REPORT

Tonkin+Taylor

Beachlands South Structure Plan Change

Geotechnical Report

Prepared for
Beachlands South Limited Partnership
Prepared by
Tonkin & Taylor Ltd
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1 Introduction

1.1 Background

Tonkin & Taylor Limited has been commissioned by Beachlands South Limited Partnership (care of Russell Property Group) to undertake a geotechnical assessment of the proposed Structure Plan and private plan change for the Beachlands South site. We have carried out this work in accordance with our proposal of 25 August 2021[1].

The site encompasses the existing Formosa Golf Resort, the large farm properties to the south, and smaller rural properties along Whitford Maraetai Road. The site comprises an area of approximately 307 hectares of land south of the existing Beachlands township and the Pine Harbour Marina, as shown in Figure 1.

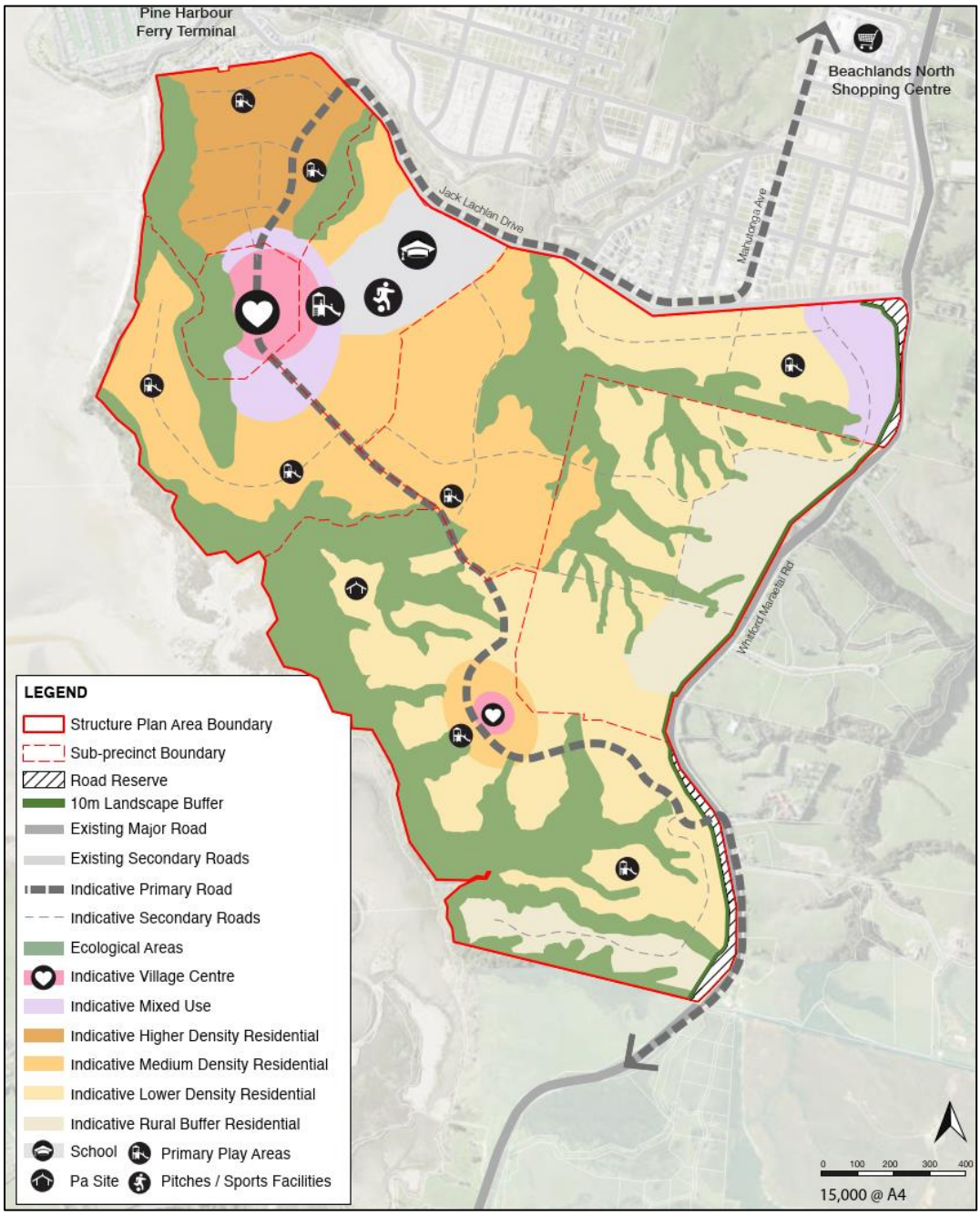


Figure 1: Proposed Structure Plan

Figure 1 also shows the indicative roading, areas of use and ecological overlay areas for the proposed structure plan. Details of the proposed structure map are included in Appendix A.

In preparing this preliminary report we have developed a ground model based on site inspections, published geological maps, historical aerial photographs, Auckland Council property files, historical geotechnical investigations in the area, and new boreholes put down across the site in November 2021.

1.2 Proposed Structure Plan and Private Plan Change

As shown in Figure 1 above, the Structure Plan proposes a village centre in the northwest of the site, with a central business village centre surrounded by mixed used land and higher density housing, giving way to medium and lower density housing with increasing distance from the centre. Ecological overlays and open space areas are proposed throughout the Plan area, generally in gullies, coastal areas and as linkages between key locations. A secondary mixed use area is proposed at the north-eastern corner of the Plan area, adjacent to Whitford Maraetai Road.

The Plan Change provides for the rezoning of the land from Rural-Countryside Living to a combination of Business, Open Space, Residential and Future Urban zones.

1.3 Purpose of this report

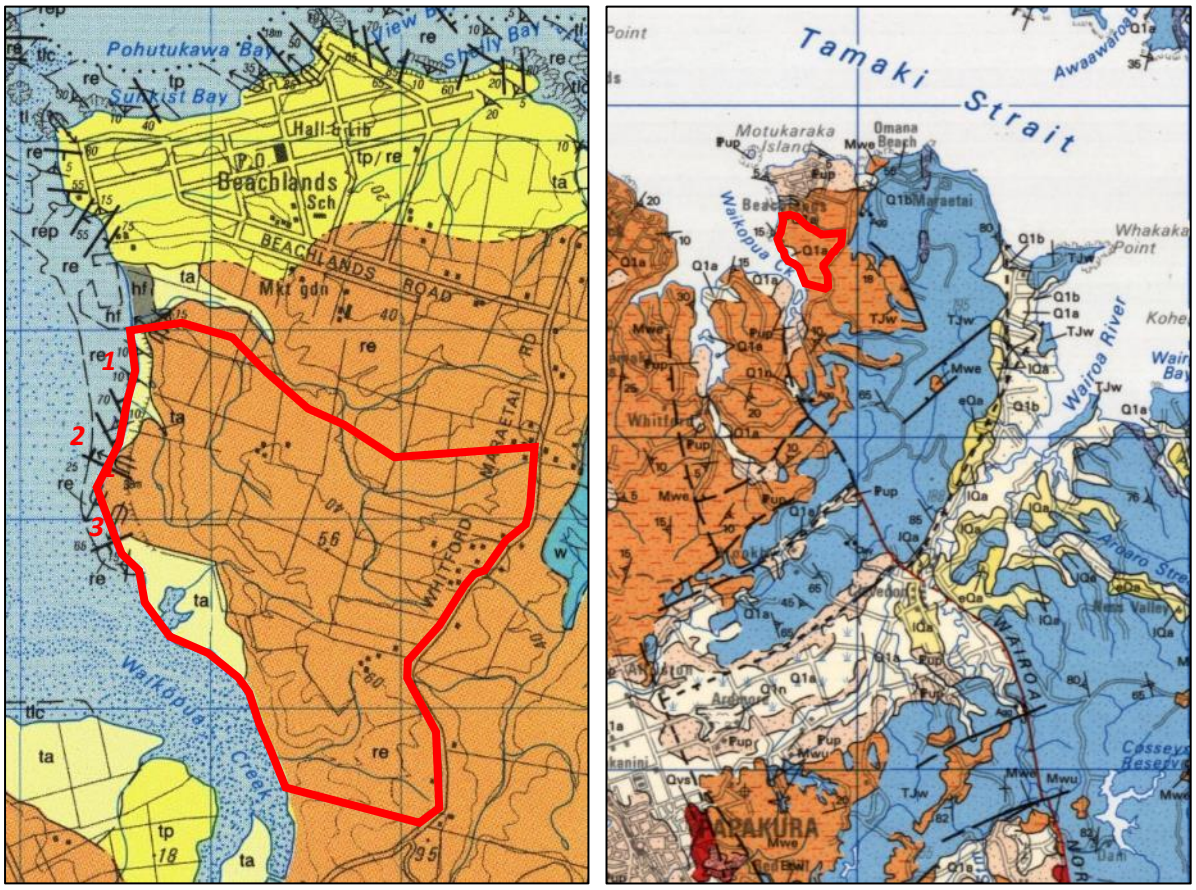
This report has been prepared to support the Structure Plan and related plan change application for Beachlands South, and to assist Auckland Council and decision makers in approving this application in accordance with the Resource Management Act 1991. The purpose of this report is to identify the potential geotechnical effects of the Structure Plan and Plan Change and identify appropriate measures that will mitigate these effects and enable the anticipated future development.

2 Review of geotechnical information

2.1 Regional geology

As shown on the geological maps shown in Figure 2, the site is expected to be generally underlain by East Coast Bays Formation flysch, consisting of alternating beds of greyish grey, muddy sandstone and siltstones East Coast Bays Formation with occasional undifferentiated Tauranga Group alluvium comprising mud, sand and gravel located along the coast, and within the stream channels across the site. No argillite or greywacke is expected at the location of the site, the nearest expression of Waipapa Group greywacke on the eastern side of the Whitford – Maraetai Road.

Inactive faults have been mapped to the east and south of the site. The nearest known active fault is the Wairoa North fault, approximately 6.5 km to the south (marked in red in Figure 2).



ta	Holocene Tauranga Group, undifferentiated alluvium
re	Miocene Waitemata Group, East Coast Bays Formation, flysch
w / TJw	Jurassic Waipapa Group, massive to thin-bedded, lithic volcaniclastic sandstone and argillite

Figure 2: Published geological maps of the location (site outlined in red).
***Left:** 1:50,000 scale map showing general geology of the site. Faults labelled 1, 2, 3 are discussed in section 3.4 of this report.*
***Right:** 1:250,000 scale map showing regional geology and proximity to faults. Source: IGNS[23].*

2.2 Historical aerial photography

A range of historical aerial photography and satellite imagery is available for the Beachlands area between the years of 1939 and 2017. The table below presents any change in the use of the site, and in the surrounding area over time. Historical aerial photography is presented in Appendix B.

Table 1: Observed land use visible in historical aerial photos

Year of imagery	Changes in land use
1939	Beachlands is lightly populated. There is very light farming activity in the Formosa site area.
1955	A few houses are visible in the Formosa site area, and light farming activity.
1961	No change from 1955.
1972	More intensive farming, more small structures, and valleys have been bridged by either structures or infilling.
1980	More structures but generally little change since the 1972 photo.
1996	Earthworks for construction of Formosa Golf Resort. Pine Harbour marina appears in the photo.
2001	Formosa Golf Resort in operation.
2017	Housing developments beginning in the property north of Formosa Golf Resort.

It is evident in the 1996 aerial photo (Appendix B) that earthworks took place across the entire Formosa site during creation of the golf course. Interpreted areas of cut and fill are presented in Figure 3, below. The aerial photos show that a number of gully features were infilled as part of the earthworks. It is unknown what preparation was carried out, nor if underdrains were installed. Certification of the earthworks has not been found during our desktop review; however hand augered boreholes put down through the fill in 2016 by Lander Geotechnical Consultants[4] and recently by Tonkin & Taylor in November 2021 encountered very stiff to hard silt/clay materials, indicating good compaction. Given the age of the fill, it is also likely that any settlements associated with self-weight of the earthworks should be effectively complete by now.

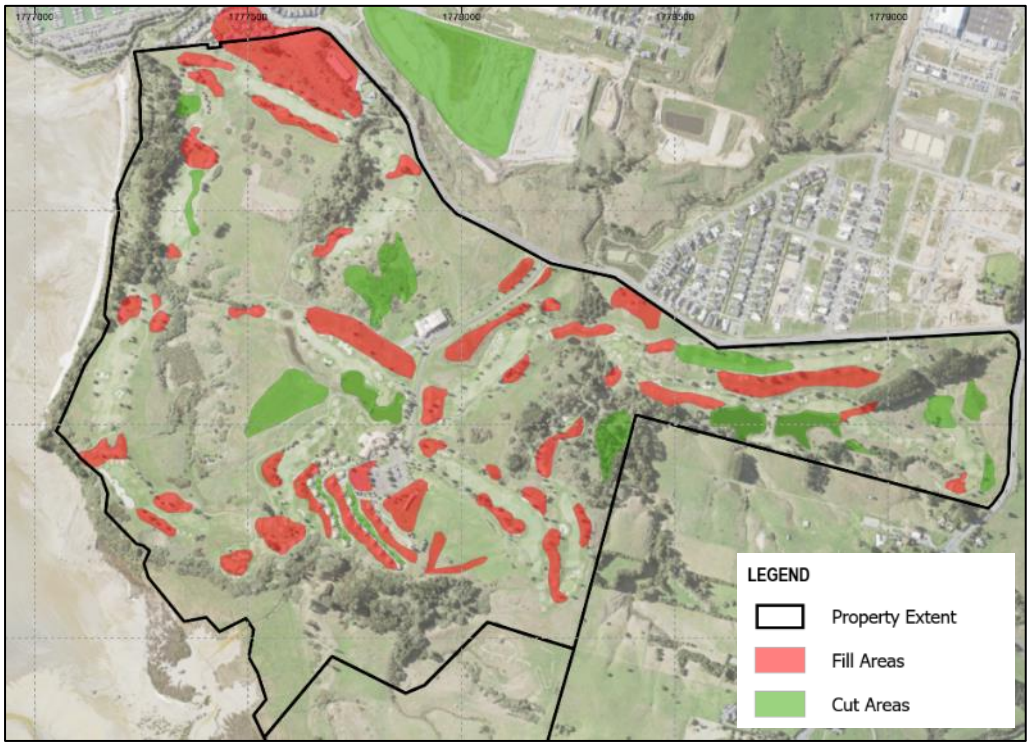


Figure 3: Areas of cut and fill, inferred from review of historical aerial photos.

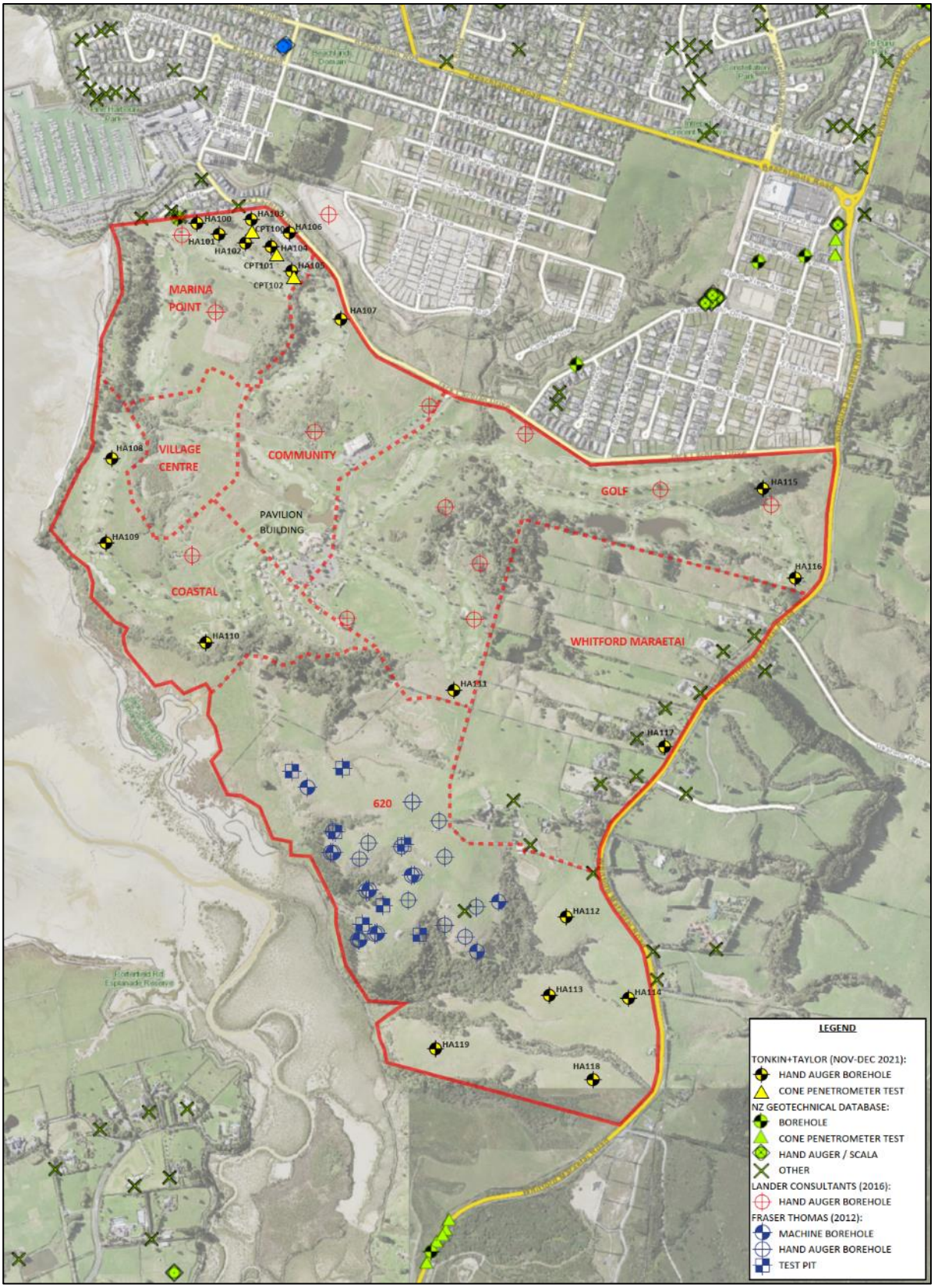


Figure 4: Known geotechnical investigations. It is understood that Foundation Engineering also carried out site investigations within the Formosa Golf Course in the mid-1990s (not shown here).

