9885-3G

18 January 2019

GEOTECHNICAL ENGINEERING FEASIBILITY ASSESSMENT
PROPOSED PLAN CHANGE
NORTH WARKWORTH AREA
WARKWORTH

Prepared For:

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KGA GEOTECHNICAL

REPORT ISSUE AUTHORISATION

Geotechnical Engineering Feasibility Assessment
Proposed Plan Change
North Warkworth Area
Warkworth

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Sheet 1	Wider Subject Area Plan
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1. INTRODUCTION

At the instruction of SF Estate Ltd, KGA Geotechnical Group Limited (KGA) has carried out a geotechnical engineering feasibility assessment for a proposed structure plan change and private plan change to achieve urban zoning of the land. The subject area is located within the North Warkworth region. Our scope was to carry out a desk study of available geotechnical information for the subject area, including information from geotechnical investigations carried out by KGA at several locations over the North Warkworth area, and provide an initial geotechnical assessment report commenting on the potential geotechnical constraints in the area with regard to the proposed development types.

This report is in support of an application to Auckland Council for a proposed plan change for the area.

2. SITE DESCRIPTION

The subject area comprises an area of land within the Future Urban Zone North Warkworth, as shown on the Wider Subject Area Plan presented as Sheet 1. The subject area is bounded to the northeast by State Highway 1, to the east by Hudson Road and the existing subdivision off View Road. The Mahurangi River extends along the southern extent of the area, with the Viv Davie-Martin Drive large lot residential subdivision bounding the western extent and the future Puhoi-Wellsford Motorway Corridor located to the northwest. The area includes the following legal properties:

- 91 Falls Road (Lot 2 DP 336399)
- 93 Falls Road (Lot 1 DP 509795)
- 215 Falls Road (Lot 1 DP 209013)
- 220 Falls Road (Lot 4 DP 522636 & Lot 5 DP 522636)
- 223 Falls Road (Lot 2 DP 508375)
- Pt Lot 1 DP 508375 Falls Road
- Lot 2 DP 509795 Falls Road
- Lot 3 DP 209013 Falls Road
- 16 View Road (Pt Lot 1 DP 204539)
- 20 View Road (Pt Lot 1 DP 62696)

- Pt 32 View Road (Lot 2 DP 431845)
- 86 Hudson Road (Lot 1 DP 375015)
- 102 Hudson Road (Lot 1 DP 527699)
- 112 Hudson Road (Lot 2 DP 527699)
- Pt Sec 4 SO 476652 Hudson Road
- 10 Sanderson Road (Lot 2 DP 522636)
- 11 Sanderson Road (Lot 2 DP 375015)
- 12 Sanderson Road (Lot 1 DP 522636)
- Lot 18 DP 9212 Sanderson Road
- 27 State Highway 1 (Lot 1 DP 405448)
- Pt Lot 1 DP 180823 State Highway 1
- Pt Lot 2 DP 180823 State Highway 1
- Sections 15, 17, 24 SO 495251

Most of the land use currently comprises pastoral farmland and rural residential properties, with industrial properties located along Sanderson Road and Hudson Road. Areas of reserve land are also present.

The Auckland Council GeoMaps website indicates that the low lying portions of the area adjacent to watercourses are within designated flood plain areas.

The geomorphology of the subject area is discussed in Section 6.

3. PROPOSED ZONING

The Plan Change area (shown on Sheet 1) is proposed to comprise a mix of Residential Large Lots, Single House Lots, Mixed Housing Urban and Mixed Housing Suburban and a Business Neighbourhood Centre . Business Light Industry Zoning is indicated in the northeast of the area and immediately to the south of Sanderson Road, with the remainder of the area comprising single lot and higher density housing areas, and a localised Business Neighbourhood Centre Zone.

4. BACKGROUND INFORMATION

As part of our desk study we have viewed a second draft report by Tonkin & Taylor (T&T) titled 'Geotechnical Desk Study North and North-West Auckland Rural Urban Boundary Project', ref 29129.001 dated August 2013. The report provides a concept level geotechnical desk study assessment for the Rural Urban Boundary Project in North and Northwest Auckland, including the area of this study. The report comments on the Instability Potential of the area and categorises the land as Low, Medium and High Instability Potential, depending on the slope profile and underlying geology. Higher Instability Potential is associated with steeper slopes and /or weaker / problematic geological units such as the Northland Allochthon.

The T&T report also categorises the areas as Low, Medium or High Development Premium depending on the potential geotechnical hazards within the area. High Development Premium areas are susceptible to one or more geotechnical hazards and / or development constraints. The report categorises the Overall, Predominant Assessed Development Premium of the Warkworth North and East as Low and highlights that geotechnical considerations / issues including slope instability, liquefaction, soil compressibility and problematic building founding soils are present within the area.

KGA have carried out an Initial Geotechnical Assessment report, Geotechnical Engineering Investigation report and Geotechnical Investigation Letter at 223 Falls Road (ref 9585-3, dated 2 September 2016, ref 9585-6A, dated 1 June 2018, and ref K170657-2A dated 1 June 2018 respectively). The work included a subsurface ground investigation comprising twenty-five hand auger boreholes, five rotary machine drilled boreholes and six static cone penetrometer (CPT) probes.

The investigation identified that the subsurface conditions generally comprised residually weathered Waitemata Group deposits overlying Waitemata Group rock at depth. Colluvial materials were identified on the steeply sloping gully sides and alluvial deposits were identified within the gully areas and low lying portions of the site adjacent to the Mahurangi River. Copies of the machine borehole logs from the investigation are presented in Appendix 2, and the approximate locations of the boreholes are shown on Sheet 2.

KGA has also carried out a detailed site investigation for the proposed development at Stubbs Farm Estate ref 170277-6A dated 1 June 2018.

As part of the investigation, subsurface conditions at the site were explored by drilling thirty-four hand auger boreholes, thirteen rotary machined drilled boreholes, thirteen CPT probes and four seismic dilatometer probes. Data from our site investigation at Stubbs Farm Estate has indicated that the site is generally underlain by residual Waitemata Group deposits, colluvium and alluvium, and that groundwater levels are relatively high across the site. Copies of the machine borehole logs from the investigation are presented in Appendix 2, and the approximate locations of the boreholes are shown on Sheet 2.

The following Council property files were viewed as part of our desk study:

- 12 Sanderson Road
- 14 Hudson Road
- 60 Hudson Road
- 93 Falls Road
- 215 Falls Road
- 220 Falls Road
- 27 State Highway 1

Geotechnical reports for new residential dwellings were viewed within the files for 12 Sanderson Road and 220 Falls Road. The geotechnical reports generally included hand auger borehole information. The subsurface materials at both sites were identified as belonging to the Pakiri Formation, part of the Waitemata Group. A hard material was identified at a depth of 4m below ground surface at the proposed platform location for 12 Sanderson Road. The sites were deemed suitable for construction of lightweight residential dwellings.

A geotechnical investigation report by Riley Consultants Ltd (ref 98367-A, dated 3 December 1998) was also viewed. This report contained subsurface information for 215 Falls Road and Lot 2 DP 209013 Falls Road. The report identifies the presence of Pakiri Formation materials at the site and confirms the presence of a safe and stable building platform with access at each site, suitable for construction of residential dwellings provided recommendations in the report were followed.

No other pertinent geotechnical information was viewed within these property files.

KGA carried out a geotechnical investigation at 30 Hudson Road (ref 4898, dated 14 May 2008) for a proposed commercial structure. The investigation identified low strength, firm to stiff alluvial deposits at the site to depths in excess of 7m.

Driven pile foundations were recommended for the development. Relatively high groundwater levels were recorded at the site at the time of the investigation. No information was found regarding actual pile depths.

Reference has been made to the New Zealand Geotechnical Database (NZGD) which contains subsurface information, including cone penetrometer testing (CPT) carried out in August 2017, and a water bore log drilled in 2008, at the property at 24 Hudson Road. The CPT plots identified low strength materials for the upper 7m to 9m, with increasing material strengths below these depths. Refusal of the cones based on the limit of reaction force was met at depths of between 12m and 17.5m below the tested ground surface. The water bore log describes 'yellow grey clay' to a depth of 3m, underlain by 'peat brown clay' to a depth of 7m with 'soft green sandstone' below to a depth of 14m. Beyond 14m depth, the material descriptions alternate between sandstone, siltstone and mudstone layers to a target depth of 160.5m.

The NZGD also contains a record of a machine borehole drilled for a water bore at the northern portion of the property at 11 Hudson Road in 2007. The borehole log records 11.5m of alluvial soils underlain by Waitemata Group (Pakiri Formation) rock to the target depth of 200m below ground surface. Parnell grit is recorded from approximately 57m to 104m depth.

A water bore log within the property at Sec 4 SO 476652 (Area C on Sheet 1) identified approximately 4m depth of 'yellow clays' from the ground surface underlain by 'puggy green mud' to a depth of approximately 5.5m. 'Firm limestone' (which is inferred to be Mahurangi Limestone) is recorded from 5.5m to a depth of approximately 77m. Sandstone material underlies the limestone to a target depth of approximately 102m.

Relevant test records from the NZGD are presented in Appendix 3, with approximate test locations shown on Sheet 2.

5. GEOLOGY

The geology of the subject area is detailed on the Geological Map of New Zealand, Map 3, Auckland (Scale 1:250,000). This shows the subject area to be predominantly underlain by mudstone and graded sandstone of the Pakiri Formation, part of the Waitemata Group. It is described as having alternating thick-bedded mudstone, volcanic-rich, graded sandstone and siltstone. These materials weather to variable strength silts and clays at shallow depths.

The northern portion of the subject area is shown to be underlain by Mahurangi Limestone (Motatau Complex), part of the Northland Allochthon. Motatau Complex rocks are carbonate-rich, blue-grey to light grey or white, muddy limestones, calcareous mudstones and calcareous sandstones. The shattered and sheared limestone and the weak mudstones are typically susceptible to deep weathering.

Motatau Complex rocks, mainly consisting of the Mahurangi Limestone, tend to be closely fractured and intensely crushed, and their strength apparently varies from moderately soft to moderately hard when fresh. When weathered they form soft to very soft yellow-white, low shear strength clay to depths of about 5m. Where the rocks of the Motatau Complex are undifferentiated on the map, they should again be approached as though they are the least stable rocks of the complex.

The portion of the subject area adjacent to the Mahurangi River is shown to be underlain by Holocene river deposits described as sand, silt mud and clay with local gravel and peat beds.

The general geology of the area, as described above, is shown in Figure 1 below.

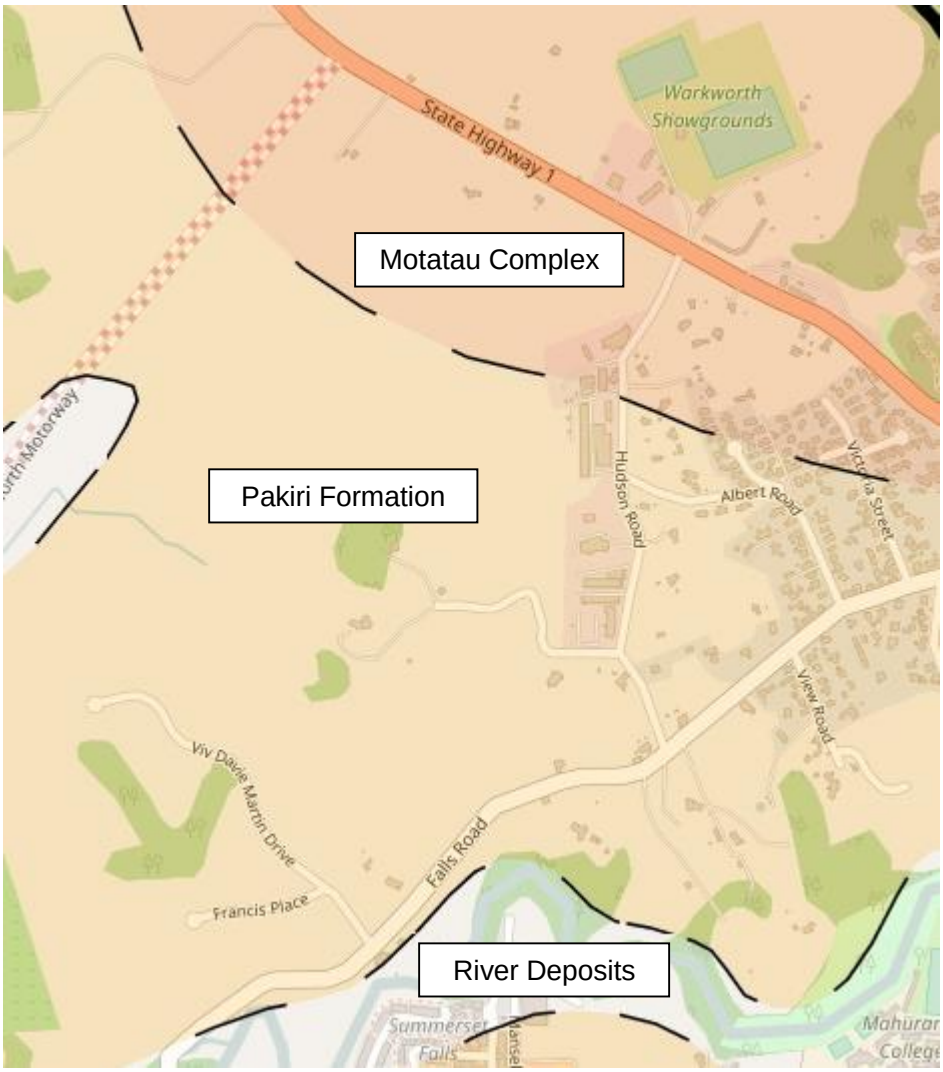


Figure 1. Annotated general geology of subject area, not to scale (GNS Science, 2013).

6. GEOMORPHOLOGY

The geomorphology of the subject area has been compiled using a combination of aerial photograph interpretation, site walkovers at accessible properties and reference to available aerial images on the Auckland Council GeoMaps and Google Earth websites.

An overview geomorphological plan of the subject area is presented as Sheet 2. For reference, the subject area has been split into three areas as shown on Sheet 2.

These areas are based on land parcel boundaries and do not reflect the natural geological boundaries between areas with different geotechnical challenges.

6.1 Area A – South of Falls Road

In general, the ground surface in this area falls to the south and southwest from a knoll and ridgeline present on 20 View Road, down to the Mahurangi River at moderate, to locally, steep grades.

A prominent backscarp feature is noted within the property at 91 Falls Road where a ridgeline is present. The ground falls steeply down from the ridge to the building platform at 93 Falls Road. Several gullies and overland flow paths extend down to the Mahurangi River in south to southwesterly directions. The ground surface downslope of the main backscarp feature to the river appears hummocky and may have formed from slumped zones.

The gullies within Area A are generally steep sided and bush covered, with active soil creep processes noted on the gully side slopes within 223 Falls Road. A river cliff is present along the southern extents of the subject area, with rock outcrops observed in the cliff face at 223 Falls Road. Rock outcrops were also observed within the river at the southwestern portion of 223 Falls Road.

Other scarp features related to previous instability are noted at the heads of gullies within Lot 3 DP 209013 Falls Road, and 223 Falls Road.

Alluvial deposits are inferred to be present within the gullies and adjacent to the Mahurangi River.

6.2 Area B – Stubbs Farm Estate

The geomorphology of the site at Stubbs Farm Estate is dominated by a generally northeast to southwest trending ridgeline with distinct, large scale crescent shaped headscarp features on each flank. A main watercourse is located at the base of the eastern side slope. The eastern headscarp feature also crosses into Area C.

Eastern Slope – East of Ridgeline

An arcuate feature, indicating the backscarp of a large scale slope failure, is present on the northern portion of the eastern side slope. It extends from near the northern end of the main watercourse at the eastern boundary, through the southern portion of the neighbouring property to the north, and back into the subject property, following the ridgeline south.

It continues to the rear of the dwelling at 12 Sanderson Road, from where it returns in an easterly trend back toward the watercourse. The backscarp is characterised by a moderate to steeply sloping ground surface, which becomes gently sloping at the base of the backscarp, with the ground surface then extending out into a colluvium lobe.

A second, large scale arcuate feature is located on the southern portion of the eastern side slope, extending to the western site boundary. The southwestern portion of the site falls at initially steep grades, becoming gentle towards the watercourse. The ground surface is hummocky in appearance, indicating the presence of a colluvium lobe.

Aerial photographs from 2001 show a stepped appearance in an intermediate zone between the two large scale scarps, indicating possible slope movement. We note that the construction of the dwelling (southern dwelling on 12 Sanderson Road) has modified the ground surface masking the features in the intermediate zone.

The large scale slip features have likely resulted from high groundwater levels with possible contribution from toe erosion from the watercourse at the eastern boundary. The landslides have the characteristics of a flow type mechanism with a large bowl shaped source area and hummocky internal profile. A lobate convex frontal part is often associated with this type of landslide but may be missing due to erosion of the toe from the watercourse.

The ground surface within the colluvium lobes on the eastern slope has a hummocky appearance and contains a series of ephemeral and permanent tributary watercourses. Pockets of reed grasses, indicative of high groundwater levels, were noted in the colluvium lobes. In the northern scarp, watercourses were observed to extend around the base of the northern and southern flanks of the backscarp to the main watercourse. Ponding of water was noted at the base of the northern scarp feature in some historical aerial photographs.

The tributary watercourse below the southern scarp have steeply incised side slopes with narrow ridgelines in between. Shallow soil creep was noted on the steeper slopes.

The building platforms for the dwellings at 12 Sanderson Road has been formed part way down the southeast facing slope, with earthworks likely to have involved excavation into the slope and some amount of filling on the downslope edge. The exposed soils noted within the sloping ground below the building platform comprised very stiff pinkish red silts. Stormwater ponds have been formed at the base of the southeast facing slopes of the southern dwelling on 12 Sanderson Road.

Northwestern Gully - West of Ridge Line

An arcuate feature, indicating past slope movement was observed to the west of the ridgeline. The feature is smaller in length than the eastern facing scarp and is confined to the northwestern corner of the site. The ground surface profile is generally moderately sloping from the ridgeline down to a bush area where a number of relatively small watercourses converge. The sloping ground surface is slightly hummocky with sporadic clusters of reed grasses. A pond is present at the base of the slope which has a man-made bund on the downslope side.

Southeastern Slope - East of Main Watercourse

The ground profile in the southeastern portion of the site falls at moderate grades from Falls Road to the north and northwest. Several minor gullies and flow paths pass down through this area. Soil creep was noted on the steeper sloping ground adjacent to Falls Road at the western end of this portion.

A dwelling is present in the southeastern corner of the site and localised filling from the formation of the building platform may be present.

