Geotechnical Subdivision Investigation Report

Harrow Green Subdivision

Lot 2 DP 61162

Springston Rolleston Road
Rolleston

Submitted to:

Kevler Developments Ltd.

Wiley Geotechnical Ltd.
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1 Executive Summary

Wiley Geotechnical Limited (WGL) was requested by Kevler Developments Ltd. to provide a Geotechnical Subdivision Report for the proposed subdivision at Lot 2 DP 61162, Springston Rolleston Road, Rolleston (herein referred to as "the site"). The result of our investigation is documented in this report. Our findings and conclusions are summarised in the table below:

Table 1: Summary of Findings

Site Sub-soil Conditions			
GNS mapped geology:	Alluvium	**Soil Classification (NZS 1170.5:2004):**	Class 'D'
CERA zone:	Green	**MBIE Technical Category:**	N/A Urban Non-residential
Groundwater Level:	At or below 5.5 m depth	**Site Specific Technical Category:**	TC1 equivalent
Natural Hazards			
Flooding and Coastal Erosion:	The majority of the site is in an area of no flood hazard or a flood depth of <0.2 m in a 200 year flood event. The south eastern side of the site and a small portion of the north western side of the site have a flood hazard of between 0.2 to 0.5 m depth, with a few locations on the south eastern side of the site having a flood hazard of between 0.5 to 1 m depth. The site is located outside of coastal erosion hazard areas.		
Land Instability:	No obvious land instability at the site.		
Seismicity:	No active faults are located on the site.		
Liquefaction and Lateral Spread Risk:	Low		
Geotechnical Assessment			
Geotechnical Ultimate Bearing Capacity:	300 kPa in native silt between 0.1 and 0.3 m depth.		
New Foundations: We consider the site is suitable for the proposed residential subdivision.			

2 Introduction

At your instruction, we have undertaken a geotechnical investigation at Lot 2 DP 61162, Springston Rolleston Road, Rolleston. This geotechnical report summarises our findings as per the brief given to us by our client. The purpose of the geotechnical investigation was to evaluate ground conditions at the site to support a Subdivision Consent application.

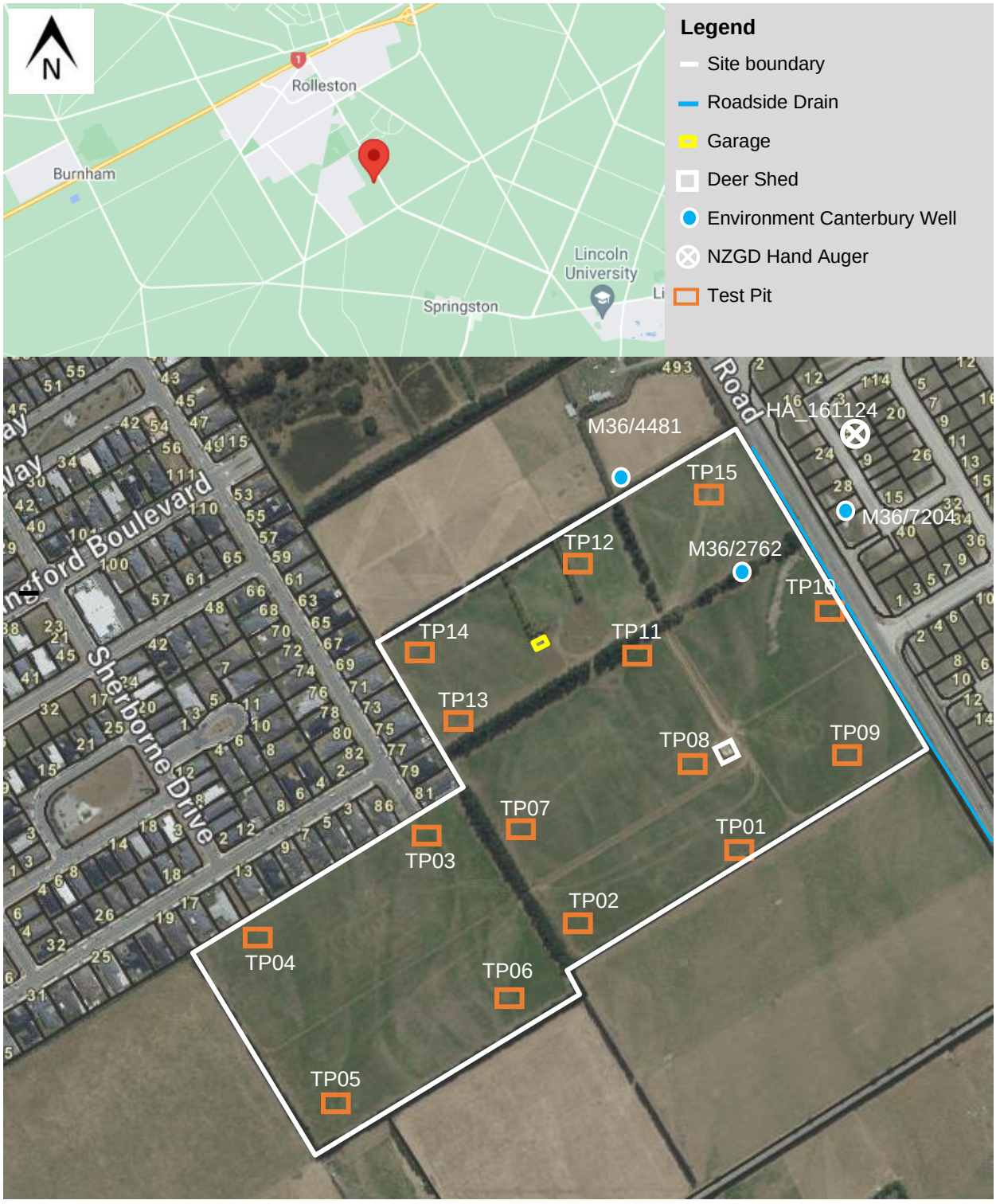
The report may be used by our clients' appointed consultants for design purposes and by the local council/authority for corresponding consent application.

