

Parsons Brinckerhoff Australia Pty Limited

ABN 80 078 004 798

21 December 2011

Michael Brown
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PLANS AND DOCUMENTS
referred to in the ULDA
APPROVAL dated 30/4/2012

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A+ GRI Rating: Sustainability Report 2010

Our ref: 201113958-LTR003-A-bt

Dear Michael

Review of Previous Geotechnical and Acid Sulfate Soils Investigation - Mayne Street, Bowen Hills

Parsons Brinckerhoff Group Inc. (Parsons Brinckerhoff) has undertaken a review of a geotechnical investigation report, prepared by Soil Surveys Engineering Pty Ltd, dated 30th September 2002 to establish its applicability to the now proposed "Bowen Hills Government Office Building". A copy of the Soil Surveys report is attached.

Soil Surveys undertook the geotechnical assessment of the subject site to support the proposal to construct a two storey extension to the then existing "Endeavour" building. The report was prepared on the assumption that the building would be of concrete slab and block work construction on concrete columns. Earthworks were expected to be limited to less than 1.0 metre in depth. The site assessment included production of 10 boreholes distributed across the site with a greater density around the proposed building. Bore holes were driven varying from 0.7 to 3.0 metres.

The current proposal for this site includes the construction of a government office building to 15 storeys with possible 6.0 metres of excavation for basement parking facilities. Acid Sulfate Soils (ASS) are typically triggered where development:

- Involves excavating more than 1,000 m³ of soil or sediment (at or below 5.0 metres Australian Height Datum (AHD) where the natural ground level is less than 20.0 metres AHD); or
- Involves using more than 1,000 m³ of material as fill (with an average depth of 0.5 of a metre or greater, at or below 5.0 metres Australian Height Datum (AHD) where the natural ground level is equal to or less than 5.0 metres AHD).

The proposal's basement will involve excavation to -3.0 metres AHD. Accordingly detailed ASS assessment will be undertaken to inform Detailed Design and subsequent Compliance Assessment can be utilised, via conditions of approval to this DA to ensure ASS is adequately managed. It is therefore considered premature to provide additional details at this stage of the development process.

For any additional information in regards to the documents reviewed or the proposed course of action, please don't hesitate to contact the undersigned on 3854 6045 or 0437 424 12.

Yours sincerely



Bill Tsui
Principal Civil Engineer
Parsons Brinckerhoff





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REF: 102-6625 / SA2885
Author: Noel Perkins

30th September, 2002

QRail
GPO Box 1429
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ATTENTION: MR SYD SHAW

Dear Sir,

**RE: GEOTECHNICAL INVESTIGATION - BOWEN HILLS CREW ADMINISTRATION
& AMENITIES BUILDING EXTENSION AND CARPARK**

1.0 INTRODUCTION

This report presents the results of the geotechnical investigation carried out by Soil Surveys Engineering Pty Limited at the above site.

It is understood that the proposed development is to consist of a two storey extension (lower floor RL 12.75m) to the existing "Endeavour" building. The building work proposed is to consist of a suspended concrete slab and load bearing reinforced block walls with concrete columns. Working loads are to consist of isolated columns of up to 500kN and wall line loads of 100kN/m. Cuts and earthworks are unknown at this stage, but are expected to be <1.0m.

The objective of this study was to identify materials and material properties and groundwater conditions to enable geotechnical assessment of the following:

- Foundation recommendations
- Pavement recommendations
- Construction recommendations (where applicable)
- Site management recommendations

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2.0 SITE INVESTIGATION

2.1 Field Investigation

Subsurface conditions were investigated by drilling and sampling seven boreholes at specified locations, to depths of 0.7m to 3.0m, using a 4WD mounted Jacro 105 drilling rig. In addition, Dynamic Cone Penetrometer tests were carried out adjacent each borehole.

The soil classification descriptions and field tests were carried out in general accordance with Australian Standards.

AS 1726-1993 Geotechnical Site Investigations

AS 1289 Methods of Testing Soils for Engineering Purposes

Details of the investigation method, borehole records, dynamic cone penetrometer results and a site plan showing the location of the boreholes are attached.

The classification of soils in the field is subjective, based on the experience and judgement of the technical driller and some variations in the soil description, from the actual material type may occur. In order to reduce any inconsistencies which may have occurred, the field descriptions have been corrected, where appropriate, to reflect the available laboratory test results.

2.2 Site Description

The site is located at the end of Mayne Street, Bowen Hills.

Access to the site is off Hudd Street to the south of the site. The general slope angle is to the east at approx. 3-5 degrees below the horizontal.

The site has been described as moderately drained with no seepage noted.

The area was previously used for other structures which have been demolished. Parts of the area appear to have been filled at some time in the past and the ground surface is very uneven.

2.3 Subsurface Profile

The subsurface profile encountered consisted of:-

- Fill - this was intersected in all the boreholes and was predominantly described as loose to medium dense SAND, and clayey SAND with some gravelly silty/clayey sand noted. A small amount of sandy CLAY was noted in BH1.
- Residual Clays - this was intersected in BH2, 3, 4, 6 and 7, was described as stiff to hard and consisted of a thin band between the fill and the weathered rock.
- Weathered Rock - this was intersected in all boreholes except Boreholes 5 and 7. This was described as very weak to weak, extremely weathered (XW) to distinctly weathered (DW) TUFF.