6.3 Area C – Northern Portion

The ground surface in the northern portion falls at generally moderate to locally steep grades from the crest of a knoll feature located adjacent to the central north boundary of the Stubbs Farm Estate. The ground surface falls from the crest of the knoll to the west, north and east. The eastern facing backscarp feature and colluvial lobe described within Area B extends partially into Area C.

The remainder of the geomorphology in Area C is characterised by relatively low lying undulating wetland areas extending to State Highway 1 to the north. The wetland areas have numerous overland flow paths and areas of reed grasses indicating high groundwater levels.

7. GEOTECHNICAL COMMENT

7.1 General Comment

This geotechnical feasibility assessment is based on a desk top study of available relevant geotechnical data, plus a walkover inspection of accessible portions of the site by professional staff from KGA and our investigation data from 223 Falls Road and Stubbs Farm Estate.

The conclusions outlined below are based on this work and will be subject to confirmation and further refinement by detailed investigation and design at subdivision design stage. These conclusions must therefore be regarded as outline and feasibility level only.

Based on the initial findings of this geotechnical assessment, the proposed zoning presented in Section 3 is suitable for the subject area provided detailed geotechnical engineering investigation and design is carried out once development details are known. Geotechnical aspects to be considered for any development within the subject area include but are not limited to an assessment of site stability, the presence of weak / soft / problematic soils and an understanding of the groundwater regime.

We agree with the liquefaction potential of the study area being low risk as defined in the T&T report. Irrespective, localised areas of higher liquefaction potential may be present within any Holocene deposits associated with alluvial deposition in the lower lying areas of the site.

Other constraints on development such as flood levels and reserve land must also be considered. More specific comment on the previously defined areas is presented below.

7.2 Area A – South of Falls Road

A preliminary geological model has been developed for the site at 223 Falls Road based on geomorphological interpretation and subsurface investigation, inferred geological section (Section C-C') has been created through the site and is presented in Appendix 1.

Geotechnical consideration for any development within Area A will include the presence of locally steeply sloping ground associated with gullies, scarp features and the river cliff. Weaker alluvial deposits are also anticipated within and adjacent to the gullies and flow paths, and within the zone of deposition from the Mahurangi River. Evidence of previous instability within the area has been observed and is discussed in Section 6. The area shows evidence of land slide movement, including a large scale feature to the east of 223 Falls Road.

Exposed rock outcrops within the site at 223 Falls Road were examined and these indicated a massive structure with no defined bedding. Within the machine boreholes drilled at 223 Falls Road, the Waitemata Group rock was noted to be intact with sub horizontal bedding. No defects associated with potential slip planes were identified within the rock core or within the rock outcrops observed at the site.

The depth of soil across the site is variable with a relatively sudden transition from soil to rock. This suggests that the underlying rock has not been sheared or deformed as in a deep seated block slide.

The mechanism of the large scale feature to the east of the site is difficult to define. The site walkover and subsurface investigation did not identify any evidence of movement within the rock mass, indicating mass movement of the soil as the more likely mechanism. The watercourse is meandering in a similar pattern both upstream and downstream of the site and observations indicate that natural stream processes of erosion and deposition is occurring. The meandering of the watercourse is likely the result of natural stream processes; however, we cannot exclude the possibility that historical slope movement has not affected the stream alignment in the past.

The soils at 223 Falls Road were generally identified as Waitemata Group soils, rather than colluvium which is indicative of slope movement. It is possible that the large scarp feature identified to the east of the site comprised a block type movement sliding over the rock, which has resulted in the soils retaining its natural structure. Secondary, rotational failures have then occurred within the overlying soil mantle, with high ground water levels a likely contributing factor.

This area (Area A) is classified as having a Medium Slope Instability Potential as per the T&T report.

Based on the identified geotechnical constraints this area can generally be categorised as Medium Development Premium as defined in the T&T report. Notwithstanding the above, localised areas such as steep gully slopes may be subject to higher geotechnical risk.

Any future site formation works must consider the stability of the site. Subject to appropriate earthworks design and layout of access roads and building platforms, and control of groundwater elsewhere over the area, Area A would be suitable for Single House residential development in terms of geotechnical constraints.

7.3 Area B – Stubbs Farm Estate and Hudson Road Industrial Area

A preliminary geological model has been developed for the site Stubbs Farm Estate based on geomorphological interpretation and subsurface investigation, inferred geological sections (Section A-A’ and B-B’) have been created through the site and are presented in Appendix 1.

Evidence of previous instability and potentially high groundwater levels is noted for the Stubbs Farm Estate area as commented on in Section 6. There is also evidence of recent slumping within the surficial soil zone. The overland flow paths and watercourses correspond to these slumped zones, indicating that surface water has possibly been a contributing factor to the movement in these areas. There are also localised steep slopes across the site.

The results of the subsurface investigation within the Stubbs Farm area indicate a deep soil (weathering) profile up to 28.5m deep where tested on the ridgelines above the noted areas of instability, with an average soil mantle thickness of 10m within the assumed slip mass.

The transition from soil to rock occurs relatively rapidly in the slip mass and the bedding within the rock was noted to be sub horizontal. With the exception of the top of the rock (interface), the rock was noted to be generally intact, with any fractures either sub-horizontal or steeply inclined. Evidence of slickensided or shear surfaces was only identified in the core of one of the machine boreholes located within the slip mass close to the rock interface (borehole MH2).

The observed slope movement has likely occurred as a failure of the soil mantle due to high groundwater levels, with a possible contribution from toe erosion from the watercourse at the eastern boundary. The boreholes above the slip scarp indicate a significant depth of soil mantle; however the boreholes within the slip zone show only a thin layer of natural soils below the colluvium, of no more than approximately 2m depth. This indicates that soil has been removed at a rate greater than natural weathering. Furthermore, the top of the rock in several boreholes showed evidence of fracturing which could be indicative of movement above causing ‘ripping’ or ‘fracturing’ of the rockhead.

Weak alluvial and colluvial deposits are present within and adjacent to the watercourses and gullies and downslope of backscarp features, and have been identified over the Stubbs Farm Estate area by subsurface exploration including machine borehole drilling and cone penetrometer testing carried out for the Stubbs Farm geotechnical investigation. Based on preliminary analyses, drainage measures will be required to control the groundwater levels at the site to assist with slope stability. Site formation works for development at Area B are expected to involve some amount of excavation into ridges and filling of gullies and low lying areas. Retention structures will likely be formed as part of any proposed development and may include toe supports within areas of instability. Geotechnical requirements of any earthworks and retaining structures will be outlined in further detailed geotechnical investigation and design.

The existing industrial area adjacent to Hudson Road is likely to be underlain by variable strength alluvial deposits and we understand a number of the structures are supported on driven piles taken through the weaker soils onto denser materials below. It is anticipated that future development in this area will require a similar foundation solution as a minimum; however it is unknown what pile lengths have been used for nearby structures.

This area is classified as having a High Slope Instability Potential as defined in the T&T report. Additional factors including re-profiling of slopes to stable angles, installation of suitable retention structures and control of groundwater levels will need to be considered in development of this area.

Based on the above, the land adjacent to the western side of Hudson Road and the lower lying land on the eastern side of the Stubbs Farm Estate, adjacent to the main watercourse, are suitable for commercial and business zoning provided the likely weak / soft deposits and potential for ground consolidation are considered in the stability and foundation design.

Based on the identified geotechnical constraints, Area B can generally be categorised as High Development Premium as defined in the T&T report.

Subject to management of groundwater and appropriate earthworks design including retention structures, and layout of access roads and building platforms, the remainder of Area B would be suitable for residential development and localised Business - Light Industry in terms of geotechnical constraints.

7.4 Area C – Northern Portion

The same comments regarding the instability and slumping for Area B are applicable to the southern portion of Area C.

The geological map of the region places a portion of the underlying materials in this area to belong to the Motatau Complex rocks (Mahurangi Limestone) of the Northland Allochthon. The weathered soils of this complex are often soft and saturated due to poor drainage properties. Any development within these materials should be carefully controlled as the near surface completely weathered materials form a capping layer which acts as a semi-impermeable layer and confines the potentially sheared materials beneath. When exposed, the sheared transition zone materials degrade rapidly as water enters the material. Capping of the sheared materials with clay is generally required where it is exposed.

Slope stability within areas underlain by allochthonous materials needs to be carefully considered as slopes are subject to instability at relatively gentle gradients. This area is classified as having a High Slope Instability Potential as defined in the T&T report. Additional factors including re-profiling of slopes to stable angles and installation of suitable retention structures can be considered. The northern area within Area C was noted as being generally swampy; hence control of groundwater levels over this area will be important in assisting with general stability.

Foundation design for any structures overlying allochthonous and alluvial materials will need to consider the potential weak / compressible soils. It is anticipated that the zoned Business-General Business area at the northeast of Area C will involve construction of large footprint warehouse type structures with concrete slab floors. Potential compressibility of materials and its impact on foundation design will need to be considered.

Based on the identified geotechnical constraints this area can generally be categorised as Medium to High Development Premium as defined in the T&T report.

Subject to management of groundwater, slope stability and possible foundation settlements, the area is suitable for a mix of residential outcomes with business (Light Industry) in the northeast portion, in terms of geotechnical constraints.

7.5 Stormwater soakage

The underlying allochthonous, alluvial, colluvial and residual soils over the subject area generally comprise silts and clays with a low permeability rate, and groundwater levels have been noted to be relatively high where recorded. Based on this, stormwater retention by ground recharge is not recommended from a geotechnical perspective. Site specific soakage assessments are to be carried out to confirm soakage capabilities of the different materials.

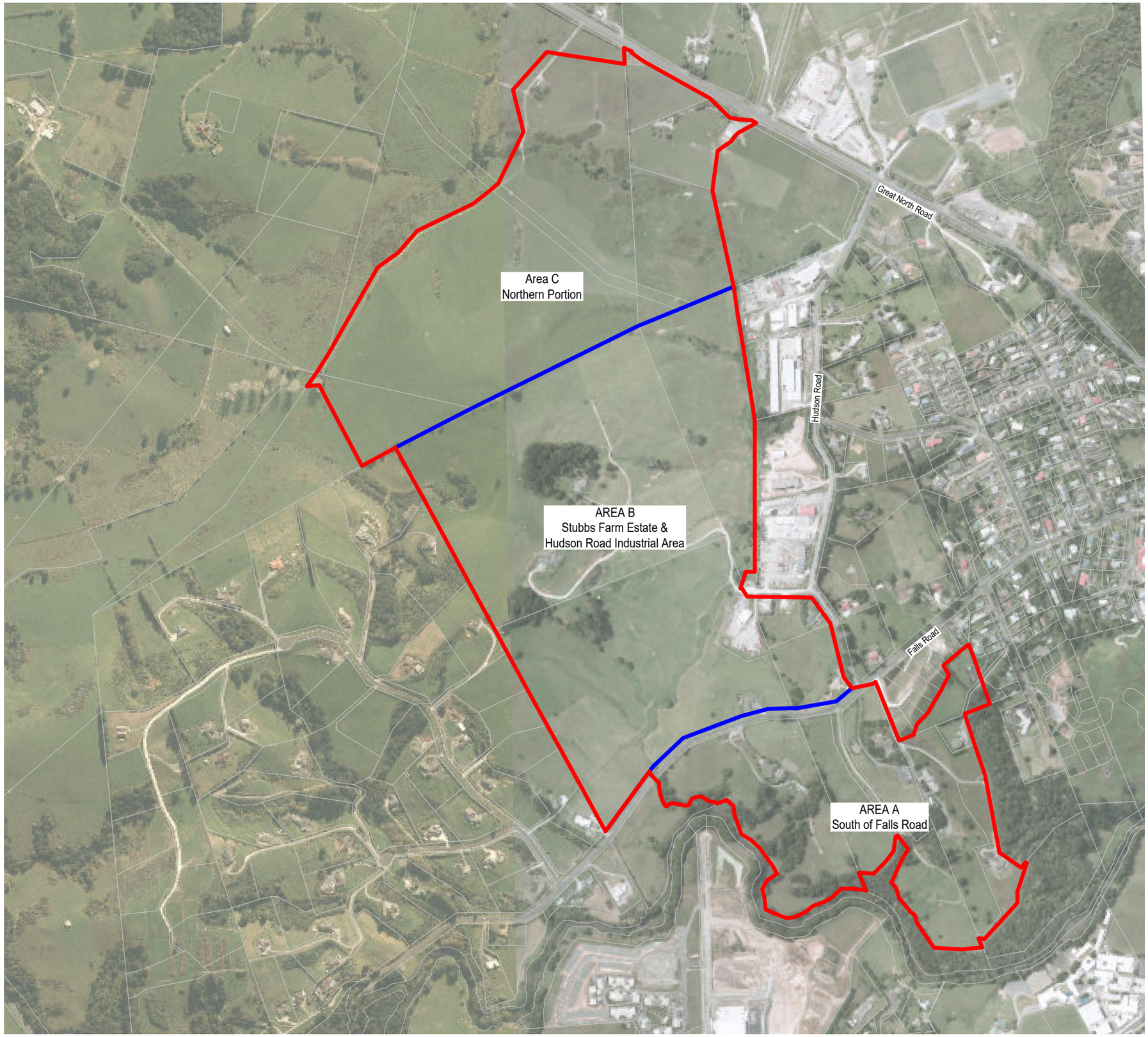
8. LIMITATIONS

This report was prepared in the context defined in Section 1.0 above and must not be relied upon by any other party other than that for whom it was prepared and the relevant Territorial Authority. It has been compiled with respect to the brief given to us, and must not be relied upon in any other context or recreated for any other purpose.

It has been prepared for preliminary planning purposes and the conclusions must be confirmed in due course by detailed ground investigation and design, where these have not already been carried out.

References:

GNS Science. New Zealand Geology Web Map. Retrieved from http://data.gns.cri.nz/geology



SCALE (1:7500)

0 150 300 450 600 750 metres

Key:

Plan Change Boundary

Area Boundaries

N

North (approx)

Notes:

1. Locations of features approximate only.
2. Locations of all buried services to be verified prior to construction.
3. Aerial photograph sourced from Auckland Council GeoMaps website.

DATE	REVISION	DESCRIPTION
18-Jan-2019	D	Revised Report Issue
05-Jul-2018	C	Revised Report Issue
22-Aug-2017	B	Area boundary amendment
24-Mar-2017	A	Report Issue

AMENDMENTS

Check all dimensions and levels on site before construction commences.
Dimensions must not be directly scaled off this drawing.
Only print copies of this drawing in full colour.

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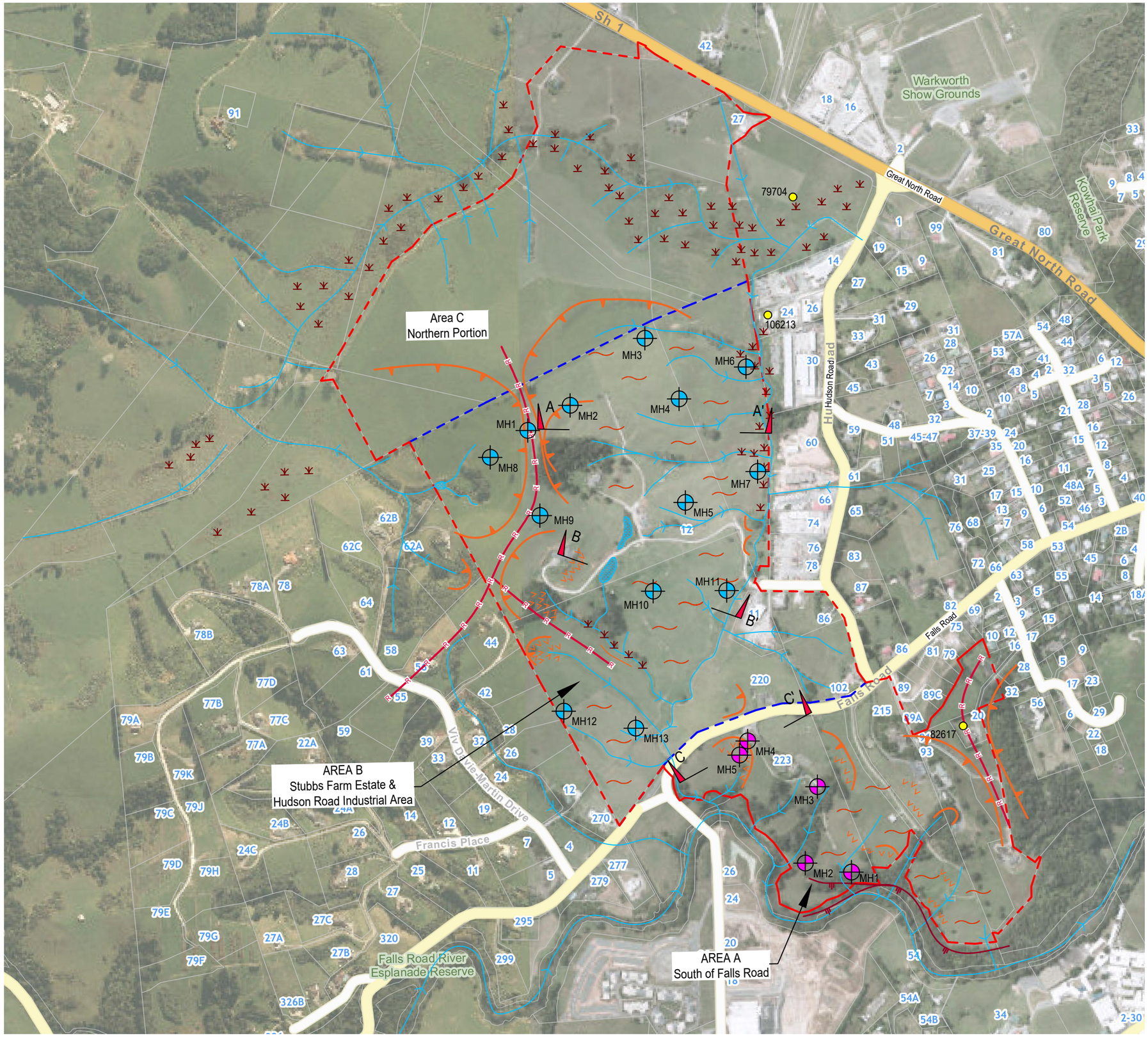
PROJECT
PROPOSED PLAN CHANGE
NORTH WARKWORTH AREA
WARKWORTH

TITLE
WIDER SUBJECT AREA PLAN

SCALE: (A3 ORIGINAL)	DATE:
1:7500	05-Jul-2018
DRAWN BY:	CHECKED BY:
JMM	TP
REVISION NO:	JOB NO:
C	9885
CAD REF:	SHEET NO:
9885_plans.dwg	1



