existing quarry face is predominantly slightly weathered to fresh, as witnessed by the numerous loose rocks in the vicinity (refer to Plate BM3). The degree of weathering would appear to increase as one moves westward, this was evident within the boreholes that were carried out as part of this investigation and is substantiated by the topography of the area which slopes away suddenly to the west with no visible rock outcrops. Elsewhere in the vicinity of the quarry, granite can be seen to be very close or at ground surface (refer to Plate BM4). This is suggestive either of a change in rock type or an increase in weathering of the rocks in this area.

3.2.2 Structural Geology

There appear to be three dominant joint sets plus one random joint set within the rock exposed at Blyth Merino Quarry. The first, Joint Set 1, trends WNW-ESE and dips steeply north at around 85 degrees. Joint Set 2 dips shallowly at around 20-30 degrees, trending NNW-SSE. Joint Set 3 trends roughly north-south and dips subvertically at around 87 degrees to the east. These joints sets are highlighted on Plate BM1 which shows the main quarry face.

The joint sets identified were noted to be medium to very widely spaced (600mm to >2000mm) giving rise to medium to very large (200mm to >2000mm) rock blocks (refer to Plate BM2). The three dominant sets of discontinuities are mutually oblique with occasional irregular joints, this gives rise to oblique-shaped (rhomboidal) equidimensional rock blocks (refer to Plates BM2 and BM3).

Joints were observed to show a high persistence with Joint Set 1 persisting down the entire length of the face and tens of metres into the face as witnessed by available exposures. With Joint Sets 2 and 3 was observed to persist across the quarry face (approximately 20m). Joint apertures assessed were seen to be partly open (0.25-0.5mm) to moderately wide (2.5-10mm) and were observed to be typically iron stained with some weathering along joint surfaces, particularly at shallower depths. Joints were predominantly rough and planar in character, some joints within Joint Set 1 were smooth planar with slickensides (slickensides pitch approximately 10 degrees to the north-west).

Plate BM1: Locality 1, Looking west at quarry face exposed at Blyth Merino Quarry showing the slightly weathered and fresh nature of the rock mass at this locality. The dominant joint sets are highlighted.

Joint Set 3 strikes sub-parallel to the quarry face and creates the flat surface of many of the blocks.

Plate BM2: Locality 1, Photo looking north at variation in block size and oblique-shaped (rhomboidal) equidimensional rock blocks.

Plate BM3: Locality 2, Photo looking south-east at both fresh and slightly weathered granodiorite blocks, note equidimensional, oblique-shaped nature of the rock blocks. These rocks were sampled and crushed for material testing.

Plate BM4: Locality 3, Photo looking north-east at upper plateau above quarry face and working area. Note granodiorite outcrops at or very close to ground surface.

Plate BM5: Locality 2, Close up detail of ex-situ block of fresh granodiorite showing pale grey, evengrained and isotropic nature of the rock mass. The white and pale grey minerals are plagioclase feldspar and quartz and the black flecks are biotite.

3.3 Borehole Investigation

Three cored boreholes were drilled at Blyth Merino (BMBH1, BMBH2 and BMBH3) between the 4th and 9th July 2007 to depths of 12m, 16m and 12m, respectively at the locations shown in Appendix A, Figure BM1. A summary of the stratigraphy encountered in the boreholes is presented in Table 3.1 with the borehole logs and core photographs presented in Appendix A.

3.5.2 Available Resources

The results of the investigation at Blyth Merino Quarry show that the hillside to the rear of the existing quarry face typically comprises a superficial layer of overburden generally less than 1.2m thick. The superficial layer overlies moderately weathered, low to high strength granodiorite with joints ranging from closely to medium spaced. The moderately weathered granodiorite thickens in extent in a northerly direction with a thickness of 4.25m recorded in the southern borehole (BMBH2) and 11.75m encountered in the northern most borehole BMBH3 (please refer to Appendix A, Figure BM4).

Underlying the moderately weathered material is high to very high strength, slightly weathered and fresh granodiorite. This material was encountered in borehole BMBH3 to a depth of more than 20.3m below existing ground level (approximate elevation 296.7mAHD). Based on the results of the quarry investigation, it is estimated within the investigated area that over 18,750m3 (approximately 28,200 tonnes) of moderately weathered material and over 108,000m3 (approximately 162,000 tonnes) of slightly weathered material or better can be sourced from Blyth Merino. The strength and jointing characteristics of this site will make extraction by controlled blasting necessary and significant processing will be required to crush and screen the rock to useable gradings.

Based on the supplied resource quantities for N1, the quantity of material necessary for select and verge materials and drainage rock for N1 can be sourced from Blyth Merino.