Late Circulation

Regulatory Committee Meeting

7 December 2017

HURUNUI DISTRICT COUNCIL

MEETING REPORT

To: Regulatory Committee

Report Prepared By: Sean Crocker, Senior Planner

Date: 7 December 2017

Significance Level: Low

Appointment of Hearing Panel for RC170163

Recommendation

THAT THE COMMITTEE APPOINT A PANEL OF ELECTED COMMISSIONERS TO HEAR AND MAKE A DECISION ON LAND-USE CONSENT RC170163.

Executive Summary

The applicant 7 Seven 7 Limited seeks consent to construct two holiday homes at 2 Oregon Heights, Hanmer Springs. The property size is less than the minimum area required for two holiday homes on one site.

Officers consider that approval of this application would trigger other similar developments that the rules in the Proposed Hurunui District Plan as Amended by Decision 2016 ("the Proposed Plan") did not anticipate in the Residential 1H zone.

Officers therefore recommend that the application be decline to maintain the integrity of the Proposed Plan.

The Delegations Manual specifies that any decision to decline a resource consent application is at the discretion of a qualified hearing commissioner/s only. Therefore this report seeks the appointment a commissioner or panel of commissioners to hear and make a decision on the proposal.

Background

Resource consent RC170163 was submitted to the Council to construct and operate two self-contained holiday homes at 2 Oregon Heights, Hanmer Springs.

The two dwellings are purpose built two-bedroom units, each approximately 90m^2 in size. The design of the dwellings would generally be consistent with the Hanmer Springs residential design standards. The exception being that the roof material and trim colour are not permitted. Officers consider the departure in design was consistent with and therefore had minimal effect in terms of the standard of design anticipated with the village.

The activity was not deemed visitor accommodation. Holiday homes are not included in the definition of visitor accommodation. There is also no managers' residence or office onsite as would be required for other visitor accommodation such as motels, hotels and camping grounds.

The Proposed Plan requires a minimum area of 700m^2 for every one holiday home on a property. The site is 989m^2, larger than the minimum area required for one holiday home, but 411m^2 less than the area required for two houses.

Officers have determined that the adverse effects of the proposal on neighbours and wider community would be less than minor, therefore notification was not required.

Officers considered that the proposed activity would maintain the amenity and visual values enjoyed within the receiving residential environment. The activities would comply with all boundary setbacks, access to sunlight and height rules in the Proposed Plan. The holiday homes can be adequately serviced by Councils water and sewerage networks. Stormwater will need to be controlled and discharged appropriately onsite. Access to the site will be improved to avoid vehicle towballs scraping on the road. The site and car parking area will be screened from adjacent properties by landscaping along the road frontage.

The applicant has offered a "no subdivision" covenant in favour of the Council. The covenant will be registered on the certificate of title to ensure that the site cannot be subdivided in the future. The covenant gives the Council the right to refuse any subdivision of the site prior to an application being lodged.

However, officers were concerned that there were no unique features about the site or activity that would stop a flood of applications for multiple holiday homes on undersized properties. The proposal was not what the minimum site area rules in the Proposed District Plan sought to promote in Hanmer Springs. Therefore, the officers recommend that the consent application be declined.

Discussion

At present the consent is on hold. The officers are awaiting a response from the applicant as to whether they can provide further evidence that the activity is unique, or that a hearing is required. Until then, commissioners cannot be appointed until a date for the hearing is known and availability is confirmed. This report seeks a mandate from the committee as to whether an individual commissioner or panel of commissioners should be appointed to make a decision on the resource consent application.

The Resource Management Act 1991 ("the Act") allow hearings to proceed with either an individual commissioner or panel of qualified commissioner's. The commissioner/s can either be qualified independent commissioner/s and/or qualified Councillor commissioner/s. A hearings panel can be a combination or either independent or elected commissioners. The Act also allows the hearing to be chaired by a commissioner who is also a qualified chairperson or not.

The Delegations Manual requires that only qualified Councillors, and/or those independent commissioners listed in the "Approved Commissioners List" can be used for resource consent hearings.

At present only two elected members Cr Dick Davison and Cr Marie Black are fully accredited commissioners.

Officers recommend that Dean Chrystal and Justine Ashley (approved commissioners) be approached if an independent commissioner/s are required. Dean and Justine are regular commissioners used for hearings in

	the Hurunui District and are both knowledgeable on the Proposed District Plan and the district. When a date for the hearing is known, and where the committee deems it necessary, Officers will approach the commissioners mentioned above to confirm their availability.
Significance	The report is of low significance. All that is requested is that the committee determine whether an individual commissioner or panel of commissioners is required to make a decision on the proposal and the make-up of any panel.
Financial Considerations	The cost of the hearing beyond the fixed fee payment is recoverable.
Options	1. Appoint an independent commissioner. 2. Appoint an elected commissioner. 3. Appoint a panel of independent commissioners. 4. Appoint a panel of elected commissioners. 5. Appoint a panel of both independent and elected commissioners.
Report Prepared by:	 Sean Crocker Senior Planner
Report Reviewed by:	 Judith Batchelor Manager Regulatory Services
Officer in Attendance:	The report author will be in attendance to speak to this report.

