

SUBDIVISION ASSESSMENT

332 KOMOKORIKI HILL ROAD

AHUROA

For: Muriwai Valley Farm Enterprises Ltd

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1. INTRODUCTION

Muriwai Valley Farm Enterprises Ltd propose to construct a 10 lot residential subdivision at 332 Komokoriki Hill Road, Ahuroa. The site is currently occupied by an existing residential dwelling with the proposed development creating new building sites within proposed Lots 2-9 via a combination of amalgamations, subdivision and boundary adjustments. The existing dwelling is contained within proposed Lot 1 and building sites within proposed Lots 2-4 have previously been assessed for engineering suitability by Richardson Stevens Consulting Engineers (Ref 12622 dated 22 July 2014). Scheme plans of the proposed development are included in Appendix 1.

This report details the assessment of engineering matters relevant to the residential development of proposed Lots 5-9 and is intended to support Resource Consent application to Auckland Council.

This report considers the following engineering aspects of the scheme:

- The existing stability of the site
- The effect of the proposed development on stability of the site
- Geotechnical suitability for foundations
- Access arrangements
- Natural hazards
- Stormwater management
- On-site wastewater management

2. SITE DESCRIPTION

The site is located at 332 Komokoriki Hill Road, Ahuroa approximately 20km southwest of Warkworth. The subdivision site contains a number of titles including Lot 3 DP 81832 (4.84ha), Pt Allotment 90 (24.75ha), Allotment 91 (27.48ha), Pt Allotment NE95 (12.41ha), Allotment S94 (3.77ha) and Allotment NE94 (23.47ha) Psh of Komokoriki with a total area of 96.73ha. Auckland Council planning maps indicate that the property is located within an East Coast Rural Zone. Some flood susceptible areas are mapped at the subdivision site but are typically confined to the watercourse margins that are present through the site.

The property is currently operated under an ecological farming regime and has been a certified organic farm for the previous 10 years. A majority of the site is in rolling pasture and is used for grazing by livestock, however large areas of bush are present in the east on the more elevated and hilly topography. A number of wetlands are also present within the property, positioned in the low lying watercourse margins and gullies that dissect the site. Scattered trees and isolated areas of bush are also present within the subdivision.

Figure 1 below taken from Auckland Council GIS shows the site and surrounds including the existing vegetation, buildings and access arrangements.

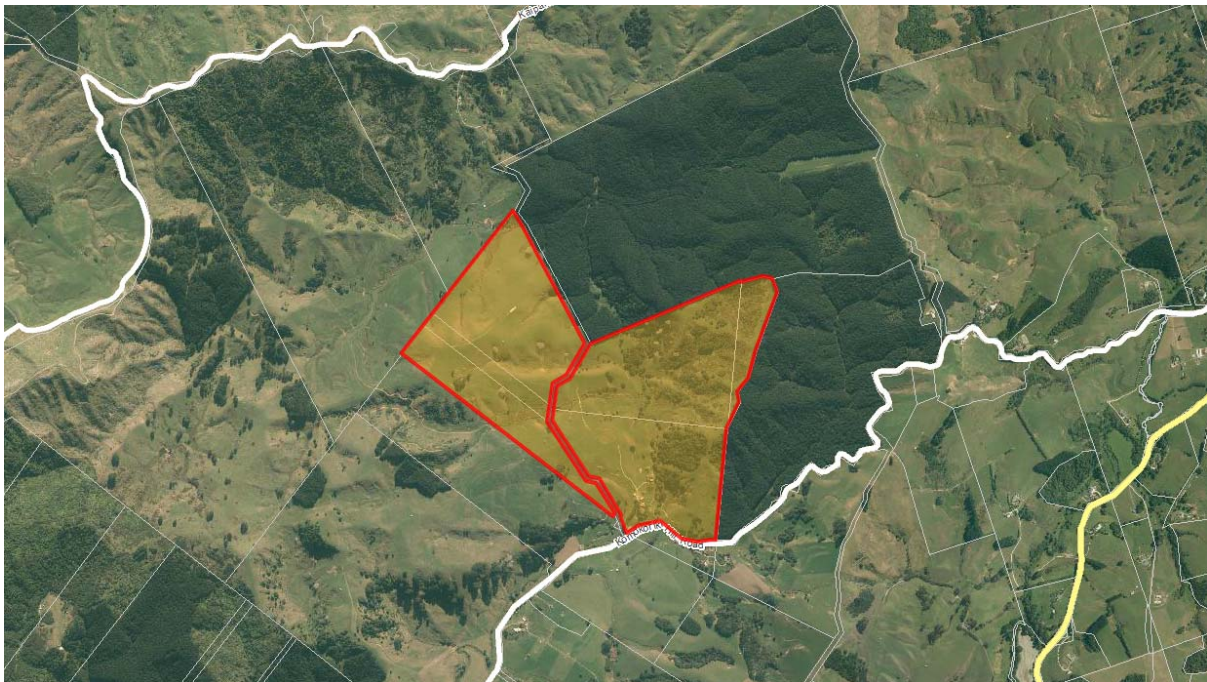


Figure 1: Auckland Council GIS aerial image

Secondary buildings and implement sheds associated with the farm operations are present at the property and typically include an old wool shed with stock yards plus a general storage and implement shed near the main dwelling within proposed Lot 1 as indicated in Figure 1. The wool shed and stock yards are located within proposed Lot 9. An existing farm shed used for hay storage is also present on the property and is positioned within proposed lot 7.

The property has road frontage with Komokoriki Hill Road and is accessed via an existing vehicle bridge crossing Kotorengaru Stream. Access to the proposed building sites within proposed Lots 5-9 will be achieved via a shared Right of Way (RoW) access from Komokoriki Hill Road shown as easements A, C & D on the enclosed scheme plan.

The site has variable graded topography with rolling pasture in the western parts of the site forming proposed Lots 5-9. The nominated building sites within the lots are elevated on the ridge lines and crests of the land offering expansive views of the surrounding countryside. Stormwater runoff follows the natural topography via overland sheet flow collecting and concentrating in a series of unnamed watercourses that drain east and south towards Komokoriki Hill Road. The watercourses that dissect the site are unnamed tributaries of Kotorengaru Stream which runs parallel with Komokoriki Hill Road and forms the southern boundary of the subdivision site. Kotorengaru Stream drains west to Araparera River before discharging to Kaipara Harbour approximately 8km southwest of the property.

3. GEOTECHNICAL

3.1 Ground Investigations

A site visit and walkover inspection of the subdivision property was carried out on 9th July 2015. A follow up visit was carried out on 11th August and a series of shallow subsurface ground investigations were carried out consisting of eight hand auger borehole with in-situ shear vane tests and 37 dynamic cone scala penetrometer tests across the building platforms and ROW access.

The location of all tests within the property and results of the ground investigations are included within Appendix 2.

3.1.1 Boreholes

A total of eight hand auger boreholes were carried out across the subdivision with two boreholes undertaken at the nominated building sites within proposed Lots 5 & 6 and a single borehole within each of the Lot 7-9 building sites. The boreholes were typically taken to 3m below ground level except where conditions were too hard to dig by hand. The boreholes revealed a general trend of moist, highly plastic, orange brown silty clay surficial soils grading to light grey silty clay with some weak gravels encountered at depth. Orange and grey mottling was observed within the groundwater fluctuation zone and standing water level where encountered was typically recorded at 1.7m - 2.4m below existing ground level.

3.1.2 Shear strength

Undrained shear strengths were measured at 0.5m intervals during excavation of the hand auger boreholes to determine the in-situ shear strength properties of the surficial soils.

The results included in Appendix 2 indicate that the peak undrained shear strengths vary significant with borehole location and depth, however are typically in excess of 80kPa with results varying between 56kPa to >208kPa. The surficial soils at the site are considered to be stiff and sensitive.

3.1.3 Scala penetrometer

A total of twenty seven dynamic cone scala penetrometer tests (SP) were undertaken within the nominated building platforms to determine the available bearing capacity for foundation design. A single test was carried out at the base of each borehole with the remainder carried out from existing ground level.

The tests recorded variable results but identified a general increase in bearing resistance with depth. At normal foundation level of 0.45m b.e.g.l. an inferred allowable bearing capacity in excess of 70kPa is considered to be available.

An additional series of ten dynamic cone scala penetrometer tests (SP) were carried out along the alignment of the existing farm track and vehicle RoW to determine the available bearing capacity for pavement design. It is expected that a design CBR of 3% is available for the vehicle access.

The allowable bearing pressures established by the scala penetrometer testing are based on the methods described by Stockwell (New Zealand Engineering (32, 6) 15 June 1977) using a correlation of mm/blow and bearing pressure. This approach is intended to ensure against

slow plastic movements of underlying soft strata and rapid local soil shear failure of the soil beneath the foundations. The inferred allowable bearing pressure includes a factor of safety of three against soil shear failure. If these allowable pressures are used, settlement should generally be within the following limits:

(i) maximum settlement of any one of a group of footings = 25 mm

(ii) maximum differential settlement between footings = 20 mm

These deflections are regarded as the acceptable limits a modern building can withstand without distress.

The assessed available bearing capacity does not consider gradual settlement of the foundation caused by consolidation (expulsion of air and water from the soil matrix voids) of underlying compressible strata such as peat or soft clay. Based on the findings of the subsurface investigations peat or soft clay is unlikely to be present beneath the nominated building platforms and consolidation settlement is not expected to affect the foundations.

3.2 Mapped Geology

The geology of the area is defined on the Institute of Geological and Nuclear Sciences Geological Map of the Auckland Area as Pakiri Formation of Warkworth Subgroup (Waitemata Group) being alternating thick-bedded, volcanic-rich, graded sandstone and siltstone with an area of (Holocene sediments) river deposits consisting of sand, silt, mud and clay with local gravel and peat beds in the south of the site on the Kotorengaru Stream alignment.

The geomorphology of the general area is that of dissected hill terrain of Waitemata Group Pakiri Formation rock.

New Zealand Land Inventory map NZMS 290 Sheet R 08/09 defines the pedology as Warkworth clay and sandy clay loam within proposed Lots 5-9 being well to moderately well drained soils of rolling land (strongly leached to weakly podzolised yellow brown earths) and Whangaripo clay loam in the hilly eastern parts of the site being well to moderately well drained soils of hilly land (moderately to strongly leached yellow brown earths).

3.3 Stability

The existing topography of the site is resultant from the regional geologic events, the natural weathering and erosion processes common to a high rainfall temperate climate zone, and the underlying geological formations. The moderately to steeply graded topography of the dissected hillsides have a significant influence on the stability of the property.

The proposed building sites are typically positioned on the gently graded terrain occupying the ridge lines however the land falls away at steeper grades below the nominated building platforms within some of the sites (lots 5-7). Land underlain by Waitemata Group Pakiri Formation residual soils at grades of up to 15° are generally considered to have a low slope instability potential. Typically, the lower lying areas, including flood plains have the lowest surface relief and therefore lowest slope instability potential.

Inspection of the site and review of historical aerial images reveals extensive areas of hummocked and undulating surface morphology due to historic land instabilities and movement on the steeper slopes and watercourse margins. The more elevated and steeper slopes within the eastern part of the site show signs of large scale historic land movement as

visible in Figure 2 below from 1976. The west of the property containing the proposed development site and residential building sites has more rolling terrain and the observed land instabilities is largely related to surface creep and shallow regolith slippage associated with saturated surface soils. A number of recent instabilities with associated head scarps were observed at the site, however the nominated building platforms within proposed Lots 5-9 do not show signs of recent instability.

The historic images indicate that the proposed building sites have remained stable over the past 40 years with no obvious signs of large scale instability over this period. However evidence of past land movement reinforces the stability sensitive nature of the development.



Figure 2: 1976 aerial image

Vegetation improves slope stability by binding of the soil, providing mechanical reinforcement to resist surface water erosion and by water uptake in transpiration processes. It is recommended that the existing vegetation within the property be retained, particularly on the gully side slopes and steeper topography below the nominated building platforms. Planting of vegetation is encouraged at site, particularly on the slopes immediately above and below the building site.

Groundwater was encountered during excavation of the boreholes at various depths across the site. The surface clays encountered at the site are of low permeability with water tending to perch within the topsoil layer creating wet to saturated conditions commonly supporting reeds that would normally grow in flat swampy areas or around springs. Below this zone the soils typically comprise silty clays and clayey silts with gravel sized fragments of the more competent materials derived from the underlying parent rock.

The widespread presence of swamp reeds growing over the elevated slopes at the property is due to the very low permeability of the surficial soils and indicates perched water with wet to saturated topsoil conditions.

Extensive cut batters and fill embankments are not required for the development but if required the batters should be constructed no steeper 5H:1V and once revegetated are

considered to remain stable. It is recommended that all cut batters in excess of 1m be retained with consideration given to the use of timber pole retaining walls.

3.4 Expansive Soils

The surficial clay soils at the site are considered to be expansive and subject to shrink/swell effects with changes in moisture. It is recommended that the subgrade within the building footprint be maintained close to its natural moisture content to avoid drying out and associated shrinkage, which may result in subgrade swelling after building construction. Subgrade swelling can have adverse effects including heaving and cracking of the floor slab plus associated cracking of the brittle cladding from differential movement. The risk of damage can be reduced during construction by placement of a 300mm minimum thick granular layer (or other barrier to water loss) within three days of excavation of the building subgrade.

If a concrete floor slab is proposed and the exposed building subgrade be subject to excessive drying prior to the placement of the barrier to soil water loss, consideration should be given to wetting up the building subgrade prior to the placement of the barrier.

The surficial soils observed during the field investigations are considered to be expansive and are interpreted as Class M to Class H1 in accordance with AS2870. It is recommended that specific engineering design of foundations for future dwellings at the site be carried out. Any strip or pad foundations at the site should be taken a minimum of 0.45m below cleared ground level.

3.5 Building Platforms

3.5.1 Proposed Lot 5

Proposed Lot 5 is sized 1.22ha and is positioned on the south facing slope of a northeast trending ridge adjacent to the southwestern property boundary. The nominated building platform is located on the elevated ridgeline at approximately RL66m with the land falling away south at an average grade of 11° to a watercourse and associated wetland area at RL45m. The slopes below the building platform exhibit hummocky surface morphology indicating that the land has been subject to past movement comprising surface creep and extending to shallow regolith slippage. Two boreholes (HA1 & HA2) were completed at the building site which were terminated at 1.9m and 2.4m depth where the soil became too hard to auger. Standing water was recorded at 1.7m depth and the presence of swamp reeds reflecting the very low permeability of the surficial soils with wet to saturated topsoil conditions. The wet conditions in the surficial clay soils plays a significant factor in the ongoing creep movement and overall stability of the building platform.

Although no evidence of recent large scale land instability was observed at the nominated building platform, given the evidence and likelihood of previous movement and nature of the underlying geology the building site is considered to be stability sensitive, reinforcing the need for good stormwater management. Any building work on the property should be designed to enhance the stability of the site through a combination of structural solutions (foundations, retaining, palisade walls), stormwater controls and earthworks.

It is recommended that future buildings on this site incorporate pile foundations taken 5m deep on the downslope side of the building. The use of pile foundations pinned to the more

competent soils and underlying weathered rock will provide a robust foundation solution to mitigate surface creep and will also aid in enhancing the overall stability of the building platform. Design parameters for the building foundations are included in Section 3.6.

3.5.2 Proposed Lot 6

Proposed Lot 6 is sized 2.06ha and is positioned north of Lot 5 on the north facing slope of the northeast ridge line that separates the two lots. The nominated building platform is sited on a north trending spur that is defined by a spring fed incised watercourse to the east and undulose topography with extensive reed growth to the west. The lot falls north to a watercourse from RL63m at the building platform to RL45m at the watercourse and associated wetland. The building site itself is gently graded at approximately 6° but the toe of the spur falls away steeply to the watercourse grades of up to 30° which show signs of instability. The spring fed watercourse to the east of the building site has created saturated ground conditions and HA3 excavated to 2.8m depth at this location recorded standing water at 1.0m depth. HA4 was excavated to 3.3m depth within the nominated building platform and did not encounter groundwater.

Given the evidence of instability and ground conditions in proximity to the building platform the recommendations for improving site stability as outlined for Lot 5 are considered applicable to Lot 6. Any building work on the property should be designed to enhance the stability of the site through a combination of structural solutions (foundations, retaining, palisade walls), stormwater controls and earthworks.

Future buildings on this site should look to incorporate pile foundations taken 5m deep on the downslope side of the building. The use of pile foundations pinned to the more competent soils and underlying weathered rock will provide a robust foundation solution to mitigate surface creep and will also aid in enhancing the overall stability of the building platform. Design parameters for the building foundations are included in Section 3.6.

3.5.3 Proposed Lot 7

Proposed Lot 7 is sized 1.33ha and occupies the north facing slope immediately east of Lot 6 and contains the existing hay shed. The land within Lot 7 falls northeast from RL64m to RL40m at an average grade of 10° to the watercourse and wetland forming the base of the slope and northern extent of the development area. The slopes within Lot 7 exhibit undulose topography indicating that the land is likely to have been subject to past movement comprising surface creep and extending to shallow regolith slippage.

The proposed building site within Lot 7 is positioned at a lower elevation below the existing hay shed at approximately RL53m. HA8 was taken to 2.8m depth within the nominated building platform with standing water recorded at 1.8m depth. The building site has gently graded topography and minor earthworks will be required for creation of the flat building platform. Batters should be constructed no steeper 5H:1V and cut batters in excess of 1m should be retained with consideration given to the use of timber pole retaining walls. Any building work at the site should be designed to enhance the stability of the site through a combination of structural solutions (foundations, retaining, palisade walls), stormwater controls and earthworks.

Shallow pad or strip footings are considered suitable for use at this location subject to the provisions included in Section 3.6 below.

3.5.4 Proposed Lot 8

Lot 8 sized 1.61ha is positioned in the centre of the development area immediately east of lot 5 and contains a gently graded area south of the proposed RoW access before falling south at an average grade of 13° to a watercourse and wetland area. The nominated building platform is positioned on the elevated flat area of the lot adjacent to the RoW access at RL60m. The south facing slopes that fall away below the proposed building area exhibit signs of surface creep and shallow regolith slippage consistent with the adjacent slopes in Lot 5. The building site however is located on flat topography and is considered to be sufficiently setback from the crest of the slope. HA5 was excavated to 3m depth within the nominated building platform and recorded standing water at 2.4m depth. Swamp reeds were observed growing on the elevated flat topography at the building site, reflecting the very low permeability of the surficial soils with wet to saturated topsoil conditions.

Buildings within Lot 8 should be set back from the crest of the south facing slopes as much as practical. Shallow pad or strip footings are considered suitable for use at this location subject to the provisions included in Section 3.6 below.

3.5.5 Proposed Lot 9

Proposed Lot 9 is sized 13.14ha and comprises the eastern part of the development area and contains the existing wool shed and stock yards. The lot extends north from the existing house and implement sheds within Lot 3 to include the RoW access plus rolling land and watercourse in the northern extent of the development sites. The lot contains varying topography but the nominated building platform is located on flat topography adjacent to the RoW access and lot 8 building site.

The steeper slopes within the lot shows signs of instability with surface creep and shallow regolith slippage consistent with the remainder of the property. HA6 was excavated to 3m depth within the nominated building platform and recorded standing water at 2.4m depth which is consistent with Lot 8. Swamp reeds were observed growing on the elevated flat topography at the building site, reflecting the very low permeability of the surficial soils with wet to saturated topsoil conditions.

The recommendations for Lot 8 are considered appropriate for the Lot 9 building site and shallow pad or strip footings are considered suitable for use at this location subject to the provisions included in Section 3.6 below.

3.6 Building Foundations

The scala penetrometer results included in Appendix 2 do not meet the NZBC B1 threshold criteria for soils to be acceptable as good ground for building foundations, however the available bearing capacity is considered to be suitable for construction of light weight timber framed dwellings. For house design it is expected that a dependable bearing capacity in excess of 90kPa will be available (an ultimate bearing capacity of 210kPa in conjunction with a strength reduction factor of 0.45).

It is anticipated that waffle raft foundation slab systems will be suitable for use at the site. The surficial soils observed during the field investigations are considered to be expansive and are interpreted as Class M to Class H1 in accordance with AS2870. Specific engineering design of foundations by a Chartered Professional Engineer will be required.

The nominated building platforms within proposed lots 5 & 6 are positioned above slopes that fall away at moderately steep grades and exhibit signs of surface creep extending to shallow slippage. It is recommended that the building platforms be supported with a series of bored pile foundations (in-ground retaining or palisade wall) with capping beam on the downslope side taken 5m minimum below existing ground level. The piles should be designed to resist creep movement in the upper 2m of the soil profile using 'at rest' earth pressures ($K_0 = 0.58$) and should be spaced at two diameters centre to centre.

A geotechnical strength reduction factor of 0.45 should be applied to the geotechnical ultimate capacity, for assessment against ULS factored structural loads. Design of the foundations by a Chartered Professional Engineer will be required with details specific to the proposed pool.

Lateral load resistance of the piles foundations can be designed using the following parameters:

- Effective friction angle $\phi' = 25^\circ$
- Undrained shear strength $S_u = 80\text{kPa}$
- Unit weight $\gamma = 17\text{kN/m}^3$

For the vertical capacity of the pile foundations, adopting a design undrained shear strength value of 80kPa, an ultimate static bearing capacity of 700kPa is considered available. It is recommended that a strength reduction factor of 0.45 be adopted for limit state design in accordance with the requirements of AS/NZS 1170, resulting in a design (dependable) bearing capacity value of 300kPa.

An ultimate skin friction value of 30kPa can be used for the design of piled foundations. It is recommended that a strength reduction factor of 0.45 be adopted for limit state design, resulting in a design (dependable) skin friction value of 15kPa.

4. WASTEWATER MANAGEMENT

4.1 Existing System

There is currently no reticulated wastewater system available at the site and as such all wastewater generated by the proposed development will require on-site management.

4.2 Management System

Design of a specimen wastewater treatment and disposal system considered suitable for use at the site has been carried out accordance with AS/NZS 1547:2012. The system has been designed to accommodate a flow of 180 l/person/day, assuming on-site roof water tank supply is used with standard fixtures. A four bedroom dwelling is used for design purposes with a maximum occupancy of six persons. This gives a design daily flow rate of 1,080 l/day for disposal system treatment.

Due to the low permeability of the surficial soils and sloping terrain it is recommended that secondary treatment systems be provided at the site ($<20\text{g/m}^3$ BOD₅ and $<30\text{g/m}^3$ SS). An enhanced nitrogen removal plant is recommended for use at the site (to achieve TN $<15\text{mg/l}$) and this will be achieved using an aerated treatment plant such as a suitably sized Hynds Ultimate system or similar. Specific design of individual systems will be required at time of Building Consent application.

