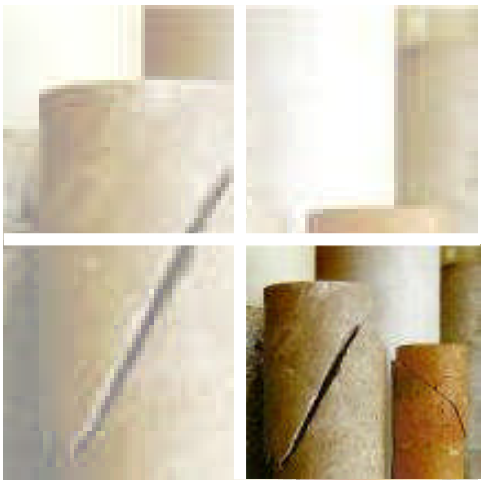

GeoAust
Geotechnical Engineers

PRELIMINARY GEOTECHNICAL ASSESSMENT
WERRIBEE EMPLOYMENT PRECINCT
PRINCES HIGHWAY
WERRIBEE VIC

PREPARED FOR
VICURBAN

JOB NO: 1548-3-R
7 APRIL 2009

DISTRIBUTION:
VICURBAN

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1 INTRODUCTION

1.1 COMMISSION

The preliminary geotechnical assessment was commissioned by Mr Tom Maidment of VicUrban. The scope of works was in accordance with our fee proposal with reference 1548-1-Q, dated 31 December 2008.

1.2 PROPOSED DEVELOPMENT

It is understood that the details of the proposed development have not been formalised, however conceptually the proposed redevelopment of the 925 hectare, Werribee Agriculture and Food Technology Precinct site is likely to incorporate structures ranging from low density residential dwellings through to multilevel commercial developments. It is anticipated that the larger commercial developments may include one or more basement levels.

1.3 AIM OF PRELIMINARY ASSESSMENT

The aim of the geotechnical assessment was to provide preliminary information on excavation, retention, earthworks and the design and construction of foundations and pavements for the anticipated range of structures.

1.4 GEOLOGY

The subject site is situated partly on the Werribee River delta deposits and partly on the Newer Volcanics of the Werribee Plains. These areas form part of the catchment known as the Werribee River Basin.

Reference to the Geological Survey of Victoria, 1:63,360 series, Melbourne sheet indicates the site to be underlain by Aeolian deposits of the Quaternary age, which comprise a thin veneer of windblown silt and clayey silt (loess). The Geological Survey of Victoria indicates the Aeolian deposits to be underlain by olivine basalt, locally referred to as 'Newer Volcanics'. The basalt is of Quaternary age and the residual clays associated with weathering of the basalt are typically highly reactive. The depth to basalt is often highly variable over short lateral distances and the mechanical properties of the basalt are also often highly variable over short distances, both laterally and vertically.

The GeoVic website by the Department of Primary Industry (DPI) (http://www.dpi.vic.gov.au) indicates geological conditions varying slightly from those indicated on the Geological Survey of Victoria, 1:63,360 series, Melbourne sheet. The GeoVic website indicates a large portion of the site to be underlain by Quaternary age Aeolian deposits comprising sand, clay, calcareous sand. The north east portion of the site is underlain by Quaternary age olivine basalt, locally referred to as 'Newer Volcanics'. A map of the site geology derived from the GeoVic website, including a description of the various geologies at and adjacent to the site is given in Appendix A.

Drillers logs of various ground water bores at the site, sourced from the GeoVic website, indicated the basalt rock to extend to depths in excess of 45 metres below the existing ground surface. The basalt appears to consist of two separate flows of lava, which are separated by a 5 – 6 metre thick layer of extremely weathered basalt at and approximately depth of 30 metres below the existing ground surface. A map of the borehole locations derived from the GeoVic website, and the drillers logs are given in Appendix B.

The basalt flows extend to depths significantly in excess of those likely to be influenced by any proposed structures at the site.

2 INVESTIGATION METHODS

2.1 FIELD METHODS

Field work was completed on 11 and 12 March 2009 under the direct supervision of a geotechnical engineer from GeoAust and included the following.

2.1.1 Boreholes

Eighteen boreholes were drilled to depths ranging between 0.9 and 6.4 metres below the existing ground surface at the approximate locations indicated in Figure 1. Boreholes were drilled using a truck mounted rotary drilling rig equipped with 100mm diameter continuous flight augers. All boreholes were drilled to effective auger refusal on medium to high strength basalt.

Bore logs were prepared in accordance with AS 1726-1993 'Geotechnical Site Investigations'. Definitions of the logging terms and symbols used are provided in Appendix C and the logs of the boreholes are provided in Appendix D.

2.1.2 In-situ Testing

Testing was carried out in accordance with the relevant test procedures given in Australian Standard AS1289 'Methods of Testing Soil for Engineering Purposes' and included the following:

- Vane shear strength testing of cohesive soils.
- Standard Penetration Testing (SPT).

Test results are included on the logs of the bores.

2.2 LABORATORY TESTING

Testing was undertaken by the laboratory of Bairnsdale Soil and Concrete Testing Pty Ltd. The laboratory is accredited by the National Association of Testing Authorities (NATA).

Testing was carried out in accordance with Australian Standard 1289, 'Methods of Testing Soil for Engineering Purposes' and included:

- 5 No. Atterberg Limit tests.
- 2 No 4 day soaked California Bearing Ratio (CBR) tests.

The Atterberg Limit tests were performed on the following disturbed sample of silty clay:

- Borehole 3, 0.5 – 0.6 metre.
- Borehole 4, 0.7 – 0.8 metre.
- Borehole 5, 0.5 – 0.6 metre.
- Borehole 5, 0.9 – 1.0 metre.
- Borehole 7, 3.0 – 3.45 metre.

The soaked CBR tests were performed on composite samples of silt (Composite Sample A) and silty clay (Composite Sample B). The composite sample was formed using the following samples of disturbed silt and clay:

Composite Sample A – (Aeolian Silt)

- Borehole 1, 0.2 – 1.0m
- Borehole 2, 0.3 – 1.0m
- Borehole 4, 0.2 – 0.7m
- Borehole 5, 0.2 – 0.7m
- Borehole 9, 0.2 – 0.5m

Composite Sample B – (Residual Basaltic Clay)

- Borehole 3, 0.3 – 0.7m
- Borehole 6, 0.2 – 1.0m
- Borehole 11, 0.2 – 1.0m
- Borehole 12, 0.2 – 1.0m
- Borehole 13, 0.2 – 1.0m
- Borehole 14, 0.2 – 0.9m
- Borehole 15, 0.2 – 1.0m
- Borehole 16, 0.2 – 1.0m
- Borehole 17, 0.2 – 1.0m
- Borehole 18, 0.2 – 1.0m

The CBR specimens were remoulded to 98% of the Standard maximum dry density ratio in accordance with Australian Standard AS1289 5.1.1.

The results of the laboratory tests are presented in Appendix E.

3 RESULTS OF INVESTIGATION

3.1 GENERAL SITE DESCRIPTION

The following site features were noted at the time of the site testing:

- The site was located within essentially flat topography. Consequently, the surface drainage of the site was generally very poor. The poor drainage characteristics of the site were previously extensively utilised at the site to flood irrigate large sections of the site. Based on information provided by Department of Primary Industries (DPI) up to 700 mega litres of water from the Werribee River was used to flood irrigate the property. The practice was continued up until the 1999, with much of the site being flood irrigated on a daily basis. The only area of the site which is currently still being irrigated is the Vegetable Growers Association market gardens located to the south of 639 Sneydes Road. Up to 5 mega litres of water per annum is being used to irrigate the market gardens. The source of the water was unknown.
- The majority of the existing one and two level DPI structures have performed extremely poorly. A number of the structures have been at least partially vacated because of the extensive cracking and distortion, and several buildings have been entirely vacated.

It is understood that the operational structures date back to 1939, although many of the poorly performing structures are less than 15 years of age and were built to current building standards. Typically, the structures were constructed on either conventional pad and strip footings, or stiffened raft slabs. The footings and slabs have settled and rotated variably. At least one of the buildings was underpinned to a depth of 2.0 metres below the existing ground surface, without benefit. A section of the same structure was subsequently underpinned to a depth of 3.0 - 4.0 metres and has apparently performed satisfactorily since.

- At the north east end of the site there were a number of low rise structures fronting onto Princes Highway and the north end of Hoppers Road. The structures included those at the sites operated by Melbourne University, Mercy Werribee Hospital and Victoria University. GeoAust was unable to carry out detailed inspections of the structures at these sites as part of the work completed. However, anecdotal information provided to us and a cursory external inspection of the structures from areas able to be accessed by the public did not indicate the presence of significant cracking and/or distortion of structures resulting from foundation movements.
- Vegetation at the site comprised predominantly grass, but also included wheat and a significant number of medium to very large sized trees. A considerable number of trees appeared to be of poor to very poor health. There were numerous trees scattered around the various DPI buildings, many of them within relatively close proximity to the structures.
- Appreciable earthworks have been carried out at the site. These include:
  - Construction of the Melbourne Water stormwater drains through the site. The locations of the drains are indicated on the Services Location Plan prepared by Arup.
  - Construction of a significant number of water channels as part of the flood irrigation scheme. The channels were most evident towards the west end of the site.
  - Re-levelling of substantial areas of the site including construction of low height levies (typically less than 0.2 metres in height) to facilitate the flood irrigation at the site.
  - Excavation of numerous farm dams. It is understood that some of the older dams were backfilled, possibly with rubbish and animal carcasses.
  - Excavation and subsequent backfilling of a number of rubbish pits and livestock burial pits. The approximate locations of the rubbish pits and burial pits are given in the report prepared by Compass Environmental Pty Ltd. Based on information provided by Ms Lyn McCluskey of DPI one or more of the burial pits contain radioactive carcasses.

- Construction of the bridge abutments for the Sneydes Road Bridge over the Maltby Bypass.
- Construction of the Melbourne Water Western Trunk Sewer through the site. At the north east corner of the site the trunk sewer comprises a tunnel with an invert level of approximately 25 metres below the ground surface. To the south east of the Melbourne Water Hoppers Crossing Pumping Station the sewer was constructed using cut and cover construction techniques. The sewer replaced the original brick lined, open channel sewer located along the north side of the Maltby Bypass.
- Minor cut and fill earthworks to accommodate the various existing buildings at subject site.

3.2 SITE DESCRIPTION AT BOREHOLE LOCATIONS

The following site features were noted at the time of the site testing in the vicinity of the borehole locations:

Borehole 1

Land Use:	Pasture.
Vegetation:	Grass. Numerous small to large trees along the north fence line.
Drainage:	Poor.
Irrigation:	Perimeter water channels with weirs and low height earth levies at regular centres indicated the area was previously flood irrigated.

Borehole 2

Land Use:	Pasture.
Vegetation:	Grass. A row of very large trees (mostly dead) along the east fence line. Small to large trees along the road reservation to the south of the site.
Drainage:	Poor
Irrigation:	Perimeter water channels with weirs and low height earth levies at regular centres indicated the area was previously flood irrigated. Heavily irrigated market gardens immediately to the east of the paddock.

Borehole 3

Land Use: Pasture.

Vegetation: Grass.
Numerous medium to large trees scattered.

Drainage: Poor.
A Melbourne Water stormwater drain was located a short distance to the east of the bore location. The drain was estimated to be approximately 3 metres deep and there was an approximate 0.5 – 1.0 metre depth of stagnant water within the drain.

Irrigation: No evidence of previous flood irrigation.

Borehole 4

Land Use: Landscaped area in front of DPI offices at 600 Sneydes Road.

Vegetation: Grass.
Numerous medium to large trees scattered.

Drainage: Poor.
The landscaped area to the south of the DPI offices was graded such that all surface runoff water would flow into a central pond. The pond was dry.

Irrigation: Perimeter water channels with weirs indicated that the area was flood irrigated prior to the construction of the DPI offices.

Borehole 5

Land Use: Pasture.

Vegetation: Grass.
A row of medium to very large trees along the south property boundary. The trees appeared to be in very poor health. Many of the trees appeared dead.

Drainage: Poor.

Irrigation: Perimeter water channels with weirs and low height earth levies at regular centres indicated the area was previously flood irrigated.

Borehole 6

Land Use: Pasture.

Vegetation: Grass
There was a stand of medium to large trees to the south of the borehole and a row of medium to large trees along the north fence line.

Drainage: Poor

Irrigation: No evidence of previous flood irrigation.

Borehole 7

Land Use: Pasture.

Vegetation: Grass.
There was a row of medium to large trees between the north fence line and Sneydes Road.

Drainage: Poor.
Melbourne Water stormwater drains were located to the east and west of the bore location. The drain to the east was estimated to be approximately 1.5 metres deep and he base of the drain was concrete lined.
In addition to the Melbourne Water drains the paddock was intersected by a shallow unlined drain, which was approximately 0.4 – 0.5 metres deep. The spoil from the excavation of the drain was spread over the paddock in the area of Borehole 7.

