MARIST HOLDINGS (GREENMEADOWS) LTD MISSION TRUST

PRELIMINARY GEOTECHNICAL REPORT FOR WESTERN HILLS RESIDENTIAL DEVELOPMENT PUKETITIRI ROAD, GREENMEADOWS

REFERENCE NUMBER: 21027

FEBRUARY 2004

REPORT PREPARED FOR:
MARIST HOLDINGS (GREENMEADOWS) LTD
MISSION TRUST

REPORT PREPARED BY:
TONKIN & TAYLOR LTD

DISTRIBUTION:
MARIST HOLDINGS (GREENMEADOWS) LTD
MISSION TRUST - 3 COPIES
TONKIN & TAYLOR LTD (FILE) 1 COPY

CONTENTS

1.0 Introduction

Tonkin & Taylor Ltd has carried out a preliminary geotechnical investigation at Puketitiri Road, Greenmeadows, in support of a proposed residential subdivision (Western Hills Residential Development) for Marist Holdings (Greenmeadows) Ltd., Mission Trust. Dezign Works HB Ltd has prepared drawings for the proposed bulk earthworks and provided the locations for approximately 200 house lots.

The report is based on visual inspection, preliminary engineering geological mapping and aerial photograph interpretation of landscape features.

A 20 tonne machine was used to excavated a series of digger pits and characterise the subsurface conditions across the site.

On the basis of our observations and geological appraisal we consider that the proposed earthworks are feasible and that a suitable building platform will be available on each lot.

2.0 Site Description

2.1 Topography

The subject property is located south of Puketitiri Road on rolling hill country in the headwaters of a small unnamed stream draining west into the Tutaekuri River. The land is pastoral and has been farmed for the last 100 years or so.

In detail, the westerly trending valley bisects the site with side slopes of 10° to 15° extending up to the crests of broad ridges on either side of the main valley. Several small gullies have been eroded on the south facing slopes of the northern ridge. Several stock water dams have been constructed on the floor of the main valley.

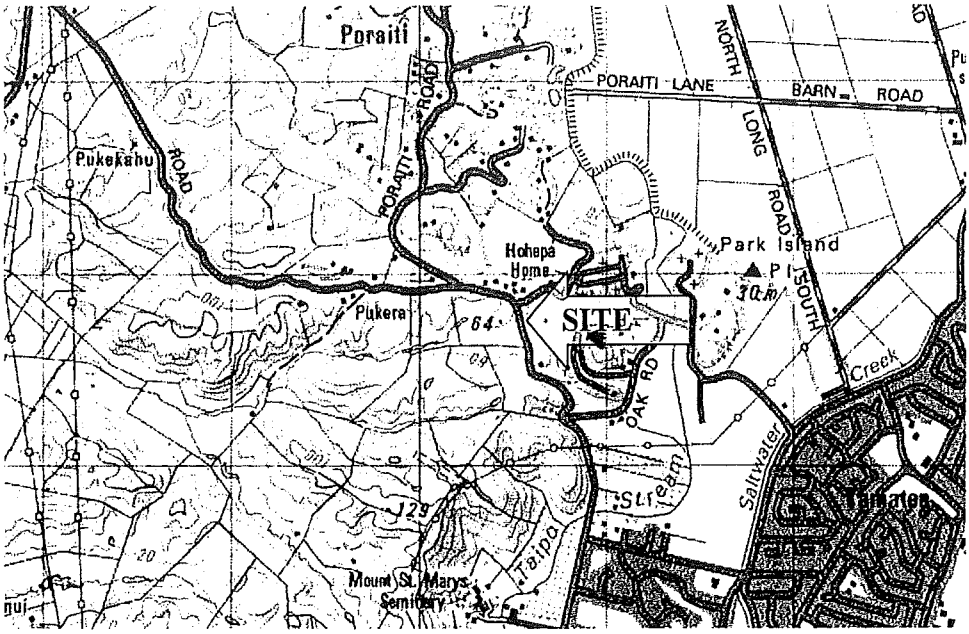

Figure 1: Location Plan

2.2 Geological Setting

The subject property is underlain by sub-horizontal to gently east-dipping beds of Nukumaruan-aged, brown, very soft, very weak siltstone overlying greyish white, slightly gravelly limestone and coquina shelly limestone at depth. The limestone and coquina are well exposed in batters on the Puketitiri Road to the east of the subject property but have not as yet been observed on the property. Recent wind blown loess and volcanic tephra mantle the topography.