HURUNUI DISTRICT COUNCIL
MEETING REPORT

To: Regulatory Committee

Report Prepared by: Monique Eade, Policy Planner

Date: 7 December 2017

Significance Level: Medium

Cliff Erosion / Stability Assessment Report for 31 Moody Street, Gore Bay

Recommendation	THAT THE COMMITTEE RESOLVE THAT A 10 METRE SETBACK BE IMPOSED FROM THE TOE OF THE CLIFF AT 31 MOODY ST, GORE BAY.
Background	A landslip occurred at the neighbouring property during a storm in 2014. Subsequent to the November 2016 earthquake Council commissioned Kirk Roberts Consulting to undertake an assessment determining the landslip and rockfall hazard at the site.
Key findings	The report considered aerial and satellite photography, previous literature and a site assessment to provide its recommendations. They found: • That the risk of rockfall at 31 Moody Street due to strong ground shaking is low to moderate. • That the primary natural hazard at the site is falling debris and the secondary hazard is shallow surficial landslips. • The primary cause is considered to be the natural weathering.
Recommendations for mitigation	In their report they suggest: • A 10 metre set-back from the toe of the cliff, especially during periods of heavy rain; or • A suitably designed retaining wall and / or rockfall barrier.
Cost effectiveness	Designing and building an adequate rockfall barrier is likely to be costly; quotes have not been requested as yet. The attached report suggests that any rockfall barrier would need to be set back three metres from the toe of the cliff. Officers are aware from discussion with the Port Robinson Reserves Advisory Group that the area near the cliff is only being used for the storage of caravans. Due to the cost of mitigating the risk and the ongoing maintenance of any mitigation work officers recommend that a 10 metre setback be imposed from the base of the cliff.

Recommended next steps	1. The findings of the report are to be discussed with the Camp Ground Manager. 2. This report is to be presented to the Cheviot Ward Committee at their next meeting.
Financial considerations	The preparation of this report was budgeted for. No additional funding is required at this time.
Legal considerations	This report will now form part of the Land Information Memorandum for 31 Moody St, Gore Bay.
Significance Consideration	This project is of medium significance due to the potential impact it has on a handful of ratepayers.
Appendices	Appendix 1 – Cliff erosion / stability assessment report including appendices A and B Appendix 2 – Appendix C of above report
Report Prepared by:	 Monique Eade Policy Planner
Report Reviewed by:	 Judith Batchelor Manager Regulatory Services
Officer in Attendance:	The report author will be in attendance to speak to this report.

STRUCTURAL
GEOTECHNICAL
CIVIL
FIRE

CLIFF EROSION/STABILITY ASSESSMENT REPORT

31 MOODY STREET
GORE BAY

PREPARED FOR HURUNUI DISTRICT COUNCIL

JOB No	1710421
DATE:	1/12/2017
ISSUE:	A

KIRK | ROBERTS
CONSULTING ENGINEERS

QUALITY CONTROL

Title:	**31 Moody Street, Gore Bay** **Cliff Erosion/Stability Assessment Report**
Client:	**Hurunui District Council**
Job Number :	**1710421**
Issue:	**A**
Date:	**1 December 2017**
Prepared By	**Name:** Scott McHardy BEng (Hons) Engineering Geology **Signature:**
Authorised By	**Name:** Jordan Walker BScGE,CPEng, MIPENZ, IntPE(NZ) **Signature:**

LIMITATIONS:

This report has been prepared at the specific instruction of our client, Hurunui District Council in connection with the geotechnical assessment of cliff erosion/stability at 31 Moody Street, Gore Bay. No liability is accepted by this company or any employee of this company with respect to its intended use by any other person or persons.

The subsurface soil conditions and the interpretations reported are those identified at the test locations at the time of the investigation and are subject to the limitations of the investigation methods. The test results represent only a small test sample of the total subsurface soils. Soil conditions may vary between the test locations and interpretation of the soil information and test results must take into account the spacing and plan location of the tests.

If subsurface conditions encountered on the site during construction appear to vary from those inferred from the information contained in this report, Kirk Roberts Consulting Engineers Ltd requests that it be notified immediately.

This report is only valid for the proposal as outlined in the introduction and the information and interpretation of the content in this report may not be relevant if the proposed development is altered in any way.

If the recipient of this report wishes to contact Kirk Roberts Consulting Engineers Ltd, either;
Email: info@kirkroberts.co.nz or Phone: 03 379 8600.

TABLE OF CONTENTS

1 INTRODUCTION

Kirk Roberts Consulting Engineers Ltd (Kirk Roberts) has been engaged by Hurunui District Council to undertake an assessment of cliff erosion/stability at the site designated 31 Moody Street, Gore Bay (hereafter referred to as the 'site').

An assessment of the neighbouring property at 42 Moody Street was completed in May/July 2014 by Tonkin & Taylor Ltd on behalf of the Earthquake Commission (ref: 53548.6691 'Claim for Natural Disaster (Landslip) Damage – O'Connor, 42 Moody Street, Gore Bay, Cheviot – EQC Ref:2014/006691). The purpose of the investigation was to assess the claim for natural disaster damage as a direct result of the landslip that occurred at the rear of the property. Subsequent to the magnitude 7.8 Kaikoura earthquake that struck 15km north-east of Culverden on 14th November 2016 causing widespread damage to buildings, infrastructure, and natural features throughout the region, Kirk Roberts Ltd have completed a site inspection to determine the magnitude of landslip and rockfall hazard at the site.

