

11 February 2022

## **PENCARROW ESTATE**

# 1491 STATE HIGHWAY 2, PONGAKAWA

# **GEOTECHNICAL INVESTIGATION REPORT FOR PLAN CHANGE**

Kevin and Andrea Marsh

TGA2021-0096AC Rev 0

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	Name	Signature	Position
Prepared by	Lydia Lysaght	Lu	Project Engineering Geologist
Reviewed by	Rob Telford	RTellord	Associate Engineering Geologist Accredited Category 1 Geo- professional
Authorised by	Matt Packard	Milaehad	Principal Geotechnical Engineer CMEngNZ, CPEng (Geotechnical) Accredited Category 1 Geo- professional



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#### **1 INTRODUCTION**

CMW Geosciences (CMW) was engaged by Kevin and Andrea Marsh to carry out a geotechnical investigation of a rural site located at 1491 State Highway 2, Pongakawa, which is being considered for a residential plan change.

The scope of work and associated terms and conditions of our engagement were detailed in our services proposal Ref. TGA2021-0096AB Rev 0, dated 3 November 2021. The purpose of this report is to describe the investigation completed, the ground conditions encountered and to provide recommendations with respect to geotechnical considerations for the proposed plan change.

This report may be used as one of the documents to support a plan change application to Western Bay of Plenty District Council (WBoPDC).

#### 2 SITE DESCRIPTION

#### 2.1 Site Location

The site comprises an area of approximately 8.8ha and is located at 1491 State Highway 2 as shown on Figure 1 below.



Figure 1: Site Location Plan (openstreetmaps.org)

#### 2.2 Landform

The current general landform, together with associated features located within and adjacent to the site is presented on the attached Geotechnical Investigation Plan as *Drawing 01*.

The majority of the site is essentially near level and occupies a broad plateau with existing ground levels ranging from RL 6m to 8m (Moturiki Datum). Several shallow swales bisect the plateau in the south, centre

and north-eastern areas. Immediately to the north, the site grades gently down to level, low lying topography at RL 3m.

The site is occupied by farmland, with a small dwelling and ancillary sheds in the south. It is bound to the north, west and south by rural properties and farm buildings, and to the east by residential properties and Arawa Road. A small pond is present in the far west.

#### 2.3 Historic Aerial Photographs

Historical aerial photographs<sup>1</sup> show:

- 1943: The site was in grazed pasture, with small farm sheds in the west. Localised depressions (swales) are evident in the south, central and north-eastern areas of the site;
- 1961: The site remained in grazed pasture, with several hedgerows and a central accessway present;
- 2003: The majority of the hedgerows had been removed. The small pond in the west of the site was evident. Residential dwellings along Arawa Road, immediately to the east had been constructed;
- 2007: A cropped area was present in the west of the site, adjacent to the small pond and farm building. The dwelling was present in the central/southern area;

Little change was noted from 2007 until the present day.

No signs of significant earthworks were noted in our review. Minor earthworks in the west of the site are likely to have occurred as a result of cropping and pond construction.

#### 3 PROPOSED DEVELOPMENT

At the time of undertaking this investigation and of writing this report the project was in the early planning stages and a scheme plan had not been supplied. However, it is understood that the site is being considered for a plan change application, to rezone the land from its existing 'rural' status to 'residential'.

Due to the level nature of the site, minor levelling earthworks are anticipated to form building areas and associated roads and infrastructure.

Localised peat undercuts within the swales or low-lying parts of the site may also be undertaken.

Based on discussion with the project planners, Momentum Planning and Design Ltd (MPAD), it is understood that the strip of land immediately to the north of the site (as depicted on *Drawing 01*) is being considered as a future wastewater disposal zone.

The stormwater disposal method(s) for a future residential development at this site is currently unknown.

#### 4 INVESTIGATION SCOPE

Following a dial before you dig search, and onsite service location, the field investigation was carried out between 17<sup>th</sup> and 18<sup>th</sup> February 2022. All fieldwork was carried out under the direction of CMW Geosciences in general accordance with the NZGS specifications<sup>2</sup> and logged in accordance with NZGS guidance<sup>3</sup>.

The scope of fieldwork completed was as follows:

• An engineering geologist undertook a walkover survey of the site to assess the general landform, site conditions and adjacent structures / infrastructure;

<sup>&</sup>lt;sup>1</sup> Retrolens website, Sourced from http://retrolens.nz and licensed by LINZ CC-BY 3.0

<sup>&</sup>lt;sup>2</sup> NZ Geotechnical Society (2017) NZ Ground Investigation Specification, Volume 1 – Master Specification

<sup>&</sup>lt;sup>3</sup> NZ Geotechnical Society (2005), Field Description of Soil and Rock, Guideline for the field classification and description of soil and rock for engineering purposes.

- An on-site services search was carried out by a specialist contractor to identify the presence of any underground obstructions or hazards prior to the field investigation program commencing;
- Nine Cone Penetrometer Tests (CPTs) and two seismic CPTs (sCPTs) denoted CPT01 to CPT08, and CPT10 to sCPT12 were pushed to depths of up to 20m to define the ground model through the site and for use in liquefaction and static settlement analyses. Results of the CPT's, presented as traces of tip resistance (qc), sleeve friction (fs), dynamic pore pressure (u2) and friction ratio (Rf) are presented in *Appendix C*;
- Twenty test pits, denoted TP01 to TP20, were excavated using a 12-tonne hydraulic excavator to depths of between 2.2m and 4m below existing ground levels. Shear vane readings and dynamic cone penetrometer tests were taken at regular intervals to provide strength information. Engineering logs and photographs of the test pits are presented in *Appendix C.*

The approximate locations of the respective investigation sites referred to above are shown on the Geotechnical Investigation Plan (*Drawing 01*). Test locations were approximated using onsite features.

#### 5 GROUND MODEL

#### 5.1 Published Geology

The published geological map<sup>4</sup> depicts the regional geology for the area as comprising Pleistocene alluvium consisting of variably degraded terraces dominated by pumiceous soils (Tauranga Group- IQa), as illustrated in Figure 2 below. To the north and west of the site, swamp deposits comprising dark brown to black peat, organic-rich mud, silt and sand (Tauranga Group- Q1a) are anticipated.



Figure 2: Regional Geology (Leonard and Begg 2010)

<sup>&</sup>lt;sup>4</sup> Leonard and Begg (2010). Geology of the Rotorua Area. GNS, Geological Map 5.

Based on the known history of the site and surrounding land levels, some superficial depths of fill could be anticipated as a result of soft landscaping.

#### 5.2 Stratigraphic Units

The ground conditions encountered and inferred from the investigation were generally consistent with the published geology for the area and can be generalised according to the following subsurface sequences.

The distribution of the various units encountered is presented on the appended Geological Section on *Drawing 02* and summarised below.

Table 1: Summary of Strata Encountered					
Unit	Top of Unit (mbgl)		Thickness (m)		
onit	Min	Max	Min	Max	
Topsoil – Organic silt	Sur	face	0.1	0.4	
Peat* – Fibrous, soft to stiff	0.4	0.5	0.1	3.0	
Pleistocene Alluvium** – Interbedded stiff to very stiff silts and loose to medium dense sands	0.2	3.5	3.0	12.3	
Pleistocene Alluvium – Medium dense sands         6.5         12.5         3.0         7.0				7.0	
Pleistocene Alluvium – Dense to very dense sands         12.5         15.5         >10					
Notes: * Strata only encountered in the low lying far north of site, and within swales ** Areas of loose sand were noted in the upper 1m at several test locations across the site					

#### 5.3 Groundwater

During the investigation, which was completed in summer conditions (January 2022), groundwater was encountered within the CPTs and test pits at depths ranging from 1.0m to 4.3m below ground level, which equates to a reduced level of approximately RL 2m to RL4m.

#### 6 GEOHAZARDS ASSESSMENT

#### 6.1 Seismicity

A seismic assessment has been carried out in general accordance with NZGS guidance<sup>5</sup>. The ultimate limit state (ULS) and serviceability limit state (SLS) peak ground accelerations (PGAs) were assessed based on a 50-year design life and Importance Level (IL) 2 buildings in accordance with the New Zealand Building Code.

The recommended PGA values for geotechnical assessment at this site are presented in *Table 2* below. Structural designers working on this site should assess seismic parameters in accordance with NZS1170:2004 and using the recommended Site Subsoil Class presented in Section 7.1 below.

Table 2: Design Peak Ground Acceleration (PGA) for Various Limit States				
Limit State	AEP	R	PGA(g) <sup>1</sup>	<b>Magnitude</b> eff
SLS	1/25	0.25	0.08	6.0

<sup>&</sup>lt;sup>5</sup> NZ Geotechnical Society publication "Earthquake geotechnical engineering practice, Module 1: Overview of the standards", (November 2021)

Table 2: Design Peak Ground Acceleration (PGA) for Various Limit States					
Limit State	AEP	R	PGA(g) <sup>1</sup>	Magnitudeeff	
ULS	1/500	1.0	0.32	6.0	
Note: R = return period factor; AEP = annual exceedance probability <sup>1</sup> As per Appendix A1 of NZGS Module 1					

#### 6.2 Preliminary Liquefaction Assessment

#### 6.2.1 General

Soil liquefaction is a process where typically saturated, granular soils develop excess pore water pressures during cyclic (earthquake) loading. Following the onset of liquefaction, the shear strength and stiffness of the liquefied soil is effectively lost causing excessive differential settlement of the ground surface, bearing capacity failure and collapse of structures and low-angle lateral spreading of slopes in liquefiable soils.

In accordance with NZGS guidance<sup>6</sup> the liquefaction susceptibility of the soils at the site has been considered with respect to geological age, soil fabric and soil consistency / density as follows:

- The peat soils are of Holocene geological age, and the silt/sand alluvial deposits are of Pleistocene geological age. Therefore, in terms of geological age, the soils are the site may be susceptible to liquefaction;
- Soils below the water table are predominantly sandy, and therefore are considered susceptible to liquefaction where saturated; and
- Sandy soils below the water table are generally medium dense to dense, and therefore in terms of soil density, may be susceptible to liquefaction.

Based on this, preliminary specific liquefaction analyses were undertaken as detailed below.

#### 6.2.2 Specific Analyses

Liquefaction analyses were undertaken using the software package CLiq by comparing the cyclic stress ratio (CSR) to the cyclic resistance ratio (CRR) from the conventional CPT.

Calculations were carried out to consider the potential for liquefaction across the full depth of the CPT tests (i.e. 20m). Additional calculations were also undertaken to assess the effects of liquefaction within the upper 10m of the soil profile only to allow the results to be classified in accordance with the estimated 'index settlements' as per MBIE guidance<sup>5</sup>.

Due to the geological age of the underlying deposits we assessed the potential for aging effects and reduced liquefaction susceptibility in accordance with Robertson<sup>7</sup>. The calculations followed the method proposed by Hayati and Andrus<sup>8</sup>, which compares the ratio of measured to estimated shear wave velocities within effected soils as derived from seismic sCPTs. The calculations indicate that the soils beneath this site are not affected by significant soil aging and the effects of aging where therefore discounted in the liquefaction analyses.

The results of the liquefaction assessment are summarised in **Table 3**, below and are presented in terms of the ULS 'index' settlements and the depth at which significant liquefaction occurs as this defines the thickness of the crust of non-liquefiable soils below the site Outputs of the calculations are given in **Appendix D**.

<sup>&</sup>lt;sup>6</sup>MBIE, Canterbury Residential Technical Guidance, Part D: Guidelines for the geotechnical investigation and assessment of subdivisions in the Canterbury region, Version 2, December 2012

<sup>&</sup>lt;sup>7</sup> P. K. Robertson (2015). Comparing CPT and Vs Liquefaction Triggering Methods, Journal of Geotechnical and Geoenvironmental Engineering, May 2015

<sup>&</sup>lt;sup>8</sup> Hayati, H., and Andrus, R. D. (2009). "Updated liquefaction resistance correction factors for aged sands." J. Geotech. Geoenviron. Eng., 10.1061/(ASCE)GT.1943-5606.0000118, 1683–1692.

Table 3: Preliminary Liquefaction Analyses Results – Index Settlements					
CPT No.	SLS Settlement (mm)	ULS Index Settlement (mm)	ULS Liquefiable Layers (mbgl <sup>2</sup> )	ULS Crust Thickness (m)	
01		110	4.0 - 9.5 <sup>1</sup>	4.0 <sup>1</sup>	
02		85	$4.0 - 5.5, 6.5 - 10^1$	4.0 <sup>1</sup>	
03		110	3.5 – 10 <sup>1</sup>	3.5 <sup>1</sup>	
04		90	5.0 – 10	5.0	
05		45	7.0 – 10	7.0	
06	<10	100	3.5 – 5, 6 – 9.5 <sup>1</sup>	3.5 <sup>1</sup>	
07		110	4.0 – 10	4.0	
08		60	4.5 – 6.5, 8.5 – 10	4.5	
10		60	4.5 – 101	4.5 <sup>1</sup>	
11		100	4.5 – 10	4.5	
12		<10	N/A	N/A	
Note: 1. The effects of isolated shallow layers < 0.1m thick are discounted from this assessment					

2. Settlements and depths are based on the existing ground profile

3. N/A = not applicable due to there being no ULS liquefiable layers

Liquefaction mitigation recommendations are discussed in Section 7.2.

#### **Slope Stability** 6.3

#### 6.3.1 General

The site is near level to gently graded with no significant slopes or escarpments. The risk of slope movement under static (i.e. non-earthquake) conditions is therefore assessed as 'low' and specific static slope stability analyses have not been undertaken.

#### 6.3.2 Lateral Spread Assessment

Following the onset of liquefaction, the liquefied soils behave as a very weak undrained material, which can give rise to lateral spreading where a free face is present within the vicinity of the site or where slopes are present over or within liquefied soils. To the north of the site, a gently graded, 2m high slope is present where the subject site slopes down towards the near level peat area in the north. Due to the presence of potentially liquefiable soils and low strength peat in this area, lateral spread analyses were undertaken for this slope.

Seismic stability analyses were undertaken for Geological Section A (Drawing 02). A liquefied soil strength ratio of 0.1 was applied to the upper interbedded silts/sands of the Pleistocene Alluvium. Liquefied strengths were not applied to the deeper, dense sand of the Pleistocene Alluvium or to soils above the groundwater table as calculations indicated that these are unlikely to liquefy in the SLS or ULS earthquakes.