No groundwater was encountered in the boreholes during the investigation. BH5 appeared to intersect an old service line and water rose in the hole when the augers were removed. The borehole was checked a few days later and was found to be dry.

A summary of the borehole intersection is set out in Table 1 with detailed borelogs and site plan at the rear of the report.

TABLE 1 BOREHOLE SUMMARY

BH	RL (m) ²	DCP Refusal (m)	Fill (m)	Residual Clay (m)	Weathered Rock (m)	Max 'V' Bit (m)	Max 'TC' Bit (m)	Total Depth (m)
1	12.8	0.5	0.00-0.40	NE	0.40-TD	0.5	0.7	0.7
2	12.1	NE	0.00-2.30	2.30-2.80	2.80-TD	2.9	NE	3.0
3	11.3	1.7	0.00-1.25	1.25-1.70	1.70-TD	1.9	2.2	2.2
4	12.2	0.5	0.00-0.60	0.60-1.80	1.80-TD	2.5	NE	3.0
5	9.7	0.6	0.00-TD	NE	NE	NE	NE	1.0
6	9.3	1.1	0.00-0.75	0.75-1.00	1.00-TD	1.0	1.1	1.1
7	9.2	NE	0.00-0.90	0.90-TD	NE	NR	NE	1.5

Notes:

1. Depth below surface at time of investigation (20th September, 2002)
2. Based on supplied contour plan
3. NE - Not Encountered

2.4 Laboratory Testing

Laboratory testing was carried out on selected samples retrieved from the site investigation program and was directed towards assessing the reactivity and strength of the subsurface material.

Laboratory testing included:-

- Shrink/Swell Index - to assess the reactivity of the subsurface material (BH3 @ 1.5m - Iss = 2.7%, BH4 @ 0.6m - Iss = 3.0%.
- Swell Pressure - to assess the potential uplift forces resulting from moisture variation within the upper level clays (BH3 @ 1.5m - SP = 400kPa, BH4 @ 0.6m - SP = 400kPa)
- California Bearing Ratio - to assess the subgrade parameters for pavement design (BH6 at 0.40m to 0.75m; CBR = 5%).

The laboratory test certificates are attached.

3.0 ENGINEERING ASSESSMENT

3.1 Traffickability and Site Preparation

At the time of the field investigation, traffickability was considered to be moderate to poor due to slope angles, vegetation and general unevenness of the ground surface.

Problems may arise from disturbance of the upper level soil fabric with removal of vegetation, existing structures and services. Depressions could be formed resulting in water traps with potential softening of adjacent and underlying soils.

Nevertheless, the contractor should fully inform himself of the ground conditions on site prior to commencement of earthworks. This requirement should be explicit in any earthworks specifications or contract.

3.2 Civil Works

Earthworks - General

It is envisaged that a building platform will be created with a cut and fill operation. The expected maximum cut and fill is <1.0m.

Earthwork procedures should be carried out in a responsible manner in accordance with AS 3798-1996 'Guidelines on Earthworks for Commercial and Residential Developments'. It is recommended that the earthworks contractor make himself familiar with site conditions.

Earthwork procedures should include the following:-

- Clearing, stripping and grubbing should be carried out in areas subject to earthworks. Also all soils containing organic matter should be stripped from the construction area. This material is not considered suitable for use as structural fill.
- Depressions formed by the removal of vegetation, underground elements etc. should have all disturbed weakened soil cleaned out and be backfilled with compacted select material.
- In areas where fill is to be placed, the existing ground surface should be proof rolled (if appropriate) using a vehicle with a tare of at least 3 tonnes. Areas demonstrating excessive movement should be treated (dried and recompacted) or removed and replaced with compacted fill. In areas of cut, proof rolling may be deferred until after the cut operation.
- Imported select fill material, if required, should be a good quality select fill material with a soaked CBR >15% and a maximum aggregate size of 75mm.
- Fill placed in the areas of the carpark should be compacted in layers (approximately 250mm loose thickness) to a density not less than 98% of maximum dry density in accordance with AS 1289 5.1.1 (Standard Compaction) for building platform and top 300mm of pavement subgrade and not less than 95% below the top 300mm of pavement subgrade.

- Field density testing should be carried out in each fill lift placed to check the standard of compaction achieved and the placement moisture content. The frequency and extent of testing should be as per guidelines in AS.3798-1996, Section 8.0.
 - The insitu soils and fill, where free of organic and deleterious material, may be used for structural fill provided the moisture content of the soils, on placement, approximates the OMC (Optimum Moisture Content) appropriate for compaction.
 - Most soils encountered on site (to borehole depths) should be within the excavation limits of a small dozer (eg. Cat D4 or similar) in bulk earthworks and a medium sized backhoe (eg. Case 580 or similar) in trench excavations.
- Excavation in the weathered rock down to 'TC' bit refusal will require a medium to large excavator with rock breakers required below this level.
- Where fill is to be placed on sloping ground, particular care should be taken with respect to benching of the subgrade such that filling is carried out on a level, refer Section 2(i) and 2(j) of AS 3798-1996.

Batters

Maximum batter angles for different material types are outlined in Table 2 for unsurcharged cut and fill batters less than 3m high. Where surcharges (eg. footings, live loads, etc.) are located within H (height of batter) of the top of the batter, then some reduction in design angle will occur. Steeper batters are possible with suitable surface protection such as stone pitching, etc. or by use of retaining structures (temporary and permanent). Fill batter slopes are dependent on suitable compaction being achieved.

