File 2503

Williams Development

SITE INVESTIGATION REPORT

PROPOSED DEVELOPMENT

249 MADRAS STREET

Keep

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Soils & Foundations (1973) Ltd

SITE INVESTIGATION REPORT

PROPOSED DEVELOPMENT - 249 MADRAS STREET

PREPARED FOR:	Alan M. Reay Consulting Engineer 147 Kilmore Street CHRISTCHURCH.
PREPARED BY:	Soils & Foundations (1973) Limited Geotechnical Engineering Services 71 Armagh Street Christchurch.
REFERENCE:	299 186R2803d
DATE:	18th June 1986

SUBSURFACE INVESTIGATION REPORT

PROPOSED DEVELOPMENT : 249 MADRAS STREET

1. INTRODUCTION

As instructed at our meeting of 28th April, and your letter of 8th May 1986, investigations have been carried out to determine the subsurface conditions and practical foundation types for the proposed development at 249 Madras Street, Christchurch.

The proposed development is a six storey commercial building covering an area of 760 sq.m. and of reinforced concrete flat slab construction. The ground floor will be used for car parking.

2. SITE DESCRIPTION

The approximately square site at 249 Madras Street is presently being used as a car park with access from Madras Street. The site is flat with a ground level about 0.3 m above kerb level, and is completely covered with ashphalt. Before being used as a carpark, two houses occupied the site.

A single storey brick building adjoins the site on the south boundary. This will be about 4 metres from the proposed development. A two storey brick building is constructed up to the west boundary and will be immediately adjacent to the rear wall of the proposed development. The type of foundation for these buildings is not known, but is assumed to be shallow footings. A two storied concrete and masonry building on the north side is separated from the site by a 3.7 metre wide access lane. This building is constructed over a basement floor.

3. SUBSURFACE INFORMATION FROM ADJACENT STRUCTURES

The location of subsurface information from several other structures in the area is shown in Figure 299/1. To the northwest, boreholes on the site of the Occidental Hotel and AAC Building show interbedded soft sediments extending to about 8 metres below ground level. 2 metres of peat or "peaty clay" was found in two of these boreholes. A thick layer of dense sand was found underneath the soft sediments. This general profile extends for some distance to the northwest, and has been found in Hereford Street, Manchester Street and Gloucester Street.

One borehole on the AAC site showed fine sediments to 4.8 metres depth, overlying gravels.

Boreholes to the south and southeast of the site show fine sediments to a depth of between 4.5 and 6 metres, overlying a gravel layer about 6 metres thick. A layer of sand about 10 metres thick was found under the

gravels, with gravels and sands at greater depth.

From this information it would appear that a thick layer of sand underlies the area with the top surface gently sloping from about 8 metre depth at Hereford Street to 12 metre depth south of Cashel Street. A 6 m thick layer of gravel lies over the sand, in the vicinity of Cashel Street, but in the vicinity of the development site, it appears that there is a relatively abrupt change from gravel to soft sediments. The near surface layers above 4 m depth are silts to fine sand over the whole area.

4. SITE INVESTIGATIONS

Eight hand auger holes were carried out to determine the near surface soil profile across the site. These were supplemented by three machine auger holes to contact the gravel. Samples and SPT testing were taken in these holes. One deep borehole to 25 m depth and second borehole to 10 m depth were drilled with a cable tool rig. The location of the investigation holes are shown on the site plan, Figure 299/2, and logs of the holes (299/1 to 299/15) are appended.

5. SUBSURFACE CONDITIONS

The investigations showed that subsurface conditions are not consistent over the whole site. The west, south and centre of the site has gravel at between 3.2 and 3.8 metre depth, and borehole 15 showed the gravel to extend to 9.2 m depth directly overlying a layer of dense sand. Auger hole 9 in the north-east corner located gravel at 4.6 m, but the cable tool hole 14 encountered only a 0.1 m thick layer of gravel at 6.0 m depth. 3 metres of firm silt and silty sand were found between this thin gravel layer and the grey sand at 9 m. It appears that the transition between the gravel and soft sediments overlying the sand layer referred to section 3 above, is quite abrupt and crosses the north east corner of the site. The gravel which is 5.7 m thick at borehole 15 has virtually disappeared at hole 14, only 11 metres away.

The near surface layers are consistent over the site. The asphalt is laid directly on either a thin layer of mottled yellow brown silt, or organic silt containing some debris. In places this disturbed topsoil extends to 0.9 m depth. Below the surface silt and topsoil, yellow brown silt was found to 1.2 - 1.6 m depth. Yellow brown silty fine to medium sand extends to between 2.5 and 5.0 m depth and overlies a thin layer of grey medium sand immediately above the gravel.

The gravel layer is water bearing, and the water table was located at 2.8 m depth.

A dense sand layer appears to underlie the whole site from 9 m to 13 m depth. Below this medium dense to dense sands extend to about 23 m depth, with silts containing lenses of organic material continuing to the full depth of 25 m investigated. The casing of hole 14 was driven on to 27.5 m depth without encountering any increase in driving

resistance, which indicates that silts extend to at least this depth.

6. FOUNDATION SYSTEMS

6.1 General

A major consideration for the design of the foundation system is the change in subsurface conditions in the north-eastern corner of the site. This affects settlements of a shallow foundation system and depth and capacity of a piled foundation.

6.2 Shallow Footings

6.2.1 Settlement

A shallow foundation system appears to be practicable on this site. Figure 299/3 gives estimates of the unfactored allowable bearing pressures on footings to limit settlement to less than 25 mm. The settlement limits are based on a foundation depth of 1.0 metre. The two sets of lines refer to:

(a) foundations on the silts and sand overlying gravel at 3.5 m depth (as in borehole 15)

(b) foundations on the silts and sand overlying silt between 6 and 8 m with sands below 8 m (as in borehole 14).