The calculations considered to stability cases:

- The stability of the slope assuming liquefied soil conditions under peak (ULS) ground acceleration to assess lateral spreading risk; and
- 2. The stability of the slope with liquefied soil parameters and zero ground acceleration to assess the risk of post-earthquake failure (termed 'flow failure').

Outputs from the stability models are presented in Appendix F. The calculations indicate that the slope is unlikely to be affected by lateral spreading in an SLS event but may have a low factor of safety (i.e. < 1.0) against lateral spreading in a ULS earthquake. Further analyses using the empirical methods by Bray & Travasarou (2007) and Jibson (2007) indicate that horizontal displacements along the affected slope would be less than approximately 100mm. Displacements of this magnitude would classify the land adjacent to the northern slope as Technical Category 2 (TC2) as defined by the MBIE guidelines for assessing liquefaction risk developed filling the Canterbury earthquakes<sup>9</sup>.

The calculations to assess flow failure risk indicate that the northern slope has a factor of safety >1.0 in these conditions and the slope is therefore unlikely to be affected by post-earthquake flow failure.

#### 6.4 Load Induced Settlement

#### 6.4.1 General

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Load-induced settlements occur in soils that are subject to static loading (e.g. by placing fill and/or building loads) where the magnitude of settlement is governed by the soil stiffness and the applied pressure.

Preliminary analyses have been undertaken to assess the likely magnitudes of settlement on account of future residential building loads. As the magnitude of earthworks is currently unknown, any potential future fill induced settlements have not been assessed.

#### 6.4.2 Preliminary Settlement Analyses for Residential Buildings

Analyses have been undertaken to quantify the predicted settlements on account of future building loads, using the geotechnical software package CPeT-IT. This program calculates the change in vertical stress due to the loading according to Boussinesq, with a 1-D constrained soil modulus parameter estimated from CPT data.

Table 4: Preliminary Static Settlement Magnitudes for Anticipated Floor Loads					
CPT No.	Widespread Load (kPa) – To represent a single level dwelling	Peat present? (Y/N)	Primary Settlement (mm)		
01		Y	60		
02		Y	40		
03		Y	80		
04		Transition	35		
05		Ν	12		
06	10	Y	10		
07		Ν	20		
08		Ν	15		
10		Y	25		
11		Ν	10		
12		Ν	22		

The results of our analyses are presented in Table 4, below.

<sup>&</sup>lt;sup>9</sup> MBIE, 'Canterbury Residential Technical Guidance – Part D: Subdivisions', December 2012.

The results of the preliminary settlement analyses suggest that areas of the site which are underlain by peat soils are likely to experience load induced settlements in excess of the NZ Building Code limits of 1 in 240 (approximately 25mm over a 6-metre length of building).

Additionally, the peat soils are likely to experience significant secondary (creep) settlements, in excess of the reported primary settlement magnitudes in Table 4 above, which are likely to continue for a number of years following construction.

Predicted static settlements due to typical residential building loads on parts of the site not underlain by peat are expected to be within the limits recommended in the NZ Building Code.

Recommendations for remediation of the areas of the site which are underlain by peat soils are provided in Section 7.3.

#### 7 GEOTECHNICAL RECOMMENDATIONS

#### 7.1 Seismic Site Subsoil Category

The geological units encountered beneath the site comprise soil strength materials, which with respect to the seismic site subsoil category defined in Section 3.1.3 of NZS1170.5, is defined as having an unconfined compressive strength (UCS) < 1MPa.

Based on those ground conditions and the results, the seismic site subsoil category is assessed as being Class D (deep soil site) in accordance with NZS1170.5.

#### 7.2 Liquefaction Mitigation

Under the ULS event, the NZ Building Code requires that dwellings do not collapse and therefore preserve life but do not need to remain serviceable. The predicted free-field liquefaction induced settlements under the ULS seismic event are in the order of 45 to 110mm over a 10m depth, with the larger settlements generally occurring beneath more low-lying parts of the site where the non-liquefiable surface crust is less thick.

Reference is made to Ishihara (1985)<sup>10</sup> with respect to assessing the contribution of a non-liquefiable crust and the risk of surface manifestation. This assessment suggests a minimum 6m thick non-liquefiable crust may be required to prevent liquefaction induced ground damage for a ULS seismic event and an Importance Level 2 (IL2) building at this site. Given that the existing crust thickness ranged from 3.5m to 7m, there is the potential for surface manifestation (e.g. sand boils) to occur during a ULS seismic event which can result in further exaggerated differential settlements and affect the ultimate bearing capacity beneath shallow footings.

Therefore, based on the index liquefaction settlement values presented in Table 3 and the marginal nonliquefiable crust present at the site, we recommend adopting an MBIE TC2/TC3 hybrid foundation solution as outlined in Section 15.4.6 of the MBIE Part C Canterbury Rebuild Technical Guidance<sup>11</sup> to address the liquefaction hazard for the proposed development.

Further detail on this has been detailed in Section 7.2.1, below.

#### 7.2.1 Enhanced TC2/TC3 Raft

A TC2/TC3 hybrid solution involves the construction of an 800mm thick, geogrid reinforced granular fill raft supporting an engineer designed or proprietary TC2 raft foundation.

 <sup>&</sup>lt;sup>10</sup> Ishihara, K., (1985) "Stability of Natural Deposits During Earthquakes," Proc. Of the Eleventh International Conference on Soil Mechanics and Foundation Engineering, San Francisco, 12-16<sup>th</sup> August 1985, Vol. 1, Theme Lectures Conferences, pp321-376.
 <sup>11</sup> Repairing and Rebuilding Houses Affected by the Canterbury Earthquake: TC3 Technical Guidance, Part C, MBIE (2015).

Prior to the construction of the gravel raft, ground improvement will be required in some areas of the site (such as to undercut loose near surface sands or remediate peat soils). This has been detailed in Section 7.3 and 7.4.2 below.

#### 7.3 Ground Improvement for Static Settlement

To minimise post construction static ground settlements on account of the presence of compressible peat, several options have been proposed, including the following:

- Locating buildings and infrastructure on the more elevated plateau areas of the site which are unlikely to experience excessive static settlements under typical residential building loads. Less critical infrastructure such as stormwater ponds may be located within the swales and peat areas, subject to appropriate engineering design;
- Construct a temporary pre-load embankment over and above design ground levels where peat is present to reduce post construction total and differential settlements;
- Remove (excavated) the peat and replace with engineered fill. This would likely require significant dewatering to achieve; and
- Pile building foundations to intercept the dense sands at depths of between approximately 14m and 20m below ground level, which are shown not to be susceptible to liquefaction.

#### 7.4 Earthworks

#### 7.4.1 General

All earthwork activities must be carried out in general accordance with the requirements of NZS 4431<sup>12</sup> and the requirements of the Western Bay of Plenty District Council Development Code under the guidance of a Category 1 Geo-professional.

High level earthworks recommendations have been provided in Sections 7.4.2 to 7.4.4 below.

#### 7.4.2 Subgrade Preparation

Preparation of the stiff and loose/medium dense subgrade beneath the proposed fill areas should comprise stripping of all vegetation, topsoil, any pre-existing fill materials or loose sands/weak silts.

Where any particularly weak materials are encountered (such as the upper 1m of loose sands), they should be undercut and reworked prior to placing engineered fill.

As discussed in Section 7.3, the peat soils will require specific ground improvement/remediation.

#### 7.4.3 Cut and Fill Batters

To reduce the effects of ongoing minor slumping or scour, self-supporting long term cut and fill batters in the friable volcanic ashes should be formed to no steeper than 1(V):2.5(H).

All formed batters should be covered by topsoil and then grassed as soon as practicable following construction to reduce the effects of surficial scour or alternatively supported to full height by specifically designed retaining walls.

#### 7.4.4 Quality Control

The source and / or type of material used for engineered fill will dictate the type of quality control testing undertaken.

<sup>&</sup>lt;sup>12</sup> Standards New Zealand (1989) Code of practice for earth fill for residential development, incorporating Amendment No. 1, NZS 4431:1989, NZ Standard

Most of the on-site soils material, excluding the peat, should be suitable for reuse as Engineer Certified Fill. Soil textures and moisture contents will however vary widely and careful management, conditioning and compaction control will be required.

For granular (sand and gravel) fill materials, testing following compaction should be principally in terms of the maximum dry density within the appropriate water content range, with accompanying Dynamic Cone Penetrometers (DCPs).

Where silts and clays are used as filling, alternative test criteria using vane shear strength and air voids should be used.

#### 7.4.5 Service Trenches

We anticipate that service trenches could be several metres deep. Based on the field investigation results, the soils to be encountered within this depth are likely to comprise stiff silts and/or loose to medium dense sands across the terrace but with fresh and fibrous peat deposits present within the swale areas.

Provided any organic or otherwise unsuitable material is cut to waste, the natural soils excavated for the trench may be used as backfill. The backfill should be compacted in thin lifts to a strength and consistency equal to the surrounding ground.

#### 7.5 Stormwater Disposal

The depth of groundwater beneath the more elevated parts of the site is such that disposal of stormwater to ground soakage could be considered for building sites on the main plateau. Shallow groundwater below the more low-lying areas and the swales may preclude the use of ground soakage in these areas.

Stormwater pond(s) and/or raingardens would also be a suitable method of stormwater disposal for flows from future roofs and hardstand areas. An appropriate location for permanent ponds would be within the swales which cut through the site.

Stormwater disposal options should be further assessed at the resource consent stage for the development.

#### 7.6 Wastewater Disposal

Based on discussions with the project planners, MPAD, it is understood that the strip of land immediately to the north of the site (depicted on *Drawing 01*) is being considered as a potential wastewater disposal field.

Although this has not been assessed in detail, it is anticipated that for wastewater disposal in this zone, a raft of fill would be required to separate the standing groundwater table from the disposal field. There would also need to be an acceptance that differential settlement magnitudes in this area may be significant, particularly on account of fill placement. The effects of this settlement on the disposal system may be reduced by pre-loading the filled disposal field and/or by using a pressure compensating drip line irrigation network.

Further geotechnical input would be required during design of the system (by others), to confirm suitability.

#### 7.7 Roading and Services

The main roads are expected to extend across the terrace. Following earthworks and subgrade trimming, a CBR of between 3 and 5 is anticipated for the natural subsoils, whilst for Engineer Certified Fill areas a CBR of 7 may be adopted.

We recommend that a programme of penetration resistance testing is carried out when the roads and pavement areas are being formed to their final levels to confirm actual CBR values.

#### 8 FURTHER WORK

Additional geotechnical inputs to support the design and construction of a residential development at this site may include, but not be limited to:

- Investigations including additional test pits, hand auger boreholes, machine boreholes and/or Cone Penetrometer Tests (CPTs) to refine ground model and further assess the extent and depth of peat soils;
- Additional analyses for the proposed development, including liquefaction, static settlement and bearing capacity, to confirm the preliminary recommendations provided in this report;
- Preparation of geotechnical reports to support the resource consent application and detailed design process; and
- Earthworks and construction observations to confirm fill compaction and finished landform.

#### 9 CONCLUSION

Provided the recommendations given in this report are followed and subject to appropriate assessment during the resource consent process, the property is considered geotechnically suitable for rezoning and residential development.

Elevated parts of the site would be classified as Technical Category TC2 or TC3 due to potential for liquefaction induced settlement as defined by the MBIE earthquake design guidelines developed for the Christchurch rebuild. Ground adjacent to the slope along the site's northern boundary may also be classified as TC2 due to the potential for lateral spreading in this area.

Residential buildings on this site would therefore require specifically designed foundations. The hybrid TC2/TC3 fill/raft foundation solutions developed in Christchurch would be appropriate for this site.

#### **USE OF THIS REPORT**

Site subsurface conditions cause more construction problems than any other factor and therefore are generally the largest technical risk to a project. These notes have been prepared to help you understand the limitations of your geotechnical report.

#### Your geotechnical report is based on project specific criteria

Your geotechnical report has been developed on the basis of our understanding of your project specific requirements and applies only to the site area investigated. Project requirements could include the general nature of the project; its size and configuration; the location of any structures on or around the site; and the presence of underground utilities. If there are any subsequent changes to your project you should seek geotechnical advice as to how such changes affect your report's recommendations. Your geotechnical report should not be applied to a different project given the inherent differences between projects and sites.

#### Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface investigation, the conditions may have changed, particularly when large periods of time have elapsed since the investigations were performed.

#### Interpretation of factual data

Site investigations identify actual subsurface conditions at points where samples are taken. Additional geotechnical information (e.g., literature and external data source review, laboratory testing on samples, etc) are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can exactly predict what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions.

#### Your report's recommendations require confirmation during construction

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced. For this reason, you should retain geotechnical services throughout the construction stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site. A geotechnical designer, who is fully familiar with the background information, is able to assess whether the report's recommendations are valid and whether changes should be considered as the project develops. An unfamiliar party using this report increases the risk that the report will be misinterpreted.

#### Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical report. Read all geotechnical documents closely and do not hesitate to ask any questions you may have. To help avoid misinterpretations, retain the assistance of geotechnical professionals familiar with the contents of the geotechnical report to work with other project design professionals who need to take account of the contents of the report. Have the report implications explained to design professionals who need to take account of them, and then have the design plans and specifications produced reviewed by a competent Geotechnical Engineer.

Appendix A: Drawings



C:\USERS\HYSHAMRASHEED\CMW GEOSCIENCES PTY LTD\CMW CONNECT - TGA2021-0096 PENCARROW ESTATE, PONGAKAWA\DRAWNGS\TGA2021-0096 SITE PI AN + SECTION DWG

EA MARSH	DRAWN:	HR	PROJECT No TG	5: A2021-0096
91 ARAWA ROAD,	CHECKED:	LGL	DRAWING:	01
VA	REVISION:	0	SCALE:	1:3000
<b>FIGATION PLAN</b>	DATE:	28/01/2022	SHEET:	A3



EA MARSH	DRAWN:	HR	PROJECT No: TGA2021-0096
91 ARAWA ROAD.	CHECKED:	LGL	DRAWING: 02
NA ,	REVISION:	0	SCALE: 1:750
S-SECTION A	DATE:	28/01/2022	SHEET: A3

PROPOSED WASTEWATER DISPOSAL ZONE

Appendix B: MPAD Development Plans



# Pencarrow Estate Constraints Map

Drawn - PF Review - RC Scale - 1:4000 @ A3 Drawing # - Pencarrow Constraints Map

nd		
-	Plan Change Boundary	
	Flood effected area*	
	Existing Building	
_	Contours with site area	
>	Open drains	

\* Flood data sourced from WBOPDC, flood data is modeled for a 1% flood event, adjusted for climate change and 1.25m sea level rise.

rea:	97722m <sup>2</sup>
ffected Area:	19471m <sup>2</sup>
strained Land:	78250m <sup>2</sup>
d:	106*

\* Lot yield has been calculated assuming 25% of unconstrained land will be used for roads and reserves. Allow for 75% of land to be allocated to lots.

