







From: Kristin Reid

Sent: Thursday, 2 February 2017 2:59 p.m.

To: 'chris.morris@odt.co.nz'

Subject: Moray Place - Geotechnical Investigations Report

Hi Chris,

Please see attached Geotechnical Report.

Let me know if you need any more information.

Kind regards,

Kristin Reid PA/Business Performance Coordinator City Property

Dunedin City Council

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Telephone: 03 477 4000; Fax: 03 474 3700; Direct Line: 474 6815

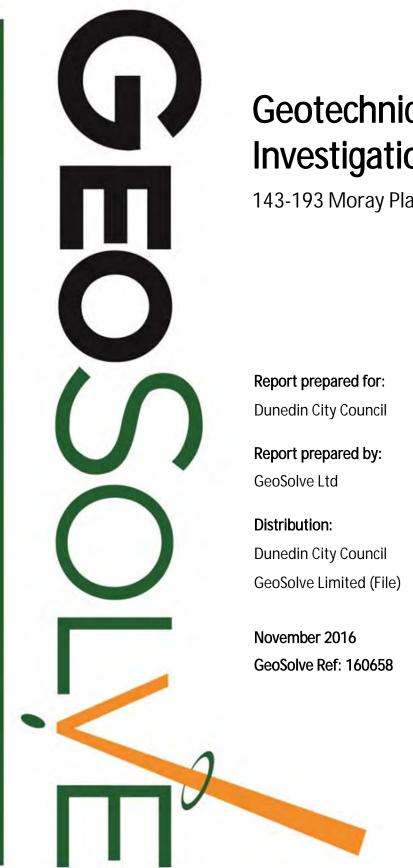
Email: <u>Kristin.Reid@dcc.govt.nz</u>













143-193 Moray Place, Dunedin







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November 2015

1 Introduction

1.1 General

This report presents the results of geotechnical investigations carried out by GeoSolve Ltd in order to determine subsoil conditions and provide geotechnical inputs for a potential commercial development at 143-193 Moray Place, Dunedin.

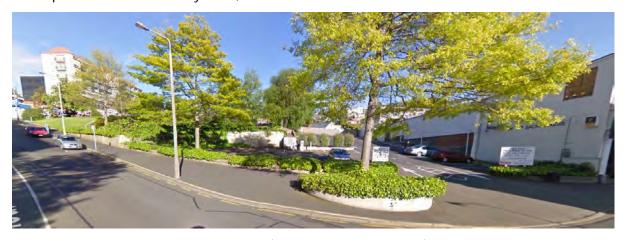


Figure 1.1 – Site photo, 1432-193 Moray Place (Source: Google Street View)

The investigations detailed in this report were carried out for Dunedin City Council in accordance with GeoSolve Ltd's proposal dated 22 September 2016, which outlines the scope of work and conditions of engagement.

We understand that the proposed development is for a potential hotel complex on the above sites and that several proposals are under consideration.

As no development plans are available, this investigation and report is general in nature and is intended to provide potential developers and their advisors a general overview of the ground conditions at the site. Additional investigations will be required as part of the detailed design of any scheme proposed.

No geotechnical assessment of the data has been carried out and no geotechnical recommendations are provided as the development plans are not defined.

We note that 62 York Place is also potentially part of the hotel development site. A separate report is provided for this site because it may not be applicable to all potential development proposals. The data from that site has been included in the geological cross sections in this report.

2 Geotechnical Investigations

GeoSolve have supervised seven machine boreholes (BH) with Standard Penetration Testing (SPTs) on site from 18-27 October 2016 comprising BH3-8. Note that BH7 was planned but not carried out due to time and budgetary constraints.

Investigation depths for each BH ranged from 7.60-21.28 m in total. BH logs and preliminary cross sections are attached at the end of this report.

An initial desktop review of existing information on the GeoSolve, DCC and Otago Regional Council databases has also been carried out.



3 Subsurface Conditions

3.1 Geological Setting

3.1.1 Regional Geology

The geology of the Dunedin area is dominated by volcanic rock types of basaltic to andesitic composition that were intruded through pre-existing marine sediments during Miocene times. Extensive volcanism at that time produced lava flows and bedded volcanoclastic materials were widely distributed by eruptions.

More recently (Pleistocene times), the hills of Dunedin have been extensively mantled by windblown loess to depths of up to several metres. Watercourses and tidal embayments such as Otago Harbour have locally deposited alluvial, estuarine and marine deposits and generally modified the volcanic landscape by deep incision and sedimentation. Fill and refuse has been placed locally during post-settlement times. Landslips have occurred on steeper hillsides particularly where springs emerge or where fills have been placed.

3.1.2 Seismicity

Dunedin has traditionally been considered to have lower than average seismic activity when compared to other areas in New Zealand, however nearby active faults are known and strong shaking is certain to occur periodically.

McCahon et al¹ states that the earthquake hazard in Dunedin is dominated by relatively infrequent moderate to large earthquakes (magnitude up to M_w 7.5) in eastern Otago, and large to very large earthquakes in the much more seismically active Fiordland and Westland regions.

