REPORT

ARITH LIMITED

Jack's Point - Henley Downs
Geotechnical Assessment Report

Tonkin & Taylor

ENVIRONMENTAL AND ENGINEERING CONSULTANTS

REPORT

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Geotechnical Assessment Report

Report prepared for:

ARITH LIMITED

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TONKIN & TAYLOR LTD

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1 Introduction

1.1 General

This report presents the results of a geotechnical investigation that has been carried out by Tonkin & Taylor Ltd (T&T) for the proposed Henley Downs subdivision development at Jack's Point, Queenstown, hereafter referred to as the site.

This report has been written to support the resource consent application for the proposed development and to allow preliminary design of the building foundations and earthworks to be completed.

The work which is described in this report has been completed in accordance with a brief from Jacks Point Ltd dated 24 May 2007. T&T's proposal dated 11 June 2007 outlines the scope of works and conditions of engagement for this report.

1.2 Proposed Development

Figure 1, Appendix A, presents a plan of the proposed subdivision lots and associated access roads.

Minor cut and fill earthworks are expected to be required on some lots to form level building platforms.

2 Site Description

2.1 General

The Henley Downs subdivision is located in the northeast region of the Jack's Point Development. The location of the site is shown on Figure 1, Appendix A. The site currently comprises farm land and is used for grazing cattle. Farm access tracks and temporary haul roads are located around the site periphery. There are no existing structures on site.

The Jack's Point site office is located south west of the Henley Downs site. Pastureland surrounds the northern and western sides of the site.

Access to the site is currently via a network of farm tracks and temporary haul roads which connect to State Highway 6 (SH6). A sealed road, which connects directly to SH6, will be constructed as part of the site subdivision works.

2.2 Topography and Surface Drainage

The site has been surveyed and topographic contours are shown on Figure 1, Appendix A. The site topography is varied. The western areas of the site are generally flat to sub-horizontal while the eastern areas of the site are generally gently to moderately sloping.

Two main drainage features currently exist on site. The first comprises a drainage ditch which runs in a north to northeasterly direction along the western periphery of the site. Stagnant water was present in this drainage ditch during the T & T site walkover inspection. The second drainage feature comprises a small creek which runs in a northwesterly direction along the northeastern periphery of the site. Water was flowing through this creek at the time of T & T's site walkover inspection.

Some ponding of surface water was observed at the time of T&T's site inspection, particularly in the low lying areas to the southwest and northwest of the site. Bullrushes were present in the low lying northwest area which indicates of the ground in this location may be permanently saturated.

Drainage across the site is generally expected to be in a north-westerly direction.

3 Geotechnical Investigations

The following geotechnical site investigation works were completed by T&T for the purposes of this report:

- A walkover inspection of the site by an Engineering Geologist;
- 36 backhoe test pits (TP 1 to TP36) excavated to a maximum depth of 4.3 m below the existing ground surface;
- 2 machine drill holes (BH1 and BH2) to a depth of 15.45 m below the existing ground surface; and
- 23 cone penetrometer tests (CPT201 to CPT 223) to a maximum depth of 13.5 m below the existing ground surface.

The location of the geotechnical investigations are shown on Figure 1, Appendix A.

Logs of the test pit excavations, machine drill holes and cone penetrometer tests are presented in Appendices B, C and D respectively.

4 Subsurface Conditions

4.1 Geological Setting

The Henley Downs Subdivision is located on the south-eastern flank of Lake Wakatipu, a feature shaped by former glacial advances.

The regional basement rock comprises ice-scoured Otago Schist. Sedimentary cover over the Otago Schist comprises quaternary till, outwash sediments and lake sediments. The schist and sediments have been eroded in post-glacial times and watercourses have deposited alluvial gravel locally.

The lake sediments which underlie the site have been deposited during times of higher lake levels associated with former interglacial periods. These sediments are sometimes interbedded with deltaic gravels. Variable quantities of younger alluvial gravels or beach gravels overlie the lake sediments and deltaic gravels. Ice-scoured schist forms the basement rock at depth and is typically mantled with till and other glacial deposits.

No active fault traces were observed in the field, nor have any been reported in this vicinity. However, significant seismic risk exists in this region from potentially strong ground shaking likely to be associated with a rupture of the Alpine Fault, located along the West Coast of the South Island.

There is a high probability that an earthquake of Magnitude 7.5 or greater will occur along the Alpine Fault within the next 50 years. This will result in strong ground shaking in the Queenstown area.

4.2 Stratigraphy

The results of the site investigation works indicate the generalised stratigraphy under the eastern side of Henley Downs site comprises:

- A surficial topsoil layer; underlain by,
- Colluvium; underlain by,
- Lake sediments and lake deposits; underlain by,
- Alluvial deposits and alluvial fan gravels (typically northeast side of site only); underlain by,
- Glacial outwash and glacial pond sediment deposits; underlain by,
- Glacial till.

The results of the site investigation works indicate the generalised stratigraphy under the western side of Henley Downs site comprises:

- A surficial topsoil layer; underlain by,
- Beach deposits; underlain by,
- Lake sediments and lake deposits; underlain by,
- Deltaic gravel and deltaic deposits (northwest of the site only).

- Glacial till.

Basement schist was not encountered at any location during the site investigation works.

Figures 2a, 2b and 2c in Appendix A present geotechnical cross-sections through the site and summarise the site stratigraphy. Detailed records of the soils encountered at each investigation location are provided in Appendix B and C.

The remainder of this section provides a brief description of the geologic units which were encountered in the investigation test pits.

Topsoil was observed to be locally present to a depth of up to 0.4 m. The topsoil was observed to comprise dark brown, moist, soft, organic silt with minor roots.

Colluvium, up to 1.3 m thick, was encountered to a maximum depth of 1.5 m below the existing ground surface in the east of the site only. The colluvium material was observed to comprise red brown, moist, loose, poorly graded, gravely silt with some sand and cobbles.

Beach deposits, up to 3.5 m thick, were encountered to a maximum depth of 3.7 m below the existing ground surface in all parts of the site except the eastern area. These deposits were observed to typically comprise brown, moist, loose to medium dense, poorly graded, sandy gravel.

Lake sediments, up to 4.0 m thick, were encountered to a maximum depth of 4.3 m below the existing ground surface. This material was observed to typically comprise grey, moist, uniform, soft to stiff silt with rare to some clay and sand.

Lake deposits, up to 0.4 m thick, were encountered to a maximum depth of 2.3 m below the existing ground surface. These deposits were found to typically comprise grey, moist, loose to medium dense, uniform, sand.

Deltaic deposits, up to 3.0 m thick, were observed to a depth of 3.4 m below the existing ground surface in the northwest part of the site. These deposits were observed to typically comprise brown, dry to moist, loose to medium dense, uniform sand with minor gravel.

Deltaic gravel layers, up to 1.2 m thick, were observed to a depth of 3.5 m below the existing ground surface in the northwest part of the site only. These gravels were observed to typically comprise grey, moist, loose to medium dense, well graded, sandy gravel.

Alluvial deposits, up to 1.8 m thick, were encountered to a maximum depth of 2.2 m below the existing ground surface in the northeast part of the site only. These deposits were observed to typically comprise grey, moist, firm to stiff, uniform, silt with minor sand and gravel.

Alluvial fan gravels, up to 3.8 m thick, were observed to a depth of 4.0 m below the existing ground surface in the northeast part of the site only. These gravels were observed to typically comprise grey, moist, medium dense to dense, well graded, sandy gravel.

Glacial outwash, up to 2.2 m thick, was observed to a depth of 2.9 m in the eastern part of the site. These outwash deposits were observed to typically comprise grey/brown, moist, medium dense, well graded, sandy gravels.

Glacial pond sediments, up to 1.3 m thick, were observed to a depth of 3.5 m in the eastern part of the site in TP 31 and 33 only. These sediments were observed to typically comprise light brown, moist, very stiff, uniform, sandy silt.

Glacial till, up to 1.9 m thick, was encountered to a depth of 4.1 m below the existing ground surface, typically in the eastern part of the site only. These deposits were observed to typically comprise grey brown, moist, dense to very dense (hard to excavate), well graded, sandy silty gravel with minor cobbles and bolders.

Basement schist rock was not encountered at the site in any location.

4.3 Groundwater

Localised perched groundwater levels were observed across site.

Seepages were observed in Test Pits TP 3-8, 12 and 13 in the lake sediments between depths of 1.9 and 3.8 m below the ground surface. The perched water was observed by the change of soil condition from moist to saturated. This mainly occurred at the change of lake sediment particle size from silt to clayey silt.

