

26 October 2018

Our Ref: 419748

Ngāi Tahu Property Limited
PO Box 13-0060
Christchurch
New Zealand

Attention: Dean Christie

Geotechnical and Foundation Report: Lot 182, Manakura Neighbourhood, Karamū Subdivision, Riccarton, Christchurch

1 Introduction

This report provides the geotechnical appraisal and foundation recommendations for Lot 182 (DP 518070), Manakura Neighbourhood, Karamū Subdivision, Riccarton, Christchurch.

We anticipate the building will comprise a residential dwelling that is designed and constructed within the scope of NZS 3604:2011. Buildings outside the scope of NZS 3604:2011 require specific engineering design.

This report is intended to be used as technical supporting documentation for foundation design and Building Consent application purposes.

2 Ground Model

Our knowledge of the ground model is based on information from a number of sources, including:

Subdivision investigation¹ including shallow and deep testing. The subdivision report concluded "*Based on our liquefaction assessment, we consider the site to behave similarly to MBIE Technical Category 1 (TC1)*". The surface geology is Springston Formation alluvium, comprising mixtures of silt, sand and gravel. Groundwater is at approximately 10m depth.

Subdivision earthworks engineering undertaken with Eliot Sinclair as designer and Engineer to Contract, and works constructed by Blakely Construction Limited. All controlled fill placed across the subdivision area was supervised by an Engineer from Eliot Sinclair & Partners, and has been certified to NZS4431 as reported in the Inspecting Engineer's Report². The existing topsoil layer and any unsuitable material was removed down to clean insitu alluvium, followed by placement of controlled fill and finished with topsoil.

Site specific testing - see details below.

¹ Aurecon (2016): "*Champions Mile – Geotechnical Investigation Report – Ngai Tahu Property Limited*", dated 23 September 2016; Revision: 1; Reference: 238331.

² Eliot Sinclair (2018) "*Inspecting Engineer's Report (NZS 4431:1989) – Stage 1B, Karamu Subdivision, Riccarton, Christchurch – Prepared for Ngai Tahu Property Ltd – 419748*" and dated 03 October 2018.

3 Site Specific Testing

Following the completion of the earthworks, we undertook site specific geotechnical testing across all residential lots within the subdivision. Testing within Lot 182 comprised 1 shallow spade hole and 3 hydraulic penetrometers³.

Table 1 presents the inferred ground profile in Lot 182. The site investigation factual records and test location plans are attached.

Table 1: Inferred ground profile in Lot 182.

| Depth (Below Ground Level) | Soil Description | Information Source |
|----------------------------|--|--|
| 0m to 0.4m | Silty TOPSOIL FILL. | Spade hole following the earthworks. |
| 0.4m to 0.45-0.55m | Controlled Fill: sandy SILT and/or silty SAND with minor to some gravel content. | Observations made during the earthworks. |
| 0.45-0.55m to 0.8-1.0m | In situ silts and sands. | Refusal depths from penetrometers and nearby CPTs. |
| 0.8-1.0m to >10m | In situ sandy gravels. | Site wide subdivision testing. |

4 Foundation Recommendations

The TC1 foundation design provisions of the MBIE residential guidelines⁴ apply to the site – refer to MBIE Section 5, Figure 5.1.

Typically, below the topsoil layer the penetrometer test results generally indicate a geotechnical ultimate bearing capacity >300 kPa. Standard foundations for dwellings within the scope of NZS 3604:2011 are suitable. Refer to MBIE Section 5.2 *Overview of new foundations options*.

For a more resilient design the TC2 raft foundations Options 2 – 4 are suitable for the site.

Foundations for dwellings outside the scope of NZS 3604:2011 require specific engineering design.

General foundation design and construction advice is as follows:

- 1 Foundations should be excavated through the topsoil layer and bear onto competent subgrade material.
- 2 All turf and topsoil shall be removed to at least 100mm bgl, along with any deeper areas of soft or organic rich topsoil, from beneath the lightly loaded floor slab area. The depth of the topsoil strip shall be confirmed at the time of inspection (as described in Section 5 below) to confirm a satisfactory surface is achieved. The subgrade will then need to be proof-rolled or compacted to achieve a firm uniform surface. The area can then be backfilled by placing and compacting AP40 sandy gravels in maximum 200mm thick loose layers to achieve a minimum dry density of 2150kg/m³ up to the underside of the floor slab.
- 3 Internal floor slab thickenings and any other pads that are supporting concentrations of weight from roof trusses or columns shall be supported on, or be replaced with, mass concrete filled pads of the same area that are excavated through the topsoil and bear onto competent subgrade material.