Narrow footings produce smaller pressure bulbs hence permitting increased bearing pressures for a given settlement. For footings less than 1 metre wide, the effective pressure bulb for settlement remains within the near surface sediments, and similar bearing pressures will produce similar settlements in both the soil profiles modelled. For wider footings, the pressure bulb extends into the relatively incompressible gravel for profile (a) and into the relatively compressible silt for profile (b) requiring different bearing pressures to limit settlements to similar amounts.

25 mm is commonly adopted as the limit on total settlement, on the basis that differential settlements are likely to be less than about 75% of the total settlement. For 25 mm total settlement, differential settlements should be less than 20 mm (1/300 x distance between columns at 6 m spacing).

It is apparent that to minimise differential settlements between the north- east corner and the remainder of the structure, bearing pressures must be reduced over the area without underlying gravels. The extent of this area is not well defined from the initial investigation, and further investigation work is recommended.

Settlement will take place during the period of construction of the building. Although settlement in the north-east corner will

be slower than over the remainder of the site for footing widths in excess of about 1.5 metres, settlement should be largely complete by the time the building is finished.

It should be noted that settlements for a given bearing pressure will be reduced from the 25 mm indicated in Figure 299/3 if the footings are founded at a greater depth. This only applies for the footings over the area of underlying gravels, as the gravels are relatively incompressible when compared with the overlying sediments, or with the silts and sand encountered in the north east corner.

6.2.2 Bearing Pressure

Also shown in Figure 299/3 are the net allowable bearing pressures derived from bearing capacity considerations and incorporating a factor of safety of 3.

The values given in Figure 299/3 apply to footings over the whole site as the bearing capacity for shallow foundations is governed by the surface sediments which are uniform across the site.

6.2.3 Seismic Loading

The near surface fine sediments have only moderate resistance to seismic loading. For shallow footings no increase in allowable stresses governed by bearing capacity is recommended. When settlements govern, an increase in bearing pressure under seismic loadings will incur settlements additional to the static value.

6.2.4 Raft Foundation

A raft foundation with a dead plus long term live load in the order of 50-60 kPa would be subject to differential settlement of the north east corner. The above loading would produce an average settlement of 5 - 10 mm over the gravels, and about 25 mm over the north-east corner.

6.3 Piles — bored or driven ?, diameter ?

6.3.1 Bearing Capacity

The gravels extending below 3.5 to 4 metres should provide good bearing for driven or cast-in place piles over most of the site. An ultimate pile tip bearing pressure of 4.5 MPa has been assessed for piles founded at 7 m depth. This depth provides adequate penetration into the bearing layer, as well as maintaining a sufficient thickness of gravel between the pile tip and the less dense sands below.

large variation

In the north east corner where the gravel layer is very thin, piles would need to be founded in the layer of dense sand between 9 and 13.5 m depth. An ultimate pile tip bearing pressure of 1.8

q_u = 1800 kPa.

N = 55

1.5 m into bearing layer.

MPa has been assessed for piles founded at 10.5 m depth. This depth again balances an adequate penetration depth into the bearing layer with sufficient thickness of dense sand below the pile tip to ensure the underlying material is not overstressed. For this reason piles should not be driven deeper than the above depths.

Confirmation of pile capacities will be required with the appropriate pile driving formula. Static factors of safety (F) should be at least 3, reducible to 2 if uniform driving conditions are encountered, and load testing is carried out.

6.3.2 Pile Settlement

Pile tip settlement may be estimated from the relationship S = B/30 F, where B is the pile diameter, F is the factor of safety and S is settlement in the same units as B. Elastic shortening of the pile should be added to this settlement. The reduction in bearing pressure for piles founded in the sand will mean that settlements for these piles are of the same order as settlements for piles founded in the denser gravels.

Settlements of pile groups (pile spacing 2.5 - 5.0 pile diameters) should be checked when dimensions and loadings of the pile groups are known. We suggest that final dimensions and loadings be forwarded to this office for comment if a piled foundation is adopted.