Irrigation: No evidence of previous flood irrigation.

Borehole 8

Land Use: Wheat field.

Vegetation: Wheat stubble.

Drainage: Poor.

Irrigation: No evidence of previous flood irrigation.

Borehole 9

Land Use: Pasture.

Vegetation: Grass.
A row of medium to large trees along the west fence line.

Drainage: Poor.

Irrigation: Perimeter water channels with weirs and low height earth levies at regular centres indicated the paddock was previously flood irrigated.

Borehole 10

Land Use: Pasture.

Vegetation: Grass.
A row of medium to large trees along the west fence line.

Drainage: Poor.

Irrigation: No evidence of previous flood irrigation.

Borehole 11

Land Use: Wheat field.

Vegetation: Wheat stubble.

Drainage: Poor.

There was an unlined drainage channel to the south of the borehole. The channel, which was approximately 1 metre deep, was dry

Irrigation: No evidence of previous flood irrigation.

Other: There was a large stockpile of predominantly clay fill immediately to the north of the paddock. The stockpile of fill was located along the south property boundary of the adjacent Victoria University site.

Borehole 12

Land Use: Wheat field.

Vegetation: Wheat stubble.

There was a stand of large trees to the south west of the borehole.

Drainage: Poor.

Irrigation: No evidence of previous flood irrigation.

Borehole 13

Land Use: Wheat field.

Vegetation: Wheat stubble.

There was a stand of large trees to the east of the borehole and a row of medium trees along the west fence line.

Drainage: Poor.

Irrigation: No evidence of previous flood irrigation.

Borehole 14

Land Use: Wheat field.

Vegetation: Wheat stubble.

Drainage: Poor.

Irrigation: No evidence of previous flood irrigation.

Borehole 15

Land Use: Wheat field.

Vegetation: Wheat stubble.
There was a row of large trees to the east of the borehole along Hackett Road.

Drainage: Poor.

Irrigation: No evidence of previous flood irrigation.

Other: There was small farm dam in the south east corner of the paddock. The dam was estimated to be approximately 2 metres deep. The depth of water was estimated to be less than 1 metre.

Borehole 16

Land Use: Wheat field.

Vegetation: Wheat stubble.

Drainage: Poor.

Irrigation: No evidence of previous flood irrigation.

Other: There was small farm dam in the north east corner of the paddock. The dam was estimated to be approximately 2 metres deep. The depth of water was estimated to be less than 1 metre.

Borehole 17

Land Use: Pasture.

Vegetation: Grass.
A row of medium to large trees along the north fence line.

Drainage: Poor.

Irrigation: No evidence of previous flood irrigation.

Other: There was excavation at the north end of the paddock towards the west end of the row of trees. The purpose of the excavation, which was partially filled with water was not immediately apparent. The near vertical sides of the excavation indicated that the excavation may be a burial pit.

Borehole 18

Land Use: Pasture.

Vegetation: Grass.

Drainage: Poor.

Irrigation: No evidence of previous flood irrigation.

3.3 BOREHOLE LOCATIONS

Boreholes were drilled at the approximate locations indicated in Figure 1. The boreholes were located on site using a hand held global positioning system unit, with an accuracy of ±5m. Coordinates of the boreholes are given in Table 3.3.1 below.

Table 3.3.1: Borehole Location Data

Borehole	MGA COORDINATES
1	55H 0295899, UTH 5803221
2	55H 0295946, UTH 5802645
3	55H 0296727, UTH 5803705
4	55H 0296687, UTH 5803049
5	55H 0296545, UTH 5802330
6	55H 0297516, UTH 5803703
7	55H 0297377, UTH 5802796
8	55H 0297318, UTH 5801759
9	55H 0298006, UTH 5801432
10	55H 0298014, UTH 5802274
11	55H 0298204, UTH 5803212
12	55H 0297823, UTH 5804474
13	55H 0298350, UTH 5804311
14	55H 0299371, UTH 5804758
15	55H 0299227, UTH 5803977
16	55H 0299176, UTH 5803146
17	55H 0299074, UTH 5802295
18	55H 0298540, UTH 5801755

3.4 SUBSURFACE CONDITIONS

The boreholes indicated the presence of variable subsurface soil conditions across the site.

To the north east of Line A-A indicated in Figure 1, Boreholes 3, 6 and 11 – 18 indicated the presence of a soil and rock profile consistent with the weathering of the Quaternary age Newer Volcanics. Typically, the residual soil profile comprised a 0.1 – 0.2 metre thick layer of high plasticity clayey silt underlain by clay. The clay was silty, of high plasticity and of very stiff consistency. At depths ranging between 0.7 and 3.4 metres below the existing ground surface extremely weathered basalt was intercepted in each of the boreholes. The basalt was of extremely low to very low rock strength, often containing an appreciable portion of high plasticity clay.

In each of the boreholes effective auger refusal was encountered on high strength basalt at depths ranging between 0.9 and 3.9 metres below the existing ground surface. The refusal depths most likely correspond to weathered basalt but possibly may correspond to a closeknit basalt boulder layer, which may be underlain by additional depths of residual clay. This however can only be verified by additional site investigation comprising NMLC diamond core drilling into the basalt.

To the south west of Line A-A indicated in Figure 1, Boreholes 1, 2, 4, 5 and 7 – 10 indicated the presence of variable depths of Aeolian silts and clays underlain a soil and rock profile consistent with the weathering of the Quaternary age Newer Volcanics. The depth of surficial silt ranged in depth between a minimum of 0.2 metres and a maximum of 2.6 metres. The silt was typically of moderate plasticity and medium density. Immediately underlying the silt high plasticity clay was intercepted. The clay was typically of very stiff consistency. At shallow depths the clay was associated with the Werribee Delta deposits. At highly variable depths the clay was consistent with residual basaltic clay encountered to the north east of Line A-A. The clay was silty, of high plasticity and of very stiff consistency. In each of the boreholes effective auger refusal was encountered on basalt at depths ranging between 1.7 and 6.4 metres below the existing ground surface. The refusal depths most likely correspond to high strength weathered basalt but possibly may correspond to a closeknit basalt boulder layer, which may be underlain by additional depths of residual clay. This however can only be verified by additional site investigation comprising NMLC diamond core drilling into the basalt.

It should be noted that basalt boulders can occur within the residual basaltic clay. The boulders can be quite large and their occurrence can be random. Furthermore, the depth to basalt can also vary significantly over short lateral distances. The boreholes are unlikely to have identified either the minimum or maximum depths to rock at the subject site.

3.5 GROUND WATER

The regional ground water table was not intercepted in any of the boreholes. No perched ground water seepage was encountered in the silt overlying the clay during auguring of the boreholes or a short time after their completion. No long term monitoring of ground water was undertaken. The surficial silts are highly likely to become unworkable at shallow depth when saturated.

Based on experience of conditions in the general area the regional ground water table is likely to be present at depths in excess of approximately 15 metres below the existing ground surface. The lithology of the ground water aquifer comprises fractured basalt. The ground water in the general area is typically quite saline, often rendering it unsuitable for even for irrigation.

3.6 LABORATORY TESTS

The laboratory test results are given in Appendix E of this report. The results of the Atterberg Limit tests are summarised in Table 3.6.1 below:

Table 3.6.1: Summary of Atterberg Limit Test Results

Borehole	Sample Depth (metre)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
3	0.5 – 0.6	83	21	62	22
4	0.7 – 0.8	62	15	47	19
5	0.5 – 0.6	39	15	24	13
5	0.9 – 1.0	78	20	58	20.5
7	3.0 – 3.45	99	18	81	25.5

The results of the Atterberg limit testing for the clay samples recovered from Boreholes 3, 4, 5 (0.9 – 1.0m) and 7 plot in the region of inorganic clay of high plasticity on the Unified Soil Classification System Plasticity Chart. The results of the Atterberg limit testing for the silt sample recovered from Borehole 5 (0.5 – 0.6m) plot in the region of inorganic medium plasticity on the Unified Soil Classification System Plasticity Chart.

The results of the soaked CBR tests are summarised in Table 3.6.2 below:

Table 3.6.2: Summary of Soaked CBR Test Results

Sample ID	Sample Type	4 Day Soaked CBR Value
Composite Sample A	Aeolian Silt	2.5
Composite Sample B	Residual Basaltic Clay	2.5

The results of the soaked CBR tests indicate low bearing strength. Based on the results of the tests subgrade improvement is likely to be required for successful pavement performance.

4 COMMENTS AND RECOMMENDATIONS

4.1 PRELIMINARY REPORT

The scope of the investigation was formed on the basis of only conceptual detail of the proposed development. The comments and recommendations of this report should be viewed as general and preliminary in nature. Additional geotechnical investigation will e required for each element of the proposed development once the details are finalised. The comments and recommendations of this report must not be used for final structural design and construction.

The following comments and recommendations have been based on an extremely limited amount of field and laboratory testing, which does not provide adequate coverage of the site for the proposed development.

4.2 SITE CLASSIFICATION

Classification of the site has taken into account the following:

- Identification of the sub soil profile.
- Field classification of soil type and plasticity.
- Established data on the performance of existing buildings on the soil profile.
- Depth of fill.

Based on the poor performance of the existing DPI buildings to the south west of Line A-A indicated in Figure 1, the site should be classified as 'Class P' in accordance with Australian Standard AS2870 – 1996, 'Residential Slabs and Footings – Construction'.

4.3 EARTHQUAKE SITE CLASSIFICATION

Australian Standard AS 1170.4 – 2007, 'Minimum Design Loads on Structures, Part 4: 'Site Sub-Soil Class' outlines the methods for assigning the sites Sub-soil Class. Based on the anticipated stratigraphy, Table 4.1 "Maximum Depth Limits for Sub-soil Class C" and Table 3.2 "Hazard Factor (Z) For Specific Australian Locations" of the standard, we recommend the following Hazard Factor and Sub-Soil Class are adopted:

- Sub-soil Class: Class C_e – Shallow soil site
- Hazard Factor (Z): 0.10

4.4 EXISTING DPI BUILDINGS – PROBABLE CAUSES OF FOOTING SUBSIDENCE

The site is underlain by high plasticity clay soils which undergo appreciable volumetric changes when subjected to changes in moisture content. Upon wetting the clays swell appreciably and conversely upon drying the clays shrink. The site is located within Climatic Zone 3, where seasonal variation of temperature, humidity and rainfall influence the moisture condition of the soil profile to a depth of at least 2.3 metres. External influences will influence the moisture content regime to greater depths.

Under normal conditions where there are no appreciable external wetting or drying influences an adequately designed and constructed footing arrangement should be capable of performing satisfactorily, even on a high plasticity clay founding stratum. However once appreciable external wetting and/or drying influences are introduced, the resultant heave and shrinkage related movements are likely to significantly exceed those able to be accommodated by a structure supported on conventional shallow spread footings.

The contributing factors to the poor performance of the existing DPI buildings are likely to include, but not limited to the following:

Long Term Deep Seated Moisture Ingress

Much of the land on which the DPI buildings are situated was previously subjected to flood irrigation. We understand that 700 megalitres of water per annum was used to irrigate predominantly the west end of the site. The irrigation, which took place between approximately 1912 and 1999, would have caused significant deep seated moisture ingress into the underlying high plasticity clays. Upon wetting the clays are likely to have heaved appreciably. Subsequent to the cessation of flood irrigation the moisture content regime within the clay has been returning to its long term equilibrium moisture content, resulting in ongoing shrinkage of the clay.

Poor Surface Drainage

Large areas of the site are essentially flat. Consequently, surface drainage of the site is very poor. Seasonal moisture ingress during winter and spring when evaporation rates are low, followed by prolonged dry periods during summer and autumn, when evaporation rates are high, lead to extreme cyclical heave and shrinkage related movements of footings. Typically, structures rarely recover in heave related movements the damage that is caused by the previous cycle of shrinkage related movements. Consequently, the damage to the structures increases with each additional drying cycle. Evidence of this can clearly be seen in the DPI Core Storage Facility where poor drainage has caused appreciable distortion within the end walls of the portal frame structure.

Trees

The drying effects of trees are a common cause of foundation movement throughout Melbourne, particularly within high plasticity clays such as those which are common to the west and north of Melbourne. Individual trees located within 1.0 times their mature height of footings are recognised as being capable of causing settlement related damage to structures in high plasticity clay. Groups of trees are capable of causing damage over a considerably larger radius. The numerous trees located within close proximity to the various DPI buildings are likely to have significantly contributed to the settlement related damage observed within the structures.