Surficial seepage associated with a small watercourse was observed in Tests Pit 20 and 21.

Minor seepage occurred in TP 25 at 1.7 m in alluvial deposit soils.

Several seepages of various water quantities occurred in other test pits across site where cohesionless soils overlied cohesive soils. Test Pit 22 showed seepage of approximately 200-300 litres per minute at 1.8 m at the contact of Beach Gravel and Lake Sediment. Test Pit 26 showed seepage of approximately 200 litres per minute at 1.8 – 2m at the contact of glacial outwash gravels and glacial pond sediment silt. Test Pit 31 showed seepage of approximately 50-100 litres per minute at 1.8 – 2m at the contact of glacial outwash gravels and glacial pond sediment silt.

Based on previous experience and deep borehole data in this area, the regional groundwater table is expected to lie approximately 20 m below the existing ground surface.

5 Geotechnical Engineering Considerations

5.1 General

The recommendations and opinions that are contained in this report are based upon preliminary ground investigation data at discrete locations and historical information held on the T&T database.

Inferences concerning the nature and continuity of the subsoil between investigation locations are inferred and cannot be guaranteed. The actual sub-surface conditions may show some variation from those described and all design recommendations contained in this report are subject to confirmation by inspection during construction.

The remainder of this section provides geotechnical recommendations to enable design of the proposed building foundations and retaining walls to be completed.

5.2 Earthworks

5.2.1 General Discussion

During earthworks operations all topsoil, organic matter and unsuitable materials should be removed from the affected areas in accordance with the recommendations of NZS 4431:1989 and the relevant Queenstown Lakes District Council (QLDC) standards.

The soils present at the site are prone to erosion, both by wind and water, and should be protected by hardfill capping or re-topsoiled/mulched and re-vegetated as soon as the finished batter or sub-grade levels are achieved.

Exposure to the elements should be limited for all soils. All bulk excavations should be left proud of the finished sub-grade level by 200 to 300 mm and the final cut to grade performed immediately prior to foundation construction. Alternatively, these areas can be undercut and rebuilt to formation level with hardfill should the sub-grade deteriorate due to exposure.

Covering of the soils with polythene sheeting will reduce degradation due to rain and surface run-off.

All water should be removed from foundation excavations using appropriate surface drains and/or pumping where necessary. Under no circumstances should water be allowed to pond or collect near or under a foundation slab. Positive grading of the sub-grade should be constructed to prevent water ingress or ponding.

Owing to the erodible nature of the soils present across the site, robust, shallow graded sediment control measures should be instigated during construction. Should slope gradients in the soil materials exceed 4%, then lining of drainage channels is recommended, e.g. with geotextile and suitably graded rock, or similarly effective armouring.

Construction sequences should be carefully planned, designed and staged to ensure satisfactory Factors of Safety against slope instability are maintained during construction.

Rare areas of perched groundwater, seeps and springs, especially during times of extended rainfall, may be encountered during construction of the proposed building foundations. Drainage measures, such as sub-soil drains, may need to be constructed as part of the building foundation works to control these features during, and after, construction.

5.2.2 Fill Earthworks

Minor fill earthworks may be required to form the proposed building platforms. Some undercut works may be required to remove localised deposits of existing uncertified fill or unsuitable material beneath the proposed building footprints.

All fill that is located beneath the proposed building footprints should comprise Engineer-approved granular material that is placed and compacted in accordance with NZS 4431:1989 and certification provided by a chartered Professional Engineer in accordance with QLDC standards.

5.2.3 Temporary Cut Slopes

Table 5.1 details the recommended batter angle for temporary cut slopes that are formed in the soil materials identified at the site.

Table 5.1 Recommended Batter Angles for Temporary Cut Slopes up to 3.0 m high

Material Type	Maximum Temporary Batter Slope Angles up to 3.0 Metres High (Horizontal to Vertical)	
	Dry Ground	Wet Ground or Slopes with Traffic Surcharge
Topsoil and roots	-	-
Colluvium and Beach Deposits	2.0H:1.0V	3.0H:1.0V
Lake Sediments	2.0H:1.0V	Specific design required
Lake Deposits, Deltaic Gravels/Deposits, and Alluvial Deposits/Fan Gravels	1.5H:1.0V	2.0H:1.0V
Engineered Fill, Glacial Outwash and Glacial Pond Deposits	1.0H:1.0V	1.5H:1.0V

Glacial Till	0.5H:1.0V	1.0H:1.0V

Temporary slopes that are required to be steeper than those described above or temporary slopes which are greater than 3.0 metres high should be structurally retained or subject to specific design by a Chartered Professional Engineer who is familiar with the on-site materials and the contents of this report.

All slopes should be periodically monitored during construction for instability and excessive erosion, and, where necessary, corrective measures implemented to the approval of a suitably qualified chartered Professional Engineer or Engineering Geologist.

All temporary slopes should be constructed in a staged "top down" manner that minimises the risk of failure during construction. Deformation monitoring should be undertaken on all slopes where the consequences of failure are significant.

5.2.4 Permanent Cut Slopes

The batter slope recommendations in Table 5.1 for wet ground may be adopted for all permanent cut slopes.

Drainage measures, such as sub-soil drains, should be installed where wet ground or groundwater seepage is encountered during excavation. The final design and location of all sub-soil drainage works should be confirmed during construction by a suitably qualified and experienced Geotechnical Engineer or Engineering Geologist.

Permanent cut slopes that are required to be steeper than those indicated in Table 5.1 or permanent cut slopes which are greater than 3.0 metres high should be structurally retained or subject to specific design by a Chartered Professional Engineer who is familiar with the on-site materials and the contents of this report.

5.2.5 Fill Slopes

All fill should be placed and compacted in accordance with NZS 4431:1989 and certification provided in accordance with QLDC standards.

The topsoil, colluvium, lake sediments, alluvial deposits and glacial pond sediments which are currently available on site comprise silt materials and are not considered suitable for use as engineered fill. The beach deposits mostly comprise poorly graded sandy gravel which may make them hard to compact. As such it is recommended the poorly graded beach deposits are deemed not suitable for use as engineered fill.

All unreinforced fill slopes that are between 0.0 and 3.0 metres high should be founded upon Engineer-approved, benched, competent ground and should be finished to a batter slope angle that is no steeper than 2.5H:1.0V (horizontal : vertical).

All reinforced fill slopes, and fill slopes which are greater than 3.0 metres high, must have specific stability analysis and engineering design carried out by a suitably qualified geotechnical engineer or engineering geologist who is familiar with the materials and the contents of this report.

5.3 Recommendations for Building Foundations

5.3.1 General

The topsoil and colluvium materials are not considered suitable as a founding material.

The engineer-approved building platform subgrade is expected to comprise a combination of beach deposits, lake sediments, lake deposits, deltaic deposits, deltaic gravels, alluvial gravel, glacial outwash and glacial till.

It should be noted, however, that the lake sediment and alluvial deposits have a low bearing capacity and are extremely sensitive. Additional building-specific geotechnical investigations will need to be undertaken to confirm the extent of these materials, and confirm the foundation and undercut design, prior to the commencement of detailed design.

All unsuitable materials that are identified in the excavations for shallow foundations, particularly colluvium and those materials which have been softened by water, should be undercut and replaced with engineered fill during construction.

Any fill that is utilised as bearing for foundations should be placed and compacted in accordance with NZS 4431:1989 and certification provided to that affect.

To minimise the effects of freeze-thaw cycles, all shallow foundations should be founded a minimum of 0.4m below the adjacent ground level.

It is recommended all building foundation sub-grade be investigated prior to the commencement of construction, inspected and tested during construction and certified by a suitably qualified and experienced geotechnical specialist to confirm the foundation sub-grade conditions are in accordance with the assumptions and recommendations provided in this report.

All future investigations should confirm the extent of the lake sediment and alluvial deposits under each building footprint and the bearing capacity which should be adopted during detailed design of the buildings.

5.3.2 Shallow Pad and Strip Foundations

5.3.2.1 Further Investigation

The most economic foundation system for buildings constructed within this Henley Downs subdivision is expected to comprise shallow strip and/or pad type footings. However, it is recommended that site specific geotechnical investigations be undertaken for each proposed building to confirm the optimum foundation solution and extent of any undercut prior to the commencement of construction.