3 Site Description

Table 2: Site Description

Site Area:	15.92 ha
Legal description	Lot 2 DP 61162
Topography:	Flat (<5°)
Site/Area Description:	The site is located in a rural area, bound by other rural properties to the south and west. Farringdon subdivision is located to the north west and another residential development is currently under construction to the north of the site. To the east of the site is Springston Rolleston Road and Acland Park subdivision. Rolleston town centre is located approximately 2.3 km north of the site. The Selwyn River is located approximately 7.8 km south west of the site.

Figure 1: Site Location Plan



Images sourced from Google Maps and Canterbury Maps. Well locations sourced from Environment Canterbury.

4 Previous Geotechnical Report

4.1 Geotechnical Desktop Report by Wiley Geotechnical Ltd. (2021)

WGL undertook a Geotechnical Desktop Report for the site to provide a geotechnical assessment, based on existing available geotechnical data and information, to inform suitability for residential land development at the site. We summarise the relevant geotechnical information:

- WGL has reviewed the nearest subsurface data available on Environment Canterbury's Well Search website. In general, the nearby subsurface data indicates surficial topsoil up to 0.2 m, underlain by medium dense to dense, interbedded silty gravels and sandy gravels to 114 m depth below ground level (bgl).
- The nearby subsurface data indicates groundwater level at the site to be between approximately 5.5 m and 6 m bgl, subject to seasonal variations and weather events.
- The majority of the site is in an area of no flood hazard or a flood depth of <0.2 m in a 200 year flood event. The south eastern side of the site and a small portion of the north western side of the site have a flood hazard of between 0.2 to 0.5 m depth, with a few locations on the south eastern side of the site having a flood hazard of between 0.5 to 1 m depth. No obvious land instability is present at the site and no active faults are located on the site.
- Based on nearby subsurface geology and groundwater levels, liquefaction and lateral spread potential are considered to be low. We have reviewed the Selwyn District Council's (SDC) Low Geotechnical Risk Area map (McMahon 2013), which indicates that the site in in an area where damaging liquefaction has been assessed as being unlikely. The possibility of liquefaction over much of this area is considered by SDC to be extremely low. In addition, this area is also considered by SDC to be free of other geo-hazards.
- 'Good ground' is expected below topsoil at 0.2 m depth, based on nearby subsurface investigations. However, geotechnical soil bearing capacity at the site should be confirmed with on-site soil testing.