Inadequate Footings

An investigation of the footings which provide support to the existing structure was not been carried out as part of the investigation completed to date. However, based on the age and type of construction of many of the buildings, and information provided by Mr Gary Nugent of DPI, a considerable number of the existing DPI structures were constructed on shallow strip and pad footings. Strip footings tend to perform poorly on high plasticity clay foundations. Typically, they offer little protection against heave and shrinkage related movements. The corners of buildings constructed on strip footings are most prone to settlements, resulting in racking cracks several metres back from the corners of the walls. Additionally, strip footings are prone to rotation as a result of the moisture gradient within the clay between the inside and outside of the footings. This tends to cause outward rotation of walls.

Individually, any of the above factors are capable of causing appreciable foundation movements and associated structural distress to a building constructed on high plasticity clay. However, if two or more factors are combined the resultant damage to buildings can be significant, as has been observed within the existing DPI buildings.

4.5 NEW STRUCTURES SOUTH WEST OF LINE A-A

4.5.1 Residential Structures

Individual residential dwellings possibly may be constructed on suitably stiffened raft slabs. The poor performance of the existing DPI buildings, including the DPI offices at 600 Sneydes Road, which was constructed on a stiffened raft slab, indicate that any proposed stiffened raft slabs will need to be designed for a characteristic surface movement (y_s) value exceeding 70 millimetres. Characteristic surface movement (y_s) values exceeding 70 millimetres are not common in either the Werribee Delta soils or the basalt plains to the west of Melbourne. Typically, characteristic surface movement (y_s) values in the range of 40 – 70 millimetres are common to these areas, which generally can be accommodated by a standard Class H stiffened raft slab in accordance with Australian Standard AS2870-1996, 'Residential Slabs and Footings – Construction'. Design of stiffened raft slabs for sites with a characteristic surface movement (y_s) value exceeding 70 millimetres cannot be based upon standard design information provided in Australian Standard AS2870-1996. Design of stiffened raft slabs for such sites will need to be based on engineering principles. The cost of such raft slabs is likely to be appreciably higher than those typically adopted in the surrounding residential subdivisions.

The successful performance of stiffened raft slabs at the subject site is highly dependant upon a relatively uniform moisture content being maintained over the life of the structure. Considerable attention to site drainage will be required to ensure adequate performance of structures. It will also be necessary to take into account the presence of existing and proposed trees in the design of stiffened raft slabs for the proposed structures. Failure to take into account these factors will result in poor footing performance.

4.5.2 Low Rise Commercial Structures

The poor performance of the existing DPI structures will necessitate that the majority of all proposed structures to the south west of Line A-A indicated in Figure 1 be fully suspended of a piled foundation arrangement.

Low rise (one and two level) structures will need to be supported on conventional bored piles founded within the very stiff clays at depths of approximately 3.0 – 4.0 metres below the existing ground. An allowable end bearing pressure of 350 kPa may be considered for preliminary proportioning of bored piles founded into the very stiff clay.

Considerable attention to site drainage will be required to ensure adequate performance of structures. It will also be necessary to take into account the presence of existing and proposed trees in the design of footings for the proposed structures. Failure to take into account these factors will result in poor footing performance.

4.5.3 Multi Level Commercial Structures

Multi-level structures will need to be suspended on piles which extend a short distance into high strength basalt underlying the clay. An allowable end bearing pressure of 1000 - 3000 kPa may be considered for preliminary proportioning of bored piles founded into the high strength basalt. Excavation of bored piles in high strength basalt will require a high capacity drilling rig equipped with a coring bucket. Penetration rates will be slow and drilling costs will be significantly higher than for the drilling of soil.

4.6 NEW STRUCTURES NORTH EAST OF LINE A-A

4.6.1 Residential Structures

The use of stiffened raft slab construction is recommended for individual residential dwellings constructed on a residual basaltic clay profile. An allowable bearing pressure of 100 kPa may be considered for preliminary proportioning of stiffened raft slab edge beams and internal load bearing ribs founded on very stiff clay.

Minimum dimensions and reinforcement of footings will need to meet the minimum requirements of Australian Standard AS 2870 – 1996, 'Residential Slabs and Footings – Construction' for a 'Class H' site classification.

Where the depth of fill exceeds 0.3 metres it may be necessary to adopt suspended raft slab construction. All edge beams and internal ribs will need to be founded on very stiff clay at the base of any fill and silt, and the slab panels will need to be designed as fully suspended.

Considerable attention to site drainage and trees, both existing and proposed, will be required to ensure adequate performance of structures. Failure to take into account these factors will result in poor footing performance.

4.6.2 Low Rise Commercial Structures

Strip and pad footings founded within residual basaltic clay are routinely adopted for flexible commercial structures constructed on the basalt plains to the west of Melbourne. The use of pad and strip footings founded on clay may be considered for any proposed commercial structures subject to:

- The superstructures being flexible and well articulated. Steel portal framed construction and precast concrete panel construction normally satisfies this criteria.
- The superstructures not being sensitive to footing movements associated with seasonal volume changes within the clay.
- The moisture content regime of the clay beneath the structures being maintained as uniform as possible. The clays must not be subject to extremes in moisture conditions resulting from poor site drainage and/or the drying effects of trees.

If the proposed structures are not flexible and/or well articulated, or the structures are sensitive to footing movements associated with seasonal volume changes within the highly plastic residual basaltic clay, it will be necessary to deepen the footings to the basalt rock.

Minimum dimensions and reinforcement of footings founded on clay will need to meet the minimum requirements of Australian Standard AS 2870 – 1996, 'Residential Slabs and Footings – Construction' for a 'Class H' site classification.

Allowable bearing pressures of 200 kPa and 250 kPa may be considered for preliminary proportioning of strip and pad footings respectively where founded on very stiff clay, subject to a minimum founding depth of 0.8 metres. Increased allowable bearing pressures of 500 kPa and 600 kPa are likely to be available for strip and pad footings respectively where founded on low or better strength weathered basalt. It is recommended that a uniform founding stratum (either clay or basalt rock) be provided throughout any structure to minimise differential movements.

If any trees are retained or proposed within 1.0 times their mature height of any proposed footings it will be necessary to deepen the footings to 2.5 metres depth or basalt rock, whichever is shallower.

4.6.3 Multi Level Commercial Structures

Pad and strip footings providing support to multi-level structures will need to be founded on high strength basalt. Allowable bearing pressures in the order of 1000 - 2000 kPa may be considered for preliminary proportioning of strip and pad footings where founded on high strength basalt. Minimal footing settlements are anticipated for footings founded on high strength basalt.

In areas of the site where the residual soils exceed approximately 1.5 – 2.0 metres and a basement level is not proposed, the use of bored piles may prove more economical than conventional pad and strip footings.

Bored piles subjected to high column loads will need to extend a short distance into high strength basalt underlying the clay. An allowable end bearing pressure of 1000 - 3000 kPa may be considered for preliminary proportioning of bored piles founded into the high strength basalt. Excavation of bored piles in high strength basalt will require a high capacity drilling rig equipped with a coring bucket. Penetration rates will be slow and drilling costs will be significantly higher than for the drilling of soil.

4.7 STRUCTURES CONSTRUCTED OVER BACKFILLED DAMS AND DRAINS

The performance of pavements and floor slabs constructed over backfilled farm dams, drains, creeks, trenches and any areas which require environmental remediation, will be largely dependant upon adequate preparation of these areas. Failure to adequately backfill the many existing and proposed site excavations will result in unacceptable cracking and distortion of floor slabs and pavements.

All excavations must be stripped of any fill and silt. Additionally, any clays which have been softened by moisture ingress must be stripped to expose either native clay of very stiff to hard consistency or weathered basalt. All backfill must be in accordance with Section 4.11.

It is recommended that all footings be founded at the base of any proposed structural fill on either native clay of very stiff to hard consistency or weathered basalt.

4.8 EXCAVATION

4.8.1 Excavation Conditions

The fill, silts and clays should be readily excavated using a 20 tonne capacity hydraulic excavator.

Excavation of basalt rock is substantially slower and more expensive than the excavation of soil. Efficient excavation of the high strength basalt will require the use of a high capacity excavator (say 25 – 30 tonne) equipped with hydraulic rock breaker to loosen the basalt rock before it can be excavated. Excavation into high strength basalt is anticipated to be slow. An allowance for some over excavation should be made for any detailed excavations in the basalt rock.

Drilling of bored pier excavations will require the use of a coring bucket to socket into the high strength basalt rock. High capacity plant is recommended and penetration rates will be slow. Drilling costs will be significantly higher than for the drilling of soil.

Ground vibration during excavation of rock will be perceivable by the occupants of adjacent buildings, but is not anticipated to be problematic with regard to the performance of the buildings. It would be prudent to conduct a full dilapidation survey of all adjoining structures and undertake vibration monitoring during the initial stages of and rock excavation. As a guide to tolerable vibration limits we suggest reference to the German Standard DIN 4150-Part 3.

Excavation of single and double level basements will not encounter the regional ground water table.

4.8.2 Site Trafficability During Construction

During summer and early autumn when evaporation rates are typically high and rainfall levels low, the trafficability of the stripped ground surface is anticipated to be quite good. Other than dust suppression no significant difficulties are anticipated. During winter and spring it is probable that only tracked machinery will be able to access the site once the surface has been stripped and is exposed to rain. If site access is to be provided for trucks once the ground surface is saturated it will be necessary to construct access tracks formed using non descript crushed rock (75mm minus), recycled brick and concrete rubble or equivalent. Under extreme conditions it will be necessary to incorporate a layer of geogrid or geotextile fabric at the base of the crushed rock.

4.9 RETENTION OF SITE EXCAVATIONS

4.9.1 Retention Systems

Where a single basement level is proposed and safe batters can be accommodated behind the proposed retention systems, the use of conventional precast concrete panel or reinforced blockwork retaining walls will be suitable. Safe batters of approximately 35° in fill and silt, and 50º in very stiff clay are anticipated under favourably dry conditions. Steeper batters may possibly be appropriate in the basalt rock.

Where safe batters cannot be accommodated or are not preferred, the use of a soldier pile retention system with infill panels is recommended, however drilling of soldier piles in the basalt rock will be difficult. A soldier pile retention system is recommended where bulk excavation is proposed adjacent to an existing structure.

If a retrained height of more than approximately 3.0 metres is proposed it may be necessary to progressively prop or anchor retention systems as excavation proceeds.

4.9.2 Lateral Earth Pressures

Permanently cantilevered retaining walls may be considered where deformation and movement behind the walls can be tolerated, such as for garden or grassed areas. A triangular lateral earth pressure distribution and an active earth pressure coefficient (Ka) of approximately 0.42 could be adopted for preliminary design. The active earth pressure coefficient should be used to calculate lateral earth pressures generated by surcharge loads.

For minimal deflection of progressively propped walls where there are movement sensitive structures or buried services within the zone of influence of the excavation, a uniform earth pressure distribution of 8H kPa, where H is the total retained height in metres, could be adopted for preliminary design. An at rest earth pressure coefficient (Ko) of 0.58 could be used to calculate lateral earth pressures generated by surcharge loads.

Preliminary unit weights of 19 kN/m^3 and $22kN/m^3$ may be adopted for soil and basalt rock respectively.

Sloping backfill should be incorporated as surcharge loading. Any temporary or permanent surcharge loads such as near by high level footings, traffic loading and compaction stresses, will also need to be included in the design of retention structures.

Retention structures must be designed such that the soil behind the wall is completely and permanently drained. If this cannot be ensured then hydrostatic pressure must be superimposed on the lateral earth pressure distributions.

Conservatively, the ultimate lateral toe resistance of retaining walls in clay may be estimated based on the following soil parameters

- Angle of internal friction: Ø = 0º (short term)
- Undrained cohesion Very stiff clay C_u = 80 kPa (short term)
- Effective angle of internal friction Ø' = 23º (long term)
- Effective cohesion C' = 0 kPa (long term)

Increased lateral resistance from basalt rock is likely to be available subject to additional investigation. It is noted that deflection criteria may govern the structural design of cantilevered soldier piles rather than ultimate lateral capacity.

4.10 PAVEMENTS

4.10.1 Design and Construction of Pavements.

Pavements and floor slabs where possible should be constructed on a native clay subgrade. This will require stripping of any fill and silt topsoil. A design CBR value of 2.5% may be assumed for preliminary design of flexible pavements constructed on a native clay subgrade.

Poor subgrade conditions exist towards the west end of the site, where the depth of silt extends to depths of up to 2.6 metres below the existing ground surface (Borehole 2). The silts are poor engineering materials and are susceptible to significant loss of strength under wet conditions.

For best performance of external pavements, all silt should be stripped to expose a native clay subgrade throughout. This will require excavation of up to 2.6 metres below existing levels and reinstatement with an imported low plasticity structural fill. This subgrade preparation option is likely to be considered cost prohibitive. The design CBR value for light duty pavements constructed on such a depth of structural fill will be largely governed by the material properties of the fill. A CBR value of approximately 4 - 5% may be tentatively assumed for a subgrade of imported low plasticity structural fill with a thickness exceeding 1.0 metre.

