# Annex R – Stage 2 Sand Deposit Investigation



# BOBS FARM SAND DEPOSIT
# STAGE 2 INVESTIGATION

| | | | |
|---|---|---|---|
| Report Title | Bobs Farm Sand Deposit Stage 2 Investigation | Report Number | 2013-11-02- D |
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| Date | 02/12/2013 | Checked by | MvK |

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## EXECUTIVE SUMMARY

Ammos Resource Management Pty Ltd (Ammos) engaged Quarry Mining Systems (QMS) to investigate the quality and quantity of sand available at their Nelson Bay Rd site at Bobs Farm, to determine what potential markets the identified sand may suit and what further work may be done to develop these markets. This report presents the results of the second of potentially five (5) stages of investigations and development, as defined in the scope later in this report.

The sand samples tested within this report were retrieved from drilling operations within the Bobs farm site. The results from these samples confirm similar sand lenses exist as described in the QMS stage 1 report with further investigations undertaken up to 16 metres below the water table defining a new sand type as described below.

Five (5) major classifications of sand exist across the Bobs Farm site as detailed in Table 1 below.

1. The topsoil / root zone sand material is recommended to be put aside for rehabilitation as noted previously in the QMS stage 1 report.
2. The mottled sand (Upper Grey Sand) is likely to be a suitable base for a number of soil type applications including sports field, some cricket and golf course applications. With further processing, if economic, this may also be suitable for a number of other markets.
3. The blonde sand layers are likely to be suitable for a number of applications including glass, some frac applications (further testing required), some construction applications, mortars, grouts, soil/sporting fields base sand, landscape/horticulture, some cricket field and golf course applications, Export decorative sands (beach, aesthetics etc.), and bio-retention.
   Components of the high silica sands (99% Silica or greater) with further testing may have applications as Industrial Fillers, silica flour, some ceramic applications, fused silica, silicon carbide and potentially Ferro-silicon production and possibly other specialist applications like electronics or watches. Further testing is required to prove up these markets.
4. The Black, Dark Mud / Sand may be suitable as the base for soil applications but is expected to be put aside from main production as a by-product which is to be

dealt with during potential sand production. This will be developed in the next stage mining plan for the site.

5. The lower grey sand unit, beneath the site water table, contained a black fleck, which was confirmed to be heavy minerals at a low percentage ranging from 0.18 to 2% in total. This quantity was believed by the QMS report authors to be too low to make mining of this sand for heavy minerals economic, See Appendix 10 of this report for independent work to confirm this. This grey sand however may be suitable for a number of other applications after some processing to remove the dark fleck depending on the costs of processing and market demand for the individual sand types at that time. As this sand sits below the existing site water table the cost to win this material and process also needs to be considered in mine planning.

*Table 1 – Sand Volume Estimates, Potential Value and Markets by Resource Type*

| Bobs Farm Site Stage 2-Sand Volume Estimates Potential Value & markets | | | | | |
|---|---|---|---|---|---|
| **Resource Type** | **Volume (m3)** | **Approx. Tonnes** | **$ / Tonne** | **Potential $ Value** | **Potential Application** |
| Top soil / Root zone | 151,477 | 242,364 | $10-$19 | $2,400,000 - $4,600,000 | Rehabilitation, seed stock |
| Sand-Mottled / Upper Grey Sand | 331,808 | 530,892 | $10-$19 | $5,300,000 - $10,000,000 | Landscape soil base, sports field top-dress sand base |
| Sand–Blonde | 2,289,773 | 3,663,636 | $10-$30* Frac or glass may attract higher prices | $36,600,000 - $109,900,000 | Potential Construction, Landscape soil base, sports field top-dress sand base, Some Frac etc.; with further processing potentially others as noted below. |
| Black Dark Mud /Sand | 343,110 | 548,976 | $0 - $10 | $0 - $5,480,000 | Soil Applications |
| Lower Grey Sand | 3,487,237 | 5,579,579 | $10-$30* Frac or glass may attract higher prices | $55,790,000 - $167,300,000 | Potential Construction, Landscape soil base, sports field top-dress sand base; with further processing potentially others as noted below |
| Totals | 6,603,405 | 10,565,448 | - | ~$100,000,000 - ~$297,280,000 | All prices are indicative only and subject to market demand |

*Note: Water Table (Hole Depth) -B1-3.5m, B2-10.2m, B3-13.2m, B4-7.3m, B5-15.4m*
*All volume and tonnage estimates are provided by VGT as presented in Appendix 8 of this report*

Overall the Bobs Farm site would appear to have at least three units of sand in mineable quantity present across the site. Two (2) units above the existing water table 'Mottled/Upper Grey' and 'Blonde' and one (1) below, the 'Lower grey' flecked sand. Other sand lenses exist which may be exploited for soil, landscape or other markets as they are uncovered. A detailed mining plan needs to be developed to address the most profitable means of extracting sand from this site overtime, to maximise value and optimise the winning and processing operations.

Note: The market prices quoted here are indicative only, subject to market demand and may vary significantly from that quoted.

It is recommended that the next QMS stage 3, mining plan, be developed to optimise extraction from the site and assist in development of the best plant processing operations to produce market ready products.

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# 1. INTRODUCTION

## 1.1 Stage 1 Review

The Bobs Farm site deposit is situated on the northern end of the Stockton Bight Dunal system, approximately 200km north of Sydney, in Port Stephens, NSW, Australia. An initial QMS Stage 1 research program was undertaken in June 2013 within this deposit and from this work a potential sand resource was identified. This Stage 1 work undertaken involved the establishment of test pits at various locations across the site to gain an understanding of the quality and consistency of the sand with depth. It was clear from this stage 1 testing that a series of sand lenses existed and a range of potential markets also existed for these sands. This prompted the need for further staged investigation to better understand the sand properties with depth across the site and to clarify the likely mineable volume that may apply to each market.

## 1.2 Outcomes of Stage 1

1. A preliminary estimate of minimum volume of sand to various datum levels.
2. A preliminary estimate of the quality of the resources in the deposit.
3. An outline of some potential markets for the quarried product.
4. A preliminary estimate of any hazardous materials within the deposit.
5. Knowledge of current water table at the test pits.

## 1.3 Background To Stage 2

The investigation in stage 2 was targeted at drilling the sand to the water table and then a further 16 metres below it to fully understand whether the sand quality changed significantly with depth across the site and whether the retrieval and subsequent processing of the sand ready for sale would be commercially viable and sustainable.

## 2. SCOPE OF INVESTIGATION

From the original Quarry Mining Systems proposal –
The scope of this investigation was to establish the projected viability of mining the sand deposit on this property. The work was to be completed in stages depending on the instructions of the owners and the results of the previous stage. Each stage was to provide greater levels of certainty about the quantity and quality of the sand deposit.

**Stage 1** investigation provided-

a. 5 test pits dug by long reach excavator to establish resource sand quantity and quality at various points on the site. Dependant on site conditions during sampling.
b. Analysis of samples from the pits.
c. Preliminary indications of sand volumes and quality available at the site.

**Stage 2** provided further testing to firm up the resource and an estimate of value at depth across the site.

**Stage 3** of the work is to outline the design of an appropriate mining plan to process the sand resource identified in stages 1 and 2.

**Stage 4** is to implement the stage 3 design work.

**Stage 5** is to be the operation and ongoing management of the plant, product testing and quality of sand supplied to the various markets.

## 3. OUTCOMES OF STAGE 2

1. Approximately five test holes were drilled to 16 metres below the existing site water table, where possible, and samples were extracted with depth for further testing.
2. Samples were tested to confirm the quality of the sand with depth in the five (5) site locations and from this estimates of various sand quantities were made.
3. Five (5) permanent water test bores were established within the site to allow ongoing water testing and monitoring. This is expected to assist in establishment of future development applications for the site as the project progresses.
4. Drilling identified potentially mineable lenses of sand and confirmed the test pit work undertaken within the QMS stage1 investigation.
5. The more detailed testing of the relevant sand lenses has confirmed the likely property with depth across the site and a more reliable estimate of saleable sand volume for the identified markets.

*Table 2 Sand Volume Estimates across the site*

| **Bobs Farm Site Stage 2 - Sand Volume Estimates** | | | | | |
|---|---|---|---|---|---|
| **Resource Type** | **Borehole- Hole Depth (m) / (Layer Depth m)** | | | | |
| | **1** | **2** | **3** | **4** | **5** |
| Top soil / Root zone | 0 – 3.8 | 0 – 3.5 | 0 - 1 | 0 – 0.2 | 0 - 1 |
| Sand- Mottled / Upper Grey Sand | - | 3.5 – 5 (1.5) | 1 – 4 (3) | 0.2 – 3 (2.8) | 1 – 5.5 (4.5) |
| Sand– Blonde | - | 5 – 10.5 (5.5) | 4 – 14.5 (10.5) | 3 – 5.6 (2.6) | 5.5 – 17.5 (12) |
| Black Dark Mud /Sand | 3.8 – 4.5 | 10.5 - 12 | 14.5 - 16 | 5.6 – 6.5 | 17.5 -20 |
| Water Table- Hole Depth | 3.5 | 10.2 | 13.2 | 7.3 | 15.4 |
| Coloured Grey bands | - | - | - | 6.5 – 11.5 | 20 – 22.6 |
| Lower Grey Sand | 4.5 – 19 (14.5) | 12 – 26.5 (14.5) | 16 – 26.5 (10.5) | 11.5 – 24 (12.5) | 22.6 – 26.5 (3.9) |

*Note: Top Soil (is at or below existing surface), Dark Sand (at Orchard RL), Variable sand quality Mixed in BH2 (near Dump site), Mottled (across site, see Stage 1Test Pits), Blonde (above water table), Black Mud or sediment (normally just beneath water table), Grey sand with black fleck (deeper beneath water table)*

## 4. GEOLOGY OF AREA

Planning of the stage 2 drilling program involved a thorough investigation of the site and Greg Thomson of VGT was engaged by QMS as an independent professional geologist to assist in optimising the drill locations to provide the most information possible for the least disturbance to the site.

Five (5) drill holes were undertaken, in areas identified across the site based upon the historical geological maps, using knowledge of geological formation and with reference to previous test pits taken on the same site in the QMS stage 1 investigation.

In establishing the drill holes it became clear that a number of different sand lenses existed with depth and similar formation characteristics were identifiable across the site from previous test pits, now in dedicated drill hole locations. The location of the water table was established across the site and the drill holes were extended up to 16 metres below the site water table with samples retrieved from these locations where possible. Upon completion of the sample extraction permanent water monitoring wells were established in a number of locations across the site.

The Stage 2 drilling investigation involved the use of different augers to capture sand samples which were logged with depth and tested to confirm physical, chemical and geological properties of the in situ sand lenses.

The test results for each hole were recorded with depth to confirm the likely properties of the sand in that region. Changes in geology with depth were inferred from the available information and were used here to confirm likely potential market applications for each sand type. See also Appendices 1 to 9 of this report.

## Bobs Farm Site - Test Pits and Bore Hole Locations

| | FEATURE | EASTING (MGA) | NORTHING (MGA) | GROUND RL (m) | TOP OF PIPE RL (MARKED WITH TEXTA) | RL OF TOP OF COVER BOX (MARKED WITH ) |
|---|---|---|---|---|---|---|
| MONITORING WELLS | PH1 | 406685.6 | 6373153.8 | 5.824 | 6.386 | 6.469 |
| | PH2 | 406592.8 | 6373286.7 | 11.719 | 12.284 | 12.369 |
| | PH3 | 406297.2 | 6373318.9 | 15.478 | 15.995 | 16.108 |
| | PH4 | 406260.7 | 6373082.8 | 9.452 | 10.008 | 10.117 |
| | PH5 | 406803.7 | 6373515.8 | 18.249 | 18.819 | 18.899 |
| TEST PITS | TP1 | 406568.0 | 6373292.5 | 12.65 | - | - |
| | TP2 | 406462.5 | 6373280.0 | 12.30 | - | - |
| | TP3 | 406276.0 | 6373056.0 | 11.90 | - | - |
| | TP4 | 406532.0 | 6373398.0 | 31.05 | - | - |
| | TP6 | 406863.0 | 6373463.0 | 7.00 | - | - |

*Table 3 Bore hole Locations*

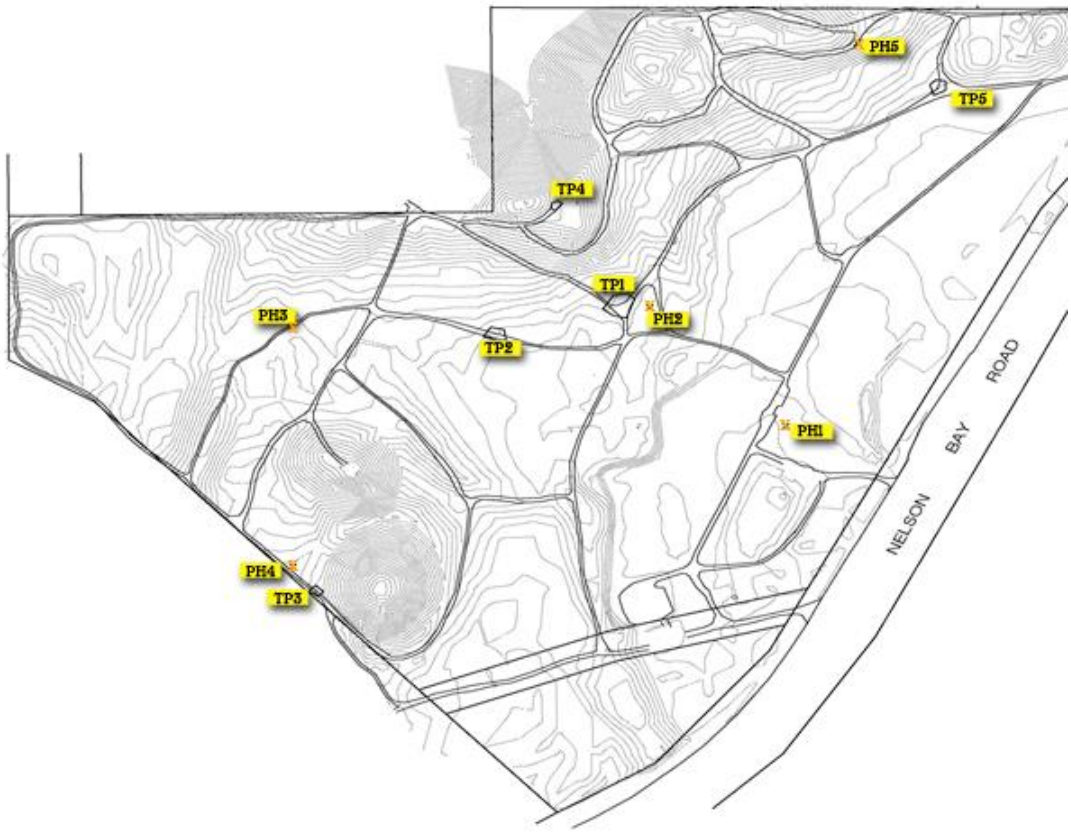



*Figure 1: Bobs Farm Test pit and Bore Hole Locations*

# 5. FIELD INVESTIGATION

## 5.1 METHODOLOGY

Each borehole was drilled using the solid flight auger technique until the water table was reached, then drilling was changed to hollow flight auger until the bottom of the hole was reached. The main reason for the change to the hollow flight auger was to prevent the hole from caving during sampling, allowing a clean and representative sample to be obtained with depth for testing.

Above the water table the samples were taken directly from between the auger flights, only after a thin outer sand layer was scraped off to avoid hole smearing as the auger is removed from the hole. By using this method the retrieved samples, were expected to have reduced contamination from the sampling process. The range of the sample depth (e.g. 1 to 2 metres), was logged and the colour, texture and or moisture content of that layer recorded. When sand layers were visibly consistent in colour, texture and moisture of the samples were obtained and logged in increments of approximately 1.0 to 1.5 metres in order to gain as many sample bags for testing as possible and accurately represent the lenses of sand with depth.

Below the water table the sand samples were taken using a sand bailer. The method consisted of manually lowering the sand bailer within the shaft of the hollow flight auger then plunging it up and down to capture as much sand sample as possible; the driller would then empty the water out of the sand bailer being careful not to lose any of the captured sand. This method was determined to be the most effective means of obtaining representative samples in the saturated conditions; however it was difficult to capture all fines within the water. This was seen to mirror any potential extraction process in future mining stages so was deemed to be a suitable sampling method.

The sample bags were sealed, labelled and clearly identified with a fully traceable numbering system which confirmed the site sample location and drill hole depth. These samples were collected and transported back by QMS to a suitable enclosed environment, at the end of each day, where they were stored until being sent away for the required testing to be conducted. Prior to being sent for testing the bulk

samples were systematically reduced into their respective test sample sizes by the cone and quartering method in accordance with AS 1141.3.1 – 2012 clause 6.4.3.
The above site sampling and logging process was designed by Greg Thomson (GT- Professional geologist), Michael van Koeverden (MvK- QMS Director, quarry products specialist and charted professional civil engineer), Mark Philpott (MP- QMS Director), and Shane Thomas (ST- Student Engineer); with QMS retrieving all samples for later testing. Sample reduction and preparation was undertaken at the QMS facility Redhead, under the supervision and direction of MvK and MP of QMS.

## 5.2 SUMMARY OF FIELD INVESTIGATION

Stage two investigations consisted of five boreholes drilled over a total of eight days on site. The drilling, was performed by Total Drilling and commenced on the 6 August 2013, with borehole one being the first hole drilled and concluding with borehole four on the 15 August 2013. The drilling process started using a truck rig; however on the 8 August 2013 the truck rig became bogged when moving from borehole BH2 to borehole BH5 and a tracked drill rig was used thereafter to traverse the soft sandy environment. The track rig arrived on site on the 9 August 2013 and moved easily across the site completing the remaining holes.

Three holes BH1, BH2 and BH4, were drilled to a depth of 16 metres below the water table, with BH3 and BH5 only reaching a depth of 15 and 13 metres below the water table respectively. Regular samples ranging between three to seven kilograms each were taken over the five bore holes above the water table, however below the water table obtaining larger sample sizes proved difficult, as the sand would not stay within the standard drilling equipment.

In order to overcome the problem of retrieving samples of adequate size, below the water table, a custom bailing tool was made by Total Drilling. The custom tool still proved difficult at times to obtain the required sample size and as such smaller samples were taken at a greater frequency to make up the required quantity, with bulk samples taken at larger intervals. In this way the sample size was maximised with depth within each hole.

## 5.3 Typical Site Borehole drilling and logging process.



*Figure 2–5: Drill down with solid flight auger to a specified depth, then the auger flights cleaned, then sand samples retrieved from between the flights for bagging.*



*Figure 6-8 - The samples were weighed, and a sand tray made for each borehole to demonstrate how the sand layering changed with depth.*



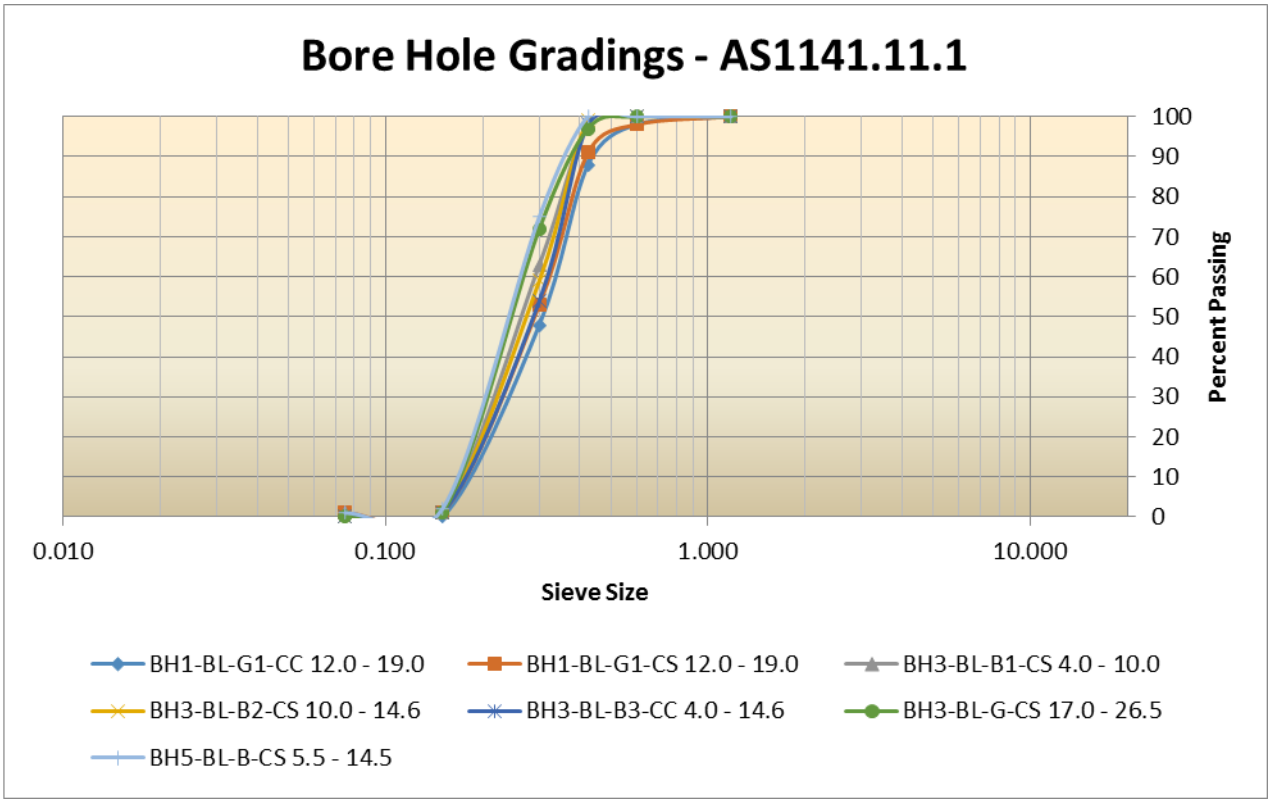


*Figure 9-11 Below the water table a sand bailer was used to retrieve the samples.*

Solid flight auger drilling was used as the first choice, where possible, as it provided a clean sample quickly. When the sand layers were saturated a hollow flight auger was required to hold the hole open as the sampling was done down the auger shaft. Below the water table a bailer was the only way to obtain significant and representative sand samples by dipping it down the hollow shaft of the auger, with the samples taken and transported by QMS for further testing and analysis.

# 6. BORE HOLE LABORATORY TESTING AND RESULTS DISCUSSION

## 6.1 Grading Summary- Construction Grading

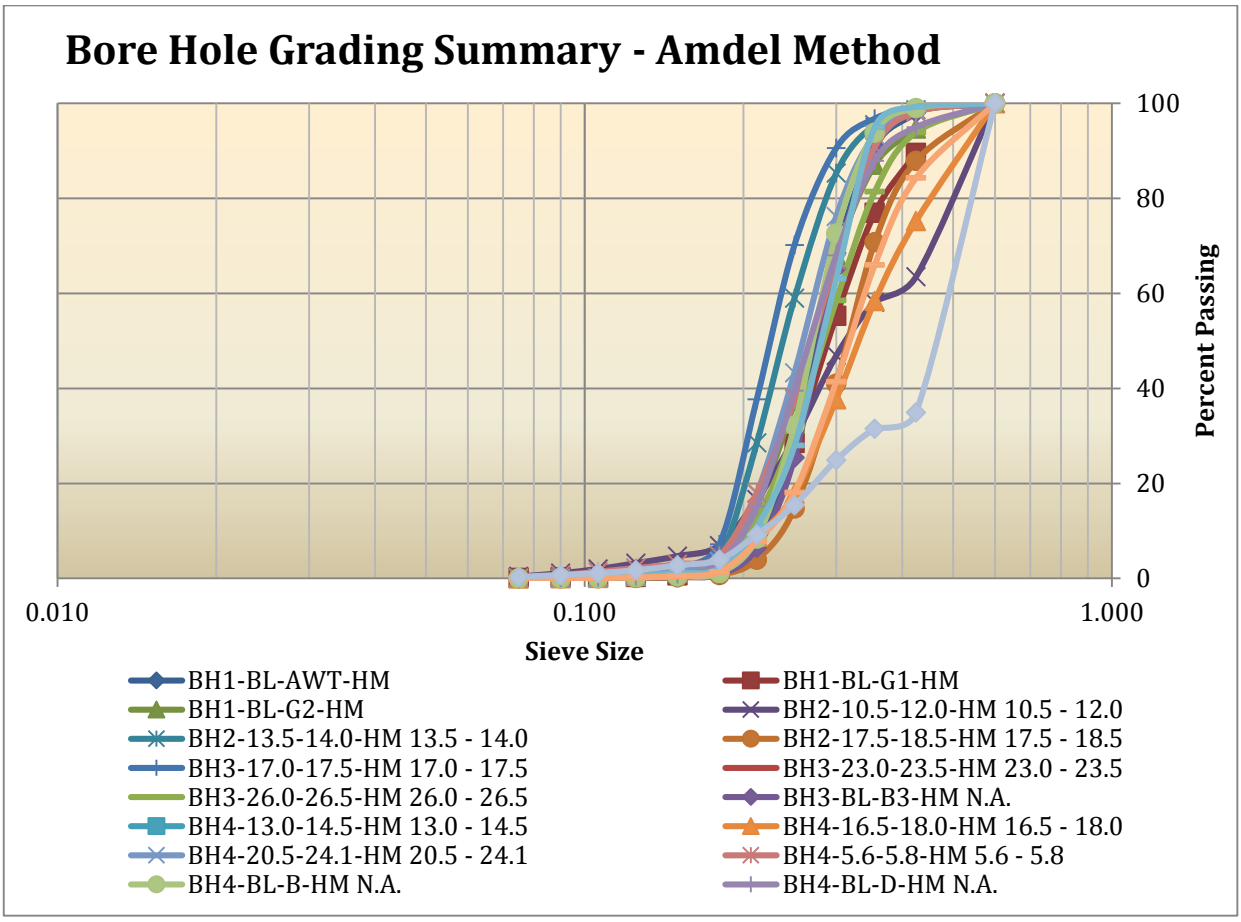



| Sample ID | BH1-BL-G1-CC | BH1-BL-G1-CS | BH3-BL-B1-CS | BH3-BL-B2-CS | BH3-BL-B3-CC | BH3-BL-G-CS | BH5-BL-B-CS |
|---|---|---|---|---|---|---|---|
| Depth | 12.0 - 19.0 | 12.0 - 19.0 | 4.0 - 10.0 | 10.0 - 14.6 | 4.0 - 14.6 | 17.0 - 26.5 | 5.5 - 14.5 |
| AS1141.11.1 - % Passing | | | | | | | |
| 1.18 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 0.600 | 98 | 98 | 100 | 100 | 100 | 100 | 100 |
| 0.425 | 88 | 91 | 98 | 99 | 98 | 97 | 100 |
| 0.300 | 48 | 53 | 63 | 59 | 54 | 72 | 75 |
| 0.150 | 0 | 1 | 1 | 1 | 1 | 1 | 2 |
| 0.075 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |

*Figure 12 Construction Grading*

Construction material gradings were undertaken on sand lenses that appeared visually suitable. Any significant discolouration, sign of contamination or dark lenses were excluded from this testing as they would be unlikely to be mined for construction applications. The cost of removing these deleterious materials from the saleable sand would potentially make production of construction sand uneconomic. This could be re-visited during the next stages as the site mining plan is developed.

## 6.2 Grading Summary- Detailed Grading




| Sample ID | BH1-BL-AWT-HM | BH1-BL-G1-HM | BH1-BL-G2-HM | BH2-10.5-12.0- | BH2-13.5-14.0-HM | BH2-17.5-18.5- | BH2-26.0-26.5- | BH2-BL-B-HM | BH3-17.0-17.5- | BH3-23.0-23.5- | BH3-26.0-26.5- | BH3-BL-B3-HM | BH4-13.0-14.5- | BH4-16.5-18.0- | BH4-20.5-24.1- | BH4-5.6-5.8- | BH4-BL-B-HM | BH4-BL-D-HM | BH5-BL-B-HM | BH5-BL-G-HM | BH5-BL-M-HM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | 0.6 - 3.5 | 12.0 - 19.0 | 4.2 - 12.0 | 10.5 - 12.0 | 13.5 - 14.0 | 17.5 - 18.5 | 26.0-26.5 | N.A. | 17.0 - 17.5 | 23.0 - 23.5 | 26.0 - 26.5 | N.A. | 13.0 - 14.5 | 16.5 - 18.0 | 20.5 - 24.1 | 5.6 - 5.8 | N.A. | N.A. | N.A. | N.A. | N.A. |
| Sieve Size | %Passing | | | | | | | | | | | | | | | | | | | | |
| 0.600 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 0.425 | 98.1 | 89.6 | 94.7 | 63.5 | 98.7 | 87.9 | 96.5 | 99.1 | 99 | 83.7 | 93.9 | 98.2 | 84.2 | 75.2 | 98.6 | 98.2 | 99 | 95 | 99.3 | 84.3 | 34.9 |
| 0.355 | 91 | 77 | 87.1 | 58.1 | 95.5 | 70.8 | 92.2 | 94.9 | 96.8 | 66.9 | 81.4 | 90.6 | 67.1 | 58.4 | 93.4 | 90.8 | 93.8 | 87.9 | 95 | 66 | 31.5 |
| 0.300 | 68.5 | 55.3 | 68 | 46.9 | 85.3 | 41 | 83.6 | 77.6 | 90.6 | 42.3 | 58.5 | 65.2 | 40.4 | 37.7 | 76.2 | 67.1 | 72.6 | 68 | 63.1 | 41.4 | 24.9 |
| 0.250 | 30.3 | 28.5 | 37.3 | 29.5 | 59 | 14.7 | 70.5 | 43.5 | 70.2 | 20.3 | 31 | 25.4 | 17.8 | 17.8 | 43.3 | 37.8 | 32.2 | 39.5 | 28 | 18.1 | 15.4 |
| 0.212 | 6.9 | 10.5 | 15.4 | 16.6 | 28.5 | 3.9 | 50.2 | 15 | 37.7 | 8.7 | 12.5 | 6.4 | 7.8 | 8.8 | 17.9 | 18 | 8.4 | 15.1 | 10.9 | 7.8 | 9.2 |
| 0.180 | 1.4 | 2.2 | 3.9 | 6.9 | 4.4 | 0.7 | 21.1 | 3.1 | 7.2 | 2.3 | 3.3 | 0.8 | 1.3 | 2.7 | 3.6 | 4.8 | 1.1 | 3.2 | 2.1 | 1.4 | 3.9 |
| 0.150 | 0.3 | 0.6 | 1.5 | 4.7 | 1.1 | 0.2 | 7.9 | 1.1 | 2.3 | 0.7 | 0.9 | 0.3 | 0.4 | 1.3 | 1.5 | 3 | 0.4 | 0.9 | 1.1 | 0.5 | 2.7 |
| 0.125 | 0.2 | 0.3 | 0.8 | 3.2 | 0.3 | 0.1 | 1.4 | 0.6 | 0.8 | 0.2 | 0.2 | 0.2 | 0.1 | 0.5 | 0.5 | 2.2 | 0.2 | 0.4 | 0.6 | 0.2 | 1.7 |
| 0.106 | 0.1 | 0.2 | 0.5 | 2 | 0.1 | 0 | 0.4 | 0.3 | 0.2 | 0.1 | 0.1 | 0.1 | 0 | 0.1 | 0.1 | 1.4 | 0.1 | 0.2 | 0.3 | 0.1 | 1.1 |
| 0.090 | 0.1 | 0.2 | 0.3 | 1.1 | 0 | 0 | 0.1 | 0.1 | 0.1 | 0 | 0 | 0.1 | 0 | 0 | 0 | 0.7 | 0 | 0.1 | 0.1 | 0 | 0.7 |
| 0.075 | 0 | 0.1 | 0.1 | 0.4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.3 |

*Figure 13 Detailed Grading Analysis*

More detailed gradings were taken to provide a full description of the sand size properties across the site. By including additional sieve sizes a broader range of potential market applications can be confirmed.

## 6.3 Sand Particle Shape and Sphericity

*Table 4: Results from the particle shape analysis*

| Sample # | Average Roundness | Average Sphericity | Comments |
|---|---|---|---|
| BH3-BL-B3-PL | 0.60 | 0.74 | Subrounded, with Moderately high sphericity |
| BH3-BL-G-PL | 0.60 | 0.75 | Subrounded, with Moderately high sphericity |
| BH5-BL-G-PL | 0.65 | 0.74 | Rounded, with Moderately high sphericity |
| BH5-BL-B-PL | 0.61 | 0.72 | Rounded, with Moderately high sphericity |

*Table 5: Results from the particle shape analysis*

| Sample # | Average Roundness | Average Sphericity | Comments |
|---|---|---|---|
| BH3-BL-B3-PL | 0.60 | 0.74 | Subrounded, with Moderately high sphericity |
| BH5-BL-B-PL | 0.61 | 0.72 | Rounded, with Moderately high sphericity |
| BH3-BL-G-PL | 0.60 | 0.75 | Subrounded, with Moderately high sphericity |
| BH5-BL-G-PL | 0.65 | 0.74 | Rounded, with Moderately high sphericity |

Blend
Clay
Blonde
Mottle
Grey

The sand lenses tested for sphericity and shape were those that were likely to be used in applications like frac sand where shape and packing efficiency are important. This included the blonde and grey sands that were clean to very clean in colour and unlikely to introduce contaminants during their use.

Sphericity= 0.72 – 0.75 and Roundness= 0.6 – 0.65 both exceed the American Petroleum Industry Specification (API) of $\geq$0.6

Grading is close to the 40/70 US mesh size.

Crushing Strength is expected to be high with the high silica content in the sands (further testing may be required here)

Borehole 3:

- Blonde (Above Water Table) 94% silica,
- Grey (Below Water Table) 88% silica

Borehole 5:

- Blonde (Above Water Table) 99% silica,
- Grey (Below Water Table) 90% silica
-

Acid Solubility is expected to be minimal due to the high silica nature within the sand.

Further testing is required to confirm the suitability of the required properties.

*Table 6 Frac Sand Report Analysis- Size.*

| Sample ID | BH3-17.0-17.5-HM | | BH3-23.0-23.5-HM | | BH3-26.0-26.5-HM | | BH3-BL-B3-HM | | BH5-BL-B-HM | | BH5-BL-G-HM | | BH5-BL-M-HM | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth | 17.0 - 17.5 | | 23.0 - 23.5 | | 26.0 - 26.5 | | N.A. | | N.A. | | N.A. | | N.A. | |
| Sieve Size | %Pass | % Ret | %Pass | % Ret | %Pass | % Ret | %Pass | % Ret | %Pass | % Ret | %Pass | % Ret | %Pass | % Ret |
| 0.600 | 100 | 0 | 100 | 0 | 100 | 0 | 100 | 0 | 100 | 0 | 100 | 0 | 100 | 0 |
| 0.425 | 99 | 1 | 83.7 | 16.3 | 93.9 | 6.1 | 98.2 | 1.8 | 99.3 | 0.7 | 84.3 | 15.7 | 34.9 | 65.1 |
| 0.355 | 96.8 | 3.2 | 66.9 | 33.1 | 81.4 | 18.6 | 90.6 | 9.4 | 95 | 5 | 66 | 34 | 31.5 | 68.5 |
| 0.300 | 90.6 | 9.4 | 42.3 | 57.7 | 58.5 | 41.5 | 65.2 | 34.8 | 63.1 | 36.9 | 41.4 | 58.6 | 24.9 | 75.1 |
| 0.250 | 70.2 | 29.8 | 20.3 | 79.7 | 31 | 69 | 25.4 | 74.6 | 28 | 72 | 18.1 | 81.9 | 15.4 | 84.6 |
| 0.212 | 37.7 | 62.3 | 8.7 | 91.3 | 12.5 | 87.5 | 6.4 | 93.6 | 10.9 | 89.1 | 7.8 | 92.2 | 9.2 | 90.8 |
| 0.180 | 7.2 | 92.8 | 2.3 | 97.7 | 3.3 | 96.7 | 0.8 | 99.2 | 2.1 | 97.9 | 1.4 | 98.6 | 3.9 | 96.1 |
| 0.150 | 2.3 | 97.7 | 0.7 | 99.3 | 0.9 | 99.1 | 0.3 | 99.7 | 1.1 | 98.9 | 0.5 | 99.5 | 2.7 | 97.3 |
| 0.125 | 0.8 | 99.2 | 0.2 | 99.8 | 0.2 | 99.8 | 0.2 | 99.8 | 0.6 | 99.4 | 0.2 | 99.8 | 1.7 | 98.3 |
| 0.106 | 0.2 | 99.8 | 0.1 | 99.9 | 0.1 | 99.9 | 0.1 | 99.9 | 0.3 | 99.7 | 0.1 | 99.9 | 1.1 | 98.9 |
| 0.090 | 0.1 | 99.9 | 0 | 100 | 0 | 100 | 0.1 | 99.9 | 0.1 | 99.9 | 0 | 100 | 0.7 | 99.3 |
| 0.075 | 0 | 100 | 0 | 100 | 0 | 100 | 0 | 100 | 0 | 100 | 0 | 100 | 0.3 | 99.7 |
| Max | | 0.300 | | 0.425 | | 0.425 | | 0.355 | | | | 0.425* | | 0.425* |
| Min | | 0.180 | | 0.212 | | 0.180 | | 0.212 | | | | 0.212 | | 0.212 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Max Size | mm | 3.36 | 2.38 | 1.68 | 1.19 | 0.841 | 0.595 | 0.4 |
| Min Size | mm | 1.680 | 0.841 | 0.841 | 0.595 | 0.400 | 0.297 | 0.210 |
| US Mesh | mesh | 6/12 | 8/16 | 12/20 | 16/30 | 20/40 | 30/50 | 40/70 |
| Crush Test | US | NT | NT | NT | NT | NT | NT | NT |

Note: NT = Not Tested

Parts of Borehole 3 and 5 appear to satisfy some of the frac sand criteria and as such additional testing may be worthwhile to prove up a potential market Demand for Frac sand has risen dramatically as the use of hydraulic fracturing becomes more frequently used to exploit natural gas trapped in shale deposits. For example, in the US, Frac sands now represent the second largest market in the US after glass making (Elliot, 2012). Frac sand has also been used in the removal of coal seam gas where it enables more effective release of gas and water from underground gas reservoirs.

## 6.4 Petrographic Examination of Sand with depth across the site

*Table 7 Material composition results from the petrographic report- grouped by borehole*

| Sample # | Material Composition | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quartz (%) | Mod strained quartz or comp grains of quartz (%) | Quartzite (%) | Chert (%) | Vein quartz (%) | Other Minerals (%) | Feldspar (%) | Argillaceous clasts (%) | Acid volcanics (%) | Intermediate Volcanics (%) | Ferruginous fragments (%) | Meta arenite (%) | Pelite (%) | Carbonaceous matter (%) | Shell fragments (%) | Check (%) | Free Silica Content (%) |
| BH1-BL-G1-PL | 80 | 11 | 2 | 4 | <1 | 1 | 1 | 1 | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 91 |
| BH1-BL-G2-PL | 54 | 4 | 0 | <1 | 0 | 0 | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 42 | 0 | 100 | 58 |
| BH2-BL-B-PL | 77 | 12 | 1 | 0 | <1 | 1 | 4 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 91 |
| BH2-BL-10.5-12.0-PL | 44 | 3 | 0 | 0 | 0 | 0 | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 53 | 0 | 100 | 47 |
| BH2-BL-G-PL | 85 | 12 | <1 | 0 | <1 | <1 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 97 |
| BH3-BL-B3-PL | 69 | 16 | 2 | 2 | 1 | <1 | 3 | 0 | 3 | 2 | 0 | 1 | 1 | 0 | 0 | 100 | 94 |
| BH3-BL-G-PL | 62 | 17 | 5 | 1 | <1 | 1 | 2 | 0 | 4 | 2 | 0 | 4 | 2 | 0 | 0 | 100 | 88 |
| BH4-BL-B-PL | 89 | 10 | <1 | 0 | <1 | <1 | <1 | 0 | 1 | <1 | <1 | 0 | 0 | 0 | 0 | 100 | 99 |
| BH4-BL-G-PL | 75 | 11 | 2 | 5 | <1 | 1 | 3 | 2 | <1 | 1 | 0 | 0 | 0 | 0 | 0 | 100 | 93 |
| BH5-BL-B-PL | 96 | 3 | <1 | 0 | <1 | <1 | <1 | 0 | 1 | <1 | <1 | 0 | 0 | 0 | 0 | 100 | 99 |
| BH5-BL-G-PL | 65 | 15 | 4 | 2 | 0 | <1 | 2 | 0 | 4 | 2 | 0 | 3 | 2 | 0 | 1 | 100 | 90 |

Blend
Clay
Blonde
Mottle
Grey

Note:
Borehole 1- Blends confirm variable silica content 58 – 91%, carbonaceous matter in a layer at 42%
Borehole 2- Clay layer- carbonaceous Matter in a layer 53%, Grey sand- silica ~ 97%
Borehole 3- Blonde sand- 94% silica, Grey sand - silica 88%
Borehole 4- Blonde sand- 99% silica, Grey sand- silica 93%
Borehole 5- Blonde sand- 99% silica, Grey sand- silica 90%

Sands suitable for glass - Free silica content in the range of 95- 99.8% with other required properties.

*Table 8 Material composition results from the petrographic report- grouped by Classification*

| Sample # | Material Composition | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quartz (%) | Mod strained quartz or comp grains of quartz (%) | Quartzite (%) | Chert (%) | Vein quartz (%) | Other Minerals (%) | Feldspar (%) | Argillaceous clasts (%) | Acid volcanics (%) | Intermediate Volcanics (%) | Ferruginous fragments (%) | Meta arenite (%) | Pelite (%) | Carbonaceous matter (%) | Shell fragments (%) | Check (%) | Free Silica Content (%) |
| BH1-BL-G1-PL | 80 | 11 | 2 | 4 | <1 | 1 | 1 | 1 | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 91 |
| BH1-BL-G2-PL | 54 | 4 | 0 | <1 | 0 | 0 | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 42 | 0 | 100 | 58 |
| BH2-BL-10.5-12.0-PL | 44 | 3 | 0 | 0 | 0 | 0 | <1 | 0 | 0 | 0 | 0 | 0 | 0 | 53 | 0 | 100 | 47 |
| BH2-BL-B-PL | 77 | 12 | 1 | 0 | <1 | 1 | 4 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 91 |
| BH3-BL-B3-PL | 69 | 16 | 2 | 2 | 1 | <1 | 3 | 0 | 3 | 2 | 0 | 1 | 1 | 0 | 0 | 100 | 94 |
| BH4-BL-B-PL | 89 | 10 | <1 | 0 | <1 | <1 | <1 | 0 | 1 | <1 | <1 | 0 | 0 | 0 | 0 | 100 | 99 |
| BH5-BL-B-PL | 96 | 3 | <1 | 0 | <1 | <1 | <1 | 0 | 1 | <1 | <1 | 0 | 0 | 0 | 0 | 100 | 99 |
| BH2-BL-G-PL | 85 | 12 | <1 | 0 | <1 | <1 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 97 |
| BH3-BL-G-PL | 62 | 17 | 5 | 1 | <1 | 1 | 2 | 0 | 4 | 2 | 0 | 4 | 2 | 0 | 0 | 100 | 88 |
| BH4-BL-G-PL | 75 | 11 | 2 | 5 | <1 | 1 | 3 | 2 | <1 | 1 | 0 | 0 | 0 | 0 | 0 | 100 | 93 |
| BH5-BL-G-PL | 65 | 15 | 4 | 2 | 0 | <1 | 2 | 0 | 4 | 2 | 0 | 3 | 2 | 0 | 1 | 100 | 90 |

| |
|---|
| Blend |
| Clay |
| Blonde |
| Mottle |
| Grey |

Note:

Free silica:

- Blonde sand had Free Silica – 91 – 99% ( Across Boreholes 2, 3, 4, 5)
- Grey Sand had Free Silica- 88 – 97% ( Across Boreholes 2 , 3, 4 and 5)
- Blend Sand – 58 – 91% (Note Borehole 1- Blend highlights the variability in silica content in this hole location)
- Clay in Borehole 2 was in a heavy 53% carbonaceous layer.

## 6.5 Soil Analysis- Extracts from reports

*Table 9 Soil Analysis and Amendment*

| **Bore Hole 1 Above Water Table - BH1-BL-AWT-SO 0.7** |
|---|
| **Key Observations.**<br>This soil has very slight acidity and has desirably low salinity levels. The cation exchange has high sodicity making it highly prone to dispersion.<br>The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention.<br>Aside from phosphorus all nutrients need boosting.<br>This soil is not recommended for phosphorus sensitive species, in particular natives. With the addition of a low P multipurpose fertiliser and compost, this soil will be suitable for plant growth. |
| **Amendment Strategy**<br>Plant growth will benefit from the application of a **Low P Multipurpose NPK fertiliser at 50g/m2.**Incorporate **10g/m2 application of gypsum** to help balance the cations and reduce dispersion<br>An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**. |
| **Bore Hole 1 Below Water Table - BH1-BL-G1-SO 0.5** |
| **Key Observations.**<br>Sample 'BH1-BL-G1-SO 0.5' was analysed for its chemical properties. This soil has extreme acidity and moderate salinity levels. The cation exchange has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from sulphate all nutrients need boosting. This soil will take time to ameliorate to become suitable for plant growth. We recommend further analysis after treatments have been applied. |
| **Amendment Strategy**<br>Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2. The** plant available nutrients are, overall, deficient. This is due to the acidity, which reduces the availability of many nutrients. A leguminous mulch (at 20% by volume) could be beneficial here If the leguminous mulch is not used, then incorporate composted organic matter i.e. **Green Waste Compost at 10L/m2** to improve soil structure and organic content, and thus further support plant growth.<br>This will also help to buffer against potential toxicities and reduce dispersion. To further control dispersive tendencies, apply **gypsum at 100 g/m2** and incorporate thoroughly. Aluminium levels should be monitored to ensure that toxicity does not occur. We recommend raising the pH to above 5.5 in CaCl2 with **lime incorporated at 200 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. Untreated, this soil is not fit for purpose. We recommend retesting the aluminium and pH a fortnight following the lime application. |

## Bore Hole 2 - BH2-10.5-12.0-SO 0.7

**Key Observations.**

Sample 'BH2-10.5-12.0-SO 0.7' was analysed for its chemical properties. This soil has strong acidity and very high salinity levels. The cation exchange is highly magnesic making the soil hardsetting and has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is moderate indicating good nutrient uptake and retention. Aside from sulphate, iron and magnesium all nutrients need boosting. Due to the high sulphate levels, soil is saline therefore select saline tolerant native species for growth.

**Amendment Strategy**

Plant growth will benefit from the application of **urea at 15g/m2** (2 applications) and **muriate of potash at 60g/m2.** To further control dispersive tendencies, apply **gypsum at 300 g/m2** and incorporate thoroughly. We recommend raising the pH to above 5.5 in CaCl2 with **lime incorporated at 300 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**

## Bore Hole 2 - BH2-BL-B-SO 0.9

**Key Observations.**

Sample 'BH2-BL-B-SO 0.9' was analysed for its chemical properties. This soil has medium acidity and desirably low salinity levels. The cation exchange is highly sodic making the soil dispersive and has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating good nutrient uptake and retention. All nutrients require boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

**Amendment Strategy -** Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2. The** plant available nutrients are, overall, deficient. This is due to the acidity, which reduces the availability of many nutrients. A leguminous mulch (at 20% by volume) could be beneficial here If the leguminous mulch is not used, then incorporate composted organic matter i.e. **Green Waste Compost at 10L/m2** to improve soil structure and organic content, and thus further support plant growth.

This will also help to buffer against potential toxicities and reduce dispersion. To further control dispersive tendencies, apply **gypsum at 50 g/m2** and incorporate thoroughly. Aluminium levels should be monitored to ensure that toxicity does not occur. We recommend raising the pH to above 5.5 in CaCl2 with **lime incorporated at 50 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. Untreated, this soil is not fit for purpose. We recommend retesting the aluminium and pH a fortnight following the lime application.

## Bore Hole 2 - BH2-BL-G-SO 0.6

**Key Observations.**

Sample 'BH2-BL-G-SO 0.6' was analysed for its chemical properties. This soil has very strong acidity and desirably low salinity levels. The cation exchange is highly sodic causing dispersion and has high levels of, hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from sulphate and zinc all

nutrients need boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

**Amendment Strategy**
Plant growth will benefit from the application of **urea at 15g/m2** (2 applications) and **muriate of potash at 45g/m2.** To help boost magnesium levels, apply **dolomite at 140 g/m2** and incorporate thoroughly. We recommend raising the pH to above 5.5 in CaCl2 with **lime incorporated at 150 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. Apply **trace elements at 15g/m2**. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

## Bore Hole 3 - BH3-BL-B3-SO 1.25

**Key Observations.**
Sample 'BH3-BL-B3-SO 1.25' was analysed for its chemical properties. This soil has slight acidity and desirably low salinity levels. The cation exchange is highly sodic and slightly magnesic making the soil highly prone to dispersion and hardsetting. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. All nutrients need boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

**Amendment Strategy**
Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2**.The plant available nutrients are overall, deficient. To further control dispersive tendencies, apply **gypsum at 50 g/m2** and incorporate thoroughly. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

## Bore Hole 3 - BH3-BL-G-SO 0.603

**Key Observations.**
Sample 'BH3-BL-G-SO 0.603' was analysed for its chemical properties. This soil has extreme acidity and low salinity levels. The cation exchange is highly sodic causing dispersion and has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from sulphate and zinc all nutrients need boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

**Amendment Strategy**
Plant growth will benefit from the application of **urea at 15g/m2** (2 applications) and **muriate of potash at 45g/m2.** To help boost magnesium levels, apply **dolomite at 140 g/m2** and incorporate thoroughly. We recommend raising the pH to above 5.5 in CaCl2 with **lime incorporated at 150 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. Apply **trace elements at 15g/m2**. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

| Bore Hole 4 - BH4-BL-B-SO 0.71 |
|---|
| **Key Observations.**<br>Sample 'BH4-BL-B-SO 0.71' was analysed for its chemical properties. This soil has slight acidity and desirably low salinity levels. The cation exchange is highly sodic and slightly magnesic making the soil highly prone to dispersion and hardsetting. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. All nutrients need boosting. We recommend further testing after treatments have been applied. |
| **Amendment Strategy**<br>Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2**.The plant available nutrients are, overall, deficient.<br>To further control dispersive tendencies, apply **gypsum at 50 g/m2** and incorporate thoroughly.<br>An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**. |
| **Bore Hole 4 - BH4-BL-G-SO 0.51** |
| **Key Observations.**<br>Sample 'BH4-BL-G-SO 0.51' was analysed for its chemical properties. This soil has very strong acidity and desirably low salinity levels. The cation exchange is highly sodic, sightly magnesic making the soil dispersive and hardsetting and has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from zinc all nutrients need boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied. |
| **Amendment Strategy**<br>Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2. The** plant available nutrients are, overall, deficient. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**. We recommend raising the pH to above 5.5 in CaCl2 with **lime incorporated at 100 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. |
| **Bore Hole 5 - BH5-BL-B-SO 1.302** |
| **Key Observations.**<br>Sample 'BH5-BL-B-SO 1.302' was analysed for its chemical properties. This soil has slight acidity and desirably low salinity levels. The cation exchange is highly sodic and slightly magnesic making the soil highly prone to dispersion and hard setting. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. All nutrients need boosting. |
| **Amendment Strategy**<br>Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2**.The plant available nutrients are, overall, deficient. To further control dispersive tendencies, apply **gypsum at 50 g/m2** and incorporate thoroughly. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**. |

| BH5-BL-M-SO 0.633 |
| --- |
| **Key Observations.**<br>Sample 'BH5-BL-M-SO 0.633' was analysed for its chemical properties. This soil has slight alkalinity and extreme salinity levels. The cation exchange is highly magnesic making the soil highly prone to hardsetting. The effective cation exchange capacity (eCEC) is high indicating excellent nutrient uptake and retention however this is been driven up by the extremely high sulphate levels. All nutrients need boosting. |
| **Amendment Strategy**<br>The saline levels are extreme therefore select saline tolerant natives for growth. Incorporate **iron sulphate at 50g/m2** to bring down the pH levels. Plant growth will benefit from the application of a **urea at 15g/m2** ( 2 applications). To further control dispersive tendencies, apply **gypsum at 300 g/m2** in 2 applications and incorporate thoroughly. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**. |

As can be seen, from the above soil analysis report extracts, all sand samples tested would be suitable for soil applications with the application of amendment strategies.

## 6.6 Waste Analysis

*Table 10 Waste Analysis Above and Below Site Water Table*

| | |
|---|---|
| *BH1-BL-AWT-SO 0.7*<br><br>*Above Water table* | Presence of a range of contaminants commonly encountered in the natural and urban areas. This assessment was conducted to provide a waste classification for off-site disposal, based on the *Waste Classification Guidelines Part 1: Classifying Waste* (NSW DECCW December 2009). Comparison of the laboratory analysis results with the criteria, indicates the material is considered to be within the classification and as a result of this process, it can be disposed of as per Schedule 1 Part 3 of the Protection of the Environment Operations Act 1997. |
| *BH1-BL-G1-SO 0.5*<br><br>*Below Water Table* | Presence of a range of contaminants commonly encountered in the natural and urban areas. This assessment was conducted to provide a waste classification for off-site disposal, based on the *Waste*<br>*Classification Guidelines Part 1: Classifying Waste* (NSW DECCW December 2009). Comparison of the laboratory analysis results with the criteria, indicates the material is considered to be within the **VENM Waste** classification and as a result of this process, it can be disposed of as per Schedule 1 Part 3 of the Protection of the Environment Operations Act 1997. |

Waste Analysis of the site was undertaken in Stage 1 and Stage 2 and confirms that the sand lenses across the site comply with Schedule 1 Part 3 of the Protection of the Environment Operations Act 1997 and would be suitable for use on or off the Bobs Farm Site.

## 6.7 Heavy Metal Analysis

*Table 11 Heavy Metal Analysis with depth across bore hole and site.*

| Sample Number | Wt % | | Wt (g) | | | |
|---|---|---|---|---|---|---|
| | -1mm+45um | | -1mm+45um | | | |
| | <2.96 | >2.96 | <2.96 | >2.96 | Total Wt. | Initial |
| BH1-BL-AWT-HM | 99.94% | 0.06% | 91.240 | 0.051 | 91.291 | 91.310 |
| BH1-BL-G1-HM | 99.80% | 0.20% | 88.820 | 0.175 | 88.995 | 89.010 |
| BH1-BL-G2-HM | 99.56% | 0.44% | 91.970 | 0.406 | 92.376 | 92.450 |
| BH2-10.5-12.0-HM | 99.64% | 0.36% | 88.440 | 0.318 | 88.758 | 89.350 |
| BH2-13.5-14.0-HM | 99.54% | 0.46% | 89.070 | 0.410 | 89.480 | 89.480 |
| BH2-17.5-18.5-HM | 99.69% | 0.31% | 89.220 | 0.278 | 89.498 | 89.510 |
| BH2-26.0-26.5-HM | 99.82% | 0.18% | 91.990 | 0.162 | 92.152 | 92.160 |
| BH2-BL-B-HM | 99.73% | 0.27% | 89.750 | 0.242 | 89.992 | 90.000 |
| BH3-17.0-17.5-HM | 98.00% | 2.00% | 88.780 | 1.808 | 90.588 | 90.600 |
| BH3-23.0-23.5-HM | 99.61% | 0.39% | 89.490 | 0.348 | 89.838 | 89.840 |
| BH3-26.0-26.5-HM | 99.88% | 0.12% | 88.200 | 0.104 | 88.304 | 88.310 |
| BH3-BL-B3-HM | 99.93% | 0.07% | 89.590 | 0.064 | 89.654 | 89.670 |
| BH4-13.0-14.5-HM | 99.79% | 0.21% | 93.150 | 0.196 | 93.346 | 93.350 |
| BH4-16.5-18.0-HM | 99.79% | 0.21% | 90.570 | 0.193 | 90.763 | 90.770 |
| BH4-20.5-24.1-HM | 99.85% | 0.15% | 90.470 | 0.135 | 90.605 | 90.610 |
| BH4-5.6-5.8-HM | 99.56% | 0.44% | 89.640 | 0.397 | 90.037 | 90.040 |
| BH4-BL-B-HM | 99.90% | 0.10% | 90.160 | 0.088 | 90.248 | 90.250 |
| BH4-BL-D-HM | 99.48% | 0.52% | 90.710 | 0.478 | 91.188 | 91.200 |
| BH5-BL-B-HM | 99.73% | 0.27% | 93.130 | 0.248 | 93.378 | 93.380 |
| BH5-BL-G-HM | 99.69% | 0.31% | 90.530 | 0.282 | 90.812 | 90.840 |
| BH5-BL-M-HM | 99.71% | 0.29% | 61.890 | 0.183 | 62.073 | 62.340 |
| BL-C-HM | 99.79% | 0.21% | 89.410 | 0.185 | 89.595 | 89.600 |
| BL-M-HM | 99.72% | 0.28% | 90.890 | 0.254 | 91.144 | 91.170 |

Tests for Heavy Metals with depth were conducted on all five (5) drilled holed on site.

As can be seen from Table 11 The percentage of sample with Density > 2.95 varies from 0.06% to 2% and is considered too low to make the mining of heavy minerals commercially viable. See also Appendices 10 and 11 of this report on work previously undertaken in the Bobs Farm area and the Stockton Bight; which confirmed the presence of ‘narrow strand’ line not economically viable to mine. (Appendix 10, 11).

# 7. Market Analysis- Summary of Potential Markets

## 7.1 Horticulture and Landscaping

### PURPOSE

Sand used in horticulture and landscaping has a broad range of specific uses. In horticulture and agriculture, silica sand is often a component in general purpose topsoil mixes and in more specialised mixes to aid drainage and plant growth. The addition of sand generally leads to better water and air flow in soil and allows for deeper root penetration in clay-rich soils. There is also evidence that silica is an important micro-nutrient for plant growth. Lime free washed silica sands (commonly called 'silver sand') are used in seed raising mixes, cuttings and for top dressing lawns.

### SPECIFICATIONS

A variety of sand particle sizes are used in top soil mixes. Typically a grain size range between 0.05mm – 1.0mm with <10% between 0.5 - 1.0 mm is used. In some cases larger grains (1-3mm) are used to increase aeration. Purity is not a critical as in other silica sand applications.

Relevant Australian Specifications:

- AS 3743-1993 Potting Mixes
- AS 2223-1978 Garden Soils for Domestic uses

### RECOMMENDED TESTS

The initial test would be standard sand gradings to determine whether screening is required, and if so the expected yield of horticultural sand. A field test with dilute hydrochloric acid may be used to indicate any potential lime content, but a whole rock chemical analysis would be required to confirm this, if a sand is to be marketed as lime free.

### MARKET SIZE

There are numerous landscape suppliers of silica sands throughout Sydney. A possible market with organic agricultural and horticultural farmers does exist. We have no information on the actual size of the market, but suspect significant tonnages may be marketed through the major landscape suppliers (e.g. Australian Native Landscapes). Further information may be gained by approaches to major plant nursery chains e.g. Flower Power, bulk suppliers (e.g. Materials in the Raw, Australian Native Landscapes) or fertiliser/potting mix manufacturers (e.g. Amgrow Specialty, formerly Patons).

### PRICE

Retail landscaping sands range in price depending on the purpose from $53.85/t for Nepean River sand,

56.90/t for Sydney Sand, (from: http://thegoodsoil.com.au/3.html). Australian Native Landscapes offer similar products at $64 - $70/t. Delivered wholesale prices would be less the retail markup.

## 7.2 Soft Fall Sand

### PURPOSE

Soft fall sand is laid under playground equipment to act as an impact absorbing medium. The aim of the soft fall material is to slow down the body over the greatest possible distance and so reduce the shock of the fall. Qualities and factors that are taken in to account are softness (a property of the particle size distribution), environmental impact, and cost, ease of maintenance and design flexibility. Sand competes with mulches, usually pine bark, and coloured synthetic rubber surfaces (Table 12).

*Table 12 Comparison of sand and other soft fall materials*

| Surface | Softness | Maintenance | Environmental Impact | Cost | Source |
|---|---|---|---|---|---|
| **Sand** | Good | Medium | Low | Low | Specialist Supplier |
| **Pine Mulch/ Chips** | Excellent | Medium | Low | Low | Specialist Supplier |
| **Synthetic Turf** | Good | Medium | Medium | High | Specialist Supplier |
| **Recycled Rubber Surfacing** | Good | Low | Low | Medium – High | Specialist Supplier |
| **EPDM Rubber Surfacing** | Good | Low | High | High | Specialist Supplier |

The main issues with the use of sand are the higher maintenance requirements for a successful long term use.

### SPECIFICATIONS

Any soft fall material must meet Australian Standard AS4422-1996 Playground surfacing – Specifications, requirements and test methods. Sand that meets these specifications may also be used for other purposes, e.g. mortar sand, horticultural sand etc.

### RECOMMENDED TESTS

Testing is outlined in the standard above. The initial test would be a standard sand grading.

#### MARKET SIZE

Not a large volume required for each playground, but the number of playgrounds is increasing. The ease of installation and the multipurpose use (doubles as a sand pit) are positive marketing aspects.

#### PRICE

Prices are expected to be similar to landscaping and horticultural sands, but there may be a premium on these prices.

### 7.3 Sports And Recreation Facilities

#### PURPOSE

Silica sand is used to create and maintain both natural and artificial playing surfaces, from recreational parks through to the world's top sporting venues. There is a large range of purpose developed sports fields requiring different qualities of turf. Typical local categories are:

- Golf courses
- General recreation landscaping around developments
- Race courses
- Sports fields for team sports and track events
- Cricket pitches

Research into sports turf is reasonably well funded, targeting particular applications e.g. Golf putting greens and bunkers. Final sand selection, however, is primarily the result of availability (Beehag, 2000) as this is a major factor in cost.

Golf putting greens and bowling greens have similar requirements, and both would require silver sand for top dressing (see horticultural section above).

The physical characteristics of sand suitable for general and specific sports turf have been developed and cover:

- particle size distribution and shape
- clay content
- hydraulic conductivity
- moisture retention
- wettability
- bulk density
- organic content
- pH and electrical conductivity
- stability, angle of repose

## 7.4 Cricket Fields

### PURPOSE

Particle size distributions suitable for cricket pitches have a relatively high fines (clay and silt) content (Golf and Sports Turf Magazine, 2013), Table 13.

*Table 13 Particle size distribution for sands recommended for cricket pitches*

| Parameter | | value |
|---|---|---|
| Particle Size | > 1.0mm, coarse sand | 0% |
| | 0.25 – 1.0mm, medium to coarse sand | 0 -10% |
| | 0.002 – 0.25mm, silt, very fine to fine | 20 -50% |
| | <0.002mm, clay | 50 – 70% |

High clay content is required for cricket pitches and therefore the type of clay is critical. Cracking, cohesion, shrinkage and crushing strength all require evaluation.

## 7.5 Golf Courses

### PURPOSE

Golf courses aim to develop turfs that grow appropriate grass, play consistently and drain rapidly. Bunkers should contain sand that has the right consistency so that the ball sits at the right level (i.e. doesn't disappear and doesn't sit too high up). The USGA is providing guidelines for all aspects of golf course construction including specifications for sands. Some work on sand specifications for Australian golf courses has been done and reported in Bunker sand specification for Australian golf courses: summary of key results (Australian Golf Union & Australian Turfgrass Research Institute, 1995).

### SPECIFICATIONS

Golf courses are aiming to develop turfs and bunkers that grow appropriate grass, play consistently and drain rapidly. The US Golfing Association provides guidelines for all aspects of golf course construction including specifications for sands. The factors they list as important in the selection of suitable bunker construction sand are listed in the table below (Moore, 1998):

*Table 14 General specifications for bunker sands on a golf course (USGA)*

| Parameter | | |
|---|---|---|
| Particle size distribution | Preferred range 0.25 – 1.00mm; silt & clay (<0.50mm) kept to a minimum as they promote crusting; particles >2.00mm damage mowing equipment | |
| Particle shape (sphericity and roundness) | Preferred sand is tending towards low sphericity and angular as it maintains stability | |
| Penetrometer value | Related to tendency of ball to bury, the higher the value the greater the resistance, measured as $kg/cm^2$ | |
| Crusting potential | The formation of a layer of dried, stiff sand on the surface, up to 5mm thick that decreases playing quality. Directly related to, and resulting from, the clay and silt content. Wet sand is dried overnight and any crust developed is noted and graded | |
| Chemical reaction (pH) and hardness | A general indicator of lime content - a calcareous sand of pH >8.0 will weather quickly. Hardness testing rates the crushing potential of the sand. Quartz is the most stable | |
| Infiltration rate | The sand's ability to drain (saturated hydraulic conductivity). Most relevant to root zone applications, but the minimum rate for bunkers is 510mm/hour. | |
| Colour | Use Munsell Colour Chart, with lighter coloured sands preferred and useful to evaluate compatibility of replacement and top-up sand | |
| Overall playing quality | A subjective evaluation, aimed at achieving uniformity throughout a course. The above factors contribute to this, but how the sand is laid and managed over time also strongly determine the playing quality. | |

A slightly older reference to Australian sand specifications for bunkers is quoted in (Australian Golf Union & Australian Turf grass Research Institute, 1995) and (Watson et al., undated), with the requirements summarised in Table 15 below. (Watson et al., undated) also discuss other qualities of the ideal bunker sand for widely variable locations, but with no quantifiable attributes.

*Table 15 : Australian specifications for golf course bunker sands*

| Parameter | | |
|---|---|---|
| Particle size distribution | Inland courses: 0.2 – 1.0mm<br>Coastal courses 0.1 – 1.0mm | |
| Particle shape (sphericity and roundness) | angular | |
| Surface crusting | < 1.0kg/cm2, with <3% clay & silt content | |
| Angle of Repose | 'Y 30° | |
| Chemical reaction (pH) and hardness | Silica | |
| Ball plugging (penetrometer value) | >2.5kg/cm2 | |
| Colour | Light, without glare | |
| Hydraulic conductivity | >25cm/hour | |

Golf turf sand is to meet USGA Root zone strict sand specifications (hydraulic conductivity ~ 1800mm/hr, pH 5.0-7.0, 1.4t/$m^3$)

## 7.6 General Sports Fields

Some criteria recommended for sports fields in general can be found in (ASTM International, 2004) and are summarised in Table 16. This document also lists an extensive range of applicable ASTM standard methods for testing. In creating a mix suitable for turf, other materials may be blended with the sand, including soil and peat and some specifications refer to the final product.

*Table 16 Specification for sports fields from ASTM F2396-04*

| Parameter | | Value |
|---|---|---|
| Particle Size Distribution | >4.75mm, gravel | 0% |
| | 3.4 – 4.75mm, gravel | <5% |
| Total gravel max 30% | 2.0 – 3.4mm, fine gravel | <20% |
| | 1.0 – 2.0mm, very coarse sand | <20% |
| 60% + in combined | 0.5 – 1.0mm, coarse sand | 25 –50% |
| medium and coarse sand | 0.25 – 0.5mm, medium sand | >25% |
| Max 15% <0.25mm | 0.15 – 0.25mm, fine sand | <10% |
| | 0.05 – 0.15mm, very fine sand | <5% |
| | 0.002 – 0.05mm, silt | <5% |
| | <0.002mm, clay | <3% |
| Sand Shape | Recommended to avoid extremes in sphericity and angularity measurements, using visual assessment | |
| $CaCO_3$ content | Overall limit for blended mix | <5% |
| Angle of Repose | Overall limit for blended mix | 35 -45$^o$ |
| Coefficient of uniformity | Sand component ($D_{60}/D_{10}$) | 2.5 - 4.5 |

### RECOMMENDED TESTS

Dense Soil Angle of Repose (DSAR) is a measure of the combined effect of sphericity and roundness of the sand (Vepraskas & Cassel, 1987) and is suitable for testing sands for golf bunkers (uniformly graded, rounded sands produce a much lower angle of repose compared to widely graded angular sands, (Beehag, 2000)). A penetrometer test is also useful to determine how the ball will sit on the sand.

The US based Sports Standards and Recreation Standards web site (http://www.astm.org/Standards/sports-and-recreation-standards.html) lists a range of relevant documents available for purchase including:

*Table 17 Sports Standards and Recreation Standards for Natural Playing Surfaces*

| Standard | Title | |
|---|---|---|
| F1632-03 (2010) | Standard Test Method for Particle Size Analysis and San Shape Grading of Golf Course Putting Green and Sports Field Rootzone Mixes | |
| F1647-11 | Standard Test Methods for Organic Matter Content of Athletic Field Rootzone Mixes | |
| F1815-11 | Standard Test Methods for Saturated Hydraulic Conductivity, Water Retention, Porosity and Bulk Density of Athletic Field Rootzones | |
| F1702-10 | Standard test Method for Measuring Impact-Attenuation Characteristics of Natural Playing Surface Systems Using a Lightweight Portable Apparatus | |

The USGA web site (http://www.usga.org/course_care/articles/construction/greens/ASTM-Procedures- Required-for-Testing-Putting-Green-Materials/) lists the ASTM procedure recommended for the testing of putting green materials.

There are specialist sport field and turf testing facilities available in Australia, eg. Ground Science (http://www.groundscience.com.au/sportsfield.html). These companies cover the broad range of tests applicable to the needs of the different types of playing fields in Australia.

### MARKET SIZE

The largest and most specialised market for sports and recreation facilities is golf courses which require different sands for turf, greens and bunkers. Higher grade courses will require more stringent specifications than others. Bowling greens, cricket pitches and multipurpose playing fields are a significant market in Australia.

### PRICE

Anecdotal reports on the web indicate that bunker sand on the web is $300 or more for a truckload.

## 7.7 Specialist Mortars

### Purpose

Mortar sand is primarily used in cement-based mortars used in the construction industry for bedding tiles and masonry and for plastering-type applications (render). The mixture has a general composition of sand, cement and water. While it has similarities to concrete, it is generally worked by hand in the housing construction industry.

The nature of the sand used has a major impact on the quality of the mortar including its requirement for additives, placement and finishing properties and its longevity and durability. A suitable mortar will retain enough water to be workable but also dry quickly enough to cause no delays in construction and will also be sufficiently strong and durable once dry.

Another specialist product is mortar sand to be used in restoration and conservation of historic buildings, particularly for mortars used in repointing with lime mortars.

### SPECIFICATIONS

As the end use for the mortar sand is variable, the specifications will be determined for that particular purpose. In general good mortar sands are preferably well graded (fine to coarse) and angular to sub angular so that they bond well with the masonry.

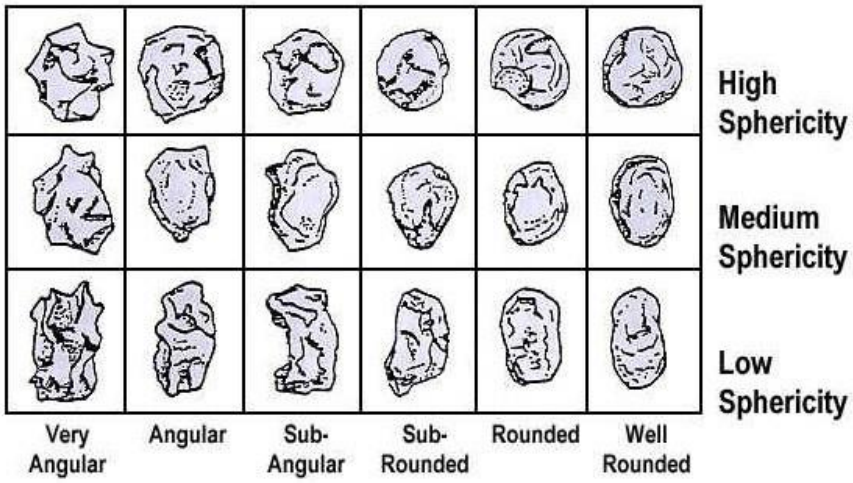



*Figure 14 Sand sphericity and roundness, with the better mortar sands located in the lower left quarter*

A NATSPEC Working Note has been developed for mortar sands primarily used in the construction industry (Busck, 2004). The standardization of the mortar sand specifications is aimed at reducing the need for additives in the work place which can compromise the longer term stability of the mortar.

The three descriptors used in Busck, 2004 to specify sand are:

1. Maximum particle size
2. Voids content, when compacted, of the <75micron fraction
3. Micro fines content of the sand: relative to the micro fines composition

The sand should be described in the terms listed in Table 18.

### Mortar Sands for Conservation Work

In general, the sand for this type of work will be required to match the characteristics of the historical material and generally uses lime as a bonding agent. It is recommended that the sand be matched for colour, grain size and grading and grain shape, and so specifications for this type of work may be on a job by job basis.

*Table 18 Mortar sand specification criteria from: (Busck, 2004)*

| Characteristic | Aust. Standard | Remarks | Tolerances |
|---|---|---|---|
| Particle size range | AS 1141.3.1<br>AS 1141.11<br>AS 1141.12 | Sampling, dry or wet sieving methods | +/- 10% |
| Maximum particle size | As above | | +/- 1% |
| Voids content | AS 1141.4 | Test is conducted on samples with removal of <75micron fraction. (container volume –mass of compacted sand)/container volume x 100%. | +/- 5% |
| Microfines content (<75micron fraction) | AS 1141.11<br>AS 1141.12 | Particle size distribution of material<75microns | +/- 1% |
| Mineralogical content of microfines | AS 1289.3.7<br>XRD, XRF | Quantitative determination is by XRD, XRF and petrographic analysis, | Variable effects, montmorillonite clay group is deleterious |
| Alkali reactive materials | AS 2758.1 | | |
| Particle strength | AS 1141.24 | For all particles > silt size, referenced to quartz | 6% |
| Organic impurities | AS 2758.1<br>AS 1141.34 | | |
| Sugar | AS 1141.35 | No positive result | 1 part in 10,000 cut off |
| Soluble salts | AS 1012.20 | Chloride ion reported if > 0.01% Sulphates reported if > 0.01%<br>Other salts must be shown to cause no deleterious effect | $Cl^-$ cut off 0.04%, $SO_3$ cut off 5% |

Some general specifications of suitable mortar sands are noted by the Heritage Council of NSW and Heritage Victoria (Young & Long, 2006) and (Young & Long, 2009):

- Sand should be washed to remove all clay and organic material
- Sharp (angular) to ensure good bonding
- Graded to provide size range from coarse to fine particles
- Finer sands have greater surface area requiring proportionally more lime
- Dry sand is better than wet sand for mortar mixing

In conjunction to this general information, size-grading specifications have been prepared for two sand types for use of the NSW Government Architect's Office in restoration work:

- Fine-medium sands – appropriate for 3mm (nominal) joint widths; and,
- Medium-coarse sands – appropriate for 10mm (nominal) joint widths.

The table below sets out the size-grading requirements.

*Table 19 Size grading specifications for mortar sands*

| | Fine-medium sand | Medium-coarse |
|---|---|---|
| SIEVE SIZE | % passing | % passing |
| 4.75m | 100 | 98- |
| 2.36m | 100 | 90- |
| 1.18m | 95- | 70- |
| 600µ | 70- | 40- |
| 300 | 35- | 10- |
| 150 | 10- | 2- |
| 75 | 0-5 | 0-5 |

### RECOMMENDED TESTS

A number of Australian Standards exist covering aspects of sands suitable for mortar. For heritage work we recommend initial tests be sizing and at least an initial visual review of typical grain shape; if these appear suitable checks should be made for any non-quartz component (chemistry and if required XRD). The remaining tests in Table 18 will then be required to confirm suitability.

### MARKET SIZE

The heritage sand market a very small specialist market. The requirements of large restorers of heritage buildings such as NSW Public Works would be a few tonnes a year. Private restoration projects are likely to use small batches of sand (often one tonne or less). Investigations by Geos Mining have revealed that few, if any, sand producers were prepared to produce small quantities of sand to a client's specification.

### PRICE

Heritage mortar sands are expected to command a generous price, as they are required in such small batches. Supplies would be priced on a job by job basis.

## 7.8 Glass Sand

### PURPOSE

Glass may be produced by heating silica sand to approximately 1,700°C for simple glass, but more commonly with the addition of fluxes (i.e.Na2O) the fusion temperature can be reduced to as low as
1,450°C (Harben, 2002). For commercial glass making, silica sand comprises about 60% of a soda-lime batch (Flat glass), >40% of insulation fibreglass, 30% of textile grade fibreglass and 65% of specialty glasses (i.e. laboratory glass).

### SPECIFICATIONS

Glass sands used in Australia require a silica purity of 99.5% and varying levels of $Fe_2O_3$ and other impurities (alkalis and colorants) depending on the purpose (Table 20). For first grade optical glass, $SiO_2$ content should be at least 99.8%, <0.1 % $Al_2O_3$ and 0.02 % $Fe_2O_3$.

*Table 20 Typical silica sand specifications of flat and container glass. Source – (Lines & Echt, undated).*

| Compound | Flat Glass | Container Glass |
|---|---|---|
| $SiO_2$ | ≥99.5% | ≥99.5% |
| $Fe_2O_3$ | ≤0.04% | ≤0.03% |
| $Al_2O_3$ | ≤0.3% | ±0.01% |
| $TiO_2$ | ≤0.1% | ≤0.03% |
| $Cr_2O_3$ | ≤2 ppm | ≤10 ppm |
| $CO_3O_4$ | ≤2 ppm | |
| $MnO_2$ | ≤20 ppm | |
| CaO-MgO | | ±0.1% |
| $ZrO_2$ | | ≤0.01% |
| $Na_2O$-$K_2O$ | | ±0.1% |
| Moisture | | ≤0.1% |

Most glass manufacturers have very stringent requirements for chromium, titanium, tin (cassiterite) and manganese which are refractory and/or tint the glass. Container glass also has stringent requirements for consistency of alumina, alkali content. Glass fibres usually have a less rigorous specification, except for optical glass fibres. Glass sand also needs to have rounded, evenly sized grains so it flows well and mixes with the other raw materials in the batch. Some heavy minerals such as chromite and rutile are refractory and cause problems in glass manufacture so are removed during processing.

## RECOMMENDED TESTS

- X-ray fluorescence analysis for major elements and specific contaminants. ICP may be an acceptable analytical method if carefully controlled, but some ICP analyses are partial, and may not fully represent the content of resistate minerals such as tungsten, titanium or zircon. For glass sands and all high purity silica markets discussed below, it is critical that the sample preparation is carefully controlled to avoid entrainment of iron or tungsten during grinding. Use of a zirconia ceramic mill is often recommended, but not if zirconium is to be analyzed.
- Mineralogical analysis by microscope or X-ray diffraction
- Grain size analysis

## MARKET SIZE

### SYDNEY MARKET

The glass manufacturing industry in Sydney is now dominated by one company, Owens-Illinois Glass, which manufactures container glass in Penrith (Viridian's Ingleburn float glass plant closed in March 2013). The Stockton Bight area is currently the only source of the relatively fine grained high quality dune sand used by the glass industry.

Most of the sand that is sold for glass manufacture in Sydney has a minimum silica level of 99.5% and 0.03%or less iron oxide ($Fe_2O_3$).

There are three existing glass sand quarries that supply the Sydney glass industry, Tilligerry Northern Dune, which has approximately 7 years of resources, Salt Ash, which is expected to operate for up to two years, and Anna Bay which has also been reported as producing a significant amount of glass sand, although this has not been confirmed. All the glass sand is processed at the Salt Ash plant. The total output of these quarries is estimated at between 250,000 and 275,000 tonnes per annum, but this would not all be glass grade sand.

The largest NSW glass sand quarry, Tilligerry sand quarry operated by Sibelco is authorised to produce up to100,000 tonnes of sand per annum.

*Table 21 Silica sand consumed for glass production in the United States in 2011. Source (Dolley, 2011).*

| Glass Product | Quantity (000' t) | Value USD (000') | USD/t |
|---|---|---|---|
| Containers | 3,710 | 101,000 | 27.26 |
| Flat, plate and window | 2,630 | 67,100 | 25.55 |
| Specialty | 391 | 15,300 | 39.15 |
| Fiberglass, unground | 366 | 9,260 | 25.29 |
| Fiberglass, ground | 393 | 17,000 | 43.33 |

In South Australia, Amcor's Barossa Valley glass plant is a major supplier of glass packaging products, particularly wine bottles, in Australia.

In Melbourne, container glass is manufactured by O-I (Owens-Illinois) in the world's largest container glass plant at West Croydon, and float glass for the construction industry is manufactured by CSR-owned Viridian Glass at Dandenong.

### EXPORT

There may be some potential for export of good quality glass sand, but detailed investigation of this is outside the scope of this review. Any export sand would need to be good quality (probably 99.7% silica or more, unless the only significant impurity is feldspar) and have low land transport costs to get a competitive FOB price, and the port logistics would also impact on its competitiveness in international markets. Recent Australian export statistics are presented below, under high quality sands, and indicate that the overall export market for glass and high quality sand is significant, in the order of 2 – 5Mtpa.

### SYDNEY MARKET PRICE

Inquiries have been made previously to both major glass manufacturers having long standing contracts for glass sand but they are not willing to reveal the prices they pay. Inquiries to sand producers were also made and are considered commercial in confidence. Industry sources indicate that the price of glass sand is
$32-40 per tonne delivered to Penrith, and this was the best price estimate we could derive early in 2013. Given the recent plant closure, which will have reduced demand, we anticipate increased competition for market share, which will prevent local price increases in the immediate future.

Based on 2005-2006 industry data, the approximate price paid for silica sands used in the glass industry were then between $22 - $25/t depending on the quality and type of glass production the sand was used for.

## 7.9 Chemicals

### PURPOSE

Silica sand is feedstock to many silica based chemicals, with the most important initial product being sodium silicate (water glass), from which a number of other chemicals can be derived. Sodium silicate is produced by combining silica sand with soda ash or caustic soda at 1300 - 1500°C within a furnace (Harben, 2002). Various grades of liquid sodium silicate are produced by varying the alkali/silica ratio and the solids content. In liquid form, sodium silicate has key uses in soaps, detergents, industrial cleaners, adhesives, cements, paints, foundry moulds, ore flotation and corrosion control in water pipes. Alkaline sodium silicate has strong buffering and solubility properties for use in heavy duty cleaners, dairy cleaners, metals cleaners and paint removers. Other products of sodium silicate include zeolite (catalyst & catalyst carrier, desiccant, molecular gas sieves), precipitated silica (fine grained filler, anti-slip agent, flow aid and dispersant) and silica gels, silica colloids and aerogels (Harben, 2002).

### SPECIFICATIONS

Silica sands for sodium silicate production must be high purity with > 99.4% silica, < 0.25% $Al_2O_3$ and <0.03% $Fe_2O_3$ (Harben, 2002).

### RECOMMENDED TESTS

Chemical purity is the critical test required for sands used as feedstock for sodium silicates, with suitable sample preparation, as discussed under glass sands.

### MARKET SIZE

Australian manufacturers include Coogee Chemicals producing a sodium silicate at Kwinana, Western Australia. PQ Australia Pty. Ltd, a subsidiary of the PQ Corporation, (the largest global supplier of sodium silicate) is a major east coast Australian distributor.

### PRICE

Prices for sodium silicate product from 2002 - 2007 ranged between $46.80/cwt (hundredweight; 1 US cwt = 0.045t or 1 UK cwt = 0.05t) to $13/cwt, in 2008 prices ranged from $40.50-44.50/cwt (ICIS, 2008). The price of feedstock sand is likely to vary with purity, but relatively high prices are anticipated.

## 7.10 Filter Sands

### PURPOSE

Filtration sands are designed to remove particulate material and algae using a range of layered sands, very fine sands grading down to coarse sands and gravels at the base of a filtration structure. Filter sand with a diameter of 0.1 mm has the ability to remove faecal coliform bacteria. The most common uses for these are for septic tank filters, industrial water treatment, swimming pools and aquariums. A newer application is the creation of storm water filtering 'natural' landscapes (bioretention systems) as a part of overall water management by local councils and government environmental bodies.

### BIORETENTION SYSTEMS

Bioretention systems are designed to treat stormwater runoff by filtering it, initially through vegetation, and then through various filter sands. Figure 15 below shows a typical design

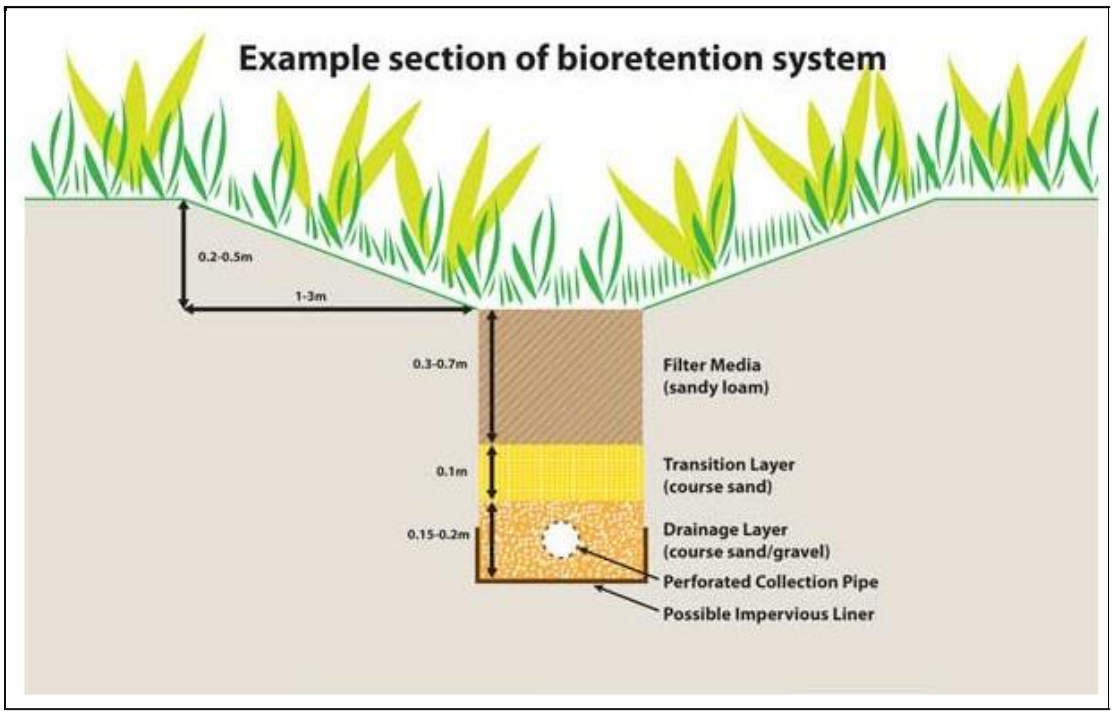



*Figure 15 General elements of design for a bioretention system*

The filter media, including the vegetation, is held in place by the coarse sand of the transition layer. The transition layer prevents the final drainage layer being clogged by the filtration media materials.

### SPECIFICATIONS

Filter sands are ideally free of dust, clay, micaceous or organic matter, with an angular or rounded grain shape (Harben, 2002). A uniform grain size is required with a narrow size distribution.

Examples of filter sand specifications used for a range of small sized filtering applications in domestic situations (e.g. swimming pools) and effluent treatment are listed in Table 22 following (PFL Water Filtration Media, 2013), (River Sands Pty Ltd, 2010).

*Table 22 Example of specifications of filter sands for domestic applications*

| | PFL high purity quartz (UK) | PFL slow filter sand (UK) | River Sands filter media, (Qld) |
|---|---|---|---|
| Size gradings | 0.5 – 1.0mm<br>0.6 – 1.18mm<br>1.0 – 2.0mm | 0.125 - 1.0mm | 3.35 -1.75mm<br>2.0 – 0.85mm<br>1.4 – 0.5mm<br>1.4 - 0.43mm<br>0.6 – 0.15mm |
| Shape | Round and spherical | | |
| Specific gravity | 2.65 | 2.65 | 2.65 |
| Hardness | 6 -7 Moh | | |
| Bulk density | 1.5t/m loose<br>1.64 t/$m^3$ compacted | 1.65t/m loose damp<br>1.8 t/$m^3$ compact damp | 1.5 t/$m^3$ |
| Acid solubility | <1% | <0.2% | <2% |
| Chemical Composition (Quartz) | >97% $SiO_2$<br>$Fe_2O_3$ <1.5%<br>$Al_2O_3$ 0.5%<br>$K_2O$ 0.02% | >99.25% $SiO_2$<br>$Fe_2O_3$ 0.08%<br>$Al_2O_3$ 0.11%<br>$K_2O$ 0.02% | >99% $SiO_2$<br>$Fe_2O_3$ 0.15%<br>$Al_2O_3$ 0.52%<br>$K_2O$ 0.01% |
| Loss on ignition | 0.05% | 0.11% | 0.6% |
| Other | | Light beige | Trace elements, friability |

### BIORETENTION SYSTEMS

The filter media should be loamy sand with high permeability even when compacted. The media may be local soils mixed with an introduced washed sand that allows for the following specifications for each of the layers to be met (Table 23 below). It should be well graded, with no gaps in the distribution and not dominated by the small particle size range (to prevent particle movement leading to structural collapse) (Facility for Advancing Water Biofiltration, 2009).

The drainage layer is composed of fine gravel 2-4mm and is about 200mm thick (River Sands Pty Ltd, 2010), (South East Queensland Healthy Waterways Partnership, 2010). Table 23 lists the parameters and the specifications for the various components of a bioretention system (South East Queensland Healthy Waterways Partnership, 2010), (Facility for Advancing Water Biofiltration, 2009).

*Table 23 Specifications for bioretention sands and media*

| Parameter | | | Tolerances |
|---|---|---|---|
| Filter media | Particle size distribution, recommended & indicative only | <0.05mm (silt & clay). <3% | Absolute limit of 3% |
| | | 0.05-0.15mm (very fine sand) 5–30% | |
| | | 0.15-0.25mm (fine sand) 10-30% | |
| | | 0.25-1.00mm medium sand) 40-60% | |
| | | 1.0-2.0mm (coarse sand) 7-10% | |
| | | >2.0mm (fine gravel) <3% | |
| | Chemical reaction (pH) and hardness | pH 5.5 – 7.5 | Natural soil range |
| | Hydraulic conductivity | 100 -500mm/hour | Up to 750 mm/hour with supplementary watering |
| | Electrical conductivity | <1.2dS/m | |
| | Acid sulphate potential | Sand resources must be certified as free of any potential | |
| Transition layer | Particle size distribution | <0.05mm (silt & clay). <2% | |
| | | >1.0mm (coarse sand) 100% | |
| | Bridging criteria | $D_{15\text{transition layer}} </= D_{85\text{filter media}}$ | D =percentile particle size |
| Drainage layer | Particle size distribution | Clean fine gravel (2-5mm, washed) | |
| | Bridging criteria | $D_{15\text{drainage layer}} </= D_{85\text{transition layer}}$ | D =percentile particle size |

### SAND FILTERS, GENERAL

Specifications for filter sands are dependent of the actual filter design. Typical parameters that are tested to characterise the product include:

- Particle size distribution
- Bulk density
- Moisture content
- Acid solubility
- Fine fraction (<75µm)
- Specific gravity

This example in Table 24, of particle size distribution specifications is from Tasmania Derwent Estuary Program http://www.derwentestuary.org.au/assets/WSUD_Guidelines_-_Chap_6_-_Sand_Filters.pdf

The specifications are for stormwater filtration systems.

*Table 24 Specifications for filter sands for stormwater, Derwent Estuary Program, Tasmania*

| | Recommended Filter sand | Fine option |
|---|---|---|
| SIEVE SIZE | % passing | % passing |
| 9.5m | 100 | - |
| 6.3m | 95- | - |
| 3.17m | 80 – 100% | - |
| 1.5m | 50 – | - |
| 1.4m | - | 100 |
| 1.0m | - | 80 |
| 0.8m | 25 – | - |
| 0.7m | - | 44 |
| 0.5m | 10 – | 8.4 |
| 0.25m | 2- | - |

Table 25, on the next page, documents a range of filter sands available at River Sands Pty Ltd, Brisbane (River Sands Pty Ltd, 2010).

*Table 25 Example of filter sands available at River Sands Pty Ltd, Brisbane*

**Standard Sizes of Filter Sand**

| Product Number | Uses | Effective Size (mm) | Nominal Size (mm) |
|---|---|---|---|
| 7M | • Filtration media for a domestic and commercial pool filter.<br>• Used as a coarse sand for wet sandblasting.<br>• Epoxy flooring. | 0.45 - 0.55 | 0.5 - 1.0* |
| 7C | • For water filtration in pool filters, commercial filters and water treatment plants.<br>• Used for wet sandblasting.<br>• Epoxy Flooring. | 0.56 - 0.70 | 0.6 - 1.2* |
| 6.5 | • For water filtration in pool filters<br>• Epoxy flooring<br>• Render scratch coats<br>• Bulking out self leveling compounds | 0.85 - 0.95* | 0.8 - 1.8 |
| 6 | • As a support layer for filter sand in a filter<br>• Bulking out cement<br>• Render scratch coats<br>• Filling around bore holes<br>• Decorative applications. | 1.5 - 1.7* | 1.5 - 3.0 |

**Source: (River Sands Pty Ltd, 2010)**

## RECOMMENDED TESTS

General standards include for filter sands include:

*Table 26 Relevant testing standards for filter sands*

| Characteristic | Aust. Standard | Remarks |
|---|---|---|
| Particle size distribution | AS1289.3.6.1-1995 | PSD is of secondary importance after hydraulic conductivity |
| Saturated hydraulic conductivity, porosity, bulk density | ASTM 1815-06 | Uses compaction method to represent field conditions |
| Soil chemistry | AS4419-2003 | Testing for total nitrogen, organic content, orthophosphate, pH, electrical conductivity |
| Soluble salts | AS 1012.20 | Salts must be shown to cause no deleterious effect |
| Moisture content | AS1289.2.11 | |
| Bulk density | AS1141.4 | |
| Acid solubility | AWWA-B100 (50% HCl) | |
| Acid Sulphate reactive materials | AS4969-2008 | Also: Guidelines for sampling and Analysis of Lowland Acid Sulphate soils in Queensland (Ahern, 1998) |

ASTM International (2006), ASTM 1815-06 Standard test methods for saturated hydraulic conductivity, water retention, porosity and bulk density of putting green and sports turf root zones.

Standards Australia (1995), AS1289.3.6.1-1995 Methods of testing soils for engineering purposes – Soil classification tests – Determination of the particle size distribution of a soil – Standard method of analysis by sieving.

## MARKET SIZE

The domestic market for these materials has not been large as the volume required for most domestic uses (e.g. swimming pools) is low. The major market is in sewage treatment plants, where significant markets exist. The move towards large scale landscaping filtration systems to manage stormwater runoff (bioretention) has increased the market for these types of filter sands.

## PRICE

Filter sands have tight specifications to be effective and so command a fairly high price.

## 7.11 Frac Sand

### PURPOSE

Frac sands are used in the hydraulic fracturing process of oil and gas production where the sand grains effectively hold induced fractures open, increasing the flow of gas or oil from a well. The particles must be round to prop open fissures and voids in rock to improve permeability and flow rates. The size and shape (sphericity and roundness) of the grains must be determined to optimize the effectiveness of the sand.

### SPECIFICATIONS

Frac sands should be comprised of durable, well-rounded silica grains with only minor amounts of impurities. Figure 16 Microscope view of a typical well rounded and sorted Frac sand below shows a typical Frac sand, viewed through a binocular microscope showing well rounded, well sorted quartz grains.



*Figure 16 Microscope view of a typical well rounded and sorted Frac sand*

The American Petroleum Institute (API) recommends typical Frac sand specifications under the current API RP 56/58/60 standard and ISO 13503-2. Typical screen sizes used are 3.3 x 1.7mm, 2.36 x 1.18mm, and 1.7 x 0.85mm, 0.425 x 0.212mm with 90 % of the material within the defined size range (Harben, 2002).

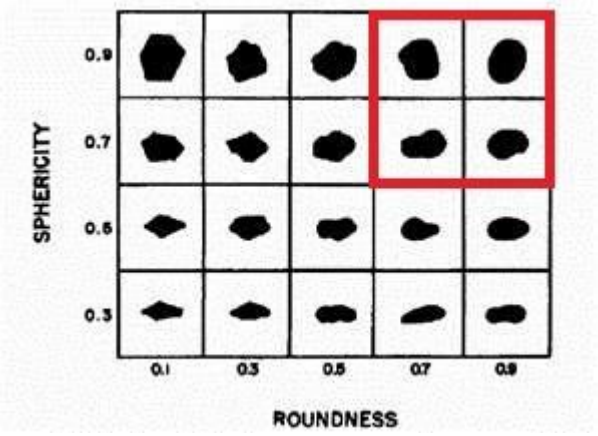



*Figure 17 Krumbein and Sloss diagram showing the API recommended sphericity and roundness of at least 0.6 for Frac sands (red box).*

Frac sands have very stringent specifications and command relatively high prices. They should contain only minor amounts of impurities such as clay feldspar or calcite. The other characteristics measured for frac sands are crush resistance, roundness and sphericity. Experience with the coal seam gas industry indicates that API specifications are widely used as the minimum specifications.

The parameters in the API specifications are listed in Table 27 and Table 28 are explained on the web sites of product suppliers in the US (CDE Global, 2013), (McLanahan, 2012). The most commonly used size grading in the US is the 0.841 – 0.400mm (20/40 US mesh).

*Table 27 Frac sand specifications from API RP56*

| Parameter | | tolerance |
|---|---|---|
| Particle size distribution | 90% of the tested sand should fall between the designated max & min sieve size. There are 8 recommended size gradings. (see below) | 0.1% oversize<br>1.0% undersize |
| Roundness & sphericity | >/= 0.6 using Krumbein & Sloss chart for visual evaluation under the microscope | |
| Crush resistance | Measures the amount of fines created when the sand is subjected to 2minutes of uniaxial compression ranging from 600psi – 4000psi | 20% - 6% depending on the size grading |
| Mineralogy | Quartz, (now some resin coated grains & ceramics) | >99% quartz (similar to glass & filter sands) |
| Solubility | Sand added to 100ml of 12 parts HCl + 3 parts HF, heated to 65.5oC in a water bath for 30 minutes | < 2% weight loss except 3% for the finest |
| Clays and fines content (turbidity) | Typically removed by washing during processing of the sand | |

*Table 28 Details of eight size gradings of recommended Frac sand products and associated crushing fines limits*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Max size (mm) | 3.36 | 2.38 | 1.68 | 1.19 | 0.841 | 0.595 | 0.400 | 0.210 |
| Min size (mm) | 1.68 | 0.841 | 0.841 | 0.595 | 0.400 | 0.297 | 0.210 | 0.105 |
| US mesh | 6/12 | 8/16 | 12/20 | 16/30 | 20/40 | 30/50 | 40/70 | 70/14 |
| Crush resistance test fines max (by weight) | 20% | | | 14% | 14% | 10% | 6% | |

The premium Frac materials are now grains coated with resin or manufactured ceramics. These new products are designed to improve resistance to crushing and to improve uniformity of shape. Maximized size and shape (i.e. >0.9 on the Krumbein and Sloss diagram) stabilises porosity and permeability and so ensures the desired regular flow out of the formation. However they are expensive and sand meeting the stringent API specifications is still the most widely used proppant material.

### RECOMMENDED TESTS

Testing of the potential sand should begin with visual assessments using the traditional microscope techniques for determining grain shape and roundness (Figure 17). Photomicrographs or direct observation using a microscope allows actual sand grains to be examined and compared for roundness using the Krumbein roundness chart and for sphericity using the Riley sphericity index.

Additional testing is given in ISO 13503-2:2006 Petroleum and natural gas industries Completion fluids and materials Part 2: Measurement of properties of proppants used in hydraulic fracturing and gravel packing operations.

### MARKET SIZE

Demand for Frac sand has risen dramatically as the use of hydraulic fracturing becomes more frequently used to exploit natural gas trapped in shale deposits. For example, in the US, Frac sands now represent the second largest market in the US after glass making (Elliot, 2012). We have not made any estimate of the market size in eastern Australia.

A good quality Frac sand would find ready export markets, particularly if its shape was significantly over the standard API spec (around 0.8or higher on the Krumbein and Sloss diagram, as the potential benefit to the producer would justify paying a premium price for the sand at the point of use.

### PRICE

In 2011 the average price per tonne for Frac sands was $54.83 USD (Dolley, 2011). This was an increase from up to $50 USD in 2010. Production of Frac sand in the US has doubled over the corresponding period, with prices nearly twice that of other premium sand products (Geology.com, 2013). We do not have any price information relevant to the current Australian market, but anecdotal evidence is that premium prices are applicable. If Frac sand is being imported, then a price of the order of $80 - $100/t may be applicable. Development of suitable local supplies could reduce the price relatively rapidly.

## 7.12 Foundry And Refractory Sand

### PURPOSE

Silica sands used in moulds and cores have proven useful for casting metals due to the high melting temperature (approx. 1,600°C). Foundry sands are typically used for casting steel, iron, aluminium and copper alloys. Refractory silica sands create a barrier between low and high temperature zones and minimise heat loss in steel, glass and ceramic kilns (Harben, 2002).

### SPECIFICATIONS

Particle size is a critical property as it affects permeability and the ability of gases to escape. Grain size in foundry sands is typically defined by the American Foundryman Society (AFS) grain fineness number (GFN) (Table 29). The GFN is determined for individual sand samples as follows:

a) The weight of each sieved size range is expressed as a percentage.
b) Each percentage is multiplied by the previous mesh number to derive the product.
c) The GFN is obtained by dividing the total product by the total percentage of retained grains.

An example of the GFN calculation is as follows:

*Table 29 Example of the calculation of the American Foundryman Society GFN. After (Brown, 2001)*

| *BS sieve number* | *% sand retained on sieve* | *Multiplied by previous sieve no.* | *Product* |
|---|---|---|---|
| 10 | nil | – | – |
| 16 | nil | – | – |
| 22 | 0.2 | 16 | 3.2 |
| 30 | 0.8 | 22 | 17.6 |
| 44 | 6.7 | 30 | 201.0 |
| 60 | 22.6 | 44 | 1104.4 |
| 100 | 48.3 | 60 | 2898.0 |
| 150 | 15.6 | 100 | 1560.0 |
| 200 | 1.8 | 150 | 270.0 |
| pan | 4.0 | 200 | 800.0 |
| Total | 100.0 | – | 6854.2 |

AFS grain fineness number = 6854.2/100

= 68.5 or 68 AFS

The GFN is approximately equivalent to the average grain size of the sand in terms of mesh size (Table 30). Foundry sands are usually between 150 - 400µm (GFN 90 - 35) with most between 220-250µm (GFN 90 -55) (Brown, 2001).

*Table 30 Approximate relationship between the GFN and average grain size. Source (Brown, 2001).*

| AFS grain fineness no. | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 80 | 90 |
|---|---|---|---|---|---|---|---|---|---|---|
| Average grain size (µm) | 390 | 340 | 300 | 280 | 240 | 220 | 210 | 195 | 170 | 150 |

Foundry sand is usually mixed with clays and other materials for use in ferrous and non-ferrous foundries. Rounded grains are usually preferred, but angular grains may be sought if higher strength is required. The silica content must be at least 98% and have limits on the levels of CaO and MgO to reduce the acid demand value (ADV).

### RECOMMENDED TESTS

A standard size grading is the first test required, followed by an estimate of grain shape, and chemistry

### MARKET SIZE

The demand for foundry sand worldwide is dependent mainly on automobile and light truck production rates.

Foundry sand is produced from several quarries in the two dune barrier systems in the Port Stephens area. Prices of foundry sand are likely to be slightly but not significantly higher than construction sand. Since the closure of the steelworks at Newcastle and the heavy industry that was associated with them, the size of the foundry sand market had decreased significantly and is no longer considered a major market for Williamtown sand. However, specialist manufacturers do exist, and additional market research is warranted if a sand has good potential for this market.

### PRICE

Based on 2005-2006 NSW industry data, the approximate price paid for silica sands used in the foundry industry was $30/ton with lower prices for lower quality foundry sands.

*Table 31 2005-2006 silica sand price per ton.*

| NSW region | Price/ton (AUD) |
|---|---|
| **Port Stephen** | $30.00 - $34.00 |
| **Lake Macquarie** | $30.00 |
| **Braidwood Area** | $7.50 |

Data from the US silica sand industry provides a rough guide to the international price of various foundry sand types (Dolley, 2011) Table 32.

*Table 32 2011 average silica sand prices per ton sold in the US for various foundry sands. Source (Dolley, 2011).*

| Foundry Sand Type | Average Price/ton (USD) |
|---|---|
| Molding and core - Unground | $36.65 |
| Molding and core - Ground | $50.33 |
| Refractory | $29.00 |
| Metallurgical flux | $11.00 |

## 7.13 Industrial Fillers, Silica Flour And Abrasives

### PURPOSE

The use of silica sand as a filler can provide a number benefits including: cost reductions, increase or decrease in weight, textural effects, and an increase in strength. The silica sand is usually ground to various sizes, the finer sizes being known as silica flour.

Silica flour is used in paints, ceramics, soap, and toothpaste, skin care products, and pharmaceuticals and as high performance fillers and in cables. The raw material is ground from < 10 microns to 100 microns depending on the application. A median size of around 60 micron is considered typical. The product is usually ground in a ceramic lined mill, to reduce iron pick up which gives an undesirable grey colour.

Silica sands act as an important abrasive agent due to its low cost, hardness, inertness and resilience. Abrasive applications include sand blasting, coated abrasives (i.e. sandpaper), scouring powders and liquids. Due to health concerns, silica sand as a sand blasting medium is heavily restricted or banned from use in Australian states. This includes any material with > 1% $SiO_2$ by weight (SWA, 2012). In NSW, the abrasives most commonly used for sand blasting are slag products and imported garnet, and ilmenite may also be used in some cases.

The use of silica in scouring powder and liquids requires similar specifications to general industrial filler use, with very tight specifications on the final size.

The Coated Abrasive Manufacturers Institute (CAMI) may have additional information on the use of silica in coated abrasives. In many cases higher performance minerals (garnet or silicon carbide) are preferred to silica sand.

### SPECIFICATIONS

The most important characteristic required is a brightness of at least 80% when ground to the desired size. This requires a visually white to off white sand with no colour streaking. Any coloured sections of sand should be able to be removed by selective extraction in the quarry. Other requirements are low iron, alumina, sodium and potassium content.

Ground silica and silica flour for filler purposes typically requires a brightness of >89% with <0.1 $Fe_2O_3$, <0.38% $Al_2O_3$, <0.1% $K_2O$ (Harben, 2002).

*Table 33 CAMI grit sizes*

| CAMI Grit designation | Average particle diameter (µm) |
|---|---|
| 24 | 708 |
| 30 | 632 |
| 36 | 530 |
| 40 | 425 |
| 50 | 348 |
| 60 | 265 |
| 80 | 190 |
| 100 | 140 |
| 120 | 115 |
| 150 | 92 |
| 180 | 82 |
| 220 | 68 |
| 240 | 53 |
| 320 | 36 |
| 360 | 28 |
| 400 | 23 |
| 500 | 20 |
| 600 | 16 |
| 800 | 12.6 |
| 1000 | 10.3 |

The chemical composition required for both ground silica and silica flour depends on the application, but is generally greater than 99%, although there are products on the market at around 95% $SiO_2$.

### RECOMMENDED TESTS

The critical tests for this use are brightness (measured on the ISO or LAB systems) and chemistry. Brightness testing requires careful sample preparation to give acceptable results; most major users have their own laboratories and will conduct their own tests. For most industrial filler uses clays would need to be removed, but a fine pure kaolin clay/silica sand mix may find applications in selected markets, although a reduced price can be expected.

### MARKET SIZE

In NSW the market is expected to be relatively small, due to limited manufacturing. The only known current producer is Sibelco, who have offered to buy high silica sand and crushed pebbles for production of silica flour, but may also use their own sources of supply (e.g. Tilligerry). Their milling is believed to be at Granville.

### PRICE

For any product to be attractive to Sibelco, we consider either the delivered price must be lower than their own supplies (probably ex Tilligerry) or the brightness and chemistry must be better.

Ground sand used as filler for paint, putty, rubber averaged $44.78 USD per ton in the US (Dolley, 2011). Price varies widely based on quality and use, and the availability of competing products eg ground calcium carbonate, feldspar, barite etc.

## 7.14 Ceramics

### PURPOSE

Ceramic silica is used in the manufacture of products such as tiles and white ware ceramics. Silicate ceramics are based on quartz plus clay, feldspar/nepheline syenite and a selection of other additives such as talc, calcium carbonate or wollastonite (calcium silicate). This mixture is ground to < 40µm, combined with 30-35% water, shaped and moulded and then fired at > 800°C. The various components are systematically melted or transformed, ultimately producing a dimensionally stable ceramic product. The type of ceramic produced depends on the batch mix and the temperature and duration in the furnace. Typically there is 10% silica in stoneware, 20% in electrical porcelain, 35% in earthenware and 30-40% in vitreous chinaware (Harben, 2002).

### SPECIFICATIONS

Ceramic grade silica is typically <74 µm, and may be ground to achieve this size, either by the producer or by the ceramic manufacturer. Chemical specifications of >97.5 % silica, < 0.55% $Al_2O_3$ and 0.2% $Fe_2O_3$ are typical, but higher alumina and alkalis may be acceptable, providing they are consistent. If clays are present they should be dominantly kaolin and should not include any significant content of expanding clays.

National Ceramic Industries achieves consistency by stockpiling and mixing, with stockpiles believed to represent a couple of years production requirements.

### RECOMMENDED TESTS

Chemistry is the first test required, and testing should be sufficient to demonstrate consistency. XRD mineralogy will also be required to confirm suitability.

### MARKET SIZE

Australia has the majority of ceramic tiles imported, for example, in 2003 over 88% of tiles were imported (mainly from Italy, China, Indonesia and Spain) (Halliday, 2003). The largest tile manufacturer in Australia is operated by National Ceramics Industries Australia Pty Ltd at the Centaurus Plant located in Rutherford, NSW. At full production capacity the Centaurus Plant can produce 12.8 million $m^2$ of ceramic wall and floor tiles (NCIA, 2010).

A number of Australian manufacturers specialise in industrial ceramics and may present a viable market. Significant industrial producers include Cooinda Ceramics, based in Bayswater, Victoria (Australia's largest wet processing industrial ceramics producer; http://www.cooinda.com.au) and KC Industries Pty Ltd based in Sydney (http://www.kcindustries.com.au).

#### PRICE

The average price of silica sands used in the ceramics industry during 2011 in the US was $57.70 USD/t (Dolley, 2011). Most ceramic manufacturers worldwide will use the lowest cost materials available, so price competition can be keen.

### 7.15 Fused Silica

#### PURPOSE

Fused silica is produced by heating high purity silica sand to temperatures of up to 2300°C, typically using a carbon electrode furnace. Due to its purity, fused silica is superior to most other glasses in terms of optical and thermal properties. Key properties of fused silica include its high temperature resistivity, low conductivity, low thermal expansion, chemical inertness and high optical transmission from ultra-violet to infra-red radiation. Common uses include reinforcement in silicon elastomers, thixotropic agent in sealants and paints, precision casting moulds, refractory bricks, speciality lenses and electronic circuitry.

#### SPECIFICATIONS

Fused silica requires high purity silica sand with properties typical of sands used in optical glass making. These require >99.5% $SiO_2$, variable $Al_2O_3$, <0.008 $Fe_2O_3$, a grains size of 0.1 – 0.5mm, <6ppm Cr, <2ppm Cobalt, 0.01 – 00.5 $TiO_2$. A constant purity and grain size is important.

#### RECOMMENDED TESTS

Chemistry would be the first test required. Heavy mineral separation or acid washing may be required to achieve the desired specifications.

#### MARKET SIZE

Fused silica represents a relatively small market given its specialised application and requirement for high purity silica. In the refractories industry fused silica has largely been replaced by fused zirconia. Total Japanese refractory fused silica usage is about 3,000 tpa. Australia's requirements for fused silica are small and it is imported, mainly from China (industry sources). There is no fused silica manufactured in Australia. Further research would be required to investigate the viability of any export market potential.

#### PRICE

Sand for this market would command a good price at the point of use, but transport costs are expected to limit the ex-quarry price for this export market.

## 7.16 Silicon Carbide And Ferrosilicon

### PURPOSE

Silicon Carbide (SiC) is produced by heating high quality silica sand and petroleum coke to high temperatures (2,200 - 2,400°C). Silicon carbide is inert, very hard, highly refractive, and very thermally conductive with a low thermal expansion (Harben, 2002). Primary uses of silicon carbide include coated abrasives (i.e. sandpaper), bonded refractories, crucibles, advanced ceramics, hot cyclone liners and metal matrix composites. Silicon carbide fibres are high strength and high modulus fibres with significant application to improve strength and heat resistance in various metals and composite materials (ie. air craft engine components). Silicon carbide can be used in steel manufacture in place of ferrosilicon.

Ferrosilicon is used as a source of silicon to reduce metals and to deoxidise steel and other ferrous alloys. It is also used to manufacture silicon, high temperature silicon alloys and in the Pidgeon process to extract magnesium from dolomite. Ferrosilicon is produced in grades ranging from 15% to 90% silicon

Both silicon carbide and ferrosilicon are produced using high quality silica sand, a carbon source (such as low sulphur coke) and, for ferrosilicon, an iron source such as scrap iron. The ingredients are fired in various types of electric furnace, with compositions and temperatures depending on the type and grade of product required.

### SPECIFICATIONS

A pure silica, at least 99.5% $SiO_2$, and preferably above 99.7%, is required. Grain size and shape is less important.

### RECOMMENDED TESTS

Chemistry would be the first test required. Heavy mineral separation may be required to achieve the desired specifications.

### MARKET SIZE

There are no Australian producers of silicon carbide at present. Although it has been considered in the past, silicon carbide production is energy and carbon intensive, so the likelihood of a plant being constructed in eastern Australia under current energy prices is low. Although Australia had ferrosilicon plants in the past, no records could be found of currently operating plants.

China is the largest producer of both silicon carbide and ferrosilicon.

### PRICE

Silicon carbide prices for 80% silicon have been reported as between $1,000-1,200/t USD. Most smelters would have their own silica supplies, or be supplied under long term contracts, so pricing for the input sand is expected to be opaque.

## 7.17 High Value Uses

These markets all require very high purity silica, which is rare without mineral processing. Flotation and acid washing may be required to achieve these specifications; heavy mineral separation by gravity may also be used (eg at Cape Flattery). The minimum requirement is over 99.8% silica.

### PURPOSE

High quality silica can be used for optical grade glassware and for manufacture of synthetic quartz crystals for watches and electronics – these are known as lascas. Newer markets include speciality electronics and certain chemical uses.

### SPECIFICATIONS

Lascas requirements are for very high purity – the highest contaminant must be <50ppm.

### RECOMMENDED TESTS

Chemical purity is the critical test. As processing is usually required to reach high grades, it is the product grade and amenability to processing that is critical. Simple laboratory tests (heavy liquid separation, washing with weak acid) will give indications whether a specific sand has potential for these markets. These should be followed up with more costly mineral process test work to confirm the suitability and design the process.

As with any sand which requires more than simple screening, in order pay for the capital involved in setting up the plant, a reasonable tonnage of suitable feedstock must be present. In most cases a rigorous program of drill testing, chemical analysis and mineral process test work will be required prior to development.

### MARKET SIZE

The market is believed to be all export, but is of significant size.

In the years leading to 2004, Australia exported approximately 3 million tonnes of sand per year, of which 1.8 million tonnes came from Cape Flattery in far northern Queensland and is mainly exported to Japan. It is high quality dune sand used for the glass, foundry and chemical industries. The deposit is owned and operated by Cape Flattery Silica Mines Pty Ltd which is owned by Mitsubishi. Silica sand was also exported from other ports shown in Table 34. The exports of sand from Bunbury and Albany are also bound for Japan or Japanese-owned glass plants in Asia. The exports from Newcastle were, in the past, a back loading deal to Japan, believed to be foundry sand, but we have no recent information.

*Table 34 Silica sand exports from Australian Ports 2011/12*

| Source: (Ports Australia, 2013) | |
|---|---|
| Port | tonnes |
| Cape Flattery (Ports North) | 1,777,000 |
| Bunbury Port Authority | 350,220 |
| Albany Port Authority | 169,599 |
| Port of Brisbane Pty Ltd | 128,271 |
| Burnie (TasPorts) | 35,249 |
| Newcastle Port Corporation | 5,497 |
| Total | 2,465,836 |

## PRICE

In 2008 the price in Japan for Cape Flattery silica sand containing less than 150 ppm Fe was reported to be US$250/t (Geos in house data, 2008).

The most recent international price comparison we could find was Japanese import figures compiled by (Lines & Echt, undated) and presented in Table 35. Whilst the figures are now well out of date, they do demonstrate relative values for sands for different purposes.

*Table 35 Japanese silica sand imports and prices 2004 Source: (Lines & Echt, undated)*

| Country | 2004 | | | Expected end uses |
|---|---|---|---|---|
| | Qty (tonnes) | Value $US | Value $US /t | |
| Korea | 20 | 69,391 | 3,469 | Specialty for electronics |
| China | 595,047 | 11,777,001 | 19.80 | Glass & foundry |
| Taiwan | 18,320 | 3,096,867 | 169 | Specialty for electronics |
| Vietnam | 156,200 | 2,674,998 | 17 | Foundry, glass & sodium silicate |
| Malaysia | 57,971 | 1,304,621 | 22.50 | Glassmaking |
| Indonesia | 9,001 | 33,335 | 3.70 | Construction sand |
| Norway | 1,038 | 1,052,667 | 1,014 | Specialty quartz for induction furnaces |
| Sweden | 114 | 22,784 | 200 | Quartz for induction furnaces |
| Belgium | 8,674 | 1,357,697 | 157 | Likely Cristobalite (calcined silica) |
| Germany | 175 | 137,130 | 784 | Specialty for electronics |
| USA | 5,580 | 6,265,938 | 1,123 | Specialty for electronics |
| Australia | 1,301,039 | 50,459,773 | 38.80 | Mainly for glass, foundry. Some for motherglass (from Tasmania) |
| Total | 2,153,346 | 78,283,376 | 36.35 | Main uses are Glass, foundry & sodium silicate. Smaller volumes for special sectors |

## 8. Borehole Summary – Material by Depth

The following analysis describes the material at specific hole depth ranges from existing ground.