Key:

- Approximate location of ridge lines
- Approximate location of backscarps
- Approximate location of minor scarps
- Approximate location of shallow surface creep
- Approximate location of watercourses and overland flow paths
- Approximate location of wetland areas
- Approximate location of hummocky Ground
- Plan Change Boundary
- Area Boundaries
- MH1 — Approximate location of machine boreholes, Mar-Apr 2017
- MH1 — Approximate location of machine boreholes, Dec 2016
- 106213 — Subsurface information from New Zealand Geotechnical Database
- A A' — Approximate cross section locations

North (approx)

Notes:

1. Locations of features approximate only.
2. Aerial photograph sourced from Auckland Council GeoMaps website.

DATE	REVISION	DESCRIPTION
18-Jan-2019	D	Revised Report Issue
05-Jul-2018	C	Revised Report Issue
01-Jun-2018	B	Revised Report Issue
24-Mar-2017	A	Report Issue

AMENDMENTS

Check all dimensions and levels on site before construction commences.
Dimensions must not be directly scaled off this drawing.
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CLIENT: SF ESTATE LTD

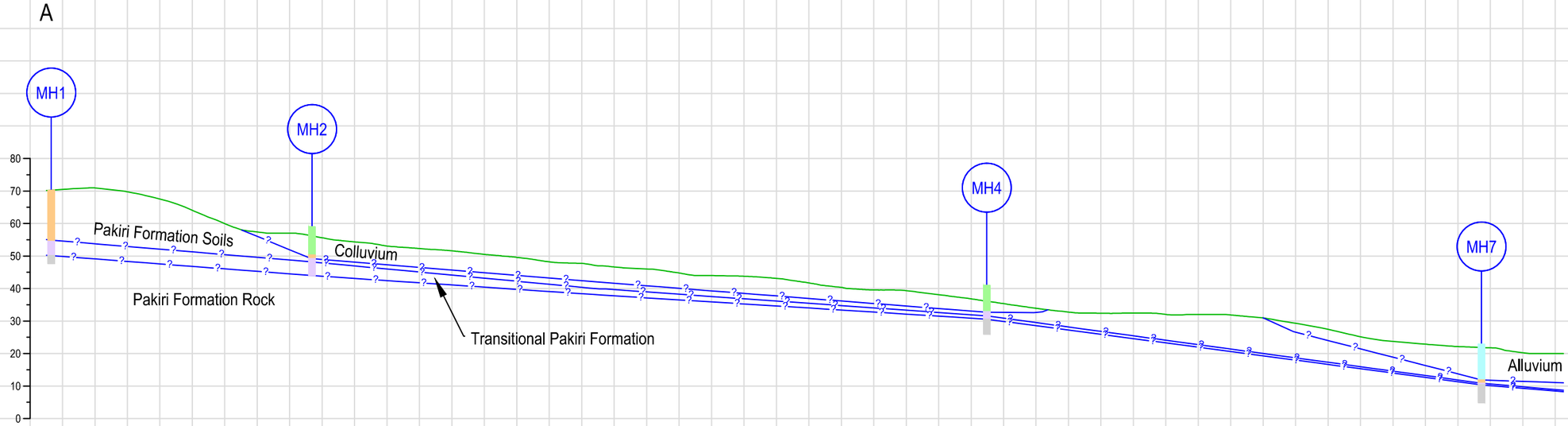
PROJECT: PROPOSED PLAN CHANGE
NORTH WARKWORTH AREA
WARKWORTH

TITLE: GEOMORPHOLOGY PLAN
SHOWING TEST LOCATIONS

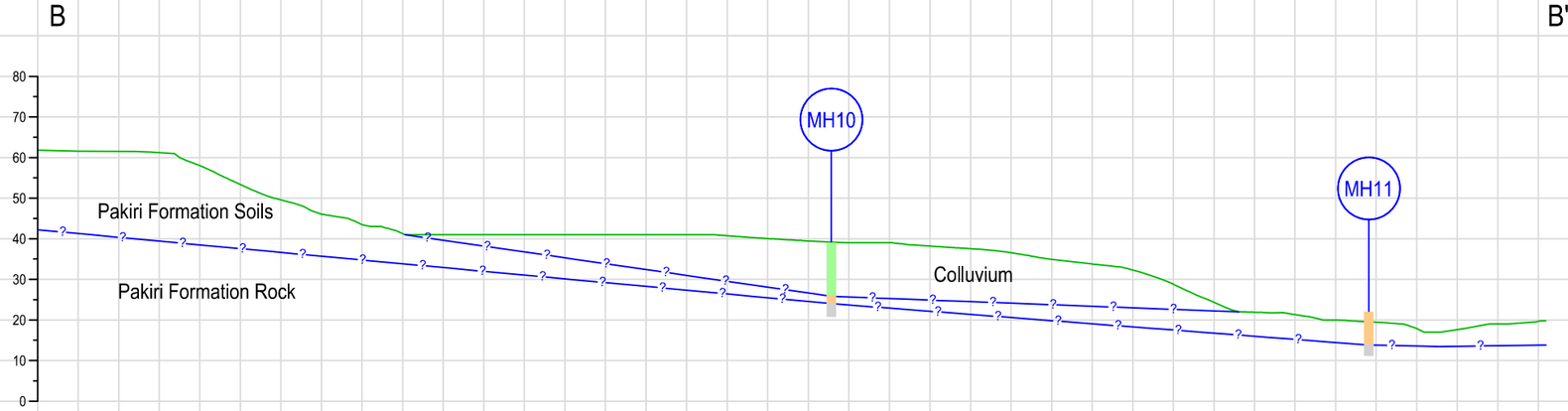
SCALE: (A3 ORIGINAL) 1:7500	DATE: 05-Jul-2018
DRAWN BY: JMM	CHECKED BY: TP
REVISION NO: C	JOB NO: 9885
CAD REF: 9885_plans.dwg	SHEET NO: 2

Appendix 1

Geological Sections



Cross Section A - A'



Cross Section B - B'

Key:

- Alluvium
- Colluvium
- Pakiri Formation Soils
- Transitional Pakiri Formation
- Pakiri Formation Rock

AH1 — Exploratory Borehole and CPT Testing locations Mar to Apr 2017

Proposed finished ground level

Existing ground level

Strata Type A

Strata Type B

Inferred strata contact boundary

End of Scala penetrometer testing

SCALE (1:1500)

0 15 30 45 60 75 metres

Notes:

1. Locations of features approximate only.
2. Ground profile based on topographical Information provided to us by Chester Consultants Ltd.
3. For detailed subsurface conditions and groundwater levels, refer to borehole logs.

Check all dimensions and levels on site before construction commences. Dimensions must not be directly scaled off this drawing. Only print copies of this drawing in full colour.

DATE	REVISION	DESCRIPTION
05-Jul-2018	A	Report Issue

AMENDMENTS

REVISION NO:	A
DATE:	05-Jul-2018
DRAWN BY:	JMM
CHECKED BY:	TP
SCALE (A3 ORIGINAL):	1:1500
CAD REF:	9885_plans.dwg

CLIENT: SF ESTATE LTD

PROJECT: PROPOSED PLAN CHANGE NORTH WARKWORTH AREA WARKWORTH

TITLE: GEOLOGICAL SECTION A - A' & B - B'

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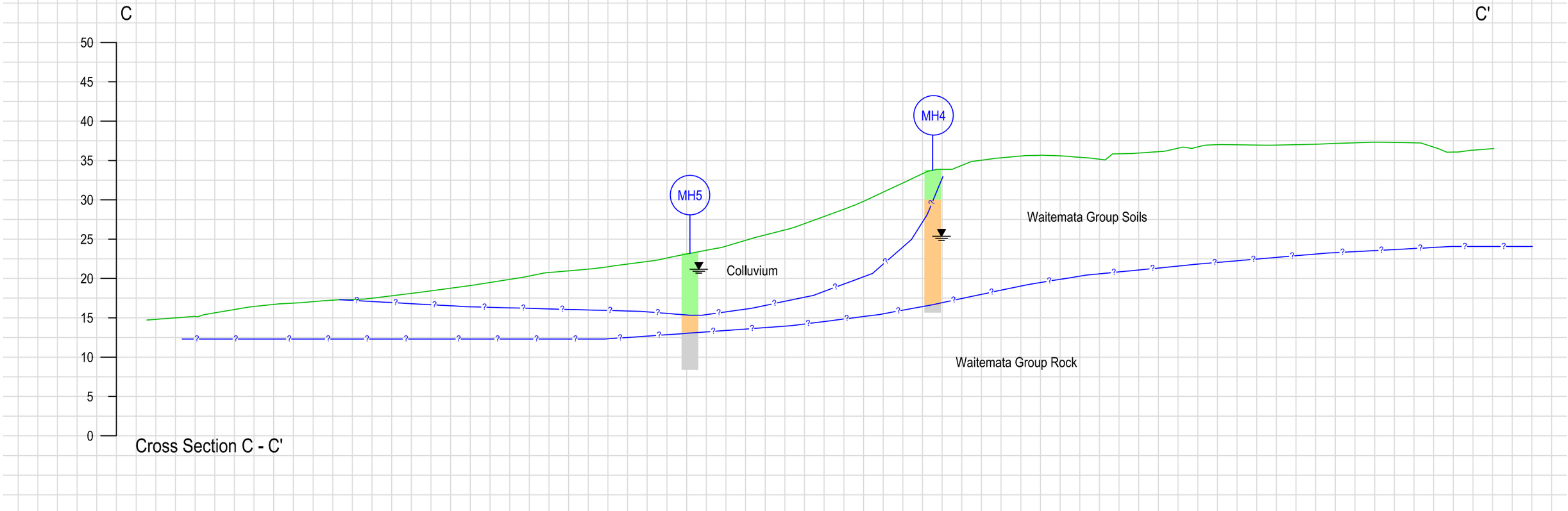
JOB NO: 9885

SHEET NO: 3A

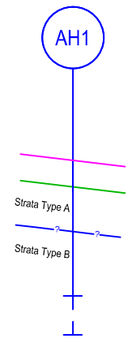


Notes:

1. Locations of features approximate only
2. Cross section profiles provided by Chester Consultants Ltd, titled, 'Earthwork Section Views', Ref 11504, dated 15-Sept-2016.
3. For full details on ground conditions, refer to individual borehole logs.

Key:

- Alluvium
- Colluvium
- Pakiri Formation Soils
- Transitional Pakiri Formation
- Pakiri Formation Rock



- Exploratory Borehole and CPT Testing locations Dec 2016
- Proposed finished ground level
- Existing ground level
- Inferred strata contact boundary
- End of Scala penetrometer testing

SCALE (1:500)

0 10 20 30 40 50 metres

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DATE	REVISION	DESCRIPTION
05-Jul-2018	A	Report Issue

AMENDMENTS

REVISION NO:	A
DRAWN BY:	JMM
SCALE (A3 ORIGINAL):	1:500
DATE:	05-Jul-2018
CHECKED BY:	TP
CAD REF:	9885_plans.dwg

CLIENT: SF ESTATE LTD

PROJECT: PROPOSED PLAN CHANGE NORTH WARKWORTH AREA WARKWORTH

TITLE: GEOLOGICAL SECTION C - C'

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JOB NO: 9885

SHEET NO: 3B

Appendix 2

Machine Borehole Logs from Site Investigations

Stubbs Farm Estate and 223 Falls Road

MACHINE BOREHOLE LOG

HOLE NO.: MH1

CLIENT: North Star Estates LTD
PROJECT: Geotechnical Investigation

JOB NO.: 9585

SITE LOCATION: 223 Falls Road, Warkworth
CO-ORDINATES: 0mE, 0mN ()
DATUM: Ground Surface
RIG: Tractor **OPERATOR:** DCN

START DATE: 12/12/2016
END DATE: 12/12/2016

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100				196/43		RO			Topsoil with clayey silt and sand; dark brown. Firm, moist. Plant fibres/rootlets common. (TOPSOIL)		TS	
60									Sandy SILT with clay; brown. Stiff to very stiff, moist, moderate plasticity. Rootlets. (COLLUVIUM)		COL.	
				119/61					Silty CLAY with some sand; light brown. stiff to very stiff, moist, moderately to highly plastic.			
100			N = 3 1, 0 0, 1 1, 1					1.0				
				82/46		ISPT			Sandy SILTS with trace clay; mottled orange/pink/brown/cream. Firm to stiff, moist, no plasticity. Exhibits 'quick' behaviour in parts. Highly weathered transitional Pakiri formation? (WAITEMATA GROUP SOILS)			
100						RO		2.0				
			N = 2 1, 0 0, 1 0, 1	61/7	21/03/2017	ISPT		3.0				
100						RO		4.0				
			N = 2 1, 1 0, 1 0, 1	125/20	14/12/2016 13/12/2016	ISPT						
100						RO		5.0	3.5m - 6.2m: Oxidation/manganese oxide weathering along fractures		WAITEMATA GROUP SOILS	
100						ISPT						
92	92		N = 50 2, 5 50	UTP/-		RO		6.0	Unweathered grey CONGLOMERATE; moderately strong to strong. Matrix supported with rounded to sub-angular clasts of siltstone. (WAITEMATA GROUP - ROCK)		WAITEMATA GROUP - ROCK	
						ISPT		7.0	Unweathered grey SANDSTONE; moderately strong to strong.			
			N = 50 50			RO			7.1m: Sub horizontal (~10 degrees) contact between conglomerate and the underlying sandstone.			
93	67					ISPT		8.0				
			N = 50 50			RO		9.0				
100	96					ISPT						
						RO						

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:1984
Water Level At Time Of Drilling	UTP = Unable To Penetrate
Out Flow / In Flow	+ = Peak Exceeded
	- = No Result

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HOLE DEPTH: 10.65m

Created: 23/03/2017 12:13:41 p.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH1

CLIENT: North Star Estates LTD
PROJECT: Geotechnical Investigation

JOB NO.: 9585

SITE LOCATION: 223 Falls Road, Warkworth
CO-ORDINATES: 0mE, 0mN ()
DATUM: Ground Surface
RIG: Tractor **OPERATOR:** DCN

START DATE: 12/12/2016
END DATE: 12/12/2016

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100	96		N = 50 50			RO			Unweathered grey SANDSTONE; moderately strong to strong.		WAITEMATA GROUP - ROCK	
						ISPT		11.0	EOH: 10.65m			
								12.0				
								13.0				
								14.0				
								15.0				
								16.0				
								17.0				
								18.0				
								19.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:1984
Water Level At Time Of Drilling	UTP = Unable To Penetrate
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	- = No Result

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HOLE DEPTH: 10.65m

Created: 23/03/2017 12:13:41 p.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH2

CLIENT: North Star Estates LTD
PROJECT: Geotechnical Investigation

JOB NO.: 9585

SITE LOCATION: 223 Falls Road, Warkworth
CO-ORDINATES: 0mE, 0mN ()
DATUM: Ground Surface
RIG: Tractor **OPERATOR:** DCN

START DATE: 12/12/2016
END DATE: 13/12/2016

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100				168/15	Groundwater Not Encountered	RC			Topsoil. (TOPSOIL)		TS	
100									Sandy SILT with trace clay; dark brown to brown. Stiff to very stiff, moist, low to no plasticity. (COLLUVIUM)		COLLUVIUM	
100			N = 2 1, 0 1, 0 0, 1	122/15				1.0				
100				92/27		ISPT			Sandy SILT; light brown, cream, orange mottling. Loose to moderately dense, moist, no plasticity. Remnant bedding/banding present. (WAITEMATA GROUP SOILS)		WAITEMATA GROUP SOILS	
100						RC		2.0		C/L		
48			N = 22 2, 5 5, 7 5, 5	UTP/-					Silty SAND; reddy brown and orange and black. Loose becoming more dense, moist, no plasticity. Sub horizontal remnant bedding/banding.			
						ISPT		3.0	3.8m: Becoming to dense to drill open barrel.			
100						RC			SAND with silt; light brown and orange. Loose to dense, moist, no plasticity. Oxidised banding present. Sub-horizontal to sub-vertical bedding. (WAITEMATA GROUP - TRANSITIONAL)		WAITEMATA GROUP - TRANSITIONAL	
100			N = 10 2, 2 2, 3 2, 3					4.0				
						ISPT						
100						RC		5.0	5.1m - 5.3m: Very steeply inclined to sub-vertical laminated bedding 6.0m - 6.1m: Fine to medium grained gravels. 6.1m - 6.2m: sub horizontal laminated bedding			
100			N = 50 4, 9 12, 38					6.0	SAND; orange and light grey. Medium dense to dense, moist, no plasticity.			
						ISPT						
92						RC			Moderately weathered creamy brown SANDSTONE. Weak to moderately strong. Closely to moderately widely spaced fractures; moderate to sub-vertical oxidised fractures. (WAITEMATA GROUP - ROCK)		WAITEMATA GROUP - ROCK	
			N = 50 50					7.0	Unweathered grey to dark grey SANDSTONE. Weak to strong. Gently to moderately inclined fractures. Moderately to widely spaced fractures. Oxidation/weathering has altered adjacent rock mass. 6.4m - 6.9m: Sub vertical and sub horizontal joints. oxidised on fractures. Undulating smooth to undulating rough. 7.1m: Very steeply inclined joint (~60 deg). Oxidised. Undulating rough.			
						ISPT		8.0				
100						RC						
70			N = 50 50					9.0				
						ISPT			EOH: 9.03m			

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:1984
Water Level At Time Of Drilling	UTP = Unable To Penetrate
Out Flow / In Flow	+ = Peak Exceeded - = No Result

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HOLE DEPTH: 9.03m

Created: 8/03/2017 2:40:02 p.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH3

CLIENT: North Star Estates LTD
PROJECT: Geotechnical Investigation

JOB NO.: 9585

SITE LOCATION: 223 Falls Road, Warkworth
CO-ORDINATES: 0mE, 0mN ()
DATUM: Ground Surface
RIG: Tractor **OPERATOR:** DCN