2.3 Historical geotechnical site investigations

A review of available records shows that there are a number of previous investigations within the Plan Change area, as shown in Figure 4. Partial records of investigations at the golf course pavilion building[5] have also been reviewed, however they are not shown on the investigation plan as this was not included in the documentation.

The investigations in the area were carried out using a range of techniques. The water bore drillholes (marked with a green X on Figure 4) are generally of less use for characterising near surface soils, but they do confirm the larger-scale geology of the site. The hand augered boreholes, machine boreholes and excavated test pits are of significantly more use to this project, as they typically describe the thickness, composition, behaviour and strength of the soils within 3 to 30 m depth of the ground surface at the time of investigation. In general, the historical site investigations support the geological model shown on the geological maps, comprising localised Tauranga Group alluvium in natural watercourses, overlying Waitemata Group overlying Waipapa Group at depth.

In the main "township" of Beachlands to the north, several hand auger logs describe the Tauranga Group as highly variable, containing both highly dilatant volcanic ash derived deposits (i.e. with very little clay content), and organic soils.

A selection of relevant historical investigation data is presented in Appendix D.

2.4 November – December 2021 geotechnical site investigations

Twenty hand augered boreholes were put down across the site during November and December 2021 at the locations shown in Figure 4, to supplement the existing historical investigation data. The boreholes were targeted in areas where existing investigation information was sparse, where more dense development is proposed in the north-western precincts, and in the northern extent of the site where historical filling occurred. Three Cone Penetrometer Tests (CPTs) were also put down in the northern fill area.

The full borehole and CPT logs are enclosed in Appendix C.

2.5 Site walkovers

Site walkovers are useful for making visual observations of geological features such as slope instability and historical earthworks. Senior Engineering Geologists from Tonkin + Taylor walked over the site on 11 July 2019 and 3 July 2020.

The Golf Course was viewed during both visits, with a focus on cut/fill for the golf course construction, land instability and erosional features. One noticeable land instability location was observed adjacent to Jack Lachlan Drive. A series of gullies were observed with surface water streams in the base. Some of these were incised indicating defined catchment areas for rainfall.

The 2020 visit also incorporated a walkover commencing at the Marina and continuing south-westwards towards 620 along the beach and into the tidal estuary. A series of coastal slope failures were observed with high angle falls and topples in the rock (several locations) and rotational semi-circular slips in the overlying soils (one main feature observed). There were also two prominent debris fans extending from the coastal slopes into the coastal zones, both were a result of an accumulation of sediment from surface water drainage channels.

Our observations are incorporated into the following sections of the report.

3 General ground model

General geological units which are expected to be encountered across the site are described below. Ground conditions are discussed in more detail in section 5 of this report.

3.1 Topsoil

The investigations within the site generally encountered 100 to 300 mm thickness of topsoil, overlying East Coast Bays Formation soils.

3.2 Fill

Localised fill materials associated with the golf course earthworks were encountered in some investigation boreholes, extending to 0.8 to 2.4 m depth. This fill is reworked ECBF soil from within the site, and was generally found to be very stiff to hard.

The recent hand auger borehole and CPT investigations around the maintenance shed in the north of the site encountered marina dredgings (HA103, HA104, HA105, CPT100, CPT101, CPT102 shown on Figure 4). This material was encountered at the ground surface, extending to approximately 2 to 6.5 m depth, generally comprising stiff to hard silt mixtures with some sand and traces of shells.

Marina dredgings comprising black silt intermixed with shell fragments was also encountered at the ground surface on the coastal slopes in the 620 Precinct, to 200 to 300 mm depth (locally 900 mm depth in one area).

3.3 Tauranga Group

In general, Tauranga Group alluvial soils are anticipated to be rare within the Structure Plan and Plan Change area, mainly confined to gully areas and the coast. Recent alluvial deposits ("Tauranga Group") were only found in one borehole, HA115, which was put down at the base of a gully at the northeast of the Structure Plan and Plan Change area. These firm to stiff deposits contained a mixture of silts, clays, sands and gravels, and are likely to comprise redeposited uncontrolled fill, possibly related to the construction of the Whitford Maraetai Road. The deposits extended to 2 m depth at HA115, and are expected to be very limited in extent, i.e. only present at the base of the gully.

The geological maps identify Tauranga Group soils to the north of the site, and they have been identified in boreholes and are exposed in cliff faces to the north of the Marina. Boreholes north of the Plan Change area and in the main township of Beachlands encountered Tauranga Group alluvium (Puketoka Formation), described largely as stiff to very stiff, grey silty clay to clayey silt. However variation exists, with beds of organic clay (HA01) which was black, very stiff and of medium plasticity, and layers of hard, white, dilatant silt, which is probably redeposited materials derived from rhyolitic volcanic ash.

3.4 East Coast Bays Formation (Waitemata Group)

East Coast Bays Formation (ECBF) of the Waitemata Group underlies much of the Auckland isthmus. Soils weathered from the ECBF rock were widely encountered across the site, below topsoil (or fill/alluvium). The soils generally comprised silts and clays, with occasional thin beds of sand or sandy silt. The ECBF soils were generally very stiff, occasionally stiff or hard.

Colluvium (soil accumulating at the foot of a slope) was encountered at one location in the south of the site, comprising very stiff clayey silt arising from ECBF soil which had slipped off the slope.

ECBF weathered rock is generally expected to be present below 1 to 10 m depth below natural ground level, comprising alternating beds of greenish grey muddy sandstone and siltstones. Bedding dips to the north (~50°) in the northern part of the Structure Plan area, changing to south (~240°) through the fold axis which plunges northwest. The bedding is then disrupted by faulting, dipping between 10° northwest to 15° west. Slightly flatter dip angles were observed in the 620 Precinct by Fraser Thomas[6], of approximately 3° to 5° to the horizontal in a westerly to north-westerly direction. No clay seams, slickensided joint surfaces or disturbed/fractured zones were observed by Fraser Thomas in the machine boreholes or test pits put down in the 620 Precinct.

There are four faults shown on the geological map (Figure 2), which are described as, from north to south:

1. two normal fault dipping 70º to the northeast into the coastal slope (striking NW-SE).
2. a reverse fault with 38m throw (displacement) dipping 25º to the North, perpendicular to the coastal slope (striking E-W).
3. a normal fault dipping 25º to the southeast, perpendicular to the coastal slope (striking NE-SW).

3.5 Groundwater

Many of the hand augered boreholes did not encounter groundwater within 4 m of the ground surface. Other boreholes in the area encountered perched groundwater at varying depths (0.7 to 18 m depth). Perched and transient groundwater could therefore be encountered at various depths through the ECBF profile above sea level, and there is also potential for it to be perched within the earthworks fill on the site.

4 Slope stability

4.1 Shallow instability near Jack Lachlan Drive

During our site visits during 2019 and 2020, it was evident that a local cut slope adjacent to Jack Lachlan Drive has become destabilised, displaying clearly visible scarp and a toe almost affecting one of the fairways, as can be seen in Figure 6 and Figure 7. The toe of this instability is clearly visible in the aerial photos (Figure 5), and it also appears that the movement has regressed across Jack Lachlan Drive. The road pavement in this location shows evidence of remediation, probably as a direct result of this slope movement.

No other clear evidence of land slippage was observed during our brief site visit, but the potential for other areas of instability within the Formosa Golf Resort site cannot be ruled out at this stage.

Figure 5: Aerial photo of slope failure adjacent to Jack Lachlan Drive

Figure 6: Headscarp of instability adjacent to Jack Lachlan Drive

Figure 7: Toe of instability near Jack Lachlan Drive

4.2 Stability of coastal slopes

The western edge of the plan change area consists of steep slopes down to the coast. These appear to be relatively stable, with only small areas of instability within the ECBF soils. A larger slip feature is located midway along the western edge of the Plan Change area (Figure 8), where a semi-circular evacuated feature is evident. This feature predates photographs taken in 1939 (Appendix B), and is still evident in the satellite photos today. The contour map shown in Figure 8 suggests this may be a drainage pathway, which on regression has instigated mass movement.

Figure 8: Contour map of coastal instability (source: LINZ).

The Fraser Thomas geotechnical report[6] for the area in the north of the 620 Precinct (shown in Figure 4 above) includes a detailed review of slope stability for this area. Their review focussed on the terraced coastal slopes in the 620 sub-precinct, which are particularly visible in the 1961 aerial photo (Figure 9), as their shape could potentially indicate ancient or historical slope movement. This would involve bedding plane failures in the ECBF materials. On the basis of site investigation boreholes, test pits and slope stability analyses, Fraser Thomas concluded that these terraces (or "benches") do not represent ancient or historical slope movement, and their opinion was that they were formed due to differential coastal erosion processes at a time when sea levels were higher than they are today. Fraser Thomas concluded that deep-seated (large scale) block slide movement is unlikely to occur, and that the main risk to housing development is defined by shallow seated soil veneer failures.

In our view, the steepness of the slope faces also tend to support the conclusion that the terraces are a result of sea level change, as a block slide in this terrain would tend to move on a shallower angled slip plane. Further assessment of this will be required at the time of future development, but in any case the indicative areas for residential development are set back to ensure they should not be affected by cliff stability. Analysis at subdivision design stage would also be required to set out Building Restriction and Limitation lines, to delineate any zones in steeper terrain where buildings may require specific geotechnical design.

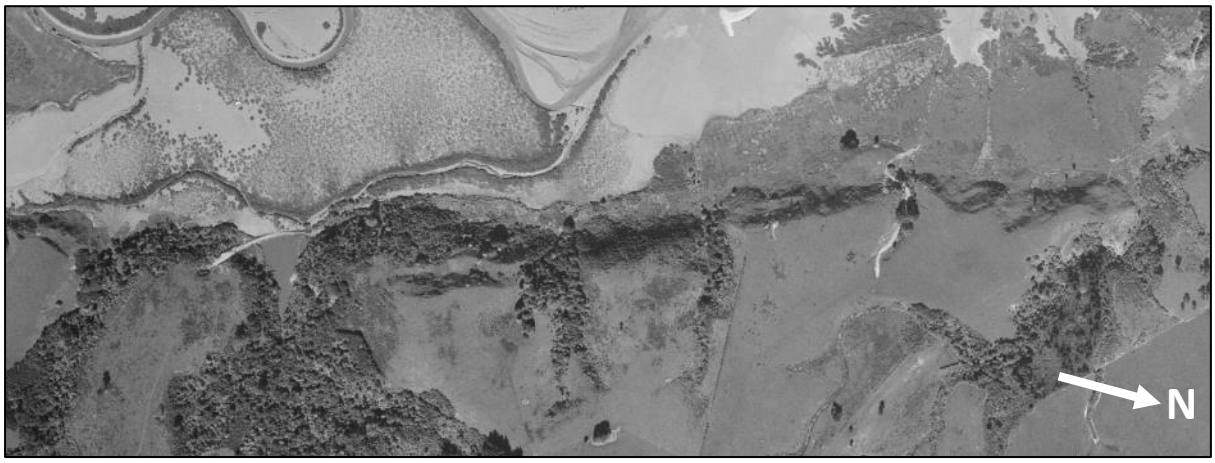


Figure 9: Aerial photo of the southern coastline (620 Precinct). Photo taken 2 November 1961. The full photo is presented in Appendix B. Source: Retrolens.

4.3 Stability of gully slopes

Surficial soil creep in terrain around gullies (typically steeper than 1V:3H) was observed during our site visits and also noted in the Fraser Thomas report, evidenced by hummocky ground and curvature/inclination of trees. The proposed Structure Plan generally designates these areas for ecological overlay or Open Space, as discussed further below.

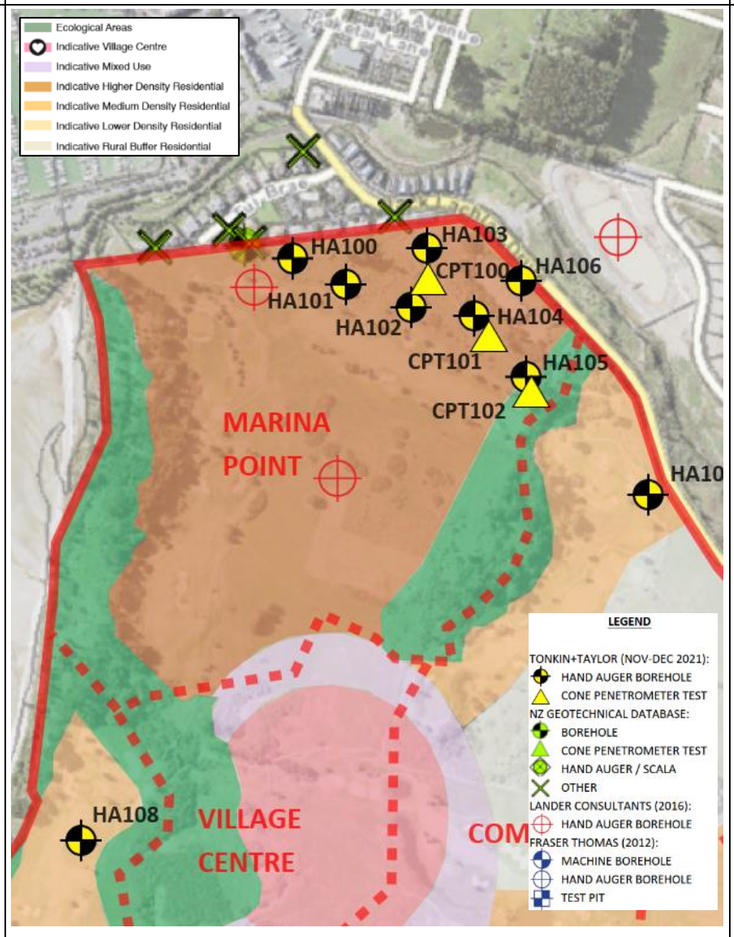
5 Geotechnical implications for each Precinct

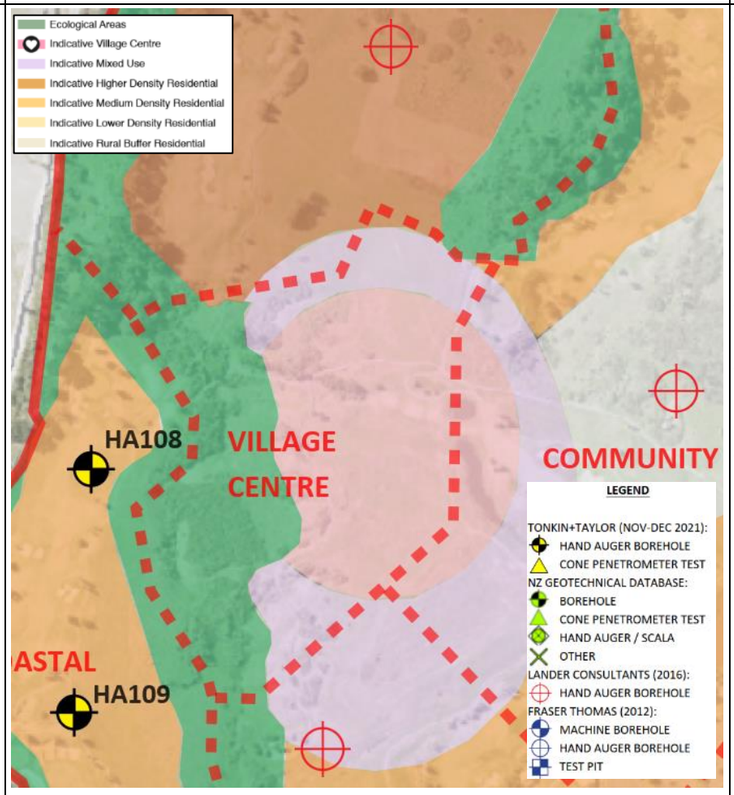
The geotechnical implications of the proposed Structure Plan can be described across the ten precincts. The location of each precinct is shown in Figure 4 above. Implications for each precinct are summarised in Table 2 below.