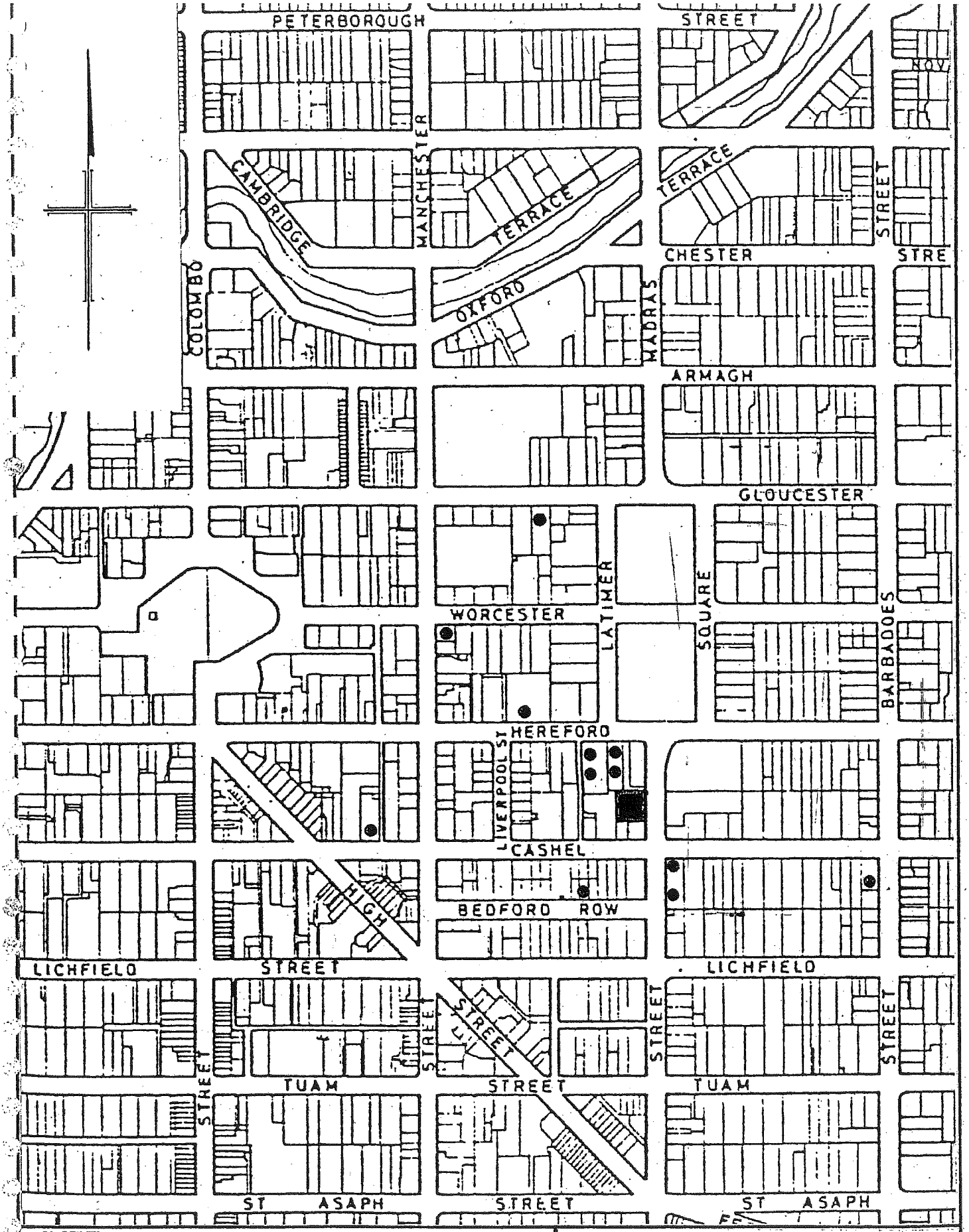
6.2.3 Uplift Capacity

Uplift resistance can be supplied by cast-in-situ bulb piles. Ultimate capacities of 400 kN for a 0.5 m² bulb with the pile founded at 7 m depth, or 750 kN for a similar pile founded at 10.5 m depth.

7. CONCLUSION

The subsurface conditions are not consistent over the whole site. However with an appropriate reduction of bearing pressures in the north east corner to limit settlements for a shallow foundation and to allow for a lower bearing capacity for a piled foundation, either a shallow foundation or piled foundation would be suitable.

It is recommended that when footing positions and loads are known further investigation holes be carried out to define the limits of the area in the north east corner of the site which is not underlain with gravel and thus define the area where deeper piles or wider footings are required.



CLIENT	DR. A.M. REAY CONSULTING ENGINEER		
DESCRIPTION	249 MADRAS STREET, LOCATION PLAN		
JOB 229	DATE June '86	DRAWN M. Smith	FIGURE 299/1

Soils & Foundations (1973) Ltd
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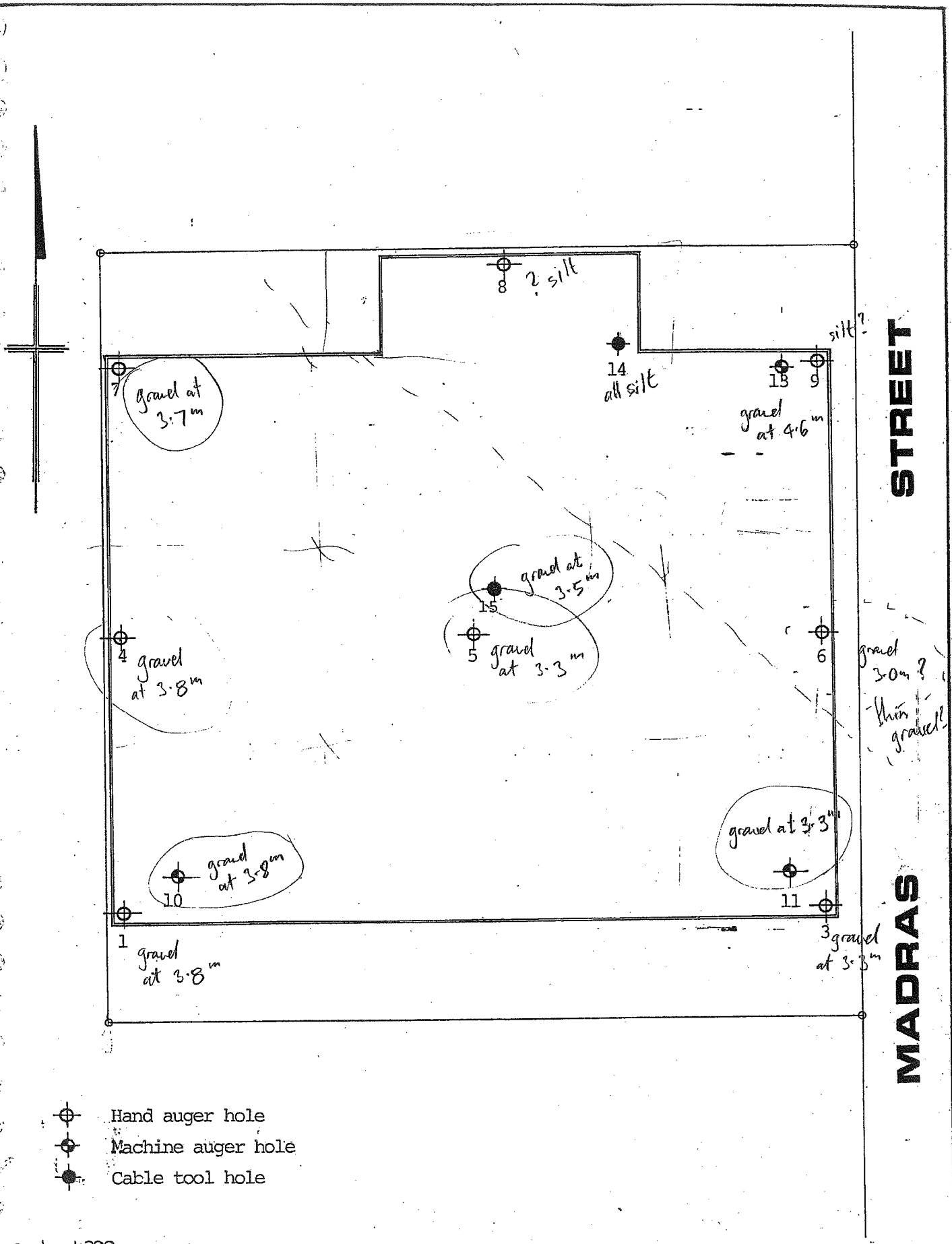
Site Investigations
Foundation Engineering
Seismic and Dynamic Studies
Offshore and Marine Foundations
Geological Reports