START DATE: 13/12/2016
END DATE: 13/12/2016

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
60				49/15	21/03/2017	RC		0.0	Topsoil with gravel.			
100									Organic clayey SILT; dark brown and dark grey. Soft to firm, moist to wet, low to moderate plasticity. Common brown and black coloured plant fibres. Becoming less organic rich towards base of the unit. (ALLUVIUM)		ALLUVIUM	
100			N = 3	61/6	14/12/2016			1.0				
100			0, 0						SAND with silt; light grey, becoming browny orange. Loose to dense, moist, no plasticity. (WAITEMATA GROUP SOILS)		WAITEMATA GROUP SOILS	
67			1, 0	23/3		ISPT		2.0				
100			1, 1			RC			SAND; dark grey. dense to very dense, moist, no plasticity.			
100			N = 50	UTP/-		RC			Unweathered grey SANDSTONE. Moderately strong to strong. Laminated bedding of dark grey to black mudstone (carbonaceous) material. Fining upwards. Gently to moderately inclined bedding. (WAITEMATA GROUP - ROCK)			
100	97		50			RC		3.0	Unweathered grey SANDSTONE. Moderately strong to very strong.		Mwg-r	
100			N = 50			ISPT		4.0				
			50			RC						
100	90					ISPT		5.0	5.4m: Very steeply inclined joint (~70 deg). Undulating smooth to undulating rough.			
			N = 50			RC			Unweathered grey to dark grey SILTSTONE. Moderately strong to strong. Sub-horizontal bedding.			
			50					6.0	EOH: 6.03m			
						ISPT		7.0				
								8.0				
								9.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:1984
Water Level At Time Of Drilling	UTP = Unable To Penetrate
Out Flow / In Flow	+ = Peak Exceeded
	- = No Result

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HOLE DEPTH: 6.03m

Created: 23/03/2017 12:20:45 p.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH4

CLIENT: North Star Estates LTD
PROJECT: Geotechnical Investigation

JOB NO.: 9585

SITE LOCATION: 223 Falls Road, Warkworth
CO-ORDINATES: 0mE, 0mN ()
DATUM: Ground Surface
RIG: Tractor **OPERATOR:** DCN

START DATE: 13/12/2016
END DATE: 14/12/2016

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100						RC			Gravel. (FILL)		FILL	
100				153/76					CLAY with silt and minor sand; brown to dark orange with creamy and red mottling. Stiff to very stiff, moist, moderate to hhigh plasticity. (WAITEMATA GROUP SOILS)			
100			N = 4 1, 0 1, 1 1, 1	111/60								
100				110/70		ISPT		1.0				
100						RC		2.0	SILT with sand and trace clay; dark red, brown and pink. Soft to stiff, moist to wet, no to minor plasticity. Common remnant sub horizontal bedding.			
71			N = 4 1, 0 1, 1 1, 1	58/27								
100						ISPT		3.0				
100			N = 2 1, 0 0, 1 0, 1	33/12		RC		4.0				
100						ISPT		5.0				
100			N = 4 1, 0 0, 1 1, 2	49/15		RC		6.0				
100						ISPT		7.0				
100			N = 4 1, 0 1, 0 1, 2	61/6		RC		8.0				
100					21/03/2017 16/12/2016						WAITEMATA GROUP SOILS	
100				92/11		DP		9.0				
100			N = 4 1, 0 1, 1 1, 1			ISPT						

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:1984
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	- = No Result

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HOLE DEPTH: 18.04m

Created: 23/03/2017 12:21:13 p.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH4

CLIENT: North Star Estates LTD
PROJECT: Geotechnical Investigation

JOB NO.: 9585

SITE LOCATION: 223 Falls Road, Warkworth
CO-ORDINATES: 0mE, 0mN ()
DATUM: Ground Surface
RIG: Tractor **OPERATOR:** DCN

START DATE: 13/12/2016
END DATE: 14/12/2016

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			N = 4 0, 1 0, 0 2, 2	35/3		RC			SILT with sand and trace clay; dark red, brown and pink. Soft to stiff, moist to wet, no to minor plasticity. Common remnant sub horizontal bedding.			
						ISPT		11.0	SAND with silt; light brown, orange, pick. Loose, moist to wet, no plasticity. Oxidation/manganese staining common along bedding/joint planes.			
100			N = 7 1, 0 0, 2 3, 2	29/3		RC						
						ISPT		12.0				
100			N = 4 1, 0 0, 0 2, 2	119/6		RC		13.0			WAITEMATA GROUP SOILS	
						ISPT						
100			N = 11 2, 2 2, 2 3, 4	UTP/-		RC		14.0	Silty SAND; cream. Very loose to loose, moist to wet.			
						ISPT		15.0	SAND with silt; dark orange and cream. moderate dense to dense, moist to wet, no plasticity, exhibits 'quick' behaviour in parts. Oxidation/manganese staining common along bedding/joint planes.			
100						RC		16.0				
			N = 50 15, 50			ISPT			Highly weathered dark cream to light brown SANDSTONE. Very weak. (WAITEMATA GROUP ROCK)			
100	75					RC		17.0	Unweathered dark grey SANDSTONE. Moderately weak to hard. Moderately widely spaced fractures, gently to steeply inclined, undulating rough aperture. Oxidised on fracture surfaces.		WGR	
			N = 50 50						17.6m: Steeply inclined (~45 deg) joint. Some oxidation on fracture surface. Planar rough to undulating smooth.			
						ISPT		18.0	EOH: 18.04m			
								19.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:1984
Water Level At Time Of Drilling	UTP = Unable To Penetrate
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	- = No Result

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HOLE DEPTH: 18.04m

Created: 23/03/2017 12:21:14 p.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH5

CLIENT: North Star Estates LTD
PROJECT: Geotechnical Investigation

JOB NO.: 9585

SITE LOCATION: 223 Falls Road, Warkworth
CO-ORDINATES: 0mE, 0mN ()
DATUM: Ground Surface
RIG: Tractor **OPERATOR:** DCN

START DATE: 14/12/2016
END DATE: 14/12/2016

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
25 50 75	25 50 75											
40				204/49		RC			Organic silty CLAY; black to dark brown. Stiff to very stiff, moist, plastic. Rootlets (TOPSOIL)		TOPSOIL	
100									Silty CLAY with trace sand; dark orange to brown. Stiff to very stiff, moist, plastic. (COLLUVIUM)		COLLUVIUM	
100			N = 5 1, 0 1, 1 2, 1	85/46								
100				76/31		ISPT		1.0	SILT with trace sand and clay; reddish brown. firm to stiff, moist to wet, low to no plasticity. (WAITEMATA GROUP SOILS/COLLUVIUM?)		WAITEMATA GROUP SOILS/COLLUVIUM?	
100					21/03/2017 16/12/2016	RC		2.0	SILT with clay and sand; cream, orange, pink and brown. Firm to stiff; moist to wet, low plasticity.			
100			N = 5 1, 0 1, 1 2, 1	52/12								
100				61/18		DP		3.0				
100						ISPT		4.0	Sandy SILT with trace clay; cream to light grey. Firm to stiff, moist, no plasticity.			
100				95/12		RC						
100			N = 7 1, 0 1, 2 2, 2			DP		5.0				
100						ISPT			SAND with silt; dark cream, orange and brown. Loose becoming medium dense, moist, no plasticity. Oxidised along bedding and joint surfaces common.			
100			N = 7 1, 1 1, 1 2, 3	137/24		RC		6.0				
100						ISPT						
100						RC		7.0				
100			N = 10 1, 2 2, 2 2, 4	200/27		ISPT						
100						RC		8.0	SAND with silt; cream to light grey. Medium dense, moist, no plasticity. Oxidised along fractured. Moderately to widely spaced joints.		WAITEMATA GROUP SOILS	
100			N = 25 2, 4 4, 5 7, 7	UTP/-		ISPT						
100						RC		9.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:1984
Water Level At Time Of Drilling	UTP = Unable To Penetrate
Out Flow / In Flow	+ = Peak Exceeded
	- = No Result

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HOLE DEPTH: 14.73m

Created: 23/03/2017 12:21:51 p.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH5

CLIENT: North Star Estates LTD
PROJECT: Geotechnical Investigation

JOB NO.: 9585

SITE LOCATION: 223 Falls Road, Warkworth
CO-ORDINATES: 0mE, 0mN ()
DATUM: Ground Surface
RIG: Tractor **OPERATOR:** DCN

START DATE: 14/12/2016
END DATE: 14/12/2016

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			N = 19 6, 4 5, 4 4, 6	UTP/-		RC ISPT		11.0	SAND with silt; cream to light grey. Medium dense, moist, no plasticity. Oxidised along fractured. Moderately to widely spaced joints. Highly to moderately weathered light grey and brown SANDSTONE. Extremely to very weak. Moderately widely spaced joints. Steep to very steeply inclined joints (~80 degrees @ 10.3-10.4m). (TRANSITIONAL WAITEMATA GROUP)		TRANSITIONAL WAITEMATA GROUP SOILS WAITEMATA GROUP ROCK	
100			N = 50 5, 7 16, 18 16			RC ISPT		12.0	Moderately weathered light grey, brown and orange SANDSTONE. Very weak to weak. (WAITEMATA GROUP ROCK)			
100			N = 50 35, 15			RC ISPT		13.0	Moderately weathered light grey SANDSTONE. Very weak to weak.			
100	45		N = 50 50			RC		14.0	Slightly weathered light grey to cream SANDSTONE. Weak to moderately strong. 13.6m: ~50 degree fracture, parallel to bedding plane. undulating smooth to undulating rough. 14.6m - 14.6m: joints at ~30 & 50 degrees. undulating rough to undulating smooth joint surfaces. Unweathered grey SANDSTONE. Moderately strong. EOH: 14.73m			
						ISPT		15.0				
								16.0				
								17.0				
								18.0				
								19.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Water	Shear Vane
▼ Standing Water Level	Corrected as per NZGS Guidelines Vane No.:1984
▽ Water Level At Time Of Drilling	UTP = Unable To Penetrate
◁ Out Flow ▷ In Flow	+ = Peak Exceeded - = No Result

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Albany | Auckland
PO Box 302 361 NHMC
09 478 6655
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KGA GEOTECHNICAL

HOLE DEPTH: 14.73m

Created: 23/03/2017 12:21:52 p.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH01

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation
JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389165.2mE, 853654.9mN ()
DATUM: 70.21m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 31/03/2017
END DATE: 03/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100				182/81		RO			Topsoil (TOPSOIL)		R	
100						RO			SILT with some clay; grey and brown. Very stiff, moist, high plasticity. (PAKIRI FORMATION - RESIDUAL SOIL)			
100			N=3 0, 1 0, 1 1, 1 for 75 mm	98/60		RO			0.4m: trace fine sand, trace roots			
100				42/17		ISPT			0.6m: orange brown, some coarse sand sized white specs			
100						RO		1.0	0.8m: some red areas of silt with minor fine sand, trace roots			
100									Sandy SILT; brownish red. Firm to stiff, moist to wet, medium plasticity; sand, fine to medium.			
100			N=7 1, 1 1, 2 2, 2 for 75 mm	100/20		ISPT		2.0	Silty fine to medium SAND; pinkish red. Firm to stiff, moist to wet, low plasticity.			
90						RO			1.5m: trace coarse sand sized cemented clasts			
100									1.6m: loose			
90			N=4 1, 0 1, 1 1, 1 for 75 mm	52/18		ISPT		3.0	2.1m: some black fine sandy areas			
100						RO			2.3m - 2.5m: 50mm relic bedding (sub horizontal), red sand interbedded with light grey silt			
90			N=4 1, 0 1, 0 1, 2 for 75 mm	42/17		ISPT		4.0	2.7m: some black sub horizontal banding			
100						RO			2.9m: 100mm relic bedding with some black banding			
50			N=7 1, 1 1, 1 2, 3 for 75 mm	63/11		ISPT		5.0	3.1m - 3.4m: 300mm alternating beds of red sandy silt with			
100						RO			3.9m: minor black streaks			
95			N=6 1, 1 1, 1 2, 2 for 75 mm	52/14		ISPT		6.0	4.6m: some black cemented silt areas			
100						RO			5.8m: black bands			
100									6.0m: some light grey areas intermixed with black bands, some silt			
								7.0	7.4m: vertical black bands			
									7.6m: orangey brown and light grey			
								8.0	8.7m: yellowish brown			
								9.0	9.2m: minor medium to coarse sand			
									9.5m - 10.2m: trace medium to coarse sand, some red orange oxidised bands		PAKIRI FORMATION - RESIDUAL SOIL	

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grassed paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:4799
In Flow / Out Flow	UTP = Unable To Penetrate
	+ = Peak Exceeded
	- = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 22.5m

Created: 14/07/2017 11:32:10 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH01

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation
JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389165.2mE, 853654.9mN ()
DATUM: 70.21m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 31/03/2017
END DATE: 03/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			N=17 2, 4 4, 4 4, 5 for 75 mm	UTP/-		RO			Silty fine to medium SAND; pinkish red. Firm to stiff, moist to wet, low plasticity.			
									10.3m: medium dense			
95						RO		11.0				
									11.3m - 11.6m: occasional pockets of red and black limonitic clasts, sometimes banded			
			N=9 1, 1 2, 2 2, 3 for 75 mm						11.7m: 150mm silt with minor clay, grey			
								12.0	11.9m: fine sand with some silt, light grey mottled orange			
100						ISPT			12.2m: limonitic bands, steeply inclined			
									12.6m: 150mm silt with minor clay, minor to some limonite			
95						RO		13.0				
			N=19 2, 3 4, 5 5, 5 for 75 mm						13.4m - 14.2m: limonite infilling relic fractures			
100						ISPT						
								14.0				
90						RO						
			N=50 + 1, 3 4, 5 11, 40 for 75 mm						14.9m: band of limonite			
100						ISPT		15.0				
									Moderately weathered, brownish grey, SANDSTONE; very weak. Fractures closely spaced, closed to gapped, steeply to very steeply inclined, undulating smooth infilled with limonite; sandstone, fine to coarse. (PAKIRI FORMATION- TRANSITIONAL)			
95	35					RC		16.0				
			N=29 1, 2 3, 4 7, 15 for 75 mm						16.4m: fractures are gently inclined to steeply inclined			
100						ISPT			16.5m: sandstone is fine grained			
								17.0				
95	55					RC			17.6m: occasional moderately thin beds of moderately weathered light grey siltstone, very weak			
			N=23 4, 5 5, 6 5, 7 for 75 mm					18.0				
100						ISPT						
									18.5m - 19.0m: core loss			
50						RC		19.0				
			N=50 + 3, 6 9, 11 12, 21 for 75						19.2m: frequent limonite inclusions along joints, very closely to closely spaced, sub horizontal			
100						ISPT						

PAKIRI FORMATION - RESIDUAL SOIL

PAKIRI FORMATION- TRANSITIONAL

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grassed paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:4799 UTP = Unable To Penetrate + = Peak Exceeded - = No Result
Water Level At Time Of Drilling	
In Flow / Out Flow	

KGA GEOTECHNICAL

HOLE DEPTH: 22.5m

Generated by GEROC Core-GS

Created: 14/07/2017 11:32:10 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH01

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389165.2mE, 853654.9mN ()
DATUM: 70.21m
RIG: Tractor Mounted Rig
OPERATOR: DCN Drilling Ltd

START DATE: 31/03/2017
END DATE: 03/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100	71		mm N=50 50 for 0 mm			RC		21.0	Moderately weathered, brownish grey, SANDSTONE; very weak. Fractures closely spaced, closed to gapped, steeply to very steeply inclined, undulating smooth infilled with limonite; sandstone, fine to coarse. (PAKIRI FORMATION- TRANSITIONAL)		PAKIRI FORMATION- TRANSITIONAL	
100	37					RC		22.0	Unweathered, grey, SILTSTONE; strong. Interbedded with sandstone, beds are very closely to moderately widely spaced, very thin to moderately thin bed thickness. Fractures, steep to very steeply inclined, moderately widely spaced, closed, undulating smooth to rough. (PAKIRI FORMATION - ROCK)		PAKIRI FORMATION - ROCK	
								23.0	EOH: 22.5m 22.5m: E.O.H. (Reached target depth)			
								24.0				
								25.0				
								26.0				
								27.0				
								28.0				
								29.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grassed paddock

Water	Shear Vane
▼ Standing Water Level	Corrected as per NZGS Guidelines
▽ Water Level At Time Of Drilling	Vane No.:4799
◁ In Flow ▷ Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 22.5m

Created: 14/07/2017 11:32:10 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH02

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation
JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389246.4mE, 853702.8mN ()
DATUM: 58.99m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 30/03/2017
END DATE: 31/03/2017
LOGGED BY: WM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100				134/57		RO			Topsoil (TOPSOIL)		TOPSOIL	
100						RO			Clayey SILT with trace sand; brown. Very stiff, moist, high plasticity. Organic material intermixed (rootlets). (COLLUVIUM)			
100				118/66		RO		1.0	0.7m: orangey brown			
100			N=4 1, 1 1, 1 1, 1 for 75 mm	66/43		ISPT			0.9m: orange mottled red			
100						RO		2.0	1.2m: minor fine sand, red			
90									1.4m: some fine to medium sand			
100			N=2 1, 0 0, 1 0, 1 for 75 mm	39/20		ISPT		3.0	Sandy SILT with some clay; red, grey and orange. Very loose to loose, moist, low to medium plasticity; sand, fine to medium.		COLLUVIUM	
100						RO			2.7m: 150mm some fine to medium sand			
100			N=2 1, 0 0, 0 1, 1 for 75 mm	29/7		ISPT		4.0	3.7m: pink, light grey and orange			
90									3.9m: reddish orange, loose			
100			N=0 0, 0 0, 0 0, 0 for 75 mm	31/11		ISPT		5.0	4.4m: very loose			
100						RO			5.2m: purplish red speckled light grey			
100			N=2 0, 1 0, 1 1, 0 for 75 mm	35/10		ISPT		6.0	5.3m: some fine to medium sand			
100						RO			5.5m: pinkish red			
100								7.0	7.1m: relic fracture, steeply inclined			
100									7.3m: relic bedding is non continuous and randomly oriented			
100			N=15 4, 2 4, 3 4, 4 for 75 mm	119/25		ISPT		8.0	8.1m: pocket of silt with coarse sand to fine gravel sized angular limonitic fragments, bedding is misaligned			
100						RO			8.2m - 8.7m: several randomly orientated relic fractures infilled with limonitic staining			
100								9.0	SILT with some clay; light grey mottled orange. Very stiff, moist, medium plasticity. Relic bedding is sub horizontal-gently inclined. (PAKIRI FORMATION - RESIDUAL SOIL)		PAKIRI FORMATION - RESIDUAL SOIL	
									9.2m: grey, very stiff to hard			
									9.5m: 50mm limonitic inclusion			
									9.7m: 100mm fine sandy silt, grey, hard, moist, low plasticity			
									Highly weathered, greenish grey, SILTSTONE; extremely weak,			

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grassed paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:4799
In Flow / Out Flow	UTP = Unable To Penetrate
	+ = Peak Exceeded
	- = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 15m