³ Hydraulic penetrometer testing was undertaken by Canterbury Geotest Ltd.

⁴ Ministry of Business, Innovation & Employment "Guidance: Repairing and Rebuilding houses affected by the Canterbury earthquakes".

- 4 Reinforcing in floor slabs shall be a minimum of 2.27kg/m² welded reinforcing mesh sheets and the reinforcing is to be Ductility Class E in accordance with NZS 4671.

5 Inspection Requirements

A suitably competent and experienced inspector should validate that the ground conditions exposed in the foundation excavations are consistent with the findings of this report and the foundation design assumptions. Loose material should be removed from excavations. Foundations should bear onto competent subgrade material.

The inspection can be undertaken by Council personnel or a consultant's engineering personnel.

Please contact us with **48 hours' notice** if you require Eliot Sinclair & Partners to undertake the inspection work. Following a satisfactory inspection, we will provide a *'Producer Statement - Construction Review'* to validate the exposed ground conditions.

6 Disclaimer

Comments made in this report are based on reporting by others, our earthworks reporting, our soil investigations, and the Ministry of Business Innovation & Employment Guidelines.

Whilst every care was taken during our investigation and interpretation of subsurface conditions, there may well be subsoil strata and features that were not detected. Additionally, on-going seismicity in the general area may lead to deterioration or additional ground movement that could not have been anticipated at time of writing of this report.

The exposure of such conditions, or occurrence of additional strong seismicity, or any future update of MBIE's guidelines or the NZBC, may require a review of our recommendations. Eliot Sinclair & Partners should be contacted to confirm the validity of this report should this occur.

This report has been prepared for the benefit of Ngāi Tahu Property Ltd (or purchasers of the site from Ngāi Tahu Property Ltd), and the Christchurch City Council. No liability is accepted by this company or any employee of this company with respect to the use of this report by any other party.

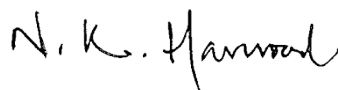
Yours sincerely
ELIOT SINCLAIR & PARTNERS LTD

Prepared By:



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Geotechnical Engineering Technologist

Reviewed & Approved for Release By:



Nick Harwood
BE(Hons) MSc DIC IntPE(NZ) CMEngNZ CPEng (1007273)
Principal
Senior Geotechnical Engineer

Encl.

- Site Investigation Records – 1 page.
- Eliot Sinclair & Partners drawings: *"Geotechnical Test Locations with Controlled Fill Thickness Contours Excluding Topsoil"*, Project No. 419748, Set No. G11, Sheet No. 1, Rev. A – 1 page.