2.3 Seismicity

The Greenmeadows area lies close to the axis of the active Napier Fault (1931) rupture in an area where shallow crustal faults and the subduction zone between the descending Pacific Plate and Australian Plate are capable of producing a wide range of earthquake shaking intensities.

Peak ground acceleration (pga) expected at 10% probability in 50 years is shown as 0.4 g on Figure 5a in "Probabilistic Seismic Hazard Assessment of New Zealand: New Active Fault Data, Seismicity Data, Attenuation

Relationships and Methods" prepared by IGNS for the Earthquake Commission Research Foundation in May, 2000.

This data uses all geological data and historical earthquake records to define locations of earthquake sources across and beneath the country, and the likely magnitudes, tectonic type or mechanism, and frequencies of earthquake that may be produced by each source.

3.0 Field Investigations

Field investigations have consisted of reconnaissance engineering geological mapping of available rock outcrops, interpretation of vertical aerial photographs and a series of 10 digger pits spread over the site. Field locations were recorded using a hand held GPS with an accuracy of ± 5m on the day and are shown on Figure 2. The digger pit logs are appended to this report.

The digger pits extended to depths of between 2 and 5 m, terminating in hard ground inferred to be the upper surface of the soft weak siltstone.

4.0 Proposed Development

The Western Hills Residential Development will involve subdivision of northeastern corner of the 295 hectare Lot 1 DP 27138 to create approximately 200 lots. Bulk earthworks with cuts of up to 5 metres from the crest of the ridges and fills of a similar depth on the valley floor are planned to produce a subdued landscape suitable for medium to high-density residential development. The proposed layout is shown on Dezign Works Drawing Number 183636/7.