This assessment report presents the results of a geotechnical site investigation and site walk-over evaluation undertaken on the 4th September 2017 at the subject property and surrounding areas, and a desktop study review of historic aerial imagery of the subject area. The purpose of this assessment is to provide the findings of the investigation, and discussion of the following geotechnical aspects:

- Assessment of cliff erosion/stability
- Current/ongoing risk to the existing property from cliff collapse
- Recommendations for protection of land and/or properties
- Recommendations for further investigations/analysis (if required)

2 SITE DESCRIPTION

The site has the physical address 31 Moody Street, Gore Bay, Cheviot and is bound by neighbouring residential properties to the north and south. The site is a long rectangular parcel of land, split in two by Moody Street which divides the property into two sections; RS 41116 to the east which has an area of 3,937 m^2 and RS 41117 on the west side with an area of 19,168 m^2. Both sites are owned by the Hurunui District Council and are operated as the Gore Bay Campsite. The eastern section is relatively flat and level, although adjacent to the eastern boundary the ground slopes steeply down to the Gore Bay beach. The western section can be further divided into two areas; the western half which comprises a near vertical cliff with steeply sloping vegetated land upslope of the cliff, and the eastern half which comprises a gently sloping grassed area situated between the cliff face and Moody Street.

The main area of concern is the cliff face and the campsite area that is located immediately adjacent to it and extends to the roadway. This area is not developed with permanent structures but is occupied by several designated tent sites. The tent sites are located along the eastern boundary, adjacent to the road, and along the base of the cliff face to the west. It is our understanding that the tent sites along the base of the cliff are no longer used for camping, at the instruction of the campsite manager.

The location of the site and surrounding area is presented in Figure 2.1.

Figure 2.1: Indicating the location of 31 Moody Street (Canterbury Maps).

3 GEOTECHNICAL INVESTIGATIONS

The Kirk Roberts geotechnical investigation included a site walk-over assessment and shallow soil testing carried out on the 4th September 2017. The exploratory investigations consisted of three hand augered boreholes (HA1 – HA3) and three Scala penetrometer tests (SP1 – SP3) to a target depth of up to 3.0 m below ground level (bgl) to assess the near-surface soil profile for the purpose of developing a geotechnical model for the assessment of instability.

The soil investigations are summarised in Table 3.1 below:

Table 3.1: Summary of investigations

Test type/code	Depth of test (m)	Comments
Hand auger *HA1 – HA3*	0.3 – 3.0	HA2 refused in gravelly topsoil
Scala Penetrometer *SP1 – SP3*	0.3 – 3.0	-

4 SUB-SURFACE CONDITIONS

4.1 Published Regional Geology

Published geology[1] of the area suggests that the site is located in close proximity to the boundary of three geological units; undifferentiated sandstone and siltstone of the Motunau Group (including Mount Brown and Waikari formations), Greta Formation siltstone, sandstone, mudstone and conglomerate of the Motunau Group, and Late Quaternary beach and terrace cover deposits.

[1] QMAP Kaikoura: Rattenbury, M.S.; Townsend, D.; Johnston. M.R. (compliers) 2006: Geology of the Kaikoura Area. Institute of Geological & Nuclear Sciences 1:250,000 geological map. Lower Hutt, New Zealand. GNS Science.

The Late Quaternary deposits include beach sand, gravel, shell and boulder banks of the modern coastal plain; marine gravel, sand and mud beneath low coastal terraces. The underlying geology of the Motunau Group comprises weak Miocene to Pliocene age sedimentary rocks formed of siliceous, micritic limestone (Amuri Limestone), locally inter-bedded with siltstone, marl, sandstone, chert or greensand. The Greta Formation is part of a group of sedimentary rocks located on the eastern coast of the north Canterbury hills, and is described as consisting of poorly bedded marine, deltaic and fluvial deposits, including conglomerates.

4.2 Soil Profile

A geotechnical investigation comprising shallow hand augered boreholes and Scala penetrometers indicates a soil profile consisting of topsoil over very loose to medium dense sand to the 3.0 m test termination depth, in the vicinity of the beach front (HA1). At test location HA3, in the vicinity of the cliff, the soil profile is noticeably different with topsoil overlying firm, becoming stiff with depth, clayey silt to 1.7 mbgl over dense silty sand to the 2.0 mbgl test termination depth. Test location HA2 was attempted in multiple locations and all encountered early refusal within the gravelly topsoil material.

Tables 4.1 and 4.2 show simplified soil profiles for the site:

Table 4.1: Simplified soil profile for HA1 (towards the beach)

Top of layer (m)	Description	Strength/Density
0.0	TOPSOIL	-
0.3	SAND	Very loose to medium dense

Table 4.2: Simplified soil profile for HA3 (towards the cliff)

Top of layer (m)	Description	Strength/Density
0.0	TOPSOIL	-
0.4	Clayey SILT	Firm to stiff
1.7	Silty SAND	Dense

The encountered soil profiles are consistent with Late Quaternary beach and terrace cover deposits at the locatoin of HA1. At the location of HA3 soils consistent with colluvium and residually weathered soils consistent with the Greta Formation were encountered. At the base of HA3 angular fine to medium gravels were recovered which is consistent with the weathering profile of an underlying rock layer. At the location of HA2, the gravelly topsoil is likely indicative of fill placed during the formation of a level platform for the campground.

5 DESKTOP STUDY

5.1 Review of Existing Hazard Assessment Report (42 Moody Street)

The Tonkin & Taylor report indicates the occurrence of a landslip on steeply sloping land immediately upslope of the cliff face, to the west of the property at 42 Moody Street. The debris flow comprised of soil, boulders and large scrub plants and covered approximately 45 m^2 of the sloping garden area, thought to be a talus slope, at the rear of the dwelling. It was noted that boulders, originating from the cemented gravel conglomerate bed had become loose and fallen, subsequently impacting and causing damage to a timber pole retaining wall. It was concluded that the landslip occurred as a result of heavy rainfall events in April 2014.