TABLE 2 MAXIMUM BATTER ANGLES (Slopes less than 3m high)

Material	Short Term	Long Term
Existing Fill	35 degrees	18 degrees
Compacted Fill	45 degrees	26 degrees
Clay Soils	45 degrees	26 degrees
Weathered Rock	60 degrees ⁽¹⁾	45 degrees ⁽¹⁾

Note: (1) Subject to inspection by experienced geotechnical engineer/engineering geologist

It is essential that permanent batters be suitably protected from erosion and scour by appropriate drainage and the establishment of ground cover and shrubs, etc. Imperative to the stability of the batters is good drainage to prevent potential fretting and/or slumping. It is therefore recommended that measures be taken to minimise the flow of water over batters.

Drying out of the reactive clays in the batters would result in surface cracks which have the potential to become saturated and fret during rainfall periods. This could result in eventual slumping and failure of these sections of the batter faces.

Consideration should therefore be given to protecting the final batter faces by cutting the slopes to a maintainable profile and providing a good surface covering, eg. vegetation, grass.

Erosion Control

Topsoiling and seeding or hydromulching on cut areas steeper than 1:5 (11 degrees) is suggested so that protection could be provided until such time as the grass cover is established.

Drain outlets would also need to consider the effects of scouring runoff water. These will need to be concrete lined near each entry and exit, with grassing further out.

The construction of asphalt surfaced roads with kerb and channelling and appropriate underground drainage will limit erosion on fill batters to the effects of localised surface runoff. Rutting, scouring and erosion is therefore possible.

It is suggested that topsoiling and seeding or hydromulching also be used on all fill batters, regardless of slope, to provide protection to the slopes until permanent grass cover is established. The seed selection for the hydromulch will depend on the season when placed, but in any case, should include a rapid growing seasonal variety that could rapidly establish itself until such time as the regular grass variety is established.

It is recommended that where possible cut and fill batters have surface and subsurface drains installed above and below the slope so that water is collected and directed away from structures.

3.3 Site Classification

While a site classification in accordance with AS 2870 'Residential Slabs and Footings' relates to residential type construction and is not directly applicable for this development, it is however a valuable method of classification.

Site investigation and laboratory test results indicate that if only soil reactivity were considered, the site may be designated Class 'M', moderately reactive, in accordance with AS 2870 'Residential Slabs and Footings'. A ground surface movement (ys) of 35mm (maximum) has been calculated for the subsurface profile encountered.

Assuming:-

- A zone of moisture variation of 1.5m
- A crack zone of 0.75m
- $\Delta pF = 1.2$

However, given the amount of fill intersected in Boreholes 2 and 3, a general site classification of 'P' (problem) site would be more appropriate.

It is recommended that the reader satisfy themselves that the use of AS 2870 is applicable for the proposed design.

The above classification is based on the existing ground profile and for a final cut to fill platform which has been prepared in accordance with Section 3.3 of this report. Where imported fill is used and/or minimum recommended compaction is not achieved the above site classification may not be appropriate.

The above y_s value has been based on the recommendations outlined in Sections 3.2 'Earthworks' and 3.6 'Site Management' being complied with. Where these recommendations cannot be met then the y_s value and classification will need to be reviewed. As an example should trees/shrubs be located within a distance equivalent to their mature height from the structures then an increased moisture active zone, say 2.5m, should be adopted. This would increase the y_s value to 55mm which relates to a site classification of 'H' (highly reactive).

3.4 Foundations

General

It is recommended that all footings extend to and found into similar material to reduce any differential settlement issues.

Given the subsurface profile encountered and the expected loads, both a high level footing system (near BH1) and a deep foundation system (near BH2) dimensioned for the loads and the allowable bearing capacity of the founding material would generally be acceptable for the proposed structure.

High Level Footings

When high level footings are adopted, our recommendation is that all perimeter footings, footings under isolated columns and strip footings below internal load bearing walls be founded at least 200mm into weathered rock. Footings should not found in fill.

Footings may be dimensioned for an allowable bearing pressure as outlined in Table 3.

TABLE 3 ALLOWABLE BEARING CAPACITY

Material	Allowable Bearing Capacity (kPa)
Topsoil/Fill	NR
<u>Clay</u> ¹	
Stiff	100
Very Stiff	200
Hard	350
<u>Weathered Rock</u>	
Above V Bit Refusal	350
Between V & TC Bit Refusal	450
Below TC Bit Refusal	800

Note: 1 Values provided for light structural or non structural loads

Where necessary, footings deeper than say 500mm may be made up with mass concrete poured to the underside of the footings, or alternatively, footings may be constructed over mass concrete filled, backhoe excavated pedestals.

Field and laboratory test results indicate that the existing natural soils, along with any controlled fill, are suitable for slab on ground construction provided that earthworks are carried out in accordance with Section 3.2.

The existing fill and topsoil is generally described as loose to medium dense. Slab on ground construction may be undertaken over this material provided it has been suitably compacted and passes a proof roll test. When the fill thickness exceeds 500mm for sand fill, it is recommended that at least a 250mm layer be removed and compacted and the layer recompacted to final level.

Deep Foundations

General

Bored piers could be considered.