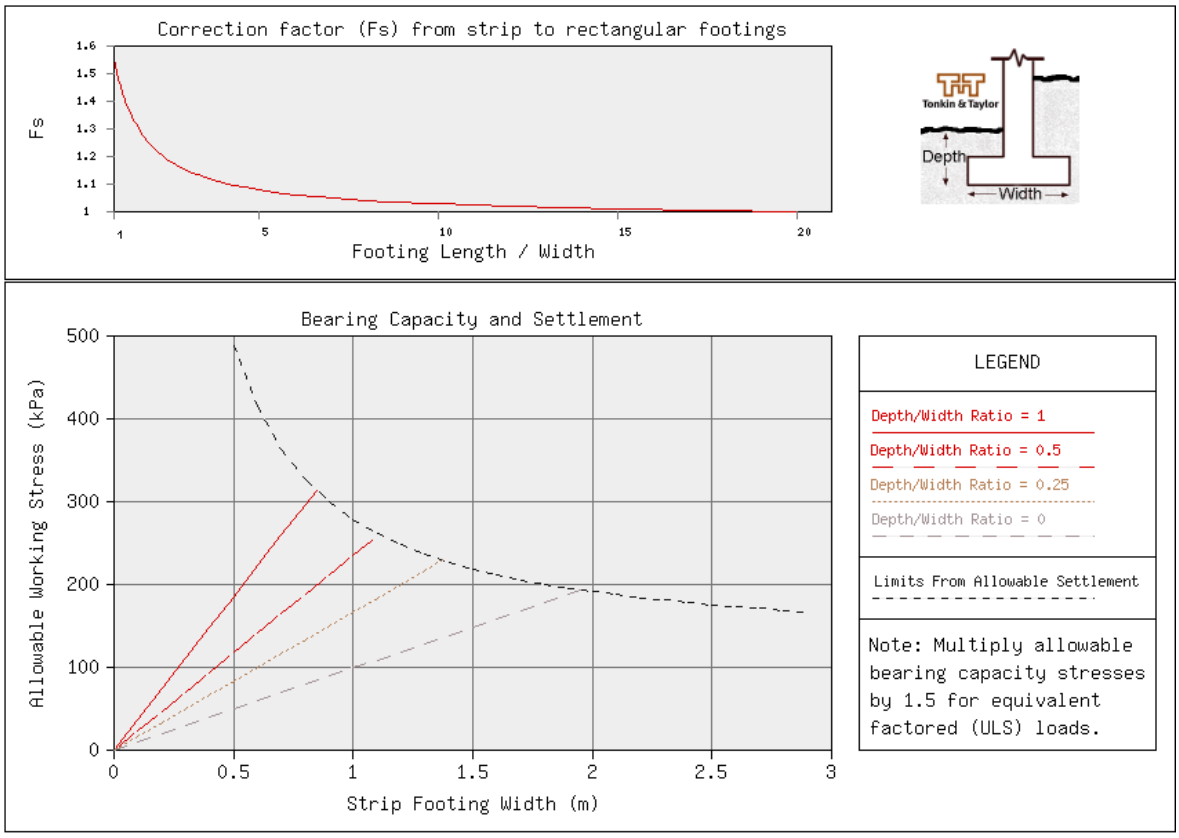
The lake sediment and alluvial deposits have low bearing capacity such that either a floating raft foundation or piling may be a more suitable foundation option.

5.3.2.2 Glacial Outwash and Glacial Till

Figure 5.1 summarises the recommended working stresses for shallow footings which bear upon glacial outwash and glacial till.

It should be noted the foundation working stresses presented in Figure 5.1 are governed by bearing capacity in the case of narrow footings and settlement in the case of wide footings.

Figure 5.1 Recommended working stresses for footings bearing upon Glacial Outwash and Glacial Till



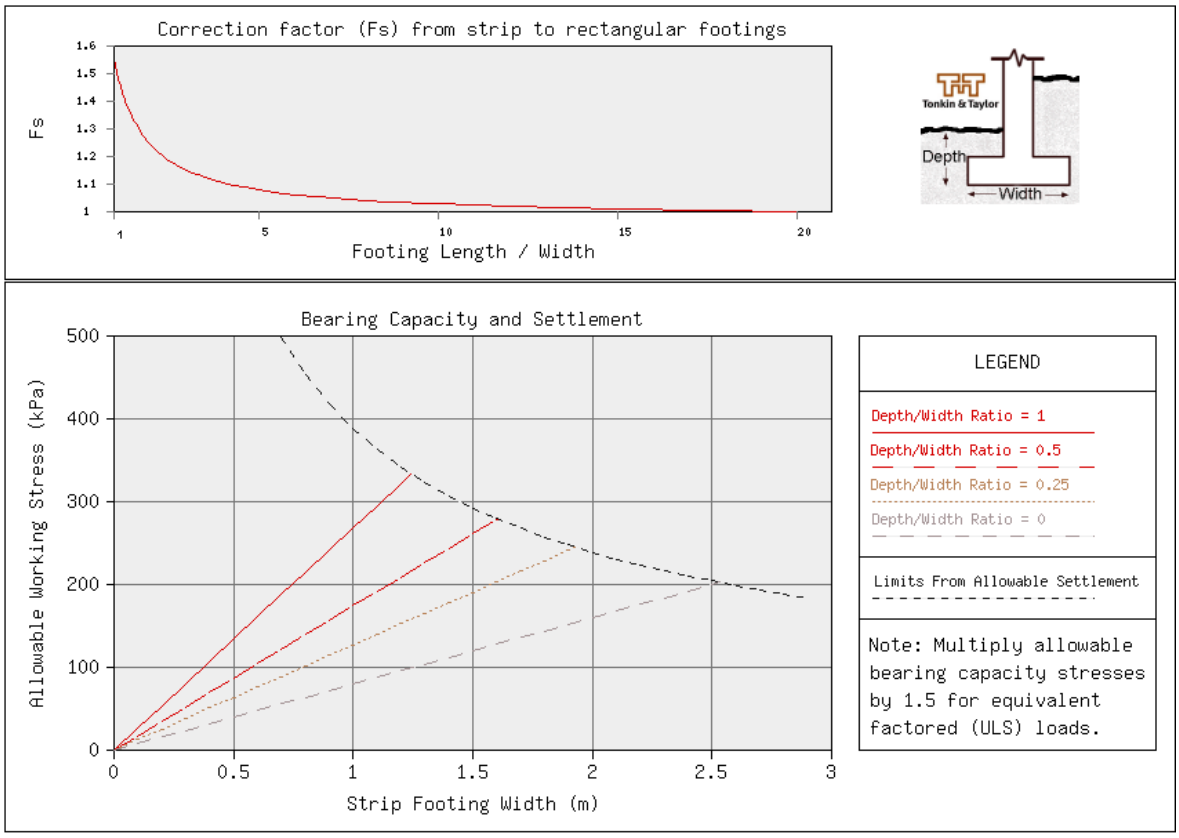
From Figure 5.1 it can be seen a working bearing strip of approximately 150 kPa is recommended for a 400 mm wide by 400 mm deep footing that bears upon a combination of glacial outwash, and glacial till. This corresponds to a factored (ULS) bearing capacity of approximately 225 kPa and an ultimate bearing capacity of 450 kPa.

5.3.2.3 Beach Deposits, Lake Deposits, Deltaic Deposits and Gravels, Alluvial Gravels, Glacial Pond Sediments and Engineered Fill

Figure 5.2 summarises the recommended working stresses for shallow footings which bear upon beach deposits, lake deposits, deltaic deposits and gravels, alluvial gravels, glacial pond sediments and engineered fill.

It should be noted the foundation working stresses presented in Figure 5.2 are governed by bearing capacity in the case of narrow footings and settlement in the case of wide footings.