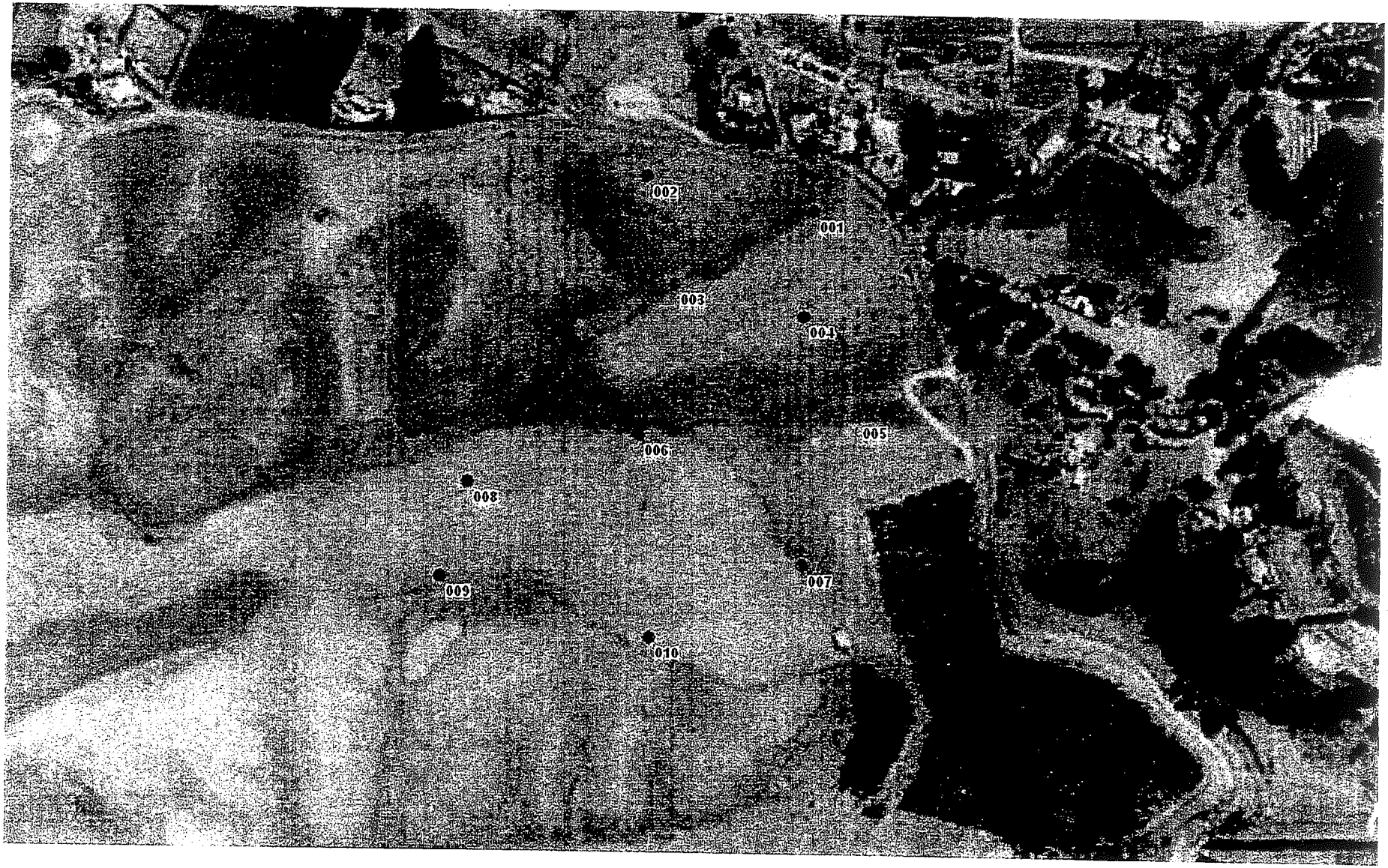

Figure2: Test Pit Location

5.0 Results of Preliminary Investigations

The preliminary test pitting shows that beneath the 200 to 300 mm of black silty topsoil there is approximately 1 metre of loose damp greyish-white pumiceous fine sand (volcanic tephra) interbedded with damp brown silt (loess) overlying weakly cemented very hard brown silt on the side slopes and crest of the ridges.

The two test pits excavated on the floor of the valley (TP 5 & 6) both encountered up to 5 metres of thinly horizontally interbedded, very moist, very dense pumiceous sand and silt. These deposits are interpreted as being recent lake deposits. Up to 4 metres of fill are to be placed in this area and any settlement associated with the fill placement is expected to occur within the period of the earthworks. If soft areas are encountered during the sub excavation prior to fill placement we recommend that these be removed and replaced with fill designed to meet a specified engineering criteria.

All test pits with the exception of Test Pit 6 encountered very hard digging with a 20 tonne digger fitted with a rock bucket at a shallow depth. We expect that light ripping will be necessary to allow bulk earthworks by motor scrapers.

5.1 Slope Stability

Based on our walkover observations and study of vertical aerial photography we have not identified any areas of slope instability on the subject property. Minor collapsed tunnel erosion, which is of a shallow nature and confined to the recent loess cover, is present on some of the gully side slopes. The proposed earthworks will remove these features.

5.2 Summary of Building Site Ground Conditions

Preparations for the proposed subdivision layout will involve earthworks, both cut and fill, as shown on Figure 3. This will reduce gradients and improved views towards the north. The subdivision layout is shown on

LOCAL AUTHORITY	: NAPIER CITY
ZONING	: WESTERN HILLS RESIDENTIAL
TOTAL AREA	: 290.2062 ha
COMPRISED IN	: CT: HBW1/63, HBW3/453
REGISTERED OWNERS	: MARIST HOLDINGS (GREENMEADOWS) LTD

FUTURE DEVELOPMENT AREA

FOOTPATH CONNECTS TO BRIDLE PATH

STREET TREES @ 20m CENTRES

TIGHT CORNER RADII – ORDER OF 2m MAX. TO REDUCE VEHICLE SPEEDS AND ALLOW FOR SAFE CONVENIENT CROSSING FOR PEDESTRIANS

BRIDLE PATH

FRYER ROAD

N

1.5 GRASS EDGE
1.5 FOOT PATH
2.5 PLANTING
2.0 PARKING
7.0 CARRIAGE WAY

NOTES:
1. ALL VEHICLE CROSSINGS 3m WIDE (AVOID DOUBLE CROSSINGS, WHICH IMPACT ON WALKABILITY).
2. SMALL RADII CORNERS TO SLOW TRAFFIC AND ASSIST PEDESTRIAN CROSSING (SHORTENS DISTANCE)
3. STREET–SIDE PARKING NOT SHOWN – BUT TO BE INTERGRATED WITHIN 2.5 m WIDE PLANTED STRIP AT SIDE OF CARRIAGEWAY.
4. VEHICLE CROSSING INDICATED WITH A AIM TO LOCATE AT LOWEST PART OF FRONTAGE AND TO THE SOUTH TO PROMOTE BEST OUTLOOK AND SUN EXPOSURE FOR LOT