### 1. Borehole 1: (Water Table at 3.5m)

#### 0 to 3.8 metres

The material within this range comprises Grey Topsoil / Sand and as discussed in the previous QMS Stage 1 report would contain significant seed stock of native flora and should be put aside for later reuse or rehabilitation across the site.

#### 3.8 to 4.5 metres

The material within this range appeared as a black mud substance which was most likely suitable for soil applications.

#### 4.5 to 19 metres (End of Hole)

The material within this range is the grey with black fleck and extends below the water table in this location. It is likely to be suitable for multiple applications as described earlier in this report.

### 2. Borehole 2: (Water Table at 10.2m)

#### 0 to 3.5 metres

The material within this range is mixed up and unclear as it was previously used as a site dump as per discussions with Bobs Farm site caretaker (Bo).

#### 3.5 to 5.0 metres

The material within this range is dark sand most likely suitable for soil applications only.

#### 5.0 to 10.5 metres

The material within this range is blonde sand most likely suited to numerous applications as noted earlier in this report.

#### 10.5 to 12 metres

The material within this range is dark mud material most likely suitable for soil applications.

#### 12 to 26.5 metres (End of Hole)

The material within this range is the Grey sand with black fleck and is suitable for numerous applications as noted earlier in this report.

## 3. Borehole 3: (Water Table at 13.2m)

### 0 to 1.0 metres

The material within this range comprises Grey Topsoil / Sand and as discussed in the previous QMS Stage 1 report would contain significant seed stock of native flora and should be put aside for later reuse or rehabilitation across the site.

### 1.0 to 4.0 metres

The material within this range is the mottled sand which may be suitable for multiple applications as described earlier in this report.

### 4.0 to 14.5 metres

The material within this range is blonde sand most likely suited to numerous applications as noted earlier in this report.

### 14.6 to 16 metres

The material within this range is black mud expected to be suitable for soil applications only

### 16 to 26.5 metres (End of Hole)

The material within this range is the Grey sand with black fleck and is suitable for numerous applications as noted earlier in this report.

## 4. Borehole 4: (Water Table at 7.3m)

### 0 to 0.2 metres

The material within this range comprises Grey Topsoil / Sand and as discussed in the previous QMS Stage 1 report would contain significant seed stock of native flora and should be put aside for later reuse or rehabilitation across the site.

### 0.2 to 3.0 metres

The material within this range is the mottled sand which may be suitable for multiple applications as described earlier in this report.

### 3.0 to 5.6 metres

The material within this range is blonde sand most likely suited to numerous applications as noted earlier in this report.

### 5.6 to 6.5 metres

The material within this range is black mud expected to be suitable for soil applications only

### 6.5 to 11.5 metres

The material within this range is variable grey coloured bands expected to be suitable for soil applications only

### 11.5 to 24 metres (End of Hole)

The material within this range is the Grey sand with black fleck and is suitable for numerous applications as noted earlier in this report.

## 5. Borehole 5: (Water Table at 15.4m)

### 0 to 1 metres

The material within this range comprises Grey Topsoil / Sand and as discussed in the previous QMS Stage 1 report would contain significant seed stock of native flora and should be put aside for later reuse or rehabilitation across the site.

### 1 to 5.5 metres

The material within this range is the mottled sand which may be suitable for multiple applications as described earlier in this report.

### 5.5 to 17.5 metres

The material within this range is blonde sand most likely suited to numerous applications as noted earlier in this report.

### 17.5 to 20 metres

The material within this range is variable grey coloured bands expected to be suitable for soil applications only

### 20 to 22.6 metres

The material within this range is Black coloured clay with shell present expected to be suitable for soil applications only

### 22.6 to 26.5 metres (End of Hole)

The material within this range is the Grey sand with black fleck and is suitable for numerous applications as noted earlier in this report.

# 9. Conclusion and Recommendations

Stage 2 drilling investigations confirmed a number of sand lenses exist across the site in what would appear to be mineable quantity. The development of a mining plan is recommended to allow optimal extraction and processing of this deposit while producing complying products for the identified markets.

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| 4 | Borehole Logs with samples and photos | | 5 |
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| 10 | Exploration Report 1995 RZM EL3085 & 2683 | RZM - 1995 | 141 |
| 11 | NSW Minerals Sands of Stockton bite 1995 | NSW Geological Survey-1995 | 53 |

GEOLOGICAL SURVEY OF NEW SOUTH WALES
DEPARTMENT OF MINERAL RESOURCES

# SAND RESOURCES OF THE STOCKTON BIGHT-PORT STEPHENS AREA

by

J WHITEHOUSE

GEOLOGICAL SURVEY REPORT: GS1995/0164 DATED: JULY 1995

MAP REFERENCE: NEWCASTLE 1:100 000 9232
PORT STEPHENS 1:100 000 9332

ACCOMPANYING FIGURES: 22098, 22099, 20602, 21301-A, 21300-A, 21235

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## ABSTRACT

This report describes an investigation of the sand resources in the Stockton Bight-Port Stephens area. The study consisted of literature reviews and discussions with mining companies, local and State government organisations and community representatives. The sand resources were also investigated by aerial photograph studies and geological mapping.

The Stockton Bight-Port Stephens area is a major source of industrial and construction sand for the Sydney and Newcastle regions and provides small amounts of foundry sand for export. It currently supplies all the colourless glass sand, and most of the coloured or amber glass sand used by the New South Wales glass manufacturing industry. The Stockton Bight-Port Stephens area also contains major deposits of heavy minerals that are an important source of rutile and zircon.

The Stockton Bight-Port Stephens area has a dual barrier sand system, the Holocene Outer Barrier, and the Pleistocene Inner Barrier, developed parallel to the present coastline. Sediments of Holocene age separate the Inner Barrier from the Outer Barrier. In the Outer Barrier, the northern part has sand suitable for foundry use and the southern part has sand suitable for construction use. Sand in the central part of the Outer Barrier is mainly used to make coloured glass. The Inner Barrier contains sand used to produce colourless glass. Deposits of heavy minerals occur throughout the Inner Barrier and the Outer Barrier.

There are, however, major environmental constraints to mineral deposit and extractive resource exploitation. These include conservation zones, urban development, water catchment protection areas, archaeologically sensitive sites, military weapons testing zones, National Parks and nature reserves. Furthermore, there is a proposal to incorporate much of Stockton Bight into the proposed Stockton Bight National Park.


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## 1. INTRODUCTION

The Stockton Bight-Port Stephens area (figure 1) contains extensive deposits of sand suitable for use in glass manufacturing, foundries, and construction applications such as concrete manufacture. The sand has other important uses such as filtration sand, as well as the manufacture of ceramic tiles and fillers. The Stockton Bight-Port Stephens area also contains significant deposits of heavy minerals, principally rutile and zircon. Furthermore, quarries at Lemon Tree Passage and Salamander Bay supply much of the hardrock aggregate needs of the region. Coal seams of the Late Permian Tomago Coal Measures occur at depths greater than several hundred metres in the western part of Port Stephens (Whitehouse 1982). It is unlikely that these seams are economically mineable because of their depth and irregular development. The extraction of methane gas from the coal measures may however be possible (Brown et al 1996).

The Stockton Bight-Port Stephens area has a diverse flora (McNair 1992) and many varieties of birds, reptiles, amphibians and small mammals, the most notable of which is the koala (eg Taylor 1989). Significant areas of prime koala habitat that contain important colonies of the koala occur in the Tilligerry Peninsula (eg Callaghan et al 1994). Extensive wetlands occur in the northern and western part of the Stockton Bight-Port Stephens area, and the Tomaree National Park covers much of the eastern part of Tomaree Headland.

The Newcastle and Sydney regions use much of the industrial and construction sand obtained from the Stockton Bight-Port Stephens area, although foundry sand is exported in small amounts. Production of industrial and construction sand has significantly increased in recent years. During 1994/95, about 1 200 000 tonnes of sand for glass manufacture, foundry and industrial uses, and construction applications were produced (Department of Mineral Resources, unpublished statistics, 1996). During this period, about 50 000 tonnes of heavy mineral concentrates were produced in the Stockton Bight-Port Stephens area. This was over half of the State's production.

## 2. BACKGROUND AND OBJECTIVES

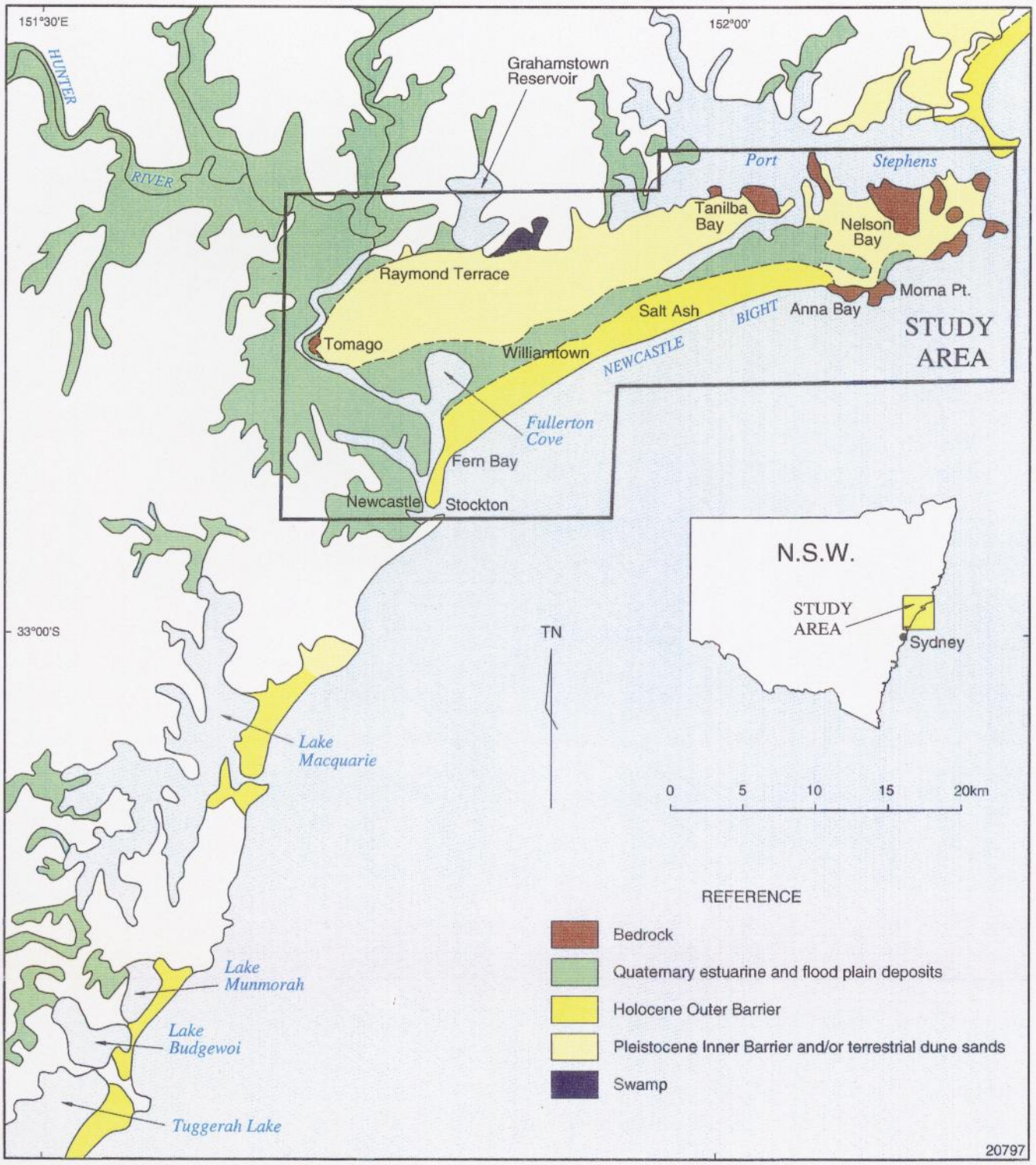
This report describes an investigation by the Geological Survey of New South Wales to identify existing and future sand resources in the Stockton Bight-Port Stephens area. The study consisted of literature reviews, interviews with mining companies, local and State government agencies and discussions with community representatives. Geological mapping and aerial photograph interpretative studies were also used to identify sand resources. Production data was obtained from statistics compiled by the Department of Mineral Resources.

The geology of the Stockton Bight-Port Stephens area, particularly the Quaternary sediments, has been the subject of many studies. Recent work by Thom et al (1992), Roy (1993), Thom et al (1994) and Boyd and Roy (1995) in particular contain excellent discussions of the Quaternary geology. There have been relatively few formal studies of the mineral deposits and extractive resources. Smith (1978)

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FIGURE 1

# LOCALITY DIAGRAM




0 1 2 3 4 5
cm

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completed a thorough study of the sand resources of the region and Robson et al (1986) prepared a management study of Newcastle (Stockton) Bight that included a review of the sand resources. In 1990, the Newcastle Bight Sand Drift Committee, which consisted of representatives of local and State government, was formed to produce a new environmental management strategy for Anna Bay. Subsequently, this study was extended to cover all of Stockton Bight and included a review of the sand resources present (HLA-Envirosciences 1995a-d).

## 3. DESCRIPTION OF STUDY AREA

### 3.1 Location and Access

The Stockton Bight-Port Stephens study area is near Newcastle, about 160 kilometres north-east of Sydney. The study area occurs almost entirely within Port Stephens Shire, in the Hunter Region of New South Wales. The Stockton Bight-Port Stephens area extends from Newcastle (south), the Hunter River (west), Newcastle Bight (east) and to the waterways of Port Stephens (north-east). The area between Nelson Bay Road, Stockton and Anna Bay is Stockton Bight and the region extending from Salt Ash to Lemon Tree Passage is the Tilligerry Peninsula.

The Stockton Bight-Port Stephens area has an extensive network of sealed roadways. The region from Fullerton Cove to Tanilba Bay and to the east of Nelson Bay Road has many unsealed four wheel drive tracks and access roads. Newcastle Airport is situated alongside the RAAF base at Williamtown. The shorelines of Port Stephens, Lemon Tree Passage and Tanilba Bay have many boat moorings and several prominent marinas.

### 3.2 Topography

The Stockton Bight-Port Stephens area contains many transgressive dunes and sand sheets, low-lying estuarine and fluvial sand and mud deposits and isolated hills of volcanic and sedimentary rocks. The central part of Port Stephens, extending from Fullerton Cove to Tilligerry Creek, consists of flat, low-lying peat and organic-rich mud deposits mostly of less than 5 metres height. Sand dunes ranging from less than 10 to over 30 metres in height dominate the coastal and landward margin.

### 3.3 Land Use

The Stockton Bight-Port Stephens area is experiencing high urban growth rates, particularly in Nelson Bay and Salamander Bay. The area is a flourishing tourist destination and major resorts operate at Anna Bay, Nelson Bay and Salamander Bay. Stockton Beach, the Tomaree Headland and the southern shores of Port Stephens provide magnificent beaches for recreational fishing, swimming and boating. The Tomaree National Park has excellent views of Tomaree Head, and has picturesque beaches, ideal for surfing and rock and beach fishing. Tidal waters in Port Stephens, at Big Swan Bay and Tilligerry Creek, support fishing and oyster farming. Grahamstown Dam, which is near Raymond Terrace, is an important source of water for the region. Groundwater resources at Tomago and Anna Bay

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provide much of the water requirements of Newcastle and the northern part of Port Stephens.

### 3.4 Flora and Fauna

The Tilligerry Peninsula contains some of the most important koala colonies in New South Wales (eg Callaghan et al 1994). Major stands of forest and swamp forest, considered prime koala habitat, occur between Mallabula and Lemon Tree Passage. A generally wide corridor of this vegetation occurs along the northern shores of Tilligerry Creek. A more patchy and discontinuous area of forest and open swamp occurs along the southern shores of Tanilba Bay and Big Swan Bay. Areas considered to be of low and marginal koala habitat occur near Tomago, over much of the Tomaree Headland, and relict dunes extending from Stockton to Anna Bay.

### 3.5 Surface Drainage

Surface drainage courses are generally ill-defined. In the east and north, the main drainage courses include Four Mile Creek, which joins Moffats Swamp near Medowie, Fenningham Island Creek, Wallis Creek and Tilligerry Creek. The Grahamstown Dam occupies a former swamp. Tilligerry Creek extends from Fullerton Cove to Lemon Tree Passage. Fullerton Cove, Big Swan Bay and Tilligerry Creek are subject to tidal flooding. Much of the central region of Port Stephens, which is typically of low permeability and low hydraulic gradient, contains many levees, open channel drains and flood gates.

### 3.6 Climate

The Port Stephens area has a mild maritime climate with warm to hot summers and high rainfall and humidity (eg Outline Planning 1994). November to March is the hottest period and July and August is the coolest period. Rainfall decreases throughout late winter and spring, with March and July the wettest months and July and September the driest months. Westerly and north-westerly winds prevail during winter and south-east to north-easterly winds dominate during spring and summer (eg Outline Planning 1994).

### 3.7 Coastal Processes

An active dune system along the coastal margin of Port Stephens is moving inland at about 4 metres per year and as much as 10 metres per year (HLA-Envirosciences 1995b). The rate of sand movement increases marginally between Stockton (south-west) and Anna Bay (north-east). Inundation of substantial areas near Nelson Bay Road may occur during the next several hundred years if the rate of dune migration is not reduced or controlled.

# 4. GEOLOGICAL SETTING

## 4.1 Regional Geology

The following account summarises a major geological study of the Quaternary geology by Thom et al (1992). The study area (plan 1 and figure 2) has late Quaternary sediments developed over more than 100 square kilometres that are less than 30 metres thick (north-west) to over 150 metres thick (south-east). The northern part of Port Stephens, the Tomaree Headland, contains dunes of Pleistocene age, beach and foredune deposits of Holocene age, and scattered exposures of the Carboniferous Nerong Volcanics. The Late Permian Newcastle Coal Measures crop out near Hexham and the Late Permian Tomago Coal Measures underlie the Quaternary sediments in the south-western part of Stockton Bight. The western margin of the Stockton Bight-Port Stephens area has an extensive cover of fluvial sediments associated with the deeply incised Hunter River.

A large, dual barrier sand system of late Quaternary age dominates the geology of he Stockton Bight-Port Stephens area. This consists of a Pleistocene Inner Barrier with marine, aeolian and estuarine sands; and a Holocene Outer Barrier with marine, aeolian and tidal delta sands. A narrow corridor of flat, low-lying estuarine, intertidal and fluvial sediment of Holocene age separates the Inner Barrier from the Outer Barrier. Pleistocene clays and sands of greater than 140 000 years of age underlay the Inner Barrier.

The Inner Barrier, which is dominated by an extensive strand plain with many vegetated transgressive dunes, formed about 140 000 to 120 000 years ago. Intensive wind erosion and sub-aerial weathering during the late Pleistocene produced topographically subdued, symmetrical dunes with well-developed soil profiles and fringing wetlands. The Outer Barrier, which began to form about 6 500 years ago, consists of strandplain, foredune and transgressive dunes. Widespread deposition of estuarine mud, mainly near Fullerton Cove, occurred during the formation of the Outer Barrier.

## 4.2 Local Geology

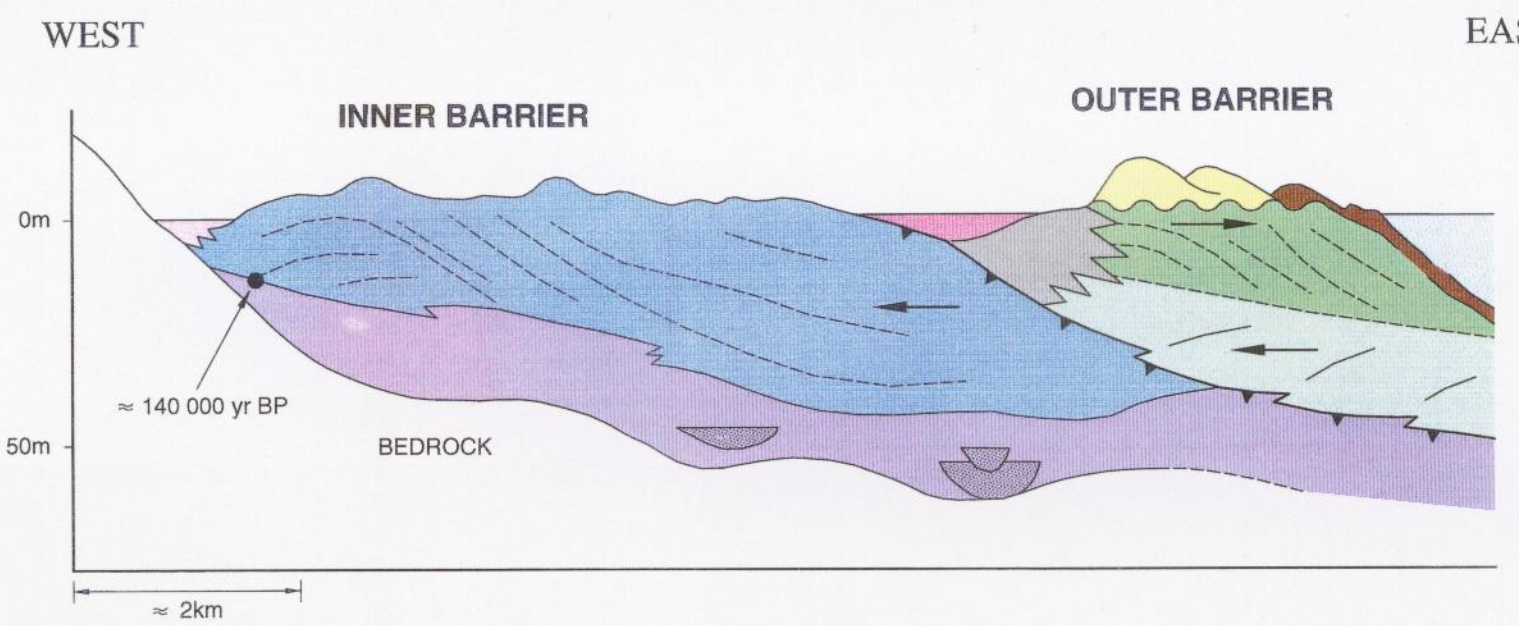
### Outer Barrier

The Holocene Outer Barrier contains active and vegetated transgressive dunes developed over a maximum length of about 32 kilometres and a maximum width of about 3 kilometres. Three distinct phases of aeolian transgression and foredune construction occurred during the Holocene "standstill". The first of these developed about 4 000 to 5 000 years ago and the second developed about 2 000 years ago. The third phase, an active dune system consisting of a coast-parallel dune sheet up to several kilometres across, began to form about 300 to 500 years ago. The first two episodes of aeolian transgression have acquired an extensive cover of vegetation owing to increased sea-surface temperatures associated with rising sea-levels, decreasing winds and increasing precipitation during the Holocene (Thom et al 1994). The active dune system consists of a steep westerly dune face, a sandsheet with numerous transverse dunes, a partially vegetated deflation plane,

FIGURE 2

# IDEALISED GEOLOGICAL SECTION ACROSS CENTRAL PART OF STOCKTON BIGHT

MODIFIED FROM THOM ET AL (1992) AND ROY ET AL (1994)




## REFERENCE

**HOLOCENE SEDIMENT UNITS**

- TRANSGRESSIVE ACTIVE BARRIER, BEACH, FORESHORE SAND
- TRANSGRESSIVE VEGETATED BARRIER SAND
- BACK BARRIER SAND AND MUD
- REGRESSIVE OUTER BARRIER SAND
- TRANSGRESSIVE TIDAL DELTA MARINE AND WASHOVER SAND
- FLOODPLAIN, LEVEE, BACKSWAMP SAND, ORGANIC-RICH MUD AND PEAT
- INTERBARRIER ORGANIC-RICH MUD AND PEAT

**PLEISTOCENE SEDIMENT UNITS**

- TRANSGRESSIVE INNER BARRIER SAND
- BASAL CLAY AND SAND LENSES WITH SOME GRAVEL
- PLEISTOCENE - HOLOCENE BOUNDARY

0 1 2 3 4 5
cm

20798

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foredune and beach. The active sand sheet is progressively burying nearby older dunes and swamps throughout Stockton Bight.

**Interbarrier Depression**

Fluvio-estuarine sediments of Holocene age separate the Outer Barrier from the Inner Barrier. The interbarrier depression, originally an open water estuary, is an extensive, low relief area of peat and organic-rich mud that developed over the past several thousand years. Sandy shorelines, backbarrier sand flats and dune sand locally alter the surface relief.

**Inner Barrier**

The Pleistocene Inner Barrier consists of many vegetated, topographically subdued transgressive dunes and sand sheets. It has a maximum length of about 32 kilometres and a maximum width of about 6 kilometres. The eastern end of the Inner Barrier contains a well-developed beach ridge plain with a maximum length of about 15 kilometres and a maximum width of about four kilometres. The general alignment of the Inner Barrier is north-north-east, perpendicular to wind and wave action from the south-east. The similar array displayed by heavy mineral strand lines near Tomago indicate that the western part of the Inner Barrier formed by beach-ridge progradation.

Erosion by westerly winds during the late Pleistocene formed numerous longitudinal, roughly east-west trending dunes. Freshwater swamps, which border many of these dunes and contain peat deposits and organic-rich sediments, formed in depressions excavated by these westerly winds. Well drained, intensely podzolised soils that typically form the upper part of the dunes supports diverse woodland communities.

**Tomaree Headland**

The Outer Barrier and the Inner Barrier merge with the western side of the Tomaree Headland. The Tomaree Headland, which does not have the bay-barrier morphology or aeolian features found in Stockton Bight, contains sand deposits that formed during prolonged periods of aeolian activity. The sand ridges in the western part of the Tomaree Headland typically enclose low lying, swampy depressions and lakes that formed in deflation basins of the Late Pleistocene dunes. Typically, Pleistocene dunes of the Tomaree Headland are deeply podzolised, containing thick A soil horizons and well-developed B horizons.

Irregular outcrops of Carboniferous Nerong Volcanics, that consist of intensely faulted and fractured rhyolitic ignimbrite, conglomerate, sandstone and siltstone (eg Buck 1995), have trapped thick accumulations of sand transported by prevailing southerly winds. The western side of Tomaree Headland contains many stabilised dunes and swamps of Pleistocene age and the eastern side contains beach and foredune deposits of Holocene age. The rocky shoreline margin on the eastern side of Tomaree Headland has beach-dune systems developed within relatively broad bays between rocky headlands.



### 4.3 Soils

Several soil types dominate the Stockton Bight-Port Stephens area (Thom et al 1992, Murphy 1995, Matthai 1995). Deep well drained Podzols and Siliceous Sands/Podzols occur on the stabilised Holocene sand dunes and stabilised Pleistocene sand dunes. The Interbarrier Depression contains poorly drained deep Humic Gleys. Swales, basins or poorly drained areas, particularly near Salamander Bay, Medowie and the Tomaree Headland, contain Peaty/Humus Podzols. Solonchaks and Calcareous Sands occur along the beach, foredunes and blowouts of active Holocene Dunes in the Outer Barrier.

### 4.4 Resource Geology

The most important geological influences on the nature and distribution of industrial and construction sand resources appear to be the following:-

A) The overall decrease in grain sizes of Outer Barrier dunes from Fullerton Cove (south-east) to Anna Bay (north-east). Construction sand deposits tend to occur in the southern part of the Outer Barrier and foundry sand deposits in the northern part. Sand deposits in the central part of the Outer Barrier are suitable for glass manufacture. However, the relatively high proportions of iron oxide and other contaminants render the latter deposits unsuitable for the economical extraction of colourless glass sand (Outline Planning Consultants 1991).

B) The prolonged sub-aerial weathering of Inner Barrier dunes, most notably in the Tilligerry Peninsula, has formed major colourless glass sand deposits of high chemical purity. Vegetated dunes of the Outer Barrier have an incipient B horizon (Bhs) overlain by a leached A soil horizon of minor thickness. Increased differentiation of the A and B soil horizons occurs in a westerly direction. Dunes of the Inner Barrier typically consist of a leached A horizon usually more several metres thick, overlying a mottled dark brown Bh horizon, with partly indurated, humate impregnated nodules. The Bh soil horizon developed owing to leaching of biogenic carbonate and iron oxide from the upper parts of dunes and their concentration in the lower part of the dunes. The humate impregnated sand in which many of the dissolved materials accumulated is often referred to as either "Waterloo Rock" or "Coffee Rock".

C) The widespread development of shallow strandline and aeolian deposits containing low grade, relatively large deposits of heavy minerals that typically have high proportions of rutile and zircon (eg Resource Planning 1991). These have largely been mined out. Deeper marine sequences underlying the coastal margin of the Outer Barrier also have demonstrated potential for heavy mineral deposits (Cable Sands Holdings et al 1990; 1992a,b; Browne 1993).

## 5. MAJOR CONSTRAINTS AFFECTING RESOURCE EXTRACTION

There are many environmental issues affecting mineral deposits and extractive resources in the Port Stephens area (plan 2). They include urban development, water catchment protection areas, archaeologically sensitive sites, military weapons

testing zones, conservation zones, National Parks and nature reserves. A discussion of these constraints occurs below:-

### 5.1 Land Use Zoning

Port Stephens Local Environmental Plan (1987) was amended some years ago to protect colourless glass sand resources in the Tilligerry Peninsula. This resulting zoning, referred to as Clause 37, was based upon advice provided by agencies including the Department of Mineral Resources. Further amendments were made in 1995. These were designed to protect areas of prime koala habitat by incorporating additional land between Tanilba Bay and Oyster Cove, and rezone parts of Lemon Tree Passage into a new provision. This zoning is known as Zone (7k) "Environmental Protection-Flora and Fauna Conservation". Clause 37 boundaries have been modified to protect colourless glass sand deposits that should have been included in the original Clause 37 area. The creation of (7k) zones will however prevent the extraction of colourless glass sand deposits along Lemon Tree Passage Road and near Tanilba Bay. The zoning may also effect hard rock aggregate deposits at the northern end of Lemon Tree Passage.

### 5.2 Flora and Fauna

The Port Stephens area has a large expanse of relatively undisturbed coast, a diverse flora (eg McNair 1992, 1993), and many varieties of birds, reptiles, frogs and mammals (eg Taylor 1989). Koalas occur throughout Lemon Tree Passage and Tanilba Bay, and major stands of forest and swamp forest, considered a prime koala habitat, occur between Mallabula and Lemon Tree Passage (Callaghan et al 1994).

### 5.3 National Parks and Nature Reserves

There are several large areas of wetlands, including Fullerton Cove, Moffats Swamp, and many freshwater swamps (Port Stephens Council 1992). However, the Anna Bay Sandbeds, nearly all of which has recently been included in the Tomaree National Park, have significant deposits of heavy minerals now sterilised by the new extensions to the national park.

### 5.4 Military Weapons Testing Areas

The coastal parts of Fullerton Cove and Anna Bay were used as bombing and shelling ranges during World War Two and as late as the 1950's (HLA-Envirosciences 1995a-d). The impact zone at Anna Bay mostly affects foundry sand deposits, whereas construction and heavy mineral deposits are affected at Fullerton Cove. Limited firing of live rounds apparently occurred at Fullerton Cove, rendering the area potentially dangerous, although the majority of munitions used that failed to detonate may now be harmless. The RAAF Weapons Testing Range along the western side of Big Swan Bay partly overlies the western extension of the Northern Dune. Although heavy minerals may be present in commercial quantities, colourless glass sand deposits thought to occur in this area may be too thin to warrant extraction.

### 5.5 Groundwater

The groundwater overall is mostly shallow, typically less than one meter deep, and more than 20 metres below some elevated dunes (Woolley et al 1995). Groundwater gradients are generally flat lying and show little regional variation. The regional hydraulic gradient is either to the south-east, towards Newcastle Bight, or to the north-east and Hunter River from a relatively shallow groundwater province near Tomago. The Hunter Water Corporation usually prohibits the removal of industrial and construction sand from within one metre of the water table. In contrast, heavy mineral mining is permitted below the water table although special conditions to prevent groundwater contamination usually apply during extraction.

### 5.6 Archaeology

Archaeological studies of the Port Stephens area have identified many significant sites and sensitive areas (Sullivan and Hibberd 1994). Pleistocene dunes typically have artefact concentrations, while Holocene dunes, foredune and beach sands often contain extensive shell middens. Extensive studies may be needed to identify areas needing specific protection. Drifting sand is uncovering and wholly or partially reburying these later deposits.

## 6. SAND RESOURCES AND EXTRACTION OPERATIONS

Sand extraction currently occurs either on freehold land or on Crown land under titles (Crown Licences or Permissive Occupancies) issued by the Department of Land and Water Conservation. Sand extraction on freehold land only requires on the agreement of the landowner, apart from development consent from the relevant local and State government agencies. Heavy minerals such as rutile and zircon are proclaimed minerals under the Mining Act, 1992. Their extraction is subject to mining titles issued by the Department of Mineral Resources. Furthermore, the Department of Mineral Resources is responsible under the Mines Inspection Act (1901) for the safe operation of mines and quarries.

Much of the construction sand needs of the Newcastle area come from deposits near Williamtown. The Tilligerry Peninsula supplies all the colourless glass needs of the New South Wales glass manufacturing industry while deposits at Salt Ash supply most of the amber or coloured glass sand requirements. Active dunes near Anna Bay are an important source of foundry and industrial sand for domestic and overseas consumption.

### 6.1 Glass Sand

#### 6.1.1 Distribution of Resources

Plan 3 shows the location of glass sand resources. During 1994/95, almost 232 000 tonnes of sand suitable for glass manufacture were produced. This consisted of about 110 000 tonnes of colourless glass sand from the Tilligerry Peninsula, and about 122 000 of coloured glass sand from Salt Ash (table 1 and figure 3).

**TABLE 1: HISTORY OF GLASS SAND PRODUCTION IN TONNES IN THE STOCKTON BIGHT-PORT STEPHENS AREA**
**SOURCE: DEPARTMENT OF MINERAL RESOURCES**

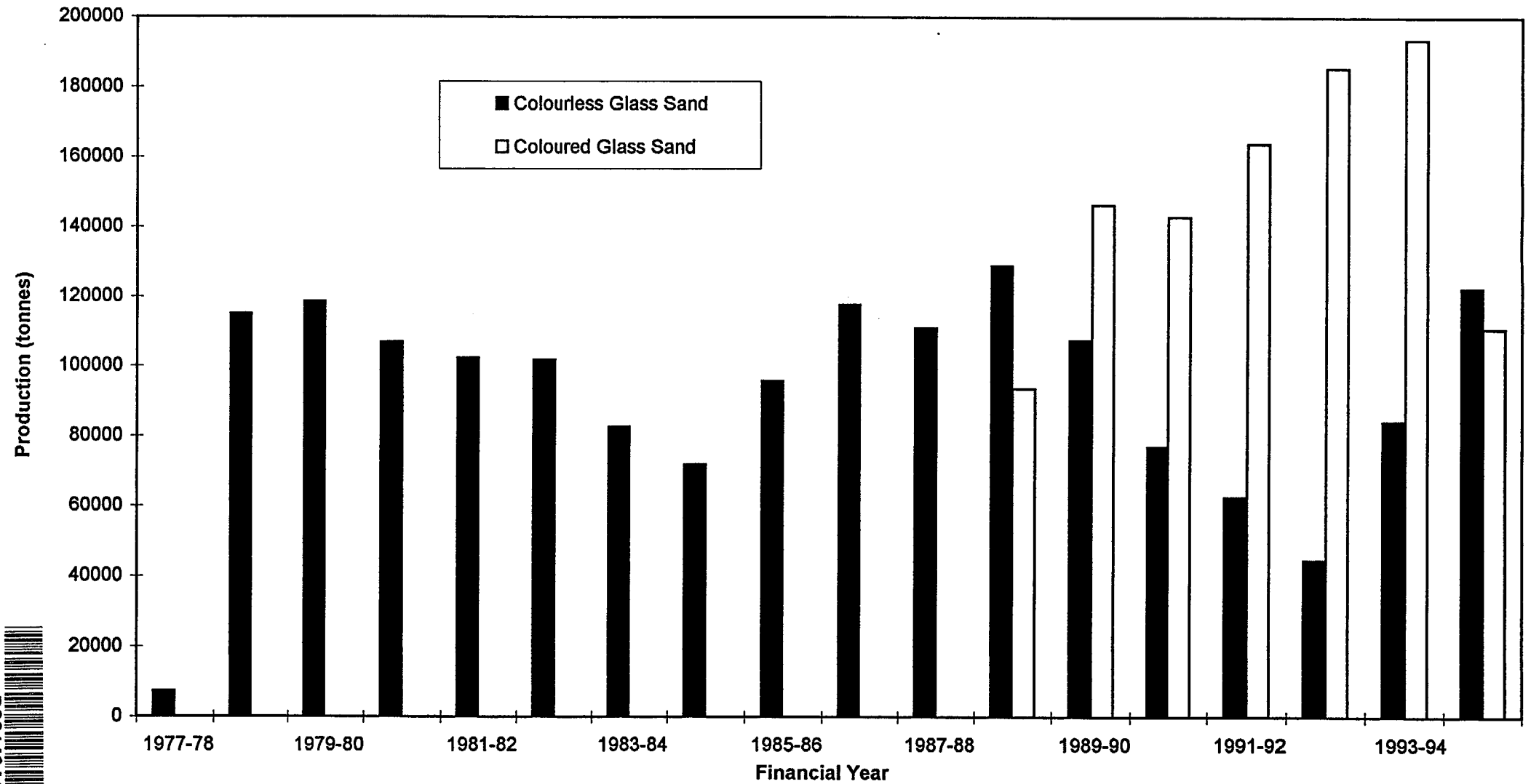
| Financial Year | PB White Minerals Lemon Tree Passage (Southern Dune) Colourless Glass Sand | ACI Industrial Minerals Lemon Tree Passage (Southern Dune) Colourless Glass Sand | ACI Industrial Minerals Salt Ash (Outer Barrier) Coloured Glass Sand | NSW Glass Sand Association Lemon Tree Passage (Southern Dune) Colourless Glass Sand | NSW Glass Sand Association Lemon Tree Passage (Northern Dune) Colourless Glass Sand | Newcastle Glassworks Lemon Tree Passage (Southern Dune) Colourless Glass Sand | Annual Production of Coloured Glass Sand | Annual Production of Colourless Glass Sand | Total Annual Production Glass Sand |
|---|---|---|---|---|---|---|---|---|---|
| 1977 - 78 | 3,199 | 4,114 | | | | | | 7,313 | 7,313 |
| 1978 - 79 | 65,130 | 46,038 | | | | 3,941 | | 115,109 | 115,109 |
| 1979 - 80 | 73,592 | 45,085 | | | | | | 118,677 | 118,677 |
| 1980 - 81 | 63,267 | 43,710 | | | | | | 106,977 | 106,977 |
| 1981 - 82 | 54,990 | 47,331 | | | | | | 102,321 | 102,321 |
| 1982 - 83 | 54,371 | 47,429 | | | | | | 101,800 | 101,800 |
| 1983 - 84 | 32,572 | 50,048 | | | | | | 82,620 | 82,620 |
| 1984 - 85 | 24,035 | 47,836 | | | | | | 71,871 | 71,871 |
| 1985 - 86 | 29,336 | | | 66,487 | | | | 95,823 | 95,823 |
| 1986 - 87 | 35,303 | | | 78,000 | | 4,430 | | 117,733 | 117,733 |
| 1987 - 88 | 35,773 | | | 71,198 | | 4,001 | | 110,972 | 110,972 |
| 1988 - 89 | 50,130 | | 93,600 | 78,200 | | 511 | 93,600 | 128,841 | 222,441 |
| 1989 - 90 | 53,938 | | 146,500 | 53,564 | | | 146,500 | 107,502 | 254,002 |
| 1990 - 91 | 44,347 | | 143,000 | 32,784 | | | 143,000 | 77,131 | 220,131 |
| 1991 - 92 | 34,223 | | 164,000 | 28,407 | | | 164,000 | 62,630 | 226,630 |
| 1992 - 93 | 25,422 | | 185,500 | 19,292 | | | 185,500 | 44,714 | 230,214 |
| 1993 - 94 | 24,226 | | 193,600 | 59,900 | | | 193,600 | 84,126 | 277,726 |
| 1994 - 95 | 31,303 | | 110,866 | | 91,172 | | 110,866 | 122,475 | 233,341 |
| TOTAL | 735,157 | 331,591 | 1,037,066 | 487,832 | 91,172 | 12,883 | 1,037,066 | 1,658,635 | 2,695,701 |



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**Figure 3: History of Glass Sand Production in the Stockton Bight-Port Stephens Area**




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The colourless glass sand deposits of the Tilligerry Peninsula occur as two sub-parallel, discontinuous, north-east to south-west trending transgressive dune systems, the "Northern Dune" and the "Southern Dune" (Smith 1978). These dunes are several kilometres apart. Typically, they have an A1 horizon about 0.3 metres deep, a leached A2 horizon up to 10 metres thick, and an underlying B horizon several metres thick. The A1 horizon is stockpiled for rehabilitation. The A2 horizon is extracted for glass manufacture and other industrial uses, such as filtration sand and ceramic applications. The B horizon is a natural extraction barrier because of the impurities present and indurated nature of the soil. The nature of the sand from the underlying C horizon is unknown although it may be suitable for construction purposes. The geology and resources of the Northern Dune and the Southern Dune are discussed below:-

A) The Southern Dune consists of several discontinuous transgressive dunes that extend almost 7 kilometres from Tilligerry Creek to Mallubula. It is up to 600 metres wide and has average dune height of mostly 10 to 12 metres. Except for a small though valuable deposit near the central part of the dune, which is affected by prime koala habitat, colourless glass sand deposits in the Southern Dune have been exhausted.

B) The Northern Dune similarly consists of several discontinuous dunes that extend from Moffats Swamp to Tanilba Bay, a distance of almost 10 kilometres. It has a maximum width of about 800 metres and an average dune height of 10 to 12 metres. The Northern Dune occurs alongside a beach ridge plain at Big Swan Bay that is currently being re-mined for heavy minerals. Prime koala habitat occurs in the north-eastern part of the Northern Dune, possibly sterilising important glass sand resources in this vicinity.

### 6.1.2 Resource Characteristics

Sand for glass manufacture must satisfy stringent quality criteria, including the need for consistent grain size and shape and high chemical purity. Typically, over 90 per cent of the sand grains should be 0.1 to 0.4 mm in size (eg Smith 1978). It should consist of almost pure silica, more than 99% (eg Manning 1995). The sand should also have accordingly small amounts of impurities such as iron oxide, and heavy minerals such as titanium dioxide and chromic oxide. These impurities, which are usually present in minor but significant amounts in dune sand, can impart undesirable colour to the glass (eg Manning 1995). The presence of chromic oxide can also produce inclusions or "stones" in the glass that may cause containers to become brittle or spontaneously fracture (eg ACI Industrial Minerals Division pers comm 1995). Spiral concentration is used to remove much of the heavy mineral impurities (eg Resource Planning 1991).

The Stockton Bight-Port Stephens area has valuable deposits of sand that satisfy strict glass manufacturing criteria (tables 2,3,4). Apart from this region, there are no known areas in the State with significant resources of, for example, colourless glass sand (table 5). Processed sand from the Northern Dune has about 99.9% silica, less than 0.05% iron oxide and titanium dioxide, and about 2 ppm chromic oxide.


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**TABLE 2: DESIRABLE AND INDICATIVE ANALYSES FOR GLASS SAND IN THE STOCKTON BIGHT-PORT STEPHENS AREA**
**(SOURCE: RESOURCE PLANNING 1994, ACI INDUSTRIAL MINERALS DIVISION 1995,1996)**

| | COLOURLESS GLASS SAND | | | | | COLOURED GLASS | | SAND |
|---|---|---|---|---|---|---|---|---|
| | Dune:<br>Geological Age:<br>Location:<br>Sample Type: | Northern Dune<br>Pleistocene<br>Big Swan Bay<br>Raw Sand | Northern Dune<br>Pleistocene<br>Big Swan Bay<br>Washed Sand | Southern Dune<br>Pleistocene<br>LTP Road<br>Raw Sand | Southern Dune<br>Pleistocene<br>LTP Road<br>Washed Sand | Dune:<br>Geological Age:<br>Location:<br>Sample Type: | Innermost ridge<br>Holocene<br>Salt Ash<br>Raw Sand | Innermost ridge<br>Holocene<br>Salt Ash<br>Washed Sand |
| Major Compound | Desirable % Total | % Total | % Total | % Total | % Total | Desirable % Total | % Total | % Total |
| SiO2 | > 99.0 | 99.810 | 99.890 | 99.750 | 99.815 | > 98.00 | 99.200 | 99.800 |
| Al2O3 | Negotiable | 0.060 | 0.036 | 0.060 | 0.070 | Negotiable | 0.400 | 0.340 |
| Fe2O3 | < 0.03 | 0.012 | 0.010 | 0.040 | 0.016 | < 0.20 | 0.200 | 0.100 |
| Cr2O3 | < 0.0006 | < 0.001 | < 0.0001 | 0.001 | 0.0002 | < 0.001 | na | na |
| TiO2 | < 0.10 | 0.040 | 0.051 | 0.130 | 0.063 | na | 0.080 | 0.040 |
| H20 | < 6% as received | na | na | na | na | < 6% as received | na | na |
| Others | Desirable % Total | Actual % Total | Actual % Total | Actual % Total | Actual % Total | Desirable % Total | Actual % Total | Actual % Total |
| MgO | na | na | na | 0.010 | 0.010 | na | < 0.10 | < 0.10 |
| MnO | na | 0.002 | 0.002 | na | na | na | na | na |
| K2O | na | na | na | < 0.01 | < 0.01 | na | 0.130 | 0.130 |
| CaO | na | 0.004 | 0.004 | < 0.01 | < 0.01 | na | na | na |
| Na2O | na | < 0.001 | < 0.001 | < 0.01 | < 0.01 | na | 0.020 | 0.020 |
| MxSO4 | na | < 0.001 | < 0.001 | na | na | na | na | na |
| AFS No<br>% retained<br>(<425 microns) | | 50 - 54<br>> 99.5 | 49 - 53<br>> 99.5 | 54 - 58<br>> 99.5 | 52 - 56<br>> 99.5 | | > 99.5 | > 99.5 |

Note: Sand for glass making should be of even grain size - > 90% of sand grains should range from 125 to 400 um.



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**TABLE 3: SIZE DISTRIBUTION AND ANALYSES FOR COLOURLESS GLASS SAND (WASHED)**
**LOCATION: NORTHERN DUNE, TANILBA BAY**
**SOURCE: ACI (1996)**

| Screen B.S.S | Aperture (mm) | Mass Retained (%) | Cum. Mass Retained (%) | Factor | Product | Chemical XRF | Analysis |
|---|---|---|---|---|---|---|---|
| 18 | 0.850 | 0 | 0 | 18 | 0 | SiO2+LOI (by balance) | 99.89 |
| 25 | 0.600 | 0.04 | 0.04 | 20 | 0.8 | Na2O | 0.010 |
| 36 | 0.425 | 2.26 | 2.3 | 30 | 67.8 | K2O | 0.010 |
| 52 | 0.300 | 30.27 | 32.57 | 40 | 1210.8 | CaO | 0.010 |
| 72 | 0.212 | 45.68 | 78.25 | 50 | 2284 | MgO | 0.010 |
| 100 | 0.150 | 20.15 | 98.4 | 70 | 1410.5 | Al2O3 | 0.036 |
| 150 | 0.106 | 1.51 | 99.91 | 100 | 151 | TiO2 | 0.051 |
| 200 | 0.075 | 0.05 | 99.96 | 140 | 7 | Fe2O3 | 0.010 |
| 300 | 0.053 | 0.02 | 99.98 | 200 | 4 | Cr2O3 ppm | 2 |
| Pan | -0.075 | 0.02 | 99.98 | 300 | 6 | | |
| Total | Product: | 5142 | Total | Retained: | 100 | | |
| | %HM = 0.01 | | | | | | |
| A.F.S: | 51 | A.F.S. = Total Product/Total Retained % | | | | | |

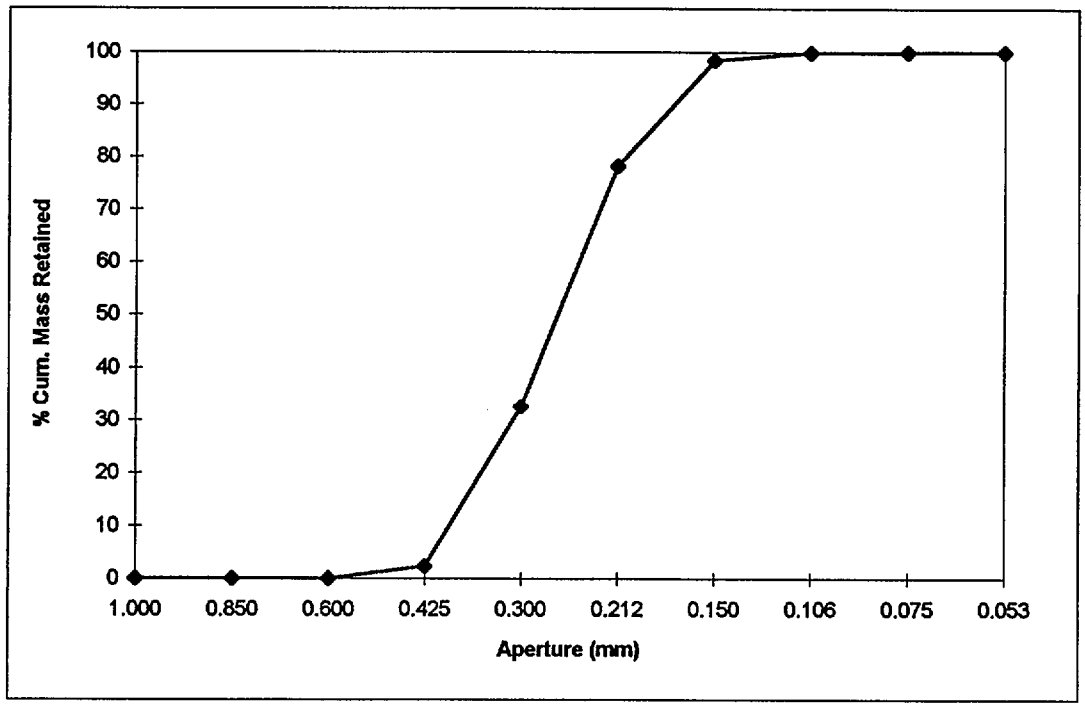
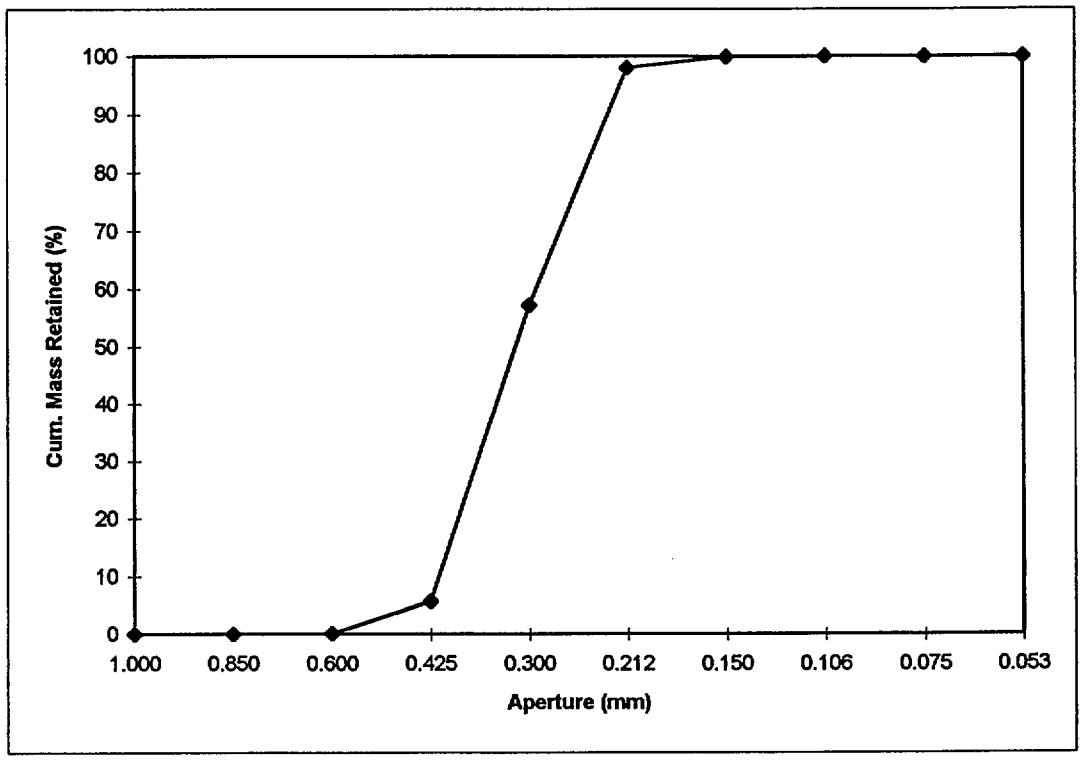


**TABLE 4: SIZE DISTRIBUTION AND ANALYSES FOR COLOURED OR AMBER GLASS SAND (WASHED)**
**LOCATION: OUTER BARRIER, SALT ASH**
**SOURCE: ACI INDUSTRIAL MINERALS DIVISION (1996)**

| Screen B.S.S | Aperture (mm) | Mass Retained (%) | Cum. Mass Retained (%) | Factor | Product | Chemical XRF | Analysis |
|---|---|---|---|---|---|---|---|
| 16 | 1.000 | 0.00 | 0 | 14 | 0 | | |
| 18 | 0.850 | 0.00 | 0 | 18 | 0 | SiO2+LOI (by balance) | 99.24 |
| 25 | 0.600 | 0.09 | 0.09 | 20 | 1.8 | Na2O | 0.028 |
| 36 | 0.425 | 5.65 | 5.74 | 30 | 169.5 | K2O | 0.147 |
| 52 | 0.300 | 51.48 | 57.22 | 40 | 2059.2 | CaO | 0.010 |
| 72 | 0.212 | 40.79 | 98.01 | 50 | 2039.5 | MgO | 0.016 |
| 100 | 0.150 | 1.92 | 99.93 | 70 | 134.4 | Al2O3 | 0.419 |
| 150 | 0.106 | 0.06 | 99.99 | 100 | 6 | TiO2 | 0.047 |
| 200 | 0.075 | | 99.99 | 140 | 0 | Fe2O3 | 0.091 |
| 300 | 0.053 | | 99.99 | 200 | 0 | Cr2O3 ppm | 2 |
| Pan | -0.075 | | 99.99 | 300 | 0 | | |
| Total Product: | | 4410 | Total Retained: | | 99.99 | | |
| %HM = 0.00 | | | | | | | |
| A.F.S: | 44 | A.F.S. = Total Product/Total Retained % | | | | | |



# TABLE 5: OVERVIEW OF COLOURLESS GLASS SAND ALTERNATIVES

| LOCATION | EVALUATION OF DEPOSITS | COMMENTS |
|---|---|---|
| **1. Illawarra Region** | | |
| - Jervis Bay | Declared a nature reserve. | Unavailable. |
| - Dunmore | Marginal quality, contaminated. | Unsuitable. |
| - Lake Illawarra | Marginal quality, contaminated, potential environmental constraints. | Unsuitable. |
| - Windang | Largely sterilised by competing land uses, limited reserves. | Unavailable. |
| ***2. Newnes Plateau** | Large reserves, extreme variability in grain size and iron content. Difficulty in meeting all colourless glass industry specifications. Low recovery rate, high wastage factor - potential environmental problems. Very costly to develop. | Potential long term source of only certain types of colourless sand. Unattractive option in short to medium term. |
| ***3. Bonnie Doon** | Small reserves of good quality colourless glass sand. | Unavailable at present. |
| **4. Sydney Off-Shore Deposits** | Primary suited to general construction purposes, and not for industrial glass purposes. Botany Bay deposits have the potential for use in coloured glass, but not colourless glass. | Unavailable. |
| **5. Somersby Deposits** | Low reserves of colourless sand, costly processing, variable quality of sand, does not meet industry specifications, low recovery rates. Potential conflict with other land uses. | Marginal suitability. |

Note: * Denotes alternatives with some potential
(Source: Outline Planning Consultants, 1994)



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# TABLE 5: OVERVIEW OF COLOURLESS GLASS SAND ALTERNATIVES CONTINUED . . .

| LOCATION | EVALUATION OF DEPOSITS | COMMENTS |
|---|---|---|
| **6. Wamberal Sands, Central Coast** | Depleted deposit, sterilised by other land uses. | Unavailable. |
| **7. Soapy Flat, Mittagong** | Poor quality, unsuited to colourless glass manufacturing. | Unsuitable. |
| **8. Southern Highlands** | Large reserves, extremely variable grain size. Difficulty in meeting all colourless glass specifications. | Potential long term source. |
| **9. Norah Head, Central Coast** | Small-medium reserves. Conflict with neighbouring/planned land uses. Opposition to extraction. | Unavailable. |
| ***10. Great Lakes Shire Deposits (Diamond Beach?)** | Large inferred reserves, good quality sand. Sand extraction currently prohibited. Higher transport costs. | Unavailable at present. Potential in longer term. |
| **11. Supply of Sand Interstate** | | |
| - Lang Lang | Does not meet all glass industry specifications. Prohibitive transport costs. Major increase in fuel usage. | Not a viable alternative to Tilligerry Peninsula. |
| - Stradbroke Is. | High quality sand. Large reserves. Prohibitive costs to supply NSW Glass industry. Major increases in fuel usage. Increased risk of contamination if transported by ship. | Not a viable alternative to Tilligerry Peninsula. |
| **12. Recycling Alternative** | Already forms a significant % of glass production. However, recycling of colourless glass well below that of other glass types. At present recycling is not a significant alternative for colourless glass producers. | Not an alternative to Tilligerry Peninsula. |

Note: * Denotes alternatives with some potential
(Source: Outline Planning Consultants, 1994)



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Sand from the Southern Dune, which is marginally finer than sand from the Northern Dune, was traditionally favoured for colourless glass manufacture. Processed sand from Salt Ash, which is used to manufacture of coloured or amber glass, has about 99.2% silica, less than 0.05% titanium dioxide, roughly 0.1% iron oxide, and about 2 ppm chromic oxide.

#### 6.1.3 Extraction Operations

The Northern Dune (table 6) has known or secured resources of about 4.7 million tonnes of colourless glass sand (ACI Industrial Minerals Division 1989; Resource Planning 1994a). PB White Minerals Pty Ltd and The New South Wales Glass Sand and Ceramic Users Association Pty Ltd have access to deposits in the Northern Dune of about one million tonnes each. These deposits are situated west of Oyster Cove Road. The Northern Dune has over several million tonnes of colourless glass sand that have yet to be allocated for exploitation. Not all of these resources will however be available for mining. As much as ten per cent of these deposits, roughly 350 000 tonnes, could be sterilised by the newly declared 7(k) Environmental Protection Zoning. A small though valuable deposit identified within the Southern Dune near Lemon Tree Passage, about 167 000 tonnes, (Outline Planning Consultants 1994) is similarly affected. Apart from the latter deposit, colourless glass sand resources in the Southern Dune are almost exhausted.

The ACI Industrial Mineral Division project at Salt Ash originally had secured deposits of about 2.5 million tonnes (Outline Planning Consultants 1991). Secured coloured glass sand resources at Salt Ash are expected to last up to 10 years whereas secured colourless glass sand deposits in the Northern Dune are likely to last about 25 to 30 years.

#### 6.1.4 Potential for Future Extraction

The resource potential of the Northern Dune west of freehold land held by PB White Minerals Pty Ltd is unclear. Indications are that the sand may be too thin for economical extraction. Also, much of this area occurs within the RAAF Air Weapons Testing Range. Apart from the major dune systems of the Tilligerry Peninsula, there do not appear to be any other resources of comparable significance. The only other Pleistocene dunes of possible interest are Big Bald Hill, near the intersection of Lemon Tree Passage Road and Oyster Cove Road, and Middle Hill, near Moffats Creek. These dunes appear to contain small areas of colourless glass sand. The vegetated dunes of the Outer Barrier do not appear to contain colourless glass sand deposits of commercial interest.

### 6.2 Foundry Sand

#### 6.2.1 Distribution of Resources

Plan 3 shows the distribution of foundry sand resources. The northern part of the Outer Barrier has large deposits of sand suitable for foundry use. During 1994/95, about 174 000 tonnes of "foundry" sand was produced in the Stockton Bight-Port Stephens area (table 7 and figure 4). However, it is not clear how much of this sand



**TABLE 6: IDENTIFIED GLASS SAND RESOURCES IN TONNES IN THE STOCKTON BIGHT-PORT STEPHENS AREA IN TONNES**

| Operator | Locality | Principal Sand Type (main use) | In situ Resources (tonnes) | Expected Life (years) | Current Status |
|---|---|---|---|---|---|
| ACI Industrial Minerals | Salt Ash | Coloured Glass | 2,500,000 | 15 - 17 | Extraction occurring |
| ACI Industrial Minerals | Lemon Tree Passage | Colourless Glass | 167,000 | 5 - 20 | Development Consent required |
| NSW Glass Sand Association | Tanilba Bay | Colourless Glass | 1,000,000 | 25 - 30 | Extraction started in late 1994 |
| NSW Glass Sand Association | Lemon Tree Passage | Colourless Glass | Extracted | 0 | Extraction ceased in late 1994 |
| PB White Minerals | Swan Bay | Colourless Glass | 1,000,000 | 20 | Extraction to start in 1995 |
| PB White Minerals | Tanilba Bay | Colourless Glass | Extracted | 0 | Extraction ceased in late 1994 |
| Note: About 2,700,000 tonnes of colourless glass sand in the Northern Dune at Tanilba Bay are yet to be allocated for extraction | | | | | |



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**TABLE 7: HISTORY OF FOUNDRY SAND PRODUCTION IN TONNES IN THE STOCKTON BIGHT-PORT STEPHENS AREA**
**SOURCE: DEPARTMENT OF MINERAL RESOURCES**

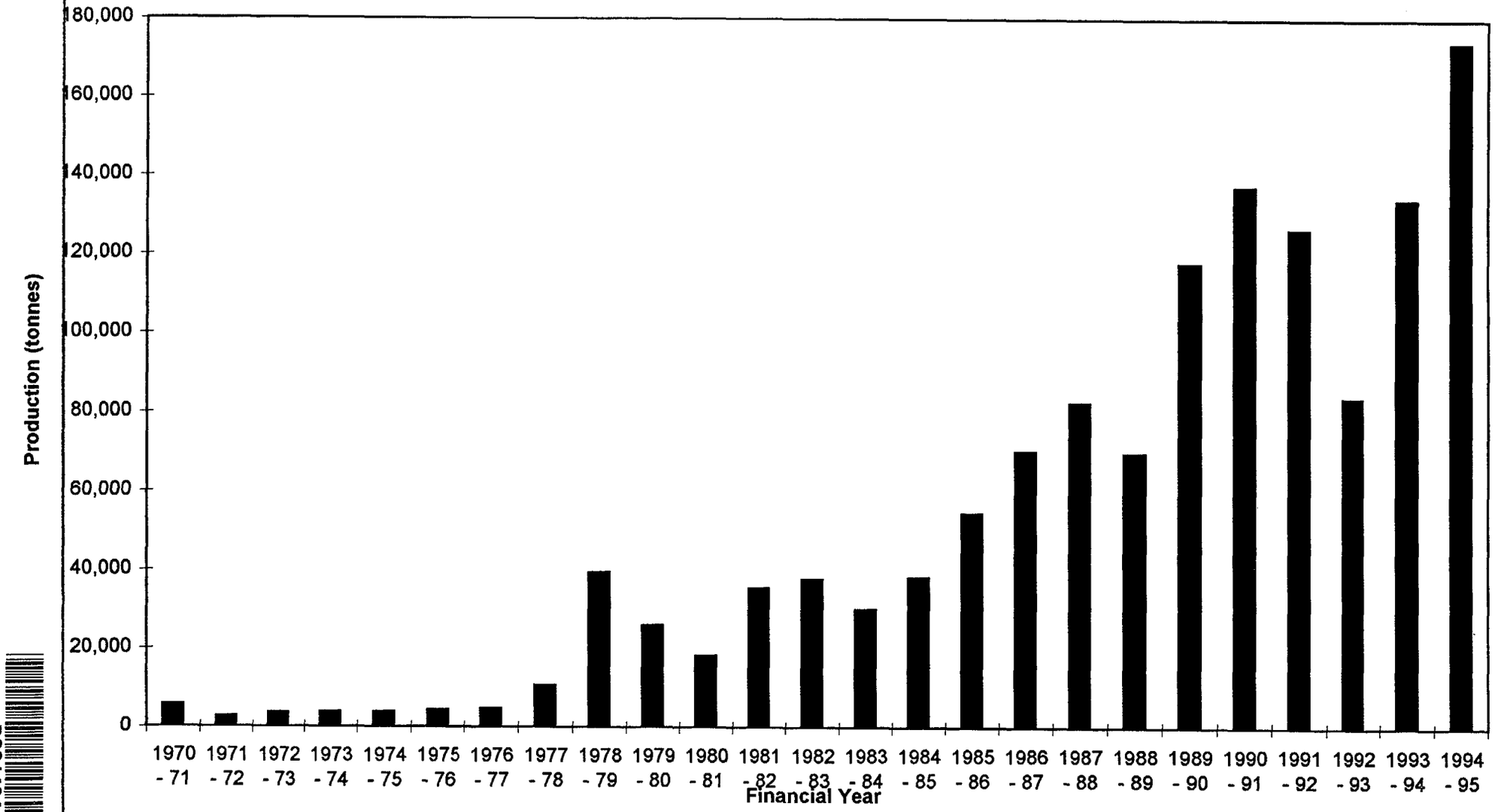
| Financial Year | Robinsons Anna Bay Sands Anna Bay | Quality Sand & Ceramics Williamtown | Metrombx Anna Bay | ToliBulkSands Williamtown | PB White Minerals Lemon Tree Passage | NSW Glass Sand Association Lemon Tree Passage | FD Leal Anna Bay | Total Annual Production |
|---|---|---|---|---|---|---|---|---|
| 1970 - 71 | 4,318 | | | | | | 1,318 | 5,636 |
| 1971 - 72 | 2,641 | | | | | | 1,575 | 2,641 |
| 1972 - 73 | 2,642 | | | | | | 991 | 3,633 |
| 1973 - 74 | 2,520 | | | | | | 1,344 | 3,864 |
| 1974 - 75 | 3,022 | | | | | | 818 | 3,840 |
| 1975 - 76 | 3,390 | | | | | | 1,029 | 4,419 |
| 1976 - 77 | 3,822 | | | | | | 950 | 4,772 |
| 1977 - 78 | 9,358 | | 17 | | | | 1,255 | 10,630 |
| 1978 - 79 | 5,255 | | 33,229 | | | | 949 | 39,433 |
| 1979 - 80 | 1,283 | | 22,100 | | | | 2,584 | 25,967 |
| 1980 - 81 | 1,500 | | 14,300 | | | | 2,533 | 18,333 |
| 1981 - 82 | 2,155 | | 31,863 | | | | 1,500 | 35,518 |
| 1982 - 83 | 6,873 | | 29,875 | | | | 1,040 | 37,788 |
| 1983 - 84 | 10,901 | | 17,147 | | | | 2,080 | 30,128 |
| 1984 - 85 | 3,800 | | 32,453 | | | | 2,005 | 38,258 |
| 1985 - 86 | 12,500 | 23,882 | 16,719 | | | | 1,500 | 54,601 |
| 1986 - 87 | 8,280 | 19,686 | 40,232 | | | | 2,000 | 70,198 |
| 1987 - 88 | 6,400 | 26,347 | 47,739 | | | | 2,080 | 82,566 |
| 1988 - 89 | 4,000 | 39,000 | 18,016 | 7,300 | | | 1,500 | 69,816 |
| 1989 - 90 | 4,000 | 43,409 | 62,000 | 8,000 | | | 490 | 117,899 |
| 1990 - 91 | 11,000 | 47,996 | 72,335 | 5,600 | | | 520 | 137,451 |
| 1991 - 92 | 9,000 | 50,968 | 62,136 | 4,352 | | | 300 | 126,756 |
| 1992 - 93 | 5,228 | 46,196 | 27,737 | 4,300 | | | 500 | 83,961 |
| 1993 - 94 | 16,191 | 65,919 | 37,453 | 5,000 | | 9,200 | 500 | 134,263 |
| 1994 - 95 | 19,858 | 80,601 | 42,069 | 3,600 | | 20,490 | 360 | 174,063 |
| TOTAL | 159,937 | 451,089 | 607,420 | 38,152 | 0 | 29,690 | 31,721 | 1,316,434 |

Note: 1. FD Leal purchases sand from Robinsons for subsequent resale.
2. Foundry sand production by Quality Sands before 1986 is unclear.



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## Figure 4: History of Foundry Sand Production in the Stockton Bight-Port Stephens Area






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was used in foundries or in other industrial applications. A small amount of the sand is exported for use in South East Asia.

### 6.2.2 Resource Characteristics

Sand for foundry use should be sub-rounded to sub-angular, even grained, and free of reactive substances (eg Smith 1978). Active dunes at Anna Bay contain major resources of foundry sand, the fine-grained nature of which render it unsuitable for concrete manufacture. Raw sand from Anna Bay (tables 8, 9) is about 97% silica, mostly less than 0.3 mm, up to one per cent calcium carbonate (Metromix Quarries pers comm 1995). Australian Fineness Number (AFN) is about 57 (Outline Planning Consultants 1990). Occasionally, the active dunes near Anna Bay contain large numbers of tree trunks, rendering the sand less suitable for foundry or industrial applications (Robinsons Anna Bay Sands Pty Ltd pers comm 1994). Such sand is mainly used as fill in local construction projects

### 6.2.3 Extraction Operations

Known or secured foundry sand resources are over 22 million tonnes, most of which is near Anna Bay (table 10). Not all the sand obtained from Anna Bay is used for foundry purposes. The State's foundries apparently prefer coarser sand of AFN 40 to 50 (ACI Industrial Minerals Division pers comm 1996). Much of the sand from Anna Bay is instead used in a variety of industrial applications. Current and anticipated production rates indicate that identified foundry sand deposits at Anna Bay alone are sufficient for well over 20 to 30 years. The major producers of foundry sand are discussed below:-

A) Robinsons Anna Bay Sands Pty Ltd currently extract foundry sand from within its freehold land in Lots 1, 2 and 3. The resources present of about 500 000 tonnes and are likely to be mined out within 5 years. Robinsons have largely extracted the foundry sand deposits within Lot 312 to prevent sand drift onto James Patterson Drive. Nearby Lot 130, which contains foundry sand resources of about 2.2 million tonnes, has yet to be allocated for extraction.

B) Metromix Pty Ltd has foundry sand resources of about 7 to 8 million tonnes at Anna Bay. Recent production rates indicate that these resources will last well into the future.

C) ACI Industrial Minerals Division have foundry sand resources at Anna Bay of about 10 million tonnes but have yet to start production. Rocla Quarry Products is unlikely to start works at Anna Bay until its existing deposits are extracted. This is not likely to occur for about 5 to 10 years. Furthermore, it is not clear how the sand would be used owing to its unsuitability for concrete manufacture. Although Port Stephens Council extracts foundry sand on an intermittent basis, its production is used as construction or fill sand.


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## TABLE 8: DESIRABLE AND INDICATIVE PROPERTIES FOR FOUNDRY SAND

| Desirable Properties of a Foundry Sand (Wong 1984) | | | | | | | Indicative Properties of Foundry Sand at Anna Bay (Metromix 1995) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Major Parameter or Compound | General Purpose Steel and Iron Foundry Sand | | | General purpose Non-ferrous Foundry Sand | | | Major Parameter or Compound | Formula or Value | % of Total | Sieve Analysis | | |
| | Value | Sieve (mm) | % Retained | Value | Sieve (mm) | % Retained | | | | AS1141.11 Sieve Analysis (mm) | % Retained Sieve | % Retained Cummulative |
| A.F.S. No. | 54 - 57 | 0.425 | < 2 | 100 - 105 | 0.425 | not given | A.F.S. Fineness No. | 55 - 58 | na | 0.425 | 0.6 | 100 |
| A.F.S. clay fines | < 0.2% | 0.300 | 10 - 20 | < 8% | 0.300 | not given | Aluminium Oxide | Al2O3 | 0.69 | 0.300 | 3.2 | 99.4 |
| Cacium Carbonate | < 0.2% | 0.212 | 30 - 65 | < 0.2% | 0.212 | 5 - 15 | Calcium Oxide | CaO | 0.25 | 0.212 | 42.8 | 96.2 |
| Combustibles | < 0.2% | 0.15 | 25 - 35 | < 0.2% | 0.15 | 25 - 30 | Chromic Oxide | Cr2O3 | < 0.001 | 0.15 | 52.5 | 53.4 |
| Silicon Dioxide | > 98% | 0.75 | < 3 | > 98% | 0.75 | 10 - 15 | Iron Oxide | Fe2O3 | 0.22 | 0.106 | 0.8 | 0.9 |
| Sodium Chloride | < 0.1% | 0.53 | < 3 | < 0.1% | 0.53 | 0.53 | Magnesium Oxide | MgO | 0.03 | 0.075 | 0.1 | 0.1 |
| | | | | | | | Potassium Oxide | K2O | 0.29 | | | |
| | | | | | | | Silicon Dioxide | SiO2 | 97.9 | | | |
| | | | | | | | Sodium Oxide | Na2O | 0.05 | | | |
| | | | | | | | Titanium Dioxide | TiO2 | 0.08 | | | |
| | | | | | | | | LOI | 0.49 | | | |

Note: Silica sand must be of even grain size - more than 90% of grains should be in range 125 to 500 um



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**TABLE 9: SIZE DISTRIBUTION AND ANALYSES FOR FOUNDRY SAND IN OUTER BARRIER ACTIVE DUNES, ANNA BAY**
**SOURCE: METROMIX PTY LTD (1995)**

| Major Compound | Formula | Percentage of Total | Sieve Analysis | | |
|---|---|---|---|---|---|
| | | | AS1141.12 Sieve Analysis (mm) | Mass Retained (%) | Cum. Mass Retained (%) |
| Aluminium Oxide | Al2O3 | 0.69 | 0.425 | 0.6 | 0.6 |
| Calcium Oxide | CaO | 0.25 | 0.3 | 3.2 | 3.8 |
| Chromic Oxide | Cr2O3 | < 0.001 | 0.212 | 42.8 | 46.6 |
| Iron Oxide | Fe2O3 | 0.22 | 0.150 | 52.5 | 99.1 |
| Magnesium Oxide | MgO | 0.03 | 0.106 | 0.8 | 99.9 |
| Potassium Oxide | K2O | 0.29 | 0.075 | 0.1 | 100 |
| Silicon Dioxide | SiO2 | 97.9 | | | |
| Sodium Oxide | Na2O | 0.05 | | | |
| Titanium Dioxide | TiO2 | 0.08 | | | |
| | LOI | 0.49 | | | |
| A.F.S NUMBERS 55 - 58 (PECOVER 1986) | | | | | |

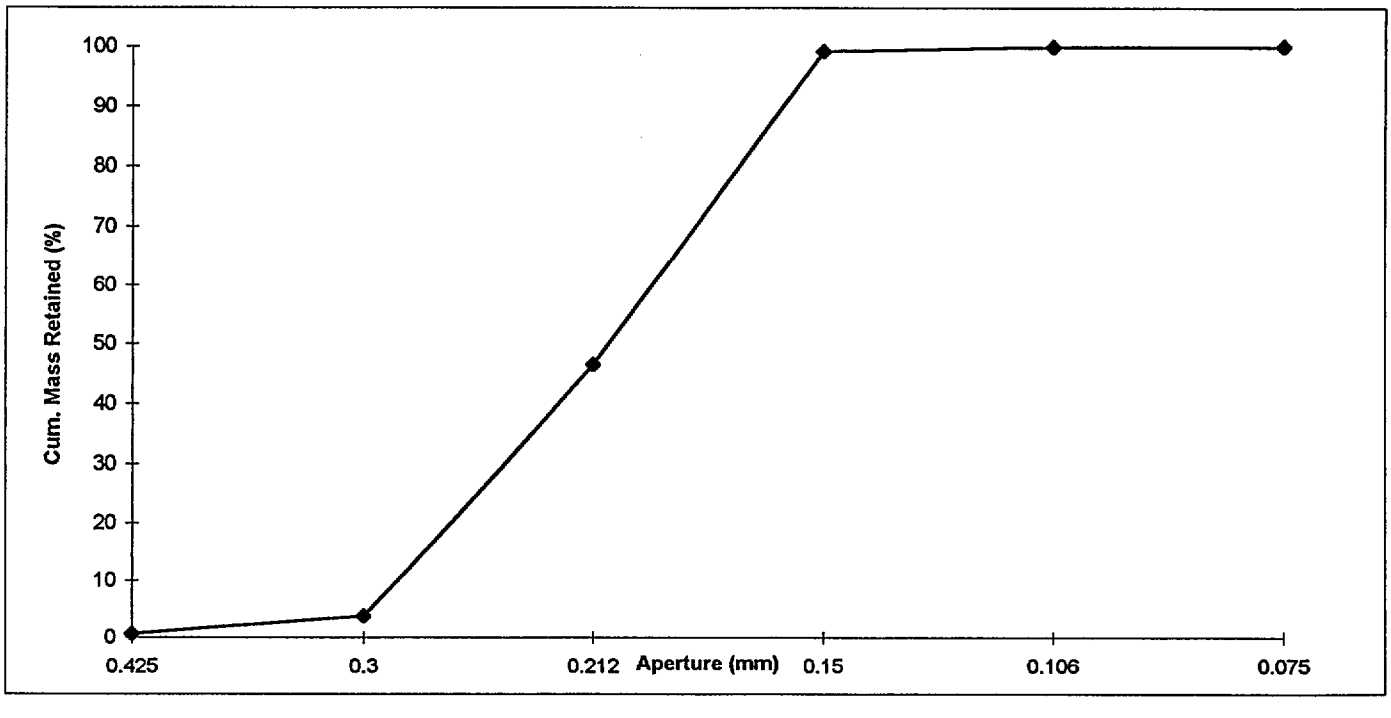


**TABLE 10: IDENTIFIED FOUNDRY SAND RESOURCES IN TONNES IN THE STOCKTON BIGHT-PORT STEPHENS AREA**

| Operator | Locality | Portions | Principal Sand Type (main use) | In situ Resources (tonnes) | Expected Life (years) | Current Status |
|---|---|---|---|---|---|---|
| ACI Industrial Minerals | Anna Bay | | Foundry | 10,000,000 | 15 - 20 | Extraction yet to occur |
| FD Leal | Anna Bay | | Foundry | 100,000 | Unknown | Extraction yet to occur |
| Metromix | Anna Bay | | Foundry | 7 - 8,000,000 | 15 - 20? | Extraction occurring |
| Port Stephens Council | Anna Bay | | Foundry | 75,000 | 2 | Intermittent extraction for fill sand |
| Robinsons Anna Bay Sands | Anna Bay | Lot 130 | Foundry | 2,200,000 | 20 | Extraction occurring |
| Robinsons Anna Bay Sands | Anna Bay | Lots 1 - 3 | Foundry | 500,000 | 5 | Extraction occurring |
| Robinsons Anna Bay Sands | Anna Bay | Lot 312 | Foundry | < 50,000 | < 6 months | D.A. required to continue extraction |
| Rocla | Anna Bay | | Foundry | 0.5 - 1,000,000 | 10 | Extraction yet to occur |
| SM Johnston | Anna Bay | | Foundry | Largely extracted | Unknown | D.A. required to continue extraction |

Note: Quality Sand and Ceramics extract large amounts of foundry and construction sand from deposits at Williamtown



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D) Quality Sand and Ceramics Pty Ltd produce about 270 000 to 330 000 tonnes industrial and construction sand annually from freehold land at Williamtown. About 20 per cent of this production, 50 000 to 70 000 tonnes, is reportedly sold as foundry sand.

#### 6.2.4 Potential for Future Extraction

The Outer Barrier dunes near Anna Bay have ample resources of sand suitable for foundry use. At current and anticipated extraction rates, identified foundry sand resources will last well into the future. In contrast, the Inner Barrier dunes do not contain any foundry sand deposits of significance.

### 6.3 Construction Sand

#### 6.3.1 Distribution of Resources

Plan 3 shows the location of construction sand resources. During 1994/95, about 713 000 tonnes of construction sand were produced, most of which came from Stockton Bight (figure 5 and table 11). The dunes of the Outer Barrier near Williamtown contain fine and medium-grained sand well suited to concrete manufacture whereas dunes of the Inner Barrier do not contain significant quantities of construction sand.

#### 6.3.2 Resource Characteristics

Raw sand (table 12) obtained from the southern part of the Outer Barrier is mostly 0.3 to 0.6 mm in size and commonly low in shell (calcium carbonate), clay or indurated sand. Active and vegetated dunes are equally important sources of construction sand. At Fullerton Cove, vegetated dunes are preferred to nearby active dunes owing to their lower calcium carbonate (Resource Planning 1994b). At this locality, the C horizon is extracted for use as construction sand after screening to remove oversize materials. The A and Bhs soil horizons stockpiled for rehabilitation purposes.

#### 6.3.3 Extraction Operations

Secured construction sand resources in the Stockton Bight-Port Stephens area are about 20 million tonnes (table 13) which are sufficient to last about 15 to 30 years at current and anticipated production rates. The major producers of construction sand are discussed below:-

A) Rocla Quarry Products extract sand near Raymond Terrace. This deposit contains about 1 to 2 million tonnes of sand that may last up to 10 years (Rocla Quarry Products pers comm 1994). The company holds a Permissive Occupancy at Anna Bay presumably from which sand is to be extracted when mining at Raymond Terrace is completed. It should be noted however that sand at Anna Bay is not suitable for use as fine aggregate in concrete production owing to its fine-grained nature.


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**TABLE 11: HISTORY OF CONSTRUCTION SAND PRODUCTION IN TONNES IN THE STOCKTON BIGHT-PORT STEPHENS AREA**
**SOURCE: DEPARTMENT OF MINERAL RESOURCES**

| Financial Year | Boral Resources Fern Bay | TollBulkSands Williamtown | Quality Sand and Ceramics Williamtown | Rocla Raymond Terrace | Glass Sand Users Association Lemon Tree Passage | ACI Industrial Minerals Salt Ash | Robinsons Anna Bay Sands Anna Bay | Port Stephens Council Anna Bay | Other Current or Past Producers | Total Annual Production |
|---|---|---|---|---|---|---|---|---|---|---|
| 1970 - 71 | 29,722 | | | 26,950 | | | 4,000 | 10,489 | 821 | 71,982 |
| 1971 - 72 | 24,852 | | | 29,700 | | | 5,720 | 3,130 | 959 | 64,361 |
| 1972 - 73 | | | | 38,000 | | | 4,096 | 55,973 | 8011 | 106,080 |
| 1973 - 74 | | 41,155 | | 59,860 | | | 5,900 | 36,860 | 6557 | 150,332 |
| 1974 - 75 | 991 | 29,419 | | 99,280 | | | 3,500 | 7,530 | 10288 | 151,008 |
| 1975 - 76 | 4,108 | 38,229 | | 58,521 | | | 3,000 | | 16374 | 120,232 |
| 1976 - 77 | 10,984 | 29,200 | | 82,500 | | | 4,000 | | 9,000 | 135,684 |
| 1977 - 78 | | 21,600 | | 88,400 | | | 5,000 | | | 115,000 |
| 1978 - 79 | | 68,300 | | 65,200 | | | 6,000 | | | 139,500 |
| 1979 - 80 | | 108,100 | | 148,240 | | | 7,500 | | | 263,840 |
| 1980 - 81 | | 65,700 | 43,800 | 90,700 | | | 9,000 | | | 209,200 |
| 1981 - 82 | | 26,200 | 197,196 | 91,900 | | | 12,000 | | | 327,296 |
| 1982 - 83 | 73,842 | 66,827 | 36,000 | 82,411 | | | 9,000 | 50,130 | | 318,210 |
| 1983 - 84 | | 69,830 | 65,000 | 86,484 | | | 10,000 | 46,717 | | 278,031 |
| 1984 - 85 | | 25,000 | 62,098 | 79,500 | | | 11,500 | 438 | | 178,536 |
| 1985 - 86 | 830 | 59,550 | 30,561 | 61,500 | | | 12,000 | 16,526 | | 180,967 |
| 1986 - 87 | 6,000 | 25,000 | 25,192 | 58,900 | | | 7,718 | | | 122,810 |
| 1987 - 88 | 6,000 | 35,526 | 84,793 | 54,057 | | | 10,140 | | | 190,516 |
| 1988 - 89 | 6,000 | 46,000 | 186,880 | 83,651 | 5,050 | 11,500 | 7,600 | | | 346,681 |
| 1989 - 90 | 6,000 | 127,000 | 142,416 | 94,137 | 3,629 | 20,100 | 10,000 | 4,130 | | 407,412 |
| 1990 - 91 | 6,000 | 164,350 | 154,009 | 88,000 | 2,750 | 41,500 | 8,000 | 12,462 | | 477,071 |
| 1991 - 92 | 6,000 | 196,368 | 220,300 | 67,679 | 8,500 | 37,000 | 9,000 | 7,024 | | 551,871 |
| 1992 - 93 | 230,659 | 228,700 | 223,119 | 77,492 | 4,300 | 28,000 | 6,500 | 13,438 | | 812,208 |
| 1993 - 94 | 288,488 | 302,500 | 229,131 | 74,318 | 12,200 | 21,100 | 16,191 | | 33,000 | 976,928 |
| 1994 - 95 | 218,515 | 269,000 | 262,045 | 64,429 | 1,284 | 7,705 | 18,383 | | | 841,361 |
| TOTAL | 918,991 | 2,043,554 | 1,962,540 | 1,851,809 | 37,713 | 166,905 | 205,748 | 264,847 | 85,010 | 7,537,117 |

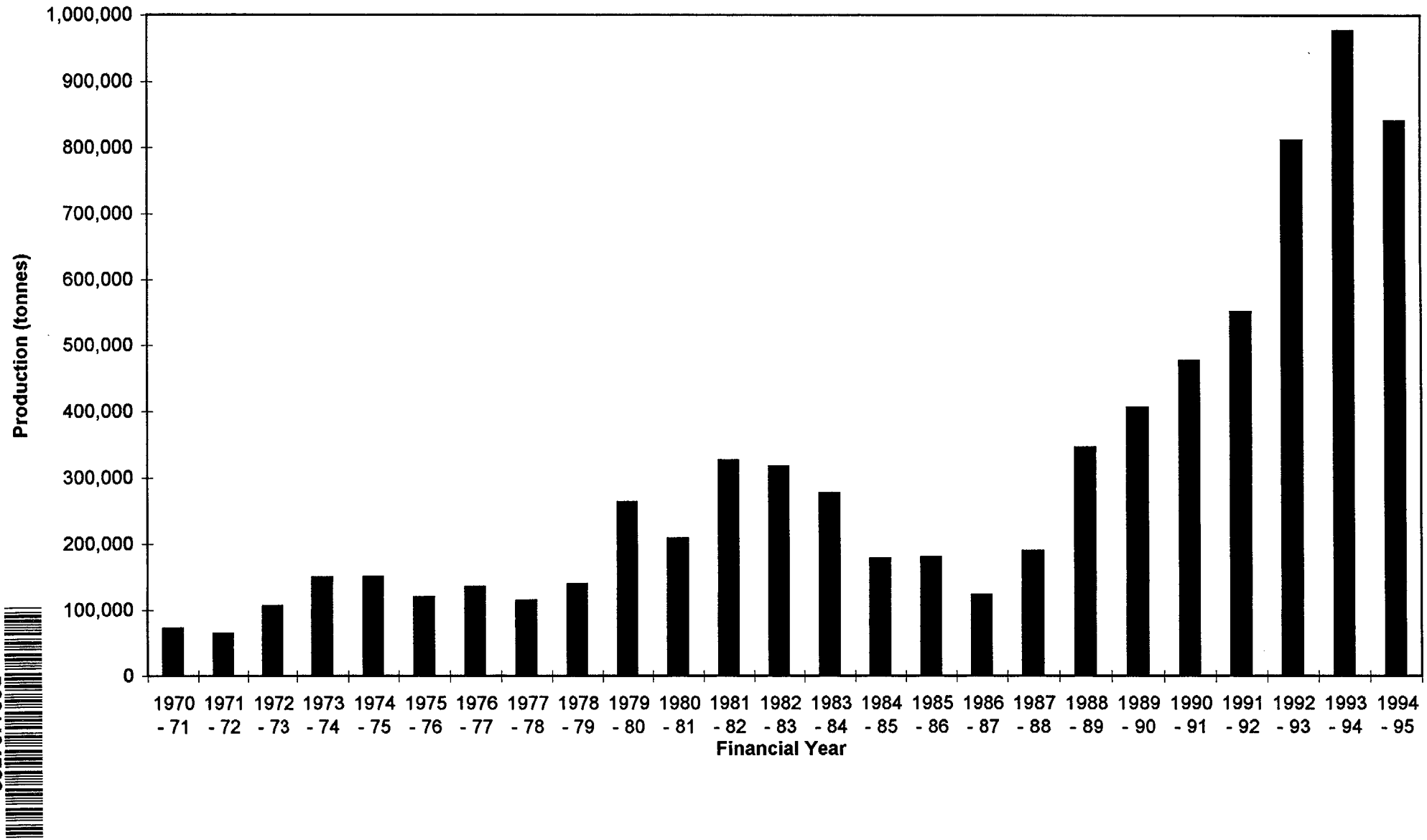
Note:
1. Other past or current producers include Slade Sand and Soil, Bruce MacKenzie, Medowie Carrying and JV Pratten and Sons.
2. Production by Boral Resources between 1986 and 1993 estimated at 3,000 to 9,000 tonnes per annum listed as 6,000 tonnes.



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**Figure 5: History of Construction Sand Production in the Stockton Bight-Port Stephens area**



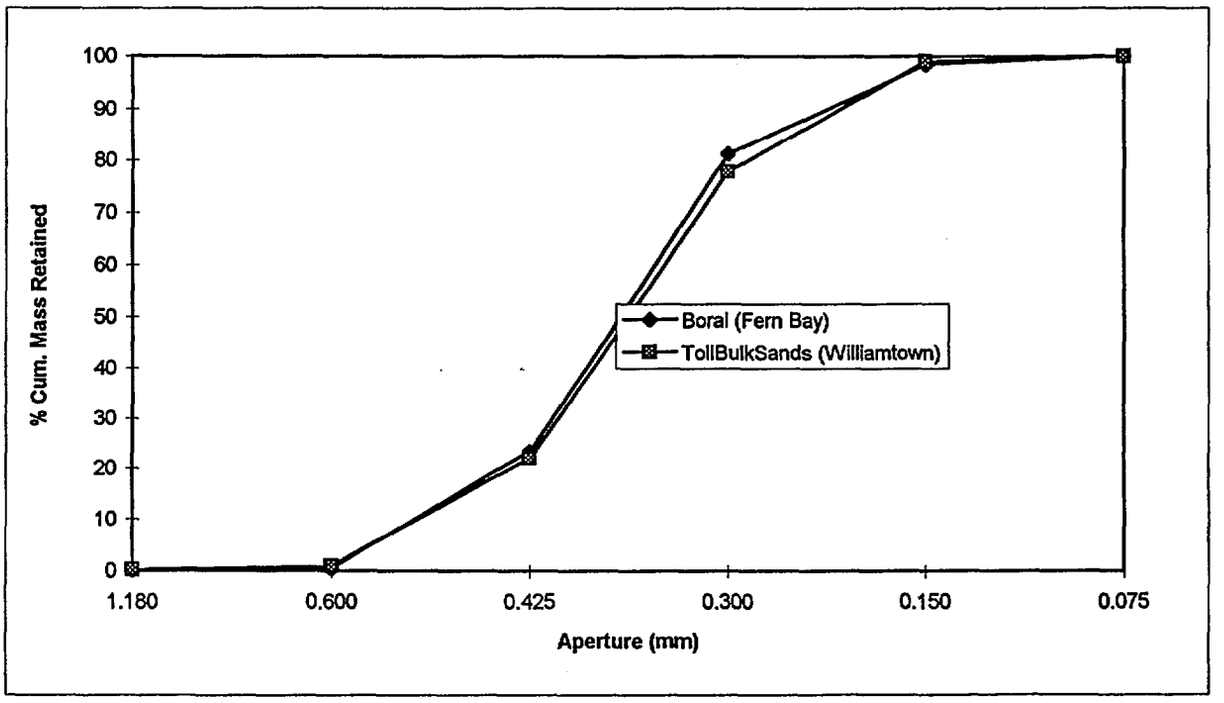

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**TABLE 12: SIZE DISTRIBUTION AND ANALYSES FOR OUTER BARRIER CONSTRUCTION SAND (RAW)**
**SOURCE: RESOURCE PLANNING (1995) AND TOLLBULKSANDS (1994)**

| | Boral Resources Fern Bay Stabilized Dune | TollBulkSands Williamtown Active Dune | Standard Concrete Sand AS 2758.1 - 1986 |
|---|---|---|---|
| Grain Size Distribution | Cum. Mass Passing (%) | Cum. Mass Passing (%) | Specification (% passing) |
| 1.18 mm | 100 | 100 | 30 - 100 |
| 0.600 mm | 98.4 | 99 | 15 - 100 |
| 0.425 mm | 81.4 | 78 | - |
| 0.300 mm | 23.5 | 22 | 5 - 50 |
| 0.150 mm | 0.5 | < 1 | 0 - 15 |
| 0.075 mm | 0.1 | 0.2 | 0 - 5 |
| Analysis | Boral Resources Fern Bay Stabilised Dune | TollBulkSands Williamtown Active Dune** | Standard Concrete Sand AS 2758.1 - 1986 |
| Dry Bulk Density (kg/cubic metre) | 2629 | 2624 | > 2100 |
| Water Absorption | 0.40% | 0.40% | Low (< 2%) |
| Sodium Sulphate Soundness | 0.8% loss | 0.9% loss | Severe (< 12)<br>Moderate (< 15)<br>Protected (< 15) |
| Silt Content | 1.75% | na | Low |
| Organic Impurities other than sugar | Lighter | na | Not Darker than Standard |
| Sugar | Not Detected | na | Low |
| Soluble Salts | 0.02% | na | Low |
| Sulphate Content as SO3 | 0.06% | na | Low |
| Chloride Content | 0.06% | < 0.1% | Low |
| Alkali Aggregate Reactivity | Innocuous | na | Inoccuous |




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**TABLE 13: IDENTIFIED CONSTRUCTION SAND RESOURCES IN TONNES IN THE STOCKTON BIGHT-PORT STEPHENS AREA**

| Operator | Locality | In situ Resources (tonnes) | Expected Life (years) | Current Status |
|---|---|---|---|---|
| Boral Resources | Fern Bay | > 5,800,000 | 10 - 15 | Extraction recommenced in 1993 |
| Makka's Sand and Soil | Salt Ash | 1.5 - 2,000,000 | > 20 | Extracted for fill-construction sand |
| Port Stephens Council | Anna Bay | 75,000 | 2 | Intermittent extraction |
| Quality Sand and Ceramics | Williamtown | 5 - 6,000,000 | 5 - 10 | Extraction occurring |
| Rocla | Raymond Terrace | 1 - 2,000,000 | 5 - 10 | Extraction occurring |
| Slade Sand and Soil | Williamtown | < 100,000 | 1 - 2 | Under extraction |
| TollBulkSands | Williamtown | > 5,000,000 | 15 - 20 | Under extraction |

Note: A large amount of sand from the Quality Sand and Ceramic deposit is sold as foundry or industrial sand.



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B) TollBulkSands extract sand from active dunes at Williamtown. Near this location, the active dunes were formerly dredged for heavy minerals by Mineral Deposits Pty Ltd. Construction sand resources, which are about 5 to 7 million tonnes, are likely to last for at least 15 to 20 years (TollBulkSands pers comm 1994). TollBulkSands mostly supply the Sydney, Newcastle and North Coast markets.

C) Boral Resources have deposits of about 5.8 million tonnes of construction sand near Fullerton Cove (Resource Planning 1994). Not all of this resource however is likely to be available for extraction. Production, which is currently about 200 000 tonnes annually, may increase to about 500 000 tonnes annually over a lifetime of about 13 years.

D) Quality Sand and Ceramics Pty Ltd produce about 270 000 to 330 000 tonnes industrial and construction sand annually from freehold land at Williamtown. About 20 per cent of this production, 50 000 to 70 000 tonnes, is reportedly sold as foundry sand. Secured resources of about 5 to 6 million tonnes are sufficient to last at least 15 years (Quality Sand and Ceramics Pty Ltd pers comm 1994)

#### 6.3.4 Potential for Future Extraction

The southern part of the Outer Barrier, from Fern Bay to Williamtown, contains fine to medium-grained sand suitable for use in concrete production. North of Lavis Lane, the active and vegetated dunes mostly contain industrial sand. In the vegetated dunes of the Inner Barrier, there are relatively few occurrences of construction sand.

## 6.4 Heavy Minerals

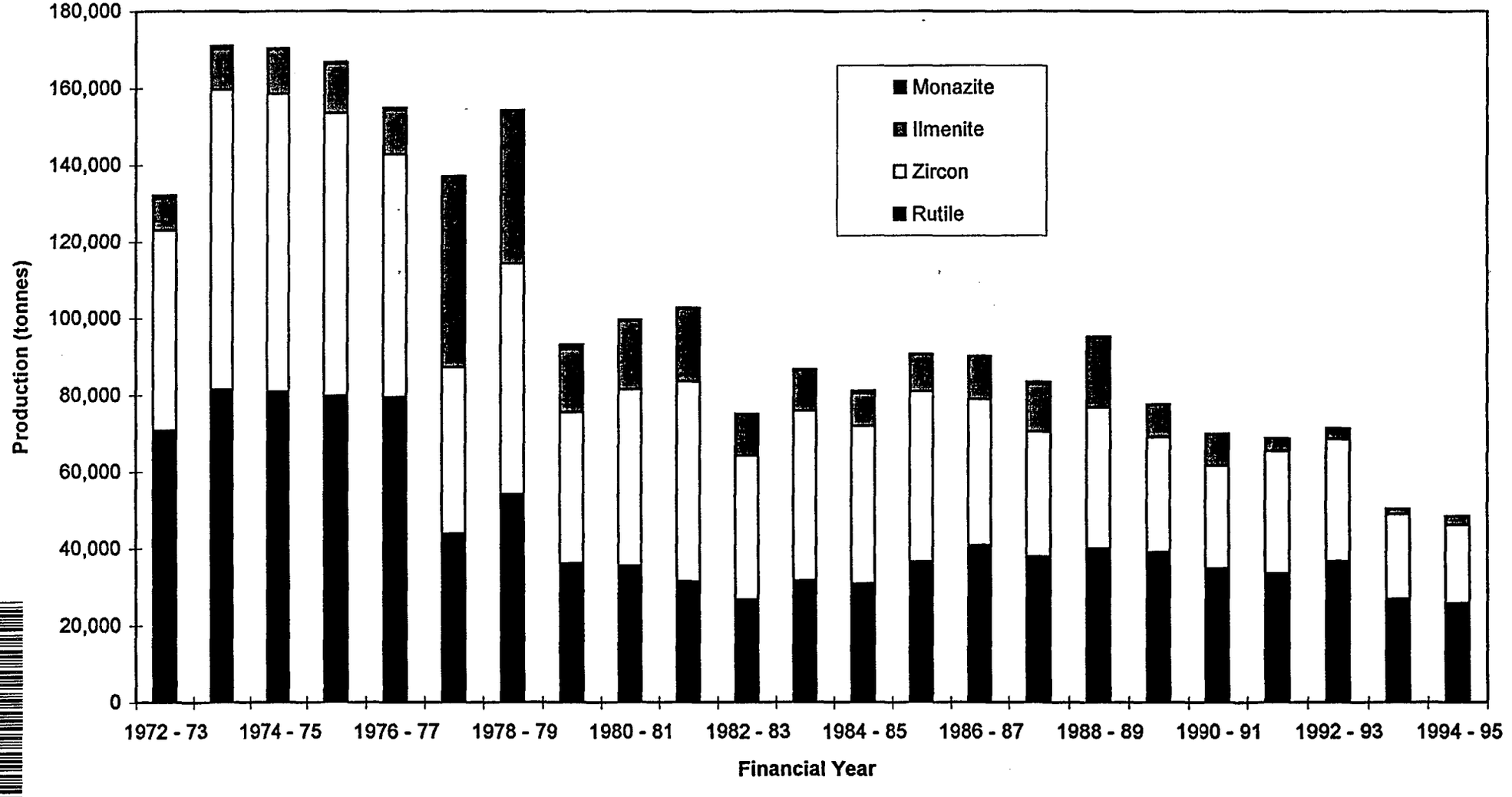
### 6.4.1 Distribution of Resources

Plan 4 shows the distribution of heavy mineral resources. Heavy minerals, principally rutile and zircon, occur widely in the Stockton Bight-Port Stephens area as strandline and aeolian dune deposits of Holocene and Pleistocene age. RZM Pty Ltd and BHP Titanium Minerals Pty Ltd, formerly Mineral Deposits Limited, have been major producers of heavy minerals from the Stockton Bight-Port Stephens area. About 50 000 tonnes heavy mineral concentrates are annually being produced in the Stockton Bight-Port Stephens area (figure 6 and table 14). Known deposits are likely to have an operational life of about several years at current or anticipated production rates.

The Inner Barrier contained an extensive network of upper and lower strandlines in the Tomago Sandbeds developed parallel to the northeasterly trend of the Inner Barrier (Boyd and Roy 1995). These have largely been mined out. The strandlines extended from Tomago, along the eastern side of Moffats Swamp Nature Reserve to Tanilba Bay, a distance of over 25 kilometres. The individual deposits attained lengths of several kilometres, widths of up to several hundred metres and had heavy mineral grades often greater than 10 per cent. The heavy mineral grades of the

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**Figure 6: History of Heavy Mineral Production in the Stockton Bight-Port Stephens Area**




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**TABLE 14: HISTORY OF HEAVY MINERAL PRODUCTION IN TONNES IN THE STOCKTON BIGHT-PORT STEPHENS AREA**
**SOURCE: DEPARTMENT OF MINERAL RESOURCES**

| | RZM TOMAGO | | | | MD STOCKTON | | | | AMC HEXHAM | | | | TOTAL | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Financial Year | Rutile | Zircon | Ilmenite | Monazite | Rutile | Zircon | Ilmenite | Monazite | Rutile | Zircon | Ilmenite | Monazite | Rutile | Zircon | Ilmenite | Monazite | Total |
| 1972 - 73 | 36,501 | 41,453 | 6,699 | 31 | | | | | 34,197 | 10,948 | 1,454 | 876 | 70,698 | 52,401 | 8,153 | 907 | 132,159 |
| 1973 - 74 | 37,284 | 45,172 | 8,472 | 252 | | | | | 44,008 | 33,204 | 2,008 | 602 | 81,292 | 78,376 | 10,480 | 854 | 171,002 |
| 1974 - 75 | 37,886 | 44,537 | 7,715 | 146 | | | | | 42,909 | 33,225 | 3923 | | 80,795 | 77,762 | 11,638 | 146 | 170,341 |
| 1975 - 76 | 36,081 | 46,760 | 7,558 | 143 | | | | | 43,610 | 27,038 | 5,185 | 484 | 79,691 | 73,798 | 12,743 | 627 | 166,859 |
| 1976 - 77 | 37,192 | 36,943 | 7,662 | | | | | | 42,213 | 26,483 | 3,827 | 607 | 79,405 | 63,426 | 11,489 | 607 | 154,927 |
| 1977 - 78 | 21,353 | 26,570 | 10,082 | | | | | | 22,473 | 16,810 | 39,774 | | 43,826 | 43,380 | 49,856 | | 137,062 |
| 1978 - 79 | 35,469 | 38,780 | 35,267 | 76 | | | | | 18,613 | 21,464 | 4,671 | | 54,082 | 60,244 | 39,938 | 76 | 154,340 |
| 1979 - 80 | 31,626 | 33,996 | 14,718 | 148 | | | | | 4,420 | 5,484 | 1,570 | 1,256 | 36,046 | 39,480 | 16,288 | 1,404 | 93,218 |
| 1980 - 81 | 29,207 | 37,496 | 14,455 | 263 | | | | | 6,272 | 8,452 | 3,574 | 3 | 35,479 | 45,948 | 18,029 | 266 | 99,722 |
| 1981 - 82 | 26,129 | 45,660 | 12,510 | 33 | | | | | 5,304 | 6,431 | 6,572 | 139 | 31,433 | 52,091 | 19,082 | 172 | 102,778 |
| 1982 - 83 | 26,739 | 37,434 | 10,818 | 108 | | | | | | | | | 26,739 | 37,434 | 10,818 | 108 | 75,099 |
| 1983 - 84 | 31,644 | 44,280 | 10,608 | 89 | | | | | | | | | 31,644 | 44,280 | 10,608 | 89 | 86,621 |
| 1984 - 85 | 30,784 | 41,071 | 8,516 | 691 | | | | | | | | | 30,784 | 41,071 | 8,516 | 691 | 81,062 |
| 1985 - 86 | 31,717 | 42,769 | 7,618 | 256 | 4,678 | 1,686 | 2,000 | | | | | | 36,395 | 44,455 | 9,618 | 256 | 90,724 |
| 1986 - 87 | 36,021 | 35,867 | 9,182 | | 4,664 | 2,263 | 2,030 | | | | | | 40,685 | 38,130 | 11,212 | | 90,027 |
| 1987 - 88 | 30,561 | 29,651 | 9,510 | 608 | 7,224 | 3,017 | 2,726 | | | | | | 37,785 | 32,668 | 12,236 | 608 | 83,297 |
| 1988 - 89 | 33,049 | 34,160 | 16,817 | 279 | 6,948 | 2,583 | 1,448 | | | | | | 39,997 | 36,743 | 18,265 | 279 | 95,284 |
| 1989 - 90 | 31,748 | 27,648 | 6,811 | 190 | 7,156 | 2,483 | 1,614 | | | | | | 38,904 | 30,131 | 8,425 | 190 | 77,650 |
| 1990 - 91 | 28,613 | 25,059 | 7,212 | 130 | 6,166 | 1,729 | 1,037 | | | | | | 34,779 | 26,788 | 8,249 | 130 | 69,946 |
| 1991 - 92 | 29,110 | 29,404 | 2,050 | 77 | 4,284 | 2,636 | 1,308 | | | | | | 33,394 | 32,040 | 3,358 | 77 | 68,869 |
| 1992 - 93 | 34,415 | 31,284 | 2,099 | | 2,157 | 725 | 675 | | | | | | 36,572 | 32,009 | 2,774 | | 71,355 |
| 1993 - 94 | 26,874 | 22,068 | 1,365 | | | | | | | | | | 26,874 | 22,068 | 1,365 | | 50,307 |
| 1994 - 95 | 25,724 | 20,350 | 2,351 | | | | | | | | | | 25,724 | 20,350 | 2,351 | | 48,425 |
| TOTAL | 540,783 | 603,547 | 181,989 | 2,948 | 43,277 | 17,122 | 12,838 | 0 | 57,082 | 58,641 | 56,161 | 1,398 | 641,142 | 679,310 | 250,988 | 4,346 | 1,575,786 |

NOTE: RZM = RZM PTY LTD, MD = MINERAL DEPOSITS LIMITED, AMC = ASSOCIATED MINERALS CONSOLIDATED
PRODUCTION FOR RZM AND AMC MAY INCLUDE PRODUCTION FROM OUTSIDE PORT STEPHENS



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Outer Barrier typically range from 0.3 to 0.5 per cent, with grades sporadically exceeding one per cent. It has been possible to mine these deposits, despite their relatively low grades, because of their large size and the presence of rutile and zircon of high purity. BHP Titanium Minerals Pty Ltd are currently seeking approval to mine a deposit of about 20 million tonnes at about 0.3 per cent heavy minerals from active dunes near Fullerton Cove (Unweldt (Australia) Pty Ltd 1995). Apart from this deposit, and minor heavy mineral resources in nearby active dunes, the Outer Barrier has almost entirely been mined out.

Pleistocene dunes of the Tomaree Headland, principally near Salamander Bay, have been extensively dredged for heavy minerals. Heavy mineral deposits within the Anna Bay Sandbeds occur within the area recently incorporated into the Tomaree National Park. Several small deposits with heavy mineral grade up to 5 per cent occur between Fingal Bay and Tomaree Head.

### 6.4.2 Resource Characteristics

At Tomago, the mined concentrate produced by RZM Pty Ltd contains about 30 to 35 per cent rutile, 30 per cent zircon, the remainder consisting of ilmenite, monazite, garnet and other accessory minerals. The coarse grain size of the heavy minerals enables them to be readily extracted to form the heavy mineral concentrates and to be separated into their constituent minerals using conventional separation technology.

### 6.4.3 Extraction Operations

RZM Pty Ltd has been mining the the Stockon Bight-Port Stephens area since about 1972. Recent exploration has concentrated on defining new heavy mineral sand deposits, evaluating tailings, and testing areas of deeper deposits under previously mined areas. In 1993, RZM Pty Ltd began remining heavy mineral deposits near Big Swan Bay that were originally mined between 1970 and 1975 by AMC Pty Ltd. BHP Titanium Minerals Pty Ltd are seeking approval to mine heavy minerals from active dunes between Williamtown and Fern Bay. This resource contains about 20 million tonnes at 0.3 per cent heavy minerals (Umweldt (Australia) Pty Ltd 1995). The company has also expressed interest in the active dunes present in nearby Housing Department land. This resource occurs in the former military weapons testing area that extends from Stockton to Williamtown.

### 6.4.4 Potential for Future Extraction

The known and secured heavy mineral deposits of the Stockton Bight-Port Stephens area are likely to last several years. There is some possibility that heavy mineral deposits of commercial interest may occur beneath the Outer Barrier at depths greater than 20 metres (eg Browne 1993). The inner shelf of Stockton Bight has potential for heavy mineral deposits but has been insufficiently explored to evaluate these resources. It appears that the various sequences, including old strand systems, are substantially eroded but preserved in part.


D001494550

Exploration near Swansea indicates the presence of relatively large, low and moderate grade (one to two per cent) heavy mineral deposits dominated by rutile and zircon in the upper several metres of the strand systems. It is possible that heavy mineral deposits of similar character may exist off the coastline of Stockton Bight.

## 7. CONCLUSIONS

The Stockton Bight-Port Stephens area has large deposits of sand suitable for use in construction, glass making and foundry applications. This region should remain an important source of construction and industrial sand for the Newcastle and Sydney regions for many years. It also contains important resources of heavy minerals although these deposits are likely to be exhausted within the next five years.

However, there are significant constraints to mineral and extractive resource extraction in the Stockton Bight-Port Stephens area. They include increasing urban development, water catchment protection areas, military weapons testing areas, and conservation zones. Furthermore, there is a proposal to incorporate much of Stockton Bight into the proposed Stockton Bight National Park.

The reconciliation of the demand for the mineral deposits and extractive resources of the Stockton Bight-Port Stephens area and the constraints affecting their development is a major challenge for industry, Government and the local community.

