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Project Number 021483.000.001

Geotechnical Review

19-25 Verran Road and 19 West Glade
Crescent, Birkenhead, Auckland

Submitted to:
Sweet New Zealand Partnership Limited
1/39 Lady Ruby Drive
East Tamaki
Auckland 1023

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ENGEO Document Control:

Report Title	Geotechnical Review - 1/19a, 2/19a, 21, 1/23, 2/23, & 25 Verran Road, & 19 West Glade Crescent, Birkenhead			
Project No.	021483.000.001	Doc ID	01	
Client	Sweet New Zealand Partnership Limited	Client Contact	Jenny Huang	
Distribution (PDF)	Jenny Huang (Sweet New Zealand Partnership Limited)			
Date	Revision Details / Status	Author	Reviewer	WP
8/12/2022	Issued to Client	HF	HL	VB

1 Introduction

ENGEO Ltd was requested by Sweet New Zealand Partnership Limited to undertake a geotechnical review of the property at 1/19a, 2/19a, 21, 1/23, 2/23, & 25 Verran Road, & 19 West Glade Crescent, Birkenhead, Auckland (herein referred to as 'the site'). This work has been carried out in accordance with our signed agreement dated 16 November 2022 (ref. P21483.000.001_01).

2 Scope of Work

The purpose of this assessment is to carry out a high-level geotechnical review of the site to support your feasibility assessment for the proposed development and help inform the fast-track building consent application for a new residential development at the site. Our scope of work for this report included:

- A desktop assessment and review of published geotechnical and geological information relevant to the site.
- A site walkover, geomorphological assessment and evaluation of the current landform by an experienced ground engineering professional.
- Preparation of this report presenting the findings of the site walkover, including preparation of a geomorphological map, a summary of the key geotechnical risks to the development based on the desktop and site walkover assessments, and geotechnical recommendations for further geotechnical investigation to support a future application for resource consent.

3 Site Description

The site at 1/19a, 2/19a, 21, 1/23, 2/23, & 25 Verran Road, & 19 West Glade Crescent (legal descriptions Lot 3 DP 71586, Flat 1 DP 184119, 1/7 SH Lot 4 DP 71586, Lot 5 DP 39117, Lot 7 DP 39117, Lot 6 DP 39117) is located in Birkenhead, Auckland.

The roughly rectangular site is bordered by residential properties on the northern, eastern and western boundaries, and by a small stream to the south, covering a combined area of approximately 2.5 Ha. The site is accessed via a shared right of way off Verran Road or from a roadway off West Glade Crescent.

The site gently to moderately (~10°) slopes from the northern boundary at RL 82 m towards the south, and then steeply slopes (>18°) from approximately RL 68 m toward to the small stream adjacent to the southern boundary (at RL 58 to RL 48 m). This is a crossfall of 24 m to 34 m across the site. Two gully features run broadly northwest to southeast and are tributaries to the small stream at the base of the slope. Approximately half of the site (southern portion) is densely vegetated.

Within the northern and central areas on-site multiple stockpiles and a stormwater pond have been formed as part of previous subdivision developments on adjacent sites.

An existing 150 mm diameter wastewater service line is shown on the Auckland Council GeoMaps portal as running through the site. This public service line enters the site from northwest to southeast, and then runs from a manhole on-site towards and beyond the eastern boundary.

4 Proposed Development

We have been provided with the BDG Architects Limited plan set for the site dated 28 November 2022 (referenced 2570, refer to Appendix 1). These plans depict a proposal to construct a new residential development that comprises a combination of apartment blocks and townhouses up to four storeys high, and a new preschool and communal area. The development will cover 25,861 m². The new residential development will be accessed by the existing driveways from Verran Road and West Glade Crescent.

These plans indicate that the buildings will mantle the existing landform to the south, with cuts and fills less than 3 m proposed (partial single level basements) on the northern side of the buildings to step the building platforms into the existing slope. No structural, foundation, basement or earthworks plans were provided at this stage of the development.

5 Desktop Assessment

5.1 Regional Geology

Regional geological mapping published by GNS Science indicates that the project site is underlain by East Coast Bays Formation (Waitemata Group) soils. The East Coast Bays Formation (ECBF) is described by GNS as *alternating sandstone and mudstone with variable volcanic content and interbedded volcanoclastic grits*. This material weathers to form a residual soil typically comprising layers of silts and clays with variable sand content.

5.2 Seismicity

The Auckland area is one of the lowest earthquake activity regions in New Zealand. Over the last 150 years, only two earthquakes with magnitudes greater than M5 have been recorded in the region. We have reviewed the GNS Science New Zealand Active Fault Database, which indicates there are no known active faults on-site.