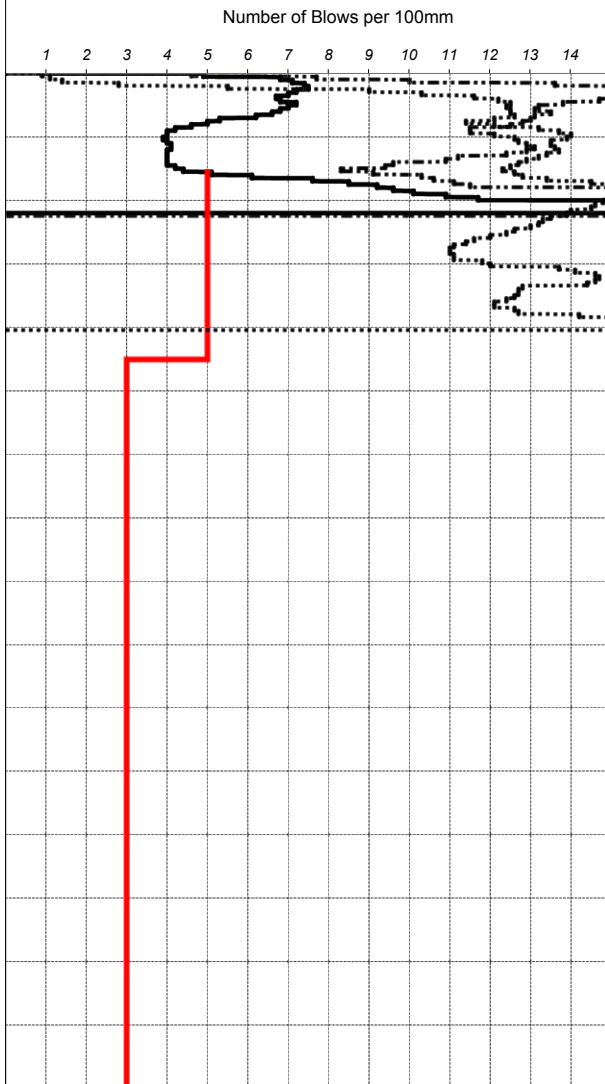
SITE INVESTIGATION RECORD

Client **Ngāi Tahu Property Ltd**

Site **Stage 1, Manakura Neighbourhood,
 Karamū Subdivision**

Technical Category
TC1 Equivalent

SCALA PENETROMETER TEST RESULTS



SOIL PROFILE

| Depth (m) | Test Location - Lot 182, A | Water |
|------------|---|-----------------------------|
| 0.0 - 0.2 | FILL: silty TOPSOIL, with some sand, with trace gravel; brown . Hard; moist; gravel, medium. | Groundwater Not Encountered |
| 0.2 - 0.4 | FILL: sandy SILT; greyish brown. Firm; moist. | |
| 0.4 - 0.55 | EOH: 0.45m - Target depth. 0.45m: Indicative depth of controlled fill at P02, P03 and A. 0.55m: Indicative depth of controlled fill at P01. | |
| 0.55 - 3.0 | | |

— Lot 182, P01 - - - Lot 182, P02 ···· Lot 182, P03

Minimum penetration resistance (based on 300mm wide footing founded at 300mm depth) required for "Good Ground" as defined in the Acceptable Solutions and Verification Methods for NZBC Clause B1 Structure.

SITE PLAN (Not to Scale)

Refer to Eliot Sinclair & Partners drawing "Geotechnical Test Locations with Controlled Fill Thickness Contours Excluding Topsoil"; Project No. 419748, Set No. G11, Sht No. 1 or 2, Rev. A.

COMMENTS

Penetrometers undertaken by Canterbury Geotest Ltd using their Hydraulic penetrometer rig.

Field Staff:

QJF

Prepared By:

QJF

Investigation Type

Hand Auger

Job Manager:

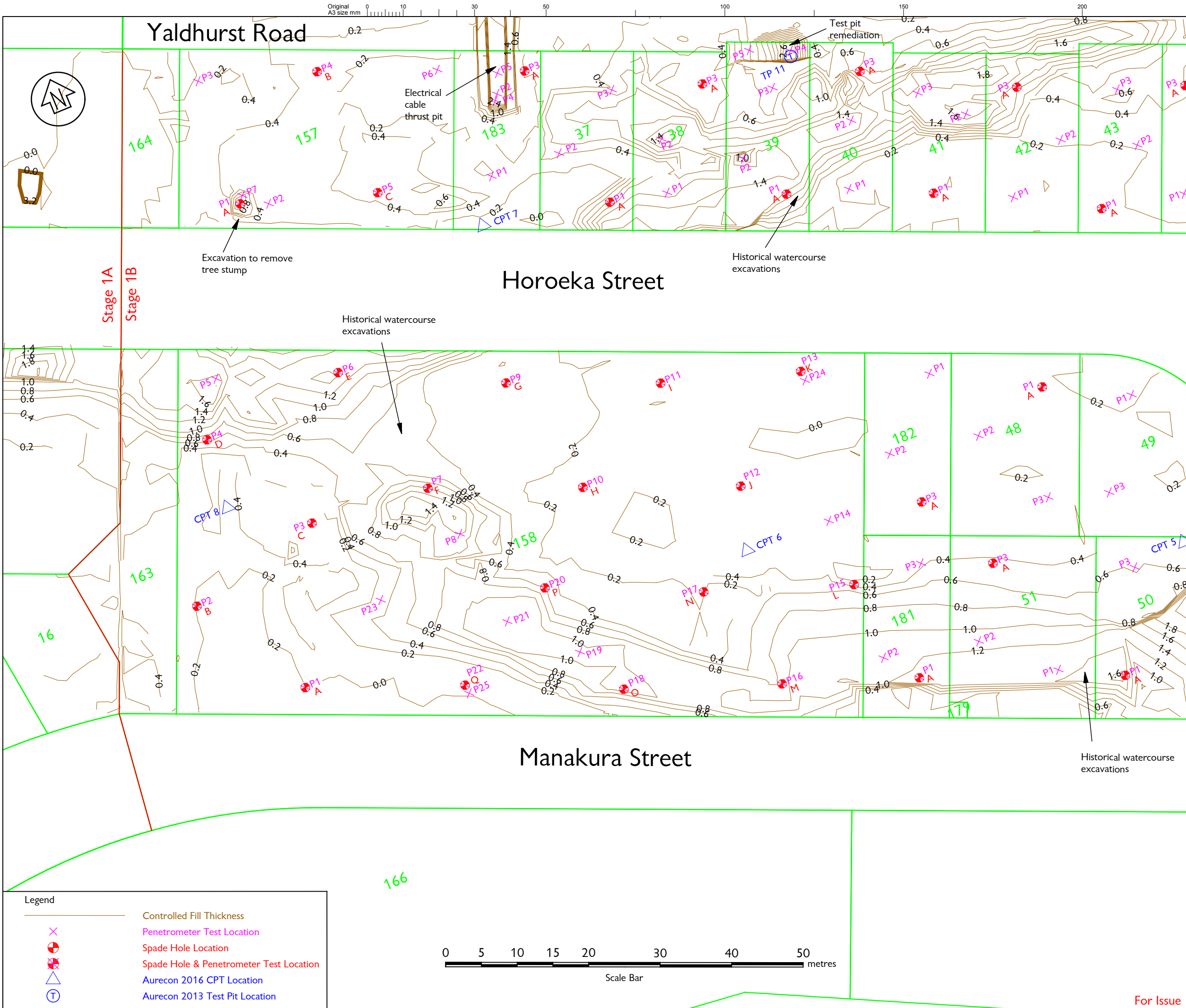
MAA

Approved By:

NKH

Spade Hole

Test Pit



Notes:
 1) The Aurecon test locations shown have been sourced from Aurecon New Zealand Limited - Champions Mile Geotechnical Investigation Report, Dated 23 September 2016. The coordinates of test locations have not been confirmed or verified by Eliot Sinclair.

| Rev. | Description | Drawn | Date |
|------|-------------|-------|------------|
| A | For Issue | RCP | 27/09/2018 |

| | | | | |
|---------------|--------------------|------------|-------------------|---------------------------------|
| Designed | Name | Date | Surveyed: | Survey Date: |
| Drawn | R.C. Paulsen | 24/09/2018 | Various | 12/2017 - 08/2018 |
| Drng. Chk | L.Jagvik, R.Orange | 24/09/2018 | Coord System: | NZGD2000 |
| Proj. Mgr | J. Schutte | | Origin of Levels: | Mt Pleasant Circuit |
| Design Review | | | Calibration: | City CDD |
| Approved | | | Origin of Levels: | EHCH |
| | | | | Masonry Nail and Washer in Kerb |
| | | | | 148 Yaldhurst Road |
| | | | | R.L. 31.287 |
| | | | | Datum: CDD |

Client
NGĀI TAHU Property

Project Title
KARAMŪ - SUBDIVISION
 Manakura Neighbourhood Stage 1B

Drawing Title
Geotechnical Test Locations with Controlled Fill Thickness Contours Excluding Topsoil

Scales
 1:500 [A3]

| Project No. | Set No. | Sht No. | Rev. |
|-------------|---------|---------|------|
| 419748 | G11 | 1 | A |

Eliot Sinclair
 surveyors | engineers | planners

Legend

| | |
|--|---|
| | Controlled Fill Thickness |
| | Penetrometer Test Location |
| | Spade Hole Location |
| | Spade Hole & Penetrometer Test Location |
| | Aurecon 2016 CPT Location |
| | Aurecon 2013 Test Pit Location |