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**APPENDIX 1**

**CROWN LAND LICENCES (LI) AND PERMISSIVE OCCUPANCIES (PO)**

**INDUSTRIAL AND CONSTRUCTION SAND OPERATIONS**

| Operator | Resource | Locality | Parish | Portions | Area (ha.) | Department of CaLM Reference | Current Status |
|---|---|---|---|---|---|---|---|
| ACI Industrial Minerals Division | Foundry Sand | Anna Bay | Tomaree | Adjacent to Portion 137 | 50 | LI 90904, 89H875 | Extraction yet to occur |
| ACI Industrial Minerals Division | Colourless Glass Sand | Tanilba Bay | Sutton | Part Portions 125, 158, 171 | 71 | LI 90885 | Extraction has commenced |
| ACI Industrial Minerals Division | Colourless Glass Sand | Lemon Tree Passage | Sutton | Part Portions 129, 179 | 38 | PO 77/13N | Under rehabilitation |
| Electric Lamp Manufacturers Pty Ltd | Colourless Glass Sand | Lemon Tree Passage | Stowell | Part Portion 22 | 1.2 | PO 70/62N, 80H2733 | Under rehabilitation |
| FD Leal | Foundry Sand | Anna Bay | Tomaree | Part Portion 132 Block C | 1.2 | PO 70/62N, 79H994 | Extraction yet to occur |
| Metromix Pty Ltd | Foundry Sand | Anna Bay | Tomaree | Part Portions 137, 138, 139 | 28 | PO 84/53N, 80H1038 | Extraction occurring |
| NSW Glass Sand Users Association | Colourless Glass Sand | Lemon Tree Passage | Sutton | Part Portions 129, 166, 171 | 25 | PO 86/27N | Under rehabilitation |
| NSW Glass Sand Users Association | Colourless Glass Sand | Lemon Tree Passage | Sutton | Part Portion 128 | 9.5 | PO 86/25N | Under rehabilitation |
| Port Stephens Council | Foundry / Construction | Anna Bay | Tomaree | Part Portion 132 Blocks A, B | 4.4 | PO 86/87N, 86H849 | Intermittent extraction |
| Robinsons Anna Bay Sands Pty Ltd | Foundry / Construction | Anna Bay | Tomaree | Adjacent to Portions 3, 132 | 3 | LI 90784, 91H84 | Largely extracted |
| Rocla Pty Ltd | Foundry Sand | Anna Bay | Tomaree | Part Portion 132 Block D | 4.2 | PO 67/11N, 79H1213 | Extraction yet to occur |



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## APPENDIX 2

## FREEHOLD EXTRACTION OPERATIONS

## INDUSTRIAL AND CONSTRUCTION SAND OPERATIONS

| Operator | Resource | Locality | Parish | Portions | Area (ha.) | Current Status |
|---|---|---|---|---|---|---|
| ACI Industrial Minerals Division | Coloured Glass | Salt Ash | Stowell | Lot DP 774726 | 47 | Extraction occurring |
| ACI Industrial Minerals Division | Colourless Glass | Lemon Tree Passage | Sutton | Portion 265, PO 79/3 for site access | 30 | Extraction completed |
| Boral Resources (Country) Pty Ltd | Construction | Fern Bay | Stowell | Lot 1 (Port 167), Lot 2 (Pt Portion 3) | 243 | Extraction occurring |
| Makka's Sand and Soil | Fill/Construction | Salt Ash | Stowell | Lot 5 DP 600870 Part Portion 149 | 18 | Extraction occurring |
| Electric Lamp Manufacturers Pty Ltd | Colourless Glass Sand | Lemon Tree Passage | Sutton | Part Portion 27 | 15 | Extraction completed |
| PB White Minerals Pty Ltd | Colourless Glass | Lemon Tree Passage | Sutton | Lots 4-5 DP 246372,<br>Part Lots 12,23 DP 753192 | 109 | Extraction completed |
| PB White Minerals Pty Ltd | Colourless Glass | Tanilba Bay | Sutton | Lot 2 DP 734441 | 117 | Under development for extraction |
| Quality Sand and Ceramics Pty Ltd | Foundry/Construction | Williamtown | Stowell | Portions 13, 75, 76, 101<br>Part Portions 82, 152 subject to ML 381<br>(over Portion 13, Part Portions 101, 76) | 77 | Extraction occurring at Portion 13<br>Extraction completed at Portion 101 |
| Robinsons Anna Bay Sands Pty Ltd | Foundry/Construction | Anna Bay | Tomaree | Lots 1, 2, 3 DP 50280 | 8.5 | Extraction occurring |
| Rocla Pty Ltd | Construction | Raymond Terrace | Elden | Lot 232 DP 593512 | 44 | Extraction occurring |
| Slade Sand and Soil | Fill/Construction | Williamtown | Stowell | Lot 3 DP 832554 | 82 | Extraction occurring |
| SM Johnson | Fill/Construction | Anna Bay | Tomaree | Portion 332 | 4.5 | Intermitent extraction occurring |
| TollBulkSands | Construction Sand | Williamtown | Stowell | Part Portions 72, 91, 93, 157<br>Lots 145, 992<br>Portions 71, 77, 100, 155, 156 | 175 | Extraction at Part Portions 72, 93, 157<br>Portions 71, 100 and Lot 992<br>(eight pits) |



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# Plan 1
# LANDUSE CONSTRAINTS IN THE STOCKTON BIGHT - PORT STEPHENS AREA

## REFERENCE

**ENVIRONMENTAL PROTECTION ZONES**
- SEPP 14 Coastal Wetlands
- Environmental protection 7(k) (flora and fauna conservation)
- Silica sand controlled development areas (clause 37)

**DEFENCE LAND FORMER WEAPONS TESTING RANGE**
- Danger Zone. Area of possible debris
- Ordinance Impact Zone.

**CURRENT RAAF AIR WEAPONS TESTING RANGE**
- impact zone
- buffer area

- Urban area
- Hunter Water Corporation Reserve
- National parks/Nature Reserves

**SOURCE:**
Port Stephens Koala Management Study 1994
HLA Envirosciences 1995
Port Stephens LEP 1987
Dept of Water Resources 1995
Hunter Water Corporation 1995

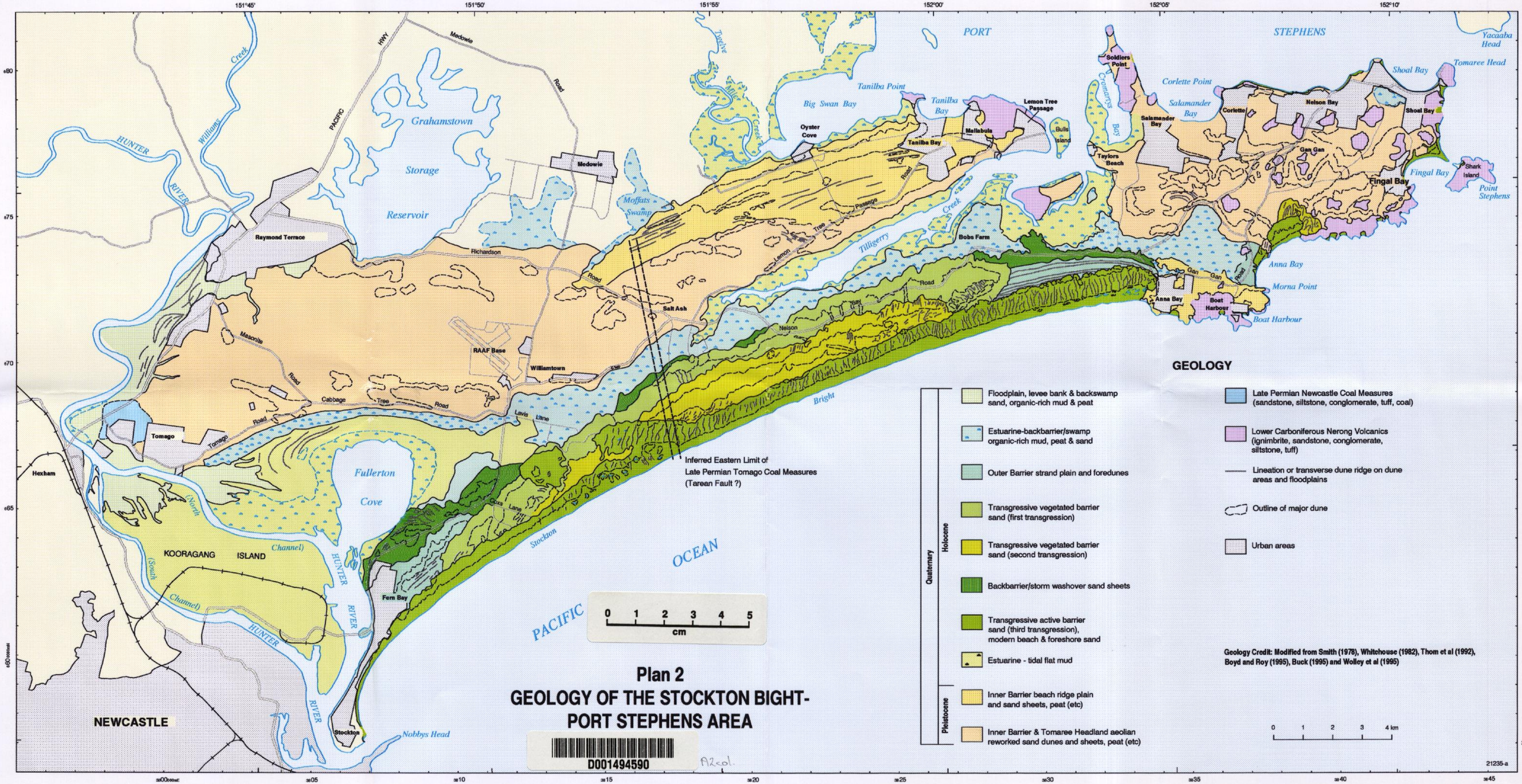
0 1 2 3 4 5 cm

0 1 2 3 4 km

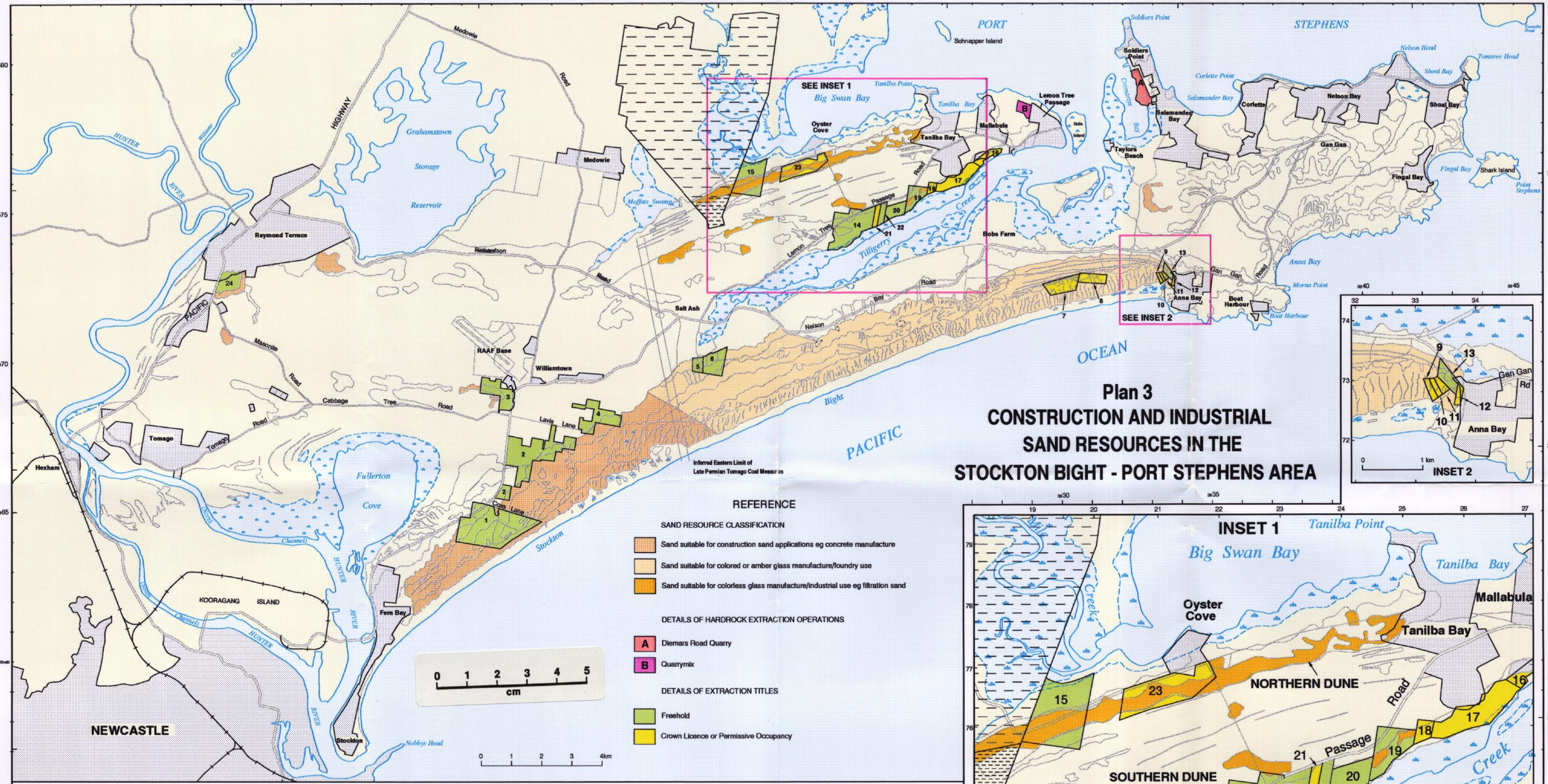
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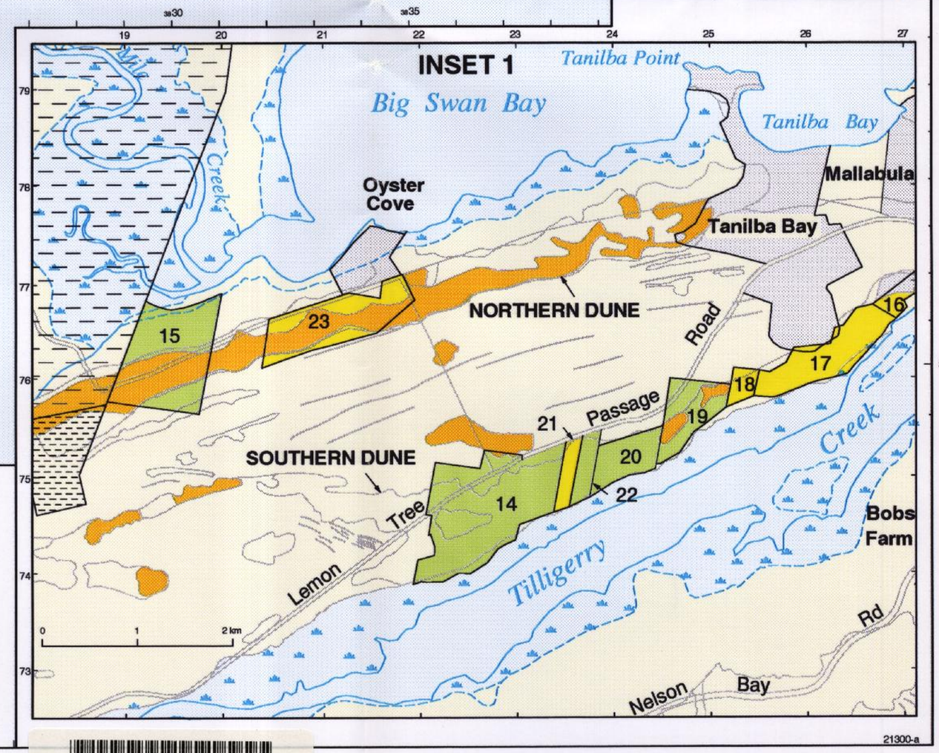

151°45'
151°50'
151°55'
152°00'
152°05'
152°10'
32°42'
32°45'
32°50'
32°55'
HUNTER RIVER
Williams
Creek
PACIFIC HWY
Medowie Road
Grahamstown
Storage
Reservoir
Medowie
Moffats Swamp
Twelve Mile Creek
Tanilba Point
Big Swan Bay
Oyster Cove
Tanilba Bay
Mallabula
Lemon Tree Passage
Bulls Island
PORT STEPHENS
Soldiers Point
Crowdys Bay
Taylors Beach
Corlette Point
Salamander Bay
Corlette
Nelson Bay
Shoal Bay
Tomaree Head
Yacaaba Head
Gan Gan
Fingal Bay
Shark Island
Point Stephens
Anna Bay
Morna Point
Boat Harbour
Bobs Farm
Tilligerry Creek
Raymond Terrace
Richardson Road
Lemon Tree Passage Road
Salt Ash
Nelson Bay Road
Masonite Road
RAAF Base
Williamtown
Cabbage Tree Road
Lavis Lane
Tomago
Tomago Road
Hexham
Fullerton Cove
North Channel
South Channel
KOORAGANG ISLAND
HUNTER RIVER
Fern Bay
Cox Lane
Stockton
Stockton Bight
OCEAN
PACIFIC
Nobbys Head
NEWCASTLE
Inferred Eastern Limit of Late Permian Tomago Coal Measures (Tarean Fault ?)
0 1 2 3 4 5 cm
Plan 2
GEOLOGY OF THE STOCKTON BIGHT-PORT STEPHENS AREA
D001494590
A2 col.
GEOLOGY
Quaternary
Holocene
Floodplain, levee bank & backswamp sand, organic-rich mud & peat
Estuarine-backbarrier/swamp organic-rich mud, peat & sand
Outer Barrier strand plain and foredunes
Transgressive vegetated barrier sand (first transgression)
Transgressive vegetated barrier sand (second transgression)
Backbarrier/storm washover sand sheets
Transgressive active barrier sand (third transgression), modern beach & foreshore sand
Estuarine - tidal flat mud
Pleistocene
Inner Barrier beach ridge plain and sand sheets, peat (etc)
Inner Barrier & Tomaree Headland aeolian reworked sand dunes and sheets, peat (etc)
Late Permian Newcastle Coal Measures (sandstone, siltstone, conglomerate, tuff, coal)
Lower Carboniferous Nerong Volcanics (ignimbrite, sandstone, conglomerate, siltstone, tuff)
Lineation or transverse dune ridge on dune areas and floodplains
Outline of major dune
Urban areas
Geology Credit: Modified from Smith (1978), Whitehouse (1982), Thom et al (1992), Boyd and Roy (1995), Buck (1995) and Wolley et al (1995)
0 1 2 3 4 km
21235-a

# Plan 3
# CONSTRUCTION AND INDUSTRIAL SAND RESOURCES IN THE STOCKTON BIGHT - PORT STEPHENS AREA










## REFERENCE

### SAND RESOURCE CLASSIFICATION

- Sand suitable for construction sand applications eg concrete manufacture
- Sand suitable for colored or amber glass manufacture/foundry use
- Sand suitable for colorless glass manufacture/industrial use eg filtration sand

### DETAILS OF HARDROCK EXTRACTION OPERATIONS

- A — Diemars Road Quarry
- B — Quarrymix

### DETAILS OF EXTRACTION TITLES

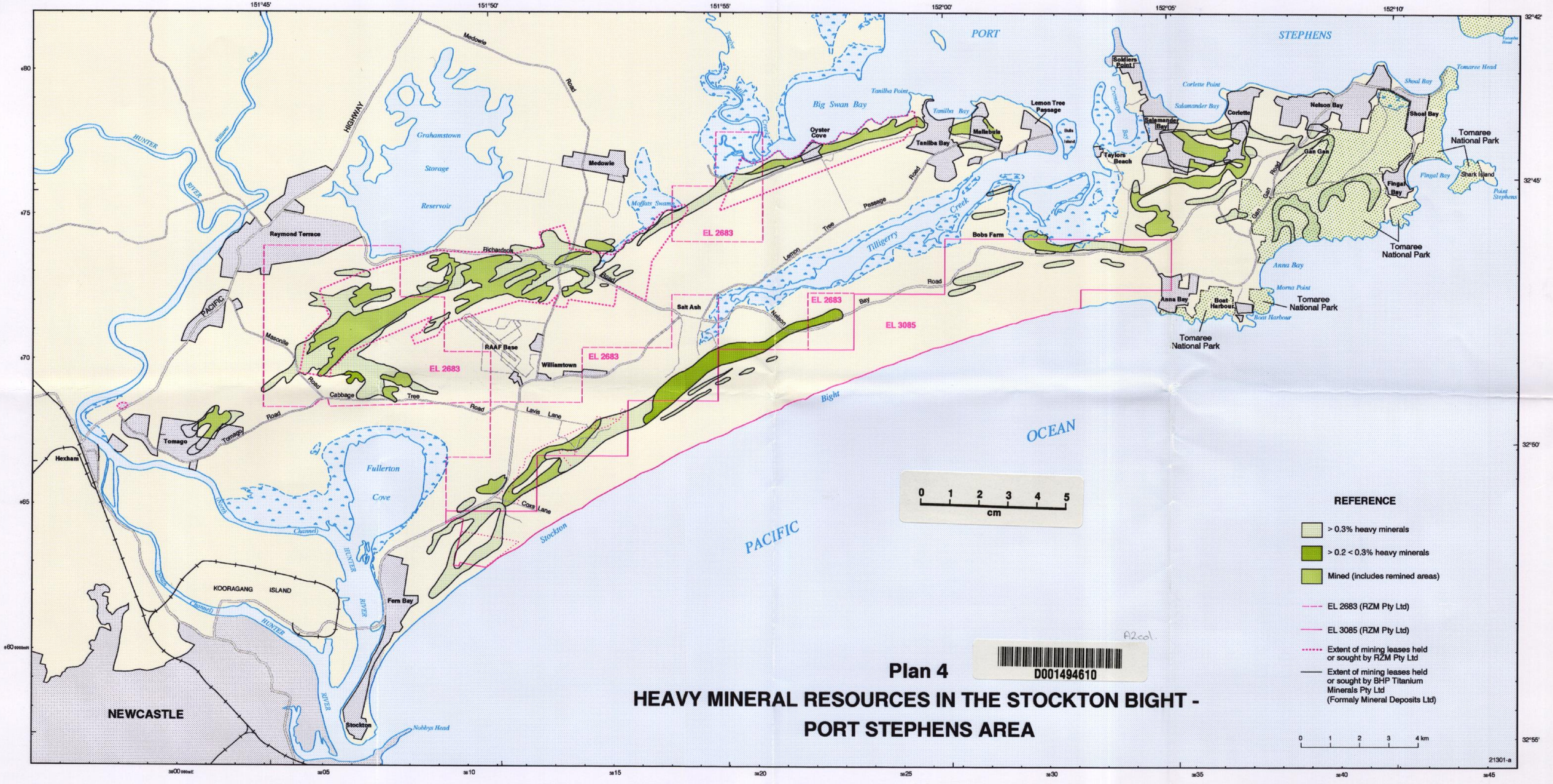
- Freehold
- Crown Licence or Permissive Occupancy

### DETAILS OF SAND EXTRACTION OPERATIONS

1. Boral Resources(Country)Pty Ltd
2. TollBulkSands
3. Slade Sand & Soil
4. Quality Sand and Ceramics Pty Ltd
5. Makka's Sand and Soil
6. ACI Industrial Minerals Division-Salt Ash
7. ACI Industrial Minerals Division -Anna Bay
8. Metromix Quarries
9. Rocla Quarry Products-Anna Bay (yet to commence extraction)
10. FD Leal
11. Port Stephens Council
12. Robinsons Anna Bay Sands Pty Ltd (under rehabilitation)
13. Robinsons Anna Bay Sands Pty Ltd
14. PB White Minerals Pty Ltd-Lemon Tree Passage
15. PB White Minerals Pty Ltd-Oyster Cove
16. NSW Glass and Ceramic Sand Users Association Pty Ltd -Lemon Tree Passage(under rehabilitation)
17. NSW Glass and Ceramic Sand Users Association Pty Ltd -Lemon Tree Passage(under rehabilitation)
18. NSW Glass and Ceramic Sand Users Association Pty Ltd -Lemon Tree Passage(under rehabilitation)
19. ACI Industrial Minerals Division-Lemon Tree Passage (yet to gain development consent)
20. ACI Industrial Minerals Division-Lemon Tree Passage (under rehabilitation)
21. Electric Lamp Manufacturers(Aust)Pty Ltd (under rehabilitation)
22. Electric Lamp Manufacturers(Aust)Pty Ltd (under rehabilitation)
23. NSW Glass and Ceramic Sand Users Association Pty Ltd-Oyster Cove
24. Rocla Quarry Products-Raymond Terrace

21300-a

D001494600




A2 col.

D001494610

# Plan 4

# HEAVY MINERAL RESOURCES IN THE STOCKTON BIGHT - PORT STEPHENS AREA

GS 1996/034

RZM

# EXPLORATION LICENCES 2683 & 3085

# ANNUAL REPORT FOR PERIOD

# 4/10/94 TO 3/10/95

*Report No. 18/95*

***Prepared by***

***ROSS HODGE***

***Heatherbrae*** ***November, 1995***

R00000025

D000004210

GS 1996/034

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**Appendix**


1 Current Drilling - Log Sheets


**Enclosure**


1 Current Drilling - Location Plan


D000004220

## 1.0 INTRODUCTION

Exploration Licences (EL's) 2683 and 3085 are located just north of Newcastle on the mid north coast of NSW **(Figure 1)**. EL 2683 extends north from Hexham to Raymond Terrace and east to Lemon Tree Passage. EL 3085 adjoins the southern boundary of EL 3085, extending north from Fern Bay to Anna Bay, and east to the high water mark in Stockton Bight **(Figure 2)**.

These areas were considered to have potential for economic grade accumulations of heavy minerals, particularly rutile and zircon which are known to occur as strandline and aeolian dunal deposits with the Pleistocene and Holocene sand masses of Australia's east coast.

EL 2683 was granted in October 1986 in respect of 80 graticular units. The area of the licence was subsequently periodically reduced by relinquishment such that at the beginning of this reporting period, it consisted of 25 units. Note that application was made in September 1995 for relinquishment of a further eight units from this EL.

EL 3085 was granted in March 1988 in respect of 35 graticular units. This area was also subsequently reduced to 25 units. Application was similarly made in September 1995 for relinquishment of a further 15 units from this EL.

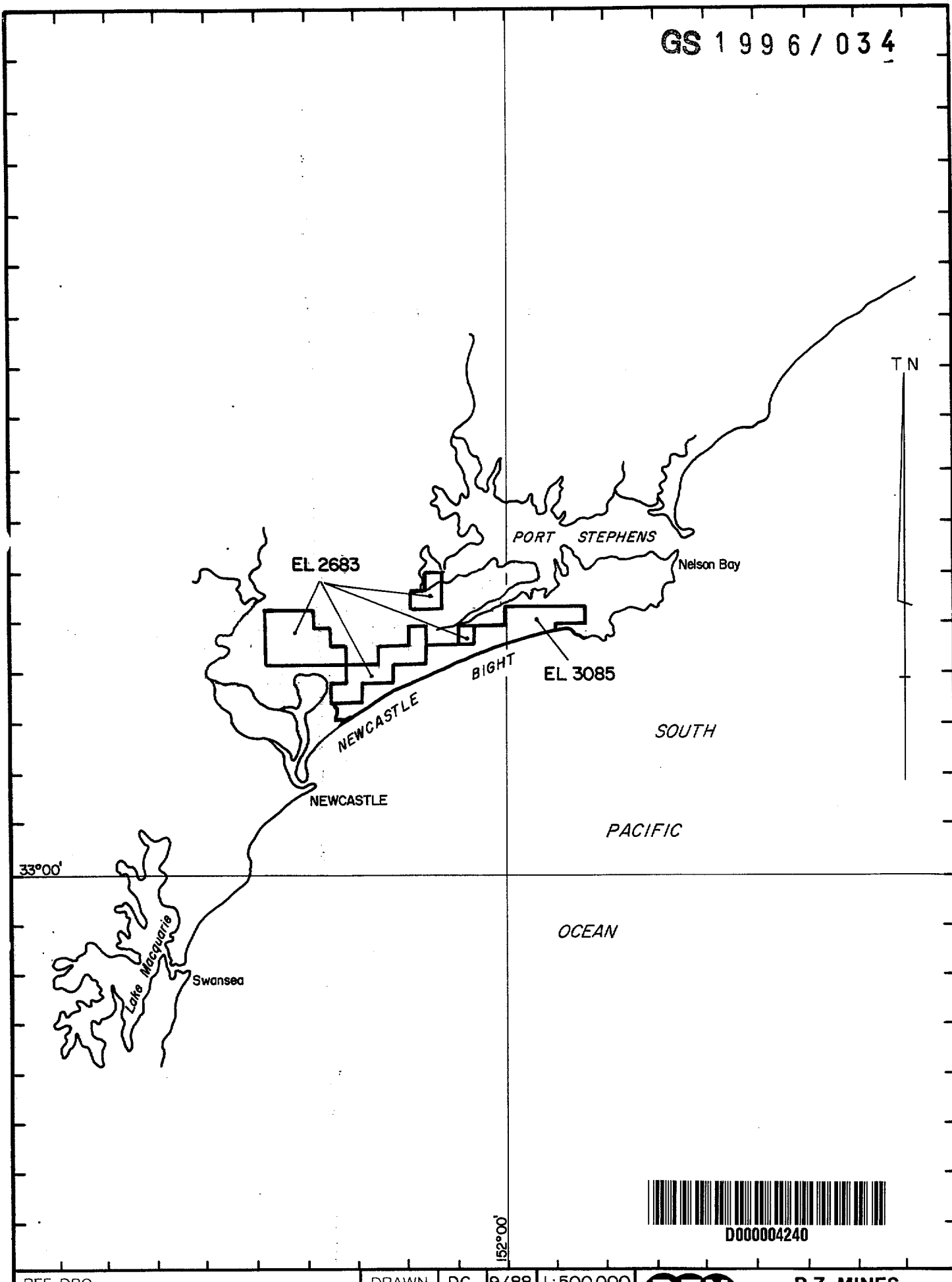
Renewal dates for the two EL's have been altered to make them coincidental. Thus, this report is on exploration activities carried out within both.

During the current reporting period, the only drilling carried out was the hand augering of several lines in the Bobs Farm area of EL 3085. This was follow up drilling aimed at better defining the extent of mineralisation indicated by earlier work.

Results confirmed the presence of a narrow strand line which, under current conditions, would probably not prove economically viable to mine.

D000004230

GS 1996/034




D000004240

| | | | | | |
|---|---|---|---|---|---|
| REF. DRG. | DRAWN | DG | 9/88 | 1:500 000 SCALE | R.Z. MINES (NEWCASTLE) PTY. LTD. |
| LEGEND | REV. | DG | 10/93 | | |
| | | DG | 11/95 | | EL 2683/ EL 3085 PORT STEPHENS (NSW) LOCATION PLAN |
| 0 1 2 3 4 5 cm | | | | | DRG. NO.—A4· 33 FIGURE NO. 1 |

UF2002

GS 1996/034

PORT STEPHENS

Soldiers Point

Big Swan Bay

Tanilba Bay

Lemon Tree Passage

Ringwood Road

HIGHWAY

GRAHAMSTOWN STORAGE RESERVOIR

Medowie

Richardson Road

RAYMOND TERRACE

Masonite Road

Cabbage Tree Road

Williamtown

EL 2683

Salt Ash

Nelson Bay

Lemon Tree Passage Road

Tilligerry Creek

Road

EL 3085

Beach

BIGHT

Stockton

NEWCASTLE

PACIFIC HUNTER

Tomago

FULLERTON COVE

RIVER

Nelson Bay

Fern Bay

20

G.N

6360 000

400 000

D000004250

A3 col.

REF. DRG.

LEGEND

Current R.Z.M. exploration tenure

Road

Town

20m topographic contour

0 1 2 3 4 5 cm

| | | | |
|---|---|---|---|
| DRAWN | DG | 9/88 | 1:100 000 SCALE |
| REV. | DG | 10/93 | |
| | DG | 11/95 | |

R.Z. MINES (NEWCASTLE) PTY. LTD.

EL 2683 / EL 3085

PORT STEPHENS (NSW)

ACCESS & TOPOGRAPHY

DRG.NO.—A3 23 FIGURE NO. 2

## 2.0 SUMMARY

This report details exploration work carried out in EL's 2683 and 3085 during the period 4 October 1994 to 3 October 1995.

Drilling carried out during this period was confined to 718.5m in 118 hand auger holes in the Bobs Farm area of the Stockton Dunes. This constituted infill drilling between holes on exiting lines where mineralisation was encountered.

Holes were drilled at 10 or 20m spacings on lines 320m apart. Due to the shallow nature of the indicated mineralisation, a maximum depth of eight metres was set for each hole, though many stopped short of this.

D000004260

## 3.0 CONCLUSIONS AND RECOMMENDATIONS

Exploration undertaken to date in EL 2683 and 3085 has indicated that, within them, the potential for the discovery of any significant, new deposits of heavy minerals is very small.

Work in EL 2683 has confirmed the continuation of orebodies currently being mined by RZM in adjoining existing mining leases. There is still potential for the existence of similar such extensions to other orebodies currently being mined or proposed to be mined.

As such it was recommended that EL 2683 be reduced in size to those 15 units covering or immediately surrounding RZM's mining leases at Tomago and Big Swan Bay. An additional two units were retained adjoining some retained in EL 3085 in the Bobs Farm area where some potential exists for the extension of a small strand line with possible long term mining prospectivity.

It is recommended that the requirement of any further exploration drilling in EL 2683 be dictated by the needs of the mining department. That is, should it be considered that mineable resources may continue beyond the bounds of the current mining leases, exploration be undertaken to define them.

Recent exploration in EL 3085 confirmed the existence of a narrow, shallow strand line in the Bobs Farm area on the western edge of the Stockton Dune system.

The narrow nature of this strand, and its situation being largely above water table, make it amenable probably only to dry mining techniques.

The relatively small tonnage involved and marginal head grade of the deposit mean it would likely not be economic to mine under the prevailing conditions.

Previous work in EL 3085 has identified some HM resources but concluded that these were at too great a depth to be viable mining propositions.

Thus, it was recommended that EL 3085 be reduced in size to the ten units (shown in **Figure 6**) which cover the Bobs Farm area alluded to above as well as areas of potential further south.

It is recommended that no further drilling be undertaken in EL 3085 until a full assessment is made of the resources therein. This should be made in conjunction with an assessment of the entire resources available to RZM on the NSW coast. Any decisions relating to EL 3085 should take this overall picture into account.

Ross Hodge

ROSS HODGE
Mine Geologist



## 4.0 LOCATION, ACCESS AND TOPOGRAPHY

### 4.1 Location

Exploration Licence 2683 is situated in the Port Stephens area, just north of the city of Newcastle on the coast of New South Wales. The Licence extends from Hexham (Newcastle) in the west, to Lemon Tree Passage in the east, a distance of 29km. The area lies 1km to 10km inland from Stockton Bight **(Figures 1 and 2).**

The Licence area encloses many active mining leases of RZM Pty Ltd in the Port Stephens are, the furthest point being some 34km by road from the Company's main office and dry plant at Tomago.

Exploration Licence 3085 is located in the Stockton Bight area on the coast of New South Wales north east of Newcastle. The Licence extends from Fern Bay in the west to Anna Bay in the east, a distance of 26km. The area includes the Stockton Dune system and beach to high water level. The Licence area directly adjoins Exploration Licence 26583 to the north **(Figures 1 and 2).**

### 4.2 Access

Access to all areas covered by the two Exploration Licences is obtained by both tar sealed and gravel roads which provide all weather access. Four-wheel drive and farm tracks are well situated to allow ready access to most areas of potential.

Access to certain areas within the two Licences is limited to a condition of tenure.

### 4.3 Topography

The topography of EL 2683 is essentially of one type, consisting of flat sand plain with an average elevation of 8m to 9m above sea level. Small sand blown dunes, generally trending west - northwest to east - southeast and up to 50m in height occur sparsely throughout the area.

In the north east the Licence area overlaps onto hard country, which is expressed as low, undulating topography and clay rich soils. Whilst in the southwest alluvial flats associated with the Hunter River occur.

Within the main sand plain, small ridge and swale structures up to one metre in height can be identified running sub parallel to the current coastline.

Along its southern margin, the Licence area encroaches onto the coastal dunes which lie inland of, and parallel to, the Stockton Bight area covered by the adjoining Exploration Licence (EL32085). These dunes attain heights of up to 40m a.s.l. within EL 2683.

## 5.0 TENURE

EL's 2683 and 3085 were both granted for Group One minerals. The two EL's comprise a major part of RZM's Port Stephens/Tomago operations, and surround the current mining tenements held respectively by RZM and Mineral Deposits Ltd.

### 5.1 Exploration Licence 2683

EL 2683 was granted to Rutile and Zircon Mines (Newcastle) Ltd (now RZM Pty Ltd) on 3rd October 1986, in respect of ELA 88 Newcastle, for an initial term of 24 months.

The EL covered an area of 80 graticular units (approximately 240km$^2$) in the Parishes of Eldon, Stockton, Stowell, Sutton and Tomaree, in the county of Gloucester, the Parishes of Alnwick, Hexham, and Newcastle in the County of Northumberland. The area of EL 2683 was reduced to 67 units in the first renewal of the Licence term. The EL was renewed for a second time over a reduced Licence area of 46 units only after resolution of a tenure dispute between Mineral Deposits Ltd and RZM Pty Ltd in June 1992. At this time, both EL 2683 and 3085 were renewed for a shortened period of 12 months to 2nd October 1993. EL 2683 was then renewed for a further period of 24 months over the remaining 46 graticular units ending on 2nd October 1995.

However, application was made in June 1994 for the relinquishment of 21 units, leaving the EL comprising 25 units. In September 1995 further application was made to reduce the Licence area by another eight units.

The locations of the remaining 17 units of EL 2683 are shown in **Figure 5**.

### 5.2 Exploration Licence 3085

EL 3085 was granted to Rutile and Zircon Mines (Newcastle) Ltd (now RZM Pty Ltd) on 23rd March 1988, in respect of ELA 93 Newcastle. The Licence was granted for an initial two year term.

The EL originally covered an area of 35 graticular units (approximately 105km$^2$) in the parishes of Stockton, Stowell, Tomaree, and Sutton in the County of Gloucester.

The area of the EL was reduced to 33 units on 23rd June 1992, after settlement of a tenure dispute between RZM and Mineral Deposits Limited. EL 3085 was renewed over a shortened period

ending on 2nd October 1993. This brought the reporting and renewal dates in line with those of the adjoining EL 2683.

The EL was reduced by 3.25 units in September 1993 and a further five units in June 1994.

In September 1995 application was made to reduce the Licence area by another 15 units, leaving it to comprise approximately ten units, as shown in **Figure 6.**

## 5.3 Exclusions and Other Tenure

i) Previous Tenure

Tenure within the current EL's has been held by a number of companies which include Associated Minerals Consolidated, Mineral Deposits Ltd and RZM Pty Ltd. Mineral Deposits holds current mining tenure in the Stockton Dunes area east of Williamtown.

ii) Exclusions

EL 2683 excludes the Williamtown RAAF base, Reserve No. 3174 being the Tilligerry Creek Fisheries area, the Silica Sand Mining area at Tanilba South Dune, and Moffats Swamp Nature Reserve (**Figure 3**). Mining tenure excluded from the Licence area is tabulated in **Table 1.**

EL 3085 excludes the areas which extend offshore past mean high water mark at Stockton Beach, the Tilligerry Creek Fisheries area and the Kooragang Island Nature Reserve.

The ordinance impact areas and areas of possible debris as outlined on **Figure 3** were not excluded from the Licence but are being treated as special areas. The two areas near Fern Bay and Birubi Point were used as artillery testing/practice and air to ground weapons ranges respectively during World War II. These areas, and those adjacent, are being tested using an analogue gradiometer for the presence of any unexploded ordinance (UXO) prior to drilling.

Current mining tenure excluded from both Licence areas is shown in **Table 1.**

GS 1996/034

PORT STEPHENS

Soldiers Point

Big Swan Bay

GRAHAMSTOWN STORAGE RESERVOIR

MOFFATS SWAMP NATURE RESERVE

RAAF AIR TO GROUND GUNNERY RANGE

Tilligerry Creek

EL 3085

ROYAL AUSTRALIAN AIR FORCE

EL 2683

AREA OF POSSIBLE DEBRIS

BIGHT

Beach

G.N

NATIONAL PARKS & WILDLIFE SERVICE

HUNTER

FULLERTON COVE

RIVER

Stockton

NEWCASTLE

ORDINANCE IMPACT AREA

AREA OF POSSIBLE DEBRIS

6360 000

400 000

D000004280

A3 Col.

REF. DRG.

LEGEND

Current R.Z.M. exploration tenure

Area excluded from exploration licence

0 1 2 3 4 5 cm

| | | | |
|---|---|---|---|
| DRAWN | DG | 9/88 | 1:100 000 SCALE |
| REV. | DG | 10/93 | |
| | DG | 11/94 | |

R.Z. MINES (NEWCASTLE) PTY. LTD.

EL 2683 / EL 3085

PORT STEPHENS (NSW)

EXCLUSIONS

DRG.NO.—A3 25 FIGURE NO. 3

GS 1996/034

PORT STEPHENS

Soldiers Point

Big Swan Bay

GRAHAMSTOWN STORAGE RESERVOIR

RZM

RZM

Tilligerry Creek

EL 3085

Area released to M.D.L. for exploration

EL 2683

MINERAL DEPOSITS

Beach

BIGHT

Stockton

NEWCASTLE

HUNTER RIVER

FULLERTON COVE

G.N

0 1 2 3 4 5 cm

6360 000

400 000

A3 Col.

REF. DRG.

LEGEND

Current R.Z.M. exploration tenure

Mining Leases / Applications

| | | | |
|---|---|---|---|
| DRAWN | DG | 9/88 | 1:100 000 SCALE |
| REV. | DG | 10/93 | |
| | DG | 11/95 | |

RZM R.Z. MINES (NEWCASTLE) PTY. LTD.

EL 2683 / EL 3085

PORT STEPHENS (NSW)

CURRENT MINING TENURE

DRG.NO.—A3 22 FIGURE NO. 4

GS 1996/034

PORT STEPHENS

Soldiers Point

Big Swan Bay

GRAHAMSTOWN STORAGE RESERVOIR

Tilligerry Creek

EL 2683

HUNTER RIVER

FULLERTON COVE

Stockton Beach

BIGHT

NEWCASTLE

SOUTH PACIFIC OCEAN

G.N

0 1 2 3 4 5 cm

6360 000

400 000

A3 sol

REF. DRG.

LEGEND

Units relinquished

Units to be retained - Renewal application 4-9-1995

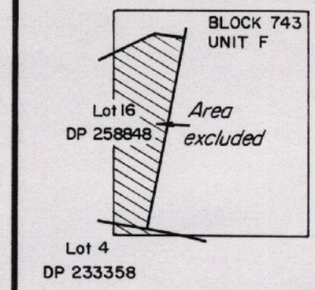
| | | | |
|---|---|---|---|
| DRAWN | DG | 7/91 | 1:100 000 SCALE |
| REV. | DG | 1/94 | |
| | DG | 11/95 | |

R.Z. MINES (NEWCASTLE) PTY. LTD.

EL 2683
PORT STEPHENS (NSW)

DRG.NO.—A3 79 FIGURE NO. 5

GS 1996/034




0 1000 metres

**DETAIL A**

32°45'S

Tilligerry Creek

Bobs Farm

Salt Ash

Birubi Point

EL 3085

Williamtown

151°48'E

152°05'E

Beach

Fullerton Cove

Stockton

OCEAN

PACIFIC

See Detail A

Hunter River

SOUTH

32°53'S

NEWCASTLE

TN

0 2 4 6 8 10 Km

A3 size

REF. DRG. NEWCASTLE 9232 PORT STEPHENS 9332

LEGEND

Area relinquished

Area to be retained - Renewal application 4-9-95

0 1 2 3 4 5 cm

| | | | |
|---|---|---|---|
| DRAWN | DG | | 1:100 000 SCALE |
| REV. | DG | 11/95 | |

**R.Z. MINES** (NEWCASTLE) PTY. LTD.

EL 3085 PORT STEPHENS (NSW)

DRG.NO.—A3 **68** FIG.NO. 6

**Table 1: MINING TENURE EXCLUDED FROM EL 2683 AND 3085**

**a) Rutile and Zircon Mines**

| No | Parish | Geographic Location |
|---|---|---|
| ML594 | Eldon | Tomago Sandbeds |
| ML744 | Stockton | Tomago Sandbeds |
| ML785 | Eldon | Tomago Sandbeds |
| ML1170 | Eldon | Tomago Sandbeds |
| ML1104 | Eldon | Tomago Sandbeds |
| ML1036 | Stockton | Tomago Sandbeds |
| ML1066 | Eldon | Tomago Sandbeds |
| ML1077 | Stowell | Tomago Sàndbeds |
| ML1071 | Eldon | Tomago Sandbeds |
| ML1068 | Stowell | Tomago Sandbeds |
| ML1067 | Stowell | Tomago Sandbeds |
| ML1069 | Stowell | Tomago Sandbeds |
| ML1070 | Stowell | Tomago Sandbeds |
| ML1078 (extinguished) | Sutton | Tomago Sandbeds |
| MLA140 | Stowell | Campvale |
| MLA189 (Dungog) | Stowell | Campvale |
| ML908 (AMC) | Stowell | Tomago Sandbeds |
| ML1068 | Stowell | Campvale |
| ML1008 (cancelled) | Stockton | Tomago Sandbeds |
| ML572 | Stockton | Tomago Sandbeds |
| ML650 | Stockton | Cabbage Tree Road |
| MPL123 | Stockton | Tomago |
| ML1222 | Eldon | Tomago Sandbeds |
| ML1225 | Eldon | Tomago Sandbeds |
| ML1226 | Eldon | Tomago Sandbeds |
| ML1315 | Sutton | Big Swan Bay |



**b) Mineral Deposits**

| No | Parish | Geographic Location |
|---|---|---|
| ML116 | Stowell | Cox's Lane |
| ML391 | Stowell | Cox's Lane |
| ML381 | Stowell | Cox's Lane |
| ML611 | Stowell | Cox's Lane |
| ML751 | Stowell | Cox's Lane |
| ML759 | Stowell | Cox's Lane |
| ML760 | Stowell | Cox's Lane |
| ML769 | Stowell | Cox's Lane |
| ML788 | Stowell | Cox's Lane |
| ML956 | Stowell | Cox's Lane |
| ML1110 | Stowell | Cox's Lane |
| ML1111 | Stowell | Cox's Lane |
| SL328 | Stowell | Cox's Lane |
| SL486 | Stowell | Cox's Lane |
| SL598 | Stowell | Cox's Lane |
| SL599 | Stowell | Cox's Lane |
| SL630 | Stowell | Cox's Lane |
| PMA - Tolls | Stowell | Cox's Lane |
| SL599 | Stowell | Cox's Lane |

## 6.0 GEOLOGY

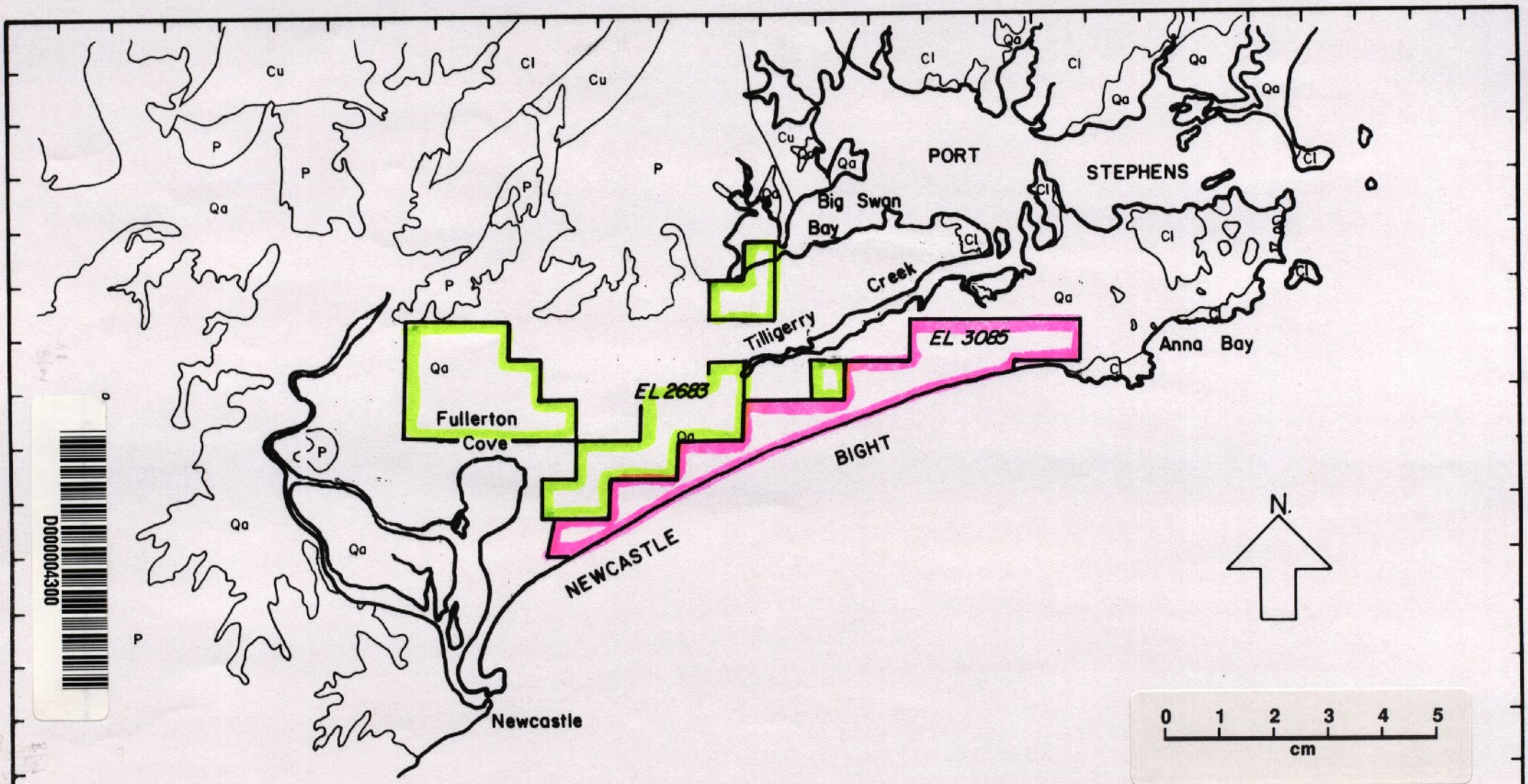
The geology of the area covered by the two Exploration Licences (EL 2683 and EL 3085) is summarised on the Newcastle 1:250,000 (Geological Series Sheet S1 56-7, compiled by the Geological Survey of New South Wales, 1966. **Figure 7** is an extract from this map.

The geology of the area covered by the two Exploration Licences consists essentially of Carboniferous and Permian sediments overlain by considerable thicknesses of Quaternary sands, silts and clays.

In the eastern portion of the Tomaree Peninsula, the underlying Carboniferous rocks belong to the Gilmore Volcanic sequence whilst the west of the area, covered by both Exploration Licences is underlain by the Permian Tomago Coal Measures.

The overall geology of the Quaternary deposits, the Tomago Sandbeds, that comprise most of the surface geology, is described in a paper by P.S. Roy published in the records of the Geological Survey of New South Wales, volume 19, part 22 pp 198-219, to which reference should be made.

GS 1996/034




D00000004300

REF DRG

LEGEND

| | |
|---|---|
| Qa | Quaternary |
| P | Permian Sediments |
| Cu | Carboniferous Sediments |
| Cl | Carboniferous Volcanics |

Current RZM exploration tenure

| | | | |
|---|---|---|---|
| DRAWN | DG | 9/88 | 1:250 000 SCALE |
| REV. | DG | 10/93 | |
| | DG | 11/95 | |

RZM R.Z. MINES (NEWCASTLE) PTY LTD

EL 2683 / EL 3085

PORT STEPHENS (NSW)

GEOLOGY

DRG NO.—A4 32 FIGURE NO. 7

## 7.0 PREVIOUS EXPLORATION

The Tomago Sandbeds and Stockton Dunes areas comprise the largest single Quaternary sand mass in Eastern New South Wales with heavy mineral potential which is currently available for exploration. All other areas with potential for major heavy mineral deposits in the coastal zone of New South Wales are either partially or completely sterilised by development or inclusion within National Parks or Nature Reserves.

Previous work within the area has shown the presence of significant heavy mineral deposits, mainly in the form of long strand line deposits sub-parallel to the current beach at Stockton Bight. Mining of these deposits was commenced in the 1960's and has continued until the present day. A number of companies has been involved in the area, with Associated Minerals Consolidated, Mineral Deposits and Rutile & Zircon Mines being the major operators. Both Mineral Deposits and Rutile & Zircon Mines (RZM) continue to operate within the area.

The original exploration of the area was carried out by a number of different syndicates and operators with a variety of tenure, resulting in a situation where the overall picture was obscured by the variety of methods used and various reporting standards.

For this reason, a programme which proposed to inspect and reassess the previous drilling and do wide spaced regional drilling, was started. The previous drilling data remains confidential because of Mineral Deposits' claimed equity over some of the area. A settlement of the dispute between RZM and MD was satisfactorily concluded in 1991.

The results of this exploration, in EL 3085, will add to the overall picture of the Port Stephens/Stockton Bight area, which is already well advanced in the adjoining Exploration Licence (EL 2683).

Application for an Exploration Licence in the Port Stephens area was made on 27th May 1985 and tenure was granted in the form of EL 2683 on 3rd October 1986. EL 2683 lies immediately north of Exploration Licence 3085 which was applied for on 23rd April 1986 and granted on 23rd March 1988.

Immediately prior to application for EL 2683, Rutile & Zircon Mines commenced tests designed to assess the viability of using geophysical methods in locating heavy mineral strand lines in the Tomago environment. From these results, it was concluded that a detailed airborne geophysical survey was not warranted.

Exploration drilling within EL 2683 has been continuous over seven years since 1987. The drilling has been directed towards the along strike extension of the main Pleistocene Inner Barrier currently being mined in

RZM's mining leases, and towards additional deep HM leads below previously explored areas.

To the beginning of the current reporting period, a total of 57,207 metres had been drilled in 4,411 holes within EL 2683.

Exploration drilling within EL 3085 has continued since 1988 and been directed at locating new HM resources in the Holocene outer barrier dune system. Apart from the HM leads on the landward edge of the Stockton Dunes, which are either being mined by other companies or are sterilised by development, no new HM resources have been identified. Large tracts of the Stockton Dunes, however, remain unexplored.

Prior to the current reporting period, a total of 27,420 metres had been drilled in 970 holes within EL 3085.

## 8.0 CURRENT EXPLORATION

All exploration drilling carried out in this reporting period was so done using Dormers hand auger equipment. Below water table, sludging gear was used. Samples of entire 0.5m intervals were bagged and transported to RZM's Heatherbrae laboratory for drying and splitting and thence to RZM's Tomago Laboratory for gravity separation.

The locations of all holes drilled during the 12 months to 3rd October 1995 are shown in **Enclosure 1.**

### Exploration Licence 2683

No exploration drilling was undertaken in EL 2683 in the 12 months period ending 3rd October 1995. The only drilling carried out was in relation to the emplacement of pre mining spearpoints for monitoring water quality and levels. This drilling was carried out in the mining leases which lie within EL 2683 and as such have been reported upon in relation to these leases.

Resource calculations were carried out on results received from previous drilling in the Blind Harrys Swamp area of the Tomago Sandbeds. An indicated resource of approximately 6.1 million tonnes of sand at a grade of 0.86% HM (at a 0.5% cut-off grade) was calculated.

### Exploration Licence 3085

Exploration drilling within EL 3085 continued in the Bobs Farm area of the Stockton Dunes. A total of 718.5m was drilled in 118 hand auger holes

These holes were on lines spaced approximately 320m apart in between existing broad spaced (1,280m apart) lines and designed to better define the extent of mineralisation indicated by previous drilling on those broad spaced lines.

Holes were spaced at 10 or 20m intervals in the zone considered to have maximum potential for mineralisation based on the earlier results. Due to the shallow nature of the mineralisation a maximum hole depth of eight metres was set for these holes with many stopping short of this after intersecting the high grade zone.

The locations of all holes drilled in this reporting period are depicted in **Enclosure 1.** Copies of log sheets for these holes are included in **Appendix 1.** Results from the drilling confirm the existence of a narrow (10 - 20 metres) shallow (between four and eight metres deep) strand line running along the western edge of the dune system.

The narrow nature of this strand and its shallow depth in relation to the water table make it largely unsuitable for a dredge mining operation. As such, the area would be more amenable to a dry mining type operation, utilising a small mobile separation plant being fed by excavator or end loader.

Overall head grades in the area (i.e. allowing dilution from sub grade sand above) is probably not sufficient to make such an operation economically viable under the present conditions.

## 9.0 EXPENDITURE

EL 2683 and EL 3085 for the period 3/10/94 to 2/10/95.

| | EL 2683 | EL 3085 |
|---|---|---|
| Geologists Salaries | 2,203 | 3,438 |
| Consultants | - | - |
| Survey - Wages & Consumables | - | - |
| Drafting | 486 | 2,671 |
| Computers | - | 96 |
| Drilling - Wages & Consumables | - | 9,957 |
| Laboratory | 1,458 | 13,700 |
| Vehicles | 314 | 2,892 |
| Tenement | 457 | 310 |
| Travel and Accommodation | - | - |
| Freight | - | - |
| Supplies | 342 | 447 |
| Sustenance | - | - |
| Communications | - | 17 |
| Maps and Air Photos | - | 318 |
| General Contractors | - | 5,119 |
| Depreciation | 472 | 1,304 |
| Compensation | - | - |
| Miscellaneous | - | 503 |
| Head Office Charges | 345 | 642 |
| Administration | 640 | 4,470 |
| Premises | 345 | 3,287 |
| Total | 7,062 | 49,171 |

Note: Administration charge calculated as 10% of other costs.

R. HODGE
Mine Geologist

## 10.0 REFERENCES


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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .6948OE
Hole No. . . . .412ON

Driller:.... G. SHEATHER
Date:..... 28/8/95
Rig:..... HD 4
Depth to Water:..... 2.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.10
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.0 | LtBr&YS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 52.7 | 51.8 | 0.07 | 2 | 0.13 | 0.13 |
| 2.0 | 6.0 | LtBrS | | | | 10 YR | 6 | 6 | 1.0 | 1.5 | 49.2 | 48.4 | 0.10 | 2 | 0.20 | 0.16 |
| | | | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 56.3 | 55.7 | 0.03 | 1 | 0.05 | 0.13 |
| | | | 10 YR | 7 | 4 | | | | 2.0 | 2.5 | 53.3 | 53.1 | 0.03 | 0 | 0.06 | 0.11 |
| | | | 10 YR | 7 | 4 | | | | 2.5 | 3.0 | 47.6 | 47.5 | 0.11 | 0 | 0.23 | 0.14 |
| | | | 10 YR | 7 | 4 | | | | 3.0 | 3.5 | 49.7 | 49.3 | 0.04 | 1 | 0.08 | 0.13 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 51.9 | 51.7 | 0.02 | 0 | 0.04 | 0.11 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 52.3 | 52.1 | 0.02 | 0 | 0.04 | 0.11 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 56.4 | 56.0 | 0.04 | 1 | 0.07 | 0.10 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 50.8 | 50.5 | 0.04 | 1 | 0.08 | 0.10 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 59.9 | 59.6 | 0.03 | 1 | 0.05 | 0.10 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .69480E
Hole No. . . . .4140N

Driller:.... G. SHEATHER
Date:..... 28/8/95
Rig:..... HD 4
Depth to Water:..... 2.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.19
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | |
| FROM | TO | DESCRIPT. | HUE | V | C | HUE V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.5 | LtBr&YS | | | | 10 YR 6 2 | 0.3 | 1.0 | 50.5 | 49.8 | 0.20 | 1 | 0.40 | 0.40 |
| 2.5 | 6.0 | LtBrS | | | | 10 YR 6 2 | 1.0 | 1.5 | 53.4 | 52.7 | 0.07 | 1 | 0.13 | 0.29 |
| | | | | | | 10 YR 6 6 | 1.5 | 2.0 | 50.5 | 50.2 | 0.14 | 1 | 0.28 | 0.28 |
| | | | 10 YR 6 6 | | | | 2.0 | 2.5 | 55.6 | 55.3 | 0.02 | 1 | 0.04 | 0.23 |
| | | | 10 YR 7 4 | | | | 2.5 | 3.0 | 53.7 | 53.4 | 0.08 | 1 | 0.15 | 0.21 |
| | | | 10 YR 7 4 | | | | 3.0 | 3.5 | 52.5 | 52.4 | 0.13 | 0 | 0.25 | 0.22 |
| | | | 10 YR 7 4 | | | | 3.5 | 4.0 | 53.6 | 53.5 | 0.13 | 0 | 0.24 | 0.22 |
| | | | 10 YR 7 4 | | | | 4.0 | 4.5 | 46.9 | 46.8 | 0.08 | 0 | 0.17 | 0.22 |
| | | | 10 YR 7 4 | | | | 4.5 | 5.0 | 60.1 | 59.7 | 0.03 | 1 | 0.05 | 0.20 |
| | | | 10 YR 7 4 | | | | 5.0 | 5.5 | 52.8 | 52.7 | 0.10 | 0 | 0.19 | 0.20 |
| | | | 10 YR 7 4 | | | | 5.5 | 6.0 | 57.0 | 56.8 | 0.06 | 0 | 0.11 | 0.19 |

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BORE HOLE LOG ~ RZM PTY. LTD.

Line No. . . . .69480E
Hole No. . . . .4160N

Driller:.... G. SHEATHER
Date:..... 28/8/95
Rig:..... HD 4
Depth to Water:..... 2.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.23
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.5 | LtBr&YS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 58.6 | 57.9 | 0.29 | 1 | 0.49 | 0.49 |
| 2.5 | 6.0 | LtBrS | | | | 10 YR | 6 | 6 | 1.0 | 1.5 | 54.4 | 53.2 | 0.35 | 2 | 0.64 | 0.56 |
| | | | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 45.6 | 44.9 | 0.27 | 2 | 0.59 | 0.57 |
| | | | 10 YR | 6 | 6 | | | | 2.0 | 2.5 | 53.5 | 53.2 | 0.08 | 1 | 0.15 | 0.47 |
| | | | 10 YR | 7 | 4 | | | | 2.5 | 3.0 | 52.4 | 52.1 | 0.04 | 1 | 0.08 | 0.40 |
| | | | 10 YR | 7 | 4 | | | | 3.0 | 3.5 | 49.3 | 49.0 | 0.03 | 1 | 0.06 | 0.35 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 58.9 | 58.7 | 0.03 | 0 | 0.05 | 0.31 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 46.4 | 46.2 | 0.04 | 0 | 0.09 | 0.28 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 61.1 | 60.9 | 0.06 | 0 | 0.10 | 0.26 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 53.8 | 53.7 | 0.05 | 0 | 0.09 | 0.24 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 55.3 | 55.1 | 0.05 | 0 | 0.09 | 0.23 |

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BORE HOLE LOG ~ RZM PTY. LTD.

Line No. . . . .6948OE
Hole No. . . . .418ON

Driller:..... G. SHEATHER
Date:..... 25/8/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.33
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ~~WET~~ | | | ~~DRY~~ | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | LtBrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 51.1 | 49.5 | 0.07 | 3 | 0.14 | 0.14 |
| 1.5 | 3.0 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 55.5 | 54.9 | 0.09 | 1 | 0.16 | 0.15 |
| 3.0 | 6.0 | LtBrS | | | | 10 YR | 4 2 | 1.5 | 2.0 | 49.1 | 48.5 | 0.20 | 1 | 0.41 | 0.22 |
| | | | | | | 10 YR | 4 2 | 2.0 | 2.5 | 52.1 | 51.7 | 0.29 | 1 | 0.56 | 0.30 |
| | | | | | | 10 YR | 5 4 | 2.5 | 3.0 | 50.0 | 49.5 | 0.38 | 1 | 0.76 | 0.38 |
| | | | 10 YR | 7 | 4 | | | 3.0 | 3.5 | 59.6 | 59.3 | 0.24 | 1 | 0.40 | 0.39 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 53.7 | 53.5 | 0.12 | 0 | 0.22 | 0.37 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 53.2 | 52.9 | 0.09 | 1 | 0.17 | 0.34 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 59.0 | 58.7 | 0.17 | 1 | 0.29 | 0.34 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 51.9 | 51.6 | 0.14 | 1 | 0.27 | 0.33 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 50.9 | 50.6 | 0.15 | 1 | 0.29 | 0.33 |

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .69480E
Hole No. . . . .4200N

Driller:..... G. SHEATHER
Date:..... 25/8/95
Rig:..... HD 4
Depth to Water:..... 5.3
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:.... 6.7

Wtd Grade Wt % : 0.26
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 7.0 | G,Y&BrS | | | | 10 YR | 8 | 2 | 0.3 | 1.0 | 47.6 | 47.0 | 0.18 | 1 | 0.38 | 0.38 |
| | | | | | | 10 YR | 7 | 4 | 1.0 | 1.5 | 60.2 | 59.5 | 0.17 | 1 | 0.28 | 0.34 |
| | | | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 52.3 | 51.7 | 0.04 | 1 | 0.08 | 0.26 |
| | | | | | | 10 YR | 5 | 4 | 2.0 | 2.5 | 51.1 | 50.6 | 0.16 | 1 | 0.31 | 0.27 |
| | | | | | | 10 YR | 6 | 6 | 2.5 | 3.0 | 53.8 | 53.4 | 0.05 | 1 | 0.09 | 0.24 |
| | | | | | | 10 YR | 6 | 6 | 3.0 | 3.5 | 52.6 | 52.1 | 0.10 | 1 | 0.19 | 0.23 |
| | | | | | | 10 YR | 7 | 4 | 3.5 | 4.0 | 49.1 | 48.8 | 0.13 | 1 | 0.26 | 0.24 |
| | | | | | | 10 YR | 8 | 2 | 4.0 | 4.5 | 56.7 | 56.5 | 0.10 | 0 | 0.18 | 0.23 |
| | | | | | | 10 YR | 8 | 2 | 4.5 | 5.0 | 53.1 | 53.0 | 0.07 | 0 | 0.13 | 0.22 |
| | | | 10 YR | 4 | 2 | | | | 5.0 | 5.5 | 50.3 | 48.5 | 0.17 | 4 | 0.34 | 0.23 |
| | | | 10 YR | 6 | 2 | | | | 5.5 | 6.0 | 46.4 | 45.6 | 0.20 | 2 | 0.43 | 0.25 |
| | | | 10 YR | 6 | 2 | | | | 6.0 | 6.5 | 44.3 | 43.8 | 0.13 | 1 | 0.29 | 0.25 |
| | | | 10 YR | 6 | 2 | | | | 6.5 | 7.0 | 44.9 | 44.4 | 0.15 | 1 | 0.33 | 0.26 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .69480E
Hole No. . . . .4220N

Driller:..... G. SHEATHER
Date:..... 25/8/95
Rig:..... HD 4
Depth to Water:..... 4.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.16
Wtd Slimes % : 2

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.0 | LtBS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 49.7 | 48.7 | 0.07 | 2 | 0.14 | 0.14 |
| 2.0 | 3.5 | BrS | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 47.0 | 46.5 | 0.07 | 1 | 0.15 | 0.14 |
| 3.5 | 4.5 | LtBrS | | | | 10 YR | 6 | 2 | 1.5 | 2.0 | 56.5 | 56.1 | 0.10 | 1 | 0.18 | 0.15 |
| 4.5 | 5.0 | BrS | | | | 5 YR | 3 | 2 | 2.0 | 2.5 | 53.0 | 52.1 | 0.05 | 2 | 0.09 | 0.14 |
| 5.0 | 6.0 | LtBrS | | | | 5 YR | 3 | 4 | 2.5 | 3.0 | 52.1 | 51.4 | 0.09 | 1 | 0.17 | 0.15 |
| | | | | | | 5 YR | 5 | 6 | 3.0 | 3.5 | 50.3 | 49.8 | 0.08 | 1 | 0.16 | 0.15 |
| | | | | | | 10 YR | 7 | 4 | 3.5 | 4.0 | 47.7 | 47.5 | 0.05 | 0 | 0.10 | 0.14 |
| | | | | | | 10 YR | 7 | 4 | 4.0 | 4.5 | 50.8 | 50.5 | 0.05 | 1 | 0.10 | 0.14 |
| | | | 10 YR | 4 | 2 | | | | 4.5 | 5.0 | 43.6 | 40.5 | 0.12 | 7 | 0.28 | 0.15 |
| | | | 10 YR | 6 | 2 | | | | 5.0 | 5.5 | 48.7 | 48.0 | 0.08 | 1 | 0.16 | 0.15 |
| | | | 10 YR | 6 | 2 | | | | 5.5 | 6.0 | 48.1 | 47.3 | 0.11 | 2 | 0.23 | 0.16 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . . .69480E
Hole No. . . . . .4240N

Driller:..... G. SHEATHER
Date:..... 24/8/95
Rig:..... HD 4
Depth to Water:..... 4.2
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.09
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.6 | LtBrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 57.8 | 57.2 | 0.07 | 1 | 0.12 | 0.12 |
| 1.6 | 4.5 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 49.9 | 49.6 | 0.02 | 1 | 0.04 | 0.09 |
| 4.5 | 6.0 | LtBrS | | | | 10 YR | 5 4 | 1.5 | 2.0 | 57.6 | 57.2 | 0.01 | 1 | 0.02 | 0.07 |
| | | | | | | 10 YR | 5 4 | 2.0 | 2.5 | 54.1 | 53.7 | 0.09 | 1 | 0.17 | 0.09 |
| | | | | | | 10 YR | 5 4 | 2.5 | 3.0 | 50.9 | 50.4 | 0.02 | 1 | 0.04 | 0.08 |
| | | | | | | 10 YR | 5 4 | 3.0 | 3.5 | 54.3 | 53.9 | 0.01 | 1 | 0.02 | 0.07 |
| | | | | | | 10 YR | 5 4 | 3.5 | 4.0 | 50.7 | 49.8 | 0.02 | 2 | 0.04 | 0.07 |
| | | | 10 YR | 4 | 2 | | | 4.0 | 4.5 | 50.6 | 49.1 | 0.12 | 3 | 0.24 | 0.09 |
| | | | 10 YR | 6 | 2 | | | 4.5 | 5.0 | 48.5 | 48.2 | 0.05 | 1 | 0.10 | 0.09 |
| | | | 10 YR | 6 | 2 | | | 5.0 | 5.5 | 49.9 | 49.6 | 0.05 | 1 | 0.10 | 0.09 |
| | | | 10 YR | 6 | 2 | | | 5.5 | 6.0 | 55.4 | 55.1 | 0.05 | 1 | 0.09 | 0.09 |

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . . .69480E
Hole No. . . . . .4260N

Driller:..... G. SHEATHER
Date:..... 24/8/95
Rig:..... HD 4
Depth to Water:..... 2.7
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.18
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.8 | LtBrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 55.0 | 54.2 | 0.06 | 1 | 0.11 | 0.11 |
| 2.8 | 6.0 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 57.5 | 57.1 | 0.03 | 1 | 0.05 | 0.09 |
| | | | | | | 10 YR | 6 2 | 1.5 | 2.0 | 52.9 | 52.6 | 0.05 | 1 | 0.09 | 0.09 |
| | | | | | | 10 YR | 6 2 | 2.0 | 2.5 | 55.1 | 54.5 | 0.18 | 1 | 0.33 | 0.14 |
| | | | 10 YR | 4 | 2 | | | 2.5 | 3.0 | 52.0 | 51.4 | 0.23 | 1 | 0.44 | 0.20 |
| | | | 10 YR | 4 | 2 | | | 3.0 | 3.5 | 47.6 | 47.1 | 0.10 | 1 | 0.21 | 0.20 |
| | | | 10 YR | 4 | 2 | | | 3.5 | 4.0 | 59.1 | 58.5 | 0.06 | 1 | 0.10 | 0.19 |
| | | | 10 YR | 4 | 2 | | | 4.0 | 4.5 | 52.2 | 51.8 | 0.08 | 1 | 0.15 | 0.18 |
| | | | 10 YR | 4 | 2 | | | 4.5 | 5.0 | 54.4 | 53.8 | 0.12 | 1 | 0.22 | 0.19 |
| | | | 10 YR | 4 | 2 | | | 5.0 | 5.5 | 51.0 | 50.4 | 0.08 | 1 | 0.16 | 0.18 |
| | | | 10 YR | 4 | 2 | | | 5.5 | 6.0 | 51.9 | 51.4 | 0.10 | 1 | 0.19 | 0.18 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .69480E
Hole No. . . . .4280N

Driller:.... G. SHEATHER
Date:..... 24/8/95
Rig:..... HD 4
Depth to Water:..... 2.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.10
Wtd Slimes % : 4

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.7 | LtBrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 48.8 | 48.0 | 0.04 | 2 | 0.08 | 0.08 |
| 1.7 | 2.6 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 57.1 | 56.4 | 0.18 | 1 | 0.32 | 0.18 |
| 2.6 | 6.0 | LtBrS | | | | 5 YR | 3 2 | 1.5 | 2.0 | 46.0 | 40.2 | 0.07 | 13 | 0.15 | 0.17 |
| | | | | | | 5 YR | 3 2 | 2.0 | 2.5 | 41.4 | 33.2 | 0.04 | 20 | 0.10 | 0.15 |
| | | | 10 YR | 4 | 2 | | | 2.5 | 3.0 | 50.5 | 49.9 | 0.06 | 1 | 0.12 | 0.15 |
| | | | 10 YR | 6 | 2 | | | 3.0 | 3.5 | 50.2 | 49.8 | 0.03 | 1 | 0.06 | 0.13 |
| | | | 10 YR | 6 | 2 | | | 3.5 | 4.0 | 56.8 | 56.4 | 0.04 | 1 | 0.07 | 0.13 |
| | | | 10 YR | 6 | 2 | | | 4.0 | 4.5 | 47.8 | 47.5 | 0.02 | 1 | 0.04 | 0.12 |
| | | | 10 YR | 6 | 2 | | | 4.5 | 5.0 | 48.1 | 47.8 | 0.02 | 1 | 0.04 | 0.11 |
| | | | 10 YR | 6 | 2 | | | 5.0 | 5.5 | 53.0 | 52.7 | 0.03 | 1 | 0.06 | 0.10 |
| | | | 10 YR | 6 | 2 | | | 5.5 | 6.0 | 49.5 | 49.2 | 0.02 | 1 | 0.04 | 0.10 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .69480E
Hole No. . . . .4300N

Driller:.... G. SHEATHER
Date:..... 24/8/95
Rig:..... HD 4
Depth to Water:..... 2.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.22
Wtd Slimes % : 3

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| | | | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 54.7 | 53.5 | 0.08 | 2 | 0.15 | 0.15 |
| | | | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 46.0 | 45.3 | 0.06 | 2 | 0.13 | 0.14 |
| | | | | | | 5 YR | 3 | 2 | 1.5 | 2.0 | 52.4 | 48.0 | 0.02 | 8 | 0.04 | 0.11 |
| | | | 5 YR | 3 | 2 | | | | 2.0 | 2.5 | 38.1 | 32.0 | 0.03 | 16 | 0.08 | 0.10 |
| | | | 10 YR | 6 | 2 | | | | 2.5 | 3.0 | 50.6 | 49.9 | 0.11 | 1 | 0.22 | 0.12 |
| | | | 10 YR | 6 | 2 | | | | 3.0 | 3.5 | 53.6 | 53.2 | 0.08 | 1 | 0.15 | 0.13 |
| | | | 10 YR | 6 | 2 | | | | 3.5 | 4.0 | 51.8 | 51.5 | 0.14 | 1 | 0.27 | 0.15 |
| | | | 10 YR | 6 | 2 | | | | 4.0 | 4.5 | 51.6 | 51.3 | 0.21 | 1 | 0.41 | 0.18 |
| | | | 10 YR | 6 | 2 | | | | 4.5 | 5.0 | 57.2 | 56.9 | 0.22 | 1 | 0.38 | 0.20 |
| | | | 10 YR | 6 | 2 | | | | 5.0 | 5.5 | 57.2 | 56.9 | 0.17 | 1 | 0.30 | 0.21 |
| | | | 10 YR | 6 | 2 | | | | 5.5 | 6.0 | 56.2 | 55.9 | 0.17 | 1 | 0.30 | 0.22 |

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .69480E
Hole No. . . . .4320N

Driller:.... G. SHEATHER
Date:..... 24/8/95
Rig:..... HD 4
Depth to Water:..... 2.7
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.12
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | LtBrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 55.3 | 54.5 | 0.04 | 1 | 0.07 | 0.07 |
| 1.5 | 3.0 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 58.3 | 57.8 | 0.07 | 1 | 0.12 | 0.09 |
| 3.0 | 6.0 | LtBrS | | | | 10 YR | 4 2 | 1.5 | 2.0 | 55.1 | 54.6 | 0.04 | 1 | 0.07 | 0.09 |
| | | | | | | 5 YR | 3 2 | 2.0 | 2.5 | 53.7 | 53.1 | 0.02 | 1 | 0.04 | 0.08 |
| | | | 5 YR | 3 | 2 | | | 2.5 | 3.0 | 47.9 | 44.9 | 0.05 | 6 | 0.10 | 0.08 |
| | | | 10 YR | 6 | 2 | | | 3.0 | 3.5 | 51.2 | 50.8 | 0.10 | 1 | 0.20 | 0.10 |
| | | | 10 YR | 6 | 2 | | | 3.5 | 4.0 | 51.7 | 51.3 | 0.08 | 1 | 0.15 | 0.11 |
| | | | 10 YR | 6 | 2 | | | 4.0 | 4.5 | 58.0 | 57.6 | 0.10 | 1 | 0.17 | 0.11 |
| | | | 10 YR | 6 | 2 | | | 4.5 | 5.0 | 57.2 | 56.9 | 0.08 | 1 | 0.14 | 0.12 |
| | | | 10 YR | 6 | 2 | | | 5.0 | 5.5 | 53.5 | 53.2 | 0.07 | 1 | 0.13 | 0.12 |
| | | | 10 YR | 6 | 2 | | | 5.5 | 6.0 | 49.7 | 49.5 | 0.07 | 0 | 0.14 | 0.12 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .69480E
Hole No. . . . .4340N

Driller:.... G. SHEATHER
Date:..... 23/8/95
Rig:..... HD 4
Depth to Water:..... 3.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.11
Wtd Slimes % : 2

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | |
| FROM | TO | DESCRIPT. | HUE | V | C | HUE V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.0 | GS | | | | 5 YR 6 1 | 0.3 | 1.0 | 43.1 | 42.7 | 0.05 | 1 | 0.12 | 0.12 |
| 2.0 | 4.0 | BrS | | | | 5 YR 6 1 | 1.0 | 1.5 | 50.6 | 50.2 | 0.10 | 1 | 0.20 | 0.15 |
| 4.0 | 6.0 | LtBrS | | | | 10 YR 6 2 | 1.5 | 2.0 | 50.7 | 49.9 | 0.04 | 2 | 0.08 | 0.13 |
| | | | | | | 10 YR 4 2 | 2.0 | 2.5 | 53.7 | 52.6 | 0.03 | 2 | 0.06 | 0.11 |
| | | | | | | 10 YR 4 2 | 2.5 | 3.0 | 46.6 | 46.2 | 0.03 | 1 | 0.06 | 0.10 |
| | | | | | | 10 YR 4 2 | 3.0 | 3.5 | 41.8 | 38.4 | 0.06 | 8 | 0.14 | 0.11 |
| | | | 10 YR 4 2 | | | | 3.5 | 4.0 | 48.4 | 44.4 | 0.07 | 8 | 0.14 | 0.11 |
| | | | 10 YR 6 2 | | | | 4.0 | 4.5 | 56.4 | 56.0 | 0.11 | 1 | 0.20 | 0.12 |
| | | | 10 YR 6 2 | | | | 4.5 | 5.0 | 52.0 | 51.7 | 0.07 | 1 | 0.13 | 0.13 |
| | | | 10 YR 6 2 | | | | 5.0 | 5.5 | 49.6 | 49.4 | 0.04 | 0 | 0.08 | 0.12 |
| | | | 10 YR 6 2 | | | | 5.5 | 6.0 | 50.7 | 50.4 | 0.02 | 1 | 0.04 | 0.11 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .69480E
Hole No. . . . .4360N

Driller:..... G. SHEATHER
Date:..... 23/8/95
Rig:..... HD 4
Depth to Water:..... 3.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.11
Wtd Slimes % : 1

| LITHOLOGY | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE V C | DRY HUE V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | 0.0 | 0.3 | | | | | | |
| | | | | 10 YR 6 2 | 0.3 | 1.0 | 57.0 | 56.4 | 0.08 | 1 | 0.14 | 0.14 |
| | | | | 10 YR 6 2 | 1.0 | 1.5 | 55.6 | 55.4 | 0.04 | 0 | 0.07 | 0.11 |
| | | | | 10 YR 6 2 | 1.5 | 2.0 | 45.3 | 45.0 | 0.07 | 1 | 0.15 | 0.12 |
| | | | | 10 YR 6 2 | 2.0 | 2.5 | 57.7 | 57.5 | 0.03 | 0 | 0.05 | 0.11 |
| | | | | 10 YR 4 2 | 2.5 | 3.0 | 52.8 | 52.3 | 0.02 | 1 | 0.04 | 0.09 |
| | | | | 10 YR 4 2 | 3.0 | 3.5 | 56.9 | 56.2 | 0.03 | 1 | 0.05 | 0.09 |
| | | | 10 YR 4 2 | | 3.5 | 4.0 | 40.2 | 38.5 | 0.06 | 4 | 0.15 | 0.10 |
| | | | 10 YR 6 2 | | 4.0 | 4.5 | 50.2 | 50.1 | 0.04 | 0 | 0.08 | 0.09 |
| | | | 10 YR 6 2 | | 4.5 | 5.0 | 50.8 | 50.6 | 0.08 | 0 | 0.16 | 0.10 |
| | | | 10 YR 6 2 | | 5.0 | 5.5 | 48.7 | 48.4 | 0.10 | 1 | 0.21 | 0.11 |
| | | | 10 YR 6 2 | | 5.5 | 6.0 | 44.6 | 44.5 | 0.06 | 0 | 0.13 | 0.11 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .69480E
Hole No. . . . .4380N

Driller:.... G. SHEATHER
Date:..... 23/8/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.18
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.0 | LtBrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 48.5 | 48.1 | 0.14 | 1 | 0.29 | 0.29 |
| 2.0 | 3.5 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 51.6 | 50.9 | 0.14 | 1 | 0.27 | 0.28 |
| 3.5 | 6.0 | LtBrS | | | | 10 YR | 6 2 | 1.5 | 2.0 | 51.1 | 50.7 | 0.02 | 1 | 0.04 | 0.21 |
| | | | | | | 10 YR | 4 2 | 2.0 | 2.5 | 51.6 | 50.9 | 0.07 | 1 | 0.14 | 0.19 |
| | | | | | | 10 YR | 4 2 | 2.5 | 3.0 | 44.6 | 43.9 | 0.08 | 2 | 0.18 | 0.19 |
| | | | 10 YR | 4 | 2 | | | 3.0 | 3.5 | 40.4 | 38.2 | 0.06 | 5 | 0.15 | 0.18 |
| | | | 10 YR | 6 | 2 | | | 3.5 | 4.0 | 50.0 | 49.7 | 0.14 | 1 | 0.28 | 0.20 |
| | | | 10 YR | 6 | 2 | | | 4.0 | 4.5 | 52.6 | 52.5 | 0.11 | 0 | 0.21 | 0.20 |
| | | | 10 YR | 6 | 2 | | | 4.5 | 5.0 | 57.8 | 57.5 | 0.07 | 1 | 0.12 | 0.19 |
| | | | 10 YR | 6 | 2 | | | 5.0 | 5.5 | 50.6 | 50.3 | 0.05 | 1 | 0.10 | 0.18 |
| | | | 10 YR | 6 | 2 | | | 5.5 | 6.0 | 52.2 | 51.9 | 0.08 | 1 | 0.15 | 0.18 |

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BORE HOLE LOG - R/M PTY. LTD.

Line No. . . . .694ROE
Hole No. . . . .4400N

Driller:.... G. SHEATHER
Date:..... 25/8/95
Rig:..... HD 4
Depth to Water:..... 3.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.22
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR --WET-- | | | --DRY-- | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | WT % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.0 | GS | | | | 5 YR | 6 | 1 | 0.3 | 1.0 | 50.7 | 49.9 | 0.05 | 2 | 0.10 | 0.10 |
| 2.0 | 4.0 | BrS | | | | 5 YR | 6 | 1 | 1.0 | 1.5 | 57.0 | 56.6 | 0.05 | 1 | 0.09 | 0.09 |
| 4.0 | 6.0 | LtBrS | | | | 5 YR | 6 | 1 | 1.5 | 2.0 | 46.2 | 45.5 | 0.06 | 2 | 0.13 | 0.10 |
| | | | | | | 10 YR | 4 | 2 | 2.0 | 2.5 | 55.1 | 54.2 | 0.09 | 2 | 0.16 | 0.12 |
| | | | | | | 10 YR | 6 | 2 | 2.5 | 3.0 | 49.9 | 49.5 | 0.10 | 1 | 0.20 | 0.13 |
| | | | | | | 10 YR | 4 | 2 | 3.0 | 3.5 | 42.6 | 40.5 | 0.09 | 5 | 0.21 | 0.15 |
| | | | 10 YR | 4 | 2 | | | | 3.5 | 4.0 | 41.6 | 40.3 | 0.08 | 3 | 0.19 | 0.15 |
| | | | 10 YR | 6 | 2 | | | | 4.0 | 4.5 | 56.8 | 56.6 | 0.44 | 0 | 0.77 | 0.23 |
| | | | 10 YR | 6 | 2 | | | | 4.5 | 5.0 | 48.5 | 48.2 | 0.12 | 1 | 0.25 | 0.23 |
| | | | 10 YR | 6 | 2 | | | | 5.0 | 5.5 | 51.5 | 51.2 | 0.10 | 1 | 0.19 | 0.22 |
| | | | 10 YR | 6 | 2 | | | | 5.5 | 6.0 | 55.1 | 54.9 | 0.12 | 0 | 0.22 | 0.22 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .69480E
Hole No. . . . .4420N

Driller:..... G. SHEATHER
Date:..... 23/8/95
Rig:..... HD 4
Depth to Water:..... 4.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.10
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.6 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 43.8 | 43.3 | 0.01 | 1 | 0.02 | 0.02 |
| 1.6 | 2.5 | BrS | | | | 10 YR | 8 | 2 | 1.0 | 1.5 | 45.7 | 45.4 | 0.08 | 1 | 0.18 | 0.09 |
| 2.5 | 3.2 | LtBrS | | | | 10 YR | 4 | 2 | 1.5 | 2.0 | 48.4 | 47.9 | 0.04 | 1 | 0.08 | 0.09 |
| 3.2 | 4.1 | BrS | | | | 5 YR | 3 | 2 | 2.0 | 2.5 | 57.6 | 55.8 | 0.05 | 3 | 0.09 | 0.09 |
| 4.1 | 6.0 | LtBrS | | | | 10 YR | 6 | 2 | 2.5 | 3.0 | 51.3 | 50.8 | 0.03 | 1 | 0.06 | 0.08 |
| | | | | | | 10 YR | 4 | 2 | 3.0 | 3.5 | 56.7 | 55.8 | 0.11 | 2 | 0.19 | 0.10 |
| | | | | | | 10 YR | 4 | 2 | 3.5 | 4.0 | 44.5 | 42.4 | 0.01 | 5 | 0.02 | 0.09 |
| | | | 10 YR | 6 | 2 | | | | 4.0 | 4.5 | 49.9 | 49.6 | 0.09 | 1 | 0.18 | 0.10 |
| | | | 10 YR | 6 | 2 | | | | 4.5 | 5.0 | 53.0 | 52.7 | 0.02 | 1 | 0.04 | 0.09 |
| | | | 10 YR | 6 | 2 | | | | 5.0 | 5.5 | 51.5 | 51.2 | 0.08 | 1 | 0.16 | 0.10 |
| | | | 10 YR | 6 | 2 | | | | 5.5 | 6.0 | 50.7 | 50.6 | 0.07 | 0 | 0.14 | 0.10 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3690N

Driller:..... G. SHEATHER
Date:..... 21/8/95
Rig:..... HD 4
Depth to Water:..... 1.8
Hole Bottom Code:..... Sand

Tenure:.....EL 3085
Parish:.....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.14
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.0 | GS | | | | 5 YR | 6 | 1 | 0.3 | 1.0 | 63.1 | 62.5 | 0.41 | 1 | 0.65 | 0.65 |
| 2.0 | 3.5 | BrS | | | | 5 YR | 6 | 1 | 1.0 | 1.5 | 54.8 | 54.2 | 0.05 | 1 | 0.09 | 0.42 |
| 3.5 | 6.0 | LtBrS | 5 YR | 6 | 1 | | | | 1.5 | 2.0 | 56.4 | 55.8 | 0.06 | 1 | 0.11 | 0.33 |
| | | | 10 YR | 5 | 4 | | | | 2.0 | 2.5 | 53.2 | 52.9 | 0.09 | 1 | 0.17 | 0.29 |
| | | | 10 YR | 5 | 4 | | | | 2.5 | 3.0 | 58.1 | 57.8 | 0.05 | 1 | 0.09 | 0.25 |
| | | | 10 YR | 5 | 4 | | | | 3.0 | 3.5 | 61.1 | 60.8 | 0.02 | 0 | 0.03 | 0.22 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 60.4 | 60.0 | 0.01 | 1 | 0.02 | 0.19 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 60.1 | 59.8 | 0.01 | 0 | 0.02 | 0.17 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 49.7 | 49.4 | 0.01 | 1 | 0.02 | 0.15 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 54.3 | 54.0 | 0.04 | 1 | 0.07 | 0.15 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 57.8 | 57.5 | 0.01 | 1 | 0.02 | 0.14 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7044OE
Hole No. . . . .3710N

Driller:.... G. SHEATHER
Date:..... 21/8/95
Rig:..... HD 4
Depth to Water:..... 1.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.05
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.1 | GS | | | | 5 YR | 6 | 1 | 0.3 | 1.0 | 59.1 | 58.2 | 0.02 | 2 | 0.03 | 0.03 |
| 1.1 | 3.2 | BrS | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 54.3 | 53.9 | 0.07 | 1 | 0.13 | 0.07 |
| 3.2 | 6.0 | LtBrS | 10 YR | 5 | 4 | | | | 1.5 | 2.0 | 56.7 | 56.2 | 0.03 | 1 | 0.05 | 0.07 |
| | | | 10 YR | 5 | 4 | | | | 2.0 | 2.5 | 55.9 | 55.6 | 0.06 | 1 | 0.11 | 0.08 |
| | | | 10 YR | 5 | 4 | | | | 2.5 | 3.0 | 54.6 | 54.2 | 0.04 | 1 | 0.07 | 0.08 |
| | | | 10 YR | 7 | 4 | | | | 3.0 | 3.5 | 56.8 | 56.4 | 0.06 | 1 | 0.11 | 0.08 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 51.6 | 51.2 | 0.01 | 1 | 0.02 | 0.07 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 61.1 | 60.6 | 0.01 | 1 | 0.02 | 0.07 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 57.1 | 56.7 | TRACE | 1 | | |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 59.1 | 58.7 | TRACE | 1 | | |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 56.3 | 55.9 | 0.01 | 1 | 0.02 | 0.05 |

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3730N

Driller:.... G. SHEATHER
Date:..... 21/8/95
Rig:..... HD 4
Depth to Water:..... 1.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.06
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.2 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 52.4 | 51.9 | 0.10 | 1 | 0.19 | 0.19 |
| 1.2 | 2.3 | BrS | | | | 5 YR | 3 | 4 | 1.0 | 1.5 | 51.9 | 51.2 | 0.02 | 1 | 0.04 | 0.13 |
| 2.3 | 6.0 | LtBrS | 5 YR | 4 | 4 | | | | 1.5 | 2.0 | 54.9 | 54.5 | 0.04 | 1 | 0.07 | 0.11 |
| | | | 10 YR | 5 | 4 | | | | 2.0 | 2.5 | 55.8 | 55.5 | 0.10 | 1 | 0.18 | 0.13 |
| | | | 10 YR | 5 | 4 | | | | 2.5 | 3.0 | 57.0 | 56.7 | 0.02 | 1 | 0.04 | 0.11 |
| | | | 10 YR | 5 | 4 | | | | 3.0 | 3.5 | 55.3 | 54.9 | 0.01 | 1 | 0.02 | 0.10 |
| | | | 10 YR | 6 | 2 | | | | 3.5 | 4.0 | 55.3 | 55.1 | 0.01 | 0 | 0.02 | 0.09 |
| | | | 10 YR | 6 | 2 | | | | 4.0 | 4.5 | 56.6 | 56.4 | TRACE | 0 | | |
| | | | 10 YR | 6 | 2 | | | | 4.5 | 5.0 | 53.0 | 52.9 | 0.01 | 0 | 0.02 | 0.07 |
| | | | 10 YR | 6 | 2 | | | | 5.0 | 5.5 | 55.2 | 55.0 | 0.01 | 0 | 0.02 | 0.06 |
| | | | 10 YR | 6 | 2 | | | | 5.5 | 6.0 | 60.4 | 60.2 | 0.03 | 0 | 0.05 | 0.06 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7044OE
Hole No. . . . .375ON

Driller:.... G. SHEATHER
Date:..... 18/8/95
Rig:..... HD 4
Depth to Water:..... 1.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 4.0
Sample Depth:.... 3.7

Wtd Grade Wt % : 0.09
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.6 | GS | | | | 5 YR 6 1 | 0.3 | 1.0 | 51.0 | 50.2 | 0.06 | 2 | 0.12 | 0.12 |
| 1.6 | 2.5 | BrS | | | | 5 YR 5 2 | 1.0 | 1.5 | 64.6 | 63.9 | 0.13 | 1 | 0.20 | 0.15 |
| 2.5 | 4.0 | LtBrS | | | | 10 YR 4 2 | 1.5 | 2.0 | 65.1 | 64.5 | 0.11 | 1 | 0.17 | 0.16 |
| | | | 10 YR 5 4 | | | | 2.0 | 2.5 | 58.3 | 58.0 | 0.02 | 1 | 0.03 | 0.13 |
| | | | 10 YR 6 2 | | | | 2.5 | 3.0 | 59.3 | 58.9 | 0.02 | 1 | 0.03 | 0.11 |
| | | | 10 YR 6 2 | | | | 3.0 | 3.5 | 55.9 | 55.7 | 0.02 | 0 | 0.04 | 0.10 |
| | | | 10 YR 6 2 | | | | 3.5 | 4.0 | 63.3 | 63.0 | 0.02 | 0 | 0.03 | 0.09 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3760N

Driller:.... G. SHEATHER
Date:..... 18/8/95
Rig:..... HD 4
Depth to Water:..... 2.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.15
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 0.9 | LtBrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 56.8 | 56.0 | 0.12 | 1 | 0.21 | 0.21 |
| 0.9 | 1.6 | YS | | | | 10 YR | 6 | 6 | 1.0 | 1.5 | 54.1 | 53.5 | 0.10 | 1 | 0.18 | 0.20 |
| 1.6 | 2.5 | LtBrS | | | | 10 YR | 7 | 4 | 1.5 | 2.0 | 59.6 | 59.4 | 0.06 | 0 | 0.10 | 0.17 |
| 2.5 | 6.0 | GS | 10 YR | 7 | 4 | | | | 2.0 | 2.5 | 52.4 | 52.3 | 0.07 | 0 | 0.13 | 0.16 |
| | | | 5 Y | 6 | 1 | | | | 2.5 | 3.0 | 54.1 | 53.9 | 0.03 | 0 | 0.06 | 0.14 |
| | | | 5 Y | 6 | 1 | | | | 3.0 | 3.5 | 51.0 | 50.8 | 0.14 | 0 | 0.27 | 0.16 |
| | | | 5 Y | 6 | 1 | | | | 3.5 | 4.0 | 62.7 | 62.5 | 0.18 | 0 | 0.29 | 0.18 |
| | | | 5 Y | 6 | 1 | | | | 4.0 | 4.5 | 56.1 | 56.0 | 0.02 | 0 | 0.04 | 0.16 |
| | | | 5 Y | 6 | 1 | | | | 4.5 | 5.0 | 51.3 | 51.1 | 0.13 | 0 | 0.25 | 0.17 |
| | | | 5 Y | 6 | 1 | | | | 5.0 | 5.5 | 59.3 | 59.1 | 0.03 | 0 | 0.05 | 0.16 |
| | | | 5 Y | 6 | 1 | | | | 5.5 | 6.0 | 53.6 | 53.4 | 0.02 | 0 | 0.04 | 0.15 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3770N

Driller:..... G. SHEATHER
Date:..... 18/8/95
Rig:..... HD 4
Depth to Water:..... 2.2
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 4.0
Sample Depth:.... 3.7

Wtd Grade Wt % : 0.14
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| | | | | | | 5 YR | 6 1 | 0.3 | 1.0 | 57.4 | 56.2 | 0.10 | 2 | 0.17 | 0.17 |
| | | | | | | 10 YR | 6 2 | 1.0 | 1.5 | 59.0 | 58.4 | 0.06 | 1 | 0.10 | 0.14 |
| | | | | | | 10 YR | 5 4 | 1.5 | 2.0 | 56.1 | 55.7 | 0.10 | 1 | 0.18 | 0.15 |
| | | | | | | 10 YR | 5 4 | 2.0 | 2.5 | 53.5 | 53.3 | 0.05 | 0 | 0.09 | 0.14 |
| | | | 10 YR | 6 | 2 | | | 2.5 | 3.0 | 56.0 | 55.8 | 0.12 | 0 | 0.21 | 0.15 |
| | | | 5 Y | 6 | 1 | | | 3.0 | 3.5 | 53.3 | 53.1 | 0.07 | 0 | 0.13 | 0.15 |
| | | | 5 Y | 6 | 1 | | | 3.5 | 4.0 | 55.0 | 54.9 | 0.03 | 0 | 0.05 | 0.14 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3780N

Driller:.... G. SHEATHER
Date:..... 18/8/95
Rig:..... HD 4
Depth to Water:..... 3.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.10
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.6 | GS | | | | 5 YR | 6 1 | 0.3 | 1.0 | 54.4 | 53.5 | 0.08 | 2 | 0.15 | 0.15 |
| 1.6 | 3.5 | BrS | | | | 5 YR | 6 1 | 1.0 | 1.5 | 49.3 | 48.7 | 0.07 | 1 | 0.14 | 0.14 |
| 3.5 | 6.0 | LtBrS | | | | 5 YR | 4 1 | 1.5 | 2.0 | 46.7 | 46.2 | 0.04 | 1 | 0.09 | 0.13 |
| | | | | | | 5 YR | 3 4 | 2.0 | 2.5 | 55.2 | 54.5 | 0.07 | 1 | 0.13 | 0.13 |
| | | | | | | 5 YR | 3 4 | 2.5 | 3.0 | 53.1 | 52.3 | 0.06 | 2 | 0.11 | 0.12 |
| | | | | | | 10 YR | 5 4 | 3.0 | 3.5 | 55.7 | 55.0 | 0.13 | 1 | 0.23 | 0.14 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 57.3 | 57.0 | 0.04 | 1 | 0.07 | 0.13 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 52.1 | 51.8 | 0.05 | 1 | 0.10 | 0.13 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 49.6 | 49.4 | 0.01 | 0 | 0.02 | 0.12 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 55.5 | 55.2 | 0.02 | 1 | 0.04 | 0.11 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 53.5 | 53.4 | 0.01 | 0 | 0.02 | 0.10 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3800N

Driller:.... G. SHEATHER
Date:..... 18/8/95
Rig:..... HD 4
Depth to Water:..... 5.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:.... 6.7

Wtd Grade Wt % : 0.10
Wtd Slimes % : 0

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 3.0 | YS | | | | 10 YR 6 6 | 0.3 | 1.0 | 56.6 | 55.9 | 0.04 | 1 | 0.07 | 0.07 |
| 3.0 | 7.0 | LtBrS | | | | 10 YR 6 6 | 1.0 | 1.5 | 61.2 | 60.9 | 0.17 | 0 | 0.28 | 0.16 |
| | | | | | | 10 YR 6 6 | 1.5 | 2.0 | 63.1 | 62.9 | 0.03 | 0 | 0.05 | 0.12 |
| | | | | | | 10 YR 6 6 | 2.0 | 2.5 | 60.9 | 60.5 | 0.03 | 1 | 0.05 | 0.11 |
| | | | | | | 10 YR 6 6 | 2.5 | 3.0 | 58.2 | 57.9 | 0.05 | 1 | 0.09 | 0.10 |
| | | | | | | 10 YR 7 4 | 3.0 | 3.5 | 59.6 | 59.4 | 0.16 | 0 | 0.27 | 0.13 |
| | | | | | | 10 YR 7 4 | 3.5 | 4.0 | 60.1 | 59.9 | 0.03 | 0 | 0.05 | 0.12 |
| | | | | | | 10 YR 7 4 | 4.0 | 4.5 | 69.9 | 69.8 | 0.06 | 0 | 0.09 | 0.11 |
| | | | | | | 10 YR 7 4 | 4.5 | 5.0 | 58.5 | 58.3 | 0.04 | 0 | 0.07 | 0.11 |
| | | | | | | 10 YR 7 4 | 5.0 | 5.5 | 59.8 | 59.5 | 0.12 | 1 | 0.20 | 0.12 |
| | | | 10 YR 7 4 | | | | 5.5 | 6.0 | 56.3 | 56.2 | 0.03 | 0 | 0.05 | 0.11 |
| | | | 10 YR 7 4 | | | | 6.0 | 6.5 | 57.3 | 57.1 | 0.01 | 0 | 0.02 | 0.11 |
| | | | 10 YR 7 4 | | | | 6.5 | 7.0 | 59.1 | 58.8 | 0.02 | 1 | 0.03 | 0.10 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3820N

Driller:.... G. SHEATHER
Date:..... 17/8/95
Rig:..... HD 4
Depth to Water:..... 3.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.39
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.0 | GS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 45.8 | 45.4 | 0.06 | 1 | 0.13 | 0.13 |
| 2.0 | 3.0 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 59.5 | 59.1 | 0.06 | 1 | 0.10 | 0.12 |
| 3.0 | 6.0 | LtBrS | | | | 10 YR | 4 2 | 1.5 | 2.0 | 50.2 | 49.8 | 0.06 | 1 | 0.12 | 0.12 |
| | | | | | | 5 YR | 3 2 | 2.0 | 2.5 | 48.1 | 47.3 | 0.44 | 2 | 0.91 | 0.30 |
| | | | | | | 5 YR | 4 4 | 2.5 | 3.0 | 54.3 | 53.6 | 0.83 | 1 | 1.53 | 0.53 |
| | | | | | | 10 YR | 6 6 | 3.0 | 3.5 | 51.7 | 51.5 | 0.53 | 0 | 1.03 | 0.61 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 53.6 | 53.4 | 0.06 | 0 | 0.11 | 0.54 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 47.2 | 47.0 | 0.07 | 0 | 0.15 | 0.49 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 46.1 | 45.9 | 0.05 | 0 | 0.11 | 0.45 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 54.2 | 54.0 | 0.06 | 0 | 0.11 | 0.42 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 55.6 | 55.4 | 0.05 | 0 | 0.09 | 0.39 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3840N

Driller:.... G. SHEATHER
Date:..... 17/8/95
Rig:..... HD 4
Depth to Water:..... 2.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.22
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.7 | LtBrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 61.3 | 60.5 | 0.05 | 1 | 0.08 | 0.08 |
| 1.7 | 6.0 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 55.6 | 55.1 | 0.22 | 1 | 0.40 | 0.21 |
| | | | | | | 10 YR | 4 2 | 1.5 | 2.0 | 53.2 | 52.4 | 0.04 | 2 | 0.08 | 0.17 |
| | | | | | | 5 YR | 4 4 | 2.0 | 2.5 | 55.0 | 54.4 | 0.10 | 1 | 0.18 | 0.17 |
| | | | 5 YR | 4 | 4 | | | 2.5 | 3.0 | 47.2 | 46.8 | 0.11 | 1 | 0.23 | 0.19 |
| | | | 10 YR | 5 | 4 | | | 3.0 | 3.5 | 51.2 | 50.9 | 0.14 | 1 | 0.27 | 0.20 |
| | | | 10 YR | 5 | 4 | | | 3.5 | 4.0 | 50.5 | 50.2 | 0.06 | 1 | 0.12 | 0.19 |
| | | | 10 YR | 5 | 4 | | | 4.0 | 4.5 | 58.4 | 57.9 | 0.12 | 1 | 0.21 | 0.19 |
| | | | 10 YR | 5 | 4 | | | 4.5 | 5.0 | 63.5 | 63.2 | 0.05 | 0 | 0.08 | 0.18 |
| | | | 10 YR | 5 | 4 | | | 5.0 | 5.5 | 48.0 | 47.7 | 0.31 | 1 | 0.65 | 0.22 |
| | | | 10 YR | 5 | 4 | | | 5.5 | 6.0 | 51.8 | 51.5 | 0.07 | 1 | 0.14 | 0.22 |

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3860N

Driller:..... G. SHEATHER
Date:..... 17/8/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.08
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | WET V | WET C | DRY HUE | DRY V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.7 | GS | | | | 5 YR | 4 1 | 0.3 | 1.0 | 58.1 | 57.2 | 0.08 | 2 | 0.14 | 0.14 |
| 1.7 | 3.1 | BrS | | | | 5 YR | 6 1 | 1.0 | 1.5 | 62.9 | 62.5 | 0.04 | 1 | 0.06 | 0.11 |
| 3.1 | 6.0 | LtBrS | | | | 10 YR | 4 2 | 1.5 | 2.0 | 48.6 | 48.1 | 0.08 | 1 | 0.16 | 0.12 |
| | | | | | | 5 YR | 4 4 | 2.0 | 2.5 | 61.9 | 61.2 | 0.03 | 1 | 0.05 | 0.11 |
| | | | | | | 10 YR | 5 4 | 2.5 | 3.0 | 53.8 | 53.2 | 0.09 | 1 | 0.17 | 0.12 |
| | | | 10 YR | 6 | 6 | | | 3.0 | 3.5 | 62.7 | 62.4 | 0.04 | 0 | 0.06 | 0.11 |
| | | | 10 YR | 6 | 6 | | | 3.5 | 4.0 | 70.6 | 70.3 | 0.01 | 0 | 0.01 | 0.10 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 42.3 | 42.1 | 0.07 | 0 | 0.17 | 0.10 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 56.1 | 55.9 | 0.02 | 0 | 0.04 | 0.10 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 58.1 | 57.9 | 0.01 | 0 | 0.02 | 0.09 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 64.1 | 63.7 | 0.01 | 1 | 0.02 | 0.08 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3880N

Driller:..... G. SHEATHER
Date:..... 17/8/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.21
Wtd Slimes % : 0

## LITHOLOGY

| DEPTH (m) FROM | DEPTH (m) TO | FIELD DESCRIPT. | COLOUR ---WET--- HUE V C | COLOUR ---DRY--- HUE V C |
|---|---|---|---|---|
| 0.0 | 0.3 | | | |
| 0.3 | 1.7 | GS | | 5 YR 6 1 |
| 1.7 | 2.7 | BrS | | 10 YR 8 2 |
| 2.7 | 3.2 | YS | | 5 YR 4 4 |
| 3.2 | 6.0 | LtBrS | | 5 YR 4 4 |
| | | | | 10 YR 6 6 |
| | | | 10 YR 7 4 | |
| | | | 10 YR 7 4 | |
| | | | 10 YR 7 4 | |
| | | | 10 YR 7 4 | |
| | | | 10 YR 7 4 | |
| | | | 10 YR 7 4 | |

## LABORATORY SAMPLE

| DEPTH (m) FROM | DEPTH (m) TO | WEIGHTS ORIG. | WASHED | H.M. | GRADES SLIMES | Wt % | PRO. |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.3 | | | | | | |
| 0.3 | 1.0 | | | | | | |
| 1.0 | 1.5 | 54.8 | 54.5 | 0.12 | 1 | 0.22 | 0.09 |
| 1.5 | 2.0 | 54.4 | 53.6 | 0.32 | 1 | 0.59 | 0.24 |
| 2.0 | 2.5 | 50.8 | 50.3 | 0.32 | 1 | 0.63 | 0.33 |
| 2.5 | 3.0 | 55.7 | 55.2 | 0.30 | 1 | 0.54 | 0.37 |
| 3.0 | 3.5 | 49.9 | 49.8 | 0.13 | 0 | 0.26 | 0.35 |
| 3.5 | 4.0 | 55.3 | 55.1 | 0.04 | 0 | 0.07 | 0.31 |
| 4.0 | 4.5 | 51.2 | 51.0 | 0.02 | 0 | 0.04 | 0.28 |
| 4.5 | 5.0 | 63.3 | 63.1 | 0.01 | 0 | 0.02 | 0.25 |
| 5.0 | 5.5 | 58.4 | 58.3 | 0.02 | 0 | 0.03 | 0.23 |
| 5.5 | 6.0 | | | | | | |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3900N

Driller:.... G. SHEATHER
Date:..... 15/8/95
Rig:..... HD 4
Depth to Water:..... 2.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.09
Wtd Slimes % : 0

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 5 YR | 6 1 | 0.3 | 1.0 | 48.0 | 47.7 | 0.13 | 1 | 0.27 | 0.27 |
| 1.5 | 3.0 | BrS | | | | 5 YR | 6 1 | 1.0 | 1.5 | 42.8 | 42.5 | 0.11 | 1 | 0.26 | 0.27 |
| 3.0 | 5.0 | YS | | | | 5 YR | 4 4 | 1.5 | 2.0 | 42.8 | 42.4 | 0.03 | 1 | 0.07 | 0.21 |
| 5.0 | 6.0 | BrS | | | | 5 YR | 4 4 | 2.0 | 2.5 | 41.2 | 41.1 | 0.02 | 0 | 0.05 | 0.17 |
| | | | | | | 5 YR | 4 4 | 2.5 | 3.0 | 42.0 | 41.7 | 0.02 | 1 | 0.05 | 0.15 |
| | | | 10 YR | 6 | 6 | | | 3.0 | 3.5 | 43.8 | 43.6 | 0.02 | 0 | 0.05 | 0.13 |
| | | | 10 YR | 6 | 6 | | | 3.5 | 4.0 | 42.1 | 42.0 | 0.02 | 0 | 0.05 | 0.12 |
| | | | 10 YR | 6 | 6 | | | 4.0 | 4.5 | 40.4 | 40.3 | 0.01 | 0 | 0.02 | 0.11 |
| | | | 10 YR | 6 | 6 | | | 4.5 | 5.0 | 44.2 | 44.1 | 0.01 | 0 | 0.02 | 0.10 |
| | | | 10 YR | 5 | 4 | | | 5.0 | 5.5 | 43.2 | 43.0 | 0.01 | 0 | 0.02 | 0.09 |
| | | | 10 YR | 5 | 4 | | | 5.5 | 6.0 | 42.0 | 41.9 | 0.01 | 0 | 0.02 | 0.09 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3920N

Driller:.... G. SHEATHER
Date:..... 15/8/95
Rig:..... HD 4
Depth to Water:..... 2.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.13
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | WET HUE | V | C | DRY HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.6 | LtBrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 44.0 | 43.7 | 0.09 | 1 | 0.20 | 0.20 |
| 1.6 | 3.1 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 59.6 | 59.2 | 0.11 | 1 | 0.18 | 0.20 |
| 3.1 | 6.0 | YS | | | | 5 YR | 4 4 | 1.5 | 2.0 | 41.2 | 39.2 | 0.16 | 5 | 0.39 | 0.25 |
| | | | | | | 5 YR | 4 4 | 2.0 | 2.5 | 54.3 | 53.5 | 0.05 | 1 | 0.09 | 0.22 |
| | | | 10 YR | 5 | 4 | | | 2.5 | 3.0 | 46.5 | 46.3 | 0.01 | 0 | 0.02 | 0.18 |
| | | | 10 YR | 6 | 6 | | | 3.0 | 3.5 | 51.2 | 51.1 | 0.10 | 0 | 0.20 | 0.18 |
| | | | 10 YR | 6 | 6 | | | 3.5 | 4.0 | 49.0 | 48.8 | 0.05 | 0 | 0.10 | 0.17 |
| | | | 10 YR | 6 | 6 | | | 4.0 | 4.5 | 57.2 | 56.9 | 0.05 | 1 | 0.09 | 0.16 |
| | | | 10 YR | 6 | 6 | | | 4.5 | 5.0 | 60.7 | 60.6 | 0.04 | 0 | 0.07 | 0.15 |
| | | | 10 YR | 6 | 6 | | | 5.0 | 5.5 | 52.3 | 52.1 | 0.03 | 0 | 0.06 | 0.14 |
| | | | 10 YR | 6 | 6 | | | 5.5 | 6.0 | 55.8 | 55.6 | 0.02 | 0 | 0.04 | 0.13 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7044OE
Hole No. . . . .394ON

Driller:..... G. SHEATHER
Date:..... 15/8/95
Rig:..... HD 4
Depth to Water:..... 2.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.08
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.7 | GS | | | | 5 YR | 4 1 | 0.3 | 1.0 | 44.4 | 43.9 | 0.05 | 1 | 0.11 | 0.11 |
| 1.7 | 4.0 | BrS | | | | 5 YR | 6 1 | 1.0 | 1.5 | 38.9 | 38.7 | 0.05 | 1 | 0.13 | 0.12 |
| 4.0 | 6.0 | YS | | | | 10 YR | 6 2 | 1.5 | 2.0 | 38.6 | 38.4 | 0.03 | 1 | 0.08 | 0.11 |
| | | | | | | 5 YR | 3 4 | 2.0 | 2.5 | 40.2 | 39.9 | 0.04 | 1 | 0.10 | 0.11 |
| | | | 10 YR | 5 | 4 | | | 2.5 | 3.0 | 39.2 | 39.1 | 0.05 | 0 | 0.13 | 0.11 |
| | | | 10 YR | 5 | 4 | | | 3.0 | 3.5 | 44.2 | 44.0 | 0.04 | 0 | 0.09 | 0.11 |
| | | | 10 YR | 5 | 4 | | | 3.5 | 4.0 | 38.3 | 38.2 | 0.02 | 0 | 0.05 | 0.10 |
| | | | 10 YR | 6 | 6 | | | 4.0 | 4.5 | 41.2 | 41.0 | 0.02 | 0 | 0.05 | 0.09 |
| | | | 10 YR | 6 | 6 | | | 4.5 | 5.0 | 43.8 | 43.4 | 0.02 | 1 | 0.05 | 0.09 |
| | | | 10 YR | 6 | 6 | | | 5.0 | 5.5 | 44.5 | 44.4 | 0.02 | 0 | 0.04 | 0.08 |
| | | | 10 YR | 6 | 6 | | | 5.5 | 6.0 | 41.2 | 41.1 | 0.02 | 0 | 0.05 | 0.08 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7044OE
Hole No. . . . .396ON

Driller:.... G. SHEATHER
Date:..... 15/8/95
Rig:..... HD 4
Depth to Water:..... 2.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.13
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | LtBrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 41.3 | 41.0 | 0.09 | 1 | 0.22 | 0.22 |
| 1.5 | 6.0 | BrS | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 43.6 | 43.4 | 0.05 | 0 | 0.11 | 0.17 |
| | | | | | | 10 YR | 4 | 2 | 1.5 | 2.0 | 36.2 | 35.9 | 0.14 | 1 | 0.39 | 0.24 |
| | | | 10 YR | 4 | 2 | | | | 2.0 | 2.5 | 43.2 | 43.0 | 0.04 | 0 | 0.09 | 0.20 |
| | | | 5 YR | 3 | 4 | | | | 2.5 | 3.0 | 43.5 | 43.2 | 0.05 | 1 | 0.11 | 0.19 |
| | | | 10 YR | 5 | 4 | | | | 3.0 | 3.5 | 43.6 | 43.3 | 0.04 | 1 | 0.09 | 0.17 |
| | | | 10 YR | 5 | 4 | | | | 3.5 | 4.0 | 50.5 | 50.3 | 0.04 | 0 | 0.08 | 0.16 |
| | | | 10 YR | 5 | 4 | | | | 4.0 | 4.5 | 36.0 | 35.9 | 0.03 | 0 | 0.08 | 0.15 |
| | | | 10 YR | 5 | 4 | | | | 4.5 | 5.0 | 39.7 | 39.5 | 0.03 | 1 | 0.08 | 0.14 |
| | | | 10 YR | 5 | 4 | | | | 5.0 | 5.5 | 41.2 | 41.0 | 0.02 | 0 | 0.05 | 0.13 |
| | | | 10 YR | 5 | 4 | | | | 5.5 | 6.0 | 46.6 | 46.3 | 0.02 | 1 | 0.04 | 0.13 |

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3980N

Driller:..... G. SHEATHER
Date:..... 15/8/95
Rig:..... HD 4
Depth to Water:..... 4.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.30
Wtd Slimes % : 1

## LITHOLOGY

| DEPTH (m) FROM | DEPTH (m) TO | FIELD DESCRIPT. | COLOUR WET HUE | COLOUR WET V | COLOUR WET C | COLOUR DRY HUE | COLOUR DRY V | COLOUR DRY C |
|---|---|---|---|---|---|---|---|---|
| 0.0 | 0.3 | | | | | | | |
| 0.3 | 1.5 | LtBrS | | | | 10 YR | 6 | 2 |
| 1.5 | 4.5 | BrS | | | | 10 YR | 6 | 2 |
| 4.5 | 6.0 | YS | | | | 10 YR | 4 | 2 |
| | | | | | | 10 YR | 4 | 2 |
| | | | | | | 5 YR | 4 | 4 |
| | | | | | | 5 YR | 4 | 4 |
| | | | | | | 5 YR | 4 | 4 |
| | | | | | | 5 YR | 4 | 4 |
| | | | 10 YR | 6 | 6 | | | |
| | | | 10 YR | 6 | 6 | | | |
| | | | 10 YR | 6 | 6 | | | |

## LABORATORY SAMPLE

| DEPTH (m) FROM | DEPTH (m) TO | WEIGHTS ORIG. | WEIGHTS WASHED | WEIGHTS H.M. | GRADES SLIMES | GRADES Wt % | GRADES PRO. |
|---|---|---|---|---|---|---|---|
| 0.0 | 0.3 | | | | | | |
| 0.3 | 1.0 | 39.2 | 38.9 | 0.08 | 1 | 0.20 | 0.20 |
| 1.0 | 1.5 | 35.3 | 35.2 | 0.08 | 0 | 0.23 | 0.21 |
| 1.5 | 2.0 | 39.9 | 39.5 | 0.06 | 1 | 0.15 | 0.19 |
| 2.0 | 2.5 | 37.5 | 37.3 | 0.13 | 1 | 0.35 | 0.23 |
| 2.5 | 3.0 | 39.3 | 39.0 | 0.10 | 1 | 0.25 | 0.23 |
| 3.0 | 3.5 | 37.8 | 37.4 | 0.06 | 1 | 0.16 | 0.22 |
| 3.5 | 4.0 | 40.2 | 39.8 | 0.16 | 1 | 0.40 | 0.25 |
| 4.0 | 4.5 | 39.3 | 39.0 | 0.21 | 1 | 0.53 | 0.28 |
| 4.5 | 5.0 | 39.6 | 39.3 | 0.14 | 1 | 0.35 | 0.29 |
| 5.0 | 5.5 | 45.9 | 45.5 | 0.16 | 1 | 0.35 | 0.29 |
| 5.5 | 6.0 | 30.6 | 30.4 | 0.12 | 1 | 0.39 | 0.30 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .3990N

Driller:..... G. SHEATHER
Date:..... 14/8/95
Rig:..... HD 4
Depth to Water:..... 4.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.46
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.2 | GS | | | | 5 YR | 6 1 | 0.3 | 1.0 | 38.1 | 38.0 | 0.08 | 0 | 0.21 | 0.21 |
| 1.2 | 6.0 | LtBrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 39.7 | 39.5 | 0.08 | 1 | 0.20 | 0.21 |
| | | | | | | 10 YR | 5 4 | 1.5 | 2.0 | 36.7 | 36.4 | 0.04 | 1 | 0.11 | 0.18 |
| | | | | | | 10 YR | 5 4 | 2.0 | 2.5 | 39.0 | 38.8 | 0.05 | 1 | 0.13 | 0.17 |
| | | | | | | 10 YR | 8 2 | 2.5 | 3.0 | 39.9 | 38.9 | 0.13 | 3 | 0.33 | 0.20 |
| | | | | | | 10 YR | 8 2 | 3.0 | 3.5 | 37.6 | 37.6 | 0.20 | 0 | 0.53 | 0.25 |
| | | | | | | 10 YR | 8 2 | 3.5 | 4.0 | 45.5 | 45.4 | 0.02 | 0 | 0.04 | 0.22 |
| | | | | | | 10 YR | 7 4 | 4.0 | 4.5 | 44.2 | 44.2 | 0.69 | 0 | 1.56 | 0.38 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 41.7 | 37.8 | 0.04 | 9 | 0.10 | 0.35 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 53.2 | 53.1 | 0.35 | 0 | 0.66 | 0.38 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 34.4 | 34.4 | 0.46 | 0 | 1.34 | 0.46 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4000N

Driller:..... G. SHEATHER
Date:..... 14/8/95
Rig:..... HD 4
Depth to Water:..... 3.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.33
Wtd Slimes % : 0

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | LtBrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 37.5 | 37.4 | 0.13 | 0 | 0.35 | 0.35 |
| 1.5 | 2.5 | BrS | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 45.7 | 45.5 | 0.10 | 0 | 0.22 | 0.29 |
| 2.5 | 6.0 | LtBrS | | | | 5 YR | 4 | 4 | 1.5 | 2.0 | 49.2 | 48.9 | 0.11 | 1 | 0.22 | 0.27 |
| | | | | | | 5 YR | 4 | 4 | 2.0 | 2.5 | 41.8 | 41.6 | 0.03 | 0 | 0.07 | 0.23 |
| | | | | | | 10 YR | 7 | 4 | 2.5 | 3.0 | 47.4 | 47.3 | 0.13 | 0 | 0.27 | 0.24 |
| | | | | | | 10 YR | 8 | 2 | 3.0 | 3.5 | 42.6 | 42.6 | 0.58 | 0 | 1.36 | 0.41 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 44.2 | 44.1 | 0.40 | 0 | 0.90 | 0.48 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 40.1 | 40.0 | 0.06 | 0 | 0.15 | 0.44 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 47.6 | 47.5 | 0.01 | 0 | 0.02 | 0.39 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 43.0 | 42.9 | 0.02 | 0 | 0.05 | 0.36 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 35.9 | 35.8 | 0.01 | 0 | 0.03 | 0.33 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7044OE
Hole No. . . . .4020N

Driller:.... G. SHEATHER
Date:..... 14/8/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.18
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 5 YR | 6 1 | 0.3 | 1.0 | 38.5 | 38.1 | 0.05 | 1 | 0.13 | 0.13 |
| 1.5 | 3.5 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 55.8 | 55.5 | 0.07 | 1 | 0.13 | 0.13 |
| 3.5 | 6.0 | LtBrS | | | | 10 YR | 4 2 | 1.5 | 2.0 | 44.8 | 44.6 | 0.08 | 0 | 0.18 | 0.14 |
| | | | | | | 5 YR | 3 2 | 2.0 | 2.5 | 53.3 | 52.3 | 0.20 | 2 | 0.38 | 0.20 |
| | | | | | | 5 YR | 3 2 | 2.5 | 3.0 | 38.9 | 38.5 | 0.05 | 1 | 0.13 | 0.18 |
| | | | 10 YR | 5 | 4 | | | 3.0 | 3.5 | 40.1 | 39.9 | 0.09 | 0 | 0.22 | 0.19 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 44.9 | 44.7 | 0.30 | 0 | 0.67 | 0.25 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 40.6 | 40.5 | 0.02 | 0 | 0.05 | 0.23 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 50.8 | 50.7 | 0.01 | 0 | 0.02 | 0.21 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 45.6 | 45.5 | 0.01 | 0 | 0.02 | 0.19 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 54.1 | 54.0 | 0.02 | 0 | 0.04 | 0.18 |