The nearest active fault is the Waikopua Fault located approximately 40 km southeast of the site. The Waikopua Fault dips southwest and is a normal (extensional) type fault. GNS Science have not established a dip angle, vertical slip rate, recurrence interval or date for the last event at the Waikopua Fault.

5.3 Volcanic Activity

Volcanic activity presents a significant risk in Auckland. However, the location and timing of eruptions are difficult to predict due to the primarily monogenetic nature of the volcanic field.

The eruption history of the Auckland Volcanic Field (AVF) is known to date back over the last 150,000 years. Nineteen eruptions are known to have occurred within the last 20,000 years with 18 of the most recent eruptions occurring between 20,000 and 10,000 years ago. Rangitoto was the last known eruption event which was estimated to be 550 years before present.

Hazards proximal to an eruption include pyroclastic surge, block fall and lava flows. Ash fall at a greater distance can cause large disturbance with remobilisation of ash deposits possible, particularly during rainfall events.

Although the AVF is thought to have a high risk of eruption, it is generally considered to have a low occurrence. Based on the number and frequency of past eruptions it is estimated there is approximately a 1 in 1000 (0.1%) chance an eruption could occur in any one year.

5.4 Historic Aerial Photography

We have reviewed historical aerial photographs of the site sourced from Auckland Council Geomaps. These photographs were viewed under the context of underlying areas of potential instability and significant changes to landform. We have summarised our key findings in Table 1.

Table 1: Historical Aerial Photograph Review

Date	Summary
1940 to 1959	The site has been developed with a row of houses built on the northwest portion of the site directly off Verran Road, as well as a house on the central-western border of the site. The wider area had been developed for residential purposes prior to the earliest aerial photography. A water reservoir had been constructed west of the site prior to the earliest available photography.
1959 to 1996	The original properties remain in place however the south-eastern portion of the site has become more densely vegetated. The residential housing density in the local area increased over this time period.
1996 to 2001	The residential housing and infrastructure density continued to increase over this time period. A portion of the south-eastern vegetation was cleared.
2001 to 2006	The residential housing and infrastructure density continued to increase over this time period. More vegetation was cleared in the site and in nearby areas. The clearance in the central and south-eastern portions of the site was to enable subdivision earthworks. The driveway was also extended south through the site to facilitate the earthworks for a stormwater pond.
2006 to 2008	The stormwater pond was fully developed in the southern portion of the site. Stockpiled materials north of the pond are visible in this photograph.
2008 to 2011	The stormwater pond was partially overgrown by vegetation during this time period.
2011 to 2016	The stormwater pond was fully overgrown over by vegetation. Residential housing density increased west of the site.
2016 to 2017	The south-eastern portion of the site was further covered by vegetation. Residential housing density increased west of the site.

6 Site Walkover

ENGEO visited the site on 29 November 2022 and made the following observations:

- The site is grassed and gently to moderately slopes (10° to 18°) from the northern boundary (~RL 82 m) to the head of the two gullies, to approximate RL 66 m (Photo 1). The slope then breaks steeply from RL 66 m and becomes densely vegetated down to the small stream at the base of the slope (~RL 54 m).
- Within the grassed portion on the northern side of the site, multiple stockpiles likely comprising uncontrolled fill were observed (Photo 2).
- A grassed accessway was observed on the north-western side of the site (Photo 3), which runs downslope toward the stormwater pond in the central area of the site. The stormwater pond mantles the RL 65 m contour, is heavily vegetated and we observed standing water within the pond.
 - It appears the stormwater pond was partially cut into the slope and then filled to form the bund on the downslope side.
- Surface water was observed within the heavily vegetated areas in various locations across the site.
- The accessway from West Glade Crescent is currently backfilled with a fill stockpile and heavily vegetated (Photo 4).
- We observed some evidence of shallow soil creep and hummocky ground within the northern grassed portion of the site. As the remainder of the site is heavily vegetated, other evidence of soil movement and instability may have been concealed during our site visit.

Figure 1: Site Photographs



Photo 1: Looking over the site from the West Glade Crescent entrance. Photo facing west.



Photo 2: Various stockpiles were observed across the site. Photo facing southwest.



Photo 3: Accessway previously cut downslope toward the sediment pond location. Photo facing east.



Photo 4: Photo of the West Glade Crescent accessway into the site. Photo facing southwest.

6.1 Geomorphological Assessment

The proposed development is located over the gently to moderately sloping areas on-site extending toward the overland flow path / gully head locations. Two overland flow paths, oriented approximately northwest-southeast, extend downslope partially intersecting the proposed building platforms for Block C, Block N, Block O and the sediment pond toward the small stream at the base of the slope.

The over-steepened nature of the slope below the sediment pond suggests that the slope is likely to be underlain by side-cast fill and native East Coast Bays Formation at depth. The landform is consistent with the similarly steep slopes of adjacent properties in the area which are also mapped as being underlain by East Coast Bays Formation soils.