REDUCE DEVELOPMENT ON VISUALLY PROMINANT RIDGE (CONCENTRATE ON FLATTER AREA)

4.4 HA GRAPES AS LANDSCAPE FEATURE

PUBLIC SPACE

CHILDRENS PLAYGROUND

VEHICLE ACCESS AND ENTRANCE LOTS ALONG LANE TO BRING ACTIVITY AND BENEFITS OF ENHANCED INFORMAL SURVEILLANCE TO LANE

2.5 PLANTING

BRIDLE PATH

PUKETITIRI ROAD

PEDESTRIANS ONLY

SHARED SURFACE

ENTRANCE SPACE

LAWN

COURT YARD

RELOCATED BUILDING FOR COMMUNITY USE

FOOTPATH TO CONNECT WITH BRIDLE/ FOOT PATH DOWN SIDE OF PUKETITIRI ROAD

PRIVATE & CONFIDENTIAL

BELVEDERE

LOW BRIDGE

VILLAGE GREEN

LANDSCAPE FEATURE EXTENDS INTO FUTURE AREA

PEDESTRIAN ONLY

SHARED (PEDESTRIAN/ VEHICLE) SURFACE

WATER BASED LANDSCAPE FEATURE

TREES @ 12m CTRS

TIGHT CORNER RADIUS FOR TRAFFIC CALMING

'MARKER' TREE

PEDESTRIAN CROSSING FACILITY

PEDESTRIAN CROSSING FACILITY

POND

FUTURE DEVELOPMENT AREA

LAST STREET

BUSH

TREES (@ 25m CTRS) & FOOTPATH CONTINUE ON EAST SIDE OF STREET

THE SURVEYING COMPANY
YOUR SUBDIVISION PROFESSIONALS
105 AVENUE ROAD EAST, HASTINGS, NEW ZEALAND.
PH: 06 878 6349, FAX: 06 878 6989,
e-mail: surveycox@xtra.co.nz
0800 TO SURVEY (0800 86 78 78)

Client: MARIST HOLDINGS (GREENMEADOWS) LTD

Project: WESTERN HILLS

TITLE: SUBDIVISION CONSENT PLAN

DRAWN	CHECKED	SHEET 1 SERIES OF 2
PDT		
SCALE: 1 : 1000 @A1	DATE: NOV 2003	DRAWING NO. 183636/7

M:\2102\7\183636-7 SP.dwg, A1 SHT 1, 16/02/2004 09:25:30 a., amm, 0.5:1

105 AVENUE ROAD EAST, HASTINGS, NEW ZEALAND.
PH: 06 878 6349, FAX: 06 878 6989,
e-mail surveycon@xtra.co.nz
0800 TO SURVEY (0800 86 78 78)

Client: MARIST HOLDINGS (GREENMEADOWS) LTD

Project: WESTERN HILLS

TITLE: CUT/FILL CONTOUR PLAN

DRAWN	CHECKED	SHEET 1 SERIES OF 2
PDT		
SCALE: 1 : 1000 @A1	DATE: NOV 2003	DRAWING NO. FIGURE 3

Dezign Works Drawing Number 183636/7. The cut areas are mainly along proposed road alignments as sidling cuts and from some of the ridge crests with the fill being placed in the floor of the main valley and in a south facing side gully as shown on the attached Dezign Works drawing. Under-drainage may be required to be installed in the floor of the valleys prior to fill placement as very moist soil was encountered in Test Pit 5.

Building sites will be located on natural ground and on smaller areas of both cut and fill. On the natural ground and in areas of cut we expect that the building platforms will be required to be taken below the base of the silt (loess) and pumiceous fine sand (volcanic ash). The earthworks to provide a level building platform may only remove these materials from the upslope part of each platform footprint. Hence, we recommend that further testing will be carried out to show that a safe bearing capacity of 100 kPa (150 kPa Ultimate Limit State) is available.