Hand auger hole
Machine auger hole
Cable tool hole

Scale 1:200

CLIENT DR. A. M. REAY, CONSULTING ENGINEER.			
DESCRIPTION 249 MADRAS STREET, SITE PLAN.			
JOB 299	DATE June '86	DRAWN M Smith	FIGURE 299/2

Soils & Foundations (1973) Ltd
S&F
Soils Mechanics Laboratory
Site Investigations
Foundation Engineering
Seismic and Dynamic Studies
Offshore and Marine Foundations
Geological Reports

Christchurch:
TASMANIA HOUSE, 71 ARMAGH ST,
P.O. BOX 451, CHRISTCHURCH, N.Z.
TELEPHONE 798-432

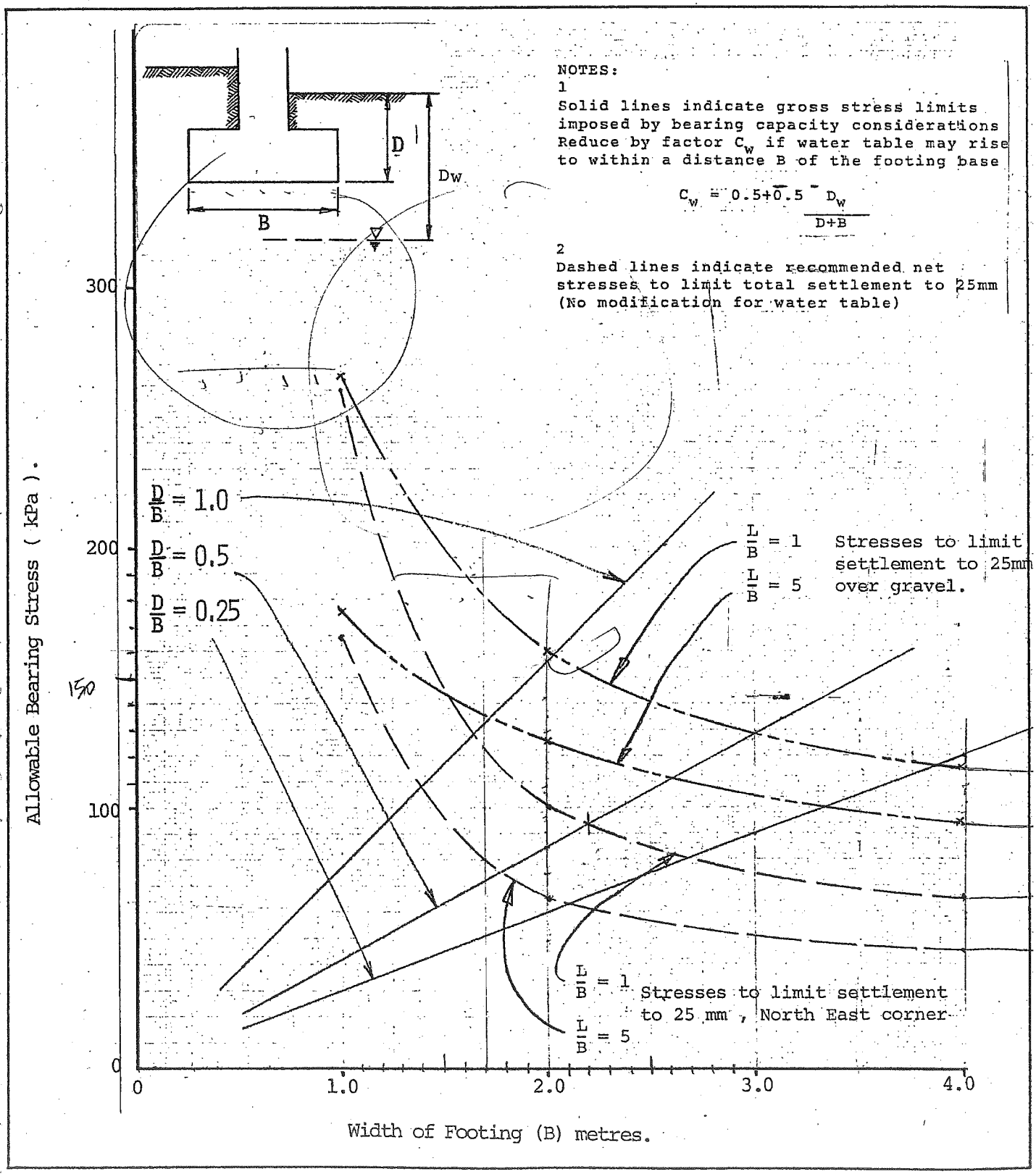
Soils & Foundations (1973) Ltd

Site Investigation Unit
Geomechanics Laboratory
Foundation Engineering
Subdivision Stability
Roading Investigations
Geological Reports
Soil Stabilisation

Ref: Date 18 JUNE '86 Reference: Ours 299 Yours

SITE: 249 MADRAS STREET.

