



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
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City Property
Dunedin City Council

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Geotechnical Investigations Report

143-193 Moray Place, Dunedin

Report prepared for:

Dunedin City Council

Report prepared by:

GeoSolve Ltd

Distribution:

Dunedin City Council

GeoSolve Limited (File)

November 2016

GeoSolve Ref: 160658



Quality
ISO 9001



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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.

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

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 basaltic 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.

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.

5 Applicability

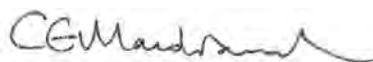
This report has been prepared for the benefit of Dunedin City Council with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

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:

A handwritten signature in black ink that reads "D Gainsford".A handwritten signature in black ink that reads "C Macdiarmid".

.....
David Gainsford

Engineering Geologist

.....
Colin Macdiarmid



Senior Geotechnical Engineer

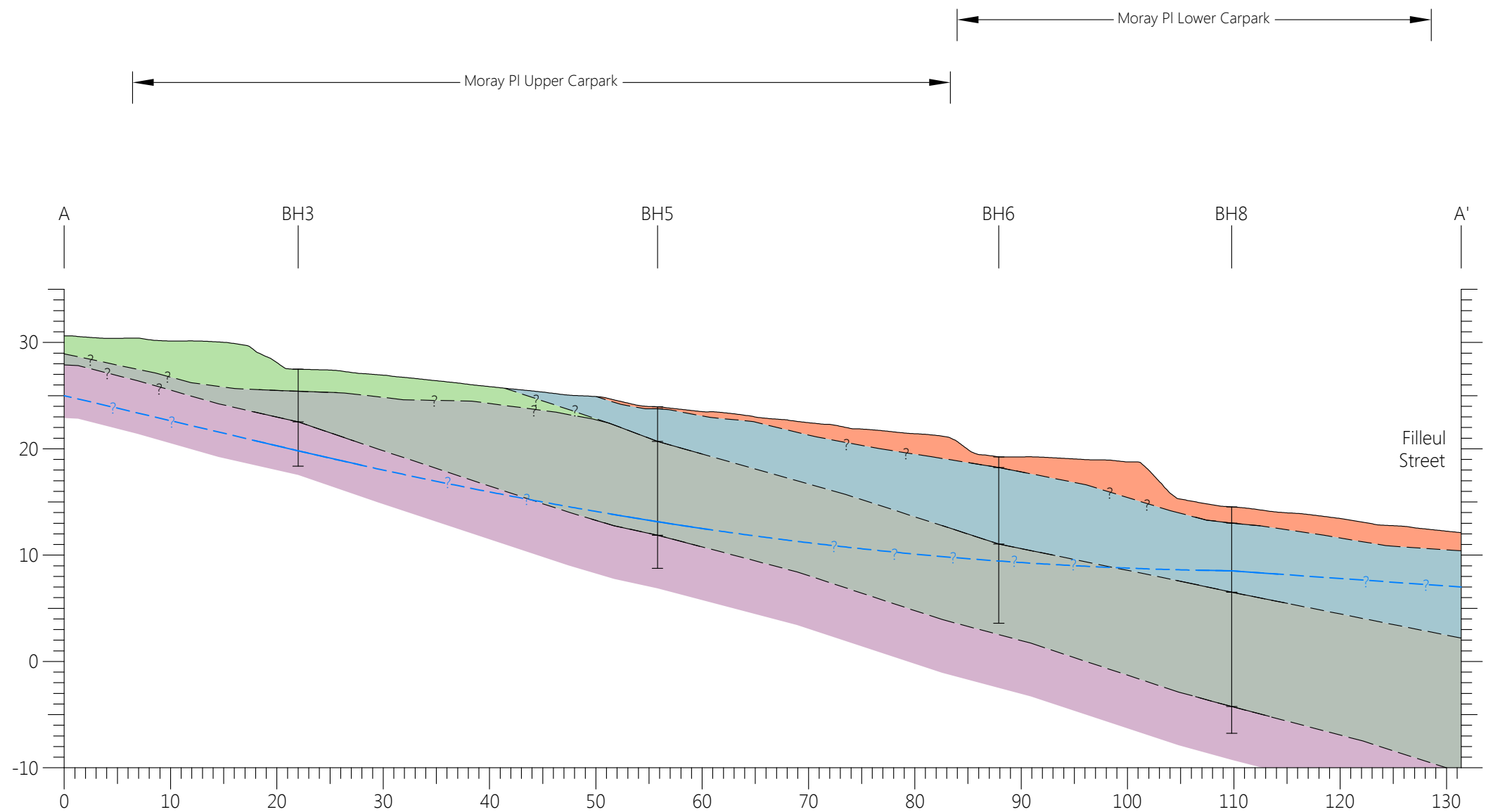


70 Macandrew Road, PO Box 2427, South Dunedin 9044, ph 03 466 402

Appendix A: Site Plan & Cross-sections



-  Bore hole location
-  Bore hole location (not drilled)



SCALE 1:500
0 5 10 15 20 25 (m)

Legend:

 Fill	 Weathered Volcanics	 Geology Confirmed	 WL Confirmed
 Loess	 Volcanic Rock	 Geology Projected	 WL Projected
 Slopewash		 Geology Inferred	 WL Inferred