The nearest active faults with demonstrated Late Quaternary movement history are the Green Island Fault and the Akatore Fault. The Green Island Fault is currently considered to be the cause of the 1974 earthquake that caused damage in Dunedin. It is mapped approximately 5km to the south of the subject site, but its projection is believed to continue through South Dunedin and may run northeast up the harbour in which case it would pass within about 4km of the site. The Akatore Fault has also been projected beneath South Dunedin; the nearest mapped trace of the fault is truncated about 6km southwest of the site, but the fault likely continues beneath South Dunedin and may run northeast up the harbour as well. Sheared fault rocks have been identified in recent drilling near Portsmouth Drive indicating continuation of fault traces up the harbour is very probable.

It should be noted the fault terminations shown on fault trace maps are often approximations (owing to lack of data) and the presence of other active faults may be unknown because they may be obscured by overburden soils. Both of these faults are likely to be capable of generating magnitude 7.5 earthquakes in Dunedin. Other known faults that have some potential to cause strong shaking in Dunedin are the Titri Fault and the North Taieri Fault, located roughly 9km and 15km southwest/west of the site, respectively.

The above faults are not included in Table 3.6 of NZS 1170.5:2004 as major faults requiring near fault factors when assessing structural design actions. Recent events in Canterbury have highlighted the issue that previously unidentified faults may be very significant factors in the actual future risk applying to any particular site.

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GeoSolve ref: 160658 November 2016

¹ McCahon, I.F., Yetton, M.D., Cook, D.R.L. (1993). The Earthquake Hazard in Dunedin. EQC report 91/56.



November 2016

Strong ground shaking throughout the South Island is likely to be associated with a rupture of the Alpine Fault, located along the West Coast of South Island. There is a high probability an earthquake with an expected magnitude of over 7.5 will occur along the Alpine Fault within the next 50 years.

Average return periods for shaking intensity are: MM 7 = 100 years, MM 8 = 450 years and MM 9 = >2,500 years. The most recent major earthquake to affect Dunedin occurred in 1974 and produced damage consistent with MM 7 intensity.

3.2 Stratigraphy

An engineering geological model for the site is shown in the cross section appended at the end of this report. More detailed geotechnical description of soils is provided in the attached borehole logs.

Published geological mapping and reporting (Benson, 1968) indicates that the site is likely to be underlain Dunedin Volcanic Group rock, possibly overlain by loess/colluvium. Localised man-made fill soils or alluvial channels are also reported in the vicinity

The generalised subsoil profile at the site comprises a surficial uncontrolled fill layer overlying gravelly and silty slopewash soils.

Uncontrolled fill generally comprised firm or medium dense gravelly SILT and sandy GRAVEL up to 1.5 m in thickness.

The slopewash soils are composed of firm silty CLAY and clayey SILT, locally with some gravel and cobbles. Due to the observed variability within these soils and the lack of shear surfaces or slickensides, these units are inferred to be an accumulation of soils derived from erosion and mass wasting further upslope. The thickness of the slopewash unit also increases in thickness with decreasing elevation on the slope (approximately 3 m near the top compared to 6.5m near the base), typical of a debris fan morphology.

These deposits are underlain by extremely to highly weathered basaltic and basanitic bedrock of the Dunedin Volcanic Group. SPT refusal was generally reached within these units.

3.3 Groundwater

The local water table was observed at approximately 4.00-4.15 m below ground level in BH3 and BH6 and was not observed in any other BHs.

Groundwater levels across the site will need to be confirmed by detailed investigation and design. Piezometers for the purposes of groundwater monitoring have been constructed in BH3, BH5 and BH7(8) to full depth. All other BHs were backfilled upon completion.



November 2016

4 Conclusions and Recommendations

- The generalised subsoil profile at the site comprises a surficial uncontrolled fill layer overlying slopewash deposits, with volcanic rock underlying the site at moderate depth.
- The local water table was observed at approximately 4.00-4.15 m below ground level in BH3 and BH6 and was not observed elsewhere.
- Further subsurface investigations and geotechnical analysis of earthworks and foundation proposals is required at detailed design stage.



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5 Applicability

This report has been prepared for the benefit of Dunedin City Council 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.

This report does not provide a detailed geotechnical investigation and assessment of the site and additional investigations and assessment will be required for specific developments on the site.

Please do not hesitate to contact the undersigned if we can provide any assistance at a later stage of the project.

Report prepared by: Reviewed and authorised for GeoSolve Ltd by:

D Gainslord CEMandraux

David Gainsford Colin Macdiarmid

Engineering Geologist Senior Geotechnical Engineer

GEOSOLVE

70 Macandrew Road, PO Box 2427, South Dunedin 9044, ph 03 466 402



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Appendix A: Site Plan & Cross-sections





Bore hole location



Bore hole location (not drilled)