MACHINE BOREHOLE LOG

HOLE NO.: MH02

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389246.4mE, 853702.8mN ()
DATUM: 58.99m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 30/03/2017
END DATE: 31/03/2017
LOGGED BY: WM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			N=50 50 for 0 mm			RO			bedding is randomly orientated sub horizontal to sub vertical. Very steeply inclined-sub vertical fractures (non-continuous), slickenslided limonitic staining on fracture surfaces. SILT; brownish grey. Hard, moist, low plasticity. (PAKIRI FORMATION - ROCK)			
100	82	500/500/500				RC		11.0	Slightly weathered, grey, SILTSTONE; moderately strong. 10.2m: grey 10.4m: moderately weathered, weak 10.7m: unweathered, strong, laminated to moderately thin bedding, subhorizontal to gently inclined, interbedded with slightly weathered grey fine sandstone 11.0m: strong, joint, very steeply inclined, undulating rough		PAKIRI FORMATION - ROCK	
100	100					RC		12.0	11.9m: joint, very steeply inclined, planar smooth			
100	63					RC		13.0 14.0	14.9m: joint, moderately inclined, undulating rough			
								15.0	EOH: 15m 15.0m: E.O.H. (Reached target depth)			
								16.0 17.0 18.0 19.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grassed paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:4799
In Flow / Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 15m

MACHINE BOREHOLE LOG

HOLE NO.: MH03

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389389.3mE, 853830.9mN ()
DATUM: 43.54m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 29/03/2017
END DATE: 29/03/2017
LOGGED BY: WM
CHECKED BY: TP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
80						RO			Topsoil (TOPSOIL)		TOPSOIL	
80						RO			SILT with some clay and trace sand; brown. Stiff to very stiff, moist, medium plasticity; sand, fine. (COLLUVIUM) 0.5m: minor fine to medium sand, orangey brown			
100			N=30, 01, 11 for 75 mm			RO		1.0	1.0m: minor medium to coarse sand sized white cemented			
						ISPT			SILT with minor clay and minor sand; light grey and red, stiff, moist to wet, low to medium plasticity; sand, fine to coarse. 1.4m: light grey mottled orange, some fine to medium sand 1.5m: red with bands of light grey, wet			
90						RO		2.0	2.1m: trace to minor fine to medium sand, light grey mottled red and orange			
			N=10, 00, 10, 00 for 75 mm						2.6m: light grey mottled red		COLLUVIUM	
100						ISPT		3.0	2.9m: minor fine to medium sand, red			
95						RO			3.6m: brown, red and light grey; trace fine to medium sand 3.8m: red			
100			N=10, 00, 01, 00 for 75 mm			ISPT		4.0	Fine to medium SAND with some silt; red with light grey and orange banding. Very loose, wet. 4.5m: orangey brown			
100						RO		5.0	Clayey SILT; orange with red and light grey. Stiff, moist to wet, medium to high plasticity.			
			N=20, 10, 00, 11 for 75 mm	41/11		ISPT		6.0	Silty fine to coarse SAND; brownish grey. Loose to medium dense, moist. 5.8m: silty fine sand			
100						RO			SILT with minor clay; orange. Stiff to very stiff, moist to wet, low to medium plasticity. Sub horizontal to sub vertical fissures throughout unit. Closely spaced. Tight/closed. Planar smooth from 6m-8m. (PAKIRI FORMATION - RESIDUAL SOIL) 6.9m: some clay, grey, medium plasticity 7.0m: very stiff 7.2m: 50mm with some fine sand 7.4m: 50mm fine sandy silt		PAKIRI FORMATION - RESIDUAL SOIL	
100			N=81, 11, 13, 33 for 75 mm			ISPT		7.0				
						RO		8.0	8.0m: very stiff to hard 8.2m: hard			
100			N=504, 13 50 for 0 mm			ISPT			Moderately to highly weathered, grey, SANDSTONE; extremely weak. Silty fine SAND; grey. Very dense, moist. (PAKIRI FORMATION- TRANSITIONAL)		PAKIRI FORMATION-TRANSITIONAL	
100	100							9.0	Moderately weathered, grey, SILTSTONE; extremely weak / SILT; grey. Hard, moist, low plasticity. (PAKIRI FORMATION - ROCK) 8.7m: 100mm moderately weathered, grey SILTSTONE; extremely weak. Silt; grey. Hard, moist. 9.4m: slightly weathered, very weak cemented clasts intermixed zone of mixed soil and rock material		PAKIRI FORMATION - ROCK	
100						RC			Unweathered, dark grey, SILTSTONE; strong; interbedded with 30-60mm layers of unweathered, dark grey, sandstone;strong.			

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping Grassed Paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:4799
In Flow / Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 10.5m

MACHINE BOREHOLE LOG

HOLE NO.: MH03

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389389.3mE, 853830.9mN ()
DATUM: 43.54m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 29/03/2017
END DATE: 29/03/2017
LOGGED BY: WM
CHECKED BY: TP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			N=50 50			RC			Unweathered, dark grey, SILTSTONE; strong; interbedded with 30-60mm layers of unweathered, dark grey, sandstone;strong. 10.2m: gently inclined bedding		ATION - ROCK	
			for 75 mm					11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0	EOH: 10.5m 10.5m: E.O.H. (Reached target depth)			

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping Grassed Paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:4799 UTP = Unable To Penetrate + = Peak Exceeded - = No Result
Water Level At Time Of Drilling	
In Flow / Out Flow	

KGA GEOTECHNICAL

HOLE DEPTH: 10.5m

Created: 14/07/2017 11:32:11 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH04

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389454.6mE, 853715.1mN ()
DATUM: 40.97m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 29/03/2017
END DATE: 30/03/2017
LOGGED BY: RM
CHECKED BY: WM

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
70				154/70		RO			Topsoil (TOPSOIL)			
100						RO			SILT with some clay and trace sand; brown. Very stiff, moist, high plasticity; sand, fine. (COLLUVIUM)			
									0.5m: orangey brown, trace rootlets			
									0.7m: clayey silt, trace rootlets			
100			N=5 1, 0 1, 1 2, 1 for 75 mm	92/46		RO		1.0				
									1.1m: minor grey areas			
									1.3m: minor light grey specs			
100				81/42		ISPT						
90						RO		2.0				
									2.0m: stiff			
									2.4m: some clay, mottled light grey, red and orange			
									2.6m: clayey silt			
			N=2 0, 0 1, 0 1, 0 for 75 mm	39/21		ISPT		3.0				
									3.0m: firm to stiff			
100						RO						
									3.8m: orange			
90								4.0	4.0m - 4.5m: 100mm interbeds of silt and some sand		COLLUVIUM	
			N=3 0, 1 0, 1 1, 1 for 75 mm	32/14		ISPT						
100									Fine sandy SILT with minor clay; grey with dark grey/black banding. Stiff to very stiff, moist. Interbedded with silt with some clay.			
								5.0	SILT with some clay; grey and red mottled orange. Stiff to very stiff, moist, high plasticity.			
									5.3m: red mottled orange brown			
90						RO						
									5.7m: minor coarse sand to medium gravel sized angular cemented clasts, reddish brown			
			N=5 1, 0 1, 1 1, 2 for 75 mm	59/31		ISPT		6.0				
100									6.5m: stiff			
						RO		7.0				
100			N=4 1, 0 1, 1 1, 1 for 75 mm	46/21		ISPT						
								8.0	Moderately to slightly weathered, orangey grey and red, SANDSTONE; extremely weak to moderately strong. Silty fine SAND; orangey grey and red. Medium dense, wet. (PAKIRI FORMATION- TRANSITIONAL)		PAKIRI FORMATION- TRANSITIONAL	
			N=21 3, 5 5, 6 5, 5 for 75 mm			RO			SILT with some clay; banded orange, red and light grey. Firm to stiff, moist to wet, low plasticity.			
100				50/10		ISPT		9.0	8.7m: stiff to very stiff, low to medium plasticity, orangey brown, minor clay			
						RO			SILT with minor clay; grey. Very stiff, moist, medium to high plasticity interbedded with fine SAND with some silt; grey. Medium dense to dense, moist. 8.9m: greyish brown, very stiff			
100									Moderately weathered, grey, fine SANDSTONE; very weak.			

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grassed paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:4799
In Flow / Out Flow	UTP = Unable To Penetrate
	+ = Peak Exceeded
	- = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 15m

MACHINE BOREHOLE LOG

HOLE NO.: MH04

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389454.6mE, 853715.1mN ()
DATUM: 40.97m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 29/03/2017
END DATE: 30/03/2017
LOGGED BY: RM
CHECKED BY: WM

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			N=50 50			RO			Interbedded with slightly weathered, weak to moderately strong, greenish grey SILTSTONE.		PAKIRI FORMATION-TRANSITIONAL	
100	81		for 0 mm			RC		11.0	Unweathered, dark grey, SILTSTONE, strong. (PAKIRI FORMATION - ROCK) 9.2m: pockets of highly weathered, extremely weak SANDSTONE 9.5m: hard			
100	100		N=50 50			RC		12.0	Unweathered, dark grey, fine SANDSTONE, strong. 11.6m: fracture, widely spaced, closed, steeply to very steeply inclined, undulating smooth		PAKIRI FORMATION - ROCK	
100	100		for 0 mm			RC		13.0	12.6m: 50mm interbeds of unweathered, dark grey, SILTSTONE, strong, closely to moderately spaced 13.0m: series of fissures at random orientations			
			N=50 50					14.0				
			for 0 mm					15.0	EOH: 15m 15.0m: E.O.H. (Reached target depth)			
			N=50 50					16.0				
			for 0 mm					17.0				
								18.0				
								19.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grassed paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:4799 UTP = Unable To Penetrate + = Peak Exceeded - = No Result
Water Level At Time Of Drilling	
In Flow / Out Flow	

KGA GEOTECHNICAL

HOLE DEPTH: 15m

Generated by GEROC Core-GS

Created: 14/07/2017 11:32:12 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH05

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389466.7mE, 853517.4mN ()
DATUM: 37.97m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 06/04/2017
END DATE: 06/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100				165/71		RO			Topsoil (TOPSOIL)		R	
100						RO			Clayey SILT; orangey brown. Very stiff, moist, high plasticity. Trace roots. (PAKIRI FORMATION - RESIDUAL SOIL/COLLUVIUM ?)			
100				100/54		RO			0.7m: some roots, some coarse sand sized cemented white clasts			
100			N=2 0, 1 0, 1 0, 1 for 75 mm	74/41		ISPT		1.0	1.0m: trace to minor clay, some light grey patches			
100									1.2m: some root fibres (5mm), some areas of red fine sand, minor fine to coarse sand			
100									1.3m: orangey brown mottled light grey, trace root fibres			
									1.5m: red, firm to stiff, wet			
								2.0	1.7m: minor clay and minor to some fine sand, red mottled light grey and orange brown			
100						RO			Sandy SILT with minor clay; pinkish red mottled light grey. Firm to stiff, wet, low plasticity; sand, fine.			
			N=2 0, 0 0, 1 0, 1 for 75 mm	23/3		ISPT			2.5m: trace coarse sand, minor fine gravel sized cemented clasts, firm			
								3.0	2.6m: some light brown streaks			
									2.8m: trace roots, some fine gravel sized cemented clasts			
100						RO			3.3m: 50mm beds of fine to medium silty SAND reddish pink			
									3.7m: 100mm bed of fine to medium silty SAND; reddish pink			
								4.0				
100			N=1 0, 0 0, 1 0, 0 for 75 mm	31/9		ISPT			Silty fine to medium SAND with minor clay; reddish pink mottled light grey. Firm to stiff, moist to wet, low plasticity.			
									4.5m: 20mm brown subhorizontal silt band			
								5.0				
100						RO			5.2m: trace coarse sand			
									5.7m: 10mm dark brown horizontal band			
			N=2 0, 0 1, 0 0, 1 for 75 mm	30/11		ISPT		6.0	6.0m - 6.4m: Lense of SILT with minor clay and trace fine sand; reddish pink mottled grey. Firm to stiff, moist to wet, medium plasticity.			
100						RO			6.6m: 10mm dark brown horizontal silt band			
									6.9m: brown bands becoming black, minor black specs			
								7.0	7.1m: pinkish red banding at random orientations, black specs at borders of banding			
100			N=1 0, 0 0, 0 1, 0 for 75 mm	33/7		ISPT						
									8.0m: black streaks more abundant and randomly oriented, greyish brown mottled reddish pink			
100						RO		8.0	8.3m: black streaks become sub vertical			
									8.5m: some limonite staining, fine gravel sized cemented clasts, stiff			
			N=2 0, 0 0, 1 0, 1 for 75 mm	34/7		ISPT			8.7m: 30mm sub horizontal band of fine to medium gravel sized cemented clasts, gently inclined band of limonite			
100						RO		9.0				
									9.7m: steeply inclined limonite infilling			

PAKIRI FORMATION - RESIDUAL SOIL/COLLUVIUM ?

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grass paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:4799
In Flow / Out Flow	UTP = Unable To Penetrate
	+ = Peak Exceeded
	- = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 16.5m

Created: 14/07/2017 11:32:12 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH05

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389466.7mE, 853517.4mN ()
DATUM: 37.97m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 06/04/2017
END DATE: 06/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			N=1 0, 1 0, 0 0, 1 for 75 mm	40/9		RO			Silty fine to medium SAND with minor clay; reddish pink mottled light grey. Firm to stiff, moist to wet, low plasticity.			
100						ISPT			10.0m: black banding becomes very thin (1mm)		PAKIRI FORMATION - RESIDUAL SOIL/COLLUVIUM ?	
100						RO		11.0	11.2m: limonite staining throughout 11.5m: randomly oriented limonitic staining			
100			N=8 0, 1 0, 2 3, 3 for 75 mm	54/13		ISPT		12.0	Completely weathered, light grey mottled orangey brown, SILTSTONE; extremely weak. Clayey SILT; light grey mottled orangey brown. Very stiff, moist, high plasticity. (PAKIRI FORMATION- TRANSITIONAL)		MATI ON- TRA	
100	66	50/60/70	N=50 50 for 0 mm			RO		13.0	Completely weathered, greyish brown, fine to medium SANDSTONE; extremely weak. Silty fine to medium SAND; greyish brown, very stiff, moist, no plasticity. (PAKIRI FORMATION - ROCK) 12.6m: sub horizontal black banding (1mm) 12.9m: highly weathered, very weak 13.2m: sub horizontal fracture, faces stained with limonite 13.4m: weak, closely spaced subhorizontal fractures, smooth stepped, fractures stained with limonite			
100	77	150/1075/ 2000				Rotary cored		14.0	Slightly weathered, grey, fine to coarse SANDSTONE; strong to very strong. 13.5m: weak to moderately strong 13.7m: steeply inclined fracture, tight 14.0m: 2 steeply inclined fractures, moderately widely spaced, undulating smooth 14.4m - 14.6m: layer of unweathered, grey, SILTSTONE; very strong 14.7m: light grey bands, very closely spaced		PAKIRI FORMATION - ROCK	
								15.0				
								16.0	16.4m: steeply inclined fracture, undulating smooth			
									EOH: 16.5m 16.5m: E.O.H. (Reached target depth)			
								17.0				
								18.0				
								19.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grass paddock

Water	Shear Vane
▼ Standing Water Level	Corrected as per NZGS Guidelines
▽ Water Level At Time Of Drilling	Vane No.:4799
◁ In Flow ▷ Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 16.5m

MACHINE BOREHOLE LOG

HOLE NO.: MH06

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389582.4mE, 853776.3mN ()
DATUM: 25.52m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 28/03/2017
END DATE: 28/03/2017
LOGGED BY: WM
CHECKED BY: TP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
80						RO			Topsoil (TOPSOIL)		R	
60						RO			SILT with minor sand; brownish grey. Stiff, moist, low to medium plasticity; sand, fine. (ALLUVIUM)		ALL.	
60			N=7 1, 0 1, 2 2, 2 for 75 mm			RO			Clayey SILT; grey mottled orange. Very stiff, moist, medium to high plasticity.			
100						ISPT		1.0	1.0m: light grey			
70						RO		2.0	2.2m: grey 2.4m: brownish grey 2.6m: 100mm with minor to some fine sand			
30			N=3 0, 1 0, 1 1, 1 for 75 mm			ISPT		3.0				
100						RO			SILT with some sand; dark grey. Firm to stiff, wet, low to medium plasticity; sand, fine.			
100			N=3 0, 0 1, 0 1, 1 for 75 mm			ISPT		4.0	3.9m: grey, black specs 4.0m: minor fine to medium sand			
100						RO			4.6m: minor medium to coarse sand			
100			N=1 0, 0 0, 0 1, 0 for 75 mm			ISPT		5.0	5.0m: organic material intermixed (woody fibres)			
100						RO			5.6m: minor fine sand			
100			N=36 2, 3 3, 4 9, 20 for 50 mm			ISPT		6.0	Silty fine to medium SAND; dark grey. Loose, wet, low plasticity.			
100						RO			6.2m: some silt			
100						RC		7.0	SILT with minor to some sand; grey. Stiff, moist, low plasticity; sand, fine. (PAKIRI FORMATION - RESIDUAL SOIL) 6.6m: very stiff		PAKIRI FORMATION - RESIDUAL SOIL	
100						ISPT			Moderately weathered, grey, fine grained SANDSTONE; extremely weak / fine SAND with minor to some silt; grey. Hard, moist to wet. (PAKIRI FORMATION- TRANSITIONAL) 7.8m: carbonaceous banding		FORMATION - TRANSITIONAL	
100			N=50 50			RC		8.0	Unweathered, dark grey, SANDSTONE, strong; frequent carbonaceous bands. (PAKIRI FORMATION - ROCK) 8.2m: occasional carbonaceous inclusions, grey		PAKIRI FORMATION - ROCK	
100			for 0 mm			RC		9.0	9.4m: joint, closed, widely spaced, very steeply inclined, planar to rough			

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grassed paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:
In Flow / Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 10.5m

MACHINE BOREHOLE LOG

HOLE NO.: MH06

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389582.4mE, 853776.3mN ()
DATUM: 25.52m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 28/03/2017
END DATE: 28/03/2017
LOGGED BY: WM
CHECKED BY: TP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			N=50 50			RC			Unweathered, dark grey, SANDSTONE, strong; frequent carbonaceous bands. (PAKIRI FORMATION - ROCK) 9.9m: dark grey, sub horizontal to gently inclined bedding		PAKIRI FORMATION - ROCK	
			for 0 mm					11.0	EOH: 10.5m 10.5m: E.O.H. (Reached target depth)			
								12.0				
								13.0				
								14.0				
								15.0				
								16.0				
								17.0				
								18.0				
								19.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grassed paddock

Water	Shear Vane
▼ Standing Water Level	Corrected as per NZGS Guidelines
▽ Water Level At Time Of Drilling	Vane No.:
◁ In Flow ▷ Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 10.5m

Created: 14/07/2017 11:32:13 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH07

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation
JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389604.7mE, 853576.3mN ()
DATUM: 22.87m
RIG: Tractor Mounted Rig
OPERATOR: DCN Drilling Ltd