Figure 5.2 Recommended working stresses for footings bearing upon Beach Deposits, Lake Deposits, Deltaic Deposits and Gravels, Alluvial Gravels, Glacial Pond Sediments and Engineered Fill



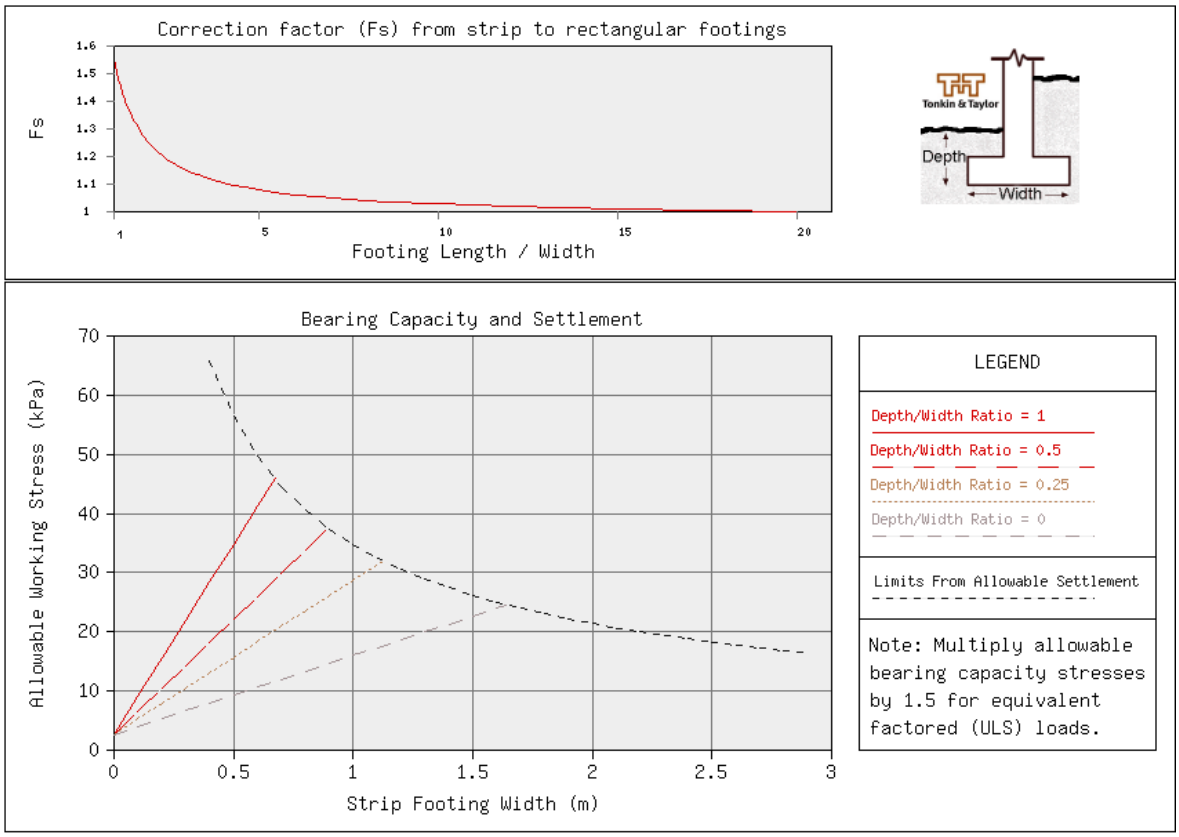
From Figure 5.2 it can be seen a working bearing strip of approximately 100 kPa is recommended for a 400 mm wide by 400 mm deep footing that bears upon a combination of beach deposits, lake deposits, deltaic deposits and gravels, alluvial gravels, glacial pond sediments, and engineered fill. This corresponds to a factored (ULS) bearing capacity of approximately 150 kPa and an ultimate bearing capacity of 300 kPa.

5.3.2.4 Lake Sediments

Assessment of the lake sediment materials encountered in the excavation pits and machine drill holes, indicates the lake sediment materials will not meet the requirements of NZS 3604:1999 with respect to the 100 kPa minimum allowable bearing pressure. As such it is recommended all foundations for structures built within the lake sediment soils be subject to specific engineering design by a Chartered Professional Engineer.

Figure 5.3 summarises the recommended working stresses for shallow footings which bear upon lake sediments. It should be noted the foundation working stresses presented in Figure 5.3 are governed by bearing capacity in the case of narrow footings and settlement in the case of wide footings.

Figure 5.3 Recommended working stresses for footings bearing upon Lake Sediments



From Figure 5.3 it can be seen a working bearing stress of approximately 28 kPa is recommended for a 400mm wide by 400mm deep footing bearing on lake sediments. This corresponds to a factored (ULS) bearing capacity of approximately 40 kPa and an ultimate bearing capacity of 80 kPa.

It should be noted the lake sediment material is extremely sensitive and a significant loss of strength or 'softening' occurs if it is disturbed during earthworks construction. Techniques to control the amount of softening should therefore be adopted.

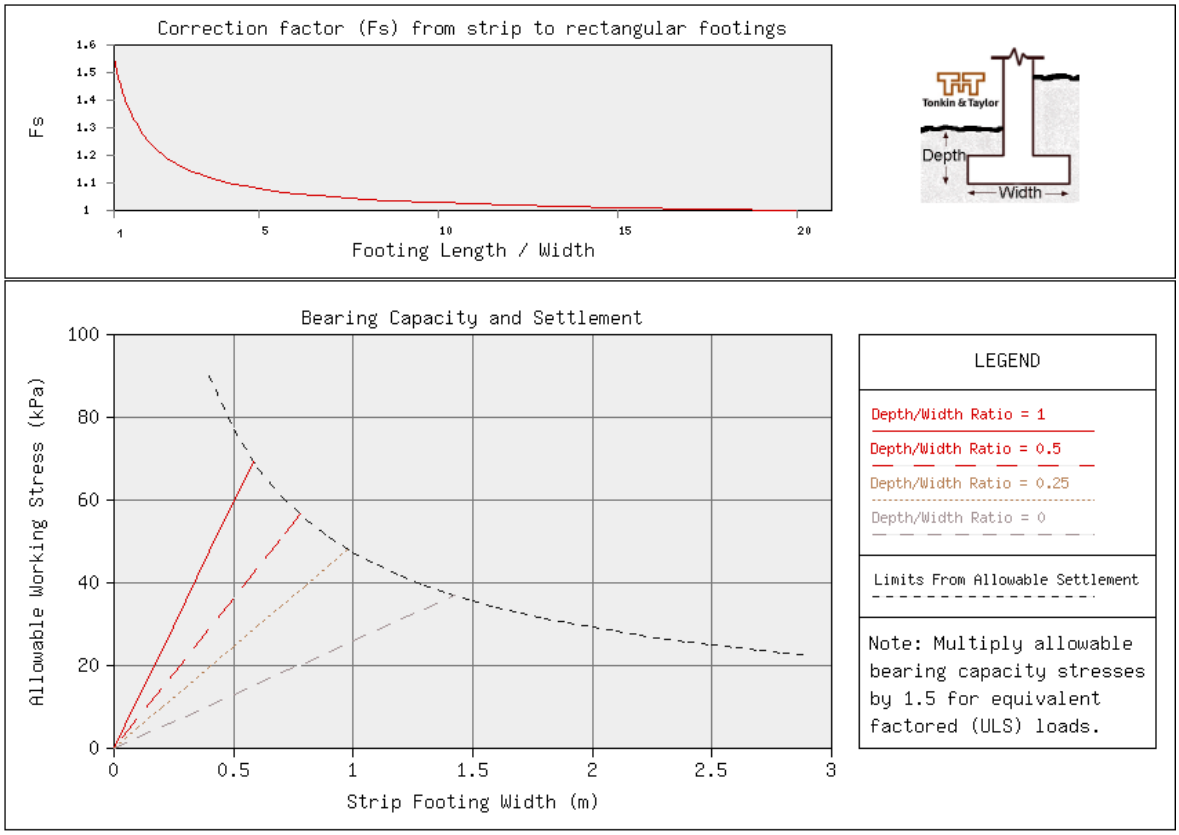
5.3.2.5 Alluvial Deposits

The alluvial deposit materials are not expected to meet the requirements of NZS 3604:1999 with respect to the 100 kPa minimum allowable bearing pressure. As such it is recommended all foundations for structures built within the alluvial deposits soil be subject to specific engineering design by a Chartered Professional Engineer.

Figure 5.4 summarises the recommended working stresses for shallow footings which bear upon alluvial deposits.

It should be noted the foundation working stresses presented in Figure 5.4 are governed by bearing capacity in the case of narrow footings and settlement in the case of wide footings.

Figure 5.4 - Recommended working stresses for footings bearing on Alluvial Deposits



From Figure 5.4 it can be seen that a recommended working bearing stress of 60 kPa is recommended for a 500mm wide by 500mm deep footing. This corresponds to a factored (ULS) bearing capacity of approximately 90kPa and an ultimate bearing capacity of 180kPa.

5.3.2.6 Construction Inspections

It is recommended that all future building foundation sub-grade be inspected, tested and certified by a suitably qualified and experienced geotechnical specialist to confirm the sub-grade conditions are in accordance with the assumptions and recommendations provided in this report. At the time of building construction, the bearing capacity of the exposed foundation sub-grade should be tested using a Scala Penetrometer, and any soft areas identified should be sub-excavated and backfilled with compacted hardfill.

5.3.3 Pile Foundations

SPT and Scala Penetrometer testing indicate the lake sediment and the alluvial deposits are very low in strength and are unlikely to be suitable for use as bearing for shallow foundations. Pile foundations may prove to be an economic foundation solution for those buildings which are to be founded upon these materials.