The recommended method for disposal of the treated wastewater within the site is to be by means of a pressure compensating dripper irrigation system. The secondary treated waste water from the treatment plant is to be discharged to land using a surface irrigation system. This system utilises a low-pressure network of 16mm diameter pipe with spaced, self-compensating drippers providing a uniform distribution of the wastewater to the designated area.

For a surface irrigation system, the dripper lines are installed on the ground surface covered with a minimum of 50mm of soil topsoil and/or mulch allowed the treated effluent to be distributed into the topsoil layer.

This type of disposal system will provide further treatment to the wastewater by retaining the effluent within the aerobic soils, and enabling significant biodegradation by the soils micro organisms. Sustainable management of on-site effluent disposal should be promoted by keeping treated wastewater within the shallow soil layers where it can easily be absorbed by plants via transpiration and into the atmosphere via evaporation.

The soil identified during field investigations is classified as weakly structured light clay being Soil Category 5 in accordance with AS/NZS 1547:2012. The design irrigation rate used for determining the required land application area is 3.0 mm/day in accordance with AS/NZS 1547:2012, requiring a land application area of 360m² with a 50% reserve area of 180m².

4.3 Site Specific Mitigation Measures

Specific mitigation measures are recommended for use of a secondary treatment system at the site and the following should be adhered to for the on-site management of wastewater:

- The system should be constructed by a registered drain layer familiar with the specific requirements of this type of system.

- A service agreement between the property owner and the supplier of the treatment plants is entered into to ensure effective ongoing operation and performance. A maintenance strategy and contract for the system shall be put into place, which will include programmed inspections and maintenance of both secondary treatment systems and application areas.
- The secondary treatment systems shall be a nitrogen removal plant such as Hynds Ultimate to achieve removed TN < 15mg/l. High nutrient levels contained in domestic effluent is a significant concern, particularly in densely populated areas with sensitive receiving environments. The use of an enhanced nitrogen removal system provides a more sustainable system and reduces the risk of contaminating the receiving water.
- To minimise the risk of slope instability/mass movement associated with the land application area the wastewater is to be applied over a large area at low rates. During installation and construction supervision by a suitably qualified geotechnical engineer should be carried out.
- The design irrigation rate should be decreased to accommodate sloping ground to minimise the risk of slope instability by applying wastewater over a large area. The design irrigation rate should be reduced by 20% for slopes in excess of 6° and 50% for slopes in excess of 12°, to ensure that effluent migration down slope is taken up adequately within the top soil and plant root system.
- A reserve area of 50% is to be set aside for the future extension of the land application area in accordance with ARC TP58 for surface PCDI for secondary treated effluent. The purpose of setting aside a reserve area for future extension of a land application system is to allow a factor of safety against unforeseen malfunction or failure, perhaps following increased household occupancy or inadvertent misuse of the system. This ensures it is possible to provide additional pre-treatment or to extend the land application system if appropriate.
- The land application areas shall be mounded to shed rainwater and are to be planted with suitable high water use vegetation to aid in evapotranspiration. Surface vegetation shall be plants such as grasses and shrubs that tolerate wet conditions and have a high evapotranspiration capacity. Such planting should be selected on the basis of local experience.
- A maximum distance of 1.0m between the irrigation lines in clay soils to provide an effective even distribution of effluent over the whole of the design area and on sloping ground all irrigation lines shall be installed along the contour.
- The irrigation area shall have an adequate depth of natural good quality topsoil (or imported topsoil if necessary) to store the applied effluent and to support the growth of vegetation to maximise evapotranspiration. A minimum topsoil depth of 200 mm is required.
- Groundwater clearance is expected to be in excess of 0.9m for secondary treated effluent using an AWTs in accordance with ARC TP58.
- Surface water clearance in excess of 15m for secondary treated effluent using an AWTs can be achieved in accordance with ARC TP58.

5. STORMWATER MANAGEMENT

5.1 Proposed Drainage

The existing drainage system will not be altered by the formation of the subdivision and surface water runoff from the developed site will be directed to the natural watercourses that dissect the property via dispersed overland flow to replicate the current drainage arrangements.

All stormwater created from the newly formed impermeable surfaces should be collected and piped away from the building sites for disposal to land in a responsible manner. Surface water runoff should not discharge above on-site wastewater disposal fields or immediately below building sites. All overflow and outlets from storage tanks should be piped in a similar manner and provided with a level spreader outlet to ensure an acceptable rate of dispersed discharge. Concentrated stormwater is not to discharge to the sloping parts of the site as this will be detrimental to slope stability.

Surface water runoff from the newly formed RoW access is to be collected in roadside swale drains for conveyance to the base of the slopes and discharge to the natural watercourse. The swale drains should discharge to the watercourse via dispersed flow to minimise the potential for erosion and instability associated with concentrated discharges. Similarly concentrated discharges from culverts should be avoided as this will promote erosion and be detrimental to stability.

The steeper slopes and cut batters within the property are prone to shallow slippage and effective surface water management is critical in securing the long term stability of these areas. Surface water interceptor and cut-off drains should be installed upslope of cut batters, and appropriate drainage channels with erosion and outlet protection provided where concentrated flows are created (i.e. vehicle access tracks).

5.2 Hydrological Neutrality

Auckland Council requires attenuation of stormwater runoff in certain circumstances, with the design criteria being that all stormwater run-off arising from new rural residential development shall be attenuated so that peak flow discharge from the post developed site is no more than pre-development levels.

Runoff from newly formed impervious areas which are a direct result of urbanisation will increase the quantity of surface water runoff. The best option for stormwater management is to avoid or minimise creation of impervious surfaces (unnecessary parking, turning and hardstand areas) resulting from the development.

The Council's District Plan requires all Rural Residential sites to achieve stormwater hydrological neutrality for volumes and time of concentration of overland flows and "Management of Stormwater in Countryside Living Zones" (The Toolbox) recommends methods and provides design guidelines for stormwater management in these circumstances. The design principles used to achieve hydrological neutrality shall be:

- (a) Overland flow disposal shall mimic as far as possible the natural drainage process of an area;
- (b) Modifications to existing drainage patterns shall be kept to a minimum;
- (c) Overland flows shall not be discharged directly into streams from a piped system;

- (d) Impervious areas shall be kept to a minimum;
- (e) Appropriate methods of stormwater detention shall be employed before dispersal into waterways, including, but not exclusively:
 - (i) swales and depression landscaping;
 - (ii) dispersion into vegetative filters;
 - (iii) dispersal trenches;
 - (iv) detention ponds;
 - (v) detention tanks;
 - (vi) vegetation planting;
 - (vii) water reuse.

Hydraulic neutrality for the subdivision can be achieved by providing a combination methods including dispersion into vegetative filters, attenuation via swales, detention tanks and water reuse. The most convenient means to achieve this for building sites is to provide individual on-site systems that collect roof runoff from the new buildings and direct to an on-site storage tank. When the storage tank is full the overflow is discharged to an attenuation tank where it is released at a slower rate to the downstream stormwater drainage system using above ground flow dispersal systems (i.e. level spreader outlet). This method can also be used to compensate for other impervious surfaces which cannot be readily collected and attenuated (i.e. driveways, paved areas, paths).

Allowing for a 300m² roof area it is likely that attenuation storage between 15-20m³ will be required for a 100 yr CC ARI event. Specific design of stormwater attenuation will be required at Building Consent stage when household units are constructed on the proposed lots to ensure the system is specific to the proposed development. Stormwater attenuation design shall be in accordance with the relevant Auckland Council standards.

It is proposed that water quality objectives for the vehicle access will be met with low impact drainage solutions comprising shallow road side vegetated swales. The overall concept of a vegetated swale is to slow stormwater flows, capture some contaminants, and allow for some reduction in the total volume of runoff. The passage of stormwater through vegetated swales utilises a number of physical, chemical, and biological factors to reduce stormwater contaminants. Surface runoff from the vehicle access to the lots will be directed via sheet flow to the road side swale drains where it will accumulate for treatment. The swale will also act as a conveyance system for directing the runoff to the wetland areas within the subdivision where further treatment will take place.

Calculations included in Appendix 3 indicate that the treatment capacity of a 2.5m wide swale drain exceeds the treatment requirements for the RoW runoff. A traditional trapezoidal profile with a 1.0m wide base and side slopes of 1:5 to facilitate easy maintenance is recommended. The longitudinal gradient of the swales varies from less than 2% to 12% in place. Swales with slopes of less than 2% at the elevated parts of the site adjacent to Lots 8 & 9 will require a perforated pipe underdrain. The steeper slopes greater than 5% will require a series of check dams to reduce flow velocities plus adequate erosion control and energy dissipation.

Maintenance of the swale systems will be required to ensure that they function as intended with the primary objectives being a dense mat of vegetation and a swale free of obstructions such as leaf litter and significant deposits of sediment. Homeowners should also be discouraged from cutting the grass too short. The swales are to be fully stabilised prior to

accepting stormwater runoff to reduce channel erosion potential. It may be necessary to provide additional protective measures until such time as the vegetation is fully established and on steeper gradients it may be necessary to provide check dams within the swale drains.

Where attenuation of the RoW runoff is required, a restricted flow outlet from the swales can be formed using a conventional scruffy dome chamber with orifice outlet or a bunded weir arrangement discharging to the downstream system. Specific design of the outlet structures and arrangements will be carried out as part of the engineering design of the subdivision and will be dependent on finished site levels and access arrangements

5.3 Flood Susceptible Areas

Auckland Council hazard maps indicate flood susceptible areas are located within the natural waterways that dissect the property and also within Kotorengaru Stream. The nominated building sites within Lots 5 – 9 are well elevated at a minimum of 10m above the adjacent watercourses and are not considered to be flood susceptible.

6. ACCESS ARRANGEMENTS

6.1 Access Routes

An existing vehicle crossing from Komokoriki Hill Road provides access to the property over Kotorengaru Stream via an existing 3.7m wide x 12.5m span single lane bridge as indicated on the site plan in Appendix 1. Review of Auckland Council records indicates that the bridge was designed by Bloxam Burnett and Oliver Ltd in 2004 to meet the requirements of NZTA BM Appendix D for Class 1 loading (0.85HN). Review of the constructed bridge was carried out by Ashby Consulting Engineering in March 2015 and concluded that the bridge is in good condition and is fit for purpose. The bridge inspection and certification was an Auckland Council requirement for creation of a RoW easement over the bridge and short length of unsealed driveway. Rodney District Council Engineering Standards (RDCES) indicate that a bridge serving 3-10 lots with a length between 6-30m requires a clear distance of 3.7m between the kerbs. The plans prepared by Bloxam Burnett and Oliver Ltd indicate a 3.7m clear distance between kerbs and on this basis it is considered that the existing bridge and vehicle crossing will be suitable for within this development.

Access to the building sites within proposed lots 5-9 will be via an existing unsealed farm track that extends north from the vehicle bridge along the eastern edge of the existing watercourse and wetlands at the entrance to the property at approximately 5°. Easement C as indicated on the site plan in Appendix 1 contains the existing farm track alignment which passes the implement shed within proposed Lot 1 and stock yards before extending through the open pasture to the elevated parts of the site at the Lots 8 & 9 building sites at increased grades of up to 7°. The RoW then continues as Easement D to the existing hay shed providing access to Lots 5-7.

It is expected that the existing farm track will be upgraded to provide suitable all weather access to the proposed building sites within Lots 5-9 including suitable surface water management incorporating roadside swale drains and erosion protected outlets as detailed in Section 5 of this report. RDCES Table 3.6 requires a carriageway width of 6m and allows for unsealed surfacing where the gradient is less than 7°. Based on a design CBR of 3% it is expected that the RoW access will require 300mm of granular pavement. All works associated with the RoW construction are to comply with RDCES and it is expected that the existing and proposed access formation will be upgraded to comply with these requirements for servicing the newly formed residential properties.

7. SUMMARY

Muriwai Valley Farm Enterprises Ltd propose to construct a 10 lot residential subdivision at 332 Komokoriki Hill Road, Ahuroa. The site is currently occupied by an existing residential dwelling with the proposed development creating new building sites within proposed Lots 2-9. This assessment has considered the residential development of proposed Lots 5 to 9.

Inspection of the development site and review of historical aerial images reveals extensive areas of hummocked and undulating surface morphology due to historic land instabilities and land movement on the steeper slopes and watercourse margins. The proposed building sites are typically positioned on the gently graded terrain occupying the ridge lines. Land underlain by Waitemata Group Pakiri Formation residual soils at grades of up to 15° are generally considered to have a low slope instability potential. The widespread presence of swamp reeds growing over the elevated slopes at the property is due to the very low permeability of the surficial soils and indicates wet to saturated topsoil conditions which plays a significant role in slope stability. Any building work on the property should be designed to enhance the stability of the site through a combination of structural solutions (foundations, retaining, palisade walls), stormwater controls and earthworks.

The nominated building platforms do not meet the NZBC B1 threshold criteria for soils to be acceptable as good ground for building foundations, however the available bearing capacity is considered to be suitable for construction of light weight timber framed dwellings. A dependable bearing capacity in excess of 90kPa is considered to be available for design of new house foundations and waffle raft or shallow reinforced concrete strip foundation systems will be suitable for use. The surficial soils are considered to be expansive and are interpreted as Class M to Class H1 in accordance with AS2870. It is recommended that specific engineering design of all foundations by a Chartered Professional Engineer will be required.

The nominated building platforms within proposed lots 5 & 6 are positioned above slopes that fall away at moderately steep grades and exhibit signs of surface creep extending to shallow slippage. It is recommended that the building platforms be supported with a series of bored pile foundations (in-ground retaining or palisade wall) with capping beam on the downslope side taken 5m minimum below existing ground level. Recommended design parameters are included in this report.

In the absence of a reticulated wastewater system, provisions will be required for on-site wastewater management and preference given to systems that disperse effluent over a wide area rather than concentrating it in one location. It is recommended that a Hynds Ultimate system or similar with enhanced nitrogen removal capable of producing secondary treated effluent in conjunction with pressure compensating dripper irrigation be used at the site. Assuming a four bedroom dwelling a land application area of 360m² with a 50% reserve area of 180m² is required. Due to low permeability soils, sloping terrain and to minimise the risk of slope instability/mass movement associated with the land application area the wastewater is to be applied over a large area at low rates in accordance with AS/NZS 1547:2012. Specific design of an on-site system will be required at the time of Building Consent.

Hydraulic neutrality for the subdivision can be achieved by providing a combination methods including dispersion into vegetative filters, attenuation via swales, detention tanks and water reuse. Where required, individual on-site attenuation tanks will be provided to

accommodate the impervious surfaces formed within each allotment. Specific design of stormwater attenuation will be required at Building Consent stage when household units are constructed on the proposed lots to ensure the system is specific to the proposed development. Overflow and outlets from storage tanks should be piped away from the building platforms and provided with a level spreader outlet to ensure an acceptable rate of dispersed discharge at the boundary. Concentrated stormwater is not to discharge to the sloping parts of the site, particularly below building platforms, as this will be detrimental to slope stability. Surface water runoff from the vehicle access will be directed via over edge flow to shallow road side vegetated swales for treatment and conveyance to the base of the slopes prior to discharge to the natural watercourses within the property.

Access to proposed Lots 5-9 can be formed via upgrading and extension of the existing unsealed farm track at gentle to moderate grades. The existing vehicle crossing and associated bridge at the entrance to the site is considered suitable for use to serve up to 10 residential properties. The unsealed rural vehicle access will be formed to the relevant Council standards including provisions for adequate stormwater management.

8. LIMITATIONS

This report has been prepared for the benefit of Muriwai Valley Farm Enterprises Ltd as our client with respect to residential subdivision at 332 Komokoriki Hill Road, Ahuroa and for Auckland Council approval. No liability is accepted by Base Group Consulting where other parties rely on the information or opinions contained in this report and any other person who relies upon any matter contained in this report does so entirely at their own risk. Any recommendations, opinions, or guidance provided by Base Group Consulting in this report are limited to technical engineering requirements and are not made under the Financial Advisers Act 2008.

Base Group Consulting have performed the services for this site assessment in accordance with the standard agreement for consulting services and current professional standards. No guarantees are either expressed or implied.

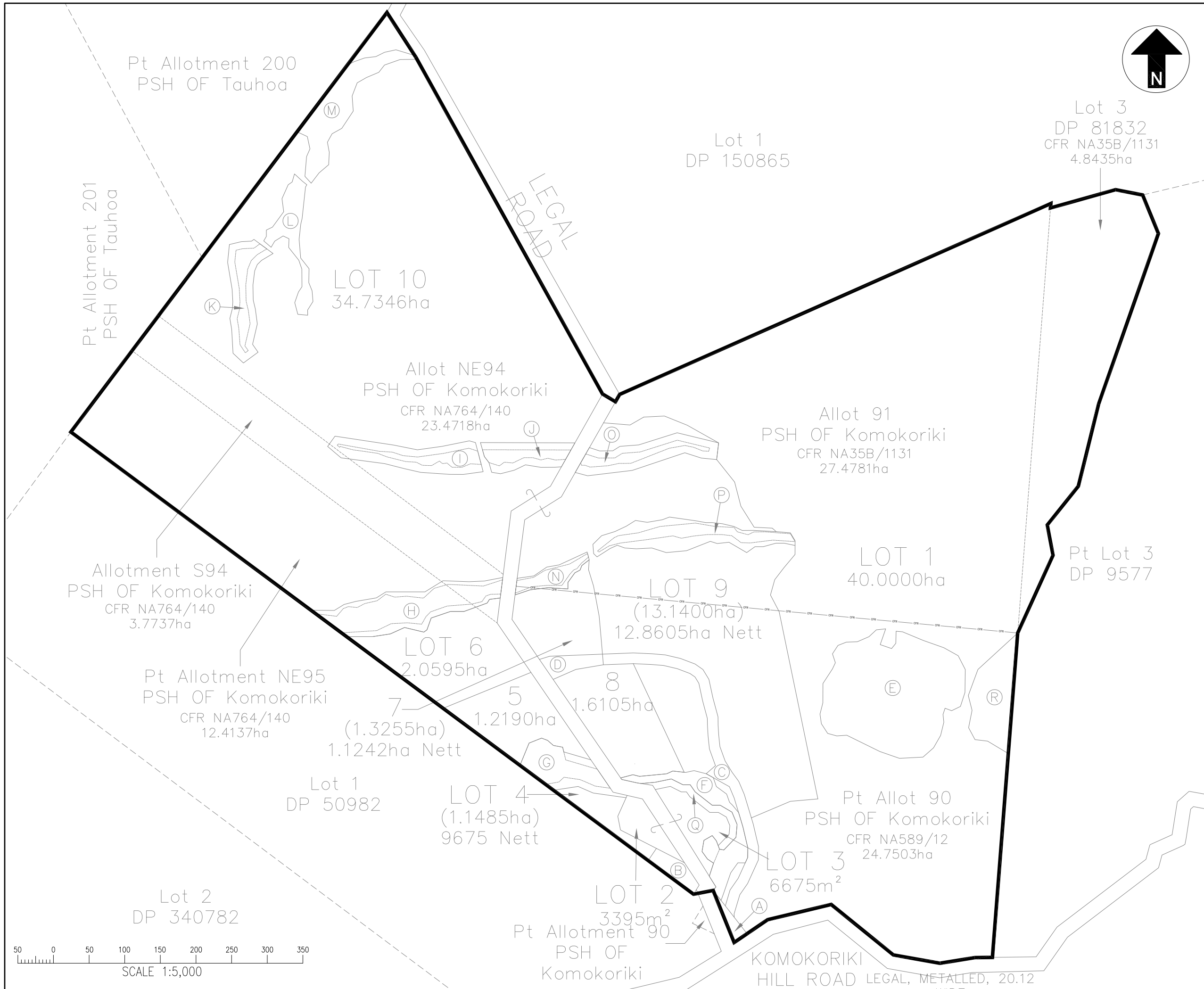


A S MacPherson

Chartered Professional Engineer

BE Civil (Hons), CPEng, MIPENZ, IntPE(NZ)

APPENDIX 1: SITE PLAN



Notes

- THIS DRAWING IS NOT TO BE SCALED.
- REFER TO REYBURN & BRYANT FOR DETAILS OF SUBDIVISION AND ASSOCIATED EASEMENTS

Legend

- PROPERTY BOUNDARY
- INDICATIVE BUILDING SITE
- SCALA PENETROMETER TEST
- HAND AUGER BOREHOLE
- SURFACE DRAIN / OLFP

Rev	Description	Date	App
APPROVAL			
MURIWAI VALLEY FARM ENTERPRISE 332 KOMOKORIKI HILL ROAD AHUROA			
BASE GROUP CONSULTING Structural & Civil Engineering <small>PO Box 1032, Whangarei 0140, New Zealand P 09 437 3432 E office@basegroup.co.nz www.basegroup.co.nz</small>			
SITE LOCATION PLAN			
Scale: 1:4,000 @ A3	Date: 28 AUG 2015	Drawn: AM	Checked:
Drawing No.: 15085/C1			Rev:

NATURAL WATERCOURSE AND ASSOCIATED WETLAND AREA AT BASE OF SLOPE FORMING NORTHERN BOUNDARY OF LOTS 6 & 7

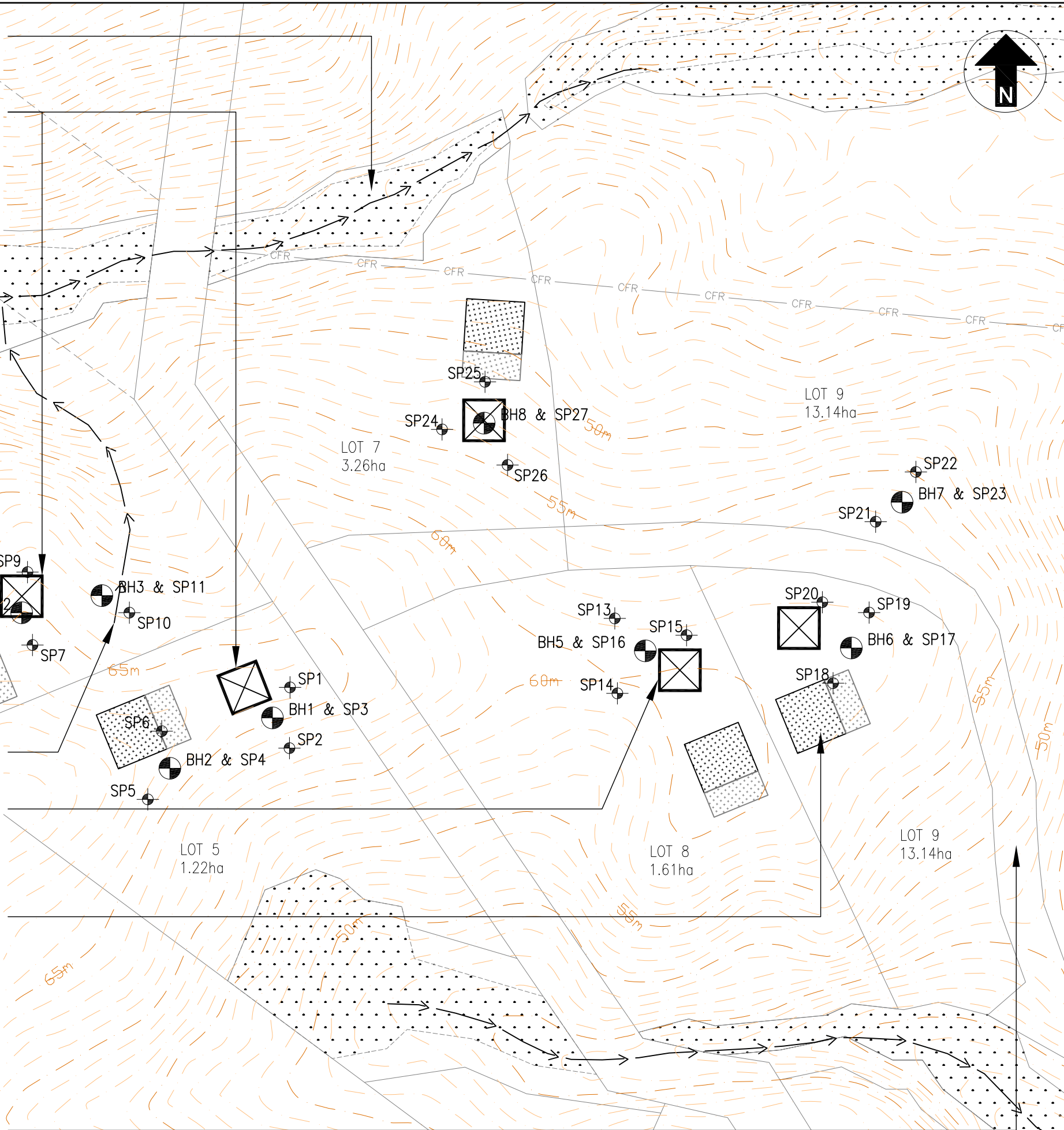
BUILDING SITES WITHIN LOTS 5 & 6 ARE POSITIONED ABOVE SLOPES THAT FALL AWAY AT MODERATELY STEEP GRADES AND EXHIBIT SIGNS OF SURFACE CREEP AND SHALLOW SLIPPAGE. BUILDING PLATFORMS ARE TO BE SUPPORTED WITH A SERIES OF BORED PILE FOUNDATIONS (IN-GROUND RETAINING OR PALISADE WALL) WITH CAPPING BEAM ON THE DOWNSLOPE SIDE

EXISTING SPRING AND ASSOCIATED WATERCOURSE WITH INCISED CHANNEL EAST OF LOT 6 BUILDING PLATFORM

BUILDING PLATFORM WITHIN LOTS 8 & 9 ON GENTLY GRADED TOPOGRAPHY, POSITIONED IN NORTH OF LOTS NEAR RIGHT OF WAY ACCESS TO PROVIDE ADEQUATE SEPARATION FROM SOUTH FACING SLOPES WHICH SHOWS SIGNS OF SURFACE CREEP AND SHALLOW SLIPPAGE

PROPOSED LAND APPLICATION AREA FOR PRESSURE COMPENSATING DRIPPER IRRIGATION SHOWN AS 360m² FOR PROPOSED LOTS 5-9 FOR USE WITH SECONDARY TREATED WASTEWATER. 50% RESERVE AREA SHOWN AS 180m². DISPOSAL FIELD TO BE PLANTED WITH SUITABLE HIGH WATER USE VEGETATION SELECTED BASED ON LOCAL KNOWLEDGE. PROPOSED LAND APPLICATION AREA SHOWN WITH 15m OFFSET FROM SURFACE FOR COMPLIANCE WITH TP58 REQUIREMENTS FOR A PERMITTED ACTIVITY

EXISTING FARM TRACK TO BE EXTENDED AND UPGRADED TO PROVIDE SUITABLE ALL WEATHER SHARED PRIVATEWAY ACCESS (EASEMENT C & D) IN ACCORDANCE WITH COUNCIL ENGINEERING STANDARDS.



- Notes
1. THIS DRAWING IS NOT TO BE SCALED.
 2. REFER TO REYBURN & BRYANT FOR DETAILS OF SUBDIVISION AND ASSOCIATED EASEMENTS
 3. NOMINATED BUILDING PLATFORMS ARE SHOWN AS 14m x 14m FOOTPRINT
 4. THE IRRIGATION FIELDS ARE BASED ON A DIR OF 3.0mm/DAY REQUIRING 360m² FOR A 4 BEDROOM DWELLING ON RAINWATER SUPPLY. IRRIGATION TO BE USED WITH SECONDARY TREATMENT SYSTEM COMPLYING WITH AUCKLAND COUNCIL REQUIREMENTS
 5. THE 50% RESERVE AREA OF 180m² ALLOWS A FACTOR OF SAFETY AGAINST UNFORESEEN MALFUNCTION OR FAILURE, PERHAPS FOLLOWING INCREASED OCCUPANCY OR INADVERTENT MISUSE OF THE SYSTEM
 6. THE CONTOURS AND LAND TOPOGRAPHY SHOWN IS BASED ON AUCKLAND COUNCIL GIS AND IS INDICATIVE ONLY

- PROPERTY BOUNDARY
- INDICATIVE BUILDING SITE
- SCALA PENETROMETER TEST
- HAND AUGER BOREHOLE
- WATERCOURSE
- WASTEWATER LAND APPLICATION AREA
- WETLAND / ECOLOGY AREA

Rev	Description	Date	App
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APPROVAL

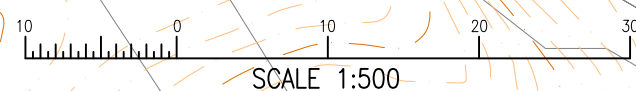
MURIWAI VALLEY FARM ENTERPRISE
332 KOMOKORIKI HILL ROAD
AHUROA



PO Box 1032, Whangarei 0140, New Zealand
P 09 437 3432 E office@basegroup.co.nz www.basegroup.co.nz

**SITE PLAN
PROPOSED LOTS 5 - 9**

Scale: 1:1,500 @ A3	Date: 02 OCT 2015	Drawn: AM	Checked:
Drawing No.: 15083/C2			Rev:



APPENDIX 2: GROUND INVESTIGATIONS



2 Norfolk Street
Whangarei
P: 09 438 4417
E: info@geocivil.co.nz
M: 027 6565 226

TEST REPORT

Lab Job No: 8288-059
Your ref.: 15083
Date of Issue: 5/08/2015
Date of Re-Issue: -
Page: 1 of 37

Test Report.

No. 15-1369

PROJECT: 332 Komokoriki Hill Road, Warkworth
CLIENT: Base Group Consulting
PO Box 1032,
Whangarei 0140
ATTENTION: Aaran MacPherson
INSTRUCTIONS: Determination of the penetration resistance using a dynamic cone (scala) Penetrometer
Hand Held Shear Vane Test
Augerholes where required (not accredited)
TEST METHOD: NZS 4402: 1988 Test 6.5.2
NZGS: August 2001
NZGS December 2005 (not accredited)
SAMPLING METHOD: N/A
TEST RESULTS: As Per Laboratory Sheets attached


S.Kokich

Laboratory Technician


D. Krissansen

Approved Signatory



Tests indicated as
not accredited are outside
the scope of the
laboratory's accreditation

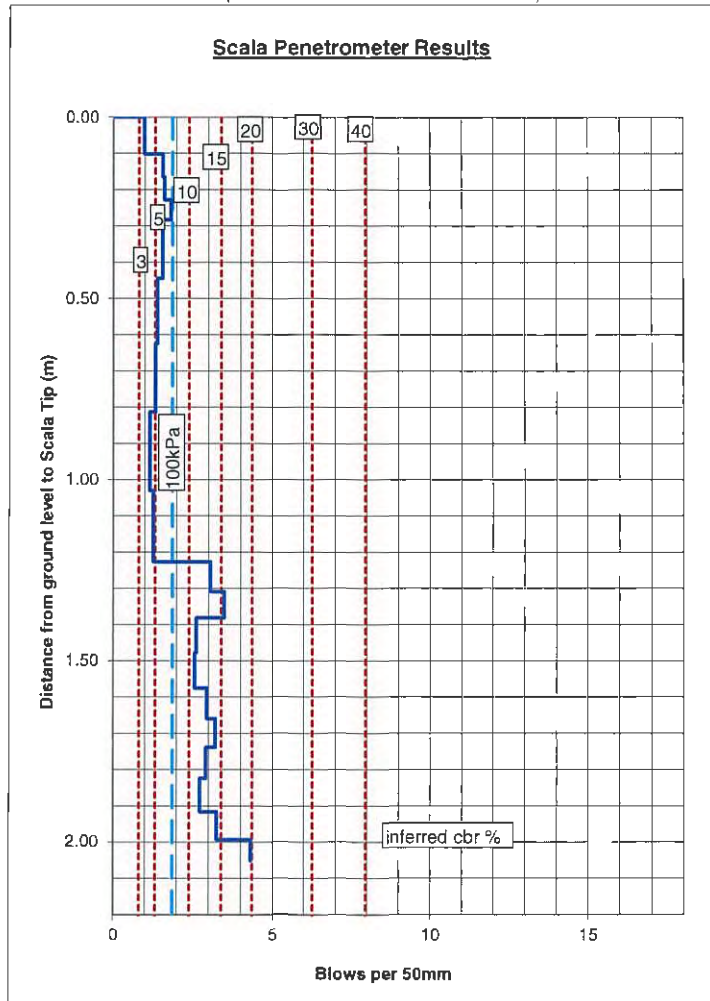
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 5 E2645859 N6524323
Start Depth (m): 0

Scala No: SP1
Ref : 15083
Report No: 15-1369
Page: 2 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	110.6	0	0	0	0	0.00
2	100.4	51	1	6	2	0.10
2	94	32	2	9	4	0.17
2	87.8	31	2	10	6	0.23
2	82.3	28	2	11	8	0.28
5	66.2	32	2	9	13	0.44
5	48.2	36	1	8	18	0.62
5	29.3	38	1	8	23	0.81
5	7.6	43	1	7	28	1.03
0	105.8	0	0	0	28	1.03
5	86.1	39	1	8	33	1.23
5	77.9	18	3	18	38	1.31
5	70.7	14	3	21	43	1.38
5	61.1	19	3	16	48	1.46
5	51.3	20	3	15	53	1.58
5	42.8	17	3	18	58	1.66
5	35	16	3	19	63	1.74
5	26.4	17	3	17	65	1.82
5	17.2	18	3	16	73	1.92
5	9.5	15	3	19	78	1.99
5	3.7	12	4	26	83	2.05



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: [Signature]
Date: 11/9/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

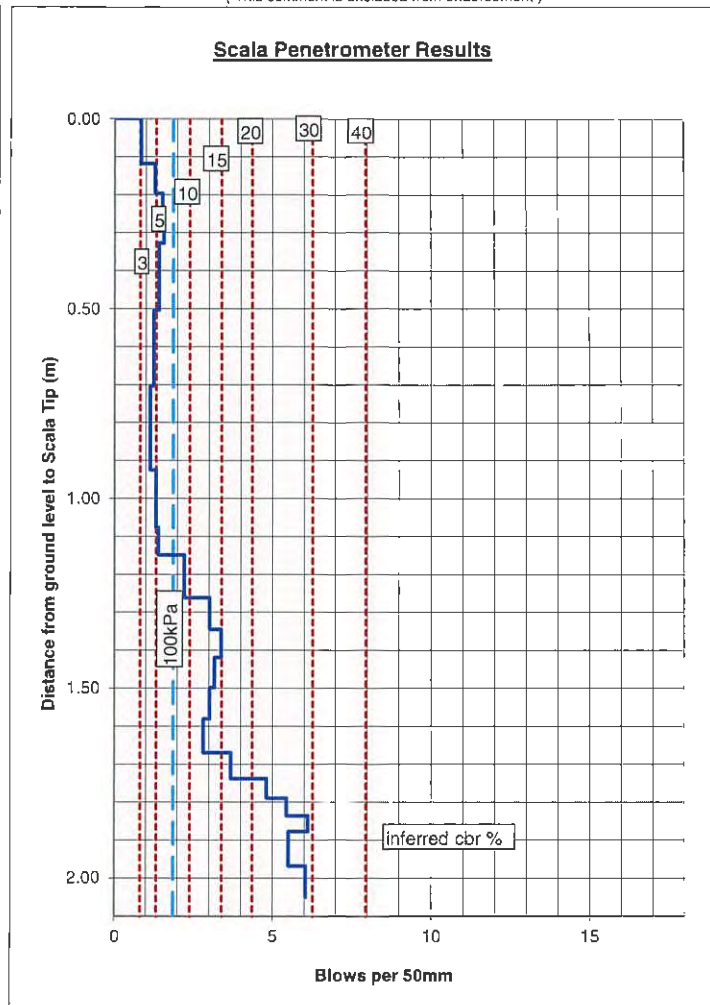
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NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 5 E2645872 N6524317
Start Depth (m): 0

Scala No: SP2
Ref : 15083
Report No: 15-1369
Page: 3 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	112.5	0	0	0	0	0.00
2	100.6	60	1	5	2	0.12
2	92.8	39	1	8	4	0.20
2	86.2	33	2	9	6	0.26
2	79.8	32	2	9	8	0.33
5	62.1	35	1	8	13	0.50
5	42.1	40	1	8	18	0.70
5	20	44	1	7	23	0.93
4	4.8	38	1	8	27	1.08
0	103.2	0	0	0	27	1.08
2	96	36	1	8	29	1.15
5	84.7	23	2	13	34	1.26
5	76.4	17	3	18	39	1.35
5	69	15	3	20	44	1.42
5	61.1	16	3	19	49	1.50
5	52.8	17	3	18	54	1.58
5	43.9	18	3	17	59	1.67
5	37.1	14	4	22	64	1.74
5	31.9	10	5	29	69	1.79
5	27.3	9	5	33	74	1.84
5	23.2	8	6	37	79	1.88
10	14.1	9	5	33	89	1.97
10	5.8	8	6	36	99	2.05



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: 17/9/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

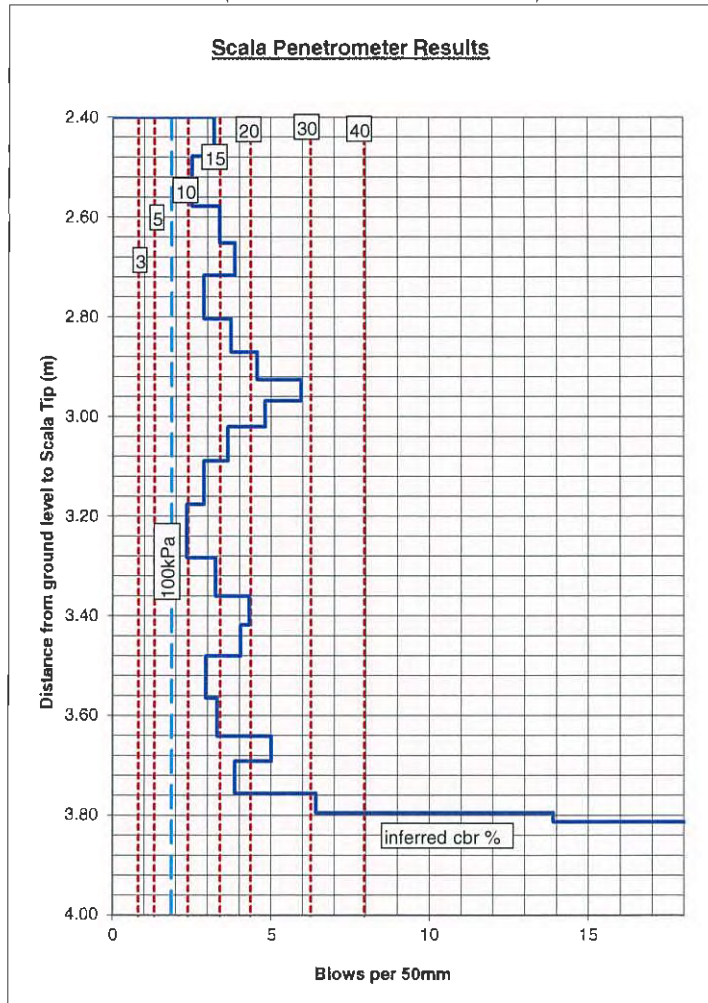
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 5 E2645831 N6524299
Start Depth (m): 2.4 Base BH2

Scala No: SP4
Ref : 15083
Report No: 15-1369
Page: 5 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	75.8	0	0	0	0	2.40
5	68	16	3	19	5	2.46
5	58	20	3	15	10	2.58
5	50.6	15	3	20	15	2.65
5	44.1	13	4	23	20	2.72
5	35.4	17	3	17	25	2.80
5	28.7	13	4	22	30	2.87
5	23.2	11	5	27	35	2.93
5	19	8	6	36	40	2.97
5	13.8	10	5	29	45	3.02
5	6.9	14	4	22	50	3.09
0	107.4	0	0	0	50	3.09
5	98.7	17	3	17	55	3.18
5	88	21	2	14	60	3.28
5	80.3	15	3	19	65	3.36
5	74.5	12	4	26	70	3.42
5	68.3	12	4	24	75	3.48
5	59.8	17	3	18	80	3.57
5	52.2	15	3	20	85	3.64
5	47.2	10	5	30	90	3.69
5	40.7	13	4	23	95	3.76
5	36.8	8	6	38	100	3.80
5	35	4	14	83	105	3.81
5	33.9	2	23	136	110	3.82



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: *11/08/15*

Note: All readings taken below 1.5m from start depth are outside the scope of this test

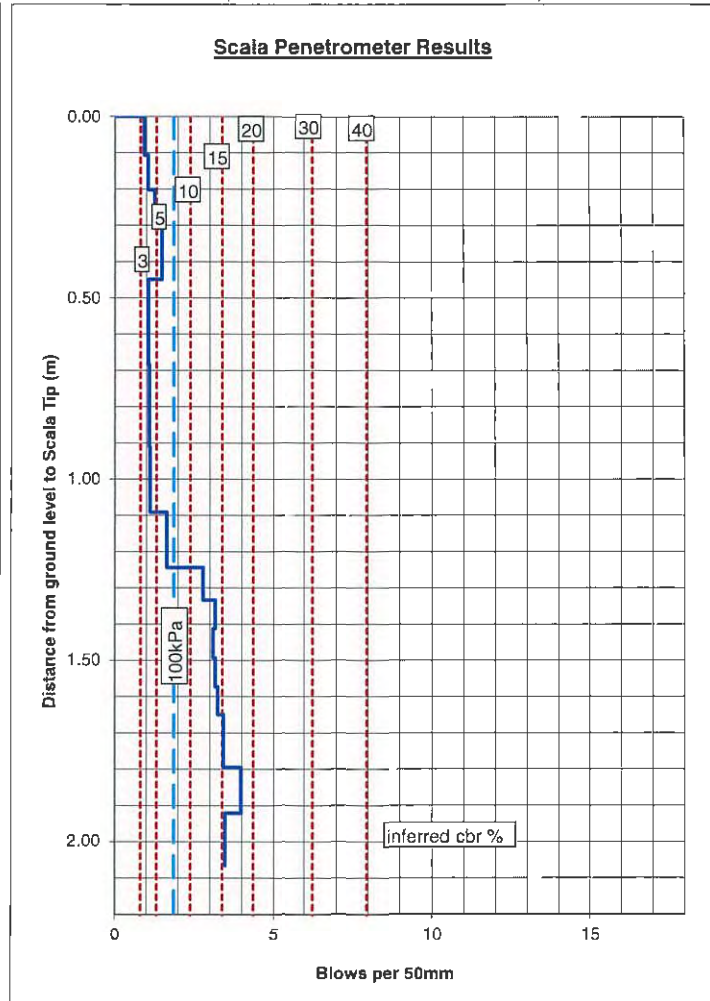
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NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 5 E2645830 N6524295
Start Depth (m): 0

Scala No: SP5
Ref : 15083
Report No: 15-1369
Page: 6 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	111.9	0	0	0	0	0.00
2	101.2	54	1	6	2	0.11
2	91.7	48	1	6	4	0.20
2	83.6	40	1	8	6	0.28
5	67	34	1	9	11	0.45
5	43.5	47	1	6	16	0.68
5	20.7	46	1	7	21	0.91
4	2.8	45	1	7	25	1.09
0	102.2	0	0	0	25	1.09
5	87	30	2	10	30	1.24
5	78	18	3	17	35	1.33
5	70.1	16	3	19	40	1.41
5	62	16	3	19	45	1.49
5	54.1	16	3	19	50	1.57
5	46.4	15	3	19	55	1.65
10	31.6	15	3	21	65	1.80
10	19.2	13	4	24	75	1.92
10	4.8	14	3	21	85	2.07



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: [Signature]
Date: 17/9/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

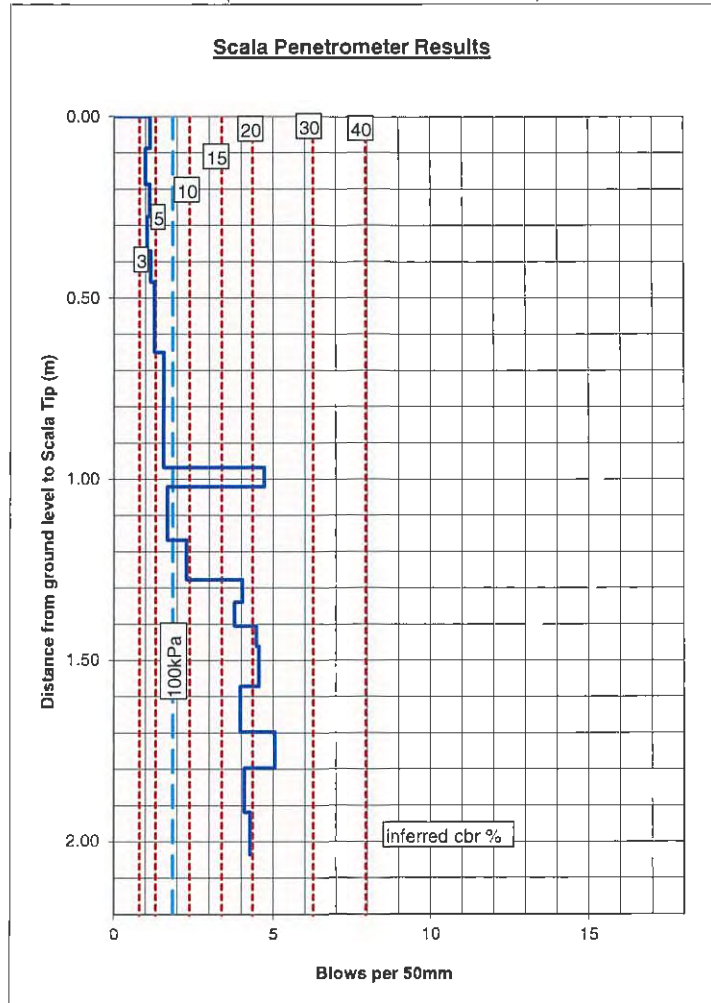
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 5 E2645824 N6524305
Start Depth (m): 0