5 Geotechnical Site Investigation

5.1 Geotechnical Visual Assessment

WGL visited the site on 13 May 2022 and made the following observations:

- The site was vacant at the time of our visit. The majority of the site comprised pasture, with a garage located on the north side of the site and an old deer shed near the centre of the site. The garage was a timber framed and timber clad structure with a concrete floor. The deer shed is a timber framed structure with iron cladding and an iron roof, with a dirt floor. A pumphouse and water tank were located on the north eastern side of the site, and a concrete sump was located near the north eastern boundary of the site. The sump drains to a roadside drain.
- There was no obvious evidence of ground cracks indicating lateral spread.
- There was no clear evidence of ground subsidence or remnant liquefaction ejecta observed within the property.

Our observations are limited to areas of the site that can be reasonably observed. We cannot fully assess areas that are obstructed by vegetation or structures.

5.2 Test Pits

WGL carried out a subsurface investigation comprising 15 test pits with associated Scala Penetrometer (Scala) tests to an approximate target depth of 2.0 m bgl at the site.

Test pits met target depth at between 1.7 m and 2.1 m depth. Standing water was not encountered in the test locations.

Test locations are presented in Figure 1 and a summary of the subsurface conditions is presented in Table 3.

Test Pit logs with associated Scala penetrometer results are presented in Appendix 1 and are written in general accordance with the New Zealand Geotechnical Society field classification guidelines (NZGS, 2005). A selection of photographs of the test pits is presented in Appendix 2.

5.3 Summary of Subsurface Conditions

Based on the subsurface investigations completed at the site, and other nearby geotechnical data, ground conditions encountered in on-site subsurface investigations are summarised in Table 3.

Table 3: Summary of sub-surface conditions

Depth (m)	Soil Description	Consistency / Density
0 to 0.3	SILT [TOPSOIL]	Soft to Very Stiff
0.1 to 0.9	SILT and SAND*[ALLUVIUM]	Stiff to Hard / Loose*
0.4 to 114**	Sandy GRAVEL [ALLUVIUM]	Medium Dense to Dense

* Only TP15 encountered loose sand from 0.5 m to 0.7 m bgl.

**Data from below 2.1 m depth is inferred from nearby subsurface data, reviewed during our Geotechnical Desktop Report, dated 03 August 2021, and summarised in section 4.1 of this report.

Groundwater

Groundwater was not encountered in our test pits. Based on nearby subsurface data, reviewed during our Geotechnical Desktop Report, dated 03 August 2021, and summarised in section 4.1 of this report, we consider groundwater level at the site to be between approximately 5.5 m and 6 m bgl. Groundwater level may vary as a result of seasonal change, recent precipitation and/or irrigation practices.

6 Geotechnical Assessment

6.1 Soil Classification

For the purpose of seismic design, we consider the soil classification to be ‘Class D – Deep or Soft Soil”, in accordance with NZS 1170.5:2004.

6.2 Liquefaction and Lateral Spreading

We consider the native stiff to hard silt and underlying gravel encountered at the site, to have a low to very low susceptibility to liquefaction owing to the nature and consistency of the soil and the depth to groundwater.

Owing to the low risk of liquefaction potential at the site, we consider the risk of liquefaction induced settlement and lateral spread to be low.

6.3 Foundation Technical Category Assessment

The site is currently categorised as Urban Non-residential by the MBIE. The Ministry of Business, Innovation and Employment (MBIE) foundation technical categorisation criteria have been used to assess the subject site, in terms of liquefaction performance in past and future seismic events.

Based on our investigation, we consider the stiff to hard silt below 0.1 to 0.3 m depth would have low liquefaction potential due to the consistency and fine-grained nature of the soil. The underlying gravel is also expected to have low liquefaction potential due to the density and grain size of the soil.

The groundwater table is expected between 5.5 m and 6 m depth dependant on seasonal variations, recent precipitation and/or irrigation practices. In order to liquefy, soils are required to be saturated. Groundwater levels at the site indicate a non-liquefiable crust of at least 5.5 m at the site.

Overall, we consider the classification of Technical Category 1 (TC1) to be appropriate for the site, and we expect the vertical liquefaction induced settlement to be less than 15 mm under SLS conditions and 25 mm under ULS conditions.