Lot sized assumed to be 550m<sup>2</sup>.

Lot yield indicative and may change.



Appendix C: Investigation Results

# CMW Geosciences – SOIL (Field Logging Guide)

#### SEQUENCE OF TERMS:

Polished

Blocky

Lensoidal

Slickensided

Fracture planes are polished or glossy

Discontinuous pockets of a soil within a different soil mass

Cohesive soil that can be broken down into small angular lumps which resist further

Fracture planes are striated

breakdown

Fine: Soil Symbol – Soil Type – Colour – Structure – (Consistency) – (Moisture) – Bedding – Plasticity – Sensitivity – Additional Comments – Origin/Geological Unit Coarse: Soil Symbol – Soil Type – Colour – Structure – Grading – Particle shape – (Relative Density) – (Moisture) – Bedding – Additional Comments – Origin/Geological Unit

BEHAVIOURAL	SOIL CLASS	SIFICATION SY	/STEM				PR	OPORTIO	DNAL TE	RMS DEFINI	ΓΙΟΝ				
Major Divisions	(behaviour ba	ased logging)	Soil Svmbol		Soil Na	ime	Fra	ction		Term	% of So	il Mass		Example	e
		Clean	GW	Well	gradeo el fine	d to	Мај	or	() [l	JPPER CASE	] ≥50 [n constitu	najor Jentsl		GRAVE	L
	Gravel	<5%		coar	se grav	/el	Sub	ordinate	()	[lower case]	20 -	50		Sandy	
	>50% of coarse	smaller 0.075mm	GP	Poor grav	iy grad el	ied			w	ith some	12 –	20		with some s	sand
	fraction	Gravel	GM	Silty	gravel		Min	or	wi	ith minor	5 –	12		with minor s	sand
Coarse	2211111	>12%	GC	Clay	ey grav	vel			with	n trace of (or slightly)	<	5	wit	h trace of san sandy)	d (slightly
more than 65%>0.06mm	Sand	Clean sand	SW	Well fine	-gradeo to coars	d sand, se	VIS	UAL PRO			AGE			(1)	
	250% of coarse		SP	sanc	iy grad I	ied	1.			1	) (		- )	1.1	[1 3
	fraction	Sand	SM	Silty	sand		(:		.)		·) ( z	2. 1	* .)		- "
	<2mm	>12%	SC	Clay	ey san	d	1	÷.	)	-:	1		1	6	/
	Exhibits		ML	Silt				1%		39	6	5%		109	%
	dilatant	inorganic	МН	Silt of plast	of high			11	>	1.44		ALI		193	324
Fine grained soils 35% or	benaviour	organic	OL	Orga	nic silt		6	<b>K</b> .		/	-1)	1.1.1	1	AL-ST	(1)
more			CL	Clay plast	of low		[-]		1.51			a let	5		
<0.06mm	No dilatant behaviour	inorganic	СН	Clay	of high	ſ	6	E.	-/	1		1	I	Chest.	
		organic	OH	Orga	nic cla	ıy	`	···	/	-	-	40%	>		
High	ly Organic So	ils	Pt	Peat				20%	2	30	70	40 %		50	%
GRAIN SIZE CF	RITERIA											SYME	HON/ BOLS	AL GRAPHIC	LOG
			CC	ARSE					l	FINE	ORGANIC	Term		Symbol	
			(	Gravel			Sand							~///	
TYPE	Boulders	Cobbles	rse	lium	e	rse	lium	e	Silt		Organic	Topso	oil		
			COE	mea	ţ.	00	mec	÷		Clay	Soil	Fill			×
Size Range	200	60	20	6	2	0.6	0.2	0.06	0.002	-					
(mm)			208		00				~~~~		14 34 34 34	Bitum	en		
Symbol			308	660	80			••••	xxx		<b>乔乔乔</b> 4	Conci	rete		
ORGANIC SOIL	S / DESCRIF	PTORS		0 00	00						ł	SHAD	DE AN	D COLOUR	
Term		Description										1		2	3
Topsoil		Surficial organic	c soil layer	that ma	ay cont	tain living	matter.	However	topsoil r	may occur at g	greater depth,	lia	ht	pinkish	nink
Organic clay, sil	t or sand	Contains finely	divided c	rganic	matter;	; may hav	ve distin	ctive sm	ell; may	stain; may o	xidize rapidly.	da	rk	reddish	red
Peat	F F F	Consists predor Firm: Fibres alr Spongy: Very o Plastic: Can be Fibrous: Plant Amorphous: N	minantly o eady com compressil moulded remains re o recognis	f plant repressed pressed ole and in hand ecognisa sable pla	emains togeth open s and sr able an ant rem	a. her tructure mears in f nd retain s nains	ingers ome stre	ength				strea	iked	brownish greenish bluish greyish	yellow brown green blue white grey
Rootlets	F (	Fine, partly dec	omposed or fill)	roots, n	ormally	/ found in	the upp	er part of	a soil pro	ofile or in a re	deposited soil				black
Carbonaceous	[	Discrete particle	es of harde	ened (ca	arbonis	ed) plant	material								
SOIL STRUCTU	JRE									GRADING	(GRAVELS & S	ANDS)			
Term	Description									Term	Description				
Homogeneous	The total la	ck of visible be	dding and	the san	ne colo	our and ap	pearanc	e through	nout	Well	Good repres	entation of	all na	rticle size ran	aes from
Bedded	The presen	ice of layers								Graded	largest to sm	allest	pu	See the rul	
Fissured	Breaks alor	ng definite plan	es of fract	ure with	little re	esistance	to fractu	ring			Limited repre	esentation	of grai	n sizes – furth	her
Polishod	Erecture pl	anos aro polich	od or aloo	<u>ev</u>					I	1	uivided into:				

Poorly

Graded

Uniformly graded

Gap graded

Most particles about the

same size

Absence of one or more

intermediate sizes

	Rounde	ed		Subrou	nded		Suban	gular		Ar	ngular
	$\bigcirc$									2	$\land$
CONSISTE	NCY TERMS	FOR FINE S	SOILS								
Descriptive	term	Undrained S	Shear Strength	ı (kPa)			Diagnostic Feature	es			Abbrevia
Very Soft			<12	Easil	y exudes bet	ween finge	ers when squeezed				VS
Soft			12-25	Easil	y indented by	y fingers					S
Firm			25-50	Inder	ited by strong	g finger pro	essure and can be in	dented by	thumb pres	ssure	F
Stiff			50-100	Cann	ot be indente	ed by thum	b pressure				St
Very Stiff			100-200	Can I	be indented t	by thumb n	ail				VSt
Hard		:	200-500	Diffic	ult to indent l	by thumb r	ail				Н
DENSITY I	NDEX (RELA	TIVE DENSI	TY) TERMS F	OR COARSE S	DILS						
Descriptive	term [	Density Index	x (RD)	SPT "N" v (blows/300	alue )mm)	Dyna	mic Cone (blows/100	)mm)		Abbreviat	tion
Very Dense	e	> 85		> 50			> 17			VD	
Dense		65 - 85	5	30 - 50	)		7 - 17			D	
Medium de	nse	35 - 65	5	10 - 30	)		3 - 7			MD	
Loose		15 - 35	;	4 - 10			1 - 3			L	
Very loose		< 15		< 4			0 - 2			VL	
	No correlation is implied be     SPT "N" values are uncorre  STURE CONDITION					n) and Dy	namic Cone Penetro	meter (Sc	ala) Test va	alues.	
MOISTURE Condition	E CONDITION Description	Coarse Soils	Fine Soils	Abbreviation	BEDDING	G THICKN	ESS (Sedimentary) Bed Thickness	BEDDI Term	NG INCLIN	ATION	(from horizo
MOISTURE Condition Dry	CONDITION Description Looks and feels dry	Coarse Soils Runs freely through	Fine Soils Hard, powdery or friable	Abbreviation D	BEDDING Term Thinly lan	G THICKNI	ESS (Sedimentary) Bed Thickness	BEDDI Term Sub-hc	NG INCLIN	ATION Inclination 0º - 5º	(from horizo
MOISTURE Condition Dry	CONDITION Description Looks and feels dry	Coarse Soils Runs freely through hands	Fine Soils Hard, powdery or friable Weakened	Abbreviation D	BEDDING Term Thinly lan	G THICKNI ninated	ESS (Sedimentary) Bed Thickness < 2mm 2mm - 6mm	BEDDI Term Sub-hc Gently	NG INCLIN prizontal inclined	ATION Inclination 0° - 5° 6° - 15°	(from horizo
MOISTURE Condition Dry Moist	E CONDITION Description Looks and feels dry	Coarse Soils Runs freely through hands	Fine Soils Hard, powdery or friable Weakened by moisture, but no free	Abbreviation D M	BEDDING Term Thinly lan Laminate Very thin	G THICKNI ninated	ESS (Sedimentary) Bed Thickness < 2mm 2mm - 6mm 6mm - 20mm	BEDDI Term Sub-ho Gently Modera inclined	NG INCLIN prizontal inclined ately	ATION Inclination 0° - 5° 6° - 15° 16° - 30°	(from horizo
MOISTURE Condition Dry Moist	ECONDITION Description Looks and feels dry	Coarse Soils Runs freely through hands	Fine Soils Hard, powdery or friable Weakened by moisture, but no free water on hands when	Abbreviation D M	BEDDING Term Thinly lan Laminate Very thin Thin	G THICKN ninated	ESS (Sedimentary) Bed Thickness < 2mm 2mm - 6mm 6mm - 20mm 20mm - 60mm	BEDDI Term Sub-hc Gently Modera inclined	NG INCLIN prizontal inclined ately d	ATION Inclination 0° - 5° 6° - 15° 16° - 30° 31° - 60°	(from horizo
MOISTURE Condition Dry Moist	E CONDITION Description Looks and feels dry Feels cool, darkened in colour	Coarse Soils Runs freely through hands Tends to cohere	Fine Soils Hard, powdery or friable Weakened by moisture, but no free water on hands when remoulding Weakened by	Abbreviation D M	BEDDING Term Thinly lan Laminate Very thin Thin Moderate	G THICKNi ninated d	ESS (Sedimentary) Bed Thickness < 2mm 2mm - 6mm 6mm - 20mm 20mm - 60mm 60mm - 200mm	BEDDI Term Sub-hc Gently Modera Steeply Very st inclinee	NG INCLIN prizontal inclined ately d y inclined teeply d	ATION Inclination 0° - 5° 6° - 15° 16° - 30° 31° - 60° 61° - 80°	(from horizo
MOISTURE Condition Dry Moist Wet	E CONDITION Description Looks and feels dry Feels cool, darkened in colour	Coarse Soils Runs freely through hands Tends to cohere	Fine Soils Hard, powdery or friable Weakened by moisture, but no free water on hands when remoulding Weakened by moisture, free water forms on	Abbreviation D M W	BEDDING Term Thinly lan Laminate Very thin Thin Moderate	aninated d ely thin	ESS (Sedimentary) Bed Thickness < 2mm 2mm - 6mm 6mm - 20mm 20mm - 60mm 60mm - 200mm 0.2m - 0.6m	BEDDI Term Sub-hc Gently Modera inclined Steeply Very st inclined Sub ve	NG INCLIN orizontal inclined ately d y inclined teeply d ertical	ATION Inclination 0° - 5° 6° - 15° 16° - 30° 31° - 60° 61° - 80° 81° - 90°	(from horizo
MOISTURE Condition Dry Moist	E CONDITION Description Looks and feels dry Feels cool, darkened in colour	Coarse Soils Runs freely through hands Tends to cohere	Fine Soils Hard, powdery or friable Weakened by moisture, but no free water on hands when remoulding Weakened by moisture, free water forms on hands when hands moisture, free water	Abbreviation D M W	BEDDING Term Thinly lan Laminate Very thin Thin Moderate Thick	G THICKN ninated d	ESS (Sedimentary) Bed Thickness < 2mm 2mm - 6mm 6mm - 20mm 20mm - 60mm 60mm - 200mm 0.2m - 0.6m 0.6m - 2m	BEDDI Term Sub-hc Gently Modera Steeply Very st inclinee Sub ve	NG INCLIN prizontal inclined ately d y inclined teeply d ertical	ATION Inclination 0° - 5° 6° - 15° 16° - 30° 31° - 60° 61° - 80° 81° - 90° SOIL	(from horizo
MOISTURE Condition Dry Moist Wet Saturated	E CONDITION Description Looks and feels dry Feels cool, darkened in colour Feels cool free water	Coarse Soils Runs freely through hands Tends to cohere	Fine Soils Hard, powdery or friable Weakened by moisture, but no free water on hands when remoulding Weakened by moisture, free water forms on hands when handling n colour and n the sample	Abbreviation D M W S	BEDDING Term Thinly lan Laminate Very thin Thin Moderate Thick Very thick	aninated d ely thin ely thick	ESS (Sedimentary) Bed Thickness < 2mm 2mm - 6mm 6mm - 20mm 20mm - 60mm 60mm - 200mm 0.2m - 0.6m 0.6m - 2m > 2m	BEDDI Term Sub-ho Gently Modera inclined Steeply Very st inclined Sub ve	NG INCLIN prizontal inclined ately d y inclined teeply d ertical TIVITY OF ptive Term	ATION Inclination 0° - 5° 6° - 15° 16° - 30° 31° - 60° 61° - 80° 81° - 90° SOIL Shea Ratio	(from horizon ar Strength $D = \frac{undisturf}{remoutd}$
MOISTURE Condition Dry Moist Wet Saturated PLASTICIT	E CONDITION Description Looks and feels dry Feels cool, darkened in colour Feels cool free water Y (CLAYS & S	Coarse Soils Runs freely through hands Tends to cohere	Fine Soils Hard, powdery or friable Weakened by moisture, but no free water on hands when remoulding Weakened by moisture, free water forms on hands when handling motolour and the sample	Abbreviation D M W S	BEDDING Term Thinly lan Laminate Very thin Thin Moderate Thick Very thick	aninated d ely thin ely thick	ESS (Sedimentary) Bed Thickness < 2mm 2mm - 6mm 6mm - 20mm 20mm - 60mm 60mm - 200mm 0.2m - 0.6m 0.6m - 2m > 2m	BEDDI Term Sub-ho Gently Modera inclined Steeply Very st inclined Sub ve SENSI Descri	NG INCLIN orizontal inclined ately d y inclined teeply d rrtical TIVITY OF ptive Term itive, norma	ATION Inclination 0° - 5° 6° - 15° 16° - 30° 31° - 60° 61° - 80° 81° - 90° SOIL Shee Ratio	$ar StrengthD = \frac{undisturf}{remould}$
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MOISTURE Condition Dry Moist Wet Saturated PLASTICIT Term High plastic	E CONDITION Description Looks and feels dry Feels cool, darkened in colour Feels cool free water Y (CLAYS & \$	Coarse Soils Runs freely through hands Tends to cohere darkened in is present or SILTS) Description Can be mo	Fine Soils Hard, powdery or friable Weakened by moisture, but no free water on hands when remoulding Weakened by moisture, free water forms on hands when handling m colour and n the sample	Abbreviation D M W S rmed over a wide tendency to volu	BEDDING Term Thinly lan Laminate Very thin Thin Moderate Thick Very thick	aninated d ely thin ely thick	ESS (Sedimentary) Bed Thickness < 2mm 2mm - 6mm 6mm - 20mm 20mm - 60mm 60mm - 200mm 0.2m - 0.6m 0.6m - 2m > 2m	BEDDI Term Sub-ho Gently Modera Steeply Very st inclined Sub ve SENSI Descrip Insens Modera	NG INCLIN orizontal inclined ately d y inclined teeply d rrtical TIVITY OF ptive Term itive, norma ately sensiti	ATION Inclination 0° - 5° 6° - 15° 16° - 30° 31° - 60° 61° - 80° 81° - 90° SOIL Shea Ration I	ar Strength $D = \frac{undisturi}{remould}$ $< 2$ $2 - 4$ $4 - 8$
MOISTURE Condition Dry Moist Wet Saturated PLASTICIT Term High plastic	E CONDITION Description Looks and feels dry Feels cool, darkened in colour Feels cool free water Y (CLAYS & S city	Coarse Soils Runs freely through hands Tends to cohere darkened in is present or SILTS) Description Can be mo cracking o	Fine Soils Hard, powdery or friable Weakened by moisture, but no free water on hands when remoulding Weakened by moisture, free water forms on handling n colour and the sample n bulded or defor r showing any ulded can be o	Abbreviation D M W W S rmed over a widd tendency to volu	BEDDING Term Thinly lan Laminate Very thin Thin Moderate Moderate Thick Very thick e range of me rme change	G THICKNI ninated d ely thin ely thick c oisture cor	ESS (Sedimentary) Bed Thickness < 2mm 2mm - 6mm 6mm - 20mm 20mm - 60mm 60mm - 200mm 0.2m - 0.6m 0.6m - 2m > 2m tents without or dilatant	BEDDI Term Sub-ho Gently Modera inclined Steeply Very st inclined Sub ve SENSI Descri Insens Modera Sensiti Extra s	NG INCLIN orizontal inclined ately d y inclined teeply d ortical TIVITY OF ptive Term itive, norma ately sensitive sensitive	ATION Inclination 0° - 5° 6° - 15° 16° - 30° 31° - 60° 61° - 80° 81° - 90° SOIL Shea Ration 1 ive	ar Strength $p = \frac{undisturb}{remouldor}$ < 2 2 - 4 4 - 8 8 - 16