It is recommended that the deep foundations used on this project be designed in accordance with AS 2159-1995 Piling - Design and installation. This code uses the limit state design method. In the limit state design method the following must be taken into account :-

- Ultimate strength - the design of a single pile or a pile group must be such that both the geotechnical strength R_g^* and the structural strength R_s^* are greater than or equal to the Design action effect S^* ie

$$R_g^* \geq S^* \text{ and } R_s^* \geq S^*$$

- Serviceability - Single piles and pile groups shall be designed for serviceability by controlling or limiting pile movements
- Durability - This is outlined in Section 6 of AS 2159-1995 and will not be discussed any further here
- Any other factors that need to be considered ie stability, scour, fatigue, cyclic loading or seismic actions - As we are not aware that any of these factors will effect the pile design they will not be considered any further.

Ultimate Strength Design

The design of a deep foundation system should consider the following:-

- Compressional capacity i.e. base bearing and skin friction design values, this will also include negative skin friction effects
- Tensional capacity and effects i.e. potential uplift due to expansive clays
- Lateral capacity of the piles
- Construction considerations, eg. articulation, underground services, etc.

Compressional Capacity

The design geotechnical strength (R_g^*) can be calculated as the ultimate geotechnical strength multiplied by the geotechnical strength reduction factor ϕ_g . The ultimate geotechnical strength parameters for the materials encountered on the site are outlined in Table 4.

TABLE 4 **ULTIMATE GEOTECHNICAL STRENGTH PARAMETERS**

Material		Base Bearing (kPa)		Skin Friction (kPa)
		L < 4D	L > 4D	
Clay	- Very Stiff	600	900	30
	- Hard	1200	1800	60
Weathered Rock	- Above V Bit Refusal	1800		60
	- Between V & TC Bit Refusal	2500		80
	- Below TC Bit Refusal	4000		125

Notes:

1. N.R. - Not Recommended
2. Ignore top 1.5m of clay profile in skin friction calculations; shrinkage of the upper level clays may occur.

Based on the range of values provided in AS2159-1995 it is recommended that a geotechnical strength reduction value of 0.45 be adopted for the design of deep foundations on this site in conjunction with the ultimate strength values provided in Table 3.

Tensional Effects - Potential Uplift

It is recommended that individual piers be assessed for uplift capacity as well as the overall pier capacity.

For a full clay profile, potential uplift pressure due to the effect of swelling soils in the top 1.5m of the clay profile must also be considered.

The design action effect S^* can be calculated using the following formula as per AS2159-1995 3.3.2(b)(i)(B) :-

$$S^* = 1.5F_{ep}$$

where F_{ep} = factored swelling pressure

The factored swelling pressure can be calculated using the "Rational Pier Formula" as $F_{ep} = 0.15 \times \text{Swell Pressure of soil} = 60\text{kPa}$

The design geotechnical strength R_{ug}^* at the top of the pile can be calculated using Section 4.3.2 of AS 2159 - 1995 where for a pile without an enlarged base :-

$$R_g^* = \phi_g R_{ug}$$

$$\text{where } R_{ug} = f_{st} A_s + W$$

where

ϕ_g = Geotechnical strength reduction factor = 0.45 (ref. AS2159-1995 Table 4.1)

R_{ug} = Ultimate geotechnical strength of pile

f_{st} = Average skin friction for condition of full mobilisation - tension pile

A_s = Surface area of pile in intimate contact with soil (ie. below 1.5m)

W = Weight of pile

It should be noted that in the above formula the weight of the pile could also include a component from the dead load (G) on the top of the pile provided the building construction has been completed. A suggested amount would be a load equivalent to 0.8G as outlined in AS1170.1-1989 Section 2.3(c).

Uplift may be reduced by constructing a separation e.g. sleeving between the pile shaft and the soil in the unstable zone.

Design Considerations

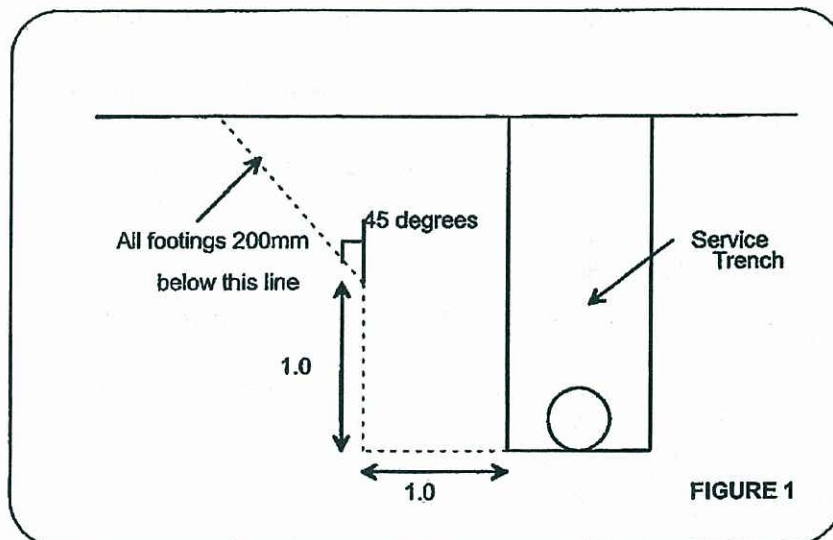
Inspections

It is recommended that inspections be undertaken by an experienced and qualified geotechnical engineer from Soil Surveys Engineering following footing excavations to confirm the adequacy of the founding soils. Inspections should be carried out prior to placement of reinforcing steel and ordering of concrete.