Scala No: SP6
Ref : 15083
Report No: 15-1369
Page: 7 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	109.8	0	0	0	0	0.00
2	101.1	44	1	7	2	0.09
2	91.1	50	1	6	4	0.19
2	82.3	44	1	7	6	0.28
2	72.8	48	1	6	8	0.37
2	64.2	43	1	7	10	0.46
5	44.8	39	1	8	15	0.65
5	29	32	2	9	20	0.81
5	13.1	32	2	9	25	0.97
5	7.8	11	5	28	30	1.02
0	106.8	0	0	0	30	1.02
5	92	30	2	10	35	1.17
5	81.1	22	2	14	40	1.28
5	74.9	12	4	24	45	1.34
5	68.3	13	4	23	50	1.41
5	62.7	11	4	27	55	1.48
10	51.7	11	5	27	65	1.57
10	39.1	13	4	24	75	1.70
10	29.2	10	5	30	85	1.80
10	17	12	4	25	95	1.92
10	6.3	12	4	26	105	2.04



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: 11/9/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

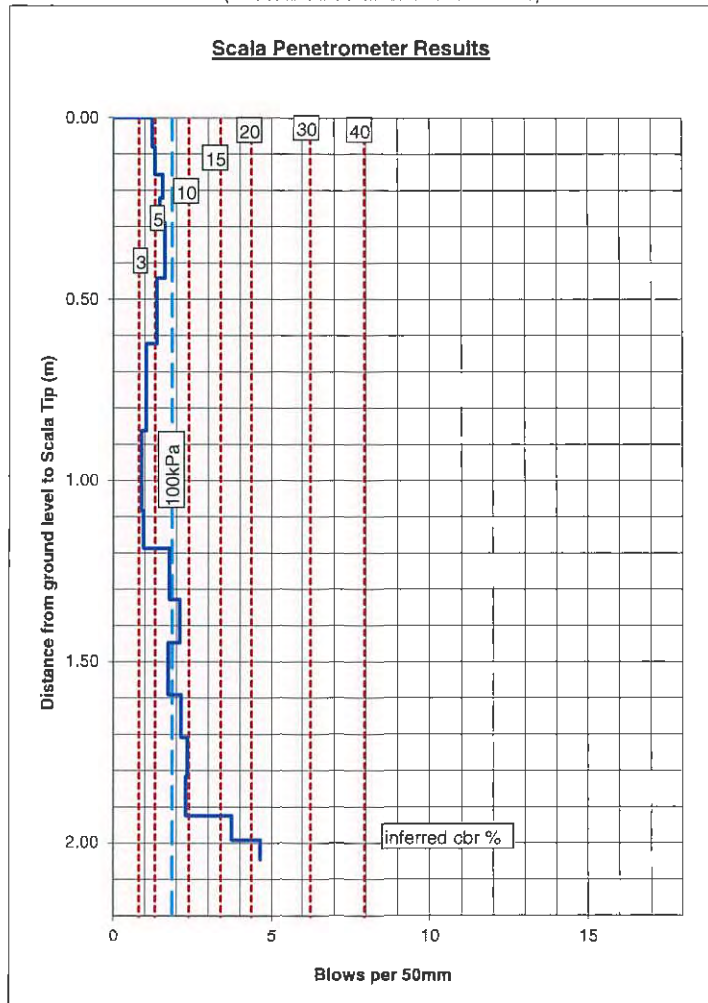
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 6 E2645758 N6524340
Start Depth (m): 0

Scala No: SP7
Ref : 15083
Report No: 15-1369
Page: 8 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	110.8	0	0	0	0	0.00
2	102.7	41	1	7	2	0.08
2	95.1	38	1	8	4	0.16
2	88.7	32	2	9	6	0.22
2	81.9	34	1	9	8	0.29
5	66.6	31	2	10	13	0.44
5	48.5	36	1	8	18	0.62
5	24.6	48	1	6	23	0.86
4	2.5	55	1	5	27	1.08
0	103.1	0	0	0	27	1.08
2	92.7	52	1	6	29	1.19
5	78.6	28	2	11	34	1.33
5	66.7	24	2	13	39	1.45
5	52.3	29	2	10	44	1.59
5	40.6	23	2	13	49	1.71
5	29.9	21	2	14	54	1.82
5	19	22	2	14	59	1.92
5	12.3	13	4	22	64	1.99
5	6.9	11	5	28	69	2.05



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: 11/8/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

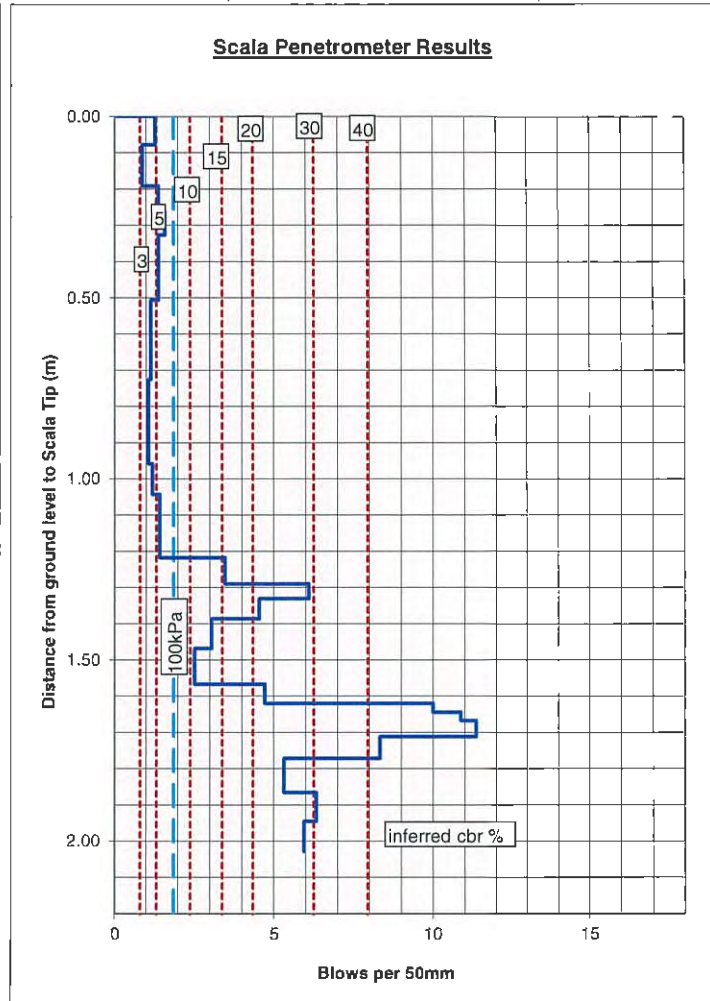
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 6 E2645745 N6524337
Start Depth (m): 0

Scala No: SP8
Ref : 15083
Report No: 15-1369
Page: 9 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	111.7	0	0	0	0	0.00
2	103.9	39	1	8	2	0.08
2	92.5	57	1	5	4	0.19
2	85.3	36	1	8	6	0.26
2	79	32	2	10	8	0.33
5	61	36	1	8	13	0.51
5	39.1	44	1	7	18	0.73
5	15.8	47	1	6	23	0.96
2	7.4	42	1	7	25	1.04
0	106.6	0	0	0	25	1.04
5	89.1	35	1	9	30	1.22
5	81.9	14	3	21	35	1.29
5	77.8	8	6	37	40	1.33
5	72.3	11	5	27	45	1.39
5	64.1	16	3	18	50	1.47
5	54.2	20	3	15	55	1.57
5	48.9	11	5	28	60	1.62
5	46.4	5	10	60	65	1.65
5	44.1	5	11	65	70	1.67
10	39.7	4	11	68	80	1.71
10	33.7	6	8	50	90	1.77
10	24.3	9	5	32	100	1.87
10	18.4	8	6	38	110	1.95
10	8	8	6	38	120	2.03



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: *11/8/15*

Note: All readings taken below 1.5m from start depth are outside the scope of this test



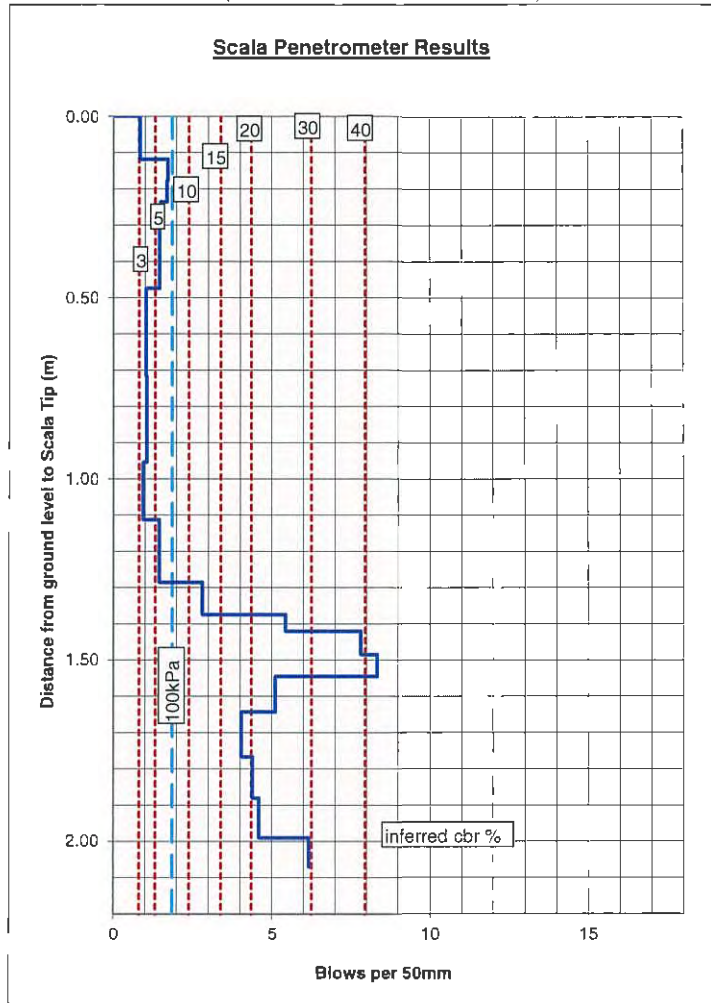
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 6 E2645753 N6524358
Start Depth (m): 0

Scala No: SP9
Ref : 15083
Report No: 15-1369
Page: 10 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	116.1	0	0	0	0	0.00
2	104.2	60	1	5	2	0.12
2	98.4	29	2	10	4	0.18
2	92.5	30	2	10	6	0.24
2	85.8	34	1	9	8	0.30
5	68.7	34	1	9	13	0.47
5	44.4	49	1	6	18	0.72
5	20.7	47	1	6	23	0.95
3	4.8	53	1	6	26	1.11
0	104.2	0	0	0	26	1.11
5	86.9	35	1	9	31	1.29
5	78	18	3	17	36	1.38
5	73.4	9	5	33	41	1.42
10	67	6	8	47	51	1.49
10	61	6	8	50	61	1.55
10	51.2	10	5	31	71	1.64
10	38.8	12	4	24	81	1.77
10	27.4	11	4	26	91	1.88
10	16.5	11	5	28	101	1.99
10	8.4	8	6	37	111	2.07



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: [Signature]
Date: 1/9/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

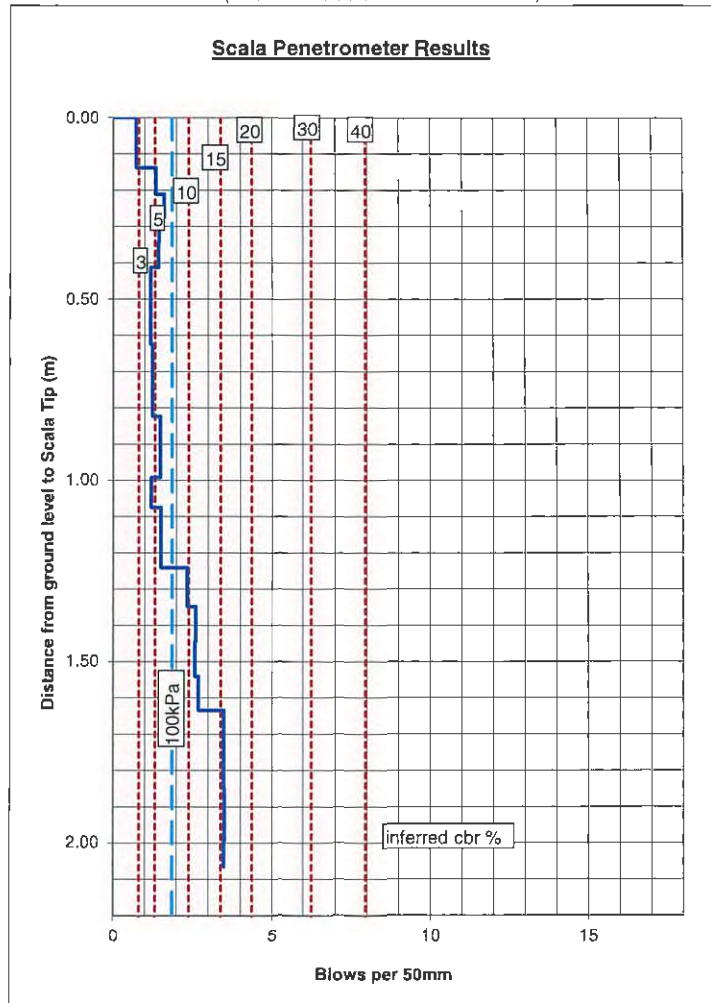
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 6 E2645780 N6524353
Start Depth (m): 0

Scala No: SP10
Ref : 15083
Report No: 15-1369
Page: 11 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	114.3	0	0	0	0	0.00
2	100.5	69	1	4	2	0.14
2	93.1	37	1	8	4	0.21
2	86.9	31	2	10	6	0.27
2	80	35	1	9	8	0.34
2	73	35	1	9	10	0.41
5	51.9	42	1	7	15	0.62
5	31.9	40	1	8	20	0.82
5	15.1	34	1	9	25	0.99
2	6.8	42	1	7	27	1.08
0	106.8	0	0	0	27	1.08
5	90.2	33	2	9	32	1.24
5	79.5	21	2	14	37	1.35
5	69.9	19	3	16	42	1.44
5	60.2	19	3	15	47	1.54
5	50.9	19	3	16	52	1.63
5	43.7	14	3	21	57	1.71
10	29.3	14	3	21	67	1.85
10	15	14	3	21	77	1.99
5	7.8	14	3	21	82	2.07



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: [Signature]
Date: 11/9/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

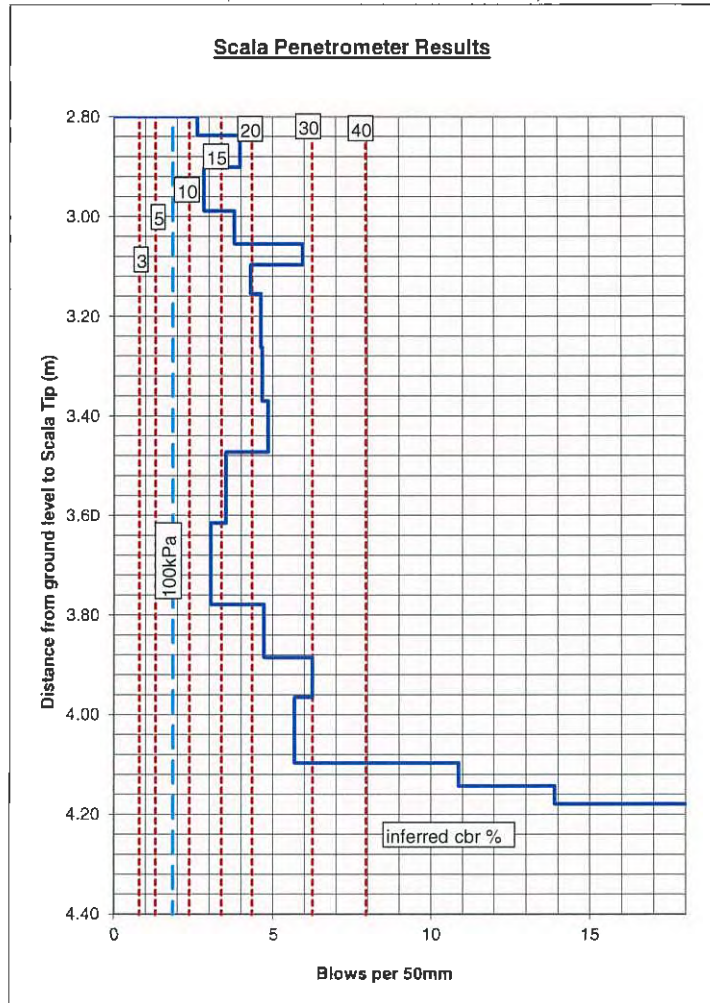
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 6 E2645776 N6524353
Start Depth (m): 2.8 Base BH3

Scala No: SP11
Ref : 15083
Report No: 15-1369
Page: 12 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	135.3	0	0	0	0	2.80
2	132.5	19	3	16	2	2.84
5	126.2	13	4	24	7	2.90
5	117.4	18	3	17	12	2.99
5	110.8	13	4	23	17	3.06
5	106.6	8	6	36	22	3.10
5	100.8	12	4	26	27	3.16
10	90	11	5	28	37	3.26
10	79.3	11	5	29	47	3.37
10	69	10	5	29	57	3.47
10	54.8	14	4	21	67	3.62
10	38.4	16	3	18	77	3.78
10	27.8	11	5	28	87	3.89
10	19.8	8	6	38	97	3.97
10	11	9	6	34	107	4.05
5	6.6	9	6	34	112	4.10
0	106.4	0	0	0	112	4.10
10	101.6	6	11	65	122	4.14
10	98.2	4	14	83	132	4.18
10	95.7	3	20	120	142	4.20



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: 11/11/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

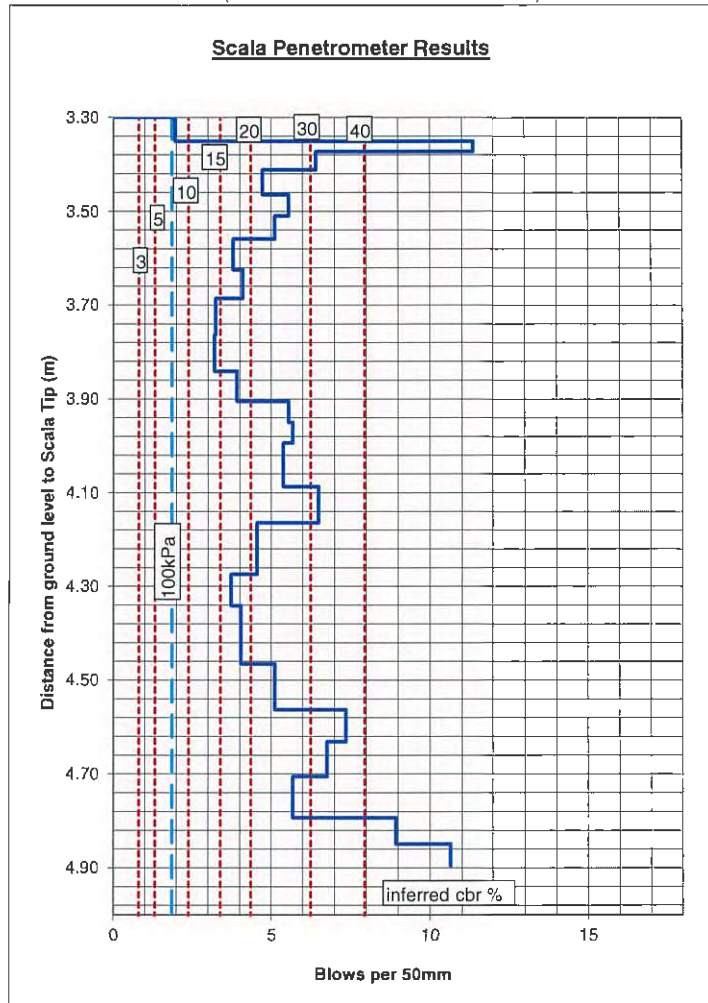
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 6 E2645751 N6524345
Start Depth (m): 3.3 Base BH4

Scala No: SP12
Ref : 15083
Report No: 15-1369
Page: 13 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	112.8	0	0	0	0	3.30
2	107.7	26	2	12	2	3.35
5	105.5	4	11	68	7	3.37
5	101.6	8	6	38	12	3.41
5	96.3	11	5	28	17	3.47
5	91.8	9	6	33	22	3.51
5	86.9	10	5	31	27	3.56
5	80.3	13	4	23	32	3.63
5	74.2	12	4	25	37	3.69
5	66.5	15	3	19	42	3.76
5	58.7	16	3	19	47	3.84
5	52.3	13	4	23	52	3.91
5	47.8	9	6	33	57	3.95
5	43.4	9	6	34	62	3.99
10	34.1	9	5	32	72	4.09
10	26.4	8	6	39	82	4.16
10	15.4	11	5	27	92	4.27
5	8.7	13	4	22	97	4.34
0	108.4	0	0	0	97	4.34
10	96	12	4	24	107	4.47
10	86.2	10	5	31	117	4.56
10	79.4	7	7	44	127	4.63
10	72	7	7	41	137	4.71
10	63.2	9	6	34	147	4.79
10	57.6	6	9	54	157	4.85
10	52.9	5	11	64	167	4.90



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: *[Signature]*

Note: All readings taken below 1.5m from start depth are outside the scope of this test