#### **TEST PIT LOG - TP01** Client: Kevin & Andrea Marsh Project: Pencarrow Estate, 1491 Arawa Road, Pongakawa Site Location: Pongakawa Project No.: TGA2021-0096 Date: 17/01/2022



1	lest Pi	t Location: Re	efer t	to Dr	awin	g 01	Logged by: BM	Checked by:	Sc	ale:		1	:25		Sheet 1 of 1
F	Positio	n: 336457.1r	nE;	800	518.3	3mN	Projection: BOP2000	LOL	Pit [	Dime	ensio	ns	: m b	oy n	n
	1		1	1		r	Datum: Moturiki		Sur	vey S	Sour	ce	: pLo	og t	ablet
ter	Sam	oles & Insitu Tests		÷	b b		Material Description			cy/ nsity	D	ynan Penet	nic Con tromete	e r	Structure & Other Observations
ndwa			Ē	th (T	hicL	Soil	: Soil symbol; soil type; colour; structure; bedding; plastici	ty; sensitivity; additional	isture	isten e Dei	(B	lows	s/100mn	n)	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect
Brour	Depth	Type & Results	R	Dep	Grapl		comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (or	igin/geological unit)	Con	Consi	5	10	15	20	Shape; Roughness; Aperture; Infill; Seepage: Spacing: Block Size:
		21								~ ×	Ļĭ	-10	, 13 .	1	Block Shape; Remarks
						fine.	Organic SILT: with trace sand; dark brownish blac	<ol> <li>No plasticity; sand,</li> </ol>							
						(Top	soil)								:
						Allu	Fine SAND: light brownish grey. Uniformly graded vial Sands)								
							, 								
	0.5	Peak = 17kPa		-	-×^- -×	Pt: P	'EA1: dark brownish black. Low plasticity, insensit itive, organic, fibrous, tree stumps.	ve to moderately							
		Residual = 9kPa			× ····×	(Pea	t)								:
					×										
					-×				м						
				1 -		-						_			· ·
					-×					F					
	1.2	Peak = 43kPa			× ····×										
		Residual = 17kPa			× ***										
					1××										
				_	110° × -										
					-×										-
	17	Peak - 13kPa			-×				W						
	1.7	Residual = 17kPa			Î x x	ML:	SILT: light brownish grey mottled orange brown. L erately sensitive	ow plasticity,							
						(Plei	stocene Alluvium)								
				2	××)	>				St					
	2.1	Book = 79kBo		2	jx^;	>			0						
	2.1	Residual = 35kPa				>									
					-		Test pit terminated at 2.20 m								
					]										-
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Т	erminat	ion Reason: Hol	l le col	lapse	1	1			1	I	L				
.	Shear Va	ane No: 3403			Б	CP No	D:								
	vernarks														
		This report	is ba	ised c	on the	attach	ed field description for soil and rock, CMW	Geosciences - Field	Loggi	ng Gı	iide, I	Rev	ision	3 - A	April 2018.

TEST PIT LOG - TP02Client: Kevin & Andrea MarshProject: Pencarrow Estate, 1491 Arawa Road, PongakawaSite Location: PongakawaProject No.: TGA2021-0096Date: 17/01/2022Test Pit Location: Refer to Drawing 01Logged by: BM



1	est Pi	t Location: Re	efer t	to Dr	awin	g 01 Log	ged by: BM	Checked by:	Sca	ale:		1:25		Sheet 1 of 1
F	Positio	n: 400761.8r	mE;	7935	560.9	mN Projection: BOP	2000	LOL	Pit D	)ime	nsion	s: m ł	oy n	n
	1		-	1	1	Datum: Moturiki			Sur∖	ey S	Source	e: pL	og t	
undwater	Sam	ples & Insitu Tests	(m)	pth (m)	phic Log	Mat Soil: Soil symbol; soil type; colour; si comments	erial Description tructure; bedding; plasticit . (origin/geological unit)	γ; sensitivity; additional	oisture Indition	sistency/ ve Density	Dyna Pen (Blow	amic Cor etromete /s/100mi	ne er m)	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect
Gro	Depth	Type & Results	L	De	Gra	Rock: Colour; fabric; rock name;	additional comments. (or	gin/geological unit)	≥ŏ	Con Relati	5 1	0 15	20	Shape, Roughness, Aperture, Imili, Seepage; Spacing; Block Size; Block Shape: Remarks
				-		OL: Organic SILT: with trace san fine. (Topsoil) SP: Fine SAND : light brownish ( (Alluvial Sands)	d; dark brownish black grey. Uniformly gradec	. No plasticity; sand,	м					
	0.7	Peak = 32kPa Residual = 17kPa				<ul> <li>P:: PEAI</li> <li>: dark brownish black. Low plasti organic, fibrous, tree stumps.</li> <li>(Peat)</li> </ul>	icity, insensitive to mod	lerately sensitive,	w					
▾	1.4	Peak = 29kPa Residual = 20kPa												-
	2.0	Peak = 58kPa Residual = 26kPa		2						F				
	2.6	Peak = 41kPa Residual = 20kPa							s					-
	3.2	Peak = 32kPa Residual = 14kPa		3										
	3.6	Peak = 89kPa Residual = 30kPa				ML: SILT: with minor clay; light b plasticity, moderately sensitive (Pleistocene Alluvium)	rownish grey mottled o	range brown. Low	_	St				-
			1	4 -		Test pit te	erminated at 4.00 m							1 -
			_	5 -										
T	erminat	ion Reason: Tar	get D	epth										
S	Shear Va Remarks	ane No: 3403				ICP No:		<b></b>		-	., _		0	1 00 10
		This report	t is ba	ised o	n the	attached field description for so	bil and rock, CMW (	beosciences - Field	∟oggir	ıg Gu	iiae, Re	vision	3 - A	лрпі 2018.

**TEST PIT LOG - TP03** Client: Kevin & Andrea Marsh Project: Pencarrow Estate, 1491 Arawa Road, Pongakawa Site Location: Pongakawa Project No.: TGA2021-0096 Date: 17/01/2022 Test Pit Location: Refer to Drawing 01 Logged by: BM



T	Fest Pit	Location: Re	efer t	to Dr	awin	g 01 Logged by: BM Checked by:	Sc	ale:		1:	25		Sheet 1 of 1
F	Positior	n: 401042.4r	nE;	7934	471.9	OmN Projection: BOP2000	Pit [	Dime	ensic	ons:	m b	y m	) ablat
ater	Samp	les & Insitu Tests		Ê	Log	Material Description	Sur	vey ansity		CE: ynamic Penetro	C Cone	eg ta	Structure & Other Observations
Groundw	Depth	Type & Results	RL (m	Depth (	Graphic	Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moistur Conditi	Consister Relative D	5	10	15 2	1) 20	Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape: Remarks
						OL: Organic SILT: with trace sand; dark brownish black. Non-plastic; sand, fine. (Topsoil) SP: Fine SAND: light brownish grey. Uniformly graded. (Alluvial Sands) Pt: PEAT: dark brownish black. Low plasticity, moderately sensitive, organic, fibrous, tree stumps.	D to M						
	0.6	Peak = 46kPa Residual = 17kPa				(Peat)	w						
◄	1.1	Peak = 41kPa Residual = 17kPa		1 -				F					
	1.6	Peak = 46kPa Residual = 14kPa											
	2.0	Peak = 72KPa Residual = 43kPa		2			S	St					
	2.5	Peak = 69kPa Residual = 41kPa				CD. Fire to medium CAND, becumish every Dearly graded introbedded with							
				3 -		SP: Fine to mealum SAND: brownish grey. Poony graded, interbedded with sandy SILT. (Pleistocene Alluvium)		L to MD				2 3 2 2 3	
					-	Test pit terminated at 3.40 m							
				4 -									
				5 -									
T S F	Ferminati Shear Va Remarks	on Reason: Ho ne No: 3403 : This report	le col	lapse	D n the	CP No: 14 attached field description for soil and rock, CMW Geosciences - Field	l Loggi	ng Gi	uide,	Revis	sion 3	3 - A	pril 2018.

# TEST PIT LOG - TP04Client: Kevin & Andrea MarshProject: Pencarrow Estate, 1491 Arawa Road, PongakawaSite Location: PongakawaProject No.: TGA2021-0096Date: 17/01/2022Test Pit Location: Refer to Drawing 01Logge



L	fest Pit	Location: Re	efer	to Dr	awir	ng 01		Logged by	y: BM	Checked by:	Sc	ale:		-	1:25		Sheet 1 of 1
F	Positior	n: 400851.8r	mE;	7934	452.	6mN	Projection	: BOP2000		LGL	Pit I	Dime	ensio	ons	: m l	oy n	ז 
-			1		1	1	Datum: M	loturiki			Sur	/ey S	Sou	rce	: pL	og t	ablet
vater	Samp	les & Insitu Tests	- -	Ē	Log			Material Desc	ription		ion e	ency/ ensity		Pene	tromete 100m	er er	Discontinuities: Depth: Defect
Apuno			RL (n	bepth	aphic	Sc	Book: Colour: fobrio:	<li>colour; structure; b comments. (origin/ge rock pame: additional</li>	edding; plasticity eological unit)	y; sensitivity; additional	Moist	insiste tive D		Diolit		,	Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill;
อ็	Depth	Type & Results			υ		ROCK: COIOUT, IADIIC, I	ock name, additional	r comments. (on	gin/geological unit)	20	Rela	5	10	) 15	20	Seepage; Spacing; Block Size; Block Shape; Remarks
						OL	Organic SILT: with	trace sand; dark b	rownish black	. Non-plastic; sand,							
						(To	osoil)				M						
					××	SP	Fine SAND: light b	rownish grey. Unif	ormly graded.		′ }						
					××	ML	Silty fine to medium	n SAND : light gre	yish yellow. P	oorly graded.	´						
				-	××	2											-
					×× ××	> ML	Sandy SILT: greyis	h brown mottled o	range brown.	Low plasticity,							
	0.8	Peak = 148kPa			××	) (Ple	eistocene Alluvium)	cononiro, cana, n									
		Residual = 41kPa			×× ××												
				1 -	××.									-		-	
					××.							VSt					
	10	D			ХX	>											
	1.5	Residual = 35kPa			XX.	>											
				-	ХX	>											· _
					××.	MH	: Clayey SILT: with r	minor sand; light g	arey mottled or	range brown. Low	_						
					××.	pla:	sticity, moderately seistocene Alluvium)	ensitive to sensitiv	e; sand, fine.	-							:
							,										
				2 -		>					м						
						$\langle$											
						$\langle$						01.11					
						$\langle$						VSt					
	2.5	Peak = 75kPa				$\langle$											-
	2.0	Residual = 29kPa				$\leq$											
						<											
	2.0	Deek - 110kDe															
	3.0	Residual = 29kPa		3		~											
						> > SM	· Silty Fine to coarse	e SAND: with som	e gravel and i	minor clay: light	_						
					××	bro	wnish yellow. Well g	raded; gravel, fine	a, weathered.	ninor oldy, light		L to				2	
					× ×							MD	H I			3	:
				-	××											3	-
T					××		0.1.7									2	-
	3.8	Peak = 75kPa				(Ple	siL1: grey. Low pla eistocene Alluvium)	sticity, sensitive.			W to						:
		Residual = 14kPa									S	St					
				4 -		1	-	Fest pit terminate	d at 4.00 m								-
					1												
				-													-
					1												:
					1												
			-	5 -	1								⊨				
Т	erminati	on Reason: Tar	rget D	Depth													
S	Shear Va	ne No: 3403			[	DCP N	lo: 14										
F	Remarks																
		This report	t is ba	ased o	on the	attac	ned field descripti	on for soil and r	ock, CMW C	Geosciences - Field	Loggi	ng Gu	uide,	Rev	vision	3 - A	pril 2018.

