

Appendix 7

Geotechnical Earthworks Letter



Project Reference: 19103

24/11/2021

Onoke Heights Limited
C/- M Holland
mark@waibury.co.nz

Dear Mark,

EARTHWORKS DESIGN REVIEW

Onoke Heights, 67 Dip Road, Kamo, Whangarei

LDE Limited have been engaged to provide geotechnical engineering support for the Onoke Heights residential development at 67 Dip Road, Kamo, Whangarei.

A geotechnical suitability report has been prepared by LDE to support the resource consent for the proposed development, with preliminary recommendations for the earthworks design for the development.

A preliminary subdivision design has now been completed with earthworks plans prepared by Blue Wallace, reference 20253, and supplied to LDE for review prior to submission for resource consent.

This report outlines our review of the proposed earthworks design and is intended to support resource consent. Further investigation and analysis will be required to inform the design of specific structures for engineering plan approval and building consent.

1 PROPOSED DESIGN

The proposed design (latest version dated 23/11/2021 at time of review), broadly comprises:

- Bulk filling to form level or near level building platforms through to south-western and central areas of the site.
 - Filling is supported by a series of broad retaining walls along the base of Lots 1-16, below Lots 35 to 43, below Lots 56-62, below Lots 69 and 70, and at the northern boundary above Lots 74-78. Several other smaller walls are also proposed.
 - Retained heights up to 5m are indicated.

- Battered cuts along the north-eastern edge of the site, along the base of the small scoria cone slope, to form the road.
- A retained cut along the northern edge of the site, below the reservoir site and driveway.
- Various shallow battered cuts and fills to the southeast of the site form building platforms and the proposed stormwater pond.

2 GEOTECHNICAL ASSESSMENT

The stability of the site was previously assessed as part of the subdivision geotechnical suitability report. The site was found to be in a generally stable condition. The steep slope up to the scoria cone on the north-eastern edge of the site was deemed 'moderate' instability hazard (in accordance with WDC EES criteria), as was the steep arcuate slope into the stream on the southern boundary of the site. Further assessment has been undertaken to consider the effects of the proposed earthworks on these two areas.

Preliminary assessment of other areas of significant earthworks have also been considered, as outlined below. Further investigation and analysis of these other areas will be required.

2.1 North-eastern slope (Lots 80 – 92)

Stability analysis has been undertaken assess the stability of this slope and the proposed earthworks. The earthworks generally comprise significant down-cutting at the lower edge of the slope, to form the road. This cut will then be battered back to natural ground level towards the top edge of the sites.

The proposed cut is deepest at the south-western boundaries of Lots 88, 89 and 90, at up to approximately 5m depth. The sites are battered back from this edge at up to 1V:2.7H (20°).

The slope has been modelled as generally described in the subdivision suitability report and shown in the cross section appended to that report (drawing 19103 G-01).

Material strength parameters for the weathered and un-weathered scoria have been conservatively estimated based on assessment of existing slopes and in particular the deep quarry cut to the north-east of the hill. Parameters for the remaining units were as given in in the report. All parameters are shown on the appended printouts.

Modelling has been undertaken in general accordance with Whangarei District Council 'Land Development Stabilisation – Technical Design Requirements', April 2018¹. Normal/design groundwater, extreme groundwater, and seismic scenarios have been analysed. The normal groundwater scenario were found to be the controlling

¹ <https://www.wdc.govt.nz/Council/Council-documents/Policies/Land-Development-Stabilisation-Policy>

case, as would be expected given the very low groundwater table, favourable drainage conditions, and low seismicity at the site.

The slope was found to be stable in the design case with the proposed cut, with the factor of safety for failures through the slope being >1.7 . The existing design of these lots is therefore considered appropriate.

It was found that any significant steepening of the cut slope, and in particularly any deep cuts (i.e. an unsupported cut for the dwelling) would result in potential instability from the reserve land above the slope. As a result specific assessment and design would be required for any future dwellings on these sites. It is generally expected that the sites will be suitable for suspended pole houses or multistorey houses cut into the slope with retaining. At the design grade some minor cuts will be required to gain access into the sites. Cuts for access are likely to also require retaining.

2.2 Stream Bank Slope (Road)

The proposed subdivision design shows the road passing near the crest of the stream bank slope, with minor fills extending over the slope crest. This slope is inferred to be in a marginal state of stability, and is not expected to meet minimum factor of safety criteria and will require specific engineering design.