For building sites located on the fill areas we expect that further investigations may not be necessary, as the fill material will be placed to meet a specified engineering criteria.

6.0 Engineering Considerations

6.1 Roading and Services

The proposed access road alignment will, for the most part, be either in cut ground or close to existing ground level. Where possible cuts in the loess-derived soils should be kept flatter than 2H to 1V and grassed to minimise the effects of erosion.

Where the carriageways are in sidling cuts we recommend that filter compatible under-drainage or geotextile be installed on the upslope side of the cut to control the potential of internal erosion from the permeable loess

and volcanic ash deposits where the cut depth is less than the thickness of these materials.

All service installations (e.g. power, stormwater, Telecom etc.) should be laid in backfilled and specifically compacted shallow trenches to prevent them from becoming cut-off drains, with associated scour and piping problems in the loess-derived soils. Trenches running parallel to contours should be avoided where possible as they can hold water and develop tension cracks. Pipe bedding should be able to drain at pipe outfalls, to prevent groundwater build-up.

6.2 Stormwater Disposal

We understand that all stormwater from the proposed development will be piped past the existing stock water dam in the main valley and discharged to open channel flow in the Tutaekuri River catchment. Also consideration is being given to keeping the stock water dam as a landscape feature pending a geotechnical review of the existing embankment.

6.3 Household Effluent Disposal

All household effluent from the proposed Western Hills Residential Development will be piped into the Napier City sewerage system.

7.0 Conclusions

On the basis of observations and geological appraisal we consider that the proposed earthworks for the Western Hills Residential Development are feasible and suitable platforms for construction of dwellings generally in accordance with NZS3604:1999 will be available on the proposed lots.

The soil encountered in the investigation test pits in the areas of cut will provide material suitable for placement as fill providing the overlying loose

damp greyish-white pumiceous fine sand (volcanic tephra) and damp brown silt (loess) is blended in with the underlying hard brown silt.

Further testing will be required to prove the bearing capacity of the exposed materials for building platforms in area of cut.

For building sites located on the fill areas we do not expect that further investigations will be necessary, as the fill material will be placed to meet a specified engineering criteria. Underdrainage may be required in the base of gullies where fill is placed.

Cuts within the loess and volcanic tephra should be kept flatter than 2H to 1V to minimise the effects of erosion.

Sidling cuts for roadways should have filter-compatible underdrainage installed on the upslope side of the cut to minimise the effects of internal erosion where the cut depth is less than the thickness of these materials.

All service installations (e.g. power, stormwater, Telecom etc.) should be laid in backfilled and specifically compacted shallow trenches to prevent them from becoming cut-off drains, with associated scour and piping problems in the loess-derived soils

Stormwater from the proposed development will be piped past the existing stock water dam in the main valley and discharged to open channel flow in the Tutaekuri River catchment.

8.0 Applicability

This report has been prepared for the benefit of Marist Holdings Greenmeadows Ltd Mission Trust with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

TONKIN & TAYLOR LTD
Environmental and Engineering Consultants

Report prepared by:

Bernard Hegan

Authorised for Tonkin & Taylor by:

Peter Millar

bdh
19 February, 2004
bdh120204.report.doc

APPENDIX A

TEST PIT LOGS

SUB-SURFACE INVESTIGATION TEST REPORT

Client:	Marist Holdings Greenmeadows Limited
Project:	Mission Trust Subdivision
Type of investigation:	Test Pit
Date tested:	2 February 2004
Tested by:	D E Jacka
Test number:	TP 2
Ground water level:	No ground water encountered
Ground level:	Not established
Test position:	See site plan

Depth, metres	Soil Description	Shear Strength kPa	
		Peak	Residual
0.25	Black SILT with a trace of fine sand and roots. Moist, firm. "Topsoil"		
0.50	Greyish-white fine SANDY SILT. Dry, loose, pumiceous. "Tephra"		
1.00	Brown SILT with a trace of fine sand. Damp, hard. "Loess"	UTP	
1.80	Brown SAND. Moist, well-graded coarse to fine. "Fluvial deposit"		
	Brown SILT with a trace of fine sand. Damp, very hard, slightly cemented.		
3.20	End of test pit, very hard digging.		