Given the depth silt, partial excavation to provide a 0.75 metre thick bridging layer of imported structural fill below the proposed subgrade level would be an economical alterative for subgrade preparation. However the performance of pavements constructed on a bridging layer of structural fill underlain by silt can be problematic. The successful performance of pavements constructed within areas of deep silt will be subject to the following:

- Adequate preparation of the subgrade.
- Adequate surface and subsurface drainage, ensuring that pavement layers and subgrades do not become saturated.

A assuming a CBR value of at least 8% for any imported low plasticity structural fill, a design CBR value of 6% may be tentatively assigned for preliminary proportioning of pavements constructed on a 0.75 metre thick bridging layer of structural fill.

As an alternative to providing a bridging layer of structural fill over the silt, it may be possible to chemically stabilise the silt with a combination of quicklime and cement. A minimum of two 0.3 metre thick layers of stabilised silt will need to be provided for any pavement which will be trafficked by commercial traffic. Additional layers of stabilised silt may need to be provided for pavements and floor slabs which will be subjected to heavy loads.

Construction of pavements is likely to be problematic during the wetter months of the year. Both the fill and native silt and clay materials are highly susceptible to softening and instability under wet conditions. Pavement construction should be undertaken during the drier months of the year to avoid the need for additional subgrade improvement and delays in construction.

4.10.2 Subgrade Drainage and Moisture Control

Effective surface and perimeter cut-off drainage must be provided and maintained to ensure that the pavement layers and subgrade cannot become saturated. Premature pavement failure of pavements and floor slabs will occur where drainage is poor.

It is recommended that at an impermeable pavement layer be constructed adjacent to the perimeter walls of any proposed ground level structures to protect the floor slab subgrade against seasonal moisture content variations. The pavement should extend at least 4 metres out from the walls of the building. Where it is not practicable to provide such a pavement it is recommended that a perimeter moisture barrier be provided. The moisture barrier can comprise a perimeter strip footing or an edge turn-down of the floor slab with a minimum depth of 1.0 metre below finished ground surface The strip or edge turn-down should also penetrate a minimum of 0.2 metres into native clay of very stiff consistency.

4.11 EARTHWORKS

The site derived silt and clays and silts are not recommended for use as structural fill. High plasticity clays are generally extremely difficult to compact and are potentially subject to appreciable volume changes if they are not properly moisture conditioned. Use of a suitable imported granular or low plasticity clay fill will assist in assuring efficient placement and present less risk with respect to long term performance of structures and pavements based on soil reactivity.

Structural fill must be placed in uniform layers not exceeding a loose thickness of 200 millimetres and compacted to at least 98% of the standard maximum dry density value as determined in accordance with Australian Standard AS1289 5.1.1-1993.

Australian Standard AS3798, ‘Guidelines on Earthworks for Commercial and Residential Developments’ provides guidance on the specification, execution and control of earthworks relevant to the subject site. Level 1 supervision in accordance with Australian Standard AS3798 is recommended for all proposed earthworks at the site.

During the wetter months of the year, particularly during winter and spring when evaporation rates are low, it is anticipated that it will not be possible to conduct earthworks at the site. Where possible all earthworks should be scheduled during the drier months of the year.

4.12 LIMITATIONS

The comments and recommendations of this report should be viewed as preliminary in nature and are likely to require revision once the architectural and structural details of the proposed development are better defined and appropriate additional geotechnical investigation has been completed. The comments and recommendations of this report must not be used for final structural design and construction.

This report is for the use of the party to whom it is addressed only and has been produced for the proposed development as described and for no other purpose. It is beyond the scope of this report to comment on any possible contamination of the site.

If you require any further information please do not hesitate to contact the undersigned.

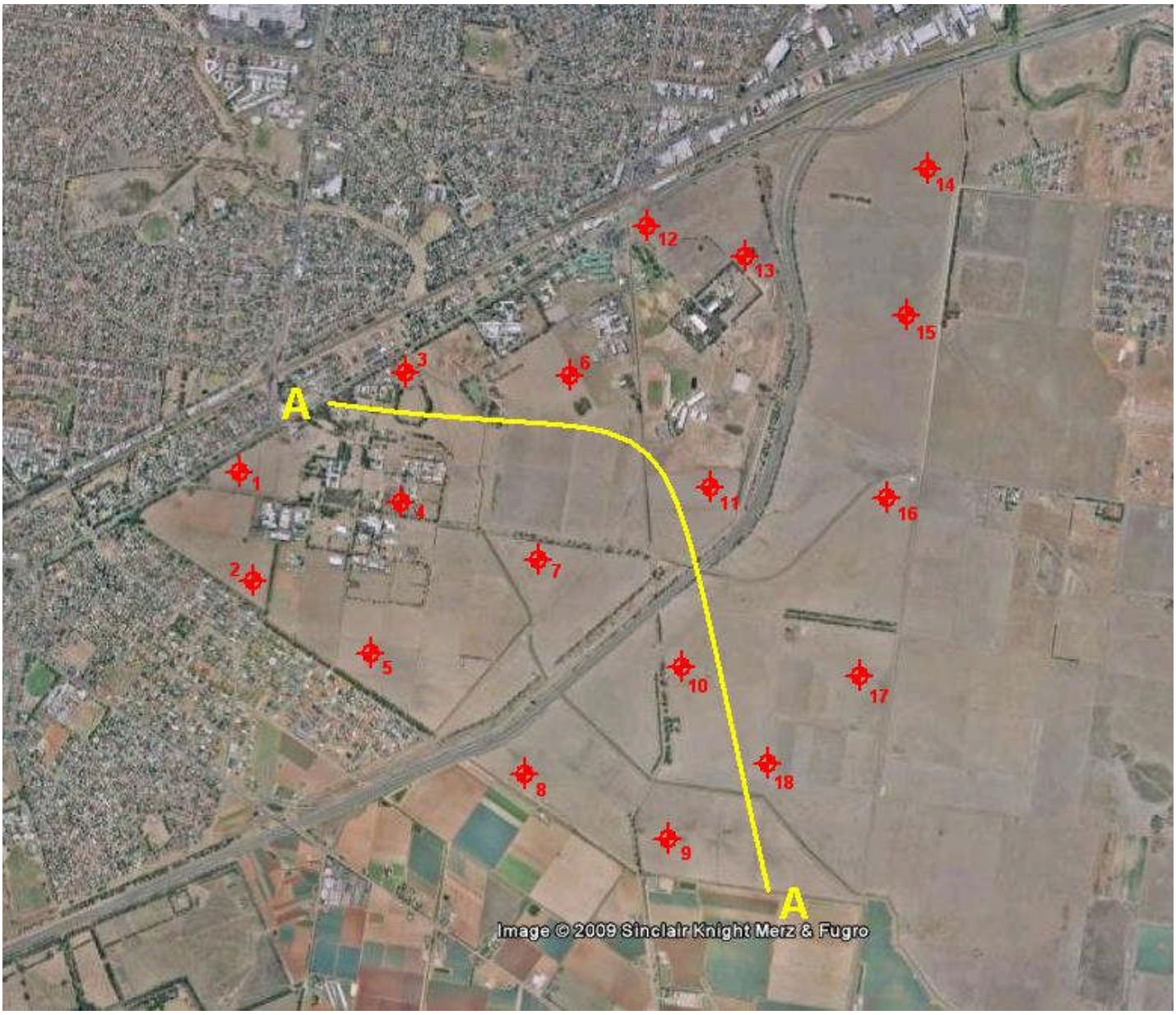
For and on behalf of
GEOAUST GEOTECHNICAL ENGINEERS PTY LTD

Stephen Mayer
BEng MIEAust CPEng EC-2262

GeoAust
Geotechnical Engineers

TEST LOCATION PLAN

JOB No:	1548
CLIENT:	VicUrban
PROJECT:	Werribee Employment Precinct
LOCATION:	Sneydes Road, Werribee



NOT TO SCALE

LEGEND

Denotes approximate borehole location

N

Figure 1

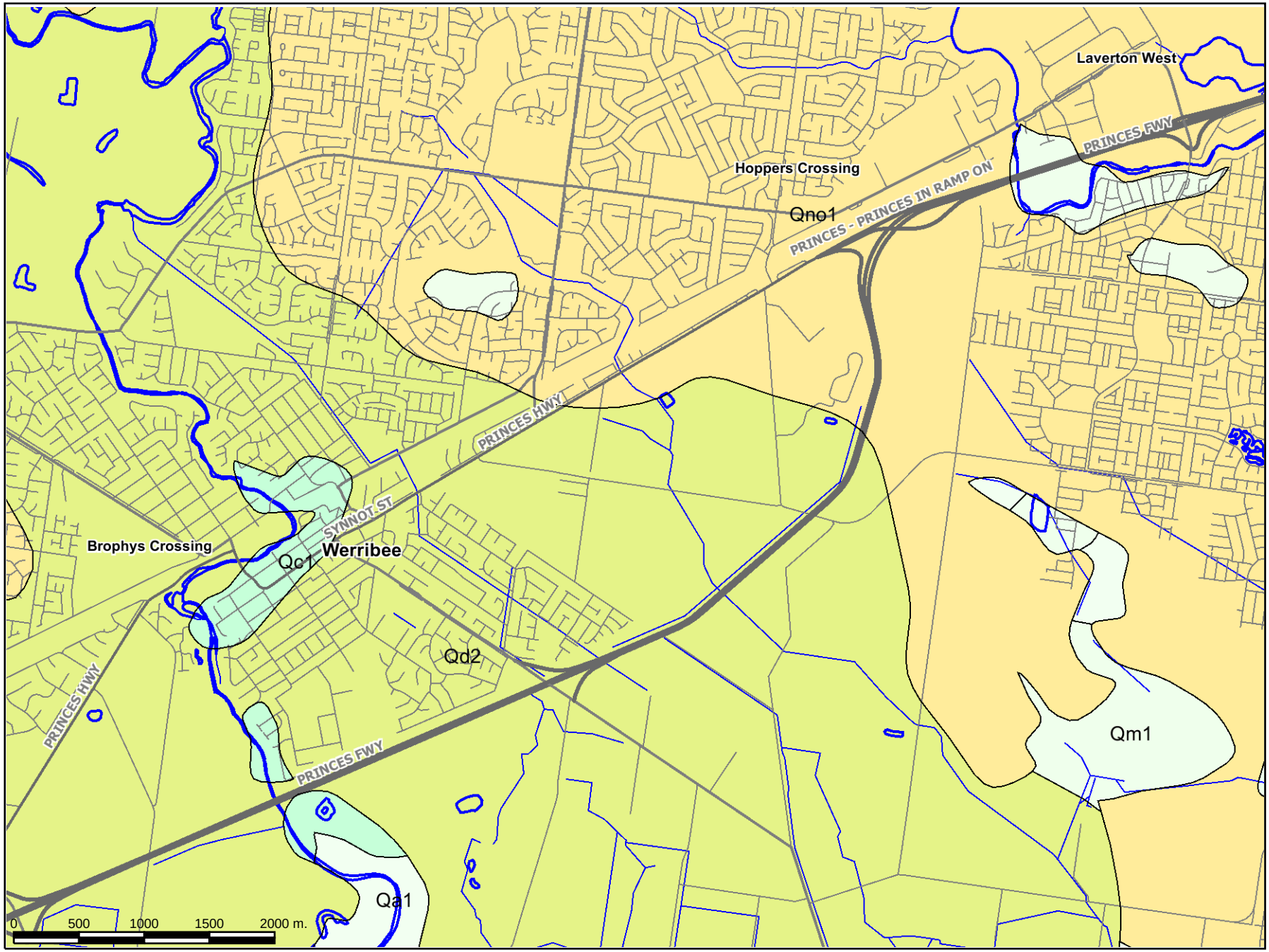
GeoAust
Geotechnical Engineers

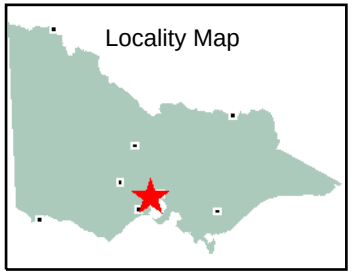
APPENDIX A

Map of Site Geology by GeoVic

Map of Site Geology

Department of Primary Industries





Legend

Miscellaneous Lines 250K

- Prior stream
- Contact Metamorphism Lines 250K

Geological Structure 250K

- Monocline, mapped
- Monocline, inferred.
- Monocline, concealed.
- Anticline, mapped.
- Anticline, inferred.
- Anticline, concealed.
- Antiform.
- Syncline, mapped.
- Syncline, inferred.
- Syncline, concealed.
- Synform.

GN MN

Geological Lines 250K

- Geological boundary, mapped.