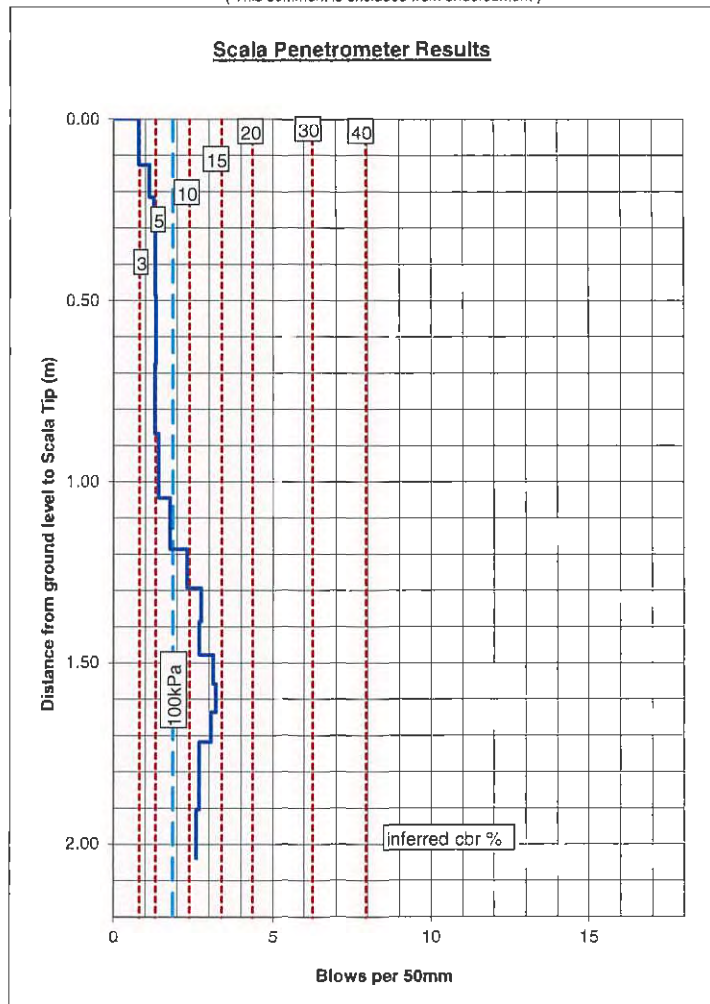
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 8 E2645990 N6524318
Start Depth (m): 0

Scala No: SP13
Ref : 15083
Report No: 15-1369
Page: 14 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	109.5	0	0	0	0	0.00
2	96.8	64	1	5	2	0.13
2	87.9	45	1	7	4	0.22
2	80	40	1	8	6	0.30
5	60.8	38	1	8	11	0.49
5	42	38	1	8	16	0.68
5	22.7	39	1	8	21	0.87
5	5	35	1	8	26	1.05
0	104.3	0	0	0	26	1.05
5	90.2	28	2	11	31	1.19
5	79.4	22	2	14	36	1.29
5	70.3	18	3	16	41	1.39
5	61	19	3	16	46	1.48
5	53	16	3	19	51	1.58
5	45.2	16	3	19	56	1.64
5	37	16	3	18	61	1.72
10	18.4	19	3	16	71	1.90
7	4.9	19	3	16	78	2.04



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: *11/8/15*

Note: All readings taken below 1.5m from start depth are outside the scope of this test

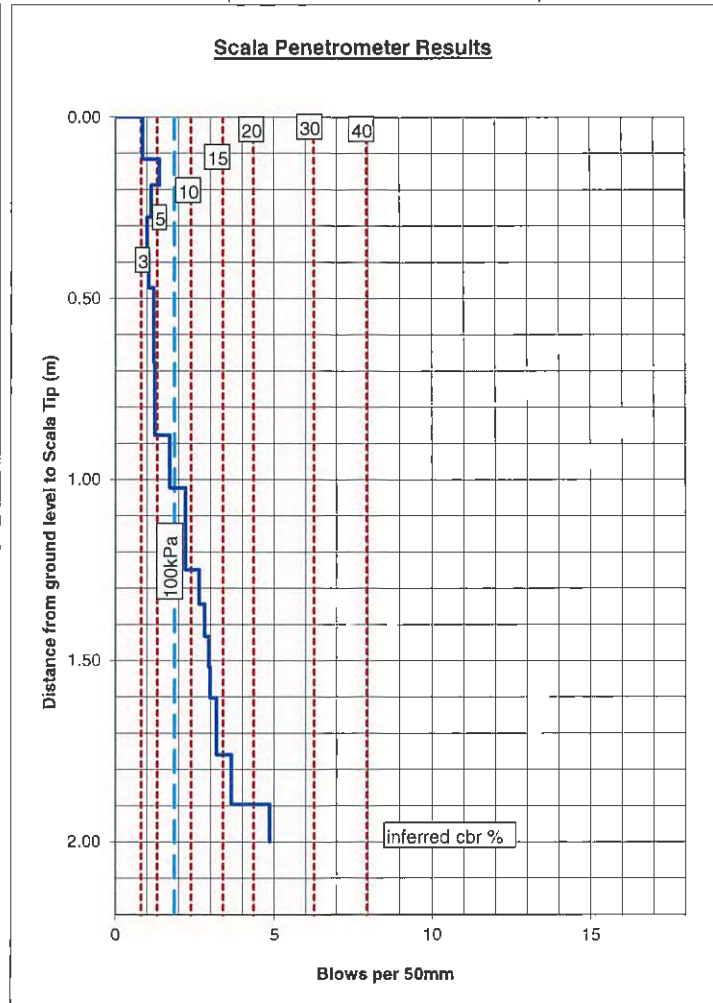
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokonki Hill Road, Warkworth
Location: Lot 8 E2645996 N6524304
Start Depth (m): 0

Scala No: SP14
Ref : 15083
Report No: 15-1369
Page: 15 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	107.4	0	0	0	0	0.00
2	95.8	58	1	5	2	0.12
2	88.6	36	1	8	4	0.19
2	79.8	44	1	7	6	0.28
2	69.8	50	1	6	8	0.38
2	60.3	48	1	6	10	0.47
5	59.8	41	1	7	15	0.68
5	19.7	40	1	7	20	0.88
5	5.1	29	2	10	25	1.02
0	104.3	0	0	0	25	1.02
5	93	23	2	13	30	1.14
5	81.7	23	2	13	35	1.25
5	72.2	19	3	16	40	1.34
5	63.3	18	3	17	45	1.43
5	54.8	17	3	18	50	1.52
5	46.4	17	3	18	55	1.60
10	30.7	18	3	19	65	1.76
10	17	14	4	22	75	1.90
10	6.7	10	5	29	85	2.00



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: 11/9/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

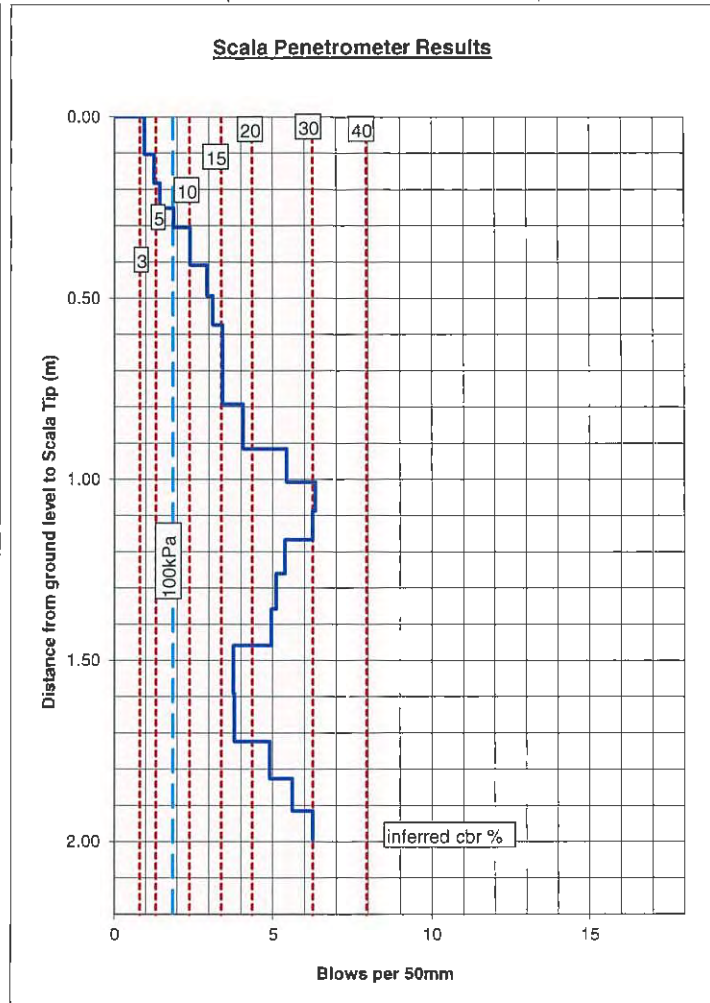
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 8 E2646004 N6524310
Start Depth (m): 0

Scala No: SP15
Ref : 15083
Report No: 15-1369
Page: 16 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	108.3	0	0	0	0	0.00
2	97.9	52	1	6	2	0.10
2	90	40	1	8	4	0.18
2	83.1	35	1	9	6	0.25
2	77.8	27	2	11	8	0.31
5	67.4	21	2	14	13	0.41
5	58.9	17	3	18	18	0.49
5	50.9	16	3	19	23	0.57
5	43.6	15	3	21	28	0.65
10	29	15	3	21	36	0.79
10	16.7	12	4	24	46	0.92
10	7.5	9	5	33	58	1.01
0	106.6	0	0	0	58	1.01
10	98.9	8	6	38	68	1.09
10	90.9	8	6	38	78	1.17
10	81.6	9	5	32	88	1.26
10	71.8	10	5	31	98	1.36
10	61.7	10	5	30	108	1.46
10	48.4	13	4	23	118	1.59
10	35.2	13	4	23	128	1.72
10	25	10	5	25	138	1.83
10	16.1	9	6	34	148	1.92
10	8.1	8	6	38	158	2.00



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: *[Signature]*

Note: All readings taken below 1.5m from start depth are outside the scope of this test

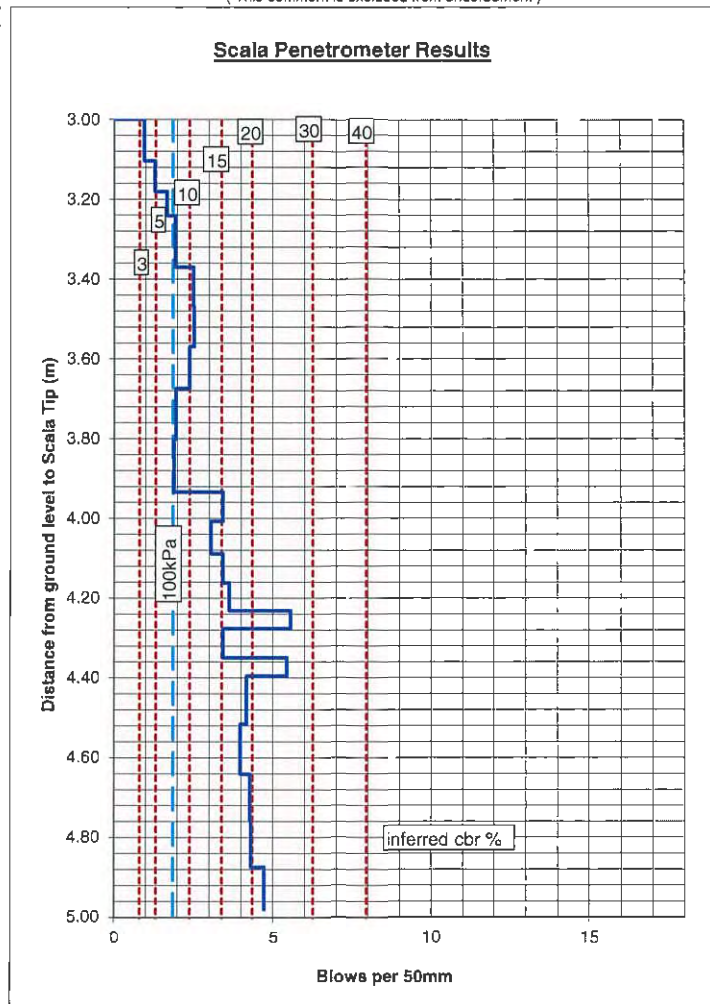
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 8 E2645999 N6524314
Start Depth (m): 3 Base BH5

Scala No: SP16
Ref : 15083
Report No: 15-1369
Page: 17 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	102.2	0	0	0	0	3.00
2	91.8	52	1	6	2	3.10
2	84.1	39	1	8	4	3.18
2	78.1	30	2	10	6	3.24
5	65.2	26	2	12	11	3.37
5	55.2	20	3	15	16	3.47
5	45.3	20	3	15	21	3.57
5	34.8	21	2	14	26	3.67
5	22	26	2	12	31	3.80
5	8.8	26	2	11	36	3.93
0	108.5	0	0	0	36	3.93
5	101.2	15	3	21	41	4.01
5	93	16	3	18	46	4.09
5	85.7	15	3	21	51	4.16
5	78.8	14	4	22	56	4.23
5	74.3	9	6	33	61	4.28
5	67	15	3	21	66	4.35
5	62.4	9	5	33	71	4.40
10	50.4	12	4	25	81	4.52
10	37.8	13	4	24	91	4.64
10	26.1	12	4	26	101	4.76
10	14.5	12	4	26	111	4.87
10	3.9	11	5	28	121	4.98



Recorded By: G.R/S,K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: *11/9/15*

Note: All readings taken below 1.5m from start depth are outside the scope of this test



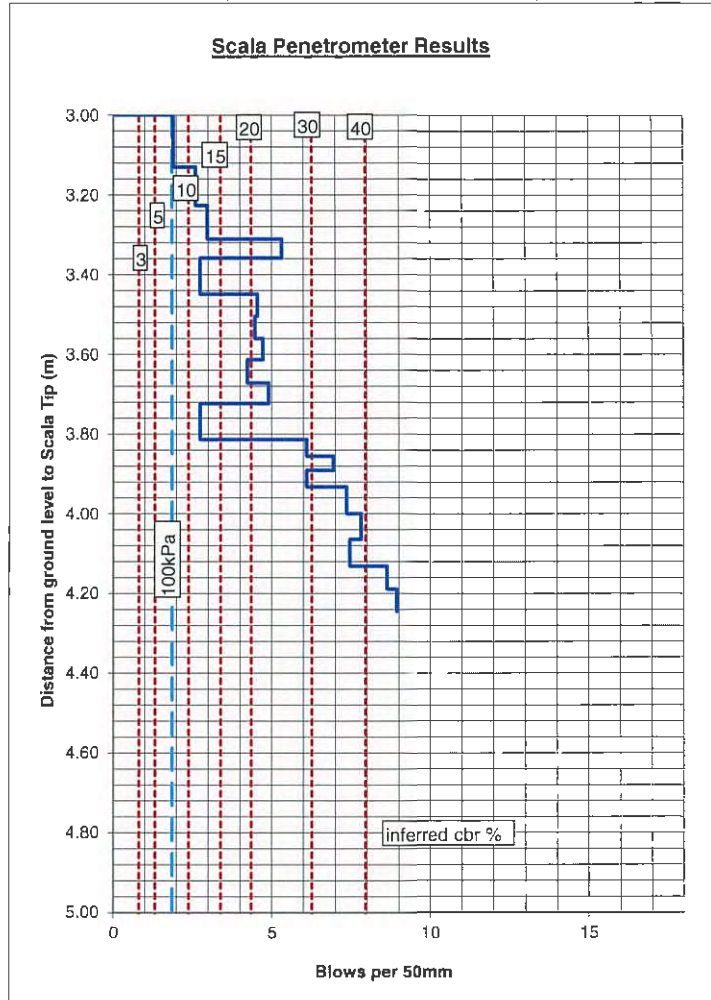
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 9 E2646044 N6524324
Start Depth (m): 3 Base of BH6

Scala No: SP17
Ref : 15083
Report No: 15-1369
Page: 18 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	90.8	0	0	0	0	3.00
5	77.7	26	2	11	5	3.13
5	68.1	19	3	16	10	3.23
5	59.7	17	3	19	15	3.31
5	55	9	5	32	20	3.36
5	45.9	18	3	16	25	3.45
5	40.4	11	5	27	30	3.50
5	34.8	11	4	27	35	3.56
5	29.5	11	5	28	40	3.61
5	23.6	12	4	25	45	3.67
5	18.5	10	5	29	50	3.72
5	9.4	18	3	16	55	3.81
0	109.5	0	0	0	55	3.81
5	105.4	8	6	37	60	3.86
5	101.8	7	7	42	65	3.89
5	97.7	8	6	37	70	3.93
10	90.9	7	7	44	80	4.00
10	84.5	6	8	47	90	4.06
10	77.8	7	7	45	100	4.13
10	72	6	9	52	110	4.19
10	66.4	6	9	54	120	4.25



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: [Signature]
Date: 17/1/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

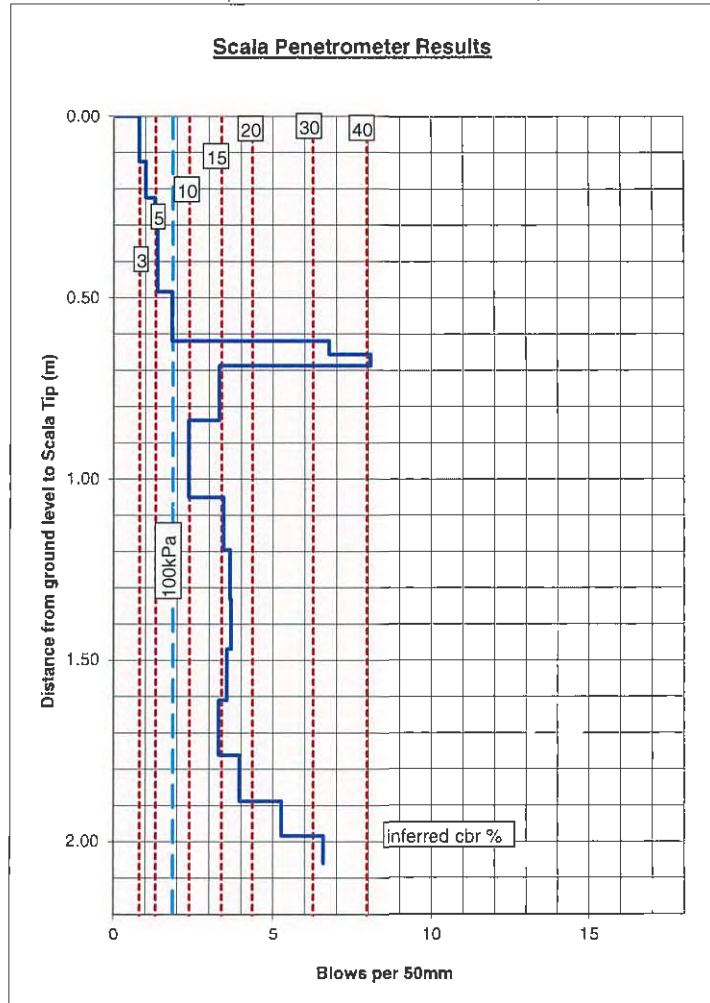
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 9 E2646041 N6524320
Start Depth (m): 0

Scala No: SP18
Ref : 15083
Report No: 15-1369
Page: 19 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	114.2	0	0	0	0	0.00
2	101.7	63	1	5	2	0.13
2	91.7	50	1	6	4	0.23
2	84	39	1	8	6	0.30
5	65.9	36	1	8	11	0.48
5	52.3	27	2	11	16	0.62
5	48.6	7	7	41	21	0.66
5	45.5	6	8	48	26	0.69
10	30.4	15	3	20	36	0.84
10	9.2	21	2	14	46	1.05
0	108.7	0	0	0	46	1.05
10	94.2	15	3	21	56	1.20
10	80.5	14	4	22	66	1.33
10	65.9	14	4	22	76	1.47
10	52.8	14	4	21	86	1.61
10	37.6	15	3	20	96	1.76
10	24.9	13	4	24	106	1.89
10	15.4	10	5	32	116	1.98
10	7.8	8	7	39	126	2.06



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: [Signature]
Date: 17/9/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

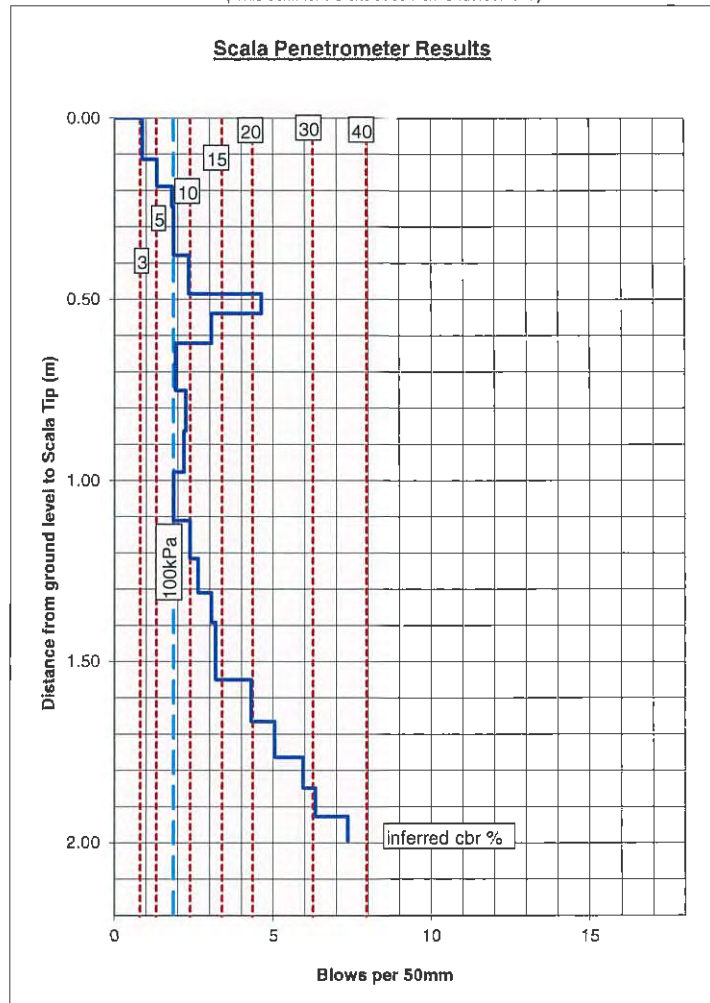
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 9 E2646051 N6524330
Start Depth (m): 0

Scala No: SP19
Ref : 15083
Report No: 15-1369
Page: 20 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	113.3	0	0	0	0	0.00
2	101.9	57	1	5	2	0.11
2	94.4	38	1	8	4	0.19
2	88.9	28	2	11	6	0.24
5	75.5	27	2	11	11	0.38
5	64.8	21	2	14	16	0.49
5	59.4	11	5	28	21	0.54
5	51.2	18	3	18	26	0.62
5	38.2	26	2	12	31	0.75
5	27.1	22	2	14	36	0.86
5	15.7	23	2	13	41	0.98
5	2.3	27	2	11	46	1.11
0	102.3	0	0	0	46	1.11
5	91.8	21	2	14	51	1.22
5	82.3	19	3	16	56	1.31
5	74.1	16	3	18	61	1.39
10	58.4	16	3	19	71	1.55
10	46.8	12	4	26	81	1.67
10	36.9	10	5	30	91	1.76
10	28.5	8	6	36	101	1.85
10	20.6	8	6	38	111	1.93
10	13.8	7	7	44	121	2.00



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: *[Signature]*

Note: All readings taken below 1.5m from start depth are outside the scope of this test