GS 1996/034

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7044OE
Hole No. . . . .4030N

Driller:..... G. SHEATHER
Date:..... 10/8/95
Rig:..... HD 4
Depth to Water:..... 3.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 1.22
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | ---WET--- | | | ---DRY--- | | | | | | | | | |
| FROM | TO | DESCRIPT. | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.1 | GS | | | | 10 YR | 8 2 | 0.3 | 1.0 | 52.1 | 51.6 | 0.14 | 1 | 0.27 | 0.27 |
| 2.1 | 6.0 | BrS | | | | 10 YR | 8 2 | 1.0 | 1.5 | 49.8 | 49.5 | 0.11 | 1 | 0.22 | 0.25 |
| | | | | | | 10 YR | 8 2 | 1.5 | 2.0 | 57.3 | 57.0 | 0.13 | 1 | 0.23 | 0.24 |
| | | | | | | 10 YR | 4 2 | 2.0 | 2.5 | 52.8 | 52.3 | 0.20 | 1 | 0.38 | 0.27 |
| | | | | | | 5 YR | 3 4 | 2.5 | 3.0 | 62.1 | 61.6 | 0.26 | 1 | 0.42 | 0.30 |
| | | | | | | 5 YR | 3 4 | 3.0 | 3.5 | 50.4 | 50.1 | 0.13 | 1 | 0.26 | 0.29 |
| | | | | | | 5 YR | 4 4 | 3.5 | 4.0 | 54.3 | 54.0 | 0.61 | 1 | 1.12 | 0.41 |
| | | | 10 YR | 4 | 2 | | | 4.0 | 4.5 | 57.4 | 57.1 | 5.71 | 1 | 9.95 | 1.54 |
| | | | 10 YR | 5 | 4 | | | 4.5 | 5.0 | 53.8 | 53.5 | 0.40 | 1 | 0.74 | 1.46 |
| | | | 10 YR | 5 | 4 | | | 5.0 | 5.5 | 49.3 | 49.2 | 0.04 | 0 | 0.08 | 1.32 |
| | | | 10 YR | 5 | 4 | | | 5.5 | 6.0 | 45.2 | 44.9 | 0.04 | 1 | 0.09 | 1.22 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7044OE
Hole No. . . . .4040N

Driller:.... G. SHEATHER
Date:..... 10/8/95
Rig:..... HD 4
Depth to Water:..... 4.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.19
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.0 | LtBrS | | | | 10 YR | 7 | 4 | 0.3 | 1.0 | 59.4 | 58.6 | 0.07 | 1 | 0.12 | 0.12 |
| 1.0 | 2.5 | YS | | | | 10 YR | 6 | 6 | 1.0 | 1.5 | 57.6 | 57.1 | 0.14 | 1 | 0.24 | 0.17 |
| 2.5 | 4.5 | LtBrS | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 64.1 | 63.5 | 0.03 | 1 | 0.05 | 0.13 |
| 4.5 | 6.0 | YS | | | | 10 YR | 7 | 4 | 2.0 | 2.5 | 58.9 | 58.5 | 0.07 | 1 | 0.12 | 0.13 |
| | | | | | | 10 YR | 7 | 4 | 2.5 | 3.0 | 60.2 | 59.8 | 0.52 | 1 | 0.86 | 0.27 |
| | | | | | | 10 YR | 8 | 2 | 3.0 | 3.5 | 55.1 | 54.8 | 0.06 | 1 | 0.11 | 0.24 |
| | | | | | | 10 YR | 6 | 2 | 3.5 | 4.0 | 61.8 | 61.7 | 0.Q4 | 0 | 0.06 | 0.22 |
| | | | | | | 10 YR | 7 | 4 | 4.0 | 4.5 | 61.6 | 61.3 | 0.07 | 0 | 0.11 | 0.21 |
| | | | 10 YR | 6 | 6 | | | | 4.5 | 5.0 | 52.0 | 51.7 | 0.02 | 1 | 0.04 | 0.19 |
| | | | 10 YR | 6 | 6 | | | | 5.0 | 5.5 | 52.4 | 52.1 | 0.13 | 1 | 0.25 | 0.19 |
| | | | 10 YR | 6 | 6 | | | | 5.5 | 6.0 | 57.5 | 57.2 | 0.11 | 1 | 0.19 | 0.19 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4050N

Driller:.... G. SHEATHER
Date:..... 10/8/95
Rig:..... HD 4
Depth to Water:..... 3.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.29
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.6 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 45.4 | 44.9 | 0.10 | 1 | 0.22 | 0.22 |
| 1.6 | 3.5 | BrS | | | | 10 YR | 8 | 2 | 1.0 | 1.5 | 54.5 | 54.0 | 0.07 | 1 | 0.13 | 0.18 |
| 3.5 | 6.0 | LtBrS | | | | 10 YR | 4 | 2 | 1.5 | 2.0 | 50.9 | 50.1 | 0.21 | 2 | 0.41 | 0.25 |
| | | | | | | 10 YR | 5 | 4 | 2.0 | 2.5 | 48.5 | 48.1 | 0.13 | 1 | 0.27 | 0.25 |
| | | | | | | 10 YR | 5 | 4 | 2.5 | 3.0 | 45.3 | 44.8 | 0.49 | 1 | 1.08 | 0.41 |
| | | | | | | 10 YR | 5 | 4 | 3.0 | 3.5 | 53.0 | 52.6 | 0.21 | 1 | 0.40 | 0.41 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 43.1 | 42.9 | 0.16 | 0 | 0.37 | 0.40 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 46.3 | 46.0 | 0.08 | 1 | 0.17 | 0.37 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 45.4 | 45.2 | 0.03 | 0 | 0.07 | 0.34 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 51.3 | 51.0 | 0.03 | 1 | 0.06 | 0.31 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 39.5 | 39.3 | 0.01 | 1 | 0.03 | 0.29 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7044OE
Hole No. . . . .407ON

Driller:.... G. SHEATHER
Date:..... 10/8/95
Rig:..... HD 4
Depth to Water:..... 4.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.30
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.1 | GS | | | | 5 YR | 6 | 1 | 0.3 | 1.0 | 58.2 | 57.1 | 0.19 | 2 | 0.33 | 0.33 |
| 2.1 | 2.5 | MInd | | | | 10YR | 8 | 2 | 1.0 | 1.5 | 57.8 | 57.5 | 0.15 | 1 | 0.26 | 0.30 |
| 2.5 | 3.9 | BrS | | | | 10YR | 8 | 2 | 1.5 | 2.0 | 53.3 | 53.0 | 0.12 | 1 | 0.23 | 0.28 |
| 3.9 | 4.2 | SInd | | | | 5 YR | 3 | 2 | 2.0 | 2.5 | 49.9 | 48.8 | 0.36 | 2 | 0.72 | 0.38 |
| 4.2 | 6.0 | LtBrS | | | | 5 YR | 3 | 4 | 2.5 | 3.0 | 46.8 | 45.7 | 0.21 | 2 | 0.45 | 0.39 |
| | | | | | | 5 YR | 4 | 4 | 3.0 | 3.5 | 57.3 | 56.8 | 0.28 | 1 | 0.49 | 0.41 |
| | | | | | | 5 YR | 4 | 4 | 3.5 | 4.0 | 46.9 | 46.2 | 0.23 | 1 | 0.49 | 0.42 |
| | | | 5 YR | 4 | 4 | | | | 4.0 | 4.5 | 48.2 | 47.8 | 0.03 | 1 | 0.06 | 0.38 |
| | | | 10YR | 7 | 4 | | | | 4.5 | 5.0 | 55.6 | 55.3 | 0.04 | 1 | 0.07 | 0.34 |
| | | | 10YR | 7 | 4 | | | | 5.0 | 5.5 | 53.6 | 53.2 | 0.05 | 1 | 0.09 | 0.32 |
| | | | 10YR | 7 | 4 | | | | 5.5 | 6.0 | 49.2 | 49.0 | 0.06 | 0 | 0.12 | 0.30 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7044OE
Hole No. . . . .4090N

Driller:..... G. SHEATHER
Date:..... 9/8/95
Rig:..... HD 4
Depth to Water:..... 3.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.21
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.7 | LtBrS | | | | 10YR | 6 | 2 | 0.3 | 1.0 | 46.4 | 46.2 | 0.08 | 0 | 0.17 | 0.17 |
| 1.7 | 2.8 | BrS | | | | 10YR | 6 | 2 | 1.0 | 1.5 | 47.3 | 47.3 | 0.08 | 0 | 0.17 | 0.17 |
| 2.8 | 6.0 | LtBrS | | | | 10YR | 4 | 2 | 1.5 | 2.0 | 38.2 | 37.5 | 0.15 | 2 | 0.39 | 0.24 |
| | | | | | | 5 YR | 3 | 4 | 2.0 | 2.5 | 47.1 | 46.3 | 0.10 | 2 | 0.21 | 0.23 |
| | | | | | | 10YR | 5 | 4 | 2.5 | 3.0 | 45.5 | 45.3 | 0.28 | 0 | 0.62 | 0.30 |
| | | | | | | 10YR | 8 | 2 | 3.0 | 3.5 | 51.0 | 50.9 | 0.18 | 0 | 0.35 | 0.31 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 44.1 | 44.0 | 0.05 | 0 | 0.11 | 0.28 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 47.9 | 47.8 | 0.04 | 0 | 0.08 | 0.26 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 42.9 | 42.8 | 0.04 | 0 | 0.09 | 0.24 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 47.6 | 47.5 | 0.04 | 0 | 0.08 | 0.23 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 48.1 | 47.9 | 0.02 | 0 | 0.04 | 0.21 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4110N

Driller:.... G. SHEATHER
Date:..... 9/8/95
Rig:..... HD 4
Depth to Water:..... 2.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.11
Wtd Slimes % : 0

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| | | | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 45.5 | 45.1 | 0.03 | 1 | 0.07 | 0.07 |
| | | | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 45.6 | 45.4 | 0.08 | 0 | 0.18 | 0.11 |
| | | | | | | 10 YR | 5 | 4 | 1.5 | 2.0 | 46.3 | 46.0 | 0.07 | 1 | 0.15 | 0.12 |
| | | | | | | 10 YR | 5 | 4 | 2.0 | 2.5 | 44.3 | 44.2 | 0.03 | 0 | 0.07 | 0.11 |
| | | | 10 YR | 7 | 4 | | | | 2.5 | 3.0 | 45.6 | 45.6 | 0.04 | 0 | 0.09 | 0.11 |
| | | | 10 YR | 7 | 4 | | | | 3.0 | 3.5 | 48.2 | 48.1 | 0.07 | 0 | 0.15 | 0.11 |
| | | | 10 YR | 8 | 2 | | | | 3.5 | 4.0 | 55.9 | 55.8 | 0.03 | 0 | 0.05 | 0.10 |
| | | | 10 YR | 8 | 2 | | | | 4.0 | 4.5 | 48.3 | 48.3 | 0.06 | 0 | 0.12 | 0.11 |
| | | | 10 YR | 8 | 2 | | | | 4.5 | 5.0 | 46.3 | 46.3 | 0.03 | 0 | 0.06 | 0.10 |
| | | | 10 YR | 8 | 2 | | | | 5.0 | 5.5 | 50.9 | 50.8 | 0.05 | 0 | 0.10 | 0.10 |
| | | | 10 YR | 8 | 2 | | | | 5.5 | 6.0 | 47.9 | 47.8 | 0.07 | 0 | 0.15 | 0.11 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4130N

Driller:..... G. SHEATHER
Date:..... 9/8/95
Rig:..... HD 4
Depth to Water:..... 2.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.12
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.1 | LtBrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 55.6 | 55.0 | 0.06 | 1 | 0.11 | 0.11 |
| 1.1 | 2.5 | BrS | | | | 10 YR | 4 2 | 1.0 | 1.5 | 55.0 | 51.7 | 0.12 | 6 | 0.22 | 0.15 |
| 2.5 | 6.0 | LtBrS | | | | 5 YR | 4 4 | 1.5 | 2.0 | 54.6 | 53.7 | 0.14 | 2 | 0.26 | 0.18 |
| | | | | | | 5 YR | 4 4 | 2.0 | 2.5 | 59.1 | 58.5 | 0.03 | 1 | 0.05 | 0.15 |
| | | | 10 YR | 7 | 4 | | | 2.5 | 3.0 | 56.0 | 55.7 | 0.03 | 1 | 0.05 | 0.14 |
| | | | 10 YR | 7 | 4 | | | 3.0 | 3.5 | 58.1 | 58.0 | 0.10 | 0 | 0.17 | 0.14 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 62.4 | 62.1 | 0.07 | 0 | 0.11 | 0.14 |
| | | | 10 YR | 8 | 2 | | | 4.0 | 4.5 | 62.9 | 62.7 | 0.02 | 0 | 0.03 | 0.12 |
| | | | 10 YR | 8 | 2 | | | 4.5 | 5.0 | 63.6 | 63.3 | 0.04 | 0 | 0.06 | 0.12 |
| | | | 10 YR | 8 | 2 | | | 5.0 | 5.5 | 63.1 | 62.9 | 0.07 | 0 | 0.11 | 0.12 |
| | | | 10 YR | 8 | 2 | | | 5.5 | 6.0 | 58.8 | 58.7 | 0.10 | 0 | 0.17 | 0.12 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7044OE
Hole No. . . . .415ON

Driller:.... G. SHEATHER
Date:..... 9/8/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.17
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | WET V | WET C | DRY HUE | DRY V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 5 YR | 6 1 | 0.3 | 1.0 | 54.4 | 53.5 | 0.02 | 2 | 0.04 | 0.04 |
| 1.5 | 6.0 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 57.1 | 56.6 | 0.15 | 1 | 0.26 | 0.13 |
| | | | | | | 10 YR | 4 2 | 1.5 | 2.0 | 49.8 | 48.4 | 0.06 | 3 | 0.12 | 0.13 |
| | | | | | | 5 YR | 3 2 | 2.0 | 2.5 | 44.3 | 43.4 | 0.45 | 2 | 1.02 | 0.33 |
| | | | | | | 5 YR | 3 2 | 2.5 | 3.0 | 56.6 | 54.9 | 0.06 | 3 | 0.11 | 0.29 |
| | | | 5 YR | 3 | 2 | | | 3.0 | 3.5 | 59.9 | 59.3 | 0.06 | 1 | 0.10 | 0.26 |
| | | | 10 YR | 5 | 4 | | | 3.5 | 4.0 | 61.7 | 61.3 | 0.07 | 1 | 0.11 | 0.24 |
| | | | 10 YR | 5 | 4 | | | 4.0 | 4.5 | 54.1 | 53.9 | 0.04 | 0 | 0.07 | 0.22 |
| | | | 10 YR | 5 | 4 | | | 4.5 | 5.0 | 62.1 | 61.8 | 0.01 | 0 | 0.02 | 0.20 |
| | | | 10 YR | 5 | 4 | | | 5.0 | 5.5 | 57.4 | 57.1 | 0.02 | 1 | 0.03 | 0.18 |
| | | | 10 YR | 5 | 4 | | | 5.5 | 6.0 | 58.5 | 58.1 | 0.03 | 1 | 0.05 | 0.17 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4170N

Driller:.... G. SHEATHER
Date:..... 9/8/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.20
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | |
| FROM | TO | DESCRIPT. | HUE | V | C | HUE V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 3.5 | GS | | | | 10 YR 6 2 | 0.3 | 1.0 | 53.1 | 52.3 | 0.05 | 2 | 0.09 | 0.09 |
| 3.5 | 6.0 | BrS | | | | 10 YR 8 2 | 1.0 | 1.5 | 60.9 | 60.5 | 0.05 | 1 | 0.08 | 0.09 |
| | | | | | | 5 YR 6 1 | 1.5 | 2.0 | 61.1 | 60.3 | 0.27 | 1 | 0.44 | 0.19 |
| | | | | | | 5 YR 6 1 | 2.0 | 2.5 | 70.2 | 69.7 | 0.30 | 1 | 0.43 | 0.25 |
| | | | | | | 5 YR 6 1 | 2.5 | 3.0 | 67.5 | 67.0 | 0.08 | 1 | 0.12 | 0.22 |
| | | | 10 YR 6 2 | | | | 3.0 | 3.5 | 68.1 | 67.7 | 0.06 | 1 | 0.09 | 0.20 |
| | | | 10 YR 5 4 | | | | 3.5 | 4.0 | 60.5 | 60.1 | 0.06 | 1 | 0.10 | 0.19 |
| | | | 10 YR 5 4 | | | | 4.0 | 4.5 | 59.0 | 58.7 | 0.08 | 1 | 0.14 | 0.18 |
| | | | 10 YR 5 4 | | | | 4.5 | 5.0 | 59.8 | 59.4 | 0.17 | 1 | 0.28 | 0.19 |
| | | | 10 YR 5 4 | | | | 5.0 | 5.5 | 56.8 | 56.5 | 0.15 | 1 | 0.26 | 0.20 |
| | | | 10 YR 5 4 | | | | 5.5 | 6.0 | 61.2 | 60.9 | 0.16 | 0 | 0.26 | 0.20 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4190N

Driller:.... G. SHEATHER
Date:..... 8/8/95
Rig:..... HD 4
Depth to Water:..... 4.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.18
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | | |
| | | | WET | | | DRY | | | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. | |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | | |
| 0.3 | 1.0 | LtBrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 42.3 | 42.1 | 0.04 | 0 | 0.09 | 0.09 | |
| 1.0 | 3.0 | YS | | | | 10 YR | 6 6 | 1.0 | 1.5 | 36.8 | 36.5 | 0.09 | 1 | 0.24 | 0.16 | |
| 3.0 | 4.4 | GS | | | | 10 YR | 6 6 | 1.5 | 2.0 | 47.3 | 46.9 | 0.05 | 1 | 0.11 | 0.14 | |
| 4.4 | 4.6 | Peat | | | | 10 YR | 6 6 | 2.0 | 2.5 | 48.3 | 47.9 | 0.04 | 1 | 0.08 | 0.13 | |
| 4.6 | 6.0 | BrS | | | | 10 YR | 6 6 | 2.5 | 3.0 | 42.3 | 42.0 | 0.02 | 1 | 0.05 | 0.11 | |
| | | | | | | 10 YR | 8 2 | 3.0 | 3.5 | 44.0 | 43.9 | 0.01 | 0 | 0.02 | 0.10 | |
| | | | | | | 10 YR | 8 2 | 3.5 | 4.0 | 38.0 | 37.9 | 0.02 | 0 | 0.05 | 0.09 | |
| | | | | | | 5 YR | 2 2 | 4.0 | 4.5 | 44.0 | 41.8 | 0.13 | 5 | 0.30 | 0.12 | |
| | | | 10 YR | 4 | 2 | | | 4.5 | 5.0 | 47.1 | 45.3 | 0.12 | 4 | 0.25 | 0.13 | |
| | | | 10 YR | 4 | 2 | | | 5.0 | 5.5 | 36.1 | 35.8 | 0.15 | 1 | 0.42 | 0.16 | |
| | | | 10 YR | 4 | 2 | | | 5.5 | 6.0 | 43.0 | 42.5 | 0.16 | 1 | 0.37 | 0.18 | |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4210N

Driller:.... G. SHEATHER
Date:..... 8/8/95
Rig:..... HD 4
Depth to Water:..... 4.3
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.17
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.1 | LtBrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 55.3 | 54.9 | 0.08 | 1 | 0.14 | 0.14 |
| 1.1 | 2.5 | YS | | | | 10 YR | 6 | 6 | 1.0 | 1.5 | 57.6 | 57.2 | 0.02 | 1 | 0.03 | 0.10 |
| 2.5 | 6.0 | LtBrS | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 54.4 | 54.1 | 0.08 | 1 | 0.15 | 0.11 |
| | | | | | | 10 YR | 6 | 6 | 2.0 | 2.5 | 60.4 | 59.9 | 0.08 | 1 | 0.13 | 0.12 |
| | | | | | | 10 YR | 6 | 2 | 2.5 | 3.0 | 54.8 | 54.5 | 0.08 | 1 | 0.15 | 0.12 |
| | | | | | | 10 YR | 8 | 2 | 3.0 | 3.5 | 63.5 | 63.2 | 0.07 | 0 | 0.11 | 0.12 |
| | | | | | | 10 YR | 8 | 2 | 3.5 | 4.0 | 52.0 | 51.8 | 0.16 | 0 | 0.31 | 0.15 |
| | | | 10 YR | 8 | 2 | | | | 4.0 | 4.5 | 47.9 | 47.8 | 0.08 | 0 | 0.17 | 0.15 |
| | | | 10 YR | 6 | 2 | | | | 4.5 | 5.0 | 53.1 | 52.8 | 0.15 | 1 | 0.28 | 0.16 |
| | | | 10 YR | 6 | 2 | | | | 5.0 | 5.5 | 57.6 | 57.4 | 0.10 | 0 | 0.17 | 0.16 |
| | | | 10 YR | 6 | 2 | | | | 5.5 | 6.0 | 56.1 | 55.9 | 0.11 | 0 | 0.20 | 0.17 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4230N

Driller:.... G. SHEATHER
Date:..... 8/8/95
Rig:..... HD 4
Depth to Water:..... 4.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.21
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | LtBrS | | | | 10 YR 6 2 | | 0.3 | 1.0 | 59.9 | 59.4 | 0.05 | 1 | 0.08 | 0.08 |
| 1.5 | 3.5 | BrS | | | | 10 YR 8 2 | | 1.0 | 1.5 | 65.7 | 65.4 | 0.06 | 0 | 0.09 | 0.09 |
| 3.5 | 5.0 | LtBrS | | | | 10 YR 5 4 | | 1.5 | 2.0 | 54.8 | 54.4 | 0.07 | 1 | 0.13 | 0.10 |
| 5.0 | 6.0 | BrS | | | | 10 YR 5 4 | | 2.0 | 2.5 | 61.0 | 60.5 | 0.06 | 1 | 0.10 | 0.10 |
| | | | | | | 5 YR 4 4 | | 2.5 | 3.0 | 55.4 | 54.2 | 0.13 | 2 | 0.23 | 0.12 |
| | | | | | | 5 YR 4 4 | | 3.0 | 3.5 | 55.6 | 54.8 | 0.22 | 1 | 0.40 | 0.17 |
| | | | | | | 10 YR 6 2 | | 3.5 | 4.0 | 61.7 | 61.2 | 0.19 | 1 | 0.31 | 0.19 |
| | | | | | | 10 YR 8 2 | | 4.0 | 4.5 | 59.8 | 59.5 | 0.18 | 1 | 0.30 | 0.20 |
| | | | 10 YR 6 2 | | | | | 4.5 | 5.0 | 60.0 | 59.7 | 0.13 | 0 | 0.22 | 0.20 |
| | | | 10 YR 4 2 | | | | | 5.0 | 5.5 | 63.0 | 62.5 | 0.16 | 1 | 0.25 | 0.21 |
| | | | 10 YR 4 2 | | | | | 5.5 | 6.0 | 57.3 | 57.0 | 0.13 | 1 | 0.23 | 0.21 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4250N

Driller:.... G. SHEATHER
Date:..... 8/8/95
Rig:..... HD 4
Depth to Water:..... 3.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.28
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.0 | GS | | | | 5 YR | 4 | 1 | 0.3 | 1.0 | 50.2 | 49.2 | 0.06 | 2 | 0.12 | 0.12 |
| 2.0 | 6.0 | BrS | | | | 10 YR | 8 | 2 | 1.0 | 1.5 | 49.5 | 49.0 | 0.03 | 1 | 0.06 | 0.09 |
| | | | | | | 5 YR | 4 | 1 | 1.5 | 2.0 | 62.3 | 61.4 | 0.20 | 1 | 0.32 | 0.16 |
| | | | | | | 10 YR | 4 | 2 | 2.0 | 2.5 | 60.9 | 60.3 | 0.20 | 1 | 0.33 | 0.20 |
| | | | | | | 10 YR | 5 | 4 | 2.5 | 3.0 | 62.0 | 61.3 | 0.29 | 1 | 0.47 | 0.25 |
| | | | | | | 10 YR | 7 | 4 | 3.0 | 3.5 | 66.4 | 65.9 | 0.24 | 1 | 0.36 | 0.27 |
| | | | 10 YR | 4 | 2 | | | | 3.5 | 4.0 | 69.7 | 69.1 | 0.12 | 1 | 0.17 | 0.25 |
| | | | 10 YR | 4 | 2 | | | | 4.0 | 4.5 | 57.0 | 56.4 | 0.12 | 1 | 0.21 | 0.25 |
| | | | 10 YR | 4 | 2 | | | | 4.5 | 5.0 | 66.3 | 66.0 | 0.18 | 0 | 0.27 | 0.25 |
| | | | 10 YR | 4 | 2 | | | | 5.0 | 5.5 | 58.3 | 57.8 | 0.23 | 1 | 0.39 | 0.26 |
| | | | | | | | | | 5.5 | 6.0 | 62.2 | 61.6 | 0.24 | 1 | 0.39 | 0.28 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4270N

Driller:.... G. SHEATHER
Date:..... 8/8/95
Rig:..... HD 4
Depth to Water:..... 3.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.47
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | WET V | WET C | DRY HUE | DRY V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | LtBrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 43.1 | 42.7 | 0.04 | 1 | 0.09 | 0.09 |
| 1.5 | 2.0 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 52.6 | 52.3 | 0.04 | 1 | 0.08 | 0.09 |
| 2.0 | 3.5 | LtBrS | | | | 5 YR | 4 4 | 1.5 | 2.0 | 47.7 | 46.6 | 0.07 | 2 | 0.15 | 0.10 |
| 3.5 | 6.0 | BrS | | | | 10 YR | 6 2 | 2.0 | 2.5 | 56.4 | 55.4 | 0.18 | 2 | 0.32 | 0.15 |
| | | | | | | 10 YR | 6 2 | 2.5 | 3.0 | 52.3 | 51.9 | 0.21 | 1 | 0.40 | 0.20 |
| | | | | | | 10 YR | 6 2 | 3.0 | 3.5 | 55.1 | 54.8 | 0.21 | 1 | 0.38 | 0.23 |
| | | | 5 YR | 3 | 4 | | | 3.5 | 4.0 | 53.1 | 52.3 | 0.43 | 2 | 0.81 | 0.31 |
| | | | 5 YR | 3 | 4 | | | 4.0 | 4.5 | 49.5 | 48.8 | 0.44 | 1 | 0.89 | 0.38 |
| | | | 5 YR | 3 | 4 | | | 4.5 | 5.0 | 53.8 | 53.3 | 0.40 | 1 | 0.74 | 0.41 |
| | | | 5 YR | 3 | 4 | | | 5.0 | 5.5 | 51.5 | 50.9 | 0.41 | 1 | 0.80 | 0.45 |
| | | | 5 YR | 3 | 4 | | | 5.5 | 6.0 | 56.5 | 55.9 | 0.39 | 1 | 0.69 | 0.47 |

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4290N

Driller:.... G. SHEATHER
Date:..... 7/8/95
Rig:..... HD 4
Depth to Water:..... 4.5
Hole Bottom Code:..... Sandy Peat

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.16
Wtd Slimes % : 5

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.0 | LtBrS | | | | 10YR | 7 4 | 0.3 | 1.0 | 66.3 | 65.7 | 0.08 | 1 | 0.12 | 0.12 |
| 1.0 | 4.5 | BrS | | | | 5 YR | 5 6 | 1.0 | 1.5 | 52.9 | 52.3 | 0.05 | 1 | 0.09 | 0.11 |
| 4.5 | 4.7 | Peat | | | | 5 YR | 5 6 | 1.5 | 2.0 | 62.2 | 61.6 | 0.08 | 1 | 0.13 | 0.12 |
| 4.7 | 6.0 | S Peat | | | | 5 YR | 5 6 | 2.0 | 2.5 | 57.6 | 57.1 | 0.04 | 1 | 0.07 | 0.10 |
| | | | | | | 5 YR | 5 6 | 2.5 | 3.0 | 54.6 | 54.2 | 0.03 | 1 | 0.05 | 0.10 |
| | | | | | | 5 YR | 5 6 | 3.0 | 3.5 | 61.2 | 60.6 | 0.02 | 1 | 0.03 | 0.09 |
| | | | | | | 5 YR | 4 4 | 3.5 | 4.0 | 64.7 | 64.2 | 0.02 | 1 | 0.03 | 0.08 |
| | | | | | | 10 YR | 4 2 | 4.0 | 4.5 | 55.0 | 52.7 | 0.03 | 4 | 0.05 | 0.08 |
| | | | 5 YR | 2 | 2 | | | 4.5 | 5.0 | 48.7 | 35.6 | 0.13 | 27 | 0.27 | 0.10 |
| | | | 5 YR | 2 | 2 | | | 5.0 | 5.5 | 51.9 | 46.8 | 0.24 | 10 | 0.46 | 0.13 |
| | | | 5 YR | 2 | 2 | | | 5.5 | 6.0 | 55.1 | 49.0 | 0.26 | 11 | 0.47 | 0.16 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4310N

Driller:..... G. SHEATHER
Date:..... 7/8/95
Rig:..... HD 4
Depth to Water:..... 4.2
Hole Bottom Code:..... Sandy Peat

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.23
Wtd Slimes % : 2

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | WET HUE | V | C | DRY HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10YR | 6 2 | 0.3 | 1.0 | 45.8 | 44.9 | 0.22 | 2 | 0.48 | 0.48 |
| 1.5 | 4.0 | BrS | | | | 10 YR | 7 4 | 1.0 | 1.5 | 47.0 | 45.0 | 0.28 | 4 | 0.60 | 0.53 |
| 4.0 | 4.2 | Peat | | | | 10 YR | 5 4 | 1.5 | 2.0 | 53.3 | 49.7 | 0.37 | 7 | 0.69 | 0.58 |
| 4.2 | 6.0 | S Peat | | | | 5 YR | 4 4 | 2.0 | 2.5 | 46.5 | 43.5 | 0.06 | 6 | 0.13 | 0.48 |
| | | | | | | 5 YR | 4 4 | 2.5 | 3.0 | 62.4 | 62.0 | 0.02 | 1 | 0.03 | 0.39 |
| | | | | | | 10 YR | 6 6 | 3.0 | 3.5 | 63.1 | 62.7 | 0.03 | 1 | 0.05 | 0.34 |
| | | | | | | 10 YR | 6 6 | 3.5 | 4.0 | 61.0 | 60.5 | 0.06 | 1 | 0.10 | 0.31 |
| | | | 10 YR | 4 | 2 | | | 4.0 | 4.5 | 66.7 | 65.9 | 0.11 | 1 | 0.16 | 0.29 |
| | | | 10 YR | 4 | 2 | | | 4.5 | 5.0 | 59.4 | 58.8 | 0.02 | 1 | 0.03 | 0.26 |
| | | | 10 YR | 4 | 2 | | | 5.0 | 5.5 | 59.5 | 58.8 | 0.04 | 1 | 0.07 | 0.24 |
| | | | 10 YR | 4 | 2 | | | 5.5 | 6.0 | 61.7 | 60.9 | 0.08 | 1 | 0.13 | 0.23 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4330N

Driller:..... G. SHEATHER
Date:..... 7/8/95
Rig:..... HD 4
Depth to Water:..... 3.1
Hole Bottom Code:..... Peat

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 3.5
Sample Depth:.... 3.2

Wtd Grade Wt % : 0.06
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 56.9 | 56.3 | 0.03 | 1 | 0.05 | 0.05 |
| 1.5 | 3.5 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 60.5 | 60.1 | 0.03 | 1 | 0.05 | 0.05 |
| | | | | | | 10 YR | 4 2 | 1.5 | 2.0 | 55.5 | 55.2 | 0.03 | 1 | 0.05 | 0.05 |
| | | | | | | 5 YR | 3 4 | 2.0 | 2.5 | 57.3 | 56.7 | 0.03 | 1 | 0.05 | 0.05 |
| | | | | | | 5 YR | 3 4 | 2.5 | 3.0 | 55.9 | 55.1 | 0.05 | 1 | 0.09 | 0.06 |
| | | | 5 YR | 4 | 4 | | | 3.0 | 3.5 | 52.2 | 51.4 | 0.05 | 2 | 0.10 | 0.06 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70440E
Hole No. . . . .4350N

Driller:.... G. SHEATHER
Date:..... 7/8/95
Rig:..... HD 4
Depth to Water:..... 3.5
Hole Bottom Code:..... Peat

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 5.0
Sample Depth:.... 4.7

Wtd Grade Wt % : 0.06
Wtd Slimes % : 9

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | WET V | WET C | DRY HUE | DRY V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.0 | GS | | | | 5 YR | 4 1 | 0.3 | 1.0 | 53.8 | 53.1 | 0.01 | 1 | 0.02 | 0.02 |
| 2.0 | 4.0 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 65.5 | 65.2 | 0.01 | 0 | 0.02 | 0.02 |
| 4.0 | 5.0 | Peat | | | | 10 YR | 6 2 | 1.5 | 2.0 | 64.4 | 63.6 | 0.03 | 1 | 0.05 | 0.03 |
| | | | | | | 5 YR | 3 4 | 2.0 | 2.5 | 64.0 | 63.4 | 0.06 | 1 | 0.09 | 0.04 |
| | | | | | | 5 YR | 4 4 | 2.5 | 3.0 | 59.4 | 58.8 | 0.04 | 1 | 0.07 | 0.05 |
| | | | | | | 10 YR | 7 4 | 3.0 | 3.5 | 64.8 | 64.6 | 0.02 | 0 | 0.03 | 0.04 |
| | | | 10 YR | 4 | 2 | | | 3.5 | 4.0 | 54.7 | 53.7 | 0.04 | 2 | 0.07 | 0.05 |
| | | | N | | 1 | | | 4.0 | 4.5 | 38.4 | 22.9 | 0.03 | 40 | 0.08 | 0.05 |
| | | | N | | 1 | | | 4.5 | 5.0 | 34.2 | 23.0 | 0.05 | 33 | 0.15 | 0.06 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7076OE
Hole No. . . . .3890N

Driller:.... G. SHEATHER
Date:..... 4/8/95
Rig:..... HD 4
Depth to Water:..... 4.2
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.13
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.1 | GS | | | | 10YR | 8 2 | 0.3 | 1.0 | 61.0 | 60.5 | 0.12 | 1 | 0.20 | 0.20 |
| 1.1 | 4.0 | LtBrS | | | | 10YR | 7 4 | 1.0 | 1.5 | 62.3 | 62.0 | 0.07 | 0 | 0.11 | 0.16 |
| 4.0 | 6.0 | YS | | | | 10YR | 6 2 | 1.5 | 2.0 | 56.3 | 55.9 | 0.10 | 1 | 0.18 | 0.17 |
| | | | | | | 10YR | 4 2 | 2.0 | 2.5 | 54.4 | 53.8 | 0.08 | 1 | 0.15 | 0.16 |
| | | | | | | 10YR | 6 2 | 2.5 | 3.0 | 59.7 | 59.5 | 0.08 | 0 | 0.13 | 0.16 |
| | | | | | | 10YR | 7 4 | 3.0 | 3.5 | 57.9 | 57.7 | 0.15 | 0 | 0.26 | 0.17 |
| | | | | | | 10YR | 7 4 | 3.5 | 4.0 | 62.2 | 62.0 | 0.05 | 0 | 0.08 | 0.16 |
| | | | 10 YR | 6 | 6 | | | 4.0 | 4.5 | 55.3 | 55.1 | 0.10 | 0 | 0.18 | 0.16 |
| | | | 10 YR | 6 | 6 | | | 4.5 | 5.0 | 54.8 | 54.5 | 0.03 | 1 | 0.05 | 0.15 |
| | | | 10 YR | 6 | 6 | | | 5.0 | 5.5 | 51.3 | 51.0 | 0.02 | 1 | 0.04 | 0.14 |
| | | | 10 YR | 6 | 6 | | | 5.5 | 6.0 | 59.4 | 59.2 | 0.02 | 0 | 0.03 | 0.13 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .3900N

Driller:..... G. SHEATHER
Date:..... 4/8/95
Rig:..... HD 4
Depth to Water:..... 5.4
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:..... 6.7

Wtd Grade Wt % : 0.24
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.2 | GS | | | | 10YR | 6 2 | 0.3 | 1.0 | 49.4 | 49.0 | 0.17 | 1 | 0.34 | 0.34 |
| 1.2 | 3.0 | YS | | | | 10YR | 6 6 | 1.0 | 1.5 | 55.6 | 55.1 | 0.22 | 1 | 0.40 | 0.37 |
| 3.0 | 4.5 | LtBrS | | | | 10YR | 6 6 | 1.5 | 2.0 | 51.3 | 50.7 | 0.19 | 1 | 0.37 | 0.37 |
| 4.5 | 5.5 | GS | | | | 10YR | 6 6 | 2.0 | 2.5 | 55.5 | 55.1 | 0.17 | 1 | 0.31 | 0.35 |
| 5.5 | 7.0 | LtBrS | | | | 10YR | 6 6 | 2.5 | 3.0 | 50.6 | 50.3 | 0.09 | 1 | 0.18 | 0.32 |
| | | | | | | 10YR | 7 4 | 3.0 | 3.5 | 46.2 | 46.0 | 0.06 | 0 | 0.13 | 0.29 |
| | | | | | | 10YR | 7 4 | 3.5 | 4.0 | 55.2 | 54.9 | 0.07 | 1 | 0.13 | 0.27 |
| | | | | | | 10YR | 7 4 | 4.0 | 4.5 | 57.3 | 57.2 | 0.05 | 0 | 0.09 | 0.25 |
| | | | | | | 10YR | 8 2 | 4.5 | 5.0 | 52.6 | 52.5 | 0.08 | 0 | 0.15 | 0.24 |
| | | | 10 YR | 8 | 2 | | | 5.0 | 5.5 | 47.7 | 47.6 | 0.13 | 0 | 0.27 | 0.24 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 51.4 | 51.3 | 0.13 | 0 | 0.25 | 0.24 |
| | | | 10 YR | 7 | 4 | | | 6.0 | 6.5 | 53.7 | 53.4 | 0.12 | 1 | 0.22 | 0.24 |
| | | | 10 YR | 7 | 4 | | | 6.5 | 7.0 | 43.3 | 43.1 | 0.10 | 0 | 0.23 | 0.24 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . . .70760E
Hole No. . . . . .3910N

Driller:..... G. SHEATHER
Date:..... 4/8/95
Rig:..... HD 4
Depth to Water:..... 5.2
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:.....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.37
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.1 | G | | | | 10YR | 6 | 2 | 0.3 | 1.0 | 56.4 | 55.7 | 0.20 | 1 | 0.35 | 0.35 |
| 1.1 | 3.5 | YS | | | | 10YR | 6 | 6 | 1.0 | 1.5 | 54.9 | 54.2 | 0.15 | 1 | 0.27 | 0.32 |
| 3.5 | 6.0 | LtBrS | | | | 10YR | 6 | 6 | 1.5 | 2.0 | 48.3 | 47.8 | 0.16 | 1 | 0.33 | 0.32 |
| | | | | | | 10YR | 6 | 6 | 2.0 | 2.5 | 57.8 | 57.3 | 0.26 | 1 | 0.45 | 0.35 |
| | | | | | | 10YR | 6 | 6 | 2.5 | 3.0 | 50.2 | 49.7 | 0.07 | 1 | 0.14 | 0.31 |
| | | | | | | 10YR | 6 | 6 | 3.0 | 3.5 | 55.3 | 55.0 | 0.03 | 1 | 0.05 | 0.27 |
| | | | | | | 10YR | 7 | 7 | 3.5 | 4.0 | 53.7 | 53.5 | 0.05 | 0 | 0.09 | 0.25 |
| | | | | | | 10YR | 7 | 4 | 4.0 | 4.5 | 58.0 | 57.7 | 0.12 | 1 | 0.21 | 0.24 |
| | | | | | | 10YR | 7 | 4 | 4.5 | 5.0 | 59.8 | 59.5 | 1.18 | 1 | 1.97 | 0.43 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 54.1 | 54.0 | 0.04 | 0 | 0.07 | 0.39 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 50.8 | 50.7 | 0.05 | 0 | 0.10 | 0.37 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7076OE
Hole No. . . . .3920N

Driller:.... G. SHEATHER
Date:..... 4/8/95
Rig:..... HD 4
Depth to Water:..... 4.3
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.26
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | |
| FROM | TO | DESCRIPT. | HUE | V | C | HUE V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 0.8 | GS | | | | 10YR 6 2 | 0.3 | 1.0 | 57.3 | 56.7 | 0.50 | 1 | 0.87 | 0.87 |
| 0.8 | 2.0 | LtBrS | | | | 10YR 7 4 | 1.0 | 1.5 | 47.6 | 47.2 | 0.16 | 1 | 0.34 | 0.65 |
| 2.0 | 2.5 | YS | | | | 10YR 7 4 | 1.5 | 2.0 | 53.3 | 53.0 | 0.15 | 1 | 0.28 | 0.54 |
| 2.5 | 6.0 | LtBrS | | | | 10YR 6 6 | 2.0 | 2.5 | 58.2 | 57.4 | 0.08 | 1 | 0.14 | 0.45 |
| | | | | | | 10YR 5 4 | 2.5 | 3.0 | 47.6 | 47.2 | 0.05 | 1 | 0.11 | 0.39 |
| | | | | | | 10YR 5 4 | 3.0 | 3.5 | 49.8 | 49.6 | 0.02 | 0 | 0.04 | 0.33 |
| | | | | | | 10YR 6 2 | 3.5 | 4.0 | 53.4 | 53.1 | 0.07 | 1 | 0.13 | 0.30 |
| | | | 10 | YR | 7 4 | | 4.0 | 4.5 | 50.5 | 50.2 | 0.05 | 1 | 0.10 | 0.28 |
| | | | 10 | YR | 7 4 | | 4.5 | 5.0 | 55.9 | 55.6 | 0.09 | 1 | 0.16 | 0.27 |
| | | | 10 | YR | 7 4 | | 5.0 | 5.5 | 50.9 | 50.7 | 0.10 | 0 | 0.20 | 0.26 |
| | | | 10 | YR | 7 4 | | 5.5 | 6.0 | 60.0 | 59.7 | 0.12 | 0 | 0.20 | 0.26 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .3930N

Driller:.... G. SHEATHER
Date:..... 4/8/95
Rig:..... HD 4
Depth to Water:..... 4.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.13
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10YR | 6 | 2 | 0.3 | 1.0 | 33.9 | 33.4 | 0.09 | 1 | 0.27 | 0.27 |
| 1.5 | 3.5 | BrS | | | | 10YR | 8 | 2 | 1.0 | 1.5 | 42.4 | 42.1 | 0.10 | 1 | 0.24 | 0.25 |
| 3.5 | 6.0 | LtBrS | | | | 10YR | 6 | 2 | 1.5 | 2.0 | 39.0 | 38.9 | 0.05 | 0 | 0.13 | 0.22 |
| | | | | | | 5 YR | 4 | 4 | 2.0 | 2.5 | 44.4 | 43.9 | 0.09 | 1 | 0.20 | 0.21 |
| | | | | | | 5 YR | 4 | 4 | 2.5 | 3.0 | 38.7 | 38.4 | 0.03 | 1 | 0.08 | 0.19 |
| | | | | | | 5 YR | 4 | 4 | 3.0 | 3.5 | 43.1 | 42.8 | 0.06 | 1 | 0.14 | 0.18 |
| | | | | | | 10 YR | 7 | 4 | 3.5 | 4.0 | 40.9 | 40.7 | 0.06 | 0 | 0.15 | 0.18 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 43.8 | 43.6 | 0.04 | 0 | 0.09 | 0.17 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 35.8 | 35.7 | 0.01 | 0 | 0.03 | 0.15 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 48.9 | 48.7 | 0.01 | 0 | 0.02 | 0.14 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 38.5 | 38.4 | 0.01 | 0 | 0.03 | 0.13 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .3950N

Driller:..... G. SHEATHER
Date:..... 25/7/95
Rig:..... HD 4
Depth to Water:..... 6.1
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:..... 6.7

Wtd Grade Wt % : 0.19
Wtd Slimes % : 0

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 4.0 | LtBrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 47.4 | 46.9 | 0.09 | 1 | 0.19 | 0.19 |
| 4.0 | 7.0 | GS | | | | 10 YR | 6 | 6 | 1.0 | 1.5 | 47.4 | 47.0 | 0.08 | 1 | 0.17 | 0.18 |
| | | | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 52.2 | 51.9 | 0.05 | 1 | 0.10 | 0.16 |
| | | | | | | 10 YR | 7 | 4 | 2.0 | 2.5 | 47.7 | 47.4 | 0.03 | 1 | 0.06 | 0.13 |
| | | | | | | 10 YR | 7 | 4 | 2.5 | 3.0 | 49.2 | 49.2 | 0.05 | 0 | 0.10 | 0.13 |
| | | | | | | 10 YR | 7 | 4 | 3.0 | 3.5 | 53.1 | 52.9 | 0.04 | 0 | 0.08 | 0.12 |
| | | | | | | 10 YR | 7 | 4 | 3.5 | 4.0 | 50.1 | 49.9 | 0.18 | 0 | 0.36 | 0.15 |
| | | | | | | 10 YR | 8 | 2 | 4.0 | 4.5 | 54.3 | 54.1 | 0.11 | 0 | 0.20 | 0.16 |
| | | | | | | 10 YR | 8 | 2 | 4.5 | 5.0 | 54.3 | 54.2 | 0.06 | 0 | 0.11 | 0.15 |
| | | | | | | 10 YR | 8 | 2 | 5.0 | 5.5 | 55.0 | 54.7 | 0.25 | 1 | 0.45 | 0.18 |
| | | | | | | 10 YR | 8 | 2 | 5.5 | 6.0 | 49.9 | 49.7 | 0.15 | 0 | 0.30 | 0.19 |
| | | | 10 YR | 8 | 2 | | | | 6.0 | 6.5 | 51.6 | 51.5 | 0.11 | 0 | 0.21 | 0.19 |
| | | | 10 YR | 8 | 2 | | | | 6.5 | 7.0 | 54.0 | 53.8 | 0.06 | 0 | 0.11 | 0.19 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7076OE
Hole No. . . . .395ON

Driller:.... G. SHEATHER
Date:..... 3/8/95
Rig:..... HD 4
Depth to Water:..... 3.4
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.15
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.4 | GS | | | | 10YR | 6 2 | 0.3 | 1.0 | 43.0 | 42.7 | 0.03 | 1 | 0.07 | 0.07 |
| 1.4 | 3.0 | BrS | | | | 10YR | 6 2 | 1.0 | 1.5 | 48.9 | 48.7 | 0.11 | 0 | 0.22 | 0.13 |
| 3.0 | 6.0 | LtBrS | | | | 5 YR | 3 4 | 1.5 | 2.0 | 40.3 | 39.4 | 0.14 | 2 | 0.35 | 0.20 |
| | | | | | | 5 YR | 3 4 | 2.0 | 2.5 | 42.3 | 41.7 | 0.03 | 1 | 0.07 | 0.17 |
| | | | | | | 5 YR | 3 4 | 2.5 | 3.0 | 38.5 | 38.2 | 0.13 | 1 | 0.34 | 0.20 |
| | | | 10 YR | 7 | 4 | | | 3.0 | 3.5 | 44.2 | 44.1 | 0.06 | 0 | 0.14 | 0.19 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 42.4 | 42.3 | 0.06 | 0 | 0.14 | 0.18 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 47.9 | 47.8 | 0.09 | 0 | 0.19 | 0.18 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 46.7 | 46.6 | 0.03 | 0 | 0.06 | 0.17 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 41.7 | 41.6 | 0.03 | 0 | 0.07 | 0.16 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 41.7 | 41.6 | 0.02 | 0 | 0.05 | 0.15 |

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7076OE
Hole No. . . . .3960N

Driller:.... G. SHEATHER
Date:..... 3/8/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.22
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.0 | GS | | | | 10YR | 6 2 | 0.3 | 1.0 | 39.7 | 39.4 | 0.09 | 1 | 0.23 | 0.23 |
| 1.0 | 3.0 | BrS | | | | 10YR | 4 2 | 1.0 | 1.5 | 40.7 | 40.4 | 0.13 | 1 | 0.32 | 0.27 |
| 3.0 | 6.0 | LtBrS | | | | 5 YR | 3 4 | 1.5 | 2.0 | 39.7 | 38.9 | 0.04 | 2 | 0.10 | 0.22 |
| | | | | | | 5 YR | 4 4 | 2.0 | 2.5 | 37.0 | 36.5 | 0.23 | 1 | 0.62 | 0.31 |
| | | | | | | 10 YR | 5 4 | 2.5 | 3.0 | 42.7 | 42.4 | 0.30 | 1 | 0.70 | 0.38 |
| | | | 10 YR | 7 | 4 | | | 3.0 | 3.5 | 34.9 | 34.7 | 0.04 | 1 | 0.11 | 0.34 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 45.1 | 44.8 | 0.02 | 1 | 0.04 | 0.30 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 34.0 | 32.3 | 0.03 | 5 | 0.09 | 0.27 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 36.8 | 36.2 | 0.02 | 2 | 0.05 | 0.25 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 44.3 | 44.0 | 0.06 | 1 | 0.14 | 0.24 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 42.8 | 42.6 | 0.02 | 0 | 0.05 | 0.22 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .3980N

Driller:.... G. SHEATHER
Date:..... 3/8/95
Rig:..... HD 4
Depth to Water:..... 2.2
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.31
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 46.7 | 46.2 | 0.17 | 1 | 0.36 | 0.36 |
| 1.5 | 2.5 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 49.5 | 49.1 | 0.41 | 1 | 0.83 | 0.56 |
| 2.5 | 3.0 | YS | | | | 5 YR | 3 4 | 1.5 | 2.0 | 41.0 | 40.5 | 0.26 | 1 | 0.63 | 0.58 |
| 3.0 | 6.0 | LtBrS | | | | 5 YR | 4 4 | 2.0 | 2.5 | 52.6 | 51.7 | 0.07 | 2 | 0.13 | 0.48 |
| | | | 10 YR | 6 | 6 | | | 2.5 | 3.0 | 44.8 | 44.6 | 0.10 | 0 | 0.22 | 0.43 |
| | | | 10 YR | 7 | 4 | | | 3.0 | 3.5 | 40.4 | 40.2 | 0.17 | 0 | 0.42 | 0.43 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 45.4 | 45.2 | 0.13 | 0 | 0.29 | 0.41 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 45.5 | 45.1 | 0.05 | 1 | 0.11 | 0.37 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 42.0 | 41.8 | 0.04 | 0 | 0.10 | 0.34 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 41.2 | 40.9 | 0.06 | 1 | 0.15 | 0.33 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 44.0 | 43.8 | 0.04 | 0 | 0.09 | 0.31 |

GS 1996/034

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .3990N

Driller:.... G. SHEATHER
Date:..... 2/8/95
Rig:..... HD 4
Depth to Water:..... 3.1
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.61
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | | LABORATORY SAMPLE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.5 | GS | | | | 5 YR | 2 | 1 | 0.3 | 1.0 | 46.3 | 45.7 | 0.09 | 1 | 0.19 | 0.19 |
| 2.5 | 4.0 | BrS | | | | 5 YR | 6 | 1 | 1.0 | 1.5 | 49.3 | 49.1 | 0.07 | 0 | 0.14 | 0.17 |
| 4.0 | 6.0 | YS | | | | 5 YR | 6 | 1 | 1.5 | 2.0 | 54.1 | 53.9 | 0.39 | 0 | 0.72 | 0.33 |
| | | | | | | 10 YR | 6 | 2 | 2.0 | 2.5 | 55.3 | 55.1 | 0.19 | 0 | 0.34 | 0.34 |
| | | | | | | 10 YR | 4 | 2 | 2.5 | 3.0 | 57.1 | 56.7 | 0.59 | 1 | 1.03 | 0.47 |
| | | | 5 YR | 3 | 4 | | | | 3.0 | 3.5 | 49.9 | 49.6 | 0.76 | 1 | 1.52 | 0.63 |
| | | | 10 YR | 5 | 4 | | | | 3.5 | 4.0 | 56.9 | 56.7 | 1.15 | 0 | 2.02 | 0.82 |
| | | | 10 YR | 6 | 6 | | | | 4.0 | 4.5 | 56.2 | 56.1 | 0.25 | 0 | 0.44 | 0.77 |
| | | | 10 YR | 6 | 6 | | | | 4.5 | 5.0 | 55.3 | 55.1 | 0.10 | 0 | 0.18 | 0.71 |
| | | | 10 YR | 6 | 6 | | | | 5.0 | 5.5 | 52.3 | 52.1 | 0.08 | 0 | 0.15 | 0.66 |
| | | | 10 YR | 6 | 6 | | | | 5.5 | 6.0 | 55.4 | 55.1 | 0.06 | 1 | 0.11 | 0.61 |

GS 1996/034

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7076OE
Hole No. . . . .4000N

Driller:.... G. SHEATHER
Date:..... 2/8/95
Rig:..... HD 4
Depth to Water:..... 5.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:.... 6.7

Wtd Grade Wt % : 0.44
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | WET V | WET C | DRY HUE | DRY V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 0.7 | GS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 57.5 | 57.0 | 0.24 | 1 | 0.42 | 0.42 |
| 0.7 | 2.5 | YS | | | | 10 YR | 6 6 | 1.0 | 1.5 | 49.3 | 49.0 | 0.14 | 1 | 0.28 | 0.36 |
| 2.5 | 5.0 | LtBrS | | | | 10 YR | 6 6 | 1.5 | 2.0 | 48.8 | 48.6 | 0.37 | 0 | 0.76 | 0.48 |
| 5.0 | 7.0 | YS | | | | 10 YR | 6 6 | 2.0 | 2.5 | 52.5 | 52.2 | 0.07 | 1 | 0.13 | 0.40 |
| | | | | | | 10 YR | 7 4 | 2.5 | 3.0 | 51.4 | 51.2 | 0.48 | 0 | 0.93 | 0.50 |
| | | | | | | 10 YR | 7 4 | 3.0 | 3.5 | 52.5 | 52.1 | 0.15 | 1 | 0.29 | 0.47 |
| | | | | | | 10 YR | 7 4 | 3.5 | 4.0 | 55.5 | 55.3 | 0.17 | 0 | 0.31 | 0.44 |
| | | | | | | 10 YR | 7 4 | 4.0 | 4.5 | 48.9 | 48.8 | 0.23 | 0 | 0.47 | 0.45 |
| | | | | | | 10 YR | 6 2 | 4.5 | 5.0 | 54.9 | 54.8 | 0.09 | 0 | 0.16 | 0.42 |
| | | | | | | 10 YR | 6 6 | 5.0 | 5.5 | 53.0 | 52.7 | 0.17 | 1 | 0.32 | 0.41 |
| | | | 10 YR | 6 | 6 | | | 5.5 | 6.0 | 51.9 | 51.6 | 0.32 | 1 | 0.62 | 0.43 |
| | | | 10 YR | 6 | 6 | | | 6.0 | 6.5 | 54.5 | 54.2 | 0.30 | 1 | 0.55 | 0.44 |
| | | | 10 YR | 6 | 6 | | | 6.5 | 7.0 | 55.5 | 55.3 | 0.26 | 0 | 0.47 | 0.44 |

GS 1996/034

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .4010N

Driller:..... G. SHEATHER
Date:..... 2/8/95
Rig:..... HD 4
Depth to Water:..... 5.1
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:.... 6.7

Wtd Grade Wt % : 0.37
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 0.8 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 51.6 | 51.2 | 0.04 | 1 | 0.08 | 0.08 |
| 0.8 | 3.0 | YS | | | | 10 YR | 6 | 6 | 1.0 | 1.5 | 55.7 | 55.3 | 0.03 | 1 | 0.05 | 0.07 |
| 3.0 | 6.0 | LtBrS | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 47.8 | 47.6 | 0.12 | 0 | 0.25 | 0.12 |
| 6.0 | 7.0 | YS | | | | 10 YR | 6 | 6 | 2.0 | 2.5 | 52.6 | 52.2 | 0.02 | 1 | 0.04 | 0.10 |
| | | | | | | 10 YR | 6 | 6 | 2.5 | 3.0 | 55.2 | 54.9 | 0.03 | 1 | 0.05 | 0.09 |
| | | | | | | 10 YR | 7 | 4 | 3.0 | 3.5 | 62.5 | 62.2 | 0.03 | 0 | 0.05 | 0.09 |
| | | | | | | 10 YR | 7 | 4 | 3.5 | 4.0 | 49.2 | 49.0 | 0.10 | 0 | 0.20 | 0.10 |
| | | | | | | 10 YR | 7 | 4 | 4.0 | 4.5 | 59.9 | 59.6 | 0.07 | 1 | 0.12 | 0.10 |
| | | | | | | 10 YR | 7 | 4 | 4.5 | 5.0 | 49.7 | 48.9 | 0.46 | 2 | 0.93 | 0.19 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 59.0 | 58.8 | 1.26 | 0 | 2.14 | 0.38 |
| | | | 10 YR | 6 | 6 | | | | 5.5 | 6.0 | 55.7 | 55.5 | 0.07 | 0 | 0.13 | 0.36 |
| | | | 10 YR | 6 | 6 | | | | 6.0 | 6.5 | 52.4 | 52.1 | 0.02 | 1 | 0.04 | 0.33 |
| | | | 10 YR | 6 | 6 | | | | 6.5 | 7.0 | 61.9 | 61.7 | 0.52 | 0 | 0.84 | 0.37 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .4020N

Driller:.... G. SHEATHER
Date:..... 2/8/95
Rig:..... HD 4
Depth to Water:..... 3.2
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.43
Wtd Slimes % : 0

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.0 | GS | | | | 5 | YR | 6 | 1 | 0.3 | 1.0 | 40.8 | 40.3 | 0.11 | 1 | 0.27 | 0.27 |
| 2.0 | 2.5 | BrS | | | | 10 | YR | 6 | 2 | 1.0 | 1.5 | 48.4 | 48.2 | 0.12 | 0 | 0.25 | 0.26 |
| 2.5 | 6.0 | LtBrS | | | | 10 | YR | 6 | 2 | 1.5 | 2.0 | 44.2 | 44.1 | 0.40 | 0 | 0.90 | 0.45 |
| | | | | | | 5 | YR | 3 | 4 | 2.0 | 2.5 | 59.8 | 59.4 | 0.43 | 1 | 0.72 | 0.51 |
| | | | | | | 10 | YR | 7 | 4 | 2.5 | 3.0 | 49.0 | 48.8 | 0.54 | 0 | 1.10 | 0.62 |
| | | | 10 | YR | 7 4 | | | | | 3.0 | 3.5 | 53.6 | 53.5 | 0.58 | 0 | 1.08 | 0.69 |
| | | | 10 | YR | 7 4 | | | | | 3.5 | 4.0 | 45.7 | 45.6 | 0.04 | 0 | 0.09 | 0.61 |
| | | | 10 | YR | 6 6 | | | | | 4.0 | 4.5 | 52.8 | 52.7 | 0.04 | 0 | 0.08 | 0.55 |
| | | | 10 | YR | 7 4 | | | | | 4.5 | 5.0 | 50.7 | 50.6 | 0.05 | 0 | 0.10 | 0.50 |
| | | | 10 | YR | 7 4 | | | | | 5.0 | 5.5 | 41.2 | 41.1 | 0.04 | 0 | 0.10 | 0.46 |
| | | | 10 | YR | 7 4 | | | | | 5.5 | 6.0 | 51.6 | 51.4 | 0.04 | 0 | 0.08 | 0.43 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .4030N

Driller:.... G. SHEATHER
Date:..... 2/8/95
Rig:..... HD 4
Depth to Water:..... 2.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.11
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.2 | GS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 46.3 | 45.9 | 0.09 | 1 | 0.19 | 0.19 |
| 1.2 | 2.5 | BrS | | | | 10 YR | 4 2 | 1.0 | 1.5 | 48.8 | 48.1 | 0.11 | 1 | 0.23 | 0.21 |
| 2.5 | 6.0 | LtBrS | | | | 5 YR | 3 4 | 1.5 | 2.0 | 51.1 | 50.5 | 0.12 | 1 | 0.23 | 0.22 |
| | | | | | | 5 YR | 4 4 | 2.0 | 2.5 | 54.1 | 53.6 | 0.03 | 1 | 0.06 | 0.18 |
| | | | 10 YR | 7 | 4 | | | 2.5 | 3.0 | 48.7 | 48.5 | 0.04 | 0 | 0.08 | 0.16 |
| | | | 10 YR | 7 | 4 | | | 3.0 | 3.5 | 54.2 | 54.0 | 0.01 | 0 | 0.02 | 0.14 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 55.6 | 55.5 | 0.02 | 0 | 0.04 | 0.12 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 54.5 | 54.3 | 0.10 | 0 | 0.18 | 0.13 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 54.5 | 54.3 | 0.04 | 0 | 0.07 | 0.13 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 52.2 | 52.0 | 0.01 | 0 | 0.02 | 0.12 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 55.4 | 55.1 | 0.01 | 1 | 0.02 | 0.11 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . . .7076OE
Hole No. . . . . .4080N

Driller:..... G. SHEATHER
Date:..... 1/8/95
Rig:..... HD 4
Depth to Water:..... 4.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.27
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 43.9 | 43.2 | 0.22 | 2 | 0.50 | 0.50 |
| 1.5 | 3.5 | BrS | | | | 10 YR | 8 | 2 | 1.0 | 1.5 | 46.6 | 46.3 | 0.18 | 1 | 0.39 | 0.45 |
| 3.5 | 6.0 | LtBrS | | | | 10 YR | 5 | 4 | 1.5 | 2.0 | 47.5 | 47.2 | 0.16 | 1 | 0.34 | 0.42 |
| | | | | | | 10 YR | 4 | 2 | 2.0 | 2.5 | 40.7 | 39.9 | 0.06 | 2 | 0.15 | 0.36 |
| | | | | | | 10 YR | 4 | 2 | 2.5 | 3.0 | 51.3 | 50.9 | 0.08 | 1 | 0.16 | 0.32 |
| | | | | | | 10 YR | 4 | 2 | 3.0 | 3.5 | 51.8 | 51.3 | 0.18 | 1 | 0.35 | 0.32 |
| | | | | | | 10 YR | 7 | 4 | 3.5 | 4.0 | 48.0 | 47.8 | 0.07 | 0 | 0.15 | 0.30 |
| | | | | | | 10 YR | 7 | 4 | 4.0 | 4.5 | 45.9 | 45.9 | 0.17 | 0 | 0.37 | 0.31 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 51.9 | 51.8 | 0.13 | 0 | 0.25 | 0.30 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 34.7 | 34.6 | 0.01 | 0 | 0.03 | 0.28 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 41.5 | 41.4 | 0.10 | 0 | 0.24 | 0.27 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .4060N

Driller:..... G. SHEATHER
Date:..... 1/8/95
Rig:..... HD 4
Depth to Water:..... 4.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.19
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 43.8 | 43.1 | 0.05 | 2 | 0.11 | 0.11 |
| 1.5 | 4.0 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 43.0 | 42.9 | 0.01 | 0 | 0.02 | 0.08 |
| 4.0 | 6.0 | LtBrS | | | | 10 YR | 4 2 | 1.5 | 2.0 | 54.5 | 53.9 | 0.05 | 1 | 0.09 | 0.08 |
| | | | | | | 5 YR | 3 4 | 2.0 | 2.5 | 38.2 | 37.1 | 0.16 | 3 | 0.42 | 0.16 |
| | | | | | | 5 YR | 4 4 | 2.5 | 3.0 | 41.1 | 40.5 | 0.18 | 1 | 0.44 | 0.21 |
| | | | | | | 5 YR | 4 4 | 3.0 | 3.5 | 44.9 | 44.5 | 0.25 | 1 | 0.56 | 0.26 |
| | | | | | | 5 YR | 4 4 | 3.5 | 4.0 | 51.0 | 50.5 | 0.10 | 1 | 0.20 | 0.25 |
| | | | 10 YR | 6 | 6 | | | 4.0 | 4.5 | 49.2 | 48.9 | 0.07 | 1 | 0.14 | 0.24 |
| | | | 10 YR | 6 | 6 | | | 4.5 | 5.0 | 44.3 | 44.2 | 0.02 | 0 | 0.05 | 0.22 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 45.1 | 44.4 | 0.02 | 2 | 0.04 | 0.20 |
| | | | | | | | | 5.5 | 6.0 | 43.9 | 43.8 | 0.02 | 0 | 0.05 | 0.19 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .4100N

Driller:.... G. SHEATHER
Date:..... 1/8/95
Rig:..... HD 4
Depth to Water:..... 4.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.12
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 0.5 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 36.8 | 36.4 | 0.02 | 1 | 0.05 | 0.05 |
| 0.5 | 1.5 | LtBrS | | | | 10 YR | 7 | 4 | 1.0 | 1.5 | 44.9 | 44.6 | 0.01 | 1 | 0.02 | 0.04 |
| 1.5 | 3.5 | BrS | | | | 10 YR | 5 | 4 | 1.5 | 2.0 | 36.7 | 36.4 | 0.03 | 1 | 0.08 | 0.05 |
| 3.5 | 6.0 | GS | | | | 10 YR | 5 | 4 | 2.0 | 2.5 | 41.6 | 41.1 | 0.06 | 1 | 0.14 | 0.07 |
| | | | | | | 10 YR | 5 | 4 | 2.5 | 3.0 | 46.8 | 46.2 | 0.07 | 1 | 0.15 | 0.09 |
| | | | | | | 10 YR | 5 | 4 | 3.0 | 3.5 | 43.7 | 43.1 | 0.07 | 1 | 0.16 | 0.10 |
| | | | | | | 10 YR | 8 | 2 | 3.5 | 4.0 | 48.1 | 47.9 | 0.17 | 0 | 0.35 | 0.13 |
| | | | | | | 10 YR | 8 | 2 | 4.0 | 4.5 | 47.9 | 47.8 | 0.04 | 0 | 0.08 | 0.13 |
| | | | 10 YR | 8 | 2 | | | | 4.5 | 5.0 | 35.1 | 34.1 | 0.02 | 3 | 0.06 | 0.12 |
| | | | 10 YR | 8 | 2 | | | | 5.0 | 5.5 | 35.3 | 35.3 | 0.03 | 0 | 0.08 | 0.12 |
| | | | 10 YR | 8 | 2 | | | | 5.5 | 6.0 | 37.9 | 37.8 | 0.04 | 0 | 0.11 | 0.12 |

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7076OE
Hole No. . . . .412ON

Driller:..... G. SHEATHER
Date:..... 1/8/95
Rig:..... HD 4
Depth to Water:..... 6.2
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:.... 6.7

Wtd Grade Wt % : 0.37
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 0.5 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 35.8 | 35.5 | 0.09 | 1 | 0.25 | 0.25 |
| 0.5 | 2.0 | YS | | | | 10 YR | 6 | 6 | 1.0 | 1.5 | 45.6 | 45.2 | 0.05 | 1 | 0.11 | 0.19 |
| 2.0 | 3.0 | LtBrS | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 41.5 | 41.1 | 0.09 | 1 | 0.22 | 0.20 |
| 3.0 | 5.5 | BrS | | | | 10 YR | 7 | 4 | 2.0 | 2.5 | 44.2 | 44.0 | 0.20 | 0 | 0.45 | 0.26 |
| 5.5 | 7.0 | LtBrS | | | | 10 YR | 7 | 4 | 2.5 | 3.0 | 44.0 | 43.9 | 0.22 | 0 | 0.50 | 0.30 |
| | | | | | | 10 YR | 5 | 4 | 3.0 | 3.5 | 50.1 | 49.9 | 0.17 | 0 | 0.34 | 0.31 |
| | | | | | | 10 YR | 5 | 4 | 3.5 | 4.0 | 38.5 | 38.4 | 0.03 | 0 | 0.08 | 0.28 |
| | | | | | | 10 YR | 7 | 4 | 4.0 | 4.5 | 40.1 | 39.9 | 0.05 | 0 | 0.12 | 0.26 |
| | | | | | | 10 YR | 4 | 2 | 4.5 | 5.0 | 34.3 | 33.8 | 0.13 | 1 | 0.38 | 0.27 |
| | | | | | | 10 YR | 4 | 2 | 5.0 | 5.5 | 40.1 | 39.6 | 0.19 | 1 | 0.47 | 0.29 |
| | | | | | | 10 YR | 7 | 4 | 5.5 | 6.0 | 45.3 | 45.2 | 0.18 | 0 | 0.40 | 0.30 |
| | | | 10 YR | 7 | 4 | | | | 6.0 | 6.5 | 32.8 | 32.7 | 0.31 | 0 | 0.95 | 0.35 |
| | | | 10 YR | 7 | 4 | | | | 6.5 | 7.0 | 43.6 | 43.5 | 0.23 | 0 | 0.53 | 0.37 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .4140N

Driller:.... G. SHEATHER
Date:..... 28/7/95
Rig:..... HD 4
Depth to Water:..... 4.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.17
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | LtBrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 50.1 | 49.6 | 0.04 | 1 | 0.08 | 0.08 |
| 1.5 | 4.0 | BrS | | | | 10YR | 6 | 2 | 1.0 | 1.5 | 48.9 | 48.7 | 0.05 | 0 | 0.10 | 0.09 |
| 4.0 | 6.0 | GS | | | | 10 YR | 4 | 2 | 1.5 | 2.0 | 47.0 | 46.7 | 0.03 | 1 | 0.06 | 0.08 |
| | | | | | | 10 YR | 4 | 2 | 2.0 | 2.5 | 49.9 | 49.6 | 0.08 | 1 | 0.16 | 0.10 |
| | | | | | | 10 YR | 4 | 2 | 2.5 | 3.0 | 49.4 | 48.9 | 0.07 | 1 | 0.14 | 0.11 |
| | | | | | | 10 YR | 4 | 2 | 3.0 | 3.5 | 48.1 | 47.1 | 0.40 | 2 | 0.83 | 0.22 |
| | | | | | | 10 YR | 4 | 2 | 3.5 | 4.0 | 52.0 | 51.5 | 0.06 | 1 | 0.12 | 0.21 |
| | | | 10 YR | 6 | 2 | | | | 4.0 | 4.5 | 63.1 | 62.9 | 0.16 | 0 | 0.25 | 0.21 |
| | | | 10 YR | 8 | 2 | | | | 4.5 | 5.0 | 45.7 | 45.6 | 0.04 | 0 | 0.09 | 0.20 |
| | | | 10 YR | 8 | 2 | | | | 5.0 | 5.5 | 49.2 | 49.0 | 0.03 | 0 | 0.06 | 0.19 |
| | | | 10 YR | 8 | 2 | | | | 5.5 | 6.0 | 52.7 | 52.6 | 0.03 | 0 | 0.06 | 0.17 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .4160N

Driller:.... G. SHEATHER
Date:..... 28/7/95
Rig:..... HD 4
Depth to Water:..... 4.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.11
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 3.0 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 41.8 | 41.3 | 0.03 | 1 | 0.07 | 0.07 |
| 3.0 | 6.0 | BrS | | | | 10YR | 6 | 2 | 1.0 | 1.5 | 54.5 | 54.1 | 0.02 | 1 | 0.04 | 0.06 |
| | | | | | | 10 YR | 6 | 2 | 1.5 | 2.0 | 58.6 | 58.3 | 0.07 | 1 | 0.12 | 0.08 |
| | | | | | | 10 YR | 6 | 2 | 2.0 | 2.5 | 47.5 | 47.3 | 0.08 | 0 | 0.17 | 0.10 |
| | | | | | | 10 YR | 6 | 2 | 2.5 | 3.0 | 46.7 | 46.3 | 0.17 | 1 | 0.36 | 0.15 |
| | | | | | | 10 YR | 4 | 2 | 3.0 | 3.5 | 50.7 | 49.8 | 0.04 | 2 | 0.08 | 0.14 |
| | | | | | | 5 YR | 3 | 4 | 3.5 | 4.0 | 55.5 | 54.9 | 0.03 | 1 | 0.05 | 0.12 |
| | | | 10 YR | 5 | 4 | | | | 4.0 | 4.5 | 49.4 | 49.1 | 0.05 | 1 | 0.10 | 0.12 |
| | | | 10 YR | 5 | 4 | | | | 4.5 | 5.0 | 41.8 | 41.6 | 0.02 | 0 | 0.05 | 0.11 |
| | | | 10 YR | 5 | 4 | | | | 5.0 | 5.5 | 48.9 | 48.7 | 0.01 | 0 | 0.02 | 0.10 |
| | | | 10 YR | 5 | 4 | | | | 5.5 | 6.0 | 54.0 | 53.8 | 0.09 | 0 | 0.17 | 0.11 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .4180N

Driller:.... G. SHEATHER
Date:..... 28/7/95
Rig:..... HD 4
Depth to Water:..... 7.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 8.0
Sample Depth:.... 7.7

Wtd Grade Wt % : 0.27
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 0.5 | GS | | | | 10 YR | 7 | 4 | 0.3 | 1.0 | 48.0 | 47.5 | 0.13 | 1 | 0.27 | 0.27 |
| 0.5 | 1.5 | YS | | | | 10YR | 6 | 6 | 1.0 | 1.5 | 50.4 | 50.1 | 0.11 | 1 | 0.22 | 0.25 |
| 1.5 | 3.0 | LtBrS | | | | 10 YR | 7 | 4 | 1.5 | 2.0 | 50.5 | 50.3 | 0.09 | 0 | 0.18 | 0.23 |
| 3.0 | 6.5 | GS | | | | 10 YR | 7 | 4 | 2.0 | 2.5 | 56.6 | 56.4 | 0.06 | 0 | 0.11 | 0.20 |
| 6.5 | 8.0 | BrS | | | | 10 YR | 7 | 4 | 2.5 | 3.0 | 53.7 | 53.6 | 0.11 | 0 | 0.20 | 0.20 |
| | | | | | | 10 YR | 8 | 2 | 3.0 | 3.5 | 52.3 | 52.1 | 0.18 | 0 | 0.34 | 0.22 |
| | | | | | | 10 YR | 8 | 2 | 3.5 | 4.0 | 53.9 | 53.6 | 0.10 | 1 | 0.19 | 0.22 |
| | | | | | | 10 YR | 8 | 2 | 4.0 | 4.5 | 54.0 | 53.8 | 0.04 | 0 | 0.07 | 0.20 |
| | | | | | | 10 YR | 8 | 2 | 4.5 | 5.0 | 46.5 | 46.3 | 0.09 | 0 | 0.19 | 0.20 |
| | | | | | | 10 YR | 8 | 2 | 5.0 | 5.5 | 47.5 | 47.3 | 0.26 | 0 | 0.55 | 0.23 |
| | | | | | | 10 YR | 8 | 2 | 5.5 | 6.0 | 54.4 | 54.2 | 0.50 | 0 | 0.92 | 0.29 |
| | | | | | | 10 YR | 8 | 2 | 6.0 | 6.5 | 50.3 | 50.0 | 0.22 | 1 | 0.44 | 0.31 |
| | | | | | | 10 YR | 4 | 2 | 6.5 | 7.0 | 49.9 | 49.6 | 0.08 | 1 | 0.16 | 0.29 |
| | | | 10 YR | 4 | 2 | | | | 7.0 | 7.5 | 38.0 | 37.8 | 0.04 | 1 | 0.11 | 0.28 |
| | | | 10 YR | 4 | 2 | | | | 7.5 | 8.0 | 54.2 | 53.8 | 0.05 | 1 | 0.09 | 0.27 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .4190N

Driller:.... G. SHEATHER
Date:..... 28/7/95
Rig:..... HD 4
Depth to Water:..... 5.5
Hole Bottom Code:.....

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.31
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.0 | GS | | | | 10 YR 8 2 | 0.3 | 1.0 | 51.8 | 51.5 | 0.18 | 1 | 0.35 | 0.35 |
| 1.0 | 2.0 | YS | | | | 10YR 6 6 | 1.0 | 1.5 | 49.0 | 48.5 | 0.08 | 1 | 0.16 | 0.27 |
| 2.0 | 6.0 | G&BrS | | | | 10 YR 6 6 | 1.5 | 2.0 | 53.2 | 52.9 | 0.11 | 1 | 0.21 | 0.25 |
| | | | | | | 10 YR 7 4 | 2.0 | 2.5 | 54.7 | 54.4 | 0.13 | 1 | 0.24 | 0.25 |
| | | | | | | 10 YR 7 4 | 2.5 | 3.0 | 51.5 | 51.3 | 0.07 | 0 | 0.14 | 0.23 |
| | | | | | | 10 YR 8 2 | 3.0 | 3.5 | 49.8 | 49.5 | 0.03 | 1 | 0.06 | 0.20 |
| | | | | | | 10 YR 6 2 | 3.5 | 4.0 | 52.0 | 51.4 | 0.19 | 1 | 0.37 | 0.22 |
| | | | | | | 10 YR 6 2 | 4.0 | 4.5 | 51.8 | 51.5 | 0.35 | 1 | 0.68 | 0.28 |
| | | | | | | 10 YR 8 2 | 4.5 | 5.0 | 53.8 | 53.6 | 0.38 | 0 | 0.71 | 0.32 |
| | | | | | | 10 YR 6 2 | 5.0 | 5.5 | 51.9 | 51.5 | 0.12 | 1 | 0.23 | 0.31 |
| | | | 10YR | 4 | 2 | | 5.5 | 6.0 | 51.8 | 51.4 | 0.14 | 1 | 0.27 | 0.31 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .4200N

Driller:.... G. SHEATHER
Date:..... 28/7/95
Rig:..... HD 4
Depth to Water:..... 4.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.17
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 54.7 | 53.9 | 0.08 | 1 | 0.15 | 0.15 |
| 1.5 | 6.0 | Br&GS | | | | 10 YR | 8 2 | 1.0 | 1.5 | 55.8 | 55.6 | 0.14 | 0 | 0.25 | 0.19 |
| | | | | | | 10 YR | 4 2 | 1.5 | 2.0 | 50.0 | 49.3 | 0.08 | 1 | 0.16 | 0.18 |
| | | | | | | 10 YR | 4 2 | 2.0 | 2.5 | 51.4 | 50.8 | 0.15 | 1 | 0.29 | 0.21 |
| | | | | | | 10 YR | 6 2 | 2.5 | 3.0 | 55.4 | 55.0 | 0.04 | 1 | 0.07 | 0.18 |
| | | | | | | 10 YR | 6 2 | 3.0 | 3.5 | 50.0 | 49.8 | 0.04 | 0 | 0.08 | 0.17 |
| | | | | | | 10 YR | 4 2 | 3.5 | 4.0 | 51.4 | 50.8 | 0.08 | 1 | 0.16 | 0.16 |
| | | | 10 YR | 5 | 4 | | | 4.0 | 4.5 | 52.1 | 51.9 | 0.10 | 0 | 0.19 | 0.17 |
| | | | 10 YR | 5 | 4 | | | 4.5 | 5.0 | 49.6 | 49.4 | 0.13 | 0 | 0.26 | 0.18 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 49.4 | 49.2 | 0.05 | 0 | 0.10 | 0.17 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 52.7 | 52.5 | 0.06 | 0 | 0.11 | 0.17 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .70760E
Hole No. . . . .4220N

Driller:..... G. SHEATHER
Date:..... 26/7/95
Rig:..... HD 4
Depth to Water:..... 4.7
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.24
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.2 | GS | | | | 5 | YR | 6 1 | 0.3 | 1.0 | 63.8 | 60.9 | 0.25 | 5 | 0.39 | 0.39 |
| 1.2 | 6.0 | LtBr&BrS | | | | 10 | YR | 6 6 | 1.0 | 1.5 | 48.5 | 48.1 | 0.01 | 1 | 0.02 | 0.24 |
| | | | | | | 10 | YR | 6 6 | 1.5 | 2.0 | 55.3 | 54.9 | 0.10 | 1 | 0.18 | 0.22 |
| | | | | | | 10 | YR | 7 4 | 2.0 | 2.5 | 41.2 | 41.0 | 0.31 | 0 | 0.75 | 0.34 |
| | | | | | | 10 | YR | 7 4 | 2.5 | 3.0 | 50.4 | 50.2 | 0.15 | 0 | 0.30 | 0.33 |
| | | | | | | 10 | YR | 8 2 | 3.0 | 3.5 | 62.8 | 62.6 | 0.04 | 0 | 0.06 | 0.29 |
| | | | | | | 10 | YR | 8 2 | 3.5 | 4.0 | 52.6 | 52.4 | 0.12 | 0 | 0.23 | 0.28 |
| | | | | | | 10 | YR | 8 2 | 4.0 | 4.5 | 67.7 | 67.4 | 0.09 | 0 | 0.13 | 0.26 |
| | | | 5 | YR | 3 2 | | | | 4.5 | 5.0 | 40.7 | 40.3 | 0.12 | 1 | 0.29 | 0.27 |
| | | | 5 | YR | 3 4 | | | | 5.0 | 5.5 | 47.2 | 46.8 | 0.08 | 1 | 0.17 | 0.26 |
| | | | 5 | YR | 3 4 | | | | 5.5 | 6.0 | 56.6 | 56.2 | 0.05 | 1 | 0.09 | 0.24 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7076OE
Hole No. . . . .4240N

Driller:..... G. SHEATHER
Date:..... 26/7/95
Rig:..... HD 4
Depth to Water:..... 4.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:.... 6.7

Wtd Grade Wt % : 0.30
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.7 | GS | | | | 5 YR | 6 1 | 0.3 | 1.0 | 39.7 | 39.2 | 0.17 | 1 | 0.43 | 0.43 |
| 1.7 | 7.0 | BrS | | | | 5 YR | 6 1 | 1.0 | 1.5 | 37.5 | 37.4 | 0.06 | 0 | 0.16 | 0.32 |
| | | | | | | 10 YR | 6 2 | 1.5 | 2.0 | 45.6 | 45.5 | 0.05 | 0 | 0.11 | 0.26 |
| | | | | | | 10 YR | 4 2 | 2.0 | 2.5 | 44.7 | 44.4 | 0.04 | 1 | 0.09 | 0.22 |
| | | | | | | 10 YR | 6 2 | 2.5 | 3.0 | 60.4 | 60.1 | 0.20 | 0 | 0.33 | 0.24 |
| | | | | | | 10 YR | 4 2 | 3.0 | 3.5 | 46.1 | 45.8 | 0.33 | 1 | 0.72 | 0.31 |
| | | | | | | 10 YR | 4 2 | 3.5 | 4.0 | 35.9 | 35.8 | 0.25 | 0 | 0.70 | 0.37 |
| | | | | | | 5 YR | 4 4 | 4.0 | 4.5 | 43.4 | 43.0 | 0.06 | 1 | 0.14 | 0.34 |
| | | | 10 YR | 5 | 4 | | | 4.5 | 5.0 | 48.9 | 48.7 | 0.04 | 0 | 0.08 | 0.31 |
| | | | 10 YR | 5 | 4 | | | 5.0 | 5.5 | 42.1 | 41.9 | 0.12 | 0 | 0.29 | 0.31 |
| | | | 10 YR | 6 | 6 | | | 5.5 | 6.0 | 46.2 | 46.1 | 0.16 | 0 | 0.35 | 0.31 |
| | | | 10 YR | 6 | 6 | | | 6.0 | 6.5 | 50.8 | 50.6 | 0.10 | 0 | 0.20 | 0.30 |
| | | | 10 YR | 6 | 6 | | | 6.5 | 7.0 | 49.3 | 49.0 | 0.14 | 1 | 0.28 | 0.30 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7076OE
Hole No. . . . .425ON

Driller:..... G. SHEATHER
Date:..... 26/7/95
Rig:..... HD 4
Depth to Water:..... 5.1
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:.... 6.7

Wtd Grade Wt % : 0.44
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 5 YR | 6 | 1 | 0.3 | 1.0 | 44.0 | 43.4 | 0.08 | 1 | 0.18 | 0.18 |
| 1.5 | 7.0 | BrS | | | | 5 YR | 5 | 6 | 1.0 | 1.5 | 43.5 | 43.2 | 0.13 | 1 | 0.30 | 0.23 |
| | | | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 41.6 | 41.3 | 0.17 | 1 | 0.41 | 0.28 |
| | | | | | | 10 YR | 6 | 6 | 2.0 | 2.5 | 50.0 | 49.7 | 0.07 | 1 | 0.14 | 0.25 |
| | | | | | | 10 YR | 5 | 4 | 2.5 | 3.0 | 48.4 | 48.1 | 0.03 | 1 | 0.06 | 0.22 |
| | | | | | | 10 YR | 5 | 4 | 3.0 | 3.5 | 51.3 | 50.9 | 0.12 | 1 | 0.23 | 0.22 |
| | | | | | | 5 YR | 3 | 4 | 3.5 | 4.0 | 53.8 | 53.3 | 0.35 | 1 | 0.65 | 0.28 |
| | | | | | | 5 YR | 3 | 4 | 4.0 | 4.5 | 59.3 | 58.7 | 0.35 | 1 | 0.59 | 0.31 |
| | | | | | | 5 YR | 3 | 4 | 4.5 | 5.0 | 50.3 | 49.6 | 0.15 | 1 | 0.30 | 0.31 |
| | | | 5 YR | 3 | 4 | | | | 5.0 | 5.5 | 56.0 | 55.6 | 0.58 | 1 | 1.04 | 0.38 |
| | | | 10 YR | 5 | 4 | | | | 5.5 | 6.0 | 54.1 | 54.0 | 0.65 | 0 | 1.20 | 0.45 |
| | | | 10 YR | 5 | 4 | | | | 6.0 | 6.5 | 57.0 | 56.8 | 0.30 | 0 | 0.53 | 0.46 |
| | | | 10 YR | 5 | 4 | | | | 6.5 | 7.0 | 45.6 | 45.4 | 0.08 | 0 | 0.18 | 0.44 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7108OE
Hole No. . . . .385ON

Driller:.... G. SHEATHER
Date:..... 26/7/95
Rig:..... HD 4
Depth to Water:..... 5.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:.... 6.7

Wtd Grade Wt % : 0.08
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | | LABORATORY SAMPLE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 5 YR | 4 | 1 | 0.3 | 1.0 | 50.7 | 50.1 | 0.04 | 1 | 0.08 | 0.08 |
| 1.5 | 7.0 | BrS | | | | 5 YR | 6 | 1 | 1.0 | 1.5 | 50.7 | 50.2 | 0.03 | 1 | 0.06 | 0.07 |
| | | | | | | 10 YR | 4 | 2 | 1.5 | 2.0 | 48.3 | 47.7 | 0.03 | 1 | 0.06 | 0.07 |
| | | | | | | 5 YR | 4 | 4 | 2.0 | 2.5 | 48.3 | 48.0 | 0.03 | 1 | 0.06 | 0.07 |
| | | | | | | 5 YR | 4 | 4 | 2.5 | 3.0 | 49.9 | 49.5 | 0.06 | 1 | 0.12 | 0.08 |
| | | | | | | 5 YR | 5 | 6 | 3.0 | 3.5 | 52.1 | 51.8 | 0.09 | 1 | 0.17 | 0.09 |
| | | | | | | 10 YR | 7 | 4 | 3.5 | 4.0 | 51.0 | 50.8 | 0.05 | 0 | 0.10 | 0.09 |
| | | | | | | 10 YR | 7 | 4 | 4.0 | 4.5 | 54.8 | 54.5 | 0.02 | 1 | 0.04 | 0.09 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 55.3 | 55.1 | 0.05 | 0 | 0.09 | 0.09 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 54.1 | 54.0 | 0.03 | 0 | 0.06 | 0.08 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 50.9 | 50.7 | 0.03 | 0 | 0.06 | 0.08 |
| | | | 10 YR | 7 | 4 | | | | 6.0 | 6.5 | 51.3 | 51.1 | 0.03 | 0 | 0.06 | 0.08 |
| | | | 10 YR | 7 | 4 | | | | 6.5 | 7.0 | 52.2 | 52.0 | 0.04 | 0 | 0.08 | 0.08 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71080E
Hole No. . . . .3870N

Driller:.... G. SHEATHER
Date:..... 25/7/95
Rig:..... HD 4
Depth to Water:..... 4.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.33
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | LtBrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 50.6 | 50.1 | 0.22 | 1 | 0.43 | 0.43 |
| 1.5 | 6.0 | Y&BrS | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 50.6 | 50.1 | 0.09 | 1 | 0.18 | 0.33 |
| | | | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 49.7 | 49.1 | 0.13 | 1 | 0.26 | 0.31 |
| | | | | | | 10 YR | 6 | 4 | 2.0 | 2.5 | 53.9 | 53.6 | 0.27 | 1 | 0.50 | 0.35 |
| | | | | | | 10 YR | 7 | 4 | 2.5 | 3.0 | 51.7 | 51.6 | 0.22 | 0 | 0.43 | 0.37 |
| | | | | | | 10 YR | 7 | 4 | 3.0 | 3.5 | 51.5 | 51.3 | 0.26 | 0 | 0.50 | 0.39 |
| | | | | | | 10 YR | 7 | 4 | 3.5 | 4.0 | 50.9 | 50.7 | 0.11 | 0 | 0.22 | 0.36 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 51.8 | 51.6 | 0.13 | 0 | 0.25 | 0.35 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 50.7 | 50.5 | 0.18 | 0 | 0.36 | 0.35 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 52.5 | 52.4 | 0.06 | 0 | 0.11 | 0.33 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 51.5 | 51.4 | 0.17 | 0 | 0.33 | 0.33 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7108OE
Hole No. . . . .3890N

Driller:..... G. SHEATHER
Date:..... 25/7/95
Rig:..... HD 4
Depth to Water:..... 2.1
Hole Bottom Code:..... Sand

Tenure:.....EL 3085
Parish:.....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.08
Wtd Slimes % : 0

| LITHOLOGY | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | LtBrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 55.4 | 55.0 | 0.11 | 1 | 0.20 | 0.20 |
| 1.5 | 6.0 | Y&BrS | | | | 10YR | 6 | 2 | 1.0 | 1.5 | 54.7 | 54.4 | 0.09 | 1 | 0.16 | 0.18 |
| | | | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 59.1 | 58.8 | 0.14 | 1 | 0.24 | 0.20 |
| | | | 10 YR | 6 | 6 | | | | 2.0 | 2.5 | 56.1 | 55.9 | 0.02 | 0 | 0.04 | 0.16 |
| | | | 10 YR | 7 | 4 | | | | 2.5 | 3.0 | 56.2 | 56.0 | 0.02 | 0 | 0.04 | 0.14 |
| | | | 10 YR | 7 | 4 | | | | 3.0 | 3.5 | 61.1 | 61.0 | 0.02 | 0 | 0.03 | 0.12 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 54.7 | 54.6 | 0.02 | 0 | 0.04 | 0.11 |
| | | | 10 YR | 8 | 2 | | | | 4.0 | 4.5 | 54.7 | 54.5 | 0.02 | 0 | 0.04 | 0.10 |
| | | | 10 YR | 8 | 2 | | | | 4.5 | 5.0 | 57.4 | 57.1 | 0.02 | 1 | 0.03 | 0.09 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 54.6 | 54.4 | 0.02 | 0 | 0.04 | 0.09 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 57.1 | 57.0 | 0.02 | 0 | 0.04 | 0.08 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . . .7108OE
Hole No. . . . . .3910N

Driller:..... G. SHEATHER
Date:..... 25/7/95
Rig:..... HD 4
Depth to Water:..... 2.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.15
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | LtBrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 48.4 | 48.0 | 0.11 | 1 | 0.23 | 0.23 |
| 1.5 | 3.5 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 48.9 | 48.6 | 0.05 | 1 | 0.10 | 0.18 |
| 3.5 | 6.0 | Y&BrS | | | | 5 YR | 3 4 | 1.5 | 2.0 | 51.4 | 50.8 | 0.02 | 1 | 0.04 | 0.14 |
| | | | | | | 5 YR | 3 4 | 2.0 | 2.5 | 51.1 | 50.7 | 0.07 | 1 | 0.14 | 0.14 |
| | | | 10 YR | 5 | 4 | | | 2.5 | 3.0 | 50.3 | 50.1 | 0.08 | 0 | 0.16 | 0.14 |
| | | | 10 YR | 5 | 4 | | | 3.0 | 3.5 | 51.4 | 51.2 | 0.13 | 0 | 0.25 | 0.16 |
| | | | 10 YR | 6 | 6 | | | 3.5 | 4.0 | 52.1 | 51.9 | 0.09 | 0 | 0.17 | 0.16 |
| | | | 10 YR | 6 | 6 | | | 4.0 | 4.5 | 53.6 | 53.4 | 0.05 | 0 | 0.09 | 0.15 |
| | | | 10 YR | 6 | 6 | | | 4.5 | 5.0 | 54.4 | 54.2 | 0.06 | 0 | 0.11 | 0.15 |
| | | | 10 YR | 6 | 6 | | | 5.0 | 5.5 | 53.2 | 53.0 | 0.02 | 0 | 0.04 | 0.14 |
| | | | 10 YR | 6 | 6 | | | 5.5 | 6.0 | 47.1 | 46.9 | 0.11 | 0 | 0.23 | 0.15 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71080E
Hole No. . . . .3930N

Driller:.... G. SHEATHER
Date:..... 25/7/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.32
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 2.5 | LtBrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 55.4 | 54.8 | 0.20 | 1 | 0.36 | 0.36 |
| 2.5 | 6.0 | BrS | | | | 10YR | 8 | 2 | 1.0 | 1.5 | 57.7 | 57.3 | 0.15 | 1 | 0.26 | 0.32 |
| | | | | | | 10YR | 6 | 2 | 1.5 | 2.0 | 56.5 | 56.3 | 0.36 | 0 | 0.64 | 0.41 |
| | | | | | | 10 YR | 6 | 2 | 2.0 | 2.5 | 55.8 | 55.4 | 0.33 | 1 | 0.59 | 0.45 |
| | | | | | | 10 YR | 5 | 4 | 2.5 | 3.0 | 59.9 | 59.6 | 0.71 | 1 | 1.19 | 0.59 |
| | | | 10 YR | 5 | 4 | | | | 3.0 | 3.5 | 57.6 | 57.2 | 0.21 | 1 | 0.36 | 0.55 |
| | | | 10 YR | 5 | 4 | | | | 3.5 | 4.0 | 57.5 | 57.2 | 0.02 | 1 | 0.03 | 0.48 |
| | | | 10 YR | 5 | 4 | | | | 4.0 | 4.5 | 58.7 | 58.4 | 0.03 | 1 | 0.05 | 0.43 |
| | | | 10 YR | 5 | 4 | | | | 4.5 | 5.0 | 54.6 | 54.3 | 0.01 | 1 | 0.02 | 0.39 |
| | | | 10 YR | 5 | 4 | | | | 5.0 | 5.5 | 51.1 | 50.9 | 0.01 | 0 | 0.02 | 0.35 |
| | | | 10 YR | 5 | 4 | | | | 5.5 | 6.0 | 56.1 | 55.6 | 0.02 | 1 | 0.04 | 0.32 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71080E
Hole No. . . . .3960N

Driller:..... G. SHEATHER
Date:..... 24/7/95
Rig:..... HD 4
Depth to Water:..... 5.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 8.0
Sample Depth:..... 7.7

Wtd Grade Wt % : 1.04
Wtd Slimes % : 0

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 0.5 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 57.5 | 57.0 | 0.37 | 1 | 0.64 | 0.64 |
| 0.5 | 2.5 | YS | | | | 10YR | 6 | 6 | 1.0 | 1.5 | 54.4 | 54.1 | 0.19 | 1 | 0.35 | 0.52 |
| 2.5 | 8.0 | LtBrS | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 52.5 | 52.3 | 0.31 | 0 | 0.59 | 0.54 |
| | | | | | | 10 YR | 6 | 6 | 2.0 | 2.5 | 55.5 | 55.3 | 0.15 | 0 | 0.27 | 0.48 |
| | | | | | | 10 YR | 7 | 4 | 2.5 | 3.0 | 58.8 | 58.6 | 0.09 | 0 | 0.15 | 0.42 |
| | | | | | | 10 YR | 7 | 4 | 3.0 | 3.5 | 55.1 | 54.9 | 0.21 | 0 | 0.38 | 0.41 |
| | | | | | | 10 YR | 7 | 4 | 3.5 | 4.0 | 53.8 | 53.5 | 0.22 | 1 | 0.41 | 0.41 |
| | | | | | | 10 YR | 7 | 4 | 4.0 | 4.5 | 60.4 | 60.2 | 0.25 | 0 | 0.41 | 0.41 |
| | | | | | | 10 YR | 7 | 4 | 4.5 | 5.0 | 52.2 | 52.1 | 0.49 | 0 | 0.94 | 0.47 |
| | | | | | | 10 YR | 8 | 2 | 5.0 | 5.5 | 55.3 | 55.2 | 0.60 | 0 | 1.08 | 0.53 |
| | | | 10 YR | 6 | 2 | | | | 5.5 | 6.0 | 58.7 | 58.6 | 4.16 | 0 | 7.09 | 1.10 |
| | | | 10 YR | 7 | 4 | | | | 6.0 | 6.5 | 59.3 | 59.1 | 1.15 | 0 | 1.94 | 1.17 |
| | | | 10 YR | 7 | 4 | | | | 6.5 | 7.0 | 54.6 | 54.3 | 0.39 | 1 | 0.71 | 1.14 |
| | | | 10 YR | 7 | 4 | | | | 7.0 | 7.5 | 55.7 | 55.6 | 0.25 | 0 | 0.45 | 1.09 |
| | | | 10 YR | 7 | 4 | | | | 7.5 | 8.0 | 61.2 | 61.0 | 0.23 | 0 | 0.38 | 1.04 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7108OE
Hole No. . . . .3970N

Driller:.... G. SHEATHER
Date:..... 24/7/95
Rig:..... HD 4
Depth to Water:..... 4.7
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 2.10
Wtd Slimes % : 0

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10 YR 6 2 | 0.3 | 1.0 | 55.8 | 55.3 | 0.14 | 1 | 0.25 | 0.25 |
| 1.5 | 2.0 | BrS | | | | 10YR 7 4 | 1.0 | 1.5 | 55.1 | 54.8 | 0.17 | 1 | 0.31 | 0.27 |
| 2.0 | 2.5 | YS | | | | 5 YR 4 4 | 1.5 | 2.0 | 53.3 | 52.9 | 0.14 | 1 | 0.26 | 0.27 |
| 2.5 | 6.0 | GS | | | | 10 YR 6 6 | 2.0 | 2.5 | 53.2 | 53.0 | 0.31 | 0 | 0.58 | 0.34 |
| | | | | | | 10 YR 7 4 | 2.5 | 3.0 | 56.4 | 56.2 | 0.19 | 0 | 0.34 | 0.34 |
| | | | | | | 10 YR 7 4 | 3.0 | 3.5 | 54.2 | 54.1 | 0.28 | 0 | 0.52 | 0.37 |
| | | | | | | 10 YR 6 2 | 3.5 | 4.0 | 61.2 | 61.0 | 9.20 | 0 | 15.03 | 2.35 |
| | | | | | | 10 YR 8 2 | 4.0 | 4.5 | 60.1 | 59.8 | 2.25 | 0 | 3.74 | 2.52 |
| | | | 10 YR 8 2 | | | | 4.5 | 5.0 | 56.9 | 56.7 | 1.36 | 0 | 2.39 | 2.50 |
| | | | 10 YR 8 2 | | | | 5.0 | 5.5 | 56.2 | 56.0 | 0.18 | 0 | 0.32 | 2.29 |
| | | | 10 YR 8 2 | | | | 5.5 | 6.0 | 58.2 | 58.1 | 0.04 | 0 | 0.07 | 2.10 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7108OE
Hole No. . . . .3980N

Driller:..... G. SHEATHER
Date:..... 24/7/95
Rig:..... HD 4
Depth to Water:..... 4.2
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.28
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.2 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 57.4 | 55.7 | 0.20 | 3 | 0.35 | 0.35 |
| 1.2 | 1.7 | BrS | | | | 10YR | 5 | 4 | 1.0 | 1.5 | 57.9 | 57.4 | 0.18 | 1 | 0.31 | 0.33 |
| 1.7 | 6.0 | GS | | | | 10 YR | 6 | 6 | 1.5 | 2.0 | 55.7 | 55.3 | 0.22 | 1 | 0.39 | 0.35 |
| | | | | | | 10 YR | 5 | 4 | 2.0 | 2.5 | 56.9 | 56.2 | 0.23 | 1 | 0.40 | 0.36 |
| | | | | | | 10 YR | 7 | 4 | 2.5 | 3.0 | 54.5 | 54.1 | 0.35 | 1 | 0.64 | 0.41 |
| | | | | | | 10 YR | 8 | 2 | 3.0 | 3.5 | 55.5 | 55.3 | 0.21 | 0 | 0.38 | 0.41 |
| | | | | | | 10 YR | 8 | 2 | 3.5 | 4.0 | 58.5 | 58.3 | 0.08 | 0 | 0.14 | 0.37 |
| | | | 10 YR | 8 | 2 | | | | 4.0 | 4.5 | 59.6 | 59.5 | 0.18 | 0 | 0.30 | 0.36 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 54.2 | 54.1 | 0.04 | 0 | 0.07 | 0.33 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 59.1 | 58.9 | 0.04 | 0 | 0.07 | 0.31 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 58.4 | 58.3 | 0.02 | 0 | 0.03 | 0.28 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . . .7108OE
Hole No. . . . . .4000N

Driller:..... G. SHEATHER
Date:..... 24/7/95
Rig:..... HD 4
Depth to Water:..... 2.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.19
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 53.9 | 53.4 | 0.17 | 1 | 0.32 | 0.32 |
| 1.5 | 2.0 | BrS | | | | 10YR | 6 | 2 | 1.0 | 1.5 | 52.0 | 51.8 | 0.17 | 0 | 0.33 | 0.32 |
| 2.0 | 6.0 | GS | | | | 5 YR | 4 | 4 | 1.5 | 2.0 | 52.4 | 51.6 | 0.22 | 2 | 0.42 | 0.35 |
| | | | | | | 10 YR | 6 | 6 | 2.0 | 2.5 | 53.8 | 53.4 | 0.10 | 1 | 0.19 | 0.31 |
| | | | 10 YR | 6 | 6 | | | | 2.5 | 3.0 | 53.8 | 53.5 | 0.06 | 1 | 0.11 | 0.28 |
| | | | 10 YR | 7 | 4 | | | | 3.0 | 3.5 | 55.7 | 55.5 | 0.06 | 0 | 0.11 | 0.25 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 53.8 | 53.6 | 0.05 | 0 | 0.09 | 0.23 |
| | | | 10 YR | 8 | 2 | | | | 4.0 | 4.5 | 56.0 | 55.9 | 0.05 | 0 | 0.09 | 0.21 |
| | | | 10 YR | 8 | 2 | | | | 4.5 | 5.0 | 57.2 | 57.0 | 0.06 | 0 | 0.10 | 0.20 |
| | | | 10 YR | 8 | 2 | | | | 5.0 | 5.5 | 56.8 | 56.7 | 0.06 | 0 | 0.11 | 0.19 |
| | | | 10 YR | 8 | 2 | | | | 5.5 | 6.0 | 59.1 | 59.0 | 0.08 | 0 | 0.14 | 0.19 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . . .71080E
Hole No. . . . . .4010N

Driller:..... G. SHEATHER
Date:..... 28/4/95
Rig:..... HD 4
Depth to Water:..... 2.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.49
Wtd Slimes % : 5

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.0 | GS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 52.1 | 51.6 | 0.19 | 1 | 0.36 | 0.36 |
| 1.0 | 1.4 | S Ind | | | | 5 YR | 4 4 | 1.0 | 1.5 | 47.2 | 46.1 | 0.16 | 2 | 0.34 | 0.35 |
| 1.4 | 6.0 | BrS | | | | 10 YR | 5 4 | 1.5 | 2.0 | 48.7 | 48.3 | 0.37 | 1 | 0.76 | 0.47 |
| | | | | | | 10 YR | 5 4 | 2.0 | 2.5 | 57.2 | 53.6 | 0.15 | 6 | 0.26 | 0.43 |
| | | | 10 YR | 6 | 2 | | | 2.5 | 3.0 | 56.5 | 50.1 | 0.17 | 11 | 0.30 | 0.40 |
| | | | 10 YR | 7 | 4 | | | 3.0 | 3.5 | 56.8 | 55.3 | 0.19 | 3 | 0.33 | 0.39 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 56.9 | 54.0 | 0.59 | 5 | 1.04 | 0.48 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 58.8 | 51.9 | 0.64 | 12 | 1.09 | 0.55 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 57.2 | 51.4 | 0.16 | 10 | 0.28 | 0.52 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 55.3 | 54.0 | 0.26 | 2 | 0.47 | 0.52 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 55.6 | 54.3 | 0.14 | 2 | 0.25 | 0.49 |

GS 1996/034

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71080E
Hole No. . . . .4020N

Driller:..... G. SHEATHER
Date:..... 28/4/95
Rig:..... HD 4
Depth to Water:..... 2.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.31
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.1 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 56.1 | 55.6 | 0.53 | 1 | 0.94 | 0.94 |
| 1.1 | 1.5 | S Ind | | | | 5 YR | 4 | 4 | 1.0 | 1.5 | 50.8 | 50.1 | 0.26 | 1 | 0.51 | 0.76 |
| 1.5 | 6.0 | BrS | | | | 10 YR | 5 | 4 | 1.5 | 2.0 | 59.3 | 58.7 | 0.38 | 1 | 0.64 | 0.73 |
| | | | | | | 10 YR | 6 | 2 | 2.0 | 2.5 | 53.4 | 53.1 | 0.42 | 1 | 0.79 | 0.74 |
| | | | 10 YR | 7 | 4 | | | | 2.5 | 3.0 | 53.0 | 52.8 | 0.04 | 0 | 0.08 | 0.62 |
| | | | 10 YR | 7 | 4 | | | | 3.0 | 3.5 | 56.6 | 56.5 | 0.01 | 0 | 0.02 | 0.52 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 55.6 | 55.5 | 0.04 | 0 | 0.07 | 0.46 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 55.5 | 55.4 | 0.02 | 0 | 0.04 | 0.41 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 57.1 | 56.9 | 0.02 | 0 | 0.04 | 0.37 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 52.9 | 52.8 | 0.02 | 0 | 0.04 | 0.34 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 56.7 | 56.5 | 0.03 | 0 | 0.05 | 0.31 |

GS 1996/034

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71080E
Hole No. . . . .4030N

Driller:.... G. SHEATHER
Date:..... 27/4/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.49
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 54.4 | 53.6 | 0.21 | 1 | 0.39 | 0.39 |
| 1.5 | 2.0 | M Ind | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 60.9 | 60.7 | 0.73 | 0 | 1.20 | 0.72 |
| 2.0 | 6.0 | BrS | | | | 5 YR | 4 | 4 | 1.5 | 2.0 | 53.2 | 52.7 | 1.14 | 1 | 2.14 | 1.14 |
| | | | | | | 5 YR | 4 | 4 | 2.0 | 2.5 | 56.5 | 56.0 | 0.32 | 1 | 0.57 | 1.01 |
| | | | | | | 10 YR | 5 | 4 | 2.5 | 3.0 | 56.0 | 55.7 | 0.13 | 1 | 0.23 | 0.87 |
| | | | 10 YR | 5 | 4 | | | | 3.0 | 3.5 | 56.9 | 56.7 | 0.18 | 0 | 0.32 | 0.78 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 52.7 | 52.5 | 0.18 | 0 | 0.34 | 0.72 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 52.5 | 52.0 | 0.03 | 1 | 0.06 | 0.64 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 52.2 | 52.1 | 0.04 | 0 | 0.08 | 0.58 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 51.8 | 51.6 | 0.04 | 0 | 0.08 | 0.53 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 54.5 | 54.4 | 0.04 | 0 | 0.07 | 0.49 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . . .71080E
Hole No. . . . . .4040N

Driller:..... G. SHEATHER
Date:..... 27/4/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.36
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 49.3 | 48.7 | 0.28 | 1 | 0.57 | 0.57 |
| 1.5 | 2.0 | M Ind | | | | 10 YR | 6 2 | 1.0 | 1.5 | 55.7 | 55.3 | 0.14 | 1 | 0.25 | 0.44 |
| 2.0 | 6.0 | BrS | | | | 5 YR | 4 4 | 1.5 | 2.0 | 52.5 | 50.6 | 0.15 | 4 | 0.29 | 0.39 |
| | | | | | | 5 YR | 4 4 | 2.0 | 2.5 | 56.7 | 56.1 | 0.17 | 1 | 0.30 | 0.37 |
| | | | | | | 10 YR | 5 4 | 2.5 | 3.0 | 58.1 | 57.6 | 0.19 | 1 | 0.33 | 0.36 |
| | | | 10 YR | 7 | 4 | | | 3.0 | 3.5 | 55.5 | 55.2 | 0.48 | 1 | 0.86 | 0.44 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 55.9 | 55.6 | 0.08 | 1 | 0.14 | 0.40 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 54.4 | 54.2 | 0.07 | 0 | 0.13 | 0.37 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 54.2 | 54.0 | 0.06 | 0 | 0.11 | 0.34 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 52.3 | 52.0 | 0.22 | 1 | 0.42 | 0.35 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 55.1 | 54.8 | 0.29 | 1 | 0.53 | 0.36 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7108OE
Hole No. . . . .4050N

Driller:.... G. SHEATHER
Date:..... 27/4/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.61
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.4 | G&BrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 52.7 | 52.2 | 0.15 | 1 | 0.28 | 0.28 |
| 1.4 | 1.8 | H Ind | | | | 10 YR | 6 2 | 1.0 | 1.5 | 52.5 | 52.1 | 0.26 | 1 | 0.50 | 0.37 |
| 1.8 | 6.0 | BrS | | | | 5 YR | 4 4 | 1.5 | 2.0 | 49.5 | 48.2 | 1.04 | 3 | 2.10 | 0.88 |
| | | | | | | 5 YR | 4 4 | 2.0 | 2.5 | 57.5 | 54.8 | 1.15 | 5 | 2.00 | 1.14 |
| | | | | | | 10 YR | 6 6 | 2.5 | 3.0 | 53.6 | 53.0 | 0.48 | 1 | 0.90 | 1.09 |
| | | | 10 YR | 5 | 4 | | | 3.0 | 3.5 | 52.5 | 52.2 | 0.28 | 1 | 0.53 | 1.00 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 51.9 | 51.6 | 0.10 | 1 | 0.19 | 0.89 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 54.8 | 54.6 | 0.05 | 0 | 0.09 | 0.80 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 51.0 | 50.7 | 0.05 | 1 | 0.10 | 0.72 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 54.9 | 54.6 | 0.05 | 1 | 0.09 | 0.66 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 53.5 | 53.2 | 0.05 | 1 | 0.09 | 0.61 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71080E
Hole No. . . . .4060N

Driller:..... G. SHEATHER
Date:..... 27/4/95
Rig:..... HD 4
Depth to Water:..... 2.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.23
Wtd Slimes % : 3

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.2 | G&BrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 54.5 | 52.8 | 0.06 | 3 | 0.11 | 0.11 |
| 1.2 | 1.7 | H Ind | | | | 10 YR | 6 2 | 1.0 | 1.5 | 52.7 | 51.6 | 0.03 | 2 | 0.06 | 0.09 |
| 1.7 | 6.0 | BrS | | | | 5 YR | 5 6 | 1.5 | 2.0 | 51.8 | 46.9 | 0.16 | 9 | 0.31 | 0.15 |
| | | | | | | 10 YR | 6 6 | 2.0 | 2.5 | 54.7 | 51.7 | 0.06 | 5 | 0.11 | 0.14 |
| | | | 10 YR | 6 | 6 | | | 2.5 | 3.0 | 54.0 | 52.4 | 0.12 | 3 | 0.22 | 0.16 |
| | | | 10 YR | 7 | 4 | | | 3.0 | 3.5 | 50.3 | 49.5 | 0.21 | 2 | 0.42 | 0.20 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 55.5 | 54.5 | 0.07 | 2 | 0.13 | 0.19 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 54.5 | 51.6 | 0.04 | 5 | 0.07 | 0.17 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 51.3 | 51.1 | 0.15 | 0 | 0.29 | 0.19 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 51.9 | 49.4 | 0.43 | 5 | 0.83 | 0.25 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 51.6 | 50.9 | 0.03 | 1 | 0.06 | 0.23 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . . .71080E
Hole No. . . . . .4070N

Driller:..... G. SHEATHER
Date:..... 27/4/95
Rig:..... HD 4
Depth to Water:..... 2.7
Hole Bottom Code:..... Sand

Tenure:.....EL 3085
Parish:.....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.43
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.6 | G&BrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 56.2 | 55.6 | 0.23 | 1 | 0.41 | 0.41 |
| 1.6 | 2.0 | S Ind | | | | 10 YR | 6 2 | 1.0 | 1.5 | 47.6 | 46.6 | 0.69 | 2 | 1.45 | 0.84 |
| 2.0 | 6.0 | BrS | | | | 5 YR | 4 4 | 1.5 | 2.0 | 52.5 | 51.1 | 0.64 | 3 | 1.22 | 0.95 |
| | | | | | | 5 YR | 4 4 | 2.0 | 2.5 | 52.1 | 51.7 | 0.14 | 1 | 0.27 | 0.80 |
| | | | 10 YR | 6 | 6 | | | 2.5 | 3.0 | 56.4 | 56.2 | 0.14 | 0 | 0.25 | 0.70 |
| | | | 10 YR | 7 | 4 | | | 3.0 | 3.5 | 56.1 | 55.8 | 0.24 | 1 | 0.43 | 0.65 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 55.0 | 54.7 | 0.04 | 1 | 0.07 | 0.58 |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 50.6 | 50.5 | 0.06 | 0 | 0.12 | 0.52 |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 52.2 | 52.0 | 0.14 | 0 | 0.27 | 0.49 |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 57.9 | 57.6 | 0.09 | 1 | 0.16 | 0.46 |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 55.7 | 55.6 | 0.07 | 0 | 0.13 | 0.43 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7108OE
Hole No. . . . .4080N

Driller:..... G. SHEATHER
Date:..... 26/4/95
Rig:..... HD 4
Depth to Water:..... 2.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.53
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | | |
| | | | WET | | | DRY | | | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. | |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | | |
| 0.3 | 1.5 | G&BrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 52.4 | 51.9 | 0.22 | 1 | 0.42 | 0.42 | |
| 1.5 | 2.0 | M Ind | | | | 10 YR | 4 2 | 1.0 | 1.5 | 56.9 | 56.1 | 0.69 | 1 | 1.21 | 0.75 | |
| 2.0 | 6.0 | BrS | | | | 5 YR | 4 4 | 1.5 | 2.0 | 53.9 | 51.8 | 0.53 | 4 | 0.98 | 0.82 | |
| | | | | | | 5 YR | 4 4 | 2.0 | 2.5 | 54.3 | 53.5 | 0.23 | 1 | 0.42 | 0.73 | |
| | | | 10 YR | 5 | 4 | | | 2.5 | 3.0 | 52.0 | 51.6 | 0.42 | 1 | 0.81 | 0.74 | |
| | | | 10 YR | 7 | 4 | | | 3.0 | 3.5 | 54.8 | 54.5 | 0.35 | 1 | 0.64 | 0.73 | |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 51.0 | 50.7 | 0.38 | 1 | 0.75 | 0.73 | |
| | | | 10 YR | 7 | 4 | | | 4.0 | 4.5 | 51.5 | 51.2 | 0.08 | 1 | 0.16 | 0.66 | |
| | | | 10 YR | 7 | 4 | | | 4.5 | 5.0 | 56.8 | 56.7 | 0.10 | 0 | 0.18 | 0.61 | |
| | | | 10 YR | 7 | 4 | | | 5.0 | 5.5 | 56.3 | 56.1 | 0.07 | 0 | 0.12 | 0.56 | |
| | | | 10 YR | 7 | 4 | | | 5.5 | 6.0 | 57.9 | 57.7 | 0.08 | 0 | 0.14 | 0.53 | |

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71080E
Hole No. . . . .4090N

Driller:.... G. SHEATHER
Date:..... 26/4/95
Rig:..... HO 4
Depth to Water:..... 2.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.29
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.1 | G&BrS | | | | 10 YR | 4 | 2 | 0.3 | 1.0 | 47.4 | 46.7 | 0.03 | 1 | 0.06 | 0.06 |
| 1.1 | 1.8 | M Ind | | | | 5 YR | 4 | 4 | 1.0 | 1.5 | 51.2 | 49.1 | 0.55 | 4 | 1.07 | 0.48 |
| 1.8 | 6.0 | BrS | | | | 5 YR | 4 | 4 | 1.5 | 2.0 | 47.5 | 46.9 | 0.36 | 1 | 0.76 | 0.56 |
| | | | | | | 10 YR | 5 | 4 | 2.0 | 2.5 | 52.1 | 51.6 | 0.02 | 1 | 0.04 | 0.45 |
| | | | 10 YR | 5 | 4 | | | | 2.5 | 3.0 | 54.1 | 53.7 | 0.40 | 1 | 0.74 | 0.50 |
| | | | 10 YR | 7 | 4 | | | | 3.0 | 3.5 | 45.8 | 45.7 | 0.02 | 0 | 0.04 | 0.43 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 49.6 | 49.3 | 0.13 | 1 | 0.26 | 0.41 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 54.4 | 54.3 | 0.04 | 0 | 0.07 | 0.37 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 52.9 | 52.6 | 0.03 | 1 | 0.06 | 0.33 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 49.8 | 49.6 | 0.03 | 0 | 0.06 | 0.31 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 42.0 | 41.7 | 0.03 | 1 | 0.07 | 0.29 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71080E
Hole No. . . . .4100N