5.2 Review of Aerial Imagery

Cliff Regression

Historic aerial imagery of the site was obtained from Environment Canterbury (ECan) Geological Information Service (GIS) and Google Earth, from which relevant images have been reviewed. The aim of the review process is to determine what, if any, regression of the clifftop has occurred over this time. If the cliffs have regressed, then a review of the imagery will allow for an estimation of the annual rate of regression to be determined. Specific attention will be given to aerial imagery taken before and after a historically documented seismic event. Specifically, the rate of cliff regression as a result of recent seismic events (in particular the 14th November 2016 Kaikoura event and the September 2010 and February 2011 Christchurch events).

Table 5.1 below presents a summary of the reviewed aerial images (all images include the subject property and surrounding area).

Table 5.1: Summary of aerial images

Source	Date of Aerial Image	Comments
Google Earth	23rd February 2010	
Google Earth	10th February 2015	
Google Earth	15th November 2016	Taken after the 14th November 2016, Kaikoura Earthquake (Image very dark and indistinct)
Google Earth	19th November 2016	Taken after the 14th November 2016, Kaikoura Earthquake

Drawing G1.0 (refer to Appendix A) shows the regression of the cliff top area from 2010 to 2016. We have taken the cliff edge to be where the land starts to noticeably slope downwards, not necessary the edge of a vertical or near vertical face, in order to provide a conservative estimate of cliff regression. We have not used the image from 15th November 2016 due to darkness and lack of clarity. It should also be noted that the ground surface profile across the western half of the subject property includes a series of near vertical faces, as well as moderately to steeply sloping topography. This varied landform, in conjunction with heavy vegetation coverage has meant there is a margin of error (±5.0 m) in the identification of a suitable reference line across the cliff face.

As can be seen from drawing G1.0, between 2010 and 2016 there is negligible regression of the cliff. In addition, the boundary between the relatively flat camp site and the toe of the steeply sloping cliff appears to remain static, although the sloping cliff face is again heavily vegetated and difficult to accurately define.

Rockfall

As described above, there has been negligible erosion of the cliff face at 31 Moody Street between 2010 and 2016 and review of all available aerial imagery identifies no displaced rocks, soil or vegetation to have run-out across the camp site.

5.3 Seismic Hazard

Although the property is within an area that is part of the North Canterbury Fold and Thrust Belt, where relatively frequent earthquakes can be experienced, there are no active faults in the immediate vicinity. Frequency of earthquakes is dependent on the tectonic activity of the plate boundary that runs through central New Zealand. It is believed that up to 10 significant earthquake events, of magnitude 6.5 to 7.5, have occurred in the region over the 150 years prior to 2010.

Based on this information and review of historic aerial imagery, we consider the risk of rockfall at 31 Moody Street due to strong ground shaking to be low to moderate.

Liquefaction susceptibility mapping for the Hurunui District Council is presented on the Canterbury Maps database (refer to figure 5.1). The subject property at 31 Moody Street is located within a zone of nil to extremely low liquefaction potential and is designated as rock or hill soils.

Based on this information we consider the risk of cliff instability due to liquefaction of susceptible soil at 31 Moody Street to be extremely low.

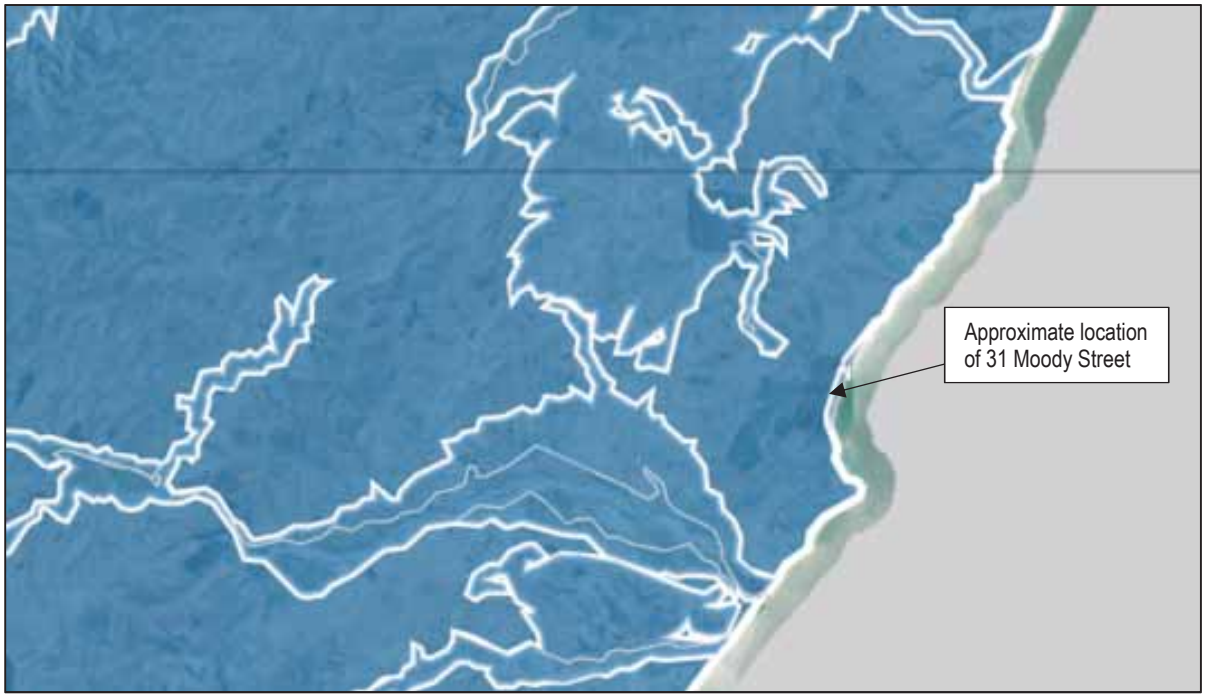


Figure 5.1: Hurunui Liquefaction Susceptibility (Canterbury Maps).