Geomorphic evidence of shallow soil creep was observed in the northern grassed portion of the site as a broad, hummocky ground surface. No obvious evidence for active or historical instability in the form of defined head scarps or debris lobes were observed in heavily vegetated areas in vicinity of the proposed development area, both during aerial photograph review and during our site walkover. However, ground cracks or other evidence of localised soil creep may be obscured by dense vegetation.

A summary of the geomorphic site features observed during the site walkover are presented on the Geomorphological Map presented in Appendix 2.

7 Geohazard Assessment

Following our site walkover and geomorphological assessment, the main geotechnical hazards that we consider will pose a risk to the development are as follows:

- The slope instability risk associated with the soil creep on the gently to moderately sloping areas on-site, the steepened overland flow path / gully areas, and any areas potentially concealed by heavy vegetation.
- Uncontrolled fill within stockpiles, and placed through the formation of construction access, the sediment pond and the accessway off West Glade Crescent.
- Groundwater and surface water risks as there are two overland flow paths on-site. Surface water was observed in various locations across the site and the proposed development includes basement walls cut into the slopes.

8 Geotechnical Recommendations

Based on this assessment we consider that the site is generally geotechnically suitable for the proposed development as shown on the development plans we have been provided by BDG Architects dated 28 November 2022. Due to the sloping nature of the site and proximity to the gully system, there will be a need for robust geotechnical investigations to support the design process as outlined in the following sections. However, from a geotechnical perspective, conventional geotechnical engineering measures will likely be suitable to mitigate the geotechnical risks and support the development.

These measures are likely to comprise a combination of underfill and counterfort drainage to suppress and control groundwater across the site, specifically designed retaining walls where integrated into buildings and on the downslope edge of buildings and fills proposed adjacent to the gullies in the southern portion of the site, and localised undercuts to remove undocumented fill previously stockpiled at the site.

As we have only reviewed conceptual drawings to date, we have made assumptions regarding the likely earthworks approach to inform the potential geotechnical risks associated with the proposed development. We recommend that we are involved in the project planning to provide input on the key geotechnical risks, and then tailor future geotechnical investigations to address and quantify the risks as the project develops.

8.1 Proposed Intrusive Geotechnical Investigations and Analysis

Subject to finalised development and earthworks plans and confirmation of the building design loads and tolerances, a geotechnical investigation will be required to support the fast-tracked application for resource consent. Recommended investigations are as follows:

- Retrieval of the Auckland Council Property File for the site to review for relevant geotechnical information, particularly with respect to the historical subdivision and stormwater pond.
- A series of test pit excavations in the northern grassed portion of the site to assess the extent of the shallow soil creep and uncontrolled fill observed on-site.

- Deep investigations (machine boreholes) to confirm the competency and extent of the underlying residual soils and bedrock for the site ground model, enable piezometer installation to assess groundwater profile, and facilitate sample collection for laboratory testing as required. This data will also be used to confirm the seismic subsoil class.
- Hand auger boreholes to target areas not easily accessed by machinery and to support detailed design of retaining structures (if required).
- Laboratory testing to confirm the site-specific expansive soil site class to inform foundation design.
- Assessment against sections E7.6.1.6 and E7.6.1.10 of the Auckland Unitary Plan to determine whether the proposed earthworks will intercept groundwater, and if as a result a resource consent for groundwater diversion and groundwater take will be required.
- Detailed slope stability analysis of at least two critical sections to assess global stability of the site and assess support options, incorporating the final proposed earthworks and building loads.
- Preliminary liquefaction, consolidation and differential settlement analysis for building platforms and accessways.
- Geotechnical recommendations for design of retaining structures proposed on-site.
- Commentary on earthworks methodology, temporary cut slopes, and sediment and erosion management controls.

8.2 Information Required

In order to progress the geotechnical investigation, analysis and reporting to support the resource consent submission, we require the following information:

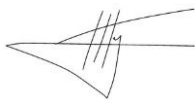
- Confirmation of the development concept and earthworks plans for the development, or preliminary cut and fill plans if the design concept is not yet progressed.
- Confirmation of the preliminary structural design and retaining concepts for the proposed development.

9 Limitations

- i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Sweet New Zealand Partnership Limited, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.
- ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.
- iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.
- iv. This Limitation should be read in conjunction with the Engineering NZ / ACENZ Standard Terms of Engagement.
- v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (09) 972 2205 if you require any further information.