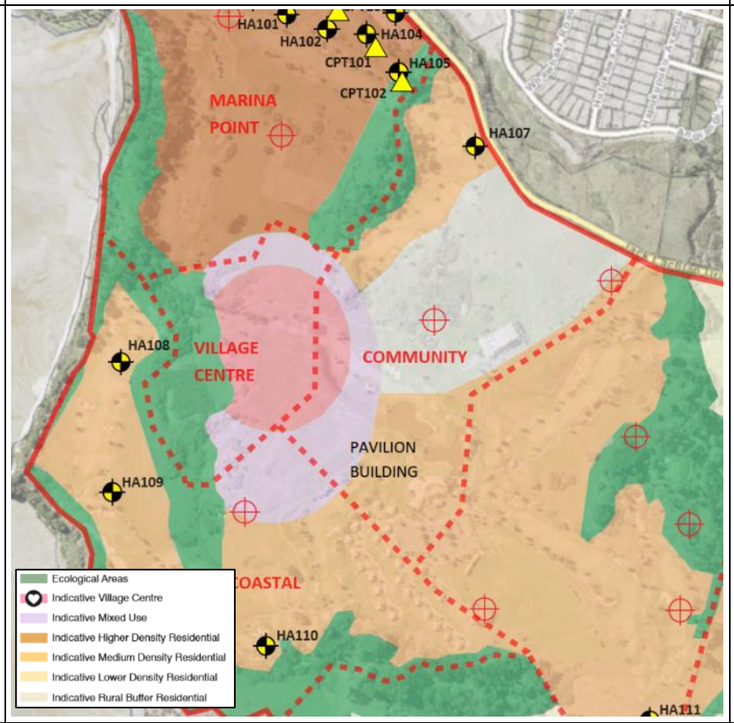
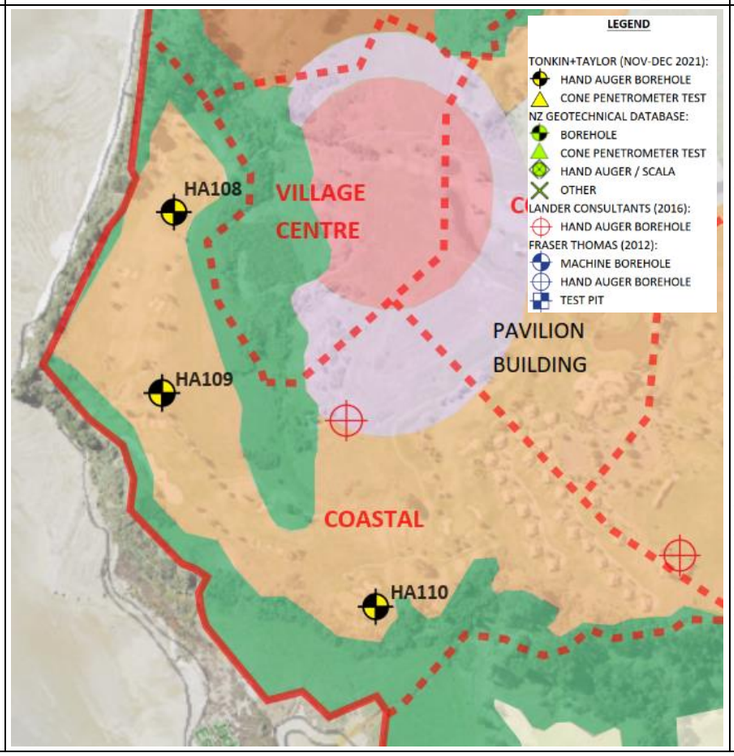
An explanation of the headings and terminology used in Table 2 is set out below:

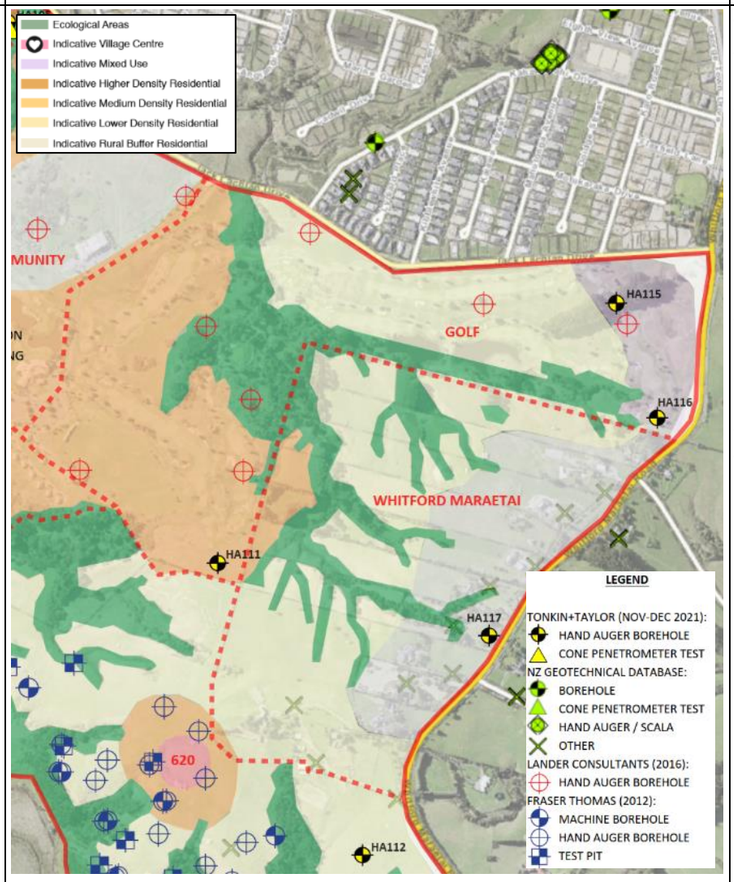
Terrain	A general description of the topography (slopes).
Ground conditions uncertainty	A broad assessment based on the number of investigations within the Precinct and the variability of this type of geological terrain.
Inferred ground conditions	A brief summary of the soil types expected in this Precinct.
Proposed zoning	Zoning proposed in the Plan Change.
Building foundations	Building foundations that are likely to be required for the proposed typologies.
Trench / basement excavations	Anticipated geotechnical issues that could be encountered during typical excavations for service trenches or single level basements.
Building Restriction Lines	Building Restriction Lines are defined in the Auckland Council Code of Practice for Land Development and Subdivision[7] as a line beyond which no development is allowed. Geotechnical triggers for Building Restriction Lines typically include clifftop edges, uneconomic ground improvement or stabilisation measures, or situations where stabilisation works would require work beyond the boundary, or increase risk to another property, or works that would not comply with Resource Consent conditions (e.g. visual impact, height to boundary etc).
Building Limitation Lines	Building Limitation Lines are defined in the AC Code of Practice[7] as a line beyond which Specific Design is required by a Chartered Professional Engineer experienced in soil mechanics (and usually slope stability). Building Limitation Lines are commonly used for subdivisions in sloping land. For the ground conditions within the Plan Change area, slopes steeper than 1V:4H are likely to require Specific Design, as they are unlikely to achieve Council standards for stability without the use of geotechnical stabilisation measures. Stabilisation measures can be used as part of the subdivision development in order to achieve Council stability requirements, and remove the need for Building Limitation Lines. The requirement for Building Limitation Lines and stabilisation measures is usually assessed during subdivision design.

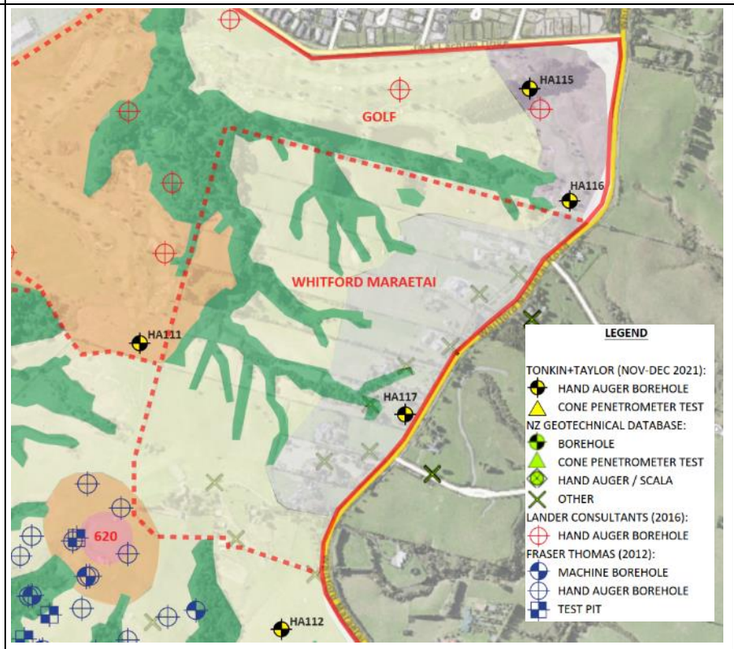
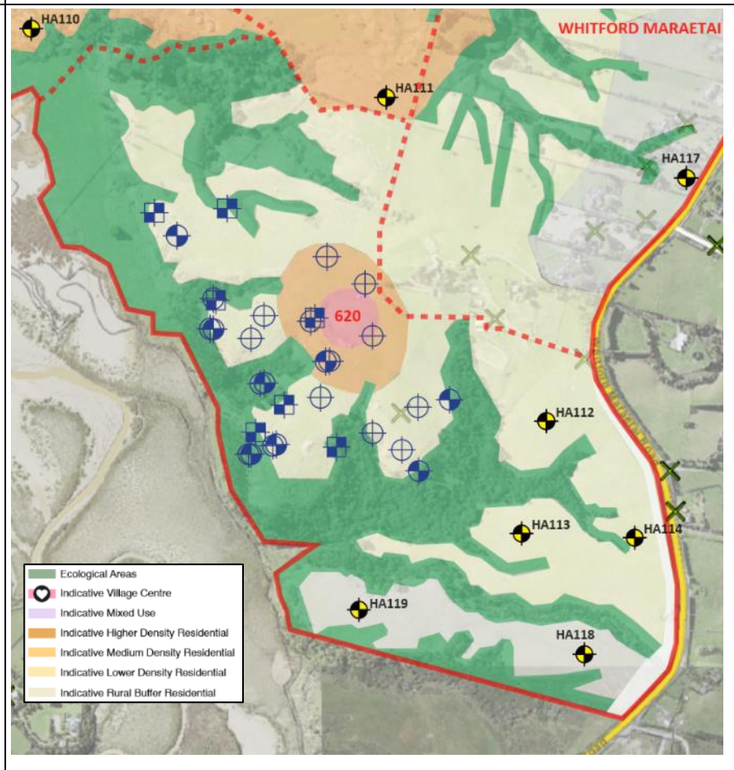
Table 2: Geotechnical assessment for each precinct

Precinct	Proposed Structure Plan	Ground conditions	Geotechnical implications
Marina Point		**Terrain** The Marina Point Precinct follows a broad ridge, gently sloping to the north at grades of 1V:10H to 1V:20H. Grades steepen to 1V:2H to 1V:5H on the east and west flanks (outside of the areas designated for housing). **Ground conditions uncertainty** Low to moderate. **Inferred ground conditions** The hand augered boreholes within the housing area (orange) generally encountered 300 mm thickness of **topsoil** overlying **very stiff to hard ECBF soils** extending to at least 4 m depth. Unweathered sandstone/mudstone weak rock was encountered below 7 m depth in the borehole on the northern boundary. Both hand augered holes were dry upon completion (i.e. groundwater was not encountered). **Groundwater** can be expected near the base of gullies and locally perched at higher levels. **Golf course fill** (HA100, HA101, HA102, HA106, HA107, HA108) was generally found to comprise competent site-won residual ECBF fill (very stiff), typically less than 1 m thick although locally 3 m thick in the north of the precinct. **Fill derived from marina dredging** was encountered in the area immediately surrounding the maintenance shed (HA103, HA104, HA105, CPT100, CPT101, CPT102). This material was generally found to comprise stiff to hard silt mixtures containing some sand and shells, extending from ground level to approximately 2 to 6.5 m depth.	**Proposed zoning** Higher density residential, i.e. Mixed Housing Urban (MHU) and Terrace Housing and Apartment Buildings (THAB) is indicated for the majority of the Marina Point Precinct, with an ecological area overlay bordering on the east and west flanks. MHU typically allows for 2 to 3 storey buildings (up to 11 m high) and THAB typically allows for 4 to 6 storey buildings (up to 16 m high). **General implications for higher density housing** The very stiff to hard ECBF soils beneath most of the Marina Point Precinct are generally suitable for typical **shallow foundations**. Embedment of approximately 600 mm below final ground level is likely to be required for soil shrink-swell resistance. Stiffer/stronger foundations may be required for 4 to 6 storey buildings, particularly for heavier superstructures (e.g. masonry cladding, tiled roofs, concrete structures). **Foundation piles** are generally unlikely to be required except for concentrated loads. The very stiff to hard soils and low groundwater are likely to provide relatively favourable conditions for **trench or basement excavations**. Perched groundwater may be encountered. The fill encountered within the Marina Point Precinct is generally expected to be suitable for development for housing. Most of the fill was found to be relatively competent, however this would be confirmed as part of normal geotechnical investigations for subdivision and house design. If site-specific investigations and design assessment indicates that houses cannot be supported on traditional or raft shallow foundations, then **timber piles** could be extended to approximately 3 to 6 m depth to found in the underlying natural ECBF soils. This is likely to be a relatively cost-efficient foundation solution, particularly for the proposed medium to high density housing. A preliminary assessment of the fill indicates that it is **unlikely to be susceptible to liquefaction** due to an ultimate limit state earthquake, as the soils are generally cohesive and/or above the water table. This should be confirmed during subdivision and development design stages with a typical suite of site-specific testing (i.e. CPTs, lab tests) and design analysis. **Building Restriction Lines** (denoting areas where development is not allowed) apply to the coastal esplanade – this is addressed in the Coastal Hazards report[8]. Building restriction lines due to geotechnical hazards are generally not anticipated to be required elsewhere within this Precinct. **Building Limitation lines** (denoting areas where specific geotechnical design is required) are likely to be required where slopes are steeper than 1V:4H. These are generally the areas shown as Ecological Overlay areas on the proposed Structure Plan. These Limitation lines would be confirmed during subdivision and development design stages.

Precinct	Proposed Structure Plan	Ground conditions	Geotechnical implications
Village Centre		**Terrain** An existing broad ridge runs along the eastern boundary of the Village Centre Precinct. The centre of the Precinct slopes to the west at grades of 1V:6H to 1V:2.5H. A gully runs along the western flank of the Precinct (proposed as an ecological area), flowing to the north. **Ground conditions uncertainty** Low to moderate uncertainty regarding ground conditions. Although no borehole records are available within this Precinct, it can be inferred that ground conditions are very likely to be similar to those found in the boreholes surrounding the area. **Inferred ground conditions** The five hand augered boreholes in the surrounding area generally encountered 200 to 400 mm thickness of **topsoil**, overlying **very stiff to hard ECBF soils** to 4 m depth. Stiff soil was encountered at 4 m depth in the borehole to the east. **Groundwater** was encountered at 1.4 m bgl in the borehole to the east (likely to be perched), but the boreholes to the north and south did not encounter groundwater at the time of drilling. Groundwater can generally be expected near the base of gullies and locally perched at higher levels. Minor areas of **fill** are expected in this area (Figure 3 above), related to landscaping for the golf course. Stiff to hard ECBF-derived fill was proven in HA108 and HA109 to 0.6 to 0.8 m depth below ground. The borehole to the east encountered very stiff silty clay fill from 0.4 to 1.8 m depth. Fill within the precinct is generally expected to be competent, although this would be confirmed as part of normal geotechnical investigations for house design.	**Proposed zoning** Business Mixed Use and Business Local Centre zoning is proposed for the Village Centre Precinct, permitting buildings of up to 18 and 24 m height. An Ecological Overlay is proposed over the gully along the western flank of the Precinct. **General implications for buildings in the village centre** The very stiff to hard ECBF soils beneath most of the Precinct are generally suitable for typical **shallow foundations**. Embedment of approximately 600 mm below final ground level is likely to be required for soil shrink-swell resistance. Stiffer/stronger foundations may be required for buildings over 4 storeys high, particularly for heavier superstructures (e.g. masonry cladding, tiled roofs, concrete structures). **Foundation piles** may be required for these types of structures (i.e. tall/heavy commercial/apartment buildings). The very stiff to hard soils and low groundwater are likely to provide relatively favourable conditions for **trench or basement excavations**. Perched groundwater may be encountered. **Building Restriction Lines** due to geotechnical hazards are generally not anticipated to be required within this Precinct. **Building Limitation lines** (denoting areas where specific geotechnical design is required) are likely to be required where slopes are steeper than 1V:4H. These are generally the areas shown as Ecological Overlay areas on the proposed Structure Plan. These Limitation lines would be confirmed during subdivision and development design stages.

Precinct	Proposed Structure Plan	Ground conditions	Geotechnical implications
Community		**Terrain** Most of the Community Precinct is flatter than 1V:8H, with local grades around the artificial ponds in the south and the gully to the northwest becoming slightly steeper. **Ground conditions uncertainty** Low to moderate uncertainty regarding ground conditions. **Inferred ground conditions** Both of the hand augered boreholes in the Precinct were put down through localised areas of fill, placed during earthworks for the golf course. The 200 to 400 mm thickness of **topsoil** was therefore placed after earthworking; however it is expected to be similar across the remainder of the Precinct. **Fill** was encountered to 1.8 and 2.4 m depth in the boreholes, comprising very stiff silt/clay. Based on a review of historical aerial photos (Figure 3 above), fill is not expected to be widespread. **Very stiff to hard ECBF soils** were encountered below the fill to 4 m depth. Similar conditions are expected directly below the topsoil across most of the Precinct where fill earthworks have not taken place. Stiff soil was encountered at 4 m depth in the borehole in the centre of the Precinct. **Groundwater** was encountered at 1.4 m depth in this borehole (likely to be perched). None of the other boreholes shown on the plan to the left encountered groundwater. Groundwater can generally be expected near the base of gullies and locally perched at higher levels.	**Proposed zoning** A range of zones are proposed for the Community Precinct. Business Mixed Use zoning is proposed in the south of the Precinct, permitting buildings of up to between 18 and 27 m in height. Open Space for sport and active recreation is proposed in the centre of the Precinct, permitting buildings up to 10 m high. A school could also be provided in this area. Medium density housing (i.e. MHU, up to 11 m height) is proposed for parts of the Precinct. **General implications for buildings** The very stiff to hard ECBF soils beneath most of the Precinct are generally suitable for typical **shallow foundations**. Embedment of approximately 600 mm below final ground level is likely to be required for soil shrink-swell resistance. **Foundation piles** are generally unlikely to be required except for concentrated loads (i.e. special structures or tall/heavy commercial/apartment buildings). The very stiff to hard soils and low groundwater are likely to provide relatively favourable conditions for **trench or basement excavations**. Perched groundwater may be encountered. **Building Restriction Lines** due to geotechnical hazards are generally not anticipated to be required within this Precinct. **Building Limitation lines** (denoting areas where specific geotechnical design is required) are likely to be required where slopes are steeper than 1V:4H. These are generally the areas shown as Ecological Overlay areas on the proposed Structure Plan. These Limitation lines would be confirmed during subdivision and development design stages.
Coastal		**Terrain** The Coastal Precinct comprises a broad north-south ridge at the coast, and flatter land to the east. It is bound to the south and the northwest by steeper gullies with slopes of up to 1V:1H (proposed as an ecological area). Slopes of up to 2V:1H are present around the shoreline. Grades within the housing area are generally flatter than 1V:8H. **Ground conditions uncertainty** Low to moderate uncertainty regarding ground conditions. **Inferred ground conditions** Hand augered boreholes in the area indicate that the area designated for housing is generally likely to be underlain by **200 to 400 mm thick layer of topsoil overlying very stiff to hard ECBF soils**. Isolated areas of stiff to hard **fill** associated with golf course landscaping are expected (Figure 3, above). **Tauranga Group soils** may be present in the base of gullies and at the base of the coastal slopes. The land with the ecological area overlay is steeper sloping, and there is evidence of historical slope movement in some places. The semi-circular shaped ancient landslip shown in Figure 8 is within the ecological area at the southern tip of the Coastal Precinct. Wet very stiff soils were encountered below 3.3 m depth in the borehole at the east of the Precinct, indicating the presence of perched groundwater. **Groundwater** is generally expected near the base of gullies and coastal slopes, and locally perched at higher levels.	**Proposed zoning** Medium density housing is proposed for most of the Precinct. This could comprise a mix of THAB, MHU and MHS housing zones. Business Mixed Use is proposed in the north of the Precinct (18 m height limit). An ecological area is proposed for the steeper terrain around the periphery of the Precinct. **General implications for buildings** Very stiff to hard ECBF soils are expected within the area designated for housing, with isolated areas of fill associated with golf course landscaping. Normal **shallow foundations** in the ECBF soils are expected to be suitable for most or all housing types in this Precinct. Embedment of approximately 600 mm below final ground level is likely to be required for soil shrink-swell resistance. Stiffer/stronger foundations may be required for 4 to 6 storey buildings, particularly for heavier superstructures (e.g. masonry cladding, tiled roofs, concrete structures). Mixed use commercial buildings are more likely to require stiffer/stronger shallow foundations/rafts. **Foundation piles** are generally unlikely to be required except for concentrated loads. The very stiff to hard soils and low groundwater are likely to provide relatively favourable conditions for **trench or basement excavations**. Perched groundwater may be encountered. **Building Restriction Lines** (denoting areas where development is not allowed) apply to the coastal esplanade – this is addressed in the Coastal Hazards report[8]. Building restriction lines due to geotechnical hazards are generally not anticipated to be required elsewhere within this Precinct. Building Limitation lines (denoting areas where specific geotechnical design is required) are likely to be required where slopes are steeper than 1V:4H. These are generally the areas shown as Ecological Overlay areas on the proposed Structure Plan. These Limitation lines would be confirmed during subdivision and development design stages.