RECOMMENDED BEARING PRESSURES FOR FOOTINGS. FIGURE 299/3



SOILS & FOUNDATIONS (1973) LIMITED

LOG OF DRILLHOLE

DRILLHOLE No. 299/1

FEATURE : 249 MADRAS STREET ..... LOCATION: SOUTH WEST CORNER

COORDINATES : SEE PLAN ..... MAP GRID: ---------- R.L. GROUND (m): ----------

ATTITUDE/DIRECTION: VERTICAL ..... MACHINE: HAND AUGER ..... DATUM: ----------

GEOLOGICAL UNIT DESCRIPTION	Core loss/ Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
DISTURBED SEDIMENTS AND FILL				OL	ASPHALT Dark brown organic silt with ash, brick, glass & bone. - moist, - soft to very soft.
RECENT		1		ML	Mottled yellow brown silt. - moist, - firm to soft, - grades coarser with depth.
ESTUARINE SEDIMENTS		2		SM	Mottled yellow brown silty fine to medium sand. - moist, - compact - grades coarser with depth.
		3		SP	Grey medium sand. - wet, compact.
		4			Grey sandy gravel.
		5			
		6			

Drill method | Date/depth (m) | Samples and Tests | Date Water level (m) | Casing (mm) | % Fluid Loss

PENETRATION (SPT) uncorrected for overburden

0 20 40 60

Water level

Water cut

Casing

COMMENTS:

Logged: M. Smith

Date: 21 May '86.

Driller: M. Smith

Started: 16 May 86

Finished: .....

Length: 3.8 m

Sheet 1 of 1 sheets

SOILS & FOUNDATIONS (1973) LIMITED — LOG OF DRILLHOLE — DRILLHOLE No. 299/3

FEATURE: 249 MADRAS STREET — LOCATION: SOUTH EAST CORNER

COORDINATES: SEE PLAN — MAP GRID: ---------- — R.L. GROUND (m): ----------

ATTITUDE/DIRECTION: VERTICAL — MACHINE: HAND AUGER — DATUM: ----------

GEOLOGICAL UNIT DESCRIPTION	Core loss/Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
		0			ASPHALT
				ML	Mottled yellowish brown and orange silt. - moist, firm.
RECENT		1		ML	Mottled yellow brown silt. - moist, - firm.
ESTUARINE		2		SM	Mottled yellow brown silty fine to medium sand. - moist, - compact.
SEDIMENTS		3		SM	Grey silty fine sand. - wet, - loose, - grades coarser with depth.
		4			Grey sandy gravel.
		5			
		6			

Drill method / Date/depth (m) / Samples and Tests / Date / Water level (m) / Casing (mm) / % Fluid Loss 0 100

PENETRATION (SPT) uncorrected for overburden 0 20 40 60

Water level — Water cut — Casing

COMMENTS:

Logged: M Smith Date: 21 May 86

Driller: M Smith Started: 16 May 86 Finished: 16 May 86

Length: 3.3 m

Sheet | of | sheets

SOILS & FOUNDATIONS (1973) LIMITED — LOG OF DRILLHOLE — DRILLHOLE No. 299/4

FEATURE : 249 MADRAS STREET ..... LOCATION: SOUTH WEST CORNER

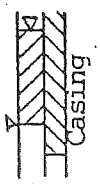
COORDINATES : SEE PLAN ..... MAP GRID: ---------- R.L. GROUND (m): ----------

ATTITUDE/DIRECTION: VERTICAL ..... MACHINE: HAND AUGER ..... DATUM: ----------

GEOLOGICAL UNIT DESCRIPTION	Core loss/Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
DISTURBED SEDIMENTS AND FILL		0		OL	ASPHALT Dark brown organic silt with ash, brick, glass & bone. - moist, - soft to very soft.
RECENT		1		ML	Mottled yellow brown silt. - moist, - firm to soft, - grades coarser with depth.
ESTUARINE SEDIMENTS		2		SM	Mottled yellow brown silty fine to medium sand. - moist, - compact - grades coarser with depth.
		3		SP	Grey medium sand. - wet, compact.
		4			Grey sandy gravel.
		5			
		6			

Drill method | Date/depth (m) | Samples and Tests | Date Water level (m) | Casing (mm) | Fluid Loss % | PENETRATION (SPT) uncorrected for overburden — 0 20 40 60

Water level - Water cut



COMMENTS:

Logged: M. Smith
Date: 21 May '86.

Driller: M. Smith
Started: 16 May '86
Finished: .....
Length: 3.8 m

Sheet | of | sheets

SOILS & FOUNDATIONS (1973) LIMITED — LOG OF DRILLHOLE — DRILLHOLE No. 299/5

FEATURE : 249 MADRAS STREET — LOCATION: CENTRE OF SITE

COORDINATES : SEE PLAN — MAP GRID: ---------- R.L. GROUND (m): ----------

ATTITUDE/DIRECTION: VERTICAL — MACHINE: HAND AUGER — DATUM: -------

GEOLOGICAL UNIT DESCRIPTION	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
				ASPHALT
			ML	Mottled yellowish brown and orange silt. - moist, firm.
RECENT	1		ML	Mottled yellow brown silt. - moist, - firm.
ESTUARINE	2		SM	Mottled yellow brown silty fine to medium sand. - moist, - compact.
SEDIMENTS	3		SM	Grey silty fine sand. - wet, - loose to compact, - grades finer with depth.
	4			
	5			
	6			

Core loss/Lift %: 50 | 100

Drill method / Date/depth (m) / Samples and Tests / Date water level (m) / Casing (mm) / % Fluid Loss: 0 | 100

PENETRATION (SPT) uncorrected for overburden: 0 | 20 | 40 | 60

Water level — Water cut

COMMENTS:

Logged: M.Smith
Date: 21 May '86

Driller: M.Smith
Started: 16 may 86
Finished: 16 may 86
Length: 3.0 m

Sheet | of | sheets

SOILS & FOUNDATIONS (1973) LIMITED — LOG OF DRILLHOLE — DRILLHOLE No. 299/6

FEATURE : 249 MADRAS STREET ..... LOCATION: CENTRE EAST WALL

COORDINATES : SEE PLAN ..... MAP GRID: ..... R.L. GROUND (m) : .....

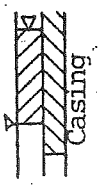
ATTITUDE/DIRECTION: VERTICAL ..... MACHINE: HAND AUGER ..... DATUM: .....