Printed on 25 March 2009 13:47:12

Map Scale 1:40,947

NOT FOR NAVIGATION

GDA Vicgrid94

Victoria The Place To Be

Query Results

Geological Polygons 250K

Unique Feature Identifier:	3030
Map Code:	Qd2
Old Map Codes:	Qpd
Unit Type:	Rock
Rank:	Formation
Unit Name:	Unnamed dune deposits
Youngest Age:	Quaternary (Pleistocene)
Oldest Age:	Quaternary (Pleistocene)
Classification or Environment:	Sedimentary (Non-Marine (Aeolian))
Feature Type:	ROCK_UNIT
Subtype:	Sedimentary
Lithological Description:	Aeolian: dune deposits: sand, clay, calcareous sand
Area Square Metres:	126296323.73
Hectares:	12629.63
Full Reference:	VANDENBERG, A.H.M., 1997. MELBOURNE SJ 55-5 Edition 2, 1:250 000 Geological Map Series. 1:250,000 geological map. Geological Survey of Victoria.
OBJECTID:	25592

Zoom to this feature

End of Result Set

Query Results

Geological Polygons 250K

Unique Feature Identifier:	303
Map Code:	Qno1
Old Map Codes:	Qvn2
Unit Type:	Rock
Rank:	Formation
Unit Name:	Unnamed sheetflow basalt
Parents Names:	Newer Volcanic Group
Youngest Age:	Quaternary (Pleistocene)
Oldest Age:	Neogene (Miocene)
Classification or Environment:	Igneous (Extrusive)
Feature Type:	ROCK_UNIT
Subtype:	Sedimentary
Lithological Description:	Basalt, minor scoria and ash: tholeiitic to alkaline
Area Square Metres:	1821233141.53
Hectares:	182123.31
Full Reference:	VANDENBERG, A.H.M., 1997. MELBOURNE SJ 55-5 Edition 2, 1:250 000 Geological Map Series. 1:250,000 geological map. Geological Survey of Victoria.
OBJECTID:	25592

Zoom to this feature

End of Result Set

Query Results

Geological Polygons 250K

Unique Feature Identifier:	3157
Map Code:	Qa1
Old Map Codes:	Qra,Qa,Qrt,Qc
Unit Type:	Rock
Rank:	Formation
Unit Name:	Unnamed alluvium
Youngest Age:	Quaternary (Holocene)
Oldest Age:	Quaternary (Holocene)
Classification or Environment:	Sedimentary (Non-Marine (Alluvial))
Feature Type:	ROCK_UNIT
Subtype:	Sedimentary
Lithological Description:	Fluvial: alluvium, gravel, sand, silt
Area Square Metres:	191637.5
Hectares:	19.16
Full Reference:	VANDENBERG, A.H.M., 1997. MELBOURNE SJ 55-5 Edition 2, 1:250 000 Geological Map Series. 1:250,000 geological map. Geological Survey of Victoria.
OBJECTID:	25592

Zoom to this feature

End of Result Set

Query Results

Geological Polygons 250K

Unique Feature Identifier:	3174
Map Code:	Qm1
Old Map Codes:	Qrm,Qm
Unit Type:	Rock
Rank:	Formation
Unit Name:	Unnamed swamp and lake deposits
Youngest Age:	Quaternary (Holocene)
Oldest Age:	Quaternary (Holocene)
Classification or Environment:	Sedimentary (Non-Marine (Paludal))
Feature Type:	ROCK_UNIT
Subtype:	Sedimentary
Lithological Description:	Paludal: lagoon and swamp deposits: silt, clay
Area Square Metres:	1148229.13
Hectares:	114.82
Full Reference:	VANDENBERG, A.H.M., 1997. MELBOURNE SJ 55-5 Edition 2, 1:250 000 Geological Map Series. 1:250,000 geological map. Geological Survey of Victoria.
OBJECTID:	25592

Zoom to this feature

End of Result Set

Query Results

Geological Polygons 250K

Unique Feature Identifier:	3137
Map Code:	Qc1
Old Map Codes:	Qrc,Qpc,Qc
Unit Type:	Rock
Rank:	Formation
Unit Name:	Unnamed colluvium
Youngest Age:	Quaternary (Holocene)
Oldest Age:	Quaternary (Holocene)
Classification or Environment:	Sedimentary (Non-Marine (Colluvial))
Feature Type:	ROCK_UNIT
Subtype:	Sedimentary
Lithological Description:	Fluvial: "gully" alluvium, colluvium: gravel, sand, silt
Area Square Metres:	770105.65
Hectares:	77.01
Full Reference:	VANDENBERG, A.H.M., 1997. MELBOURNE SJ 55-5 Edition 2, 1:250 000 Geological Map Series. 1:250,000 geological map. Geological Survey of Victoria.
OBJECTID:	25592

Zoom to this feature

End of Result Set

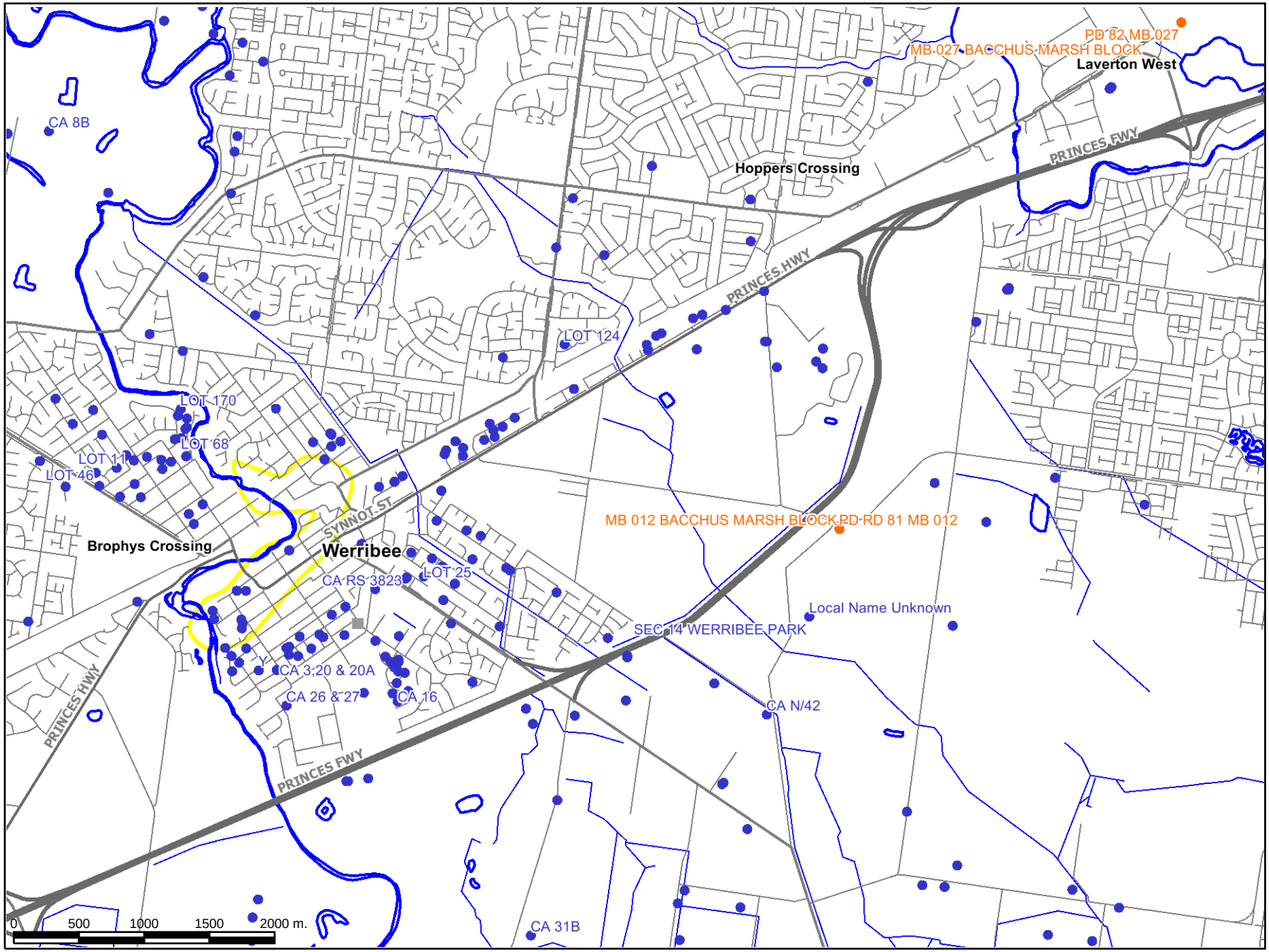
GeoAust
Geotechnical Engineers

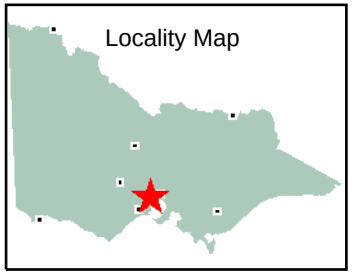
APPENDIX B

Map and of Ground Water Bores and Driller's Logs by GeoVic

Map Of Ground Water Bores

Department of Primary Industries





Legend

- Boreholes - All
- Boreholes - Coal
- Boreholes - Engineering
- Boreholes - Environmental monitoring
- Boreholes - Extractive Industries
- Boreholes - General Geological
- Boreholes - Minerals - base metals
- Boreholes - Minerals - gold
- Boreholes - Minerals - heavy mineral sand
- Boreholes - Minerals general
- Boreholes - Petroleum
- Boreholes - Groundwater
- Boreholes - Other
- Groundwater Boreholes - CLPR - copy
- Wells - Petroleum - copy
- Confidential Well
- Dry Plugged and Abandoned
- Gas Show (strong)
- Gas Well
- Oil Show (strong)

Printed on 25 March 2009 14:03:43

Map Scale 1:40,947

NOT FOR NAVIGATION

GDA Vicgrid94

Victoria The Place To Be

GEDIS Borehole System

Borehole Details

Borehole Summary Information

Site ID:	59877
Parish Name:	DEUTGAM 10046
Purpose:	Groundwater
Sub Purpose:	
Method:	Air Percussion/Air Rotary
Usage:	Groundwater Observation
Status:	
Other Names:	Rural Water Comm Borehole Name: 059877

Location:

Datum	MGAEm	MGANm	MGA Zone	Latitude	Longitude	+/-	Method
GDA94	298162	5803934	55	37.88974	144.70467	100.0 m	Approximation from map

Location Check:	
Elevation:	-999.0 m Kelly Bush: Unknown Elevation Acc: Unknown
Maps	Werribee(7822.3.2) 1:25000
Orientation/Depth:	Measured Depth: 45.56 m Collar Inclination: Unknown Collar Azimuth: Unknown
Authority:	Rural Water Commission
Regulation:	Melbourne and Metropolian Board or Works (Act unknown)
Operator:	Melbourne & Metropolitan Board of Works
Contractor:	Unknown (or Not Specified)
Completed On:	07/04/1982
Child Borehole Details:	None Recorded

Contact :

Selected core is available for inspection at Werribee, Contact
A. Olshina
GeoScience Victoria
GPO Box 4440 Melbourne Victoria 3001
Email: avi.olshina@dpi.vic.gov.au
Ph: (03) 9658 4533
Fax: (03) 9658 4555

Available Data

Attributes		Links		External Data	
Core Samples:	0	Tenements:		Aquifer:	1982
Lithology Log:	1	References:		Construction:	1982
Qualitative Log:	0	Surveys:		Water Chem:	0
Quantitative Log:	0	Projects:	1	Water Level:	0
Strat Log:	0	Notes:		Pump Test:	0
Biostratigraphy:	0	Petroleum Well:	0		
Geophys Logs:	0	Petroleum Casing:	0		
Temp Samples:	0				
Collar Data:	0				
Downhole Survey:	0				

Borehole Project Details

Project Code	Project Description
LITHO	Lithological Logs

No Borehole Notes Recorded

No Borehole References Recorded

No Borehole Core Samples Recorded

Lithological Logs

Drillers Log created by UNKNOWN on April 21, 1982

From	To	Comments
0.0	1.0	STIFF BROWN CLAY
1.0	29.0	GREY MODERATELY WEATHERED BASALT WITH SEAMS OF COMPLETELY TO HIGHLY WEATHERE D BASALT
29.0	36.0	RED GREY AND BROWN COMPLETELY TO HIGHL Y WEATHERED BASALT
36.0	45.56	BLUE GREY MODERATELY WEATHERED BASALT

No Borehole Quantitative Logs Recorded

No Borehole Qualitative Logs Recorded

No Borehole Stratigraphic logs Recorded

No Borehole Biostratigraphy Recorded

No Borehole Geophysical Header Logs Recorded

No Borehole Geophysical Data Logs Recorded

No Geothermal Information Recorded

No Down Hole Survey Information Recorded

No Collar Information Recorded

GEDIS Borehole System

Borehole Details

Borehole Summary Information

Site ID:	59517
Parish Name:	DEUTGAM 2
Purpose:	Groundwater
Sub Purpose:	
Method:	Percussion (cable)
Usage:	Groundwater Investigation
Status:	
Other Names:	Location of bore: WERRIBEE
	Drilling Rig Borehole Name: 16/65/000
	Rural Water Comm Borehole Name: 059517