START DATE: 07/04/2017
END DATE: 07/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100				142/54		RO			Topsoil (TOPSOIL)		R	
100						RO			Clayey SILT; brownish grey. Very stiff, moist, high plasticity. Trace root fibres. (ALLUVIUM)			
									0.5m: brownish grey mottled orange			
100				65/47		RO		1.0	0.8m: trace to minor fine sand			
									0.9m: some sub horizontal orange banding			
100			N=2 0, 0 1, 0 1, 0 for 75 mm	44/23		ISPT			1.1m: red mottled orange brown, some pinkish red areas of silty fine to medium SAND, some coarse sand sized white cemented clasts			
									1.3m: red with minor light grey areas			
100						RO		2.0	1.4m: minor fine to medium sand			
									Silty fine to medium SAND; greyish brown. Very loose, moist to wet. 1.9m: fine gravel sized grey weakly cemented clasts, firm to			
			N=6 0, 1 0, 1 2, 3 for 75 mm	24/6		ISPT			2.4m: trace root fibres, minor black specs (1-2mm)			
100									2.5m: 10mm band of coarse sand to fine gravel sized limonite clasts			
								3.0	2.8m: 10mm band of coarse sand to fine gravel sized limonite clasts			
95						RO			2.9m: black specs (1-2mm), band of limonite			
									CLAY with some sand; grey-blueish grey. Firm, moist to wet, high plasticity; sand, fine. Contains decaying fibrous organic material (1-5mm) throughout.			
								4.0	3.0m - 3.4m: lense of silty CLAY; orange mottled light grey. Firm to stiff, moist, high plasticity			
100			N=2 0, 0 0, 1 0, 1 for 75 mm	40/14		ISPT			Sandy SILT with trace clay; blueish grey. Firm to stiff, wet, no plasticity. Decaying fibrous organic matter throughout.		ALLUVIUM	
								5.0				
85						RO			5.6m: organic material stops			
									5.9m: 10mm sub horizontal to gently inclined streaks of brown			
95			N=0 0, 0 0, 0 0, 0 for 75 mm			ISPT		6.0				
									6.5m: thin bands of greenish grey containing trace to minor coarse sand			
100						RO		7.0				
									7.1m: trace fine to medium gravel sized cemented clasts			
									7.4m: trace fibrous organics			
100			N=0 0, 0 0, 0 0, 0 for 75 mm	30/7		ISPT		8.0	7.7m: trace root fibres			
									8.3m: very thin orangey brown streaks, randomly oriented			
100						RO		9.0				
100			N=0 0, 0 0, 0 0, 0 for 75 mm			ISPT						
95						RO						

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Moderately sloping grass paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:4799
In Flow / Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 18m

Generated by GEROC Core-GS

Created: 14/07/2017 11:32:13 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH07

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389604.7mE, 853576.3mN ()
DATUM: 22.87m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 07/04/2017
END DATE: 07/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
95			N=8 0, 0 1, 1 3, 3 for 75 mm	53/7		RO			Sandy SILT with trace clay; blueish grey. Firm to stiff, wet, no plasticity. Decaying fibrous organic matter throughout. 10.5m: very thin subhorizontal brown streaks		ALLUVIUM	
100						ISPT		11.0				
100			N=14 0, 1 2, 2 4, 6 for 75 mm	65/13		RO			Silty fine SAND; blueish grey. Very loose, wet. Brown streaks occurring throughout at random orientations. (PAKIRI FORMATION - RESIDUAL SOIL) 11.1m: limonite infilled band 11.6m: limonite infilled band 11.9m: 50mm lense of coarse sand to fine gravel sized angular limonite clasts		PAKIRI FORMATION - RESIDUAL SOIL	
100						ISPT		12.0				
90	85	300/350/400	N=50 13, 17 25, 30 for 0 mm	UTP/-		RO			Completely weathered, grey, fine to medium SANDSTONE; extremely weak. Silty fine to medium SAND; grey. Loose, moist. (PAKIRI FORMATION - ROCK) 12.1m: fracture, gently inclined, undulating smooth, limonite covering fracture surfaces 12.4m: fracture, moderately widely spaced, gently inclined, undulating smooth, limonite on surface 12.9m: angular limonite clasts 13.0m: extremely weak to weak, gently inclined fracture, undulating smooth, limonite on surface, minor coarse sand 13.3m: very weak 13.4m: fracture, gently inclined, moderately widely spaced, undulating smooth, limonite on surface 13.9m: moderately weathered, grey, moderately strong to strong, 4 fractures, closely spaced, undulating smooth, moderately inclined, limonite on fracture surface 14.4m: 3 fractures, moderately widely spaced, undulating smooth, moderately to steeply inclined, limonite on surface		PAKIRI FORMATION - ROCK	
100						ISPT		13.0				
95	38	75/150/400	N=50 24, 35 for 0 mm			RC		14.0				
						Rotary		15.0				
90	77	50/250/600				cored			15.0m: Extremely weak; silty fine SAND; brown. Loose, moist. Intermixed with limonite. 15.2m: slightly weathered, grey, very strong 15.4m: fracture, undulating smooth, steeply inclined 15.8m: unweathered 16.6m: 2 fractures, closely spaced, undulating smooth, steeply inclined 17.1m: 100mm layer of unweathered, grey, SILTSTONE, extremely strong 17.6m: fracture, moderately inclined, undulating smooth 17.9m: fracture, steeply inclined, undulating smooth			
								16.0 17.0 18.0	EOH: 18m 18.0m: E.O.H. (Reached target depth)			
								19.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Moderately sloping grass paddock

Water	Shear Vane
▼ Standing Water Level	Corrected as per NZGS Guidelines Vane No.:4799 UTP = Unable To Penetrate + = Peak Exceeded - = No Result
▽ Water Level At Time Of Drilling	
◁ In Flow ▷ Out Flow	

KGA GEOTECHNICAL

HOLE DEPTH: 18m

MACHINE BOREHOLE LOG

HOLE NO.: MH08

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation
JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389093.5mE, 853603.4mN ()
DATUM: 57.55m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 04/04/2017
END DATE: 04/04/2017
LOGGED BY: RM
CHECKED BY: WM

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100				133/43		RO			Topsoil (TOPSOIL) Clayey SILT; dark brown. Stiff, moist, high plasticity. Minor root fibres intermixed. (COLLUVIUM) 0.4m: light brown, very stiff			
100				81/31		RO			0.7m: minor coarse sand sized white specs, minor orange brown areas 1.0m: minor red areas of red sandy SILT			
100			N=1 1, 0 0, 0 1, 0 for 75 mm	34/13		RO		1.0	1.2m: some medium to coarse sand sized white clasts, orange brown mottled light grey		COLLUVIUM	
100						ISPT			Sandy SILT with minor clay; orange brown mottled light grey. 1.5m - 1.6m: 100mm lense of clayey SILT; orange brown mottled light grey. Stiff, moist to wet, medium plasticity.			
100						RO		2.0	1.9m: fine to coarse gravel sized weakly cemented clasts			
100			N=2 1, 0 0, 0 1, 1 for 75 mm	71/13		ISPT		3.0	SILT with some clay; reddish orange mottled brown. Firm, wet, medium plasticity. (PAKIRI FORMATION - RESIDUAL SOIL) 2.2m: light brown with minor orange brown bands (2mm) 2.5m: light grey 2.8m: orange brown mottled light grey, subhorizontal relic bedding 3.0m: some black horizontal staining 3.2m: 50mm horizontal relic bedding 3.5m: trace to minor fine sand			
66			N=6 1, 1 1, 1 2, 2 for 75 mm	44/6		RO		4.0	3.8m: black staining on surface of relic bedding 4.3m: some black specs 4.5m: coarse sand to fine gravel sized limonite clasts, trace to minor fine sand		PAKIRI FORMATION - RESIDUAL SOIL	
100						ISPT		5.0	4.9m: orange brown, trace coarse gravel sized limonite clasts			
100			N=3 1, 0 0, 1 1, 1 for 75 mm			ISPT			5.5m: minor to some fine sand, orangey brown mottled light grey, relic bedding 5.6m: minor fine sand, grey, stiff			
100						ISPT		6.0	5.8m: very stiff 6.0m: 50mm lense of clayey SILT			
100						RO			6.5m: very thin sub horizontal light grey bands 7.2m: hard			
100			N=50 + 5, 9 8, 13 25, 10 for 5 mm			ISPT		7.0	Highly weathered, grey, SILTSTONE; extremely weak. SILT with minor clay and trace sand; grey. Hard, moist, medium plasticity; sand, fine. (PAKIRI FORMATION - ROCK) 7.9m: weakly to moderately strong		PAKIRI FORMATION - ROCK	
80	80					RC		8.0	Slightly weathered, grey, SILTSTONE; moderately strong. 8.5m: 50mm sub horizontal bed of fine to medium sandstone			
95	95	200/200/200				RC		9.0	9.7m - 10.1m: alternating (10-50mm) sub horizontal beds of fine to medium sandstone			

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grassed paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:4799
In Flow / Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 10.5m

MACHINE BOREHOLE LOG

HOLE NO.: MH08

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389093.5mE, 853603.4mN ()
DATUM: 57.55m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 04/04/2017
END DATE: 04/04/2017
LOGGED BY: RM
CHECKED BY: WM

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
95	95					RC			Slightly weathered, grey, SILTSTONE; moderately strong.		PARNELL FORMATION - ROCK	
									10.3m: 2 fractures, closely spaced, very narrow to tight, undulating smooth, very steeply inclined			
									EOH: 10.5m 10.5m: E.O.H. (Reached target depth)			
								11.0				
								12.0				
								13.0				
								14.0				
								15.0				
								16.0				
								17.0				
								18.0				
								19.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grassed paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:4799
In Flow Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 10.5m

MACHINE BOREHOLE LOG

HOLE NO.: MH09

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389188.6mE, 853492.4mN ()
DATUM: 74.59m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 04/04/2017
END DATE: 05/04/2017
LOGGED BY: WM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
95				137/34		RO			Topsoil (TOPSOIL)		R	
95						RO			Clayey SILT with trace sand; brown. Very stiff, moist, high plasticity; sand, fine. (PAKIRI FORMATION - RESIDUAL SOIL)			
100			N=3 1, 0 1, 0 1, 1 for 75 mm	84/31		RO			Silty CLAY; orange. Very stiff, moist, high plasticity.			
100				97/44		ISPT		1.0	1.1m: trace fine sand 1.3m: minor coarse sand to fine gravel sized angular limonite fragments inclusions, brown			
90						RO		2.0	Clayey SILT with trace sand; banded red, light grey and brown. Stiff, moist, medium to high plasticity. Occasional bands of cemented oxidised minerals.			
100			N=4 0, 1 1, 1 1, 1 for 75 mm	51/16		ISPT		3.0	2.2m: pink, red and orangey brown 2.7m: banded purplish red and light grey 2.9m: minor fine sand			
65						RO		4.0	3.4m: some fine sand 3.6m: orangey brown, occasional interbeds with some fine to medium sand			
100			N=1 0, 1 0, 1 0, 0 for 75 mm	43/28		ISPT			4.4m: no sand			
80						RO		5.0	SILT with some sand and minor clay; light grey mottled red. Firm to stiff, moist, low to medium plasticity; sand, fine to coarse.			
100			N=4 0, 1 1, 1 1, 1 for 75 mm	28/11		ISPT		6.0	5.3m: fine to medium sandy SILT, banded red and light grey 5.8m: relic fracture, steeply inclined 6.4m: pink, red and light grey			
100						RO		7.0	Silty fine SAND with minor clay; pinkish red and light grey. Loose, moist to wet, low to medium plasticity.			
100			N=3 1, 0 0, 1 1, 1 for 75 mm	44/17		ISPT			7.3m: pinkish red with light grey banding, trace medium sand			
100						RO		8.0	8.6m: 50mm band of minor clay, reddish brown			
100			N=3 0, 0 1, 0 1, 1 for 75 mm	30/14		ISPT		9.0	Sandy SILT with minor clay; pinkish red with light grey bands. Firm to stiff, moist to wet, medium plasticity; sand, fine.			
100						RO			9.2m: oxidised staining along gently inclined relic fracture 9.9m: minor coarse sand to fine gravel sized light grey cemented clasts			

PAKIRI FORMATION - RESIDUAL SOIL

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Top of ridge, near levelled grassed area

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:4799 UTP = Unable To Penetrate + = Peak Exceeded - = No Result
Water Level At Time Of Drilling	
In Flow / Out Flow	

KGA GEOTECHNICAL

HOLE DEPTH: 31.5m

Generated by GEROC Core-GS

Created: 14/07/2017 11:32:14 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH09

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389188.6mE, 853492.4mN ()
DATUM: 74.59m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 04/04/2017
END DATE: 05/04/2017
LOGGED BY: WM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			N=5 0, 0 1, 1 1, 2 for 75 mm	60/27		RO			SILT with some clay; banded pink and light grey. Stiff, moist, medium plasticity. 10.1m: minor fine sand 10.4m: no sand			
100						ISPT			Sandy SILT; red with yellow banding. Stiff, moist, low to medium plasticity; sand, fine.			
100			N=4 1, 1 1, 1 1, 1 for 75 mm	43/14		RO		11.0	11.2m: trace to minor coarse sand to fine gravel sized cemented clasts 11.3m: yellow mottled red 11.6m: yellow mottled orange 11.7m: red with light grey banding			
100						ISPT		12.0	SILT with some clay and trace to minor sand; banded red, light grey and orangey yellow. Stiff, moist, medium plasticity; sand, fine. 13.3m: 20mm band of SILT with some clay			
100			N=5 0, 1 1, 1 1, 2 for 75 mm	48/26		RO		13.0	Sandy SILT with minor clay; red with yellowy light grey bands. Stiff, moist, low to medium plasticity; sand, fine to medium. Trace to minor coarse sand sized cemented clasts. 13.4m: 100mm SILT with some clay and minor fine sand 13.5m: cemented limonite fragments intermixed			
100						ISPT						
100			N=7 0, 1 1, 1 2, 3 for 75 mm	65/20		RO		14.0	14.0m: pinkish red		PAKIRI FORMATION - RESIDUAL SOIL	
100						ISPT		15.0	14.8m: relic steeply inclined fracture infilled with limonite 14.9m: black, oxidised minerals within relic joints 15.2m: 200mm SILT with some clay and minor fine sand 15.5m: yellowy light grey with red banding			
100			N=13 1, 2 2, 3 3, 5 for 75 mm	81/20		RO		16.0	16.0m: red			
100						ISPT			16.4m: relic gently inclined joint infilled with limonite 16.5m: light grey mottled reddish orange			
100			N=13 1, 1 2, 3 4, 4 for 75 mm	105/23		RO		17.0	17.0m: pockets of limonitic soil 17.2m: occasional inclusions of limonitic soil 17.4m: red 17.6m: reddish grey 17.8m: light grey, limonite staining alone randomly orientated relic joints			
100						ISPT		18.0	Silty fine to medium SAND; brown. Medium dense, moist, low plasticity.			
100			N=14 2, 3 3, 3 4, 4 for 75 mm	100/21		RO		19.0	19.3m: two relic steeply inclined fractures with oxidised mineral staining along fracture planes, closely spaced			
100						ISPT			Sandy SILT; light grey mottled red and orange. Very stiff, moist, low to medium plasticity; sand, fine to medium.			

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Top of ridge, near levelled grassed area

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:4799
In Flow / Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 31.5m

MACHINE BOREHOLE LOG

HOLE NO.: MH09

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389188.6mE, 853492.4mN ()
DATUM: 74.59m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 04/04/2017
END DATE: 05/04/2017
LOGGED BY: WM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			N=14 1, 1 2, 2 4, 6 for 75 mm	121/20		RO			Sandy SILT; light grey mottled red and orange. Very stiff, moist, low to medium plasticity; sand, fine to medium.			
									Silty fine to medium SAND; brownish light grey. Medium dense, moist, low plasticity. 20.8m: randomly aligned joints with limonitic staining			
100						ISPT		21.0	21.1m: light grey mottled orange			
100			N=12 2, 2 2, 3 3, 4 for 75 mm	111/23		RO			SILT with minor to some clay and trace to minor sand; light grey mottled orange. Very stiff, moist, medium plasticity; sand, fine. Relic bedding is gently inclined. 22.0m: some fine sand			
								22.0	Sandy SILT with minor clay; light grey. Very stiff, moist, medium plasticity; sand, fine.			
100						ISPT						
100			N=23 2, 2 4, 6 5, 8 for 75 mm	117/23		RO			Silty fine SAND; grey mottled orange. Medium dense, moist, low to medium plasticity. 23.0m: relic sub vertical fracture infilled with limonite		RESIDUAL SOIL	
								23.0	23.8m: relic very steeply inclined fracture infilled with limonite			
100						ISPT		24.0	Sandy SILT; light grey. Very stiff, moist to wet, low plasticity; sand, fine to coarse.			
100									Silty fine SAND; reddish brown and light grey. Medium dense, moist, low plasticity. 24.8m: weakly cemented siltstone inclusion			
100			N=19 2, 3 5, 5 4, 5 for 75 mm	139/31		RO		25.0	25.2m: relic very steeply inclined fracture infilled with limonite, minor coarse sand to fine gravel sized cemented clasts 25.5m: frequent limonitic staining along relic joints			
100						ISPT		26.0	Sandy SILT; light grey. Very stiff, moist, low to medium plasticity; sand, fine. 26.6m: minor fine sand, hard 26.8m: some fine sand			
100			N=32 5, 6 8, 6 8, 10 for 75 mm	UTP/-		RO						
								27.0				
100						ISPT						
100			N=50 12, 14 15, 17 19 for 0 mm			RC		28.0	Completely to highly weathered, grey, SANDSTONE; extremely weak. Silty fine to medium SAND; grey. Dense, moist. (PAKIRI FORMATION- TRANSITIONAL) 28.2m: series of sub vertical fractures infilled with limonite		FORMATION- TRANSITI	
100						ISPT			Highly weathered, light grey, SILTSTONE; weak. (PAKIRI FORMATION - ROCK) 28.4m: highly weathered, weak 28.9m: very steeply inclined joint 29.1m: grey 29.3m: brownish light grey		PAKIRI FORMATION - ROCK	
								29.0				
100			N=50 19, 25 35, 20			RC			29.6m: 2 very closely spaced, very steeply inclined joints, closed, planar smooth			

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Top of ridge, near levelled grassed area

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:4799
In Flow / Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 31.5m