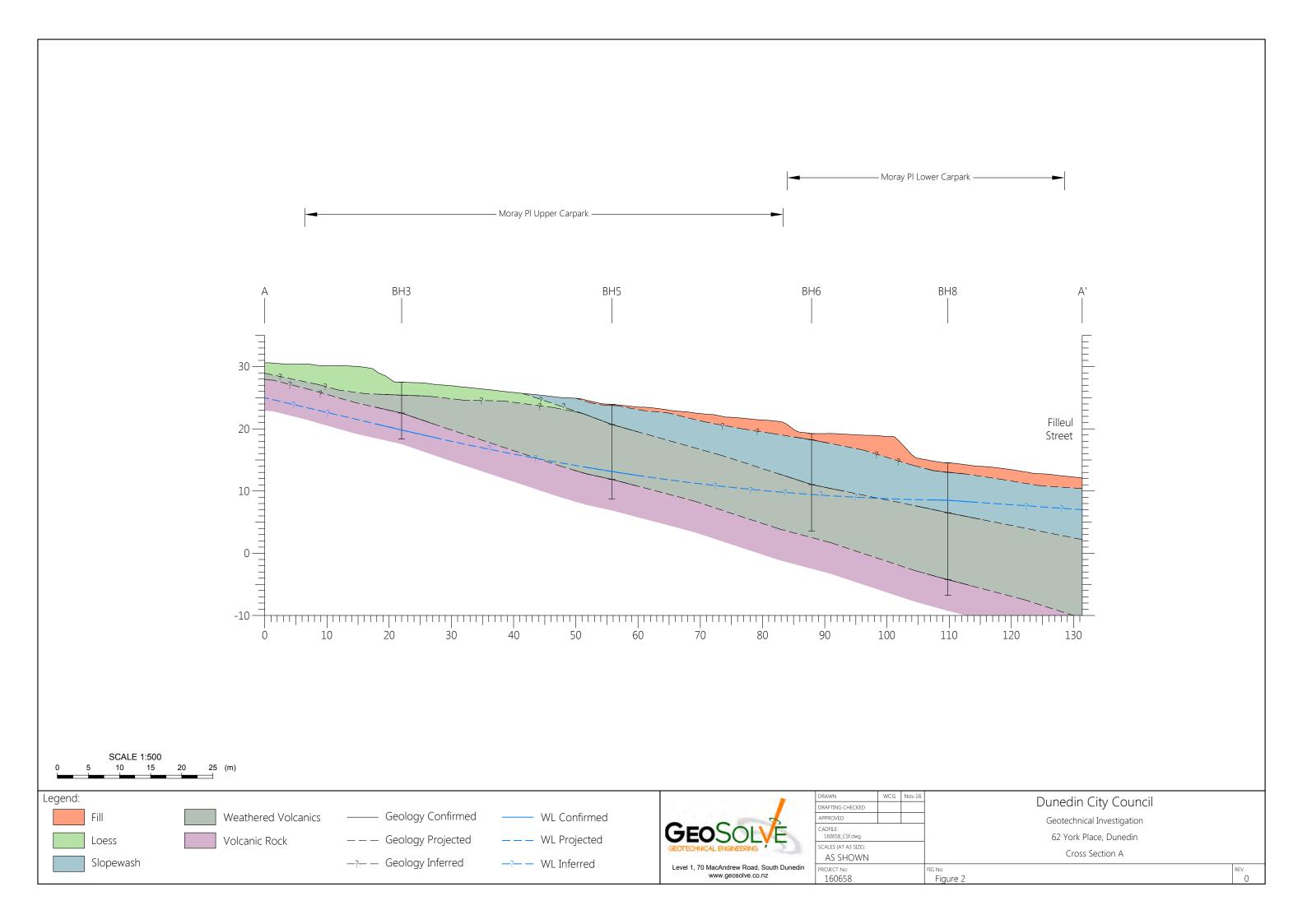


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	APPROVED	CEM	11/16
n e	FILE : PDF		
	SCALE:		
	As Shown		
d	PROJECT No.		

Dunedin City Council Geotechnical Investigation 143-191 Moray Place, Dunedin Site Plan

FIG No. Appendix A - Figure 1

REV. 0





Appendix B: Site Borehole Logs



GEOSOLVE LTD

BORE HOLE LOG

BOREHOLE No:

BH3

SHEET OF

DRILLED BY: McMILLAN'S LOGGED BY: D GAINS FORD

CHECKED: M WALROND START DATE: 26/10/2016

FINISH DATE: 26/10/2016

PROJECT: DCC 143-193 MORAY PLACE

E1406089

LOCATION: SEE SITE PLAN CO-ORDINATES: N4917057

JOB No: 160658

DIRECTION: VEKTICAL ANGLE FROM HORIZ.: 90°

R.L. COLLAR: DATUM: GROUND LEVEL

R.L. GROUND: 33,36 m

DRILL TYPE/METHOD/FLUID: SONIC D.T. 45

GEOLOGICAL UNIT **DESCRIPTION OF CORE TESTING** Core Recovery (%) Moisture Condition Sampling Method Strength/Density Classification Hammer Efficiency: 91.4°/, SOIL: Classification, colour, consistency / density, **Drillers Notes** RL (m) Depth (m) Borehole Diameter: 114 mm Water Leve Installation Box moisture, plasticity Water Loss Liner: №0 22 22 22 0.00m silty GRAVEL; dark grey; fine to medium subangular gravel, well graded; non plastic sity _ X medium dense, wet.
0.05m clayey SILT: light brown-grey mottled orange-brown, low plasticity, localisad dark × - \times \times × ~ Grange-brown, low plasticity, large flecks, soft to firm, moist. 900 XX LOESS - X SPT @ 1.52m STIFF 2, 4, 5, 7, 7, 8 KERY N=27 2.08m CLAY, brown, high plasticity, firm, ~ × moist. - × 2.65m silty CLAY. brown nottled yellow, orange and black, low plasticity minor fine to medium subangular gravel breaks down into sand and non-plastic silt (relict crystals in residual soil) very stiff, moist 01/97 SPT @ 3.04n (6) 3, 4, 5, 8, 6, 4 100 00 2.84-3.04 Crystalline texture N= 23 3.04m CLAY with minor silt; brown with yellow, pink and brown nothing, stiff, J Moist V 001 4.00m Becoming saturated SPT @ 4.56m 6, 7, 8, 10, 9, 8 4.95m Extremely weathered ROCK; black nothed dark red, brown-yellow and orange, 5— N=35 MODERATELY weak to moderately strong breaks down to non plastic silty clay, moderately + strong, saturated SPT@6.08m 4 7, 18, 20, 22, 18, -N= 60+ for 365mm EATHER + 6.70 m Vesicular textures present. 00 Becoming moderately strong to strong. 7<u>-</u> 67mbg) + SPT @ 7.60m Y 10, 39, 47, 13, -, 0 8-N=60+ for Z35mm 100 SPT @ 9.12m 4, 18, 34, 26, -, -N = 60+ for 290 mm EOH 9,12-M