TEST PIT LOG - TP05Client: Kevin & Andrea MarshProject: Pencarrow Estate, 1491 Arawa Road, PongakawaSite Location: PongakawaProject No.: TGA2021-0096Date: 18/01/2022Test Pit Location: Refer to Drawing 01Logged by: BM



Test Pit L	_ocation: Re	efer	to Dr	rawin	ıg 01			L	∟ogged	by: BM	(	Checked by	/:	Sca	ale:			1:2	5		Sheet 1 of 1
Position:	400626.1n	nE;	793	553.3	3mN	Pro Da	ojectior atum: N	n: B( Motu	<sup>,</sup> OP200 uriki	0			F	Pit E Surv	Dime vev \$	ensi Sou	ions irce	s:m : p	by Loc	' m ci ta	ablet
Sample: Sample: Depth	s & Insitu Tests Type & Results	RL (m)	Depth (m)	Graphic Log	So	il: Soil syn Rock: Co	nbol; soil typ blour; fabric;	pe; colo comm ; rock n	Material D our; structur nents. (origi name; additi	)escription 'e; bedding; p in/geological u ional commer	olasticity; s unit) nts. (origin	sensitivity; addition 1/geological unit)	al	Moisture Condition	Consistency/ Relative Density		Dyna Pene (Blow	mic C etrome s/100	one eter mm)	)	Structure & Other Observations Discontinuities: Depth; Defect Number; Defect Type; Dip; Defe Shape; Roughness; Aperture; Inf Seepage; Spacing; Block Size;
			-		OL: fine (Top SM (Ple	Organic osoil) : Silty Fir istocene	SILT: with ne to medi Alluvium) SILT: light (	ium SA ) brown	AND: light	rk brownish brownish y	i black. N /ellow. Po	Non-plastic; san oorly graded. //n. Low plasticity	d,		L					2 2 2 1 2 1	
1.0	Peak = 75kPa Residual = 20kPa		1		(Ple	istocene	Alluvium)	)		uun.											
2.0	Peak = 119kPa Residual = 20kPa		2 -		· · · · · ·	at 2.20m	, becoming	g claye	ey SILT					М	VSt to						
2.5	Peak = 87kPa Residual = 32kPa		-												St						
3.0	Peak = 84kPa Residual = 32kPa		3 -																		
			4 -		SM whi (Ple	: Silty Fir	ie to coars graded; gr Alluvium)	se SAÑ <sup>·</sup> avel, fi <u>)</u> Test p	ND: with n	ninor gravel Jium, weath ated at 4.0	I and cla hered.	y; light yellowish	n								
Termination Shear Vand Remarks:	n Reason: Tarı e No: 3403	] get D	)epth	1C	DCP N	lo:	14														

TEST PIT LOG - TP06
Client: Kevin & Andrea Marsh
Project: Pencarrow Estate, 1491 Arawa Road, Pongakawa
Site Location: Pongakawa
Project No.: TGA2021-0096
Date: 17/01/2022
Test Pit Location: Refer to Drawing 01 Logged
D



L   T	Fest Pit	Location: Re	efer	to Di	rawin	g 01				Lo	gged b	oy: BM	1 (	Checked by	/:	Sca	ale:			1:25		Sheet 1 of 1
F	Positio	n: 400935.7r	nE;	793	429.2	2mN	Ρ	rojecti	ion:	BO	P2000	Í		LGL	F	it D	)ime	nsio	ons	: m	by ı	m
	1		1		1		D	atum:	Mo	oturil	ki				S	Surv	ey S	Soui	ce	: pl	og	tablet
ater	Samp	oles & Insitu Tests		Ê	bo.					N	laterial Des	scription				D =	icy/ insity		)ynar Pene	nic Co tromet	ne er	Structure & Other Observations
ewbr			L (III)	oth (n	hic L	So	oil: Soil sy	/mbol; soil	l type;	colour	structure;	bedding; p	plasticity; s	sensitivity; addition	al	nditio	isten e De	(E	Blows	s/100m	ım)	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect
Grou	Depth	Type & Results	2	Dep	Grap		Rock: C	Colour; fab	oric; ro	ock nam	ne; addition	al comme	ents. (origin	n/geological unit)		8 S	Cons telativ	5	10	) 15	20	Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size;
						OL:	: Organi	ic SILT: w	with tr	ace sa	and: dark	brownisł	h black. N	Non-plastic: san	d.		Ľ.					Block Shape; Remarks
					P	fine	). Pooil)				,			···· p····, ···	_,							
					-	SP:	: Fine S	AND: ligi	ht bro	ownish	n grey. Po	orly grad	ded.				LP					
							uvial Sa	inds)														
					-× <u>"w</u> ×	Pt:	PEAT: d	lark brow	wnish	black	. Low pla	sticity, or	ganic, fib	orous, tree stum	os.		S to F					
				-		(Pe	at)								_/							-
	0.7	Book - 46kBo			XX	ML: (Ple	: SILT: o eistocen	orange. L le Alluviu	.ow pl um)	lastici	ty, moder	ately sen	nsitive.									
	0.7	Residual = 17kPa																				
					1×x	>																
				1 -	$ \times \times $	>													_		_	
					⊀ × × −× × ∶	>																
						>																
						>																
	1.5	Peak = 69kPa Residual = 35kPa		-	ÊXX	мн	: Claye	y SILT: w	vith m	inor s	and; light	grey. Lov	w plastici	ity, moderately								-
						sen Ple	isitive; s eistocen	and, fine e Alluviu	e to m um)	nediun	٦.											
	2.0	Peak = 64kPa		2 -	<u>-</u> x_;	>										м						
		Residual = 29kPa			1×J																	
					<u>k</u>	>											VSt to					
						>											St					
						>																
	2.5	Peak = 107kPa		-		>																-
		Residual – SSRI a			<u>txx</u>																	
					<u>Éx</u> x	1																
	2.0	Deek - 116kDe																				
	3.0	Residual = 32kPa		3 -																		
					1××																	
					<u>tx</u> x)	>																
				-	<u>+~~</u>	>																-
						>																
						>																
					<u>}</u> xx																	
				4 -					Te	est pit	terminat	ed at 4.0	00 m								-	
					-																	
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					-																	-
					1																	
					-																	
					]																	
					-																	
			4	5 -	1													$\vdash$				-
Т	erminat	ion Reason: Tar	get D	)epth	1	I									I_			L				
s	Shear Va	ine No: 3403			C	OCP N	lo:															
F	Remarks	:																				
		This report	t is ba	ased r	on the	attacl	hed fiel	ld descr	riptio	n for	soil and	rock. C	MW Ge	osciences - F	ield Lo	aain	ıa Gı	iide.	Rev	/isior	3 - 1	April 2018.
L									.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		and	, <b>-</b>		1.1.1.1.000		39"	3 50					





#### **TEST PIT LOG - TP10** Client: Kevin & Andrea Marsh Project: Pencarrow Estate, 1491 Arawa Road, Pongakawa Site Location: Pongakawa Project No.: TGA2021-0096 Date: 17/01/2022



C   T	Date: 17 Test Pit	7/01/2022 Location: Re	efer i	to Dr	awin	a 01		l oaaed t	ov: BM	Checked by:	Sc	ale:		1	·25		Sheet 1 of 1
F	Position	: 400783.5n	nE;	793	359.2	2mN	Projection:	BOP2000	)	LGL	Pit [	Dime	ensio	ons	: m	by r	n
	1			1			Datum: M	oturiki			Sur	vey S	Sou	rce	pL	.og 1	tablet
ater	Sampl	es & Insitu Tests		Ê	60-			Material Des	scription		e 5	icy/ ensity		Dynar Pene	nic Co tromet	ne er	Structure & Other Observations
awpur			(m)	pth (r	phic L	Soi	I: Soil symbol; soil type	; colour; structure; comments. (origin/	bedding; plasticit geological unit)	y; sensitivity; additional	Distur	sisten ve De	(	Blows	/100m	ım)	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect
Grot	Depth	Type & Results	œ	De	Gra		Rock: Colour; fabric; r	ock name; addition	al comments. (or	gin/geological unit)	Žΰ	Con Relati	5	10	15	20	Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size;
-						OL:	Organic SILT: dark	brownish black.	Non-plastic; sa	ind, fine.		_					Block Shape, Remarks
						(Top	osoil)										
																	-
											м						-
				-		SP:	Fine SAND: light br ivial Sands)	ownish grey. poo	orly graded.								-
												LP					
	0.8	Peak = 43kPa			NR X-	Pt: F	PEAT: dark brownish	1 black. Low plas	sticity, , modera	ately sensitive,							
		Residual = 20kPa		1 -	×			inps.									
					-×	(Pea	at)				w						
					×	-											-
					×	-											
		5 1 10 5			-×	-											:
	1.5	Residual = 17kPa		_	-×	-											-
					-×	-											-
					×												
					-× ×												-
	2.0	Peak = 38kPa Residual = 17kPa		2 -	×							F					
					-× ×												
					-×												
						-											-
	2.5	Peak = 43kPa Residual = 20kPa		-	×												-
					-× ×						W to						
					-^ 						S						
					₩ ¥×												
				3 -	×	5								_			-
					ХŶ	ML: (Ple	SILT: light brownish istocene Alluvium)	grey. Low plast	icity.								
				-	ХŶ	>											-
	3.6	Peak = 104kPa Residual = 29kPa			ХŶ	>						VSt					-
					ХŶ	>											-
					KX)	>											
				4 -	$\times \times $	>	т	est pit terminat	red at 4 00 m		_						
								oot pit torriniat									
																	:
																	-
				-	-												-
					-												
				5 -	1								$\square$			_	
Т	erminatio	on Reason: Tar	] get ei	pth	1												1
s	hear Var	ne No: 3403	55	•	C	OCP N	0:										
R	Remarks:																
		This report	is ba	ased o	n the	attach	ed field description	on for soil and	rock, CMW (	Geosciences - Fiel	d Loggi	ng Gu	uide,	Rev	ision	3 - A	April 2018.

**TEST PIT LOG - TP11** Client: Kevin & Andrea Marsh Project: Pencarrow Estate, 1491 Arawa Road, Pongakawa Site Location: Pongakawa Project No.: TGA2021-0096 Date: 17/01/2022 Test Pit Location: Refer to Drawing 01 Logged by: BM



1	Fest Pit	Location: Re	efer t	to Dr	awin	g 01			Log	gged by:	BM	Checked by:	Sc	ale:		1:2	25		Sheet 1 of 1
F	Position	: 400673.8r	nE;	793 <sup>-</sup>	198.0	)mN	Proj	ection:	: BOF	2000		LGL	Pit	Dime	ensior	าร: n	n by	' m	l
	1		1		1	1	Dat	um: M	oturik	ci			Sur	vey \$	Sourc	e: p	oLog	g ta	ablet
oundwater	Sample	es & Insitu Tests	RL (m)	epth (m)	aphic Log	Soil	l: Soil symb	ol; soil type	Ma ; colour; : comment	aterial Descrip structure; bed s. (origin/geol	otion ding; plastici ogical unit)	ty; sensitivity; additional	Aoisture	nsistency/ tive Density	Dy Pe (Blo	namic netron ows/10	Cone neter 0mm)		Structure & Other Observations Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill;
ß	Depth	Type & Results		Δ	ő		Rock: Colo	ur; fabric; r	ock name	e; additional c	omments. (or	rigin/geological unit)	20	Rela	5	10 1	5 20	)	Seepage; Spacing; Block Size; Block Shape; Remarks
	0.5	Peak = 77kPa Residual = 30kPa				OL: fine. (Top ML: sanc (Plei	Organic S soil) SILT: with d, fine to n istocene A	some sar nedium. Nluvium)	trace sa	nd; dark brc	wnish blac	k. Non-plastic; sand, Jerately sensitive;		St					
	1.0	Peak = 122kPa Residual = 30kPa		1 -		MH: plast (Plei	Clayey S ticity, mod istocene A	ILT: with n lerately se Illuvium)	ninor sa ensitive;	nd; light gre sand, fine t	y streaked o medium.	orange brown. Low							
	1.5	Peak = 107kPa Residual = 27kPa											м						
	2.0	Peak = 119kPa Residual = 30kPa		2		2							IVI	VSt					
	2.5	Peak = 137kPa Residual = 45kPa				2													
	3.0	Peak = 131kPa Residual = 42kPa		3 -															
	3.5	Peak = 140kPa Residual = 45kPa		4 -		SM: brow (Plei	Silty Fine vnish yello istocene A	to coarse ow. Well gr ulluvium) T	e SAND: raded, v Fest pit t	: with some weathered; g terminated	gravel and gravel, fine. at 4.00 m	minor clay; light	M to W	-					
				5 -															
T S F	Ferminatio Shear Van Remarks:	n Reason: Tar le No: 0830 This report	get D is ba	epth ised o	E n the	OCP No	o: ed field d	descriptio	on for s	soil and roo	ck, CMW	Geosciences - Fie	ld Loggi	ng Gi	uide, R	evisio	on 3	- Ap	pril 2018.