6 ENGINEERING GEOLOGY ISSUES

6.1 Site Assessment

Kirk Roberts Consulting Engineers Ltd carried out a site visit and walk-over assessment on the 4th September 2017. The following items were noted:

- At the base of the cliff the underlying soil profile includes topsoil over firm to stiff clayey silt, over dense silty sand. This profile is consistent with colluvium overlying residually weathered soil. Soils encountered were firm-stiff generally increasing to very stiff at the base of the hole where practical refusal was achieved on inferred rock.
- The cliff face is generally moderately steep to near vertical, and comprises weak rocks of the Greta Formation.
- There is evidence of general frittering of loose material along the cliff face, although no material was seen to have run-out across the camp site grounds.
- Areas of the cliff face overlooking the camp ground are generally well covered by vegetation, however several bare areas were observed. This suggests erosion of the surface material and subsequent displacement of the vegetation.

- There is little evidence of global slope instability although there is the potential for shallow surficial landslips (ie less than 1.0 m in depth) to occur, as evidenced by areas of displaced vegetation and the slip that occurred on the neighbouring site.
- Overland flow into gulley's has caused the concentration of water flow and the formation of cavities within the cliff face. The erosion of fines has led to a localised weakening of the soil/rock matrix and the potential for larger gravel, cobbles etc. to become displaced.
- The site manager has installed a wire mesh rockfall barrier at a critical point along the toe of the cliff face. A significant amount of rockfall debris was seen to have accumulated behind the barrier (photo 1).
- The site manager has stopped the use of tent sites that are along the toe of the cliff face due to the risk of falling rock debris.

Photo 1: Rockfall protection barrier installed by campsite manager

6.2 Method of Cliff Erosion

Based on site observations we conclude that the dominant natural hazard at the site is falling debris, with the secondary hazard being surficial landslips of the overlying residually weathered soils. The primary cause of these hazards is considered to be erosion of fines within the soil/rock matrix due to surface run-off and periods of heavy rainfall. Seismicity and strong ground shaking is considered to have less of an influence on cliff stability than erosion.

6.3 Cliff Erosion/Stability Protection Measures

As evidenced by the above photo, rockfall material of up to cobble size was seen to have collected behind, and in some areas in front of, the existing rockfall barrier. We are unsure if any of the fallen material that is currently located in front of the barrier was displaced prior to its erection, or whether the debris managed to work its way through, under, or around the barrier subsequent to it being built.

Potential runout of landslip material has been assessed based on a cliff height of 20 m, a conservative 0.5-1.0 m thickness of near surface colluvium, and an angle of repose of 18 degrees (1V to 3H). By considering these parameters, we estimate that runout resulting from a typical shallow slip failure could extend to a distance of 6-8 m from the base of the cliff. By applying a factor of safety of 1.25 (or 25%) we consider a safe set-back from the toe of the cliff to be 10 m. This restriction zone may be reduced subject to the installation of new, suitably designed and constructed retaining structures and/or rockfall protection barriers. The retaining structures/rockfall barriers would be subject to specific design but preliminary assessment suggests they would be 2.0-2.5 m high and installed a minimum of 3 m from the toe of the cliff, along the length of the camp ground at risk as presented in Drawing G1.0, Appendix A. Appropriate maintenance of the structure is required to prevent reduced functionality, including the regular removal of accumulated debris.

Construction of retaining structures are subject to setting out and identification of the cliff base by an approved surveyor.

Where possible, we recommend maintaining adequate vegetative cover to help bind the overlying residual soils and reduce the likelihood of ground crack/tunnel gulley formation. Measures to control surface water runoff should also be implemented to reduce the potential for erosion of the loess soils and ingress of water into existing ground cracks/cavities.

All remedial protection measures should receive appropriate maintenance, including periodic inspections and removal of built up debris.

7 CONCLUSIONS

This assessment report presents the results of a geotechnical site investigation and site walk-over evaluation undertaken on the 4th September 2017 at the subject property and surrounding areas, and a desktop study review of historic aerial imagery of the subject area.

The geotechnical investigation comprising shallow hand augered boreholes and Scala penetrometers indicates a soil profile consisting of topsoil over very loose to medium dense sand to the 3.0 m test termination depth, in the vicinity of the beach front (HA1). At test location HA3, in the vicinity of the cliff, the soil profile is noticeably different with topsoil overlying firm, becoming stiff with depth, clayey silt to 1.7 mbgl over dense silty sand to the 2.0 mbgl test termination depth.

Review of a Tonkin & Taylor report for the site adjacent to 31 Moody Street indicates the occurrence of a landslip on steeply sloping land immediately upslope of the cliff face, to the west of the property at 42 Moody Street. The debris flow comprised of soil, boulders and large scrub plants and covered approximately 45 m^2 of the sloping garden area, thought to be a talus slope, at the rear of the dwelling.