Precinct	Proposed Structure Plan	Ground conditions	Geotechnical implications
Golf		**Terrain** The western part of the Golf Precinct is relatively flat, with grades of 1V:30H to 1V:4H in the areas designated for housing. Slopes in the east of the Precinct are generally flatter than 1V:4H. Slopes of up to 1V:2H are present in the vegetated gullies in the centre and south of the Precinct. **Ground conditions uncertainty** Low to moderate uncertainty regarding ground conditions. **Inferred ground conditions** Most of the boreholes within the Precinct encountered 200 mm thickness of **topsoil, overlying very stiff to hard ECBF** silt/clay, extending to the base of the boreholes at 4 m depth. **Golf course fill** is present in isolated parts of the Precinct (Figure 3, above). Boreholes put down within the precinct indicate that the fill is generally very stiff, extending to 0.2 to 2.8 m depth, overlying the ECBF. **Recent alluvial deposits** were found in the base of the gully at the northwest of the site (HA115). Based on published geological maps (Figure 2), Waipapa Group soils are inferred to be at the ground surface no closer than 70 metres to the east of Whitford-Maraetai Road, and therefore unlikely to be present within this Precinct. **Perched groundwater** was encountered at 2 to 4 m depth in some of the boreholes. Groundwater was found at 1 m depth in HA115, put down in the base of the gully at the northeast of the Precinct. **Localised shallow instability** was observed in a cut slope as shown in section 4.1 of this report. The cause of the instability is not clear, though it is likely to be related to the cut earthworks carried out for golf course landscaping.	**Proposed zoning** Medium density housing is proposed for the western part of the Precinct (likely to comprise MHU zoning). Lower density housing (MHS, 1 to 2 storeys up to 8 m height) is proposed for most of the Precinct. Business Mixed Use and Business Light Industry is proposed in the eastern edge of the Precinct, adjacent to the Whitford-Maraetai Road. An ecological area overlay is proposed in the steeper terrain around the gullies to the east, and a Golf Course overlay is proposed over the eastern portion of this precinct too. **General implications for buildings** Very stiff to hard ECBF soils are expected within the area designated for housing, with isolated areas of fill associated with golf course landscaping. **Normal shallow foundations** in the ECBF soils are expected to be suitable for most or all housing types in this Precinct. Embedment of approximately 600 mm below final ground level is likely to be required for soil shrink-swell resistance. The very stiff to hard soils and low groundwater are likely to provide relatively favourable conditions for **trench excavations**. Perched groundwater may be encountered. **Bulk earthworks** may be preferable in Business zones, to flatten existing slopes and remove building restriction zones. The very stiff to hard ECBF soil should be suitable for use as cut-to-fill structural fill, subject to normal handling measures to control moisture content and achieve acceptable stability and strength. Alluvial deposits will probably need to be removed from gullies prior to earthworking. The **local shallow instability** observed within this Precinct is not thought to represent wider issues. Normal geotechnical investigation and analysis measures will be required as part of the subdivision design, to confirm that slopes achieve the stability criteria set out in the Auckland Code of Practice for Land Development. **Building Restriction Lines** due to geotechnical hazards are generally not anticipated to be required within this Precinct. **Building Limitation lines** (denoting areas where specific geotechnical design is required) are likely to be required where slopes are steeper than 1V:4H. These are generally the areas shown as Ecological Overlay areas on the proposed Structure Plan. These Limitation lines would be confirmed during subdivision and development design stages.

Precinct	Proposed Structure Plan	Ground conditions	Geotechnical implications
Whitford Maraetai		**Terrain** Slopes in the Whitford Maraetai Precinct are generally flatter than 1V:4H, except in the vegetated gullies to the north and west, where the ground steepens up to 1V:2H. **Ground conditions uncertainty** Low to moderate uncertainty regarding ground conditions. It can be inferred with some confidence that ground conditions within this Precinct are similar to those found in the surrounding areas. Based on published geological maps (Figure 2), Waipapa Group soils are inferred to be at the ground surface no closer than 70 metres to the east of Whitford-Maraetai Road, and therefore unlikely to be present within these Precincts. **Inferred ground conditions** It is expected that **very stiff to hard ECBF soils** will be present beneath a veneer of topsoil. **Tauranga Group deposits** may be present in the base of gullies. **Groundwater** is generally expected near the base of gullies, and locally perched at higher levels.	**Proposed zoning** Under the current Plan Change application, this Precinct will be zoned Future Urban. Under the Structure Plan, lower density housing (MHS, 1 to 2 storeys up to 8 m height) is proposed for the flatter parts of the west of the Precinct. Rural buffer (Residential – Single House Zone, 1 to 2 storeys up to 8 m height) is proposed for the east of the Precinct. An ecological area is proposed for the steeper gullies across the Precinct. Medium density housing is proposed at the west of the Precinct – this is discussed in the Golf Precinct section above. **General implications for buildings** The very stiff to hard ECBF soils expected to underlie most of this Precinct are suitable for typical **shallow foundations**. Embedment of approximately 600 mm below final ground level is likely to be required for soil shrink-swell resistance. The very stiff soils and low groundwater are likely to provide relatively favourable conditions for **trench excavations**. Perched groundwater may be encountered. **Building Restriction Lines** due to geotechnical hazards are generally not anticipated to be required within this Precinct. **Building Limitation lines** (denoting areas where specific geotechnical design is required) are likely to be required where slopes are steeper than 1V:4H. These are generally the areas shown as Ecological Overlay areas on the proposed Structure Plan. These Limitation lines would be confirmed during subdivision and development design stages.
620		**Terrain** Slopes in the 620 Precinct are generally flatter than 1V:4H, except in the vegetated gullies and coastal slopes, where the ground steepens up to 1V:1H. **Ground conditions uncertainty** Low. Extensive site investigations have been carried out in this Precinct[6], as shown to the left. **Inferred ground conditions** Based on the site investigations carried out in this Precinct, 100 to 300 mm of **topsoil** is expected to overlie **stiff to hard ECBF soils** within the areas designated for housing. On the west-facing coastal slopes within the areas proposed as an ecological area, **marina dredgings** comprising black silt intermixed with shell fragments was encountered to 200 to 300 mm depth, locally increasing to 900 mm depth on the lower slope bench in the northwest of the site. **Sandstone and mudstone extremely to very weak rock** was generally encountered below 2 to 5.5 m depth. **Tauranga Group deposits** may be present in the base of gullies. **Perched groundwater** was measured at various depths in standpipes installed in the machine boreholes, ranging from 2.5 18.2 m depth.	**Proposed zoning** Under the current Plan Change application, this precinct will be zoned Future Urban. Under the Structure Plan, lower density housing (MHS, 1 to 2 storeys up to 8 m height) is proposed for the flatter parts of the Precinct. A village centre (Business – Neighbourhood Centre up to 13 m height) surrounded by medium density housing (MHU, 2 to 3 storeys up to 11 m height) is proposed for the flatter land at the centre of the Precinct. Rural buffer (Residential – Single House Zone, 1 to 2 storeys up to 8 m height) is proposed for the south of the Precinct. An ecological area is proposed for the steeper gullies across the Precinct. **General implications for buildings** The stiff to hard ECBF soils expected to underlie most of the Precinct are suitable for typical shallow foundations. Embedment of approximately 600 mm below final ground level is likely to be required for soil shrink-swell resistance. Stiffer/stronger foundations may be required for heavier buildings (e.g. masonry cladding, tiled roofs, concrete structures). Foundation piles are generally unlikely to be required except for concentrated loads. The very stiff to hard soils and low groundwater are likely to provide relatively favourable conditions for trench excavations. Perched groundwater may be encountered. **Building Restriction Lines** (denoting areas where development is not allowed) apply to the coastal esplanade – this is addressed in the Coastal Hazards report[8]. Building restriction lines due to geotechnical hazards are generally not anticipated to be required elsewhere within the Precinct, although future consideration could be given to the southern boundary of the 620 Precinct as part the necessary future plan change application to achieve a live zoning over this precinct (ecological restrictions may prevent development in the base of this gully in any case). **Building Limitation lines** (denoting areas where specific geotechnical design is required) are likely to be required where slopes are steeper than 1V:4H. These are generally the areas shown as Ecological Overlay areas on the proposed Structure Plan. These Limitation lines would be confirmed during subdivision and development design stages.

6 General geotechnical considerations

6.1 Slope stability and earthworks

As noted above, both historical and recent landslip movement has been found within the Structure Plan and Plan Change area, and there may be other unstable areas within the site which could become evident with detailed geotechnical site investigations.

Active and potential slope instability is common for land in Auckland, and it can be assessed and managed as part of subdivision design development. In general, the geotechnical issues associated with subdivision in ECBF terrain are well understood and unlikely to become a critical impediment to the proposed development of the site. Potential for medium to large scale instability is generally anticipated to be mainly in the ecological overlay areas, where slopes are steeper than 1V:4H. Typically, for slopes exceeding 1V:4H, provision for creep induced movements and lateral loads on structures need to be considered, whereas for slopes exceeding 1V:3H stabilisation or retention is likely to be required.

Building Limitation Lines (denoting areas where specific geotechnical design is required) will be determined at the time of subdivision and development design on the basis of geotechnical investigations and slope stability analyses for particular development proposals. Any necessary measures to stabilise unstable slopes can include techniques such as design of earthworks to reduce loads on slopes, excavating weak soils, placement of engineered fill, installation of subsoil drains and installation of in-ground structures such as piles, retaining walls and reinforced earth.

Building Restriction Lines (denoting areas where development is not allowed) apply to the coastal esplanade – this is addressed in the Coastal Hazards report[8]. Building restriction lines due to geotechnical hazards are generally not anticipated to be required elsewhere within the Plan Change area.

ECBF soils are usually suitable for earthworks fill, subject to the normal engineering measures.

6.2 Liquefaction

Loose sandy or silty ground with a high water table can be subject to liquefaction during an earthquake. The existing ponds and wetlands might be susceptible to liquefaction; however these areas are not extensive and are generally designated for ecological overlay areas where development could be restricted in any case. Liquefaction is unlikely to be a significant design issue for subdivision of this site, however a typical suite of site investigations, tests and analyses should be carried out at subdivision stage to confirm this.

6.3 Expansive soils

Expansive soils are clayey soils that undergo appreciable volume change upon changes in moisture content. This ‘shrink-swell’ effect results in movement of the near-surface soils over the course of seasonal moisture fluctuations and affects the design of shallow building foundations. The ECBF soils expected across the Structure Plan area are expected to be typical of Auckland geological conditions, and moderate expansivity can be expected. Commonly used design solutions such as embedment of strip footings or use of stiffened (waffle / ribraft) slabs are likely to be suitable for buildings in these ground conditions.

6.4 Forested and vegetated areas

There may be some areas with established tree cover which are designated for development. These areas may require additional site and earthworks preparation such as ripping and backfilling to

reduce the impact of any remaining root structures and transient soil moisture content (which can cause shrink/swell).

Where mature trees are located close to proposed structures the potential effects of water demand for the trees and resultant shrinkage potential should be considered.

7 Conclusions

Suitability of ground conditions for the Structure Plan

The ground conditions within the Beachlands South Plan Change area are generally suitable for the indicative land uses as shown on the Structure Plan.

General ground conditions

Ground conditions are expected to be typical of Auckland conditions, generally comprising a thin veneer of topsoil overlying very stiff to hard East Coast Bays Formation soils. Localised areas of fill associated with golf course landscaping are expected and have been preliminarily mapped and investigated. The fill encountered to date has generally been competent, however normal geotechnical investigation and design measures will still be required at subdivision and building design stages.

Building foundations

Traditional shallow foundations are likely to be suitable for the vast majority of the building typologies proposed under the Structure Plan. Stiffer/stronger foundations may be required for buildings greater than 3 storeys high or heavier buildings (e.g. masonry cladding, tiled roofs, concrete structures). Foundation piles are generally unlikely to be required except for concentrated loads, or in isolated areas where foundations need to extend through existing fill (typically less than 5m thick).

Slope stability and earthworks

Localised historical and recent landslip movement has been found within the Structure Plan area. Most of the areas of instability are located in steeper gully areas proposed as ecological areas. Normal geotechnical investigations and analysis should be carried out during design of the subdivision and development, to establish Building Limitation Lines and/or inform design of earthworks. The AUP framework and Chapter E36 in particular is considered to be sufficient for addressing any geotechnical hazards for subdivision and development within the plan change area and no specific mitigation is required.

The very stiff to hard ECBF soils beneath most of the site are usually suitable for earthworks fill, subject to normal engineering measures.

Excavations

The very stiff soils and low groundwater are likely to provide relatively favourable conditions for trench or basement excavations. Perched groundwater may be encountered.

Liquefaction

Liquefaction is unlikely to be a significant design issue for subdivision of this site.

8 Applicability

This report has been prepared for the exclusive use of our client Beachlands South Limited Partnership, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of a Plan Change application and that Auckland Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

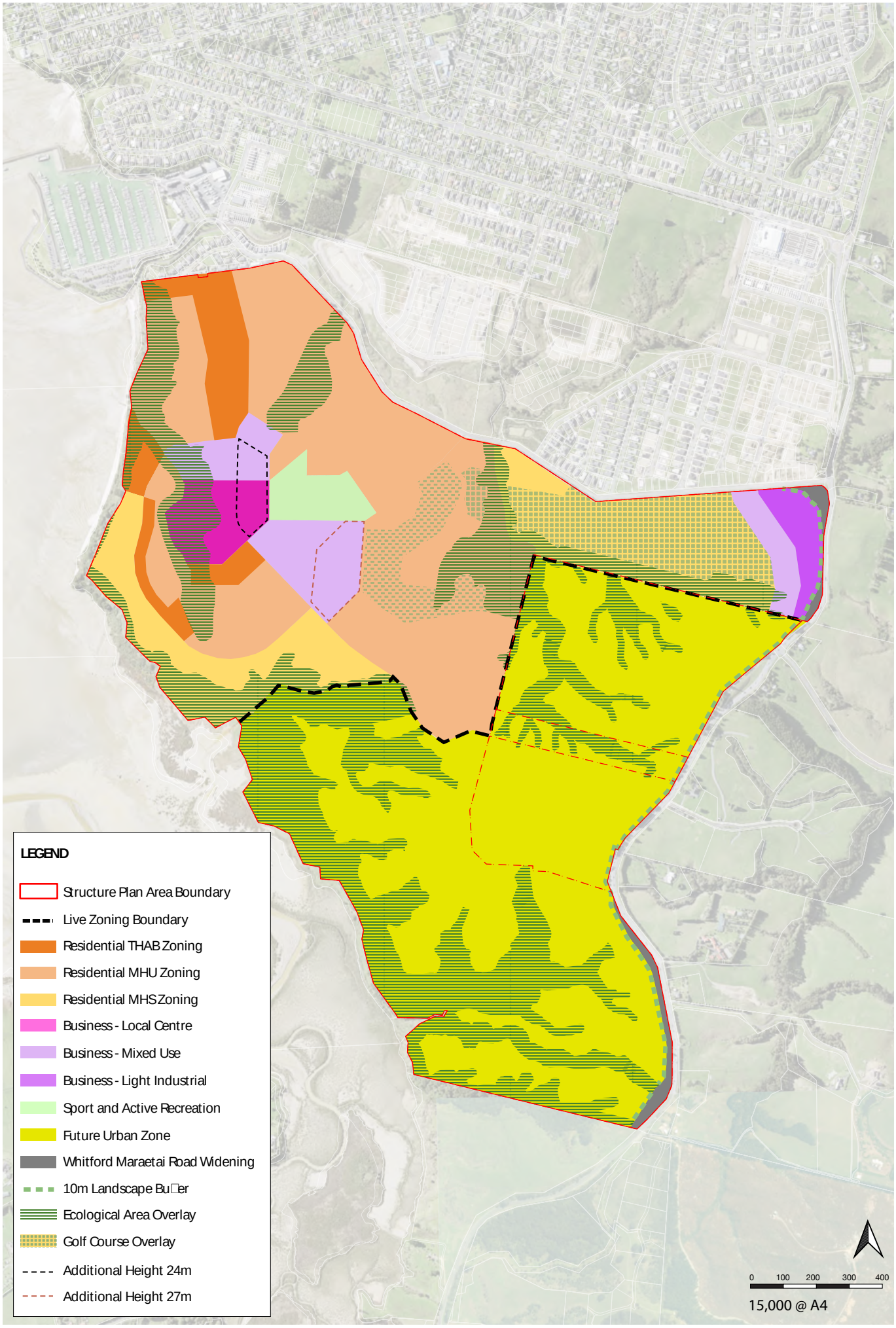
Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
.....	.....
Mark Thomas	Peter Millar
Senior Geotechnical Engineer	Project Director

M Thomas
p:\1014358\1014358.3000\workingmaterial\structure plan change geotech report v1.1\2022-01 beachlands south plan change geotech report v1.1.docx

9 References

[1] Tonkin & Taylor (25 August 2021), *Proposal – Beachlands South – Structure Plan Change – Geotechnical Engineering.* T+T job number 1014358.3000.
[2] Kermode, L.O. (1992), *Geology of the Auckland urban area. Scale 1:50,000.* Institute of Geological & Nuclear Sciences geological map 2.
[3] Edbrooke, S.W. (compiler) 2001, *Geology of the Auckland area. Scale 1:250,000.* Institute of Geological & Nuclear Sciences geological map 3.
[4] Lander, S.G. (10 Feb 2016), *Statement of Evidence on Behalf of 110 Formosa (NZ) Limited.* For the hearing for Submission 7318 for 018 – Rezoning and Precincts.
[5] Incomplete copy of several reports provided by the vendor (scanned microfilm records presumably sourced from Auckland Council, ref 9347 782, dated 27 October 1998). The provided data included part of a report provided by Foundation Engineering, which only shows logs for boreholes 1 to 8 (of 14) dated 2 April 1997.
[6] Fraser Thomas Ltd (21 Dec 2012), *Ahuareka Special Rural Settlement, 650 Whitford-Maraetai Road, Whitford: Geotechnical Investigation Report.* FT reference 60834. Report is not issued with a date or version number.
[7] Auckland Council (19 April 2012), *Code of Practice for Land Development and Subdivision – Section 2 – Earthworks and Geotechnical Requirements.* V1.5.
[8] Tonkin + Taylor (December 2021), *Coastal Hazard Assessment – Beachlands South Private Plan Change.* T+T job number 1014358 v3.