TEST PIT LOG - TP12Client: Kevin & Andrea MarshProject: Pencarrow Estate, 1491 Arawa Road, PongakawaSite Location: PongakawaProject No.: TGA2021-0096Date: 17/01/2022Test Pit Location: Refer to Drawing 01Logged by: BM



Test Pit	Location: Re	efer	to Di	rawin	g 01	Logged by: BM	Checked by: LGL	Sca	ale:		1:25		Sheet 1 of 1
Position	: 400673.7r	nE;	793	197.0	mN Projection) Datum: M	1: BOP2000 Aoturiki		Pit L Surv	Dime /ev \$	nsion Source	s:mt e:pLo	oy n oa t	า ablet
Sample	es & Insitu Tests	RL (m)	(m) the	aphic Log	Soil: Soil symbol; soil type	Material Description pe; colour; structure; bedding; pl comments. (origin/geological u	asticity; sensitivity; additional ınit)	foisture ondition	nsistency/ ive Density	Dyn: Pen (Blov	amic Con etromete vs/100mn	e r n)	Structure & Other Observations Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape: Roughness: Aperture: Inf
Depth	Type & Results		ă	5	Rock: Colour; fabric;	, rock name; additional commen	ts. (origin/geological unit)	≥0	Cor Relat	5 1	0 15 :	20	Seepage; Spacing; Block Size; Block Shape; Remarks
0.5	Peak = 61kPa Residual = 26kPa Peak = 119kPa		-		OL: Organic SILT: with fine. (Topsoil) SP: Fine SAND : light t (Pleistocene Alluvium) ML: Sandy SILT: orang coarse. (Pleistocene Alluvium)	I trace sand; dark brownish brownish grey. Uniformly gr j ge. Low plasticity, moderate	black. Non-plastic; sand, raded.	/	St				
1.0	Residual = 26kPa				MH: Clayey SILT: with plasticity, moderately s	minor sand; light grey strea	aked orange brown. Low medium.						
1.5	Peak = 78kPa Residual = 29kPa		-		(Fielslocette Alluvium)				VSt to St				
2.0	Peak = 90kPa Residual = 26kPa		2 -					М					
2.5	Peak = 104kPa Residual = 29kPa		-										
3.0	Peak = 116kPa Residual = 29kPa		3 -						VSt				
3.5	Peak = 130kPa Residual = 35kPa		-										
			4			Test pit terminated at 4.00	0 m						
			-										
				-									
				-									
			5 -	-									
Terminatio	on Reason <sup>.</sup> Tar	1 aet D	epth	1				1				-	1
Shear Var	ne No: 3403	901 0	Spur	D	CP No:								
Remarks:													
	This report	is ba	ised c	on the	attached field descripti	tion for soil and rock, CN	MW Geosciences - Field	Loggii	ng Gu	iide, Re	vision	3 - A	pril 2018.

#### **TEST PIT LOG - TP13** Client: Kevin & Andrea Marsh Project: Pencarrow Estate, 1491 Arawa Road, Pongakawa Site Location: Pongakawa Project No.: TGA2021-0096 Date: 17/01/2022 Test Pit Location: Refer to Drawing 01 Logg



T	est Pi	t Location: Re	efer t	o Dr	rawir	g 01 Logged by: BM Check	ked by:	Sca	ale:		1:	:25		Sheet 1 of 1			
Position: Projection: BOP2000							5L	Pit Dimensions: m by m									
<u> </u>					_			Sun	/ey a		vnami	ic Con	e e	Structure & Other Observations			
ndwate	Sam	E	(m)	hic Lo	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity	/; additional	isture	istency e Dens	Penetrometer (Blows/100mm)				Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect				
Grou	Depth	Depth Type & Results		Dep	Grap	Rock: Colour; fabric; rock name; additional comments. (origin/geologic	cal unit)	ĕö	Cons Relativ	5	10	] 15 :	20	Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size; Block Shape: Remarks			
						OL: Organic SILT: with trace sand; dark brownish black. Non-plas fine.	stic; sand,										
							/	м									
						SP: Fine SAND: light brownish grey. Uniformly graded. (Alluvial Sands)											
				-		Pt: PEAT: dark brownish black I ow plasticity moderately sensiti								-			
						organic, fibrous, tree stumps.	10,										
	0.7	Peak = 41kPa Residual = 17kPa Peak = 38kPa Residual = 14kPa Peak = 43kPa Residual = 20kPa		1 -		(Peat)											
					- Mr. X-												
								w			-		+				
	1.2																
					-×												
					-×									· · · · · · · · · · · · · · · · · · ·			
┹					-												
	1.7																
					-X				F								
				2 -							-			-			
	2.4				- × 10- 110 × -												
													-				
				-										-			
					- NIC - X-												
	2.0	Pook = 22kPo						VV to S									
	2.5	Residual = 14kPa		3 -	-× <u></u> -								_				
						ML: Sandy SILI: greyish brown streaked orange brown. Low plas moderately sensitive; sand, fine to coarse. (Pleistocane Alluvium)	sticity,										
	3.5	Peak = 75kPa Residual = 29kPa		-	-× × - × ×									-			
									St								
					-												
				4 -	- × × × ×												
					-	lest pit terminated at 4.00 m											
					-												
					-												
				-										-			
					1												
					1												
				5	-												
					-									-			
	Shear Va	ane No: 3403	yeı D	eptii	0	CP No:											
F	Remarks	:															
		This report	is ba	sed c	on the	attached field description for soil and rock, CMW Geoscien	ces - Field	Loggir	ng Gu	ide, F	Revi	sion	3 - A	pril 2018.			

TEST PIT LOG - TP14Client: Kevin & Andrea MarshProject: Pencarrow Estate, 1491 Arawa Road, PongakawaSite Location: PongakawaProject No.: TGA2021-0096Date: 17/01/2022Test Pit Location: Refer to Drawing 01Logged by: BM



T	est Pit	Location: Re	efer t	to Dr	rawir	ıg 01		Logge	d by: BM	Checked by:	Sc	ale:		1:2	25		Sheet 1 of 1
Position: 400974.6mE; 793492.0mN Projection: BOP2000								Pit	Pit Dimensions: m by m								
							Datum: N	/loturiki			Sur	vey :		ce: namic		g ta	3DIEI Structure & Other Observations
water	Sampl	es & Insitu Tests	Ê	Ē	c Log	Soil	Caile Cail aumhale aoil terra	Material	Material Description	sticity: sensitivity: additional	tion	tency/ Densit	Pe (Bl	enetro ows/10	meter 00mm	)	Discontinuities: Depth; Defect
ground	Depth	Type & Results	RL (	Depth	Graphi	F	Rock: Colour; fabric;	comments. (or rock name; add	igin/geological unit ditional comments.	t) . (origin/geological unit)	Mois	Consis	-	10	15 0		Number; Detect Type; Dip; Detect Shape; Roughness; Aperture; Infili; Seepage: Spacing: Block Size;
0	Dopui						Draania CII Tr dark	k hroumish hk	ak Nan nlastia	and fine		Rec				:0 	Block Shape; Remarks
						OL: C	Jrganic SILT: dark	( Drownish Dia	ICK. NON-Plastic	; sand, fine.							-
					]	SP: F	ine SAND: light b	prownish grey	. Poorly graded		/ D to M						
						(Allu	/lai Sands)										-
					-×	Pt: P	EAT c brownish black.	Low plasticity	/: moderatelv se	ensitive, organic, fibrou	s.						-
		Peak = 49kPa Residual = 14kPa Peak = 43kPa Residual = 14kPa Peak = 43kPa Residual = 17kPa				<pre>viree stumps. (Peat)</pre>	,		,	,							
	0.8																
					->->->->->->->->->->->->->->->->->->->	-											
				1 -							M to W						
						-											
					-×	2											
	1.3				-×												
					-×	4											
					- ×	-											
	1.8					4											
				2		4						F					-
				2 -		c.											
						c.											
	2.4					4											
					-316 × - -× 316	c											-
				-	316, X - X 316, X -	c.											
					- <u>146</u>	c					W to						1
					-X						S						
	2.9	Peak = 46kPa Residual = 12kPa			-X.	c											1
				3 -	× ***	SP: Fine to medium SAN											
																-	
				-			ND: brownish grey. Poorly gr	raded, interbedded with	h					2			
						(Pleis	stocene Alluvium)	i								3	
												L to MD				1	-
					]											1	
				4													-
				-				Test pit term	inated at 4.00 i	m							-
					-												
					-												-
					-												-
					-												1
					1												
					1												-
				5 -	1								$\mid \mid$	_			_
Т	Termination Reason: Target Depth																
s	Shear Va	ne No: 3403	5 -		0	OCP No	: 14										
R	Remarks:																
		This report	is ba	ised o	on the	attache	ed field descript	tion for soil a	and rock, CM	N Geosciences - Fie	eld Logg	ng Gı	uide, F	levisi	ion 3	3 - A	pril 2018.
## **TEST PIT LOG - TP15** Client: Kevin & Andrea Marsh Project: Pencarrow Estate, 1491 Arawa Road, Pongakawa Site Location: Pongakawa Project No.: TGA2021-0096 Date: 18/01/2022 Test Pit Location: Refer to Drawing 01



	Jate: 1	8/01/2022 Location: Re	ofor		owin	c 01 Checked by: BM Checked by:	Sec	. ماد			1.2	5		Sheet 1 of 1
Position: 400622.4mE; 793550.2mN     Projection: BOP2000     LGL     Dotation: 1.20     Differ 1.20														
			,			Datum: Moturiki	Surv	/ey S	Sou	rce	: р		g ta	ablet
er	Samr	oles & Insitu Tests			b		-	sy/ isity		Dynai Pene	mic C	Cone		Structure & Other Observations
ndwat	oum		Ê	th (n	hic Lo	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional	isture	istenc e Den	(	Blows	s/100	Dmm)		Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect
Grou	Depth	Type & Results	R	Dep	Grap	Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Cor	Cons telativ	Ę	5 1(	<b>)</b> 1:	5 20	0	Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size;
						OL: Organic SILT: with trace sand; dark brownish black. Non-plastic; sand,		Ľ	$\vdash$					Block Shape; Remarks
						fine.	D to							:
						(Topsoil)	/ 101	LP						
					-×	(Alluvial Sands)								
	0.5	Peak = 43kPa			× ***	: dark brownish black. Low plasticity, moderately sensitive, organic, fibrous,								-
		Residual = 14kPa			×	tree stumps								
						(Peat)		F						
					× <u>~~</u> ×			Г						-
					× ***		M to							
	1.0	Peak = 41kPa Residual = 20kPa		1 -	× *		**							-
					× <u></u> ×									-
						SW: Fine to coarse SAND: grey. Well graded, pumiceous. (Alluvial Sands)								
								LP						
				-	]									-
┛					×	Pt: PEAT: dark brownish black. Low plasticity, organic, moderately								- -
	1.7	Peak = 43kPa Residual = 20kPa			一 一 二 二 二 二 二 二 二 二	sensitive, librous, tree stumps.		F						
					- <u>× ///</u> ×									
				2 -		(Pleistocene Alluvium)							2	_
					]				Н				3	
					]								2	
													3	
													4	
				-			W to S						4	-
								L to					2	
								WD					3	
									Н				2	
				3 -									4	-
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				-		Test nit terminated at 3 50 m							4	-
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				4 -										
					1									
					-									
					-									:
				-	]									-
					1									-
					]									
				5 -	1								_	-
٦	Termination Reason: Hole collapse													
5	Shear Va	ine No: 3403			D	CP No: 14								
F	Remarks	:												
		This report	is ba	ised c	on the	attached field description for soil and rock, CMW Geosciences - Field	Loggir	ng Gu	uide,	Rev	/isic	on 3	- A	pril 2018.

## **TEST PIT LOG - TP16** Client: Kevin & Andrea Marsh Project: Pencarrow Estate, 1491 Arawa Road, Pongakawa Site Location: Pongakawa Project No.: TGA2021-0096 Date: 17/01/2022



	Jate: 1 Test Pit	7/01/2022 : Location: Re	efer t	o Dr	awin	a 01 Logged by: Checked by:	Sc	ale:		1:2	25	Sheet 1 of 1
F	Position	n: 400640.8r	nE;	793	583.8	BmN Projection: BOP2000	Pit [	Dime	nsion	s: n	n by	m
			1	1	1	Datum: Moturiki	Sur	vey S	Source	e: p	bLog	tablet
ater	Samp	oles & Insitu Tests		Ê	bo.	Material Description	e د	icy/ insity	Dyn Per	amic etron	Cone neter	Structure & Other Observations
empur			(ll)	pth (n	phic L	Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/aeological unit)	Distur	sisten ve De	(Blov	vs/10	0mm)	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect
Grot	Depth	Type & Results	~	De	Gray	Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	l≚S	Con: Relativ	5	0 1	5 20	Shape; Roughness; Aperture; Intill; Seepage; Spacing; Block Size;
						OL: Organic SILT: with trace sand; dark brownish black. Non-plastic; sand,						Block Snape; Remarks
						fine.						
						(Topsoil)	D to M					
	0.4	Book = 59kBo				SP: Fine SAND : light brownish grey. Poorly graded.		LP				
	0.4	Residual = 14kPa		_		Pt: PEAT						-
					×	: dark brownish black. Low plasticity, , moderately sensitive, organic, fibrous, tree stumps.						:
					1. 	(Peat)						
					-× <u>"w</u> -							-
					×							
	1.0	Peak = 38kPa Residual = 17kPa		1 -	-×			-				
							w					-
	15	Peak = 43kPa		_								-
		Residual = 14kPa										-
					-^	SW: Fine to coarse SAND: with trace gravel: light grey. Well graded	_					
					]	pumiceous. (Alluvial Sande)						
_												
┛				2 -		from 2.00m to 2.05m, Thin organic layer		LP				
	2.2	Deels = 67kDe				ML: Sandy SILT: greyish brown streaked orange brown. Low plasticity,	W to					
	2.2	Residual = 17kPa				(Pleistocene Alluvium)	S	St				
					<u> </u>	To do the main do do 40 m						
				-	1	lest pit terminated at 2.40 m						-
					-							
												-
					-							
					-							
				3 -								
					1							
					-							
					-							
				-								-
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				4 -	-							
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					-							
					]							
												:
				5 -	1				$\vdash$	-		
	[erminati	on Reason Ho		anse	1							
	Shear Va	ine No: 3403	.5 001	apse	C	DCP No:						
F	Remarks	:										
		This report	is ha	sed r	n the	attached field description for soil and rock CMW Geosciences - Field	Logai	na Gi	ide Re	visiv	on 3 -	April 2018.
		1113 10001				allastica lista accomption for con and rook, Onity Ocosolonices - Field						