A range of pile material types may be utilised for the building foundations. The choice of pile type and size will depend upon a range of factors including the

structural loads, ground conditions, cost, noise constraints and possible ground vibrations.

Both driven timber and bored concrete pile foundations are expected to be suitable for the subsoil conditions that are present under the proposed building footprints, however, temporary casing may be required in some locations to enable the sucessful construction of bored piles.

All piles should extend through the lake sediments and alluvial deposits and bear upon the more competent underlying soil materials, such as deltaic gravels, glacial till etc.

Where the lake sediments and alluvial deposits are very deep and end bearing upon more competent materials is not practicable, the piles will likely need to be in the order of 10 to 15 m long to develop sufficient shaft friction. In this instance, an alternative foundation system, such as a raft foundation, may be more appropriate.

For preliminary design purposes it is recommended the ultimate geotechnical capacity of all piles be estimated using the ultimate end bearing capacity and shaft resistance values presented in Table 5.2.

Table 5.2 Recommended Preliminary Design Parameters for Driven Timber Piles or Bored Cast In-situ Reinforced Concrete Piles

Material	Ultimate End-Bearing Resistance $q_{b\ ult}$ (kPa)	Ultimate Shaft Friction Resistance $q_{s\ ult}$ (kPa)
Lake Sediments	0 (See Notes 1, 2, 3 and 4)	5 (See Notes 1, 2 and 3)
Alluvial Deposits	250 (See Notes 1, 2, 3 and 4)	10 (See Notes 1, 2 and 3)
Alluvial Gravels	500 (See Notes 1, 2, 3 and 4)	15 (See Notes 1, 2 and 3)
Deltaic Deposits and Gravel	1,000 (See Notes 1, 2, 3 and 4)	30 (See Notes 1, 2 and 3)
Glacial Outwash and Glacial Pond Deposits	1,800 (See Notes 1, 2, 3 and 4)	60 (See Notes 1, 2 and 3)
Glacial Till	2,700 (See Notes 1, 2, 3 and 4)	90 (See Notes 1, 2 and 3)

Note 1: During detailed design the pile shaft resistance over the first 3 pile diameters (3D) length and over the last 3D length should be ignored.

Note 2: The ultimate end-bearing and skin friction capacities assume:

i) The total pile length is greater than 6D; and;

ii) The pile centre to centre spacing is greater than or equal to 3D.

Note 3: The ultimate pile capacities are to be used in conjunction with the strength reduction factor(s) stipulated in Table 5.3 of this report.

Note 4: It is recommended all piles be founded at approximately the same level to minimise the risk of differential settlement

Appropriate allowance should be made during the design of all foundation piles for issues such as group effects, lateral loading, liquefaction and negative skin friction. Adjacent piles should be constructed at a centre-to-centre spacing that is no closer than 3.0 times the pile diameter, measured centre to centre, to avoid group effects.

For preliminary design purposes it is recommended the designer assumes temporary casing will be required to prevent the collapse of all bored pile holes during construction.

Due to the interbedded and variable nature of the bearing stratum, it is recommended additional building-specific investigation drilling be completed on site to confirm the sub-surface stratigraphy and geotechnical conditions which underlie the building footprint.

Table 5.3 summarises the recommended geotechnical strength reduction factors (Φ_g) that should be applied to the ultimate geotechnical capacities during ultimate limit state design.

Table 5.3 Recommended Geotechnical Strength Reduction Factors for Ultimate Limit State Design

Method of Assessment of Ultimate Capacity	Range of Values of Φ_g (See Note 1)
(a) Ultimate limit state load combinations	
• Driven piles verified by dynamic load testing (PDA) to failure supported by single matching	0.65 to 0.85 (See Note 2)
• Driven piles verified by dynamic analysis using driving formulae	0.45 to 0.55 (See Note 3)
• Bored pile and shallow foundation capacities presented in this report (Static analysis)	0.50
(b) Over strength reactions	0.80

Note 1: The recommended strength reduction factors for piles are based on those set out in the Australian Standard AS 2159:1995 "Piling-Design and Installation".

Note 2: 0.65 recommended where, for each type of pile not less than 3 piles and not less than 3.0% of piles are tested to develop a pile driving criteria to be applied to all other piles.

0.75 recommended where, for each type of pile not less than 3 piles and not less than 10.0% of piles are tested to develop a pile driving criteria to be applied to all other piles.

Note 3: 0.50 recommended for this site.

5.3.4 Raft Foundations

Raft foundations may be more appropriate for buildings founded on lake sediments and alluvial deposits where the depth to a competent bearing layer is considerable. The raft foundations may comprise either a floating concrete raft or a geogrid reinforced gravel raft.

A geogrid reinforced gravel raft may be useful if additional filling is required on site and would likely comprise excavation up to 1.0 m below the existing ground level and backfilling with suitable free-draining granular backfill. A geogrid and geotextile should be placed between the sub-grade material and the overlying backfill.

The geotextile will act as a separation layer to prevent contamination of the granular fill by migration of fines from the underlying soft material

5.3.5 Foundation settlement

The issue of foundation settlement should be checked during the detailed design of all building foundations.

5.3.6 Building Foundation Slab Drainage Layer

Perched groundwater seepage flows were observed in some low lying areas to the north and south west of the site. In order to minimise the risk of groundwater seepage into the finished buildings, it is recommended a 100mm minimum thickness of free draining granular fill and a network of subsoil drainage pipes be constructed beneath the building footprint in areas where perched water seepage flows are present, and behind all retaining walls. The outlet of all foundation slab and retaining wall drains should be connected to the permanent piped stormwater system.

5.4 Retention Design

Recommended geotechnical parameters for retaining wall design are presented in Table 5.4 of this report.

All retaining walls should be designed by a Chartered Professional Engineer with due allowance made for issues such as traffic surcharge and groundwater pressures.

It is recommended that appropriate drainage measures, such as drainage gravel and sub-soil drains, be provided behind all retaining walls over the entire retained height to control potential groundwater pressures. The outlet of all sub-soil drains should be connected to the permanent piped stormwater system.

Comprehensive waterproofing should be provided to the retaining face of all building retaining walls to minimise groundwater seepage into the finished building.

If excessive groundwater seepages are encountered during construction, horizontal drains should be installed to collect and control such groundwater flows. The location and design of all sub-soil drains should be confirmed on site by a Geotechnical Engineer or Engineering Geologist.

Table 5.4 Recommended Geotechnical Design Parameters

Unit	Bulk Density γ (kN/m³)	Effective Cohesion c′ (kPa)	Effective Friction Angle Ø′ (degrees)	Elastic Modulus E (MPa)	Poisson's Ratio ν
Topsoil and roots	15.0	All topsoil is to be removed from the earthworks and building footprint areas as per the recommendations of Section 5.2 of this report.			
Engineered Fill	18.5	0	35	10.0 to 15.0	0.30
Colluvium	17.0	0	32	10.0 to 15.0	0.25
Beach Deposits	17.0	0	32	15.0 – 20.0	0.30
Lake Sediments and Deposits	18.0	1	25	5.0 to 10.0	0.35
Deltaic Deposit/ Gravel	19.0	0	32	12.0 to 20.0	0.30
Alluvial Deposit	18.0	1	29	15.0 – 20.0	0.30
Alluvial Gravel	20.0	0	32	20.0 to 25.0	0.30
Glacial Outwash	20.0	0	37	20.0 to 25.0	0.30
Glacial Pond Sediments	20.0	1	35	20.0 to 25.0	0.30
Glacial Till	20.0	2	38	25.0 to 30.0	0.30

5.5 Existing Slope Instability

No areas of existing geotechnical instability were identified on site during the site walk-over inspection.

5.6 Liquefaction Potential

5.6.1 Earthquake Risk

No active fault traces were observed in the immediate vicinity of the site. However, a significant seismic risk exists in the Queenstown region from potentially strong ground shaking associated with rupture of the Alpine Fault which is located along the west coast of the South Island.

There is a high probability that an earthquake with a magnitude greater than 7.5 will occur along the Alpine Fault within the next 50 years. Such an earthquake would result in strong and prolonged shaking in Queenstown.

5.6.2 Ground Shaking Hazard Class

The proposed site development was assigned an Importance Level of 2, in terms of NZS1170.5:2005. An Importance Level of 2 requires an Ultimate Limit State (ULS) design seismic event with an annual probability of exceedance (AEP) of 1/500 (i.e. a 10% chance of occurring in the next 50 years) and a Serviceability Limit State (SLS) design seismic event with an AEP of 1/25 (i.e. an 80% chance of occurring in the next 50 years). For this event, a Peak Ground Acceleration (PGA) for the ULS and the SLS of 0.40g and 0.10g respectively were determined in accordance with the recommendations of NZS1170.5:2005.