Location:	Datum	MGAEm	MGANm	MGA Zone	Latitude	Longitude	+/-	Method
	GDA94	297246	5804008	55	37.88887	144.69427	300.0 m	Digitised metric

Location Check:	
Elevation:	-999.0 m Kelly Bush: Unknown Elevation Acc: Unknown
Maps	Werribee(7822.3.2) 1:25000
Orientation/Depth:	Measured Depth: 25.91 m Collar Inclination: Unknown Collar Azimuth: Unknown
Authority:	Dept. Manufacturing & Industry
Regulation:	Regulation Unknown
Operator:	Department of Manufacturing & Industry Development, Victoria
Contractor:	Unknown (or Not Specified)
Completed On:	25/08/1965
Child Borehole Details:	None Recorded

Contact : Selected core is available for inspection at Werribee, Contact

A. Olshina
GeoScience Victoria
GPO Box 4440 Melbourne Victoria 3001
Email: avi.olshina@dpi.vic.gov.au
Ph: (03) 9658 4533
Fax: (03) 9658 4555

Available Data

Attributes		Links		External Data	
Core Samples:	0	Tenements:		Aquifer:	1965
Lithology Log:	1	References:		Construction:	0
Qualitative Log:	0	Surveys:		Water Chem:	0
Quantitative Log:	0	Projects:	1	Water Level:	0
Strat Log:	0	Notes:		Pump Test:	0
Biostratigraphy:	0	Petroleum Well:	0		
Geophys Logs:	0	Petroleum Casing:	0		
Temp Samples:	0				
Collar Data:	0				

Attributes	Links	External Data
Downhole Survey: 0		

Borehole Project Details

Project Code	Project Description
LITHO	Lithological Logs

No Borehole Notes Recorded

No Borehole References Recorded

No Borehole Core Samples Recorded

Lithological Logs

Drillers Log created by UNKNOWN on August 25, 1965

From	To	Comments
0.0	0.61	RED SOIL
0.61	1.22	GREY CLAY
1.22	2.13	GREY AND YELLOW CLAY
2.13	3.05	BASALT BOULDERS AND CLAY
3.05	4.57	BASALT MEDIUM HARD
4.57	11.28	BASALT VERY HARD
11.28	13.11	HONEYCOMB BASALT
13.11	13.72	BASALT YELLOW ROCK AND YELLOW CLAY
13.72	22.86	BASALT HARD
22.86	24.38	BASALT GREY CLAY
24.38	25.91	BASALT GREY CLAY

No Borehole Quantitative Logs Recorded

No Borehole Qualitative Logs Recorded

No Borehole Stratigraphic logs Recorded

No Borehole Biostratigraphy Recorded

No Borehole Geophysical Header Logs Recorded

No Borehole Geophysical Data Logs Recorded

No Geothermal Information Recorded

No Down Hole Survey Information Recorded

No Collar Information Recorded

GEDIS Borehole System

Borehole Details

Borehole Summary Information

Site ID:	93777
Parish Name:	TARNEIT 10041
Purpose:	Groundwater
Sub Purpose:	
Method:	Air Percussion/Air Rotary
Usage:	Stock/Poultry water supply
Status:	
Other Names:	Rural Water Comm Borehole Name: 093777

Location:	Datum	MGAEm	MGANm	MGA Zone	Latitude	Longitude	+/-	Method
	GDA94	299382	5804264	55	37.88704	144.71863	100.0 m	Approximation from map

Location Check:	
Elevation:	-999.0 m Kelly Bush: Unknown Elevation Acc: Unknown
Maps	Werribee(7822.3.2) 1:25000
Orientation/Depth:	Measured Depth: 31.39 m Collar Inclination: Unknown Collar Azimuth: Unknown
Authority:	Rural Water Commission
Regulation:	Groundwater Act
Operator:	Private Individual/Corporation
Contractor:	Unknown (or Not Specified)
Completed On:	31/12/1983
Child Borehole Details:	None Recorded

Contact :

Selected core is available for inspection at Werribee, Contact
A. Olshina
GeoScience Victoria
GPO Box 4440 Melbourne Victoria 3001
Email: avi.olshina@dpi.vic.gov.au
Ph: (03) 9658 4533
Fax: (03) 9658 4555

Available Data

Attributes		Links		External Data	
Core Samples:	0	Tenements:		Aquifer:	1983
Lithology Log:	1	References:		Construction:	1983
Qualitative Log:	0	Surveys:		Water Chem:	0
Quantitative Log:	0	Projects:	1	Water Level:	0
Strat Log:	0	Notes:		Pump Test:	0
Biostratigraphy:	0	Petroleum Well:	0		
Geophys Logs:	0	Petroleum Casing:	0		
Temp Samples:	0				
Collar Data:	0				
Downhole Survey:	0				

Borehole Project Details

Project Code	Project Description
LITHO	Lithological Logs

No Borehole Notes Recorded

No Borehole References Recorded

No Borehole Core Samples Recorded

Lithological Logs

Drillers Log created by UNKNOWN on December 31, 1983

From	To	Comments
0.0	1.0	TOPSOIL
1.0	3.0	CLAY & RUBBLE
3.0	31.39	BASALT

No Borehole Quantitative Logs Recorded

No Borehole Qualitative Logs Recorded

No Borehole Stratigraphic logs Recorded

No Borehole Biostratigraphy Recorded

No Borehole Geophysical Header Logs Recorded

No Borehole Geophysical Data Logs Recorded

No Geothermal Information Recorded

No Down Hole Survey Information Recorded

No Collar Information Recorded

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APPENDIX C

Definitions of Logging Terms and Symbols

APPENDIX C

EXPLANATION NOTES FOR BOREHOLE AND TEST PIT LOGS

SOIL CLASSIFICATION AND LOG SYMBOLS

SOIL CLASSIFICATION CHART

	MAJOR DIVISIONS		SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
	MORE THAN 50% OF COARSE FRACTION IS LARGER THAN 2.0MM	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL SMALLER THAN 63MM IS LARGER THAN 0.075MM	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION IS SMALLER THAN 2.0MM	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL SMALLER THAN 63MM IS SMALLER THAN 0.075MM	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

GROUND WATER

	Inflow
	Outflow
	Standing level on completion
1/2 	Standing level 1/2 hour after completion
	Collapse of borehole annulus
VS	Very slight seepage
S	Slight seepage rate
M	Moderate seepage rate
H	High seepage rate
NOT OBSERVED	Ground water observation not possible. Ground water may or may not be present
NOT ENCOUNTERED	Ground water was not evident during excavation or a short time after completion

SAMPLING AND TESTING

DS	Disturbed sample
U60	Thin walled tube sample. Number indicates nominal sample diameter in mm
ES	Environmental sample
SPT	Standard penetration test
3/6/9 N=15	3,6 and 9 refer to blows per 150mm penetration. N=15 is the sum of blows after the initial 150mm penetration
3/6/9 blows for 20mm penetration: N>15.	3 and 6 refer to blows per 150mm penetration. 9 blows resulted in 20mm penetration at which point practical refusal of penetration occurred
S=47kPa	In-situ vane shear test. Result expressed as peak undrained shear strength in kPa
PP=145kPa	Pocket penetrometer test. Result expressed as dial reading in kPa
DCP	Dynamic Cone Penetrometer Test
EX	Excavation. Test starts at base of excavation
S	DCP sank under own weight or last blow of previous 100mm increment
E	End of DCP test
R	End of DCP test due to effective refusal of penetration

Figure C-1

APPENDIX C

EXPLANATION NOTES FOR BOREHOLE AND TEST PIT LOGS

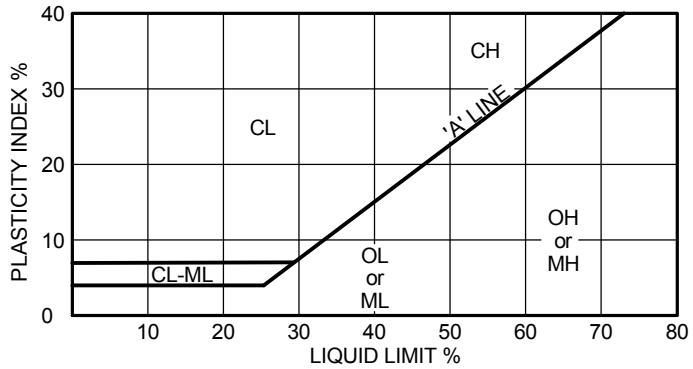
SOIL DESCRIPTION

PARTICLE SIZE

MAJOR DIVISION	SUB-DIVISION	SIZE (mm)
Boulders		>200mm
Cobbles		63 to 200mm
Gravel	Coarse	20 to 63mm
	Medium	6 to 20mm
	Fine	2.36 to 6mm
Sand	Coarse	0.6 to 2.36mm
	Medium	0.2 to 0.6mm
	Fine	0.075 to 0.2mm

0.075mm is the approximate minimum particle size discernible by eye

PLASTICITY CHART



MATERIAL PROPORTIONS

COARSE GRAINED SOILS		FINE GRAINED SOILS		IDENTIFICATION
% Fines	Modifier	% Coarse	Modifier	Field Assessment
⩽ 5	Omit or use 'trace'	⩽ 15	Omit or use 'trace'	Presence just detectable by feel or eye. Properties little or no different to those of primary soil
> 5 ⩽ 12	Describe as 'with clay/silt' as applicable	> 15 ⩽ 30	Describe as 'with sand/gravel' as applicable	Presence easily detected by feel or eye. Properties little or no different to those of primary soil
> 12	Prefix soil as 'silty/clayey' as applicable	> 30	Prefix soil as 'sandy/gravelly'	Presence obvious by feel or eye. Properties of soil are altered from those of the primary soil

COHESIVE SOILS - CONSISTENCY TERMS

LOG SYMBOL	TERM	UNDRAINED STRENGTH	FIELD ASSESSMENT
VS	Very Soft	<12kPa	Exudes between fingers when squeezed
S	Soft	12 - 25kPa	Can be moulded by light finger pressure
F	Firm	25 - 50kPa	Can be moulded by strong finger pressure
St	Stiff	50 -100kPa	Cannot be moulded by fingers. Can be indented by thumb
VSt	Very Stiff	100 - 200kPa	Can be indented by thumb nail
H	Hard	> 200kPa	Can be indented by thumb nail with difficulty

GRANULAR SOILS - DENSITY

LOG SYMBOL	TERM	DENSITY INDEX (%)
VL	Very Loose	< 15
L	Loose	15 - 35
MD	Medium Dense	35 - 65
D	Dense	65 - 85
VD	Very Dense	> 85

MOISTURE CONDITION

LOG SYMBOL	TERM	FIELD ASSESSMENT
D	Dry	Clay and silt are hard, friable, powdery, well dry of plastic limit. Sands and gravels are cohesionless, free running
M	Moist	Feels cool, darkened colour. Cohesive soils can be moulded. Granular soils tend to cohere
W	Wet	Feels cool, darkened in colour. Cohesive soils weakened, free water forms on hands when handling. Granular soils cohere

FIELD ASSESSMENT OF FILL COMPACTION

LOG SYMBOL	TERM
APC	Appears poorly compacted
AMC	Appears moderately compacted
AWC	Appears well compacted

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APPENDIX C

EXPLANATION NOTES FOR BOREHOLE AND TEST PIT LOGS

ROCK DESCRIPTION

STRENGTH OF INTACT ROCK MATERIAL

LOG SYMBOL	TERM	POINT LOAD INDEX (MPa) Is50	FIELD ASSESSMENT
EL	Extremely Low	Is50 <0.03	Easily remoulded by hand to a material with soil properties
VL	Very Low	0.03 ⩽ Is50 < 0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; pieces up to 30mm thick can be broken by finger pressure
L	Low	0.1 ⩽ Is50 < 0.3	Easily scored with knife; indentations 1mm to 3mm after firm blows with pick point; core 150mm long and 50mm diameter can be broken by hand; sharp edges of core friable
M	Medium	0.3 ⩽ Is50 < 1.0	Readily scored with knife; core 150mm long and 50mm diameter can be broken by hand with difficulty
H	High	1 ⩽ Is50 < 3	Core 150mm long and 50mm diameter cannot be broken by hand but can be broken by single firm blow of pick; rock rings under hammer
VH	Very High	3 ⩽ Is50 < 10	Hand held specimen breaks with pick after more than one blow; rock rings under hammer
EH	Extremely High	10 ⩽ Is50	Specimen requires many pick blows to break intact rock, rock rings under hammer

ROCK WEATHERING CLASSIFICATION

LOG SYMBOL	TERM	DEFINITION
EW	Extremely Weathered	Rock is weathered to such an extent that it has soil properties , i.e. it iether disintegrates or can be remoulded in water
DW	Distinctly Weathered	Rock strength usually changed by weathering. May be discoloured. Porosity may be increased by leaching, or may be decreased by deposition of weathering products in pores
SW	Slightly Weathered	Rock is slightly discoloured but shows little or no change of strength from fresh rock
FR	Fresh	Rock shows no sign of decomposition or staining

ROCK MASS PROPERTIES

TERM	SEPARATION OF STRATIFICATION PLANES	TERM	DESCRIPTION
Thinly laminated	< 6mm	Fragmented	Primarily fragments < 20mm length and mostly of width < core diameter
Laminated	6mm to 20mm	Highly fractured	Core lengths generally less than 20mm to 40mm with occasional fragments
Very thinly bedded	20mm to 60mm	Fractured	Core lengths mainly 30mm to 100mm with occasional shorter and longer pieces
Thinly bedded	60mm to 200mm	Slightly fractured	Core lengths generally 0.3m to 1.0m with occasional longer and shorter sections
Medium bedded	0.2m to 0.6m		
Thickly beddded	0.6m to 2.0m		
Massive	> 2m	Unbroken	Core has no fractures

ROCK QUALITY DESIGNATION (RQD). RQD is calculated for each core run. The RQD is the sum of the length of all pieces of rock core longer than 100mm expressed as a percentage of the total length of rock core recovered.