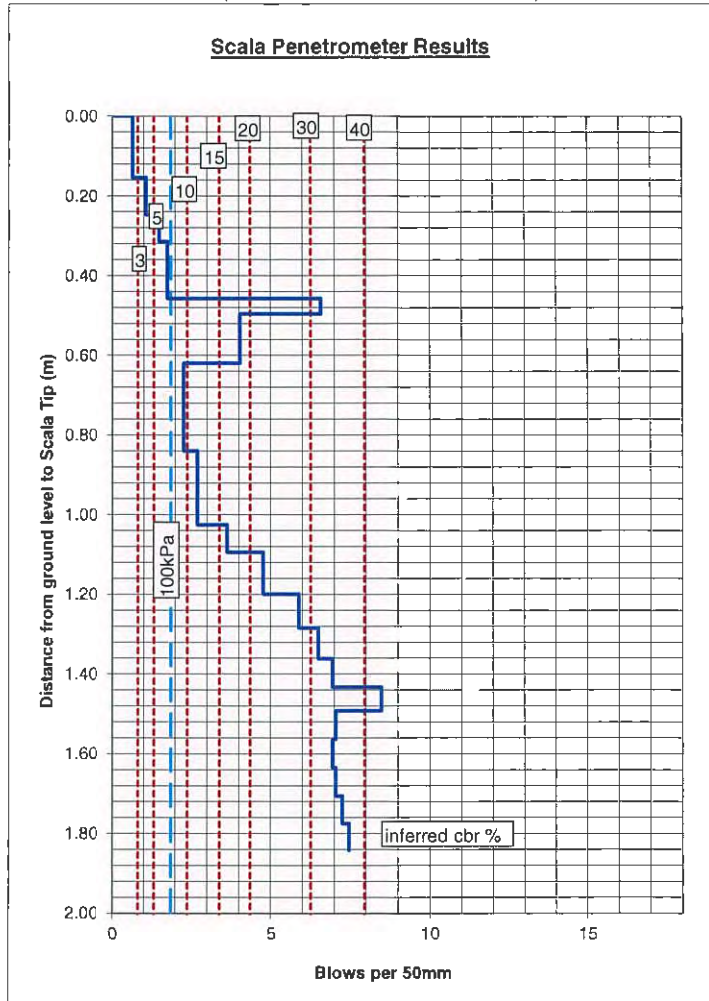
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 9 E2646840 N6524333
Start Depth (m): 0

Scala No: SP20
Ref : 15083
Report No: 15-1369
Page: 21 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	114.8	0	0	0	0	0.00
2	99.3	78	1	4	2	0.16
2	90	47	1	6	4	0.25
2	83.3	34	1	9	6	0.32
5	69	29	2	10	11	0.46
5	65.2	8	7	39	16	0.50
10	52.8	12	4	24	26	0.62
10	30.8	22	2	14	36	0.84
10	12.3	19	3	16	46	1.03
5	5.4	14	4	22	51	1.09
0	104.8	0	0	0	51	1.09
10	94.3	11	5	29	61	1.20
10	85.8	9	6	35	71	1.28
10	78.1	8	6	39	81	1.36
10	70.9	7	7	42	91	1.43
10	65	6	8	51	101	1.49
10	57.9	7	7	42	111	1.56
10	50.7	7	7	42	121	1.64
10	43.6	7	7	42	131	1.71
10	36.7	7	7	43	141	1.78
10	30	7	7	45	151	1.84



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: *1/9/15*

Note: All readings taken below 1.5m from start depth are outside the scope of this test

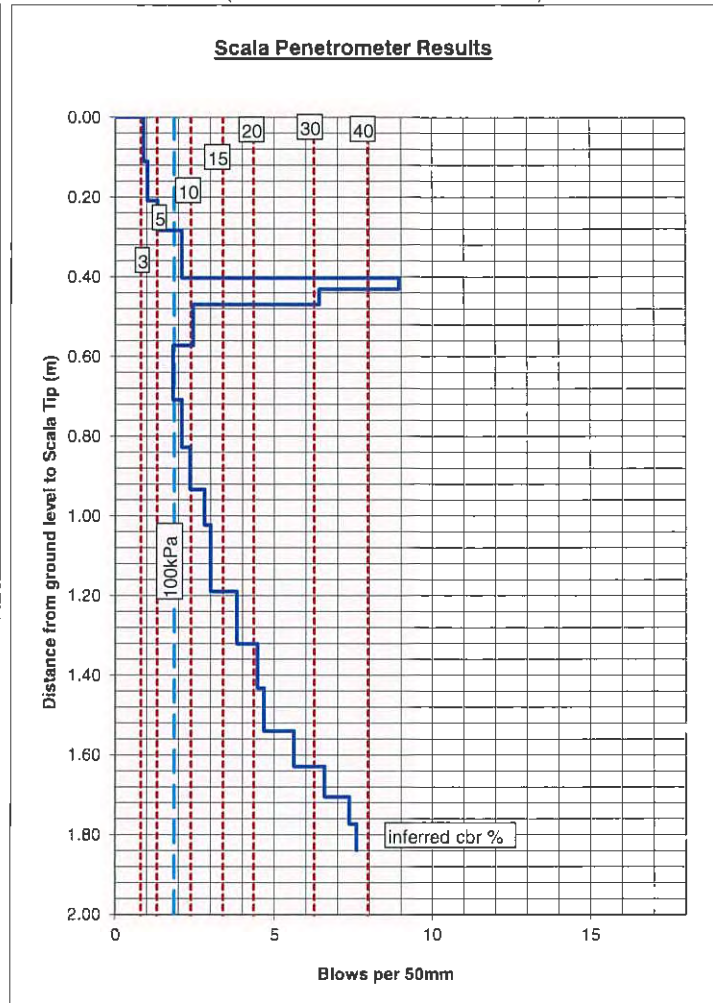
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 11 E2646052 N6524373
Start Depth (m): 0

Scala No: SP21
Ref : 15083
Report No: 15-1369
Page: 22 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	114.2	0	0	0	0	0.00
2	103.1	56	1	5	2	0.11
2	93.3	48	1	6	4	0.21
2	85.8	38	1	8	6	0.28
5	73.9	24	2	13	11	0.40
5	71.1	6	9	54	16	0.43
5	67.2	8	6	38	21	0.47
5	57	20	2	15	26	0.57
5	43.3	27	2	11	31	0.71
5	31.4	24	2	13	36	0.83
5	20.8	21	2	14	41	0.93
5	11.9	18	3	17	46	1.02
0	111.4	0	0	0	46	1.02
10	94.7	17	3	18	56	1.19
10	81.6	13	4	23	66	1.32
10	70.4	11	4	27	76	1.43
10	59.7	11	5	28	86	1.54
10	50.8	9	6	34	96	1.63
10	43.2	8	7	39	106	1.71
10	36.4	7	7	44	116	1.77
10	29.8	7	8	45	126	1.84



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: 11/8/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

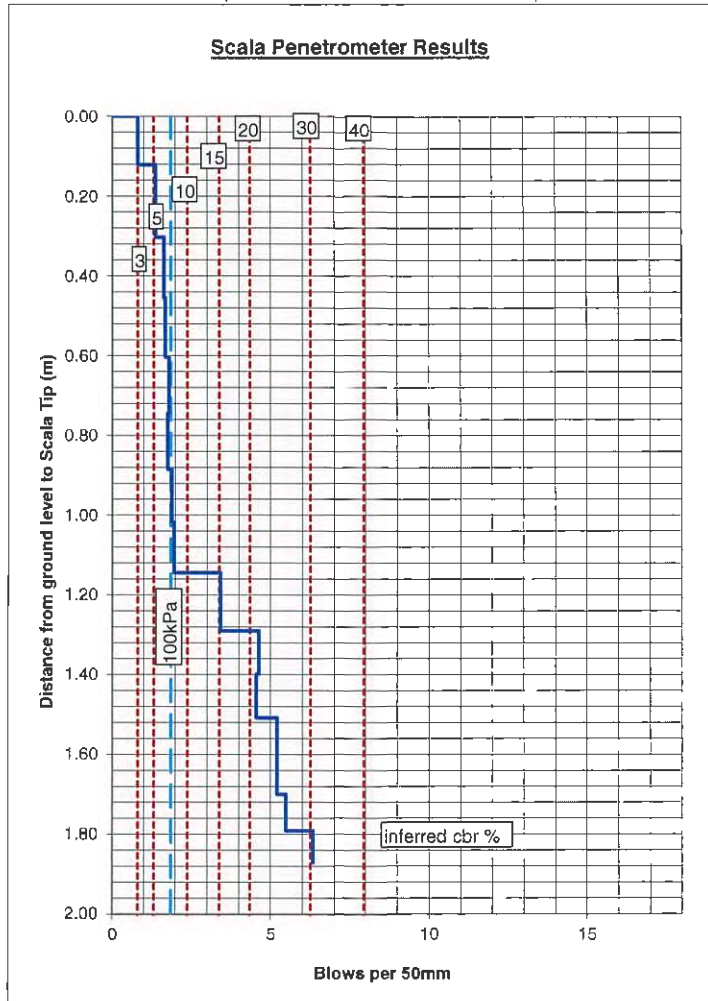
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 11 E2646056 N6524387
Start Depth (m):

Scala No: SP22
Ref : 15083
Report No: 15-1369
Page: 23 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	110.2	0	0	0	0	0.00
2	98	61	1	5	2	0.12
5	79.9	36	1	8	7	0.30
5	64.7	30	2	10	12	0.46
5	49.8	30	2	10	17	0.60
5	35.9	28	2	11	22	0.74
5	21.7	28	2	11	27	0.89
5	8.5	26	2	11	32	1.02
0	108.1	0	0	0	32	1.02
5	95.4	25	2	12	37	1.14
10	80.8	15	3	21	47	1.29
10	70	11	5	28	57	1.40
10	59	11	5	27	67	1.51
10	49.4	10	5	31	77	1.60
10	39.8	10	5	31	87	1.70
10	30.7	9	5	33	97	1.79
10	22.8	8	6	36	107	1.87



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: [Signature]
Date: 11/9/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

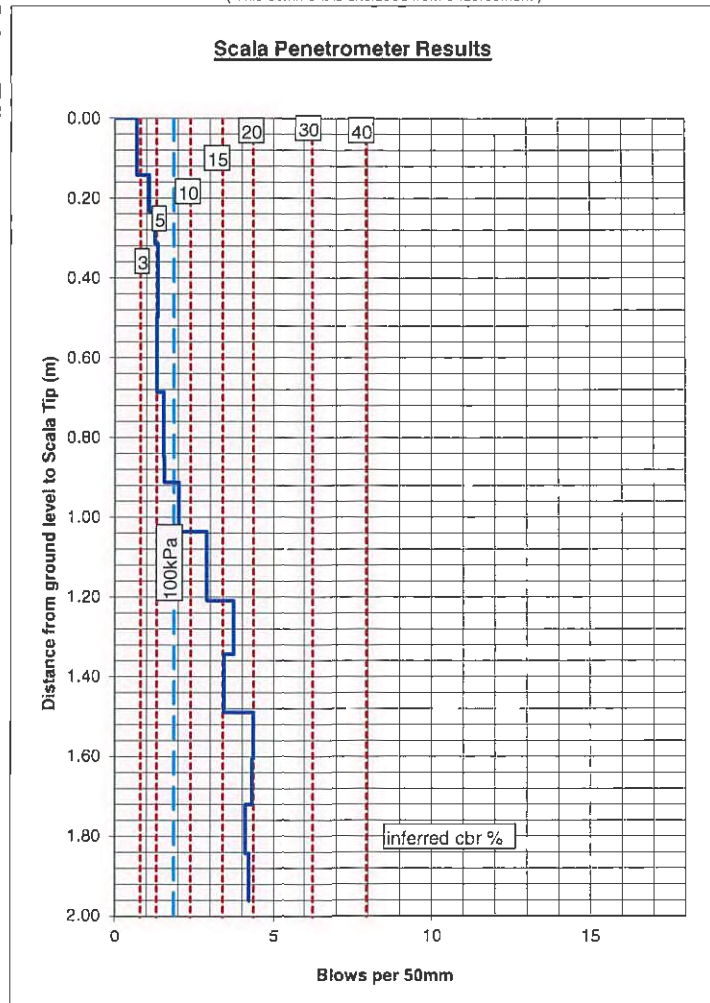
DYNAMIC CONE (SCALA) PENETROMETER
NZS 4402 :1988 Test 6.5.2

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Job: 332 Komokoriki Hill Road, Warkworth
Location: Lot 7 E2645905 N6524394
Start Depth (m): 0

Scala No: SP26
Ref : 15083
Report No: 15-1369
Page: 27 of 37

The line are the suggested correlation of CBR values based on Figure 5.3, Correlation of Dynamic Cone Penetration and CBR AUSTRROADS (2004) "Pavement Design - a guide to the design of road Pavements"
(This comment is excluded from endorsement)

No. Blows	Tip to ref (cm)	mm / blow	blows / 50mm	Blows / 300mm	Total Blows	depth (m)
0	101.5	0	0	0	0	0.00
2	87.2	72	1	4	2	0.14
2	78	46	1	7	4	0.24
2	70.1	40	1	8	6	0.31
5	51.7	37	1	8	11	0.50
5	32.9	36	1	8	16	0.69
5	16.7	32	2	9	21	0.85
2	10.3	32	2	9	23	0.91
0	109.8	0	0	0	23	0.91
5	97.4	25	2	12	28	1.04
10	80.1	17	3	17	38	1.21
10	66.7	13	4	22	48	1.34
10	52.1	15	3	21	58	1.49
10	40.6	12	4	25	68	1.60
10	29	12	4	26	78	1.72
10	16.8	12	4	25	86	1.84
10	4.9	12	4	25	98	1.98



Recorded By: G.R/S.K/D.O
Date: 11/08/2015
Checked by: *[Signature]*
Date: 11/08/15

Note: All readings taken below 1.5m from start depth are outside the scope of this test

AUGERHOLE LOG

Job No.: 8288-059	Borehole No.: BH1 Lot 5	Sheet: 1 of 1
Report No.: 15-1369	Coordinates:	Date: 11/08/15
Client: Base Group Consulting	Location: 332 Komokoriki Hill Road Warkworth	Ground Level: 0
Client Ref. No.: 15083		
Project: Geotechnical Investigations		

Geological Interpretation <small>In accordance with NZGS 2005</small>	UCS	Legend	Depth (m)	Water	Vane Shear Strength (kPa)				Values	Samples
					50	100	150	200		
TOPSOIL, silty clay, some organics (roots), moist, friable, dark brown.	OH									
Silty CLAY, traces of roots, traces of fine sand, orangish brown, friable, moist, high plasticity.	CH									
Silty CLAY, orangy brown with minor grey, moist, high plasticity.	CH		0.5						142 67	
Silty CLAY, traces of extremely weak gravels to 5mm, light orangish grey, moist, high plasticity.	CH		1.0						136 43	
CLAY, minor silt, light grey with minor light orange, very moist, high plasticity.	CH		1.5						206+	
Silty CLAY, minor very weak gravels to 5mm, wet to saturated, light grey.	CH			SWL 1.70m						
Silty CLAY, minor very weak gravels to 5mm, wet to saturated, light grey.	CH								UTP	
End of Borehole - Too hard too auger.			2.0							

Remarks Water in hole in-filled to 1.0m after dug.	Water		Investigation Type	
		Standing Water Level	<input checked="" type="checkbox"/>	Hand Auger
		Out flow	<input type="checkbox"/>	Test Pit
		In flow		

Contractor: Geocivil	Rig/Plant Used: Hand Auger	Page No.: 29 of 37	Logged By: S.K/D.O	Checked By: 	Hole Depth: 1.90 m
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AUGERHOLE LOG

2 Norfolk Street,
Whangarei,
M:027 6565226
E: info@geocivil.co.nz

Job No.: 8288-059 **Borehole No.:** BH2 Lot 5 **Sheet:** 1 of 1
Report No.: 15-1369
Client: Base Group Consulting **Coordinates:** **Date:** 11/08/15
Client Ref. No.: 15083
Project: Geotechnical Investigations **Location:** 332 Komokoriki Hill Road Warkworth **Ground Level:** 0

Geological Interpretation <small>In accordance with NZGS 2005</small>	UCS	Legend	Depth (m)	Water	Vane Shear Strength (kPa)				Values	Samples
					50	100	150	200		
TOPSOIL, silty clay, some organics (roots), moist, friable, dark brown.	OH									
Silty CLAY, traces of fine sand, traces of organics (roots), greyish brown, moist, high plasticity, friable.	CH									
Silty CLAY, traces of fine sand, greyish brown with minor orange, moist, high plasticity.	CH		0.5						107	36
CLAY, minor silt, greyish brown with some orange, moist, fat, high plasticity.	CH		1.0						56	30
Silty CLAY, traces of extremely weak gravels to 5mm, light brownish grey with minor orange, moist, high plasticity.	CH		1.5						64	24
Silty CLAY, some extremely weak (crushable) gravels to 5mm, light brownish grey with minor orange, moist, high plasticity.	CH		2.0						208+	-
Silty CLAY, some extremely weak gravels to 5mm, greyish green, moist, high plasticity, very stiff, friable.	CH									
Silty CLAY, some extremely weak gravels to 5mm, dark grey, moist, high plasticity, very stiff, friable.	CH									
Silty CLAY, some extremely weak gravels to 5mm, dark grey mixed with greyish green, moist, high plasticity, very stiff, friable.	CH									UTP
End of Borehole - Too hard too auger.			2.5							

Remarks

Water

Standing Water Level Hand Auger
 Out flow Test Pit
 In flow

Contractor: Geocivil **Rig/Plant Used:** Hand Auger **Page No.:** 30 of 37 **Logged By:** S.K. **Checked By:** *[Signature]* **Hole Depth:** 2.40 m

Produced with Core-GS

AUGERHOLE LOG

Job No.: 8288-059	Borehole No.: BH3 Lot 6	Sheet: 1 of 1
Report No.: 15-1369	Coordinates:	Date: 11/08/15
Client: Base Group Consulting	Location: 332 Komokoriki Hill Road Warkworth	Ground Level: 0
Client Ref. No.: 15083		
Project: Geotechnical Investigations		

Geological Interpretation <small>In accordance with NZGS 2005</small>	UCS	Legend	Depth (m)	Water	Vane Shear Strength (kPa)				Values	Samples
					50	100	150	200		
TOPSOIL, silty clay, some organics (roots), moist, friable, dark brown.	OH									
Silty CLAY, traces of fine sand, orangey brown, moist, high plasticity.	CH		0.5						131	
									71	
CLAY, some silt, traces of fine sand, orange with some grey, moist, fat, high plasticity.	CH		1.0	SWL 1.00m					86	
									43	
Silty CLAY, traces of extremely weak gravels, light grey brown with very minor orange mottling, very moist, high plasticity.	CH		1.5						117	
									45	
Silty CLAY, light brownish grey, wet, soft, high plasticity.	CH		2.0						93	
									40	
Silty CLAY, light brownish grey, wet, soft, high plasticity.	CH		2.5						101	
									33	
End of Borehole - Hole collapsed.			3.0							

Remarks	Water		Investigation Type	
		Standing Water Level	<input checked="" type="checkbox"/>	Hand Auger
		Out flow	<input type="checkbox"/>	Test Pit
		In flow		

Contractor: Geocivil	Rig/Plant Used: Hand Auger	Page No.: 31 of 37	Logged By: S.K/D.O	Checked By: 	Hole Depth: 2.80 m
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AUGERHOLE LOG

2 Norfolk Street,
Whangarei,
M:027 6565226
E: info@geocivil.co.nz

Job No.: 8288-059 **Borehole No.:** BH4 Lot 6 **Sheet:** 1 of 1
Report No.: 15-1369 **Coordinates:** **Date:** 11/08/15
Client: Base Group Consulting **Location:** 332 Komokoriki Hill Road **Ground Level:** 0
Client Ref. No.: 15083 Warkworth

Geological Interpretation <small>In accordance with NZGS 2005</small>	UCS	Legend	Depth (m)	Water	Vane Shear Strength (kPa)		Samples		
					Tested in accordance with NZGS Aug 2001				
					50	100	150	200	Values
TOPSOIL, silty clay, some organics (roots), moist, friable, dark brown.	OH								
Silty CLAY, traces of roots, orangey brown, moist, high plasticity.	CH								
Silty CLAY, orangey brown minor grey, moist, high plasticity.	CH		0.5						122 36
Very silty CLAY, traces of extremely weak sand/gravel, friable, moist, moderate to high plasticity, light orangish brown.	CH		1.0						170 30
Silty CLAY, traces of fine sand/extremely weak gravels, light grey brown with very minor orange mottling, moist, high plasticity.	CH		1.5	Groundwater Not Encountered					189+
Very silty CLAY, traces of extremely weak gravels, light grey, friable, moist, moderate plasticity.	CH								
Silty CLAY, minor extremely weak gravels, light yellowish grey, moist, moderate to high plasticity.	CH		2.0						176 27
Silty CLAY, minor extremely weak gravels to 5mm, light grey brown.	CH		2.5						122 35
Silty CLAY, minor extremely weak gravels to 5mm, light grey brown with very minor orange mottling.	CH		3.0						189+
Very silty CLAY, minor extremely weak gravels to 5mm, friable, moist, moderate to high plasticity, light brownish grey.	CH								-
End of Borehole			3.5						

Remarks	Water	Investigation Type
	Standing Water Level Out flow In flow	<input checked="" type="checkbox"/> Hand Auger <input type="checkbox"/> Test Pit

Contractor: Geocivil	Rig/Plant Used: Hand Auger	Page No.: 32 of 37	Logged By: S.K	Checked By: 	Hole Depth: 3.30 m
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Produced with Core-GS

AUGERHOLE LOG

Job No.: 8288-059 **Borehole No.:** BH5 Lot 8 **Sheet:** 1 of 1
Report No.: 15-1369 **Coordinates:** **Date:** 11/08/15
Client: Base Group Consulting **Location:** 332 Komokoriki Hill Road **Ground Level:** 0
Client Ref. No.: 15083 **Warkworth**
Project: Geotechnical Investigations

Geological Interpretation <small>In accordance with NZGS 2005</small>	UCS	Legend	Depth (m)	Water	Vane Shear Strength (kPa)				Values	Samples
					50	100	150	200		
TOPSOIL, silty clay, some organics (roots), moist, friable, dark brown.	OH		0.0 - 0.1							
Silty CLAY, traces of fine sand, brown with minor orange, moist, high plasticity.	CH		0.1 - 0.3							
Silty CLAY, traces of fine sand, orange brown, moist, high plasticity.	CH		0.3 - 0.5						120	
Silty CLAY, traces of fine sand, light brown with very minor orange, moist, high plasticity.	CH		0.5 - 1.0						43	
Silty CLAY, traces of fine sand, light grey with very minor orange, soft, moist, high plasticity.	CH		1.0 - 1.5						81	
Silty CLAY, traces of fine sand, light grey brown with some orange, soft, very moist, high plasticity.	CH		1.5 - 2.0						104	
Silty CLAY, traces of fine sand, light grey brown with some orange, soft, wet to saturated, high plasticity.	CH		2.0 - 2.5						70	
Silty CLAY, traces of fine sand, light grey brown with some orange, soft, wet to saturated, high plasticity.	CH		2.5 - 3.0	SWL 2.40m					97	
End of Borehole - Target depth.			3.0						27	
									84	
									41	