6.4 Bearing Capacity Assessment

Scala penetrometer tests were undertaken at the site to assess the subsurface strength profile and to determine if ground beneath the site meets the requirements of ‘good ground’, defined in NZS 3604:2011. Based on the geological conditions and Scala penetrometer and shear vane test results, we consider the soil underlying the site to meet the criteria for ‘good ground’ below the topsoil layer at 0.3 m depth.

Based on our Scala penetrometer results, we recommend a geotechnical ultimate bearing capacity of 300kPa can be achieved in the native silt layer at 0.1 to 0.3 m depth.

7 Assessment Against RMA Section 106

Assessment against Section 106 of the Resource Management Act is a requirement for potential future subdivision.

We have assessed the natural hazards associated with the site in accordance with Section 106 of the Resource Management Act. We consider the current ground surface not to be presently subject to erosion, subsidence, falling debris, slippage or inundation by soil or rock in accordance with the provision of Section 106 of the Resource Management Act 1991.

The Selwyn’s Flooding and Coastal Hazards maps website shows the majority of the site to have either no flood hazard or a flood depth of <0.2 m in a 200 year flood event. The south eastern side of the site and a small portion of the north western side of the site have a flood hazard of between 0.2 to 0.5 m depth, with a few locations on the south eastern side of the site having a flood hazard of between 0.5 to 1 m depth.

SDC's Low Geotechnical Risk Area map (McMahon 2013), indicates that the site is in an area where damaging liquefaction has been assessed as being unlikely. Based on our subsurface investigations at the site, we consider risk of land damage as a result of liquefaction occurring at the site in a future severe earthquake event is assessed to be very low. In addition, this area is also considered by SDC to be free of other geo-hazards.

We do not consider that residential use of the land is likely to accelerate, worsen or result in material damage to the land provided that the proper engineering practices are followed during any development, including those recommended in this report.

8 Roads and Accessways

The proposed new subdivision will contain new roads and shared accessways. New roads are expected to be constructed on the native soil material, below topsoil. All vegetation, organic or deleterious material including topsoil and non-engineered fill should be removed from under pavement areas prior to aggregate placement.

The results of our Scala penetrometer tests, undertaken in the approximate locations of the proposed new roads, indicate a CBR value of 10 can be adopted provided good construction practices are followed and all road cut surfaces are kept dry during construction. otherwise, a CBR value of 5 is recommended if road construction is likely to be carried out in wet conditions.

Earthworks should be carried out in accordance with the recommendations of NZS4431 'Code of Practice for Earth Fill for Residential Development' unless noted otherwise herein.

9 Conclusion

Based on available published geotechnical data and our on-site observations and testing, we consider the site to be geotechnically suitable for the proposed residential subdivision. A Statement of Professional Opinion on the Suitability of Land for Subdivision is presented in Appendix 2.

We summarise the primary geotechnical conclusions and recommendations of this assessment:

- The geotechnical soil investigation indicates that the general stratigraphy of the ground underlying the site comprises topsoil to a depth of 0.1 to 0.3 m, underlain by stiff to hard silt to between 0.4 m and 0.9 m depth. The silt is further underlain by medium dense to dense silty and sandy gravel to a depth of at least 114 m.
- Groundwater is expected between 5.5 m to 6 m bgl under static conditions, based on our on-site observations and groundwater data obtained in our desktop study, subject to seasonal variation and rainfall events.
- In terms of NZS 1170, Class D sub-soil conditions (deep or soft soils) are assessed to underlie the site due to the considerable depth to inferred bedrock based on the geology of the area.
- The risk of land damage as a result of liquefaction occurring at the site in a future severe earthquake event is assessed to be very low. The reasons for this include:

  - The composition and consistency of the silt and gravel layers underlying topsoil generally indicates the material is unlikely to be liquefiable.
  - SDC's Low Geotechnical Risk Area map (McMahon 2013), indicates that the site is in an area where damaging liquefaction has been assessed as being unlikely. The possibility of liquefaction over much of this area is considered by SDC to be extremely low. In addition, this area is also considered by SDC to be free of other geo-hazards.
  - In terms of the current MBIE technical categorisation, past and future performance of the site is assessed to be equivalent to Technical Category 1.