GEOLOGICAL UNIT DESCRIPTION	Core loss/Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
		0			ASPHALT
				ML	Mottled yellowish brown and orange silt. - moist, firm.
RECENT		1		ML	Mottled yellow brown silt. - moist, - firm.
ESTUARINE		2		SM	Mottled yellow brown silty fine to medium sand. - moist, - compact.
SEDIMENTS		3		SM	Grey silty fine sand. - wet, - loose,
		4			
		5			
		6			

Drill method / Date/depth (m) / Samples and Tests / Date Water level (m) / Casing (mm) / % Fluid Loss 100

PENETRATION (SPT) uncorrected for overburden 0 20 40 60

Water level - Water cut



COMMENTS:

Logged: M.J.Smith
Date: 21 May '86

Driller: M.J.Smith
Started: 16 May '86
Finished: 16 May '86

Length: 3.0 m

Sheet 1 of 1 sheets

SOILS & FOUNDATIONS (1973) LIMITED

LOG OF DRILLHOLE

DRILLHOLE No. 299/7

FEATURE : 249 MADRAS STREET ..... LOCATION: NORTH WEST CORNER

COORDINATES : SEE PLAN ..... MAP GRID: ..... R.L. GROUND (m) : .....

ATTITUDE/DIRECTION: VERTICAL ..... MACHINE: HAND AUGER ..... DATUM: .....

GEOLOGICAL UNIT DESCRIPTION	Core loss/Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
		0			ASPHALT
DISTURBED SEDIMENTS AND FILL				OL	Dark brown organic silt with ash, brick, glass & bone. - moist, - soft to very soft.
RECENT		1		ML	Mottled yellow brown silt. - moist, - firm. - grades coarser with depth.
ESTUARINE SEDIMENTS		2		SM	Mottled yellow brown silty fine to medium sand. - moist, - compact, - grades coarser with depth.
		3		SP	Grey medium sand. - wet, compact.
		4			Grey sandy gravel.
		5			
		6			

Drill method | Date/depth (m) | Samples and Tests | Water level (m) Date | Casing (mm) | % Fluid Loss 0 100

PENETRATION (SPT) uncorrected for overburden 0 20 40 60

Water level - Water cut

COMMENTS:

Logged: M.Smith. Date: 21 May '86.

Driller: M.Smith Started: 16 May 86 Finished: 16 May 86

Length: 3.7 m

Sheet 1 of 1 sheets

SOILS & FOUNDATIONS (1973) LIMITED

LOG OF DRILLHOLE

DRILLHOLE No. 299/8

FEATURE : 249 MADRAS STREET LOCATION: CENTRE NORTH WALL

COORDINATES : SEE PLAN MAP GRID: ---------- R.L. GROUND (m): ----------

ATTITUDE/DIRECTION: VERTICAL MACHINE: HAND AUGER DATUM: -------

GEOLOGICAL UNIT DESCRIPTION	Core loss/ Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
DISTURBED SEDIMENTS AND FILL		0		OL	ASPHALT Dark brown organic silt with ash, brick, and glass. - moist, - soft to very soft.
RECENT		1		ML	Mottled yellow brown silt. - moist, - soft to firm, - grades coarser with depth.
ESTUARINE SEDIMENTS		2		SM	Mottled yellow brown silty fine to medium sand. - moist, - compact, - grades coarser with depth.
		3			
		4			
		5			
		6			

Drill method | Date/depth (m) | Samples and Tests | Date Water level (m) | Casing (mm) | Fluid Loss | PENETRATION (SPT) uncorrected for overburden 0 20 40 60

Water level

Water cut

Casing

COMMENTS:

Logged: M.Smith Date: 21 May '86

Driller: M.Smith Started: 16 May '86 Finished: 16 May '86

Length: 3.0 m

Sheet | of | sheets

SOILS & FOUNDATIONS (1973) LIMITED — LOG OF DRILLHOLE — DRILLHOLE No. 299/9

FEATURE : 249 MADRAS STREET ..... LOCATION: NORTH EAST CORNER

COORDINATES : SEE PLAN ..... MAP GRID: ..... R.L. GROUND (m) : .....

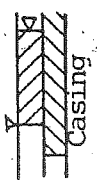
ATTITUDE/DIRECTION: VERTICAL ..... MACHINE: HAND AUGER ..... DATUM: .....

GEOLOGICAL UNIT DESCRIPTION	Core loss/ Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
		0			ASPHALT
RECENT				ML	Mottled yellowish brown and orange silt. - moist, firm.
		1		ML	Mottled yellow brown silt. - moist, - firm.
				ML SM	Blue green grey sandy silt to silty sand. - moist to wet - soft
ESTUARINE		2			
		3		SW	Mottled yellow brown fine to medium sand. - wet, - compact
SEDIMENTS		4			
		5			
		6			

Drill method / Date/depth (m) / Samples and Tests / Date Water level (m) / Casing (mm) / % Fluid Loss

PENETRATION (SPT) uncorrected for overburden: 0 20 40 60

Water level - Water cut



COMMENTS:

Logged: M. Smith
Date: 21 May '86

Driller: M. Smith
Started: 16 May '86
Finished: 16 May '86
Length: 4.0 m

Sheet | of | sheets

SOILS & FOUNDATIONS (1973) LIMITED — LOG OF DRILLHOLE — DRILLHOLE No. 299/10

FEATURE : 249 MADRAS STREET ..... LOCATION: SOUTH WEST CORNER

COORDINATES : SEE PLAN ..... MAP GRID: ---------- R.L. GROUND (m): ----------

ATTITUDE/DIRECTION: VERTICAL ..... MACHINE: HAND AUGER ..... DATUM: ----------

GEOLOGICAL UNIT DESCRIPTION	Depth (m)	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
DISTURBED SEDIMENTS AND FILL	0	OL	ASPHALT Dark brown organic silt with ash, brick, glass & bone. - moist, - soft to very soft.
RECENT	1	ML	Mottled yellow brown silt. - moist, - firm to soft, - grades coarser with depth.
ESTUARINE SEDIMENTS	2	SM	Mottled yellow brown silty fine to medium sand. - moist, - compact - grades coarser with depth.
	3	SP	Grey medium sand. - wet, compact.
	4		Grey sandy gravel.
	5		
	6		

Core loss/Lift %: 50 50

Drill method: Date/depth (m)

Samples and Tests: Date

Water level (m): Casing (mm)

Fluid Loss: % % 100

PENETRATION (SPT) uncorrected for overburden: 0 20 40 60

Water level / Water cut — Casing

COMMENTS:

Logged: M. Smith Date: 2 May '86.