Remarks	Water	Investigation Type
	Standing Water Level Out flow In flow	<input checked="" type="checkbox"/> Hand Auger <input type="checkbox"/> Test Pit

Contractor: Geocivil	Rig/Plant Used: Hand Auger	Page No.: 33 of 37	Logged By: S.K/D.O	Checked By: 	Hole Depth: 3.00 m
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Produced with Core-GS

AUGERHOLE LOG

Job No.: 8288-059	Borehole No.: BH6 Lot 9	Sheet: 1 of 1
Report No.: 15-1369	Coordinates:	Date: 11/08/15
Client: Base Group Consulting	Location: 332 Komokoriki Hill Road Warkworth	Ground Level: 0
Client Ref. No.: 15083		
Project: Geotechnical Investigations		

Geological Interpretation <small>In accordance with NZGS 2005</small>	UCS	Legend	Depth (m)	Water	Vane Shear Strength (kPa)				Values	Samples
					50	100	150	200		
TOPSOIL, silty clay, some organics (roots), moist, friable, dark brown.	OH									
Clayey SILT, moist, light orange brown, friable, moderate plasticity.	MH		0.5						134 39	
SILT, minor clay, light grey, moist, slight plasticity.	ML									
Very silty CLAY, traces of fine sand, brownish grey, moist, moderate plasticity.	CH		1.0						169 92	
Silty CLAY, traces of fine sand, orange with very minor grey, moist, high plasticity.	CH		1.5						134 67	
Silty CLAY, traces of fine sand, brownish grey with minor orange, moist, high plasticity.	CH		2.0						125 74	
Silty CLAY, minor fine sand, light grey with very minor orange and red mottling, very moist, high plasticity.	CH									
Silty CLAY, minor fine sand, light grey with very minor orange and red mottling, wet, high plasticity.	CH		2.5	SWL 2.40m					137 74	
End of Borehole - Target depth.			3.0						122 67	

Remarks	Water		Investigation Type		
	Standing Water Level	Out flow	<input checked="" type="checkbox"/> Hand Auger	<input type="checkbox"/> Test Pit	
In flow					
Contractor: Geocivil	Rig/Plant Used: Hand Auger	Page No.: 34 of 37	Logged By: S.K	Checked By:	Hole Depth: 3.00 m

AUGERHOLE LOG

2 Norfolk Street,
Whangarei,
M:027 6565226
E: info@geocivil.co.nz

Job No.: 8288-059	Borehole No.: BH7 Lot 11	Sheet: 1 of 1
Report No.: 15-1369	Coordinates:	Date: 11/08/15
Client: Base Group Consulting	Location: 332 Komokoriki Hill Road Warkworth	Ground Level: 0
Client Ref. No.: 15083		
Project: Geotechnical Investigations		

Geological Interpretation <small>In accordance with NZGS 2005</small>	UCS	Legend	Depth (m)	Water	Vane Shear Strength (kPa)		Samples
					50	100 150 200	
TOPSOIL, silty clay, some organics (roots), moist, friable, dark brown.	OH		0.0 - 0.2				
Very silty CLAY, minor fine sand, brown, moderate plasticity, moist.	CH		0.2 - 0.5				
Silty CLAY, minor fine sand, moist, high plasticity, brownish orange.	CH		0.5		122		
			0.6		66		
Silty CLAY, minor fine sand, moist, high plasticity, light orange brown with some grey.	CH		1.0		176		
			1.1		92		
Silty CLAY, minor fine sand, moist, high plasticity, light orange brown with some grey.	CH		1.5		151		
			1.6		68		
Silty CLAY, minor sand/weak gravel to 5mm, greyish pink, saturated, moderate to high plasticity, soft.	CH		2.0		142		
			2.1		69		
Silty CLAY, minor sand/weak gravel to 5mm, greyish pink, saturated, moderate to high plasticity, soft.	CH		2.5	SWL 2.40m	120		
			2.6		73		
End of Borehole - Target depth.			3.0		111		
			3.1		47		

Remarks	Water	Investigation Type
Water in hole in-filled to 1.3m after dug.	<input checked="" type="checkbox"/> Standing Water Level <input type="checkbox"/> Out flow <input type="checkbox"/> In flow	<input checked="" type="checkbox"/> Hand Auger <input type="checkbox"/> Test Pit

Contractor: Geocivil	Rig/Plant Used: Hand Auger	Page No.: 35 of 37	Logged By: S.K/D.O	Checked By: 	Hole Depth: 3.00 m
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Produced with Core-GS

AUGERHOLE LOG

2 Norfolk Street,
Whangarei,
M: 027 6565226
E: info@geocivil.co.nz

Job No.: 8288-059	Borehole No.: BH8 Lot 7	Sheet: 1 of 1
Report No.: 15-1369	Coordinates:	Date: 11/08/15
Client: Base Group Consulting	Location: 332 Komokoriki Hill Road Warkworth	Ground Level: 0
Client Ref. No.: 15083		
Project: Geotechnical Investigations		

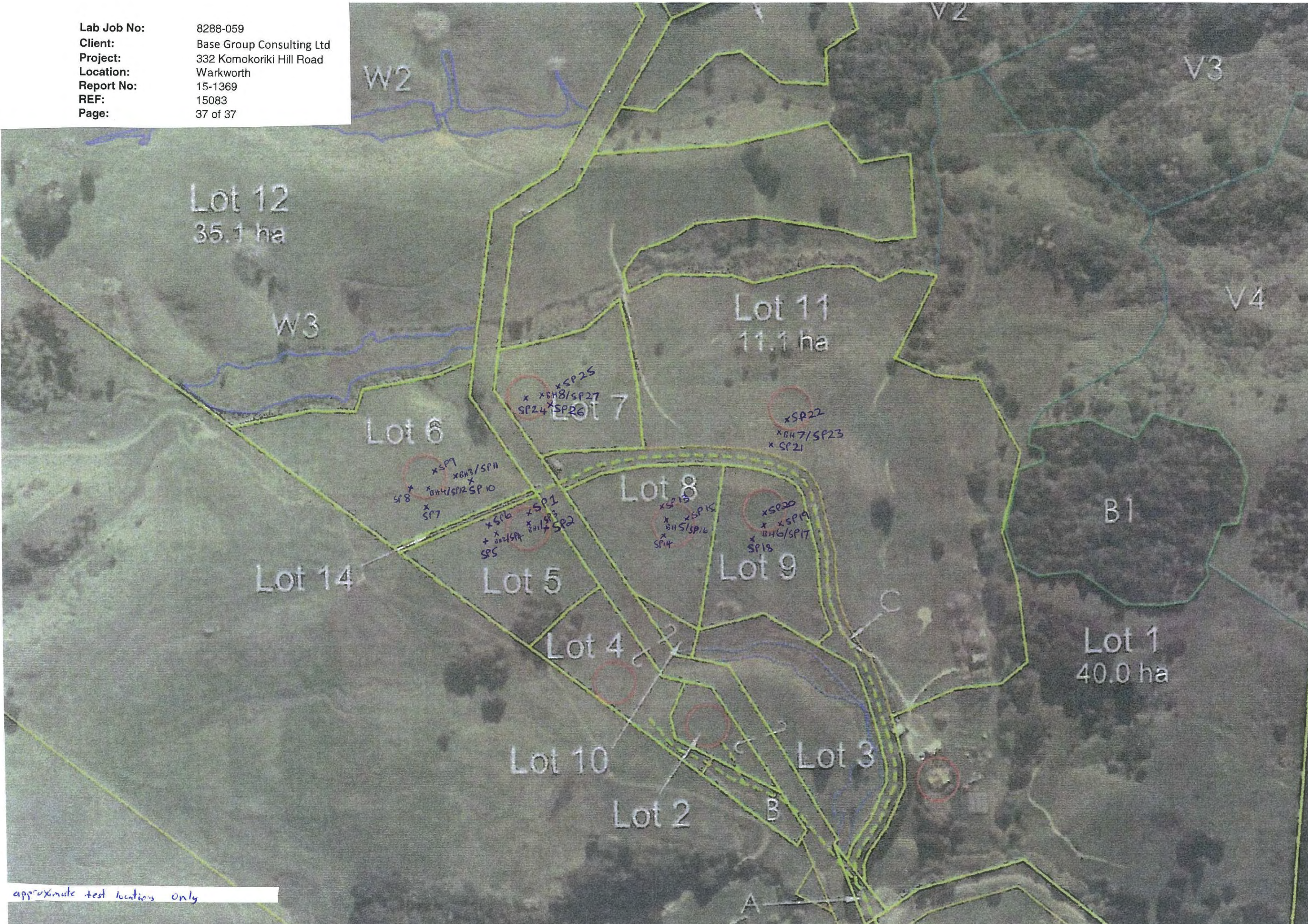
Geological Interpretation <small>In accordance with NZGS 2005</small>	UCS	Legend	Depth (m)	Water	Vane Shear Strength (kPa)				Values	Samples
					50	100	150	200		
TOPSOIL, silty clay, some organics (roots), moist, friable, dark brown.	OH									
Silty CLAY, traces of fine sand, orangey brown, moist, high plasticity.	CH									
CLAY, some silt, traces of fine sand, moist, high plasticity, fat.	CH		0.5						134	
									53	
	CH		1.0						99	
									50	
CLAY, some silt, traces of very weak gravels, saturated, high plasticity, fat, light orange grey.	CH		1.5						101	
									36	
	CH		2.0	SWL 1.80m					83	
									21	
Silty CLAY, minor sand/extremely weak gravels to 10mm, light grey orange, saturated, high plasticity.	CH		2.5						59	
									24	
End of Borehole - Hole collapsed.			3.0							

Remarks	Water		Investigation Type	
		Standing Water Level	<input checked="" type="checkbox"/>	Hand Auger
		Out flow	<input type="checkbox"/>	Test Pit
		In flow		

Contractor: Geocivil	Rig/Plant Used: Hand Auger	Page No.: 36 of 37	Logged By: S.K	Checked By: 	Hole Depth: 2.80 m
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Produced with Core-GS

Lab Job No: 8288-059
Client: Base Group Consulting Ltd
Project: 332 Komokoriki Hill Road
Location: Warkworth
Report No: 15-1369
REF: 15083
Page: 37 of 37



approximate test locations only

APPENDIX 3: WASTEWATER AND STORMWATER ASSESSMENT

On-site Wastewater Management in accordance with AS/NZS1547:2012 - Individual Lot Assessment

Project Reference	15083	Assessed by	AM
Client	Muriwai Valley Farm	Date Assessed	17/09/2015
Site Location	332 Komokoriki Hill Road		
Site and soil evaluation			
Desktop	Legal description Lot size Soil map	Lots 5-9 96.73ha Warkworth clay and sandy clay loam	Well/moderately well drained No 1600mm
Site investigations	Ground slope Ground shape Ground shape Aspect Exposure Shelterbelts Topo features Wind direction	<5.7 Linear Planar S Exposed No Sloping topography S-E	Indicative permeability Flood Susceptible Annual rainfall Other Land instabilities Boulders/Rock outcrops Vegetation Watercourse Concentrated runoff Soil surface Season Buildings Services
Soil Assessment	Colour Texture Coarse Fragments Structure	Orange brown Light clays None Highly structured	Creep No Pasture Yes None Firm clay, moist Winter Hay shed None
Soil Assessment	Colour Texture Coarse Fragments Structure	Orange brown Light clays None Highly structured	Approximately 1.7m Stiff, moist Pasture
Land Application systems			
Design parameters	Water source Daily use / person Soil category	Roof runoff 180 litres / person / day 5	No. of bedrooms Design occupancy Design daily flow 4 6 1.08 m³ <3m³ OK
Design system	Level of treatment DLR/DIR System type Design LTAR	Secondary 3.0 mm/day Irrigation 3.0 mm/day	Area required Width Length No. required 360 m² 18 20 1.0
Clearance	Boundaries Groundwater Buildings Reserve area	>3m >0.6m >6m >50% 180 m²	Clearance to surface water Clearance to bores Cut off drains required Surface water interceptor >15m horizontally >20m horizontally Yes Yes

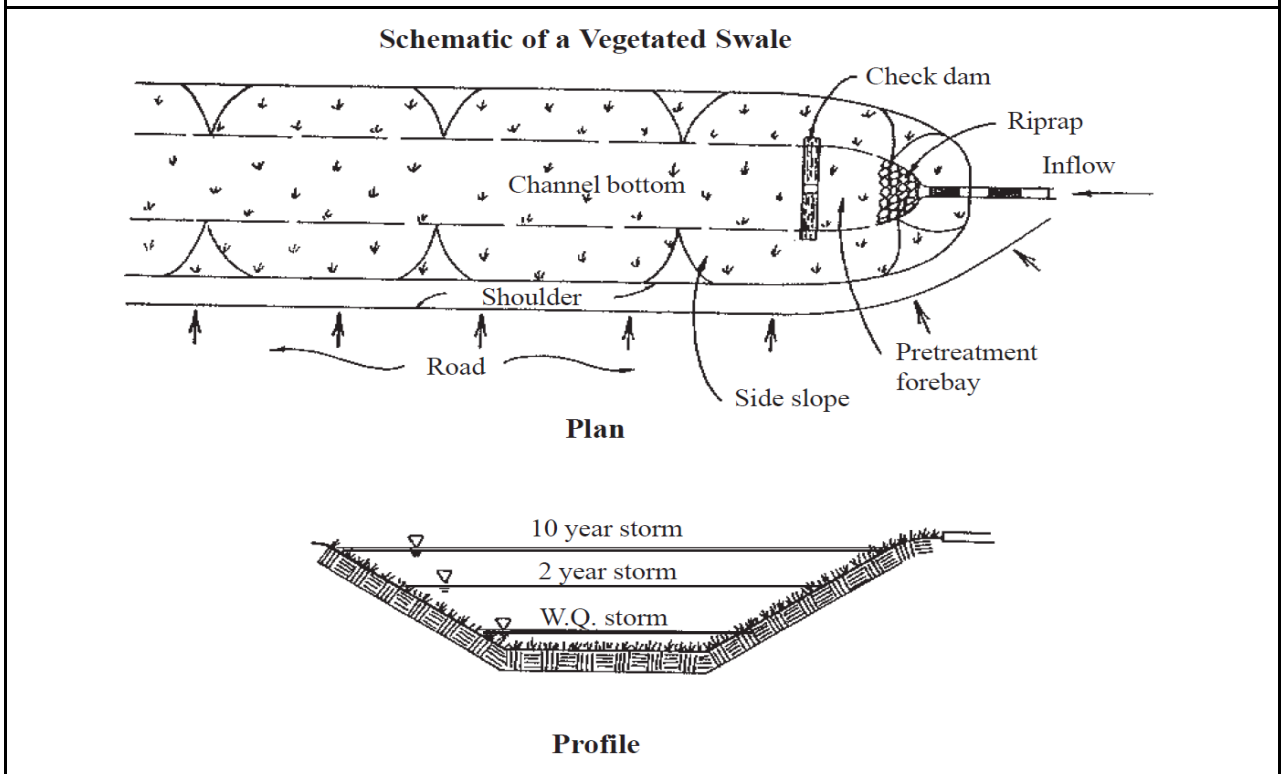
Determination of Soil Category		
Gravels and sands	Very little to no coherence; cannot be moulded; single grains stick to fingers	Rapidly drained
Sandy Loams	Forms a cast but will not roll into a coherent ball; individual sand grains can be seen and felt; gives a ribbon 15-25 mm long	Well drained
Loams	As for sandy loams but cast feels spongy, with no obvious sandiness or silkiness; may feel greasy if much organic matter is present; forms a thick ribbon about 25 mm long	Moderately well drained
Clay Loams	Can be rolled into a ball with a rather spongy feel; slightly plastic; smooth to manipulate; will form a ribbon 40-50 mm long	Imperfectly drained
Light Clays	Smooth plastic ball that can be rolled into a rod; slight resistance to shearing between thumb and forefinger; forms a ribbon 50-75 mm long	Poorly drained
Medium to Heavy Clays	Smooth plastic ball that handles like stiff plasticine; can be moulded into rods without fracture; firm resistance to ribboning; forms a ribbon 75 mm or more in length	Very poorly drained

Determination of Soil Structure	
Massive	Cohesive, with any partings both vertically and horizontally spaced at greater than 100 mm. Pieces do not break along planes of weakness but break according to stress loads
Weak	Peds indistinct and barely observable on pit face. When disturbed approx. 30 % consist of peds smaller than 100 mm
Moderate	Peds well formed and evident when disturbed but not distinct in undisturbed soil. When disturbed 30% - 60 % consists of peds smaller than 100 mm
Strong	Peds quite distinct in undisturbed soil. When disturbed > 60% consists of peds smaller than 100 mm

Trapesoidal swale design to ARC TP10 Chapter 9: Swale and filter strip design

Geometry				Properties			
Base width	b	1.000	m	Height of swale plants	Planting	50	mm
Water quality flow depth	d	0.043	m	Mannings number	n	0.164	
Swale side slope H:1V	Z	5		Longitudinal slope	s	0.08	%
Top width	T	1.432	m	WQ flow depth over grass	depth	OK	
WQ Event				Length			
WQ flow rate	$Q_{(WQ)}$	0.011	m ³ /s	Average flow velocity	V	0.213	m/s
Swale hydraulic radius	R	0.043	m	Min. hydraulic retention time	HRT	9	min
Flow velocity	$V_{(WQ)}$	0.213	m/s	Required swale length	Length	115.1	m
Sectional area required	$A_{(WQ)}$	0.053	m ²				
Sectional area provided	A	0.053	m ²				
10yr ARI Event				100yr ARI Event			
10 yr ARI flow rate	$Q_{(10)}$	0.051	m ³ /s	100 yr ARI flow rate	$Q_{(100)}$	0.085	m ³ /s
10yr ARI flow depth	$d_{(10)}$	0.096	m	100 yr ARI flow depth	$d_{(100)}$	0.123	m
Swale hydraulic radius	R	0.096	m	Swale hydraulic radius	R	0.124	m
Flow velocity	$V_{(10)}$	0.362	m/s	Flow velocity	$V_{(100)}$	0.428	m/s
Sectional area required	$A_{(10)}$	0.141	m ²	Sectional area required	$A_{(100)}$	0.198	m ²
Sectional area provided	A	0.141	m ²	Sectional area provided	A	0.198	m ²
Top width	T	1.955	m	Top width	T	2.227	m

ROW Access Swale (from ARC Low Impact Design Manual)



APPENDIX 4: RICHARDSON STEVENS SUITABILITY REPORT

SUITABILITY REPORT

332 Komokoriki Hill Road, Makarau

Report prepared for: Homeworld / Muriwai Valley Farm

Report prepared by: Iain Mackay

Report reviewed by: Steve Turner

Report reference: 12622

Date: 22 July 2014

Issue	Details	Date
1	For building consent	22/7/2014

Contents

1.0	Introduction	1
2.0	Site Description / Proposed Development	1
3.0	Site Investigations	1
4.0	Geology	2
5.0	Suitability Assessment	3
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5.2	Foundations	4
5.3	Expansive Soils	6
5.4	Earthworks	6
6.0	Stormwater Management	7
7.0	Conclusions	7
8.0	Limitations	8

Appendices

A	Auckland GIS Maps
B	Site Testing

SUITABILITY REPORT

332 Komokoriki Hill Road, Makarau

1.0 Introduction

Our client Homeworld has commissioned Richardson Stevens Consultants (1996) Ltd to make an assessment of the property (Pt Allotment 90 PSH of Komokoriki and Pt Allotment NE95 PSH of Komokoriki) for three new dwellings for Muriwai Valley Farms.

2.0 Site Description / Proposed Development

Muriwai Valley Farms propose to construct three new dwellings at 332 Komokoriki Hill Road, Makarau. The new dwellings construction will consist of lightweight timber frame construction on concrete foundations. Two of the proposed dwelling sites are on top of an east facing ridgeline with steep slopes to the north down to a wetland area. The third site is in a lower lying area adjacent to the wetland to the west of the other two sites. Ground cover of the sites is pasture. For clarity the building sites have been numbered 1, 2 and 3 in this report from east to west (refer attached plan). An existing dwelling and sheds are located to the east of the proposed sites. The platforms and an existing access drive have been created for sites 1 and 2 with site 3 untouched.

3.0 Site Investigations

A site visit including a walkover inspection of the building areas and subsoil testing was conducted on 3 July 2014. Hand augered boreholes were excavated over the three building sites with in-situ undrained shear strengths taken at regular intervals within the boreholes using a pilcon shear vane. Scala Penetrometer testing was completed over sites 1 and 2.

The walkover inspection encountered no signs of instability or creep at the building sites, however active shallow creep was observed just south of the building sites 2 and 3.

Building site 1 is located over a moderately sloping northeast slope. A cut of approximately 1m and fill of 0.5m has been constructed to create a flat building platform. Subsoil testing close to the cut encountered stiff silt underlain with very stiff silt (siltstone) to 1.2m. At the front of the platform subsoil testing found approximately 0.6m of clay/silt fill followed by firm clayey silt and very stiff silt (siltstone) to 2.2m. An additional borehole was excavated between building sites 1 and 2 for the proposed wastewater disposal areas. Shear strengths ranged from 65kPa to greater than 223kPa. Scala Penetrometer testing over the platform encountered soft bearing capacities under 300kPa to 1.6m at the front and rear of the platform.

Building site 2 is located at the top of an east facing ridgeline. The slope to the north of the platform is steep down to a wetland area and the slope to the south is moderate. A cut of approximately 1m and small amount of fill has been constructed to create a flat building platform. Subsoil testing close to the cut encountered firm silt underlain with hard silt (siltstone) to 1.0m. At the front of the platform subsoil testing found 1.2m of clayey silt followed by very stiff/hard silt (siltstone) to 2.0m. Shear strengths ranged from 120kPa to greater than 223kPa. Scala Penetrometer testing over the platform encountered soft bearing capacities under 300kPa to 1.2m at the front and rear of the platform.

Building site 3 is located at the top of an southeast facing ridgeline. The slope to the northeast of the platform is steep down to a wetland area and the slope to the southwest is moderate. The ground at the proposed building location is virgin and appears to have not been modified. Subsoil testing was completed at the northwest and southeast area of the proposed dwelling location. In both locations testing encountered firm clayey silt followed by very stiff silt with black seams to a maximum tested depth of 2.5m. Shear strengths ranged from 70kPa to greater than 223kPa.