CORE RECOVERY. Core recovery is calculated for each core run. Core recovery is the total length of core, rock or soil, recovered expressed as a percentage of the total length of the core run.

ROCK DEFECT DESCRIPTION - Description order: type, orientation in degrees, infill, infill thickness, surface shape, roughness

DEFECT TYPE		INFILL		INFILL THICKNESS		SURFACE SHAPE		ROUGHNESS	
LOG SYMBOL	TERM	LOG SYMBOL	TERM	LOG SYMBOL	TERM	LOG SYMBOL	TERM	LOG SYMBOL	TERM
BP	Bedding parting	**KL**	Clean	**V**	Veneer <1mm thick	**PL**	Planar	**SL**	Slickensided
JT	Joint	**CL**	Clay			**CV**	Curved	**PO**	Polished
FT	Fault	**CA**	Carbonate	**SN**	Stain <1mm thick	**IR**	Irregular	**SO**	Smooth
SM	Seam	**RF**	Rock fragments			**UN**	Undulose	**RO**	Rough
SH	Sheared zone	**RC**	Rock fragments and clay	**5**	5mm thick	**ST**	Stepped	**VR**	Very Rough
CR	Crushed seam								
IF	Infilled zone								
FR	Fractured zone								

Figure C-3

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APPENDIX D

Logs of Boreholes 1 – 18

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BOREHOLE LOG

TEST LOCATION 1
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 11/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.3		ML	**SILT:** low plasticity, pale brown	Dry	MD				0.5			
				ML	**SILT:** medium plasticity, with clay fines, pale brown	Dry	MD				1.0			
		1.1		ML	**SILT:** medium plasticity, with clay fines, with fine grained sand, pale brown	Dry	MD				1.5			5/7/9 N = 16.
		2.1		CH	**CLAY:** high plasticity, silty, trace sand, grey mottled brown	MC>PL	VSt				2.0			
											2.5			
											3.0			2/4/8 N = 12.
		3.7		CH	**CLAY:** high plasticity, silty, pale grey trace yellow-brown	MC>PL	VSt				3.5			
											4.0			
											4.5			3/5/8 N = 13.
											5.0			
											5.5			
		6.4									6.0			
					END OF BOREHOLE LOG AT 6.4M									EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-1

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E-mail: enquiries@geoaust.com.au

BOREHOLE LOG

TEST LOCATION 2
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 11/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.3		ML	**SILT:** low plasticity, pale brown	Dry	MD				0.5			
		1.1		ML	**SILT:** medium plasticity, with clay fines, pale brown	Dry	MD				1.0			
		2.6		ML	**SILT:** medium plasticity, with clay fines, with fine grained sand, pale brown	Dry to Moist	MD				1.5			5/7/9 N = 16.
				CH	**CLAY:** high plasticity, silty, grey and brown, trace yellow-brown	MC>PL	VSt				2.0			
		3.7		CH	**CLAY:** high plasticity, silty, pale grey mottled yellow-brown	MC>PL	VSt				2.5			
											3.0			4/8/13 N = 21.
											3.5			
											4.0			
											4.5			5/8/10 N = 18.
		5.2		-	**BASALT:** grey and brown	EW	EL to VL				5.0			
		5.7									5.5			
					END OF BOREHOLE LOG AT 5.7M									EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-2

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BOREHOLE LOG

TEST LOCATION 3
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 11/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED			-	**FILL: Silt,** medium plasticity, with fine grained gravel, dark brown and dark grey	Dry	APC							3 additional boreholes drilled in the vicinity of Borehole 3 refused on basalt at 0.8-.09m.
		0.2		MH	**SILT:** high plasticity, clayey, brown	Dry	MD							
		0.3		CH	**CLAY:** high plasticity, silty, brown, trace grey and red-brown tending brown with depth	MC<PL	VSt				0.5			S > 120kPa
		0.7		-	**BASALT:** brown and grey	EW	EL							S > 120kPa
		0.9			END OF BOREHOLE LOG AT 0.9M									EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-1

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BOREHOLE LOG

TEST LOCATION 4
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 11/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.2		-	**FILL: Silt,** low plasticity, with fine to coarse grained gravel, grey	Dry	APC							2 additional boreholes drilled in the vicinity of Borehole 4 refused on basalt at 1.5 and 1.7m.
		0.7		ML	**SILT:** medium plasticity, with clay fines, yellow-grey	Dry	MD				0.5			
		1.4		CH	**CLAY:** high plasticity, silty, grey and yellow-brown	MC<PL	VSt				1.0			S > 120kPa S > 120kPa
		1.7		-	**BASALT:** grey and brown, with carbonates and clay seams	EW	EL to VL				1.5			
					END OF BOREHOLE LOG AT 1.7M									EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-4

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BOREHOLE LOG

TEST LOCATION 5
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 11/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample (DS / U60 / ES)	Depth	DCP Test / Test	Comments and Test Results
	NOT ENCOUNTERED	0.5		ML	**SILT:** low plasticity, trace silt fines, brown-grey	Dry	MD		0.5		
		0.7		ML	**SILT:** medium plasticity, with clay fines, brown	Dry	MD				S > 120kPa
				CH	**CLAY:** high plasticity, silty, brown tending brown with grey with depth	MC<PL	VSt		1.0		S > 120kPa
		1.3		CH	**CLAY:** high plasticity, silty, trace fine grained gravel, grey, trace brown and yellow-brown	MC>PL	VSt		1.5		S > 120kPa 4/5/7 N = 12.
		2.2		CH	**CLAY:** high plasticity, silty, grey, trace yellow-brown	MC>PL	VSt		2.0		
									2.5		
									3.0		
		3.2			END OF BOREHOLE LOG AT 3.2M						EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-5

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BOREHOLE LOG

TEST LOCATION 6
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 11/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.15		MH	**SILT:** high plasticity, clayey, brown	Dry	MD							
				CH	**CLAY:** high plasticity, silty, dark brown tending brown with depth	MC<PL	VSt				0.5			S > 120kPa
		0.6		CH	**CLAY:** high plasticity, silty, with carbonates	MC<PL	VSt							
		0.8		CH	**CLAY:** high plasticity, silty, grey	MC>PL	VSt				1.0			S > 120kPa
														S > 120kPa
											1.5			S > 120kPa
		1.7		-	**BASALT:** grey and brown, with clay	EW	EL to VL							
		2.1			END OF BOREHOLE LOG AT 2.1M						2.0			EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-6

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BOREHOLE LOG

TEST LOCATION 7
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 11/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample (DS / U60 / ES)	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.35		-	**FILL: Silt,** high plasticity, clayey, with lumps of silty clay, yellow-brown	Dry	MD		0.5			
		0.5		-	**FILL: Silty Clay,** high plasticity, with silt, grey	MC<PL	VSt					
		0.7		ML	**SILT:** medium plasticity, with clay fines, brown	Dry	MD					
		0.9		CH	**CLAY:** high plasticity, silty, brown, trace grey	MC<PL	VSt		1.0			S > 120kPa
				CH	**CLAY:** high plasticity, silty, grey	MC>PL	VSt		1.5			S > 120kPa
									2.0			2/4/6 N = 10.
		2.8		CH	**CLAY:** high plasticity, silty, grey	MC>PL	VSt		2.5			
									3.0			3/4/6 N = 10.
									3.5			
									4.0			
		4.4		-	**BASALT:** brown and grey, with high plasticity clay	EW	EL		4.5			
		5.2							5.0			
					END OF BOREHOLE LOG AT 5.2M							EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-7

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BOREHOLE LOG

TEST LOCATION 8
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 12/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.3		MH	**SILT:** high plasticity, clay, grey-brown	Dry	MD				0.5			S > 120kPa
		0.7		CH	**CLAY:** high plasticity, silty, grey mottled red-brown and brown	MC<PL	VSt				1.0			S > 120kPa
		2		CH	**CLAY:** high plasticity, silty, brown tending grey mottled brown with depth	MC>PL	VSt				1.5			4/5/6 N = 11.
		3		CH	**CLAY:** high plasticity, silty, grey	MC>PL	VSt				2.0			
		4.6		CH	**CLAY:** high plasticity, silty, grey trace yellow-brown	MC>PL	VSt				2.5			3/3/5 N = 8.
		4.8		-	**BASALT:** brown and grey, with clay	EW	VL				3.0			
					END OF BOREHOLE LOG AT 4.8M						3.5			12/22 blows for 130mm penetration: N > 22. Hammer double bouncing
											4.0			
											4.5			EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-8

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BOREHOLE LOG

TEST LOCATION 9
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 12/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.1		ML	**SILT:** low plasticity, with clay fines, grey	Dry	MD							
				ML	**SILT:** medium plasticity, clayey, yellow-brown	Dry	MD							
		0.5		CH	**CLAY:** high plasticity, silty, brown-grey	MC<PL	VSt				0.5			S > 120kPa
		1		CH	**CLAY:** high plasticity, silty, grey	MC>PL	VSt				1.0			S > 120kPa
											1.5			3/3/4 N = 7.
		2.5		CH	**CLAY:** high plasticity, silty, grey trace yellow-brown	MC>PL	VSt				2.0			
											2.5			
											3.0			3/4/13 N = 17.
		3.5		-	**BASALT:** brown and grey, with clay	EW	VL				3.5			
		4									4.0			
					END OF BOREHOLE LOG AT 4M									EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-9

GeoAust
Geotechnical Engineers
1/63 Industrial Drive BRAESIDE VIC 3195
T: (03) 9587 1811 F: (03) 9587 9411
E-mail: enquiries@geoaust.com.au

BOREHOLE LOG

TEST LOCATION 10
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 12/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.2		ML	**SILT:** medium plasticity, with clay fines, grey-brown	Dry	MD							
		0.4		CH	**CLAY:** high plasticity, silty, brown	MC<PL	VSt							
				CH	**CLAY:** high plasticity, silty, grey, trace brown tending grey with depth	MC>PL	VSt				0.5			S > 120kPa
											1.0			S > 120kPa
											1.5			2/3/5 N = 8.
		2		CH	**CLAY:** high plasticity, silty, grey, trace yellow-brown	MC>PL	VSt				2.0			
											2.5			
											3.0			3/5/10 N = 15.
		3.5		-	**BASALT:** with clay, brown and grey	EW	VL				3.5			
		3.7			END OF BOREHOLE LOG AT 3.7M									EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-10

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BOREHOLE LOG

TEST LOCATION 11
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 12/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED			MH	**SILT:** high plasticity, clayey, pale brown	Dry	MD							
		0.2		CH	**CLAY:** high plasticity, silty, brown	MC<PL	VSt							
		0.5		CH	**CLAY:** high plasticity, silty, grey with seams and bands of carbonates	MC>PL	VSt				0.5			S > 120kPa
											1.0			S > 120kPa
		1.6		-	**BASALT:** with clay, brown and grey	EW	VL				1.5			S > 120kPa
		2									2.0			
					END OF BOREHOLE LOG AT 2M									EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-11

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BOREHOLE LOG

TEST LOCATION 12
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 12/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.15		MH	**SILT:** high plasticity, clayey, brown	Dry	MD							
		0.5		CH	**CLAY:** high plasticity, silty, brown	MC<PL	VSt				0.5			S > 120kPa
		0.7		CH	**CLAY:** high plasticity, silty, grey	MC>PL	VSt							
		1.1		CH	**CLAY:** high plasticity, silty, with carbonates, grey and pale grey	MC<PL	VSt				1.0			S > 120kPa
		1.6		-	**BASALT:** with clay, grey and brown	EW	VL				1.5			
		2.1		-	**BASALT:** dark grey	DW (HW)	L to M				2.0			
					END OF BOREHOLE LOG AT 2.1M									EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-12