MACHINE BOREHOLE LOG

HOLE NO.: MH09

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389188.6mE, 853492.4mN ()
DATUM: 74.59m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 04/04/2017
END DATE: 05/04/2017
LOGGED BY: WM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			for 0 mm			ISPT / RC		31.0	Highly weathered, light grey, SILTSTONE; weak. (PAKIRI FORMATION - ROCK) Highly weathered, brownish light grey, fine to medium SANDSTONE; weak. Highly weathered, brownish grey, SILTSTONE; weak. 30.5m: grey, moderately weathered 30.8m: very thin to moderately thin interbeds of moderately weathered, grey, fine SANDSTONE; moderately strong 31.3m: weak to moderately strong EOH: 31.5m 31.5m: E.O.H. (Reached target depth)		PAKIRI FORMATION ROCK	

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Top of ridge, near levelled grassed area

Water

- Standing Water Level
- Water Level At Time Of Drilling
- In Flow / Out Flow

Shear Vane

Corrected as per NZGS Guidelines
Vane No.:4799
UTP = Unable To Penetrate
+ = Peak Exceeded
- = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 31.5m

Created: 14/07/2017 11:32:14 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH10

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389404.8mE, 853347.9mN ()
DATUM: 38.92m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 03/04/2017
END DATE: 03/04/2017
LOGGED BY: WM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
60				112/38		RO			Topsoil (TOPSOIL)			
100						RO			Clayey SILT with trace sand; brown. Very stiff, moist, high plasticity; sand, fine. (COLLUVIUM)			
									0.5m: orange brown			
100			N=4 1, 0 1, 1 1, 1 for 75 mm			RO			Silty CLAY; brownish orange. Very stiff, moist, high plasticity.			
								1.0	1.2m: trace fine to medium sand, mottled red			
20				69/42		ISPT			1.6m: minor fine sand			
90						RO		2.0	Silty fine to medium SAND; red. Loose, moist to wet. Trace coarse sand to fine gravel sized cemented clasts.			
100			N=2 0, 0 0, 1 0, 1 for 75 mm			ISPT		3.0	2.9m: fine sand with some silt, no cemented clasts, very loose			
95						RO			3.7m: light grey			
									3.8m: red mottled orange			
								4.0	4.0m: orangey light grey			
80			N=0 0, 1 0, 0 0, 0 for 75 mm			ISPT			4.2m: red mottled orange			
100						RO		5.0	5.1m: greenish brown, relic bedding randomly inclined and inconsistent, limonite stained surfaces are steeply inclined			
									5.5m: orangey brown			
100			N=3 0, 1 0, 1 1, 1 for 75 mm			ISPT		6.0				
						RO			6.5m - 7.5m: core loss			
50						ISPT		7.0	7.6m: brown			
									8.0m: brownish grey mottled red orange, wet			
100			N=3 0, 1 0, 1 1, 1 for 75 mm			RO		8.0	8.2m - 8.3m: 100mm SILT with minor sand; light grey. Firm to stiff, wet, low plasticity; sand, fine. Limonite staining along relic bedding.			
									8.4m: light grey, steeply inclined fractures are closely spaced and infilled with limonite			
60						ISPT		9.0	8.9m: very closely spaced fractures infilled with oxidised			
100						RO			9.0m: brownish grey			
									9.2m: loose			

COLLUVIUM

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Moderately sloping grassed paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:4799
In Flow / Out Flow	UTP = Unable To Penetrate
	+ = Peak Exceeded
	- = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 18m

Created: 14/07/2017 11:32:15 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH10

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389404.8mE, 853347.9mN ()
DATUM: 38.92m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 03/04/2017
END DATE: 03/04/2017
LOGGED BY: WM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			N=6 1, 0 1, 1 2, 2 for 75 mm			RO			Silty fine to medium SAND; red. Loose, moist to wet. Trace coarse sand to fine gravel sized cemented clasts.			
100						ISPT			10.5m: trace medium to coarse sand			
100			N=7 1, 1 1, 2 2, 2 for 75 mm			RO		11.0	11.1m: no medium to coarse sand, oxidised staining along randomly aligned relic joints		COLLUVIUM	
100						ISPT		12.0	11.8m: very steeply inclined relic joint with smooth surfaces			
100			N=14 2, 2 3, 3 4, 4 for 75 mm	85/17		RO		13.0	13.2m: some fine sand SILT with some clay and minor sand; light grey. Very stiff, moist, medium plasticity; sand, fine. (PAKIRI FORMATION - RESIDUAL SOIL) 13.3m: trace fine sand		PAKIRI FORMATION - RESIDUAL SOIL	
100						ISPT			Silty fine SAND with trace medium to coarse sand; grey. Medium dense, moist.			
90			N=50 9, 14 25, 25 for 0 mm			RO		14.0	13.4m: two closely spaced gently inclined fractures infilled with limonite, some fine sand 14.1m: some silt 14.7m: dense, open fracture, gently inclined, infilled with 14.8m: 150mm silty			
100						ISPT		15.0	Completely to highly weathered, brownish grey, fine to medium SANDSTONE; extremely weak. Fine to medium SAND with minor silt; brownish grey.. Dense to very dense, moist. (PAKIRI FORMATION - ROCK) 15.3m: moderately weathered, moderately strong		PAKIRI FORMATION - ROCK	
100	80					RC		16.0	15.5m: moderately spaced fractures, steep to very steeply inclined, planar smooth 15.6m: unweathered, strong			
100	60	50/200/350				RC		17.0	16.9m: fracture, sub vertical, undulating smooth 17.2m - 17.5m: slightly weathered, very close to closely spaced fractures, gently to moderately inclined, undulating smooth, oxidised surfaces 17.6m: unweathered			
		20/75/450						18.0	EOH: 18m 18.0m: E.O.H. (Reached target depth)			
								19.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Moderately sloping grassed paddock

Water	Shear Vane
▼ Standing Water Level	Corrected as per NZGS Guidelines Vane No.:4799 UTP = Unable To Penetrate + = Peak Exceeded - = No Result
▽ Water Level At Time Of Drilling	
◁ In Flow ▷ Out Flow	

KGA GEOTECHNICAL

HOLE DEPTH: 18m

Created: 14/07/2017 11:32:15 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH11

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389545.7mE, 853349.3mN ()
DATUM: 21.82m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 10/04/2017
END DATE: 10/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
90				98/68		RO			Clayey SILT; orange brown. Very stiff, moist, no plasticity. Minor intermixed topsoil. (PAKIRI FORMATION - RESIDUAL SOIL) 0.3m: trace roots 0.4m: minor orange streaks 0.6m: some clay and minor fine sand, minor coarse sand sized white cemented clasts, reddish orange			
100						RO						
100			N=2 1, 0 0, 0 1, 1 for 75 mm	57/16		RO		1.0	Silty fine to medium SAND with trace to minor clay; reddish orange. Loose, moist. Some coarse sand sized cemented clasts. 1.4m: fine sandy SILT, orangey-red			
100				114/11		ISPT			1.7m: small pockets of white clay, some fine gravel sized weakly cemented clasts			
95						RO		2.0	2.0m: silty fine to medium SAND; light brown 2.1m: wet 2.3m: trace coarse sand 2.6m: minor areas of limonite staining 2.8m: minor to some coarse sand, subhorizontal thin black			
100			N=7 1, 0 1, 1 2, 3 for 75 mm	57/10		ISPT		3.0	3.0m: trace black specs			
						RO			3.5m - 4.5m: 100% core loss (sandy)		PAKIRI FORMATION - RESIDUAL SOIL	
100			N=1 0, 0 0, 1 0, 0 for 75 mm			ISPT		4.0				
						RO		5.0	4.7m: thin subhorizontal black streak			
100			N=2 0, 1 0, 0 1, 1 for 75 mm			ISPT		6.0	5.6m: coarse sand sized black specs 5.7m: silty SAND becomes very dark brown for 100mm 5.8m: 30mm black subhorizontal band 6.0m: minor clay, low plasticity			
95						RO			6.4m: moist to wet, randomly oriented black staining 6.5m: light brown mottled orange			
100			N=20 2, 2 5, 8 6, 4 for 75 mm			ISPT		7.0	7.2m: limonite stained surface 7.4m: subhorizontal thin brown streak, some fine gravel sized black specs 7.5m: medium dense, some limonite stained surfaces, some angular fine gravel sized limonite clasts			
100	100					Rotary cored		8.0	Highly weathered, greyish brown, fine to coarse SANDSTONE; weak to moderately strong. Some fine gravel sized clasts. (PAKIRI FORMATION - ROCK) 8.1m: moderately to slightly weathered, grey, strong to very strong 8.2m: unweathered, extremely strong		PAKIRI FORMATION - ROCK	
								9.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grass paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:4799 UTP = Unable To Penetrate + = Peak Exceeded - = No Result
Water Level At Time Of Drilling	
In Flow / Out Flow	

KGA GEOTECHNICAL

HOLE DEPTH: 10.5m

Created: 14/07/2017 11:32:15 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH11

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389545.7mE, 853349.3mN ()
DATUM: 21.82m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 10/04/2017
END DATE: 10/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100	100					Rotary cored			Highly weathered, greyish brown, fine to coarse SANDSTONE; weak to moderately strong. Some fine gravel sized clasts. (PAKIRI FORMATION - ROCK)		PAKIRI FORMATION - ROCK	
									EOH: 10.5m 10.5m: E.O.H. (Reached target depth)			
								11.0				
								12.0				
								13.0				
								14.0				
								15.0				
								16.0				
								17.0				
								18.0				
								19.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grass paddock

Water	Shear Vane
▼ Standing Water Level	Corrected as per NZGS Guidelines
▽ Water Level At Time Of Drilling	Vane No.:4799
◁ In Flow ▷ Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 10.5m

MACHINE BOREHOLE LOG

HOLE NO.: MH12

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389234.1mE, 853118.9mN ()
DATUM: 40.13m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 10/04/2017
END DATE: 10/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100						RO			Topsoil (TOPSOIL)		R	
100						RO			SILT with some clay; dark brown. Very stiff, moist, high plasticity. Trace roots. (PAKIRI FORMATION - RESIDUAL SOIL)			
70			N=2 1, 0 1, 0 1, 0 for 75 mm	73/26		RO			0.4m: trace fine sand, minor red bands, medium sand sized white specs			
100				61/27		ISPT		1.0	0.6m: red areas of SILT with minor clay, some medium sand sized white specs			
90						RO			0.7m: reddish brown, minor to some fine to medium sand			
100			N=4 1, 0 1, 1 1, 1 for 75 mm	52/12		ISPT		2.0	1.0m: some fine to medium sand, firm to stiff, medium			
100						RO			1.4m: some black streaks, becomes sandy SILT with some clay for 100mm			
100			N=2 0, 0 0, 1 0, 1 for 75 mm			ISPT		3.0	2.1m: minor fine sand			
100						RO			2.3m: some yellowy brown areas, black streaks occur			
100			N=1 0, 0 0, 0 1, 0 for 75 mm			ISPT		4.0	2.7m: some fine sand, trace root fibres			
95						RO			2.8m: black areas getting progressively larger			
100			N=10 1, 2 2, 2 3, 3 for 75 mm	163/21		ISPT		5.0	3.0m: some minor to coarse sand sized white cemented clasts			
100						RO			3.6m: yellowish brown area, 50mm black area			
100		50/150/200	N=2 1, 0 0, 0 1, 1 for 75 mm	32/3		ISPT		6.0	4.2m: 50mm lense of clayey SILT; light grey mottled red			
100		100/800/1200				RO			Sandy SILT with minor clay; reddish pink mottled yellowy brown. Firm to stiff, moist to wet, low plasticity; sand, fine. Black streaks throughout.		PAKIRI FORMATION - RESIDUAL SOIL	
								7.0	5.7m: 30mm band of black silt			
									6.5m: coarse sand to fine gravel sized white and pink cemented clasts throughout			
								8.0	7.2m: 100mm lense of horizontal relic bedding, beds are clayey SILT			
									7.7m: black streaks are very steeply inclined			
								9.0	8.2m: 100mm lense of horizontal relic bedding			
									8.8m: 50mm black staining, some fine to medium gravel sized cemented clasts			
									9.0m: light brown with pockets of silt with minor clay			
									9.5m - 10.5m: Core loss (100%)			

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grass paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:1984
In Flow / Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 21m

Created: 14/07/2017 11:32:16 a.m.

MACHINE BOREHOLE LOG

HOLE NO.: MH12

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389234.1mE, 853118.9mN ()
DATUM: 40.13m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 10/04/2017
END DATE: 10/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
80			N=1 0, 1 0, 0 0, 1 for 75 mm			RO			Sandy SILT with minor clay; reddish pink mottled yellowy brown. Firm to stiff, moist to wet, low plasticity; sand, fine. Black streaks throughout.			
						ISPT			10.6m: light grey			
100			N=50 1, 2 9, 20 21 for 0 mm	49/3		RO		11.0	11.0m: fine to coarse gravel sized angular white cemented clasts, clasts are clayey SILT 11.1m: thin relic bedding with limonite staining 11.4m: 50mm lense of silty SAND with coarse sand to fine gravel sized angular limonite clasts 11.6m: trace to minor coarse sand 11.7m: 30mm lense of coarse sand to fine gravel sized angular limonite clasts		PAKIRI FORMATION - RESIDUAL SOIL	
100						ISPT		12.0				
100			N=50 18, 32			RC		13.0	Slightly weathered, dark grey, fine to coarse SANDSTONE; very strong. 12.8m: completely weathered 12.9m: Extremely weak. Sandy SILT; light brown. Very stiff, wet, no plasticity; sand, fine to coarse. 13.0m: fine gravel sized clay clasts 13.1m: limonitic soil bands, hard 13.5m: limonitic banding			
50			for 0 mm			ISPT						
100						RC		14.0	Sandy SILT; light grey. Firm, wet, low plasticity; sand, fine. 13.7m: very steeply inclined fracture infilled with limonite			
									Sandy SILT; light brownish grey. Very stiff, moist, low plasticity; sand, fine. 14.4m: minor coarse sand, occasional limonitic staining			
100						RC		15.0	Completely weathered, greyish brown, fine to coarse SANDSTONE; extremely weak. Fine to coarse SAND with some silt; greyish brown. Dense, moist. (PAKIRI FORMATION-TRANSITIONAL) 14.5m: zone with minor cemented limonite (50mm) 14.7m: steeply inclined fracture infilled with limonite		PAKIRI FORMATION- TRANSITIONAL	
100			N=50 15, 18 27, 23					16.0	15.2m: very steeply inclined joints with limonite staining, closely spaced 15.5m - 15.7m: 3 closely spaced, steeply inclined fractures infilled with limonite 15.8m: sand is fine			
			for 0 mm			ISPT			15.9m: moderately inclined fracture infilled with limonite and a sub vertical fracture with limonite staining 16.2m: light brownish grey			
100			N=50 22, 28			RC		17.0	16.6m: minor medium to coarse sand 16.7m: subvertical joist with limonite staining 16.8m: very steeply inclined fracture infilled with limonite 17.0m - 17.4m: subvertical joint with limonite staining			
			for 0 mm			ISPT		18.0	17.6m - 18.0m: subvertical joist infilled with limonite			
100	29		N=50 21, 29			RC		19.0	18.3m: highly weathered, very weak 18.5m: very steeply inclined joint with oxidised mineral staining Highly weathered, light grey, fine to coarse SANDSTONE; very weak. Gritty, grit is fine gravel sized clasts. (PAKIRI FORMATION - ROCK) 19.0m: very steeply inclined fracture infilled with limonite 19.3m: weak 19.5m: gently inclined joint with limonite staining 19.6m - 19.8m: 2 very steeply inclined fractures infilled with limonite 19.9m: fine sandstone, sub horizontal joints		PAKIRI FORMATION - ROCK	
			for 0 mm			ISPT						

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grass paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines
Water Level At Time Of Drilling	Vane No.:1984
In Flow / Out Flow	UTP = Unable To Penetrate + = Peak Exceeded - = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 21m

MACHINE BOREHOLE LOG

HOLE NO.: MH12

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389234.1mE, 853118.9mN ()
DATUM: 40.13m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 10/04/2017
END DATE: 10/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100	100					RC		0.0	Highly weathered, light grey, fine to coarse SANDSTONE; very weak. Gritty, grit is fine gravel sized clasts. (PAKIRI FORMATION -		PAKIRI FORMATION - ROCK	
									Slightly weathered, grey, fine SANDSTONE; moderately strong. Occasionally gritty.			
									20.2m: gently inclined fracture			
									20.4m: unweathered, strong			
									Unweathered, grey, CONGLOMERATE; strong. Grain sizes from fine sand to coarse gravel.			
								21.0	Unweathered, grey, SILTSTONE; strong.			
									21.0m: E.O.H. (Reached target depth)			
								22.0				
								23.0				
								24.0				
								25.0				
								26.0				
								27.0				
								28.0				
								29.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grass paddock

Water	Shear Vane
▼ Standing Water Level	Corrected as per NZGS Guidelines Vane No.:1984
▽ Water Level At Time Of Drilling	UTP = Unable To Penetrate
◁ In Flow ▷ Out Flow	+ = Peak Exceeded
	- = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 21m

MACHINE BOREHOLE LOG

HOLE NO.: MH13

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389371.8mE, 853084.6mN ()
DATUM: 23.39m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 07/04/2017
END DATE: 07/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100						RO			Topsoil (TOPSOIL)		R	
100				137/52		RO			Clayey SILT; greyish brown. Very stiff, moist, high plasticity. Minor root fibres. (ALLUVIUM)			
									0.4m: trace fine sand, greyish brown mottled orange, trace			
									0.8m: greyish brown, minor reddish orange patches			
100			N=2 0, 0 1, 0 0, 1 for 75 mm	79/43		RO		1.0				
100				61/31		ISPT			1.4m: silty CLAY, dark greyish brown, stiff to very stiff			
40						RO		2.0				
			N=0 0, 0 0, 0 0, 0 for 75 mm	40/21		RO		3.0	Organic clayey SILT; dark brown with black areas. Firm, moist, wet, medium plasticity. Contains fragments (1-5mm) fibrous decaying matter.			
									3.4m: some decaying wood fragments throughout (1-20mm)			
100						RO		4.0	3.9m: organic silty CLAY			
									4.1m: wood fragment (100mm)			
									4.2m: chunks of decaying wood throughout			
100			N=1 0, 0 0, 1 0, 0 for 75 mm	15/3		ISPT					ALLUVIUM	
100						RO		5.0	4.9m: soft to firm			
									5.2m: organic material smaller in size (1-10mm)			
									5.5m: firm to stiff			
			N=0 0, 0 0, 0 0, 0 for 75 mm	21/5		ISPT		6.0	6.0m: minor organics			
									6.1m: some organics			
									6.3m: soft to firm			
90						RO		7.0	6.7m: light greyish brown			
			N=0 0, 0 0, 0 0, 0 for 75 mm	15/2		ISPT			Sandy SILT with some clay; brownish grey. Stiff, moist, medium to high plasticity; sand, fine.			
100						RO		8.0	8.0m: minor fibres of black organics			
									8.5m: stiff to very stiff			
									8.7m: some organic content (~30mm)			
			N=3 0, 1 0, 1 1, 1 for 75 mm	95/15		ISPT		9.0	8.9m: low plasticity, very stiff			
100						RO			9.2m: some organics			
									Silty CLAY; brownish grey. Firm, moist, high plasticity.			
									9.7m: rotting wood fragment (50mm)			