- The geotechnical ultimate bearing capacity of the native silt, underlying topsoil between 0.1 m and 0.3 m bgl in our test pit locations, is expected to be 300 kPa; this equates to 150 kPa ULS bearing pressure and 100 kPa allowable bearing pressure. As such, this material generally complies with the definition of 'good ground' in accordance with NZS 3604:2001. We recommend the foundation bearing capacity for any new dwelling to be confirmed at the building consent stage.

10 Recommendations

10.1 House Foundations

This section provides generic foundation advice for the wider subdivision development. It does not constitute detailed design of foundations, and it is recommended additional investigations are completed on each building lot once earthworks have been completed and lot locations finalised.

The site has a low liquefaction risk and is considered equivalent to MBIE's Technical Category 1 (TC1) for foundation design purposes. It is likely that standard NZ3604 type foundations and TC1 waffle slab foundation are suitable.

10.2 Site Preparation & Earthwork

Areas to be filled should be stripped completely of any topsoil, organics, and any unsuitable foundation materials identified during the stripping process prior to placement of fill.

Subgrade soils should be inspected by a geotechnical engineer or engineering geologist prior to placement of engineered fill to confirm the suitability of the exposed subgrade soils.

Stripped topsoil and or unsuitable materials should be stockpiled and may be reused later for landscaping or respread over lots once engineered filling has been completed. It is recommended that no more than 0.4 m of topsoil or non-engineered fill is placed or respread over the completed lots.

Topsoil or unsuitable foundation soils should not exceed 0.4 m total thickness on any lot.

Any contaminated soils identified during investigations or during earthworks should be contained and dealt with according to the advice of the environmental consultant specialist.

Engineered fill for foundations may comprise of imported or site won materials that are approved by the geotechnical engineer or engineering geologist. Due to natural variability of the subgrade soils at the site, any re-use of site won material for backfill should have sufficient laboratory testing, with samples taken from the stockpiled materials to assess the placement and compaction requirements.

Earthworks should be carried out to the requirements of NZS 4431:1989, 'Code of Practice for Earth filling for Residential Development'. Engineered hardfill (typically AP40 or AP60) should be placed and compacted in layers not exceeding 200 mm thick and achieve a compaction density of 95% of the maximum dry density achieved in a laboratory environment.

Considerations for erosion control must be made. Swales or bunds may need to be constructed to avoid sediment runoff.

10.3 Civil Design

Civil engineering design for stormwater disposal, road pavement design, and earthworks associated with this development will need to be completed at the detailed design stage of the project.

Beneath topsoil, pavement subgrades are generally assumed to be sand, silty sand, sandy silt, and gravel. The natural subgrade soils are expected to provide a suitable foundation for roading and paving.

Based on the natural geology of the site; comprising of sandy gravel deposits at depth and ground water table depths of generally greater than 3.0m bgl, we consider on site disposal of stormwater to be generally suitable at the discretion of the civil engineer.

10.4 Deep Excavation

Consultation with the geotechnical engineer or engineering geologist should be made prior to completing excavations deeper than 1.5 m depth, within 2.0m of site boundaries, to confirm the stability of excavations.

In general, the natural surficial soils comprising of sand, silty sand, and sandy silt were stable upon excavating however the sandy gravel soils at depth often became unstable once excavated and may require temporary shoring or battering during deeper excavations.

10.5 Geotechnical Review

This report is provided based solely on our fieldwork assessment, and information provided to WGL by the Client at the time of report writing. Therefore, we strongly recommend that, should any relevant building information become available, then WGL must be contacted to ensure that this report and the amount of investigation contained therein are appropriate for building consent application.

11 References

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Environment Canterbury, Canterbury Maps. Retrieved June 2022 from https://apps.canterburymaps.govt.nz/AdvancedViewer/

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New Zealand Geotechnical Society (2005). Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes.

Standards Association of New Zealand (2011). Timber-framed Buildings, NZS 3604:2011.

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NZS1170.0:2004. Australia/New Zealand Standard, Structural Design Actions, Part 0: General Principals. Standards New Zealand, Wellington, New Zealand.

NZS1170.5:2004. Australia/New Zealand Standard, Structural Design Actions, Part 5: Earthquake Actions – New Zealand. Standards New Zealand, Wellington, New Zealand.

12 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, Kevler Developments Ltd., 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 New Zealand/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, if you require any further information.