Driller: M. Smith Started: 16 May '86 Finished: .....

Length: 3.8 m

Sheet 1 of 1 sheets

SOILS & FOUNDATIONS (1973) LIMITED — LOG OF BOREHOLE — BOREHOLE NO. [illegible]

FEATURE : 249 MADRAS STREET — LOCATION: SOUTH EAST CORNER

COORDINATES : SEE PLAN — MAP GRID: ---------- — R.L. GROUND (m) : ----------

ATTITUDE/DIRECTION: VERTICAL — MACHINE: HAND AUGER — DATUM: ----------

GEOLOGICAL UNIT DESCRIPTION	Core loss/Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
		0			ASPHALT
				ML	Mottled yellowish brown and orange silt. - moist, firm.
RECENT		1		ML	Mottled yellow brown silt. - moist, - firm.
ESTUARINE		2		SM	Mottled yellow brown silty fine to medium sand. - moist, - compact.
SEDIMENTS		3		SM	Grey silty fine sand. - wet, - loose, - grades coarser with depth.
		4			Grey sandy gravel.
		5			
		6			

Drill method | Date/depth (m) | Samples and Tests | Date Water level (m) | Casing (mm) | % Fluid Loss 0 100 | PENETRATION (SPT) uncorrected for overburden 0 20 40 60

Water level - Water cut

Casing

COMMENTS:

Logged: M.Smith Date: 21.May.'86.

Driller: M.Smith Started: 16 May '86 Finished: 16 May '86

Length: 3.3 m

Sheet | of | sheets

(1973) LIMITED

FEATURE : 249 MADRAS STREET ..... LOCATION: NORTH EAST CORNER

COORDINATES : SEE PLAN ..... MAP GRID: ..... R.L. GROUND (m) : .....

ATTITUDE/DIRECTION: VERTICAL ..... MACHINE: HAND AUGER ..... DATUM: .....

GEOLOGICAL UNIT DESCRIPTION	Core loss/ Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
		0			ASPHALT
RECENT				ML	Mottled yellowish brown and orange silt. - moist, firm.
		1		ML	Mottled yellow brown silt. - moist, - firm.
				ML SM	Blue green grey sandy silt to silty sand. - moist to wet - soft
ESTUARINE		2		SW	Mottled yellow brown fine to medium sand. - wet, - compact
SEDIMENTS		3			
		4			
		5			
		6			

Drill method | Date/depth (m) | Samples and Tests | Date | Water level (m) | Casing (mm) | % Fluid Loss 0 8 | PENETRATION (SPT) uncorrected for overburden 0 20 40 60

Water level ▽ Water cut

Casing

COMMENTS:

Logged: M. Smith

Date: 21 May '86

Driller: M. Smith

Started: 16 May '8

Finished: 16 May '8

Length: 4.6 m

Sheet | of | sheets

SOILS & FOUNDATIONS (1973) LIMITED — LOG OF DRILLHOLE — DRILLHOLE No. 299/14

FEATURE : 249 MADRAS STREET ..... LOCATION: NORTH.EAST.CORNER...

COORDINATES : See plan ..... MAP GRID: ..... R.L. GROUND (m): .....

ATTITUDE/DIRECTION: Vertical ..... MACHINE: Hand Auger ..... DATUM: .....

GEOLOGICAL UNIT DESCRIPTION	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
	0			ASPHALT
			ML	Mottled yellowish brown and orange silt. - moist, firm.
RECENT	1		ML	Mottled yellow brown silt. - moist, - firm.
			ML	Blue green grey sandy silt to silty sand. -moist to wet
ESTUARINE	2		SW	Mottled yellow brown fine to medium sand. - wet - compact
	3			
	4			
SEDIMENTS	5		SW	Grey fine to medium sand - wet - dense
	6			

Drill method: Date/depth (m): Samples and Tests: Water level (m): Date: 31 MAY '86 2.8 m: Casing (mm): % Fluid Loss: Core loss/Lift %: PENETRATION (SPT) uncorrected for overburden 0 20 40 60

Water level ▽ Water cut ▽ Casing

COMMENTS:

Logged: M.T.Smith. Date: 5 June '86.

Driller: B.Baunk Started: 31 May '86 Finished: 2 June '86

Length: 25 m

Sheet 1 of 5 sheets

SOILS & FOUNDATIONS (1973) LIMITED

LOG OF DRILLHOLE

DRILLHOLE No. 299/14

FEATURE : ..... LOCATION: .....

COORDINATES : ..... MAP GRID: ..... R.L. GROUND (m) : .....

ATTITUDE/DIRECTION: ..... MACHINE: .....DATUM:.....

GEOLOGICAL UNIT DESCRIPTION	Core loss/Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
RECENT		6		GW	Grey sandy gravel - wet - dense - Gravel - poorly graded. Subrounded greywacke - sand - medium
		7		ML	Grey silt - wet - firm to stiff - trace roots - grades coarser with depth
		8		SW	Grey silty fine to medium sand - wet - dense - grades coarser with depth
ESTUARINE		9			
		10		SP	Grey medium sand - wet - dense to very dense - trace silt
SEDIMENTS		11			
		12		SW	Grey silty fine to medium sand - wet - very dense - occasional silt lenses

Drill method | Date/depth (m) | Samples and Tests | Date Water level (m) | Casing (mm) | % Fluid Loss

PENETRATION (SPT) uncorrected for overburden

0 20 40 60

Water level

Water cut

Casing

COMMENTS:

Logged: .....

Date: .....

Driller: .....

Started: .....

Finished: .....

Length: .....m

SOILS & FOUNDATIONS (1973) LIMITED

LOG OF DRILLHOLE

DRILLHOLE No. 299/14

FEATURE : ..... LOCATION: .....