5.6.3 Basis of liquefaction analysis

The liquefaction potential has been assessed using the software "Liquefy Pro" version 5.2D. This programme analyses liquefaction potential from CPT data. Liquefy Pro results for the ULS and for the SLS are presented in Appendix F, and a site plan of the liquefaction potential areas, are presented in Appendix E.

Liquefy Pro can use four methods to evaluate the $CRR_{7.5}$ from CPT data. The four methods are:

- Seed et al.
- Suzuki et al.
- Robertson et al.
- Modified Robertson

The Robertson et al. and the Modified Robertson Method methods include a separate calculation for fines content in the liquefaction calculation. The Modified Robertson Method was selected to analyses the CPT data because it is considered the best methodology for assessing the type of soil that was present on site and because of the additional fines calculation and correction.

For the purposes of the liquefaction assessment it has been assumed the near surface soils become saturated with time.

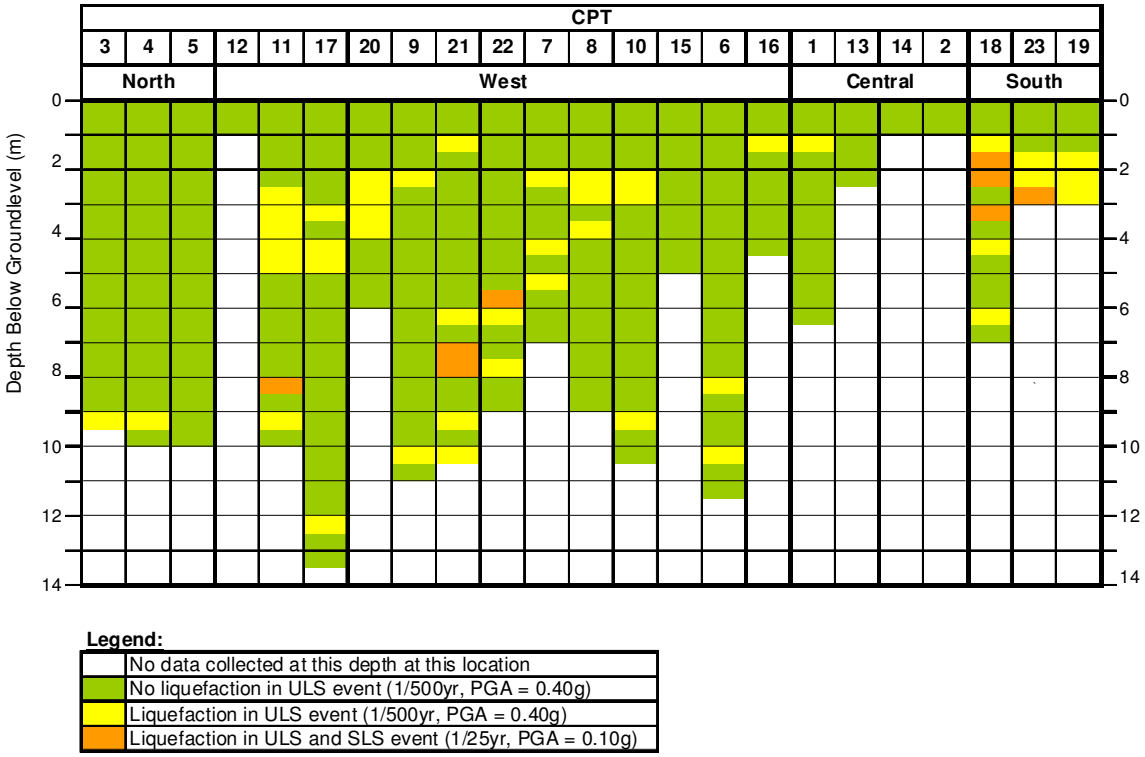
5.6.4 Summary of Liquefaction Potential

The results of the Liquefy Pro analysis indicate there is a high probability of liquefaction under the western side of this site, if it is subjected to strong earthquake shaking.

For the ULS design event, liquefaction is predicted across the west and south of the site with limited liquefaction in the north and central site areas. For the SLS design event, liquefaction is predicted across the west and south of the site only. No liquefaction is predicted in the east of the site.

The thickness of the liquefaction zone varies across the site; therefore differential settlements during both an ULS and a SLS event can be expected. Liquefaction is expected to be concentrated in the wet sand layers perched above the lake sediments and in the wet sandy beach deposit layers from 2 m to 9 m depth. The liquefaction assessment results are presented in Table 5.5.

Table 5.5 - Liquefaction Potential with Depth



5.6.5 Liquefaction Induced Settlement

During earthquake shaking, loose sands have a tendency to densify. If the sand is saturated, and of sufficiently low permeability such that pore water can not drain, then this tendency for densification leads to an increase in pore pressure as load is transferred from the soil skeleton to the pore water. This is the basic mechanism causing liquefaction. With time after the earthquake shaking has ceased the pressurised pore water is able to drain, allowing the soil skeleton to densify, resulting in ground settlement.

The results of the Liquefy Pro analysis indicate there is a high probability of liquefaction induced settlement under the western and southern sides of this site for both the ULS and SLS design events.

The liquefaction induced settlement is not uniform across the site and as such, some differential settlement can be expected. The ULS design event is predicted to induce settlement up to around 5 mm in the centre of the site, up to around 80 mm in the west of the site adjacent to the creek, and up to 65 mm in the south of the site. The SLS design event is predicted to induce settlement up to around 30 mm in the west of the site adjacent to the creek and up to around 40 mm in the low lying area at the south of the site. No liquefaction induced settlement is predicted in the east of the site.

The Liquefy Pro analysis is empirical and approximate and can have a margin of error of +/- 50%.

5.6.6 Liquefaction Remediation Options

Figure 1 "Liquefaction Potential Site Plan" in Appendix F shows the area of the site that is susceptible to liquefaction if the ground becomes saturated. Remedial options to address the liquefaction issue include designing special foundations within the west and south of the site which can tolerate liquefaction.

Raft foundations or strip footings interconnected with ground beams are expected to be appropriate for the proposed buildings within the west and south of the site.

Works to address the potential liquefaction issue should be assessed and designed during the detailed design phase of project. An assessment of potential lateral spread, and remediation of this issue, should also be undertaken at this stage of the project.

5.7 Subsoil Class for Seismic Design

For detailed design purposes the level of seismic acceleration should be estimated in accordance with the recommendations of NZS 1170.5:2004. It is recommended that 'Class C - shallow soil sites' conditions be adopted in relation to NZS 1170.5:2004.

5.8 Natural Hazards

The development is not located in an area of known geotechnical hazards, however, a risk of seismic activity has been identified for the region as a whole and provision should be made for seismic ground accelerations during detailed design of all proposed structures.

5.9 Aquifers

No aquifer resource is expected to be adversely affected by the proposed development.

5.10 Additional Geotechnical Investigations

Additional building-specific geotechnical investigations should be undertaken to confirm the inferred geotechnical conditions, liquefaction susceptability and preliminary design recommendations that are presented in this report.

5.11 Roading

The very low strength of the lake sediments in some areas of the site may indicate that they are unlikely to be suitable as bearing for the proposed subdivision roads without prior engineering improvement works. Therefore, we recommended that the geogrid reinforced gravel raft, outlined in Section 5.3.4 of this report, or similar, be used beneath the proposed road footprints where lake sediments with low bearing capacity are present.

5.12 Environmental Issues during Construction

5.12.1 Erosion and Sediment control

Effective systems for erosion control are run-off diversion drains and contour drains, while for sediment control options are earth bunds, silt fences, hay bales, vegetation buffer strips and sediment ponds.

The least amount of subsoil should be exposed at any stage of the construction and vegetation re-established as soon as possible or mulch applied.

Details for the implementation of erosion and sediment control measures can be accessed at the following internet link:

http://www.aucklandcity.govt.nz/council/documents/district/Ann14.pdf

Further detail related to construction sites can be found at:

http://www.itd.idaho.gov/manuals/Online_Manuals/BMP/

5.12.2 Noise and Vibration

It is expected that conventional earthmoving and construction equipment such as bulldozers, excavators and dump trucks will be used during the earthworks construction.

Appropriate actions should be taken during construction to minimise noise and vibration nuisance to adjacent properties and ensure noise and vibration levels are maintained below acceptable limits in accordance with QLDC requirements.

5.12.3 Dust

The sub-surface soils on site may present a potential to generate dust. The Contractor should take appropriate measures to control dust in accordance with QLDC requirements. Regular damping with sprinklers should be effective to prevent airborne dust during the construction.