Comments:

Test pit excavated by Hitachi 20 tonne hydraulic excavator

D E JACKA

Date issued: 4 February 2004

SUB-SURFACE INVESTIGATION TEST REPORT

Client: Marist Holdings Greenmeadows Limited
Project: Mission Trust Subdivision
Type of investigation: Test Pit
Date tested: 2 February 2004
Tested by: D E Jacka
Test number: TP 3
Ground water level: No ground water encountered
Ground level: Not established
Test position: See site plan

Depth, metres	Soil Description	Shear Strength kPa	
		Peak	Residual
0.25	Black SILT with a trace of fine sand and roots. Moist, firm. "Topsoil"		
0.40	Greyish-white fine SANDY SILT. Dry, loose, pumiceous. "Tephra"		
0.55	Brownish-grey SILT with a trace of fine sand. Damp, hard, jointed 20-50mm.	UTP	
1.00	Light brown SILT with a trace of fine sand. Damp, hard. "Loess"	UTP	
	Brown SILT with a trace of fine sand. Damp, very hard, slightly cemented.	UTP	
2.80	End of test pit, very hard digging.		

Comments:

Test pit excavated by Hitachi 20 tonne hydraulic excavator

D E JACKA

Date issued: 4 February 2004

SUB-SURFACE INVESTIGATION TEST REPORT

Client:	Marist Holdings Greenmeadows Limited
Project:	Mission Trust Subdivision
Type of investigation:	Test Pit
Date tested:	2 February 2004
Tested by:	D E Jacka
Test number:	TP 4
Ground water level:	No ground water encountered
Ground level:	Not established
Test position:	See site plan

Depth, metres	Soil Description	Shear Strength kPa	
		Peak	Residual
0.25	Black SILT with a trace of fine sand and roots. Moist, firm. "Topsoil"		
0.45	Greyish-white fine SANDY SILT. Dry, loose, pumiceous. "Tephra"		
0.80	Light brown SILT with a trace of fine sand. Damp, hard. "Loess"	UTP	
	Brown SILT with a trace of fine sand. Damp, very hard, slightly cemented.	UTP	
2.80	End of test pit, very hard digging.		

Comments:

Test pit excavated by Hitachi 20 tonne hydraulic excavator

D E JACKA

Date issued: 4 February 2004

SUB-SURFACE INVESTIGATION TEST REPORT

Client: Marist Holdings Greenmeadows Limited
Project: Mission Trust Subdivision
Type of investigation: Test Pit
Date tested: 2 February 2004
Tested by: D E Jacka
Test number: TP 5
Ground water level: 3.80 metres
Ground level: Not established
Test position: See site plan

Depth, metres	Soil Description	Shear Strength kPa	
		Peak	Residual
0.20	Black SILT with a trace of fine sand and roots. Moist, firm. "Topsoil"		
0.40	Grey SILT. Dry, hard, jointed 40 to 80mm.		
0.70	Brownish-white fine SANDY SILT. Dry, loose, pumiceous. "Tephra"		
1.20	Grey with brown mottle SILT. Moist, stiff to hard.	96 UTT	32
2.90	Brown SILT with a trace of fine sand. Damp, very hard, slightly cemented.	UTP	
4.40	Grey and brown SANDS and SILTS. Very moist, very dense, pumiceous. Laminated bedding, alternating grey and brown strata. Beds 10 to 20mm thick, horizontal, some graded bedding. "Lacustrine deposit" End of test pit. Very hard digging.		

Comments:

Test pit excavated by Hitachi 20 tonne hydraulic excavator

D E JACKA

Date issued: 4 February 2004

SUB-SURFACE INVESTIGATION TEST REPORT

Client:	Marist Holdings Greenmeadows Limited
Project:	Mission Trust Subdivision
Type of investigation:	Test Pit
Date tested:	2 February 2004
Tested by:	D E Jacka
Test number:	TP 6
Ground water level:	3.80 metres
Ground level:	Not established
Test position:	See site plan

Depth, metres	Soil Description	Shear Strength kPa	
		Peak	Residual
0.60	Black SILT with a trace of fine sand and roots. Moist, firm. "Topsoil"		
0.90	Light grey SILT. Moist, stiff, pumiceous. "Tephra"		
		105	36
		151	38
		180	48
	Brown SILT with a trace of fine sand. Moist, hard, very slightly cemented.		
5.10	End of test pit, firm digging.		