Underground Services

Where footings are located adjacent to underground services, the footings should extend to base a minimum of 200mm below the trench base level for a distance of 1m out from the trench. Beyond 1m, the footings should be taken a minimum of 200mm below an imaginary line drawn up at 45 degrees from the trench base level; Figure 1 refers.

These requirements do not override minimum footing base levels.



3.5 Pavements

Design Values

It is understood that a flexible pavement is proposed for the majority of the driveway and carparking areas (although some rigid pavement areas may be adopted).

Boreholes 5, 6 and 7 were drilled to assess subgrade conditions.

Detailed final pavement levels have not been supplied at the present time (however, are expected to be of the order of 0.5m of cut and fill) and as such, the pavement subgrade could vary from the soils and weathered rock to future placed fill.

Laboratory testing of the Clayey Sand (existing fill) from BH6 produced a Soaked CBR value of 5.0%.

This value represents the subgrade strength available in the material compacted to 98% standard density ratio and then subjected to saturation. This situation could occur in the long term if proper site drainage and maintenance procedures are not adopted.

Dynamic cone penetrometer test results indicate insitu CBR values, in the upper level fill and natural soils are quite variable across the site, ranging from 5% to in excess of 10%.

Experience indicates that with soils that are substantially in excess or dry of the optimum moisture content appropriate for compaction, as on this site, the indicative insitu CBR values can be misleading, as they can tend to over or under estimate the subgrade strength achievable.

For design consideration both insitu and laboratory derived CBR values have been assessed.

Based on the above and providing that the recommendations outlined in the following section are complied with, the following pavement design values may be adopted for the development.

TABLE 5 DESIGN VALUES

Material	CBR Value (%)	Modulus of Subgrade Reaction (kPa/mm)
Controlled Fill ⁽¹⁾	10	53
	15	60
Clay Soil ⁽²⁾	3	25
Existing Fill ⁽³⁾ / Sandy Soil	5	37
Weathered Rock ⁽²⁾	10-15	53-60

Note: 1. Use CBR value of imported material, see Section 3.2

2. Presumptive Design Values

3. Assumes material passes proof roll

Construction Considerations

Along with recommendations contained in Sections 3.1 and 3.2, the following general earthworks recommendations are made:-

- i) Incorporate a perimeter drain at the pavement edges to prevent possible deterioration under wet weather.
- ii) Pavements should be well drained both during and upon completion of construction. Water should not be allowed to pond on or near pavement surfaces.
- iii) Pavement gravel should comply with the DOT quality specifications for sub base and base course material.
- iv) Subgrades should be compacted to achieve the minimum density ratios as outlined in Section 3.2 'Earthworks'.
- v) It is recommended that inspection and testing be carried out following general earthworks to confirm subgrade conditions.
- vi) Concrete pavements should preferably be keyed and dowelled at transverse joints and keyed and tied at longitudinal joints.

3.6 Site Management

In order to minimise foundation movement, it is important that proper site management methods be observed for the existing soil conditions by both the builder at the time of the construction and the owner throughout the life of the proposed development.

- It is important that the site be well drained. The ground around the building should slope away at 1 in 20 for 2 metres and then fall to the stormwater system to prevent ponding of water adjacent to the building.
- Footings should be placed with minimal delay after excavation (at least same day of excavation) to avoid desiccation or wetting of the founding soils. If concrete cannot be poured the same day as footings are excavated, a 50mm (minimum) blinding layer should be placed.
- The importance of avoiding leakage from underground services and drains near the building is stressed. Any leaking services or blocked drains should be remedied promptly. It is advisable to use flexible joints, allowing horizontal and vertical movement where service pipes pass through the foundation structure (floor and slab). The bases of services trenches should fall away from the building.
- Do not let the slab subgrade "dry out" prior to casting.
- Future shrubs and trees should be planted at a distance at least equivalent to their mature height away from the building to avoid shrinkage movement in expansive founding soils. Existing trees that encroach this restriction should be removed.

4.0 LIMITATIONS

We have prepared this report for the use of **QRAIL**, for design purposes in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for use by parties other than **QRAIL** or their associated design consultants. It may not contain sufficient information for purposes of other parties or for other uses.

Soil Surveys Engineering offer a documentation review service to verify that the intent of geotechnical recommendations is properly reflected in the design. It is recommended that the client avail themselves of this service; our standard rates will apply.

Yours faithfully,



P. J. DIXON (RPEQ 4150)

for and on behalf of

SOIL SURVEYS ENGINEERING PTY LIMITED

Registered Professional Engineering Company of Qld No. 195

Attachments.

- 1) Borehole Records
- 2) Dynamic Cone Penetrometer Results
- 3) Laboratory Test Results
- 4) Site Plan
- 5) Notes Relating to this Report

 **SOIL SURVEYS ENGINEERING PTY LIMITED**



Soil Surveys Engineering Pty. Limited

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BOREHOLE RECORD SHEET

Borehole Number : **1**

Project Number : 102-6625

Project Name : Proposed Office Building

Location : Mayne Rd., Bowen Hills

Client : Qld Rail

Date : 20/09/2002

Page : 1

Easting : Northing : RL : 12.80
Logger : LJ Driller : LJ Drilling Rig : Jacro105

Drilling Method					Depth	Graphic	Description	DCP Test (blows/100mm)					Samples and Remarks
V	TC	VB	BR	INCL				5	10	15	20	25	
					0.10		FILL Gravelly Clayey SAND (SC) Medium dense, fine to coarse grained, brown, low plasticity fines, fine to coarse size gravel, moist						
					0.40		FILL Sandy CLAY (CH) Very stiff, medium to high plasticity, dark brown, fine to medium grained sand, with coarse grained sand, fine size gravel, moist						
					0.50		NATURAL TUFF (XW) Very weak, pale grey mottled yellow, moist						
					0.70		TUFF (XW) Weak, pale grey mottled yellow, moist						
					1.0		Borehole Terminated 0.70m						
					2.0								
					3.0								
					4.0								
					5.0								

COMMENTS

1) Groundwater not observed. 2) Max V bit at 0.5m. 3) Max TC bit at 0.7m. 4) DCP refusal at 0.5m.