It is expected that a cantilevered timber pole retaining wall will be suitable to support the proposed fill for the road. Due to the presence of low strength tephra soils and the steep downslope angle it is likely that an engineered retaining wall will be required to achieve the required factors of safety.

2.3 Lot 78 (Reservoir Cut)

A large cut is proposed at the northern edge of Lot 78, adjacent to the Reservoir site. Earthworks plans show this being retained over 3m at the boundary.

Given the some-what unfavourable ground conditions for cantilever retaining, as noted in the geotechnical suitability report, and the potential surcharge loading that would need to be considered for the usage of the site above, it may not be practical to retain this slope. If retaining is proposed then this may need to be set within the site to reduce retained heights, which would then limit the building area.

It is recommended that this lot be graded to an even slope in a similar manner to Lots 80 to 92. The site would then be suitable for similar types of dwellings as outlined in Section 2.1 or may otherwise be cut flat and retained at the time of building consent, subject to specific engineering design.

2.4 Deep Fills

Through the central area of the site, fills up to approximately 6.5m are proposed. These are expected to be constructed as some form of MSE wall. The internal stability of the proposed fill will therefore need to be addressed as part of the geotechnical design. It is expected that global stability and bearing capacity will be

checked as part of the design. Preliminary analysis indicates that the proposed fill depths can be achieved with conventional MSE construction (e.g. Redirock walls), without significantly affected the instability hazard at the site.

Preliminary settlement analysis has been undertaken to check expected settlements under the proposed fill loads, with the primary concern being the potential consolidation of the loose tephra soil in the fill areas. Based on a lower bound oedometric modulus of 5MPa, estimated from the consolidation stages of CU triaxial tests, total expected settlement would be on the order 150 to 200mm. Further investigation and analysis are proposed as part of detailed design.

Settlement of the tephra soils is expected to be near immediate. No settlement of building sites is expected to occur beyond the completion of the subdivision.

3 CONCLUSIONS

Based on our review of the supplied earthworks design, subject to the above recommendations and detailed design requirements, the proposed works are not expected to adversely affect the stability of the site.

The building sites created by the works are expected to be suitable to support dwellings, subject to requirements for specific engineering design at some lots.

4 LIMITATIONS

This letter has been prepared exclusively for Onoke Heights Limited with respect to the brief given to us. Information, opinions, and recommendations contained in it cannot be used for any other purpose or by any other entity without our review and written consent. LDE Ltd accepts no liability or responsibility whatsoever for or in respect of any use or reliance upon this report by any third party.

This report was prepared in general accordance with current standards, codes, and practice at the time of this report. These may be subject to change.

This report should be read in its entirety to understand the context of the opinions and recommendations given.

For and on Behalf of Land Development and Engineering Ltd

Report prepared by:



Finlay Wallen-Halliwell
Engineering Geologist
BSc, PMEG

Report reviewed by:



Aaron Holland
Senior Civil & Geotechnical Engineer
CMEngNZ (CPEng)

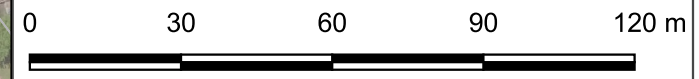
Attached: Stability Analysis for north-eastern slope



LEGEND

Section line

Basemaps
LINZ Aerial Basemap



SCALE A3: 1:1500

NOTES
 1. Aerial basemap and property boundaries sourced from LINZ Data Service (CC-BY 4.0).
 2. Design surface from Blue Wallace ref. 20253 dated 23/11/2021. See full earthworks plan set for details.