GEO SOLVE
GEOTECHNICAL ENGINEERING
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DRAWN	WCG	Nov.16
DRAFTING CHECKED		
APPROVED		
CADFILE: 160658_CSF.dwg		
SCALES (AT A3 SIZE): AS SHOWN		
PROJECT No: 160658		

Dunedin City Council		
Geotechnical Investigation		
62 York Place, Dunedin		
Cross Section A		
FIG No: Figure 2	REV. 0	

Appendix B: Site Borehole Logs



BOREHOLE No: **BH³**

SHEET 1 OF 1

DRILLED BY: M^cMILLAN'S
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: N4917057
E1406089

JOB No: 160658
DIRECTION: VERTICAL
ANGLE FROM HORIZ.: 90°

R.L. GROUND: 33.36m
R.L. COLLAR:
DATUM: GROUND LEVEL

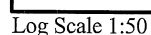
DRILL TYPE/METHOD/FLUID: SONIC D.T. 45

COMMENTS: ALL SPT 'N' VALUES ARE UNCORRECTED.

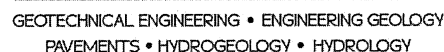
Survey method: GPS (NZTM)











BOREHOLE No: **BH 6**

SHEET 1 OF 2

DRILLED BY: M^CMILLANS

LOGGED BY: D GAINSFORD

CHECKED: M WALKOND

START DATE: 18/10/2016

FINISH DATE: 18 / 10 / 2016

PROJECT: DCC 143-193 MORAY PLACE

JOB No: 160658

R.L. GROUND: 24.44m

LOCATION: SEE SITE PLAN

DIRECTION: VERTICAL

R.L. COLLAR:

CO-ORDINATES: N 4917072
E 1406154

ANGLE FROM HORIZ.: 90°

DATUM: GROUND LEVEL

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

COMMENTS: ALL SPT 'N' VALUES ARE UNCORRECTED.

Survey method: GPS (NZTM)



BOREHOLE No: **BH 8**

SHEET 1 OF 2

DRILLED BY: M^CMILLAN'S
LOGGED BY: D GAINSFORD

CHECKED: M WALROND
START DATE: 17/10/2016
FINISH DATE: 19/10/2016

PROJECT: DCC 143-193 MORAY PLACE
LOCATION: SEE SITE PLAN
CO-ORDINATES: N 4917084
E 1406175

JOB No: 160658
DIRECTION: VERTICAL
ANGLE FROM HORIZ.: 90°

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

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

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Sampling Method	Core Recovery (%)	Moisture Condition	Strength/Density Classification	RL (m)	Depth (m)	Graphic Log	Drillers Notes	TESTING		Water Loss (%)	Water Level	Casing	Installation	Core Box
										Hammer Efficiency: 91.4%	Borehole Diameter: 114 mm					
FILL	0.00m SAND; black, fine with some non-plastic silt, medium dense, moist.	SONIC	100	FIRM	FIRM	0.00	0.00	X			25	25				
	0.10m sandy GRAVEL; black, gravel fine, angular, poorly graded; sand fine to medium, medium dense, moist.	SONIC	100													
SLOPEWASH	0.25m gravelly SILT; black - dark grey, non-plastic silt; fine to medium, angular gravel; firm, moist	SPT	100	MOIST	FIRM	0.25	0.25	X		SPT@ 1.52m 2, 3, 5, 5, 6, 6 N=22	25	25				
	1.52m SILT with some clay; light brown mottled light grey and black, low plasticity, firm, moist	SPT	100													
	2.30m Becoming light grey, mottled orange, brown and black.	SONIC	100													
		SPT	100													
	4.38m silty CLAY; light grey-brown mottled orange-brown, low to medium plasticity, firm, moist, minor manganese and iron flecks.	SONIC	100													
	5.02m - 5.22m Lens of fine to medium subangular basalt gravel, with cobble	SPT	100													
	5.50m Becoming light grey, mottled orange-brown	SONIC	100													
	6.02m silty CLAY; light brown, mottled grey, yellow-brown, orange and black, low to medium plasticity, firm, moist, rare fine subangular basalt gravels.	SPT	100													
	7.06 - 7.12m Lens of basalt cobbles, subangular to subrounded	SONIC	100													
	7.12 - 7.36m Lens of fine to coarse, subangular to subrounded basalt gravel	SPT	100													
WEATHERED VOLCANICS	7.36m CLAY light brown, minor orange-brown mottling, soft, moist, rare fine to medium subrounded quartz gravels.	SONIC	100	SOFT TO FIRM	SOFT	7.36	7.36	X		SPT@ 7.60m 1, 1, 0, 1, 1, 3 N=5	25	25				
	7.90m Becoming wet.	SPT	100													
	8.03m CLAY, light brown mottled purple, red and white, high plasticity, relict crystalline texture (fine angular gravels, break down to non-plastic silt), soft, moist	SONIC	100													
	9.12m - 9.57m SPT disturbance in core. Becoming soft to firm.	SPT	100													

COMMENTS: ALL SPT 'N' VALUES ARE UNCORRECTED.

Survey method: GPS (NZTM)