COMMENTS: ALL SPT 'N' VALUES ARE UNCORRECTED.

Log Scale 1:50

Survey method: GPS (NZTM)



GEOSOLVE LTD

BORE HOLE LOG

BOREHOLE No:

BH 4

SHEET OF

TESTING

DRILLED BY: MEMILL ANS LOGGED BY: D GAINSFORD

CHECKED: M WALROND START DATE: 26/10/2016

DATUM: GROUND LEVEL FINISH DATE: 26/10/2016

PROJECT: DCC 143-193 MORAY PLACE

E 1406129

LOCATION: SEE SITE PLAN CO-ORDINATES: N 4917052 DIRECTION: VERTICAL

R.L. GROUND: 28.74m JOB No: 160658 R.L. COLLAR:

ANGLE FROM HORIZ.: 940 °

DRILL TYPE/METHOD/FLUID: SONIC DTUS

DESCRIPTION OF CORE

	GEOLOGICAL UNI	SOIL: Classification, colour, consistency / density, moisture, plasticity	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	Hammer Efficiency: 91.41% Borehole Diameter: 114% Liner: No	25 50 Water Loss (%) 75	Water Level	Casing	Installation	Core Box
	TOPSOIL	grass and rootlets, soft, moist. O.15 m gravelly SILT, grey-brown, low Plasticity, moderately exidised fine to coarse angular gravel (basalt and brick frequents) 60 mm & cobbbe at 1.22m, firm to very stiff,		x				STATIC W.L. RECORDED 26/0/16							
		1.40m Dark brown manganese flechs	T-92	001			2—) × × × ×		SPT @1.52m 3, 3, 5, 5, 7, 7 N= 24		NO STR			
		2.70m Becoming dark brown. Manganese flechs absent.	SONK	100				0 × 0 × × 0 × 0 × 0		SPT @ 3.0hm					
			ST	001			,	0 x x		1, 1, 3, 6, 6, 6 N=21					
	PEWASH		× × × × × × × × × × × × × × × × × × ×		SPT @ 4.56m										
	SLOPE		SFT	00	MOIST	STIFF	5—	× × o × ×		2,3,3,6,7,9 N=25					
	SLOR	5.80m Becoming wet.	Jimos	007		VERY	6—	× × × × ×		SPT @ 6.08m					
		6.42m clayey SILT; light grey, nottled dark brown and orange-brown, low	600	a0+				X X		2,3,4,6,6,7 N=23					
	-	plasticity, iron and manganese staining, very stiff, moist	201015	2			7	X X X X X X X X X X X X X X X X X X X							
			1.05				8—	× × × × × × ×		SPT@ 7.60m 3, 10, 9, 5, 8, 8 N=30					
- - - - - - - -		8.59m CLAY: light brown-purple, mothers yellow, red and orange-brown, high plasticity, rare relict crystalline texture, very stiff, moist (residual soil)	SONIC	(00)			9—	Aller Angelin Project Angelin Project Angelin		SPT @ 9.12m					
	WEATHER ED VOLCANICS		105	50				Pagenta pagent and a pagent and		2,6,8,7,7,8 N=30					
1	COMMENT	S: ALL SPT 'N' VALUES ARE UNLOR	RE	CT	ED.								I		ᅦ

Log Scale 1:50

Survey method: GPS (NZTM)



GEOSOLVE LTD

BORE HOLE LOG

BOREHOLE No:

BH 4

SHEET OF

DRILLED BY: M' MILLANS LOGGED BY: D GAINSFORD

CHECKED: M WALROND START DATE: 26/10/2016

FINISH DATE: 26/10/2016

PROJECT: DCC 143-193 MORAY PLACE

LOCATION: SEE SITE PLAN
CO-ORDINATES: N 4917052

Log Scale 1:50

E1406129

JOB No: 160658

DIRECTION: VERTICAL
ANGLE FROM HORIZ: 90°

R.L. COLLAR: DATUM:

Survey method: GPS (NZTM)

R.L. GROUND:

DRILL TYPE/METHOD/FLUID: SONIC DT45

	Ħ	DESCRIPTION OF CORE								TESTING					
	GEOLOGICAL UNIT	SOIL: Classification, colour, consistency / density, moisture, plasticity	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	Hammer Efficiency: %\.\\'/\ Borehole Diameter: \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	25 50 Water Loss (%) 75	Water Level	Casing	Installation	Core Box
=	0 8	10.10m silty CLAY with rare gravel, purple -red with orange oxidation mottling, low plasticity; fine argular white gravels (crystals) which break down to non-plastic silt, very shift, noist 10.60m Becoming silty CLAY with some	JIMOS LUS			VL.	-	× - × × - ×		SPT@ 10.64m 7, 8, 9, 8, 9, 10 N=36					
\1 <u>-</u>	WEATHERED	gravel.	Somic Sp	00)	T SIOM	VERY STIF	11-	Normania William Normania Wil		14 = >0					
13		EOH 12.61m	145	0			12-	W		SPT @ 12.16m 7, 8, 9, 8, 9, 10 N=36					
13-							13-	The second secon	And the second s						
- - 4- -							14-								
15—							15								
16—		,					16								
							17-								
18—							18-								
9-							19-								
- - - -	COMMENT	S: ALL SPT 'N' VALUES ARE UNCO	2. V2.	EC	TED										



LOCATION: SEE SITE PLAN

GEOSOLVE LTD BORE HOLE LOG

BOREHOLE No:

BH 5

SHEET OF

DRILLED BY: Mª MILLANS LOGGED BY: D GAINS FORD

CHECKED: M WALROND START DATE: 21/10/2016 FINISH DATE: 25 /10 / 2016

JOB No: 160658

DIRECTION: VERTICAL

CO-ORDINATES: N 4917080

PROJECT: DCC 143-193 MORAY PLACE

ANGLE FROM HORIZ.: 90°

R.L. GROUND: 29.28m

DATUM: GROUND LEVEL

R.L. COLLAR:

		E 1406118	DRILL TY							T. 45	FINISH DAT	L. <i>L</i>		- 1 6		
ŀ	<u> </u>	DESCRIPTION OF CORE							- 10		TESTING					
	GEOLOGICAL UNIT	SOIL: Classification, colour, consistency / density, moisture, plasticity		Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	Hammer Efficiency: จ1. ५% Borehole Diameter: นนุคค Liner: ผ่ง	25 50 Water Loss (%) 75	Water Level	Casing	Installation	Core Box
	FILL	0.00m ASPHALT; black, hard. 0.05m clayey SILT; light brown, I Plasticity, rare fine argular grave clay pipe at 0.10m, soft to firm, 0.19m clayey SILT; light grey, moth -brown, low plasticity, rare fine row gravel, soft to firm, moist. 1.52m Becoming stiff.	ow I, broken moist hed orange aded	TINGS	60)		STIFF	1			SPT@ 1.52m		10.80m bg1 18/11/16			
		and the second of the second o		135	Oe)		72	2			1, 2, 3, 3, 5, 5 N= 16					
				SOME	100		7	3-			SPT @ 3.04n					
	SLOPEWASH	3.25m silty CLAY; light brown no and dark brown, some fine sulto subrounded gravel and non-plastiff to very stiff, moist 4.01m silty CLAY with some light brown mottled yellow, orange-black, low plasticity, gravel fine to subrounded to subangular, stiff, moist.	Hed black eagular skic silt,	297	(fe)		VERY				2, 2, 4, 6, 6, 7 N= 23					
	J.			١.	100		27 18-6	4 -			SPT @ 4.56m					
				287	180	MOIST	₩.	5—			2, 2, 3, 3, 4, 4 N=14					
_ _ _ _		5.46-6.08m Locally wet.		5000	001		V	6—			SPT @ 6.08m					
		6.92m silty CLAY with rare gravel;	liab to	7	601		3				2, 3, 5, 5, 5, S N=20					
	J	low to medium plasticity; fine to me subrounded gravel, stiff, moist	yellow.	JINOS	000		No.	7-			SPT @ 7.60m					
	0 >	7.90m Locally includes grey non plast		1792	100		1	8-			2, 2, 3, 3, 3, 5 N=14					
	Ē	8.35m silty CLAY: light brown nothed dark brown and dark grey, low plasticitive to coarse rounded gravels stiff, me	orst.	20N(C	001			9—			SPT @ 9.12m					
	WEATHER	9.28-9.32m Lens of dark red, low pl		\dashv	100		7				2, 3, 3, 3, 4, 4					
1				Solvic	001			_								

COMMENTS: ALL SPT 'N' VALUES ARE UN CORRECTED

Log Scale 1:50

Survey method: 4PS (NZTM)



LOCATION: SEE SITE PLAN

COMMENTS: ALL SPT

Log Scale 1:50

PROJECT: DCC 143-193 MORAY PLACE

GEOSOLVE LTD

BORE HOLE LOG

R.L. GROUND: 29.28m

R.L. COLLAR:

JOB No: 160658

DIRECTION: VERTICAL

BOREHOLE No:

BH 5

SHEET OF

DRILLED BY: MEMILLANS LOGGED BY: D GAINS FORD

CHECKED: M WALROND START DATE: 21/10/2016

FINISH DATE: 25/10/2016 CO-ORDINATES: N 4917080 ANGLE FROM HORIZ.: 90° DATUM: GROUND LEVEL E1406118 DRILL TYPE/METHOD/FLUID: SONIC DT.45 GEOLOGICAL UNIT **DESCRIPTION OF CORE TESTING** Core Recovery (%) Moisture Condition Hammer Efficiency: 91.4°/ Sampling Method Strength/Density Classification SOIL: Classification, colour, consistency / density, **Drillers Notes** Water Level Graphic Log Installation Borehole Diameter: ۱۱۹۸۸ RL (m) Depth (m) Water Loss (moisture, plasticity Liner: NO 222 0000 000 - × - × - × 10.05-10.20m Lens of fine to cobble STIFF subrounded basalt gravels. 10.20m silty CLAY, dark red, low plasticity relief crystalline texture, minor fine to SPT@ 10.64m VERY medium subangular gravel, vistiff, moist 7, 10, 10, 9, 10, 14 * 11_ N= 43 ys. 11.26m clayer GRAVEL, black mottled brown and red, fine to coarse subangular basalt 00 0 1-00 gravel; low plasticity clay, highly oxidised, some medium to coarse sand, dense to \triangleleft 0000 vey derse, wet. 12-12-12.07m Extremely weathered ROCK, black, crystalline, massive, breaks down to fire-coarse gravel with low plasticity clay, highly oxidised SPT@ 12.16m 5, 17, 15, 17, 15,13 N= 60 for 450mm orange-brown, basalt, moderately strong, wet WEATHERED 13 SONIC + 8 SPT@ 13.68m 13.81 m Extremely to highly weathered ROCK, grey, light brown and light red-brown, massive, crystalline, breaks down to low plasticity sity clay and fine to cobble grower, 0 5, 11, 17, 33 10, -14— N=60+ for 310mm + moderately strong to strong wet 00 15-+ SPT@15.20m 4, 5, 6, 7, 7, 10 00 W EOH 15.65m N=30 16-

UNCORRECTED,

Survey method: GPS (NZTM)

VALUES ARE



GEOSOLVE LTD

BORE HOLE LOG

BOREHOLE No:

BH 6

SHEET OF

DRILLED BY: MEMILL ANS LOGGED BY: D GAINSFORD

CHECKED: M WALROND START DATE: 18/10/2016

FINISH DATE: 18 /10 /2016

PROJECT: DCC 143-193 MORAY PLACE

LOCATION: SEE SITE PLAN CO-ORDINATES: N 4917072

Log Scale 1:50

E 140 6154

JOB No: 160658

DIRECTION: VERTICAL

ANGLE FROM HORIZ.: 90°

R.L. COLLAR: DATUM: GROUND LEVEL

Survey method: GPS (NZTM)

R.L. GROUND: Zula, La Cam

DRILL TYPE/METHOD/FLUID: SONIC D. T. 45

	GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	TESTING Hammer Efficiency: จา. ५% Borehole Diameter: แนกค Liner: N 0	25 50 Water Loss (%) 75	Water Level	Casing	Installation	Core Box
1	7	0.00m gravely SILT; brown mottled red and black; non plastic silt fine angular gravel and brick fragments; firm moist 0.27m clayer SILT; light grey-brown mottled orange-brown; low plasticity, firm to stiff moist. 0.80m gravelly SILT; brown mottled grey and red; non plastic silt, fine angular gravel and brick fragments, firm moist.	Jimes	0 0			1	X X X X X X X X X X X X X X X X X X X				. RECORDED 18/10/16			
2—		brick fragments, firm moist. 1.00m clayey SILT; light brown-grey mottled orange-brown low plasticity, rare white and black clay inclusions and fine subangular basalt gravel very stiff, moist 1.82m Occasionally with black manganese flecks	7-92	@ 	-	VERY STIFF	2—	X X X X X X X X X X X		SPT@1.5Zm 2,3,5,7,7,8 N=27		NO STATIC W.L			
3		2.90m silty CLAY; light brown nottled orange, low plasticity, frequent iron and manganess	SOMIC	Cel	SIOW	TO V.STIFF	3—	x x x x x x x x x x		SPT@3.04n					
		oxidation firm to stiff, moist. 3.04 - 3.34 SPT disturbance in core. 3.24 m Becoming soft and wet with rane fine subrounded basalt gravels 3.94 m & 5mm thick laminations visible.	JINOS	001	WET	ST11FF-	4-	0 100 X		2,3,5,5,6 N=Z1					
5	SLOPEWASH	4.30-4.56m Locally soft and saturated. 4.62m clayey SILT: light brown mothed orange-brown dark brown and black, low plasticity, manganese and iron exidation throughout stiff, saturated.	wreathereses of	0		STIFF	5—	**************************************		SPT@ 4.56m 2,4,4,5,5,6 N=20					
6—		5.46-5.76m Minor rounded to subrounded fine basalt gravel 5.80m Becoming light brown-grey. 6.08m Becoming very stiff	JINOS	Code (Internal Code)		STIFF	6-	× × × × × × × × × × × × × × × × × × ×		SPT@6.08m					
7		6.95 m gravelly CLAY; brown mottled black and orange-brown, high plasticity; fine angular to subangular gravel, poorly graded, soft to firm saturated. 7.43-7.53 m. "Gravel locally rounded, fine to coarse, wet. 7.60m CLAY with rare gravel; brown high plasticity; fine subrounded basalt gravel."	SONIC SET			VERY	7-	× × × × × × × × × × × × × × × × × × ×		3, 5, 5, 8, 7, 8 N=28					
8-			\	O	SATURATED	FIRM	8—	0 1 0 1 0 0		SPT @ 7.60m 1, 2, 2, 2, 3, 3 N=10					
9—	ATHERED LCANICS	8.20m CLAY with rare silt and gravet,	SONIC	O C I			9-	×		SPT @ 9.12m					
-	WE	TS: ALL SPT 'N' VALVES ARE UNCOKREC	145	001		FIRM	-			1,0,2,2,3 N=9					