COORDINATES : ..... MAP GRID: ..... R.L. GROUND (m): .....

ATTITUDE/DIRECTION: ..... MACHINE: .....DATUM:.....

GEOLOGICAL UNIT DESCRIPTION	Core loss/Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
RECENT		12		SP	Grey medium sand - wet - dense to very dense - trace silt
		13			
				SP SW	Grey silty medium sand - wet - loose to medium dense
		14			
ESTUARINE		15			
		16		SP	Grey fine to medium sand - wet - dense
SEDIMENTS		17			
		18			

Drill method | Date/depth (m) | Samples and Tests | Date Water level (m) | Casing (mm) | Fluid Loss | PENETRATION (SPT) uncorrected for overburden (0 20 40 60)

Water level

Water cut

Casing

COMMENTS:

Logged: .....

Date: .....

Driller: .....

Started: .....

Finished: .....

Length: .....m

SOILS & FOUNDATIONS (1973) LIMITED — LOG OF DRILLHOLE — DRILLHOLE No. 299/14

FEATURE : ..... LOCATION: .....

COORDINATES : ..... MAP GRID: ..... R.L. GROUND (m) : .....

ATTITUDE/DIRECTION: ..... MACHINE: ..... DATUM: .....

GEOLOGICAL UNIT DESCRIPTION	Core loss/ Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
PECENT		18			
		19			
		20		SW	Grey silty fine to medium sand - wet - medium dense - silt lense @ 18.75m (100-200mm thick) & @ 20m
ESTUARINE		21			
		22			- occasional lenses of silt <50mm thick
SEDIMENTS		23			
		24		ML	Grey silt with some to rare organic material. - wet to saturated, - organics - roots

Drill method / Date/depth (m) / Samples and Tests / Date Water level (m) / Casing (mm) / % Fluid Loss 100

PENETRATION (SPT) uncorrected for overburden 0 20 40 60

Water level

Water cut

Casing

COMMENTS: - peaty silt @ 24m 100-200 mm thick

Logged: .....

Date: .....

Driller: .....

Started: .....

Finished: .....

Length: .....m

SOILS & FOUNDATIONS (1973) LIMITED

LOG OF DRILLHOLE

DRILLHOLE No. 299/14

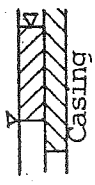
FEATURE : ..... LOCATION: .....

COORDINATES : ..... MAP GRID: ..... R.L. GROUND (m) : .....

ATTITUDE/DIRECTION: ..... MACHINE: .....DATUM:.....

GEOLOGICAL UNIT DESCRIPTION	Core loss/ Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED	Drill method Date/depth (m)	Samples and Tests	Water level (m) Date	Casing (mm)	% Fluid Loss	PENETRATION (SPT) uncorrected for overburden 0 20 40 60
		24			Grey silt with some to rare organics - wet - organics-roots - peaty silt @ 24m, 100-200 thick						
		25									
		26									
		27									
		28									
		29									
		30									

Water level - Water cut



COMMENTS:

Logged: .....

Date: .....

Driller: .....

Started: .....

Finished: .....

Length: .....m

Sheet 5 of 5 sheets

SOILS & FOUNDATIONS (1973) LIMITED

LOG OF DRILLHOLE

DRILLHOLE No. 299/15

FEATURE : 249 MADRAS STREET LOCATION: CENTRE OF SITE

COORDINATES : SEE PLAN MAP GRID: ---------- R.L. GROUND (m) : ----------

ATTITUDE/DIRECTION: VERTICAL MACHINE: CABLE TOOL DATUM: ------

GEOLOGICAL UNIT DESCRIPTION	Core loss/ Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
		0			ASPHALT
RECENT				ML	Mottled yellowish brown and orange silt. - moist, firm.
		1		ML	Mottled yellow brown silt. - moist, - firm.
ESTUARINE					
		2		SM	Mottled yellow brown silty fine to medium sand. - moist, - compact.
SEDIMENTS				SM	Grey silty fine sand. - wet, - loose to compact, - grades finer with depth.
		3			
		4			
RECENT				GW	Grey sandy fine to coarse gravel. - wet, - dense to very dense, - Gravel - round to subround greywacke. - Sand - fine to medium.
ALLUVIUM		5			
		6			

Drill method | Date/depth (m) | Samples and Tests | Date Water level (m) | Casing (mm) | Fluid Loss % 0 100 | PENETRATION (SPT) uncorrected for overburden 0 20 40 60

Water level

Water out

Casing

COMMENTS:

Logged: M. Smith

Date: 16 June '86

Driller: B. Brunk

Started: 14 June '86

Finished: 15 June '86

Length: 10.0 m

SOILS & FOUNDATIONS (1973) LIMITED — LOG OF DRILLHOLE — DRILLHOLE No. 299/15

FEATURE : ..... LOCATION: .....

COORDINATES : ..... MAP GRID: ..... R.L. GROUND (m): .....

ATTITUDE/DIRECTION: ..... MACHINE: .....DATUM:.....

GEOLOGICAL UNIT DESCRIPTION	Core loss/ Lift %	Depth (m)	Graphic Log	USC Symbol	DESCRIPTION OF MATERIAL RECOVERED
RECENT		6			
		7		GW	Grey sandy fine to coarse gravel. - wet, - dense to very dense, - Gravel - round to subround greywacke. - Sand - fine to medium.
ALLUVIUM		8			
		9		GW	Grey sandy fine to medium gravel. - wet, - dense to very dense
				SP SW	Grey fine to medium sand. - wet to saturated, - dense. - wood @ 9.8m
		10			
		11			
		12			

Drill method | Date/depth (m) | Samples and Tests | Date | Water level (m) | Casing (mm) | Fluid Loss % (0–100) | PENETRATION (SPT) uncorrected for overburden (0 20 40 60)

Water level

Water cut

Casing

COMMENTS:

Logged: .....

Date: .....

Driller: .....

Started: .....

Finished: .....

Length: .....m

Sheet 2 of 2 sheets