6 Conclusions and Recommendations

Proposed Development

- From a geotechnical perspective T&T considers the proposed Henley Downs subdivision development to be technically feasible; however; detailed design of all future earthworks, retaining structures and building foundations must be completed in accordance with the recommendation provided in this report prior to commencing construction.
- If lake sediment and beach deposit soils

Existing Geotechnical Conditions

- Subsurface conditions at the site are expected to comprise:
    - Topsoil; underlain by,
    - Colluvium (eastern side of site only); underlain by,
    - Beach deposits (excluding eastern side of site); underlain by,
    - Lake sediment and lake deposits; underlain by,
    - Deltaic gravel and deltaic deposits (northwest of the site only); underlain by,
    - Alluvial deposits and alluvial fan gravels (typically northeast side of site only); underlain by
    - Glacial outwash and glacial pond sediment deposits (typically eastern side of site only); underlain by,
    - Glacial till (typically eastern side of site only); underlain by,
    - Schist bedrock at an unconfirmed depth.
- Table 5.4 of this report summarises the recommended geotechnical design parameters for the soil materials present on site.

Earthworks Construction

- During the earthworks operations all topsoil, organic matter and unsuitable materials should be removed from the affected areas in accordance with the recommendations of NZS 4431:1989.
- All fill that is utilised as bearing for foundations should be placed, compacted and certified in accordance with the recommendations of NZS 4431:1989.
- The on-site soils are prone to wind and water erosion. Section 5.11.1 of this report outlines special measures that should be instigated to control these issues.
- Exposure to the elements should be limited for all soils. All bulk excavations should be left proud of the finished sub-grade level by 200 to 300mm and the final cut to grade performed immediately prior to foundation construction. Alternatively, these areas can be undercut and rebuilt to formation level with hardfill should the sub-grade deteriorate due to exposure.

- Rare areas of perched groundwater, seeps and springs, especially during times of extended rainfall, may be encountered during construction of the proposed building foundations. Drainage measures, such as horizontal drains, may need to be constructed as part of the building foundation works to control these features during, and after, construction.
- All water should be removed from the excavations by using appropriate surface drains and/or pumping. Under no circumstances should water be allowed to pond or collect near or under a building foundation. Positive grading of the sub-grade should be undertaken to prevent water ingress or ponding.
- All slopes should be constructed in a staged "top down" manner that minimises the risk of failure during construction. Deformation monitoring will be required for all slopes where the consequences of failure are significant.

Cut and Fill Slopes

- Table 5.1 of this report summarises the recommended batter slope angles for temporary cut slopes in soil materials up to 3.0 m high.
- The batter slope recommendations for wet ground outlined in Table 5.1 may be adopted for all permanent cut slopes.
- Drainage measures should be installed to the approval of a suitably qualified and experienced Geotechnical Engineer or Engineering Geologist if wet ground or groundwater seepage is encountered during the excavations.
- All temporary and permanent cut slopes required to be steeper or higher than that outlined in Table 5.1 should be structurally retained and subject to specific design by a Geotechnical Chartered Professional Engineer.
- The excavation works should be regularly inspected during construction by a suitably qualified Geotechnical Engineer or Engineering Geologist to confirm the recommendations of this report.
- Section 5.2.5 of this report summarises the recommended batter slope angles for slopes formed in engineered fill.
- All fill should be placed and compacted in accordance with NZS 4431:1989 and certification in accordance with QLDC standards provided to that effect.

Future Building Foundations

- Recommendations for the working bearing pressures of shallow foundations are presented in Figures 5.1, 5.2, 5.3, and 5.4 of this report.
- Pile foundations are recommended to support sensitive components of the proposed buildings or building founded on lake sediments and alluvial deposits with low bearing capacity.
- Recommendations for the design of pile foundations are presented in Table 5.2 of this report.
- Temporary casings are expected to be required during the construction of bored piles to prevent pile hole collapse.

- Raft foundations are recommended to support buildings founded on lake sediments and alluvial deposits where the depth to a competent bearing layer is considerable.
- Recommendations for the design of raft foundations are outlined in Section 5.3.4 of this report.
- The issue of foundation settlement should be checked during detailed design of the proposed foundations.
- In order to minimise the risk of groundwater seepage into the finished buildings, a 100 mm minimum thickness of free draining granular fill and a network of subsoil drainage pipes should be constructed beneath the foundation slabs floor slabs in areas where perched water seepage flows are present and behind all retaining walls. The outlet of all foundation slab and retaining wall drains should be connected to the permanent piped stormwater system.
- All foundation sub-grade should be inspected by a suitably qualified Geotechnical Engineer or Engineering Geologist to confirm the recommendations presented in this report.

Retention Design

- All retaining walls should be designed by a Chartered Professional Engineer.
- Recommended geotechnical parameters for design of all retaining structures are presented in Table 5.4 of this report.
- Due allowance should be made during detailed design of all basement retaining walls for issues such as traffic surcharge and sloping ground surface behind and in front of the retaining walls.
- Drainage measures such as gravel and sub-soil drains should be provided behind all retaining walls.
- Comprehensive waterproofing and/or drainage measures should be provided to the retaining face of all basement retaining walls to minimise the risk of groundwater seepage into the finished building.
- All retained soil should be inspected by a suitably qualified Geotechnical Engineer or Engineering Geologist to confirm the recommendations presented in this report.

Liquefaction Assessment

- There is a high probability of liquefaction under the western side of this site, if the ground is saturated and subjected to strong earthquake shaking (a ULS event). This issue should be addressed during the detailed design of any structures in this area of the Henley Downs site.
- There is the potential for isolated liquefaction however this is not a widespread issue and should not affect resource consent. Liquefaction assessment and remediation design options can take place on the potential areas identified in this report on a case by case basis.

Seismic Issues

- A risk of seismic activity has been identified for the region as a whole and provision should be made for seismic ground accelerations during detailed design of all proposed structures.
- The magnitude of seismic acceleration should be estimated in accordance with the recommendations of NZS 1170.5:2004 assuming "Class C - shallow soil site" ground conditions.

Geotechnical Issues to be addressed during Detailed Design

- Detailed design of the proposed foundation configurations including assessment of foundation settlement.
- Additional building-specific geotechnical investigations should be undertaken to confirm the inferred geotechnical conditions and preliminary design recommendations that are presented in this report.
- Individual building platform investigations should be undertaken to identify if soft lake sediment or alluvial soils underlie the platform. If unfavourable soil conditions are found further foundation design will be required.

7 Applicability

This report has been prepared for the benefit of Jacks Point Limited Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

During construction, all foundation excavations should be examined by an inspector or engineer who is competent to confirm the subsurface conditions encountered are compatible with the inferred conditions on which this report has been based and assess any support requirements.

It is important that Tonkin and Taylor Limited be contacted if there is any variation in subsoil conditions from those described in this report.

TONKIN & TAYLOR LTD

Environmental and Engineering Consultants

Site investigations by:

pp. 

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Fraser Wilson/Kylie Govan

ENGINEERING GEOLOGIST/
GEOTECHNICAL ENGINEER

Report prepared by:

pp. 

.....