▼ Water First Noted ▼ Water Steady Level

Approved : _____

Date : ____/____/____

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BOREHOLE RECORD SHEET

Borehole Number : 2

Project Number : 102-6625

Project Name : Proposed Office Building

Location : Mayne Rd., Bowen Hills

Client : Qld Rail

Date : 20/09/2002

Page : 1

Easting : Northing : RL : 12.10
Logger : LJ Driller : LJ Drilling Rig : Jacro105

Drilling Method						Depth	Graphic	Description	DCP Test (blows/100mm)					Samples and Remarks
V	TC	VS	RR	RE/C	Other				5	10	15	20	25	
						0.03		FILL Bitumen						
						0.20		FILL Gravelly Silty SAND (SM) Medium dense, fine to coarse grained, pale grey, low plasticity fines, fine to medium size gravel, moist						
								FILL Clayey SAND (SC) Medium dense, fine to coarse grained, dark brown, low plasticity fines, with fine to medium size gravel, moist.						
						1.0								U50 PP>600(100)
						1.40		FILL Clayey SAND (SC) Loose to medium dense, fine to medium grained, yellow brown mottled pale brown, low to medium plasticity fines, with coarse grained sand, trace of fine to medium size gravel, moist.						U50 PP>600(96)
						2.0								
						2.30		NATURAL Sandy CLAY (CH) Very stiff to hard, medium to high plasticity, grey red mottled, fine to medium grained sand, trace of coarse grained sand, fine size gravel, moist.						
						2.65		Sandy CLAY (CH) Very stiff to hard, medium to high plasticity, pale grey mottled orange yellow, fine to medium grained sand, moist						
						2.80								
						2.90		TIUFF (XW) Very weak, pale grey, moist						
						3.00		TIUFF (XW) Weak, pale grey, moist						
								Borehole Terminated 3.00m						
						4.0								
						5.0								

COMMENTS

1) Groundwater not observed. 2) Max V bit at 2.9m.

▼ Water First Noted ▼ Water Steady Level

Approved : _____

Date : ____/____/____

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BOREHOLE RECORD SHEET

Borehole Number : **3**

Project Number : 102-6625

Project Name : Proposed Office Building

Location : Mayne Rd., Bowen Hills

Client : Qld Rail

Date : 20/09/2002

Page : 1

Easting : Northing : RL : 11.30

Logger : LJ Driller : LJ Drilling Rig : Jacro105

Drilling Method					Depth	Graphic	Description	DCP Test (blows/100mm)					Samples and Remarks
V	TC	VB	RE	INCL				5	10	15	20	25	
					0.80		FILL Clayey SAND (SC) Loose to medium dense, fine to coarse grained, dark brown, low to medium plasticity fines, trace of fine to medium size gravel, clay lumps, moist.						U50 PP=200(100)
					1.0		FILL Clayey SAND (SC) Medium dense, fine to coarse grained, grey brown, low to medium plasticity fines, trace of fine to medium size gravel, clay lumps, moist.						
					1.25		NATURAL Sandy CLAY (CH) Very stiff to hard, medium to high plasticity, grey mottled red yellow orange, fine to medium grained sand, moist.						U50 PP=550(100)
					1.70		TUFF (XW) Very weak, pale grey, moist.						
					1.90		TUFF (XW) Weak, pale grey, moist.						
					2.00		TUFF (XW) Weak, pale grey mottled orange, moist.						
					2.20		Borehole Terminated 2.20m						
					3.0								
					4.0								
					5.0								

COMMENTS

1) Groundwater not observed. 2) Max V bit at 1.9m. 3) Max TC bit at 2.2m. 4) DCP Refusal at 1.7m.

▼ Water First Noted ▼ Water Steady Level

Approved : _____

Date : ____/____/____

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BOREHOLE RECORD SHEET

Borehole Number : 4

Project Number : 102-6625

Project Name : Proposed Office Building

Location : Mayne Rd., Bowen Hills

Client : Qld Rail

Date : 20/09/2002

Page : 1

Easting : Northing : RL : 12.20
Logger : LJ Driller : LJ Drilling Rig : Jacro105

Drilling Method					Depth	Graphic	Description	DCP Test (blows/100mm)					Samples and Remarks
V	TC	WB	RR	NALC				5	10	15	20	25	
					0.15		FILL Silty SAND (SM) Medium dense, fine to medium grained, pale brown, low plasticity fines, with <u>fine to medium size gravel, moist</u>						
					0.60		FILL Clayey SAND (SC) Medium dense, fine to coarse grained, pale brown, low plasticity fines, with fine to coarse size gravel, trace of cobbles, moist.						
					1.0		NATURAL Sandy CLAY (CH) Hard, medium to high plasticity, grey mottled yellow red orange, fine to medium grained sand, moist.						U50 PP=550(80)
					1.80								
					2.0		TUFF (XW) Very weak, pale grey mottled orange, with bands of sandy clay, moist.						
					2.50		TUFF (XW) Weak, pale grey mottled orange, moist.						
					3.0								D
					3.00		Borehole Terminated 3.00m						
					4.0								
					5.0								

COMMENTS

1) Groundwater not observed. 2) Max V bit at 2.5m. 3) DCP Refusal at 0.5m.