GeoAust
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BOREHOLE LOG

TEST LOCATION 13
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 12/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.1		MH	**SILT:** high plasticity, clayey, grey-brown	Dry	MD							
				CH	**CLAY:** high plasticity, silty, brown	MC<PL	VSt							
		0.5		CH	**CLAY:** high plasticity, silty, with seams of carbonate, grey	MC>PL	VSt				0.5			S > 120kPa
											1.0			S > 120kPa
		1.2		-	**BASALT:** with clay, grey with brown	EW	EL				1.5			
		1.7			END OF BOREHOLE LOG AT 1.7M									EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-13

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BOREHOLE LOG

TEST LOCATION 14
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 12/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.15		MH	**SILT:** high plasticity, clayey, grey-brown	Dry	MD							
		0.4		CH	**CLAY:** high plasticity, silty, brown	MC<PL	VSt							S > 120kPa
		0.9		CH	**CLAY:** high plasticity, silty, grey	MC>PL	VSt				0.5			S > 120kPa
		1.5		-	**BASALT:** with clay, brown and grey	EW	VL				1.0			
					END OF BOREHOLE LOG AT 1.5M						1.5			EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-14

GeoAust
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BOREHOLE LOG

TEST LOCATION 15
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 12/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.15		MH	**SILT:** high plasticity, clayey, brown	Moist	MD							
		0.4		CH	**CLAY:** high plasticity, silty, brown	MC<PL	VSt							S > 120kPa
		1		CH	**CLAY:** high plasticity, silty, with seams and bands of carbonates, grey with pale grey	MC>PL	VSt				0.5			S > 120kPa
		2		CH	**CLAY:** high plasticity, silty, grey	MC>PL	VSt				1.0			
											1.5			4/4/6 N = 10.
					END OF BOREHOLE LOG AT 2M						2.0			EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-15

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BOREHOLE LOG

TEST LOCATION 16
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 12/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.15		MH	**SILT:** high plasticity, clayey, grey	Dry	MD							
				CH	**CLAY:** high plasticity, silty, grey	MC>PL	VSt				0.5			S > 120kPa
		1		CH	**CLAY:** high plasticity, silty, trace carbonates, pale grey	MC>PL	VSt				1.0			S > 120kPa
											1.5			3/4/4 N = 8.
											2.0			
											2.5			
											3.0			5/7/21 N = 28.
		3.4		-	**BASALT:** with clay, grey and brown	EW	VL				3.5			
		3.9												
					END OF BOREHOLE LOG AT 3.9M									EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-16

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Geotechnical Engineers
1/63 Industrial Drive BRAESIDE VIC 3195
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E-mail: enquiries@geoaust.com.au

BOREHOLE LOG

TEST LOCATION 17
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 12/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.1		MH	**SILT:** high plasticity, clayey, brown	Dry	MD							
				CH	**CLAY:** high plasticity, silty, dark brown with dark grey	MC<PL	VSt							
		0.4		CH	**CLAY:** high plasticity, silty, grey	MC>PL	VSt				0.5			S > 120kPa
											1.0			S > 120kPa
		1.6		-	**BASALT:** with clay, grey and brown	EW	VL				1.5			3/4/5 N = 9.
		2.2		-	**BASALT:** grey and brown	DW (HW)	L				2.0			
		3									2.5			
											3.0			
					END OF BOREHOLE LOG AT 3M									EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-17

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BOREHOLE LOG

TEST LOCATION 18
SHEET 1 of 1

JOB No: 1548
CLIENT: VicUrban
PROJECT: Werribee Employment Precinct
Sneydes Road, Werribee
LOCATION: Refer to Test Location Plan (Figure 1)

DRILLED BY: C.C. **LOGGED BY:** S.M **DATE:** 12/03/2009

Method	Ground Water	Depth	Graphic Log	Classification Symbol	Material description	Moisture / Weathering	Density / Consistency	Sample DS	Sample U60	Sample ES	Depth	DCP Test	Test	Comments and Test Results
	NOT ENCOUNTERED	0.05		MH	**SILT:** high plasticity, clayey, grey	Dry	MD							
				CH	**CLAY:** high plasticity, silty, dark grey	MC<PL	VSt							
		0.5		CH	**CLAY:** high plasticity, silty, grey	MC>PL	VSt				0.5			
		1		CH	**CLAY:** high plasticity, silty, trace carbonates to 1.5m, pale grey	MC>PL	VSt				1.0			
											1.5			4/4/6 N = 10.
											2.0			
											2.5			
		2.6		-	**BASALT:** with clay, grey and brown	EW	EL							
											3.0			
		3.2			END OF BOREHOLE LOG AT 3.2M									EFFECTIVE AUGER REFUSAL ON BASALT

Refer Appendix C for definition of logging terms and symbols

Figure D-18

GeoAust
Geotechnical Engineers

APPENDIX E

Results of Laboratory Testing

BAIRNSDALE SOIL & CONCRETE TESTING PTY LTD
ABN 13 060 304 243
72 Dalmahoy Street (PO Box 1049) Bairnsdale 3875
Telephone (03) 51521766 Mobile 0428 516422 Fax (03) 51531068
NATA Acc.No 3729

SOILS & PAVEMENT MATERIALS
LABORATORY STRENGTH AND CLASSIFICATION SUMMARY

Client : GeoAust Geotechnical Engineers Address: 1/63 Industrial Drive, Braeside 3195	Job/Project: 1548	Location : Werribee Employment Precinct. Sneydes Road, Werribee	
Test(s) Requested : AS1289.5.1.1, 6.1.1	Material : Clay	Sampled From : 0.2 - 1.0m.	Date Sampled : Sampled By : Client Marked: Comp B

LAB NO	SIEVE ANALYSIS PRIOR TO COMPACTION (% Passing)											PLASTICITY TESTS (%)				APD	TREATMENT AFTER COMPACTION	
	mm									um		LL	PL	PI	LS	t/m3	CURE	SOAK
	75	53	37.5	26.5	19	13.2	9.5	4.75	2.36	425	75						1 Day	4 Days
1183/7																		

MOIST.CONTENT %	29.7				MAX.CBR %	
DRY DENSITY t/m3	1.432				@ M/C %	
CBR %	*2.3*	*1.7*			COMPACT.EFFORT	**STD**
PENETRATION mm	2.5	5.0			MAX.DRY DENS. (before soaking) t/m^3	**1.460**
SWELL %	3.3				MAX.DRY DENS. (after soaking) t/m^3	
TEST M/C % TOP 30mm	39.7				OPT.M/C %	**28.9**
REMAINDER	30.4				LABORATORY MOISTURE RATIO %	
OVERSIZE % 0.0	SURCHARGE MASS (kg)		4.5	INSITU M/C % 23.5	LABORATORY DENSITY RATIO %	**98**

Note: Sieve analysis performed on minus 19mm material

NATA Accredited Laboratory Number: 3729
This document is issued in accordance with NATA's accreditation requirements.

REPORT NO	**081183**
Page No	2 of 4
NATA Approved Signatory	S Prosser
Date	01/04/09

Form: CBR(7/2/06)L

BAIRNSDALE SOIL & CONCRETE TESTING PTY LTD

ABN 13 060 304 243
72 Dalmahoy Street (PO Box 1049) Bairnsdale 3875
Telephone (03) 51521766 Mobile 0428516422 Fax (03) 51531068
NATA Acc.No.3729

LABORATORY COMPACTION TEST

Client	GeoAust Geotechnical Engineers	Location	
Address	1/63 Industrial Drive, Braeside 3195	Sneydes Road, Werribee	
Project		Job No	Date Received 25/03/09
Werribee Employment Precinct		1548	Sampled By Client

LAB NO	MATERIAL	SUPPLIER	SAMPLED FROM
1183/6	Clay		Marked "Comp A"
1183/7	Clay		Marked "Comp B"

LAB	COMPACTION		A		B		C		D		E	
NO	TYPE	MOULD	M/C	DD	M/C	DD	M/C	DD	M/C	DD	M/C	DD
1183/6	STD	A	14.4	1.737	15.8	1.750	17.6	1.750	19.2	1.715		
1183/7	STD	A	25.0	1.379	27.0	1.428	28.6	1.458	30.6	1.417		

OPT.M/C	MAX.DD
%	t/m3
16.2	**1.753**
28.9	**1.460**

NOTE: Mould A = 105mm, B = 152mm

LAB	SIEVE ANALYSIS											PLASTICITY		
NO	75.0	53.0	37.5	26.5	19.0	13.2	9.50	4.75	2.36	425	75	LL	PL	PI	LS
1															
2															
3															
4															
5															
6															

NATA Accredited Laboratory Number: 3729
This document is issued in accordance with NATA's accreditation requirements.

All testing has been carried out in accordance with the following TEST METHODS :
AS1289.1.1, 5.1.1

Form: COMP-MA(29/08/01)

REPORT NO	**081183**
Page No	3 of 4
NATA Approved Signatory	S Prosser
Date	01/04/09

BAIRNSDALE SOIL & CONCRETE TESTING PTY LTD

ABN 13 060 304 243
72 DALMAHOY STREET (PO BOX 1049) BAIRNSDALE 3875
TELEPHONE (03) 51521766 MOBILE 0428 516422 FAX (03) 51531068
NATA Acc.No 3729

SUBGRADE MATERIALS REPORT

Client : GeoAust Geotechnical Engineers
Address : 1/63 Industrial Drive, Braeside 3195

Job/Project : Werribee Employment Precinct
Sneydes Road, Werribee
Job No: 1548

Sample Description : Clay

Sampled From :
1183/1 - BH 3 (0.5 - 0.6m.)
1183/2 - BH 4 (0.7 - 0.8m.)
1183/3 - BH 5 (0.5 - 0.6m.)
1183/4 - BH 5 (0.9 - 1.0m.)
1183/5 - BH 7 (3.0 - 3.45m.)

Sampled By : Client

Date Submitted : 25/03/09

Test(s) Requested : AS1289.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Laboratory Sample No : 1183/1 - 1183/5

RESULTS OF ANALYSIS

	SIEVE ANALYSIS (% passing)											PLASTICITY			
Lab No	75.0	53.0	37.5	26.5	19.0	13.2	9.50	4.75	2.36	425	75	LL (%)	PL (%)	PI (%)	LS (%)
1183/1												83	21	62	22.0
1183/2												62	15	47	19.0
1183/3												39	15	24	13.0
1183/4												78	20	58	20.5
1183/5												99	18	81	25.5

Note: Sieves 75.0 - 2.36 are in mm & 425 - 75 are in um.
Sample Preparation: Oven dried
Preparation Method : Dry
Size of LS moulds : 254 & 255mm
Crumbling/curling occur : Crumbling & Curling
Remarks :

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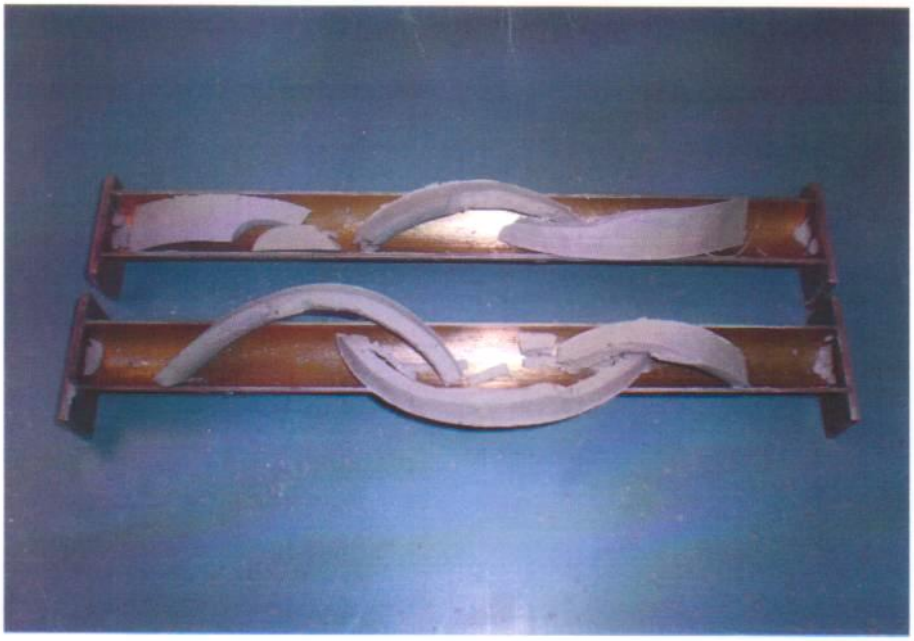
Date	01/04/09

Form:Subgrade Materials(23/08/01)



Linear Shrinkages for Sample No 081183/5