Report prepared by

Helen Kellett, BSc, MEngNZ
Engineering Geologist

Report reviewed by

Raymond Su, CPEng, CMEngNZ, IntPE(NZ)
Associate Geotechnical Engineer

APPENDIX 1:

Test Pit and Scala Penetrometer Test Logs

WILEY GEOTECHNICAL LTD

Test Pit No. TP01

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TOPSOIL	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			F-St	D				2
	ML	SILT with trace sand and gravel; brown. Low plasticity. [Alluvium]			H	D				4, 4, 8
ALLUVIUM	GW	GRAVEL with some sand and trace silt and cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular.Cobbles up to 150 mm diameter. Sand becomes trace from 1.8 m depth.		1 2	MD-D	D				
		EOH 2.1 m depth.		3						

NOTES: Groundwater was not encountered.
Test pit met target depth at 2.1 m depth.
Scala penetrometer met practical refusal at 0.5 m depth.

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP02

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TS	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			S	M				1
ALLUVIUM	ML	SILT with trace sand and gravel; brown. Low plasticity. [Alluvium]			VSt-H	M				5
	GM	Silty, fine to coarse GRAVEL with trace sand and cobbles; greyish brown. Well graded, subrounded to subangular. Cobbles up to 100 mm diameter.			MD-D	M				7
	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 200 mm diameter. Becomes silty GRAVEL with trace sand from 1.0 m to 1.2 m depth.		1	MD-D	M				
		EOH:2.0 m depth.		2						
				3						

NOTES: Groundwater was not encountered.
Test pit met target depth at 2.0 m depth.
Scala penetrometer met practical refusal at 0.4 m depth.
TS = TOPSOIL

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP03

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TOPSOIL	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			F	M				2
	ML	SILT with trace sand and gravel; brown. Low plasticity.			St-VSt	M				2, 4
	GM	Silty, fine to coarse GRAVEL with trace sand and cobbles; greyish brown. Well graded, subrounded to subangular. Cobbles up to 100 mm diameter.			MD-D	M				6
ALLUVIUM	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 200 mm diameter.		1	MD-D	M / W				
		EOH: 1.7 m depth.		2, 3						

SCALA PENETROMETER BLOWS / 100 mm: 5, 10, 15

NOTES: Groundwater was not encountered.
Test pit met target depth at 1.7 m depth.
Scala penetrometer met practical refusal at 0.5 m depth.

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP04

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TS	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			S	M				1
ALLUVIUM	ML	SILT with trace sand and gravel; brown. Low plasticity.			F-H	M				2, 4, 4, 5, 6
		Becomes gravelly SILT from 0.6 m depth.								
	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 190 mm diameter.		1	MD-D	M				
						W				
		EOH: 2.0 m depth.		2						
				3						

NOTES: Groundwater was not encountered.
Test pit met target depth at 2.0 m depth.
Scala penetrometer met practical refusal at 0.7 m depth.
TS = TOPSOIL

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP05

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TOPSOIL	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			F	M				
ALLUVIUM	ML	SILT with trace sand and gravel; brown. Low plasticity. Becomes gravelly SILT from 0.7 m depth.			St-H	M				
	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 200 mm diameter.		1	MD-D	M				
		EOH: 2.1 m depth.		2						
				3						

SCALA PENETROMETER BLOWS / 100 mm: 5, 10, 15; 2, 3, 4, 7, 10

NOTES: Groundwater was not encountered.
Test pit met target depth at 2.1 m depth.
Scala penetrometer met practical refusal at 0.6 m depth.

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP06

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TOPSOIL	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			S-F	M				1
ALLUVIUM	ML	SILT with trace sand and gravel; brown. Low plasticity.			St-VSt	M				3, 4, 4, 3, 4, 5, 7, 12
	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 200 mm diameter.		1	MD-D	W				
		EOH: 2.1 m depth.		2						
				3						

NOTES: Groundwater was not encountered.
Test pit met target depth at 2.1 m depth.
Scala penetrometer met practical refusal at 1.0 m depth.