Comments:

Test pit excavated by Hitachi 20 tonne hydraulic excavator

D E JACKA

Date issued: 4 February 2004

SUB-SURFACE INVESTIGATION
TEST REPORT

Client:	Marist Holdings Greenmeadows Limited
Project:	Mission Trust Subdivision
Type of investigation:	Test Pit
Date tested:	2 February 2004
Tested by:	D E Jacka
Test number:	TP 7
Ground water level:	No ground water encountered
Ground level:	Not established
Test position:	See site plan

Depth, metres	Soil Description	Shear Strength kPa	
		Peak	Residual
0.35	Black SILT with a trace of fine sand and roots. Moist, firm. "Topsoil"		
0.65	Greyish-white fine SAND. Damp, loose, pumiceous. "Tephra"		
1.10	Brown SILT with a trace of fine sand. Damp, hard.	UTP	
1.60	Greyish-brown SAND. Moist, medium-dense, pumiceous. "Tephra" Sand: well-graded, coarse to fine.		
2.20	Brown SILT with a trace of fine sand. Damp, very hard, slightly cemented. End of test pit, very hard digging.		

Comments:

Test pit excavated by Hitachi 20 tonne hydraulic excavator

D E JACKA

Date issued: 4 February 2004

SUB-SURFACE INVESTIGATION TEST REPORT

Client: Marist Holdings Greenmeadows Limited
Project: Mission Trust Subdivision
Type of investigation: Test Pit
Date tested: 2 February 2004
Tested by: D E Jacka
Test number: TP 8
Ground water level: No ground water encountered
Ground level: Not established
Test position: See site plan

Depth, metres	Soil Description	Shear Strength kPa	
		Peak	Residual
0.20	Black SILT with a trace of fine sand and roots. Moist, firm. "Topsoil"		
0.40	Greyish-white silty fine SAND. Damp, loose, pumiceous. "Tephra"		
0.70	Greyish-brown SILT. Dry, hard.	UTP	
	Brown SILT with a trace of fine sand. Damp, very hard, cemented.		
1.30	End of test pit, very hard digging.		

Comments:

Test pit excavated by Hitachi 20 tonne hydraulic excavator

D E JACKA

Date issued: 4 February 2004

SUB-SURFACE INVESTIGATION TEST REPORT

Client:	Marist Holdings Greenmeadows Limited
Project:	Mission Trust Subdivision
Type of investigation:	Test Pit
Date tested:	2 February 2004
Tested by:	D E Jacka
Test number:	TP 9
Ground water level:	No ground water encountered
Ground level:	Not established
Test position:	See site plan

Depth, metres	Soil Description	Shear Strength kPa	
		Peak	Residual
0.20	Dark brown SILT with a trace of fine sand and roots. Damp, firm. "Topsoil"		
0.60	Brownish-white silty fine SAND. Dry, loose, pumiceous. "Tephra"		
	Brown SILT with some fine sand. Damp, very hard, cemented, jointed. Joint spacing 100-200mm, dark brown staining on joint faces.		
1.20	End of test pit, very hard digging.		

Comments:

Test pit excavated by Hitachi 20 tonne hydraulic excavator

D E JACKA

Date issued: 4 February 2004

SUB-SURFACE INVESTIGATION TEST REPORT

Client:	Marist Holdings Greenmeadows Limited
Project:	Mission Trust Subdivision
Type of investigation:	Test Pit
Date tested:	2 February 2004
Tested by:	D E Jacka
Test number:	TP 10
Ground water level:	No ground water encountered
Ground level:	Not established
Test position:	See site plan

Depth, metres	Soil Description	Shear Strength kPa	
		Peak	Residual
0.20	Black SILT with a trace of fine sand and roots. Damp, firm. "Topsoil"		
0.50	Brownish-white silty fine SAND. Dry, loose, pumiceous. "Tephra"		
	Brown SILT with some fine sand. Damp, very hard, cemented, jointed. Joint spacing 100-200mm, dark brown staining on joint faces.		
2.20	End of test pit, very hard digging.		

Comments:

Test pit excavated by Hitachi 20 tonne hydraulic excavator

D E JACKA

Date issued: 4 February 2004