Appendix A: Proposed Structure Plan Zoning Map


LEGEND
Structure Plan Area Boundary
Live Zoning Boundary
Residential THAB Zoning
Residential MHU Zoning
Residential MHS Zoning
Business - Local Centre
Business - Mixed Use
Business - Light Industrial
Sport and Active Recreation
Future Urban Zone
Whitford Maraetai Road Widening
10m Landscape Buffer
Ecological Area Overlay
Golf Course Overlay
Additional Height 24m
Additional Height 27m
0 100 200 300 400
15,000 @ A4

Appendix B: Historical aerial photos

- **1939 Aerial photograph**
- **1955 Aerial photograph**
- **1961 Aerial photograph**
- **1972 Aerial photograph**
- **1980 Aerial photograph**
- **1996 Aerial photograph**
- **2001 Satellite image**
- **2017 Satellite image**

1939 Aerial Photograph

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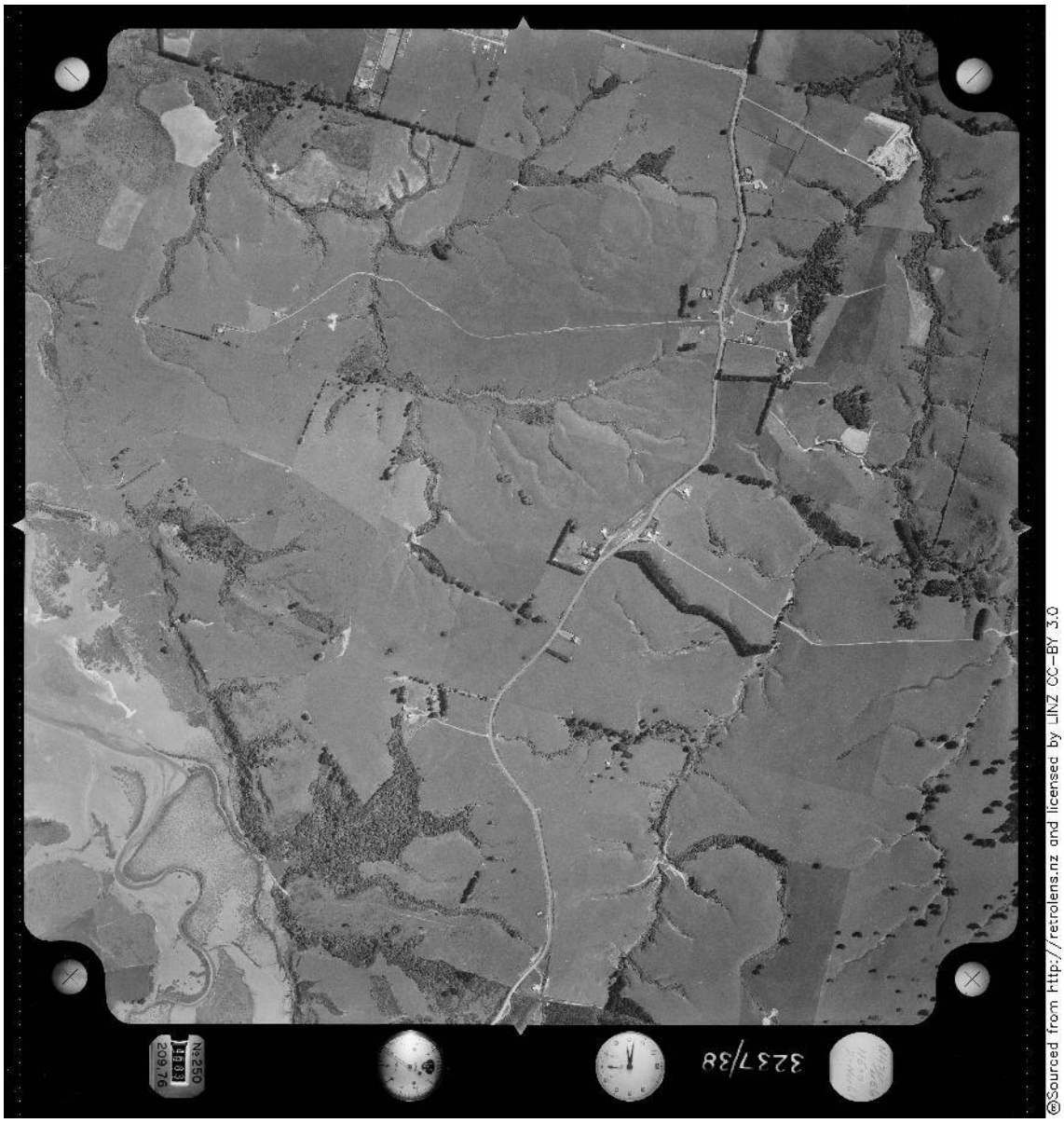
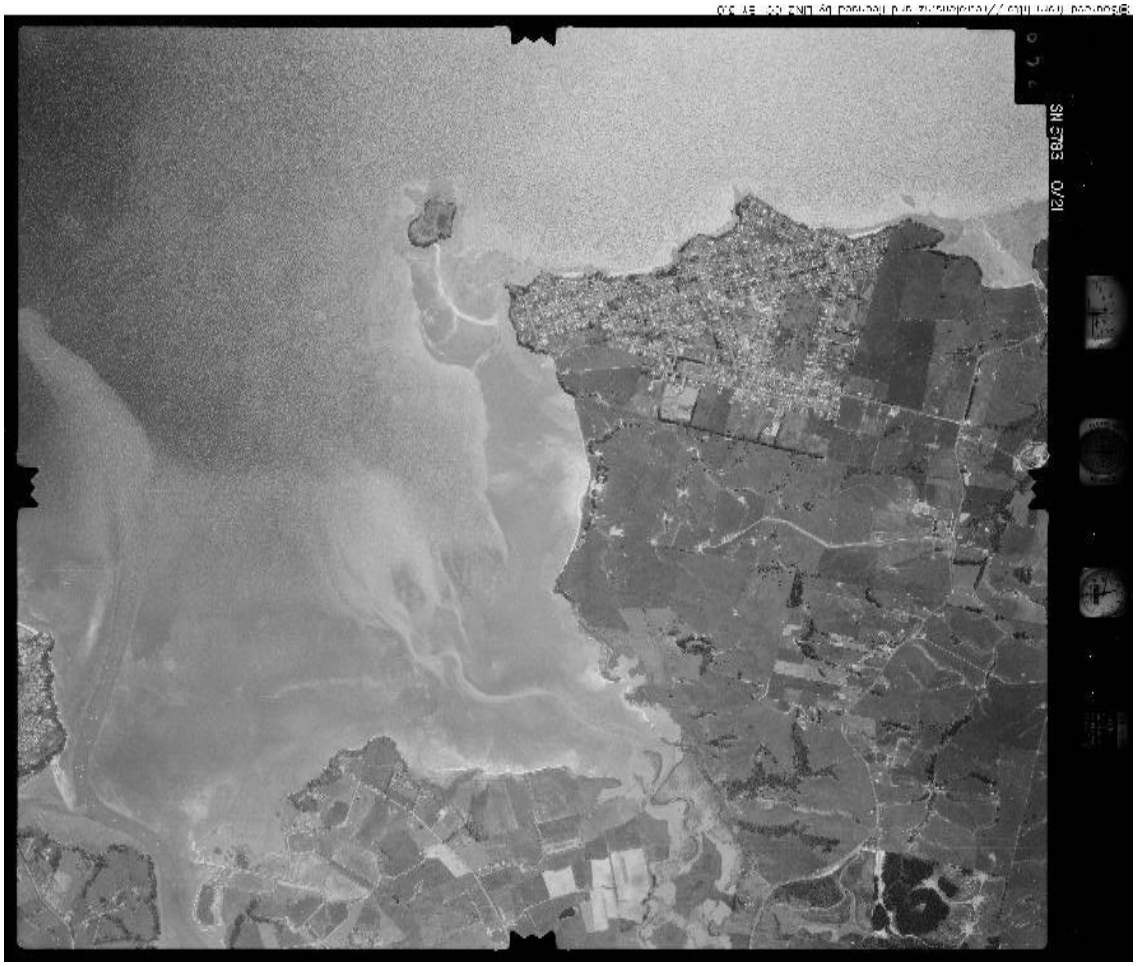
1955 Aerial Photograph



1961 Aerial Photo

1972 Aerial Photograph



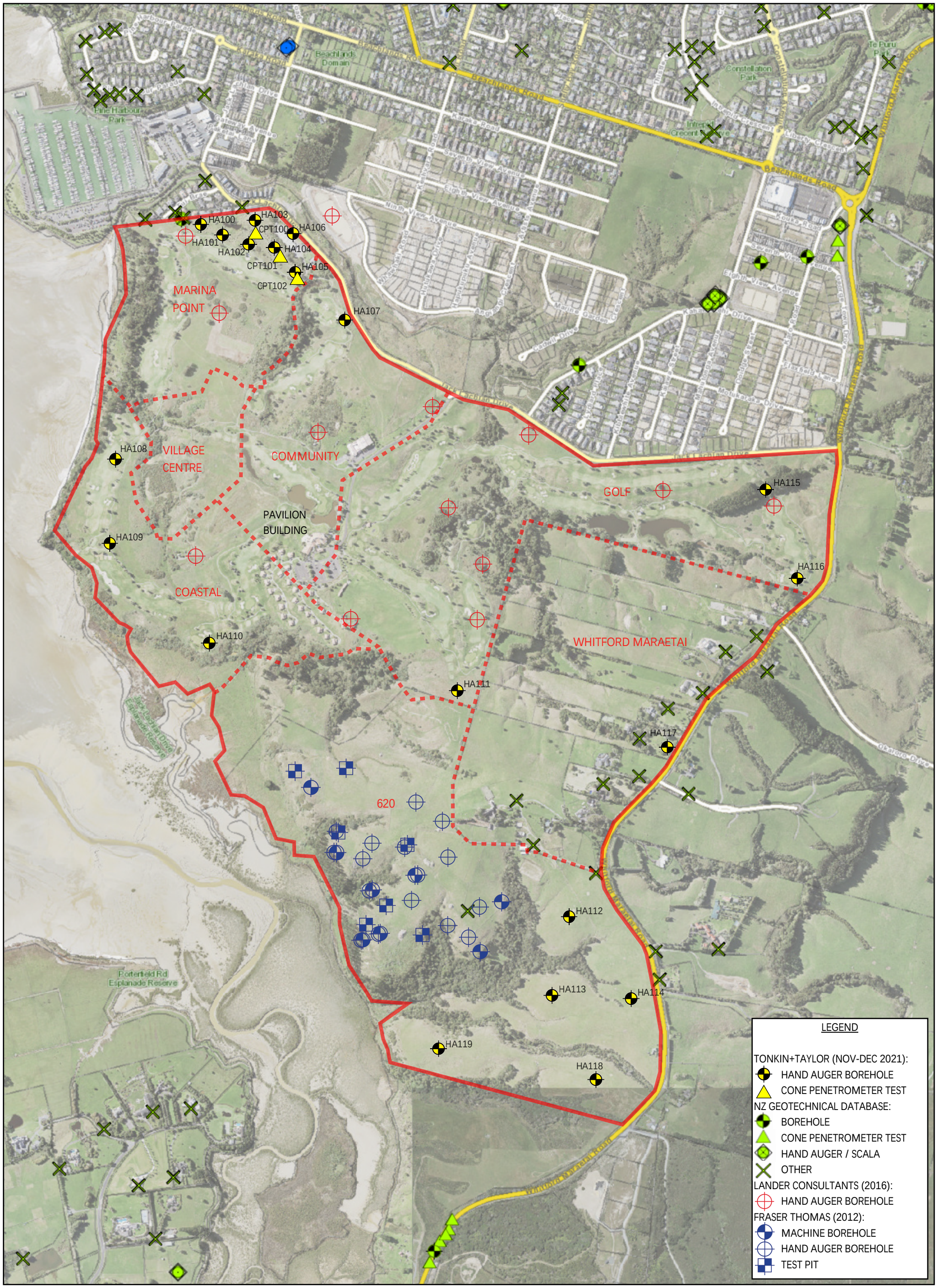
Aerial Photograph 1980

1996 Aerial Photograph

2001 Satellite Imagery

2017 Satellite Imagery

Appendix C: Geotechnical site investigations, 2021



Tonkin+Taylor

DRAWN: M THOMAS 09/21
CHECKED: B WESTGATE
APPROVED: P MILLAR
JOB No: 1014358.3000
SCALE: 1:10,000 AT A3
INVESTIGATION LOCATIONS ARE APPROXIMATE

BEACHLANDS SOUTH LIMITED PARTNERSHIP
STRUCTURE PLAN
KNOWN GEOTECHNICAL INVESTIGATIONS
SKETCH PLAN

V 1.1

HAND AUGER LOG

HOLE Id: **HA100**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5915375 mN 1777484 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 22/11/2021
		METHOD: Hand auger	HOLE FINISHED: 22/11/2021
R.L.:	19m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: VEMA CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Fill					>217 kPa						M	TP		*0.00m:* Silty fine to coarse GRAVEL, trace sand; brown. Tightly packed, moist, well graded. Gravel, sub-angular, basalt; sand, fine.
												H		*0.50m:* Clayey SILT, trace sand; brown mottled orange. Hard, moist, medium plasticity. Sand, fine.
Residual East Coast Bays Formation Soils	22/11/2021	100	HA		209/92 kPa		18	1		RS	M-W	VSt-H		*0.90m:* Silty CLAY; grey streaked orange. Very stiff to hard, moist to wet, high plasticity.
					81/37 kPa							St		*1.50 - 2.00m:* Stiff.
														1.90 - 2.00m: pink streaks.
					92/34 kPa		17	2			W			*2.00m:* SILT, some clay; orange. Stiff, wet, low plasticity.
					217/43 kPa							H		*2.50 - 2.80m:* Hard.
												St		*2.80m:* CLAY, some silt; orange. Stiff, wet, high plasticity.
	22/11/2021				74/40 kPa		16	3						
					174/52 kPa							VSt		*3.40m:* SILT, some clay; light grey mottled orange. Very stiff, wet, low plasticity.
														3.80 - 4.40m: orange.
					183/43 kPa		15	4						*4.10 - 4.40m:* wet to saturated.
					>217 kPa							H		*4.40m:* Clayey SILT; light grey. Hard, wet, medium plasticity.
														4.80m: Silty CLAY; grey. Hard, wet, high plasticity.
					>217 kPa		14	5						5m: Target depth

0.0-5.0m

COMMENTS:

Hole Depth 5m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:04:55 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA100**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2 JOB No.: 1014358.3000	
CO-ORDINATES: (NZTM2000)	5915375 mN 1777484 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 22/11/2021 HOLE FINISHED: 22/11/2021 DRILLED BY: T+T
R.L.:	19m		
DATUM:	NZVD2016		LOGGED BY: VEMA CHECKED: NBK

0.00-5.00m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:04:55 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA101**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5915347 mN 1777546 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 22/11/2021
		METHOD: Hand auger	HOLE FINISHED: 22/11/2021
R.L.:	18m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Topsoil									TS		M	S		*0.00m:* Clayey SILT, trace rootlets; dark brown. Soft, moist, medium plasticity.
Fill												VSt		*0.15m:* Clayey SILT, some sand; brown mottled grey. Very stiff, moist, medium plasticity. Sand, fine.
					>207 kPa							VSt-H		*0.50m:* Silty CLAY, trace rootlets and trace sand; grey mottled brown. Very stiff to hard, moist, high plasticity. Sand, fine.
Residual East Coast Bays Formation Soils	DRY 22/11/2021	100	HA		192/109 kPa AL & LS @ 1.00m		17	1		RS		VSt		*0.90m:* Clayey SILT; brown streaked orange. Very stiff, moist, high plasticity.
					132/72 kPa						M-W			*1.40m:* Silty CLAY; light grey streaked orange. Very stiff, moist to wet, high plasticity.
					144/69 kPa		16	2			W			*1.80m:* SILT, some clay; light grey streaked orange. Very stiff, wet, low to medium plasticity.
					124/49 kPa									
					115/52 kPa		15	3						*3.30m:* Silty CLAY; grey mottled orange. Very stiff, wet, high plasticity.
					184/61 kPa									
					192/103 kPa		14	4						
							13	5						4.2m: Target depth

COMMENTS:

Hole Depth 4.2m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:03 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA102**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5915329 mN 1777607 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 22/11/2021
		METHOD: Hand auger	HOLE FINISHED: 22/11/2021
R.L.:	17m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: VEMA CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Fill		100	HA		157/45 kPa		16	1			M	St		*0.00m:* SILT, some sand; dark brown. Stiff, moist, low to medium plasticity.
												VSt		*0.20m:* Clayey SILT; dark brown mottled orange. Very stiff, moist, medium plasticity.
					153/51 kPa									*1.10 - 1.90m:* Low to medium plasticity.
					135/52 kPa									
					68/37 kPa		15	2			W	St-VSt		*1.90m:* SILT, some clay; grey. Stiff to very stiff, wet, low to medium plasticity.
					135/63 kPa									
					162/72 kPa		14	3		RS		VSt		*3.10m:* Silty CLAY; yellow brown. Very stiff, wet, high plasticity.
Residual East Coast Bays Formation Soils	DRY 22/11/2021				144/62 kPa									
					135/52 kPa		13	4						4m: Target depth
							12	5						

0.0-4.0m

COMMENTS:

Hole Depth 4m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:11 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA102**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5915329 mN 1777607 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 22/11/2021 HOLE FINISHED: 22/11/2021 DRILLED BY: T+T
R.L.:	17m		
DATUM:	NZVD2016		LOGGED BY: VEMA CHECKED: NBK

0.00-4.00m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:11 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA103**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5915379 mN 1777646 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 22/11/2021
		METHOD: Hand auger	HOLE FINISHED: 22/11/2021
R.L.:	19m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Fill		100	HA		121/43 kPa		18	1			W	St-VSt		*0.00m:* Clayey SILT, some sand, trace gravel; brown mottled orange & grey. Stiff to very stiff, wet, medium plasticity. Sand, fine to medium; gravel, fine, angular, basalt.
					146/72 kPa							VSt		*0.70m:* Silty CLAY, trace rootlets and trace sand; grey mottled brown. Very stiff, wet, high plasticity. Sand, fine.
												St		*1.20m:* Organic SILT; black. Stiff, wet, low plasticity. Organics, rootlets (decomposed).
					>207 kPa							VSt		*1.40m:* Clayey SILT, some sand, trace shell fragments; grey mottled black. Very stiff, wet, medium plasticity. Sand, fine to medium.
					172/52 kPa		17	2						*1.90 - 2.80m:* grey.
					101/53 kPa									*2.80 - 5.00m:* grey mottled black with some fine to coarse sand & shell fragments.
					92/63 kPa		16	3				St		*3.00 - 3.90m:* Stiff.
					91/66 kPa									
					112/69 kPa		15	4				VSt		
					145/61 kPa									
Residual East Coast Bays Formation Soils	DRY 22/11/2021				135/69 kPa		14	5		RS				*5.00m:* Clayey SILT; light grey streaked orange. Very stiff, wet, medium plasticity.
														5.2m: Target depth

COMMENTS:

Hole Depth 5.2m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:18 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA104**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5915315 mN 1777676 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 23/11/2021
		METHOD: Hand auger	HOLE FINISHED: 23/11/2021
R.L.:	21m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: VEMA CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Fill					68/31 kPa						M	St		*0.00m:* Sandy SILT; light brown. Stiff, moist, low plasticity. Sand, fine to medium.
					189/107 kPa		20	1				VSt		*0.60m:* Clayey SILT, trace sand; orange brown. Very stiff, moist, medium plasticity. Sand, fine.
					153/55 kPa							VSt-H		*1.50m:* Silty CLAY; brown streaked grey. Very stiff to hard, moist, high plasticity.
					>217 kPa		19	2						
					107/52 kPa									
					148/83 kPa		18	3			W	VSt		*2.90m:* Clayey SILT, trace shell fragments and trace sand; dark grey. Very stiff, wet, medium plasticity. Sand, fine.
					154/77 kPa									
					129/52 kPa		17	4						
					138/48 kPa									
					129/68 kPa		16	5						
														5.2m: Target depth

COMMENTS:

Hole Depth 5.2m

Scale 1:28

Rev.: A

0.0-5.0m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:26 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA104**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5915315 mN 1777676 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 23/11/2021 HOLE FINISHED: 23/11/2021 DRILLED BY: T+T
R.L.:	21m		
DATUM:	NZVD2016		LOGGED BY: VEMA CHECKED: NBK

0.00-5.00m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:26 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA105**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5915271 mN 1777719 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 23/11/2021
		METHOD: Hand auger	HOLE FINISHED: 23/11/2021
R.L.:	22m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 S 25 F 50 St 100 VSt 200 H	DESCRIPTION
Fill					>207 kPa		21	1			D	VSt		*0.00m:* SILT, some clay; brown. Very stiff, dry, low plasticity.
											M	H		*0.40m:* Silty CLAY, trace sand; brown mottled orange. Hard, moist, high plasticity. Sand, fine.
					>207 kPa						W	VSt		*0.80m:* Organic SILT; black. Very stiff, wet, low plasticity. Organics, rootlets (partially decomposed).
												VSt-H		*1.00m:* Clayey SILT, trace shell fragments and trace sand; grey mottled brown. Very stiff to hard, wet, medium plasticity. Sand, fine.
					189/61 kPa									
					192/43 kPa		20	2						*2.10 - 3.80m:* some fine to medium sand and shell fragments.
					146/63 kPa									
					>207 kPa		19	3						
					126/66 kPa									
												VSt		*3.80m:* Sandy SILT, trace shell fragments; grey. Very stiff, wet, low plasticity. Sand, fine.
					169/81 kPa		18	4						
Residual East Coast Bays Formation Soils	DRY 23/11/2021				201/92 kPa						M-W			*4.20m:* Silty CLAY; light grey streaked orange. Very stiff, moist to wet, high plasticity.
					179/109 kPa		17	5						
														5.2m: Target depth

COMMENTS:

Hole Depth 5.2m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:33 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA106**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5915355 mN 1777733 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 23/11/2021
		METHOD: Hand auger	HOLE FINISHED: 23/11/2021
R.L.:	17m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: VEMA CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Fill					● 201/86 kPa		16	1			D	St		*0.00m:* Gravelly SILT, some sand; light brown. Stiff, dry, low plasticity. Gravel, fine, sub-angular, basalt; sand, fine to medium.
					● 146/78 kPa						M	VSt		*0.20m:* Sandy SILT; light grey speckled brown. Very stiff, moist, low plasticity. Sand, fine.
					● >207 kPa									*0.90m:* SILT, some clay; orange brown. Very stiff, moist, medium plasticity.
					● >207 kPa		15	2				H		*1.70m:* Silty CLAY, trace sand; dark grey. Hard, moist, high plasticity. Sand, fine.
Residual East Coast Bays Formation Soils	DRY 22/11/2021				● >207 kPa						W	VSt		*2.30m:* Clayey SILT; orange streaked grey. Very stiff, wet, medium plasticity.
					● 195/121 kPa		14	3				VSt-H		*2.80m:* Silty CLAY; light grey streaked orange. Very stiff to hard, wet, high plasticity.
					● >207 kPa									
					● >207 kPa		13	4						4m: Target depth
							12	5						

0.0-4.0m

COMMENTS:

Hole Depth 4m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:41 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA106**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5915355 mN 1777733 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 23/11/2021 HOLE FINISHED: 23/11/2021 DRILLED BY: T+T
R.L.:	17m		
DATUM:	NZVD2016		LOGGED BY: VEMA CHECKED: NBK

0.00-4.00m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:41 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA107**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5915161 mN 1777873 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 24/11/2021
		METHOD: Hand auger	HOLE FINISHED: 24/11/2021
R.L.:	19m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS									ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 VSt H	DESCRIPTION	
Fill					>207 kPa						D	VSt		*0.00m:* SILT, some rootlets and some clay; brown. Very stiff, dry, low plasticity.	
											M	VSt-H		*0.20m:* Clayey SILT, trace sand; brown mottled orange. Very stiff to hard, moist, medium plasticity. Sand, fine.	
Residual East Coast Bays Formation Soils	DRY 24/11/2021	100	HA		146/89 kPa		18	1				VSt		*0.60m:* Silty CLAY; light grey streaked orange. Very stiff, moist, high plasticity.	
					121/75 kPa						W	VSt-H		*1.90m:* Clayey SILT; grey streaked orange. Very stiff to hard, wet, medium plasticity.	
					>207 kPa		17	2							
					144/52 kPa										
					>207 kPa		16	3				H		*3.00m:* SILT, some clay; orange. Hard, wet, low to medium plasticity.	
					>207 kPa									*3.70m:* Clayey SILT; grey. Hard, wet, medium plasticity.	
					>207 kPa		15	4							0.0-4.2m
							14	5						4.2m: Target depth	

COMMENTS:

Hole Depth 4.2m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:48 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA107**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5915161 mN 1777873 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 24/11/2021 HOLE FINISHED: 24/11/2021 DRILLED BY: T+T
R.L.:	19m		
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

0.00-4.20m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:48 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA108**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5914649 mN 1777242 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 24/11/2021
		METHOD: Hand auger	HOLE FINISHED: 24/11/2021
R.L.:	19m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Fill					>207 kPa						D	St		*0.00m:* SILT, some clay, trace rootlets; brown. Stiff, dry, low plasticity.
											M	VSt-H		*0.25m:* Clayey SILT; orange brown. Very stiff to hard, moist, medium plasticity.
Residual East Coast Bays Formation Soils					>207 kPa		18	1						*0.80m:* Silty CLAY; light grey streaked orange. Very stiff to hard, moist, high plasticity.
					144/78 kPa									*1.50 - 2.00m:* pink streaks.
		100	HA		135/58 kPa		17	2			W	VSt		*2.00m:* SILT, some clay; brown mottled orange. Very stiff, wet, low to medium plasticity.
	24/11/2021				135/52 kPa									*2.40 - 2.70m:* pink streaked grey.
					109/40 kPa		16	3						*2.70m:* Clayey SILT; pink streaked grey. Very stiff, wet, medium plasticity.
	24/11/2021				149/49 kPa									*3.70 - 3.80m:* orange.
					189/61 kPa		15	4						0.0-4.2m
							14	5						4.2m: Target depth

COMMENTS:

Hole Depth 4.2m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:55 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA108**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2 JOB No.: 1014358.3000	
CO-ORDINATES: (NZTM2000)	5914649 mN 1777242 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 24/11/2021 HOLE FINISHED: 24/11/2021 DRILLED BY: T+T
R.L.:	19m		
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

0.00-4.20m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:05:55 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA109**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5914403 mN 1777234 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 24/11/2021
		METHOD: Hand auger	HOLE FINISHED: 24/11/2021
R.L.:	23m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS									ENGINEERING DESCRIPTION				
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Fill					>207 kPa						M	St		*0.00m:* Clayey SILT, some rootlets; brown. Stiff, moist, medium plasticity.
											W	VSt-H		*0.20m:* Clayey SILT, some gravel, trace sand; mottled brown. Very stiff to hard, wet, low plasticity. Gravel, fine to medium, sub-angular, sandstone; sand, fine.
Residual East Coast Bays Formation Soils					184/115 kPa		22	1			M	VSt		*0.65m:* Silty CLAY; orange streaked light grey. Very stiff, moist, high plasticity.
					>207 kPa							VSt-H		*1.50m:* CLAY, some silt; grey streaked pink. Very stiff to hard, moist, high plasticity.
	DRY 24/11/2021	100	HA		>207 kPa		21	2						
					135/83 kPa						W	VSt		*2.90m:* Silty CLAY; light grey. Very stiff, wet, high plasticity.
					129/75 kPa		20	3						
					189/63 kPa									*3.50m:* Clayey SILT; light grey streaked orange. Very stiff, wet, medium plasticity.
					207/75 kPa		19	4						0.0-4.2m
							18	5						4.2m: Target depth

COMMENTS:

Hole Depth 4.2m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:03 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA109**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5914403 mN 1777234 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 24/11/2021 HOLE FINISHED: 24/11/2021 DRILLED BY: T+T
R.L.:	23m		
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

0.00-4.20m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:03 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA110**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5914246 mN 1777561 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 24/11/2021
		METHOD: Hand auger	HOLE FINISHED: 24/11/2021
R.L.:	27m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS									ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION	
Topsoil									TS		M	St		*0.00m:* Clayey SILT, some rootlets; brown. Stiff, moist, medium plasticity.	
												St-VSt		*0.20m:* Silty CLAY; light grey streaked orange. Stiff to very stiff, moist, high plasticity.	
					98/61 kPa										
					AL & LS @ 0.50m										
					92/43 kPa		26	1							
					61/35 kPa						W	St		*1.20m:* Clayey SILT; grey streaked orange. Stiff, wet, medium plasticity.	
														1.60m: SILT, some clay; brown mixed grey. Stiff, wet, low plasticity.	
	24/11/2021				>207 kPa		25	2							
Residual East Coast Bays Formation Soils												H		*2.10m:* Clayey SILT; grey streaked orange. Hard, wet, medium plasticity.	
					>207 kPa										
												VSt		*2.80m:* Silty CLAY; dark grey. Very stiff, wet, high plasticity.	
					161/43 kPa		24	3							
	24/11/2021													*3.40m:* Clayey SILT; dark grey. Very stiff, wet, medium plasticity.	
					132/52 kPa										
					109/46 kPa		23	4							0.0-4.2m
														4.2m: Target depth	
							22	5							

COMMENTS:

Hole Depth 4.2m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:10 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA110**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2 JOB No.: 1014358.3000	
CO-ORDINATES: (NZTM2000)	5914246 mN 1777561 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 24/11/2021 HOLE FINISHED: 24/11/2021 DRILLED BY: T+T
R.L.:	27m		
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

0.00-4.20m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:10 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA111**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5914063 mN 1778205 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 24/11/2021
		METHOD: Hand auger	HOLE FINISHED: 24/11/2021
R.L.:	53m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS									ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION	
Topsoil									TS		M	St		*0.00m:* Clayey SILT, some rootlets; brown. Stiff, moist, low plasticity.	
Fill												VSt		*0.15m:* Clayey SILT, trace sand; brown mottled orange. Very stiff, moist, medium plasticity. Sand, fine.	
					164/89 kPa									*0.50m:* Silty CLAY; light grey streaked orange. Very stiff, moist, high plasticity.	
					149/75 kPa		52	1							
											W			*1.10m:* SILT, some clay; brown mottled orange. Very stiff, wet, low plasticity.	
					201/72 kPa									*1.25 - 1.50m:* pink with grey streaks.	
												VSt-H		*1.50m:* Clayey SILT; pink. Very stiff to hard, wet, medium plasticity.	
					>207 kPa		51	2							
Residual East Coast Bays Formation Soils					201/72 kPa									*2.60 - 3.40m:* mottled pink and orange.	
					>207 kPa		50	3							
	24/11/2021				149/75 kPa									*3.70 - 4.20m:* pink mottled grey.	
					164/38 kPa		49	4							0.0-4.2m
							48	5						4.2m: Target depth	

COMMENTS:

Hole Depth 4.2m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:18 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA111**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5914063 mN 1778205 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 24/11/2021 HOLE FINISHED: 24/11/2021 DRILLED BY: T+T
R.L.:	53m		
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

0.00-4.20m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:18 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA112**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5913410 mN 1778574 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 23/11/2021
		METHOD: Hand auger	HOLE FINISHED: 23/11/2021
R.L.:	64m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Topsoil									TS		D	St		*0.00m:* Clayey SILT, some rootlets; brown. Stiff, dry, low plasticity.
Residual East Coast Bays Formation Soils	23/11/2021	100	HA		195/92 kPa AL & LS @ 0.50m 138/81 kPa 112/69 kPa 118/63 kPa 109/66 kPa 138/69 kPa >207 kPa 189/78 kPa		63 62 61 60 59	1 2 3 4 5			M W	VSt		*0.30m:* Silty CLAY; orange. Very stiff, moist, high plasticity. *1.20m:* CLAY, some silt; light grey streaked orange. Very stiff, wet, high plasticity. *2.30m:* Clayey SILT; orange speckled grey. Very stiff, wet, medium plasticity. *3.50m:* Clayey SILT; light grey streaked orange. Very stiff, wet, low plasticity.
														4.2m: Target depth

COMMENTS:

Hole Depth 4.2m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:25 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA113**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5913175 mN 1778495 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 23/11/2021
		METHOD: Hand auger	HOLE FINISHED: 23/11/2021
R.L.:	57m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS									ENGINEERING DESCRIPTION				
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Topsoil									TS		M	St		*0.00m:* Clayey SILT; brown. Stiff, moist, medium plasticity.
												VSt		*0.15m:* Silty CLAY; orange brown. Very stiff, moist, high plasticity.
					124/59 kPa									
					86/48 kPa		56	1						
					>207 kPa						W	VSt-H		*1.50m:* Clayey SILT; pink mottled orange. Very stiff to hard, wet, medium plasticity.
Residual East Coast Bays Formation Soils		100	HA		>207 kPa		55	2						
												H		*2.10m:* SILT, some clay; pink mixed light grey. Hard, wet, low plasticity. Friable.
					>207 kPa									*2.50m:* Clayey SILT; grey mottled orange. Hard, wet, medium plasticity.
	DRY 23/11/2021				>207 kPa		54	3						0.0-3.2m
							53	4						3.2m: Target depth
							52	5						

COMMENTS:

Hole Depth 3.2m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:32 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA113**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5913175 mN 1778495 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 23/11/2021 HOLE FINISHED: 23/11/2021 DRILLED BY: T+T
R.L.:	57m		
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

0.00-3.20m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:33 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA114**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5913202 mN 1778700 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 23/11/2021
		METHOD: Hand auger	HOLE FINISHED: 23/11/2021
R.L.:	64m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: VEMA CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS									ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 VSt H	DESCRIPTION	
Topsoil									TS		D	VSt		*0.00m:* Sandy SILT; brown. Very stiff, dry, low plasticity. Sand, fine.	
											M			*0.20m:* Silty CLAY; yellow streaked grey. Very stiff, moist, high plasticity.	
					139/55 kPa										
					153/55 kPa		63	1			W			*0.90m:* CLAY, some silt; orange streaked light grey. Very stiff, wet, high plasticity.	
					174/68 kPa										
					159/71 kPa		62	2							
Residual East Coast Bays Formation Soils		100	HA		98/49 kPa										
					95/46 kPa		61	3				St		*2.60m:* Silty CLAY; orange brown. Stiff, wet, high plasticity.	
	23/11/2021				89/52 kPa							St-VSt		*3.40m:* Clayey SILT; orange. Stiff to very stiff, wet, medium plasticity.	
	20/11/2021				110/49 kPa		60	4							
					144/62 kPa							VSt		*4.60m:* Clayey SILT; dark grey. Very stiff, wet, medium plasticity.	
					141/80 kPa		59	5						5m: Target depth	