GEOSOLVE LTD BORE HOLE LOG

BOREHOLE No:

BH 6

SHEET OF

DRILLED BY: M'MILLAN'S LOGGED BY: D GAINSFORD

CHECKED: M WALROND START DATE: 18/10/2016

DATUM: GROUND LEVEL | FINISH DATE: 18/10/2016

PROJECT: DCC 143-193 MORAY PLACE

LOCATION: SEE SITE PLAN CO-ORDINATES: N 4917072

Log Scale 1:50

E1406154

JOB No: 160658 R.L. GROUND: 24. 44m

DIRECTION: VERTICAL ANGLE FROM HORIZ.: 90°

R.L. COLLAR:

DRILL TYPE/METHOD/FLUID: SONIC

GEOLOGICAL UNIT **DESCRIPTION OF CORE TESTING** Core Recovery (%) Moisture Condition Sampling Method Hammer Efficiency: ٩١.५% SOIL: Classification, colour, consistency / density, **Drillers Notes** Water Level Borehole Diameter: \\4 m m RL (m) Depth (m) Core Box moisture, plasticity Water Loss 22 22 22 22 10.29m silty CLAY, light brown mottled orange-brown and black; non plastic to STIFF SPT@10.64m low plasticity, some extremely weathered rock fragments up to 100mm & very stiff, X 3, 3, 6, 6, 7, 7 ٥ 11moist. 11-X, ... N= 26 × 11.66-11.79 m Lens of black clayer silt, non plastic with some red-yellow nothing.

11.79 m silty CLAY, light brown grey mothed black, red and orange-brown; low to no plasticity, locally clayer SILT and extremely to highly weathered rock fragments, relict crystalline texture, v. stiff, moist. 601 せいい × -VOLCANICS X 12— SPT @ 12.16m 3, 6, 6, 10, 12, 11 ___ × N=39 X Somic 8 × -_ × SPT @ 13.68m 5 3,5,5,6,7,8 0 14-N= 26 14.45m clayed SILT, light grey, non-plastic, 00 14.92m Black basalt fragment (subangular cobble)
14.96m silty CLAY brown mottled orange-brown
red and black, low plasticity, relict crystalline
texture, Stiff, moist. 15— SPT@15.20m EOH 15.65m 16— COMMENTS: ALL SPT VALUES ARE UNCOKRECTED Survey method: GPS (NZTM)



GEOSOLVE LTD

BORE HOLE LOG

BOREHOLE No:

BH 8

SHEET OF

DRILLED BY: MªMILLAN'S LOGGED BY: D GAINSFORD

CHECKED: M WALROND START DATE: 17/10/2016

DRILL TYPE/METHOD/FLUID: SONIC D.T. 45

PROJECT: DCC 143-193 MORAY PLACE

E1406175

LOCATION: SEE SITE PLAN CO-ORDINATES: N 4917084

JOB No: 160658

DIRECTION: VERTICAL

ANGLE FROM HORIZ.: 90°

HORIZ.: 90° DATUM: GROUND LEVEL FINISH DATE: 19/10/2016

R.L. GROUND: 19.69m

GEOLOGICAL UNIT DESCRIPTION OF CORE TESTING Core Recovery (%) Hammer Efficiency: 91.4% Strength/Density Classification Sampling Method SOIL: Classification, colour, consistency / density, **Drillers Notes** Borehole Diameter: 114 mm Water Level RL (m) Depth (m) Box moisture, plasticity Liner: NO Graphic I Core Water 2202 0.00m SAND; black, fine with some non-plastic silt, medium dense, noist. × 0.0° O. 10m sandy GRAVEL; Black, gravel fine, angular, poorly graded; sand fine to medium; ××0 medium dense, moist.

0.25m gravely SILT; black-dark grey,
non-plastic silt; fine to medium, angular gravel; 00 XX ×Xo × firm, moist X o 1.52m SILT with some clay; light brown nottled light grey and black; low plasticity, SPT@ 1.52m 2, 3, 5, 5, 6, 6 firm, moist 2-N=22 2.30m Becoming light grey, nothed orange, brown and black. 00 SPT@3.04m 0 1, 2, 4, 5, 6, 7 N= Z2 \times \times × -4.38m silty CLAY; light grey-brown nottled orange-brown, low to medium plasticity, firm, moist, minor manganese and iron SLOPEWASH SPT@ 4.56m ~ × 1, 3, 4, 4, 6, 8 flectes 000 N=ZZ 5.02m-5.22m Lens of fine to medium subangular basalt gravel, with cobble 169 5.50m Becoming light grey, mottled orange-_ X 0 brown 6.02 m silty CLAY; light brown, nottled gray, yellow-brown, orange and black, low to medium plasticity, firm, noist, rare fine subangulation $- \times$ V SPT@6.08m garage and 2, 3, 5, 5, 6, 7 × basalt gravels. N=23 7.06-7.12m Lens of basalt cobbles, subangular 0000 to subrounded 000 7.12-7.36m Lens of fine to coarse Subongular to subrounded basalt gravel
7.36m CLAY light brown, minor orangebrown mottling, soft, noist rare fine to medium
5.50m Borning quarte gravels. SPT@7.60m 1,1,0,1,1,3 7.90m Becoming wet.
8.03m CLAY, light brown mottled purple, red and white, high plasticity, relict crystalline texture (fine angular gravels, break down to non-plastic sitt), soft, moist N=S 00) FIRM 4ERED FANICS 2 9.12 m = 9.57m SPT disturbance in core SPT @ 9.12m WEATHE Becoming soft to firm. 50FT 1,0,0,2,2,2 00 N= 6

COMMENTS: ALL SPT 'N' VALUES ARE UNCORRECTED.