## **TEST PIT LOG - TP17** Client: Kevin & Andrea Marsh Project: Pencarrow Estate, 1491 Arawa Road, Pongakawa Site Location: Pongakawa Project No.: TGA2021-0096 Date: 17/01/2022



L   T	est Pit	Location: Re	efer t	to Dr	awin	ig 01		Logged	by: BM	Checked by:	Sc	ale:			1:25		Sheet 1 of 1				
F	Positio	n: 400865.3r	nE;	7934	446.0	) DmN	Projection	BOP200	0	LGL	Pit I	Dime	ensi	ons	: m	by n	1				
	1			1			Datum: M	oturiki			Sur	vey \$	Sou	rce	: pL	og t	ablet				
ater	Samp	oles & Insitu Tests		Ê	Fog			Material D	escription		e e	ncy/ ensity		Dyna Pene	mic Col tromete	ne er	Structure & Other Observations				
Mpun			SL (m	epth (	phic	Soi	il: Soil symbol; soil type	; colour; structure comments. (origir	e; bedding; plastic n/geological unit)	ity; sensitivity; additional	loistu onditi	ive De	(	BIOM	s/100m	m)	Number; Defect Type; Dip; Defect Shape: Roughness: Aperture: Infill:				
0 0	Depth	Type & Results		ă	Ga		Rock: Colour; fabric; r	ock name; additio	onal comments. (o	rigin/geological unit)	≥õ	Cor	5	5 1(	15	20	Seepage; Spacing; Block Size; Block Shape: Remarks				
						OL:	Organic SILT: with	trace sand; dar	k brownish blac	k. Non-plastic; sand,											
						SP:	Fine SAND: light br	ownish grey. U	Iniformly graded	ł.	_/ D to M		LI			1					
						(Ple	istocene Alluvium)									2					
				-		SM:	Silty Fine to mediu	m SAND: light	greyish yellow.	Poorly graded.	_	L to	ΗΙ			2	-				
					× × ·	(Ple	istocene Alluvium)	-				MD	H			4					
					×	×							T			2					
					× ×	>										2					
				1 -	$\times \times$	ML: moc	Sandy SILI: greyisi lerately sensitive; sa	n brown streak and, fine to coa	ed orange brow arse.	n. Low plasticity,											
(Pleistocene Alluvium)																					
	1.5	Peak = 142kPa		-	ХŶ	>											-				
		Residual = 43kPa			ХX	>											-				
					××,																
					XX	2															
	2.0	Peak = 96kPa		2 -	X X	2											-				
		Residual = 29kPa			×× ××	2															
										MH:	Clayey SILT: with r	ninor sand; ligh	nt grey streaked	orange brown. Low	-						
						plas (Ple	ticity, moderately se istocene Alluvium)	ensitive; sand, t	fine to medium.								-				
	25	Peak = 188kPa				>					м	St to VSt									
	2.0	Residual = 43kPa															:				
																	-				
	3.0	Peak - 101kPa		2																	
	3.0	Residual = 29kPa		3 -		2															
	25	Deek = 174kDe																			
	3.5	Residual = 29kPa															-				
						3											:				
						>															
				4	1		T	est pit termina	ated at 4.00 m		T										
					1												:				
					1																
					1																
					1												:				
					1																
																	] :				
T	erminat	ion Reason: Tar	get de	epth	г		0. 14														
	emarka				L		0. 14														
	Ginaiks	This report	tie he	1004 c	n the	attach	ad field docoriet	on for soil or	drock CMMA	Geoscioneco Eiel	dlocci	ng ().	ide	Pa	leion	з ^	pril 2018				
L		тлі тероп	ne ng	เอตน 0	n ule	ลแสบโ	ieu neiu uescripti	UT IOT SOIL AN		Geosciences - FIEI	u rođaj	ng Gl	uue,	1761	າອາດເງ	J - A	φi ii 2010.				

TEST PIT LOG - TP18Client: Kevin & Andrea MarshProject: Pencarrow Estate, 1491 Arawa Road, PongakawaSite Location: PongakawaProject No.: TGA2021-0096Date: 17/01/2022Test Pit Location: Refer to Drawing 01Logged by: BM



L	fest Pit	t Location: Re	efer t	o Dr	awin	g 01	Logged by: BM	Checked by:	Sc	ale:		1:25	Sheet 1 of 1
F	Positio	n: 400924.0r	nE;	7934	473.6	SmN Projection:	: BOP2000	LGL	Pit I	Dime	nsions	s: m by i	m
			-		1	Datum: M	oturiki		Sur	vey S	Source	e: pLog	tablet
Broundwater	Samp	ples & Insitu Tests	RL (m)	Depth (m)	Graphic Log	Soil: Soil symbol; soil type Rock: Colour; fabric; r	Material Description e; colour; structure; bedding; pla comments. (origin/geological un rock name; additional comments	asticity; sensitivity; additional nit) s. (origin/geological unit)	Moisture Condition	consistency/ lative Density	Dyna Pen (Blow	amic Cone etrometer /s/100mm)	Discontinuities: Depth; Defect Number; Defect Type; Dip; Defect Shape; Roughness; Aperture; Infill; Seenge; Snorging; Block Size;
	Bopul					OL: Organic SILT: with t	trace sand: dark brownish b	black Non-plastic: sand	-	Re C			Block Shape; Remarks
						fine.		black. Non-plastic, sand,	D to				
						(Topsoil) SP: Fine SAND: light br	rownish arey. Poorly grader	d/					
					-X 910	(Alluvial Sands)	h black I ow plasticity mod	lerately sensitive	M to				
				-	-× <u>**</u>	organic, fibrous, tree stu	umps.						
						(Peat)	rownish grov Low plasticity	/ moderately sensitive:	/				
	0.7	Peak = 43kPa Residual = 17kPa				sand, fine to medium.	Townish grey. Low plasticity	y, moderately sensitive,					
						(Matua Subgroup)							
				1 -		, ,							
					(					E to			
	1.2	Peak = 75kPa			(					St			
		Residual – 4 mi a			(	- -			М				
					(	- -							
					(	- -							-
					(								
	1.8	Peak = 75kPa			(								
		Residual - 20ki a			<u>( x x</u> X <u>x</u> )	MH: Clayey SILT: with n	ninor sand; light grey. Low	plasticity; sand, fine to					
-				2 -		medium. (Matua Subgroup)							
-										1			
						at 2.20m, Interbedde	ed with thin sand layers						:
													-
	2.5	Peak = 119kPa Residual = 46kPa		-									-
					{					Vet			
					$\frac{1 \times x}{1 \times x}$					VSI			-
									S				
	3.0	Peak = 104kPa		3 -									
		Residual – 4 IKra											
													-
	3.5	Peak = 116kPa		-	$\frac{x \times x}{x \times x}$								
		Residual = 26kPa				Т	Test pit terminated at 3.60	) m					-
					1								
					1								
				4 -									
					-								
													-
					1								:
					1								
					-								
				E -									:
			1		-								-
	erminat	ion Reason: Hol	le coll	apse	-								
	onear Va	ane ino: 3403			Ľ								
•	kemarks	·					<b>,</b> .,			~			A
		This report	is ba	sed o	n the	attached field descriptio	on for soil and rock, CM	ivv Geosciences - Field	∟oggi	ng Gu	iiae, Re	vision 3	April 2018.

## **TEST PIT LOG - TP19** Client: Kevin & Andrea Marsh Project: Pencarrow Estate, 1491 Arawa Road, Pongakawa Site Location: Pongakawa Project No.: TGA2021-0096 Date: 17/01/2022



	Fest Pit	Location: Re	efer t	o Dr	awin	g 01			L	ogged k	by:	Check	ed by:	Sca	ale:		1	:25		Sheet 1 of 1
F	Positio	n: 400988.8r	nE;	7934	144.7	′mN	Proje	ction:	BOP	2000	-	Le	<del>)</del> L	Pit D	Dime	nsic	ons	: m	by I	n tablat
-							Datur	n. wc	JUNKI					Sun	/ey a		ynan	nic Co	ne	Structure & Other Observations
dwate	Samp	oles & Insitu Tests	Ē	E     G     Adterial Description     E       Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional     E	sture dition	stency. Dens	Penetrometer (Blows/100mm)				Discontinuities: Depth; Defect Number: Defect Type: Dip: Defect									
Grour	Depth	Type & Results	R	Dep	Graph		Rock: Colour;	co ; fabric; ro	omments ock name	. (origin/geo ; additional c	logical unit) comments. (c	origin/geologica	al unit)	Mai Can	Consi Relative	5	10	15	20	Shape; Roughness; Aperture; Infill; Seepage; Spacing; Block Size;
						OL: (	Organic SIL	T: with tr	race sar	nd; dark bro	ownish bla	ck. Non-plas	tic; sand,					T	T	Block Snape; Remarks
						ine.	noil)													-
						ML:	SILT: orange	e. Low p	asticity	, moderate	ly sensitive	e to sensitive		-						
	0.4	Peak = 43kPa Residual = 26kPa			× × > < × ×	(Pleis	stocene Allu	uvium)												-
					$(\times \times)$															-
														D to						
	0.0	Book = 61kBo			$(\times \times $									м	F to					
	0.9	Residual = 32kPa		1 -	$(\times \times $										St		_		_	
					$(\times \times $															
					$\hat{\mathbf{x}}$	a	t 1.20m, bea	coming li	ight brov	vn										
					× × > < × ×															:
	1.5	Peak = 127kPa Residual = 26kPa		-		MH:	Clayey SILT	T: light br	rown str	eaked ora	nge. Low p	plasticity, mod	lerately							-
						sens (Pleis	stocene Allu	sitive. Jvium)												-
	2.0	Peak - 142kPa																		
	2.0	Residual = 29kPa																		-
	2.5	Peak = 119kPa Residual = 29kPa		-																
		riooladar zoni a													VSt					
														м						-
						a	t 2.90m, cor	ntains mi	inor san	d										-
	3.0	Peak = 142kPa Residual = 38kPa		3 -																
																				-
	3.5	Peak = 116kPa		-																-
		Residual = 43KPa																		-
						SW: white	Fine to coa . Well grad	rse SAN ed, pumi	ID: with iceous.	minor grav	el and trac	ce silt; light ye	ellowish							-
						(Pleis	stocene Allı	uvium)												
				4 -	· · · · ·			Te	əst pit te	erminated	at 4.00 m	1							+	
					-															-
					-															-
				5 -																
1   4	Terminati Shear Va	on Reason: Tar	get D	epth	п		) <sup>.</sup>													
F	Remarks	:			U	J. 140														
		This report	is ba	sed o	n the	attache	ed field de	scriptio	on for s	oil and ro	ck, CMW	Geoscienc	es - Field	Loggir	ng Gu	ide,	Rev	ision	3 - 2	April 2018.
		-																		

TEST PIT LOG - TP20Client: Kevin & Andrea MarshProject: Pencarrow Estate, 1491 Arawa Road, PongakawaSite Location: PongakawaProject No.: TGA2021-0096Date: 17/01/2022Test Pit Location: Refer to Drawing 01Logged by: BM



Projection:         400788.4mil:         79343.4mil         Projection:         D02000         Pit Dimensions:         Pi	Test Pit	Location: Re	efer	to Dr	awin	g 01	Logged by: BM	Checked by:	Sca	ale:		1:25		Sheet 1 of 1
Description         Description <thdescription< th=""> <thdescription< th=""></thdescription<></thdescription<>	Position	: 400788.4n	nE;	793	433.4	mN Projection: E	BOP2000	LOL	Pit D	)ime	nsion	s:m l	oy n	n ablet
B         Depth         Tops & Result         L         Z         S         S         Depth         Tops & Result         L         Z         S         S         Depth         Tops & Result         L         S         Depth         Tops & Result         Tops & Result         Tops & Result         Tops & Result         Curry more stand; table down the stand; comme is defined owned that. Non-plastic; using the more stand; table down the messare of table downed that. Non-plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the more stand; table gray streaked or tange brown. Low plastic; using the tange brown browne stand; table gray streaked or tange	Sample	es & Insitu Tests	(m)	pth (m)	phic Log	Soil: Soil symbol; soil type; coi	Material Description lour; structure; bedding; plas iments. (origin/geological unit	icity; sensitivity; additional	oisture	sistency/ ve Density	Dyn Per (Blow	amic Cor etromete vs/100m	ne er m)	Structure & Other Observations Discontinuities: Depth; Defect Number; Defect Type; Dip; Defec Shape; Roughness; Aperture; Infil
0         Post = 100-Ps         N	o Depth	Type & Results	Ľ.	De	Gra	Rock: Colour; fabric; rock	name; additional comments.	(origin/geological unit)	Σŏ	Con Relati	5 '	0 15	20	Shape; Roughness; Aperture; In Seepage; Spacing; Block Size Block Shape; Remarks
0.5     Post = 1540° Post = 300° Post = 200° 20     1						OL: Organic SILT: with trac fine. \ (Topsoil)	æ sand; dark brownish bl	ack. Non-plastic; sand,	D to M					
10       Peck = 104Pb       I       I       Image: Ima	0.5	Peak = 104kPa Residual = 35kPa		-		ML: SILT: with some sand; sand, fine. (Pleistocene Alluvium)	orange. Low plasticity, m	oderately sensitive;						
1.5       Peak = 1040Ps Peakal = 358Ps       1       2       Image: Peak = 1040Ps Peakal = 258Ps       1       <	1.0	Peak = 104kPa Residual = 29kPa		1 -										-
2.0       Peak = 104kPa Residual = 28kPa       2         2.5       Peak = 174kPa Residual = 43kPa       4         3.0       Peak = 172kPa Residual = 35kPa       3         3.5       Peak = 101kPa Residual = 35kPa       3         3.5       Peak = 101kPa Residual = 35kPa       4         4       Test pit terminated at 4.00 m       1	1.5	Peak = 119kPa Residual = 35kPa		_		MH: Clayey SILT: with mino plasticity, moderately sensi (Pleistocene Alluvium)	or sand; light grey streak itive; sand, fine to mediur	ed orange brown. Low n.						
2.5       Peak = 174kPa Residual = 43kPa       3         3.0       Peak = 122kPa Residual = 35kPa       3         3.5       Peak = 101kPa Residual = 35kPa       3         3.5       Peak = 101kPa Residual = 35kPa       4         4       Test pit terminated at 4.00 m	2.0	Peak = 104kPa Residual = 29kPa		2 -					м	VSt				-
3.0       Peak = 122kPa Residual = 35kPa       3	2.5	Peak = 174kPa Residual = 43kPa		-										
3.5       Peak = 101kPa Residual = 35kPa       Image: Construction of the second secon	3.0	Peak = 122kPa Residual = 35kPa		3 -										
A SM: Silty Fine to coarse SAND: light brownish grey. Well graded. (Pleistocene Alluvium) A Test pit terminated at 4.00 m	3.5	Peak = 101kPa Residual = 35kPa		-										
				4 -		SM: Silty Fine to coarse SA (Pleistocene Alluvium) Test	AND: light brownish grey. t pit terminated at 4.00 r	Well graded. n		LP				-
				-										
				5 -										1