0.0-5.0m

COMMENTS:

Hole Depth 5m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:40 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA114**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5913202 mN 1778700 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 23/11/2021 HOLE FINISHED: 23/11/2021 DRILLED BY: T+T
R.L.:	64m		
DATUM:	NZVD2016		LOGGED BY: VEMA CHECKED: NBK

0.00-5.00m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:40 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA115**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering | LOCATION: 110 Jack Lachlan Drive, Beachlands 2571 | JOB No.: 1014358.3000

CO-ORDINATES: (NZTM2000) 5914594 mN 1779098 mE

R.L.: 37m

DATUM: NZVD2016

DRILL TYPE: 50mm Hand Auger

METHOD: Hand auger

HOLE STARTED: 09/12/2021

HOLE FINISHED: 09/12/2021

DRILLED BY: T+T

LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Topsoil											M	F		*0.00m:* Clayey SILT, some rootlets; brown. Firm, moist, low plasticity.
											W			*0.10m:* Clayey SILT, trace rootlets and trace sand; brown mottled orange. Firm, wet, medium plasticity. Sand, fine.
					63/29 kPa							St		*0.50m:* Silty CLAY, trace sand; brown. Stiff, wet, high plasticity. Sand, fine.
	09/12/2021										W-S	LP		*0.80m:* Silty sandy fine to medium GRAVEL, trace organics; grey brown. Loosely packed, wet to saturated, poorly graded. Gravel, sub-angular, greywacke; sand, fine to medium; organics, wood fragments.
Alluvial Deposits (redeposited uncontrolled fill?)	09/12/2021	100	HA				36	1			W	F		*1.20m:* Silty CLAY, some gravel, trace sand; grey. Firm, wet, high plasticity. Gravel, fine to medium, sub-angular, basalt; sand, fine.
					58/32 kPa									
					144/49 kPa		35	2			M-W	VSt		*2.00m:* Clayey SILT; orange streaked light grey. Very stiff, moist to wet, medium plasticity.
Residual East Coast Bays Formation Soils											W	H		*2.35m:* Gravelly SILT, some sand; orange. Hard, wet, low plasticity. Gravel, fine, sub-angular, manganese nodules; sand, fine. 0.0-2.5m
					UTP		34	3						2.5m: END OF BOREHOLE. Refusal
							33	4						
							32	5						

COMMENTS:

Hole Depth 2.5m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:47 pm - Produced with Core-GS by GeRoc

Tonkin+Taylor

HAND AUGER PHOTOS

BOREHOLE No.: **HA115**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5914594 mN 1779098 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 09/12/2021 HOLE FINISHED: 09/12/2021 DRILLED BY: T+T
R.L.:	37m		
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

0.00-2.50m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:48 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA116**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5914313 mN 1779222 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 09/12/2021
		METHOD: Hand auger	HOLE FINISHED: 09/12/2021
R.L.:	52m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS										ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION		
Topsoil									TS		M	F		*0.00m:* Clayey SILT, some rootlets; brown. Firm, moist, medium plasticity.		
												St		*0.20m:* SILT, some clay; brown. Stiff, moist, low to medium plasticity.		
					AL @ 0.50m 138/81 kPa							VSt		*0.50m:* Silty CLAY; orange. Very stiff, moist, high plasticity.		
					161/86 kPa		51	1						*1.00m:* Clayey SILT; light grey streaked orange. Very stiff, moist, medium plasticity.		
					115/55 kPa											
					124/46 kPa		50	2								
Residual East Coast Bays Formation Soils	09/12/2021	100	HA								W			*2.10m:* Silty CLAY; light grey streaked orange. Very stiff, wet, high plasticity.		
					132/46 kPa											
	09/12/2021				135/52 kPa		49	3						*2.90m:* Clayey SILT; grey mixed orange. Very stiff, wet, medium plasticity.		
					>207 kPa							H		*3.30m:* SILT, some clay; grey. Very stiff, wet, medium plasticity. *3.50 - 4.20m:* Hard.		
					195/63 kPa		48	4								0.0-4.2m
							47	5						4.2m: Target depth		

COMMENTS:

Hole Depth 4.2m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:55 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA116**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5914313 mN 1779222 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 09/12/2021 HOLE FINISHED: 09/12/2021 DRILLED BY: T+T
R.L.:	52m		
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

0.00-4.20m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:06:55 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA117**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5913842 mN 1778798 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 09/12/2021
		METHOD: Hand auger	HOLE FINISHED: 09/12/2021
R.L.:	65m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Topsoil									TS		D	VSt		*0.00m:* SILT, some rootlets and some clay; brown. Very stiff, dry, low plasticity.
											M			*0.20m:* Clayey SILT; brown. Very stiff, moist, medium plasticity.
					AL @ 0.50m >207 kPa							H		*0.50 - 0.90m:* Hard.
					121/58 kPa		64	1				VSt		*0.90m:* Silty CLAY; orange brown. Very stiff, moist, high plasticity.
Residual East Coast Bays Formation Soils		100	HA		>207 kPa						W	H		*1.40m:* Clayey SILT, trace sand; brown mixed orange. Hard, wet, medium plasticity. Sand, fine.
					189/121 kPa		63	2						
					>207 kPa						M			*2.50m:* SILT, some clay; orange mixed grey. Hard, moist, low plasticity.
					>207 kPa		62	3						3m: Target depth
							61	4						
							60	5						

0.0-3.0m

COMMENTS:

Hole Depth 3m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:07:03 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA117**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5913842 mN 1778798 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 09/12/2021 HOLE FINISHED: 09/12/2021 DRILLED BY: T+T
R.L.:	65m		
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

0.00-3.00m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:07:03 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA118**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering | LOCATION: 110 Jack Lachlan Drive, Beachlands 2571 | JOB No.: 1014358.3000

CO-ORDINATES: (NZTM2000) 5912931 mN 1778593 mE

R.L.: 65m

DATUM: NZVD2016

DRILL TYPE: 50mm Hand Auger

METHOD: Hand auger

HOLE STARTED: 09/12/2021

HOLE FINISHED: 09/12/2021

DRILLED BY: T+T

LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Topsoil									TS		D	St		*0.00m:* SILT; brown. Stiff, dry, non-plastic.
												VSt-H		*0.30m:* Clayey SILT, trace rootlets; orange brown. Very stiff to hard, dry, medium plasticity.
					>207 kPa						M	VSt		*0.70m:* Silty CLAY; light grey streaked orange. Very stiff, moist, high plasticity.
					155/83 kPa		64	1						
					106/63 kPa									
Residual East Coast Bays Formation Soils		100	HA		103/52 kPa		63	2			W			*1.95m:* Clayey SILT; light grey. Very stiff, wet, medium plasticity.
					81/49 kPa							St		*2.50 - 2.70m:* Stiff.
					92/63 kPa		62	3						*2.70m:* Silty CLAY; light grey streaked orange. Stiff, wet, high plasticity.
					144/61 kPa							VSt		*3.30m:* Clayey SILT; orange. Very stiff, wet, medium plasticity.
	DRY 09/12/2021													*3.60m:* Silty CLAY; grey mixed brown. Very stiff, wet, high plasticity.
					109/75 kPa		61	4						4m: Target depth
							60	5						

0.0-4.0m

COMMENTS:

Hole Depth 4m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:07:10 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA118**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5912931 mN 1778593 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 09/12/2021 HOLE FINISHED: 09/12/2021 DRILLED BY: T+T
R.L.:	65m		
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

0.00-4.00m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:07:10 pm - Produced with Core-GS by GeRoc

HAND AUGER LOG

HOLE Id: **HA119**

SHEET: 1 OF 1

PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2571	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5912991 mN 1778137 mE	DRILL TYPE: 50mm Hand Auger	HOLE STARTED: 09/12/2021
		METHOD: Hand auger	HOLE FINISHED: 09/12/2021
R.L.:	34m		DRILLED BY: T+T
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

GEOLOGICAL	METHOD OBSERVATIONS								ENGINEERING DESCRIPTION					
STRATIGRAPHY / ENG GEOLOGICAL UNIT / ADDITIONAL OBSERVATIONS	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm) 0 1 2 3 4 5 6 7 8 9	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING CLASSIFICATION	MOISTURE CLASSIFICATION	CONSISTENCY / DENSITY CLASSIFICATION	ESTIMATED SOIL SHEAR STRENGTH (Su, kPa) VS 12 25 50 100 200 H	DESCRIPTION
Topsoil											D	St		*0.00m:* SILT, some clay, trace rootlets; brown. Stiff, dry, low plasticity.
											M	VSt		*0.25m:* Clayey SILT; brown. Very stiff, moist, medium plasticity.
					178/81 kPa									*0.50m:* Silty CLAY; orange brown. Very stiff, moist, high plasticity.
					141/63 kPa		33	1						
											W			*1.10m:* Clayey SILT; light grey streaked orange. Very stiff, wet, medium plasticity.
Residual East Coast Bays Formation Soils		100	HA		121/43 kPa									*1.50 - 2.10m:* brown.
					118/58 kPa		32	2						*2.10m:* Silty CLAY; light grey. Very stiff, wet, high plasticity.
	DRY 09/12/2021				>207 kPa									*2.90 - 3.00m:* Orange, some manganese nodules and trace fine sand. 0.0-3.0m
					161/69 kPa		31	3						3m: Target depth
							30	4						
							29	5						

COMMENTS:

Hole Depth 3m

Scale 1:28

Rev.: A

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:07:18 pm - Produced with Core-GS by GeRoc

HAND AUGER PHOTOS

BOREHOLE No.: **HA119**

SHEET: 1 OF 1

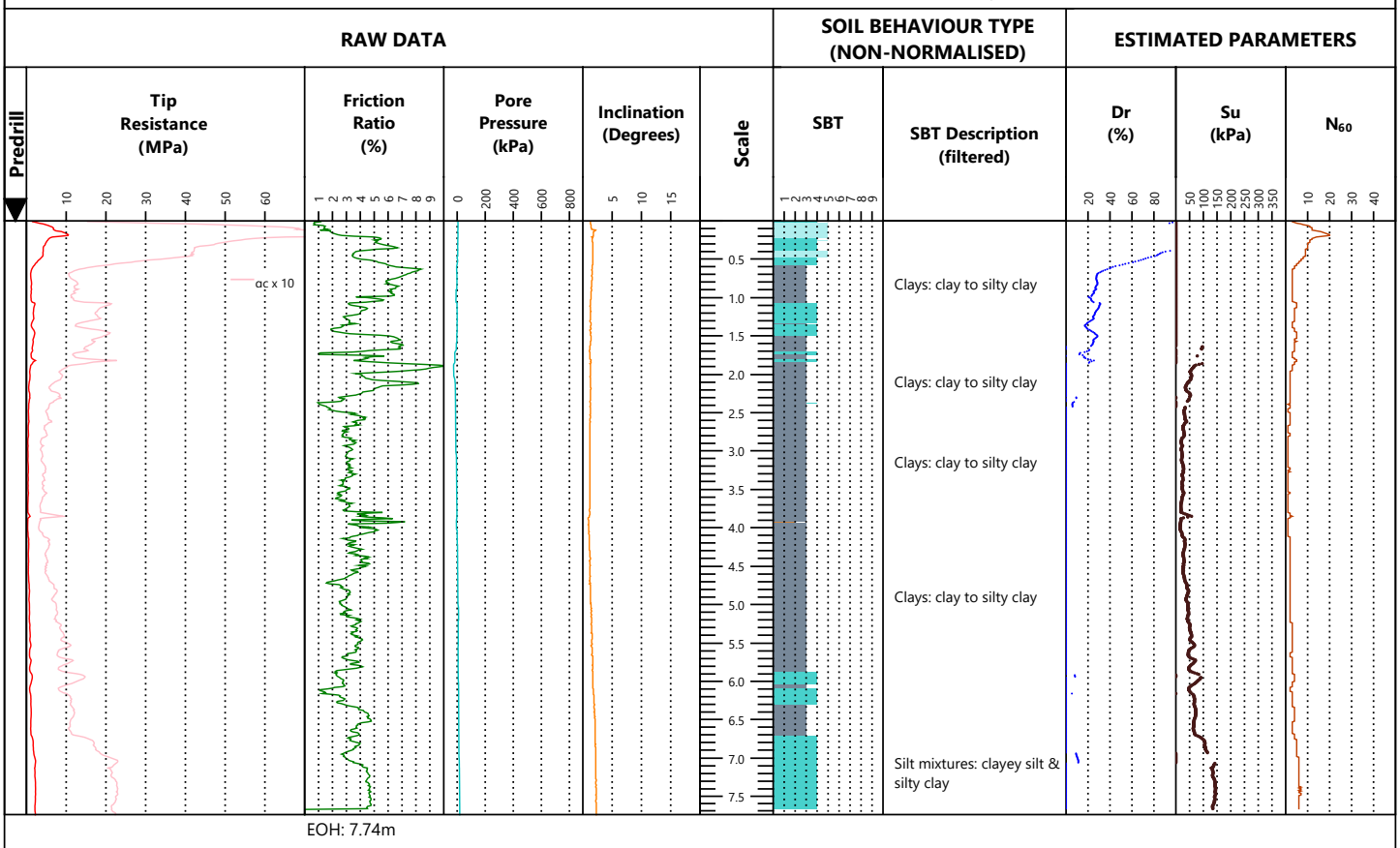
PROJECT: Geotechical Engineering		LOCATION: 110 Jack Lachlan Drive, Beachlands 2	JOB No.: 1014358.3000
CO-ORDINATES: (NZTM2000)	5912991 mN 1778137 mE	DRILL TYPE: 50mm Hand Auger METHOD: Hand auger	HOLE STARTED: 09/12/2021 HOLE FINISHED: 09/12/2021 DRILLED BY: T+T
R.L.:	34m		
DATUM:	NZVD2016		LOGGED BY: CMCD CHECKED: NBK

0.00-3.00m

HandAugerLog_CANDIDATE_v018 - ATOMIC LOSS DETL - 17/12/2021 1:07:18 pm - Produced with Core-GS by GeRoc

McMILLAN Drilling	Client: Tonkin and Taylor Ltd	Bore No.: CPT100
	Project: Jack Lachlan Drive, Beachlands	Job No.: 301544

Site Location: Jack Lachlan Drive, Beachlands
Date: 9/12/2021
Grid Reference: - -
Rig Operator: E. Green
Elevation: 0.00m **Datum:** Ground
Equipment: Pagani TG63-150



Cone Type: I-C2xFXYP100-10 - Compression
Cone Reference: 201116
Cone Area Ratio: 0.75
Standards: ISO 22476-1:2012

Predrill: -
Water Level: -
Collapse: 0.7m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	3.2405	3.3180
Local Friction	0.0131	0.0143
Pore Pressure	-0.0206	-0.0260

Termination

Target Depth ☐

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other: Anchor ☑

Soil Behaviour Type (SBT) - Robertson et al. 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

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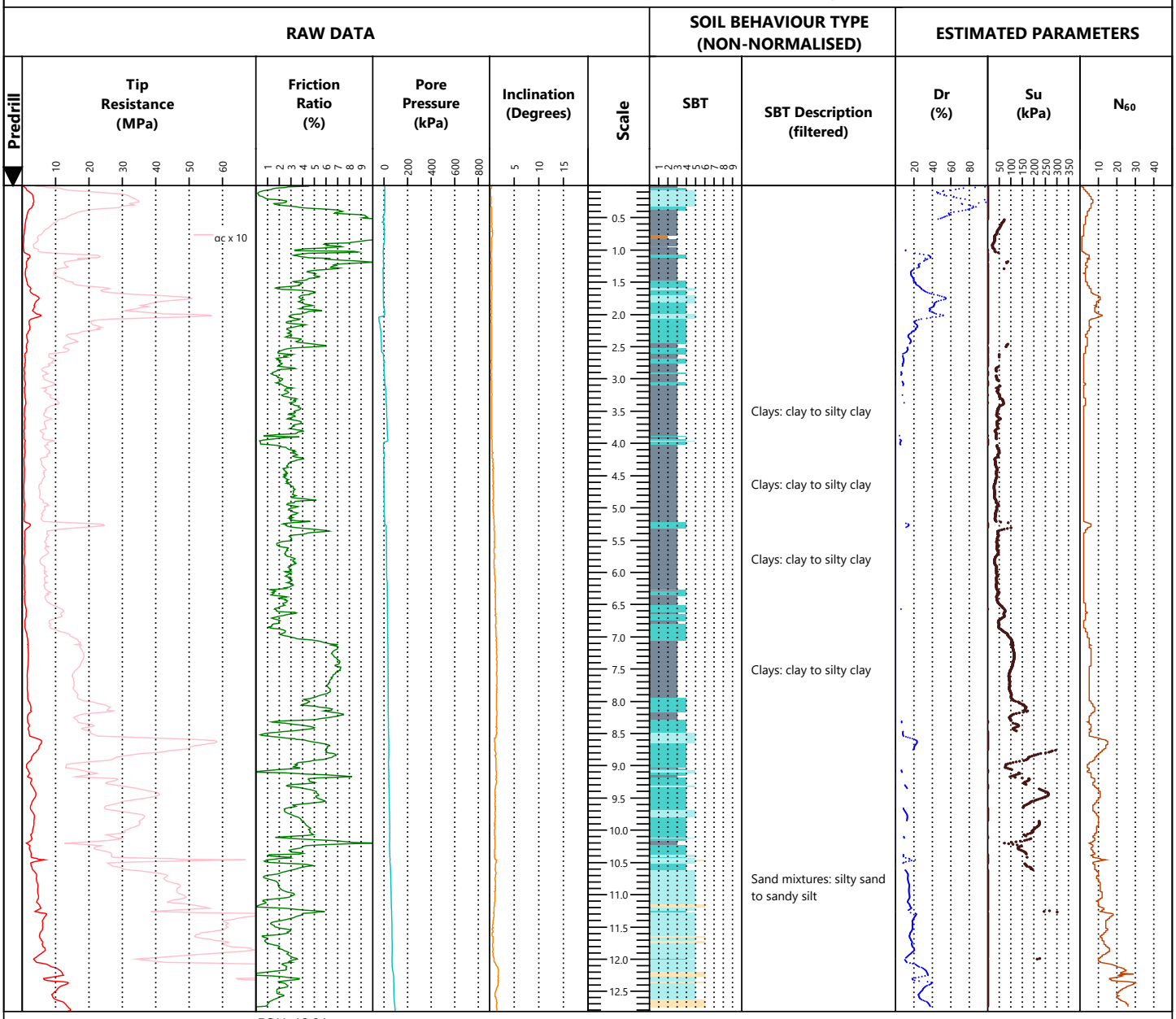
McMILLAN Drilling