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP07

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TOPSOIL	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			F-St	M				2
	ML	SILT with trace sand and gravel; brown. Low plasticity. Becomes gravelly SILT from 0.4 m depth.			H	M				5 6
ALLUVIUM	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 210 mm diameter.		1	MD-D	M W				
		EOH: 1.8 m depth.		2 3						

NOTES: Groundwater was not encountered.
Test pit met target depth at 1.8 m depth.
Scala penetrometer met practical refusal at 0.4 m depth.

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP08

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TS	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			F	M				2
ALLUVIUM	ML	SILT with trace sand and gravel; brown. Low plasticity.			St-H	M				5
	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 160 mm diameter.		1	MD-D	D M W				9
		EOH: 1.9 m depth.		2 3						

NOTES: Groundwater was not encountered.
Test pit met target depth at 1.8 m depth.
Scala penetrometer met practical refusal at 0.4 m depth.
TS = TOPSOIL

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP09

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TOPSOIL	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			F-St	M				
	ML	SILT with trace sand and gravel; brown. Low plasticity. Becomes gravelly SILT from 0.4 m depth.			H	M				
ALLUVIUM	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 200 mm diameter.		1	MD-D	M W				
		EOH: 1.9 m depth.		2 3						

NOTES: Groundwater was not encountered.
Test pit met target depth at 1.9 m depth.
Scala penetrometer met practical refusal at 0.4 m depth.

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP10

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TOPSOIL	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			F-St	M				2
	ML	SILT with trace sand and gravel; brown. Low plasticity.			St-H	M				4, 5, 7
		Becomes gravelly SILT from 0.5 m depth.								
ALLUVIUM	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 230 mm diameter.		1	MD-VD	M				
						W				
		EOH: 2.0 m depth.		2						
				3						

SCALA PENETROMETER BLOWS / 100 mm: 5, 10, 15

NOTES: Groundwater was not encountered.
Test pit met target depth at 2.0 m depth.
Scala penetrometer met practical refusal at 0.5 m depth.

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP11

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TS	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			St	M				4
ALLUVIUM	ML	SILT with trace sand and gravel; brown. Low plasticity.			VSt-H	M				7
ALLUVIUM	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 220 mm diameter.		1	MD-D	D				
						M				
						W				
		EOH: 1.8 m depth.		2						
				3						

NOTES: Groundwater was not encountered.
Test pit met target depth at 1.8 m depth.
Scala penetrometer met practical refusal at 0.3 m depth.
TS = TOPSOIL

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP12

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TOPSOIL	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			St-VSt	M				4
	ML	SILT with trace sand and gravel; brown. Low plasticity.			H	M				5, 9, 11
ALLUVIUM	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 300 mm diameter.		1	MD-D	M / W				
		EOH: 2.0 m depth.		2						
				3						

NOTES: Groundwater was not encountered.
Test pit met target depth at 2.0 m depth.
Scala penetrometer met practical refusal at 0.5 m depth.

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP13

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TOPSOIL	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			F-VSt	D				
	ML	SILT with trace sand and gravel; brown. Low plasticity. [ALLUVIUM] Becomes gravelly SILT from 0.4 m depth.			H	D				
ALLUVIUM	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 190 mm diameter.		1	MD-D	D				
						M				
		EOH: 1.9 m depth.		2						
				3						

SCALA PENETROMETER BLOWS / 100 mm: 5, 10, 15; 2, 5, 7, 8, 10

NOTES: Groundwater was not encountered.
Test pit met target depth at 1.9 m depth.
Scala penetrometer met practical refusal at 0.6 m depth.

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP14

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TOPSOIL	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			St-VSt	M				3, 6, 6
ALLUVIUM	ML	SILT with trace sand and gravel; brown. Low plasticity. [Alluvium] Becomes gravelly SILT from 0.8 m depth.			VSt-H	M				
	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 190 mm diameter. Becomes silty GRAVEL with trace sand from 1.0 m to 1.2 m depth.		1	MD-D	M W				
		EOH: 1.8 m depth.		2 3						

NOTES: Groundwater was not encountered.
Test pit met target depth at 1.8 m depth.
Scala penetrometer met practical refusal at 0.4 m depth.