4.0 Geology

The Institute of Geological & Nuclear Sciences 1:2500000 Geological Map 3 of the Auckland area outlines the Geology in the area of the property as Pakiki Formation of the Warkworth Subgroup. The East Coast Bays Formation is described as *"Pakiki Formation outcrops north of Hatfields Beach in the east and almost across to the Kaipara Harbour in the west. In the east it conformably overlies basal shallow marine sediments of the Kawau Subgroup, with the transition to bathyal turbidites marked by up to 10m of massive to laminated mudstone. Pakiki*

Formation is dominated by 10-30m thick pockets of graded, medium to coarse grained sandstones (beds typically 1-4m thick), alternating with thinner intervals of laminated siltstone and fine-grained sandstone (beds typically 0.05-0.2m thick). The lithic sandstones are co-dominated by volcanic and argillaceous rock fragments, with minor quartz and plagioclase. Intercalated volcanoclastic submarine mass flow deposits, probably derived from the Kaipara Volcano to the west, are common in the west but are relatively rare in the east. Pakiri Formation in the west also contains many lenses or disrupted thrust wedges of Northland Allochthon lithologies, often with northwest over southeast thrust relationships”

From our subsoil investigations, it is concluded that the building site is located within the Pakiri Formation of the Warkworth Subgroup.

5.0 Suitability Assessment

The walkover inspection of the property revealed no signs of deep seated ground movement within the proposed development areas. From observation of the property and aerial photos of the property, slopes on convergent areas around the development area have signs of shallow seated ground movement by the presence of hummocky ground. The Geological Map 3 of the Auckland area indicates a 30° southwest dipping direction for the siltstone, however the shallow seated ground movement does not appear to be consistent with this dipping. Aerial photos of the area show no previous signs of ground movement in the development areas.

From observation in the area and previous testing in this type of geology the likely failure mechanism is rotational failure of the completely weathered clayey soils overlying the less weathered siltstone. **The risk of instability is relatively low for the building platforms** with the limited earthworks and the lightweight nature of the proposed dwellings. For the three building sites a specific stability assessment has been undertaken for each building site.

5.1 Slope Stability

Building Site 1

The building platform has been constructed and has had little effect on the overall gradient of the northeast slope. As the foundations for the dwelling are proposed to extend into the underlying siltstone (refer Section 5.2), the likely failure mechanism of rotational movement of weathered clayey soil over the less weathered siltstone is low. In addition to the foundations, the gradient of the slope flattens out to the wetlands below the platform and is essentially buttressed by this area reducing the risk of any rotational movement. Accordingly, provided no further major earthworks are undertaken and foundation

recommendations are followed (Section 5.2), the risk of instability for the building site is low.

Building Site 2

The areas of the building platform that are potentially subject to the failure mechanism of rotational movement of weathered clayey soil over the less weathered siltstone are the northern and southern slopes. The northern slope is steep, however no signs of rotational movement is present along this steep bank adjacent to the wetlands. The southern slope also has signs of creep. Tiers in the slope indicate shallow surface creep is present in these areas and foundations designed to account for this creep (refer Section 5.2) are proposed. The foundation retaining will also eliminate any risk of rotational movement to the building platform. Accordingly, provided no further major earthworks are undertaken and foundation recommendations are followed (Section 5.2), the risk of instability for the building site is low.

Building Site 3

To create a flat building platform a cut depth of approximately 3m will be required. Provided the fill is removed from the platform, this is expected to have an overall net stabilizing effect on the platform. As with building site 2, the northeast slope is steep. However no signs of rotational movement is present along this steep bank adjacent to the wetlands. The southwest slope also has signs of creep. Tiers in the slope indicate shallow surface creep is present in these areas and foundations designed to accommodate this creep (refer Section 5.2) are proposed. The foundation retaining will also eliminate any risk of rotational movement to building platform. The transition between the volcanic material and the siltstone is unknown, however with the removal of the soil and the lightweight nature of the proposed dwelling the risk of instability is low for the building platform. Accordingly, provided the cut material is removed from the site and foundation recommendations are followed (Section 5.2), the risk of instability for the building site is low.

5.2 Foundations

Building Site 1

Due to the lower shear strengths and fill at the front of the platform, we recommend that foundations extend into the underlying hard siltstone to bridge the soft saturated layers. Any fill/topsoil located within the building envelope should be replaced with compacted hardfill. The foundation design will need to be completed by a Chartered Professional Engineer due to the expansive soils and soft underlying soils.

The following soil parameters (above the siltstone) derived from subsoil testing should be used for the foundation design:

Pressure Coefficient	Ko
Soil Density (γ)	18KN/m ³
Effective Stress Angle (ϕ)	25°
Undrained Soil Strength (Su)	50kPa

Building Site 2

The slope to the north of the platform is steep (25°) and has signs of shallow surface creep (tiers over the slope). The slope to the south of the platform has similar indications. Soil creep is caused by the seasonal shrink/swell characteristics of clayey soil, normally on slopes greater than 14°. To protect the building platform from the possible creep regression foundations adjacent to the northern slope and southern slope will need to be specifically designed to retain the top 1.5m (below original ground level) of soil subject to creep. The foundation design for the dwelling will need to be completed by a Chartered Professional Engineer due to the expansive soils and creep present.

The following soil parameters (above the siltstone) derived from subsoil testing should be used for the foundation design:

Pressure Coefficient	Ko
Soil Density (γ)	18KN/m ³
Effective Stress Angle (ϕ)	25°
Undrained Soil Strength (Su)	80kPa

Building Site 3

As with building site 2 the slope to the northeast of the platform is steep (25°) and has signs of shallow surface creep (tiers over the slope). The slope to the southwest of the platform has similar indications. Soil creep is caused by the seasonal shrink/swell characteristics of clayey soil, normally on slopes greater than 14°. To protect the building platform from the possible creep regression foundations adjacent to the northern slope and southern slope will need to be specifically designed to retain the top 1.0m (below original ground level) of soil subject to creep. Alternatively if the dwelling has a 4m setback from the top of the northeast slope and a 8m setback from the top of the southwest slope this is considered a sufficient separation from soil subject to creep. The foundation design for the dwelling will need to be completed by a Chartered Professional Engineer due to the expansive soils and creep present.

The following soil parameters (above the siltstone) derived from subsoil testing should be used for the foundation design:

Pressure Coefficient	Ko
Soil Density (γ)	18KN/m ³
Effective Stress Angle (ϕ)	25°
Undrained Soil Strength (Su)	50kPa

5.3 Expansive Soils

Based on our inspection of the soils present on site, we recommend remaining foundations (not subject to creep) for all building sites should be designed for Site Class (M) – Moderately Reactive soils in accordance with the classifications contained in AS2870:2011. For the proposed buildings we recommend that remaining foundations should embed a minimum depth of 500mm below cleared ground level to minimize the effects of any seasonal shrinking/swelling of the soils. The foundation design for the dwelling will need to be completed by Chartered Professional Engineer.

5.4 Earthworks

Building Site 1

At the time of inspection it was noted that some water was pooling on the building platform. The platform should be graded with a minimum slope of 2° towards the north to aid runoff and avoid pooling. A swale drain should be provided to collect the runoff from the platform. No further earthworks should be undertaken as this could increase the risk of instability. Fill removed from within the building envelope should be removed from the building platform.

Building Site 2

As with site 1 the platform should be graded with a minimum slope of 2° towards the stable driveway swale south to aid runoff and avoid pooling. No further earthworks should be undertaken as this could increase the risk of instability. Fill removed from within the building envelope should be removed from the building platform.

Building Site 3

To create a flat building platform a cut depth of approximately 3m will be required. The fill from the cut operation will need to be removed from the platform to avoid surcharging the slope surrounding the platform. Exposed cuts will need to have a maximum slope of 2H:1V and a minimum separation of 3m from the building. As with sites 1 and 2 the proposed

platform should be graded with a minimum slope of 2° towards a stable driveway swale south to aid runoff and avoid pooling.

The potential for seasonal shrinkage and swelling within the subsoils is important with respect to floor slabs especially with regard to potential slab cracking. We recommend particular care should be taken following removal of the drier surface soils to protect the exposed moist soils forming the slab subgrade from drying out. Should these soils regain moisture following construction they may swell. Maintaining the natural moisture content of the subgrade soils may be achieved by fine spraying with a hose. If this is not practical then similar heavy spraying of the compacted slab base course, before laying the impermeable membrane, a day or two before pouring the slab will allow some of the recovery swelling.

Provided the above recommendations are followed Richardson Stevens Consultants (1996) Ltd considers the risk of instability to the proposed building sites will be low.

6.0 Stormwater Management

Rainwater from the proposed dwellings will be stored in rainwater storage tanks. From Table C12 of THE COUNTRYSIDE LIVING TOOLBOX: A GUIDE FOR THE MANAGEMENT OF STORMWATER DISCHARGES IN COUNTRYSIDE LIVING AREAS IN THE AUCKLAND REGION, a minimum tank volume of 35m³ is required for three bedroom dwellings with roof areas over 200m². Therefore two 25m³ tanks will be required for each dwelling. The overflow from the tanks can be piped to the wetland area in front of the building sites. Draining to the wetland to the north of the building platforms will provide some treatment and storage. Under no circumstances should concentrated flows from any source discharge into or onto the ground in an uncontrolled fashion.

7.0 Conclusions

It is the conclusion of Richardson Stevens Consultants (1996) Ltd that subject to the recommendations of this report the building sites are suitable for the proposed dwellings. We also conclude that in terms of Section 72 of the Building Act 2004 that:

- (a) The building work to which an application for a building consent relates will not accelerate, worsen, or result in subsidence or slippage on the land on which the building work is to be carried out or any other property; and

- (b) The land on which the building work is to be carried out is not subject to or is not likely to be subject to subsidence or slippage.

8.0 Limitations

This report has been prepared solely for the benefit of our client and the Auckland Council. The purpose is to determine the engineering suitability of the proposed residential building, in relation to the material covered by the report. The reliance by other parties on the information or opinions contained therein shall, without our prior review and agreement in writing, do so at their own risk.

This report does not address matters relating to the National Environmental Standard for Contaminated Sites, and if applicable separate advice should be sought on this matter from a suitably qualified person.

Recommendations and opinions in this report are based on data obtained as previously detailed. The nature and continuity of subsoil conditions away from the test locations are inferred and it should be appreciated that actual conditions could vary from those assumed.

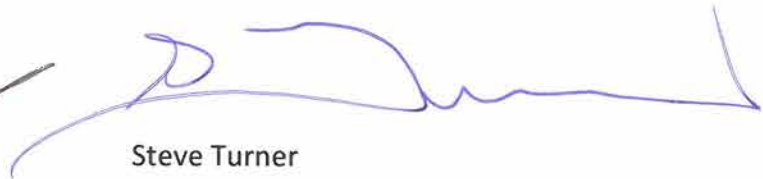
If during the construction process, conditions are encountered that differ from the inferred conditions on which the report has been based, the site should be examined by a suitably qualified engineer to determine if any modification of the design based upon this report is required.

Prepared by:



Iain Mackay
Engineering Technician

Approved by:

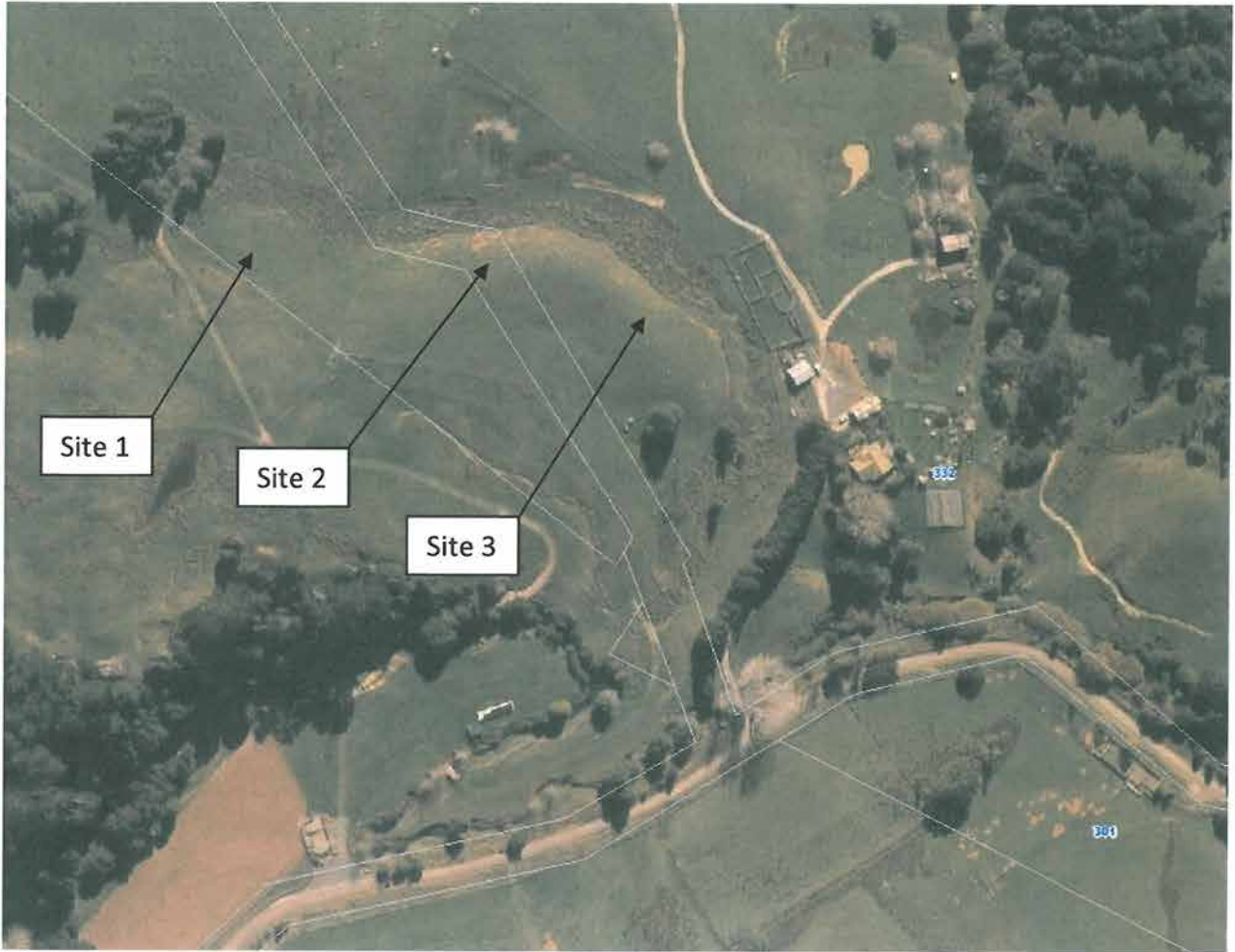


Steve Turner
Chartered Professional Engineer

Richardson Stevens Consultants (1996) Ltd

Appendix A

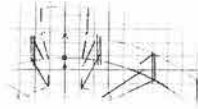
Auckland GIS Maps



Auckland GIS Site Map

Appendix B

Site Testing



Project New Development
Client Muriwai Valley Farms

Strengths Shown are Ultimate Bearing

Test 1, west corner of building site 1

height	# of blows	max. depth	depth/ blow	KPa	CBR
3005					
2315	10	690	69	154	2
1890	10	1115	43	230	4
1690	5	1315	40	242	4
1350	10	1655	34	277	5
1220	10	1785	13	>300	16
1125	10	1880	10	>300	24

Test 2, north corner of building site 1

height	# of blows	max. depth	depth/ blow	KPa	CBR
3005					
2055	20	950	48	210	4
1750	7	1255	44	225	4
1375	10	1630	38	255	5
1020	15	1985	24	>300	8
770	20	2235	13	>300	17

Test 3, east corner of building site 1

height	# of blows	max. depth	depth/ blow	KPa	CBR
1500					
815	15	685	46	217	4
620	10	880	20	>300	10
320	10	1180	30	>300	6

Test 4, south corner of building site 1

height	# of blows	max. depth	depth/ blow	KPa	CBR
3005					
2030	10	975	98	115	2
1780	7	1225	36	266	5
1410	15	1595	25	>300	8
1315	10	1690	10	>300	24
1210	10	1795	11	>300	21

Test 5, east corner of building site 2

height	# of blows	max. depth	depth/ blow	KPa	CBR
1500					
895	20	605	30	>300	6
275	15	1225	41	236	4
105	10	1395	17	>300	12

Test 6, centre of building site 2

height	# of blows	max. depth	depth/ blow	KPa	CBR
1500					
1055	10	445	45	222	4
685	10	815	37	258	5
530	10	970	16	>300	13

Test 7, west corner of building site 2

height	# of blows	max. depth	depth/ blow	KPa	CBR
3005					
2490	10	515	52	196	3
1680	18	1325	45	220	4
1235	20	1770	22	>300	9
1150	10	1855	9	>300	27

Appendix C

Site Plan



- NOTES:**
- All services should be located on-site prior to commencement of works.
 - All works to be constructed to WDC Environmental Engineering Standards.
 - Locations of feature shown approximate only.
 - All dimensions should be confirmed on-site.
- This plan is copyright to Richardson Stevens Consultants (1996) Ltd and should not be reproduced without prior permission.

- Key:**
- Borehole
 - Scala Penetrometer



Richardson Stevens
CONSULTING ENGINEERS

2 Seaview Road Whangarei 0110
T: 09 438 3273 F: 09 438 5734
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Title
SITE PLAN
SUBSOIL TESTING

Client
Homeworld - Muriwai Valley Farms

Location
332 Komakoriki Hill Road, Makarau

Date	22/7/14	A	Report Issue
File	12622	Scale	1:1,000
Drawn by	IM	Original	A4
Rev		Rev	A
		Sheet	1/1

APPENDIX 5: BRIDGE ASSESSMENT



Ashby Consulting Engineering Ltd

Structural, Civil & Geotechnical Engineering

3 Elizabeth Street
PO Box 124 Warkworth 0941
Auckland. N.Z.

Ph 09 425 9422 , Fax 09 425 9431
E-mail: info@ashby.net.nz

Our Reference: 4321
CB
12 March 2015

Mr. David Crabb
332 Komokariki Hill Road
Makarau
Warkworth 0981

Dear David,

RE: Structural Inspection
Precast accessway bridge at 332 Komokariki Hill Road

Per your request I have reviewed the file related to the design and placement of the precast concrete bridge that provides access to your property at 332 Komokariki Hill Road.

Ashby Consulting Engineering undertook a bridge inspection of the previous bridge at this location in December 2003 and noted that the structure (an old railway carriage frame) was in need of replacement. Photographs of the bridge including the original abutments are in the file.

A decision was made to replace the bridge structure and a 3.7m wide ex State Highway 27 detour bridge was obtained along with an engineer's review and PS1 certifying it for use as a farm bridge in its new configuration. The engineer's PS1 and drawing are attached.

It was decided to leave the existing concrete abutments in place and form new abutments immediately behind the existing ones. Ashby's undertook scala penetrometer testing in March 2004 to look at ground conditions for founding the new bridge abutments. The tests indicated moderate soil strengths down to bedrock on both sides of the stream. Ashby's recommended that the new abutments be founded on piles that were spiked and driven to bedrock depth on both sides.

Though we have no record of it, the owner confirmed that the pile foundation and abutments were constructed per the engineers drawing and Ashby's recommendations. He distinctly remembers the piles being spiked and driven to refusal in bedrock.

The bridge was inspected by an engineer from this office on the 9th of March 2015. The bridge deck and integral curbs appeared in good shape with no signs of cracking or deterioration. The timber rails on either side of the deck are in good condition and securely bolted to the sides of the bridge. The galvanized bolts are in good condition with little sign of deterioration. The underside of the bridgedeck is clean and free of any cracks, spalls or rust staining that might indicate deterioration. The

new abutments appeared solid and level with no signs of settlement or rotation nor did they have any signs of cracks, spalls or rust staining. The top of a pile was just visible beneath one end of a new abutment and the pile appeared in as-new condition.

The old abutments in front of the new ones appear in substantially the same shape and position as they were shown in the photographs from 2003 further supporting that those areas of the bank have been free of significant movement or erosion since the new bridge has been installed. Both the old and new abutments are well above the water level of the creek and the riverbank slopes away from the bottom of the old abutments with no signs of settlement or undercutting from high water events.

Based on a review of the design and construction records available as well as a visual site inspection it's my opinion the bridge is in good condition and fit for its intended purpose subject to ongoing inspections and maintenance as required.

Should you have any questions about the records or inspection, don't hesitate to contact me.

Regards,



Frank (Chip) Babbott
MIPENZ, CPEng, BSME

Enc : PS1, bridge drawing

cc : file

PRODUCER STATEMENT – PS1 – DESIGN

ISSUED BY: MJ Bloxam
(Suitably qualified Design Professional)

TO: Mr David Crabb
(Owner)

COPY

TO BE SUPPLIED TO: Rodney District Council
(Territorial Authority)

IN RESPECT OF: Farm access bridge replacement with prestressed concrete kerbed bridge (ex State Highway 27 detour) and timber railing
(Description of Building Work)

AT: 332 Komokoriki Hill Road
(Address)

LOT: Pt. Allot. 90 Parish of Komokoriki DP: SO: 896 and 39221

Bloxam, Burnett & Olliver Limited has been engaged by Quigley's Technical Services Ltd
(Design Firm) (Owner/Developer/Contractor)

to provide structural design of 12.6m pre-stressed concrete bridge, timber rails and piles in respect of the requirements of Clause(s)3 of the Building Regulations 1992 for

All Part only as specified

of the building work. The design has been prepared in accordance with TNZ Bridge Manual (Appendix D) B1/VM/4
(Verification Method(s)/acceptable solution(s))

(respectively) of the approved documents issued by the Building Industry Authority and the work is described on Bloxam, Burnett & Olliver Limited drawings titled Replacement Farm Bridge
(Design Firm)

and numbered 129800-28-01B and 129800-300 and the specification and other documents according to which the building is proposed to be constructed.

As an independent design professional covered by a current policy of Professional Indemnity Insurance to a minimum value of \$200,000, I BELIEVE ON REASONABLE GROUNDS that subject to:

- (i) the site verification of the following design assumptions soil conditions similar to those described in Colin Ashby Consulting Ltd's report of 08/03/04 (Ref. 4301)
- and (ii) all proprietary products meeting the performance specification requirements,

the drawings, specifications and other documents according to which the building is proposed to be constructed comply with the relevant provisions of the Building Code.

M. J. Bloxam
(Signature suitably qualified Design Professional)

Date 4/8/04

BSc (Hons) Civil Eng
(Professional Qualifications)

ERB/AERB Reg No 5267

PO Box 9041, Hamilton
(Address)

Member ACENZ
IPENZ NZIA

This form to accompany Form 3 of the Building Regulations 1992 for the application of a Building Consent