Driller:..... G. SHEATHER
Date:..... 26/4/95
Rig:..... HD 4
Depth to Water:..... 2.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.34
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10 YR | 4 | 2 | 0.3 | 1.0 | 48.6 | 47.8 | 0.19 | 2 | 0.39 | 0.39 |
| 1.5 | 6.0 | BrS | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 55.7 | 55.3 | 0.33 | 1 | 0.59 | 0.47 |
| | | | | | | 5 YR | 5 | 2 | 1.5 | 2.0 | 55.1 | 54.7 | 0.41 | 1 | 0.74 | 0.55 |
| | | | | | | 10 YR | 5 | 4 | 2.0 | 2.5 | 55.3 | 54.9 | 0.24 | 1 | 0.43 | 0.53 |
| | | | 10 YR | 5 | 4 | | | | 2.5 | 3.0 | 56.0 | 55.6 | 0.33 | 1 | 0.59 | 0.54 |
| | | | 10 YR | 7 | 4 | | | | 3.0 | 3.5 | 56.6 | 56.4 | 0.19 | 0 | 0.34 | 0.51 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 49.8 | 49.7 | 0.14 | 0 | 0.28 | 0.48 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 53.9 | 53.7 | 0.07 | 0 | 0.13 | 0.43 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 52.7 | 52.6 | 0.05 | 0 | 0.09 | 0.40 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 51.6 | 51.6 | 0.05 | 0 | 0.10 | 0.37 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 53.9 | 53.7 | 0.04 | 0 | 0.07 | 0.34 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71080E
Hole No. . . . .4110N

Driller:..... G. SHEATHER
Date:..... 26/4/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.12
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.2 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 47.2 | 46.7 | 0.06 | 1 | 0.13 | 0.13 |
| 1.2 | 2.7 | M Ind | | | | 5 YR | 5 | 2 | 1.0 | 1.5 | 50.2 | 46.3 | 0.10 | 8 | 0.20 | 0.16 |
| 2.7 | 6.0 | BrS | | | | 5 YR | 4 | 4 | 1.5 | 2.0 | 51.6 | 50.7 | 0.11 | 2 | 0.21 | 0.17 |
| | | | | | | 5 YR | 4 | 4 | 2.0 | 2.5 | 51.7 | 50.7 | 0.16 | 2 | 0.31 | 0.20 |
| | | | | | | 10 YR | 6 | 6 | 2.5 | 3.0 | 52.2 | 51.7 | 0.10 | 1 | 0.19 | 0.20 |
| | | | 10 YR | 7 | 4 | | | | 3.0 | 3.5 | 52.4 | 52.1 | 0.06 | 1 | 0.11 | 0.19 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 54.4 | 54.1 | 0.03 | 1 | 0.06 | 0.17 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 48.8 | 48.7 | 0.01 | 0 | 0.02 | 0.15 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 53.7 | 53.4 | 0.01 | 1 | 0.02 | 0.14 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 54.7 | 54.5 | 0.01 | 0 | 0.02 | 0.13 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 47.0 | 46.9 | 0.01 | 0 | 0.02 | 0.12 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71080E
Hole No. . . . .4120N

Driller:.... G. SHEATHER
Date:..... 21/4/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.16
Wtd Slimes % : 2

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | WET V | WET C | DRY HUE | DRY V | DRY C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.3 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 54.1 | 52.8 | 0.12 | 2 | 0.22 | 0.22 |
| 1.3 | 6.0 | BrS | | | | 5 YR | 4 | 4 | 1.0 | 1.5 | 53.0 | 50.3 | 0.20 | 5 | 0.38 | 0.29 |
| | | | | | | 5 YR | 4 | 4 | 1.5 | 2.0 | 54.3 | 52.1 | 0.14 | 4 | 0.26 | 0.28 |
| | | | | | | 5 YR | 4 | 4 | 2.0 | 2.5 | 52.3 | 50.7 | 0.10 | 3 | 0.19 | 0.26 |
| | | | | | | 5 YR | 5 | 6 | 2.5 | 3.0 | 56.2 | 55.5 | 0.07 | 1 | 0.12 | 0.23 |
| | | | 10 YR | 5 | 4 | | | | 3.0 | 3.5 | 55.7 | 55.5 | 0.04 | 0 | 0.07 | 0.21 |
| | | | 10 YR | 5 | 4 | | | | 3.5 | 4.0 | 55.5 | 55.2 | 0.09 | 1 | 0.16 | 0.20 |
| | | | 10 YR | 5 | 4 | | | | 4.0 | 4.5 | 57.4 | 57.2 | 0.06 | 0 | 0.10 | 0.19 |
| | | | 10 YR | 5 | 4 | | | | 4.5 | 5.0 | 57.8 | 57.5 | 0.07 | 1 | 0.12 | 0.18 |
| | | | 10 YR | 5 | 4 | | | | 5.0 | 5.5 | 53.2 | 53.2 | 0.04 | 0 | 0.08 | 0.17 |
| | | | 10 YR | 5 | 4 | | | | 5.5 | 6.0 | 55.2 | 55.0 | 0.01 | 0 | 0.02 | 0.16 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71080E
Hole No. . . . .4130N

Driller:..... G. SHEATHER
Date:..... 21/4/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.24
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR | | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| | | | WET | | | DRY | | | | | | | | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.3 | GS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 50.1 | 49.1 | 0.18 | 2 | 0.36 | 0.36 |
| 1.3 | 6.0 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 55.3 | 54.8 | 0.09 | 1 | 0.16 | 0.28 |
| | | | | | | 10 YR | 6 2 | 1.5 | 2.0 | 50.9 | 50.3 | 0.13 | 1 | 0.26 | 0.27 |
| | | | | | | 5 YR | 4 4 | 2.0 | 2.5 | 52.2 | 51.3 | 0.13 | 2 | 0.25 | 0.27 |
| | | | | | | 5 YR | 4 4 | 2.5 | 3.0 | 52.3 | 51.9 | 0.25 | 1 | 0.48 | 0.31 |
| | | | 10 YR | 5 | 4 | | | 3.0 | 3.5 | 55.9 | 55.6 | 0.05 | 1 | 0.09 | 0.27 |
| | | | 10 YR | 5 | 4 | | | 3.5 | 4.0 | 51.9 | 51.6 | 0.12 | 1 | 0.23 | 0.27 |
| | | | 10 YR | 5 | 4 | | | 4.0 | 4.5 | 53.3 | 53.2 | 0.06 | 0 | 0.11 | 0.25 |
| | | | 10 YR | 5 | 4 | | | 4.5 | 5.0 | 54.3 | 54.1 | 0.14 | 0 | 0.26 | 0.25 |
| | | | 10 YR | 5 | 4 | | | 5.0 | 5.5 | 57.7 | 57.6 | 0.09 | 0 | 0.16 | 0.24 |
| | | | 10 YR | 5 | 4 | | | 5.5 | 6.0 | 54.5 | 54.3 | 0.11 | 0 | 0.20 | 0.24 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71080E
Hole No. . . . .4140N

Driller:..... G. SHEATHER
Date:..... 21/4/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.40
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 52.8 | 52.2 | 0.45 | 1 | 0.85 | 0.85 |
| 1.5 | 6.0 | BrS | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 52.7 | 52.3 | 0.16 | 1 | 0.30 | 0.62 |
| | | | | | | 5 YR | 4 | 4 | 1.5 | 2.0 | 52.3 | 51.1 | 0.15 | 2 | 0.29 | 0.52 |
| | | | | | | 5 YR | 4 | 4 | 2.0 | 2.5 | 52.7 | 52.0 | 0.04 | 1 | 0.08 | 0.42 |
| | | | | | | 10 YR | 5 | 4 | 2.5 | 3.0 | 52.6 | 52.3 | 0.06 | 1 | 0.11 | 0.37 |
| | | | 10 YR | 5 | 4 | | | | 3.0 | 3.5 | 52.7 | 52.6 | 0.11 | 0 | 0.21 | 0.34 |
| | | | 10 YR | 5 | 4 | | | | 3.5 | 4.0 | 52.2 | 52.0 | 0.17 | 0 | 0.33 | 0.34 |
| | | | 10 YR | 6 | 2 | | | | 4.0 | 4.5 | 54.6 | 54.5 | 0.44 | 0 | 0.81 | 0.39 |
| | | | 10 YR | 6 | 2 | | | | 4.5 | 5.0 | 51.9 | 51.7 | 0.27 | 0 | 0.52 | 0.41 |
| | | | 10 YR | 6 | 2 | | | | 5.0 | 5.5 | 54.6 | 54.5 | 0.29 | 0 | 0.53 | 0.42 |
| | | | 10 YR | 6 | 2 | | | | 5.5 | 6.0 | 55.5 | 55.3 | 0.12 | 0 | 0.22 | 0.40 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71720E
Hole No. . . . .3900N

Driller:.... G. SHEATHER
Date:..... 19/4/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.16
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 6.0 | BrS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 53.0 | 52.2 | 0.10 | 2 | 0.19 | 0.19 |
| | | | | | | 10 YR | 6 2 | 1.0 | 1.5 | 49.5 | 49.1 | 0.05 | 1 | 0.10 | 0.15 |
| | | | | | | 10 YR | 6 2 | 1.5 | 2.0 | 51.6 | 51.3 | 0.09 | 1 | 0.17 | 0.16 |
| | | | | | | 10 YR | 5 4 | 2.0 | 2.5 | 50.5 | 50.2 | 0.09 | 1 | 0.18 | 0.16 |
| | | | | | | 10 YR | 5 4 | 2.5 | 3.0 | 51.4 | 50.8 | 0.17 | 1 | 0.33 | 0.19 |
| | | | 10 YR | 5 | 4 | | | 3.0 | 3.5 | 51.7 | 51.5 | 0.06 | 0 | 0.12 | 0.18 |
| | | | 10 YR | 5 | 4 | | | 3.5 | 4.0 | 53.2 | 52.9 | 0.15 | 1 | 0.28 | 0.20 |
| | | | 10 YR | 5 | 4 | | | 4.0 | 4.5 | 53.8 | 53.5 | 0.03 | 1 | 0.06 | 0.18 |
| | | | 10 YR | 5 | 4 | | | 4.5 | 5.0 | 52.1 | 51.9 | 0.08 | 0 | 0.15 | 0.18 |
| | | | 10 YR | 5 | 4 | | | 5.0 | 5.5 | 52.7 | 52.5 | 0.08 | 0 | 0.15 | 0.17 |
| | | | 10 YR | 5 | 4 | | | 5.5 | 6.0 | 50.7 | 50.6 | 0.03 | 0 | 0.06 | 0.16 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71720E
Hole No. . . . .3920N

Driller:.... G. SHEATHER
Date:..... 19/4/95
Rig:..... HD 4
Depth to Water:..... 3.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.08
Wtd Slimes % : 3

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 6.0 | BrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 50.6 | 49.8 | 0.01 | 2 | 0.02 | 0.02 |
| | | | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 52.1 | 51.7 | 0.01 | 1 | 0.02 | 0.02 |
| | | | | | | 10 YR | 4 | 2 | 1.5 | 2.0 | 50.4 | 48.0 | 0.04 | 5 | 0.08 | 0.04 |
| | | | | | | 10 YR | 5 | 4 | 2.0 | 2.5 | 50.6 | 48.5 | 0.05 | 4 | 0.10 | 0.05 |
| | | | | | | 10 YR | 5 | 4 | 2.5 | 3.0 | 50.7 | 46.8 | 0.02 | 8 | 0.04 | 0.05 |
| | | | | | | 10 YR | 5 | 4 | 3.0 | 3.5 | 47.5 | 43.8 | 0.02 | 8 | 0.04 | 0.05 |
| | | | 5 YR | 4 | 4 | | | | 3.5 | 4.0 | 50.4 | 50.0 | 0.11 | 1 | 0.22 | 0.07 |
| | | | 5 YR | 4 | 4 | | | | 4.0 | 4.5 | 50.8 | 50.1 | 0.13 | 1 | 0.26 | 0.09 |
| | | | 5 YR | 4 | 4 | | | | 4.5 | 5.0 | 52.4 | 52.0 | 0.03 | 1 | 0.06 | 0.09 |
| | | | 5 YR | 4 | 4 | | | | 5.0 | 5.5 | 46.7 | 46.1 | 0.03 | 1 | 0.06 | 0.09 |
| | | | 5 YR | 4 | 4 | | | | 5.5 | 6.0 | 54.4 | 53.7 | 0.03 | 1 | 0.06 | 0.08 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71720E
Hole No. . . . .3940N

Driller:.... G. SHEATHER
Date:..... 19/4/95
Rig:..... HD 4
Depth to Water:..... 4.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:.... 6.7

Wtd Grade Wt % : 0.15
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR ---WET--- | | | ---DRY--- | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 7.0 | BrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 51.0 | 49.9 | 0.04 | 2 | 0.08 | 0.08 |
| | | | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 53.0 | 52.3 | 0.05 | 1 | 0.09 | 0.09 |
| | | | | | | 5 YR | 4 | 4 | 1.5 | 2.0 | 50.3 | 49.8 | 0.02 | 1 | 0.04 | 0.07 |
| | | | | | | 5 YR | 4 | 4 | 2.0 | 2.5 | 51.0 | 50.5 | 0.04 | 1 | 0.08 | 0.07 |
| | | | | | | 10 YR | 6 | 2 | 2.5 | 3.0 | 56.5 | 56.1 | 0.29 | 1 | 0.51 | 0.15 |
| | | | | | | 10 YR | 6 | 2 | 3.0 | 3.5 | 52.4 | 52.2 | 0.17 | 0 | 0.32 | 0.18 |
| | | | | | | 10 YR | 6 | 2 | 3.5 | 4.0 | 54.1 | 53.8 | 0.20 | 1 | 0.37 | 0.21 |
| | | | | | | 10 YR | 7 | 4 | 4.0 | 4.5 | 50.8 | 50.2 | 0.03 | 1 | 0.06 | 0.19 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 53.0 | 52.6 | 0.05 | 1 | 0.09 | 0.18 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 42.3 | 42.0 | 0.03 | 1 | 0.07 | 0.17 |
| | | | 10 YR | 6 | 6 | | | | 5.5 | 6.0 | 50.2 | 49.9 | 0.04 | 1 | 0.08 | 0.16 |
| | | | 10 YR | 6 | 6 | | | | 6.0 | 6.5 | 52.7 | 52.3 | 0.04 | 1 | 0.08 | 0.15 |
| | | | 10 YR | 6 | 6 | | | | 6.5 | 7.0 | 50.6 | 50.3 | 0.03 | 1 | 0.06 | 0.15 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7172OE
Hole No. . . . .3960N

Driller:..... G. SHEATHER
Date:..... 19/4/95
Rig:..... HD 4
Depth to Water:..... 3.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.12
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 6.0 | BrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 53.9 | 53.3 | 0.03 | 1 | 0.06 | 0.06 |
| | | | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 54.2 | 53.7 | 0.02 | 1 | 0.04 | 0.05 |
| | | | | | | 10 YR | 6 | 2 | 1.5 | 2.0 | 60.2 | 60.0 | 0.04 | 0 | 0.07 | 0.05 |
| | | | | | | 10 YR | 6 | 2 | 2.0 | 2.5 | 56.5 | 56.3 | 0.25 | 0 | 0.44 | 0.14 |
| | | | | | | 10 YR | 5 | 4 | 2.5 | 3.0 | 52.3 | 51.9 | 0.02 | 1 | 0.04 | 0.12 |
| | | | | | | 10 YR | 5 | 4 | 3.0 | 3.5 | 53.7 | 53.4 | 0.08 | 1 | 0.15 | 0.13 |
| | | | 10 YR | 5 | 4 | | | | 3.5 | 4.0 | 53.5 | 53.3 | 0.22 | 0 | 0.41 | 0.17 |
| | | | 10 YR | 5 | 4 | | | | 4.0 | 4.5 | 55.0 | 54.9 | 0.03 | 0 | 0.05 | 0.15 |
| | | | 10 YR | 5 | 4 | | | | 4.5 | 5.0 | 57.1 | 56.9 | 0.03 | 0 | 0.05 | 0.14 |
| | | | 10 YR | 5 | 4 | | | | 5.0 | 5.5 | 54.2 | 53.9 | 0.03 | 1 | 0.06 | 0.13 |
| | | | 10 YR | 5 | 4 | | | | 5.5 | 6.0 | 57.1 | 56.8 | 0.02 | 1 | 0.04 | 0.12 |

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BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71720E
Hole No. . . . .3970N

Driller:..... G. SHEATHER
Date:..... 20/4/95
Rig:..... HD 4
Depth to Water:..... 2.0
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.19
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.0 | GS | | | | 5 YR | 6 1 | 0.3 | 1.0 | 52.4 | 51.8 | 0.13 | 1 | 0.25 | 0.25 |
| 1.0 | 6.0 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 49.0 | 48.4 | 0.33 | 1 | 0.67 | 0.43 |
| | | | | | | 10 YR | 6 2 | 1.5 | 2.0 | 52.2 | 51.1 | 0.10 | 2 | 0.19 | 0.36 |
| | | | | | | 10 YR | 6 2 | 2.0 | 2.5 | 52.4 | 52.3 | 0.21 | 0 | 0.40 | 0.37 |
| | | | 10 YR | 5 | 4 | | | 2.5 | 3.0 | 54.0 | 53.7 | 0.10 | 1 | 0.19 | 0.33 |
| | | | 10 YR | 6 | 2 | | | 3.0 | 3.5 | 51.8 | 51.6 | 0.10 | 0 | 0.19 | 0.31 |
| | | | 10 YR | 6 | 2 | | | 3.5 | 4.0 | 50.6 | 50.3 | 0.03 | 1 | 0.06 | 0.28 |
| | | | 10 YR | 6 | 2 | | | 4.0 | 4.5 | 52.1 | 51.9 | 0.03 | 0 | 0.06 | 0.25 |
| | | | 10 YR | 6 | 2 | | | 4.5 | 5.0 | 53.1 | 52.9 | 0.02 | 0 | 0.04 | 0.23 |
| | | | 10 YR | 6 | 2 | | | 5.0 | 5.5 | 53.4 | 53.4 | 0.02 | 0 | 0.04 | 0.21 |
| | | | 10 YR | 6 | 2 | | | 5.5 | 6.0 | 52.4 | 52.1 | 0.02 | 1 | 0.04 | 0.19 |

GS 1996/034

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . . .71720E
Hole No. . . . . .3980N

Driller:..... G. SHEATHER
Date:..... 19/4/95
Rig:..... HD 4
Depth to Water:..... 2.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.13
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.0 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 53.2 | 52.7 | 0.03 | 1 | 0.06 | 0.06 |
| 1.0 | 1.5 | M Ind | | | | 5 YR | 4 | 4 | 1.0 | 1.5 | 47.6 | 46.4 | 0.09 | 3 | 0.19 | 0.11 |
| 1.5 | 6.0 | BrS | | | | 10 YR | 5 | 4 | 1.5 | 2.0 | 52.4 | 51.4 | 0.21 | 2 | 0.40 | 0.20 |
| | | | | | | 10 YR | 6 | 2 | 2.0 | 2.5 | 49.9 | 49.7 | 0.20 | 0 | 0.40 | 0.24 |
| | | | 10 YR | 6 | 2 | | | | 2.5 | 3.0 | 48.5 | 48.3 | 0.08 | 0 | 0.16 | 0.23 |
| | | | 10 YR | 6 | 2 | | | | 3.0 | 3.5 | 47.5 | 47.3 | 0.05 | 0 | 0.11 | 0.21 |
| | | | 10 YR | 6 | 2 | | | | 3.5 | 4.0 | 48.7 | 48.6 | 0.02 | 0 | 0.04 | 0.19 |
| | | | 10 YR | 6 | 2 | | | | 4.0 | 4.5 | 51.6 | 51.4 | 0.02 | 0 | 0.04 | 0.17 |
| | | | 10 YR | 6 | 2 | | | | 4.5 | 5.0 | 52.0 | 51.8 | 0.01 | 0 | 0.02 | 0.15 |
| | | | 10 YR | 6 | 2 | | | | 5.0 | 5.5 | 53.7 | 53.5 | 0.01 | 0 | 0.02 | 0.14 |
| | | | 10 YR | 6 | 2 | | | | 5.5 | 6.0 | 51.2 | 51.0 | 0.02 | 0 | 0.04 | 0.13 |

GS 1996/034

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71720E
Hole No. . . . .3990N

Driller:.... G. SHEATHER
Date:..... 20/4/95
Rig:..... HD 4
Depth to Water:..... 2.5
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:.... 5.7

Wtd Grade Wt % : 0.28
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.5 | GS | | | | 10 YR | 6 2 | 0.3 | 1.0 | 51.1 | 50.5 | 0.33 | 1 | 0.65 | 0.65 |
| 1.5 | 6.0 | BrS | | | | 10 YR | 6 2 | 1.0 | 1.5 | 52.3 | 52.0 | 0.15 | 1 | 0.29 | 0.50 |
| | | | | | | 5 YR | 4 4 | 1.5 | 2.0 | 52.2 | 51.1 | 0.06 | 2 | 0.11 | 0.38 |
| | | | | | | 5 YR | 4 4 | 2.0 | 2.5 | 51.6 | 51.3 | 0.35 | 1 | 0.68 | 0.45 |
| | | | 10 YR | 7 | 4 | | | 2.5 | 3.0 | 47.9 | 47.7 | 0.10 | 0 | 0.21 | 0.41 |
| | | | 10 YR | 7 | 4 | | | 3.0 | 3.5 | 51.7 | 51.4 | 0.07 | 1 | 0.14 | 0.36 |
| | | | 10 YR | 7 | 4 | | | 3.5 | 4.0 | 53.3 | 53.0 | 0.06 | 1 | 0.11 | 0.33 |
| | | | 10 YR | 6 | 2 | | | 4.0 | 4.5 | 47.9 | 47.7 | 0.09 | 0 | 0.19 | 0.31 |
| | | | 10 YR | 6 | 2 | | | 4.5 | 5.0 | 49.0 | 48.9 | 0.07 | 0 | 0.14 | 0.29 |
| | | | 10 YR | 6 | 2 | | | 5.0 | 5.5 | 51.2 | 51.1 | 0.02 | 0 | 0.04 | 0.27 |
| | | | 10 YR | 6 | 2 | | | 5.5 | 6.0 | 52.4 | 52.2 | 0.21 | 0 | 0.40 | 0.28 |

GS 1996/034

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . . .71720E
Hole No. . . . . .4000N

Driller:..... G. SHEATHER
Date:..... 18/4/95
Rig:..... HD 4
Depth to Water:..... 2.5
Hole Bottom Code:..... Sand

Tenure:.....EL 3085
Parish:.....TOMAREE
Surface RL:.....
Total Depth:..... 6.0
Sample Depth:..... 5.7

Wtd Grade Wt % : 0.19
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 6.0 | BrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 52.5 | 51.9 | 0.10 | 1 | 0.19 | 0.19 |
| | | | | | | 10 YR | 8 | 2 | 1.0 | 1.5 | 53.7 | 53.4 | 0.14 | 1 | 0.26 | 0.22 |
| | | | | | | 10 YR | 8 | 2 | 1.5 | 2.0 | 56.6 | 56.1 | 0.11 | 1 | 0.19 | 0.21 |
| | | | | | | 10 YR | 4 | 2 | 2.0 | 2.5 | 47.4 | 46.5 | 0.20 | 2 | 0.42 | 0.26 |
| | | | 10 YR | 4 | 2 | | | | 2.5 | 3.0 | 55.0 | 54.6 | 0.09 | 1 | 0.16 | 0.24 |
| | | | 10 YR | 5 | 4 | | | | 3.0 | 3.5 | 56.7 | 56.5 | 0.07 | 0 | 0.12 | 0.22 |
| | | | 10 YR | 5 | 4 | | | | 3.5 | 4.0 | 51.3 | 51.1 | 0.07 | 0 | 0.14 | 0.21 |
| | | | 10 YR | 5 | 4 | | | | 4.0 | 4.5 | 54.6 | 54.4 | 0.17 | 0 | 0.31 | 0.22 |
| | | | 10 YR | 6 | 2 | | | | 4.5 | 5.0 | 53.4 | 53.2 | 0.08 | 0 | 0.15 | 0.22 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 57.2 | 57.0 | 0.04 | 0 | 0.07 | 0.20 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 55.9 | 55.7 | 0.05 | 0 | 0.09 | 0.19 |

GS 1996/034

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .7172OE
Hole No. . . . .4010N

Driller:..... G. SHEATHER
Date:..... 18/4/95
Rig:..... HD 4
Depth to Water:..... 2.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:.... 6.7

Wtd Grade Wt % : 0.30
Wtd Slimes % : 0

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 7.0 | BrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 56.5 | 56.1 | 0.10 | 1 | 0.18 | 0.18 |
| | | | | | | 10 YR | 8 | 2 | 1.0 | 1.5 | 55.2 | 55.0 | 0.08 | 0 | 0.14 | 0.16 |
| | | | | | | 10 YR | 8 | 2 | 1.5 | 2.0 | 55.6 | 55.4 | 0.29 | 0 | 0.52 | 0.27 |
| | | | | | | 10 YR | 6 | 2 | 2.0 | 2.5 | 60.0 | 59.8 | 0.14 | 0 | 0.23 | 0.26 |
| | | | 10 YR | 6 | 2 | | | | 2.5 | 3.0 | 55.3 | 55.0 | 0.21 | 1 | 0.38 | 0.28 |
| | | | 10 YR | 4 | 2 | | | | 3.0 | 3.5 | 58.4 | 58.1 | 0.99 | 1 | 1.70 | 0.50 |
| | | | 10 YR | 5 | 4 | | | | 3.5 | 4.0 | 49.4 | 49.1 | 0.21 | 1 | 0.43 | 0.49 |
| | | | 10 YR | 5 | 4 | | | | 4.0 | 4.5 | 57.0 | 56.8 | 0.06 | 0 | 0.11 | 0.45 |
| | | | 10 YR | 5 | 4 | | | | 4.5 | 5.0 | 55.9 | 55.9 | 0.02 | 0 | 0.04 | 0.40 |
| | | | 10 YR | 5 | 4 | | | | 5.0 | 5.5 | 55.5 | 55.4 | 0.04 | 0 | 0.07 | 0.37 |
| | | | 10 YR | 5 | 4 | | | | 5.5 | 6.0 | 58.5 | 58.3 | 0.03 | 0 | 0.05 | 0.34 |
| | | | 10 YR | 5 | 4 | | | | 6.0 | 6.5 | 56.7 | 56.6 | 0.02 | 0 | 0.04 | 0.32 |
| | | | 10 YR | 5 | 4 | | | | 6.5 | 7.0 | 57.6 | 57.4 | 0.03 | 0 | 0.05 | 0.30 |

GS 1996/034

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71720E
Hole No. . . . .4020N

Driller:..... G. SHEATHER
Date:..... 18/4/95
Rig:..... HD 4
Depth to Water:..... 3.0
Hole Bottom Code:..... Sand

Tenure:.....EL 3085
Parish:.....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:..... 6.7

Wtd Grade Wt % : 1.25
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD DESCRIPT. | COLOUR WET | | | COLOUR DRY | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | | HUE | V | C | HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 7.0 | BrS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 55.1 | 54.7 | 0.19 | 1 | 0.34 | 0.34 |
| | | | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 57.0 | 56.7 | 0.19 | 1 | 0.33 | 0.34 |
| | | | | | | 5 YR | 3 | 4 | 1.5 | 2.0 | 54.6 | 54.0 | 1.03 | 1 | 1.89 | 0.79 |
| | | | | | | 10 YR | 5 | 4 | 2.0 | 2.5 | 56.1 | 55.6 | 2.91 | 1 | 5.19 | 1.79 |
| | | | | | | 10 YR | 5 | 4 | 2.5 | 3.0 | 58.4 | 58.0 | 2.89 | 1 | 4.95 | 2.38 |
| | | | 10 YR | 5 | 4 | | | | 3.0 | 3.5 | 55.2 | 54.9 | 1.39 | 1 | 2.52 | 2.40 |
| | | | 10 YR | 5 | 4 | | | | 3.5 | 4.0 | 55.3 | 55.1 | 0.31 | 0 | 0.56 | 2.15 |
| | | | 10 YR | 5 | 4 | | | | 4.0 | 4.5 | 54.5 | 54.4 | 0.37 | 0 | 0.68 | 1.98 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 56.7 | 56.6 | 0.02 | 0 | 0.04 | 1.77 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 53.8 | 53.6 | 0.01 | 0 | 0.02 | 1.60 |
| | | | 10 YR | 6 | 2 | | | | 5.5 | 6.0 | 53.5 | 53.0 | 0.02 | 1 | 0.04 | 1.46 |
| | | | 10 YR | 6 | 2 | | | | 6.0 | 6.5 | 56.5 | 56.5 | 0.06 | 0 | 0.11 | 1.35 |
| | | | 10 YR | 6 | 2 | | | | 6.5 | 7.0 | 55.9 | 55.8 | 0.01 | 0 | 0.02 | 1.25 |

GS 1996/034

BORE HOLE LOG - RZM PTY. LTD.

Line No. . . . .71720E
Hole No. . . . .4040N

Driller:..... G. SHEATHER
Date:..... 20/4/95
Rig:..... HD 4
Depth to Water:..... 3.8
Hole Bottom Code:..... Sand

Tenure:....EL 3085
Parish:....TOMAREE
Surface RL:.....
Total Depth:..... 7.0
Sample Depth:..... 6.7

Wtd Grade Wt % : 0.18
Wtd Slimes % : 1

| LITHOLOGY | | | | | | | LABORATORY SAMPLE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEPTH (m) | | FIELD | COLOUR | | | | DEPTH (m) | | WEIGHTS | | | GRADES | | |
| FROM | TO | DESCRIPT. | WET HUE | V | C | DRY HUE | V | C | FROM | TO | ORIG. | WASHED | H.M. | SLIMES | Wt % | PRO. |
| 0.0 | 0.3 | | | | | | | | 0.0 | 0.3 | | | | | | |
| 0.3 | 1.3 | GS | | | | 10 YR | 6 | 2 | 0.3 | 1.0 | 51.6 | 51.0 | 0.08 | 1 | 0.16 | 0.16 |
| 1.3 | 7.0 | BrS | | | | 10 YR | 6 | 2 | 1.0 | 1.5 | 56.2 | 55.9 | 0.05 | 1 | 0.09 | 0.13 |
| | | | | | | 5 YR | 4 | 4 | 1.5 | 2.0 | 54.7 | 54.0 | 0.34 | 1 | 0.62 | 0.27 |
| | | | | | | 10 YR | 5 | 4 | 2.0 | 2.5 | 51.6 | 51.2 | 0.35 | 1 | 0.68 | 0.36 |
| | | | | | | 10 YR | 7 | 4 | 2.5 | 3.0 | 55.4 | 55.2 | 0.19 | 0 | 0.34 | 0.36 |
| | | | | | | 10 YR | 7 | 4 | 3.0 | 3.5 | 56.9 | 56.7 | 0.07 | 0 | 0.12 | 0.32 |
| | | | 10 YR | 7 | 4 | | | | 3.5 | 4.0 | 55.7 | 55.5 | 0.04 | 0 | 0.07 | 0.29 |
| | | | 10 YR | 7 | 4 | | | | 4.0 | 4.5 | 49.5 | 49.3 | 0.03 | 0 | 0.06 | 0.26 |
| | | | 10 YR | 7 | 4 | | | | 4.5 | 5.0 | 51.6 | 51.5 | 0.03 | 0 | 0.06 | 0.24 |
| | | | 10 YR | 7 | 4 | | | | 5.0 | 5.5 | 52.9 | 52.7 | 0.01 | 0 | 0.02 | 0.22 |
| | | | 10 YR | 7 | 4 | | | | 5.5 | 6.0 | 55.9 | 55.7 | 0.02 | 0 | 0.04 | 0.20 |
| | | | 10 YR | 7 | 4 | | | | 6.0 | 6.5 | 57.4 | 57.2 | 0.03 | 0 | 0.05 | 0.19 |
| | | | 10 YR | 7 | 4 | | | | 6.5 | 7.0 | 54.8 | 54.7 | 0.02 | 0 | 0.04 | 0.18 |

EL 2683

EL 3085

SUTTON

TOMAREE

Tilligerry Creek

Mud Island Creek

Fenninghams Island

Bobs Farm Creek

Jessies Island

Wallis Creek

Uptons Island

BOBS FARM

Pig Creek

Crown Land

TOMAGO SANDBEDS

URALLA

NEWCASTLE BIGHT

Stockton Beach

Line AB1

Line AB2

4060N

4300N

4540N

4560N

3520N

3450N

3400N

3320N

70760E

71080E

69480E

68840E

67560E

66280E

70120E

71400E

NOTE
For drilling results see Plans 9232-5-14 & 9332-5-1

For drilling results of line AB1 see Drg. No. AB CS01

D000004330
A3 Col.
GS 1996/034

REF. DRG. WILLIAMTOWN 9232-II-N MORNA POINT 9332-III-N

LEGEND

Drill line - with line number & extent

0 1 2 3 4 5 cm

| | | | |
|---|---|---|---|
| DRAWN | DG | 9/89 | 1:25000 SCALE |
| REV. | DG | 4/90 | |
| REV. | DG | 11/92 | |
| | DG | 10/93 | |
| | DG | 11/95 | |

R.Z. MINES (NEWCASTLE) PTY. LTD.

EL 2683/ EL 3085 PORT STEPHENS
DRILL LINE LOCATION PLAN
STOCKTON DUNES

DRG.NO.—A3 65 FIG. NO.

Warabrook, Newcastle Laboratory

Coffey Testing Pty Ltd
ABN 92 114 364 046
19 Warabrook Boulevard
Warabrook NSW 2304

Phone: +61 2 4016 2300
Fax: +61 2 4016 2380

Report No: WARA13S-05193-1
Issue No: 1

# Material Test Report

Client: QUARRY MINING SYSTEMS PTY LTD
PO Box 7030
Redhead NSW 2290

Principal:
Project No.: INFOWARA01492AA
Project Name: Material Testing
Lot No.: - TRN:

Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 17/09/2013

## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05193 |
| Client Sample: | BH1-BL-G1-CC |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

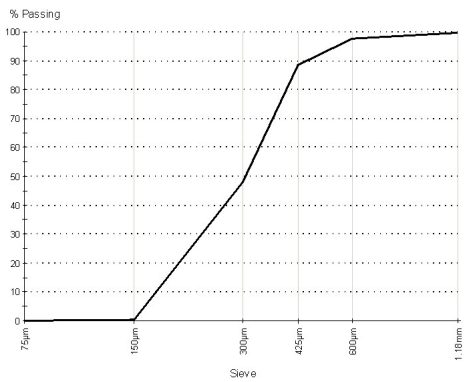
| Description | Method | Result | Limits |
|---|---|---|---|
| Loss 0.600 to 0.300 mm (%) | AS 1141.24 | 0.7 | |
| Total Weighted Loss (%) | | 0.7 | |
| Date Tested | | 17/09/2013 | |
| Uncompacted Bulk Density (t/m³) | AS 1141.4 | 1.45 | |
| Compacted Bulk Density (t/m³) | | 1.58 | |
| Aggregate Moisture Condition | | Dried | |
| Nominal Size Of Sample (mm) | | 0 | |
| Date Tested | | 5/09/2013 | |
| Apparent Particle Density (t/m³) | AS 1141.5 | 2.59 | |
| Particle Density Dry (t/m³) | | 2.56 | |
| Particle Density SSD (t/m³) | | 2.57 | |
| Water Absorption (%) | | 0.5 | |
| Date Tested | | 11/09/2013 | |

## Particle Size Distribution

| | |
|---|---|
| Method: | AS 1141.11.1 |
| Drying by: | Oven |
| Date Tested: | 6/09/2013 |
| Note: | Sample Washed |

| Sieve Size | % Passing | Limits |
|---|---|---|
| 1.18mm | 100 | |
| 600µm | 98 | |
| 425µm | 88 | |
| 300µm | 48 | |
| 150µm | 0 | |
| 75µm | 0 | |

## Chart




## Comments

N/A


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Warabrook, Newcastle Laboratory

Coffey Testing Pty Ltd
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19 Warabrook Boulevard
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Phone: +61 2 4016 2300
Fax: +61 2 4016 2380

Report No: WARA13S-05194-1
Issue No: 1

# Material Test Report

Client: QUARRY MINING SYSTEMS PTY LTD
PO Box 7030
Redhead NSW 2290

Principal:
Project No.: INFOWARA01492AA
Project Name: Material Testing
Lot No.: - TRN:

Accredited for compliance with ISO/IEC 17025.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Approved Signatory: Chris Blackford (Geotechnician)
NATA Accredited Laboratory Number:431
Date of Issue: 12/09/2013

## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05194 |
| Client Sample: | BH1-BL-G1-CS |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

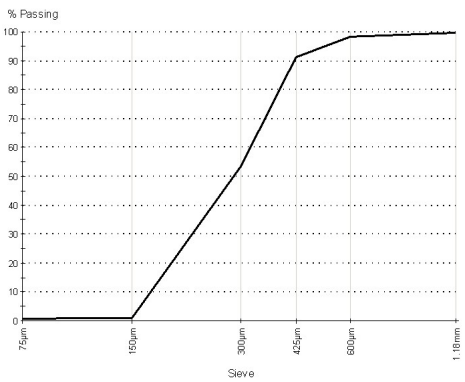
| Description | Method | Result | Limits |
|---|---|---|---|
| Clay and Fine Silt (%) | AS 1141.33 | 11 | |
| Date Tested | | 6/09/2013 | |

## Particle Size Distribution

| | |
|---|---|
| Method: | AS 1141.11.1 |
| Drying by: | Oven |
| Date Tested: | 6/09/2013 |
| Note: | Sample Washed |

| Sieve Size | % Passing | Limits |
|---|---|---|
| 1.18mm | 100 | |
| 600µm | 98 | |
| 425µm | 91 | |
| 300µm | 53 | |
| 150µm | 1 | |
| 75µm | 1 | |

## Chart




## Comments

N/A


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Warabrook, Newcastle Laboratory

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Phone: +61 2 4016 2300
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Report No: WARA13S-05194-2
Issue No: 1

# Material Test Report

Client: QUARRY MINING SYSTEMS PTY LTD
PO Box 7030
Redhead NSW 2290

Principal:
Project No.: INFOWARA01492AA
Project Name: Material Testing
Lot No.: - TRN:

Accredited for compliance with ISO/IEC 17025.

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## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05194 |
| Client Sample: | BH1-BL-G1-CS |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

| Description | Method | Result | Limits |
|---|---|---|---|
| Organic Impurities | AS 1141.34 | Fail | |
| Method of Assessment | | Reference glass | |
| Date Tested | | 6/09/2013 | |

## Particle Size Distribution

## Chart

## Comments

N/A


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Report No: WARA13S-05195-1
Issue No: 1

# Material Test Report

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Project No.: INFOWARA01492AA
Project Name: Material Testing
Lot No.: - TRN:

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## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05195 |
| Client Sample: | BH3-BL-B1-CS |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

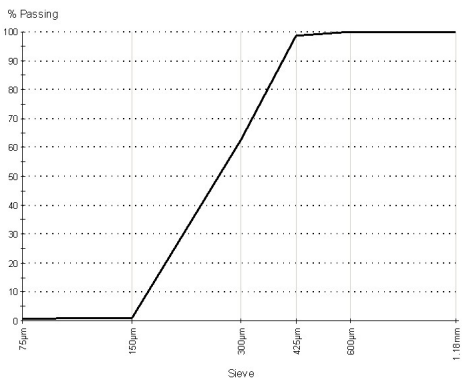
| Description | Method | Result | Limits |
|---|---|---|---|
| Clay and Fine Silt (%) | AS 1141.33 | 3 | |
| Date Tested | | 6/09/2013 | |

## Particle Size Distribution

| | |
|---|---|
| Method: | AS 1141.11.1 |
| Drying by: | Oven |
| Date Tested: | 6/09/2013 |
| Note: | Sample Washed |

| Sieve Size | % Passing | Limits |
|---|---|---|
| 1.18mm | 100 | |
| 600µm | 100 | |
| 425µm | 98 | |
| 300µm | 63 | |
| 150µm | 1 | |
| 75µm | 1 | |

## Chart




## Comments

N/A


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Report No: WARA13S-05195-2
Issue No: 1

# Material Test Report

Client: QUARRY MINING SYSTEMS PTY LTD
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Principal:
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Project Name: Material Testing
Lot No.: - TRN:

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NATA Accredited Laboratory Number:431
Date of Issue: 17/09/2013

## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05195 |
| Client Sample: | BH3-BL-B1-CS |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

| Description | Method | Result | Limits |
|---|---|---|---|
| Organic Impurities | AS 1141.34 | Fail | |
| Method of Assessment | | Reference glass | |
| Date Tested | | 6/09/2013 | |

## Particle Size Distribution

## Chart

## Comments

N/A


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# Material Test Report

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Issue No: 1

| | |
|---|---|
| Client: | QUARRY MINING SYSTEMS PTY LTD<br>PO Box 7030<br>Redhead NSW 2290 |
| Principal: | |
| Project No.: | INFOWARA01492AA |
| Project Name: | Material Testing |
| Lot No.: | - TRN: |

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## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05196 |
| Client Sample: | BH3-BL-B2-CS |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

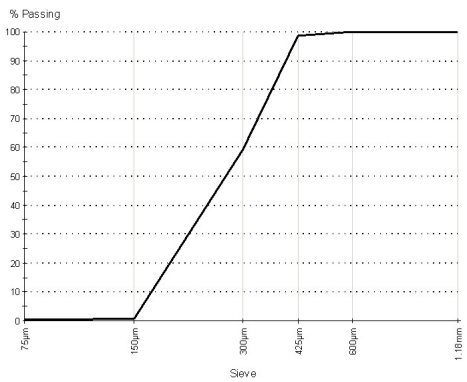
| Description | Method | Result | Limits |
|---|---|---|---|
| Clay and Fine Silt (%) | AS 1141.33 | 1 | |
| Date Tested | | 6/09/2013 | |

## Particle Size Distribution

| | |
|---|---|
| Method: | AS 1141.11.1 |
| Drying by: | Oven |
| Date Tested: | 6/09/2013 |
| Note: | Sample Washed |

| Sieve Size | % Passing | Limits |
|---|---|---|
| 1.18mm | 100 | |
| 600µm | 100 | |
| 425µm | 99 | |
| 300µm | 59 | |
| 150µm | 1 | |
| 75µm | 0 | |

## Chart




## Comments

N/A


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Issue No: 1

# Material Test Report

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Project No.: INFOWARA01492AA
Project Name: Material Testing
Lot No.: - TRN:

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## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05196 |
| Client Sample: | BH3-BL-B2-CS |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

| Description | Method | Result | Limits |
|---|---|---|---|
| Organic Impurities | AS 1141.34 | Fail | |
| Method of Assessment | | Reference glass | |

## Particle Size Distribution

## Chart

## Comments

N/A


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Issue No: 1

# Material Test Report

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## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05197 |
| Client Sample: | BH3-BL-B3-CC |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

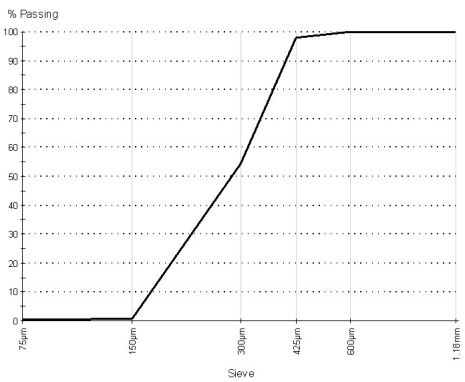
| Description | Method | Result | Limits |
|---|---|---|---|
| Loss 0.600 to 0.300 mm (%) | AS 1141.24 | 0.2 | |
| Total Weighted Loss (%) | | 0.2 | |
| Uncompacted Bulk Density (t/m³) | AS 1141.4 | 1.49 | |
| Compacted Bulk Density (t/m³) | | 1.60 | |
| Aggregate Moisture Condition | | Dried | |
| Nominal Size Of Sample (mm) | | 0 | |
| Date Tested | | 5/09/2013 | |
| Apparent Particle Density (t/m³) | AS 1141.5 | 2.61 | |
| Particle Density Dry (t/m³) | | 2.60 | |
| Particle Density SSD (t/m³) | | 2.60 | |
| Water Absorption (%) | | 0.3 | |
| Date Tested | | 11/09/2013 | |

## Particle Size Distribution

| | |
|---|---|
| Method: | AS 1141.11.1 |
| Drying by: | Oven |
| Date Tested: | 6/09/2013 |
| Note: | Sample Washed |

| Sieve Size | % Passing | Limits |
|---|---|---|
| 1.18mm | 100 | |
| 600µm | 100 | |
| 425µm | 98 | |
| 300µm | 54 | |
| 150µm | 1 | |
| 75µm | 0 | |

## Chart




## Comments

N/A


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Issue No: 1

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## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05197 |
| Client Sample: | BH3-BL-B3-CC |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

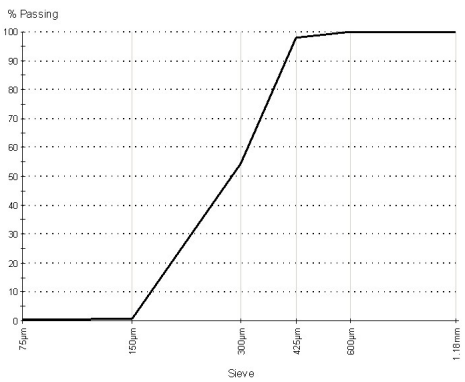
| Description | Method | Result | Limits |
|---|---|---|---|
| Loss 0.600 to 0.300 mm (%) | AS 1141.24 | 0.2 | |
| Total Weighted Loss (%) | | 0.2 | |
| Uncompacted Bulk Density (t/m³) | AS 1141.4 | 1.49 | |
| Compacted Bulk Density (t/m³) | | 1.60 | |
| Aggregate Moisture Condition | | Dried | |
| Nominal Size Of Sample (mm) | | 0 | |
| Date Tested | | 5/09/2013 | |
| Apparent Particle Density (t/m³) | AS 1141.5 | 2.61 | |
| Particle Density Dry (t/m³) | | 2.60 | |
| Particle Density SSD (t/m³) | | 2.60 | |
| Water Absorption (%) | | 0.3 | |
| Date Tested | | 11/09/2013 | |

## Particle Size Distribution

| | |
|---|---|
| Method: | AS 1141.11.1 |
| Drying by: | Oven |
| Date Tested: | 6/09/2013 |
| Note: | Sample Washed |

| Sieve Size | % Passing | Limits |
|---|---|---|
| 1.18mm | 100 | |
| 600µm | 100 | |
| 425µm | 98 | |
| 300µm | 54 | |
| 150µm | 1 | |
| 75µm | 0 | |

## Chart




## Comments

N/A


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Issue No: 1

# Material Test Report

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Lot No.: - TRN:

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## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05198 |
| Client Sample: | BH3-BL-G-CS |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

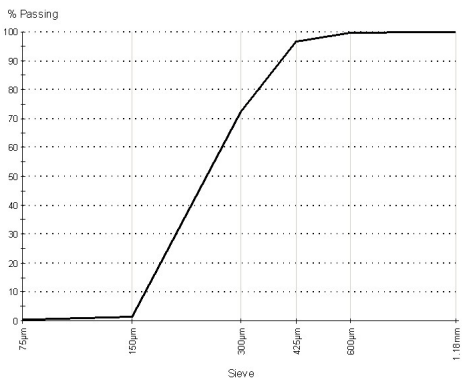
| Description | Method | Result | Limits |
|---|---|---|---|
| Clay and Fine Silt (%) | AS 1141.33 | 1 | |
| Date Tested | | 6/09/2013 | |

## Particle Size Distribution

| | |
|---|---|
| Method: | AS 1141.11.1 |
| Drying by: | Oven |
| Date Tested: | 6/09/2013 |
| Note: | Sample Washed |

| Sieve Size | % Passing | Limits |
|---|---|---|
| 1.18mm | 100 | |
| 600µm | 100 | |
| 425µm | 97 | |
| 300µm | 72 | |
| 150µm | 1 | |
| 75µm | 0 | |

## Chart




## Comments

N/A


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Issue No: 1

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Project Name: Material Testing
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Date of Issue: 17/09/2013

## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05198 |
| Client Sample: | BH3-BL-G-CS |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

| Description | Method | Result | Limits |
|---|---|---|---|
| Organic Impurities | AS 1141.34 | Fail | |
| Method of Assessment | | Reference glass | |
| Date Tested | | 6/09/2013 | |

## Particle Size Distribution

## Chart

## Comments

N/A


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## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05199 |
| Client Sample: | BH5-BL-B-CS |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

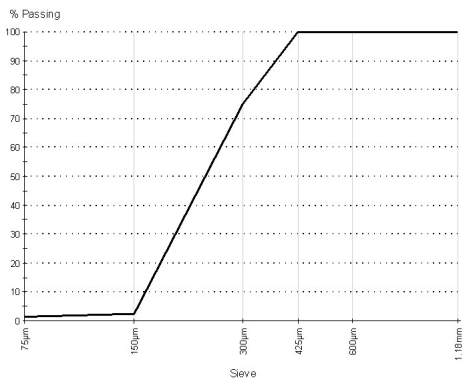
| Description | Method | Result | Limits |
|---|---|---|---|
| Clay and Fine Silt (%) | AS 1141.33 | 2 | |
| Date Tested | | 6/09/2013 | |

## Particle Size Distribution

| | |
|---|---|
| Method: | AS 1141.11.1 |
| Drying by: | Oven |
| Date Tested: | 6/09/2013 |
| Note: | Sample Washed |

| Sieve Size | % Passing | Limits |
|---|---|---|
| 1.18mm | 100 | |
| 600µm | 100 | |
| 425µm | 100 | |
| 300µm | 75 | |
| 150µm | 2 | |
| 75µm | 1 | |

## Chart




## Comments

N/A


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Report No: WARA13S-05199-2
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# Material Test Report

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Lot No.: - TRN:

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Date of Issue: 17/09/2013

## Sample Details

| | |
|---|---|
| Sample ID: | WARA13S-05199 |
| Client Sample: | BH5-BL-B-CS |
| Date Sampled: | 09/05/2013 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | No Specification |
| Sampling Method: | AS1141.3.1 Clause 6.9.2 by Client |
| Project Location: | Bobs Farm, NSW |
| Sample Location: | Onsite Bore Hole |

## Other Test Results

| Description | Method | Result | Limits |
|---|---|---|---|
| Organic Impurities | AS 1141.34 | Pass | |
| Method of Assessment | | Reference glass | |
| Date Tested | | 6/09/2013 | |

## Particle Size Distribution

## Chart

## Comments

N/A


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# Quarry Mining Systems Pty Ltd

# Bobs Farm Stage Two Geological Assessment

# December 2013



Prepared by:

## VGT Pty Ltd

in conjunction with:

## Quarry Mining Systems Pty Ltd



| Prepared by: | |
|---|---|
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| | | |
|---|---|---|
| Report Date: | 3/12/2013 | |
| Report Number: | BF13A | |
| Copy Number: | | |
| Report Authorised by: | Michael van Koeverden | Date: 3/12/2013 |
| | Greg Thomson | Date: 3/12/2013 |


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# Appendices

Appendix A Figures
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# Acronyms and Terms Used Throughout the Report

Through this document, a number of Acronyms and reference terms are frequently used. To assist the reader, the following lists are provided.

## Section 1. Acronyms and Glossary

| Word | Meaning |
|---|---|
| **Acid Sulphate Soils (ASS)** | Naturally acid clays, mud and other sediments usually found in swamps and estuaries. They may become extremely acidic when drained and exposed to oxygen, and may produce acidic leachate and run-off which can pollute receiving waters and liberate toxins. ASS is classified as materials which are above the groundwater, are undergoing oxidation and have a pH of less than 4.0. |
| **Alluvial Soil** | Juvenile soils formed by deposition from still or moving water. Little pedological development beyond some accumulation of organic matter at the surface. |
| **AHD – Australian Height Datum** | A height of zero was assigned to the mean sea level determination at 30 tide gauges around the Australian Mainland coastline, measured over a three year period from 1966 to 1968. Ref 2. |
| **Aquifer** | A soil or rock layer or group of layers that is sufficiently saturated and permeable to yield significant quantities of water. |
| **Bed Rock** | The unweathered rock that lies below loose surface deposits of soil and alluvium. |
| **Earthworks** | The process of extracting, moving and depositing earth during construction. |
| **Embankment** | A mound or bank of earth or stone formed to support a roadway, serve as a protective barrier, or the like. |
| **Erosion** | The natural process where wind or water detaches a soil particle and provides energy to move the particle. |
| **Excavation** | The act or process of digging out earth during construction. |
| **Floodplain** | Large flat area of alluvium adjacent to a watercourse, characterised by frequent active erosion and aggregation by channelled and overbank stream flow. |
| **Groundwater** | All waters occurring below the land surface. The upper surface of the soils saturated by groundwater in any particular area is called the water table. |
| **Hydrology** | The study of rainfall and surface water runoff processes. |
| **Palaeosol** | Ancient soil |
| **pH** | A measure of the degree of acidity or alkalinity expressed on a logarithmic scale of 1-14, on which 1 is most acid, 7 is neutral and 14 is most basic. |
| **Rehabilitation** | The restoration of a landscape and especially the vegetation following its disturbance. |
| **Remnant vegetation** | Native vegetation remaining after widespread clearing has taken place. |
| **RL** | Relative Level above sea level |
| **Rudite** | A word derived from Latin word “Rudus” which means crushed stone, debris or rubble. This is a general term for a sedimentary rock composed of rounded or angular pebbles, cobbles and / or boulders. Rudites are mostly composed of siliciclastic gravel known as Conglomerates. Ref 4. |
| **Sand** | Are categorised as particles that range between 0.0625 mm to 2.00 mm. Ref 1. These can be made from quartz, limestone, feldspar, basalts, latites, organic particles and olivine. These deposits are found on beaches, dunes, |

| Word | Meaning |
|---|---|
| | rivers, glacial outwash and volcanic slopes. |
| **Sediment** | Material of varying sizes that has been or is being moved from its site of origin by the action of wind, water or gravity. |
| **Sedimentation basin** | An area where run-off is ponded to allow sediment to be deposited. The longer the period that run-off is held, the smaller the size of the sediment deposited. Such basins have to be cleaned regularly. |
| **Silt** | Are categorised as particles that range between 0.0625 mm to 0.0039 mm. Ref 1 |
| **Soil** | That part of the upper weathered layer of the earth's crust that can support plant growth. Any naturally occurring loose or soft deposit forming part of the earth's crust and resulting from weathering or breakdown of rock formation or from the decay of vegetation. |
| **Soil Texture Group** | An important attribute of soils that affects the effectiveness of sediment retention structures is the proportion of particles finer than 0.02 mm. Particles that are finer than 0.02 mm are relatively difficult to trap in simple sediment retention basins, while those that are coarser are not. |
| **T – Tonnes** | Weight measurement being 1000 kilograms. |
| **Unconsolidated Sediments** | These are loose, not compacted. Beach sand (unconsolidated sediment) can be compressed and squeezed at depth to produce sandstone (consolidated rock) |
| **Waste** | Includes any matter (whether liquid, solid, gaseous or radioactive) that is discharged, emitted or deposited in the environment in such volume, constituency, or manner as to cause an alteration to the environment. |

## References


1. Pettijohn F.J, Potter, P.E. and Siever R. 1972 Sand and Sandstone.
2. G.C. Luton and G.M Johnson 2001
3. Penguin Geology Dictionary, Whitten and Brooks 1982

# Section 2. Executive Summary

The purpose of this assessment is to determine the quality and quantity of the underlying stratum and how can it be utilised in the construction industry.

The site is made up of recently deposited sand dunes, 7,000 to 9,000 years old, and a five drill hole program was undertaken to assess the sand to a depth obtainable by dredge (around 16 metres below the water table). Obtaining samples below the water table in unconsolidated sediments is difficult, due to the collapsing nature of the sediments. Specialised drilling techniques were adopted to ensure holes did not collapse and a bailing tool was also used at specific points down each hole to capture samples for logging and testing.

Listed below are the identified resource unit and rounded calculated tonnes.

***Table 1. Resource Unit and Tonnes***

| Resource Unit | Tonnes |
|---|---|
| Top Soil | 242,360 |
| Upper Grey Sand | 530,890 |
| Blonde Sand to 4.3m RL | 2,789,240 |
| Blonde Sand Remaining | 874,390 |
| Black Carbonaceous | 548,980 |
| Lower Grey Sand | 5,579,580 |

The top soil should be stored and used for rehabilitation activities; the upper grey sand is not extensive but appears to be a transitional zone between the surface and the blonde sand unit below. The blonde occurs above the water table and at a total of 3.6 million tonnes is a significant portion of the resource.

The black carbonaceous band appears to be a marker band and is situated in the vicinity of the water table. The largest unit is the lower grey sand making up 5.5 million tonnes.

The resource based upon the JORC Code 2012 is considered to be an Indicted Mineral Resource.

# Section 3. Introduction

## 3.1. Introduction

Quarry Mining Systems Pty Limited (client) engaged VGT Pty Limited to fully evaluate the sand resources at 51 Nelson Bay Road, Bobs Farm, refer to *Figure One* for site location.

## 3.2. Resource Constraints

The client seeking to assess the site as completely as possible, the depth of the resource is to be reviewed beneath the water table to depth accessible by dredging. The lateral extent was constrained by the property boundaries.

## 3.3. Regional Geology

Referencing the Newcastle and Port Stephens 1:100,000 geological sheets, the site is underlain by sand dunes ranging between 7,000 and 9,000 years old, found in the Holocene Epoch. *Figure Two* shows the geological units which have been interpolated to the other sand deposits in the local area, which show that the units are similar to four other key local sand producers, being *3, 4, 5* and *6* on *Figure Two.*

## 3.4. Previous Investigations

The initial investigation was undertaken in April 2013.

A long reach excavator was used to allow holes to be sunk to reasonable depths. Five test pit holes were sunk TP1 to TP6, TP 5 was not sunk, see *Figure Three* for site locations. None of the holes reached its proposed depth due to significant amounts of caving during digging. The deepest holes TP 1 and 2 had the largest areas that allowed a very large hole to be created, about 18 metres by 15 metres.

***Table 2. Test Pit Summary Data***

| Hole Number | Easting | Northing | Ground Level (m) | Hole Depth |
|---|---|---|---|---|
| TP 1 | 406568.0 | 6373292.5 | 12.65 | 6.0 |
| TP 2 | 406462.5 | 6373280.0 | 12.30 | 6.5 |
| TP 3 | 406276.0 | 6373056.0 | 11.90 | 5.5 |
| TP 4 | 406532.0 | 6373998.0 | 31.05 | 4.7 |
| TP 6 | 406863.0 | 6373463.0 | 7.00 | 4.0 |

Note: Test Pit 5 was not required, all data provided by Tatersall Lander Pty Ltd, job no. 212434

The stratum that were intersected are listed below and depths were measured from the existing surface as:

1. Sandy Soil - Little sandy soil (0.1 metres)
2. Sand - Grey, Light Brown, fine to medium grained, with roots (1.0 metre)
3. Sand - Dark Brown, with orange mottles (3.0 metres)
4. *Sand - Yellow to Light Orange, Medium grained (intersected only 0.5 to 2.0 metres)

The thickness of Unit 4 is unknown as all of the holes did reach the basement of this strata unit.

This investigation shows that there are construction sands available on the site, the dark brown sands, from the field tests show that there could be a high proportion of organics, which not useful in the construction industry but could have good top dressing properties in the landscape industry.

The lowermost sand unit yellow light orange (gold) has the greatest potential for construction applications, this is the most attractive sand and similar to that found in other surrounding quarries.

Unit one is light coloured sand but has some roots from the surface that would require removal. Unit two, from the field tests show high proportions of organics, and could be used in the landscape industry. Unit three is a clean yellow gold colour ranging from medium to coarse grained sand, this is the most attractive sand and similar to that found in other surrounding quarries.

***Table 3. Test pit Results***

| Hole Number | Unit One (base depth metres) | Unit Two (base depth metres) | Hole Depth |
|---|---|---|---|
| TP 1 | 1.2 | 5 | 6.0 |
| TP 2 | 1.2 | 4.3 | 6.5 |
| TP 3 | 1.6 | 3.0 | 5.5 |
| TP 4 | 1.0 | 4.3 | 4.7 |
| TP 6 | 0.9 | 3.8 | 4.0 |

Note: Test Pit 5 was not required

The deepest hole was TP 2 which was 6.5 metres, all holes were terminated due to excessive hole collapse.

# Section 4. Current Geological Investigation

## 4.1. Assessment Goals

This assessment was designed to better evaluate the sand resource at depth and below the water table. The sample hole depths were designed to target the depth of dredging which is approximately 16 metres below the water table.

## 4.2. Assessment Methodology

The unconsolidated nature of these sediments requires specialised drilling techniques. Obtaining good representative samples at their insitu depths is vital in determining the resource.

Total Drilling Services were engaged to drill the holes. Initially solid flight augers were used until the samples became moist. Once the water table was intersected hollow flight augers were used to ensure the hole did not collapse and samples were collected using a specifically designed bailer constructed by Total Drilling. VGT assisted on the first day of drilling, QMS took all samples and prepared the sand trays to represent each hole with depth.

## 4.3. Drilling Results

The samples that were collected by QMS and logged by VGT are presented in the sand trays as seen in *Appendix B* of this report. The colours were determined using the AS 2700 – 1985 colour chart for comparison and consistency.

Five bore holes were sunk at the locations found on *Figure Three.* The drill logs are found in *Appendix B.*

***Table 4. Drill Hole Results***

| Hole Number | Easting | Northing | Ground Level (m) | Ground Water Level (RL m) | Hole Depth (m) |
|---|---|---|---|---|---|
| BH 1 | 406685.6 | 6373153.8 | 5.824 | 2.30 | 19.00 |
| BH 2 | 406592.8 | 6373286.7 | 11.719 | 2.00 | 26.50 |
| BH 3 | 406297.2 | 6373318.9 | 15.478 | 2.30 | 26.50 |
| BH 4 | 406260.7 | 6373082.8 | 9.452 | 2.20 | 24.00 |
| BH 5 | 406803.7 | 6373515.8 | 18.249 | 2.80 | 26.50 |
| Average | | | | 2.32 | |

Note: All survey data provided by Tatersall Lander Pty Ltd, job no. 212434

*Table 4* provides the survey co-ordinates of the drill boles and the measured water table depth, both provided by Tatersall Lander. The calculated average water table depth for this site is 2.32 metres RL.

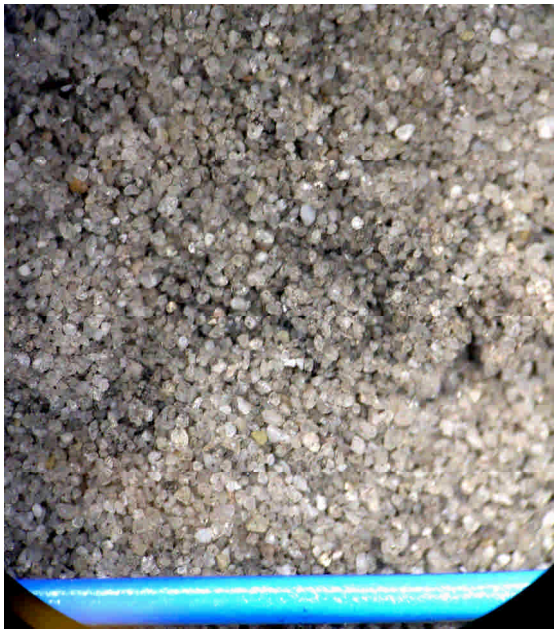
***Table 5. Drill Hole Geology Summary***

| Hole Number | Upper Grey Sand Unit (RL m) | Blonde Sand Unit (RL m) | Black Palaeosol Unit (RL m) | Lower grey Sand (RL m) | Hole Depth (m) |
|---|---|---|---|---|---|
| BH 1 | 5.8 – 4.8 | 4.8 – 2.0 | 2.2 – 1.3 | | 19.00 |
| BH 2 | 11.7 – 6.8 | 6.8 – 1.2 | 1.2 - -0.3 | -0.3- -14.8 | 26.50 |
| BH 3 | 15.4– 12.4 | 12.4 – 0.0 | 0.0 - -1.4 | -1.4- -11.9 | 26.50 |
| BH 4 | | | 2.8 – 1.9 | 1.9 - | 24.00 |
| BH 5 | | | | | 26.50 |

Bore Hole 1 samples above the water table provide useful data but below the water table the samples are mixed and not considered reliable. This was due to the inadequate sample retrieval system used. Bore holes 2 to 5 adopted an alternative sampling system which provided good sample return below the water table, as described in *Section 4.2.*

*Table 5* examines in more detail the different stratigraphy's found on site and their respective heights above sea level. In general this deposit is defined from the surface as:

1. Grey Sandy Soil – This unit had some organics and the following colours were observed Cloud Grey, Pearl Grey, Oyster, Koala grey. Photograph from BH 3, 0.0-0.3 metres. The blue scale is a 1mm thick paper clip.



2. Upper Grey Sand - This unit has no organics, quartz grains dominate with the following colours were observed Lead Grey, Cloud Grey, Pearl Grey, Oyster, Koala grey. As seen in the photoplate below (from BH 2, 1.5 - 2.0) the sand grains are fine grained, clear and opaque. The blue scale is a 1mm thick paper clip.



3. Blonde Sand – This unit is dominated by Quartz. This was described in the logs with the following colours; Tan, Raffia, Buff, and Pale Ochre. Photograph from BH 5, 9.5 – 10.5 metres. The blue scale is a 1mm thick paper clip.

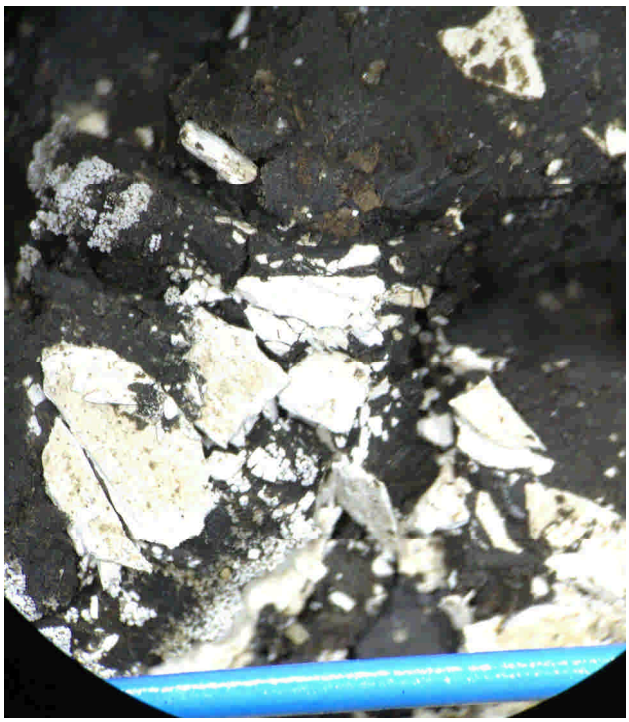


4. Black Carbonaceous band comprised of black organic clay, sand and shells – This unit was found close to the water table, as seen in Table 4.3

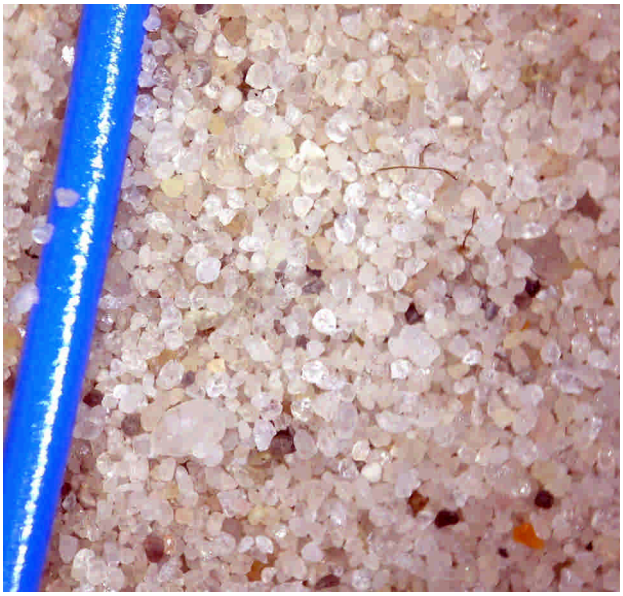
***Table 6. Carbonaceous Band and the Water Table***

| Hole Number | Proximity to Water Table |
|---|---|
| BH 1 | 1.0 metre below |
| BH 2 | 0.4 metres below |
| BH 3 | 1.4 metres below |
| BH 4 | 1.3 metres above |
| BH 5 | 4.6 metres below |

With four of the holes finding this band below the water table it is possible this could be acting as a perched aquifer layer. This would require further analysis from a ground water specialist. The photograph below is from BH 5, 20.5 to 21.0 metres. The blue scale is a 1mm thick paper clip.



5. Lower Grey Sand - Quartz dominates this with clear and opaques colours. There is some with heavy minerals seen as black grains. The photograph below is from BH 2, 17.5 to 18.5 metres. The blue scale is a 1mm thick paper clip.



# Section 5. Resource Assessment

## 5.1. Background

This resource assessment is divided into three resource categories upper, mid and lower.

The purpose of assessing these categories is to differentiate between what the author considers to be easy and hard to obtain development consent.

The upper resource area is a typical extraction scenario which operates 2 metres above the ground water table.

The mid resource area occurs from the water table (RL 2.3 metres) to the proposed 2 metre buffer layer (RL 4.3 metres). The rationale is to examine more accurately the angle of repose in this portion of the deposit.

The lower has proposed extraction occurring below the water table; which is considered to be more difficult to obtain consent from Government authorities.

*Table 7* examines the broader resource units itemised in *Section 4.3* to better evaluate the resource.

***Table 7. Resource Average Thickness Summary***

| Hole Number | Top soil (metres) | Upper Grey Unit (metres) | Blonde Unit to 4.3 m RL (metres) | Blonde Unit to Black (metres) | Black Unit (metres) | Lower grey (metres) |
|---|---|---|---|---|---|---|
| BH 1 | 0.6 | 0.4 | 0.5 | 2.3 | 0.7 | 14.5 |
| BH 2 | 0.5 | 3.0 | 4.0 | 3.1 | 1.4 | 14.5 |
| BH 3 | 0.3 | 0.7 | 10.2 | 3.4 | 1.0 | 10.9 |
| BH 4 | 0.2 | 0 | 5.1 | 0.3 | 0.9 | 17.5 |
| BH 5 | 0.5 | 0.5 | 12.4 | 6.6 | 2.6 | 3.9 |
| Average | 0.42 | 0.92 | 6.44 | 3.14 | 1.32 | |

## 5.2. Upper Resource Assessment

The upper resource assessment has the following assumptions and is constrained by the following:

1. Survey provided by Tatersall Lander Pty Ltd, job no. 212434.
2. 15 metre buffer from fence line, giving an area of 360,661 metres squared.
3. Base of resource is 2 metres above the calculated average water level of 2.3 metres RL, thus 4.3 metres RL is the adopted base of this resource area.
4. Density of sand is 1.6 g/cm$^3$, (1.6T/m$^3$).
5. The angle of repose of dry sand is 18 degrees.
6. 3 dimensional SURPAC software was used to calculate the volumes.

***Table 8. Upper Resource Volumes***

| | Top soil | Upper Grey Unit | *Blonde Unit to 4.3 m RL | Total |
|---|---|---|---|---|
| Thickness | 0.42 | 0.92 | n/a | n/a |
| Volume | 151,477 | 331,808 | 1,743,278 | 2,226,563 |
| Tonnes | 242,364 | 530,892 | 2,789,244 | 3,562,500 |

Note: * this volume was determined by subtracting the soil and upper grey from the total resource for this unit

## 5.3. Mid Resource Assessment

The mid resource assessment has the following assumptions and is constrained by the following:

1. Survey provided by Tatersall Lander Pty Ltd, job no. 212434.
2. 15 metre buffer from fence line, giving an area of 360,661 metres squared.
3. The resource base is the water table at RL 2.3 metres and the top is the RL 4.3 metres.
4. Density of sand is 1.6 g/cm$^{3,}$ (1.6T/m$^3$).
5. The adopted angle of repose for the moist sand is 18 degrees.
6. 3 dimensional SURPAC software was used to calculate the volumes.

***Table 9. Mid Resource Volumes***

| | Blonde Sand Unit |
|---|---|
| Volume | 546,495 |
| Tonnes | 874,392 |

## 5.4. Lower Resource Assessment

The lower resource assessment has the following assumptions and is constrained by the following:

1. Survey provided by Tatersall Lander Pty Ltd, job no. 212434.
2. 15 metre buffer from fence line, giving an area of 360,661 metres squared
3. The adopted resource base is 16 metres below the water table, this is the depth a dredge can extract. The adopted base of the resource is RL -13.7 metres.
4. Density of sand is 1.6 g/cm$^3$ (1.6T/m$^3$).
5. The adopted angle of repose for the wet sand is 42 degrees.
6. 3 dimensional SURPAC software was used to calculate the volumes.

The black carbonaceous clay and black sand band mostly occurs below the water table and for the purposes of this assessment has been assumed to be on average occurring at RL 1 m. The measured lateral extent of the black band is 259,932 metres squared.

***Table 10. Lower Resource Volumes***

| | Black Carbonaceous Unit | *Lower Grey Sand | Total |
|---|---|---|---|
| Thickness | 1.32 | n/a | n/a |
| Volume | 343,110 | 3,487,237 | 3,830,347 |
| Tonnes | 548,976 | 5,579,579 | 6,128,555 |

Note: * this volume was determined by subtracting the soil and upper grey from the total resource for this unit

## 5.5. Total Resource Summary

The resource assessment summarised in *Table 11* shows the largest resource is the lower resource category at 6.1 million tonnes followed by the upper at 3.5 million tonnes.

***Table 11. Resource Category Summary***

| Resource Category | Status | Base of Extraction RL (m) | Batter angle (degrees) | Volume (BCM) | Tonnes |
|---|---|---|---|---|---|
| Upper | Dry | 4.3 | 18 | 2,226,563 | 3,562,500 |
| Mid | Moist | 2.3 | 18 | 546,495 | 874,392 |
| Lower | Wet | -13.7 | 42 | 3,830,347 | 6,128,555 |
| Total | | | | 6,603,405 | 10,565,448 |

***Table 12. Resource Unit Summary***

| Resource Unit | Volume | Tonnes |
|---|---|---|
| Top Soil | 151,477 | 242,364 |
| Upper Grey Sand | 331,808 | 530,892 |
| Blonde Sand to 4.3m RL | 1,743,278 | 2,789,244 |
| Blonde Sand Remaining | 546,495 | 874,392 |
| Black Carbonaceous | 343,110 | 548,976 |
| Lower Grey Sand | 3,487,237 | 5,579,579 |

*Table 12* shows the different resource units found on the site. The top soil should be stored and used for rehabilitation activities; the upper grey sand is not extensive but appears to be a transitional zone between the surface and the blonde sand unit below. The blonde occurs above the water table and at a total of 3.6 million tonnes is a significant portion of the resource.

The black carbonaceous band appears to be a marker band and is situated in the vicinity of the water table. The largest unit is the lower grey sand making up 5.5 million tonnes.

## 5.6. JORC Code Description

The resource based upon the JORC Code 2012 is considered to be an ***Indicted Mineral Resource****, which is defined for which quantity, grade (or quality), density, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit.*

# Section 6. References

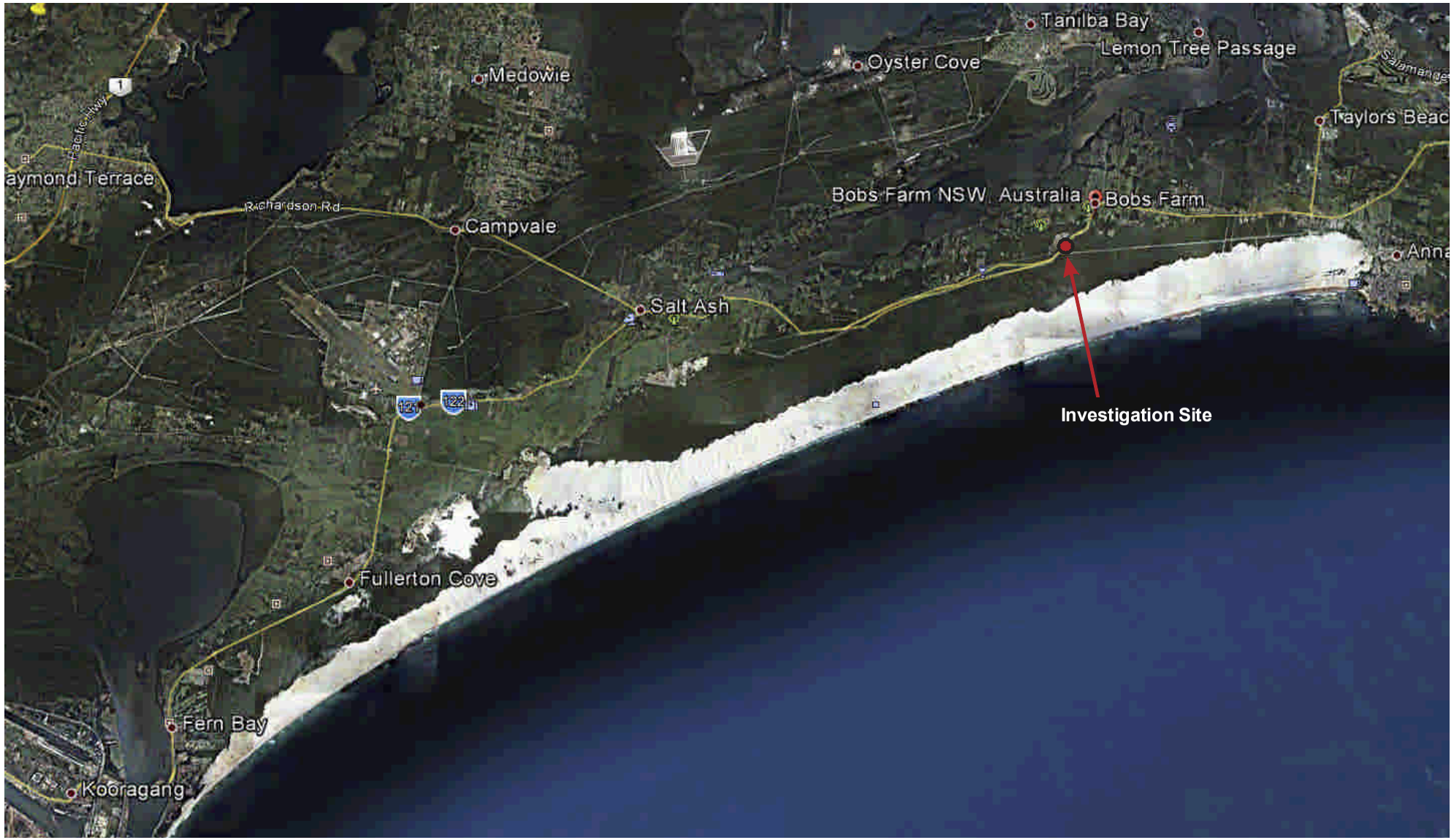
**Ref. 1.** Newcastle and Port Stephens 1:100,000 geological sheets

**Ref. 2.** Pettijohn F.J, Potter, P.E. and Siever R. 1972 Sand and Sandstone

# Appendix A: Figures

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Plan of:*** | Bobs Farm Site Investigation Location | ***Location:*** | Bobs Farm, Port Stephens | ***Projection:*** | N/A | ***Date:*** | 2/05/2013 | ***Version:*** | A |
| | | | | ***Contour Interval:*** | N/A | ***Sheet:*** | 1 of 1 | ***Survey:*** | N/A |
| | | | | | | ***Plan By:*** | TO | ***Source:*** | Google Earth |
| ***Figure:*** | ONE | ***Council:*** | Port Stephens | | | ***Project Manager:*** | GVT | | |
| ***Client:*** | QMS Pty Ltd | ***Scale:*** | | | | ***Office:*** | Thornton | ***Our Ref:*** | V:\Jobs_EMS Quarry Works\Bobs Farm.cdr |

vgt
Environmental Compliance Solutions

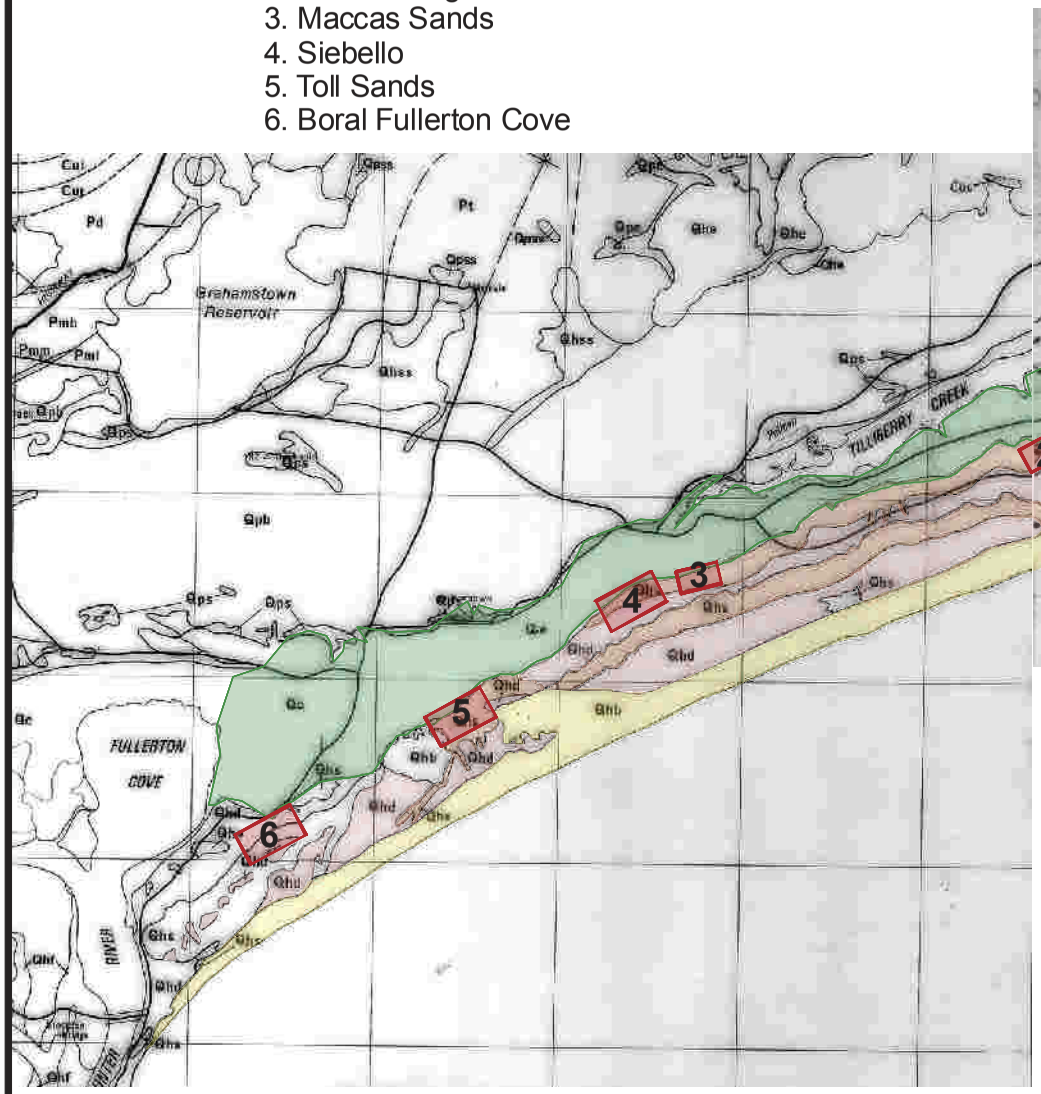


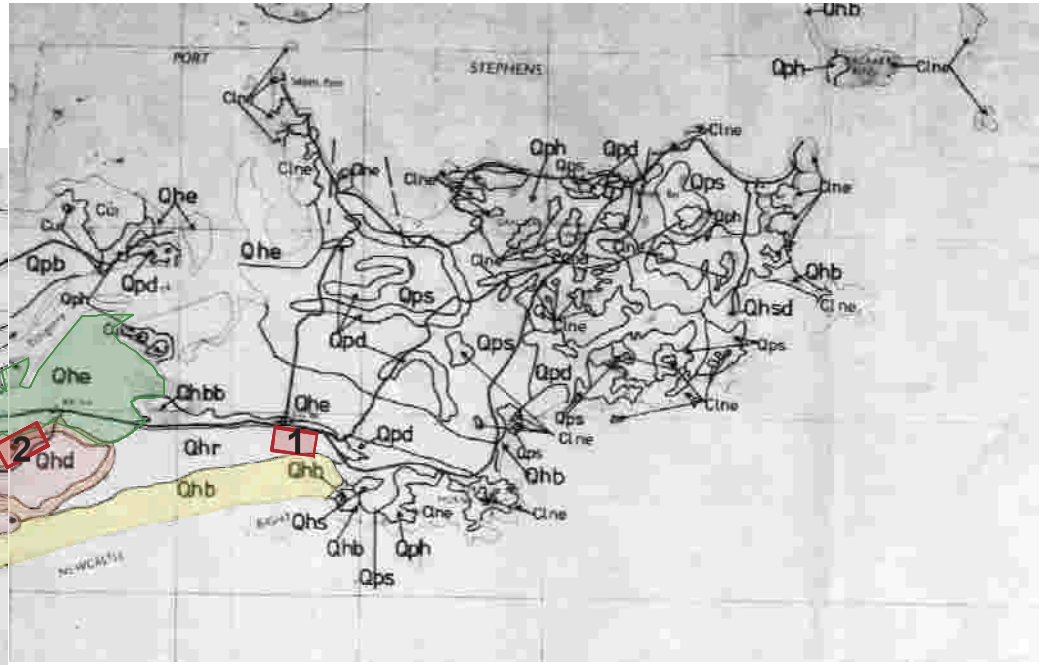

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Plan of:** | Bobs Farm Geology Map | **Location:** | Bobs Farm, Port Stephens | **Projection:** | N/A | **Date:** | 2/05/2013 | **Version:** | A |
| | | | | **Contour Interval:** | N/A | **Sheet:** | 1 of 1 | **Survey:** | N/A |
| | | | | | | **Plan By:** | TO | **Source:** | N/A |
| **Figure:** | TWO | **Council:** | Port Stephens | | | **Project Manager:** | GVT | | |
| **Client:** | QMS Pty Ltd | **Scale:** | | | | **Office:** | Thornton | **Our Ref:** | V:\Jobs_EMS Quarry Works\Bobs Farm.cdr |

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1. Anna Bay Sands
2. Site Investigation
3. Maccas Sands
4. Siebello
5. Toll Sands
6. Boral Fullerton Cove




Qhb, Sand, present beach and active dunes

Qhd, Sand, older beach and low level windblown dunes

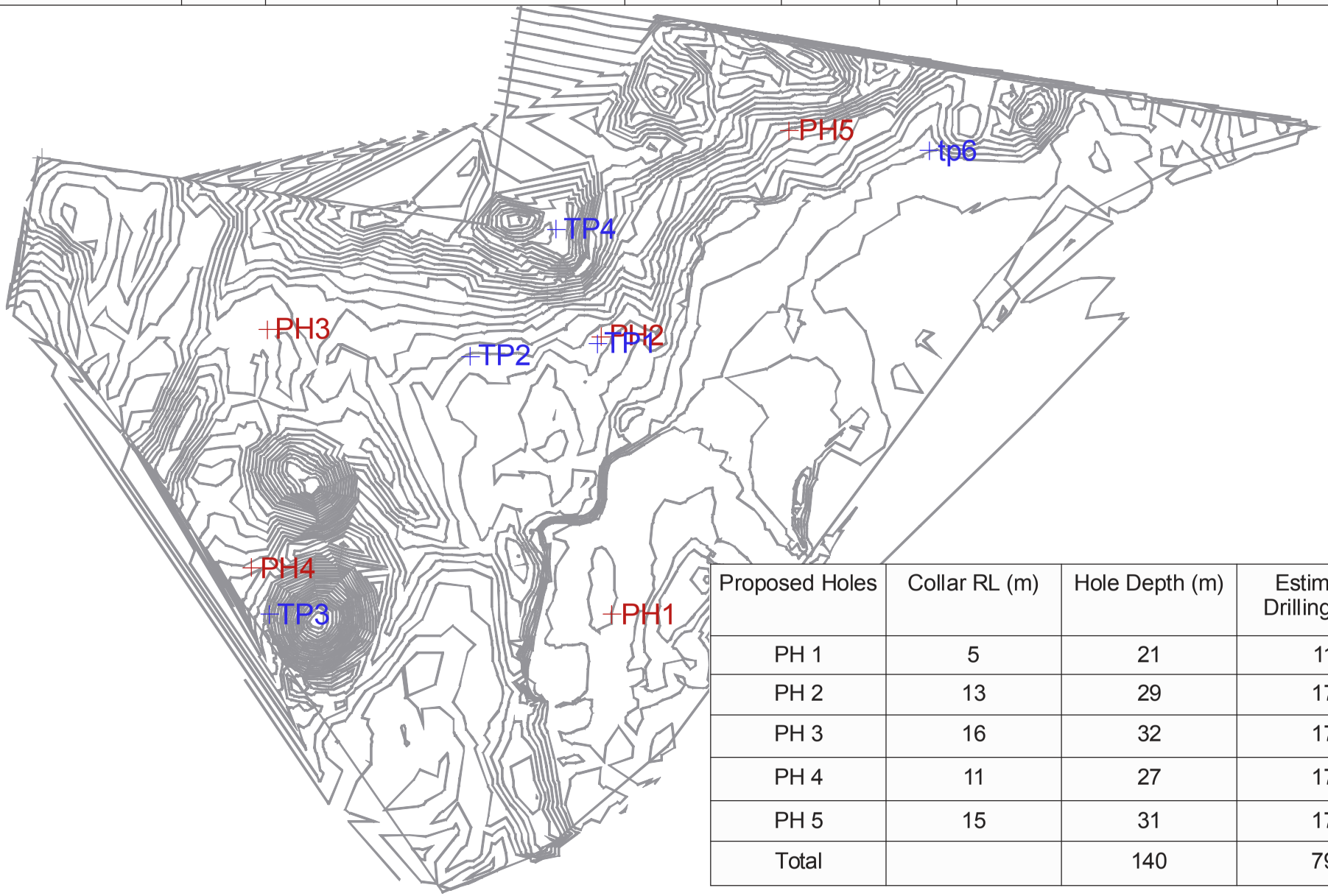
Qhs, Sand, stable dunes

Qe, Silt, clay and estuarine sediments

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Plan of:** | Bobs Farm Site Site Plan with Drillhole Locations | **Location:** | Bobs Farm, Port Stephens | **Projection:** | N/A | **Date:** | 11/06/2013 | **Version:** | B |
| | | | | **Contour Interval:** | 5m | **Sheet:** | 1 of 1 | **Survey:** | QMS |
| | | | | | | **Plan By:** | TO | **Source:** | VGT Pty Ltd |
| **Figure:** | THREE | **Council:** | Port Stephens | | | **Project Manager:** | GVT | | |
| **Client:** | QMS Pty Ltd | **Scale:** | | | | **Office:** | Thornton | **Our Ref:** | V:\Jobs_EMS Quarry Works\Bobs Farm.cdr |

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| Proposed Holes | Collar RL (m) | Hole Depth (m) | Estimated Drilling Time |
|---|---|---|---|
| PH 1 | 5 | 21 | 11 |
| PH 2 | 13 | 29 | 17 |
| PH 3 | 16 | 32 | 17 |
| PH 4 | 11 | 27 | 17 |
| PH 5 | 15 | 31 | 17 |
| Total | | 140 | 79 |

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Plan of:*** | Bobs Farm Quarry BH-1 | ***Location:*** | Bobs Farm | ***Projection:*** | N/A | ***Date:*** | 26/11/2013 | ***Version:*** | A |
| | | | | ***Contour Interval:*** | N/A | ***Sheet:*** | 1 of 2 | ***Survey:*** | N/A |
| | | | | | | ***Plan By:*** | TO | ***Source:*** | VGT Pty Ltd |
| ***Figure:*** | FOUR | ***Council:*** | Port Stephens Council | | | ***Project Manager:*** | GVT | | |
| ***Client:*** | EMS | ***Scale:*** | | | | ***Office:*** | Thornton | ***Our Ref:*** | V:\Jobs_EMS Quarry\Bobs Farm\BFBH1 drill log |

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## Drill Hole Number: BH 1

Project: Bobs Farm
Drilling Co: Total Drill
Date: August 2013

Job Number: QMS
Logged By: G THOMSON

Hole Depth: 19m
Hole Dia: 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | Remarks |
|---|---|---|---|---|
| Ground Surface | | | | |
| SAND - Cloud grey with roots, mg | | | | Solid flight augers |
| SAND - Pearl grey, mg | | | | GR 406691; 6373153, rl 5.8m |
| SAND - Tan, mg | | | | Colours from AS 2700- 1985 |
| | | | | medium grained (mg) |
| Water Table 3.5m | | | | Water Table 3.0m |
| | | | | Moist samples |
| SAND -Black, mg, Sulphur smell | | | | Minor heavy mineral? |
| PALEOSOL - Black, cricket pitch? | | | | Sulphur smell |
| SAND - Dark earth, mg | | | | Sulphur smell |
| SAND - Mixed sample, dark earth, mcg | | | | Hollow flight augers |
| | | | | Could not retrieve samples |
| | | | | Sampled from top of hole |
| | | | | As part of hole cleaning up augers |
| SAND - Mixed sample, dark earth, mcg | | | | |




Borehole 1 Summary- Blended Sample (Above Water Table)
0.6 - 3.5m
BH1-BL-AWT

| Grading | | Soil | Petrography | Waste | Heavy Metals | Markets |
|---|---|---|---|---|---|---|
| Sieve (mm) | % Pass | Slight Acidity and low salinity levels. Low cation exchange = poor nutrient uptake. Low P fertiliser and compost suitable for plant growth | Not Tested | Can be disposed of as per Schedule 1 Part 3 of the Protection of the Environment Operations Act 1997. | 0.06% | Soil Applications, Fill Sand, |
| 0.600 | 100 | | | | | |
| 0.425 | 98.1 | | | | | |
| 0.355 | 91 | | | | | |
| 0.300 | 58.5 | | | | | |
| 0.250 | 30.3 | | | | | |
| 0.212 | 6.9 | | | | | |
| 0.180 | 1.4 | | | | | |
| 0.150 | 0.3 | | | | | |
| 0.125 | 0.2 | | | | | |
| 0.106 | 0.1 | | | | | |
| 0.090 | 0.1 | | | | | |
| 0.075 | 0 | | | | | |

Borehole 1 Summary- Blended Sample (Below Water Table)
4.2 - 12m
BH1-BL-G2

| Grading | | Soil | Petrography | Waste | Heavy Metals | Markets |
|---|---|---|---|---|---|---|
| Sieve (mm) | % Pass | Not Tested- Not significant Volume | 58 % Free Silica | Not Tested- Not significant Volume | 0.44% | Soil Applications, Fill Sand, |
| 0.600 | 100 | | | | | |
| 0.425 | 64.7 | | | | | |
| 0.355 | 87.1 | | | | | |
| 0.300 | 68 | | | | | |
| 0.250 | 37.3 | | | | | |
| 0.212 | 15.4 | | | | | |
| 0.180 | 3.9 | | | | | |
| 0.150 | 1.5 | | | | | |
| 0.125 | 0.8 | | | | | |
| 0.106 | 0.5 | | | | | |
| 0.090 | 0.3 | | | | | |
| 0.075 | 0.1 | | | | | |

Borehole 1 Summary- Blended Sample (Below Water Table)
12 - 19m
BH1-BL-G1

| Grading | | Soil | Petrography | Waste | Heavy Metals | Markets |
|---|---|---|---|---|---|---|
| Sieve (mm) | % Pass | Extreme Acidity and moderate salinity \| Low cation exchange = poor nutrient uptake \| Multipurpose low P, organic matter, gypsum and testing | 91% Free Silica* | the material is considered to be within the VENM Waste classification and as a result of this process, it can be disposed of as per Schedule 1 Part 3 of the Protection of the Environment Operations Act 1997. | 0.20% | Possible construction sand with washing, soil with treatment. |
| 0.600 | 100 | | | | | |
| 0.425 | 89.6 | | | | | |
| 0.355 | 77 | | | | | |
| 0.300 | 59.8 | | | | | |
| 0.250 | 28.5 | | | | | |
| 0.212 | 10.5 | | | | | |
| 0.180 | 2.2 | | | | | |
| 0.150 | 0.6 | | | | | |
| 0.125 | 0.3 | | | | | |
| 0.106 | 0.2 | | | | | |
| 0.090 | 0.2 | | | | | |
| 0.075 | 0.1 | | | | | |

* Note: Alumina expected to be <4% and Iron Oxide expected to be low

Logged By: G THOMSON

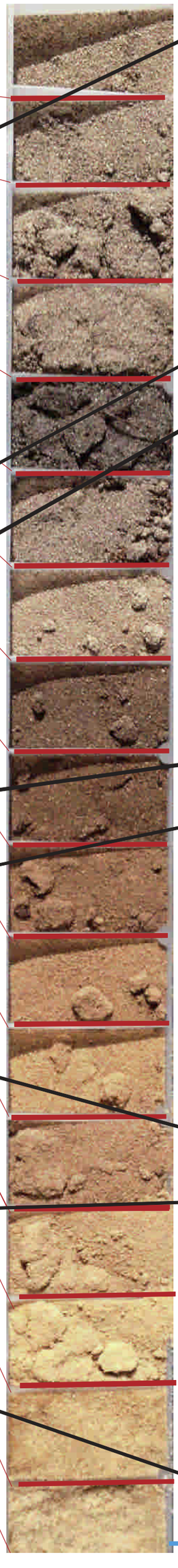
Hole Depth: 26.5 m

Hole Dia: 4.5 inch

| Depth | Graphic Log | Heavy Mineral | Remarks |
|---|---|---|---|
| 0 | | | Minor Organics |
| 1 | | | GR 406592; 6373286 RL 11.7 |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | Water Table 10.0m |
| 10 | | | |
| 11 | | | Cores retrived from drill |
| 12 | | | |
| 13 | | | (mcg) medium coarse grained |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |
| 21 | | | |
| 22 | | | |

.2m

%



Water Table 10.2m

**Bore Hole 2- Property Summary-Blended, Abov**

4.2 - 9.5m

BH2-BL-B- (Water Table at 10.2m Hole

| Grading | | Soil | Petrography |
|---|---|---|---|
| Sieve (mm) | Amdel % Pass | Medium Acidity and low salinity levels. Very Low cation exchange = poor nutrient uptake and retention. Low P fertiliser and compost suitable for plant growth | 91% Free Silic |
| 1.18 | NR | | |
| 0.600 | NR | | |
| 0.425 | 99.1 | | |
| 0.355 | 94.9 | | |
| 0.300 | 77.6 | | |
| 0.250 | 43.5 | | |
| 0.212 | 15 | | |
| 0.180 | 3.1 | | |
| 0.150 | 1.1 | | |
| 0.125 | 0.6 | | |
| 0.106 | 0.3 | | |
| 0.090 | 0.1 | | |
| 0.075 | 0 | | |

**Bore Hole 2- Property Summary- Below W**

10.5 - 12m

BH2-10.5-12.0 (Water Table at 10.2m Hol

| Grading | | Soil | Petrograph |
|---|---|---|---|
| Sieve (mm) | Amdel % Pass | Strong acidity and very high salinity levels. Moderate cation exchange = good nutrient uptake and retention. Urea Application,Potash, gypsum and lime, compost suitable for plant growth and testing | 47% Free Silica |
| 1.18 | NR | | |
| 0.600 | NR | | |
| 0.425 | 63.5 | | |
| 0.355 | 58.1 | | |
| 0.300 | 46.9 | | |
| 0.250 | 29.5 | | |
| 0.212 | 16.6 | | |
| 0.180 | 6.9 | | |
| 0.150 | 4.7 | | |
| 0.125 | 3.2 | | |
| 0.106 | 2 | | |
| 0.090 | 1.1 | | |
| 0.075 | 0.4 | | |

**Bore Hole 2- Property Summary- Below Wa**

13.5 - 14m

BH2-13.5-14

| Grading | | Soil | Petr |
|---|---|---|---|
| Sieve (mm) | Amdel % Pass | Strong Acidity and low salinity levels. Low cation exchange = poor nutrient uptake. Urea Application,Potash, gypsum Testing and compost suitable for plant growth | 97% Fre |
| 1.18 | NR | | |
| 0.600 | NR | | |
| 0.425 | 98.7 | | |
| 0.355 | 95.5 | | |
| 0.300 | 85.3 | | |
| 0.250 | 59 | | |
| 0.212 | 28.5 | | |
| 0.180 | 4.4 | | |
| 0.150 | 1.1 | | |
| 0.125 | 0.3 | | |
| 0.106 | 0.1 | | |
| 0.090 | 0 | | |
| 0.075 | 0 | | |

**Bore Hole 2- Property Summary- Below Water**

17.5 - 18.5m

BH2-17.5-18.5

| Grading | | Soil | Petrograp |
|---|---|---|---|
| Sieve (mm) | Amdel % Pass | Strong Acidity and low salinity levels. Low cation exchange = poor nutrient uptake. Urea Application,Potash, gypsum Testing and compost suitable for plant growth | 97% Free S |
| 1.18 | NR | | |
| 0.600 | NR | | |
| 0.425 | 87.9 | | |
| 0.355 | 70.8 | | |
| 0.300 | 41 | | |
| 0.250 | 14.7 | | |
| 0.212 | 3.9 | | |
| 0.180 | 0.7 | | |
| 0.150 | 0.2 | | |
| 0.125 | 0.1 | | |
| 0.106 | 0 | | |
| 0.090 | 0 | | |
| 0.075 | 0 | | |

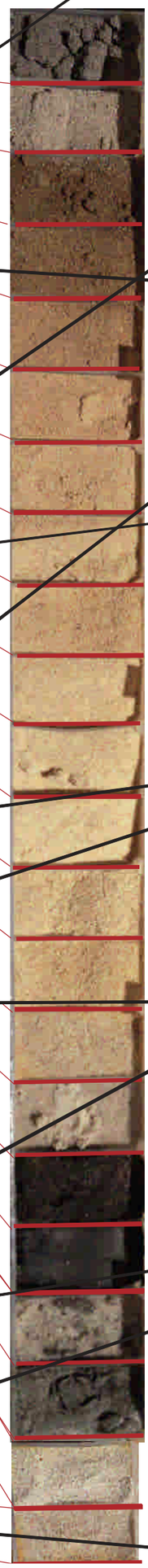
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Plan of:*** | Bobs Farm Quarry BH-3 | ***Location:*** | Bobs Farm | ***Projection:*** | N/A | ***Date:*** | 26/11/2013 | ***Version:*** | A |
| | | | | ***Contour Interval:*** | N/A | ***Sheet:*** | 1 of 2 | ***Survey:*** | N/A |
| | | | | | | ***Plan By:*** | TO | ***Source:*** | VGT Pty Ltd |
| ***Figure:*** | SIX | ***Council:*** | Port Stephens Council | | | ***Project Manager:*** | GVT | | |
| ***Client:*** | EMS | ***Scale:*** | | | | ***Office:*** | Thornton | ***Our Ref:*** | V:\Jobs_EMS Quarry\Bobs Farm\BFBH1 drill log |

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## Drill Hole Number: BH 3

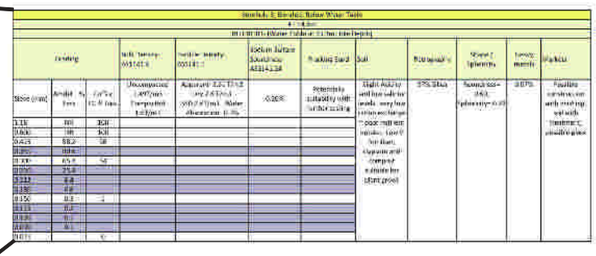
Project: Bobs Farm
Drilling Co: Total Drill
Date: August 2013
Job Number: QMS
Logged By: G THOMSON
Hole Depth: 26.5
Hole Dia: 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | Remarks |
|---|---|---|---|---|
| Ground Surface | | | | |
| SANDY LOAM SOIL - Koala Grey, mg | | | | GR 406297; 6373318; rl 15.4 |
| SAND - Pearl grey, mg | | | | |
| SAND - Wombat, mg | | | | |
| SAND- Tan, mg | | | | |
| SAND - Buff, mg | | | | |
| SAND - Raffia, mg | | | | |
| SAND - Raffia, mg | | | | |
| SAND - Pearl grey, mcg, moist | | | | |
| CLAY - Back, dark grey, silty | | | | |
| SAND - Lead grey, with 5% black spec | | | | |
| SAND -Koala grey, cg, 5% black fleck | | | | |
| SAND -Koala grey, cg, 5% black fleck | | | | |



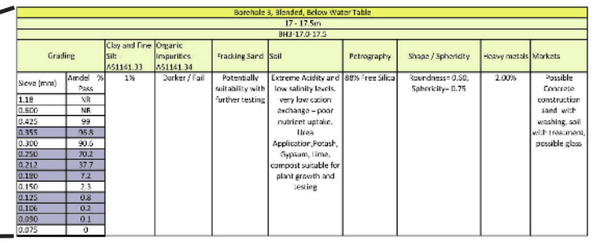
**Bore Hole 3- Property Summary- Blended Blonde-Above Water Table**
4 - 10m
BH3-BL-B1- (Water Table at 13.2m Hole Depth)

| Grading | | Clay and Fine Silt- AS1141.33 | Organic - AS1141.34 | Petrography | Fracking Sand | Markets |
|---|---|---|---|---|---|---|
| Sieve (mm) | Coffey CS % Pass | 3% | Darker / Fail | 91 - 94% Silica | Potentially 40/70 suitability with further testing | Soil , Concrete sand, Fill Sand, |
| 1.18 | 100 | | | | | |
| 0.600 | 100 | | | | | |
| 0.425 | 98 | | | | | |
| 0.355 | | | | | | |
| 0.300 | 63 | | | | | |
| 0.250 | | | | | | |
| 0.212 | | | | | | |
| 0.180 | | | | | | |
| 0.150 | 1 | | | | | |
| 0.125 | | | | | | |
| 0.106 | | | | | | |
| 0.090 | | | | | | |
| 0.075 | 1 | | | | | |



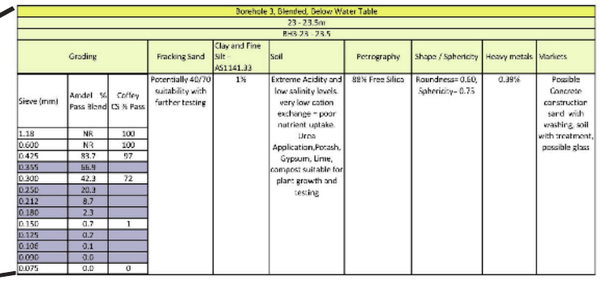
**Borehole 3, Blended, Blonde, Above and Just below Water Table**
10 - 14.6m
BH3-BL-B2- (Water Table at 13.2m Hole Depth)

| Grading | | Clay and Fine Silt- AS1141.33 | Organic - AS1141.34 | Petrography | Fracking Sand | Markets |
|---|---|---|---|---|---|---|
| Sieve (mm) | % Pass | 1% | Darker / Fail | 92 - 94% Silica | Potentially 40/70 suitability with further testing | Soil ( Treated) , Possible fine construction |
| 1.18 | 100 | | | | | |
| 0.600 | 100 | | | | | |
| 0.425 | 99 | | | | | |
| 0.355 | | | | | | |
| 0.300 | 59 | | | | | |
| 0.250 | | | | | | |
| 0.212 | | | | | | |
| 0.180 | | | | | | |
| 0.150 | 1 | | | | | |
| 0.125 | | | | | | |
| 0.106 | | | | | | |
| 0.090 | | | | | | |
| 0.075 | 0 | | | | | |



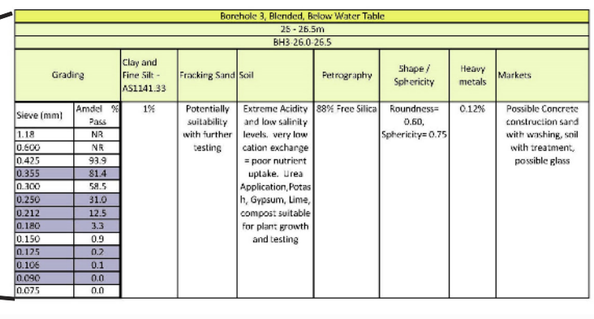
**Borehole 3, Blended, Below Water Table**
17 - 17.5m
BH3-17.0-17.5

| Grading | | Clay and Fine Silt- AS1141.33 | Organic Impurities AS1141.34 | Fracking Sand | Soil | Petrography | Shape / Sphericity | Heavy metals | Markets |
|---|---|---|---|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | 1% | Darker / Fail | Potentially suitability with further testing | Extreme Acidity and low salinity levels. very low cation exchange = poor nutrient uptake. Urea Application,Potash, Gypsum, Lime, compost suitable for plant growth and testing | 88% Free Silica | Roundness= 0.60, Sphericity= 0.75 | 2.00% | Possible Concrete construction sand with washing, soil with treatment, possible glass |
| 1.18 | NR | | | | | | | | |
| 0.600 | NR | | | | | | | | |
| 0.425 | 99 | | | | | | | | |
| 0.355 | 96.8 | | | | | | | | |
| 0.300 | 90.6 | | | | | | | | |
| 0.250 | 70.2 | | | | | | | | |
| 0.212 | 37.7 | | | | | | | | |
| 0.180 | 7.2 | | | | | | | | |
| 0.150 | 2.3 | | | | | | | | |
| 0.125 | 0.8 | | | | | | | | |
| 0.106 | 0.2 | | | | | | | | |
| 0.090 | 0.1 | | | | | | | | |
| 0.075 | 0 | | | | | | | | |



**Borehole 3, Blended, Below Water Table**
23 - 23.5m
BH3.23 - 23.5

| Grading | | | Fracking Sand | Clay and Fine Silt AS1141.33 | Soil | Petrography | Shape / Sphericity | Heavy metals | Markets |
|---|---|---|---|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass Blend | Coffey CS % Pass | Potentially 40/70 suitability with further testing | 1% | Extreme Acidity and low salinity levels. very low cation exchange = poor nutrient uptake. Urea Application,Potash, Gypsum, Lime, compost suitable for plant growth and testing | 88% Free Silica | Roundness= 0.60, Sphericity= 0.75 | 0.38% | Possible Concrete construction sand with washing, soil with treatment, possible glass |
| 1.18 | NR | 100 | | | | | | | |
| 0.600 | NR | 100 | | | | | | | |
| 0.425 | 83.7 | 97 | | | | | | | |
| 0.355 | 68.9 | | | | | | | | |
| 0.300 | 42.2 | 72 | | | | | | | |
| 0.250 | 20.3 | | | | | | | | |
| 0.212 | 8.7 | | | | | | | | |
| 0.180 | 2.3 | | | | | | | | |
| 0.150 | 0.7 | 1 | | | | | | | |
| 0.125 | 0.2 | | | | | | | | |
| 0.106 | 0.1 | | | | | | | | |
| 0.090 | 0.0 | | | | | | | | |
| 0.075 | 0.0 | 0 | | | | | | | |



**Borehole 3, Blended, Below Water Table**
25 - 26.5m
BH3-26.0-26.5

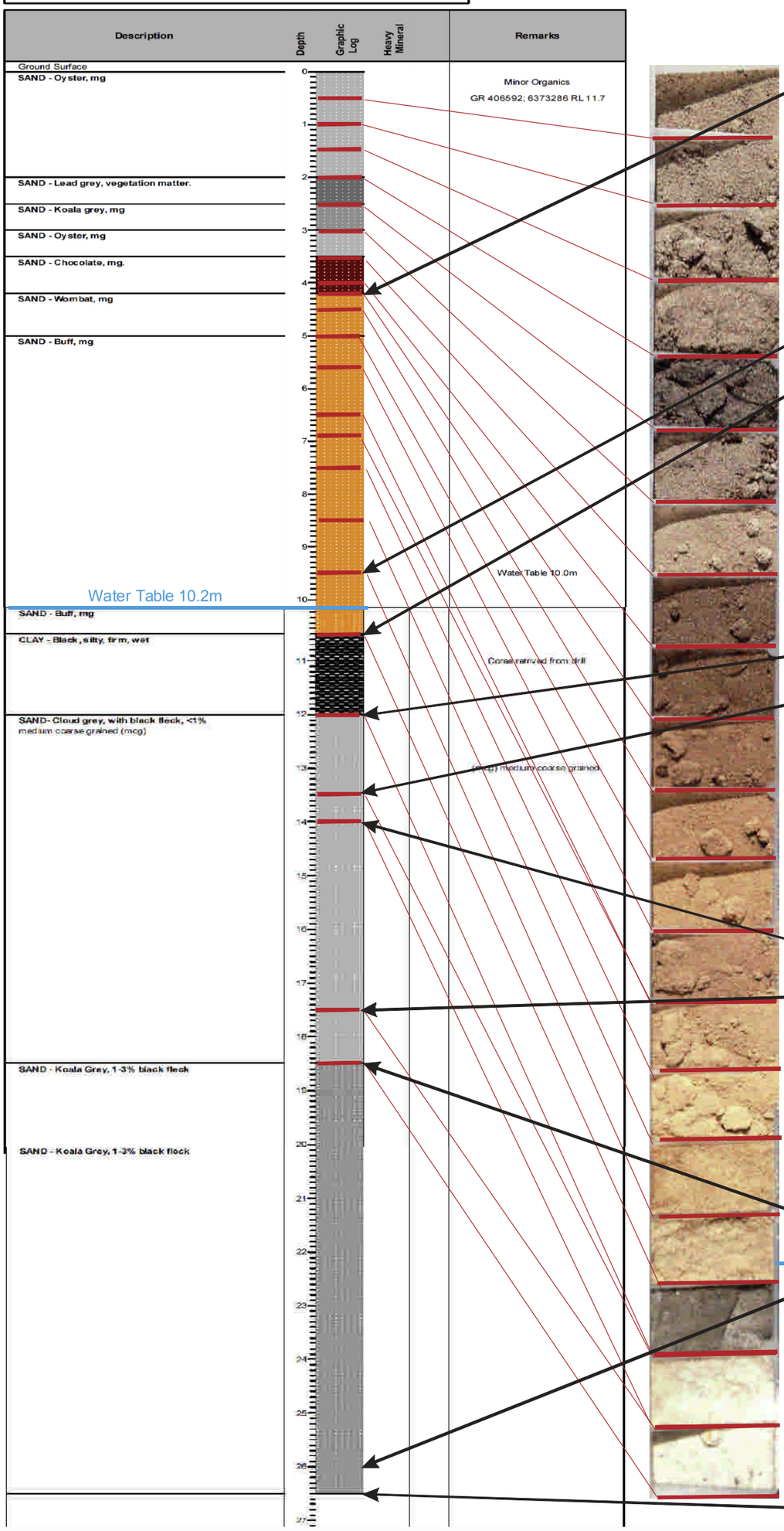
| Grading | | Clay and Fine Silt - AS1141.33 | Fracking Sand | Soil | Petrography | Shape / Sphericity | Heavy metals | Markets |
|---|---|---|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | 1% | Potentially suitability with further testing | Extreme Acidity and low salinity levels. very low cation exchange = poor nutrient uptake. Urea Application,Potash, Gypsum, Lime, compost suitable for plant growth and testing | 88% Free Silica | Roundness= 0.60, Sphericity= 0.75 | 0.12% | Possible Concrete construction sand with washing, soil with treatment, possible glass |
| 1.18 | NR | | | | | | | |
| 0.600 | NR | | | | | | | |
| 0.425 | 93.9 | | | | | | | |
| 0.355 | 81.4 | | | | | | | |
| 0.300 | 58.5 | | | | | | | |
| 0.250 | 31.0 | | | | | | | |
| 0.212 | 12.5 | | | | | | | |
| 0.180 | 3.3 | | | | | | | |
| 0.150 | 0.9 | | | | | | | |
| 0.125 | 0.2 | | | | | | | |
| 0.106 | 0.1 | | | | | | | |
| 0.090 | 0.0 | | | | | | | |
| 0.075 | 0.0 | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Plan of:** | Bobs Farm Quarry BH-2 | **Location:** | Bobs Farm | **Projection:** | N/A | **Date:** | 26/11/2013 | **Version:** | A |
| | | | | **Contour Interval:** | N/A | **Sheet:** | 1 of 2 | **Survey:** | N/A |
| | | | | | | **Plan By:** | TO | **Source:** | VGT Pty Ltd |
| **Figure:** | FIVE | **Council:** | Port Stephens Council | | | **Project Manager:** | GVT | | |
| **Client:** | EMS | **Scale:** | | | | **Office:** | Thornton | **Our Ref:** | V:\Jobs_EMS Quarry\Bobs Farm\BFBH1 drill log |

vgt Environmental Compliance Solutions

## Drill Hole Number: BH 2

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013
**Job Number:** QMS
**Logged By:** G THOMSON
**Hole Depth:** 26.5 m
**Hole Dia:** 4.5 inch




**Bore Hole 2- Property Summary-Blended, Above Water Table**
4.2 - 9.5m
BH2-BL-B- (Water Table at 10.2m Hole Depth)

| Grading | | Soil | Petrography | Heavy Metals | Markets |
|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | Medium Acidity and low salinity levels. Very Low cation exchange = poor nutrient uptake and retention. Low P fertiliser and compost suitable for plant growth | 91% Free Silica | 0.27% | Soil , Concrete sand, Fill Sand, |
| 1.18 | NR | | | | |
| 0.600 | NR | | | | |
| 0.425 | 99.1 | | | | |
| 0.355 | 94.9 | | | | |
| 0.300 | 77.6 | | | | |
| 0.250 | 43.5 | | | | |
| 0.212 | 15 | | | | |
| 0.180 | 3.1 | | | | |
| 0.150 | 1.1 | | | | |
| 0.125 | 0.6 | | | | |
| 0.106 | 0.3 | | | | |
| 0.090 | 0.1 | | | | |
| 0.075 | 0 | | | | |