CLIENT
Onoke Heights

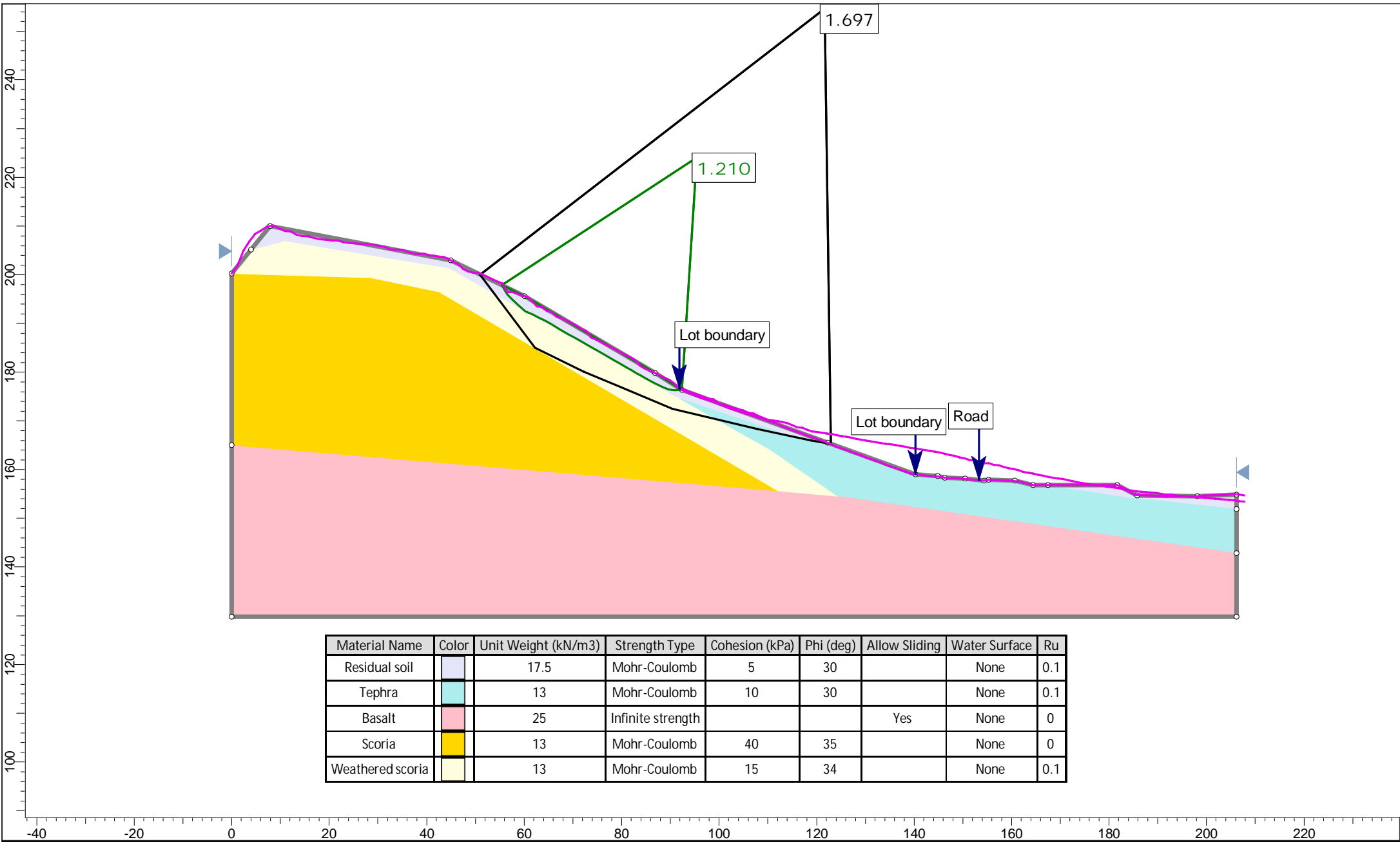
PROJECT
Onoke Heights Development
67 Dip Road
Whangarei

DRAWING TITLE
Cross section location plan



PROJECT REF	DRAWING REF	REVISION
19103	G02	A
DATE	PREPARED BY	CHECKED BY
23/11/2021	FWH	AH

FILE PATH
M-FILES\LDE - Project\0430\19103 - Dip Rd Earthworks Check\19103 Base Data v1.qgz



Material Name	Color	Unit Weight (kN/m ³)	Strength Type	Cohesion (kPa)	Phi (deg)	Allow Sliding	Water Surface	Ru
Residual soil	Light Blue	17.5	Mohr-Coulomb	5	30		None	0.1
Tephra	Light Green	13	Mohr-Coulomb	10	30		None	0.1
Basalt	Pink	25	Infinite strength			Yes	None	0
Scoria	Yellow	13	Mohr-Coulomb	40	35		None	0
Weathered scoria	Light Yellow	13	Mohr-Coulomb	15	34		None	0.1



Project		Section 101 - 67 Dip Road, Kamo 19103	
Analysis Description		Group 1 - Master Scenario	
Drawn By	FWH	Scale	1:1000
		Date	23/11/2021
File Name	19103 CS-101.slmd		