

9 May 2017

Raymond O'Brien and Victoria Pichler
C/- Terra Group NZ Limited
PO Box 12858
Penrose Auckland

Dear Raymond and Victoria,

RE: Geotechnical Plan Review of 287 Tuhirangi Road, Makarau, Auckland
(Our Reference: 13704.000.001_02)

1 Introduction

ENGEO Ltd was requested by Terra Group NZ Limited (Terra) on behalf of Raymond O'Brien and Victoria Pichler to provide a geotechnical review of the proposed Range Isopach Plan by Terra Group NZ Ltd (project number: 23406, drawing number: CP-200, rev: A, received 27 April 2017 for the NZ Shooting Sports Centre. This plan is included at the rear of this report as Attachment 1.

Based on our discussions with Dale Boddie of Terra (emails dated 26 and 27 April 2017), we understand the proposed clubhouse is to be relocated offsite and it is intended to construct 33 shooting bays, two areas for car parking and an accessway.

This report should be read in conjunction with our Geomorphic Assessment Report of 287 Tuhirangi Road, Makarau (project number: 13846.000.000_02, dated 17 March 2017).

2 Review of Proposed Earthworks Plans

We have been provided with the proposed Range Isopach Plan by Terra Group NZ Limited (described above). Based on our review of the plan and discussions with Dale Boddie, we have summarised the key geotechnical features below;

- 33 new shooting bays are to be constructed ranging from 20 m to 36 m in length;
- Two new carparks covering approximately 47,000 m²;
- Anticipated 68,000 m³ of cut and 22,000 m³ of fill, with cut and fill thicknesses varying from up to 12 m and 9 m across the site, respectively. The greatest volume of fill is to be placed in the northeast corner of the site, and the greatest volume of cut is located between shooting bays 24 and 26;
- Removal of material at the base of the slope at the back of the northern shooting bays 23 to 30. The proposed cut slopes range from 12° to 25°; and

- Removal of material at the base of the slope at the back of the northern shooting bays 15, 16 and 12 in the northeast corner of the site. The proposed cut slopes range from 20° to 55°.

3 ENGEO Past Investigations

ENGEO has completed a geomorphic assessment of the site (described above) comprising of a review of historical aerial photography, preparation of a geomorphic map encompassing the area of development, and seven test pits. Our assessment identified three geologic units onsite; Mahurangi Limestone, Cornwallis Formation and East Coast Bays Formation. We also found evidence of active and historic instability in the form of shallow and deep-seated failures.

We provided recommendations for further subsurface investigations and development of cross sections for computational slope stability analyses.

4 Geotechnical Conclusions and Recommendations

Based on our past site investigation and observations, and review of the proposed Range Isopach Plan by Terra Group NZ Ltd (project number: 23406, drawing number: CP-200, rev: A, received 27 April 2017), we consider the site to be generally suitable for the proposed development. We recommend further geomorphic and slope stability assessment of the slopes located adjacent to shooting bays 23 to 28, as the proposed cut in this location is significant and there is a risk that the cut may destabilise the toe of the slope.

Due to the geological setting of the site and restrictions with access for further investigations at present, it is our opinion that the risk of instability along shooting bays 12, 15 and 16, and 23 to 28 is unable to be adequately quantified until earthworks are well underway and access to the cut area is made possible.

We recommend that additional geotechnical assessments be conducted during the earthworks to further develop the ground model and complete computer slope stability analyses. This will enable us provide recommendations during construction for earthworks modifications and / or slope retaining measures where required.

5 Earthworks Operations

We understand that final site layout and earthworks / site preparation requirements have not yet been finalised. Accordingly, we recommend that the site preparation plans be discussed with ENGEO (or a suitably qualified Geotechnical Engineer familiar with both the site and the content of this report) for advice regarding optimising slope stabilisation and cut-to-fill operations during earthworks and site preparation.