Report prepared by



Hamish Foy, RPGeo

Senior Geotechnical Engineer

Report reviewed by



Heather Lyons, CMEngNZ (PEngGeol)

Associate Engineering Geologist

10 References

Auckland Council (2022), <https://www.aucklandcouncil.govt.nz/property-rates-valuations/Pages/find-property-rates-valuation.aspx>. Site accessed 28 November 2022

Auckland Council (2022), <https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html>. Site accessed 28 November 2022.

APPENDIX 1:

Proposed Development Plans

Apartment Unit Typology Schedule:

- Type 1: 3-Level, 3-Bed
113m² Gross Floor Area
Total amount of units: 12 units.
- Type 2: 3-Level, 3-Bed
109m² Gross Floor Area
Total amount of units: 33 units.
- Type 3: 1-Level, 2-Bed Ground Floor
70m² Gross Floor Area.
Total amount of units: 3 units.
- Type 3a: 1-Level, 2-Bed Ground Floor
70m² Gross Floor Area.
Total amount of units: 5 units.
- Type 4: 1-Level, 2-Bed Ground Floor
70m² Gross Floor Area.
Total amount of units: 8 units.
- Type 5: 1-Level, 2-Bed Apartment
70m² GFA + 11m² Balcony.
Total amount of units: 24 units.
- Type 5a: 1-Level, 2-Bed Apartment
70m² GFA + 3m² Balcony.
Total amount of units: 4 units.
- Type 6: 1-Level, 2-Bed Ground Floor
76m² Gross Floor Area.
Total amount of units: 1 units.
- Type 7: 1-Level, 1-Bed Ground Floor
50m² Gross Floor Area.
Total amount of units: 2 units.
- Type 8: 1-Level, 2-Bed Apartment
70m² GFA + 11m² Balcony.
Total amount of units: 12 units.
- Type 8a: 1-Level, 2-Bed Apartment
70m² GFA + 3m² Balcony.
Total amount of units: 6 units.
- Type 9: 1-Level, 1-Bed Ground Floor
50m² Gross Floor Area.
Total amount of units: 4 units.
- Type 10: 1-Level, 1-Bed Ground Floor
53m² Gross Floor Area.
Total amount of units: 1 units.



1. SITE PLAN MASTERPLAN

SCALE 1:250 @A1, 1:100 @A3

Gross Floor Area = External wall face / centre line intertenancy walls

PROPOSED DEVELOPMENT NOTES

- Total Site Area: 25,861m²
Ecological Area: 9,735m²
Usable Site Area: 16,126m²
- Unit total:**
- 1 Bedroom Units: 07 units (6.0% of development)
 - 2 Bedroom Units: 63 units (55% of development)
 - 3 Bedroom T/H: 45 units (39% of development)

Planning:

- Total Building & Impervious Coverage: TBC

Parking

- Car Parks: 92 parks estimated
- Bike Parks: 128 parks

APPENDIX 2: Geomorphological Map



1. Boundaries from Quickmap Enterprise.
2. Aerial image sourced from LINZ Data Service and licensed for re-use under the Creative Commons Attribution 4.0 New Zealand License (Auckland 0.075m Urban Aerial Photos 2017).
3. Coordinate Origin: Mt Eden, Projection: Geodetic 2000.
4. Contours sourced from LINZ LiDAR DEM data.

The map displays the following features and their approximate locations:

- Hummocky Ground:** Represented by a cluster of small, dark, irregular shapes at the top left.
- Stormwater Pond (Approximate):** Represented by a light blue, irregular shape below the hummocky ground.
- Approximate Areas of Fill:** Represented by a hatched (diagonal lines) area below the stormwater pond.
- Measured Slope Angle:** Indicated by a line segment with an arrow and the label "10°" below it.
- Watercourse (Permanent):** Represented by a blue line with arrows indicating flow direction, located below the slope angle measurement.
- Overland Flow Path (From Auckland Council Geomaps):** Represented by a dashed blue line with arrows indicating flow direction, located below the permanent watercourse.
- Head of Gully:** Represented by a dashed line with arrows pointing towards a central point, located below the overland flow path.
- Approx. Site Boundary:** Represented by a thick, solid black line, located below the head of gully.
- Contour Lines (1m Interval):** Represented by thin, solid black lines, with one line labeled "60", located below the site boundary.
- Wastewater (Approximate location):** Represented by a thick, dashed black line at the bottom of the map.

The ENGEO logo, with "EN" in grey and "GEO" in blue.

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DRAFT

A	30.11.22	Draft for review	DF	-
Rev	Date	Description	Drwn	Chkd

GEOMORPHOLOGY MAP

Client: Sweet New Zealand Partnership Limited		Figure:
Project: 19-25 Verran Road and 19 West Glade Crescent, Birkenhead, Auckland	Designed: HF	1
	Drawn: DF	
	Checked: -	
	Date: 30.11.22	
Project No: 21483.000.001	Scale: 1:1000	Size: A3 Rev: A