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grass paddock

Water	Shear Vane
Standing Water Level	Corrected as per NZGS Guidelines Vane No.:1984
Water Level At Time Of Drilling	UTP = Unable To Penetrate
In Flow / Out Flow	+ = Peak Exceeded
	- = No Result

KGA GEOTECHNICAL

HOLE DEPTH: 16.5m

MACHINE BOREHOLE LOG

HOLE NO.: MH13

CLIENT: SF Estate Limited
PROJECT: Geotechnical Investigation

JOB NO.: K170277

SITE LOCATION: Stubbs Farm
CO-ORDINATES: 389371.8mE, 853084.6mN ()
DATUM: 23.39m
RIG: Tractor Mounted Rig **OPERATOR:** DCN Drilling Ltd

START DATE: 07/04/2017
END DATE: 07/04/2017
LOGGED BY: RM
CHECKED BY: JP

TCR (%)	RQD (%)	Fracture Spacing (min/av/max)	SPT	Vane Shear Strength (kPa)	Ground Water	Method	Sample	Depth	Description	Graphic Log	Geological Unit	Installation
100			N=1 0, 0 0, 0 0, 1 for 75 mm	43/12		RO			Silty CLAY; brownish grey. Firm, moist, high plasticity. 10.2m: minor organic		ALLUVIUM	
100						ISPT						
100			N=6 0, 0 1, 1 2, 2 for 75 mm	38/12		RO		11.0	Silty fine to coarse SAND; dark grey. Loose, moist. (PAKIRI FORMATION - RESIDUAL SOIL) 11.6m: SILT with some fine sand 11.7m: 100mm lense of CLAY 11.9m: SILT with some fine sand 12.1m: silty fine to coarse SAND 12.5m: sandy SILT with some clay, medium plasticity 12.9m: Reddish orange; extremely weak. Silty fine SAND; reddish orange. Loose, moist.		PAKIRI FORMATION - RESIDUAL SOIL	
100						ISPT		12.0				
100						RO						
100	63	20/40/100	N=50 50, 0 0, 0 0, 0 for 0 mm			RC		13.0	Completely weathered, grey, fine to medium SANDSTONE; extremely weak. Sandy SILT with some clay; grey. Very stiff, moist, medium plasticity. (PAKIRI FORMATION - ROCK) 13.0m: very weak, some limonite staining, light brown 13.2m: 4 fractures, very closely spaced, gently inclined, undulating smooth, limonitic staining on surfaces 13.4m: trace coarse sand sized clasts, minor black specs 13.5m: slightly weathered, grey, strong to very strong		PAKIRI FORMATION - ROCK	
100	100					Rotary cored		14.0				
								15.0	15.6m - 15.8m: fine to coarse gravel sized clasts			
								16.0	EOH: 16.5m 16.5m: E.O.H. (Reached target depth)			
								17.0				
								18.0				
								19.0				

Notes & Abbreviations

Soils logged in accordance with 'The guidelines for the classification and description of soil and rock for engineering purposes' December 2005, NZGS

REMARKS

Gently sloping grass paddock

Water	Shear Vane
▼ Standing Water Level	Corrected as per NZGS Guidelines Vane No.:1984 UTP = Unable To Penetrate + = Peak Exceeded - = No Result
▽ Water Level At Time Of Drilling	
◁ In Flow ▷ Out Flow	

KGA GEOTECHNICAL

HOLE DEPTH: 16.5m

Created: 14/07/2017 11:32:16 a.m.

Appendix 3

Relevant Test Records From New Zealand Geotechnical Database

DRILLWELL EXPLORATION N.Z. LIMITED

DRILLING CONTRACTORS

DAILY LOG SHEET

15461 FILE WC/150/1

LOG No. 25221

P.O. BOX 360 MANUREWA

Client: Rodney D.C. Council

Date: 17-9-96

Consultant/Engineer:

Rig No: 15

Location: View Road Warkworth

Tender Truck No: 19

Purpose of Bore: 100 mm Test Hole

Compressor No:

Bore Size: 100 mm Map Reference No: R09 588319

Bore Hole No: 1.

Permit No: C512-12-1819

Work Details:

Arrival at site with equipment

Planked trucks over a runaway due to steep slope.

Set and levelled up rig over drilled peg

Cut slush pit dug

unloaded gear.

Set up pumping station

Drilled 150 mm hole to 22 metres Having 80% circulation loss

Mixed up mud and bran to seal up formation for fluid return

Pulled back rods.

Ceased work.

Bore Log: (lost circulation

0m - 14 Brown Sandy silt

14 - Brown Fine Sandy silt with ~22 weathered Sandstone layers

13 NOV 1996 ON GTGS

BC - 5332.

GROUNDWATERS

W.R. No.

NAME Rodney D.C.

TECHNICAL FILES C512/12/1819

RB ACTIONED

BORE LOG ✓

PUMP TEST

COMPUTER ✓

WATER QUAL

Materials Used: 10 Bags Rhagol

1 bag Pac R x 25 kg

1 bag bran

Digger Hire.

Start Time: 11.30a **Finish Time:** 6.00p **Total Time:** 6½ hrs **Meals and Other Breaks:** ✓

Drill Rig Km	92 km	Rig Working Hours:	6½ hrs	Client's Representative:	
Water Tender Truck Km	92 km	Compressor Hours			
6 x 6 Crane Truck Km		DH Hammer Hours		Drill Crew:	2 Brown
Lt. Rig Towing Truck Km		Contract Rates			
Utility or Van Service Km	2 Km	Travel Hours		Driller:	D Brown
Other		Other			

NZGD Ref 82617

1/2

DRILLWELL EXPLORATION N.Z. LIMITED
DRILLING CONTRACTORS
DAILY LOG SHEET

LOG No. 25222

P.O. BOX 360 MANUREWA

Client: Rodney D. Stud Council

Date: 18-9-96

Consultant/Engineer:

Rig No: 15

Location: View Road

Tender Truck No: 19

Purpose of Bore: 100 mm test Hole

Compressor No:

Bore Size: 100 mm Map Reference No: R09 588319

Bore Hole No:

Permit No:

Work Details:

lowered rods.
Added mud & bran
to flush pit.
D.W 150 mm hole to
91-70 with no fluid
return. Filled Out.
Installed 100 mm casing
mixed up mud and
pumped behind casing.
lowered 100 mm collars
and rods.
ceased work

Bore Log:

22 - 41 weathered sandstone
Firm / Hard
41 - 91-70 waitemata Hard sandstone
with v Hard bands

Total water loss at
70 metres.

Materials Used: 8 Bags Blaogel
3 Liters quikmud
1 bag bran
92-0 metres 100 mm casing

Start Time: 7-00 **Finish Time:** 6.45 p **Total Time:** 11¾ hrs **Meals and Other Breaks:** ✓

Drill Rig Km	:	Rig Working Hours:	: 11¾ hrs	Client's Representative:	
Water Tender Truck Km	:	Compressor Hours	:		
6 x 6 Crane Truck Km	:	DH Hammer Hours	:	Drill Crew:	Z Brown
Lt. Rig Towing Truck Km	:	Contract Rates	:		
Utility or Van Service Km	: 4 km	Travel Hours	:	Driller:	D. Gunn
Other	:	Other	:		

NZGD Ref 82617

2/2

Walkato Valley Authority

Ground Water

Auckland Regional Authority

BC 1977 ✓ Filed

DRILLERS' LOG FORM

R09 584330

WELL OWNER TOM MULLIGAN LOCALITY MAIN ROAD WARKWORTH

ADDRESS 2 MILL STREAM PLACE W.WTH MAP SHEET No. N34 165 160 . Bore local ±

DRILLING FIRM G & G DRILLING GRID REFERENCE

DRILLER P. Grond WELL No. JOB No.

Date of Starting 2ND FEBRUARY 1978 Date of Finishing 21ST FEBRUARY 1978

STRATA

Depth From Surface Top	Bottom	Description of Ground Passed Through
0'	14'	YELLOW CLAYS
14'	18'	PUGGY GREEN MUD
18'	35'	GREEN/GREY MUDSTONE
35'	252'	FIRM LIMESTONE
252'	293'	LIME/TRACES SANDSTONE
293'	294'	LAYER FINE SHINGLE
294'	315'	SANDSTONE
315'	336'	SANDSTONE/SHINGLE

Reduced Level of Well Site (m)

Max. Drawdown (m)

At (Litres/Min.)

Casing Diameter (~~cm~~) 3"

Length (m) 210 FT

Screen

Pump Depth (~~m~~) 63 FT

Static Water Level* (~~m~~) 25 FT

Yield 700 GALS/HR (~~Litres/Min.~~)

Water Quality

Hour Meter Reading

*or Artesian Head

Remarks TESTED BORE AT 294 FT SUPPLY 200 GALS/HR ADVISED TO CARRY ON. CASED BORE TO 210 FT WITH 3" PVC.

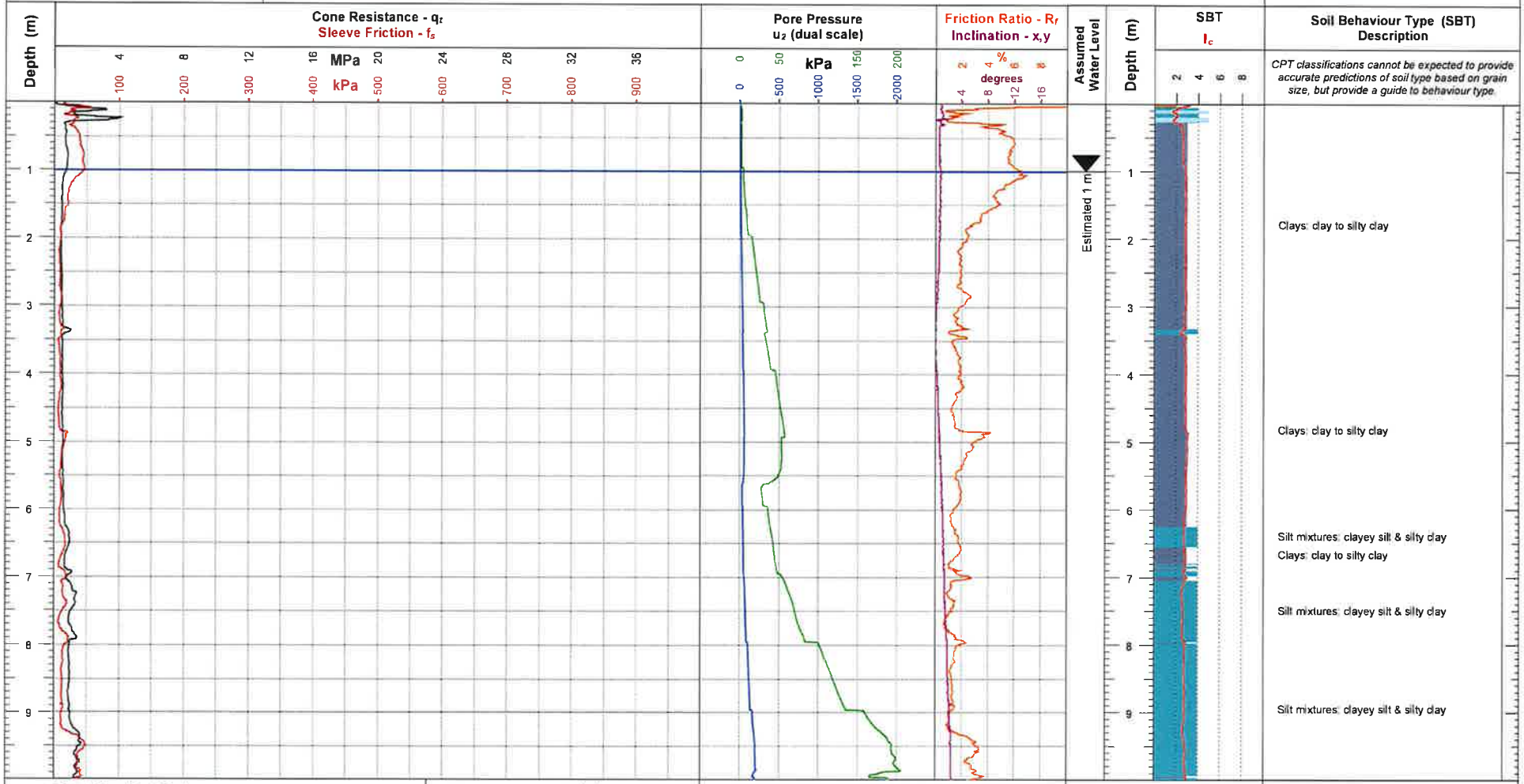
RICE PRINTERS

NZGD REF 79704

Tonkin+Taylor

CONE PENETRATION TEST (CPT) LOG

GROUND INVESTIGATION



Client: Tonkin + Taylor
Project: 24 Hudson Road
Location: Warkworth, Auckland
Engineer: Luke Storie
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Tony Whitelaw
Cone Ref: MKJ335
Cone Type: 10 cm² Compression Piezocone
Area Ratio: 0.8
Filter Type: u2

NZTM2000 N,E (m): 5971082.14, 1747849.68
WGS84, (deg): 174.648621, -36.394048
Location Method: Handheld GPS
Surveyor: N/A

Elevation (m): -
Date of Test: 8/08/2017
Depth (m): 17.54
Pre-Drill (m): N/A

Client Job Ref:

CPT Number: CPT-01

Termination Reason: Limit of reaction force

G.I. Job Ref: 17-430

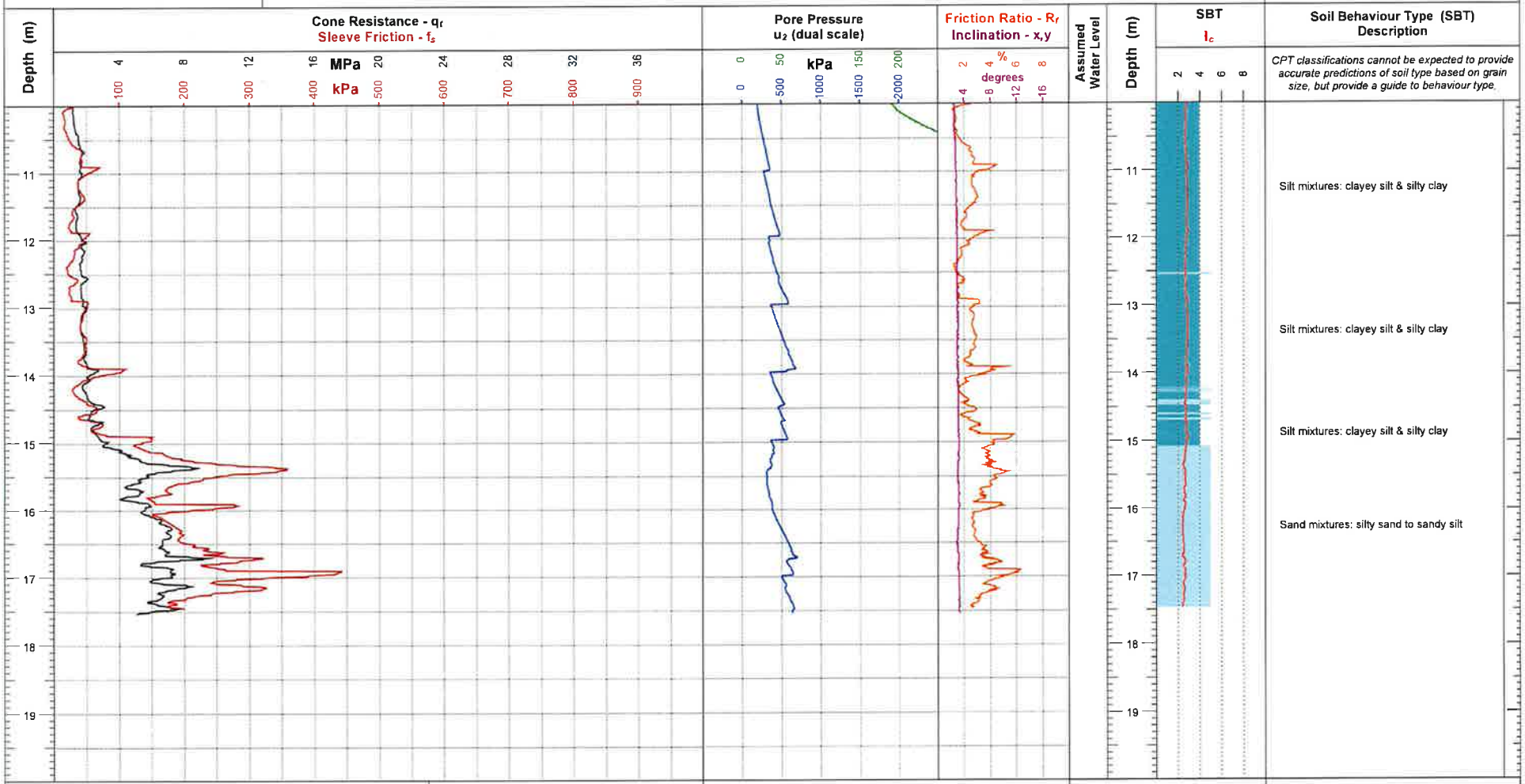
Remarks: Mixed fill at surface

NZGDRC 106213 1/2

Tonkin+Taylor

CONE PENETRATION TEST (CPT) LOG

GROUND INVESTIGATION



Client: Tonkin + Taylor
Project: 24 Hudson Road
Location: Warkworth, Auckland
Engineer: Luke Storie
Contractor: Ground Investigation Ltd. www.g-i.co.nz

Operator: Tony Whitelaw
Cone Ref: MKJ335
Cone Type: 10 cm² Compression Piezocone
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NZTM2000 N,E (m): 5971082.14, 1747849.68
WGS84, (deg): 174.648621, -36.394048
Location Method: Handheld GPS
Surveyor: N/A
Termination Reason: Limit of reaction force

Elevation (m): -
Date of Test: 8/08/2017
Depth (m): 17.54
Pre-Drill (m): N/A

Client Job Ref:
CPT Number: CPT-01
G.I. Job Ref: 17-430

Remarks: Mixed fill at surface

NZGD REF 106213
2/2