**Bore Hole 2- Property Summary- Below Water Table**
10.5 - 12m
BH2-10.5-12.0 (Water Table at 10.2m Hole Depth)

| Grading | | Soil | Petrography | Heavy Metals | Markets |
|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | Strong acidity and very high salinity levels. Moderate cation exchange = good nutrient uptake and retention. Urea Application,Potash, gypsum and lime, compost suitable for plant growth and testing | 47% Free Silica | 0.36% | Soil Applications,Fill Sand, |
| 1.18 | NR | | | | |
| 0.600 | NR | | | | |
| 0.425 | 63.5 | | | | |
| 0.355 | 58.1 | | | | |
| 0.300 | 46.9 | | | | |
| 0.250 | 29.5 | | | | |
| 0.212 | 16.6 | | | | |
| 0.180 | 6.9 | | | | |
| 0.150 | 4.7 | | | | |
| 0.125 | 3.2 | | | | |
| 0.106 | 2 | | | | |
| 0.090 | 1.1 | | | | |
| 0.075 | 0.4 | | | | |

**Bore Hole 2- Property Summary- Below Water Table**
13.5 - 14m
BH2-13.5-14

| Grading | | Soil | Petrography | Heavy Metals | Markets |
|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | Strong Acidity and low salinity levels. Low cation exchange = poor nutrient uptake. Urea Application,Potash, gypsum Testing and compost suitable for plant growth | 97% Free Silica | 0.46% | Possible concrete construction sand with washing, soil with treatment, possible glass and ceramics |
| 1.18 | NR | | | | |
| 0.600 | NR | | | | |
| 0.425 | 98.7 | | | | |
| 0.355 | 95.5 | | | | |
| 0.300 | 85.3 | | | | |
| 0.250 | 59 | | | | |
| 0.212 | 28.5 | | | | |
| 0.180 | 4.4 | | | | |
| 0.150 | 1.1 | | | | |
| 0.125 | 0.3 | | | | |
| 0.106 | 0.1 | | | | |
| 0.090 | 0 | | | | |
| 0.075 | 0 | | | | |

**Bore Hole 2- Property Summary- Below Water Table**
17.5 - 18.5m
BH2-17.5-18.5

| Grading | | Soil | Petrography | Heavy Metals | Markets |
|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | Strong Acidity and low salinity levels. Low cation exchange = poor nutrient uptake. Urea Application,Potash, gypsum Testing and compost suitable for plant growth | 97% Free Silica | 0.46% | Possible concrete construction sand with washing, soil with treatment, possible glass and ceramics |
| 1.18 | NR | | | | |
| 0.600 | NR | | | | |
| 0.425 | 87.9 | | | | |
| 0.355 | 70.8 | | | | |
| 0.300 | 41 | | | | |
| 0.250 | 14.7 | | | | |
| 0.212 | 3.9 | | | | |
| 0.180 | 0.7 | | | | |
| 0.150 | 0.2 | | | | |
| 0.125 | 0.1 | | | | |
| 0.106 | 0 | | | | |
| 0.090 | 0 | | | | |
| 0.075 | 0 | | | | |

Water Table 10.2m

**Bore Hole 2- Property Summary- Below Water Table**
25 - 26.5m
BH2-26-26.5

| Grading | | Soil | Petrography | Heavy Metals | Markets |
|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | Strong Acidity and low salinity levels. Low cation exchange = poor nutrient uptake. Urea Application,Potash, gypsum Testing and compost suitable for plant growth | 97% Free Silica | 0.46% | Possible concrete construction sand with washing, soil with treatment, possible glass and ceramics |
| 1.18 | NR | | | | |
| 0.600 | NR | | | | |
| 0.425 | 96.5 | | | | |
| 0.355 | 92.2 | | | | |
| 0.300 | 83.5 | | | | |
| 0.250 | 70.5 | | | | |
| 0.212 | 50.2 | | | | |
| 0.180 | 21.1 | | | | |
| 0.150 | 7.9 | | | | |
| 0.125 | 1.4 | | | | |
| 0.106 | 0.4 | | | | |
| 0.090 | 0.1 | | | | |
| 0.075 | 0 | | | | |

Above Water Table

Below Water Table

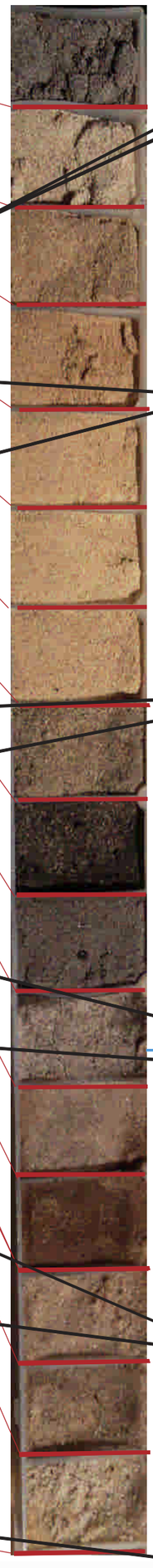
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Plan of:** | Bobs Farm Quarry BH-4 | **Location:** | Bobs Farm | **Projection:** | N/A | **Date:** | 26/11/2013 | **Version:** | A |
| | | | | **Contour Interval:** | N/A | **Sheet:** | 1 of 2 | **Survey:** | N/A |
| | | | | | | **Plan By:** | TO | **Source:** | VGT Pty Ltd |
| **Figure:** | SEVEN | **Council:** | Port Stephens Council | | | **Project Manager:** | GVT | | |
| **Client:** | EMS | **Scale:** | | | | **Office:** | Thornton | **Our Ref:** | V:\Jobs_EMS Quarry\Bobs Farm\BFBH1 drill log |

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## Drill Hole Number: BH 4

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013
**Job Number:** QMS
**Logged By:** G THOMSON
**Hole Depth:** 24 m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | Remarks |
|---|---|---|---|---|
| Ground Surface | | | | |
| SAND - Koala grey, mg, sandy loam soil. | 0 | | | GR 409260; 6373082 rl9.4 |
| SAND - Tan, mg | 1 | | | |
| | 2 | | | |
| SAND- Rafia, mg, minor buff mottles | 3 | | | |
| | 4 | | | |
| | 5 | | | |
| SAND - Oyster / black, mg | 6 | | | |
| SAND - Black, silty high organcs? | | | | |
| SAND - Driftwood, mg | | | | |
| Water Table 7.3m | 7 | | | |
| | 8 | | | |
| SAND - Tan, mg | 9 | | | |
| SAND - Buff, mg | 10 | | | |
| SAND - Driftwood, mcg | 11 | | | |
| SAND- Cloud grey, mcg, 2-4% black speck | 12 | | | |
| | 13 | | | |
| | 14 | | | |
| | 15 | | | |
| | 16 | | | |
| | 17 | | | |
| | 18 | | | |
| | 19 | | | |
| | 20 | | | |
| | 21 | | | |
| | 22 | | | |
| | 23 | | | |
| | 24 | | | |
| | 25 | | | |



**Borehole 4- Blended, Blonde, Above Water Table**
1.5 - 5.8m
BH4-BL-B

| Grading | | Soil | Petrography | Heavy Metals | Markets |
|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | | | | |
| 1.18 | NR | Slight Acidity and low salinity levels. very low cation exchange = poor nutrient uptake. Low P fertiliser, Gypsum and compost suitable for plant growth | 99% Silica | 0.10% | Soil ( Treated) , Glass, Possible fine construction concrete sand |
| 0.600 | NR | | | | |
| 0.425 | 99 | | | | |
| 0.355 | 93.8 | | | | |
| 0.300 | | | | | |
| 0.250 | 32.2 | | | | |
| 0.212 | 8.4 | | | | |
| 0.180 | 1.1 | | | | |
| 0.150 | 0.4 | | | | |
| 0.125 | 0.2 | | | | |
| 0.106 | 0.1 | | | | |
| 0.090 | 0 | | | | |
| 0.075 | 0 | | | | |

**Borehole 4- Blended, Blonde, Above Water Table**
5.6 - 5.8m
BH4-5.6-5.8

| Grading | | Soil | Heavy Metals |
|---|---|---|---|
| Sieve (mm) | Amdel % Pass | | |
| 1.18 | NR | Slight Acidity and low salinity levels. very low cation exchange = poor nutrient uptake. Low P fertiliser, Gypsum and compost suitable for plant growth | 0.44% |
| 0.600 | NR | | |
| 0.425 | 98.2 | | |
| 0.355 | 90.8 | | |
| 0.300 | 69.1 | | |
| 0.250 | 37.8 | | |
| 0.212 | 18 | | |
| 0.180 | 4.8 | | |
| 0.150 | 3 | | |
| 0.125 | 2.2 | | |
| 0.106 | 1.4 | | |
| 0.090 | 0.7 | | |
| 0.075 | 0 | | |

**Borehole 4, Blended, Below Water Table**
8.5 - 11.5m
BH4-BL-D - (Water Table at 7.3m Hole Depth)

| Grading | | Heavy Metals |
|---|---|---|
| Sieve (mm) | Amdel % Pass | 0.52% |
| 1.18 | NR | |
| 0.600 | NR | |
| 0.425 | 95 | |
| 0.355 | 87.9 | |
| 0.300 | 68 | |
| 0.250 | 39.5 | |
| 0.212 | 15.1 | |
| 0.180 | 3.2 | |
| 0.150 | 0.9 | |
| 0.125 | 0.4 | |
| 0.106 | 0.2 | |
| 0.090 | 0.1 | |
| 0.075 | 0 | |

**Borehole 4, Blended, Below Water Table**
13.0-14.5m
BH4-13.0-14.5 - (Water Table at 7.3m Hole Depth)

| Grading | | Soil | Petrography | Heavy Metals | Markets |
|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | | | | |
| 1.18 | NR | Very strong acidity and low salinity levels. very low cation exchange = poor nutrient uptake. Low P fertiliser and compost suitable for plant growth | 93% Free Silica | 0.21% | Possible construction with washing, soil with treatment, |
| 0.600 | NR | | | | |
| 0.425 | 84.2 | | | | |
| 0.355 | 67.1 | | | | |
| 0.300 | 40.4 | | | | |
| 0.250 | 17.8 | | | | |
| 0.212 | 7.8 | | | | |
| 0.180 | 1.3 | | | | |
| 0.150 | 0.4 | | | | |
| 0.125 | 0.1 | | | | |
| 0.106 | 0 | | | | |
| 0.090 | 0 | | | | |
| 0.075 | 0 | | | | |

Water Table 7.3m

**Borehole 4, Blended, Below Water Table**
16.5- 18.0m
BH4-16.5-18.0 - (Water Table at 7.3m Hole Depth)

| Grading | | Soil | Petrography | Heavy Metals | Markets |
|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | | | | |
| 1.18 | NR | Very strong acidity and low salinity levels. very low cation exchange = poor nutrient uptake. Low P fertiliser and compost suitable for plant growth | 93% Free Silica | 0.21% | Possible construction with washing, soil with treatment, |
| 0.600 | NR | | | | |
| 0.425 | 75.2 | | | | |
| 0.355 | 58.4 | | | | |
| 0.300 | 37.7 | | | | |
| 0.250 | 17.8 | | | | |
| 0.212 | 8.8 | | | | |
| 0.180 | 2.7 | | | | |
| 0.150 | 1.3 | | | | |
| 0.125 | 0.5 | | | | |
| 0.106 | 0.1 | | | | |
| 0.090 | 0 | | | | |
| 0.075 | 0 | | | | |

**Borehole 4, Blended, Below Water Table**
20.5- 24.1m
BH4-20.5-24.1 - (Water Table at 7.3m Hole Depth)

| Grading | | Soil | Petrography | Heavy Metals | Markets |
|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | | | | |
| 1.18 | NR | Very strong acidity and low salinity levels. very low cation exchange = poor nutrient uptake. Low P fertiliser and compost suitable for plant growth | 93% Free Silica | 0.15% | Possible construction with washing, soil with treatment, |
| 0.600 | NR | | | | |
| 0.425 | 98.6 | | | | |
| 0.355 | 93.4 | | | | |
| 0.300 | 76.2 | | | | |
| 0.250 | 43.3 | | | | |
| 0.212 | 17.9 | | | | |
| 0.180 | 3.6 | | | | |
| 0.150 | 1.5 | | | | |
| 0.125 | 0.5 | | | | |
| 0.106 | 0.1 | | | | |
| 0.090 | 0 | | | | |
| 0.075 | 0 | | | | |

Above Water Table | Below Water Table

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Plan of:** | Bobs Farm Quarry BH-5 | **Location:** | Bobs Farm | **Projection:** | N/A | **Date:** | 26/11/2013 | **Version:** | A |
| | | | | **Contour Interval:** | N/A | **Sheet:** | 1 of 2 | **Survey:** | N/A |
| | | | | | | **Plan By:** | TO | **Source:** | VGT Pty Ltd |
| **Figure:** | EIGHT | **Council:** | Port Stephens Council | | | **Project Manager:** | GVT | | |
| **Client:** | EMS | **Scale:** | | | | **Office:** | Thornton | **Our Ref:** | V:\Jobs_EMS Quarry\Bobs Farm\BFBH1 drill log |

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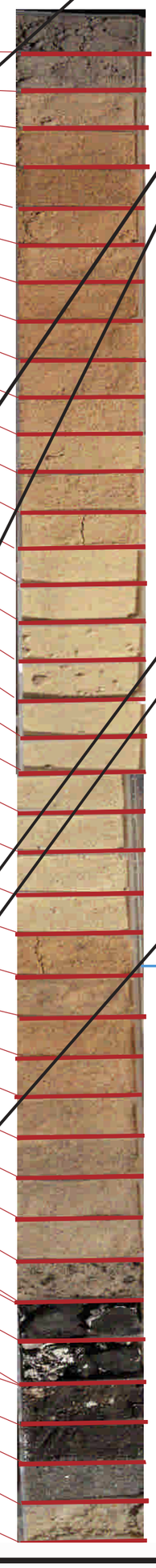
## Drill Hole Number: BH 5

Project: Bobs Farm
Drilling Co: Total Drill
Date: August 2013

Job Number: QMS
Logged By: G THOMSON

Hole Depth: 26.5 m
Hole Dia: 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | Remarks |
|---|---|---|---|---|
| Ground Surface | | | | |
| SAND - Koala grey, darker at top, mg organic at top and silty at base | | | | GR 406803; 6372515; n118.2 |
| SAND - Tan / buff, mg, silty in part | | | | |
| SAND - Buff, mg | | | | |
| SAND - Raffia, mg, no silt | | | | |
| SAND - Raffia, mg, no silt | | | | |
| SAND -Pale Ochre, mc | | | | |
| Water Table 15.4m | | | | |
| SAND-Cloud grey, minor pale ochre, mcg | | | | |
| SAND-Cloud grey, with 5-10% black fleck | | | | |
| CLAY - Black , shell common | | | | |
| SAND - Lead grey, shells | | | | |
| SAND-Light grey, 1-2% black speck minor shell grit, mcg | | | | |



Borehole 5, Blended, Blonde, Above Water Table
5.5 - 14.5m
BH5-BL-B- (Water Table at 15.4m Hole Depth)

| Grading | | | Clay & Fine Silt AS1141.33 | Organics - AS1141.34 | Fracking Sand | Shape & Sphericity | Soil | Petrography | Heavy Metals | Markets |
|---|---|---|---|---|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | CoPhy CS % Pass | 2% | lighter / Pass | Potentially 40/70 suitability with further testing | Roundness= 0.61, Sphericity= 0.72 | Slight Acidity and low salinity levels, very low cation exchange = poor nutrient uptake, Low P Fertiliser, Gypsum and compost suitable for plant growth | 90% Free Silica | 0.27% | Soil ( Treated) , Glass and ceramics, Possible fine construction |
| 1.18 | NR | 100 | | | | | | | | |
| 0.600 | NR | 100 | | | | | | | | |
| 0.425 | 99.8 | 100 | | | | | | | | |
| 0.355 | 95 | - | | | | | | | | |
| 0.300 | 63.1 | 75 | | | | | | | | |
| 0.250 | 28 | - | | | | | | | | |
| 0.212 | 10.9 | - | | | | | | | | |
| 0.180 | 2.1 | - | | | | | | | | |
| 0.150 | 1.1 | 2 | | | | | | | | |
| 0.125 | 0.8 | - | | | | | | | | |
| 0.106 | 0.3 | - | | | | | | | | |
| 0.090 | 0.1 | - | | | | | | | | |
| 0.075 | 0 | 1 | | | | | | | | |

Borehole 5, Blended, Mottled, Below Water Table
20.0 - 22.0m
BH5-BL-M- (Water Table at 15.4m Hole Depth)

| Grading | | Soil | Heavy Metals | Markets |
|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | Slight Alkalinity and extreme salinity levels. high cation exchange = excellent nutrient uptake and retention. Iron Sulphate, Urea, Gypsum, Green waste compost suitable for plant growth | 0.29% | Soil ( Treated) , Glass and ceramics, Possible fine construction |
| 1.18 | NR | | | |
| 0.600 | NR | | | |
| 0.425 | 34.9 | | | |
| 0.355 | 31.5 | | | |
| 0.300 | 24.9 | | | |
| 0.250 | 15.4 | | | |
| 0.212 | 9.2 | | | |
| 0.180 | 3.9 | | | |
| 0.150 | 2.7 | | | |
| 0.125 | 1.7 | | | |
| 0.106 | 1.1 | | | |
| 0.090 | 0.7 | | | |
| 0.075 | 0.3 | | | |

Borehole 5, Blended Grey, Below Water Table
23.0 - 25.65m
BH5-BL-G- (Water Table at 15.4m Hole Depth)

| Grading | | Fracking Sand | Shape & Sphericity | Petrography | Heavy Metals | Markets |
|---|---|---|---|---|---|---|
| Sieve (mm) | Amdel % Pass | Potentially 40/70 suitability with further testing | Roundness= 0.65, Sphericity= 0.74 | 90% Free Silica | 0.31% | Possible construction with washing, soil with treatment |
| 1.18 | NR | | | | | |
| 0.600 | NR | | | | | |
| 0.425 | 84.3 | | | | | |
| 0.355 | 66 | | | | | |
| 0.300 | 41.4 | | | | | |
| 0.250 | 18.1 | | | | | |
| 0.212 | 7.8 | | | | | |
| 0.180 | 1.4 | | | | | |
| 0.150 | 0.5 | | | | | |
| 0.125 | 0.2 | | | | | |
| 0.106 | 0.1 | | | | | |
| 0.090 | 0 | | | | | |
| 0.075 | 0 | | | | | |

Water Table 15.4m

Borehole 5, Blended Clay, Below Water Table
BH5-BL-G- (Water Table at 15.4m Hole Depth)

| Grading | | Heavy Metals | Markets |
|---|---|---|---|
| Sieve (mm) | Amdel % Pass | 0.46% | Possible construction with washing, soil with treatment |
| 1.18 | NR | | |
| 0.600 | NR | | |
| 0.425 | 97.1 | | |
| 0.355 | 89.1 | | |
| 0.300 | 66.7 | | |
| 0.250 | 27.8 | | |
| 0.212 | 9.1 | | |
| 0.180 | 1.3 | | |
| 0.150 | 0.4 | | |
| 0.125 | 0.2 | | |
| 0.106 | 0.1 | | |
| 0.090 | 0 | | |
| 0.075 | 0 | | |

Borehole 5, Blended Mottled, Below Water Table
BH5-BL-M-HM- (Water Table at 15.4m Hole Depth)

| Grading | | Heavy Metals | Markets |
|---|---|---|---|
| Sieve (mm) | Amdel % Pass | 0.18% | Possible construction with washing, soil with treatment |
| 1.18 | NR | | |
| 0.600 | NR | | |
| 0.425 | 99 | | |
| 0.355 | 94.2 | | |
| 0.300 | 72.6 | | |
| 0.250 | 34.1 | | |
| 0.212 | 10.6 | | |
| 0.180 | 1.5 | | |
| 0.150 | 0.5 | | |
| 0.125 | 0.2 | | |
| 0.106 | 0.1 | | |
| 0.090 | 0 | | |

Above Water Table | Below Water Table

# Appendix B: Drill Logs

# Drill Hole Number: BH 1

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 19m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| Ground Surface | 0 | | | | |
| **SAND - Cloud grey with roots, mg** | | | | | Solid flight augers |
| **SAND - Pearl grey, mg** | | | | | GR 406691; 6373153, rl 5.8m<br>Colours from AS 2700- 1985 |
| **SAND - Tan, mg** | 1 | | | | medium grained (mg) |
| | 2 | | | | |
| | 3 | | | | Water Table 3.0m<br>Moist samples<br>Minor heavy mineral? |
| **SAND -Black, mg, Sulphur smell** | 4 | | | | Sulphur smell |
| **PALEOSOL - Black, cricket pitch?** | | | | | |
| **SAND - Dark earth, mg** | 5 | | | | Sulphur smell |
| **SAND - Mixed sample. dark earth, mcg** | 6 | | | | Hollow flight augers |
| | | | | | Could not retrieve samples |
| | 7 | | | | Sampled from top of hole |
| | | | | | As part of hole cleaning up augers |
| | 8 | | | | |
| | 9 | | | | |
| | 10 | | | | |

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# Drill Hole Number: BH 1

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 19m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| **SAND - Mixed sample. dark earth, mcg** | 11<br>12<br>13<br>14<br>15<br>16<br>17<br>18<br>19<br>20 | | | | |

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# Drill Hole Number: BH 2

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 26.5 m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| Ground Surface | | | | | |
| **SAND - Oyster, mg** | 0 | | | | Minor Organics<br>GR 406592; 6373286 RL 11.7 |
| **SAND - Lead grey, vegetation matter.** | 2 | | | | |
| **SAND - Koala grey, mg** | | | | | |
| **SAND - Oyster, mg** | 3 | | | | |
| **SAND - Chocolate, mg.** | 4 | | | | |
| **SAND - Wombat, mg** | | | | | |
| **SAND - Buff, mg** | 5 | | | | |
| | 6 | | | | |
| | 7 | | | | |
| | 8 | | | | |
| | 9 | | | | Water Table 10.0m |
| | 10 | | | | |

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# Drill Hole Number: BH 2

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 26.5 m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| **SAND - Buff, mg** | | | | | |
| **CLAY - Black, silty, firm, wet** | 11 | | | | Cores retrived from drill |
| **SAND- Cloud grey, with black fleck, <1%** medium coarse grained (mcg) | 12 | | | | |
| | 13 | | | | (mcg) medium coarse grained |
| | 14 | | | | |
| | 15 | | | | |
| | 16 | | | | |
| | 17 | | | | |
| | 18 | | | | |
| **SAND - Koala Grey, 1-3% black fleck** | 19 | | | | |
| | 20 | | | | |

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# Drill Hole Number: BH 2

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 26.5 m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| **SAND - Koala Grey, 1-3% black fleck** | 21 22 23 24 25 26 27 28 29 30 | | | | |

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# Drill Hole Number: BH 3

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 26.5
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| Ground Surface | | | | | |
| **SANDY LOAM SOIL - Koala Grey, mg** | 0 | | | | GR 406297; 6373318; rl 15.4 |
| **SAND - Pearl grey, mg** | | | | | |
| **SAND - Wombat, mg** | 1 | | | | |
| **SAND - Tan, mg** | 2 | | | | |
| **SAND - Buff, mg** | 3 | | | | |
| **SAND - Raffia, mg** | 4 | | | | |
| | 5 | | | | |
| | 6 | | | | |
| | 7 | | | | |
| | 8 | | | | |
| | 9 | | | | |
| | 10 | | | | |

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# Drill Hole Number: BH 3

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 26.5
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| **SAND - Raffia, mg** | 11, 12, 13 | | | | |
| **SAND - Pearl grey, mcg, moist** | 14 | | | | |
| **CLAY - Back, dark grey, silty** | 15 | | | | |
| **SAND - Lead grey, with 5% black spec** | | | | | |
| **SAND -Koala grey, cg, 5% black fleck** | 16, 17, 18, 19, 20 | | | | |

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# Drill Hole Number: BH 3

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 26.5
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| **SAND -Koala grey, cg, 5% black fleck** | 21 22 23 24 25 26 27 28 29 30 | | | | |

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# Drill Hole Number: BH 4

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 24 m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| Ground Surface | 0 | | | | GR 406260; 6373082 rl 9.4 |
| **SAND - Koala grey, mg, sandy loam soil.** | | | | | |
| **SAND - Tan, mg** | 1 | | | | |
| | 2 | | | | |
| **SAND- Rafia, mg, minor buff mottles** | 3 | | | | |
| | 4 | | | | |
| | 5 | | | | |
| **SAND - Oyster / black, mg** | | | | | |
| **SAND - Black, silty high organcs?** | 6 | | | | |
| **SAND - Driftwood, mg** | 7 | | | | |
| | 8 | | | | |
| **SAND - Tan, mg** | 9 | | | | |
| **SAND - Buff, mg** | 10 | | | | |

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# Drill Hole Number: BH 4

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 24 m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| **SAND - Driftwood, mcg** | 11 | | | | |
| **SAND- Cloud grey, mcg, 2-4% black speck** | 12 13 14 15 16 17 18 19 20 | | | | |

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# Drill Hole Number: BH 4

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 24 m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| | 21 | | | | |
| | 22 | | | | |
| | 23 | | | | |
| | 24 | | | | |
| | 25 | | | | |
| | 26 | | | | |
| | 27 | | | | |
| | 28 | | | | |
| | 29 | | | | |
| | 30 | | | | |

VGT
PO Box 2335
GREENHILLS NSW 2323

# Drill Hole Number: BH 5

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 26.5 m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| Ground Surface | | | | | |
| **SAND - Koala grey, darker at top, mg** organic at top and sitly at base. | 0 | | | | GR 406803; 6373515; rl 18.2 |
| **SAND - Tan / buff, mg, sitly in part** | 1 | | | | |
| **SAND - Buff, mg** | 2 | | | | |
| | 3 | | | | |
| | 4 | | | | |
| | 5 | | | | |
| **SAND - Raffia, mg, no silt** | 6 | | | | |
| | 7 | | | | |
| | 8 | | | | |
| | 9 | | | | |
| | 10 | | | | |

VGT
PO Box 2335
GREENHILLS NSW 2323

# Drill Hole Number: BH 5

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 26.5 m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| **SAND - Raffia, mg, no silt** | 11 12 13 14 | | | | |
| **SAND -Pale Ochre, mc** | 15 16 17 | | | | |
| **SAND-Cloud grey, minor pale ochre, mcg** | 18 19 | | | | |
| **SAND-Cloud grey, with 5-10% black fleck** | 20 | | | | |

**VGT**
**PO Box 2335**
**GREENHILLS NSW 2323**

# Drill Hole Number: BH 5

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013

**Job Number:** QMS
**Logged By:** G THOMSON

**Hole Depth:** 26.5 m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| **CLAY - Black, shell common** | 21 | | | | |
| | 22 | | | | |
| **SAND - Lead grey, shells** | | | | | |
| **SAND-Light grey, 1-2% black speck**<br>minor shell grit, mcg | 23 | | | | |
| | 24 | | | | |
| | 25 | | | | |
| | 26 | | | | |
| | 27 | | | | |
| | 28 | | | | |
| | 29 | | | | |
| | 30 | | | | |

**VGT**
**PO Box 2335**
**GREENHILLS NSW 2323**

## Wet Sizing Results

| Sample Number | Wt% | | | | Wt (g) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | +1mm | -1mm+45 um | -45 um | Total | +1mm | -1mm+45 um | -45 um | Total | Initial |
| BH1-BL-AWT-HM | 0% | 99.6% | 0.4% | 100% | 0.033 | 303.91 | 1.13 | 305.07 | 305.29 |
| BH1-BL-G1-HM | 0% | 99.2% | 0.4% | 100% | 0.847 | 215.05 | 0.87 | 216.77 | 217.09 |
| BH1-BL-G2-HM | 0% | 98.0% | 1.9% | 100% | 0.390 | 311.04 | 6.03 | 317.46 | 318.22 |
| BH2-10.5-12.0-HM | 21% | 60.4% | 18.5% | 79% | 39.163 | 112.30 | 34.45 | 185.91 | 190.56 |
| BH2-13.5-14.0-HM | 0% | 99.9% | 0.1% | 100% | 0.065 | 238.67 | 0.21 | 238.95 | 239.22 |
| BH2-17.5-18.5-HM | 1% | 98.7% | 0.0% | 99% | 3.116 | 239.85 | 0.01 | 242.98 | 243.11 |
| BH2-26.0-26.5-HM | 0% | 99.9% | 0.0% | 100% | 0.282 | 241.35 | 0.07 | 241.70 | 241.95 |
| BH2-BL-B-HM | 0% | 99.5% | 0.5% | 100% | 0.035 | 408.18 | 1.87 | 410.09 | 410.17 |
| BH3-17.0-17.5-HM | 0% | 100.0% | 0.0% | 100% | 0.034 | 249.76 | 0.03 | 249.82 | 250.00 |
| BH3-23.0-23.5-HM | 0% | 99.5% | 0.1% | 100% | 1.147 | 242.22 | 0.15 | 243.52 | 243.57 |
| BH3-26.0-26.5-HM | 0% | 100.0% | 0.0% | 100% | 0.080 | 257.30 | 0.00 | 257.38 | 257.60 |
| BH3-BL-B3-HM | 0% | 99.9% | 0.1% | 100% | 0.00 | 571.38 | 0.78 | 572.16 | 572.91 |
| BH4-13.0-14.5-HM | 1% | 98.8% | 0.0% | 99% | 2.893 | 236.82 | 0.02 | 239.73 | 239.88 |
| BH4-16.5-18.0-HM | 4% | 96.2% | 0.1% | 96% | 9.132 | 232.16 | 0.13 | 241.42 | 241.50 |
| BH4-20.5-24.1-HM | 0% | 99.9% | 0.1% | 100% | 0.062 | 243.49 | 0.21 | 243.76 | 243.79 |
| BH4-5.6-5.8-HM | 0% | 97.7% | 1.9% | 100% | 1.098 | 265.78 | 5.24 | 272.12 | 272.32 |
| BH4-BL-B-HM | 0% | 99.7% | 0.3% | 100% | 0.002 | 304.35 | 0.79 | 305.14 | 305.53 |
| BH4-BL-D-HM | 0% | 99.2% | 0.6% | 100% | 0.624 | 240.09 | 1.34 | 242.05 | 242.55 |
| BH5-BL-B-HM | 0% | 99.5% | 0.5% | 100% | 0.009 | 623.44 | 3.25 | 626.70 | 627.04 |
| BH5-BL-G-HM | 0% | 99.6% | 0.1% | 100% | 0.773 | 249.99 | 0.16 | 250.92 | 251.01 |
| BH5-BL-M-HM | 25% | 33.3% | 41.7% | 75% | 46.930 | 62.34 | 78.12 | 187.39 | 196.78 |
| BL-C-HM | 0% | 99.9% | 0.0% | 100% | 0.310 | 1449.59 | 0.60 | 1450.50 | 1450.78 |
| BL-M-HM | 0% | 99.7% | 0.2% | 100% | 0.390 | 1560.61 | 3.66 | 1564.66 | 1565.40 |

## Separation Results

| Sample Number | Wt % | | Wt (g) | | | |
|---|---|---|---|---|---|---|
| | -1mm+45um | | -1mm+45um | | | |
| | <2.96 | >2.96 | <2.96 | >2.96 | Total Wt. | Initial |
| BH1-BL-AWT-HM | 99.94% | 0.06% | 91.240 | 0.051 | 91.291 | 91.310 |
| BH1-BL-G1-HM | 99.80% | 0.20% | 88.820 | 0.175 | 88.995 | 89.010 |
| BH1-BL-G2-HM | 99.56% | 0.44% | 91.970 | 0.406 | 92.376 | 92.450 |
| BH2-10.5-12.0-HM | 99.64% | 0.36% | 88.440 | 0.318 | 88.758 | 89.350 |
| BH2-13.5-14.0-HM | 99.54% | 0.46% | 89.070 | 0.410 | 89.480 | 89.480 |
| BH2-17.5-18.5-HM | 99.69% | 0.31% | 89.220 | 0.278 | 89.498 | 89.510 |
| BH2-26.0-26.5-HM | 99.82% | 0.18% | 91.990 | 0.162 | 92.152 | 92.160 |
| BH2-BL-B-HM | 99.73% | 0.27% | 89.750 | 0.242 | 89.992 | 90.000 |
| BH3-17.0-17.5-HM | 98.00% | 2.00% | 88.780 | 1.808 | 90.588 | 90.600 |
| BH3-23.0-23.5-HM | 99.61% | 0.39% | 89.490 | 0.348 | 89.838 | 89.840 |
| BH3-26.0-26.5-HM | 99.88% | 0.12% | 88.200 | 0.104 | 88.304 | 88.310 |
| BH3-BL-B3-HM | 99.93% | 0.07% | 89.590 | 0.064 | 89.654 | 89.670 |
| BH4-13.0-14.5-HM | 99.79% | 0.21% | 93.150 | 0.196 | 93.346 | 93.350 |
| BH4-16.5-18.0-HM | 99.79% | 0.21% | 90.570 | 0.193 | 90.763 | 90.770 |
| BH4-20.5-24.1-HM | 99.85% | 0.15% | 90.470 | 0.135 | 90.605 | 90.610 |
| BH4-5.6-5.8-HM | 99.56% | 0.44% | 89.640 | 0.397 | 90.037 | 90.040 |
| BH4-BL-B-HM | 99.90% | 0.10% | 90.160 | 0.088 | 90.248 | 90.250 |
| BH4-BL-D-HM | 99.48% | 0.52% | 90.710 | 0.478 | 91.188 | 91.200 |
| BH5-BL-B-HM | 99.73% | 0.27% | 93.130 | 0.248 | 93.378 | 93.380 |
| BH5-BL-G-HM | 99.69% | 0.31% | 90.530 | 0.282 | 90.812 | 90.840 |
| BH5-BL-M-HM | 99.71% | 0.29% | 61.890 | 0.183 | 62.073 | 62.340 |
| BL-C-HM | 99.79% | 0.21% | 89.410 | 0.185 | 89.595 | 89.600 |
| BL-M-HM | 99.72% | 0.28% | 90.890 | 0.254 | 91.144 | 91.170 |

## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 1 |
| **Sample Tested** | BH1-BL-AWT-HM |

**SCREEN SIZING**

**Sample Weight** 307.84 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 5.71 | 1.9 | 1.9 | 98.1 |
| 0.355 | 22.05 | 7.2 | 9.0 | 91.0 |
| 0.300 | 69.16 | 22.5 | 31.5 | 68.5 |
| 0.250 | 117.49 | 38.2 | 69.7 | 30.3 |
| 0.212 | 71.81 | 23.3 | 93.1 | 6.9 |
| 0.180 | 17.07 | 5.6 | 98.6 | 1.4 |
| 0.150 | 3.35 | 1.1 | 99.7 | 0.3 |
| 0.125 | 0.36 | 0.1 | 99.8 | 0.2 |
| 0.106 | 0.23 | 0.1 | 99.9 | 0.1 |
| 0.090 | 0.16 | 0.1 | 99.9 | 0.1 |
| 0.075 | 0.15 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.02 | 0.0 | | |
| **Total** | 307.56 | 100.0 | | |
| **Wt Loss** | 0.28 | 0.09 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 13/9/13 |
| File ref | QM24 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

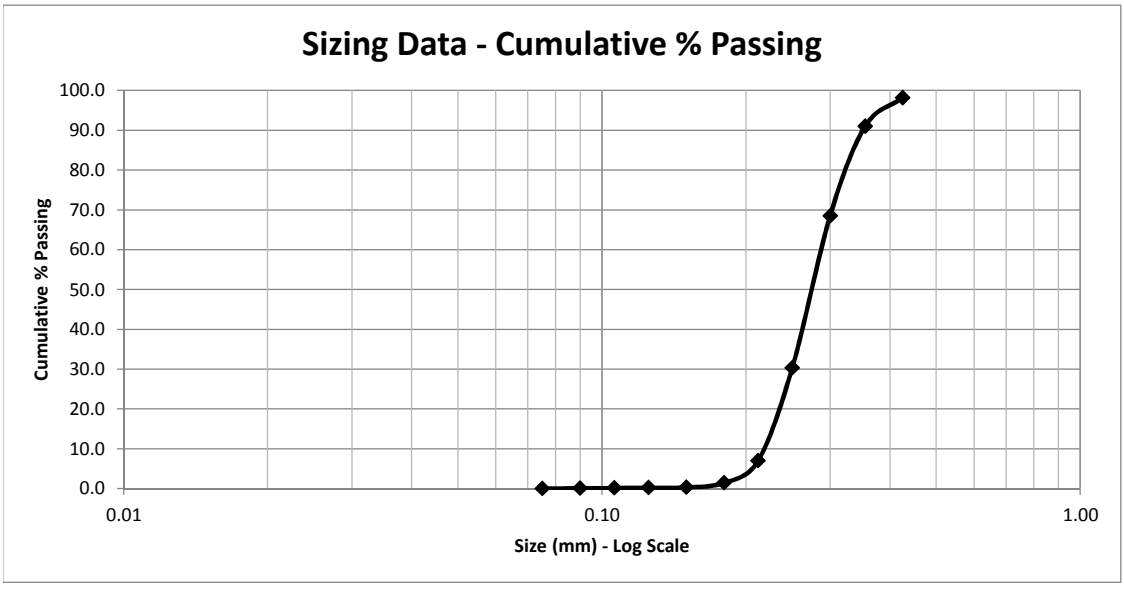
**Comments:**

d95 = 0.380 mm

d80 = 0.320 mm

d50 = 0.273 mm

d10 = 0.219 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 2 |
| **Sample Tested** | BH1-BL-G1-HM |

**SCREEN SIZING**

**Sample Weight** 214.99 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 22.28 | 10.4 | 10.4 | 89.6 |
| 0.355 | 27.20 | 12.7 | 23.0 | 77.0 |
| 0.300 | 46.59 | 21.7 | 44.7 | 55.3 |
| 0.250 | 57.56 | 26.8 | 71.5 | 28.5 |
| 0.212 | 38.69 | 18.0 | 89.5 | 10.5 |
| 0.180 | 18.02 | 8.4 | 97.8 | 2.2 |
| 0.150 | 3.38 | 1.6 | 99.4 | 0.6 |
| 0.125 | 0.66 | 0.3 | 99.7 | 0.3 |
| 0.106 | 0.16 | 0.1 | 99.8 | 0.2 |
| 0.090 | 0.07 | 0.0 | 99.8 | 0.2 |
| 0.075 | 0.07 | 0.0 | 99.9 | 0.1 |
| -0.075 | 0.30 | 0.1 | | |
| **Total** | 214.98 | 100.0 | | |
| **Wt Loss** | 0.01 | 0.00 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 13/9/13 |
| File ref | QM25 |

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Sizings.xls 16Sep2013 *Version 5a*

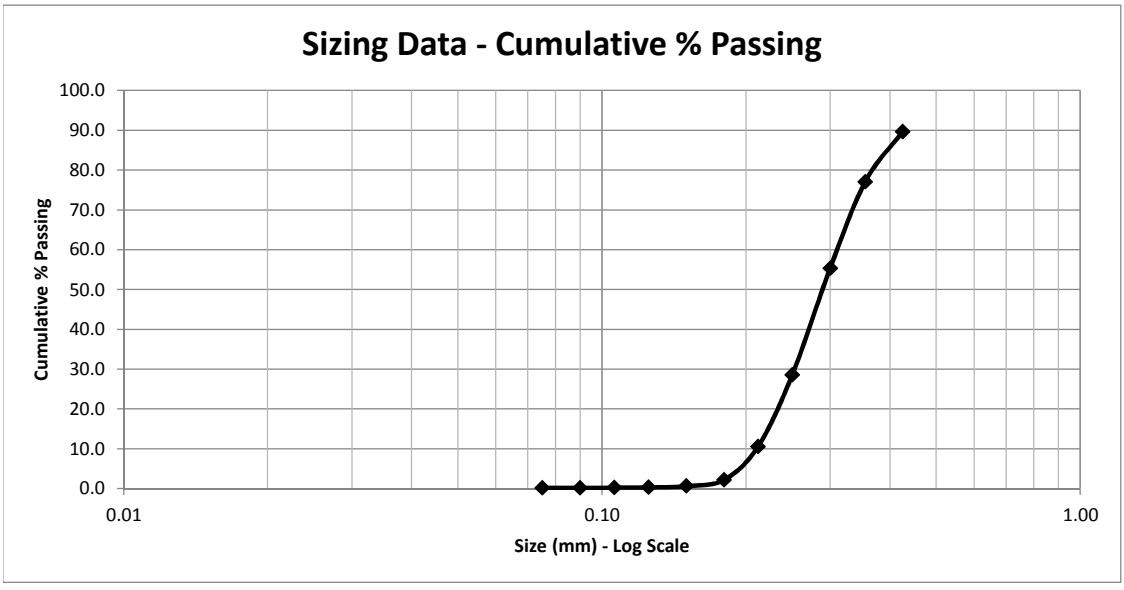
**Comments:**

d95 > 0.425 mm

d80 = 0.367 mm

d50 = 0.289 mm

d10 = 0.211 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 3 |
| **Sample Tested** | BH1-BL-G2-HM |

**SCREEN SIZING**

**Sample Weight** 308.32 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 16.30 | 5.3 | 5.3 | 94.7 |
| 0.355 | 23.36 | 7.6 | 12.9 | 87.1 |
| 0.300 | 59.01 | 19.1 | 32.0 | 68.0 |
| 0.250 | 94.56 | 30.7 | 62.7 | 37.3 |
| 0.212 | 67.72 | 22.0 | 84.6 | 15.4 |
| 0.180 | 35.24 | 11.4 | 96.1 | 3.9 |
| 0.150 | 7.46 | 2.4 | 98.5 | 1.5 |
| 0.125 | 2.17 | 0.7 | 99.2 | 0.8 |
| 0.106 | 0.88 | 0.3 | 99.5 | 0.5 |
| 0.090 | 0.73 | 0.2 | 99.7 | 0.3 |
| 0.075 | 0.64 | 0.2 | 99.9 | 0.1 |
| -0.075 | 0.20 | 0.1 | | |
| **Total** | 308.27 | 100.0 | | |
| **Wt Loss** | 0.05 | 0.02 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 13/9/13 |
| File ref | QM26 |

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Sizings.xls 16Sep2013 *Version 5a*

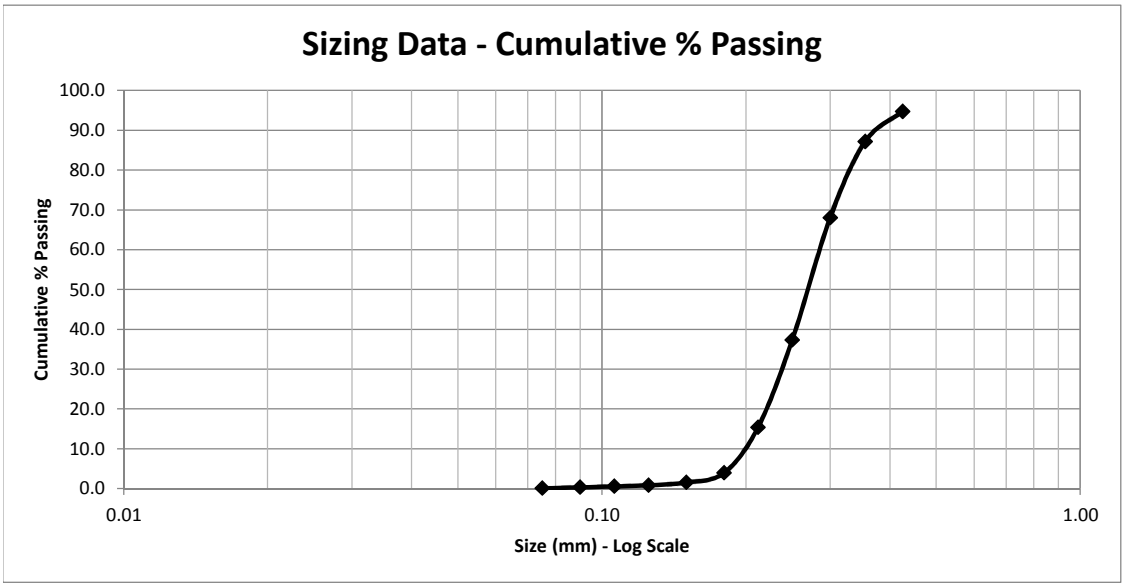
**Comments:**

d95 > 0.425 mm

d80 = 0.328 mm

d50 = 0.268 mm

d10 = 0.199 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 4 |
| **Sample Tested** | BH2-10.5-12.0-HM |

**SCREEN SIZING**

**Sample Weight** 142.18 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 51.54 | 36.5 | 36.5 | 63.5 |
| 0.355 | 7.60 | 5.4 | 41.9 | 58.1 |
| 0.300 | 15.69 | 11.1 | 53.1 | 46.9 |
| 0.250 | 24.68 | 17.5 | 70.5 | 29.5 |
| 0.212 | 18.16 | 12.9 | 83.4 | 16.6 |
| 0.180 | 13.69 | 9.7 | 93.1 | 6.9 |
| 0.150 | 3.02 | 2.1 | 95.3 | 4.7 |
| 0.125 | 2.10 | 1.5 | 96.8 | 3.2 |
| 0.106 | 1.80 | 1.3 | 98.0 | 2.0 |
| 0.090 | 1.23 | 0.9 | 98.9 | 1.1 |
| 0.075 | 1.00 | 0.7 | 99.6 | 0.4 |
| -0.075 | 0.54 | 0.4 | | |
| **Total** | 141.05 | 100.0 | | |
| **Wt Loss** | 1.13 | 0.79 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | HR |
| Test Date | 16/9/13 |
| File ref | QM27 |

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Sizings.xls 16Sep2013 *Version 5a*

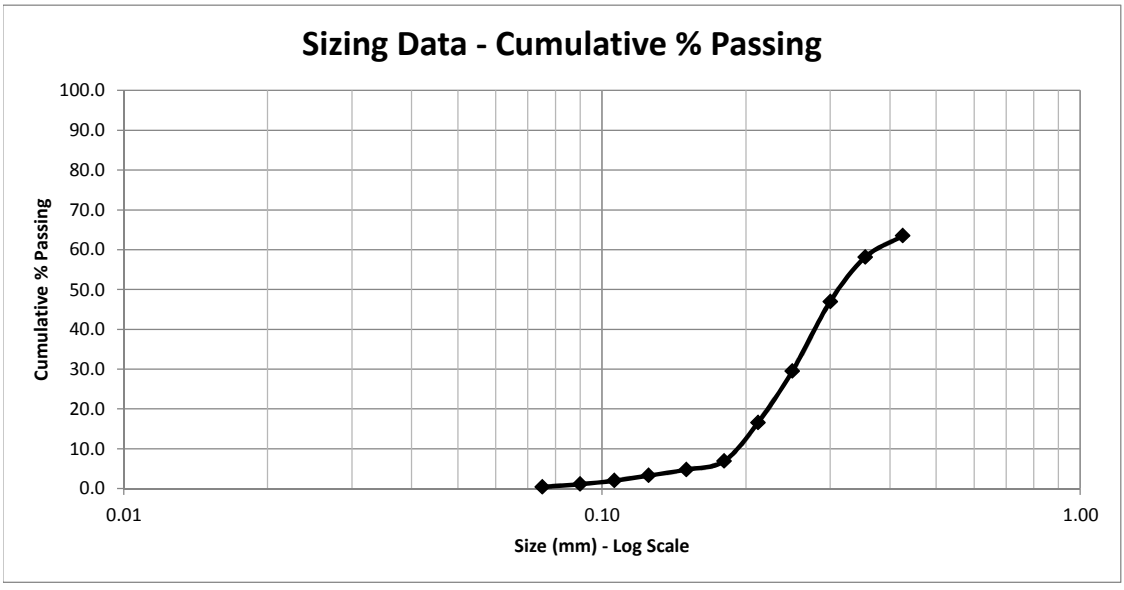
**Comments:**

d95 > 0.425 mm

d80 > 0.425 mm

d50 = 0.314 mm

d10 = 0.192 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 5 |
| **Sample Tested** | BH2-13.5-14.0-HM |

**SCREEN SIZING**

**Sample Weight** 237.28 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 3.02 | 1.3 | 1.3 | 98.7 |
| 0.355 | 7.69 | 3.2 | 4.5 | 95.5 |
| 0.300 | 24.07 | 10.2 | 14.7 | 85.3 |
| 0.250 | 62.32 | 26.3 | 41.0 | 59.0 |
| 0.212 | 72.22 | 30.5 | 71.5 | 28.5 |
| 0.180 | 57.00 | 24.1 | 95.6 | 4.4 |
| 0.150 | 7.89 | 3.3 | 98.9 | 1.1 |
| 0.125 | 1.96 | 0.8 | 99.7 | 0.3 |
| 0.106 | 0.40 | 0.2 | 99.9 | 0.1 |
| 0.090 | 0.11 | 0.0 | 100.0 | 0.0 |
| 0.075 | 0.07 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.03 | 0.0 | | |
| **Total** | 236.78 | 100.0 | | |
| **Wt Loss** | 0.50 | 0.21 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | RP |
| Test Date | 13/9/13 |
| File ref | QM28 |

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Sizings.xls 16Sep2013 *Version 5a*

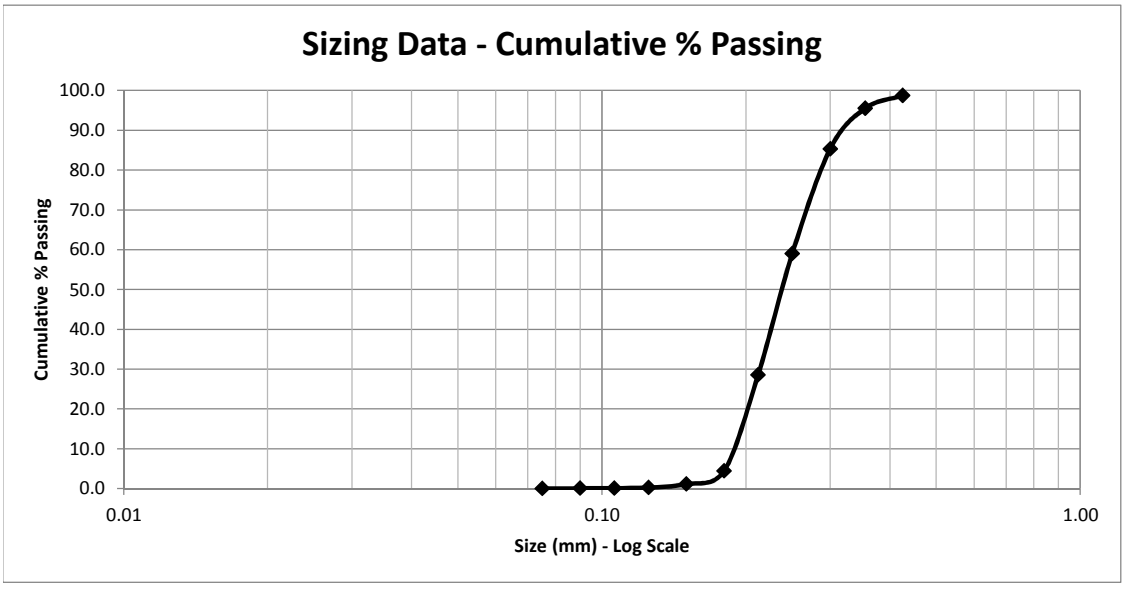
**Comments:**

d95 = 0.350 mm

d80 = 0.285 mm

d50 = 0.237 mm

d10 = 0.190 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 6 |
| **Sample Tested** | BH2-17.5-18.5-HM |

**SCREEN SIZING**

**Sample Weight** 248.11 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 30.08 | 12.1 | 12.1 | 87.9 |
| 0.355 | 42.46 | 17.1 | 29.2 | 70.8 |
| 0.300 | 73.79 | 29.7 | 59.0 | 41.0 |
| 0.250 | 65.27 | 26.3 | 85.3 | 14.7 |
| 0.212 | 26.84 | 10.8 | 96.1 | 3.9 |
| 0.180 | 7.99 | 3.2 | 99.3 | 0.7 |
| 0.150 | 1.16 | 0.5 | 99.8 | 0.2 |
| 0.125 | 0.27 | 0.1 | 99.9 | 0.1 |
| 0.106 | 0.11 | 0.0 | 100.0 | 0.0 |
| 0.090 | 0.07 | 0.0 | 100.0 | 0.0 |
| 0.075 | 0.03 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.00 | 0.0 | | |
| **Total** | 248.07 | 100.0 | | |
| **Wt Loss** | 0.04 | 0.02 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 13/9/13 |
| File ref | QM29 |

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Sizings.xls 16Sep2013 *Version 5a*

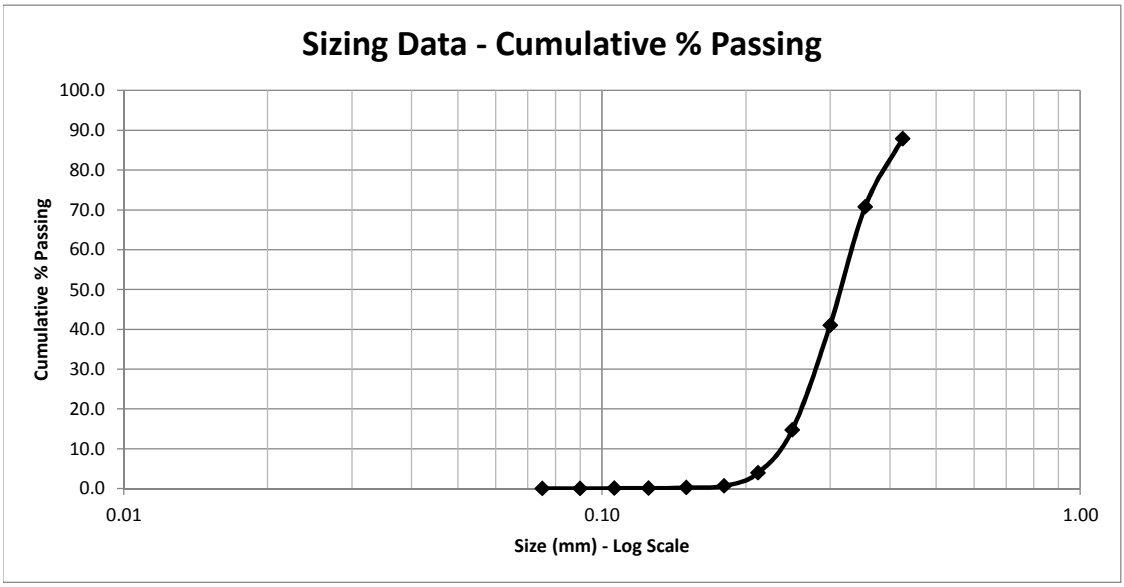
**Comments:**

d95 > 0.425 mm

d80 = 0.385 mm

d50 = 0.314 mm

d10 = 0.236 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 7 |
| **Sample Tested** | BH2-26.0-26.5-HM |

**SCREEN SIZING**

**Sample Weight** 240.65 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 8.30 | 3.5 | 3.5 | 96.5 |
| 0.355 | 10.54 | 4.4 | 7.8 | 92.2 |
| 0.300 | 20.48 | 8.5 | 16.4 | 83.6 |
| 0.250 | 31.68 | 13.2 | 29.5 | 70.5 |
| 0.212 | 48.65 | 20.2 | 49.8 | 50.2 |
| 0.180 | 69.85 | 29.1 | 78.9 | 21.1 |
| 0.150 | 31.84 | 13.2 | 92.1 | 7.9 |
| 0.125 | 15.59 | 6.5 | 98.6 | 1.4 |
| 0.106 | 2.48 | 1.0 | 99.6 | 0.4 |
| 0.090 | 0.62 | 0.3 | 99.9 | 0.1 |
| 0.075 | 0.28 | 0.1 | 100.0 | 0.0 |
| -0.075 | 0.01 | 0.0 | | |
| **Total** | 240.32 | 100.0 | | |
| **Wt Loss** | 0.33 | 0.14 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 13/9/13 |
| File ref | QM30 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

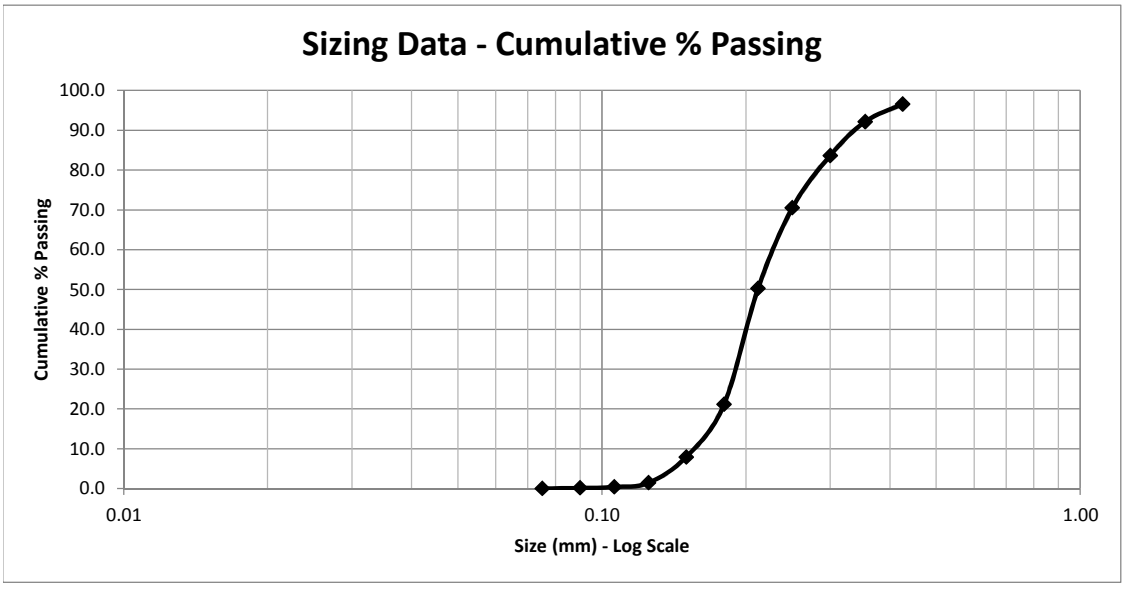
**Comments:**

d95 = 0.392 mm

d80 = 0.282 mm

d50 = 0.212 mm

d10 = 0.156 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 8 |
| **Sample Tested** | BH2-BL-B-HM |

**SCREEN SIZING**

**Sample Weight** 399.58 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 3.64 | 0.9 | 0.9 | 99.1 |
| 0.355 | 16.64 | 4.2 | 5.1 | 94.9 |
| 0.300 | 69.09 | 17.3 | 22.4 | 77.6 |
| 0.250 | 136.05 | 34.1 | 56.5 | 43.5 |
| 0.212 | 113.91 | 28.5 | 85.0 | 15.0 |
| 0.180 | 47.21 | 11.8 | 96.9 | 3.1 |
| 0.150 | 7.89 | 2.0 | 98.9 | 1.1 |
| 0.125 | 2.26 | 0.6 | 99.4 | 0.6 |
| 0.106 | 1.11 | 0.3 | 99.7 | 0.3 |
| 0.090 | 0.66 | 0.2 | 99.9 | 0.1 |
| 0.075 | 0.54 | 0.1 | 100.0 | 0.0 |
| -0.075 | 0.01 | 0.0 | | |
| **Total** | 399.01 | 100.0 | | |
| **Wt Loss** | 0.57 | 0.14 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | HR |
| Test Date | 16/9/13 |
| File ref | QM31 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

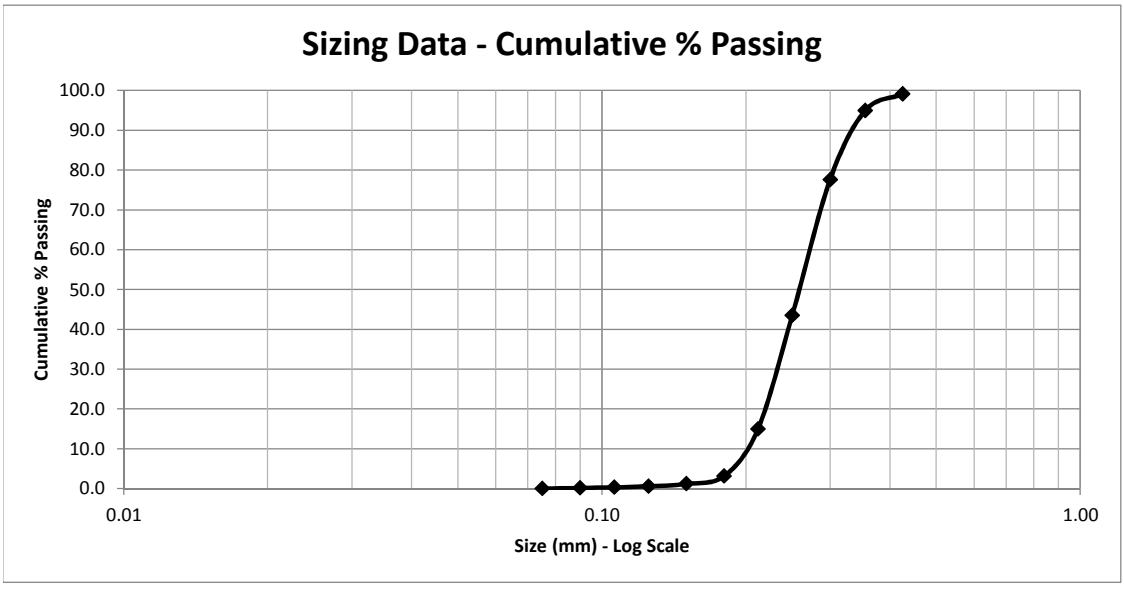
**Comments:**

d95 = 0.356 mm

d80 = 0.304 mm

d50 = 0.257 mm

d10 = 0.201 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 9 |
| **Sample Tested** | BH3-17.0-17.5-HM |

**SCREEN SIZING**

**Sample Weight** 246.32 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 2.40 | 1.0 | 1.0 | 99.0 |
| 0.355 | 5.44 | 2.2 | 3.2 | 96.8 |
| 0.300 | 15.27 | 6.2 | 9.4 | 90.6 |
| 0.250 | 50.35 | 20.5 | 29.8 | 70.2 |
| 0.212 | 79.82 | 32.4 | 62.3 | 37.7 |
| 0.180 | 75.04 | 30.5 | 92.8 | 7.2 |
| 0.150 | 12.06 | 4.9 | 97.7 | 2.3 |
| 0.125 | 3.76 | 1.5 | 99.2 | 0.8 |
| 0.106 | 1.40 | 0.6 | 99.8 | 0.2 |
| 0.090 | 0.39 | 0.2 | 99.9 | 0.1 |
| 0.075 | 0.17 | 0.1 | 100.0 | 0.0 |
| -0.075 | 0.00 | 0.0 | | |
| **Total** | 246.10 | 100.0 | | |
| **Wt Loss** | 0.22 | 0.09 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 16/9/13 |
| File ref | QM32 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

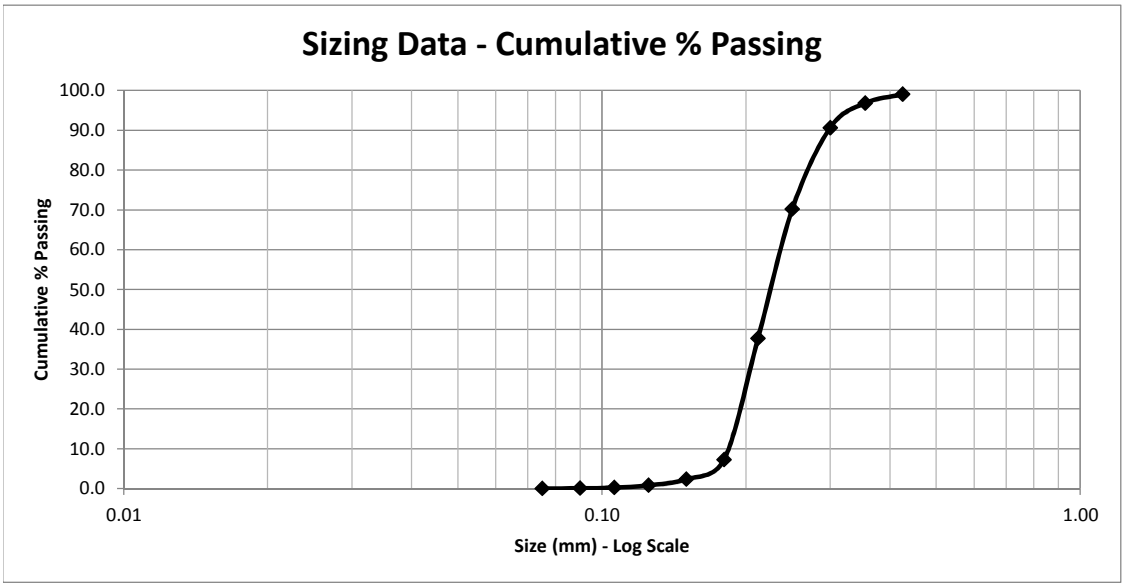
**Comments:**

d95 = 0.331 mm

d80 = 0.267 mm

d50 = 0.224 mm

d10 = 0.184 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 10 |
| **Sample Tested** | BH3-23.0-23.5-HM |

**SCREEN SIZING**

**Sample Weight** 245.38 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 40.00 | 16.3 | 16.3 | 83.7 |
| 0.355 | 41.09 | 16.8 | 33.1 | 66.9 |
| 0.300 | 60.00 | 24.5 | 57.7 | 42.3 |
| 0.250 | 54.04 | 22.1 | 79.7 | 20.3 |
| 0.212 | 28.24 | 11.5 | 91.3 | 8.7 |
| 0.180 | 15.67 | 6.4 | 97.7 | 2.3 |
| 0.150 | 3.90 | 1.6 | 99.3 | 0.7 |
| 0.125 | 1.33 | 0.5 | 99.8 | 0.2 |
| 0.106 | 0.30 | 0.1 | 99.9 | 0.1 |
| 0.090 | 0.11 | 0.0 | 100.0 | 0.0 |
| 0.075 | 0.02 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.00 | 0.0 | | |
| **Total** | 244.70 | 100.0 | | |
| **Wt Loss** | 0.68 | 0.28 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | HR |
| Test Date | 16/9/13 |
| File ref | QM33 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

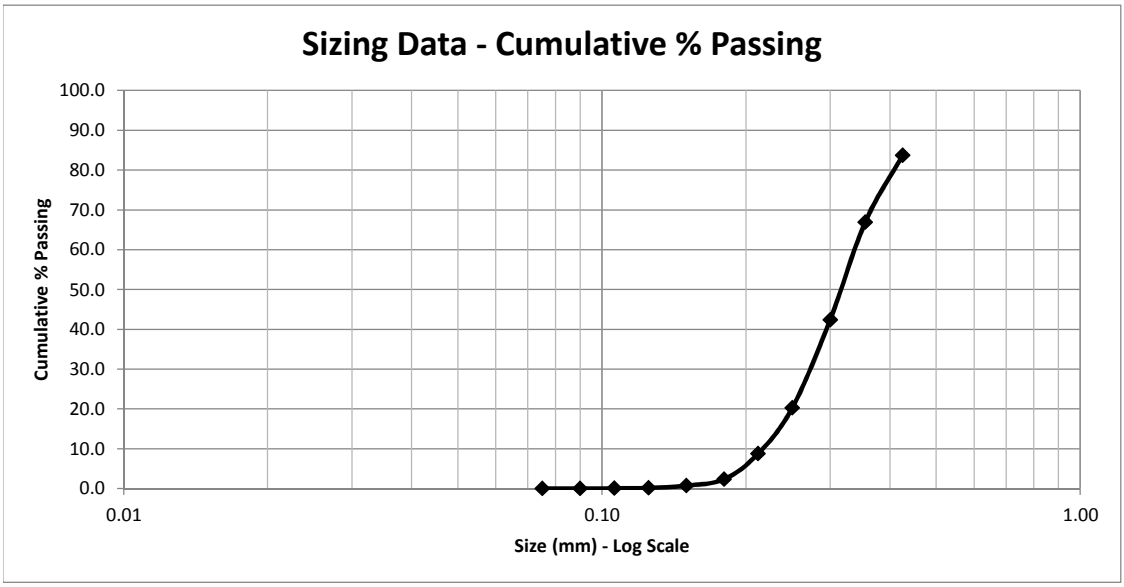
**Comments:**

d95 > 0.425 mm

d80 = 0.405 mm

d50 = 0.315 mm

d10 = 0.217 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 11 |
| **Sample Tested** | BH3-26.0-26.5-HM |

**SCREEN SIZING**

**Sample Weight** 256.09 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 15.49 | 6.1 | 6.1 | 93.9 |
| 0.355 | 32.05 | 12.5 | 18.6 | 81.4 |
| 0.300 | 58.64 | 22.9 | 41.5 | 58.5 |
| 0.250 | 70.52 | 27.6 | 69.0 | 31.0 |
| 0.212 | 47.35 | 18.5 | 87.5 | 12.5 |
| 0.180 | 23.44 | 9.2 | 96.7 | 3.3 |
| 0.150 | 6.06 | 2.4 | 99.1 | 0.9 |
| 0.125 | 1.85 | 0.7 | 99.8 | 0.2 |
| 0.106 | 0.39 | 0.2 | 99.9 | 0.1 |
| 0.090 | 0.12 | 0.0 | 100.0 | 0.0 |
| 0.075 | 0.05 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.00 | 0.0 | | |
| **Total** | 255.96 | 100.0 | | |
| **Wt Loss** | 0.13 | 0.05 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 16/9/13 |
| File ref | QM34 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

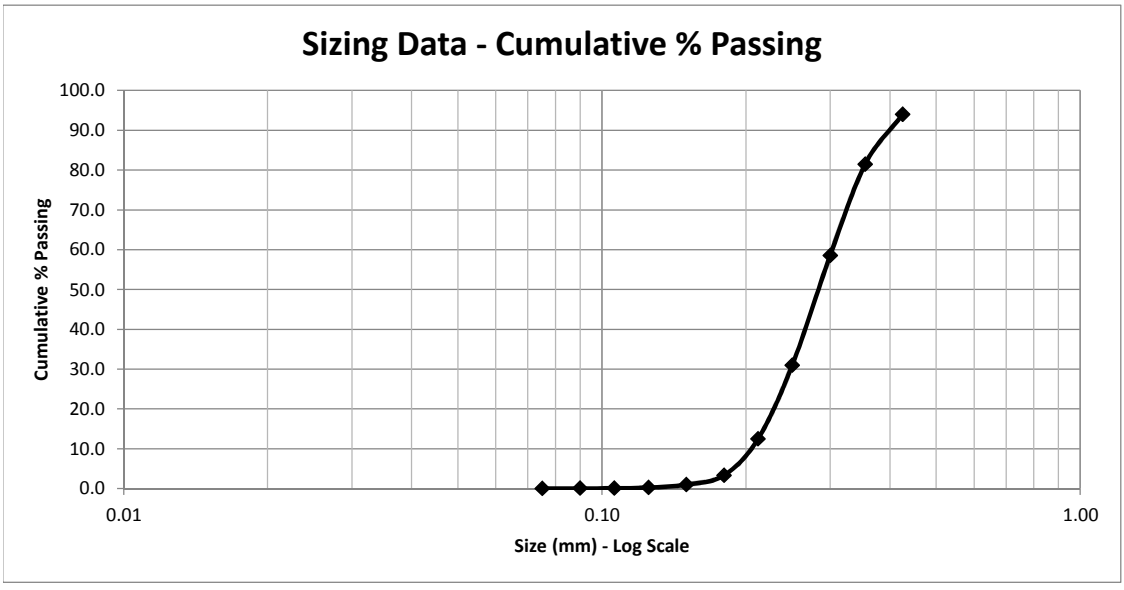
**Comments:**

d95 > 0.425 mm

d80 = 0.350 mm

d50 = 0.283 mm

d10 = 0.205 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 12 |
| **Sample Tested** | BH3-BL-B3-HM |

**SCREEN SIZING**

**Sample Weight** 573.57 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 10.27 | 1.8 | 1.8 | 98.2 |
| 0.355 | 43.58 | 7.6 | 9.4 | 90.6 |
| 0.300 | 145.68 | 25.4 | 34.8 | 65.2 |
| 0.250 | 227.91 | 39.8 | 74.6 | 25.4 |
| 0.212 | 109.06 | 19.0 | 93.6 | 6.4 |
| 0.180 | 31.70 | 5.5 | 99.2 | 0.8 |
| 0.150 | 3.13 | 0.5 | 99.7 | 0.3 |
| 0.125 | 0.68 | 0.1 | 99.8 | 0.2 |
| 0.106 | 0.37 | 0.1 | 99.9 | 0.1 |
| 0.090 | 0.30 | 0.1 | 99.9 | 0.1 |
| 0.075 | 0.27 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.03 | 0.0 | | |
| **Total** | 572.98 | 100.0 | | |
| **Wt Loss** | 0.59 | 0.10 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 13/9/13 |
| File ref | QM35 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

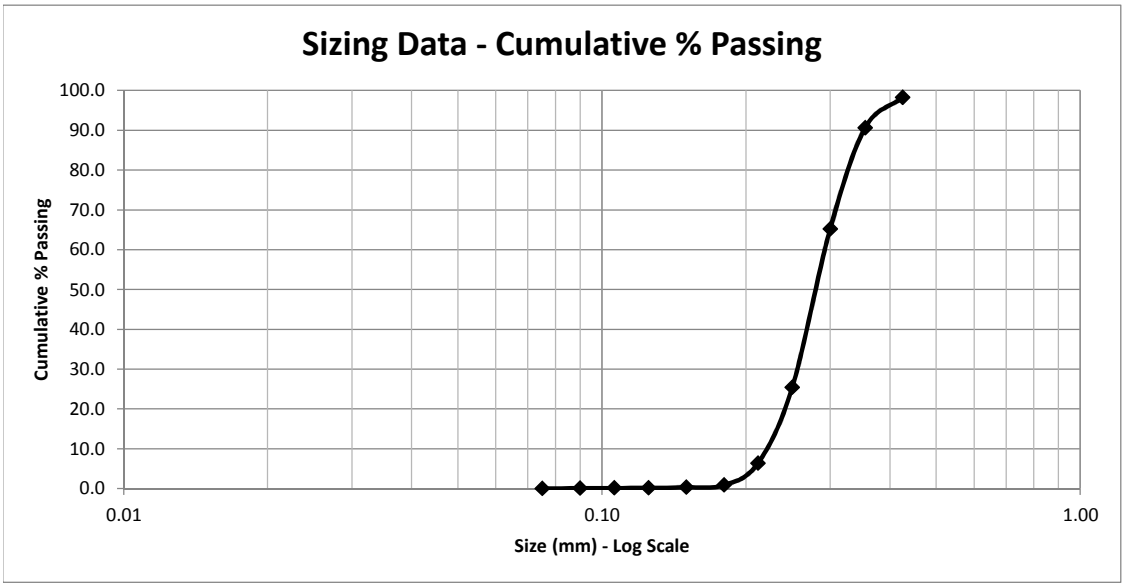
**Comments:**

d95 = 0.381 mm

d80 = 0.323 mm

d50 = 0.278 mm

d10 = 0.221 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 13 |
| **Sample Tested** | BH4-13.0-14.5-HM |

**SCREEN SIZING**

**Sample Weight** 247.53 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 38.82 | 15.8 | 15.8 | 84.2 |
| 0.355 | 42.23 | 17.1 | 32.9 | 67.1 |
| 0.300 | 65.83 | 26.7 | 59.6 | 40.4 |
| 0.250 | 55.61 | 22.6 | 82.2 | 17.8 |
| 0.212 | 24.62 | 10.0 | 92.2 | 7.8 |
| 0.180 | 15.88 | 6.4 | 98.7 | 1.3 |
| 0.150 | 2.36 | 1.0 | 99.6 | 0.4 |
| 0.125 | 0.68 | 0.3 | 99.9 | 0.1 |
| 0.106 | 0.12 | 0.0 | 100.0 | 0.0 |
| 0.090 | 0.07 | 0.0 | 100.0 | 0.0 |
| 0.075 | 0.04 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.00 | 0.0 | | |
| **Total** | 246.26 | 100.0 | | |
| **Wt Loss** | 1.27 | 0.51 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | HR |
| Test Date | 16/9/13 |
| File ref | QM36 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

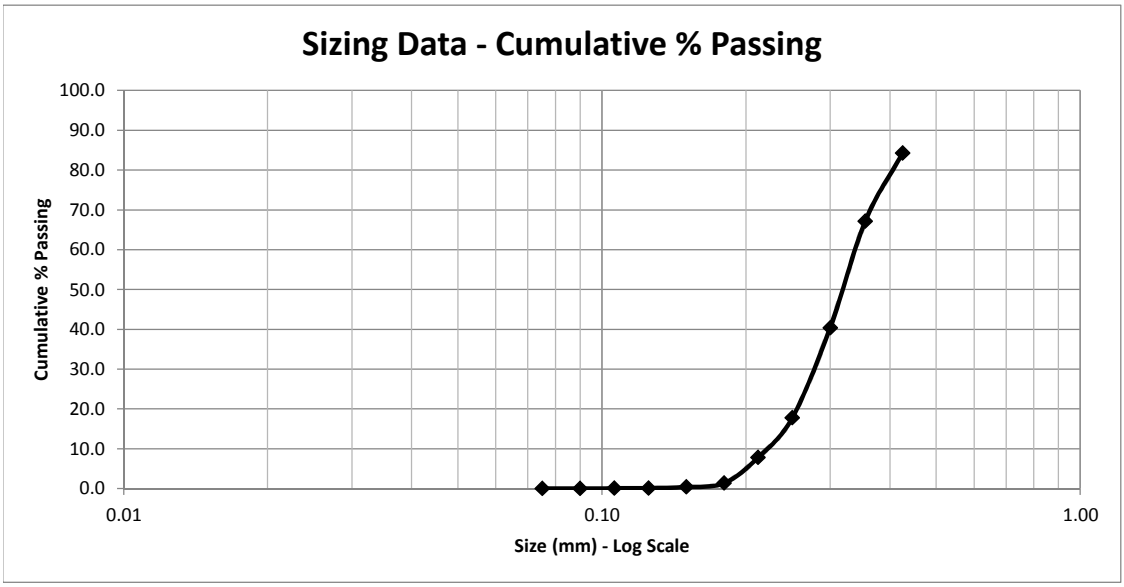
**Comments:**

d95 > 0.425 mm

d80 = 0.402 mm

d50 = 0.317 mm

d10 = 0.221 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 14 |
| **Sample Tested** | BH4-16.5-18.0-HM |

**SCREEN SIZING**

**Sample Weight** 244.96 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 60.66 | 24.8 | 24.8 | 75.2 |
| 0.355 | 41.26 | 16.9 | 41.6 | 58.4 |
| 0.300 | 50.66 | 20.7 | 62.3 | 37.7 |
| 0.250 | 48.55 | 19.8 | 82.2 | 17.8 |
| 0.212 | 22.24 | 9.1 | 91.2 | 8.8 |
| 0.180 | 14.72 | 6.0 | 97.3 | 2.7 |
| 0.150 | 3.43 | 1.4 | 98.7 | 1.3 |
| 0.125 | 2.16 | 0.9 | 99.5 | 0.5 |
| 0.106 | 0.80 | 0.3 | 99.9 | 0.1 |
| 0.090 | 0.22 | 0.1 | 100.0 | 0.0 |
| 0.075 | 0.12 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.00 | 0.0 | | |
| **Total** | 244.82 | 100.0 | | |
| **Wt Loss** | 0.14 | 0.06 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 16/9/13 |
| File ref | QM37 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

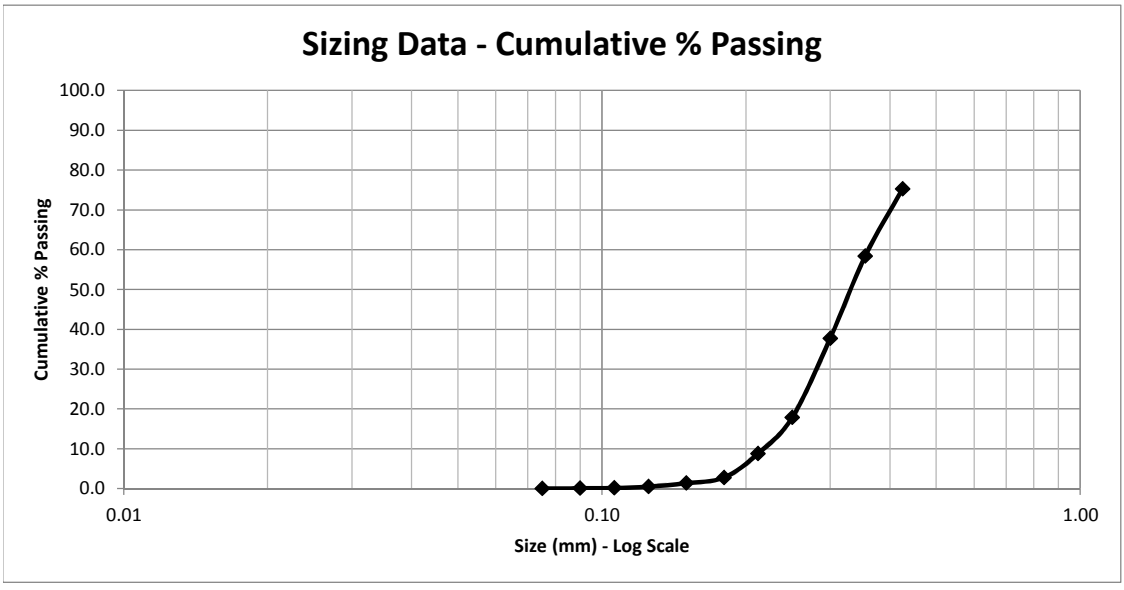
**Comments:**

d95 > 0.425 mm

d80 > 0.425 mm

d50 = 0.331 mm

d10 = 0.218 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 15 |
| **Sample Tested** | BH4-20.5-24.1-HM |

**SCREEN SIZING**

**Sample Weight** 243.42 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 3.37 | 1.4 | 1.4 | 98.6 |
| 0.355 | 12.65 | 5.2 | 6.6 | 93.4 |
| 0.300 | 41.73 | 17.2 | 23.8 | 76.2 |
| 0.250 | 79.97 | 32.9 | 56.7 | 43.3 |
| 0.212 | 61.77 | 25.4 | 82.1 | 17.9 |
| 0.180 | 34.76 | 14.3 | 96.4 | 3.6 |
| 0.150 | 5.23 | 2.2 | 98.5 | 1.5 |
| 0.125 | 2.43 | 1.0 | 99.5 | 0.5 |
| 0.106 | 0.82 | 0.3 | 99.9 | 0.1 |
| 0.090 | 0.24 | 0.1 | 100.0 | 0.0 |
| 0.075 | 0.12 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.00 | 0.0 | | |
| **Total** | 243.09 | 100.0 | | |
| **Wt Loss** | 0.33 | 0.14 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | RP |
| Test Date | 13/9/13 |
| File ref | QM38 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

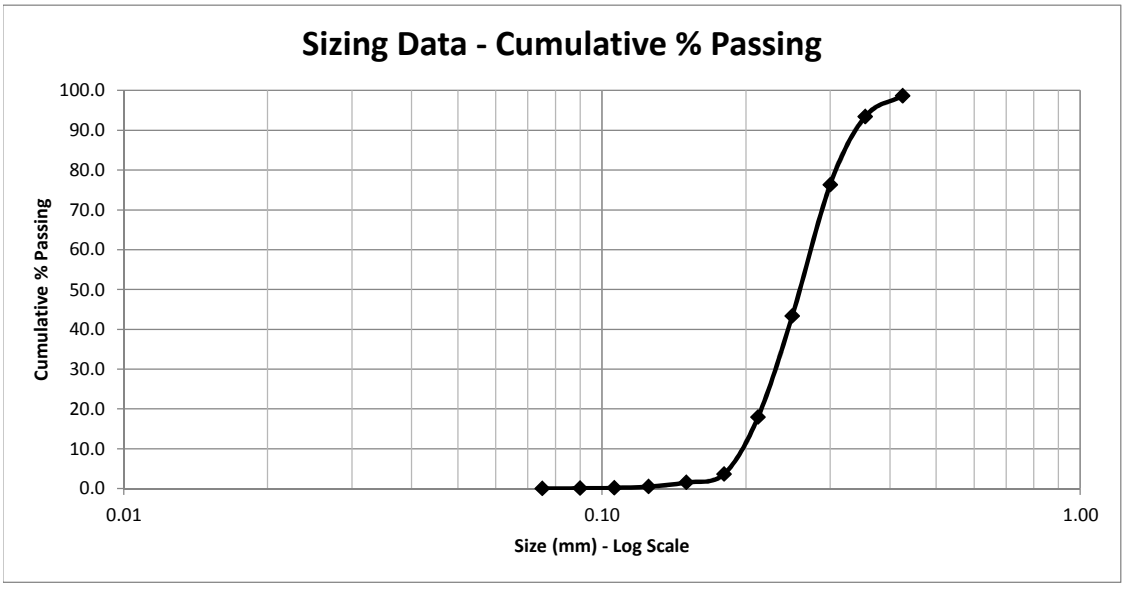
**Comments:**

d95 = 0.367 mm

d80 = 0.307 mm

d50 = 0.258 mm

d10 = 0.197 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 16 |
| **Sample Tested** | BH4-5.6-5.8-HM |

**SCREEN SIZING**

**Sample Weight** 264.90 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 4.87 | 1.8 | 1.8 | 98.2 |
| 0.355 | 19.41 | 7.3 | 9.2 | 90.8 |
| 0.300 | 57.41 | 21.7 | 30.9 | 69.1 |
| 0.250 | 82.65 | 31.3 | 62.2 | 37.8 |
| 0.212 | 52.61 | 19.9 | 82.0 | 18.0 |
| 0.180 | 34.69 | 13.1 | 95.2 | 4.8 |
| 0.150 | 4.86 | 1.8 | 97.0 | 3.0 |
| 0.125 | 2.23 | 0.8 | 97.8 | 2.2 |
| 0.106 | 2.12 | 0.8 | 98.6 | 1.4 |
| 0.090 | 1.74 | 0.7 | 99.3 | 0.7 |
| 0.075 | 1.77 | 0.7 | 100.0 | 0.0 |
| -0.075 | 0.06 | 0.0 | | |
| **Total** | 264.42 | 100.0 | | |
| **Wt Loss** | 0.48 | 0.18 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | RP |
| Test Date | 13/9/13 |
| File ref | QM39 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

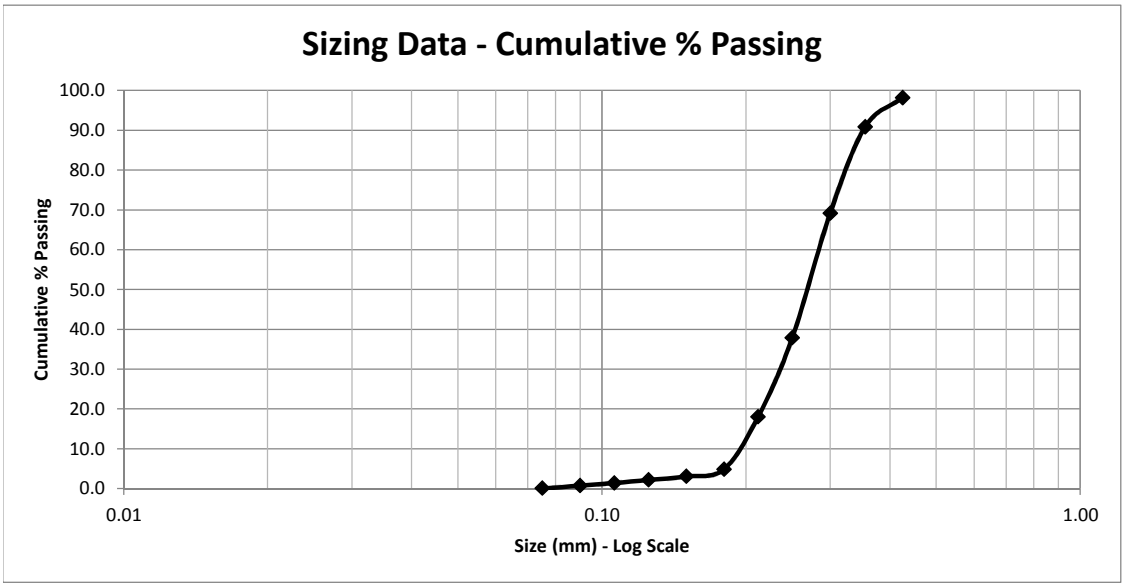
**Comments:**

d95 = 0.380 mm

d80 = 0.320 mm

d50 = 0.266 mm

d10 = 0.195 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 17 |
| **Sample Tested** | BH4-BL-B-HM |

**SCREEN SIZING**

**Sample Weight** 302.49 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 3.13 | 1.0 | 1.0 | 99.0 |
| 0.355 | 15.51 | 5.1 | 6.2 | 93.8 |
| 0.300 | 64.10 | 21.2 | 27.4 | 72.6 |
| 0.250 | 122.36 | 40.5 | 67.8 | 32.2 |
| 0.212 | 71.98 | 23.8 | 91.6 | 8.4 |
| 0.180 | 22.21 | 7.3 | 98.9 | 1.1 |
| 0.150 | 2.12 | 0.7 | 99.6 | 0.4 |
| 0.125 | 0.48 | 0.2 | 99.8 | 0.2 |
| 0.106 | 0.24 | 0.1 | 99.9 | 0.1 |
| 0.090 | 0.20 | 0.1 | 100.0 | 0.0 |
| 0.075 | 0.15 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.00 | 0.0 | | |
| **Total** | 302.48 | 100.0 | | |
| **Wt Loss** | 0.01 | 0.00 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 13/9/13 |
| File ref | QM40 |

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Sizings.xls 16Sep2013 *Version 5a*

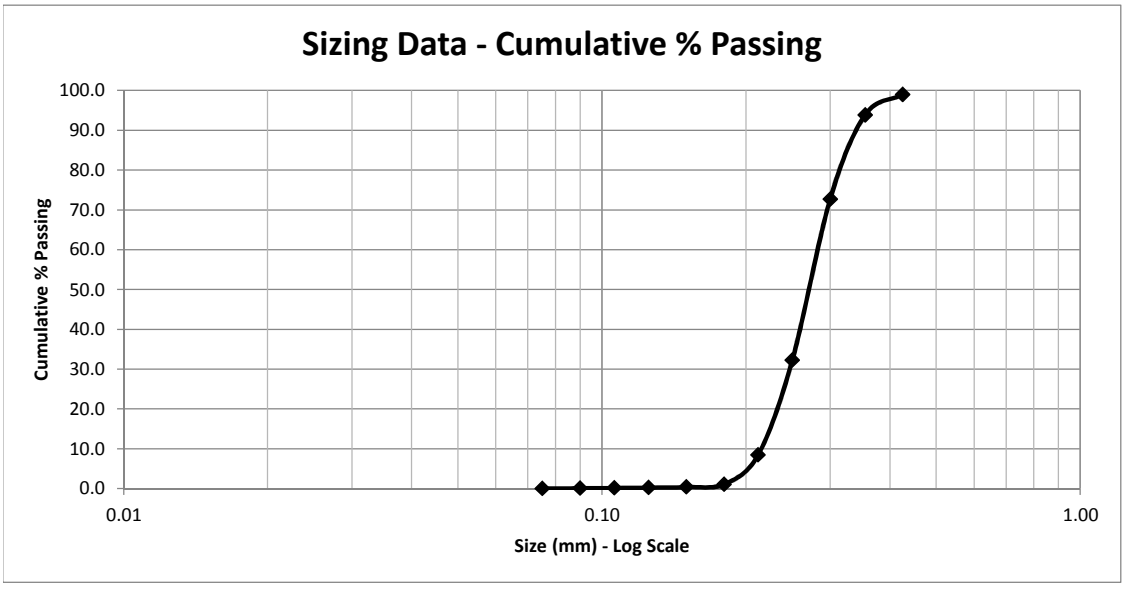
**Comments:**

d95 = 0.363 mm

d80 = 0.311 mm

d50 = 0.268 mm

d10 = 0.215 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 18 |
| **Sample Tested** | BH4-BL-D-HM |

**SCREEN SIZING**

**Sample Weight** 235.97 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 11.81 | 5.0 | 5.0 | 95.0 |
| 0.355 | 16.63 | 7.1 | 12.1 | 87.9 |
| 0.300 | 47.13 | 20.0 | 32.0 | 68.0 |
| 0.250 | 67.03 | 28.4 | 60.5 | 39.5 |
| 0.212 | 57.66 | 24.4 | 84.9 | 15.1 |
| 0.180 | 28.15 | 11.9 | 96.8 | 3.2 |
| 0.150 | 5.38 | 2.3 | 99.1 | 0.9 |
| 0.125 | 1.21 | 0.5 | 99.6 | 0.4 |
| 0.106 | 0.40 | 0.2 | 99.8 | 0.2 |
| 0.090 | 0.24 | 0.1 | 99.9 | 0.1 |
| 0.075 | 0.21 | 0.1 | 100.0 | 0.0 |
| -0.075 | 0.00 | 0.0 | | |
| **Total** | 235.85 | 100.0 | | |
| **Wt Loss** | 0.12 | 0.05 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 13/9/13 |
| File ref | QM41 |

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Sizings.xls 16Sep2013 *Version 5a*

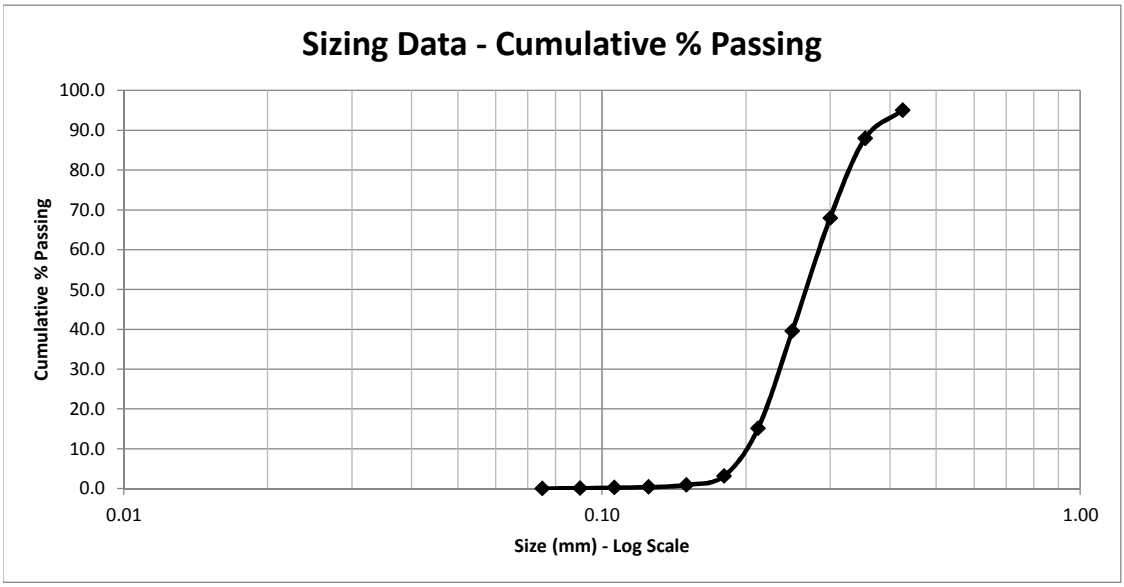
**Comments:**

d95 > 0.425 mm

d80 = 0.326 mm

d50 = 0.266 mm

d10 = 0.201 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 19 |
| **Sample Tested** | BH5-BL-B-HM |

**SCREEN SIZING**

**Sample Weight** 623.97 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 4.23 | 0.7 | 0.7 | 99.3 |
| 0.355 | 26.92 | 4.3 | 5.0 | 95.0 |
| 0.300 | 199.04 | 31.9 | 36.9 | 63.1 |
| 0.250 | 218.20 | 35.0 | 72.0 | 28.0 |
| 0.212 | 106.85 | 17.1 | 89.1 | 10.9 |
| 0.180 | 55.04 | 8.8 | 97.9 | 2.1 |
| 0.150 | 6.30 | 1.0 | 98.9 | 1.1 |
| 0.125 | 2.84 | 0.5 | 99.4 | 0.6 |
| 0.106 | 1.86 | 0.3 | 99.7 | 0.3 |
| 0.090 | 1.07 | 0.2 | 99.9 | 0.1 |
| 0.075 | 0.81 | 0.1 | 100.0 | 0.0 |
| -0.075 | 0.03 | 0.0 | | |
| **Total** | 623.19 | 100.0 | | |
| **Wt Loss** | 0.78 | 0.13 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 13/9/13 |
| File ref | QM42 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

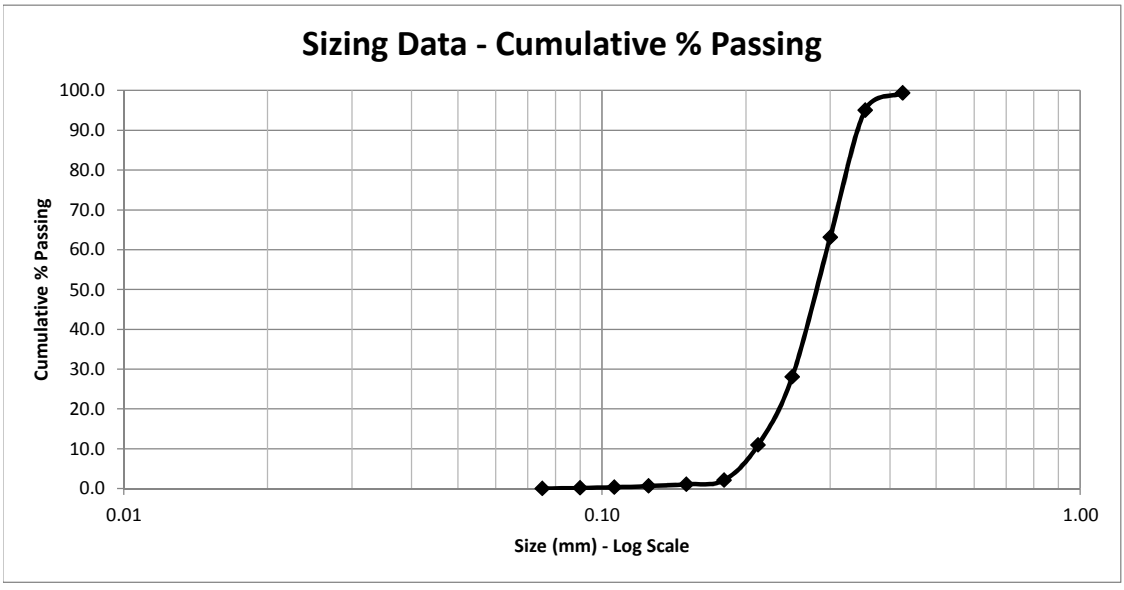
**Comments:**

d95 = 0.355 mm

d80 = 0.317 mm

d50 = 0.279 mm

d10 = 0.210 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 20 |
| **Sample Tested** | BH5-BL-G-HM |

**SCREEN SIZING**

**Sample Weight** 250.07 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 39.17 | 15.7 | 15.7 | 84.3 |
| 0.355 | 45.81 | 18.3 | 34.0 | 66.0 |
| 0.300 | 61.63 | 24.7 | 58.6 | 41.4 |
| 0.250 | 58.03 | 23.2 | 81.9 | 18.1 |
| 0.212 | 25.88 | 10.4 | 92.2 | 7.8 |
| 0.180 | 16.00 | 6.4 | 98.6 | 1.4 |
| 0.150 | 2.30 | 0.9 | 99.5 | 0.5 |
| 0.125 | 0.80 | 0.3 | 99.8 | 0.2 |
| 0.106 | 0.21 | 0.1 | 99.9 | 0.1 |
| 0.090 | 0.12 | 0.0 | 100.0 | 0.0 |
| 0.075 | 0.05 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.00 | 0.0 | | |
| **Total** | 250.00 | 100.0 | | |
| **Wt Loss** | 0.07 | 0.03 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | HR |
| Test Date | 16/9/13 |
| File ref | QM43 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

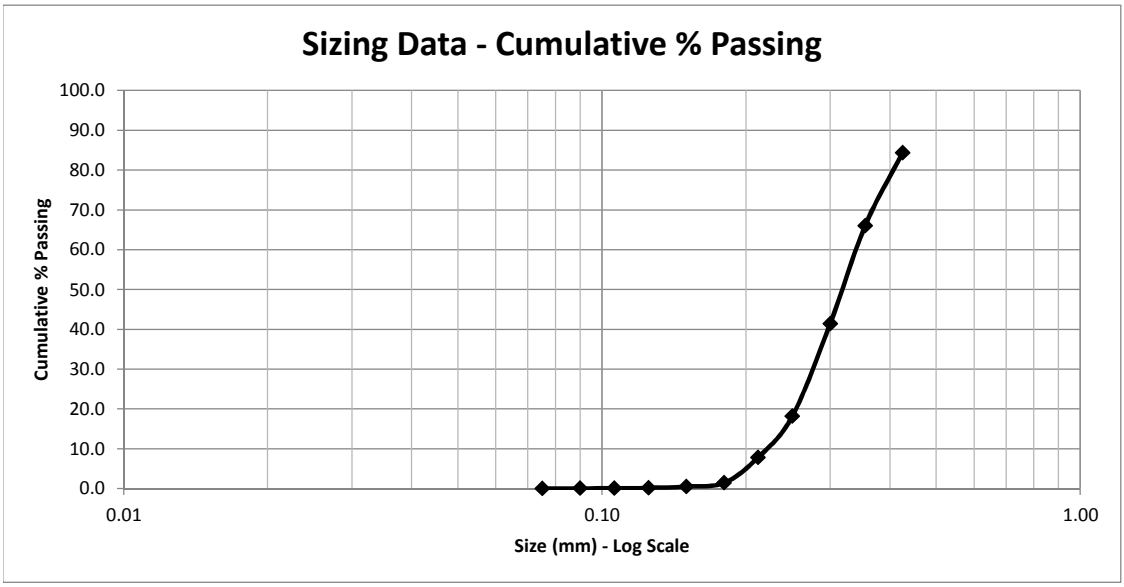
**Comments:**

d95 > 0.425 mm

d80 = 0.402 mm

d50 = 0.317 mm

d10 = 0.221 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 21 |
| **Sample Tested** | BH5-BL-M-HM |

**SCREEN SIZING**

**Sample Weight** 90.75 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 59.02 | 65.1 | 65.1 | 34.9 |
| 0.355 | 3.11 | 3.4 | 68.5 | 31.5 |
| 0.300 | 5.96 | 6.6 | 75.1 | 24.9 |
| 0.250 | 8.65 | 9.5 | 84.6 | 15.4 |
| 0.212 | 5.58 | 6.2 | 90.8 | 9.2 |
| 0.180 | 4.81 | 5.3 | 96.1 | 3.9 |
| 0.150 | 1.16 | 1.3 | 97.3 | 2.7 |
| 0.125 | 0.85 | 0.9 | 98.3 | 1.7 |
| 0.106 | 0.54 | 0.6 | 98.9 | 1.1 |
| 0.090 | 0.39 | 0.4 | 99.3 | 0.7 |
| 0.075 | 0.33 | 0.4 | 99.7 | 0.3 |
| -0.075 | 0.30 | 0.3 | | |
| **Total** | 90.70 | 100.0 | | |
| **Wt Loss** | 0.05 | 0.06 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 16/9/13 |
| File ref | QM44 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

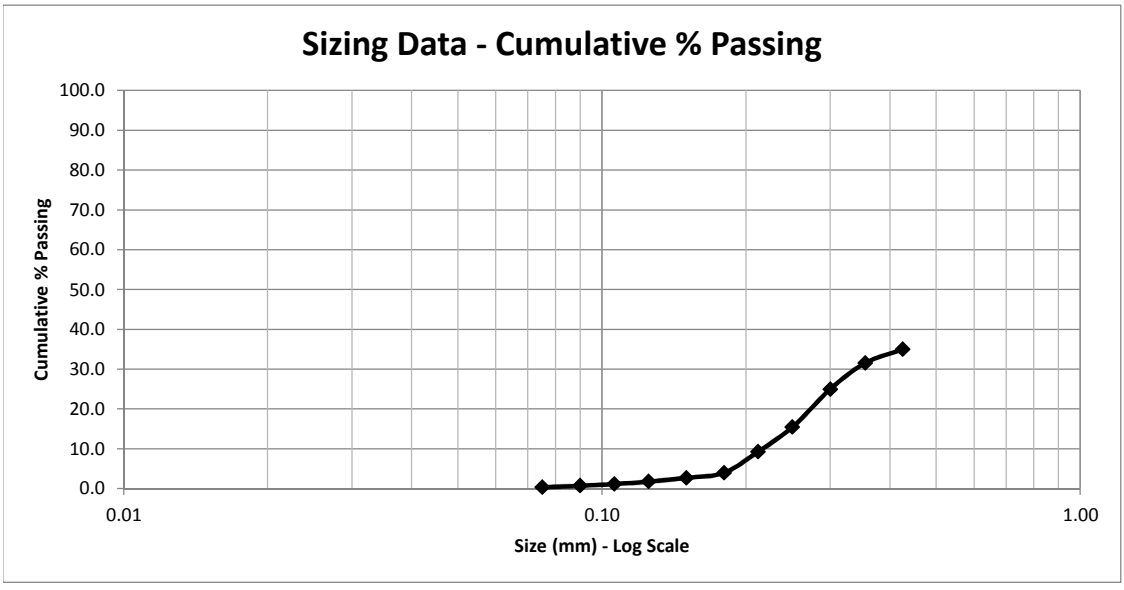
**Comments:**

d95 > 0.425 mm

d80 > 0.425 mm

d50 > 0.425 mm

d10 = 0.217 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 22 |
| **Sample Tested** | BL-C-HM |

**SCREEN SIZING**

**Sample Weight** 1451.29 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 42.33 | 2.9 | 2.9 | 97.1 |
| 0.355 | 115.62 | 8.0 | 10.9 | 89.1 |
| 0.300 | 324.71 | 22.4 | 33.3 | 66.7 |
| 0.250 | 564.69 | 38.9 | 72.2 | 27.8 |
| 0.212 | 271.43 | 18.7 | 90.9 | 9.1 |
| 0.180 | 112.83 | 7.8 | 98.7 | 1.3 |
| 0.150 | 13.48 | 0.9 | 99.6 | 0.4 |
| 0.125 | 3.46 | 0.2 | 99.8 | 0.2 |
| 0.106 | 1.51 | 0.1 | 99.9 | 0.1 |
| 0.090 | 0.63 | 0.0 | 100.0 | 0.0 |
| 0.075 | 0.35 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.00 | 0.0 | | |
| **Total** | 1451.04 | 100.0 | | |
| **Wt Loss** | 0.25 | 0.02 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | JL |
| Test Date | 16/9/13 |
| File ref | QM45 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

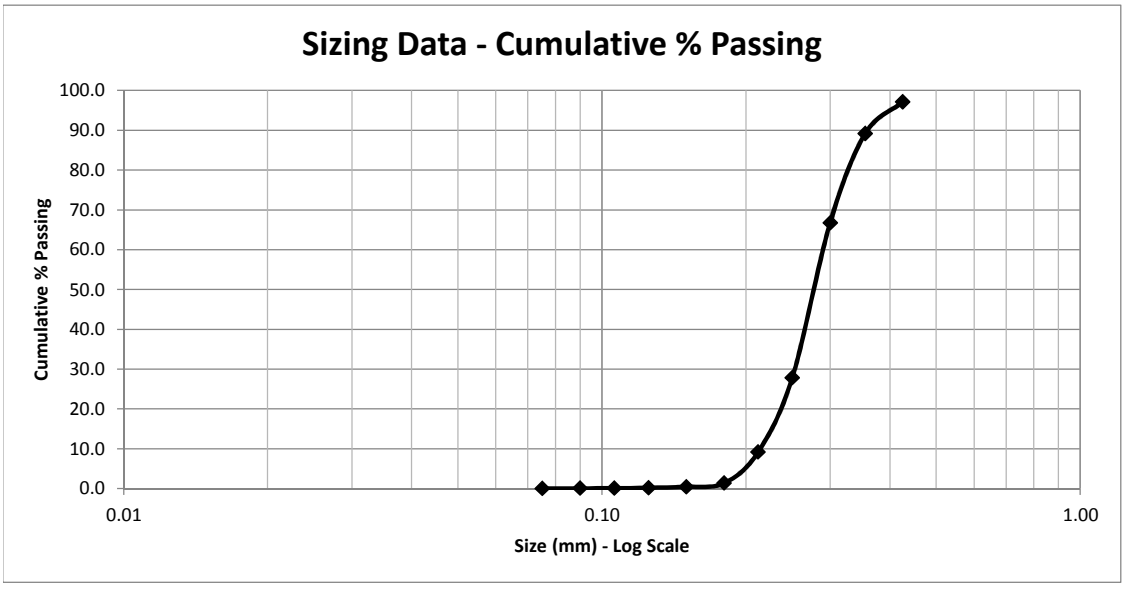
**Comments:**

d95 = 0.395 mm

d80 = 0.325 mm

d50 = 0.275 mm

d10 = 0.214 mm



## SIZE DISTRIBUTION

| | |
|---|---|
| **Test No** | 23 |
| **Sample Tested** | BL-M-HM |

**SCREEN SIZING**

**Sample Weight** 1551.31 **g**

| Screen Aperture | Weight Retained | | Cumulative Weight | |
|---|---|---|---|---|
| **mm** | **g** | **%** | **% Retained** | **% Passing** |
| 0.425 | 14.99 | 1.0 | 1.0 | 99.0 |
| 0.355 | 75.19 | 4.9 | 5.8 | 94.2 |
| 0.300 | 333.26 | 21.5 | 27.4 | 72.6 |
| 0.250 | 596.58 | 38.6 | 65.9 | 34.1 |
| 0.212 | 362.11 | 23.4 | 89.4 | 10.6 |
| 0.180 | 140.66 | 9.1 | 98.5 | 1.5 |
| 0.150 | 16.71 | 1.1 | 99.5 | 0.5 |
| 0.125 | 4.10 | 0.3 | 99.8 | 0.2 |
| 0.106 | 1.83 | 0.1 | 99.9 | 0.1 |
| 0.090 | 0.86 | 0.1 | 100.0 | 0.0 |
| 0.075 | 0.46 | 0.0 | 100.0 | 0.0 |
| -0.075 | 0.00 | 0.0 | | |
| **Total** | 1546.75 | 100.0 | | |
| **Wt Loss** | 4.56 | 0.29 | | |

| | |
|---|---|
| Printed | 18/09/13 |
| Job No. | N5677HL13 |
| Technician | HR |
| Test Date | 16/9/13 |
| File ref | QM46 |

Gamdel

Sizings.xls 16Sep2013 *Version 5a*

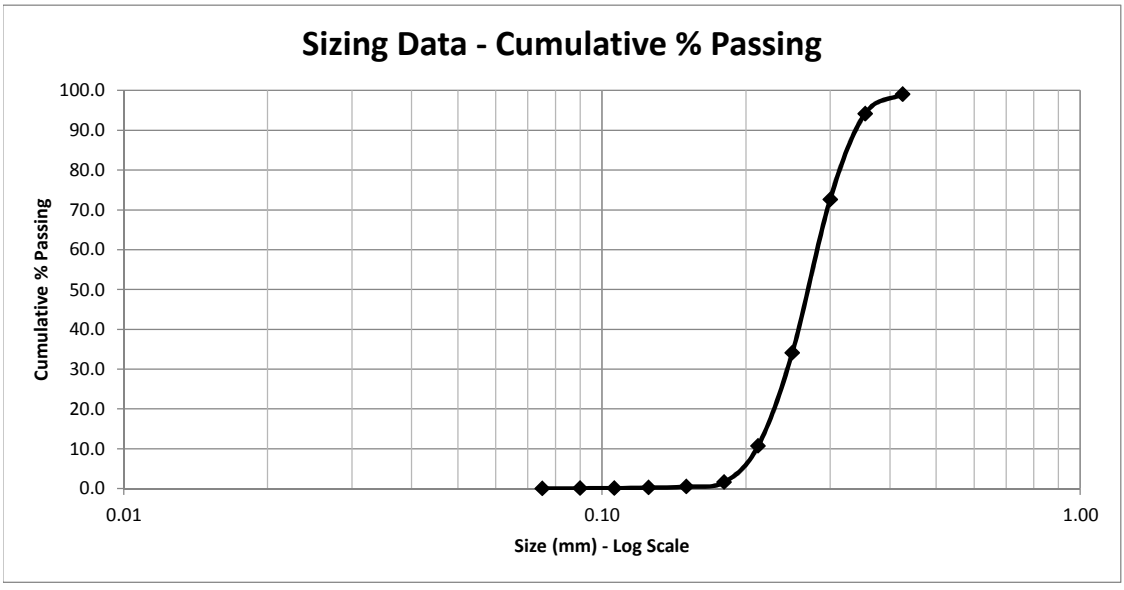
**Comments:**

d95 = 0.361 mm

d80 = 0.311 mm

d50 = 0.267 mm

d10 = 0.210 mm



## Wet Sizing Results

| Sample Number | % | | | WT. (g) | | | |
|---|---|---|---|---|---|---|---|
| | +75 um | -75 um | Total | +75 um | -75 um | Total | Initial |
| BH1-BL-AWT-HM | 99.5% | 0.5% | 100% | 307.84 | 1.66 | 309.50 | 309.55 |
| BH1-BL-G1-HM | 99.5% | 0.5% | 100% | 214.99 | 1.00 | 215.99 | 216.01 |
| BH1-BL-G2-HM | 98.0% | 2.0% | 100% | 308.32 | 6.26 | 314.58 | 315.37 |
| BH2-10.5-12.0-HM | 76.4% | 23.6% | 100% | 142.18 | 43.91 | 186.09 | 191.08 |
| BH2-13.5-14.0-HM | 99.9% | 0.1% | 100% | 237.28 | 0.30 | 237.58 | 237.93 |
| BH2-17.5-18.5-HM | 99.9% | 0.1% | 100% | 248.11 | 0.33 | 248.44 | 248.46 |
| BH2-26.0-26.5-HM | 99.9% | 0.1% | 100% | 240.65 | 0.15 | 240.80 | 240.86 |
| BH2-BL-B-HM | 99.3% | 0.7% | 100% | 399.58 | 2.63 | 402.21 | 402.35 |
| BH3-17.0-17.5-HM | 99.9% | 0.1% | 100% | 246.32 | 0.26 | 246.58 | 246.71 |
| BH3-23.0-23.5-HM | 99.8% | 0.2% | 100% | 245.38 | 0.45 | 245.83 | 248.14 |
| BH3-26.0-26.5-HM | 100.0% | 0.0% | 100% | 256.09 | 0.10 | 256.19 | 256.37 |
| BH3-BL-B3-HM | 99.8% | 0.2% | 100% | 573.57 | 1.41 | 574.98 | 575.11 |
| BH4-13.0-14.5-HM | 99.9% | 0.1% | 100% | 247.53 | 0.24 | 247.77 | 247.85 |
| BH4-16.5-18.0-HM | 99.9% | 0.1% | 100% | 244.96 | 0.27 | 245.23 | 245.46 |
| BH4-20.5-24.1-HM | 99.9% | 0.1% | 100% | 243.42 | 0.20 | 243.62 | 243.77 |
| BH4-5.6-5.8-HM | 96.6% | 3.4% | 100% | 264.90 | 9.31 | 274.21 | 274.68 |
| BH4-BL-B-HM | 99.7% | 0.3% | 100% | 302.49 | 0.80 | 303.29 | 303.62 |
| BH4-BL-D-HM | 99.4% | 0.6% | 100% | 235.97 | 1.37 | 237.34 | 238.45 |
| BH5-BL-B-HM | 99.3% | 0.7% | 100% | 623.97 | 4.13 | 628.10 | 628.27 |
| BH5-BL-G-HM | 99.8% | 0.2% | 100% | 250.07 | 0.58 | 250.65 | 250.69 |
| BH5-BL-M-HM | 45.4% | 54.6% | 100% | 90.75 | 109.14 | 199.89 | 203.22 |
| BL-C-HM | 99.9% | 0.1% | 100% | 1451.29 | 1.02 | 1452.31 | 1452.54 |
| BL-M-HM | 99.7% | 0.3% | 100% | 1551.31 | 4.84 | 1556.15 | 1556.94 |

# Solid Waste Assessment & Classification


**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 02 9980 6554
**Fax:** 02 9484 2427
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au


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**Batch N°: 27554** **Sample N°: 1** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Quarry Mining Systems Pty Ltd** | Project Name: | **REF 1308105** |
| Client Contact: | **Mark Philpott** | Location: | |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH1-BL-AWT-SO 0.7** |
| Address: | **PO Box 7030**<br>**Redhead NSW 2290** | Description: | **Soil** |
| | | Test Type: | **FSC, BWC** |

## REPORT SUMMARY

**Material Type:** ○ Soil ○ Other

The results of laboratory testing conducted on this material indicate the presence of a range of contaminants commonly encountered in the natural and urban areas. This assessment was conducted to provide a waste classification for off-site disposal, based on the *Waste Classification Guidelines Part 1: Classifying Waste* (NSW DECCW December 2009). Comparison of the laboratory analysis results with the criteria, indicates the material is considered to be within the classification and as a result of this process, it can be disposed of as per Schedule 1 Part 3 of the Protection of the Environment Operations Act 1997.