Client: Tonkin and Taylor Ltd	**Bore No.:** CPT101
Project: Jack Lachlan Drive, Beachlands	**Job No.:** 301544

Site Location: Jack Lachlan Drive, Beachlands
Date: 9/12/2021
Grid Reference: - -
Rig Operator: E. Green
Elevation: 0.00m **Datum:** Ground
Equipment: Pagani TG63-150



EOH: 12.81m

Cone Type: I-C2xFXYP100-10 - Compression
Cone Reference: 201116
Cone Area Ratio: 0.75
Standards: ISO 22476-1:2012

Predrill: -
Water Level: -
Collapse: 0.8m

Zero load outputs (MPa)	Before test	After test
Tip Resistance	3.1916	3.3191
Local Friction	0.0120	0.0138
Pore Pressure	-0.0218	0.0046

Termination

Target Depth ☐

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other: Anchor ☑

Soil Behaviour Type (SBT) - Robertson et al. 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

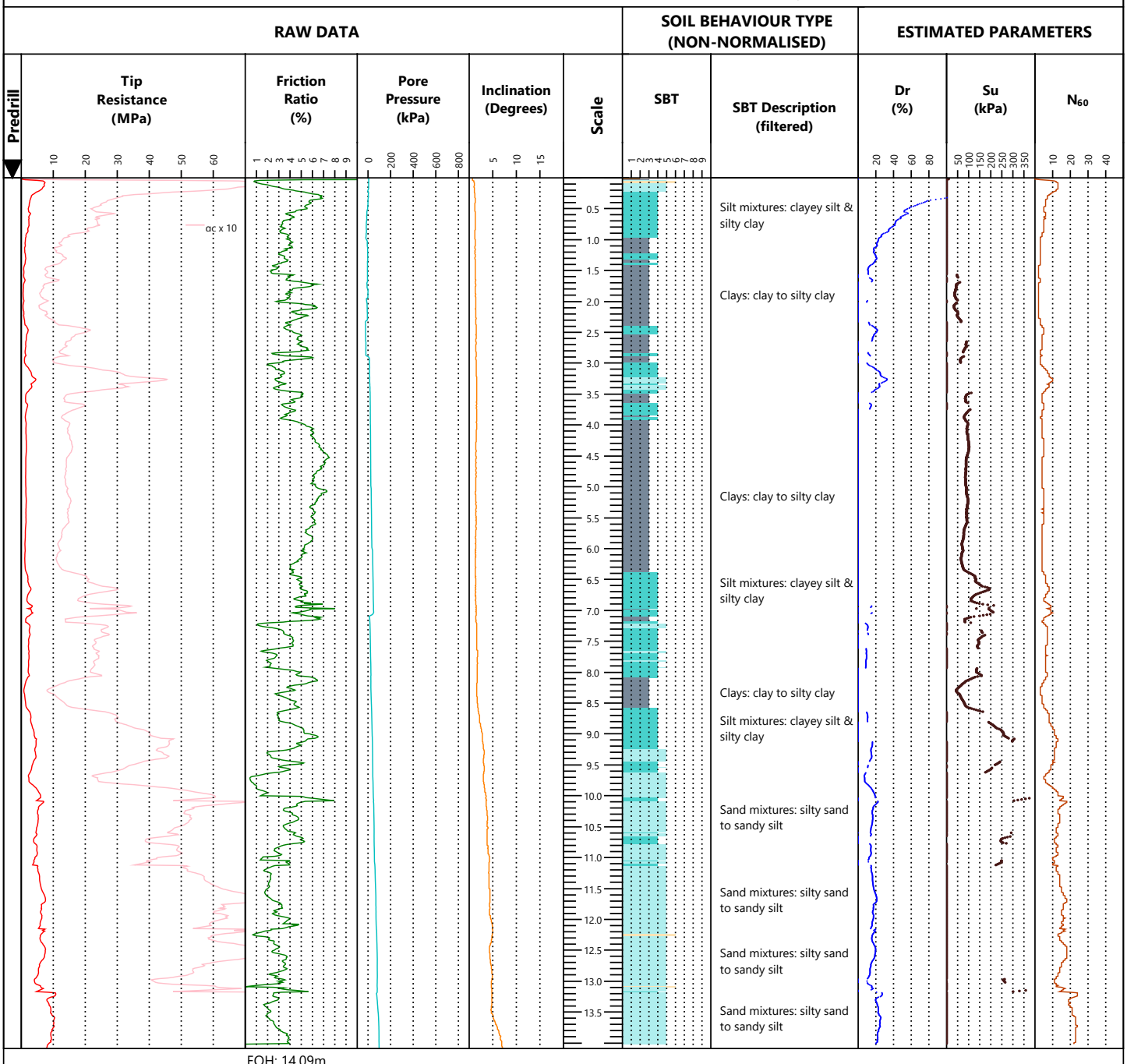
Remarks

Generated with Core-GS by Geroc

McMILLAN Drilling

Client:	Tonkin and Taylor Ltd
Project:	Jack Lachlan Drive, Beachlands
Bore No.:	CPT102
Job No.:	301544

Site Location: Jack Lachlan Drive, Beachlands
Date: 9/12/2021
Grid Reference: - -
Rig Operator: E. Green
Elevation: 0.00m **Datum:** Ground
Equipment: Pagani TG63-150



EOH: 14.09m

Cone Type: I-C2xFXYP100-10 - Compression
Cone Reference: 201116
Cone Area Ratio: 0.75
Standards: ISO 22476-1:2012

Predrill: -
Water Level: -
Collapse: -

Zero load outputs (MPa)	Before test	After test
Tip Resistance	3.2024	3.2978
Local Friction	0.0123	0.0144
Pore Pressure	-0.0160	-0.0136

Termination

Target Depth ☐

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other: Anchor ☑

Soil Behaviour Type (SBT) - Robertson et al. 1986

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine-grained	6	Sands: clean sands to silty sands
2	Clay - organic soil	7	Dense sand to gravelly sand
3	Clays: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff fine-grained

Notes & Limitations

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P. K. Robertson and K.L. Cabal (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use, and should be carefully reviewed by the user. No warranty is provided as to the correctness or the applicability of any of the geotechnical soil and design parameters shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Remarks

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TEST DETAIL

PointID: CPT100
Sounding: 1

Operator: E. Green
Cone Type: I-C2xFXYP100-10 - Compression
Cone Reference: 201116
Cone Area Ratio: 0.75

Date: 9/12/2021
Predrill: 0.00m
Water Level: -
Collapse: 0.7m

Termination

Target Depth ☐

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other: Anchor ☑

Zero load outputs (MPa)	Before test	After test
Tip Resistance	3.2405	3.3180
Local Friction	0.0131	0.0143
Pore Pressure	-0.0206	-0.0260

PointID: CPT101
Sounding: 2

Operator: E. Green
Cone Type: I-C2xFXYP100-10 - Compression
Cone Reference: 201116
Cone Area Ratio: 0.75

Date: 9/12/2021
Predrill: 0.00m
Water Level: -
Collapse: 0.8m

Termination

Target Depth ☐

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other: Anchor ☑

Zero load outputs (MPa)	Before test	After test
Tip Resistance	3.1916	3.3191
Local Friction	0.0120	0.0138
Pore Pressure	-0.0218	0.0046

PointID: CPT102
Sounding: 3

Operator: E. Green
Cone Type: I-C2xFXYP100-10 - Compression
Cone Reference: 201116
Cone Area Ratio: 0.75

Date: 9/12/2021
Predrill: 0.00m
Water Level: -
Collapse: -

Termination

Target Depth ☐

Effective Refusal

Tip ☐
Gauge ☐
Inclinometer ☐
Other: Anchor ☑

Zero load outputs (MPa)	Before test	After test
Tip Resistance	3.2024	3.2978
Local Friction	0.0123	0.0144
Pore Pressure	-0.0160	-0.0136

Generated with Core-GS by Geroc

CPT CALIBRATION AND TECHNICAL NOTES

These notes describe the technical specifications and associated calibration references pertaining to the following cone types:

- I-CFXY-10 measuring cone resistance, sleeve friction and inclination (standard cone, 10cm²);
- I-CFXY-15 measuring cone resistance, sleeve friction and inclination (standard cone, 15cm²);
- I-CFXYP20-10 measuring cone resistance, sleeve friction, inclination and pore pressure (piezocone, 10cm²);
- I-CFXYP100-10 measuring cone resistance, sleeve friction, inclination and high range pore pressure (piezocone, 10cm²);
- I-C2xFXYP100-10 measuring cone resistance, high range sleeve friction, inclination and high range pore pressure (piezocone, 10cm²);
- I-C5F0p15XYP20-10 measuring sensitive cone resistance, sleeve friction, inclination and pore pressure (piezocone, 10cm²).
- I-CFXYP20-15 measuring cone resistance, sleeve friction, inclination and pore pressure (piezocone, 15cm²);

Dimensions

Dimensional specifications for all cone types are detailed below. All tolerances are routinely checked prior to testing and measurements taken are electronically recorded. All records are kept on file and available on request.

A.P. van den Berg Machinefabriek

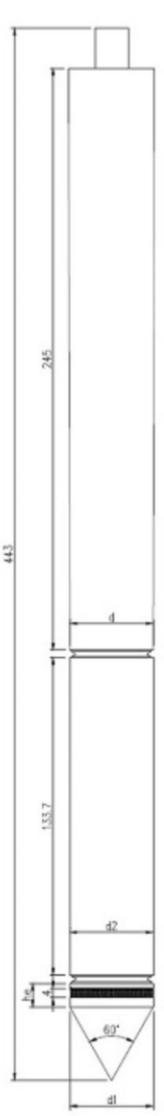
tel.: +31 (0)513-631355
info@apvandenberg.com

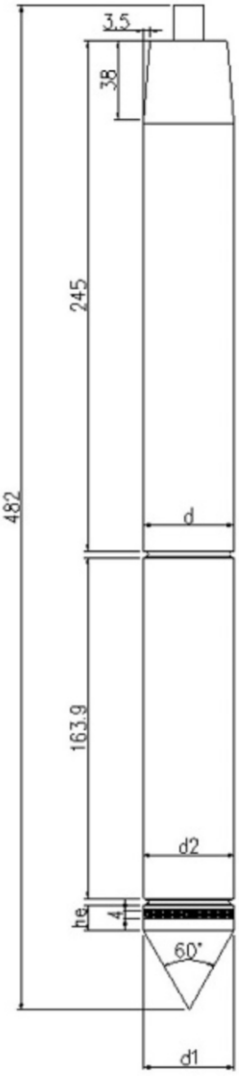
DEVIATION of Straightness + MINIMUM Dimensions tip, friction jacket, cone adapter

Standards:

EN ISO 22476-1
APB-standard

Type of cone:	Icone 10 cm²	Icone 15 cm²
ALLOWABLE SIZE VARIATION		
Diameter of tip:	35,3 ≤ d1 ≤ 36,0	43,2 ≤ d_1 ≤ 44,1
Diameter of centering ring CFP	35,3 ≤ d1 ≤ 36,0	43,2 ≤ d_1 ≤ 44,1
Diameter of friction jacket:	$d_1 \leq d_2 < d_1 + 0{,}35$	$d_1 \leq d_2 < d_1 + 0{,}43$
Height dimension of tip edge:	$7 \leq h_e \leq 10$	$9 \leq h_e \leq 12$
PRODUCTION DIMENSIONS		
Tip:	$d_1 = 35{,}7\ ^{+0,2}_{0}$	$d_1 = 43{,}8\ ^{+0,2}_{0}$
Jacket (C-cone):	$d_2 = 35{,}7\ ^{+0,2}_{0}$	$d_2 = 43{,}7\ ^{+0,2}_{0}$
Friction jacket (CF-cone):	$d_2 = 35{,}9\ ^{+0,1}_{0}$	$d_2 = 44{,}0\ ^{+0,1}_{0}$
Tip for used cone:	$d_1 = 35{,}5\ ^{+0,1}_{0}$	$d_1 = 43{,}5\ ^{+0,1}_{0}$
MINIMUM DIMENSIONS		
Minimum diameter jacket (C-cone):	d_2 = 35,2 (APB standard)	d_2 = 43,0 (APB standard)
Minimum diameter friction jacket (CF-cone):	d_2 = 35,3	d_2 = 43,2
Use "used cone"-tip when friction jacket diameter:	$d_2 \leq 35{,}65$	$d_2 \leq 43{,}7$
Minimum diameter of cone adaptor:	d = 35,3	d = 43,8
Maximum deviation of straightness:	1 mm on a length of 1000 mm (max. oscillation 1,0 mm.)	1 mm on a length of 1000 mm (max. oscillation: 2.0 mm)

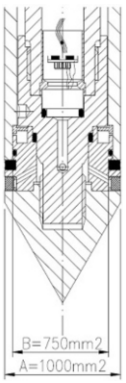




Tip and Local Friction sensor displacement

The different distances of the sensors are compensated depending on the cone types:

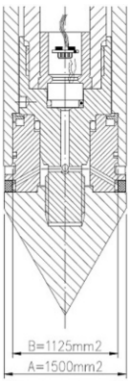
- 10cm² cones: 80mm
- 15cm² cones: 100mm



Cone area ratio

α = B / A = 0.75

β = 1 - B / A = 0.25



McMILLAN Drilling

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CPT CALIBRATION AND TECHNICAL NOTES

Calibration

Each cone has a unique identification number that is electronically recorded and reported for each CPT test. The identification number enables the operator to compare 'zero-load offsets' to manufacturer calibrated zero-load offsets.

The recommended maximum zero-load offset for each sensor is determined as ± 5% of the nominal measuring range.

In addition to maximum zero-load offsets, the difference in zero load offset before and after the test is limited as ± 2% of the maximum measuring range. See table below:

	Tip (MPa)		Friction (MPa)			Pore Pressure (MPa)	
Maximum Measuring Range:	150	15 *	1.50	0.3 *	3 **	3	15 ***
Nominal Measuring Range:	75	7.5 *	1.00	0.15 *	1 **	2	10 ***
Max. 'zero-load offset':	7.5	0.75 *	0.10	0.015 *	0.1 **	0.2	1 ***
Max 'before and after test':	3	0.3 *	0.03	0.006 *	0.06 **	0.06	0.3 ***

***** I-C5F0p15XYP20-10 ("sensitive")
** I-C2xFXYP100-10 (high range friction and pore water pressure sensors)
******* I-CFXYP100-10 (high range pore water pressure sensor)

Note: The zero offsets are electronically recorded and reported for each test in the same units as that of each sensor.

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Calibration Certificate

CALIBRATION RvA K 176

a.p. van den berg

1.1 General

Probe number:	201116
Probe type:	I-C2xFXYP100-10
Description:	Tip 75 MPa Sleeve 1.00 MPa Inclinometer 20° Pore 10MPa
Part number:	0100279B
Certificate number:	201116-1
Manufacturer:	A.P. van den Berg, Heerenveen (NL)
Calibration lab.:	A.P. van den Berg Ingenieursburo, IJzerweg 4, 8445 PK, Heerenveen (NL) RvA accredited laboratory according to ISO/IEC 17025:2017
Location of calibration:	Heerenveen (NL)
Client:	McMillan Drilling Ltd 120 High Street SOUTHBRIDGE, CANTERBURY New Zealand

1.2 Calibration equipment

Reference measuring equipment:

DAQ MX238B 00E816	January 2019 (HBM: QW0467)
DAQ MX440B 00FCAA	February 2019 (HBM: QW0939)
Loadcell 100kN F34717	August 2019 (HBM: 79169 2019-08)
Loadcell 20kN H22789	August 2019 (HBM: 79121 2019-08)
Sensor 200 Bar 10157399	July 2020 (Trescal: 2007-11422)
ACS-080-SC00-HE2-PM 12/17 2321909	April 2020 (Trescal: 2003-14016)
Temperature logger 6550-10277418	March 2019 (Control company: 6550-10277418)

1.3 Laboratory conditions:

Ambient temperature: 23.3 ± 2 °C

1.4 Measurement uncertainty

The expanded combined uncertainty (k=2) of the sensor at laboratory conditions was analysed according to ISO/IEC Guide 98-3:2008.
The results of the measurement uncertainty analysis of the different parameters are as listed below:

Cone resistance	5.64 + 0.17%	(kPa)
Sleeve friction	0.17 + 0.11%	(kPa)
Pore Pressure 2 MPa sensor	4.16 + 0.04%	(kPa)
Pore Pressure 10 MPa sensor	4.16 + 0.10%	(kPa)
Inclination	0.41	(degrees)

1.4 Standard and method of calibration

EN ISO 22476-1 2012 Class 2

1.5 Results

The probe complies with the requirements of the above-mentioned standard and indicated calibration class.

Calibrated by:	W. de Boer
Calibration Date:	11 November 2020
Signature:	
QA Manager:	N.R.E. de Jong
Date:	11 November 2020
Signature:	
Expiration date according to EN ISO 22476-1:	12 May 2021

1.6 Remarks

The calibration results only relate to the probe identified in this certificate. This new calibration certificate replaces all previously issued certificates for this probe. The calibration certificate documents the traceability to national and international standards, which realize the units of measurement according to the International System of Units (SI). This calibration certificate may not be reproduced other than in full and except with permission of the issuing laboratory. Calibration certificates without signature are not valid.

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Appendix D: Historical geotechnical investigations

- **Sketch plan, historical geotechnical investigations**
- **Statement of Evidence by Shane Gareth Lander**
- **Fraser Thomas, Geotechnical Investigation Report, 650 Whitford-Maraetai Road**
- **Partial records, Foundation Engineering, Pavilion Building**
- **New Zealand Geotechnical Database, various nearby borehole logs**

APPENDIX D IS PROVIDED AS A SEPARATE PDF