▼ Water First Noted ▼ Water Steady Level

Approved : _____

Date : ____/____/____

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BOREHOLE RECORD SHEET

Borehole Number : **5**

Project Number : 102-6625

Project Name : Proposed Office Building

Location : Mayne Rd., Bowen Hills

Client : Qld Rail

Date : 20/09/2002

Page : 1

Easting : Northing : RL : 9.70

Logger : LJ Driller : LJ Drilling Rig : Jacro105

Drilling Method					Depth	Graphic	Description	DCP Test (blows/100mm)					Samples and Remarks
V	TC	VB	RE	INCL				5	10	15	20	25	
					0.30		FILL Gravelly Clayey SAND (SC) Medium dense, fine to coarse grained, brown, low plasticity fines, fine to coarse size gravel, with cobbles, moist.						
					0.50		FILL Clayey SAND (SC) Medium dense, fine to coarse grained, dark brown, low to medium plasticity fines, with fine to medium size gravel, trace of cobbles, moist.						
					1.00		FILL Clayey SAND (SC) Medium dense, fine to coarse grained, yellow brown, low to medium plasticity fines, with fine to medium size gravel, moist.						
					1.00		Borehole Terminated 1.00m						
					2.0								
					3.0								
					4.0								
					5.0								

COMMENTS

1) Groundwater not observed. 2) DCP Refusal at 0.6m.

▼ Water First Noted ▼ Water Steady Level

Approved : _____

Date : ____/____/____

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BOREHOLE RECORD SHEET

Borehole Number : **6**

Project Number : 102-6625

Project Name : Proposed Office Building

Location : Mayne Rd., Bowen Hills

Client : Qld Rail

Date : 20/09/2002

Page : 1

Easting : Northing : RL : 9.30
Logger : LJ Driller : LJ Drilling Rig : Jacro105

Drilling Method					Depth	Graphic	Description	DCP Test (blows/100mm)					Samples and Remarks
V	TC	WB	RR	NMLC				5	10	15	20	25	
					0.40		FILL Gravelly Clayey SAND (SC) Medium dense, fine to coarse grained, brown, low plasticity fines, fine to coarse size gravel, with cobbles, moist.						CBR
					0.75		FILL Clayey SAND (SC) Medium dense, fine to medium grained, dark brown, low to medium plasticity fines, with coarse grained sand, trace of fine to medium size gravel, moist.						
					1.00		NATURAL Sandy CLAY (CH) Stiff, medium to high plasticity, pale grey mottled orange, fine to medium grained sand, moist.						
					1.10		TUFF (XW) Weak, pale grey, moist.						
							Borehole Terminated 1.10m						
					2.0								
					3.0								
					4.0								
					5.0								

COMMENTS

1) Groundwater not observed. 2) Max V bit at 1.0m. 3) Max TC bit at 1.1m. 4) DCP Refusal at 1.1m.

▼ Water First Noted ▼ Water Steady Level

Approved : _____

Date : ____/____/____

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BOREHOLE RECORD SHEET

Borehole Number : 7

Project Number : 102-6625

Easting : Northing : RL : 9.20

Logger : LJ Driller : LJ Drilling Rig : Jacro105

Project Name : Proposed Office Building

Location : Mayne Rd., Bowen Hills

Client : Qld Rail

Date : 20/09/2002

Page : 1

Drilling Method					Depth	Graphic	Description	DCP Test (blows/100mm)					Samples and Remarks
V	TC	VB	RE	INCL				5	10	15	20	25	
					0.50		FILL Gravelly Clayey SAND (SC) Medium dense, fine to coarse grained, brown, low plasticity fines, fine to coarse size gravel, with cobbles, moist.						CBR
					0.90		FILL Clayey SAND (SC) Medium dense, fine to medium grained, grey mottled orange, low plasticity fines, moist.						
					1.50		NATURAL Sandy CLAY (CH) Stiff, medium to high plasticity, brown mottled grey red yellow, fine to medium grained sand, moist.						
					1.50		Borehole Terminated 1.50m						
					2.0								
					3.0								
					4.0								
					5.0								

COMMENTS

1) Groundwater not observed.