EC (dS/m): 0.02 pH (in $H_2O$): 6.8

| CONTAMINANT | | SCC: (mg/kg) | TCLP: (mg/L) | CLASSIFICATION |
|---|---|---|---|---|
| **METALS AND METALLOIDS** | | | | |
| Arsenic | (As) | <2 | | CT1 - General Solid Waste (suitable for recycling) |
| Beryllium | (Be) | | | Not determined |
| Cadmium | (Cd) | <0.4 | | CT1 - General Solid Waste (suitable for recycling) |
| Chromium VI | (CrVI) | | | Not determined |
| Total Chromium | (Cr) | <5 | | |
| Copper | (Cu) | <5 | N/A | Suitable for recycling |
| Fluoride | (F) | | | Not determined |
| Lead | (Pb) | <5 | | CT1 - General Solid Waste (suitable for recycling) |
| Mercury | (Hg) | <0.05 | | CT1 - General Solid Waste (suitable for recycling) |
| Molybdenum | (Mo) | - | | Not determined |
| Nickel | (Ni) | <5 | | CT1 - General Solid Waste (suitable for recycling) |
| Selenium | (Se) | - | | Not determined |
| Silver | (Ag) | | | Not determined |
| Zinc | (Zn) | <5 | N/A | Suitable for recycling |
| **BTEX (MONO AROMATIC HYDROCARBONS)** | | | | |
| Benzene | | <0.1 | | CT1 - General Solid Waste (suitable for recycling) |
| Toluene | | <0.1 | | CT1 - General Solid Waste (suitable for recycling) |
| Ethylbenzene | | <0.1 | | CT1 - General Solid Waste (suitable for recycling) |
| meta & para-Xylene | | <0.2 | | |
| ortho-Xylene | | <0.1 | | |
| Xylenes (total) | | <0.2 | | CT1 - General Solid Waste (suitable for recycling) |
| **TOTAL PETROLEUM HYDROCARBONS (TPH)** | | | | |
| C6 - C9 | | <20 | N/A | SCC1 - General Solid Waste (suitable for recycling) |
| C10 - C14 | | <20 | | |
| C15 - C28 | | <50 | | |
| C29 - C36 | | <50 | | |
| C10-C36 Total TPH | | <50 | N/A | SCC1 - General Solid Waste (suitable for recycling) |
| **CYANIDES** | | | | |
| Cyanide (amenable) | | | | Not determined |
| Cyanide (Total) | | | | Not determined |
| **PHENOXY ACID HERBICIDES** | | | | |
| 2,4-D | (2,4-Dichlorophenoxy-acetic acid) | | | Not determined |
| Fluroxypyr | | | | Not determined |
| Picloram | | | | Not determined |
| Triclopyr | | | | Not determined |

| CONTAMINANT | SCC: (mg/kg) | TCLP: (mg/L) | CLASSIFICATION |
|---|---|---|---|
| **SCHEDULED CHEMICALS - ORGANOCHLORINE PESTICIDES (OCP)** | | | |
| Aldrin | <0.05 | | |
| “Benzene, hexachloro” | <0.05 | | |
| “Benzene, pentachloronitro” | | | |
| alpha - BHC | <0.05 | | |
| beta - BHC | <0.05 | | |
| gamma - BHC (Lindane) | <0.05 | | |
| delta - BHC | <0.05 | | |
| Chlordane | <0.1 | | |
| DDD | <0.05 | | |
| DDE | <0.05 | | |
| DDT | <0.05 | | |
| Dieldrin | <0.05 | | |
| Endrin | <0.05 | | |
| Endrin aldehyde | <0.05 | | |
| Endosulfan | <0.05 | | CT1 - General Solid Waste (suitable for recycling) |
| Heptachlor | <0.05 | | |
| Heptachlor epoxide | <0.05 | | |
| Hexachlorophene | | | |
| Isodrin | | | |
| Pentachlorobenzene | | | |
| Pentachlorophenol | | | |
| “1,2,4,5-tetrachlorobenzene” | | | |
| “2,3,4,6-tetrachlorophenol” | | | |
| “1,2,4-trichlorobenzene” | | | |
| “2,4,5-Trichlorophenoxy acetic acid, salts and esters” | | | |
| Total Positive Scheduled Chemicals | <0.1 | N/A | SCC1 - General Solid Waste (suitable for recycling) |
| Total Moderately Harmful Pesticides | | N/A | Not determined |
| **POLYCYCLIC AROMATIC HYDROCARBONS (PAH)** | | | |
| Acenaphthene | <0.5 | | |
| Acenaphthylene | <0.5 | | |
| Anthracene | <0.5 | | |
| Benzo(a)anthracene | <0.5 | | |
| Benzo(a)pyrene | <0.5 | | CT1 - General Solid Waste (suitable for recycling) |
| Benzo(b,k)fluoranthene | | | |
| Benzo(ghi)perylene | <0.5 | | |
| Chrysene | <0.5 | | |
| “Dibenzo(a,h)anthracene” | <0.5 | | |
| Fluoranthene | <0.5 | | |
| Fluorene | <0.5 | | |
| “Indeno(1,2,3-cd)pyrene” | <0.5 | | |
| Naphthalene | <0.5 | | |
| Phenanthrene | <0.5 | | |
| Pyrene | <0.5 | | |
| Total Positive PAH’s | <0.5 | N/A | SCC1 - General Solid Waste (suitable for recycling) |
| **POLYCHLORINATED BIPHENYLS (PCB)** | | | |
| Arochloro 1016 | <0.5 | | |
| Arochloro 1221 | | | |
| Arochloro 1232 | <0.5 | | |
| Arochloro 1242 | <0.5 | | |
| Arochloro 1248 | <0.5 | | |
| Arochloro 1254 | <0.5 | | |
| Arochloro 1260 | <0.5 | | |
| Arochloro 1262 | | | |
| Arochloro 1268 | | | |
| Total Positive PCB’s | <0.5 | N/A | SCC1 - General Solid Waste (suitable for recycling) |
| **NITRATED COMPOUNDS - EXPLOSIVES** | | | |
| “2,4-Dinitrotoluene” | | | Not determined |

| CONTAMINANT | SCC: (mg/kg) | TCLP: (mg/L) | CLASSIFICATION |
|---|---|---|---|
| **OTHER VOLATILE ORGANIC COMPOUNDS (VOC)** | | | |
| Carbon tetrachloride | | | Not determined |
| Chlorobenzene | | | Not determined |
| Chloroform | | | Not determined |
| “1,2-Dichlorobenzene” | | | Not determined |
| “1,4-Dichlorobenzene” | | | Not determined |
| “1,2-Dichloroethane” | | | Not determined |
| “1,1-Dichloroethylene” | | | Not determined |
| Dichloromethane | | | Not determined |
| Styrene (vinyl benzene) | | | Not determined |
| “1,1,1,2-Tetrachloroethane” | | | Not determined |
| “1,1,2,2-Tetrachloroethane” | | | Not determined |
| Tetrachloroethylene | | | Not determined |
| “1,1,1-Trichloroethane” | | | Not determined |
| “1,1,2-Trichloroethane” | | | Not determined |
| Trichloroethylene | | | Not determined |
| Vinyl chloride | | | Not determined |
| **OTHER SEMI-VOLATILE ORGANIC COMPOUNDS (SVOC)** | | | |
| Chlorpyrifos | | | Not determined |
| Nitrobenzene | | | Not determined |
| Phenol (non-halogenated) | | | Not determined |
| “2,4,5-Trichlorophenol” | | | Not determined |
| “2,4,6-Trichlorophenol” | | | Not determined |
| **OTHER CONTAMINANTS** | | | |
| Methyl ethyl ketone | | | Not determined |
| Tebuconazole | | | Not determined |
| Plasticiser compounds | | | Not determined |
| Cresol (total) | | | Not determined |
| **ASBESTOS_DETECTION** | | | |
| Asbestos Detection | | | |

## DETAILED SUMMARY

*Waste Classification Guidelines Part 1: Classifying Waste* (DECCW, Dec. 2009)

**Abbreviations:** ND - Not Determined (Analyte not tested)
SCC - Specific Contaminant Concentration
TCLP - Toxicity Characteristics Leaching Procedure

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Consultant:

**Chantal Hooper**

Date of Report: **17/09/2013**

Authorised Signatory:

**Simon Leake**

**All analyses performed by a NATA accredited sub-contracting laboratory.**

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# Solid Waste Assessment & Classification

**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 02 9980 6554
**Fax:** 02 9484 2427
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au

Tests are performed under a quality system certified as complying with ISO 9001: 2008. Results and conclusions assume that sampling is representative. This document shall not be reproduced except in full.

**Batch N°: 27554** **Sample N°: 2** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

Client Name: **Quarry Mining Systems Pty Ltd**
Client Contact: **Mark Philpott**
Client Job N°:
Client Order N°:
Address: **PO Box 7030, Redhead NSW 2290**

Project Name: **REF 1308105**
Location:
SESL Quote N°:
Sample Name: **BH1-BL-G1-SO 0.5**
Description: **Soil**
Test Type: **FSC, BWC**

## REPORT SUMMARY

**Material Type:** ◉ Soil ○ Other

The results of laboratory testing conducted on this material indicate the presence of a range of contaminants commonly encountered in the natural and urban areas. This assessment was conducted to provide a waste classification for off-site disposal, based on the *Waste Classification Guidelines Part 1: Classifying Waste* (NSW DECCW December 2009). Comparison of the laboratory analysis results with the criteria, indicates the material is considered to be within the **VENM Waste** classification and as a result of this process, it can be disposed of as per Schedule 1 Part 3 of the Protection of the Environment Operations Act 1997.

EC (dS/m): 0.23 pH (in $H_2O$): 3.9

| CONTAMINANT | | SCC: (mg/kg) | TCLP: (mg/L) | CLASSIFICATION |
|---|---|---|---|---|
| **METALS AND METALLOIDS** | | | | |
| Arsenic | (As) | <2 | | CT1 - General Solid Waste (suitable for recycling) |
| Beryllium | (Be) | | | Not determined |
| Cadmium | (Cd) | <0.4 | | CT1 - General Solid Waste (suitable for recycling) |
| Chromium VI | (CrVI) | | | Not determined |
| Total Chromium | (Cr) | <5 | | |
| Copper | (Cu) | <5 | N/A | Suitable for recycling |
| Fluoride | (F) | | | Not determined |
| Lead | (Pb) | <5 | | CT1 - General Solid Waste (suitable for recycling) |
| Mercury | (Hg) | <0.05 | | CT1 - General Solid Waste (suitable for recycling) |
| Molybdenum | (Mo) | - | | Not determined |
| Nickel | (Ni) | <5 | | CT1 - General Solid Waste (suitable for recycling) |
| Selenium | (Se) | - | | Not determined |
| Silver | (Ag) | | | Not determined |
| Zinc | (Zn) | <5 | N/A | Suitable for recycling |
| **BTEX (MONO AROMATIC HYDROCARBONS)** | | | | |
| Benzene | | <0.1 | | CT1 - General Solid Waste (suitable for recycling) |
| Toluene | | <0.1 | | CT1 - General Solid Waste (suitable for recycling) |
| Ethylbenzene | | <0.1 | | CT1 - General Solid Waste (suitable for recycling) |
| meta & para-Xylene | | <0.2 | | |
| ortho-Xylene | | <0.1 | | |
| Xylenes (total) | | <0.2 | | CT1 - General Solid Waste (suitable for recycling) |
| **TOTAL PETROLEUM HYDROCARBONS (TPH)** | | | | |
| C6 - C9 | | <20 | N/A | SCC1 - General Solid Waste (suitable for recycling) |
| C10 - C14 | | <20 | | |
| C15 - C28 | | <50 | | |
| C29 - C36 | | <50 | | |
| C10-C36 Total TPH | | <50 | N/A | SCC1 - General Solid Waste (suitable for recycling) |
| **CYANIDES** | | | | |
| Cyanide (amenable) | | | | Not determined |
| Cyanide (Total) | | | | Not determined |
| **PHENOXY ACID HERBICIDES** | | | | |
| 2,4-D | (2,4-Dichlorophenoxy-acetic acid) | | | Not determined |
| Fluroxypyr | | | | Not determined |
| Picloram | | | | Not determined |
| Triclopyr | | | | Not determined |

| CONTAMINANT | SCC: (mg/kg) | TCLP: (mg/L) | CLASSIFICATION |
|---|---|---|---|
| **SCHEDULED CHEMICALS - ORGANOCHLORINE PESTICIDES (OCP)** | | | |
| Aldrin | <0.05 | | |
| "Benzene, hexachloro" | <0.05 | | |
| "Benzene, pentachloronitro" | | | |
| alpha - BHC | <0.05 | | |
| beta - BHC | <0.05 | | |
| gamma - BHC (Lindane) | <0.05 | | |
| delta - BHC | <0.05 | | |
| Chlordane | <0.1 | | |
| DDD | <0.05 | | |
| DDE | <0.05 | | |
| DDT | <0.05 | | |
| Dieldrin | <0.05 | | |
| Endrin | <0.05 | | |
| Endrin aldehyde | <0.05 | | |
| Endosulfan | <0.05 | | CT1 - General Solid Waste (suitable for recycling) |
| Heptachlor | <0.05 | | |
| Heptachlor epoxide | <0.05 | | |
| Hexachlorophene | | | |
| Isodrin | | | |
| Pentachlorobenzene | | | |
| Pentachlorophenol | | | |
| "1,2,4,5-tetrachlorobenzene" | | | |
| "2,3,4,6-tetrachlorophenol" | | | |
| "1,2,4-trichlorobenzene" | | | |
| "2,4,5-Trichlorophenoxy acetic acid, salts and esters" | | | |
| Total Positive Scheduled Chemicals | <0.1 | N/A | SCC1 - General Solid Waste (suitable for recycling) |
| Total Moderately Harmful Pesticides | | N/A | Not determined |
| **POLYCYCLIC AROMATIC HYDROCARBONS (PAH)** | | | |
| Acenaphthene | <0.5 | | |
| Acenaphthylene | <0.5 | | |
| Anthracene | <0.5 | | |
| Benzo(a)anthracene | <0.5 | | |
| Benzo(a)pyrene | <0.5 | | CT1 - General Solid Waste (suitable for recycling) |
| Benzo(b,k)fluoranthene | | | |
| Benzo(ghi)perylene | <0.5 | | |
| Chrysene | <0.5 | | |
| "Dibenzo(a,h)anthracene" | <0.5 | | |
| Fluoranthene | <0.5 | | |
| Fluorene | <0.5 | | |
| "Indeno(1,2,3-cd)pyrene" | <0.5 | | |
| Naphthalene | <0.5 | | |
| Phenanthrene | <0.5 | | |
| Pyrene | <0.5 | | |
| Total Positive PAH's | <0.5 | N/A | SCC1 - General Solid Waste (suitable for recycling) |
| **POLYCHLORINATED BIPHENYLS (PCB)** | | | |
| Arochloro 1016 | <0.5 | | |
| Arochloro 1221 | | | |
| Arochloro 1232 | <0.5 | | |
| Arochloro 1242 | <0.5 | | |
| Arochloro 1248 | <0.5 | | |
| Arochloro 1254 | <0.5 | | |
| Arochloro 1260 | <0.5 | | |
| Arochloro 1262 | | | |
| Arochloro 1268 | | | |
| Total Positive PCB's | <0.5 | N/A | SCC1 - General Solid Waste (suitable for recycling) |
| **NITRATED COMPOUNDS - EXPLOSIVES** | | | |
| "2,4-Dinitrotoluene" | | | Not determined |

| CONTAMINANT | SCC: (mg/kg) | TCLP: (mg/L) | CLASSIFICATION |
|---|---|---|---|
| **OTHER VOLATILE ORGANIC COMPOUNDS (VOC)** | | | |
| Carbon tetrachloride | | | Not determined |
| Chlorobenzene | | | Not determined |
| Chloroform | | | Not determined |
| “1,2-Dichlorobenzene” | | | Not determined |
| “1,4-Dichlorobenzene” | | | Not determined |
| “1,2-Dichloroethane” | | | Not determined |
| “1,1-Dichloroethylene” | | | Not determined |
| Dichloromethane | | | Not determined |
| Styrene (vinyl benzene) | | | Not determined |
| “1,1,1,2-Tetrachloroethane” | | | Not determined |
| “1,1,2,2-Tetrachloroethane” | | | Not determined |
| Tetrachloroethylene | | | Not determined |
| “1,1,1-Trichloroethane” | | | Not determined |
| “1,1,2-Trichloroethane” | | | Not determined |
| Trichloroethylene | | | Not determined |
| Vinyl chloride | | | Not determined |
| **OTHER SEMI-VOLATILE ORGANIC COMPOUNDS (SVOC)** | | | |
| Chlorpyrifos | | | Not determined |
| Nitrobenzene | | | Not determined |
| Phenol (non-halogenated) | | | Not determined |
| “2,4,5-Trichlorophenol” | | | Not determined |
| “2,4,6-Trichlorophenol” | | | Not determined |
| **OTHER CONTAMINANTS** | | | |
| Methyl ethyl ketone | | | Not determined |
| Tebuconazole | | | Not determined |
| Plasticiser compounds | | | Not determined |
| Cresol (total) | | | Not determined |
| **ASBESTOS_DETECTION** | | | |
| Asbestos Detection | | | |

## DETAILED SUMMARY

*Waste Classification Guidelines Part 1: Classifying Waste* (DECCW, Dec. 2009)

**Abbreviations:** ND - Not Determined (Analyte not tested)
SCC - Specific Contaminant Concentration
TCLP - Toxicity Characteristics Leaching Procedure

**Limitation of liability:** This document and the the limited analysis undertaken should not be construed as a site contamination report. It does not meet the NSW EPA requirements in relation to a contamination assessment for the proposed land use. The findings presented are based on a.) the sample submitted to SESL by the client or their agent, or b.) site conditions that existed at the time of sampling by SESL field personnel. In the case of sampling by SESL, conclusions are based on the investigation of conditions at specific locations, chosen to be representative as possible under the given circumstances. SESL has used a degree of care, skill and diligence normally exercised by environmental consultants in similar circumstances and locality. No other warranty expressed or implied is made or intended. Section 143 of the Protection of the Environment Operations Act 1997 states that if waste is transported to a place that cannot lawfully be used as a waste facility for that waste, then the transporter and owner of the waste are each guilty of an offence. The transporter and owner of the waste have duty to ensure that the waste is disposed of in an appropriate manner. SESL accepts no liability whatsoever for the unlawful disposal of any waste from any site. Subject to payment of all fees due, the client alone shall have a licence to use this document. This document may not be reproduced except in full.

Consultant:

**Chantal Hooper**

Date of Report: **17/09/2013**

Authorised Signatory:

**Simon Leake**

**All analyses performed by a NATA accredited sub-contracting laboratory.**

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

**Batch N°: 27554** **Sample N°: 1** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Quarry Mining Systems Pty Ltd** | Project Name: | **REF 1308105** |
| Client Contact: | **Mark Philpott** | Location: | |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH1-BL-AWT-SO 0.7** |
| Address: | **PO Box 7030**<br>**Redhead NSW 2290** | Description: | **Soil** |
| | | Test Type: | **FSC, BWC** |

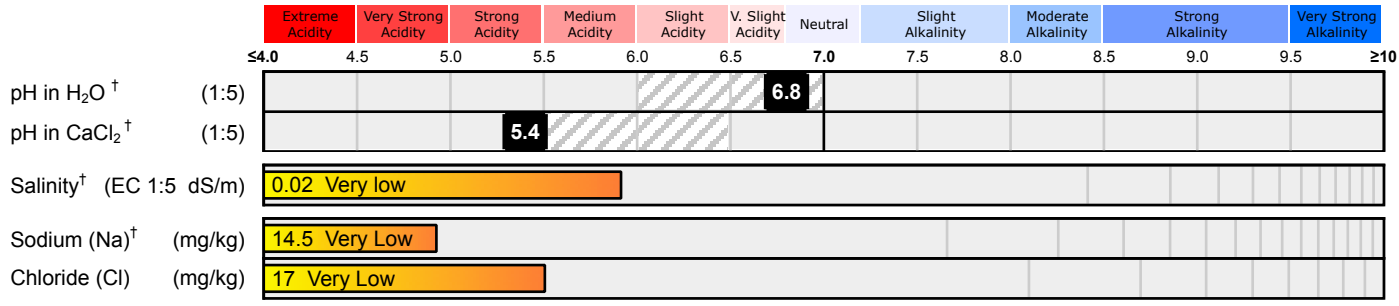
## RECOMMENDATIONS

**Key Observations.**
Sample 'BH1-BL-AWT-SO 0.7' was analysed for its chemical properties. This soil has very slight acidity and has desirably low salinity levels. The cation exchange has high sodicity making it highly prone to dispersion. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from phosphorus all nutrients need boosting.
This soil is not recommended for phosphorus sensitive species, in particular natives. With the addition of a low P multipurpose fertiliser and compost, this soil will be suitable for plant growth.

**Amendment Strategy**
Plant growth will benefit from the application of a **Low P Multipurpose NPK fertiliser at 50g/m2**
Incorporate **10g/m2 application of gypsum** to help balance the cations and reduce dispersion
An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

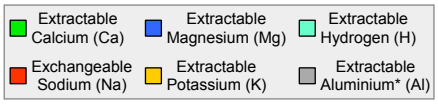
## pH and ELECTRICAL CONDUCTIVITY

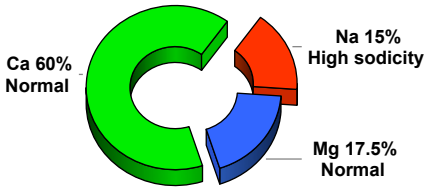



## CATION BALANCE

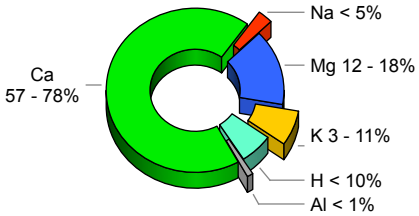
### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2



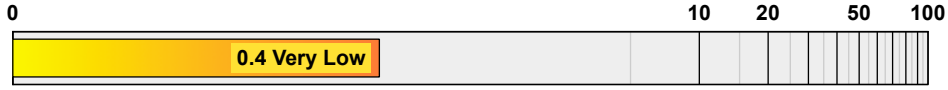




ACTUAL




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### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)




### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| **Ca:Mg** | **3.4** | 4.1 – 6.0 |
| Comment: Calcium low | | |
| **Mg:K** | **?** | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| **K/(Ca+Mg)** | **0** | < 0.07 |
| Comment: Acceptable | | |
| **K:Na** | **0** | N/A |

**Sodium Absorption Ratio:** D.N.T.

**Electrochemical Stability Index (ESI):**
0 High potential for dispersion and soil structure collapse

### SOLUBLE CATIONS (meq/100g)

Na: K: Ca: Mg:

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
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**Batch N°: 27554** **Sample N°: 1** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | 1 | | 0.2 | 4.2 | 4 |
| Phosphate-P ($PO_4$) | 60.3 | | 12 | 12.6 | 0.6 |
| Potassium (K) † | <3.90 | | 0.8 | 35.5 | 34.7 |
| Sulphate-S ($SO_4$) | 14 | | 2.8 | 13.6 | 10.8 |
| Calcium (Ca) † | 47.5 | | 9.5 | 252.8 | 243.3 |
| Magnesium (Mg) † | 8 | | 1.6 | 26.7 | 25.1 |
| Iron (Fe) | 31.3 | | 6.2 | 110.1 | 103.9 |
| Manganese (Mn) † | <0.55 | | 0.1 | 8.8 | 8.7 |
| Zinc (Zn) † | <0.65 | | 0.1 | 1 | 0.9 |
| Copper (Cu) | <0.64 | | 0.1 | 1.3 | 1.2 |
| Boron (B) † | <0.1 | | 0 | 0.5 | 0.5 |

### Explanation of graph ranges:

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

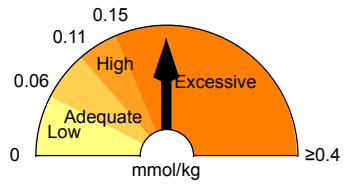
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m$^3$ and selected soil depth.

### Phosphorus Saturation Index




0.2

**Excessive.** Exceeds environmental threshold. Implement improved P management to reduce potential for nonpoint P pollution.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | **8** |
| Sum of Base Cations (meq/100g$^{-1}$): | **0.4** |
| Eff. Cation Exch. Capacity (eCEC): | **0.4** |
| Base Saturation (%): | **100** |
| Exchangeable Acidity (meq/100g$^{-1}$): | **-** |
| Exchangeable Acidity (%): | **-** |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **0** |
| – to neutralise Al (g/sqm): | **-** |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **5**

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Did not test** |
| Typical clay content: | **Did not test** |
| Size: | |
| Gravel content: | **Did not test** |
| Aggregate strength: | **Did not test** |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Did not test** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | **-** |

**Requires EC and Soil Texture result.**

| | |
|---|---|
| Organic Carbon (OC%)†: | **Did not test** |
| Organic Matter (OM%): | **-** |

Additional comments:

**Consultant: Chantal Hooper**

**Authorised Signatory: Simon Leake**

**Date of Report: 17 Sep 2013**

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


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**Batch N°: 27554** **Sample N°: 2** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Quarry Mining Systems Pty Ltd** | Project Name: | **REF 1308105** |
| Client Contact: | **Mark Philpott** | Location: | |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH1-BL-G1-SO 0.5** |
| Address: | **PO Box 7030**<br>**Redhead NSW 2290** | Description: | **Soil** |
| | | Test Type: | **FSC, BWC** |

## RECOMMENDATIONS

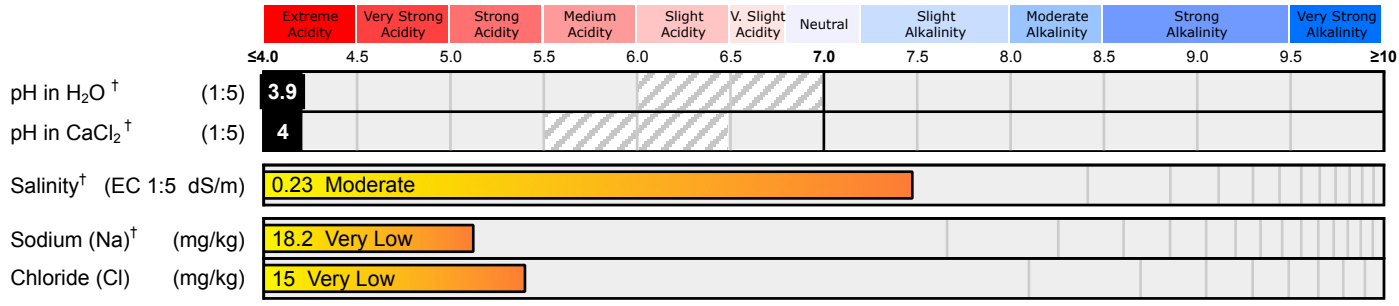
**Key Observations.**

Sample 'BH1-BL-G1-SO 0.5' was analysed for its chemical properties. This soil has extreme acidity and moderate salinity levels. The cation exchange has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from sulphate all nutrients need boosting. This soil will take time to ameliorate to become suitable for plant growth. We recommend further analysis after treatments have been applied.

**Amendment Strategy -** Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2. The** plant available nutrients are, overall, deficient. This is due to the acidity, which reduces the availability of many nutrients. A leguminous mulch (at 20% by volume) could be beneficial here If the leguminous mulch is not used, then incorporate composted organic matter i.e. **Green Waste Compost at 10L/m2** to improve soil structure and organic content, and thus further support plant growth. This will also help to buffer against potential toxicities and reduce dispersion. To further control dispersive tendencies, apply **gypsum at 100 g/m2** and incorporate thoroughly. Aluminium levels should be monitored to ensure that toxicity does not occur. We recommend raising the pH to above 5.5 in $CaCl_2$ with **lime incorporated at 200 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. Untreated, this soil is not fit for purpose. We recommend retesting the aluminium and pH a fortnight following the lime application.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

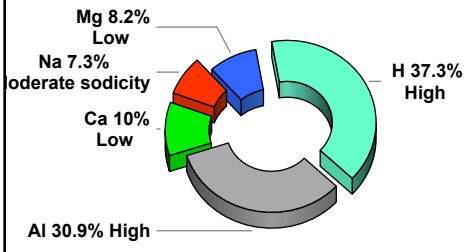
## pH and ELECTRICAL CONDUCTIVITY



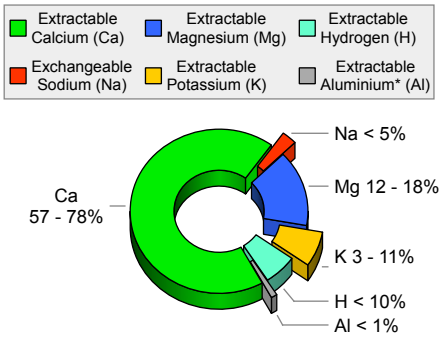

## CATION BALANCE

### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2

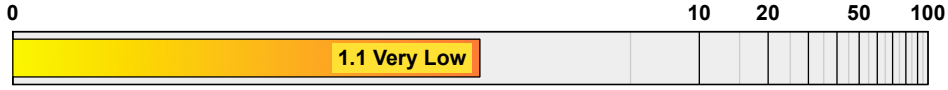



ACTUAL




IDEAL

### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)




### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 1.2 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | ? | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 0 | N/A |

**Sodium Absorption Ratio:** D.N.T.

**Electrochemical Stability Index (ESI):**
0.03 High potential for dispersion and soil structure collapse

**SOLUBLE CATIONS** (meq/100g)

Na: K: Ca: Mg:

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**Batch N°: 27554** **Sample N°: 2** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | <0.05 | | <0.3 | 4.2 | 3.9 |
| Phosphate-P ($PO_4$) | 13 | | 2.6 | 12.6 | 10 |
| Potassium (K) † | <3.90 | | 0.8 | 35.5 | 34.7 |
| Sulphate-S ($SO_4$) | 193 | | 38.5 | 13.6 | Drawdown |
| Calcium (Ca) † | 22.7 | | 4.5 | 252.8 | 248.3 |
| Magnesium (Mg) † | 11.2 | | 2.2 | 26.7 | 24.5 |
| Iron (Fe) | 135.5 | | 27 | 110.1 | 83.1 |
| Manganese (Mn) † | <0.55 | | 0.1 | 8.8 | 8.7 |
| Zinc (Zn) † | <0.65 | | 0.1 | 1 | 0.9 |
| Copper (Cu) | <0.64 | | 0.1 | 1.3 | 1.2 |
| Boron (B) † | <0.1 | | 0 | 0.5 | 0.5 |

### Explanation of graph ranges:

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

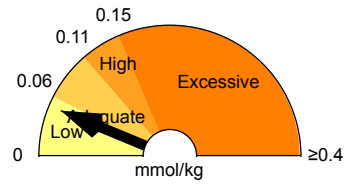
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m$^3$ and selected soil depth.

### Phosphorus Saturation Index




0.05

**Low.** Plant response to applied P is likely.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | **7.9** |
| Sum of Base Cations (meq/100g$^{-1}$): | **0.3** |
| Eff. Cation Exch. Capacity (eCEC): | **1.1** |
| Base Saturation (%): | **27.27** |
| Exchangeable Acidity (meq/100g$^{-1}$): | **0.41** |
| Exchangeable Acidity (%): | **37.27** |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **370** |
| – to neutralise Al (g/sqm): | **50** |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **0**

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Did not test** |
| Typical clay content: | **Did not test** |
| Size: | |
| Gravel content: | **Did not test** |
| Aggregate strength: | **Did not test** |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Did not test** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | **-** |

**Requires EC and Soil Texture result.**

| | |
|---|---|
| Organic Carbon (OC%)†: | **Did not test** |
| Organic Matter (OM%): | **-** |

Additional comments:

**Consultant: Chantal Hooper**

**Authorised Signatory: Simon Leake**

**Date of Report: 17 Sep 2013**

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 02 9980 6554
**Fax:** 02 9484 2427
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au


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**Batch N°: 27554** **Sample N°: 3** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Quarry Mining Systems Pty Ltd** | Project Name: | **REF 1308105** |
| Client Contact: | **Mark Philpott** | Location: | |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH2-10.5-12.0-SO 0.7** |
| Address: | **PO Box 7030**<br>**Redhead NSW 2290** | Description: | **Soil** |
| | | Test Type: | **FSC** |

## RECOMMENDATIONS

**Key Observations.**

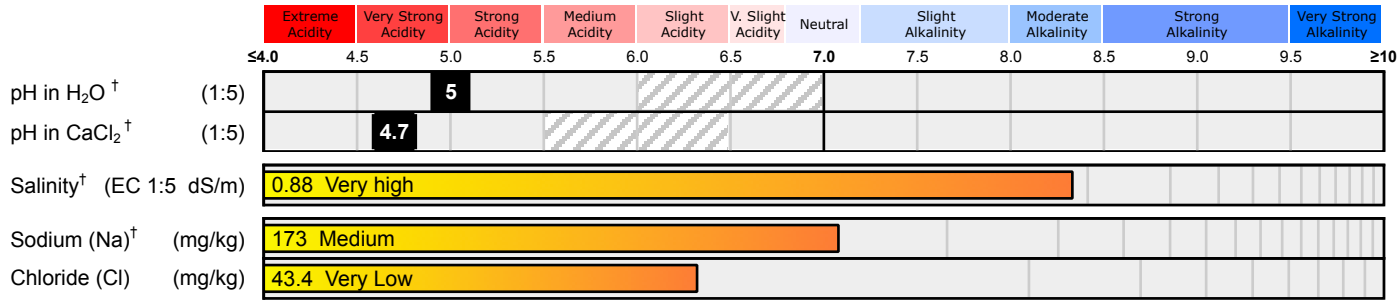
Sample 'BH2-10.5-12.0-SO 0.7' was analysed for its chemical properties. This soil has strong acidity and very high salinity levels. The cation exchange is highly magnesic making the soil hardsetting and has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is moderate indicating good nutrient uptake and retention. Aside from sulphate, iron and magnesium all nutrients need boosting. Due to the high sulphate levels, soil is saline therefore select saline tolerant natives species for growth.

**Amendment Strategy**

Plant growth will benefit from the application of **urea at 15g/m2** (2 applications) and **muriate of potash at 60g/m2.** To further control dispersive tendencies, apply **gypsum at 300 g/m2** and incorporate thoroughly. We recommend raising the pH to above 5.5 in $CaCl_2$ with **lime incorporated at 300 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

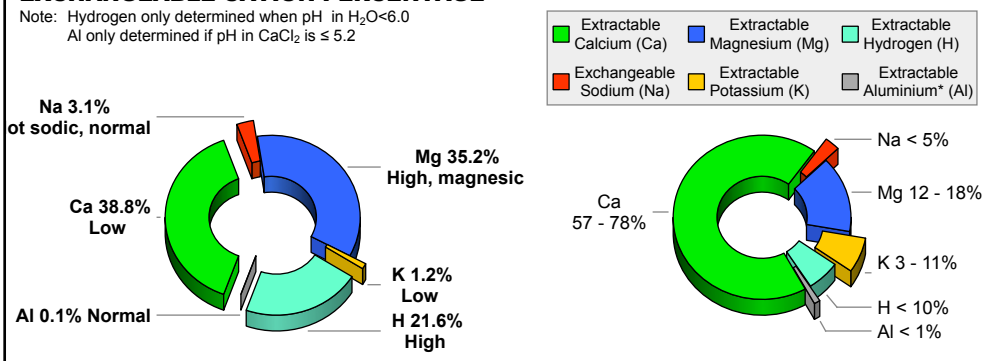
## pH and ELECTRICAL CONDUCTIVITY




## CATION BALANCE

### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2




### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)




### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 1.1 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | 29.7 | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0.02 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 0.4 | N/A |

**Sodium Absorption Ratio:** D.N.T.

**Electrochemical Stability Index (ESI):**
0.28 Low potential for dispersion and soil structure collapse

**SOLUBLE CATIONS** (meq/100g)

Na: K: Ca: Mg:

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

**Batch N°: 27554** **Sample N°: 3** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | 0.2 | | 0 | 4.2 | 4.2 |
| Phosphate-P ($PO_4$) | 16 | | 3.2 | 12.6 | 9.4 |
| Potassium (K) † | 115 | | 22.9 | 69 | 46.1 |
| Sulphate-S ($SO_4$) | 906 | | 180.7 | 13.6 | Drawdown |
| Calcium (Ca) † | 1893 | | 377.7 | 491.6 | 113.9 |
| Magnesium (Mg) † | 1041 | | 207.7 | 51.3 | Drawdown |
| Iron (Fe) | 561.6 | | 112 | 110.1 | Drawdown |
| Manganese (Mn) † | 10 | | 2 | 8.8 | 6.8 |
| Zinc (Zn) † | 4.7 | | 0.9 | 1 | 0.1 |
| Copper (Cu) | <0.64 | | 0.1 | 1.3 | 1.2 |
| Boron (B) † | <0.1 | | 0 | 0.5 | 0.5 |

### Explanation of graph ranges:

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

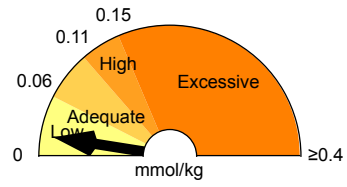
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m$^3$ and selected soil depth.

### Phosphorus Saturation Index




0.02

**Low.** Plant response to applied P is likely.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | **7.2** |
| Sum of Base Cations (meq/100g$^{-1}$): | **19.1** |
| Eff. Cation Exch. Capacity (eCEC): | **24.4** |
| Base Saturation (%): | **78.28** |
| Exchangeable Acidity (meq/100g$^{-1}$): | **5.27** |
| Exchangeable Acidity (%): | **21.6** |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **524** |
| – to neutralise Al (g/sqm): | **4** |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **302**

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Did not test** |
| Typical clay content: | **Did not test** |
| Size: | |
| Gravel content: | **Did not test** |
| Aggregate strength: | **Did not test** |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Did not test** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | **-** |

**Requires EC and Soil Texture result.**

| | |
|---|---|
| Organic Carbon (OC%)†: | **Did not test** |
| Organic Matter (OM%): | **-** |

Additional comments:

**Consultant: Chantal Hooper**

**Authorised Signatory: Simon Leake**

**Date of Report: 17 Sep 2013**

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

ASPAC

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
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**Tel:** 02 9980 6554
**Fax:** 02 9484 2427
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au


**Batch N°: 27554** **Sample N°: 4** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Quarry Mining Systems Pty Ltd** | Project Name: | **REF 1308105** |
| Client Contact: | **Mark Philpott** | Location: | |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH2-BL-B-SO 0.9** |
| Address: | **PO Box 7030**<br>**Redhead NSW 2290** | Description: | **Soil** |
| | | Test Type: | **FSC** |

## RECOMMENDATIONS

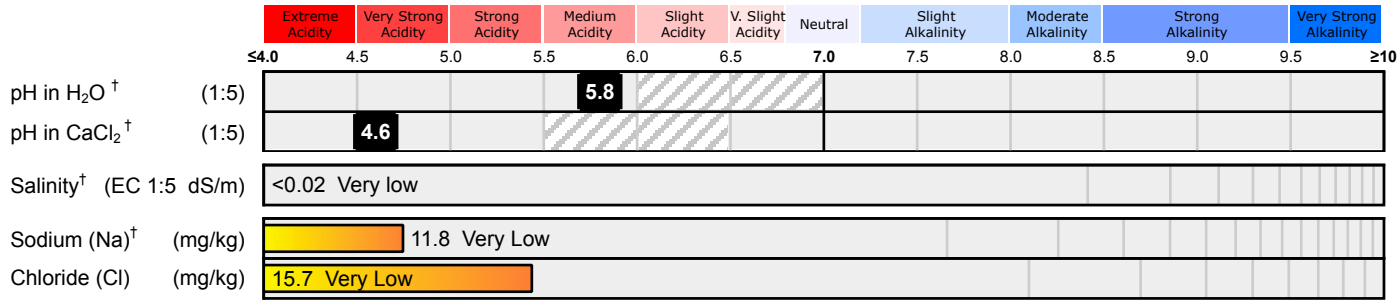
**Key Observations.**

Sample 'BH2-BL-B-SO 0.9' was analysed for its chemical properties. This soil has medium acidity and desirably low salinity levels. The cation exchange is highly sodic amaking the soil dispersive and has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating good nutrient uptake and retention. All nutrients require boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

**Amendment Strategy -** Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2. The** plant available nutrients are, overall, deficient. This is due to the acidity, which reduces the availability of many nutrients. A leguminous mulch (at 20% by volume) could be beneficial here If the leguminous mulch is not used, then incorporate composted organic matter i.e. **Green Waste Compost at 10L/m2** to improve soil structure and organic content, and thus further support plant growth. This will also help to buffer against potential toxicities and reduce dispersion. To further control dispersive tendencies, apply **gypsum at 50 g/m2** and incorporate thoroughly. Aluminium levels should be monitored to ensure that toxicity does not occur. We recommend raising the pH to above 5.5 in $CaCl_2$ with **lime incorporated at 50 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. Untreated, this soil is not fit for purpose. We recommend retesting the aluminium and pH a fortnight following the lime application.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

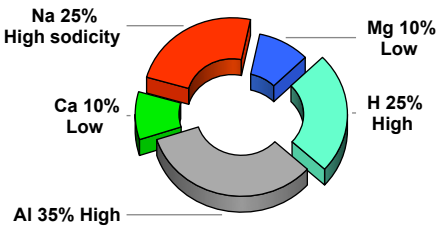
## pH and ELECTRICAL CONDUCTIVITY



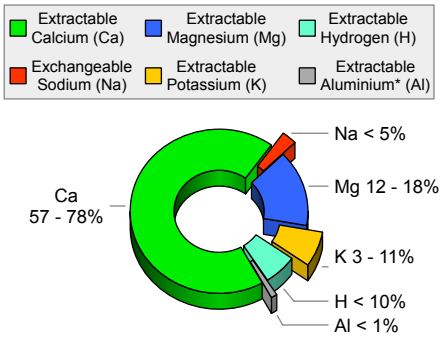

## CATION BALANCE

### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2

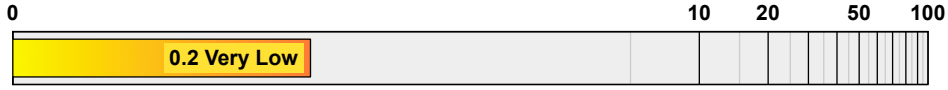



ACTUAL




IDEAL

### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)




### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 1 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | ? | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 0 | N/A |

**Sodium Absorption Ratio:** D.N.T.

**Electrochemical Stability Index (ESI):**
0 High potential for dispersion and soil structure collapse

**SOLUBLE CATIONS** (meq/100g)

Na: K: Ca: Mg:


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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

**Batch N°: 27554** **Sample N°: 4** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | <0.05 | | <0.3 | 4.2 | 3.9 |
| Phosphate-P ($PO_4$) | 6.2 | | 1.2 | 12.6 | 11.4 |
| Potassium (K) † | <3.90 | | 0.8 | 35.5 | 34.7 |
| Sulphate-S ($SO_4$) | 8.9 | | 1.8 | 13.6 | 11.8 |
| Calcium (Ca) † | <4.0 | | 0.8 | 252.8 | 252 |
| Magnesium (Mg) † | <2.40 | | 0.5 | 26.7 | 26.2 |
| Iron (Fe) | 57.5 | | 11.5 | 110.1 | 98.6 |
| Manganese (Mn) † | <0.55 | | 0.1 | 8.8 | 8.7 |
| Zinc (Zn) † | 1.6 | | 0.3 | 1 | 0.7 |
| Copper (Cu) | 0.8 | | 0.2 | 1.3 | 1.1 |
| Boron (B) † | <0.1 | | 0 | 0.5 | 0.5 |

### Explanation of graph ranges:

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

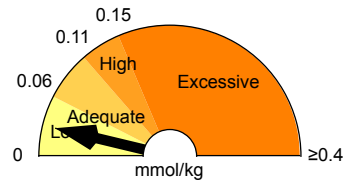
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m$^3$ and selected soil depth.

### Phosphorus Saturation Index




0.03

**Low.** Plant response to applied P is likely.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | **8** |
| Sum of Base Cations (meq/100g$^{-1}$): | **0.1** |
| Eff. Cation Exch. Capacity (eCEC): | **0.2** |
| Base Saturation (%): | **50** |
| Exchangeable Acidity (meq/100g$^{-1}$): | **0.05** |
| Exchangeable Acidity (%): | **25** |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **88** |
| – to neutralise Al (g/sqm): | **10** |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **0**

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Did not test** |
| Typical clay content: | **Did not test** |
| Size: | |
| Gravel content: | **Did not test** |
| Aggregate strength: | **Did not test** |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Did not test** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | **-** |

**Requires EC and Soil Texture result.**

| | |
|---|---|
| Organic Carbon (OC%)†: | **Did not test** |
| Organic Matter (OM%): | **-** |
| Additional comments: | |

**Consultant: Chantal Hooper** **Authorised Signatory: Simon Leake** **Date of Report: 17 Sep 2013**

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

ASPAC

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
**Mailing Address:** PO Box 357, Pennant Hills NSW 1715
**Tel:** 02 9980 6554
**Fax:** 02 9484 2427
**Em:** info@sesl.com.au
**Web:** www.sesl.com.au


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**Batch N°: 27554** **Sample N°: 5** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

Client Name: **Quarry Mining Systems Pty Ltd**
Client Contact: **Mark Philpott**
Client Job N°:
Client Order N°:
Address: **PO Box 7030, Redhead NSW 2290**

Project Name: **REF 1308105**
Location:
SESL Quote N°:
Sample Name: **BH2-BL-G-SO 0.6**
Description: **Soil**
Test Type: **FSC**

## RECOMMENDATIONS

**Key Observations.**

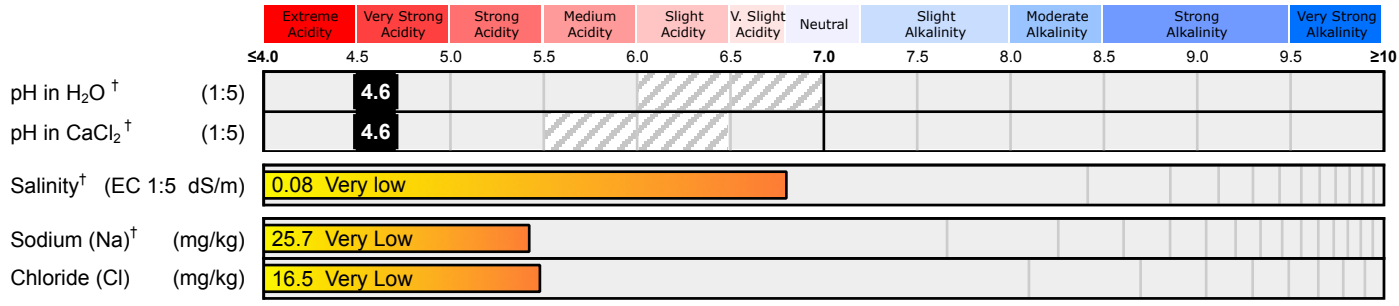
Sample 'BH2-BL-G-SO 0.6' was analysed for its chemical properties. This soil has very strong acidity and desirably low salinity levels. The cation exchange is highly sodic causing dispersion and has high levels of, hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from sulphate and zinc all nutrients need boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

**Amendment Strategy**

Plant growth will benefit from the application of **urea at 15g/m2** (2 applications) and **muriate of potash at 45g/m2.** To help boost magnesium levels, apply **dolomite at 140 g/m2** and incorporate thoroughly. We recommend raising the pH to above 5.5 in $CaCl_2$ with **lime incorporated at 150 g/m2** to prevent aluminium toxicity occuring and increase the availability of other nutrients. Apply **trace elements at 15g/m2**. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

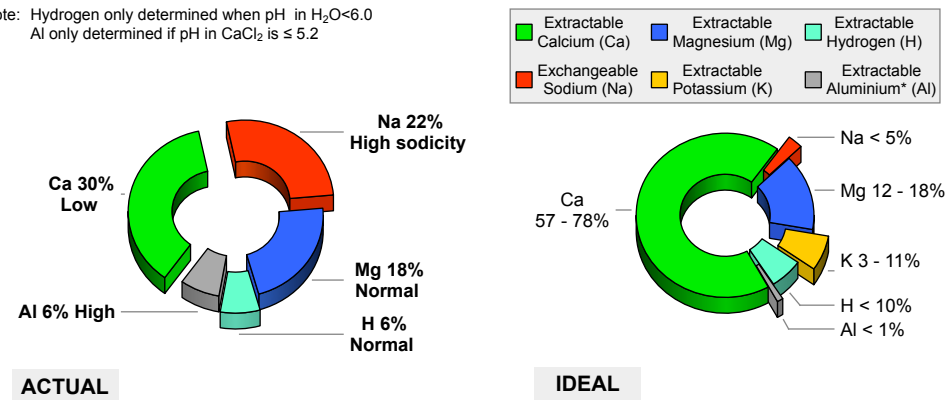
## pH and ELECTRICAL CONDUCTIVITY



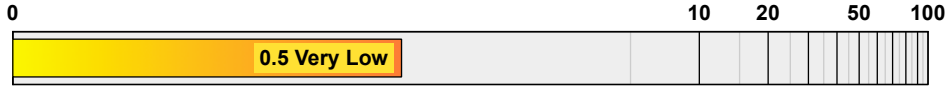

## CATION BALANCE

### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2




### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)




### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 1.7 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | ? | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 0 | N/A |

**Sodium Absorption Ratio:** D.N.T.

**Electrochemical Stability Index (ESI):**
0 High potential for dispersion and soil structure collapse

**SOLUBLE CATIONS** (meq/100g)

Na: K: Ca: Mg:

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


**Sample Drop Off:** 16 Chilvers Road, Thornleigh NSW 2120
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AUSTRALIA'S MOST TRUSTED EARTH SCIENCE SERVICES

**Batch N°: 27554** **Sample N°: 5** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | <0.05 | | <0.3 | 4.2 | 3.9 |
| Phosphate-P ($PO_4$) | 4.3 | | 0.9 | 12.6 | 11.7 |
| Potassium (K) † | <3.90 | | 0.8 | 35.5 | 34.7 |
| Sulphate-S ($SO_4$) | 94 | | 18.8 | 13.6 | Drawdown |
| Calcium (Ca) † | 30 | | 6 | 252.8 | 246.8 |
| Magnesium (Mg) † | 11 | | 2.2 | 26.7 | 24.5 |
| Iron (Fe) | 38.2 | | 7.6 | 110.1 | 102.5 |
| Manganese (Mn) † | 0.9 | | 0.2 | 8.8 | 8.6 |
| Zinc (Zn) † | 17 | | 3.4 | 1 | Drawdown |
| Copper (Cu) | 2.9 | | 0.6 | 1.3 | 0.7 |
| Boron (B) † | <0.1 | | 0 | 0.5 | 0.5 |

### Explanation of graph ranges:

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

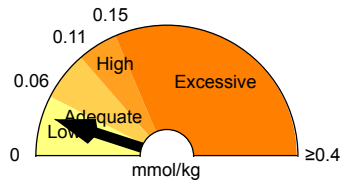
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m$^3$ and selected soil depth.

### Phosphorus Saturation Index




0.04

**Low.** Plant response to applied P is likely.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | **8** |
| Sum of Base Cations (meq/100g$^{-1}$): | **0.4** |
| Eff. Cation Exch. Capacity (eCEC): | **0.5** |
| Base Saturation (%): | **80** |
| Exchangeable Acidity (meq/100g$^{-1}$): | **0.03** |
| Exchangeable Acidity (%): | **6** |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **218** |
| – to neutralise Al (g/sqm): | **4** |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **0**

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Did not test** |
| Typical clay content: | **Did not test** |
| Size: | |
| Gravel content: | **Did not test** |
| Aggregate strength: | **Did not test** |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Did not test** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | **-** |

**Requires EC and Soil Texture result.**

| | |
|---|---|
| Organic Carbon (OC%)†: | **Did not test** |
| Organic Matter (OM%): | **-** |

Additional comments:

**Consultant: Chantal Hooper**

**Authorised Signatory: Simon Leake**

**Date of Report: 17 Sep 2013**

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


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**Batch N°: 27554** **Sample N°: 6** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

Client Name: **Quarry Mining Systems Pty Ltd**
Client Contact: **Mark Philpott**
Client Job N°:
Client Order N°:
Address: **PO Box 7030, Redhead NSW 2290**

Project Name: **REF 1308105**
Location:
SESL Quote N°:
Sample Name: **BH3-BL-B3-SO 1.25**
Description: **Soil**
Test Type: **FSC**

## RECOMMENDATIONS

**Key Observations.**

Sample 'BH3-BL-B3-SO 1.25' was analysed for its chemical properties. This soil has slight acidity and desirably low salinity levels. The cation exchange is highly sodic and slightly magnesic making the soil highly prone to dispersion and hardsetting. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. All nutrients need boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

**Amendment Strategy**

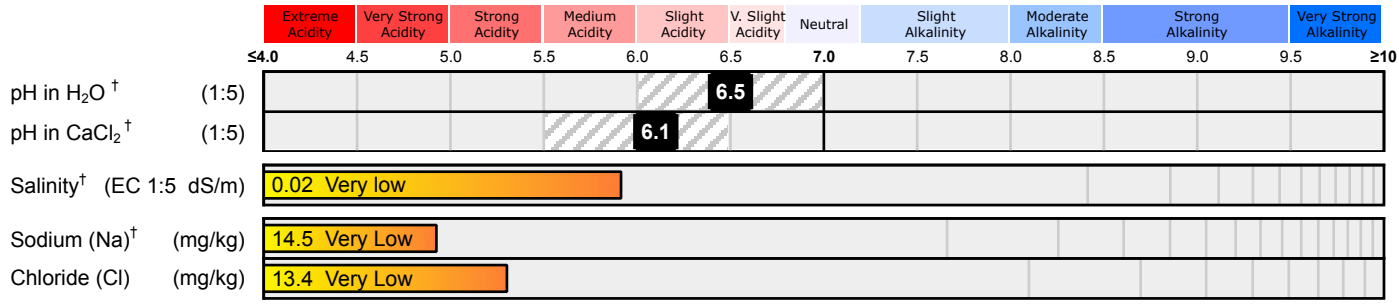
Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2**.The plant available nutrients are overall, deficient.

To further control dispersive tendencies, apply **gypsum at 50 g/m2** and incorporate thoroughly.

An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

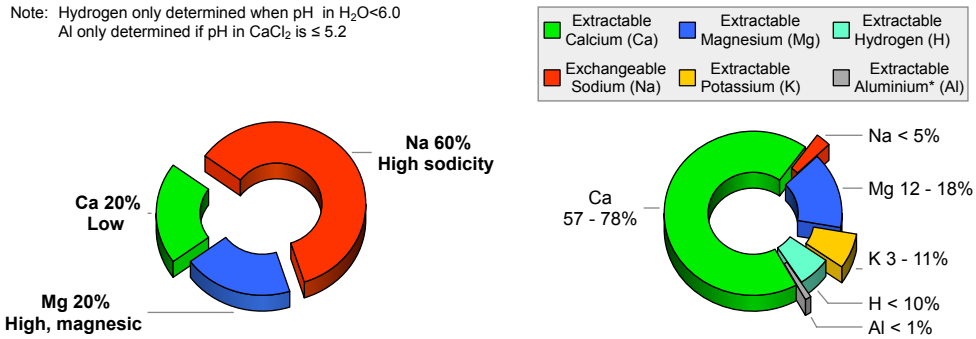
## pH and ELECTRICAL CONDUCTIVITY




## CATION BALANCE

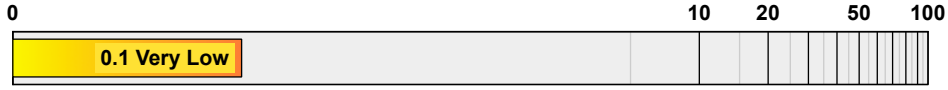
### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2




ACTUAL IDEAL

### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)




### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 1 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | ? | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 0 | N/A |

**Sodium Absorption Ratio:** D.N.T.

**Electrochemical Stability Index (ESI):**
0 High potential for dispersion and soil structure collapse

**SOLUBLE CATIONS** (meq/100g)

Na: K: Ca: Mg:

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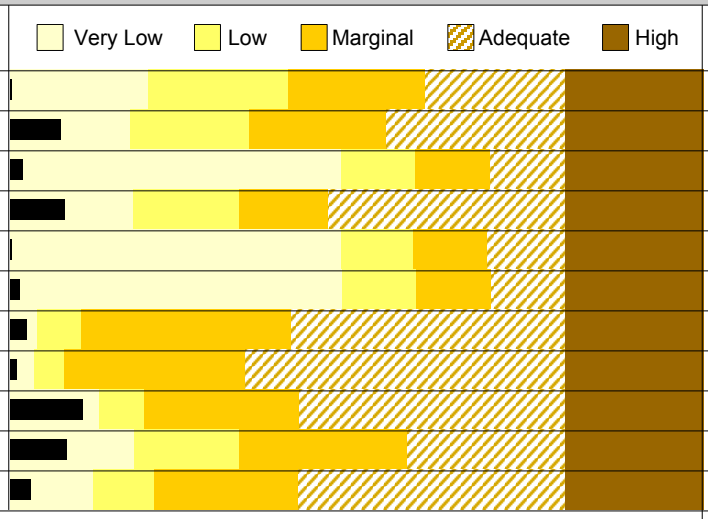
# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

**Batch N°: 27554** **Sample N°: 6** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | <0.05 | | <0.3 | 4.2 | 3.9 |
| Phosphate-P ($PO_4$) | 5.9 | | 1.2 | 12.6 | 11.4 |
| Potassium (K) † | <3.90 | | 0.8 | 35.5 | 34.7 |
| Sulphate-S ($SO_4$) | 6.7 | | 1.3 | 13.6 | 12.3 |
| Calcium (Ca) † | <4.0 | | 0.8 | 252.8 | 252 |
| Magnesium (Mg) † | <2.40 | | 0.5 | 26.7 | 26.2 |
| Iron (Fe) | 16.2 | | 3.2 | 110.1 | 106.9 |
| Manganese (Mn) † | <0.55 | | 0.1 | 8.8 | 8.7 |
| Zinc (Zn) † | <0.65 | | 0.1 | 1 | 0.9 |
| Copper (Cu) | <0.64 | | 0.1 | 1.3 | 1.2 |
| Boron (B) † | <0.1 | | 0 | 0.5 | 0.5 |



**Explanation of graph ranges:**

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

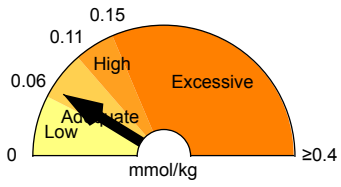
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m$^3$ and selected soil depth.

### Phosphorus Saturation Index




0.07

**Adequate.** Economic response to P unlikely. P application recommended maintaining current P level.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | - |
| Sum of Base Cations (meq/100g$^{-1}$): | **0.1** |
| Eff. Cation Exch. Capacity (eCEC): | **0.1** |
| Base Saturation (%): | **100** |
| Exchangeable Acidity (meq/100g$^{-1}$): | - |
| Exchangeable Acidity (%): | - |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **0** |
| – to neutralise Al (g/sqm): | - |

**Gypsum Application Rate**

| | |
|---|---|
| – to achieve 67.5% exch. Ca (g/sqm): | **8** |

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Did not test** |
| Typical clay content: | **Did not test** |
| Size: | |
| Gravel content: | **Did not test** |
| Aggregate strength: | **Did not test** |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Did not test** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | - |

**Requires EC and Soil Texture result.**

| | |
|---|---|
| Organic Carbon (OC%)†: | **Did not test** |
| Organic Matter (OM%): | - |

Additional comments:

**Consultant: Chantal Hooper** **Authorised Signatory: Simon Leake** **Date of Report: 17 Sep 2013**

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


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**Fax:** 02 9484 2427
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**Web:** www.sesl.com.au


**Batch N°: 27554** **Sample N°: 7** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Quarry Mining Systems Pty Ltd** | Project Name: | **REF 1308105** |
| Client Contact: | **Mark Philpott** | Location: | |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH3-BL-G-SO 0.603** |
| Address: | **PO Box 7030**<br>**Redhead NSW 2290** | Description: | **Soil** |
| | | Test Type: | **FSC** |

## RECOMMENDATIONS

**Key Observations.**

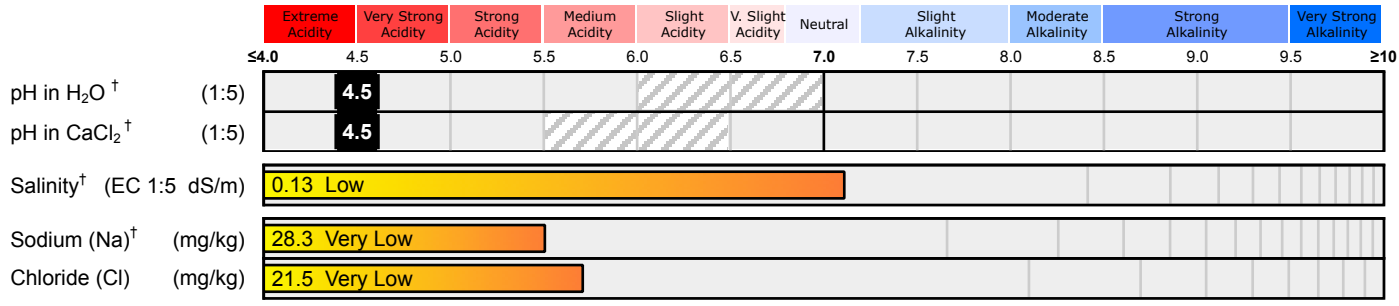
Sample 'BH3-BL-G-SO 0.603' was analysed for its chemical properties. This soil has extreme acidity and low salinity levels. The cation exchange is highly sodic causing dispersion and has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from sulphate and zinc all nutrients need boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

**Amendment Strategy**

Plant growth will benefit from the application of **urea at 15g/m2** (2 applications) and **muriate of potash at 45g/m2.** To help boost magnesium levels, apply **dolomite at 140 g/m2** and incorporate thoroughly. We recommend raising the pH to above 5.5 in $CaCl_2$ with **lime incorporated at 150 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients. Apply **trace elements at 15g/m2**. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

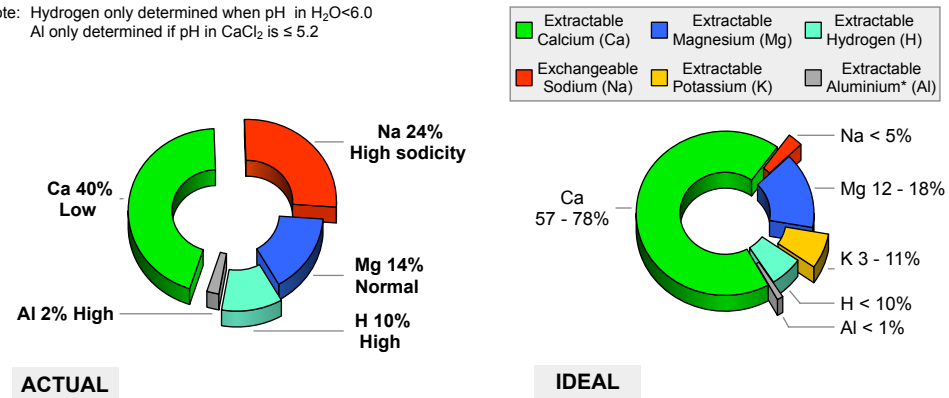
## pH and ELECTRICAL CONDUCTIVITY



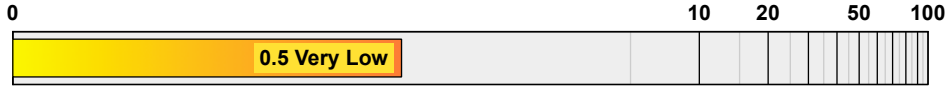

## CATION BALANCE

### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2




### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)




### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 2.9 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | ? | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 0 | N/A |

**Sodium Absorption Ratio:** D.N.T.

**Electrochemical Stability Index (ESI):**
0.01 High potential for dispersion and soil structure collapse

**SOLUBLE CATIONS** (meq/100g)

Na: K: Ca: Mg:

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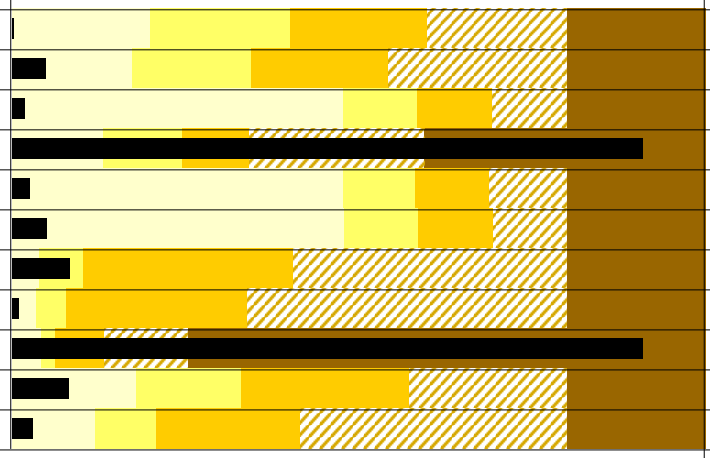
# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

**Batch N°: 27554** **Sample N°: 7** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | <0.05 | | <0.3 | 4.2 | 3.9 |
| Phosphate-P ($PO_4$) | 3.9 | | 0.8 | 12.6 | 11.8 |
| Potassium (K) † | <3.90 | | 0.8 | 35.5 | 34.7 |
| Sulphate-S ($SO_4$) | 104 | | 20.7 | 13.6 | Drawdown |
| Calcium (Ca) † | 39.6 | | 7.9 | 252.8 | 244.9 |
| Magnesium (Mg) † | 8.4 | | 1.7 | 26.7 | 25 |
| Iron (Fe) | 57.4 | | 11.5 | 110.1 | 98.6 |
| Manganese (Mn) † | <0.55 | | 0.1 | 8.8 | 8.7 |
| Zinc (Zn) † | 18 | | 3.6 | 1 | Drawdown |
| Copper (Cu) | <0.64 | | 0.1 | 1.3 | 1.2 |
| Boron (B) † | <0.1 | | 0 | 0.5 | 0.5 |



### Explanation of graph ranges:

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

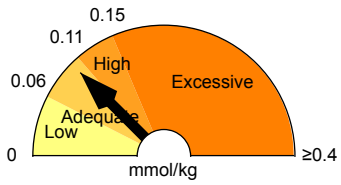
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m$^3$ and selected soil depth.

### Phosphorus Saturation Index




0.1

**Adequate.** Economic response to P unlikely. P application recommended maintaining current P level.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | **8** |
| Sum of Base Cations (meq/100g$^{-1}$): | **0.4** |
| Eff. Cation Exch. Capacity (eCEC): | **0.5** |
| Base Saturation (%): | **80** |
| Exchangeable Acidity (meq/100g$^{-1}$): | **0.05** |
| Exchangeable Acidity (%): | **10** |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **234** |
| – to neutralise Al (g/sqm): | **1** |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **0**

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Did not test** |
| Typical clay content: | **Did not test** |
| Size: | |
| Gravel content: | **Did not test** |
| Aggregate strength: | **Did not test** |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Did not test** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | **-** |

**Requires EC and Soil Texture result.**

| | |
|---|---|
| Organic Carbon (OC%)†: | **Did not test** |
| Organic Matter (OM%): | **-** |

Additional comments:

**Consultant: Chantal Hooper**

**Authorised Signatory: Simon Leake**

**Date of Report: 17 Sep 2013**

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

**Batch N°: 27554** **Sample N°: 8** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

Client Name: **Quarry Mining Systems Pty Ltd**
Client Contact: **Mark Philpott**
Client Job N°:
Client Order N°:
Address: **PO Box 7030, Redhead NSW 2290**

Project Name: **REF 1308105**
Location:
SESL Quote N°:
Sample Name: **BH4-BL-B-SO 0.71**
Description: **Soil**
Test Type: **FSC**

## RECOMMENDATIONS

**Key Observations.**

Sample 'BH4-BL-B-SO 0.71' was analysed for its chemical properties. This soil has slight acidity and desirably low salinity levels. The cation exchange is highly sodic and slightly magnesic making the soil highly prone to dispersion and hardsetting. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. All nutrients need boosting. We recommend further testing after treatments have been applied.

**Amendment Strategy**

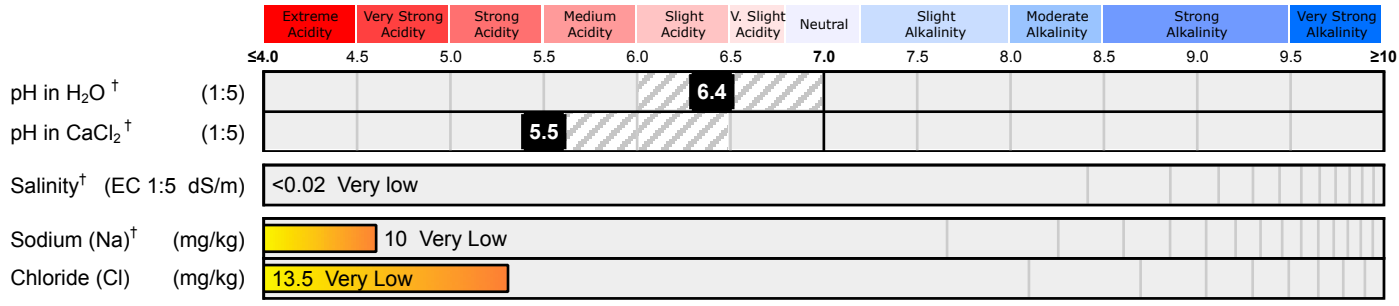
Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2**.The plant available nutrients are, overall, deficient.

To further control dispersive tendencies, apply **gypsum at 50 g/m2** and incorporate thoroughly.

An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

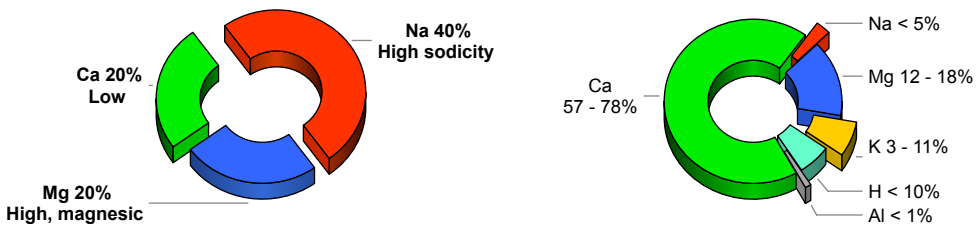
## pH and ELECTRICAL CONDUCTIVITY




## CATION BALANCE

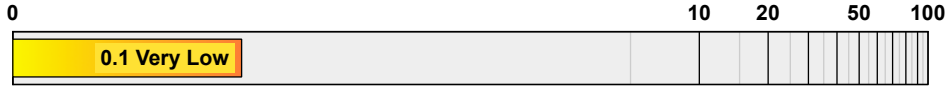
### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2




ACTUAL IDEAL

### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)




### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 1 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | ? | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 0 | N/A |

**Sodium Absorption Ratio:** D.N.T.

**Electrochemical Stability Index (ESI):**
0 High potential for dispersion and soil structure collapse

**SOLUBLE CATIONS** (meq/100g)

Na: K: Ca: Mg:

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

**Batch N°: 27554** **Sample N°: 8** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | <0.05 | | <0.3 | 4.2 | 3.9 |
| Phosphate-P ($PO_4$) | 5.8 | | 1.2 | 12.6 | 11.4 |
| Potassium (K) † | <3.90 | | 0.8 | 35.5 | 34.7 |
| Sulphate-S ($SO_4$) | 4.9 | | 1 | 13.6 | 12.6 |
| Calcium (Ca) † | <4.0 | | 0.8 | 252.8 | 252 |
| Magnesium (Mg) † | 2.6 | | 0.5 | 26.7 | 26.2 |
| Iron (Fe) | 31.4 | | 6.3 | 110.1 | 103.8 |
| Manganese (Mn) † | <0.55 | | 0.1 | 8.8 | 8.7 |
| Zinc (Zn) † | <0.65 | | 0.1 | 1 | 0.9 |
| Copper (Cu) | <0.64 | | 0.1 | 1.3 | 1.2 |
| Boron (B) † | <0.1 | | 0 | 0.5 | 0.5 |

### Explanation of graph ranges:

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

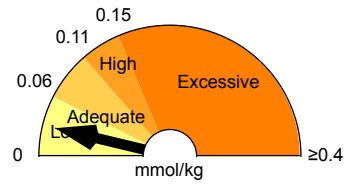
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m$^3$ and selected soil depth.

### Phosphorus Saturation Index




0.03

**Low.** Plant response to applied P is likely.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | **8** |
| Sum of Base Cations (meq/100g$^{-1}$): | **0.1** |
| Eff. Cation Exch. Capacity (eCEC): | **0.1** |
| Base Saturation (%): | **100** |
| Exchangeable Acidity (meq/100g$^{-1}$): | **-** |
| Exchangeable Acidity (%): | **-** |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **0** |
| – to neutralise Al (g/sqm): | **-** |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **8**

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Did not test** |
| Typical clay content: | **Did not test** |
| Size: | |
| Gravel content: | **Did not test** |
| Aggregate strength: | **Did not test** |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Did not test** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | **-** |

**Requires EC and Soil Texture result.**

| | |
|---|---|
| Organic Carbon (OC%)†: | **Did not test** |
| Organic Matter (OM%): | **-** |

Additional comments:

**Consultant: Chantal Hooper**

**Authorised Signatory: Simon Leake**

**Date of Report: 17 Sep 2013**

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


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**Em:** info@sesl.com.au
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**Batch N°: 27554** **Sample N°: 9** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Quarry Mining Systems Pty Ltd** | Project Name: | **REF 1308105** |
| Client Contact: | **Mark Philpott** | Location: | |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH4-BL-G-SO 0.51** |
| Address: | **PO Box 7030**<br>**Redhead NSW 2290** | Description: | **Soil** |
| | | Test Type: | **FSC** |

## RECOMMENDATIONS

**Key Observations.**

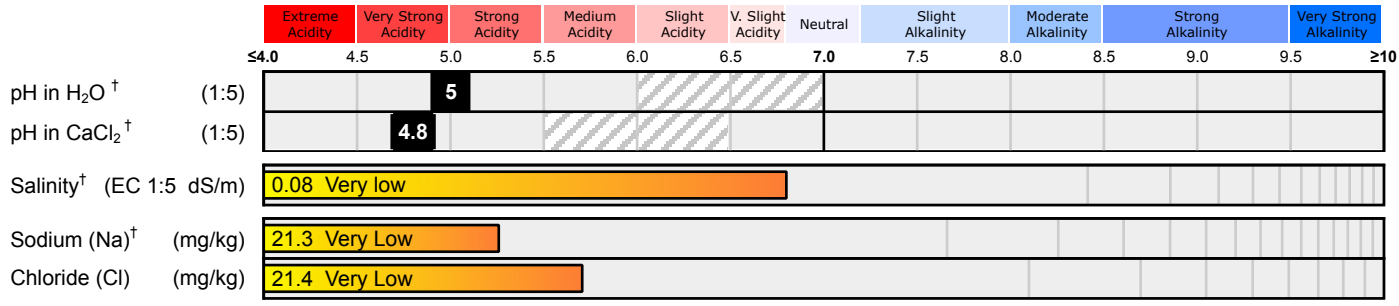
Sample 'BH4-BL-G-SO 0.51' was analysed for its chemical properties. This soil has very strong acidity and desirably low salinity levels. The cation exchange is highly sodic, sightly magnesic making the soil dispersive and hardsetting and has high levels of hydrogen and aluminium, leading to the acidity. The high acidity has increased the availability of aluminium, which will result in plant toxicities. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. Aside from zinc all nutrients need boosting. This soil will take time to ameliorate and we recommend further testing after treatments have been applied.

**Amendment Strategy**

Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2. The** plant available nutrients are, overall, deficient. An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**. We recommend raising the pH to above 5.5 in $CaCl_2$ with **lime incorporated at 100 g/m2** to prevent aluminium toxicity occurring and increase the availability of other nutrients.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

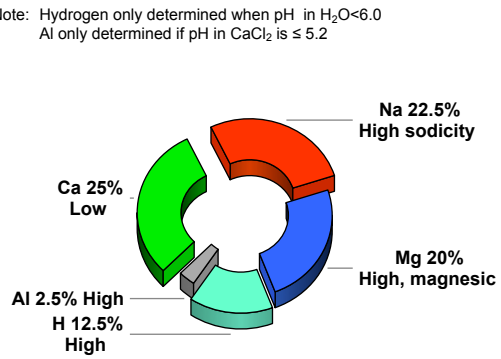
## pH and ELECTRICAL CONDUCTIVITY



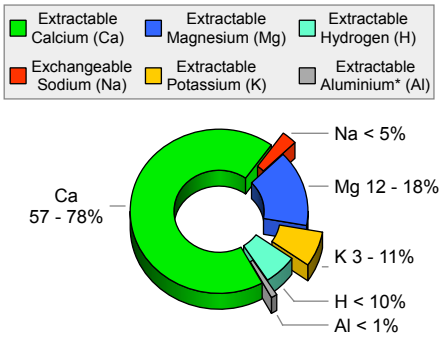

## CATION BALANCE

### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2

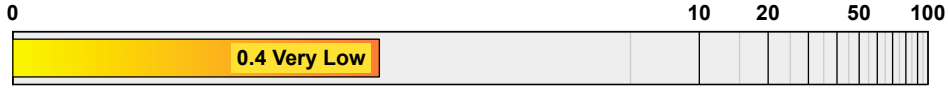



ACTUAL




IDEAL

### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)




### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 1.3 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | ? | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 0 | N/A |

**Sodium Absorption Ratio:** D.N.T.

**Electrochemical Stability Index (ESI):**
0 High potential for dispersion and soil structure collapse

**SOLUBLE CATIONS** (meq/100g)

Na: K: Ca: Mg:


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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


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**Batch N°: 27554** **Sample N°: 9** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | <0.05 | | <0.3 | 4.2 | 3.9 |
| Phosphate-P ($PO_4$) | 3.9 | | 0.8 | 12.6 | 11.8 |
| Potassium (K) † | <3.90 | | 0.8 | 35.5 | 34.7 |
| Sulphate-S ($SO_4$) | 49 | | 9.8 | 13.6 | 3.8 |
| Calcium (Ca) † | 20.1 | | 4 | 252.8 | 248.8 |
| Magnesium (Mg) † | 9.9 | | 2 | 26.7 | 24.7 |
| Iron (Fe) | 52.5 | | 10.5 | 110.1 | 99.6 |
| Manganese (Mn) † | <0.55 | | 0.1 | 8.8 | 8.7 |
| Zinc (Zn) † | 9.6 | | 1.9 | 1 | Drawdown |
| Copper (Cu) | 0.9 | | 0.2 | 1.3 | 1.1 |
| Boron (B) † | <0.1 | | 0 | 0.5 | 0.5 |

### Explanation of graph ranges:

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

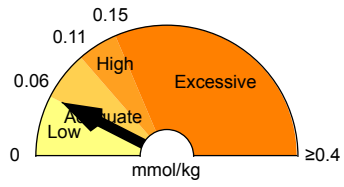
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m$^3$ and selected soil depth.

### Phosphorus Saturation Index




0.06

**Adequate.** Economic response to P unlikely. P application recommended maintaining current P level.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | **8** |
| Sum of Base Cations (meq/100g$^{-1}$): | **0.3** |
| Eff. Cation Exch. Capacity (eCEC): | **0.4** |
| Base Saturation (%): | **75** |
| Exchangeable Acidity (meq/100g$^{-1}$): | **0.05** |
| Exchangeable Acidity (%): | **12.5** |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **161** |
| – to neutralise Al (g/sqm): | **1** |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **0**

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Did not test** |
| Typical clay content: | **Did not test** |
| Size: | |
| Gravel content: | **Did not test** |
| Aggregate strength: | **Did not test** |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Did not test** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | **-** |

**Requires EC and Soil Texture result.**

| | |
|---|---|
| Organic Carbon (OC%)†: | **Did not test** |
| Organic Matter (OM%): | **-** |

Additional comments:

**Consultant: Chantal Hooper**

**Authorised Signatory: Simon Leake**

**Date of Report: 17 Sep 2013**

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

**Batch N°: 27554** **Sample N°: 10** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

Client Name: **Quarry Mining Systems Pty Ltd**
Client Contact: **Mark Philpott**
Client Job N°:
Client Order N°:
Address: **PO Box 7030, Redhead NSW 2290**

Project Name: **REF 1308105**
Location:
SESL Quote N°:
Sample Name: **BH5-BL-B-SO 1.302**
Description: **Soil**
Test Type: **FSC**

## RECOMMENDATIONS

**Key Observations.**

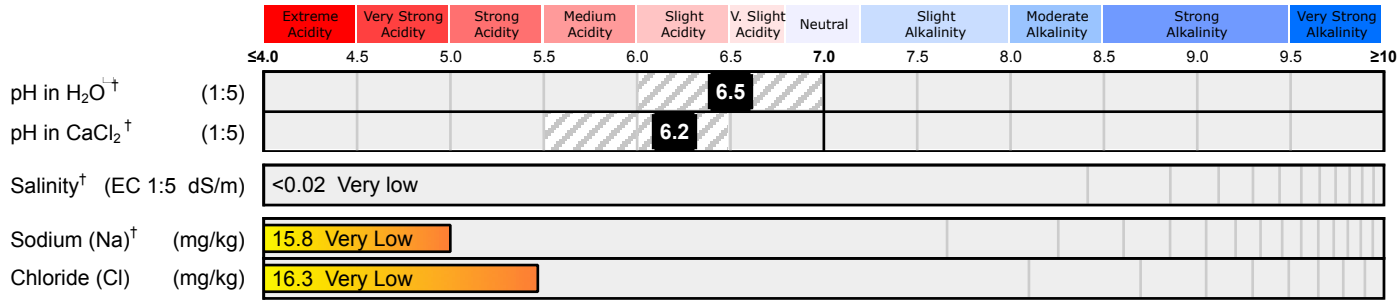
Sample 'BH5-BL-B-SO 1.302' was analysed for its chemical properties. This soil has slight acidity and desirably low salinity levels. The cation exchange is highly sodic and slightly magnesic making the soil highly prone to dispersion and hardsetting. The effective cation exchange capacity (eCEC) is very low indicating poor nutrient uptake and retention. All nutrients need boosting.

**Amendment Strategy**

Plant growth will benefit from the application of a **multipurpose low P (for natives) NPK fertiliser at 50 g/m2**.The plant available nutrients are, overall, deficient.
To further control dispersive tendencies, apply **gypsum at 50 g/m2** and incorporate thoroughly.
An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

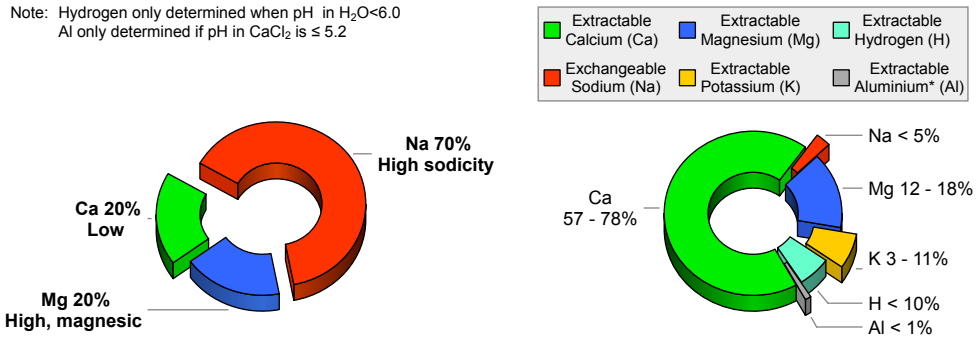
## pH and ELECTRICAL CONDUCTIVITY




## CATION BALANCE

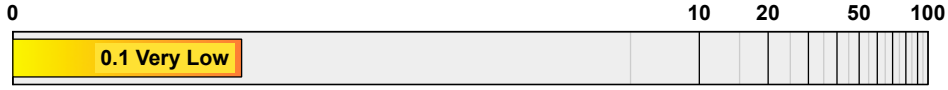
### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2




ACTUAL IDEAL

### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)




### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 1 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | ? | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 0 | N/A |

**Sodium Absorption Ratio:** D.N.T.

**Electrochemical Stability Index (ESI):**
0 High potential for dispersion and soil structure collapse

**SOLUBLE CATIONS** (meq/100g)

Na: K: Ca: Mg:

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

**Batch N°: 27554** **Sample N°: 10** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | <0.05 | | <0.3 | 4.2 | 3.9 |
| Phosphate-P ($PO_4$) | 5.4 | | 1.1 | 12.6 | 11.5 |
| Potassium (K) † | <3.90 | | 0.8 | 35.5 | 34.7 |
| Sulphate-S ($SO_4$) | 4.4 | | 0.9 | 13.6 | 12.7 |
| Calcium (Ca) † | <4.0 | | 0.8 | 252.8 | 252 |
| Magnesium (Mg) † | 3 | | 0.6 | 26.7 | 26.1 |
| Iron (Fe) | 33 | | 6.6 | 110.1 | 103.5 |
| Manganese (Mn) † | <0.55 | | 0.1 | 8.8 | 8.7 |
| Zinc (Zn) † | <0.65 | | 0.1 | 1 | 0.9 |
| Copper (Cu) | <0.64 | | 0.1 | 1.3 | 1.2 |
| Boron (B) † | <0.1 | | 0 | 0.5 | 0.5 |

### Explanation of graph ranges:

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

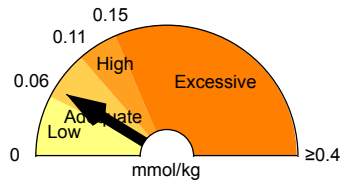
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m$^3$ and selected soil depth.

### Phosphorus Saturation Index




0.07

**Adequate.** Economic response to P unlikely. P application recommended maintaining current P level.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | - |
| Sum of Base Cations (meq/100g$^{-1}$): | **0.1** |
| Eff. Cation Exch. Capacity (eCEC): | **0.1** |
| Base Saturation (%): | **100** |
| Exchangeable Acidity (meq/100g$^{-1}$): | - |
| Exchangeable Acidity (%): | - |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **0** |
| – to neutralise Al (g/sqm): | - |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **8**

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Did not test** |
| Typical clay content: | **Did not test** |
| Size: | |
| Gravel content: | **Did not test** |
| Aggregate strength: | **Did not test** |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Did not test** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | - |

**Requires EC and Soil Texture result.**

| | |
|---|---|
| Organic Carbon (OC%)†: | **Did not test** |
| Organic Matter (OM%): | - |

Additional comments:

**Consultant: Chantal Hooper** **Authorised Signatory: Simon Leake** **Date of Report: 17 Sep 2013**

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant

**Batch N°: 27554** **Sample N°: 11** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

| | | | |
|---|---|---|---|
| Client Name: | **Quarry Mining Systems Pty Ltd** | Project Name: | **REF 1308105** |
| Client Contact: | **Mark Philpott** | Location: | |
| Client Job N°: | | SESL Quote N°: | |
| Client Order N°: | | Sample Name: | **BH5-BL-M-SO 0.633** |
| Address: | **PO Box 7030**<br>**Redhead NSW 2290** | Description: | **Soil** |
| | | Test Type: | **FSC** |

## RECOMMENDATIONS

**Key Observations.**

Sample 'BH5-BL-M-SO 0.633' was analysed for its chemical properties. This soil has slight alkalinity and extreme salinity levels. The cation exchange is highly magnesic making the soil highly prone to hardsetting. The effective cation exchange capacity (eCEC) is high indicating excellent nutrient uptake and retention however this is been driven up by the extremely high sulphate levels. All nutrients need boosting.

**Amendment Strategy**

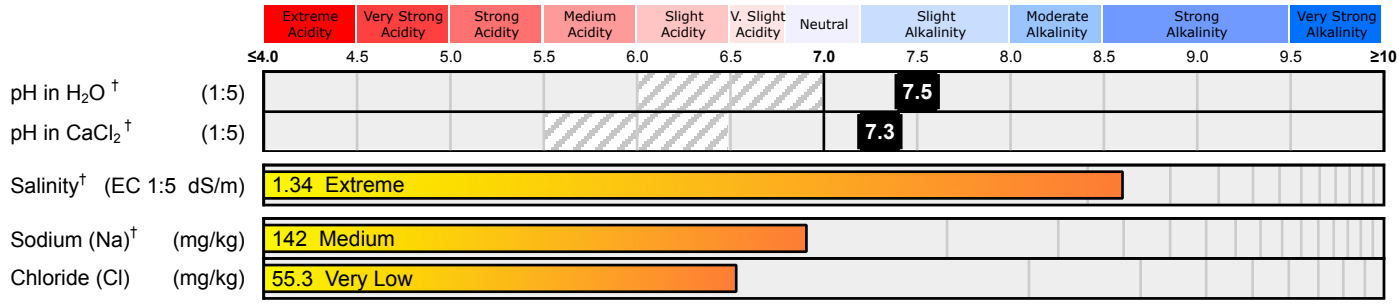
The saline levels are extreme therefore select saline tolerant natives for growth. Incorporate **Iron sulphate at 50g/m2** to bring down the pH levels. Plant growth will benefit from the application of a **urea at 15g/m2** ( 2 applications).

To further control dispersive tendencies, apply **gypsum at 300 g/m2** in 2 applications and incorporate thoroughly.

An application of organic matter would aid in boosting organic levels, improve, aeration and drainage and the overall health of the soil, i.e. **Green Waste Compost at 10L/m2**.

**SOIL SAMPLE DEPTH (mm):** ○ 100 ◉ 150 ○ 200 **FERTILITY RATING:** ○ Low ◉ Moderate ○ High

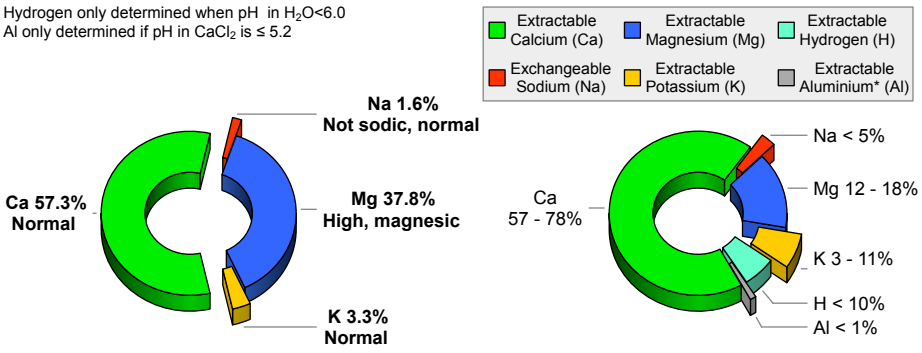
## pH and ELECTRICAL CONDUCTIVITY




## CATION BALANCE

### EXCHANGEABLE CATION PERCENTAGE

Note: Hydrogen only determined when pH in $H_2O$<6.0
Al only determined if pH in $CaCl_2$ is ≤ 5.2




### EFFECTIVE CATION EXCHANGE CAPACITY (eCEC)




### CATION RATIOS

| Ratio | Result | Target Range |
|---|---|---|
| Ca:Mg | 1.5 | 4.1 – 6.0 |
| Comment: Calcium low | | |
| Mg:K | 11.5 | 2.6 – 5.0 |
| Comment: Potential Potassium deficiency | | |
| K/(Ca+Mg) | 0.03 | < 0.07 |
| Comment: Acceptable | | |
| K:Na | 2 | N/A |

**Sodium Absorption Ratio:** D.N.T.

**Electrochemical Stability Index (ESI):**
0.84 Low potential for dispersion and soil structure collapse

**SOLUBLE CATIONS** (meq/100g)

Na: K: Ca: Mg:

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# Soil Chemistry Profile

## Mehlich 3 - Multi-nutrient Extractant


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**Batch N°: 27554** **Sample N°: 11** **Date Received: 5/9/13** **Report Status:** ○ Draft ◉ Final

## PLANT AVAILABLE NUTRIENTS

| Major Nutrients | Result (mg/kg) | Very Low / Low / Marginal / Adequate / High | Result (g/sqm) | Desirable (g/sqm) | Adjustment (g/sqm) |
|---|---|---|---|---|---|
| Nitrate-N ($NO_3$) | <0.05 | | <0.3 | 4.2 | 3.9 |
| Phosphate-P ($PO_4$) | 48 | | 9.6 | 12.6 | 3 |
| Potassium (K) † | 496 | | 99 | 77.4 | Drawdown |
| Sulphate-S ($SO_4$) | 1305 | | 260.3 | 13.6 | Drawdown |
| Calcium (Ca) † | 4431 | | 884 | 551.2 | Drawdown |
| Magnesium (Mg) † | 1772 | | 353.5 | 57.7 | Drawdown |
| Iron (Fe) | 317.7 | | 63.4 | 110.1 | 46.7 |
| Manganese (Mn) † | 16 | | 3.2 | 8.8 | 5.6 |
| Zinc (Zn) † | 3.4 | | 0.7 | 1 | 0.3 |
| Copper (Cu) | <0.64 | | 0.1 | 1.3 | 1.2 |
| Boron (B) † | <0.1 | | 0 | 0.5 | 0.5 |

### Explanation of graph ranges:

**Very Low**
Growth is likely to be severely depressed and deficiency symptoms present. Large applications for soil building purposes are usually recommended. Potential response to nutrient addition is >90%.

**Low**
Potential "hidden hunger", or sub-clinical deficiency. Potential response to nutrient addition is 60 to 90%.

**Marginal**
Supply of this nutrient is barely adequate for the plant, and build-up is still recommended. Potential response to nutrient addition is 30 to 60%.

**Adequate**
Supply of this nutrient is adequate for the plant, and and only maintenance application rates are recommended. Potential response to nutrient addition is 5 to 30%.

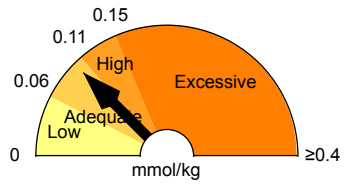
**High**
The level is excessive and may be detrimental to plant growth (i.e. phytotoxic) and may contribute to pollution of ground and surface waters. Drawdown is recommended. Potential response to nutrient addition is <2%.

**NOTES:** Adjustment recommendation calculates the elemental application to shift the soil test level to within the **Adequate** band, which maximises growth/yield, and economic efficiency, and minimises impact on the environment.

**Drawdown:** The objective nutrient management is to utilise residual soil nutrients. There is no agronomic reason to apply fertiliser when soil test levels exceed **Adequate**.

• g/sqm measurements are based on soil bulk density of 1.33 tonne/m³ and selected soil depth.

### Phosphorus Saturation Index




0.1

**Adequate.** Economic response to P unlikely. P application recommended maintaining current P level.

### Exchangeable Acidity

| | |
|---|---|
| Adams-Evans Buffer pH (BpH): | - |
| Sum of Base Cations (meq/100g$^{-1}$): | **38.7** |
| Eff. Cation Exch. Capacity (eCEC): | **38.7** |
| Base Saturation (%): | **100** |
| Exchangeable Acidity (meq/100g$^{-1}$): | - |
| Exchangeable Acidity (%): | - |

**Lime Application Rate**

| | |
|---|---|
| – to achieve pH 6.0 (g/sqm): | **0** |
| – to neutralise Al (g/sqm): | - |

**Gypsum Application Rate**

– to achieve 67.5% exch. Ca (g/sqm): **680**

The CGAR is corrected for a soil depth of 150mm and any Lime addition to achieve pH 6.0.

### Physical Description

| | |
|---|---|
| Texture: | **Did not test** |
| Typical clay content: | **Did not test** |
| Size: | |
| Gravel content: | **Did not test** |
| Aggregate strength: | **Did not test** |
| Structural unit: | **Did not test** |
| Potential infiltration rate: | **Did not test** |
| Permeability (mm/hr): | **Did not test** |
| Calculated $EC_{SE}$ (dS/m): | - |

**Requires EC and Soil Texture result.**

| | |
|---|---|
| Organic Carbon (OC%)†: | **Did not test** |
| Organic Matter (OM%): | - |

Additional comments:

**Consultant: Chantal Hooper**

**Authorised Signatory: Simon Leake**

**Date of Report: 17 Sep 2013**

**METHOD REFERENCES:**
pH (1:5 $H_2O$) - Rayment & Higginson (1992) 4A1,
pH (1:5 $CaCl_2$) - Rayment & Higginson (1992) 4B1,
EC (1:5) - Rayment & Higginson (1992) 3A1,
Chloride - Rayment & Higginson (1992) 5A2,
Nitrate - Rayment & Higginson (1992) 7B1
Aluminium - SESL in-house,
$PO_4$, K, $SO_4$, Ca, Mg, Na, Fe, Mn, Zn, Cu, B - Mehlich 3 (1984),
Buffer pH and Hydrogen - Adams-Evans (1972)
Texture/Structure/Colour - PM0003 (Texture- "Northcote" (1992), Structure- "Murphy" (1991), Colour- "Munsell" (2000))

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| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Plan of:*** | Bobs Farm Quarry BH-1 | ***Location:*** | Bobs Farm | ***Projection:*** | N/A | ***Date:*** | 26/11/2013 | ***Version:*** | A |
| | | | | ***Contour Interval:*** | N/A | ***Sheet:*** | 2 of 2 | ***Survey:*** | N/A |
| | | | | | | ***Plan By:*** | TC | ***Source:*** | VGT Pty Ltd |
| ***Figure:*** | ONE | ***Council:*** | Port Stephens Council | | | ***Project Manager:*** | GVT | | |
| ***Client:*** | EMS | ***Scale:*** | | | | ***Office:*** | Thornton | ***Our Ref:*** | V:\Jobs_EMS Quarry\Bobs Farm\BFBH1 drill log |

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## Drill Hole Number: BH 1

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013
**Job Number:** QMS
**Logged By:** G THOMSON
**Hole Depth:** 19m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| Ground Surface | | | | | |
| **SAND - Cloud grey with roots, mg** | 0 | | | | Solid flight augers |
| **SAND - Pearl grey, mg** | | | | | GR 406691; 6373153, rl 5.8m |
| **SAND - Tan, mg** | 1 | | | | Colours from AS 2700- 1985 |
| | | | | | medium-grained (mg) |
| | 2 | | | | |
| | 3 | | | | Water Table 3.0m<br>Moist samples<br>Minor heavy mineral? |
| Water Table 3.5m | | | | | |
| **SAND -Black, mg, Sulphur smell** | 4 | | | | Sulphur smell |
| **PALEOSOL - Black, cricket pitch?** | | | | | |
| **SAND - Dark earth, mg** | 5 | | | | Sulphur smell |
| **SAND - Mixed sample. dark earth, mcg** | 6 | | | | Hollow flight augers |
| | | | | | Could not retrieve samples |
| | 7 | | | | Sampled from top of hole |
| | | | | | As part of hole cleaning up augers |
| | 8 | | | | |
| | 9 | | | | |
| | 10 | | | | |
| **SAND - Mixed sample. dark earth, mcg** | | | | | |
| | 11 | | | | |
| | 12 | | | | |
| | 13 | | | | |
| | 14 | | | | |
| | 15 | | | | |
| | 16 | | | | |
| | 17 | | | | |
| | 18 | | | | |
| | 19 | | | | |
| | 20 | | | | |



BH1-BL-AWT
0.6 to 3.5m

Above Water Table

Water Table 3.5m

Not Tested

Below Water Table

BH1-BL-G2
4.2 to 12m

BH1-BL-G1
12 to 19m

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Plan of:*** | Bobs Farm Quarry BH-2 | ***Location:*** | Bobs Farm | ***Projection:*** | N/A | ***Date:*** | 26/11/2013 | ***Version:*** | A |
| | | | | ***Contour Interval:*** | N/A | ***Sheet:*** | 2 of 2 | ***Survey:*** | N/A |
| | | | | | | ***Plan By:*** | TC | ***Source:*** | VGT Pty Ltd |
| ***Figure:*** | TWO | ***Council:*** | Port Stephens Council | | | ***Project Manager:*** | GVT | | |
| ***Client:*** | EMS | ***Scale:*** | | | | ***Office:*** | Thornton | ***Our Ref:*** | V:\Jobs_EMS Quarry\Bobs Farm\BFBH1 drill log |

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## Drill Hole Number: BH 2

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013
**Job Number:** QMS
**Logged By:** G THOMSON
**Hole Depth:** 26.5 m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| Ground Surface | | | | | |
| SAND - Oyster, mg | 0 | | | | Minor Organics |
| | 1 | | | | GR 406592; 6373286 RL 11.7 |
| SAND - Lead grey, vegetation matter. | 2 | | | | |
| SAND - Koala grey, mg | | | | | |
| SAND - Oyster, mg | 3 | | | | |
| SAND - Chocolate, mg. | 4 | | | | |
| SAND - Wombat, mg | | | | | |
| SAND - Buff, mg | 5 | | | | |
| | 6 | | | | |
| | 7 | | | | |
| | 8 | | | | |
| | 9 | | | | |
| | 10 | | | | Water Table 10.0m |
| Water Table 10.2m | | | | | |
| SAND - Buff, mg | | | | | |
| CLAY - Black, silty, firm, wet | 11 | | | | Cores retrived from drill |
| SAND- Cloud grey, with black fleck, <1% medium coarse grained (mcg) | 12 | | | | |
| | 13 | | | | (mcg) medium coarse grained |
| | 14 | | | | |
| | 15 | | | | |
| | 16 | | | | |
| | 17 | | | | |
| | 18 | | | | |
| SAND - Koala Grey, 1-3% black fleck | 19 | | | | |
| | 20 | | | | |
| SAND - Koala Grey, 1-3% black fleck | 21 | | | | |
| | 22 | | | | |
| | 23 | | | | |
| | 24 | | | | |
| | 25 | | | | |
| | 26 | | | | |
| | 27 | | | | |



Not Tested
Too Variable

BH2-BL-B
4.2 to 9.5m

Water Table 10.2m

10.5 to 12.0m

13.5 to 14.0m

17.5 to 18.5m

26.0 to 26.5m

Above Water Table

Below Water Table

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Plan of:*** | Bobs Farm Quarry BH-3 | ***Location:*** | Bobs Farm | ***Projection:*** | N/A | ***Date:*** | 26/11/2013 | ***Version:*** | A |
| | | | | ***Contour Interval:*** | N/A | ***Sheet:*** | 2 of 2 | ***Survey:*** | N/A |
| | | | | | | ***Plan By:*** | TC | ***Source:*** | VGT Pty Ltd |
| ***Figure:*** | THREE | ***Council:*** | Port Stephens Council | | | ***Project Manager:*** | GVT | | |
| ***Client:*** | EMS | ***Scale:*** | | | | ***Office:*** | Thornton | ***Our Ref:*** | V:\Jobs_EMS Quarry\Bobs Farm\BFBH1 drill log |

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## Drill Hole Number: BH 3

Project: Bobs Farm
Drilling Co: Total Drill
Date: August 2013
Job Number: QMS
Logged By: G THOMSON
Hole Depth: 26.5
Hole Dia: 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | | Remarks |
|---|---|---|---|---|---|
| Ground Surface | | | | | |
| SANDY LOAM SOIL - Koala Grey, mg | 0 | | | | GR 406297; 6373318; rl 15.4 |
| SAND - Pearl grey, mg | | | | | |
| SAND - Wombat, mg | 1 | | | | |
| SAND- Tan, mg | 2 | | | | |
| SAND - Buff, mg | 3 | | | | |
| SAND - Raffia, mg | 4 | | | | |
| | 5 | | | | |
| | 6 | | | | |
| | 7 | | | | |
| | 8 | | | | |
| | 9 | | | | |
| | 10 | | | | |
| SAND - Raffia, mg | 11 | | | | |
| | 12 | | | | |
| Water Table 13.2m | 13 | | | | |
| SAND - Pearl grey, mcg, moist | 14 | | | | |
| CLAY - Back, dark grey, silty | 15 | | | | |
| SAND - Lead grey, with 5% black spec | 16 | | | | |
| SAND -Koala grey, cg, 5% black fleck | 17 | | | | |
| | 18 | | | | |
| | 19 | | | | |
| | 20 | | | | |
| SAND -Koala grey, cg, 5% black fleck | 21 | | | | |
| | 22 | | | | |
| | 23 | | | | |
| | 24 | | | | |
| | 25 | | | | |
| | 26 | | | | |
| | 27 | | | | |



Not Tested
Too Variable

BH3-BL-B1
4.0 to 10.0m(~6m Bench)

BH3-BL-B2
10.0 to 14.6m

Water Table 13.2m

Above Water Table

Below Water Table

Not Tested
Too Variable

17.0 to 17.5m

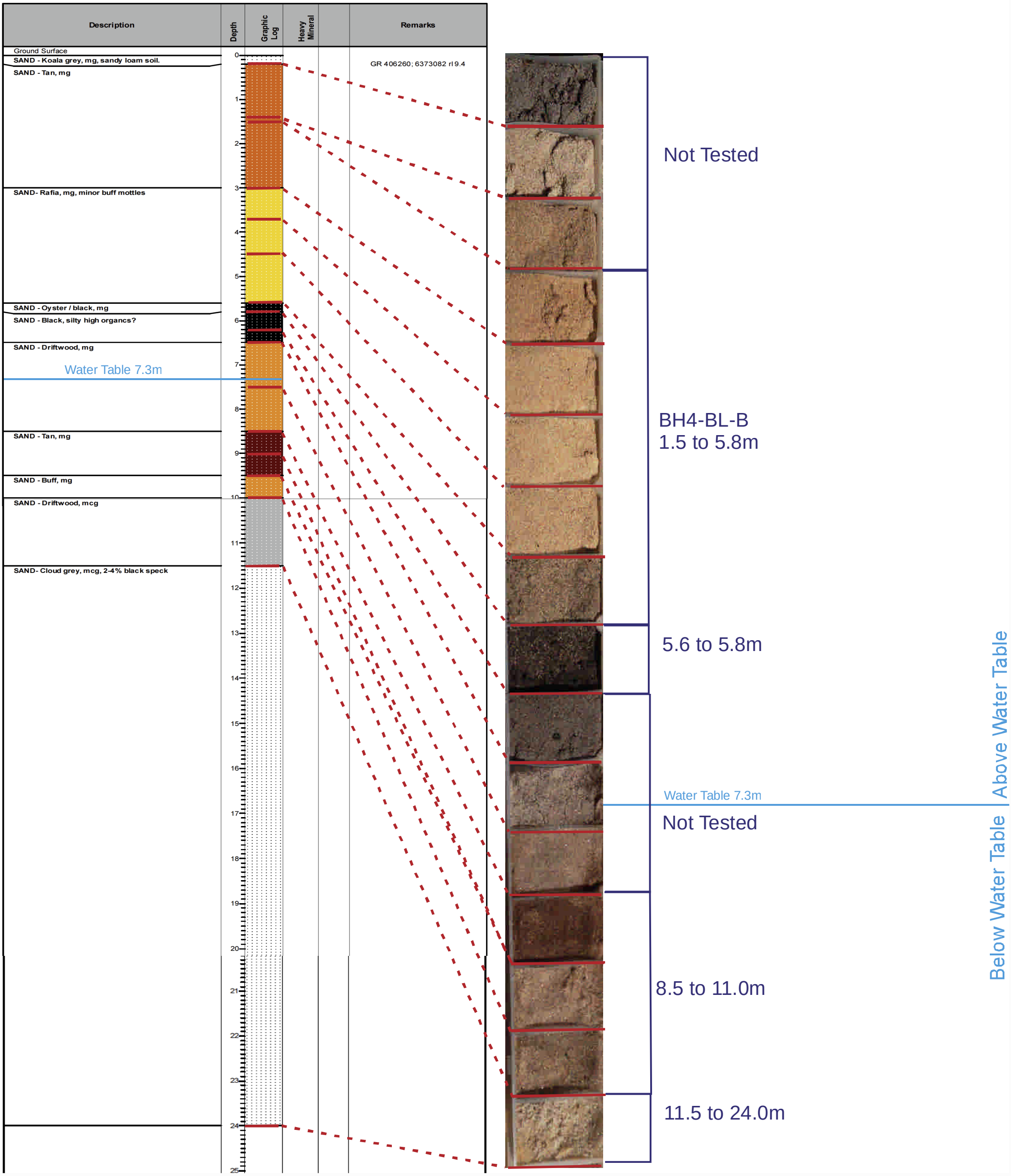
26.0 to 26.5m

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Plan of:*** | Bobs Farm Quarry BH-4 | ***Location:*** | Bobs Farm | ***Projection:*** | N/A | ***Date:*** | 26/11/2013 | ***Version:*** | A |
| | | | | ***Contour Interval:*** | N/A | ***Sheet:*** | 2 of 2 | ***Survey:*** | N/A |
| | | | | | | ***Plan By:*** | TC | ***Source:*** | VGT Pty Ltd |
| ***Figure:*** | FOUR | ***Council:*** | Port Stephens Council | | | ***Project Manager:*** | GVT | | |
| ***Client:*** | EMS | ***Scale:*** | | | | ***Office:*** | Thornton | ***Our Ref:*** | V:\Jobs_EMS Quarry\Bobs Farm\BFBH1 drill log |

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## Drill Hole Number: BH 4

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013
**Job Number:** QMS
**Logged By:** G THOMSON
**Hole Depth:** 24 m
**Hole Dia:** 4.5 inch



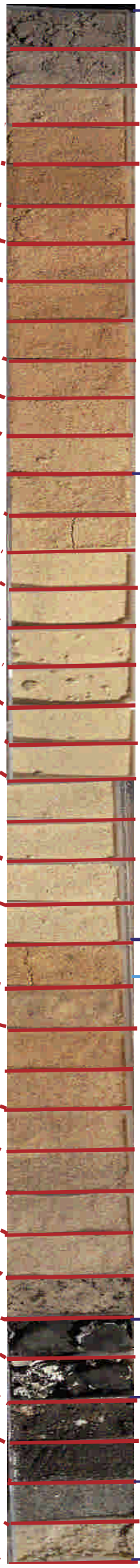
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ***Plan of:*** | Bobs Farm Quarry BH-5 | ***Location:*** | Bobs Farm | ***Projection:*** | N/A | ***Date:*** | 26/11/2013 | ***Version:*** | A |
| | | | | ***Contour Interval:*** | N/A | ***Sheet:*** | 2 of 2 | ***Survey:*** | N/A |
| | | | | | | ***Plan By:*** | TC | ***Source:*** | VGT Pty Ltd |
| ***Figure:*** | FIVE | ***Council:*** | Port Stephens Council | | | ***Project Manager:*** | GVT | | |
| ***Client:*** | EMS | ***Scale:*** | | | | ***Office:*** | Thornton | ***Our Ref:*** | V:\Jobs_EMS Quarry\Bobs Farm\BFBH1 drill log |

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## Drill Hole Number: BH 5

**Project:** Bobs Farm
**Drilling Co:** Total Drill
**Date:** August 2013
**Job Number:** QMS
**Logged By:** G THOMSON
**Hole Depth:** 26.5 m
**Hole Dia:** 4.5 inch

| Description | Depth | Graphic Log | Heavy Mineral | Remarks |
|---|---|---|---|---|
| Ground Surface | | | | |
| **SAND - Koala grey, darker at top, mg** organic at top and sitly at base. | 0 | | | GR 406803; 6373515; rl 18.2 |
| **SAND - Tan / buff, mg, sitly in part** | 1 | | | |
| **SAND - Buff, mg** | 2 | | | |
| | 3 | | | |
| | 4 | | | |
| | 5 | | | |
| **SAND - Raffia, mg, no silt** | 6 | | | |
| | 7 | | | |
| | 8 | | | |
| | 9 | | | |
| | 10 | | | |
| **SAND - Raffia, mg, no silt** | 11 | | | |
| | 12 | | | |
| | 13 | | | |
| | 14 | | | |
| **SAND -Pale Ochre, mc** | 15 | | | |
| Water Table 15.4m | 16 | | | |
| | 17 | | | |
| **SAND-Cloud grey, minor pale ochre, mcg** | 18 | | | |
| | 19 | | | |
| **SAND-Cloud grey, with 5-10% black fleck** | 20 | | | |
| **CLAY - Black , shell common** | 21 | | | |
| | 22 | | | |
| **SAND - Lead grey, shells** | 23 | | | |
| **SAND-Light grey, 1-2% black speck** minor shell grit, mcg | 24 | | | |
| | 25 | | | |
| | 26 | | | |
| | 27 | | | |



Not Tested

BH5-BL-B
5.5 to 14.5m

Water Table 15.4m

Not Tested

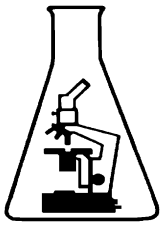
BH5-BL-M
20.0 to 22.0m

BH5-BL-G
23.0 to 25.65m

Above Water Table | Below Water Table

# Geochempet Services

ABN 980 6945 3445
**PETROLOGICAL and GEOCHEMICAL CONSULTANTS**
**Principals: K.E. Spring B.Sc.(Hons), MAppSc and H.M. Spring B.Sc.**



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## PARTICLE SHAPE ANALYSIS ON A SAND SAMPLE BH3-BL-G-PL

Prepared for

**QUARRY MINING SYSTEMS PTY LTD**
**NSW**

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued by

H.M. Spring B.Sc
10 October 2013



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**Sample No**: BH3- BL-G-PL **Date Received**: 10/09/13

**Work Requested** Particle Shape Analysis

**Methods** : Shape analysis was performed by measuring roundness and then sphericity each for 50 grains per sample observed with binocular microscopy in random linear traverses of prepared subsample.

Roundness and sphericity are different shape attributes, but they do tend to show sympathetic variation in rock/mineral samples. The index for roundness varies between 0 and 1 as fragments vary from completely angular to completely rounded; the index for sphericity varies between 0 and 1 as fragments vary from thin plates or slivers to very equidimensional pieces. The difference between roundness and sphericity can be illustrated by noting that a cube and a sphere both have high sphericity, but the cube has zero roundness and the sphere has perfect roundness: similarly, a capsule shape (or cylinder with rounded ends) may have perfect roundness, but low sphericity.

There are mathematical models behind the indices for roundness and sphericity, but in practice the indices are estimated by visual comparison with a reference chart of fragments of varied roundness and sphericity (from a text by Krumbein and Sloss, 1963). The concepts, recommended procedures and the reference chart are available in the American Petroleum Institute (19C) API Recommended Practices for Testing Sand Used in Hydraulic Fracturing Operations and ISO 13503 Measurement of Properties of a Proppants used in Hydraulic Fracturing and Gravel–Packing Operations.

**Results**: Results are summarised in Table 1 (simple averages) and in graphical form (frequency distributions for roundness and sphericity).

**Table 1.** Average Roundness and Sphericity for Sample

| Sample Number | Average Roundness | Average Sphericity |
|---|---|---|
| BH3-BL-G-PL | 0.60 | 0.75 |

- Averages based on 50 observations per characteristic

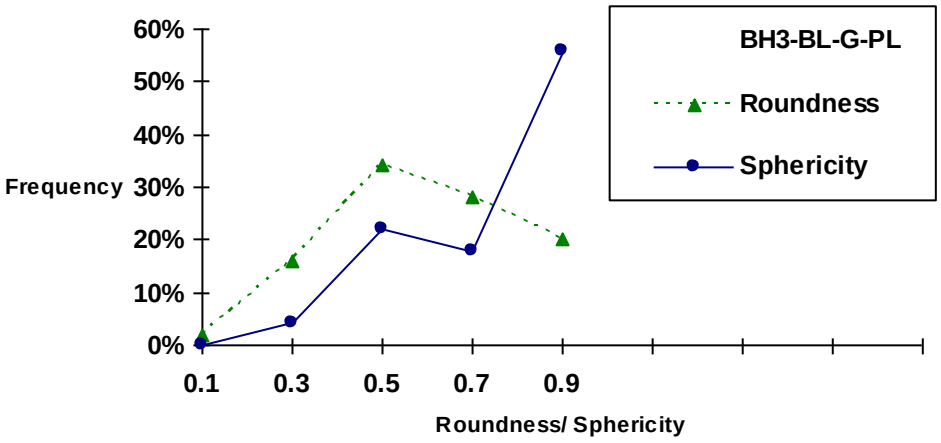
Qualitative terms which can be applied are:

**Roundness**
0.0-0.2 Angular
0.2-0.4 Subangular
0.4-0.6 Subrounded
0.6-0.8 Rounded
0.8-1.0 Well Rounded

**Sphericity**
0.0-0.4 Low Sphericity
0.4-0.6 Moderately Low Sphericity
0.6-0.8 Moderately High Sphericity
0.8-1.0 High Sphericity



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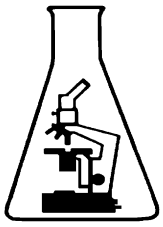

**Graph 1: Distribution of Roundness and Sphericity**
**Sample BH3-BL-G-PL**



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## PARTICLE SHAPE ANALYSIS ON A SAND SAMPLE BH3-BL-B3-PL

Prepared for

**QUARRY MINING SYSTEMS PTY LTD**
**NSW**

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued by

H.M. Spring B.Sc
10 October 2013



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**Sample No**: BH3- BL-B3-PL **Date Received**: 10/09/13

**Work Requested** Particle Shape Analysis

**Methods** : Shape analysis was performed by measuring roundness and then sphericity each for 50 grains per sample observed with binocular microscopy in random linear traverses of prepared subsample.

Roundness and sphericity are different shape attributes, but they do tend to show sympathetic variation in rock/mineral samples. The index for roundness varies between 0 and 1 as fragments vary from completely angular to completely rounded; the index for sphericity varies between 0 and 1 as fragments vary from thin plates or slivers to very equidimensional pieces. The difference between roundness and sphericity can be illustrated by noting that a cube and a sphere both have high sphericity, but the cube has zero roundness and the sphere has perfect roundness: similarly, a capsule shape (or cylinder with rounded ends) may have perfect roundness, but low sphericity.

There are mathematical models behind the indices for roundness and sphericity, but in practice the indices are estimated by visual comparison with a reference chart of fragments of varied roundness and sphericity (from a text by Krumbein and Sloss, 1963). The concepts, recommended procedures and the reference chart are available in the American Petroleum Institute (19C) API Recommended Practices for Testing Sand Used in Hydraulic Fracturing Operations and ISO 13503 Measurement of Properties of a Proppants used in Hydraulic Fracturing and Gravel–Packing Operations.

**Results**: Results are summarised in Table 1 (simple averages) and in graphical form (frequency distributions for roundness and sphericity).