In addition, we provide the following preliminary recommendations to assist with developing the site development and grading plans:

- During excavation, all undocumented fill and loose / soft / organic material should be removed from the base of excavations prior to filling. All topsoil in areas of earthworks should be stripped prior to fill placement. Exposed subgrades should be firm and non-yielding and free and any loose soil or debris prior to placement of fill;
- All excavated soil should be either removed from site or placed in an engineer approved stockpile at an appropriate location to avoid unfavourable loading on construction or

preconstruction slope batters, particularly in the vicinity of the stream in the southeast corner of the site;

- All cuts greater than 1.5 m in soil or rock should be supported with a specifically designed retaining wall or properly keyed and benched into native ground and will need to be approved by a Chartered Professional Engineer practising in Geotechnical Engineering;
- For planning purposes, unsupported, finished slope grades should be no steeper than 1 Vertical to 2: Horizontal (26 degrees from horizontal) in soil;
- All excavated soil should be removed from site or placed in an engineered stockpile that is strategically placed such that would not trigger slope instability. If there is any soil to be placed permanently on site, we suggest contacting ENGEO for further guidance; and
- Any proposed earthworks and drainage plans should be approved by a suitably qualified Geotechnical Engineer familiar with both the site and the recommendations within this report for review and comment.

6 Limitations

- i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our clients, Raymond O'Brien and Victoria Picher, 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 IPENZ / 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



Kuanjin Lee

Engineering Geologist

Report reviewed by



Don Bruggers, MIPENZ, CPEng

Principal Geotechnical Engineer



Heather Lyons

Senior Engineering Geologist

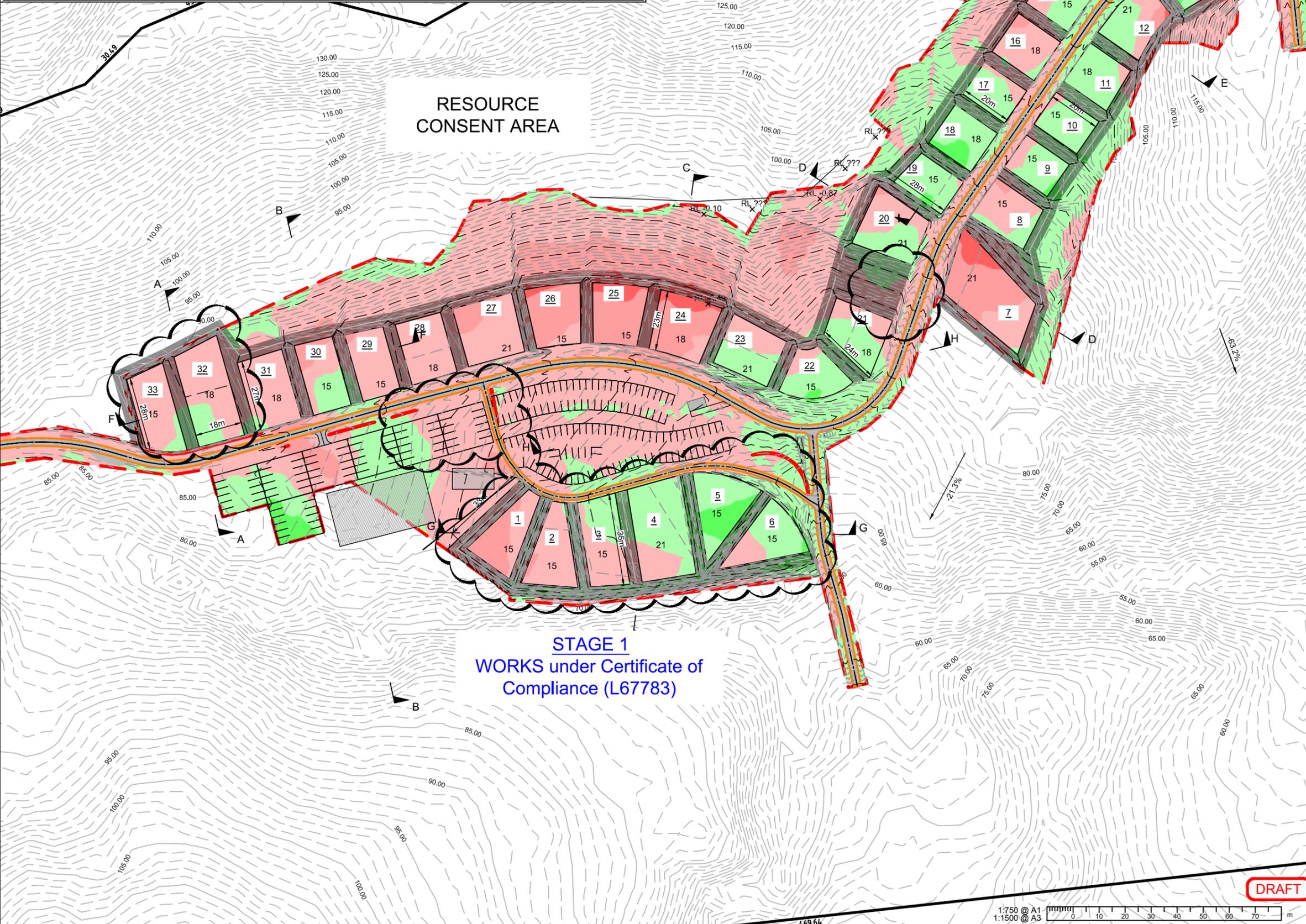
Attachments:

Proposed Range Isopach Plan

EARTHWORKS SUMMARY			
	AREA	CUT	FILL
EARTHWORK AREA - (WHOLE SITE INCLUDING MINOR EXISTING ROAD ADJUSTMENTS)	57,000 m ²		
UNADJUSTED EARTHWORKS (INCLUDING RANGE AND ROAD EARTHWORKS) EXCLUDING SUBGRADE VOL.		68,000 m ³	22,000 m ³
CONTAMINATED			
ESTIMATED UNSUITABLE MATERIAL (e.g. PEAT, MX RAMPS, CONCRETE)		- 2000 m ³	
TOPSOIL VOLUME (ASSUME 0.3 OVER RANGE AND CARPARK AREA 47,000m ²)	47,000m ²	14,100 m ³	

REVISION			
ISSUE	DATE	DETAIL	
A	15/09/16	FOR INFORMATION	

SURFACE LEVEL DATA			
NUMBER	MINIMUM LEVEL	MAXIMUM LEVEL	COLOUR
1	-12.00	-9.00	Red
2	-9.00	-6.00	Red
3	-6.00	-3.00	Red
4	-3.00	0.00	Red
5	0.00	3.00	Green
6	3.00	6.00	Green
7	6.00	9.00	Green



STAGE	
PROJECT CONSULTANTS	
 PO BOX 12858, Penrose, New Zealand Auckland: (09) 357 3557 Northland: (09) 431 4444 Christchurch: (03) 379 5055 Email: terra@terragroup.co.nz Web: www.terragroup.co.nz	
DRAWINGS ARE COPYRIGHT AND PROPERTY OF TERRA CONSULTANTS	
CLIENT	
V.PICHLER	
PROJECT	
NZ SHOOTING SPORTS CENTER	
LOCATION	
273 TUHIRANGI ROAD, MAKARAU, AUCKLAND	
DRAWING TITLE	
RANGE ISOPACH PLAN	
ORIENTATION	SCALE A1: 1:750 A3: 1:1500
	DATE 15/09/2016
	SURVEYED
	DESIGNED D.B.
	DRAWN D.BODDIE
	CHECKED G.C.
PROJECT NUMBER 23406	DWG NUMBER CP-200 REVISION A