▼ Water First Noted ▼ Water Steady Level

Approved : _____

Date : ____/____/____



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BOREHOLE RECORD SHEET

Borehole Number : **8**

Project Number : 102-6625

Project Name : Proposed Office Building

Location : Mayne Rd., Bowen Hills

Client : Qld Rail

Date : 16/11/2002

Page : 1

Easting : Northing : RL : 12.20
Logger : LJ Driller : LJ Drilling Rig : Jacro105

Drilling Method					Depth	Graphic	Description	DCP Test (blows/100mm)					Samples and Remarks
V	TC	WB	RR	NMLC				5	10	15	20	25	
					0.10		FILL TOPSOIL Clayey SAND (SC) Medium dense, fine to medium grained, brown, low plasticity fines, trace of fine roots, moist.						
					0.30		FILL Clayey SAND (SC) Dense to very dense, fine to medium grained, brown, low plasticity fines, with coarse grained sand, trace of fine to coarse size gravel, moist.						
					0.75		FILL Clayey SAND (SC) Dense to very dense, fine to medium grained, grey brown, low plasticity fines, trace of fine to coarse size gravel, moist.						
					1.0		NATURAL Sandy CLAY (CH) Very stiff to hard, medium to high plasticity, pale grey orange mottled, fine to medium grained sand, trace of coarse grained sand, moist.						
					1.10								
					1.20	✓	TUFF (XW) Very weak, pale grey, moist.						U50 PP>600(75)
						✓	TUFF (XW) Weak, pale grey, moist.						
					1.50	✓							
							Borehole Terminated 1.50m						
					2.0								
					3.0								
					4.0								
					5.0								

COMMENTS

1) Groundwater not observed. 2) Max V bit at 1.2m. 3) Max TC bit at 1.5m. 4) DCP Refusal at 0.3m.

▼ Water First Noted ▼ Water Steady Level

Approved : _____

Date : ____/____/____

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BOREHOLE RECORD SHEET

Borehole Number : 9

Project Number : 102-6625

Easting : Northing : RL : 12.40

Logger : LJ Driller : LJ Drilling Rig : Jacro105

Project Name : Proposed Office Building

Location : Mayne Rd., Bowen Hills

Client : Qld Rail

Date : 16/11/2002

Page : 1

Drilling Method						Depth	Graphic	Description	DCP Test (blows/100mm)					Samples and Remarks
V	TC	VB	RB	NRBC	Chng				5	10	15	20	25	
						0.06		FILL Bitumen						
						0.40		FILL Clayey Sandy GRAVEL (GC) Medium dense to dense, fine to medium size, pale brown, fine to coarse grained sand, low plasticity fines, moist.						
						0.75		FILL Clayey SAND (SC) Medium dense to dense, fine to medium grained, dark brown, low plasticity fines, with coarse grained sand, trace of fine size gravel, moist.						
						1.00		NATURAL Clayey SAND (SC) Medium dense to dense, fine to medium grained, pale brown mottled orange, with fine to medium size gravel, moist.						
						1.40		Sandy CLAY (CH) Very stiff to hard, grey mottled orange, fine to medium grained sand, trace of coarse grained sand, moist.						
						1.50		TUFF (XW-DW) Weak, pale grey, moist.						
						2.0		Borehole Terminated 1.50m						
						3.0								
						4.0								
						5.0								

COMMENTS

1) Groundwater not observed. 2) Max V bit at 1.4m. 3) Max TC bit at 1.5m. 4) DCP Refusal at 0.9m.

▼ Water First Noted ▼ Water Steady Level

Approved : _____

Date : ____/____/____

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BOREHOLE RECORD SHEET

Borehole Number : 10

Project Number : 102-6625

Project Name : Proposed Office Building

Location : Mayne Rd., Bowen Hills

Client : Qld Rail

Date : 16/11/2002

Page : 1

Easting : Northing : RL : 13.60
Logger : LJ Driller : LJ Drilling Rig : Jacro105

Drilling Method					Depth	Graphic	Description	DCP Test (blows/100mm)					Samples and Remarks
V	TC	WB	RR	NAIL				5	10	15	20	25	
					0.10		FILL TOPSOIL Clayey SAND (SC) Medium dense to very dense, fine to medium grained, brown, low plasticity fines, with coarse grained sand, trace of fine size gravel, fine roots, moist						U50 PP=320>600 (50)
					0.35		FILL Clayey SAND (SC) Medium dense to very dense, fine to medium grained, brown, low plasticity fines, with coarse grained sand, trace of fine size gravel, moist						
					0.55		NATURAL Clayey SAND (SC) Medium dense to very dense, fine to medium grained, grey brown, low plasticity fines, with fine to medium size gravel, moist						
					0.90		Sandy CLAY (CH) Very stiff, medium to high plasticity, grey pale grey orange mottled, fine to medium grained sand, trace of coarse grained sand, moist						
					1.10		TUFF (XW) Very weak, pale grey, moist						
					1.35		TUFF (XW) Weak, pale grey, moist.						
							Borehole Terminated 1.35m						
					2.0								
					3.0								
					4.0								
					5.0								

COMMENTS

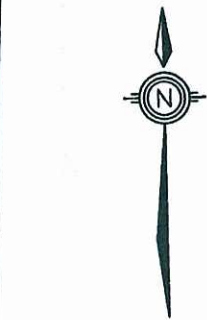
1) Groundwater not observed. 2) Max V bit at 1.1m. 3) Max TC bit at 1.35m. 4) DCP Refusal at 1.1m.

▼ Water First Noted ▼ Water Steady Level

Approved : _____

Date : ____/____/____

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MAYNE ST.

INNER CITY BYPASS

PROPOSED CARPARK

RAILWAY LINE



SCALE 1:500

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Soil Surveys

SOIL SURVEYS ENGINEERING PTY.LTD.

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SITE PLAN

PROPOSED TRAIN STATION

MAYNE RD., BOWEN HILLS

DRAWN
A. A.

DATE
24.09.2002

CHECKED

DRAWING NO
102-6625-01

A3