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

WILEY GEOTECHNICAL LTD

Test Pit No. TP15

SITE: Harrow Green, Lot 2 DP 61162, Springston Rolleston Road, Rolleston

REF: C21123

Sheet 1 of 1

GEOLOGY	USCS SYMBOL	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	Consistency/Density	Moisture Condition	Water Level	Excavatability (Relative Scale)	Vane Shear Strength Peak/Remolded (kPa)	SCALA PENETROMETER BLOWS / 100 mm
TS	ML	SILT with trace sand, gravel and rootlets; brown. Low plasticity. [TOPSOIL]			St	M				3
ALLUVIUM	ML	SILT with trace sand and gravel; brown. Low plasticity. Becomes gravelly SILT from 0.4 m depth.			VSt-H	M				6, 6
	SW	Fine to coarse SAND with trace gravel; greyish brown. Well graded, subrounded to subangular.			L	M				
	GW	Sandy, fine to coarse GRAVEL with trace cobbles; greyish brown. Well graded, subrounded to subangular. Sand fine to coarse, well graded, subrounded to subangular. Cobbles up to 200 mm diameter.		1	MD-D	M / W				
		EOH: 1.8 m depth.		2, 3						

NOTES: Groundwater was not encountered.
Test pit met target depth at 1.8 m depth.
Scala penetrometer met practical refusal at 0.4 m depth.
TS = TOPSOIL

LOGGED BY: HK
DATE EXCAVATED: 13/05/2022
METHOD: Kubota U35-4, 4 tooth bucket.

APPENDIX 2:

Test Pit Photographs

Figure 1: Selection of Test Pit Photographs (randomly selected)

Photo 1: Test Pit 1, south side of site.

Photo 2: Test Pit 4, west side of site.

Photo 3: Test Pit 7, centre of site.

Photo 4: Test Pit 9, south east corner of site.

Photo 5: Test Pit 13, north side of site.

Photo 6: Test Pit 15, north east corner of site.

APPENDIX 3:

Statement of Professional Opinion on the Suitability of Land for Subdivision

Statement of Professional Opinion on the Suitability of Land for Subdivision

(Appendix I to the Infrastructure Design Standard)

Issued by: Wiley Geotechnical Ltd.
(Geotechnical engineering firm or suitably qualified engineer)

To: Kevler Developments Ltd.
(Owner/Developer)

To be supplied to: Selwyn District Council
(Territorial authority)

In respect of: subdivision
(Description of proposed infrastructure/land development)

At: Lot 2 DP 61162, Springston Rolleston Road, Rolleston
(Address)

I Raymond Su on behalf of Wiley Geotechnical Ltd.
(Geotechnical engineer) *(Geotechnical engineering firm)*

hereby confirm:

1. I am a suitably qualified and experienced geotechnical engineer and was retained by the owner/developer as the geotechnical engineer on the above proposed development.

2. My/the geotechnical assessment report, dated 14/06/2022 has been carried out in accordance with the Department of Building and Housing *Guidelines for geotechnical investigation and assessment of subdivisions* and includes:
   (i) Details of and the results of my/the site investigations.
   (ii) A liquefaction assessment.
   (iii) An assessment of rockfall and slippage, including hazards resulting from seismic activity.
   (iv) An assessment of the slope stability and ground bearing capacity confirming the location and appropriateness of building sites.
   (v) Recommendations proposing measures to avoid, remedy or mitigate any potential hazards on the land subject to the application, in accordance with the provisions of Section 106 of the Resource Management Act 1991.

3. In my professional opinion, I consider that Council is justified in granting consent incorporating the following conditions:

   Please refer to the Geotechnical Investigation Report, dated 08/06/2022, reference 21123_3_V0.

4. This professional opinion is furnished to the territorial authority and the owner/developer for their purposes alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any building.

5. This certificate shall be read in conjunction with my/the geotechnical report referred to in Clause 2 above, and shall not be copied or reproduced except in conjunction with the full geotechnical completion report.

6. The geotechnical engineering firm issuing this statement holds a current policy of professional indemnity insurance of no less than $ 500,000
(Minimum amount of insurance shall be commensurate with the current amounts recommended by IPENZ, ACENZ, TNZ, INGENIUM.)

..... Date: 14/06/2022

(Signature of Engineer)

Qualifications and experience:

BE(Hon), MEngSc (Geotechnical), CPEng, CMEngNZ, IntPE(NZ). Over 20 years of professional geotechnical engineering experience in subdivision, commercial and infrastructure projects across New Zealand, Australia and Asia.