Survey method: GPS (NZTM)



GEOSOLVE LTD

BORE HOLE LOG

BOREHOLE No:

BH 8

SHEET OF

DRILLED BY: MCMILLANS LOGGED BY: D GAINSFORD

CHECKED: M WALROND START DATE: 17 /10/2016

DATUM: GROUND LEVEL FINISH DATE: 19/10/2016

PROJECT: DCC 143-193 MOKAY PLACE JOB No: 160658

E1406175

LOCATION: SEE SITE PLAN CO-ORDINATES: N4917084

Log Scale 1:50

DIRECTION: VERTICAL

ANGLE FROM HORIZ.: 90°

R.L. GROUND: 19.69m R.L. COLLAR:

Survey method: GPS (NZTM)

DRILL TYPE/METHOD/FLUID: SONIC DT45

	ΤΙΝ	DESCRIPTION OF CORE		<u>_</u>	_					TESTING					
	GEOLOGICAL UNIT	SOIL: Classification, colour, consistency / density, moisture, plasticity	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m) Depth (m)	Graphic Log	Drillers Notes	Hammer Efficiency: 91. 4°/₀ Borehole Diameter: 11 4 ΜΜΛ Liner: NO	25 50 Water Loss (%) 75	Water Level	Casing	Installation	Core Box
1.1.1.1.1		10.25m silty CLAY; orange-brown with light grey-brown and black veining, non-plastic, stiff, moist	Sarvić	993		STIFF	-	Magazine Magazine Magazine Magazine Magazine		(070)0 (1					
11 —		nottled orange black, yellow and red low plasticity, rare fine tomedium subrounded basalt gravel, stiff moist	4	(5) (5) (6)		TS.Y	11—	XXX		SPT@ 10.64m 8,8,7,7,11,13 N=38					
12 13 14 1		10.64-11.10m SPT disturbance 10.71m silty CLAY; light brown nottled orange -brown, non plastic to low plasticity, very stiff moist 11.05m Becoming nottled light gray. 11.36m silty of CLAY; purple—brown with white red and black mottling, low plasticity, relict crystalline texture, stiff, moist	- 5:	001		TO V.STIFF	12—	*		SPT @ 12.16m					
		crystalline texture, stiff, moist 11.87m silty CLAY; orange-brown mothed brown, low plasticity, highly oxidized, rare fine sand, firm, moist.	P.	8		77172		American		0, 2, 4, 6, 6, 7 N = 23					
		12.16-12.32 m Locally purple, high plasticity 13.15 m CLAY with minor growel; purple with minor orange-brown, white and red flecks (relict constalling texture)	Sonic	00)			13-	X							
	NICS	subangular growed breaks down to non-plastic sitt, stiff to very stiff, moist 13.72m Purple-black angular-subangular cobbles 13.98 - 14.55m Locally soft and saturated. 14.20 - 14.50m Included fine to cobble, angular gravels of weathered basalt.	ţ	001		O V. STIFF	- - 4- - -	X		SPT@ 13.68m 4, 12, 14, 9, 7, 20 for 55mm N=50+					
15—	7016	14.55m gravelly CLAY: light brown nottled red, white and black non plastic to low plasticity, minor sitt and fine sand, relict crystalline textures. fine to medium, subangular to angular gravel, breaks down to non-plastic silt. Stiff wet.	Sour	0.01	7210	STIFF TO	15	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0							
-	THERED	15.15m silty CLAY; brown-red low plasticity, rare fine black sand (crystals); rare fine to medium angular, black basalt gravel and red yellow or orange-brown mottling; stiff moist		0	Σ			× - ×		SPT@15.20m 6,5,10,10,8,12 N=40					
16—	₩ E	16.72-17.02m SPT disturbance. 17.02m Locally with some white, fire, angular gravels (crystals)	135	001			16—	> ×							
			2,5	0		STIFF	17—	Name		SPT@16.72m 2,3,3,4,4,5 N=16					
			SONIC	000			18—	0 X							
- - - - -		18.78m Extremely to highly weathered ROCK;	1.35	<u>.</u>			X		SPT @ 18.24m 20, 40, -, -, -, - N=60+						
19—		down to clayey aRAVEL with some silf strong, moist 19.27m Moderately weathered ROCK: orange-brown mothed black. 0-30mm defeat some	ONIC	00)		-0NG	19—	+ + + + + + + + + + + + + + + + + + + +		SPT@19.76m					
		strong, moist. 20.60m Unweathered ROCK, black basalt, 10-50m. defect speciag, extremely strong, moist EOH 21.728m, extremely strong, moist FS: ALL SPT'N' VALUES ARE UN COR	VI	0		V. STR		+ + +		15, 45, -, -, -, -, N=60+ SPT @ 21.28m 50,10, -, -, -, -, -, -, -, -, -, -, -, -, -,					