**Table 1.** Average Roundness and Sphericity for Sample

| Sample Number | Average Roundness | Average Sphericity |
|---|---|---|
| BH3-BL-B3-PL | 0.60 | 0.74 |

- Averages based on 50 observations per characteristic

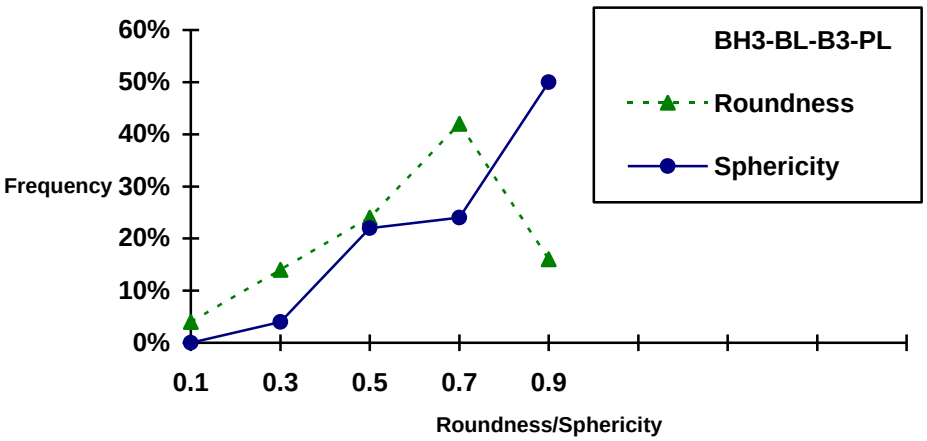
Qualitative terms which can be applied are:

**Roundness**
0.0-0.2 Angular
0.2-0.4 Subangular
0.4-0.6 Subrounded
0.6-0.8 Rounded
0.8-1.0 Well Rounded

**Sphericity**
0.0-0.4 Low Sphericity
0.4-0.6 Moderately Low Sphericity
0.6-0.8 Moderately High Sphericity
0.8-1.0 High Sphericity



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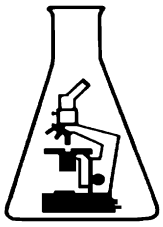

**Graph 1: Distribution of Roundness and Sphericity**
**Sample BH3-BL-B3-PL**



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## PARTICLE SHAPE ANALYSIS ON A SAND SAMPLE BH5-BL-G-PL

Prepared for

**QUARRY MINING SYSTEMS PTY LTD**
**NSW**

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued by

H.M. Spring B.Sc
10 October 2013



*The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services.*

**Sample No**: BH5- BL-G-PL **Date Received**: 10/09/13

**Work Requested** Particle Shape Analysis

**Methods** : Shape analysis was performed by measuring roundness and then sphericity each for 50 grains per sample observed with binocular microscopy in random linear traverses of prepared subsample.

Roundness and sphericity are different shape attributes, but they do tend to show sympathetic variation in rock/mineral samples. The index for roundness varies between 0 and 1 as fragments vary from completely angular to completely rounded; the index for sphericity varies between 0 and 1 as fragments vary from thin plates or slivers to very equidimensional pieces. The difference between roundness and sphericity can be illustrated by noting that a cube and a sphere both have high sphericity, but the cube has zero roundness and the sphere has perfect roundness: similarly, a capsule shape (or cylinder with rounded ends) may have perfect roundness, but low sphericity.

There are mathematical models behind the indices for roundness and sphericity, but in practice the indices are estimated by visual comparison with a reference chart of fragments of varied roundness and sphericity (from a text by Krumbein and Sloss, 1963). The concepts, recommended procedures and the reference chart are available in the American Petroleum Institute (19C) API Recommended Practices for Testing Sand Used in Hydraulic Fracturing Operations and ISO 13503 Measurement of Properties of a Proppants used in Hydraulic Fracturing and Gravel–Packing Operations.

**Results**: Results are summarised in Table 1 (simple averages) and in graphical form (frequency distributions for roundness and sphericity).

**Table 1.** Average Roundness and Sphericity for Sample

| Sample Number | Average Roundness | Average Sphericity |
|---|---|---|
| BH5-BL-G-PL | 0.65 | 0.74 |

- Averages based on 50 observations per characteristic

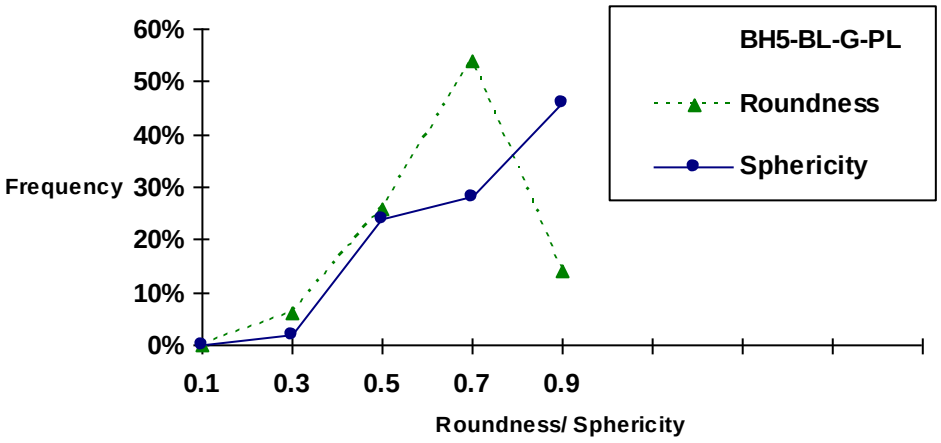
Qualitative terms which can be applied are:

**Roundness**
0.0-0.2 Angular
0.2-0.4 Subangular
0.4-0.6 Subrounded
0.6-0.8 Rounded
0.8-1.0 Well Rounded

**Sphericity**
0.0-0.4 Low Sphericity
0.4-0.6 Moderately Low Sphericity
0.6-0.8 Moderately High Sphericity
0.8-1.0 High Sphericity



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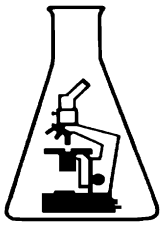

**Graph 1: Distribution of Roundness and Sphericity**
**Sample BH5-BL-G-PL**



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## PARTICLE SHAPE ANALYSIS ON A SAND SAMPLE BH5-BL-B-PL

Prepared for

**QUARRY MINING SYSTEMS PTY LTD**
**NSW**

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued by

H.M. Spring B.Sc
10 October 2013



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**Sample No**: BH5- BL-B-PL **Date Received**: 10/09/13

**Work Requested** Particle Shape Analysis

**Methods** : Shape analysis was performed by measuring roundness and then sphericity each for 50 grains per sample observed with binocular microscopy in random linear traverses of prepared subsample.

Roundness and sphericity are different shape attributes, but they do tend to show sympathetic variation in rock/mineral samples. The index for roundness varies between 0 and 1 as fragments vary from completely angular to completely rounded; the index for sphericity varies between 0 and 1 as fragments vary from thin plates or slivers to very equidimensional pieces. The difference between roundness and sphericity can be illustrated by noting that a cube and a sphere both have high sphericity, but the cube has zero roundness and the sphere has perfect roundness: similarly, a capsule shape (or cylinder with rounded ends) may have perfect roundness, but low sphericity.

There are mathematical models behind the indices for roundness and sphericity, but in practice the indices are estimated by visual comparison with a reference chart of fragments of varied roundness and sphericity (from a text by Krumbein and Sloss, 1963). The concepts, recommended procedures and the reference chart are available in the American Petroleum Institute (19C) API Recommended Practices for Testing Sand Used in Hydraulic Fracturing Operations and ISO 13503 Measurement of Properties of a Proppants used in Hydraulic Fracturing and Gravel–Packing Operations.

**Results**: Results are summarised in Table 1 (simple averages) and in graphical form (frequency distributions for roundness and sphericity).

**Table 1.** Average Roundness and Sphericity for Sample

| Sample Number | Average Roundness | Average Sphericity |
|---|---|---|
| BH5-BL-B-PL | 0.61 | 0.72 |

- Averages based on 50 observations per characteristic

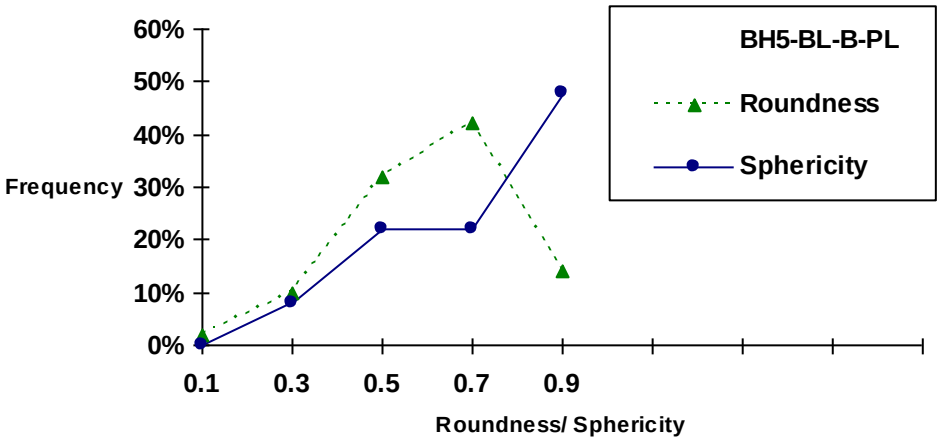
Qualitative terms which can be applied are:

**Roundness**
0.0-0.2 Angular
0.2-0.4 Subangular
0.4-0.6 Subrounded
0.6-0.8 Rounded
0.8-1.0 Well Rounded

**Sphericity**
0.0-0.4 Low Sphericity
0.4-0.6 Moderately Low Sphericity
0.6-0.8 Moderately High Sphericity
0.8-1.0 High Sphericity



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**Graph 1: Distribution of Roundness and Sphericity**
**Sample BH5-BL-B-PL**



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GEOCHEMPET SERVICES BRISBANE

# Geochempet Services

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## PETROGRAPHIC REPORT ON A SAND (BH1-BL-G1-PL) FROM NSW SAND DEPOSIT

Prepared for

**QUARRY MINING SYSTEMS PTY LTD**

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued By:

L. P. Evans, B.Sc
11th October, 2013



*The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services.*

**Sample Label**: BH1-BL-G1-PL **Date Sampled**: 14/08/13

**Sample Type**: Sand **Date Supplied**: 03/09/13

**Sample Source**: NSW Sand Deposit

**Project #**: 1308105

**Methods** Account taken of ASTM C 295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete*, the AS2758.1 – 1998 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*, the AS1141 Standard Guide for the *Method for sampling and testing aggregates*, of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, entitled (HB 79-1996) *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

**Identification** Medium to fine quartz sand

**Description**

The sample consisted of about 500g of dark yellowish brown, slightly silty, free-flowing, dry fine sand. Close inspection revealed that the sand consists mainly of subangular and subrounded quartz grains. In a crude dry sieving test of a small subsample 0.1% of the sand was found to be finer than 0.075 mm sieve, 33.6% was coarser than 0.075 mm sieve but finer than a 0.3 mm sieve, about 64.3% was found to lie between 0.3 mm and 1.18 mm, and 2.1% amount exceeded 1.18 mm, with maximum diameter being 1 mm; coarse fraction lithology included quartz, lithic clasts and plant material. There are no apparent deleterious grain coatings.

After a subsample was swirled in water it settled rapidly in a fashion consistent with an absence of clay and the presence of only a small amount of silt.

Microscopic identifications at 100 random points falling within sectioned clasts revealed the following composition (volume % of clast types) for the sample:

| | |
|---|---|
| 80% | quartz as unstrained to mildly strained free grains (69%) and simple crystalline composite grains (8%) |
| 11% | moderately strained simple or composite grains of quartz |
| 2% | quartzite |
| <1% | vein quartz |
| 4% | chert |
| 1% | other minerals (epidote, hornblende, tourmaline, zircon) |
| 1% | feldspar grains (<1% plagioclase and 1% K-feldspar) |
| 1% | argillaceous clasts |
| <1% | acid volcanics |



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In thin section, the grains are sub-rounded to sub-angular, with a thin discontinuous staining or partial ferruginous rind, or a carbonaceous staining.

A simultaneous count of total quartz content yielded 91%, comprising 89% free quartz grains or simple crystalline composite grains, and 2% quartz locked within lithic clasts of quartzite, vein quartz and acid volcanic/tuffaceous rock.

In thin section the most abundant fragments are seen to be quartz, occurring mainly as single unstrained to mildly strained sand grains (69%) and less commonly as simple crystalline composite grains (8%), lithic clasts of vein quartz (<1%) and 1% quartzite. Moderately strained quartz in simple or composite grains made up 12%.

Feldspar grains, specifically orthoclase feldspar (orthoclase and rarely microcline) amounts to 2% and plagioclase feldspar (lightly sericitized) amounts to 2%.

Other minor clasts include acid volcanic/tuffaceous rock with a finely crystalline and devitrified quartzofeldspathic groundmass (4%), and ferruginized argillaceous clasts.

**Comments and Interpretations**

The submitted sand sample (labelled BH1-BL-G1-PL) from NSW sand deposit is considered to qualify for broad identification for engineering purposes as a medium to fine quartz sand.

The **free silica content** (or total quartz content) of the sand is **about 91%**, comprising 89% free quartz grains or simple crystalline composite grains, and 2% quartz locked within lithic clasts of quartzite, vein quartz and acid volcanic/tuffaceous rock.

The sand is predicted to be **physically suitable for use as sand in concrete** because it is composed mainly of naturally worn, small grains of quartz and feldspar: both minerals are regarded as hard, strong and durable. The minor other mineral and rock fragments are also regarded as robust and durable. However, it should be noted that carbonaceous staining (colloidal carbon) of sand grains has been observed to upset setting times in concrete.

Because the sand carries 12% of moderately strained quartz (as free grains and in quartzite and vein quartz), and <1% microcrystalline quartz in lithic clasts of acid volcanic/tuffaceous rock, it is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**.

Therefore, the submitted sand sample is considered to be **provisionally suitable for use as concrete** sand, provided that attention is given to the potential for ASR activity in the sand. Further testing should be undertaken to determine the presence of colloidal carbon within the sand.

Guidance on how to deal with the perceived potential for deleterious alkali-silica reactivity may be found in the 1996 joint publication of the *Cement and Concrete Association of Australia* and *Standards Australia*, entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia.*



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The sand has potential to be suitable for other durable construction uses.

It is noted also that the sand is **not recommended** for use in the manufacture of glass and ceramics. Sands suitable for glass manufacture are described as having silica content (i.e. a SiO2 content) of 95 to 99.8%, and the amount and nature of the impurities is important. Alumina should be less than 4% and iron oxide should be quite low (1% being acceptable only for amber glass). Sand for glass manufacture should be of even grainsize, generally less than 20 mesh (i.e. less than about 0.85 mm) and coarser than 100 mesh (i.e. coarser than about 0.15 mm).

It should be noted that there may be an uncertain potential to generate filter sand products from the supplied sand sample, but the grainsize may be too fine. The general requirements involve high quartz content, screening to a narrow and relatively coarse size range, and low solubility in acid. High sphericity and roundness are advantageous, but not as important as in the case of frac sand. Water supply authorities and manufacturers of sand filters for swimming pools should be able to supply you with their specifications for filter sand.

**Free Silica Content**

About 91% in the form of quartz as free grains and locked in lithic clasts of quartzite, vein quartz and acid volcanic rock.

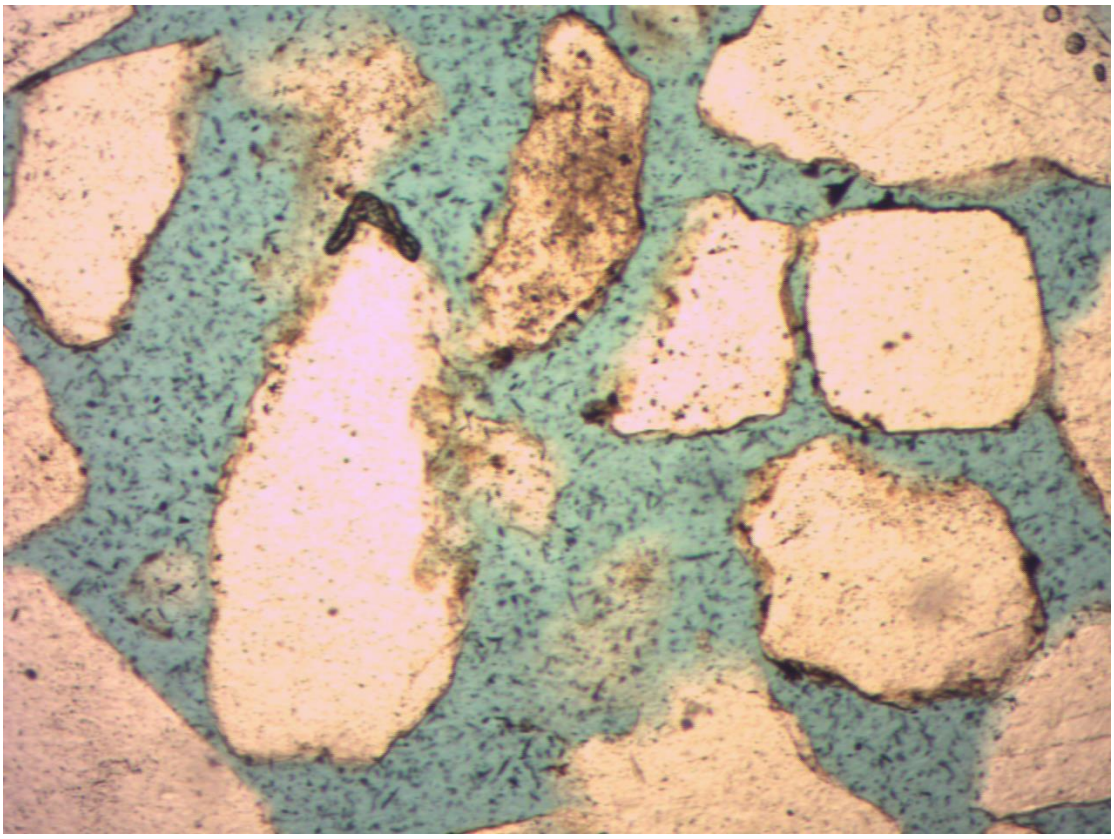


**PLATE 1**: Microphotograph of sample BH2-BL-B-PL, displaying quartz grains with staining around the grain margins of either a ferruginous clay or carbonaceous staining.



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## PETROGRAPHIC REPORT ON A SAND (BH1-BL-G2-PL) FROM NSW SAND DEPOSIT

Prepared for

**QUARRY MINING SYSTEMS PTY LTD**

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued By:

L. P. Evans, B.Sc
11 October, 2013



*The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services.*

**Sample Label**: BH1-BL-G2-PL **Date Sampled**: 14/08/13

**Sample Type**: Sand **Date Supplied**: 03/09/13

**Sample Source**: NSW Sand Deposit

**Project #**: 1308105

**Methods** Account taken of ASTM C 295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete,* the AS2758.1 – 1998 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B),* the AS1141 Standard Guide for the *Method for sampling and testing aggregates*, of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, entitled (HB 79-1996) *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

**Identification**: Medium to fine carbonaceous quartz sand

**Description**:

The sample consisted of about 500g of dark brown, clumped sand. In a crude dry sieving test of a small subsample about 0.2% of the sand was found to be finer than 0.075 mm sieve, 26.5% was coarser than 0.075 mm sieve but finer than a 0.3 mm sieve, about 64.8% was found to lie between 0.3 mm and 1.18 mm, and 8.5% exceeded 1.18 mm due to the clumping together of the fragments. Sieve fractions should be treated with caution due to the fine material being weakly clay cemented together in to coarse fragments. A turbidity test resulted in the observation of a lot of floating carbonaceous matter.

A thin section was prepared for microscopic examination in transmitted polarized light. A count of 100 widely spaced points falling within sectioned fragments gave the following composition (expressed in volume percent):

| | |
|---|---|
| 54% | quartz as unstrained or faintly strained free grains (50%) or simple crystalline composites of several grains (4%) |
| 4% | quartz as moderately strained free grains or simple crystalline composite grains |
| <1% | lithic clasts of chert |
| <1% | feldspar grains |
| <1% | clay intermingled with carbonaceous material (illite/chlorite) |
| 42% | carbonaceous matter (as coatings, as a cement in sparse lumps and as free fragments) |

The sand dominantly contains fragments of variably current-aligned detrital carbonaceous material of variable maturation, with a less dominant fraction of quartz and sparse feldspars. Some fragments of carbonaceous material retains there laminated texture. There is some minor clay intermingled with the carbonaceous material.



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Carbonaceous material is present as wisps or clots, and deposited in a planar fashion. Quartz clasts run between coarse silts to fine sand (0.05 – 0.2 mm in diameter). Carbonaceous matter within the sand occurs in various ways. As a very incomplete carbon coating (translucent brown to black) on quartz sand grains. A related, but less common occurrence is as a complete carbon coating of quartz sand grains. A third mode of occurrence which is quite common is as a carbon cement within clusters of a few quartz sand grains. The carbonaceous material very commonly occurs as free particles of carbonaceous matter. A fifth and least common mode of occurrence is as particles of black charcoal (cellular plant characteristics preserved).

The most abundant sand clasts are free, simple grains of unstrained or faintly strained quartz (50%); crystalline composite grains of several unstrained or faintly strained grains of quartz amount to 4% and moderately strained grains of quartz amount to an additional 4%. Quartzite and chert is present in minor amounts.

Other quite minor or trace detrital components of the sand comprise a few grains of feldspar (microcline and plagioclase).

**Comments and Interpretations**:

The submitted sand sample (labelled BH1-BL-G2-PL) from NSW sand deposit is considered to qualify for broad identification for engineering purposes as medium to fine carbonaceous quartz sand.

The **free silica content** (or total **quartz content** as defined in the Queensland Department of Main Roads Test Method Q188) is about **58%,** comprising about 47% common quartz as fine sand grains or simple crystalline composite grains and about <1% cherty or finely microcrystalline quartz in clasts of chert.

The sand is considered **unsuitable for durable construction uses including concrete sand**. The carbonaceous matter in this abundance (42%) is predicted to be capable of retarding/inhibiting the setting of concrete.

The sand **has potential for use as soil** and other landscaping uses.

The sand is **unsuitable for frac proppant, foundry, filter, ceramics and glass manufacture**.

**Free Silica Content**

About 58% in the form of quartz as free grains and locked in lithic clasts of quartzite.



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**Digital Photomicrograph**

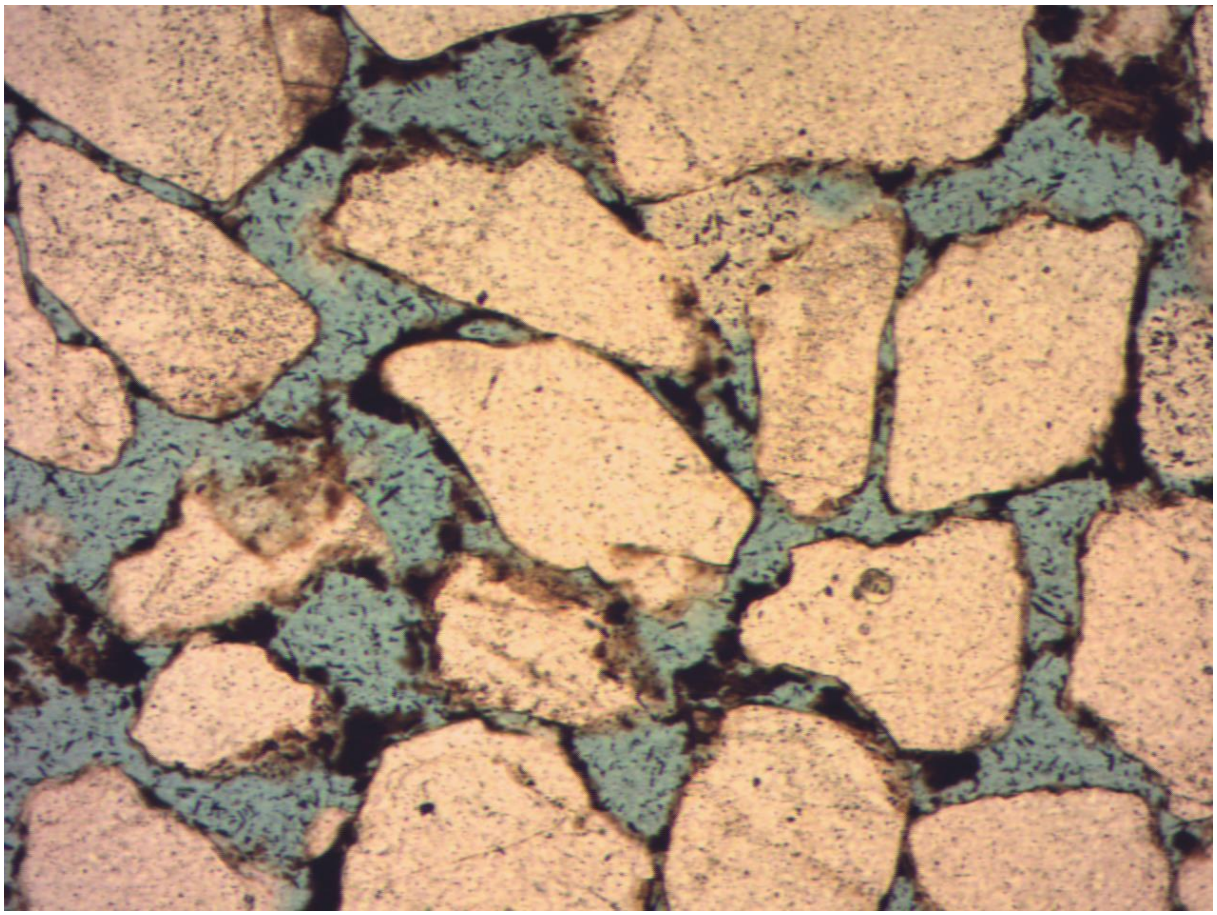


**Figure 1:** Image width is 2.77 mm. Field of view is dominated by quartz grains in white and carbonaceous material as variably shaped fragments. Grain margins are lined with ferruginous and carbonaceous material (possibly colloidal carbon). The view is in plane polarised light to better illuminate the dark carbonaceous material.



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GEOCHEMPET SERVICES BRISBANE

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## PETROGRAPHIC REPORT ON A SAND (BH2-BL-G-PL) FROM NSW SAND DEPOSIT

Prepared for

**QUARRY MINING SYSTEMS PTY LTD**

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued By:

L Pearson

L Pearson, B.Sc (Hons)
9th October, 2013



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**Sample Label**: BH2-BL-G-PL **Date Sampled**: 14/08/13

**Sample Type**: Sand **Date Supplied**: 03/09/13

**Sample Source**: NSW Sand Deposit

**Project #**: 1308105

**Methods** Account taken of ASTM C 295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete*, the AS2758.1 – 1998 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*, the AS1141 Standard Guide for the *Method for sampling and testing aggregates*, of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, entitled (HB 79-1996) *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

**Identification** Fine to medium quartz sand

**Description**

The sample consisted of about 500g of pale yellowish grey, clean, free-flowing, dry fine sand. Close inspection revealed that the sand consists mainly of subangular and subrounded quartz grains. In a crude dry sieving test of a small subsample about 0.1% of the sand was found to be finer than 0.075 mm sieve, 64.1% was coarser than 0.075 mm sieve but finer than a 0.3 mm sieve, about 35.6% was found to lie between 0.3 mm and 1.18 mm, and 0.2% exceeded 1.18 mm, with maximum diameter being 1 mm; coarse fraction lithology included quartz, lithic clasts and plant material. There are no apparent deleterious grain coatings.

After a subsample was swirled in water it settled rapidly in a fashion consistent with an absence of clay and the presence of only a small amount of silt.

Microscopic identifications at 100 random points falling within sectioned clasts revealed the following composition (volume % of clast types) for the sample:

| | |
|---|---|
| 85% | quartz as unstrained to mildly strained free grains (78%) and simple crystalline composite grains (7%) |
| 12% | moderately strained simple or composite grains of quartz |
| <1% | quartzite |
| <1% | vein quartz |
| <1% | other minerals (epidote, hornblende, tourmaline, zircon) |
| 1% | feldspar grains (1% plagioclase and <1% K-feldspar) |
| 2% | acid volcanics (<1% microcrystalline quartz) |



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A simultaneous count of total quartz content yielded 97%, comprising 97% free quartz grains or simple crystalline composite grains, and <1% quartz locked within lithic clasts of quartzite, vein quartz and acid volcanic/tuffaceous rock.

In thin section the most abundant fragments are seen to be quartz, occurring mainly as single unstrained to mildly strained sand grains (78%) and less commonly as simple crystalline composite grains (7%), lithic clasts of vein quartz (<1%) and <1% quartzite. Moderately strained quartz in simple or composite grains made up 12%.

Feldspar grains, specifically orthoclase feldspar (orthoclase and rarely microcline) amounts to <1% and plagioclase feldspar (lightly sericitized) amounts to 1%.

Other minor clasts include acid volcanic/tuffaceous rock with a finely crystalline and devitrified quartzofeldspathic groundmass (2%).

**Comments and Interpretations**

The submitted sand sample (labelled BH2-BL-G-PL) from NSW sand deposit is considered to qualify for broad identification for engineering purposes as clean fine to medium quartz sand.

The **free silica content** (or total quartz content) of the sand is **about 97%**, comprising 97% free quartz grains or simple crystalline composite grains, and <1% quartz locked within lithic clasts of quartzite, vein quartz and acid volcanic/tuffaceous rock.

The sand is predicted to be **physically suitable for use as sand in concrete** because it is composed mainly of naturally worn, small grains of quartz and feldspar: both minerals are regarded as hard, strong and durable. The minor other mineral and rock fragments are also regarded as robust and durable.

Because the sand carries 13% of moderately strained quartz (as free grains and in quartzite and vein quartz), and <1% microcrystalline quartz in lithic clasts of acid volcanic/tuffaceous rock, it is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**.

Therefore, the supplied sand sample is considered to be **suitable for use as concrete sand**, provided that attention is given to the potential ASR reactivity of the sand.

Guidance on how to deal with the perceived potential for deleterious alkali-silica reactivity may be found in the 1996 joint publication of the *Cement and Concrete Association of Australia* and *Standards Australia*, entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*.

The sand has potential to be suitable for other durable construction uses.

It is noted also that the sand has good potential for use in the manufacture of glass and ceramics. Sands suitable for glass manufacture are described as having silica content (i.e. a SiO2 content) of 95 to 99.8%, and the amount and nature of the impurities is important. Alumina should be less than 4% and iron oxide should be quite low (1% being acceptable only for amber glass). Sand for glass manufacture should be of even



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grainsize, generally less than 20 mesh (i.e. less than about 0.85 mm) and coarser than 100 mesh (i.e. coarser than about 0.15 mm).

It should be noted that there may be an uncertain potential to generate filter sand products from the supplied sand sample, but the grainsize may be too fine. The general requirements involve high quartz content, screening to a narrow and relatively coarse size range, and low solubility in acid. High sphericity and roundness are advantageous, but not as important as in the case of frac sand. Water supply authorities and manufacturers of sand filters for swimming pools should be able to supply you with their specifications for filter sand.

**Free Silica Content**

About 97% in the form of quartz as free grains and locked in lithic clasts of quartzite, vein quartz and acid volcanic rock.



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GEOCHEMPET SERVICES BRISBANE

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Prepared for

**QUARRY MINING SYSTEMS PTY LTD**

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued By:

L. P. Evans, B.Sc
11th October, 2013



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**Sample Label**: BH2-BL-B-PL **Date Sampled**: 14/08/13

**Sample Type**: Sand **Date Supplied**: 03/09/13

**Sample Source**: NSW Sand Deposit

**Project #**: 1308105

**Methods** Account taken of ASTM C 295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete*, the AS2758.1 – 1998 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*, the AS1141 Standard Guide for the *Method for sampling and testing aggregates*, of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, entitled (HB 79-1996) *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

**Identification** Medium to fine quartz sand

**Description**

The sample consisted of about 500g of pale yellowish grey, clean, free-flowing, dry fine sand. Close inspection revealed that the sand consists mainly of subangular and subrounded quartz grains. In a crude dry sieving test of a small subsample about 0.5% of the sand was found to be finer than 0.075 mm sieve, 21.9% was coarser than 0.075 mm sieve but finer than a 0.3 mm sieve, about 77.6% was found to lie between 0.3 mm and 1.18 mm, and 0.1% exceeded 1.18 mm, with maximum diameter being 1 mm; coarse fraction lithology included quartz, lithic clasts and plant material. There are no apparent deleterious grain coatings.

After a subsample was swirled in water it settled rapidly in a fashion consistent with an absence of clay and the presence of only a small amount of silt.

Microscopic identifications at 100 random points falling within sectioned clasts revealed the following composition (volume % of clast types) for the sample:

| | |
|---|---|
| 77% | quartz as unstrained to mildly strained free grains (69%) and simple crystalline composite grains (8%) |
| 12% | moderately strained simple or composite grains of quartz |
| 1% | quartzite |
| <1% | vein quartz |
| 1% | other minerals (epidote, hornblende, tourmaline, zircon) |
| 4% | feldspar grains (2% plagioclase and 2% K-feldspar) |
| 1% | argillaceous clasts |
| 4% | acid volcanics (1% microcrystalline quartz) |



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A simultaneous count of total quartz content yielded 91%, comprising 89% free quartz grains or simple crystalline composite grains, and 2% quartz locked within lithic clasts of quartzite, vein quartz and acid volcanic/tuffaceous rock.

In thin section the most abundant fragments are seen to be quartz, occurring mainly as single unstrained to mildly strained sand grains (69%) and less commonly as simple crystalline composite grains (8%), lithic clasts of vein quartz (<1%) and 1% quartzite. Moderately strained quartz in simple or composite grains made up 12%.

Feldspar grains, specifically orthoclase feldspar (orthoclase and rarely microcline) amounts to 2% and plagioclase feldspar (lightly sericitized) amounts to 2%.

Other minor clasts include acid volcanic/tuffaceous rock with a finely crystalline and devitrified quartzofeldspathic groundmass (4%), and ferruginized argillaceous clasts.

**Comments and Interpretations**

The submitted sand sample (labelled BH2-BL-B-PL) from NSW sand deposit is considered to qualify for broad identification for engineering purposes as clean medium to fine quartz sand.

The **free silica content** (or total quartz content) of the sand is **about 91%**, comprising 89% free quartz grains or simple crystalline composite grains, and 2% quartz locked within lithic clasts of quartzite, vein quartz and acid volcanic/tuffaceous rock.

The sand is predicted to be **physically suitable for use as sand in concrete** because it is composed mainly of naturally worn, small grains of quartz and feldspar: both minerals are regarded as hard, strong and durable. The minor other mineral and rock fragments are also regarded as robust and durable.

Because the sand carries 12% of moderately strained quartz (as free grains and in quartzite and vein quartz), and <1% microcrystalline quartz in lithic clasts of acid volcanic/tuffaceous rock, it is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**.

Guidance on how to deal with the perceived potential for deleterious alkali-silica reactivity may be found in the 1996 joint publication of the *Cement and Concrete Association of Australia* and *Standards Australia,* entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia.*

The sand has potential to be suitable for other durable construction uses.

It is noted also that the sand is **not recommended** for use in the manufacture of glass and ceramics. Sands suitable for glass manufacture are described as having silica content (i.e. a SiO2 content) of 95 to 99.8%, and the amount and nature of the impurities is important. Alumina should be less than 4% and iron oxide should be quite low (1% being acceptable only for amber glass). Sand for glass manufacture should be of even grainsize, generally less than 20 mesh (i.e. less than about 0.85 mm) and coarser than 100 mesh (i.e. coarser than about 0.15 mm).



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It should be noted that there may be an uncertain potential to generate filter sand products from the supplied sand sample, but the grainsize may be too fine. The general requirements involve high quartz content, screening to a narrow and relatively coarse size range, and low solubility in acid. High sphericity and roundness are advantageous, but not as important as in the case of frac sand. Water supply authorities and manufacturers of sand filters for swimming pools should be able to supply you with their specifications for filter sand.

**Free Silica Content**

About 91% in the form of quartz as free grains and locked in lithic clasts of quartzite, vein quartz and acid volcanic rock.

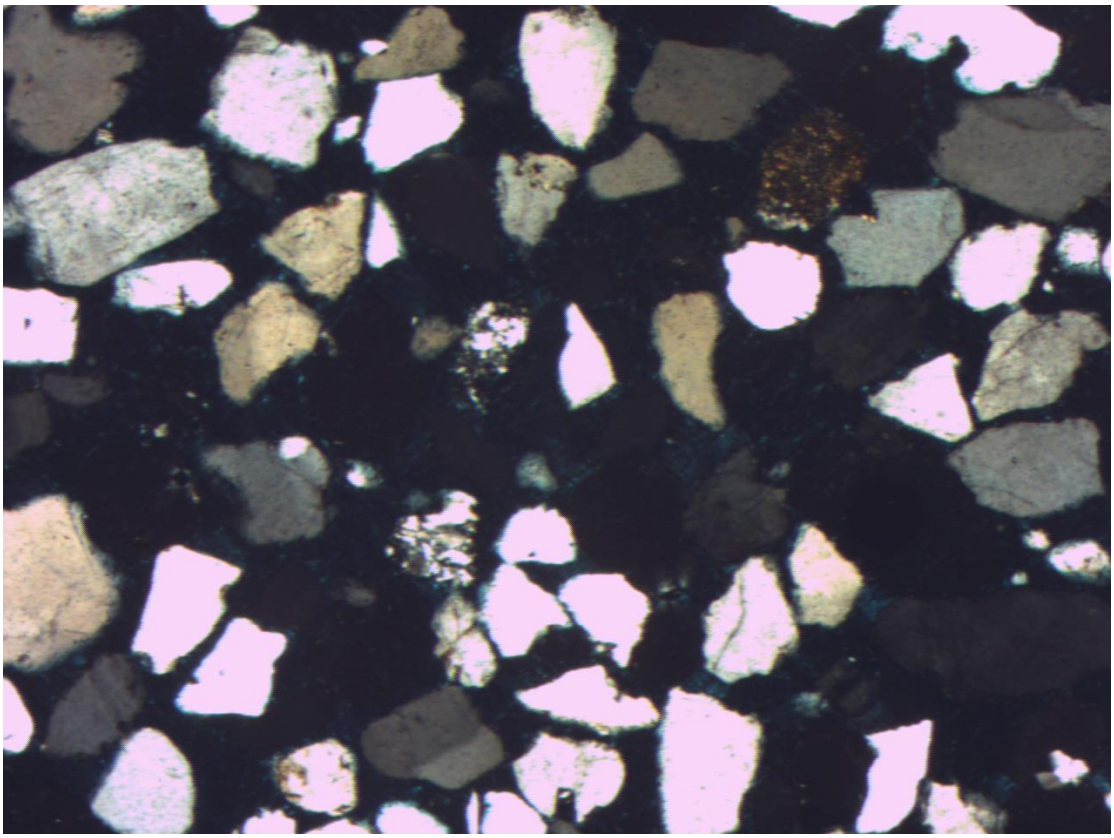


**PLATE 1**: Microphotograph of sample BH2-BL-B-PL, displaying brightly birefringent quartz, moderately birefringent and untwinned orthoclase (top left), and an argillaceous clast (dark brown top right). Field of view is 5 mm.



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# Geochempet Services

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## PETROGRAPHIC REPORT ON A SAND (BH2-10.5-12.0-PL) FROM NSW SAND DEPOSIT

Prepared for

**QUARRY MINING SYSTEMS PTY LTD**

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued By: L Pearson

L Pearson, B.Sc (Hons)
9th October, 2013



*The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services.*

**Sample Label**: BH2-10.5-12.0-PL **Date Sampled**: 14/08/13

**Sample Type**: Sand **Date Supplied**: 03/09/13

**Sample Source**: NSW Sand Deposit

**Project #**: 1308105

**Methods** Account taken of ASTM C 295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete,* the AS2758.1 – 1998 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B),* the AS1141 Standard Guide for the *Method for sampling and testing aggregates*, of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, entitled (HB 79-1996) *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

**Identification**: Coarse carbonaceous quartz sand

**Description**:

The sample consisted of about 500g of dark brown, clumped sand. In a crude dry sieving test of a small subsample about 0.2% of the sand was found to be finer than 0.075 mm sieve, 6.9% was coarser than 0.075 mm sieve but finer than a 0.3 mm sieve, about 13.7% was found to lie between 0.3 mm and 1.18 mm, and 79.2% exceeded 1.18 mm due to the clumping together of the fragments. Sieve fractions should be treated with caution due to the fine material being weakly clay cemented together in to coarse fragments. A turbidity test resulted in the observation of a lot of floating carbonaceous matter.

A thin section was prepared for microscopic examination in transmitted polarized light. A count of 100 widely spaced points falling within sectioned fragments gave the following composition (expressed in volume percent):

| | |
|---|---|
| 44% | quartz as unstrained or faintly strained free grains (42%) or simple crystalline composites of several grains (2%) |
| 3% | quartz as moderately strained free grains or simple crystalline composite grains |
| <1% | lithic clasts of chert |
| <1% | feldspar grains |
| <1% | clay intermingled with carbonaceous material (illite/chlorite) |
| 53% | carbonaceous matter (as coatings, as a cement in sparse lumps and as free fragments) |

The sand dominantly contains fragments of variably current-aligned detrital carbonaceous material of variable maturation, with a less dominant fraction of quartz and sparse feldspars. Some fragments of carbonaceous material retains there laminated texture. There is some minor clay intermingled with the carbonaceous material.



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Carbonaceous material is present as wisps or clots, and deposited in a planar fashion. Quartz clasts run between coarse silts to fine sand (0.05 – 0.2 mm in diameter). Carbonaceous matter within the sand occurs in various ways. As a very incomplete carbon coating (translucent brown to black) on quartz sand grains. A related, but less common occurrence is as a complete carbon coating of quartz sand grains. A third mode of occurrence which is quite common is as a carbon cement within clusters of a few quartz sand grains. The carbonaceous material very commonly occurs as free particles of carbonaceous matter. A fifth and least common mode of occurrence is as particles of black charcoal (cellular plant characteristics preserved).

The most abundant sand clasts are free, simple grains of unstrained or faintly strained quartz (42%); crystalline composite grains of several unstrained or faintly strained grains of quartz amount to 2% and moderately strained grains of quartz amount to an additional 3%. Quartzite and chert is present in minor amounts.

Other quite minor or trace detrital components of the sand comprise a few grains of feldspar (microcline and plagioclase).

**Comments and Interpretations**:

The submitted sand sample (labelled BH2-10.5-12.0-PL) from NSW sand deposit is considered to qualify for broad identification for engineering purposes as coarse carbonaceous quartz sand.

The **free silica content** (or total **quartz content** as defined in the Queensland Department of Main Roads Test Method Q188) is about **47%,** comprising about 47% common quartz as fine sand grains or simple crystalline composite grains and about <1% cherty or finely microcrystalline quartz in clasts of chert.

A caution is added that such carbonaceous sand has potential to contain some highly undesirable colloidal carbon which is not detectable petrographically. The abundance of carbonaceous material in this sample warrants an inclusion of this warning. Colloidal carbon retards the setting of concrete.

The sand is considered **unsuitable for durable construction uses including concrete sand**. The carbonaceous matter in this abundance (53%) is predicted to be capable of retarding/inhibiting the setting of concrete.

The sand **has potential for use as soil** and other landscaping uses.

The sand is **unsuitable for frac proppant, foundry, filter, ceramics and glass manufacture**.

**Free Silica Content**

About 47% in the form of quartz as free grains and locked in lithic clasts of quartzite.



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**Digital Photomicrograph**

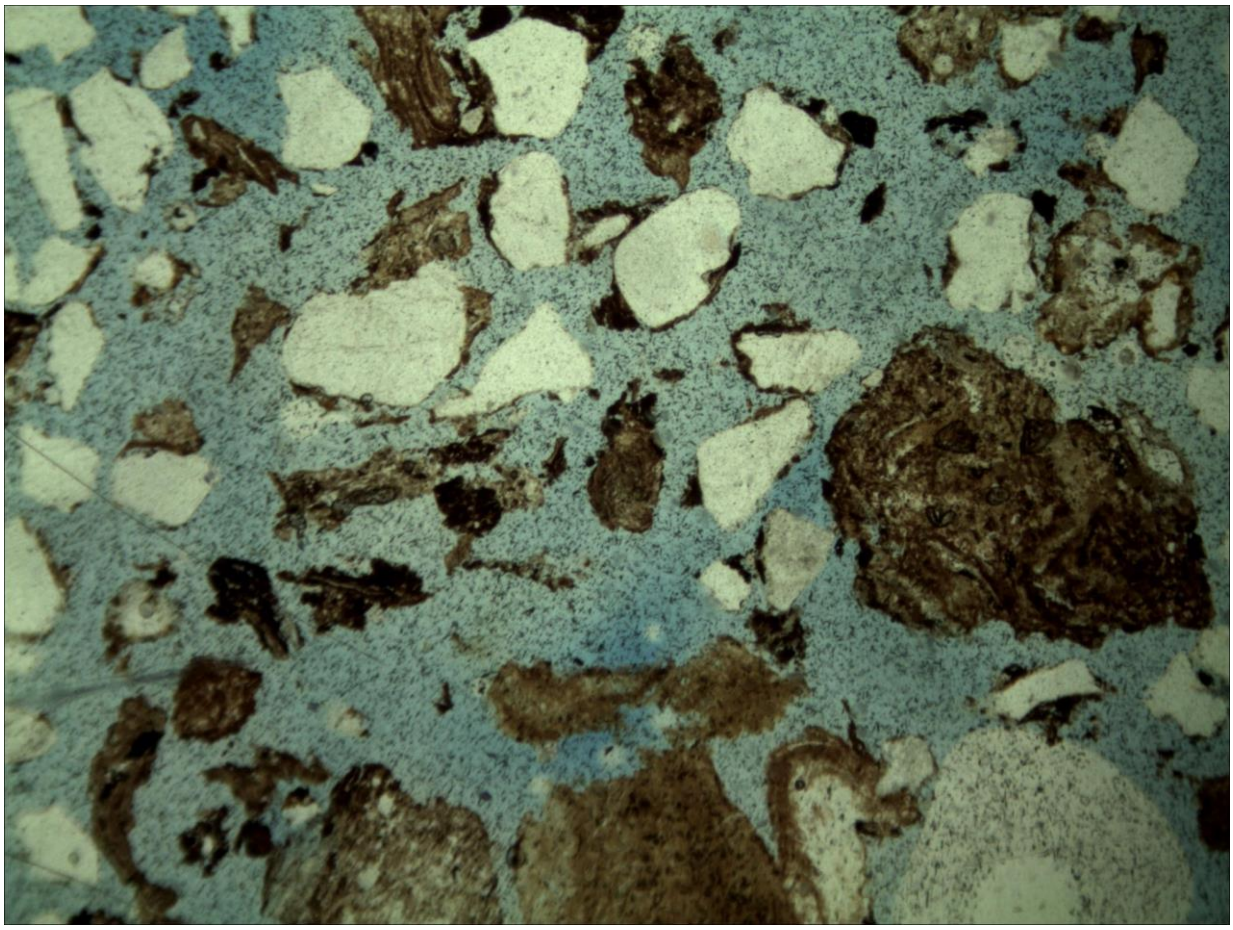


**Figure 1:** Image width is 2.77mm. Field of view is dominated by quartz grains in white and carbonaceous material as variably shaped fragments, the view is in plane polarised light to better illuminate the dark carbonaceous material.



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# Geochempet Services

**ABN 980 6945 3445**
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## PETROGRAPHIC REPORT ON A SAND SAMPLE (BH3-BL-G-PL) FROM

Prepared for

## QUARRY MINING SYSTEMS PTY LTD NSW

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued By: H M Spring

H.M. Spring, B.Sc
10th October 2013



*The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services.*

| | | | |
|---|---|---|---|
| **Sample No**: | BH3-BL-G-PL | **Date Sampled:** | 09/05/13 |
| **Type of Product**: | Sand | **Project number**: | 1308105 |
| **Source**: | Unknown | | |

**Work Requested** Petrographic analysis in relation to suitability for use in concrete aggregate: petrographic assessment of potential for alkali-silica reactivity

**Methods** Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete,* the AS2758.1 – 1998 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B),* the AS1141 Standard Guide for the *Method for sampling and testing aggregates*; Method 65: Alkali aggregate reactivity – Qualitative petrological screening for potential alkali-silica reaction and of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, (HB 79-1996) entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

**Identification** Quartz sand

**Description**

The sample consisted of about 500 gm of very pale yellow brown quartz sand. Quartz grains are mainly subrounded to rounded in shape. In a crude test of a small subsample, about less than 1% was finer than 0.075 mm, about 37.2% of the sand passed a 0.3 mm sieve, about 62.6% was found to be coarser than 0.3 mm and finer than 1.18 mm, and 0.2% is coarser than 1.18 mm, ranging up to approximately 2mm. The minor coarse fragment consist of quartz and lithics fragments

A thin section was prepared for microscopic examination in transmitted polarized light. A count of 100 widely spaced points falling within sectioned sand clasts gave the following composition:

| | |
|---|---|
| 62% | quartz as unstrained or mildly strained free grains (51%) and simple crystalline composites of similar quartz (11%) |
| 17% | quartz as moderately strained free grains |
| <1 | vein quartz |
| 1% | chert |
| 5% | quartzite (4% moderately strained) |
| 2% | feldspar |
| 1% | other mineral grains (including tourmaline, rutile, calcite and opaque oxide) |
| 4% | lithic clasts of acid volcanics (1% quartz) |
| 2% | lithic clasts of intermediate volcanics |



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4% lithic clasts of meta arenite ( 2% quartz)

2% lithic clasts of pelite

The sand consists almost entirely of quartz. The most abundant quartz in the form of simple grains of unstrained or mildly strained quartz (51%), minor crystalline composite grains of similarly unstrained or mildly strained quartz (11%) and moderately strained free grains (17%). Other siliceous clasts include 5% quartzite and 1% chert.

Feldspar amount to 2%, predominately plagioclase. Other free minerals amount about 1% and include tourmaline, rutile, calcite and opaque oxide.

Other minor clasts include 4% acid volcanics (carrying about 20-35% of finely microcrystalline quartz), 2% intermediate volcanic, 4% meta arenite (composed of mainly quartz and sericite) and 2% pelite.

**Comments and Interpretations**

This sand sample labelled BH3-BL-G-PL is considered to consist of clean quartz sand which may be described broadly for engineering purposes as medium to fine quartz sand.

The **free silica content** of the sand is **about 88%,** comprising 79% as free quartz grains or simple crystalline composite grains, 7% quartz locked within sand-sized lithic clasts (i.e. within small rock fragments) and 2% chert or finely microcrystalline quartz (within clasts of pelite, chert and acid volcanic/tuffaceous rock).

Since the sand is dominated by essentially hard, strong and durable rock and mineral fragments, it is predicted to be **physically suitable for use as concrete sand** and other durable construction uses.

The sand as a whole is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**. It carries about 21% of moderately stained quartz and 2% finely microcrystalline quartz.

Thus, sand of the type represented in the supplied sample is interpreted to be **suitable for use in concrete** provided that appropriate precautions are taken in mix and engineering design to take account of its perceived potential for mild or slow deleterious alkali-silica reactivity.

It should be noted that there may be a potential to generate filter sand products from the supplied sand sample. The general requirements involve high quartz content, screening to a narrow and relatively coarse size range, and low solubility in acid.

**Free Silica Content**

The free silica content is about 88%.



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# Geochempet Services

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## PETROGRAPHIC REPORT ON A SAND SAMPLE (BH3-BL-B3-PL) FROM

Prepared for

## QUARRY MINING SYSTEMS PTY LTD NSW

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued By: H M Spring

H.M. Spring, B.Sc
10th October 2013



*The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services.*

| | | | |
|---|---|---|---|
| **Sample No**: | BH3-BL-B3-PL | **Date Sampled:** | 09/05/13 |
| **Type of Product**: | Sand | **Project number**: | 1308105 |
| **Source**: | Unknown | | |

**Work Requested** Petrographic analysis in relation to suitability for use in concrete aggregate: petrographic assessment of potential for alkali-silica reactivity

**Methods** Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete,* the AS2758.1 – 1998 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B),* the AS1141 Standard Guide for the *Method for sampling and testing aggregates*; Method 65: Alkali aggregate reactivity – Qualitative petrological screening for potential alkali-silica reaction and of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, (HB 79-1996) entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

**Identification** Quartz sand

**Description**

The sample consisted of about 1.3 kg of light yellow brown quartz sand. Quartz grains are mainly subrounded to rounded in shape. In a crude test of a small subsample, about 0.1% was finer than 0.075 mm, about 25% of the sand passed a 0.3 mm sieve, about 74.9% was found to be coarser than 0.3 mm and finer than 1.18 mm, and less than 1% is coarser than 1.18 mm. The trivial coarse fraction consist of one shell fragment and one lithic grain.

A thin section was prepared for microscopic examination in transmitted polarized light. A count of 100 widely spaced points falling within sectioned sand clasts gave the following composition:

| | |
|---|---|
| 69% | quartz as unstrained or mildly strained free grains (56%) and simple crystalline composites of similar quartz (13%) |
| 16% | quartz as moderately strained free grains |
| 1% | vein quartz |
| 2% | chert |
| 2% | quartzite (1% moderately strained) |
| 3% | feldspar |
| <1% | other mineral grains (including tourmaline, rutile, calcite and opaque oxide) |
| 3% | lithic clasts of acid volcanics (1% quartz) |



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2% lithic clasts of intermediate volcanics

1% lithic clasts of meta arenite ( 3% quartz)

1% lithic clasts of pelite

The sand consists almost entirely of quartz. The most abundant quartz in the form of simple grains of unstrained or mildly strained quartz (56%), minor crystalline composite grains of similarly unstrained or mildly strained quartz (13%) and moderately strained free grains (16%). Other siliceous clasts include 1% vein quartz, 2% quartzite and 2% chert.

Feldspar amount to 2%, predominately plagioclase. Other free minerals amount to less than 1% and include tourmaline, rutile, calcite and opaque oxide.

Other minor clasts include 3% acid volcanics (carrying about 20-35% of finely microcrystalline quartz), 2% intermediate volcanic, 1% meta arenite (composed of mainly quartz and sericite) and 1% pelite.

**Comments and Interpretations**

This sand sample labelled BH3-BL-B3-PL is considered to consist of clean quartz sand which may be described broadly for engineering purposes as medium to fine quartz sand.

The **free silica content** of the sand is **about 94%,** comprising 85% as free quartz grains or simple crystalline composite grains, 6% quartz locked within sand-sized lithic clasts (i.e. within small rock fragments) and 3% chert or finely microcrystalline quartz (within clasts of pelite, chert and acid volcanic/tuffaceous rock).

Since the sand is dominated by essentially hard, strong and durable rock and mineral fragments, it is predicted to be **physically suitable for use as concrete sand** and other durable construction uses.

The sand as a whole is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**. It carries about 17% of moderately stained quartz. 1% heavily strained vein quartz and 3% finely microcrystalline quartz.

Thus, sand of the type represented in the supplied sample is interpreted to be **suitable for use in concrete** provided that appropriate precautions are taken in mix and engineering design to take account of its perceived potential for mild or slow deleterious alkali-silica reactivity.

It should be noted that there may be a potential to generate filter sand products from the supplied sand sample. The general requirements involve high quartz content, screening to a narrow and relatively coarse size range, and low solubility in acid.

**Free Silica Content**

The free silica content is about 94%.



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GEOCHEMPET SERVICES BRISBANE

# Geochempet Services

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## PETROGRAPHIC REPORT ON A SAND (BH4-BL-G-PL) FROM NSW SAND DEPOSIT

Prepared for

**QUARRY MINING SYSTEMS PTY LTD**

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued By:

L. P. Evans, B.Sc
11th October, 2013



*The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services.*

**Sample Label**: BH4-BL-G-PL **Date Sampled**: 14/08/13

**Sample Type**: Sand **Date Supplied**: 03/09/13

**Sample Source**: NSW Sand Deposit

**Project #**: 1308105

**Methods** Account taken of ASTM C 295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete*, the AS2758.1 – 1998 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*, the AS1141 Standard Guide for the *Method for sampling and testing aggregates*, of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, entitled (HB 79-1996) *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

**Identification** Medium to fine quartz sand

**Description**

The sample consisted of about 500g of pale yellowish grey, clean, free-flowing, dry fine sand. Close inspection revealed that the sand consists mainly of subangular and subrounded quartz grains. In a crude dry sieving test of a small subsample a trace amount of the sand was found to be finer than 0.075 mm sieve, 31.1% was coarser than 0.075 mm sieve but finer than a 0.3 mm sieve, about 67.2% was found to lie between 0.3 mm and 1.18 mm, and 1.7% exceeded 1.18 mm, with maximum diameter being 1 mm; coarse fraction lithology included quartz, lithic clasts and plant material. There are no apparent deleterious grain coatings.

After a subsample was swirled in water it settled rapidly in a fashion consistent with an absence of clay and the presence of only a small amount of silt.

Microscopic identifications at 100 random points falling within sectioned clasts revealed the following composition (volume % of clast types) for the sample:

| | |
|---|---|
| 75% | quartz as unstrained to mildly strained free grains (73%) and simple crystalline composite grains (2%) |
| 11% | moderately strained simple or composite grains of quartz |
| 2% | quartzite |
| <1% | vein quartz |
| 5% | chert |
| 1% | other minerals (epidote, hornblende, tourmaline, zircon) |
| 3% | feldspar grains (2% plagioclase and 1% K-feldspar) |
| 2% | argillaceous clasts |
| <1% | acid volcanics |
| 1% | volcaniclastic siltstone |



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A simultaneous count of total quartz content yielded 93%, comprising 86% free quartz grains or simple crystalline composite grains, and 7% quartz locked within lithic clasts of quartzite, chert, vein quartz, volcaniclastic siltstone and acid volcanic/tuffaceous rock.

In thin section the most abundant fragments are seen to be quartz, occurring mainly as single unstrained to mildly strained sand grains (73%) and less commonly as simple crystalline composite grains (2%), lithic clasts of vein quartz (<1%) and 2% quartzite. Moderately strained quartz in simple or composite grains made up 11%. Finely microcrystalline lithic clasts of chert were seen as 5% of the sample

Feldspar grains, specifically orthoclase feldspar (orthoclase and rarely microcline) amounts to 1% and plagioclase feldspar (lightly sericitized) amounts to 2%.

Other minor clasts include acid volcanic/tuffaceous rock with a finely crystalline and devitrified quartzofeldspathic groundmass (<1%), volcaniclastic siltstone (1%)and ferruginized argillaceous clasts (2%).

**Comments and Interpretations**

The submitted sand sample (labelled BH4-BL-G-PL) from NSW sand deposit is considered to qualify for broad identification for engineering purposes as clean medium to fine quartz sand.

The **free silica content** (or total quartz content) of the sand is **about 93%**, comprising 86% free quartz grains or simple crystalline composite grains, and 7% quartz locked within lithic clasts of quartzite, chert, vein quartz, volcaniclastic siltstone and acid volcanic/tuffaceous rock.

The sand is predicted to be **physically suitable for use as sand in concrete** because it is composed mainly of naturally worn, small grains of quartz and feldspar: both minerals are regarded as hard, strong and durable. The minor other mineral and rock fragments are also regarded as robust and durable.

Because the sand carries 11% of moderately strained quartz (as free grains and in quartzite and vein quartz), and 5% microcrystalline quartz in lithic clasts of chert, volcaniclastic siltstone acid volcanic/tuffaceous rock, it is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**.

Guidance on how to deal with the perceived potential for deleterious alkali-silica reactivity may be found in the 1996 joint publication of the *Cement and Concrete Association of Australia* and *Standards Australia,* entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia.*

The sand has potential to be suitable for other durable construction uses.

It is noted also that the sand is **not recommended** for use in the manufacture of glass and ceramics. Sands suitable for glass manufacture are described as having silica content (i.e. a SiO2 content) of 95 to 99.8%, and the amount and nature of the impurities is important. Alumina should be less than 4% and iron oxide should be quite low (1% being acceptable only for amber glass). Sand for glass manufacture



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should be of even grainsize, generally less than 20 mesh (i.e. less than about 0.85 mm) and coarser than 100 mesh (i.e. coarser than about 0.15 mm).

It should be noted that there may be an uncertain potential to generate filter sand products from the supplied sand sample, but the grainsize may be too fine. The general requirements involve high quartz content, screening to a narrow and relatively coarse size range, and low solubility in acid. High sphericity and roundness are advantageous, but not as important as in the case of frac sand. Water supply authorities and manufacturers of sand filters for swimming pools should be able to supply you with their specifications for filter sand.

**Free Silica Content**

About 93% in the form of quartz as free grains and locked in lithic clasts of quartzite, vein quartz and acid volcanic rock.



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GEOCHEMPET SERVICES BRISBANE

# Geochempet Services

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## PETROGRAPHIC REPORT ON A SAND (BH4-BL-B-PL) FROM NSW SAND DEPOSIT

Prepared for

**QUARRY MINING SYSTEMS PTY LTD**

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued By:

L Pearson, B.Sc (Hons)
9th October, 2013



*The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services.*

**Sample Label**: BH4-BL-B-PL **Date Sampled**: 14/08/13

**Sample Type**: Sand **Date Supplied**: 03/09/13

**Sample Source**: NSW Sand Deposit

**Project #**: 1308105

**Methods** Account taken of ASTM C 295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete*, the AS2758.1 – 1998 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*, the AS1141 Standard Guide for the *Method for sampling and testing aggregates*, of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, entitled (HB 79-1996) *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

**Identification** Fine to medium quartz sand

**Description**

The sample consisted of about 500g of pale yellowish brown, clean, free-flowing, dry fine sand. Close inspection revealed that the sand consists mainly of subangular and subrounded quartz grains. In a crude dry sieving test of a small subsample about 0.1% of the sand was found to be finer than 0.075 mm sieve, 60.3% was coarser than 0.075 mm sieve but finer than a 0.3 mm sieve, about 39.6% was found to lie between 0.3 mm and 1.18 mm, and trace amounts exceeded 1.18 mm; the two small coarse fraction fragments were composed of plant material. There are no apparent deleterious grain coatings.

After a subsample was swirled in water it settled rapidly in a fashion consistent with an absence of clay and the presence of only a small amount of silt.

Microscopic identifications at 100 random points falling within sectioned clasts revealed the following composition (volume % of clast types) for the sample:

| | |
|---|---|
| 89% | quartz as unstrained to mildly strained free grains (87%) and simple crystalline composite grains (2%) |
| 10% | moderately strained simple or composite grains of quartz |
| <1% | quartzite |
| <1% | vein quartz |
| <1% | other minerals (epidote, hornblende, tourmaline, zircon) |
| <1% | feldspar grains (<1% plagioclase and <1% K-feldspar) |
| 1% | acid volcanics (<1% microcrystalline quartz) |
| <1% | intermediate volcanics |
| <1% | ferruginous fragments |



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A simultaneous count of total quartz content yielded 99%, comprising 99% free quartz grains or simple crystalline composite grains, and <1% quartz locked within lithic clasts of quartzite, vein quartz and acid volcanic/tuffaceous rock.

In thin section the most abundant fragments are seen to be quartz, occurring mainly as single unstrained to mildly strained sand grains (87%) and less commonly as simple crystalline composite grains (2%), lithic clasts of vein quartz (<1%) and <1% quartzite. Moderately strained quartz in simple or composite grains made up 10%.

Feldspar grains, specifically orthoclase feldspar (orthoclase and rarely microcline) amounts to <1% and plagioclase feldspar (lightly sericitized) amounts to <1%.

Other minor clasts include acid volcanic/tuffaceous rock with a finely crystalline and devitrified quartzofeldspathic groundmass (1%). Minor amounts of intermediate volcanics composed of minor quartz and feldspars with minor mafic minerals were observed, some are lightly ferruginised. Some are moderately sericitized. Minor ferruginous fragments are observed.

**Comments and Interpretations**

The submitted sand sample (labelled BH4-BL-B-PL) from NSW sand deposit is considered to qualify for broad identification for engineering purposes as clean fine to medium quartz sand.

The **free silica content** (or total quartz content) of the sand is **about 99%**, comprising 99% free quartz grains or simple crystalline composite grains, and <1% quartz locked within lithic clasts of quartzite, vein quartz and acid volcanic/tuffaceous rock.

The sand is predicted to be **physically suitable for use as sand in concrete** because it is composed mainly of naturally worn, small grains of quartz and feldspar: both minerals are regarded as hard, strong and durable. The minor other mineral and rock fragments are also regarded as robust and durable.

Because the sand carries 10% of moderately strained quartz (as free grains and in quartzite and vein quartz), and <1% microcrystalline quartz in lithic clasts of acid volcanic/tuffaceous rock, it is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**.

Guidance on how to deal with the perceived potential for deleterious alkali-silica reactivity may be found in the 1996 joint publication of the *Cement and Concrete Association of Australia* and *Standards Australia,* entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia.*

The sand has potential to be suitable for other durable construction uses.

It is noted also that the sand has good potential for use in the manufacture of glass and ceramics. Sands suitable for glass manufacture are described as having silica content (i.e. a SiO2 content) of 95 to 99.8%, and the amount and nature of the impurities is important. Alumina should be less than 4% and iron oxide should be quite low (1% being acceptable only for amber glass). Sand for glass manufacture should be of even



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grainsize, generally less than 20 mesh (i.e. less than about 0.85 mm) and coarser than 100 mesh (i.e. coarser than about 0.15 mm).

It should be noted that there may be an uncertain potential to generate filter sand products from the supplied sand sample, but the grainsize may be too fine. The general requirements involve high quartz content, screening to a narrow and relatively coarse size range, and low solubility in acid. High sphericity and roundness are advantageous, but not as important as in the case of frac sand. Water supply authorities and manufacturers of sand filters for swimming pools should be able to supply you with their specifications for filter sand.

**Free Silica Content**

About 99% in the form of quartz as free grains and locked in lithic clasts of quartzite, vein quartz and acid volcanic rock



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# Geochempet Services

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## PETROGRAPHIC REPORT ON A SAND SAMPLE (BH5-BL-G-PL) FROM

Prepared for

## QUARRY MINING SYSTEMS PTY LTD NSW

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued By: H M Spring

H.M. Spring, B.Sc
10th October 2013



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**Sample No**: BH5-BL-G-PL **Date Sampled:** 09/05/13

**Type of Product**: Sand **Project number**: 1308105

**Source**: Unknown

**Work Requested** Petrographic analysis in relation to suitability for use in concrete aggregate: petrographic assessment of potential for alkali-silica reactivity

**Methods** Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete,* the AS2758.1 – 1998 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B),* the AS1141 Standard Guide for the *Method for sampling and testing aggregates*; Method 65: Alkali aggregate reactivity – Qualitative petrological screening for potential alkali-silica reaction and of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, (HB 79-1996) entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

**Identification** Quartz sand

**Description**

The sample consisted of about 500 gm of light grey damp quartz sand. Quartz grains are mainly subrounded to rounded in shape. In a crude test of a small subsample, about less than 1% was finer than 0.075 mm, about 27.5% of the sand passed a 0.3 mm sieve, about 72% was found to be coarser than 0.3 mm and finer than 1.18 mm, and 0.5% is coarser than 1.18 mm, ranging up to approximately 3mm. The minor coarse fragment consist of quartz, lithics and a few shell fragments

A thin section was prepared for microscopic examination in transmitted polarized light. A count of 100 widely spaced points falling within sectioned sand clasts gave the following composition:

| | |
|---|---|
| 65% | quartz as unstrained or mildly strained free grains (53%) and simple crystalline composites of similar quartz (12%) |
| 15% | quartz as moderately strained free grains |
| 2% | chert |
| 4% | quartzite (3% moderately strained) |
| 2% | feldspar |
| <1% | other mineral grains (including tourmaline, rutile, calcite and opaque oxide) |
| 4% | lithic clasts of acid volcanics (1% quartz) |
| 2% | lithic clasts of intermediate volcanics |



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3% lithic clasts of meta arenite ( 3% quartz)

2% lithic clasts of pelite

1% shell fragments

The sand consists almost entirely of quartz. The most abundant quartz in the form of simple grains of unstrained or mildly strained quartz (53%), minor crystalline composite grains of similarly unstrained or mildly strained quartz (12%) and moderately strained free grains (15%). Other siliceous clasts include 4% quartzite and 2% chert.

Feldspar amount to 2%, predominately plagioclase. Other free minerals amount to less than 1% and include tourmaline, rutile, calcite and opaque oxide.

Other minor clasts include 4% acid volcanics (carrying about 20-35% of finely microcrystalline quartz), 2% intermediate volcanic, 3% meta arenite (composed of mainly quartz and sericite) and 2% pelite.

Shell fragments amount to about 1% of the sample.

**Comments and Interpretations**

This sand sample labelled BH5-BL-G-PL is considered to consist of clean quartz sand which may be described broadly for engineering purposes as medium to fine quartz sand.

The **free silica content** of the sand is **about 90%,** comprising 80% as free quartz grains or simple crystalline composite grains, 7% quartz locked within sand-sized lithic clasts (i.e. within small rock fragments) and 3% chert or finely microcrystalline quartz (within clasts of pelite, chert and acid volcanic/tuffaceous rock).

Since the sand is dominated by essentially hard, strong and durable rock and mineral fragments, it is predicted to be **physically suitable for use as concrete sand** and other durable construction uses.

The sand as a whole is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**. It carries about 18% of moderately stained quartz and 3% finely microcrystalline quartz.

Thus, sand of the type represented in the supplied sample is interpreted to be **suitable for use in concrete** provided that appropriate precautions are taken in mix and engineering design to take account of its perceived potential for mild or slow deleterious alkali-silica reactivity.

It should be noted that there may be a potential to generate filter sand products from the supplied sand sample. The general requirements involve high quartz content, screening to a narrow and relatively coarse size range, and low solubility in acid.

**Free Silica Content**

The free silica content is about 90%.



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GEOCHEMPET SERVICES BRISBANE

# Geochempet Services

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## PETROGRAPHIC REPORT ON A SAND (BH5-BL-B-PL) FROM NSW SAND DEPOSIT

Prepared for

**QUARRY MINING SYSTEMS PTY LTD**

Purchase Order: Q1420

Invoice Number: 00005395

Client Ref: Mark Philpott

Issued By:

L Pearson

L Pearson, B.Sc (Hons)
9th October, 2013



*The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services.*

**Sample Label**: BH5-BL-B-PL **Date Sampled**: 14/08/13

**Sample Type**: Sand **Date Supplied**: 03/09/13

**Sample Source**: NSW Sand Deposit

**Project #**: 1308105

**Methods** Account taken of ASTM C 295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete*, the AS2758.1 – 1998 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*, the AS1141 Standard Guide for the *Method for sampling and testing aggregates*, of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, entitled (HB 79-1996) *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

**Identification** Medium to fine quartz sand

**Description**

The sample consisted of about 500g of light yellowish brown, clean, free-flowing, dry fine sand. Close inspection revealed that the sand consists mainly of subrounded quartz grains. In a crude dry sieving test of a small subsample about 0.5% of the sand was found to be finer than 0.075 mm sieve, 49.5% was coarser than 0.075 mm sieve but finer than a 0.3 mm sieve, about 50% was found to lie between 0.3 mm and 1.18 mm, and trace amounts exceeded 1.18 mm. There are no apparent deleterious grain coatings.

After a subsample was swirled in water it settled rapidly in a fashion consistent with an absence of clay and the presence of only a small amount of silt.

Microscopic identifications at 100 random points falling within sectioned clasts revealed the following composition (volume % of clast types) for the sample:

| | |
|---|---|
| 96% | quartz as unstrained to mildly strained free grains (93%) and simple crystalline composite grains (3%) |
| 3% | moderately strained simple or composite grains of quartz |
| <1% | quartzite |
| <1% | vein quartz |
| <1% | other minerals (epidote, hornblende, tourmaline, zircon) |
| <1% | feldspar grains (<1% plagioclase and <1% K-feldspar) |
| 1% | acid volcanics (<1% microcrystalline quartz) |
| <1% | intermediate volcanics |
| <1% | ferruginous fragments |



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A simultaneous count of total quartz content yielded 99%, comprising 99% free quartz grains or simple crystalline composite grains, and <1% quartz locked within lithic clasts of quartzite, vein quartz and acid volcanic/tuffaceous rock.

In thin section the most abundant fragments are seen to be quartz, occurring mainly as single unstrained to mildly strained sand grains (93%) and less commonly as simple crystalline composite grains (3%), lithic clasts of vein quartz (<1%) and <1% quartzite. Moderately strained quartz in simple or composite grains made up 3%.

Feldspar grains, specifically orthoclase feldspar (orthoclase and rarely microcline) amounts to <1% and plagioclase feldspar (lightly sericitized) amounts to <1%.

Other minor clasts include acid volcanic/tuffaceous rock with a finely crystalline and devitrified quartzofeldspathic groundmass (1%). Minor amounts of intermediate volcanics composed of minor quartz and feldspars with minor mafic minerals were observed, some are lightly ferruginised. Some are moderately sericitized. Minor ferruginous fragments are observed.

**Comments and Interpretations**

The submitted sand sample (labelled BH5-BL-B-PL) from NSW sand deposit is considered to qualify for broad identification for engineering purposes as clean medium to fine quartz sand.

The **free silica content** (or total quartz content) of the sand is **about 99%**, comprising 99% free quartz grains or simple crystalline composite grains, and <1% quartz locked within lithic clasts of quartzite, vein quartz and acid volcanic/tuffaceous rock.

The sand is predicted to be **physically suitable for use as sand in concrete** because it is composed mainly of naturally worn, small grains of quartz and feldspar: both minerals are regarded as hard, strong and durable. The minor other mineral and rock fragments are also regarded as robust and durable.

Because the sand carries 3% of moderately strained quartz (as free grains and in quartzite and vein quartz), and <1% microcrystalline quartz in lithic clasts of acid volcanic/tuffaceous rock, it is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**.

Guidance on how to deal with the perceived potential for deleterious alkali-silica reactivity may be found in the 1996 joint publication of the *Cement and Concrete Association of Australia* and *Standards Australia,* entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia.*

The sand has potential to be suitable for other durable construction uses.

It is noted also that the sand has good potential for use in the manufacture of glass and ceramics. Sands suitable for glass manufacture are described as having silica content (i.e. a SiO2 content) of 95 to 99.8%, and the amount and nature of the impurities is important. Alumina should be less than 4% and iron oxide should be quite low (1% being acceptable only for amber glass). Sand for glass manufacture should be of even



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grainsize, generally less than 20 mesh (i.e. less than about 0.85 mm) and coarser than 100 mesh (i.e. coarser than about 0.15 mm).

It should be noted that there may be an uncertain potential to generate filter sand products from the supplied sand sample, but the grainsize may be too fine. The general requirements involve high quartz content, screening to a narrow and relatively coarse size range, and low solubility in acid. High sphericity and roundness are advantageous, but not as important as in the case of frac sand. Water supply authorities and manufacturers of sand filters for swimming pools should be able to supply you with their specifications for filter sand.

**Free Silica Content**

About 99% in the form of quartz as free grains and locked in lithic clasts of quartzite, vein quartz and acid volcanic rock

**Digital Photomicrograph**

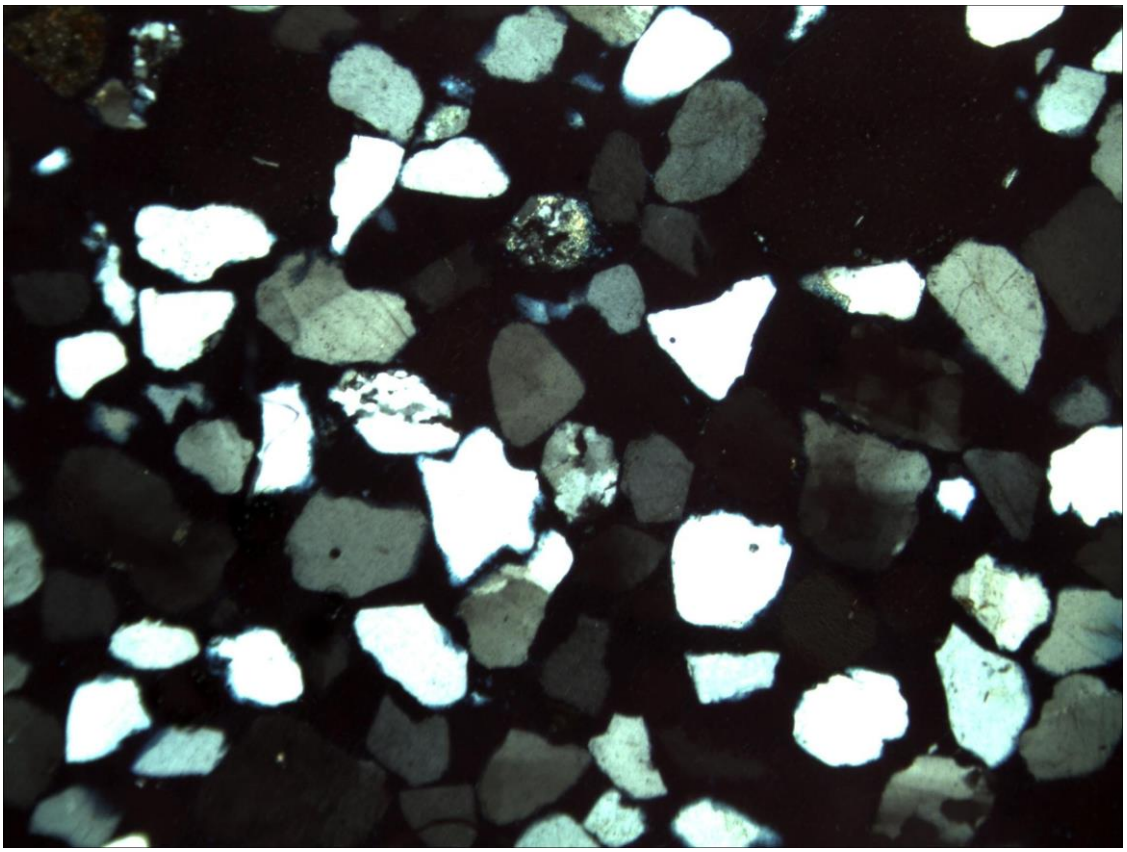


**Figure 1:** Image width is 2.77mm. Field of view is dominated by quartz grains at various levels of extinction. There sub-rounded average shape size is evident.



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# Bobs Farm – Stage 2 Testing- Borehole Summary

## Borehole 1 – BH1 – 19 metres depth




*Fig ? Borehole photos of sand lenses with* depth

| Sample No | No of bore samples | Mass of Test Sample (kg) | Actual Mass (kg) | Bore Hole Samples with Depth | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| BH1-BL-AWT-HM | 6 | 0.6 | 0.700 | BH1-0.6-1.0 | BH1-1.0-1.5 | BH1-1.5-2.0 | BH1-2.2-2.5 | BH1-2.5-3.0 | BH1-3.0-3.5 |
| BH1-BL-AWT-SO | 6 | 0.6 | 0.700 | BH1-0.6-1.0 | BH1-1.0-1.5 | BH1-1.5-2.0 | BH1-2.2-2.5 | BH1-2.5-3.0 | BH1-3.0-3.5 |
| BH1-BL-G1-CC | 5 | 6 | 6.000 | BH1-12.0-13.0 | BH1-13.0-15.0 | BH1-15.0-16.5 | BH1-16.5-18.5 | BH1-18.5-19.0 | |
| BH1-BL-G1-CS | 5 | 3 | 3.000 | BH1-12.0-13.0 | BH1-13.0-15.0 | BH1-15.0-16.5 | BH1-16.5-18.5 | BH1-18.5-19.0 | |
| BH1-BL-G1-HM | 5 | 0.6 | 0.500 | BH1-12.0-13.0 | BH1-13.0-15.0 | BH1-15.0-16.5 | BH1-16.5-18.5 | BH1-18.5-19.0 | |
| BH1-BL-G1-PL | 5 | 0.4 | 0.500 | BH1-12.0-13.0 | BH1-13.0-15.0 | BH1-15.0-16.5 | BH1-16.5-18.5 | BH1-18.5-19.0 | |
| BH1-BL-G1-SO | 5 | 0.6 | 0.500 | BH1-12.0-13.0 | BH1-13.0-15.0 | BH1-15.0-16.5 | BH1-16.5-18.5 | BH1-18.5-19.0 | |
| BH1-BL-G2-HM | 4 | 0.6 | 0.800 | BH1-4.2-4.5 | BH1-4.5-5.0 | BH1-5.0-5.5 | BH1-11.0-12.0 | | |
| BH1-BL-G2-PL | 4 | 0.4 | 0.400 | BH1-4.2-4.5 | BH1-4.5-5.0 | BH1-5.0-5.5 | BH1-11.0-12.0 | | |

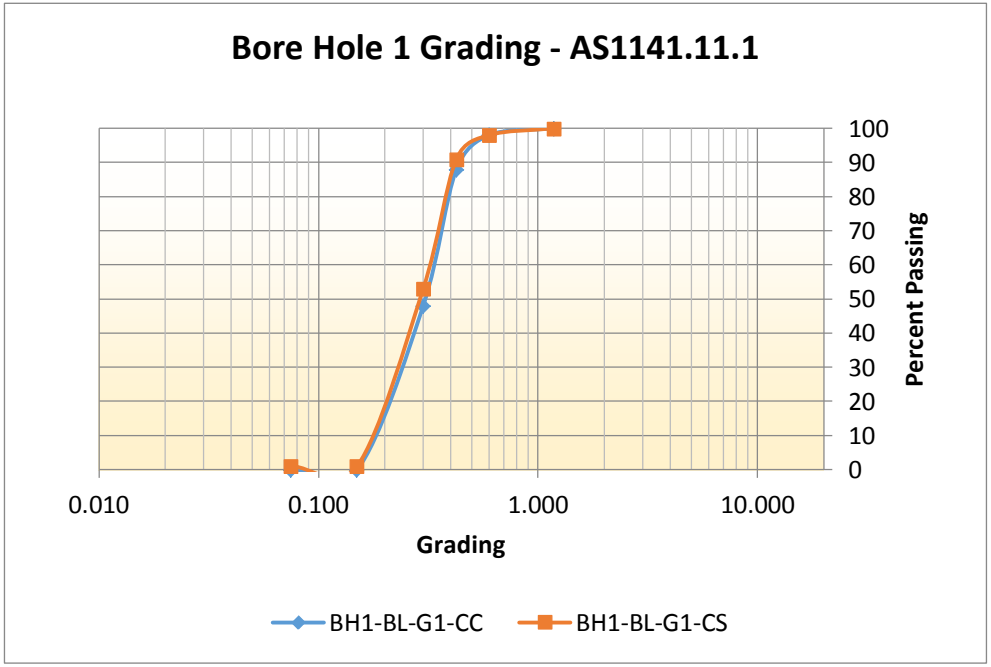
| Key | Test | Lab | Sample (kg) |
|---|---|---|---|
| CS | Wash Grading AS1141.11.1 | Coffey | 3 |
| | Clay & Fine Silt AS1141.33 | | |
| | Organic Impurities AS1141.34 | | |
| CC | Bulk Density AS1141.4 | Coffey | 6 |
| | Particle Density and Water Absorption AS11 | | |
| | Sodium Sulfate Soundness AS1141.24 | | |
| SO | FSC - Full Soil Chemistry | SESL | 0.6 |
| | Basic Waste Classification BWC - BH1 | | |
| HM | Heavy Liquid Separation | Bureau Veritas | 0.6 |
| | Combined Grading | | |
| PL | Petrological | Geochempet | 0.4 |
| | Shape Analysis | | |

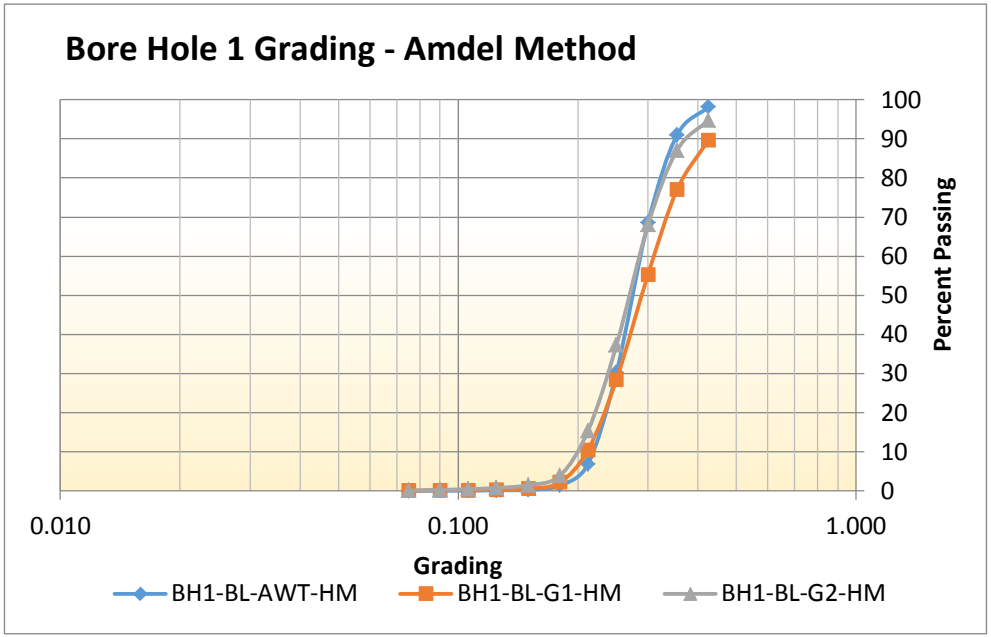
| Code | Detail |
|---|---|
| BL-M | Blended Mottled |
| BL-HM | Blended High Mottled |
| BL-LM | Blended Low Mottled |
| BL-C | Blended Construction |
| BL-HM-P | Petrographic |
| BL-C-P | Petrographic |
| BH3-BL-B | Blended Blonde |
| BH3-BL-G | Blended Grey |
| BH1-BL-AWT | Above Water Table |
| BL-BH-M | Blended Borehole Mottled |
| BL-BH-B | Blended Borehole Blonde |

A precise nomenclature was used to classify each borehole sample for laboratory testing as per Table 2.

| Sample | Depth |
|---|---|
| BH1-BL-AWT-HM | 0.6 - 3.5 |
| BH1-BL-AWT-SO | 0.6 - 3.5 |
| BH1-BL-G1-CC | 12.0 - 19.0 |
| BH1-BL-G1-CS | 12.0 - 19.0 |
| BH1-BL-G1-HM | 12.0 - 19.0 |
| BH1-BL-G1-PL | 12.0 - 19.0 |
| BH1-BL-G1-SO | 12.0 - 19.0 |
| BH1-BL-G2-HM | 4.2 - 12.0 |
| BH1-BL-G2-PL | 4.2 - 12.0 |

| | |
|---|---|
| BH1 | Bore Hole 1 |
| BL | Blended |
| AWT | Above Water Table |
| G1 | Grey 1 |
| G2 | Grey 2 |
| HM | Heavy Metal |
| SO | Soils |
| CC | Construction Complex |
| CS | Construction Simple |
| PL | Petrological |



# Borehole 2 – BH2 – 26.5 metres depth




*Fig ? Borehole photos of sand lenses with* depth

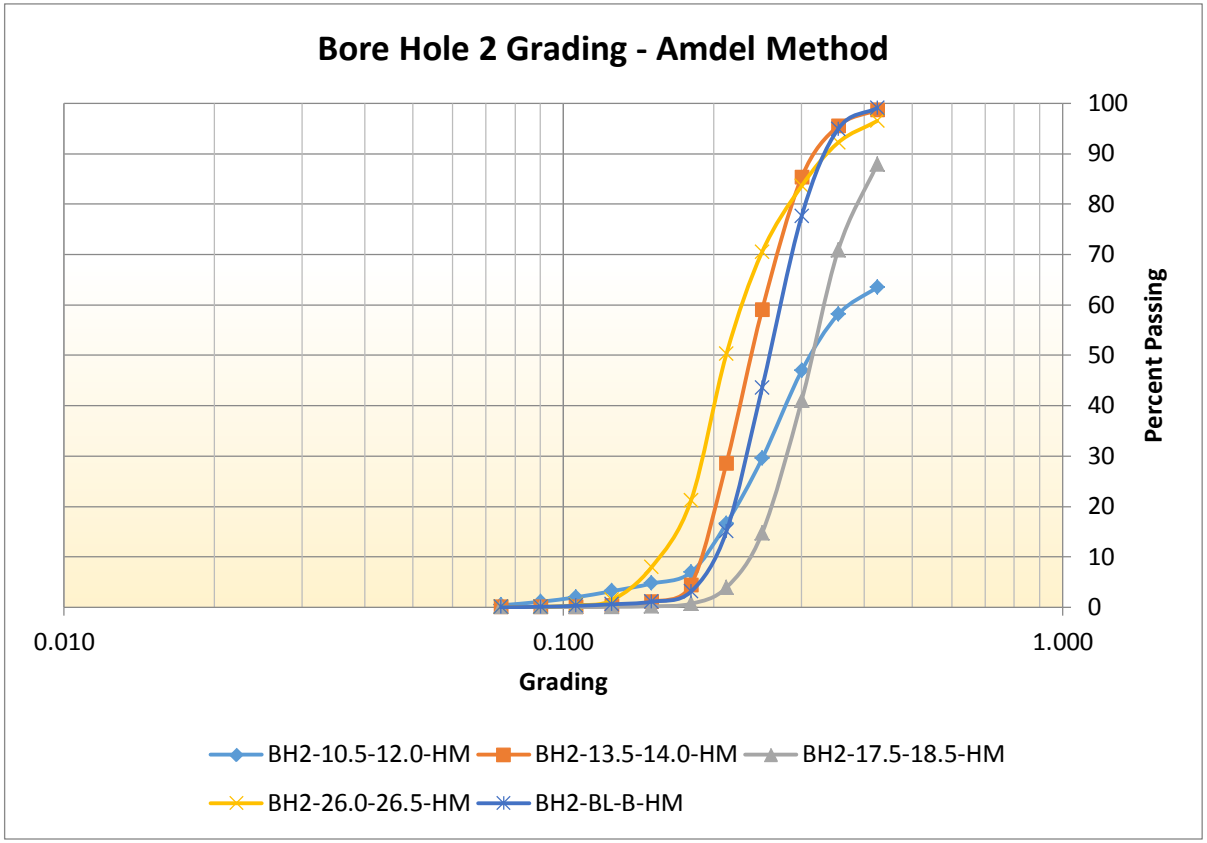
| Sample No | No of bore samples | Mass of Test Sample (kg) | Actual Mass (kg) | Bore Hole Samples with Depth | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| BH2-10.5-12.0-HM | 1 | 0.6 | 0.700 | BH2-10.5-12.0 | | | | | | |
| BH2-10.5-12.0-PL | 1 | 0.4 | 0.700 | BH2-10.5-12.0 | | | | | | |
| BH2-10.5-12.0-SO | 1 | 0.6 | 0.700 | BH2-10.5-12.0 | | | | | | |
| BH2-13.5-14.0-HM | 1 | 0.6 | 0.600 | BH2-13.5-14.0 | | | | | | |
| BH2-17.5-18.5-HM | 1 | 0.6 | 0.600 | BH2-17.5-18.5 | | | | | | |
| BH2-26.0-26.5-HM | 1 | 0.6 | 0.600 | BH2-26.0-26.5 | | | | | | |
| BH2-BL-B-HM | 7 | 0.6 | 0.900 | BH2-4.2-4.5 | BH2-4.5-5.0 | BH2-5.0-5.5 | BH2-5.5-6.5 | BH2-6.9-7.5 | BH2-7.5-8.5 | BH2-8.5-9.5 |
| BH2-BL-B-PL | 7 | 0.4 | 0.800 | BH2-4.2-4.5 | BH2-4.5-5.0 | BH2-5.0-5.5 | BH2-5.5-6.5 | BH2-6.9-7.5 | BH2-7.5-8.5 | BH2-8.5-9.5 |
| BH2-BL-B-SO | 7 | 0.6 | 0.900 | BH2-4.2-4.5 | BH2-4.5-5.0 | BH2-5.0-5.5 | BH2-5.5-6.5 | BH2-6.9-7.5 | BH2-7.5-8.5 | BH2-8.5-9.5 |
| BH2-BL-G-PL | 3 | 0.4 | 0.400 | BH2-13.5-14.0 | BH2-17.5-18.5 | BH2-26.0-26.5 | | | | |
| BH2-BL-G-SO | 3 | 0.6 | 0.600 | BH2-13.5-14.0 | BH2-17.5-18.5 | BH2-26.0-26.5 | | | | |

| Key | Test | Lab | Sample (kg) |
|---|---|---|---|
| CS | Wash Grading AS1141.11.1 | Coffey | 3 |
| | Clay & Fine Silt AS1141.33 | | |
| | Organic Impurities AS1141.34 | | |
| CC | Bulk Density AS1141.4 | Coffey | 6 |
| | Particle Density and Water Absorption AS | | |
| | Sodium Sulfate Soundness AS1141.24 | | |
| SO | FSC - Full Soil Chemistry | SESL | 0.6 |
| | Basic Waste Classification BWC - BH1 | | |
| HM | Heavy Liquid Separation | Bureau Veritas | 0.6 |
| | Combined Grading | | |
| PL | Petrological | Geochempet | 0.4 |
| | Shape Analysis | | |

| Code | Detail |
|---|---|
| BL-M | Blended Mottled |
| BL-HM | Blended High Mottled |
| BL-LM | Blended Low Mottled |
| BL-C | Blended Construction |
| BL-HM-P | Petrographic |
| BL-C-P | Petrographic |
| BH3-BL-B | Blended Blonde |
| BH3-BL-G | Blended Grey |
| BH1-BL-AWT | Above Water Table |
| BL-BH-M | Blended Borehole Mottled |
| BL-BH-B | Blended Borehole Blonde |

| Sample | Depth |
|---|---|
| BH2-10.5-12.0-HM | 10.5 - 12.0 |
| BH2-10.5-12.0-PL | 10.5 - 12.0 |
| BH2-10.5-12.0-SO | 10.5 - 12.0 |
| BH2-13.5-14.0-HM | 13.5 - 14.0 |
| BH2-17.5-18.5-HM | 17.5 - 18.5 |
| BH2-26.0-26.5-HM | 26.0 - 26.5 |
| BH2-BL-B-HM | 4.2 - 9.5 |
| BH2-BL-B-PL | 4.2 - 9.5 |
| BH2-BL-B-SO | 4.2 - 9.5 |
| BH2-BL-G-PL | 13.5 - 26.5 |
| BH2-BL-G-SO | 13.5 - 26.5 |

| | |
|---|---|
| BH2 | Bore Hole 2 |
| BL | Blended |
| AWT | Above Water Table |
| G1 | Grey 1 |
| G2 | Grey 2 |
| HM | Heavy Metal |
| SO | Soils |
| CC | Construction Complex |
| CS | Construction Simple |
| PL | Petrological |



# Borehole 3 – BH3 – 26.7 metres depth




*Fig ? Borehole photos of sand lenses with* depth

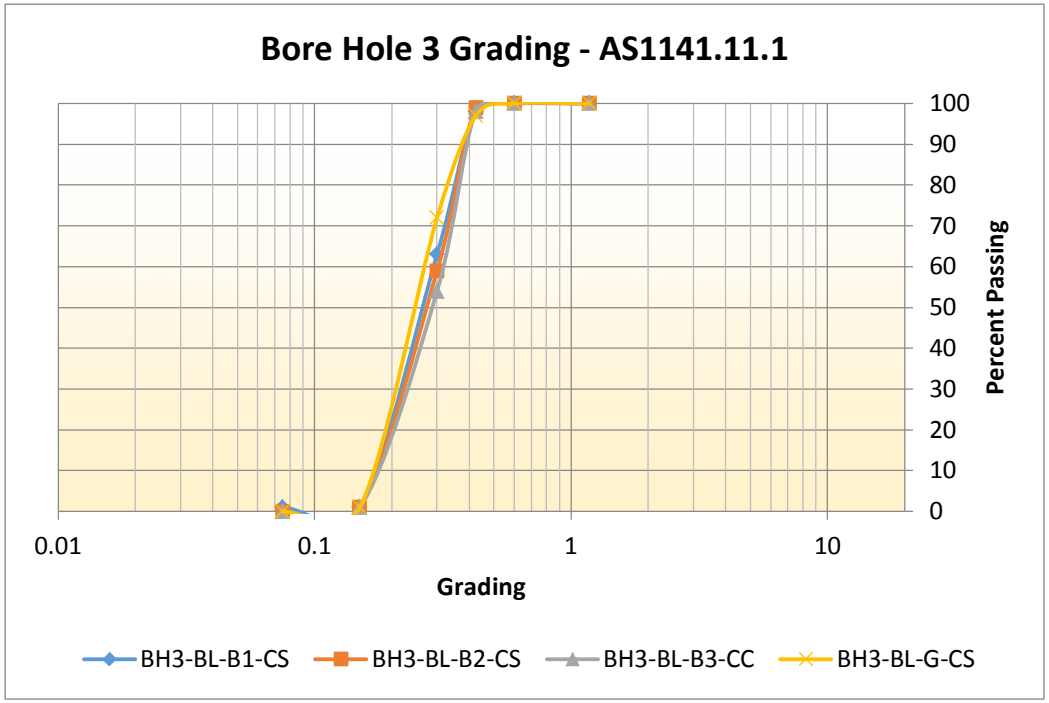
| Sample No | No of bore samples | Mass of Test Sample (kg) | Actual Mass (kg) | Bore Hole Samples with Depth | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH3-17.0-17.5-HM | 1 | 0.6 | 0.600 | BH3-17.0-17.5 | | | | | | | | | | | |
| BH3-23.0-23.5-HM | 1 | 0.6 | 0.600 | BH3-23.0-23.5 | | | | | | | | | | | |
| BH3-26.0-26.5-HM | 1 | 0.6 | 0.500 | BH3-26.0-26.5 | | | | | | | | | | | |
| BH3-BL-B1-CS | 6 | 3 | 3.200 | BH3-4.0-5.0 | BH3-5.0-6.0 | BH3-6.0-7.0 | BH3-7.0-8.0 | BH3-8.0-9.0 | BH3-9.0-10.0 | | | | | | |
| BH3-BL-B2-CS | 5 | 3 | 4.000 | BH3-10.0-11.0 | BH3-11.0-12.0 | BH3-12.0-13.0 | BH3-13.0-14.0 | BH3-14.0-14.6 | | | | | | | |
| BH3-BL-B3-CC | 12 | 6 | 6.800 | BH3-4.0-5.0 | BH3-5.0-6.0 | BH3-6.0-7.0 | BH3-7.0-8.0 | BH3-8.0-9.0 | BH3-9.0-10.0 | BH3-10.0-11.0 | BH3-11.0-12.0 | BH3-12.0-13.0 | BH3-13.0-14.0 | BH3-14.0-14.6 | BH3-14.0-14.6 |
| BH3-BL-B3-HM | 12 | 0.6 | 1.300 | BH3-4.0-5.0 | BH3-5.0-6.0 | BH3-6.0-7.0 | BH3-7.0-8.0 | BH3-8.0-9.0 | BH3-9.0-10.0 | BH3-10.0-11.0 | BH3-11.0-12.0 | BH3-12.0-13.0 | BH3-13.0-14.0 | BH3-14.0-14.6 | BH3-14.0-14.6 |
| BH3-BL-B3-PL | 12 | 0.4 | 1.300 | BH3-4.0-5.0 | BH3-5.0-6.0 | BH3-6.0-7.0 | BH3-7.0-8.0 | BH3-8.0-9.0 | BH3-9.0-10.0 | BH3-10.0-11.0 | BH3-11.0-12.0 | BH3-12.0-13.0 | BH3-13.0-14.0 | BH3-14.0-14.6 | BH3-14.0-14.6 |
| BH3-BL-B3-SO | 12 | 0.6 | 1.250 | BH3-4.0-5.0 | BH3-5.0-6.0 | BH3-6.0-7.0 | BH3-7.0-8.0 | BH3-8.0-9.0 | BH3-9.0-10.0 | BH3-10.0-11.0 | BH3-11.0-12.0 | BH3-12.0-13.0 | BH3-13.0-14.0 | BH3-14.0-14.6 | BH3-14.0-14.6 |
| BH3-BL-G-CS | 3 | 3 | 3.100 | BH3-17.0-17.5 | BH3-23.0-23.5 | BH3-26.0-26.5 | | | | | | | | | |
| BH3-BL-G-PL | 3 | 0.4 | 0.643 | BH3-17.0-17.6 | BH3-23.0-23.6 | BH3-26.0-26.6 | | | | | | | | | |
| BH3-BL-G-SO | 3 | 0.6 | 0.603 | BH3-17.0-17.7 | BH3-23.0-23.7 | BH3-26.0-26.7 | | | | | | | | | |

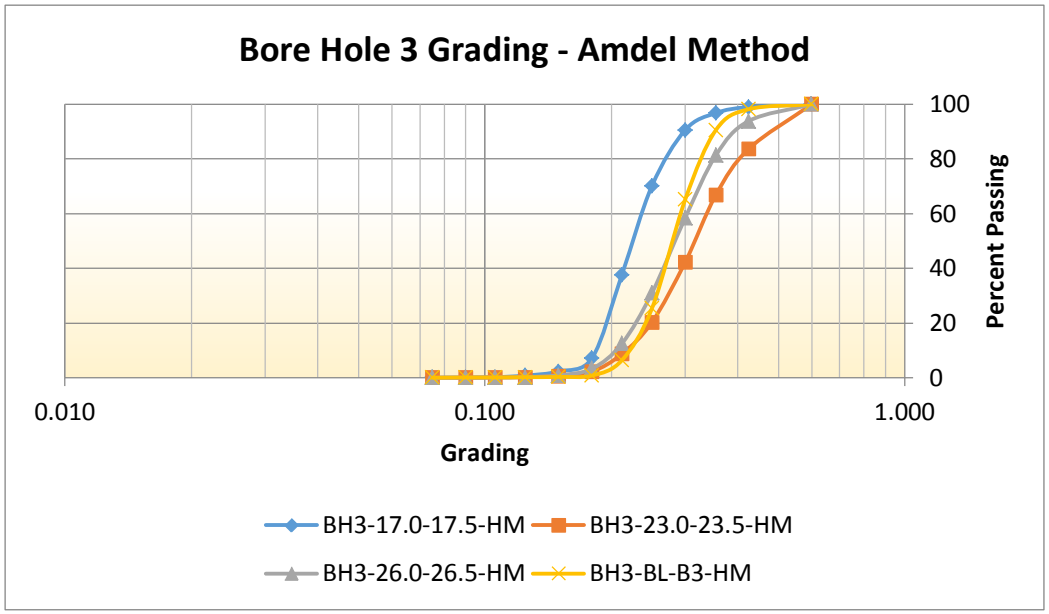
| Key | Test | Lab | Sample (kg) |
|---|---|---|---|
| CS | Wash Grading AS1141.11.1 | Coffey | 3 |
| | Clay & Fine Silt AS1141.33 | | |
| | Organic Impurities AS1141.34 | | |
| CC | Bulk Density AS1141.4 | Coffey | 6 |
| | Particle Density and Water Absorption AS | | |
| | Sodium Sulfate Soundness AS1141.24 | | |
| SO | FSC - Full Soil Chemistry | SESL | 0.6 |
| | Basic Waste Classification BWC - BH1 | | |
| HM | Heavy Liquid Separation | Bureau Veritas | 0.6 |
| | Combined Grading | | |
| PL | Petrological | Geochempet | 0.4 |
| | Shape Analysis | | |

| Code | Detail |
|---|---|
| BL-M | Blended Mottled |
| BL-HM | Blended High Mottled |
| BL-LM | Blended Low Mottled |
| BL-C | Blended Construction |
| BL-HM-P | Petrographic |
| BL-C-P | Petrographic |
| BH3-BL-B | Blended Blonde |
| BH3-BL-G | Blended Grey |
| BH1-BL-AWT | Above Water Table |
| BL-BH-M | Blended Borehole Mottled |
| BL-BH-B | Blended Borehole Blonde |

| Sample | Depth |
|---|---|
| BH3-17.0-17.5-HM | 17.0 - 17.5 |
| BH3-23.0-23.5-HM | 23.0 - 23.5 |
| BH3-26.0-26.5-HM | 26.0 - 26.5 |
| BH3-BL-B1-CS | 4.0 - 10.0 |
| BH3-BL-B2-CS | 10.0 - 14.6 |
| BH3-BL-B3-CC | 4.0 - 14.6 |
| BH3-BL-B3-HM | 4.0 - 14.6 |
| BH3-BL-B3-PL | 4.0 - 14.6 |
| BH3-BL-B3-SO | 4.0 - 14.6 |
| BH3-BL-G-CS | 17.0 - 26.5 |
| BH3-BL-G-PL | 17.0 - 26.6 |
| BH3-BL-G-SO | 17.0 - 26.7 |

| | |
|---|---|
| BH3 | Bore Hole 3 |
| BL | Blended |
| AWT | Above Water Table |
| G1 | Grey 1 |
| G2 | Grey 2 |
| HM | Heavy Metal |
| SO | Soils |
| CC | Construction Complex |
| CS | Construction Simple |
| PL | Petrological |



## Borehole 4 – BH4 – 24.2 metres depth



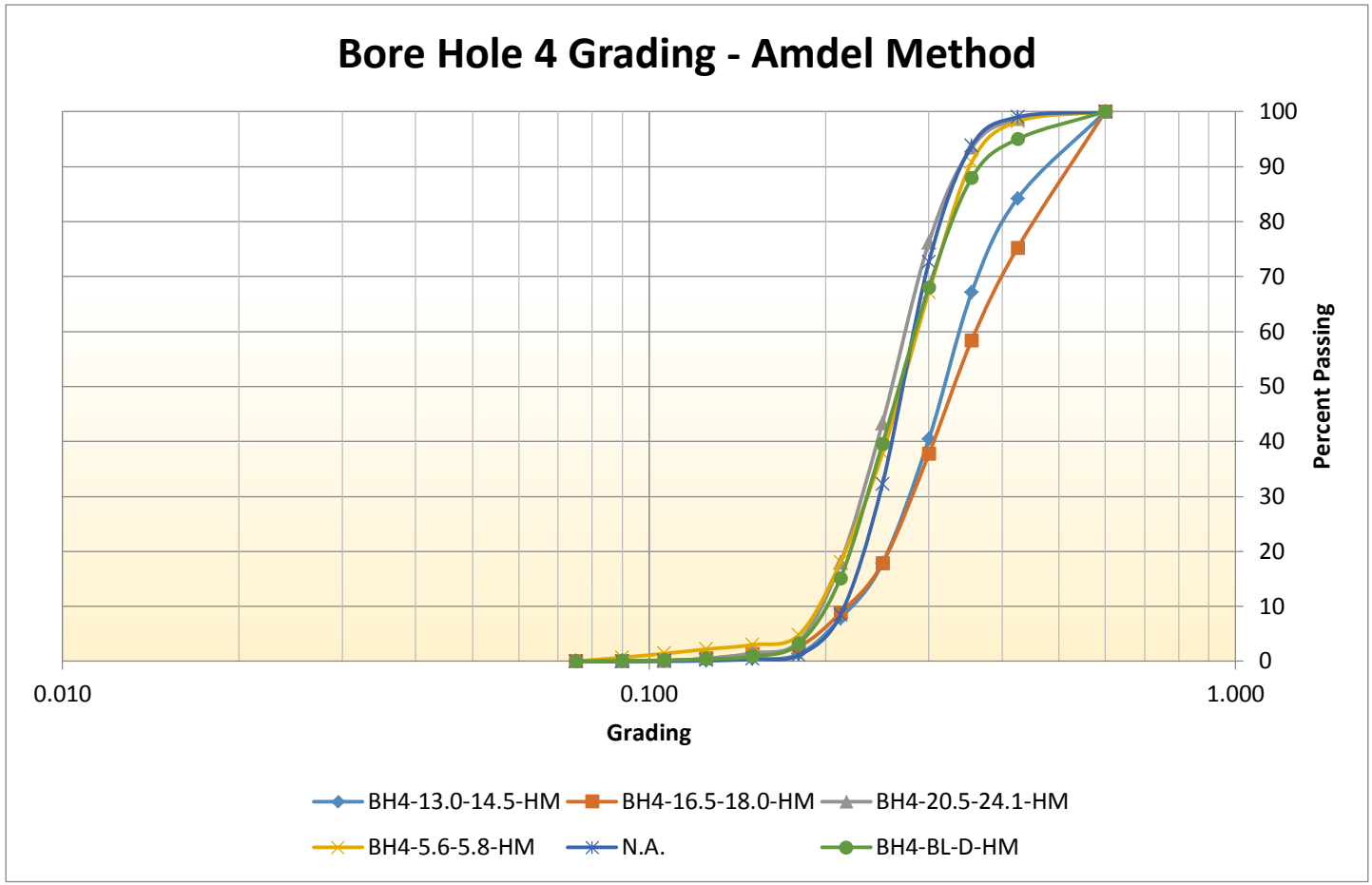

*Fig ? Borehole photos of sand lenses with* depth

| Sample No | No of bore samples | Mass of Test Sample (kg) | Actual Mass (kg) | Bore Hole Samples with Depth | | | |
|---|---|---|---|---|---|---|---|
| BH4-13.0-14.5-HM | 1 | 0.6 | 0.600 | BH4-13.0-14.5 | | | |
| BH4-16.5-18.0-HM | 1 | 0.6 | 0.600 | BH4-16.5-18.0 | | | |
| BH4-20.5-24.1-HM | 1 | 0.6 | 0.600 | BH4-20.5-24.1 | | | |
| BH4-5.6-5.8-HM | 1 | 0.6 | 0.595 | BH4-5.6-5.8 | | | |
| BH4-BL-B-HM | 4 | 0.6 | 0.646 | BH4-1.5-3.0 | BH4-3.0-3.7 | BH4-3.7-4.5 | BH4-4.5-5.6 |
| BH4-BL-B-PL | 4 | 0.4 | 0.643 | BH4-1.5-3.1 | BH4-3.0-3.8 | BH4-3.7-4.6 | BH4-4.5-5.7 |
| BH4-BL-B-SO | 4 | 0.6 | 0.710 | BH4-1.5-3.2 | BH4-3.0-3.9 | BH4-3.7-4.7 | BH4-4.5-5.8 |
| BH4-BL-D-HM | 3 | 0.6 | 0.612 | BH4-8.5-9.0 | BH4-9.5-10.0 | BH4-10.0-11.5 | |
| BH4-BL-G-PL | 3 | 0.4 | 0.501 | BH4-13.0-14.5 | BH4-16.5-18.0 | BH4-20.5-24.1 | |
| BH4-BL-G-SO | 3 | 0.6 | 0.510 | BH4-13.0-14.6 | BH4-16.5-18.1 | BH4-20.5-24.2 | |

| Key | Test | Lab | Sample (kg) |
|---|---|---|---|
| CS | Wash Grading AS1141.11.1 | Coffey | 3 |
| | Clay & Fine Silt AS1141.33 | | |
| | Organic Impurities AS1141.34 | | |
| CC | Bulk Density AS1141.4 | Coffey | 6 |
| | Particle Density and Water Absorption AS1141.5 | | |
| | Sodium Sulfate Soundness AS1141.24 | | |
| SO | FSC - Full Soil Chemistry | SESL | 0.6 |
| | Basic Waste Classification BWC - BH1 | | |
| HM | Heavy Liquid Separation | Bureau Veritas | 0.6 |
| | Combined Grading | | |
| PL | Petrological | Geochempet | 0.4 |
| | Shape Analysis | | |

| Code | Detail |
|---|---|
| BL-M | Blended Mottled |
| BL-HM | Blended High Mottled |
| BL-LM | Blended Low Mottled |
| BL-C | Blended Construction |
| BL-HM-P | Petrographic |
| BL-C-P | Petrographic |
| BH3-BL-B | Blended Blonde |
| BH3-BL-G | Blended Grey |
| BH1-BL-AWT | Above Water Table |
| BL-BH-M | Blended Borehole Mottled |
| BL-BH-B | Blended Borehole Blonde |

| Sample | Depth |
|---|---|
| BH4-13.0-14.5-HM | 13.0 - 14.5 |
| BH4-16.5-18.0-HM | 16.5 - 18.0 |
| BH4-20.5-24.1-HM | 20.5 - 24.1 |
| BH4-5.6-5.8-HM | 5.6 - 5.8 |
| BH4-BL-B-HM | 1.5 - 5.6 |
| BH4-BL-B-PL | 1.5 - 5.7 |
| BH4-BL-B-SO | 1.5 - 5.8 |
| BH4-BL-D-HM | 8.5 - 11.5 |
| BH4-BL-G-PL | 13.0 - 24.1 |
| BH4-BL-G-SO | 13.0 - 24.2 |



# Borehole 5 – BH5 – 25.65 metres depth




*Fig ? Borehole photos of sand lenses with* depth

| Sample No | No of bore samples | Mass of Test Sample (kg) | Actual Mass (kg) | Bore Hole Samples with Depth | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BH5-BL-B-CS | 12 | 3 | 3.800 | BH5-5.5-6.0 | BH5-6.0-6.5 | BH5-6.5-7.0 | BH5-7.0-7.5 | BH5-7.5-8.0 | BH5-8.0-8.5 | BH5-8.5-9.5 | BH5-9.5-10.5 | BH5-10.5-11.5 | BH5-11.5-12.5 | BH5-12.5-13.5 | BH5-13.5-14.5 |
| BH5-BL-B-HM | 12 | 0.6 | 1.330 | BH5-5.5-6.0 | BH5-6.0-6.5 | BH5-6.5-7.0 | BH5-7.0-7.5 | BH5-7.5-8.0 | BH5-8.0-8.5 | BH5-8.5-9.5 | BH5-9.5-10.5 | BH5-10.5-11.5 | BH5-11.5-12.5 | BH5-12.5-13.5 | BH5-13.5-14.5 |
| BH5-BL-B-PL | 12 | 0.4 | 1.239 | BH5-5.5-6.0 | BH5-6.0-6.5 | BH5-6.5-7.0 | BH5-7.0-7.5 | BH5-7.5-8.0 | BH5-8.0-8.5 | BH5-8.5-9.5 | BH5-9.5-10.5 | BH5-10.5-11.5 | BH5-11.5-12.5 | BH5-12.5-13.5 | BH5-13.5-14.5 |
| BH5-BL-B-SO | 12 | 0.6 | 1.302 | BH5-5.5-6.0 | BH5-6.0-6.5 | BH5-6.5-7.0 | BH5-7.0-7.5 | BH5-7.5-8.0 | BH5-8.0-8.5 | BH5-8.5-9.5 | BH5-9.5-10.5 | BH5-10.5-11.5 | BH5-11.5-12.5 | BH5-12.5-13.5 | BH5-13.5-14.5 |
| BH5-BL-G-HM | 4 | 0.6 | 0.632 | BH5-23.0-23.5 | BH5-23.5-24.5 | BH5-24.5-25.5 | BH5-25.5-25.65 | | | | | | | | |
| BH5-BL-G-PL | 4 | 0.4 | 0.434 | BH5-23.0-23.5 | BH5-23.5-24.5 | BH5-24.5-25.5 | BH5-25.5-25.65 | | | | | | | | |
| BH5-BL-M-HM | 3 | 0.6 | 0.637 | BH5-20.0-20.5 | BH5-20.5-21.0 | BH5-21.0-22.0 | | | | | | | | | |
| BH5-BL-M-SO | 3 | 0.6 | 0.633 | BH5-20.0-20.5 | BH5-20.5-21.0 | BH5-21.0-22.0 | | | | | | | | | |
| BL-C-HM | 5 | 0.6 | 3.100 | TP1-4 | TP2-4 | TP3-2 | TP3-3 | TP4-3 | | | | | | | |
| BL-M-HM | 9 | 0.6 | 3.300 | TP1-2 | TP1-3 | TP2-2 | TP2-3 | TP3-1 | TP4-1 | TP4-2 | TP6-2 | TP6-3 | | | |
| BH-C-PL | 5 | 0.4 | 1.100 | TP1-4 | TP2-4 | TP3-2 | TP3-3 | TP4-3 | | | | | | | |
| BH-HM-PL | 6 | 0.4 | 1.100 | TP1-2 | TP2-2 | TP3-1 | TP4-1 | TP4-2 | TP6-2 | | | | | | |

| Key | Test | Lab | Sample (kg) |
|---|---|---|---|
| CS | Wash Grading AS1141.11.1 | Coffey | 3 |
| | Clay & Fine Silt AS1141.33 | | |
| | Organic Impurities AS1141.34 | | |
| CC | Bulk Density AS1141.4 | Coffey | 6 |
| | Particle Density and Water Absorption AS1141.5 | | |
| | Sodium Sulfate Soundness AS1141.24 | | |
| SO | FSC - Full Soil Chemistry | SESL | 0.6 |
| | Basic Waste Classification BWC - BH1 | | |
| HM | Heavy Liquid Separation | Bureau Veritas | 0.6 |
| | Combined Grading | | |
| PL | Petrological | Geochempet | 0.4 |
| | Shape Analysis | | |

| Code | Detail |
|---|---|
| BL-M | Blended Mottled |
| BL-HM | Blended High Mottled |
| BL-LM | Blended Low Mottled |
| BL-C | Blended Construction |
| BL-HM-P | Petrographic |
| BL-C-P | Petrographic |
| BH3-BL-B | Blended Blonde |
| BH3-BL-G | Blended Grey |
| BH1-BL-AWT | Above Water Table |
| BL-BH-M | Blended Borehole Mottled |
| BL-BH-B | Blended Borehole Blonde |

| Sample | Depth |
|---|---|
| BH5-BL-B-CS | 5.5 - 14.5 |
| BH5-BL-B-HM | 5.5 - 14.5 |
| BH5-BL-B-PL | 5.5 - 14.5 |
| BH5-BL-B-SO | 5.5 - 14.5 |
| BH5-BL-G-HM | 23.0 - 25.65 |
| BH5-BL-G-PL | 23.0 - 25.65 |
| BH5-BL-M-HM | 20.0 - 22.0 |
| BH5-BL-M-SO | 20.0 - 22.0 |
| BL-C-HM | N.A. |
| BL-M-HM | N.A. |
| BH-C-PL | N.A. |
| BH-HM-PL | N.A. |