A desktop study of cliff regression and rockfall at the subject property indicates that between 2010 and 2016 there is negligible regression of the cliff. In addition, the boundary between the relatively flat camp site and the toe of the steeply sloping cliff appears to remain static, although the sloping cliff face is again heavily vegetated and difficult to accurately define. Review of all available aerial imagery identifies no displaced rocks, soil or vegetation to have run-out across the camp site.

We consider the risk of rockfall at 31 Moody Street due to strong ground shaking to be low to moderate.

The subject property at 31 Moody Street is located within a zone of nil to extremely low liquefaction potential and is designated as rock or hill soils. We therefore consider the risk of cliff instability due to liquefaction to be extremely low.

Based on site observations we conclude that the dominant natural hazard at the site is falling debris, with the secondary hazard being shallow surficial landslips. The primary cause of these hazards is considered to be the natural weathering process resulting from erosion of fines within the soil/rock matrix due to vegetative growth, surface run-off due to periods of heavy rainfall and seasonal moisture variations. Seismicity and strong ground shaking is considered to have less of an influence on cliff stability than erosion.

We estimate that runout resulting from a typical shallow slip failure could extend a distance of 6-8 m from the base of the cliff. By applying a factor of safety of 1.25 (or 25%) we consider a safe set-back from the toe of the cliff to be 10 m. While we do not believe this land to be at imminent risk of inundation, it would be advisable that any tent sites within this set-back zone be cordoned off; especially during periods of expected heavy rain.

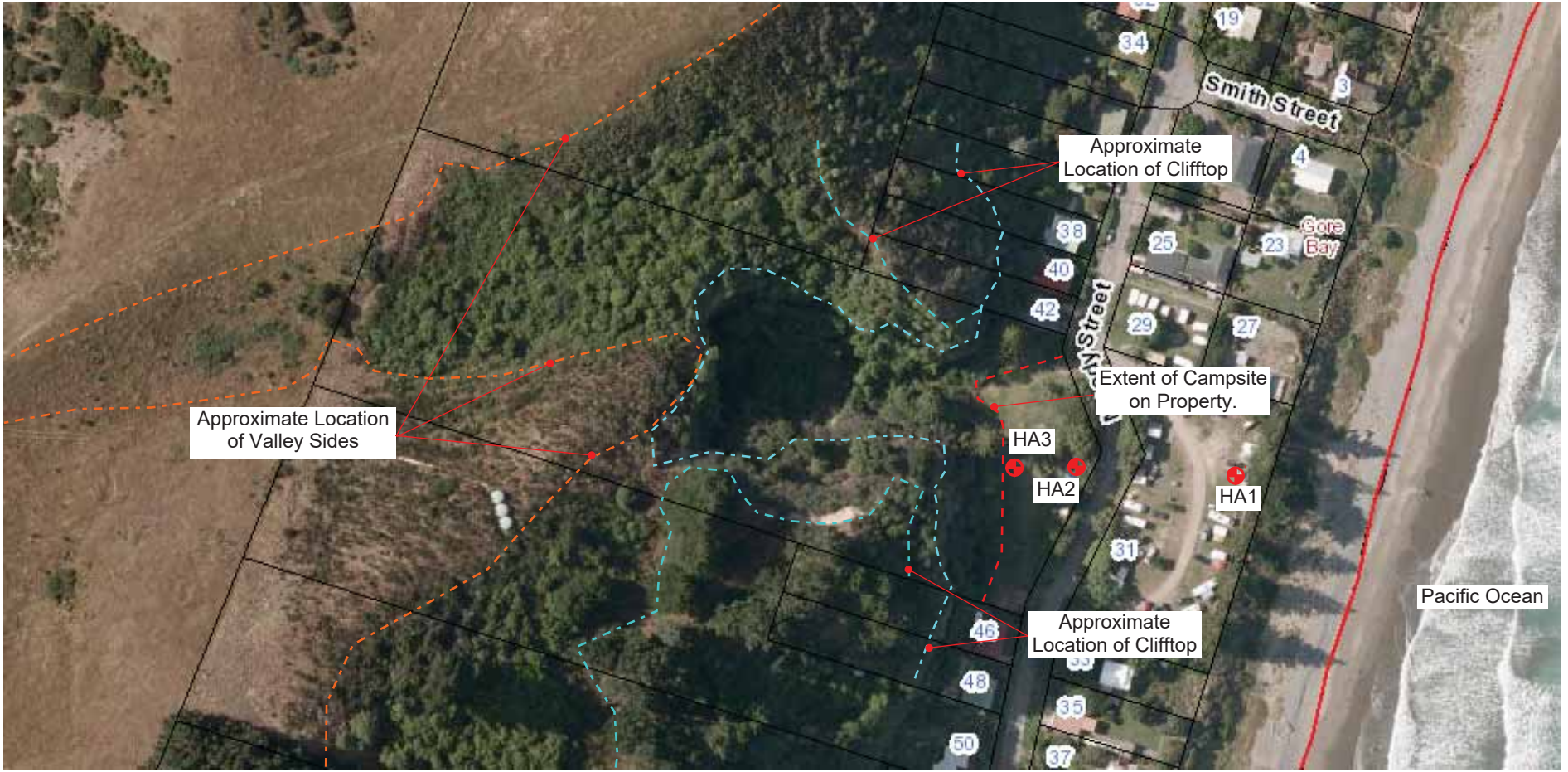
Alternatively, a suitably designed retaining wall and/or rockfall barrier installed at the base of the cliff could be considered, subject to additional investigation and design input. Preliminary assessment suggests that a wall some 2.0-2.5 m high installed approximately 3 m from the toe of the cliff would be sufficient to protect the campsites from falling debris and landslip material as presented in Drawing G1.0, Appendix A. Structures of reduced height may be appropriate, but they would need to be situated further out into the campsite area to account for the accumulation of debris. Additionally, regular maintenance of a retaining structure would be required to clear away debris as it accumulates.