TEST PIT LOG - TP21	
Client: Kevin & Andrea Marsh	
Project: Pencarrow Estate, 1491 Arawa Road, Ponga	akawa
Site Location: Pongakawa	
Project No.: TGA2021-0096	
Date: 18/01/2022	
Test Pit Location: Refer to Drawing 01	Logge



-	Test Pit	Location: Re	efer t	to Dr	awin	ng 01	Logged by: BM	Checked by:	Sc	ale:		1:2	5	Sheet 1 of 1
F	Positior	n: 400672.7r	nE;	7934	405.6	6mN Projection	n: BOP2000	LGL	Pit [	Dime	ensior	ıs: m	ı by	m
_			1	1		Datum: M	<i>l</i> loturiki		Sur	vey S	Sourc	e: p	Log	tablet
ater	Samp	les & Insitu Tests	-	Ê	Log		Material Description		e e	ncy/ ensity	Dy P€	namic C netrom	cone eter	Discontinuities: Depth: Defect
Mpund			RL (m	epth (	aphic	Soil: Soil symbol; soil typ	be; colour; structure; bedding; pla comments. (origin/geological ur	asticity; sensitivity; additional nit)	Aoistu	nsiste tive D		JWS/100	)	Number; Defect Type; Dip; Defect Shape: Roughness: Aperture: Infill:
ğ	Depth	Type & Results			ő	Rock: Colour; fabric;	rock name; additional comment	s. (origin/geological unit)	20	Rela	5	10 1	5 20	Seepage; Spacing; Block Size; Block Shape; Remarks
						OL: Organic SILT: with fine	n trace sand; dark brownish l	black. Non-plastic; sand,						
					<b>K</b>	(Topsoil)			D to					
					$\times$	ML: SILT: light orange.	Low plasticity.							
						MH: Clayey SILT: with	minor sand; light grey strea	ked orange brown. Low						
	0.5	Peak = 90kPa Residual = 17kPa		-		plasticity, moderately s (Pleistocene Alluvium)	sensitive; sand, fine to medi	um.						-
						3								
	1.0	Peak = 87kPa Residual = 23kPa		1 -		>							-	
						>								
										St				
									M to W					
	1.5	Peak = 75kPa Residual = 35kPa		-										-
	2.0	Peak = 93kPa Residual = 35kPa		2 -										-
					$\frac{1}{2} \times \frac{1}{2}$	SW/: Eine to opprov SA	ND: grov Wall graded num							
				-		(Pleistocene Alluvium)	and, grey, wen graded, pun	iiceous.						3
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				3 -			Test pit terminated at 3.00	) m				-		
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				5 -										
<u> </u>	Forminati	n Popper 11-1		lonar	1									<u> </u>
	Shear Va	ne No: 3403		apse	П	DCP No: 14								
F	Remarks				_									
		This report	is ha	ised o	n the	attached field descript	tion for soil and rock_CM	IW Geosciences - Field	Loani	na Gi	lide. R	evisio	n 3 -	April 2018.
						4000/hpt			- 33'	5.00	-,		-	


































































**Appendix D: Liquefaction Analyses** 



CLiq v.3.0.2.1 - CPT Liquefaction Assessment Software - Report created on: 4/02/2022, 1:57:24 PM Project file: C:\Users\LydiaL\CMW Geosciences Pty Ltd\CMW Connect - TGA2021-0096 Pencarrow Estate, Pongakawa\Office Technical\Cliq\TGA2021-0096 CLiq.clq



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## CPT name: CPT04



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## CPT name: sCPT05



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**CPT** basic interpretation plots

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**CPT** basic interpretation plots

CLig v.3.0.2.1 - CPT Liguefaction Assessment Software - Report created on: 4/02/2022, 1:57:34 PM Project file: C:\Users\LydiaL\CMW Geosciences Pty Ltd\CMW Connect - TGA2021-0096 Pencarrow Estate, Pongakawa\Office Technical\Cliq\TGA2021-0096 CLiq.clq



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## CPT name: CPT11



CLiq v.3.0.2.1 - CPT Liquefaction Assessment Software - Report created on: 4/02/2022, 1:57:36 PM Project file: C:\Users\LydiaL\CMW Geosciences Pty Ltd\CMW Connect - TGA2021-0096 Pencarrow Estate, Pongakawa\Office Technical\Cliq\TGA2021-0096 CLiq.clq



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CLiq v.3.0.2.1 - CPT Liquefaction Assessment Software - Report created on: 4/02/2022, 1:52:23 PM Project file: C:\Users\LydiaL\CMW Geosciences Pty Ltd\CMW Connect - TGA2021-0096 Pencarrow Estate, Pongakawa\Office Technical\Cliq\TGA2021-0096 CLiq.clq



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## CLiq v.3.0.2.1 - CPT Liquefaction Assessment Software - Report created on: 4/02/2022, 1:52:25 PM Project file: C:\Users\LydiaL\CMW Geosciences Pty Ltd\CMW Connect - TGA2021-0096 Pencarrow Estate, Pongakawa\Office Technical\Cliq\TGA2021-0096 CLig.clg

CPT name: CPT03



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**CPT** basic interpretation plots

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CPT basic interpretation plots

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Liquefaction analysis overall plots



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CLiq v.3.0.2.1 - CPT Liquefaction Assessment Software - Report created on: 4/02/2022, 1:52:34 PM Project file: C:\Users\LydiaL\CMW Geosciences Pty Ltd\CMW Connect - TGA2021-0096 Pencarrow Estate, Pongakawa\Office Technical\Cliq\TGA2021-0096 CLiq.clq Appendix E: Settlement Analyses



CPT: CPT01 Total depth: 19.96 m, Date: 24/01/2022 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00 Cone Type: Cone Operator:

### Project:

Location:

## Settlements calculation according to theory of elasticity\*



#### **Calculation properties**

Footing type: Rectangular Footing width: 15.00 (m) L/B: 1.0 Footing pressure: 10.00 (kPa) Embedment depth: 0.00 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: No Calculate secondary settlements: No Time period for primary consolidation: N/A Time period for second. settlements: N/A \* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$S = C_{\alpha} \cdot \Delta z \cdot \log(t/t_{p})$$

1



Project:

Location:

CPT: CPT02 Total depth: 20.00 m, Date: 24/01/2022 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00 Cone Type: Cone Operator:

## Settlements calculation according to theory of elasticity\*



#### **Calculation properties**

Footing type: Rectangular Footing width: 15.00 (m) L/B: 1.0 Footing pressure: 10.00 (kPa) Embedment depth: 0.00 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: No Calculate secondary settlements: No Time period for primary consolidation: N/A Time period for second. settlements: N/A \* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$\mathbf{S} = \mathbf{C}_{\alpha} \cdot \Delta \mathbf{z} \cdot \log(\mathbf{t}/\mathbf{t}_{p})$$



**Project:** 

Location:

CPT: CPT03 Total depth: 19.97 m, Date: 24/01/2022 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00 Cone Type: Cone Operator:

# Settlements calculation according to theory of elasticity\*



Footing type: Rectangular Footing width: 15.00 (m) L/B: 1.0 Footing pressure: 10.00 (kPa) Embedment depth: 0.00 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: No Calculate secondary settlements: No Time period for primary consolidation: N/A Time period for second. settlements: N/A

\* Primary settlements calculation is performed according to

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$S = C_{\alpha} \cdot \Delta z \cdot \log(t/t_{p})$$

where  $t_p$  is the duration of primary consolidation

**Calculation properties** the following formula:



CPT: CPT04 Total depth: 19.97 m, Date: 24/01/2022 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00 Cone Type: Cone Operator:

### Project:

Location:

## Settlements calculation according to theory of elasticity\*



#### **Calculation properties**

Footing type: Rectangular Footing width: 15.00 (m) L/B: 1.0 Footing pressure: 10.00 (kPa) Embedment depth: 0.30 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: No Calculate secondary settlements: No Time period for primary consolidation: N/A Time period for second. settlements: N/A \* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$\mathbf{S} = \mathbf{C}_{\alpha} \cdot \Delta \mathbf{z} \cdot \log(\mathbf{t}/\mathbf{t}_{p})$$



CPT: CPT06 Total depth: 19.96 m, Date: 24/01/2022 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00 Cone Type: Cone Operator:

### Project:

Location:

## Settlements calculation according to theory of elasticity\*



#### **Calculation properties**

Footing type: Rectangular Footing width: 15.00 (m) L/B: 1.0 Footing pressure: 10.00 (kPa) Embedment depth: 0.30 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: No Calculate secondary settlements: No Time period for primary consolidation: N/A Time period for second. settlements: N/A \* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$S = C_{\alpha} \cdot \Delta z \cdot \log(t/t_{p})$$



## **CPT: CPT07** Total depth: 19.96 m, Date: 24/01/2022 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00 Cone Type: Cone Operator:

# **Project:**

Location:

# Settlements calculation according to theory of elasticity\*



#### **Calculation properties**

\* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$\mathbf{S} = \mathbf{C}_{\alpha} \cdot \Delta \mathbf{z} \cdot \log(\mathbf{t}/\mathbf{t}_{p})$$

where  $t_p$  is the duration of primary consolidation

Footing type: Rectangular Footing width: 15.00 (m) L/B: 1.0 Footing pressure: 10.00 (kPa) Embedment depth: 0.30 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: No Calculate secondary settlements: No Time period for primary consolidation: N/A Time period for second. settlements: N/A



Project:

Location:

CPT: CPT08 Total depth: 20.00 m, Date: 24/01/2022 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00 Cone Type: Cone Operator:

# Settlements calculation according to theory of elasticity\*



#### **Calculation properties**

Footing type: Rectangular Footing width: 15.00 (m) L/B: 1.0 Footing pressure: 10.00 (kPa) Embedment depth: 0.30 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: No Calculate secondary settlements: No Time period for primary consolidation: N/A Time period for second. settlements: N/A \* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$S = C_{\alpha} \cdot \Delta z \cdot \log(t/t_p)$$



CPT: CPT10 Total depth: 19.98 m, Date: 24/01/2022 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00 Cone Type: Cone Operator:

### Project:

Location:

## Settlements calculation according to theory of elasticity\*



#### **Calculation properties**

\* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$\mathbf{S} = \mathbf{C}_{\alpha} \cdot \Delta \mathbf{z} \cdot \log(\mathbf{t}/\mathbf{t}_{p})$$

where  $t_{\mbox{\tiny p}}$  is the duration of primary consolidation

Footing type: Rectangular Footing width: 15.00 (m) L/B: 1.0 Footing pressure: 10.00 (kPa) Embedment depth: 0.30 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: No Calculate secondary settlements: No Time period for primary consolidation: N/A Time period for second. settlements: N/A



Project:

Location:

CPT: CPT11 Total depth: 19.95 m, Date: 24/01/2022 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00 Cone Type: Cone Operator:

# Settlements calculation according to theory of elasticity\*



#### **Calculation properties**

Footing type: Rectangular Footing width: 15.00 (m) L/B: 1.0 Footing pressure: 10.00 (kPa) Embedment depth: 0.30 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: No Calculate secondary settlements: No Time period for primary consolidation: N/A Time period for second. settlements: N/A \* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$S = C_{\alpha} \cdot \Delta z \cdot \log(t/t_{p})$$



Project:

Location:

CPT: sCPT05 Total depth: 20.42 m, Date: 24/01/2022 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00 Cone Type:

Cone Operator:

# Settlements calculation according to theory of elasticity\*



#### **Calculation properties**

Footing type: Rectangular Footing width: 15.00 (m) L/B: 1.0 Footing pressure: 10.00 (kPa) Embedment depth: 0.30 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: No Calculate secondary settlements: No Time period for primary consolidation: N/A Time period for second. settlements: N/A \* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$S = C_{\alpha} \cdot \Delta z \cdot \log(t/t_{p})$$

1

where  $t_p$  is the duration of primary consolidation



CPT: sCPT12 Total depth: 20.42 m, Date: 24/01/2022 Surface Elevation: 0.00 m Coords: X:0.00, Y:0.00 Cone Type: Cone Operator:

### Project:

Location:

## Settlements calculation according to theory of elasticity\*



#### **Calculation properties**

Footing type: Rectangular Footing width: 15.00 (m) L/B: 1.0 Footing pressure: 10.00 (kPa) Embedment depth: 0.30 (m) Footing is rigid: No Remove excavation load: No Apply 20% rule: No Calculate secondary settlements: No Time period for primary consolidation: N/A Time period for second. settlements: N/A \* Primary settlements calculation is performed according to the following formula:

$$S = \sum \frac{\Delta \sigma_v}{M_{CPT}} \Delta z$$

\* Secondary (creep) settlements calculation is performed according to the following formula:

$$\mathbf{S} = \mathbf{C}_{\alpha} \cdot \Delta \mathbf{z} \cdot \log(\mathbf{t}/\mathbf{t}_{p})$$

where  $t_p$  is the duration of primary consolidation

Appendix F: Lateral Spread Analyses