APPENDIX A – DRAWINGS

- Site Testing Location Plan – SK-1
- Approximate Cliff Regression and Recommend Extent of Rockfall Protection Barrier – Drawing G1.0

KIRK | ROBERTS CONSULTING ENGINEERS LTD

N



Site Plan created by using the Latest Satellite Imagery from Canterbury Maps Database, with the location of Soil Test Locations, cliffs and valleys side walls are approximately only and should not be relied on.

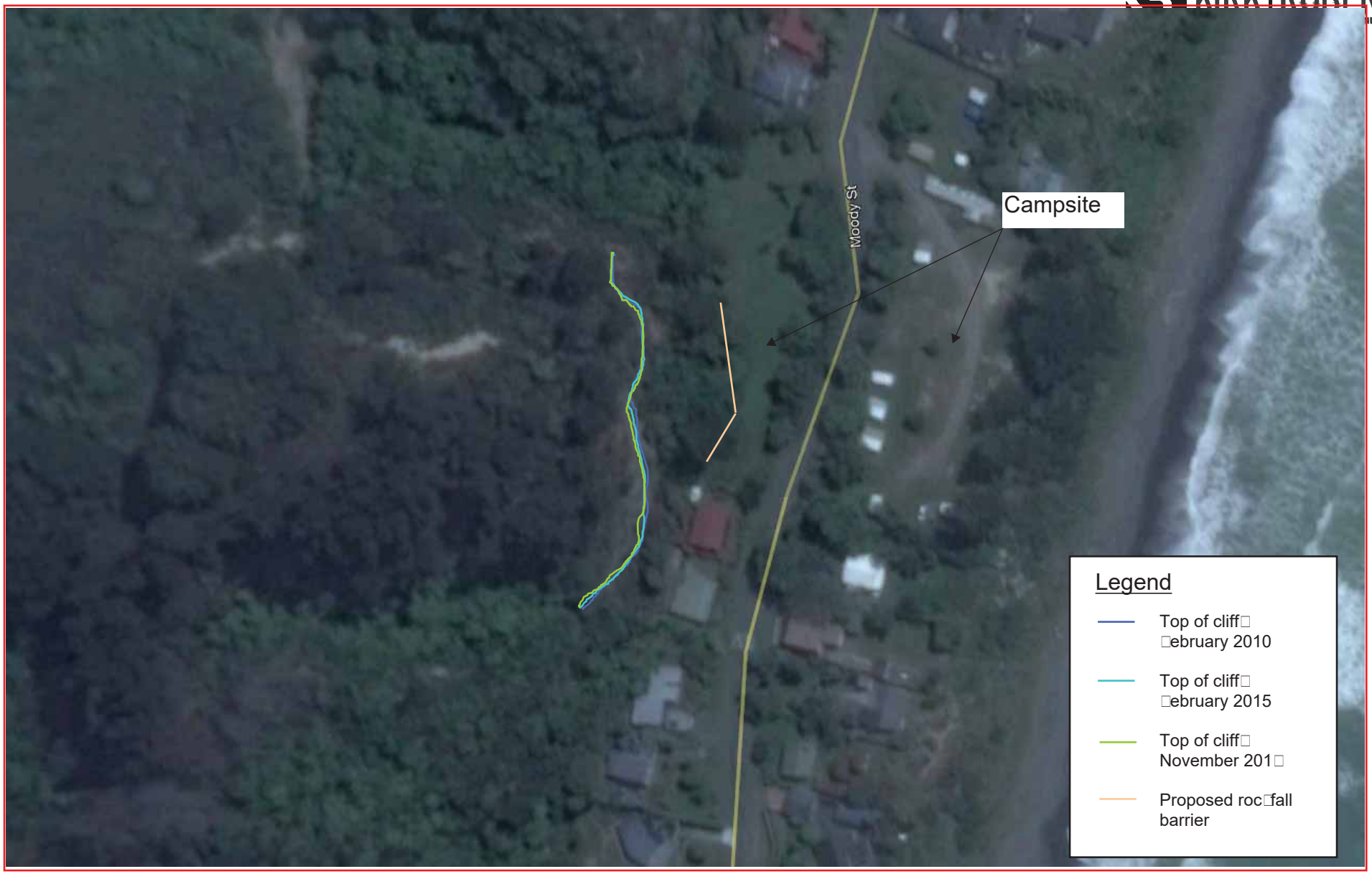
DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A4

CAD REF :

SCALES : Not To Scale		Client: Hurunui District Council	SOIL TEST LOCATION PLAN	Job No. 1710421	Sheet No. SK-1	Rev. A
	DATE					
DESIGNED		Site: 31 Moody Street, Gore Bay				
DRAWN	AJ - 25.10.2017					
CHECKED						
APPROVED						

KIRK | ROBERTS
ENGINEERS LTD



DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A4

CAD REF :

SCALES :	
	DATE
DESIGNED	
DRAWN	
CHECKED	
APPROVED	

Client: Hurunui District Council

Site: 31 Moody Street

Cliff □egression and Proposed Extent of □oc□fall Barrier at 31 Moody Street

ACENZ IPENZ

Job No.	Sheet No.	Rev.
1710421	G1.0	A

APPENDIX B – EXPLORATORY HOLE RECORDS

- Hand Auger Borehole and Scala Penetrometer Logs

SCALA PENETROMETER & HAND AUGER RESULTS

KIRK ROBERTS CONSULTING ENGINEERS LTD

Scala Penetrometer:	SP-1
Hand Auger:	HA-1
Job No.:	1710421
Client:	Hurunui District Council
Site Address:	31 Moody Street
Town/City:	Gore Bay
Date:	04/09/17
Weather:	Fine
Operator:	AJ & SM

Geological Formation	Depth (m)	Sample Description	Graphic	USCS	D_r	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration
	0.0	**TOPSOIL** Dark brown, organic silt, loose, dry.		OL				2, 2, 2, 2, 2
	0.5	**SAND** Light brown grey sand, with trace silt, loose to medium dense, dry, sand, fine.		S	VL L	Groundwater Not Encountered		3, 3, 3, 3, 3
	1.0	**SAND** Brownish grey sand, with trace silt, medium dense, dry, sand, fine to medium.			MD			4, 4, 4, 4, 5, 5, 5, 5, 5, 5, 6, 6, 6, 6
	2.5				D			8, 8, 8, 8
	3.0	EOH: 3.00m 3.0m: Target Depth.						

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.

Symbols:

- Standing Water Level
- Out flow
- In flow

Generated with CORE-GS

SCALA PENETROMETER & HAND AUGER RESULTS

KIRK ROBERTS CONSULTING ENGINEERS LTD

Scala Penetrometer:	SP-2
Hand Auger:	HA-2
Job No.:	1710421
Client:	Hurunui District Council
Site Address:	31 Moody Street
Town/City:	Gore Bay
Date:	04/09/17
Weather:	Fine
Operator:	AJ & SM

Geological Formation	Depth (m)	Sample Description	Graphic	USCS	D_r	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration (1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19)
	0.5	**TOPSOIL** Dark brown, organic gravelly silt, very dense, moist; gravel, fine. EOH: 0.30m 0.3m: Unable to Penetrate beyond this Depth due to Presence of Fine to Medium Gravels.		OL		Groundwater Not Encountered		8 12 20

0.5

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.

Symbols:

- Standing Water Level
- Out flow
- In flow

337 Saint Asaph Street, Christchurch 8011

Generated with CORE-GS

SCALA PENETROMETER & HAND AUGER RESULTS

KIRK | ROBERTS CONSULTING ENGINEERS LTD

Scala Penetrometer:	SP-3
Hand Auger:	HA-3
Job No.:	1710421
Client:	Hurunui District Council
Site Address:	31 Moody Street
Town/City:	Gore Bay
Date:	04/09/17
Weather:	Fine
Operator:	AJ & SM

Geological Formation	Depth (m)	Sample Description	Graphic	USCS	D_r	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration
	0.0	**TOPSOIL** Dark brown, organic silt, with minor clay, firm, moist.		OL		Groundwater Not Encountered		2, 2
	0.5	**SILT** Yellowish brown, clayey silt, with some sand, firm to stiff, moist; sand, fine.		MH				3, 3, 3, 4, 4, 4, 5, 5, 6, 7, 7, 8, 11
	1.0	1.3m: Containing trace of fine gravels.						
	1.5	1.6m: Becoming Sandy.						9, 10, 11, 11, 12, 15
	2.0	**Silty SAND** Yellowish brown, silty sand, with some gravel, with trace clay, very dense, wet, sand, fine to coarse; gravel, fine. EOH: 2.00m		SM	D			20
	2.5	2.0m: Unable to Penetrate Beyond this Depth due to Presence of Fine to Medium gravels.						
	3.0							

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.

Symbols:

- Standing Water Level
- Out flow
- In flow

337 Saint Asaph Street, Christchurch 8011

Generated with CORE-GS

APPENDIX C – AERIAL / SATELLITE IMAGERY

- Aerial / Satellite Imagery from 2010 to 2016

KIRK | ROBERTS
ENGINEERS LTD

DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A4

CAD REF :

SCALES :	
	DATE
DESIGNED	
DRAWN	
CHECKED	
APPROVED	

Client: Hurunui District Council

Site: 31 Moody Street

Cliff □egression at 31 Moody Street

ACENZ IPENZ

Job No.	Sheet No.	Rev.
1710421	□ig.1	A

KIRK | ROBERTS
ENGINEERS LTD

DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A4

CAD REF :

SCALES :	
	DATE
DESIGNED	
DRAWN	
CHECKED	
APPROVED	

Client: Hurunui District Council

Site: 31 Moody Street

Cliff □egression at 31 Moody Street

ACENZ IPENZ

Job No.	Sheet No.	Rev.
1710421	□ig.2	A

KIRK | ROBERTS
ENGINEERS LTD

DO NOT SCALE - IF IN DOUBT, ASK

ORIGINAL SIZE A4

CAD REF :

SCALES :	
	DATE
DESIGNED	
DRAWN	
CHECKED	
APPROVED	

Client: Hurunui District Council

Site: 31 Moody Street

Cliff □egression at 31 Moody Street

ACENZ IPENZ

Job No.	Sheet No.	Rev.
1710421	□ig.3	A