Kylie Govan

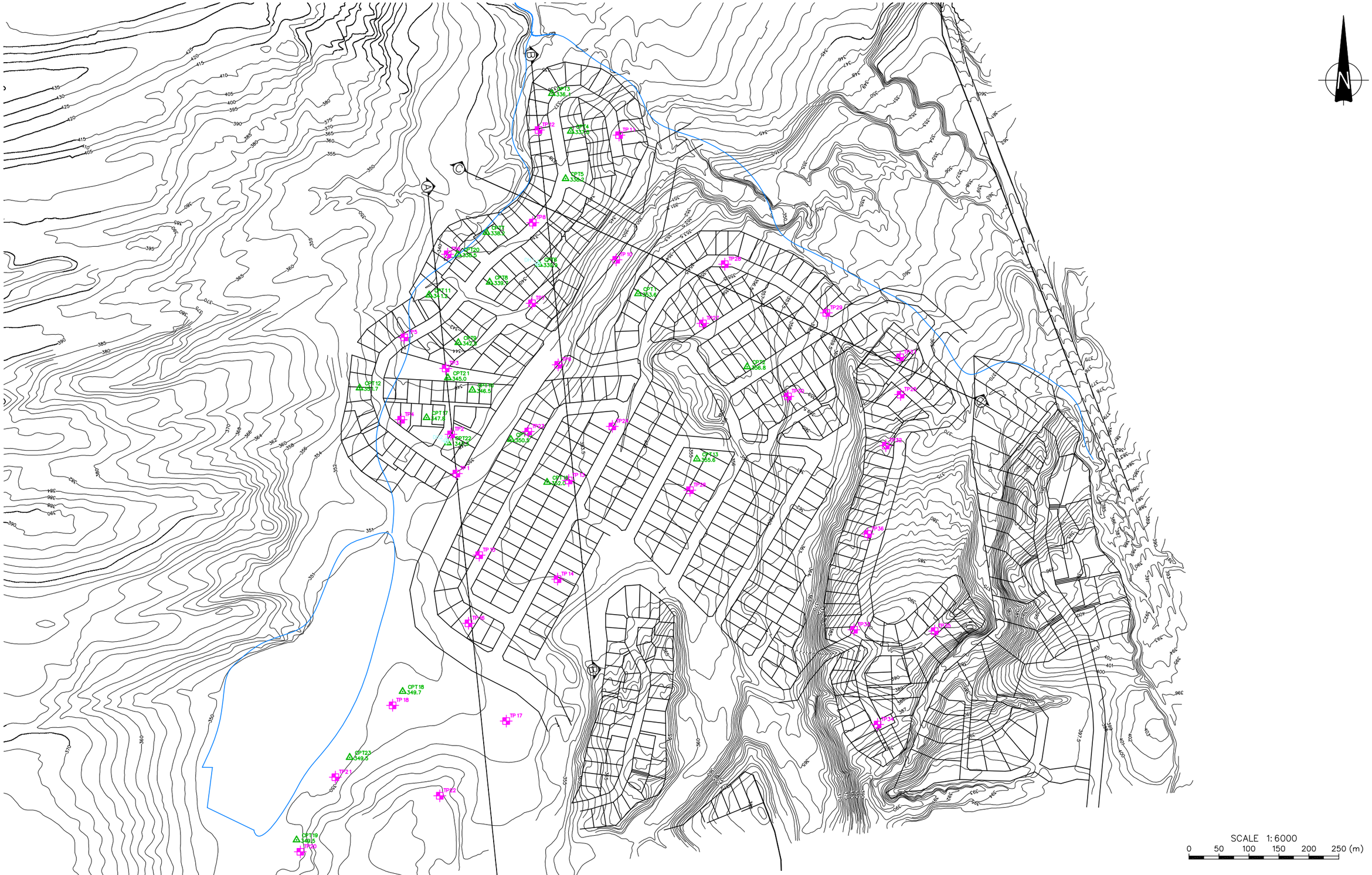
GEOTECHNICAL ENGINEER

Authorised for Tonkin & Taylor

Anthony Fairclough

SENIOR GEOTECHNICAL ENGINEER

Appendix A: Investigation Site Plan



Tonkin & Taylor
Environmental & Engineering Consultants
☐ Auckland ☐ Nelson ■ Dunedin ☐ Christchurch ☐ Wellington ☐ Hamilton ☐ Tauranga

DRAWN	EJD	Oct.07
DRAFTING CHECKED		
APPROVED		
CADFILE : \\Site Plan Rev A.dwg		
SCALES (AT A3 SIZE) 1:6000		
PROJECT No. 880054		

ARITH LIMITED

HENLEY DOWNS SUBDIVISION
JACKS POINT – HENLEY DOWNS

Geological Investigation Site Plan

FIG. No. Figure 1

REV. 0

Appendix B: Test Pit Logs

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 1**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING: See site plan mE	EQUIPMENT: 20T Excavator	OPERATOR: Nick
NORTHING: See site plan mN	INFOMAP NO.	COMPANY: Wilson's Contracting
ELEVATION: 350m m	DIMENSIONS:	HOLE STARTED: 29-Aug-07
METHOD: Site contour plan	EXCAV. DATUM:	HOLE FINISHED: 29-Aug-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	0.0		Brown, Organic SILT with minor roots. Uniform, Soft. Sub-horizontal.	Moist	TOPSOIL
				Light brown, SAND. Sand is fine to medium. Uniform, Loose to medium dense. Sub-horizontal.	Moist	BEACH DEPOSITS
		0.4		Grey brown, Sandy GRAVEL to gravelly SAND. Sand is medium to coarse; gravel is fine to medium. Clasts subrounded with rare sub-angular. Poorly graded, Loose. Sub-horizontal.	Moist	BEACH DEPOSITS
		0.8				
		1.2		Light grey, Clayey SILT. High dry strength. P.P.=4.5 average. Uniform, Stiff. Sub-horizontal.	Moist	LAKE SEDIMENTS
		1.6		Light grey, SILT with rare clay. P.P.=2.5 average. Uniform, Firm to stiff. Sub-horizontal.	Moist	LAKE SEDIMENTS
				Grey, SILT with rare clay. P.P.=2.5 average. Uniform, Firm to stiff. Sub-horizontal.	Moist	LAKE SEDIMENTS
		2.0		Light brown, SAND. Sand is fine. P.P.=2 average. Loose to medium dense.	Moist	LAKE DEPOSITS
				Grey, SAND. Sand is fine. P.P.=3.5 average. Medium dense.	Moist	LAKE DEPOSITS
				Light brown, SAND. Sand is fine. P.P.=2 average. Loose to medium dense.	Moist	LAKE DEPOSITS
		2.4		Grey, SAND. Sand is fine. P.P.=3.5 average. Medium dense.	Moist	LAKE DEPOSITS
				Light grey, Sandy GRAVEL. Sand is fine to coarse; gravel is fine to coarse. Well graded, Loose to medium dense. Sub-horizontal.	Moist	DELTAIC GRAVEL
		2.8				
		3.2				
		3.6		Total Depth = 3.5 m		
		4.0				
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: FAW
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EXCAVATION LOG

EXCAVATION NUMBER: **TP 2**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	346m m	DIMENSIONS:		HOLE STARTED: 29-Aug-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 29-Aug-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	0.4		TOPSOIL with reeds.		
		0.8		Brown and grey, SAND. Sand is fine.		BEACH DEPOSITS
		1.2		Grey, Clayey SILT with minor fine sand. Dilatent, slightly plastic, Firm, finger pressive. Massive, organic colour.	Moist	LAKE SEDIMENTS
		1.6				
		2.0				
		2.4		Blue grey, Clayey SILT with minor fine sand. S.V. at 2.5m, Peak=6, Residual=12. Slightly plastic, dilantent, Soft. Massive.	Moist	LAKE SEDIMENTS
		2.8				
		3.2		Blue grey, Clayey SILT with minor fine sand, occasion laminae of black organic silt. Soft to very soft. Massive, horizontal organic silt laminae.	Saturated	LAKE SEDIMENTS
		3.6				
		4.0		Total Depth = 3.7 m		
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 3**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator	OPERATOR: Nick
NORTHING:	See site plan mN	INFOMAP NO.	COMPANY: Wilson's Contracting
ELEVATION:	345m m	DIMENSIONS:	HOLE STARTED: 29-Aug-07
METHOD:	Site contour plan	EXCAV. DATUM:	HOLE FINISHED: 29-Aug-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
				TOPOSIL.		
		0.4		Brown, SAND. Sand is fine to medium. Loose to medium dense.	Moist	BEACH DEPOSITS
		0.8		Grey, SILT with some (100mm) horizone of silt with some clay. Non-plastic, Firm to stiff. Horizontal bedded.	Moist	
		1.2				
		1.6		Grey, SILT with minor clay. Dilatent, slightly plastic, Firm.	Moist	
	Groundwater @ 2.5 m	2.0				
		2.4				
		2.8		Blackish grey, Clayey SILT with fine organic matler. Slightly plastic, dilatent. S.V. at 3.0m. Peak=11, Residual=4; S.V. at 3.0m. Peak=12, Residual=5. P.P.=0.25 at 3.0m. Lab sample at 3.0m, Soft. Massive, strong organic colour.	Saturated	
		3.2				
		3.6				
				Total Depth = 3.6 m		
		4.0				
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 4**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	347m m	DIMENSIONS:		HOLE STARTED: 29-Aug-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 29-Aug-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.4		TOPSOIL.		
		0.8		Light brown, Silty SAND. Sand is fine. Loose to medium dense. Horizontal bedded.	Moist	LAKE SEDIMENTS
	▽Groundwater @ 2.2 m	1.2		Brownish grey, Clayey SILT. Slightly plastic, dilatent, Firm. Massive.	Moist	LAKE SEDIMENTS
		1.6				
		2.0				
		2.4		Grey, Clayey SILT with organic fragments. S.V. at 3.6m. Peak=12 Residual=2; Peak=12 Residual=3. Slightly plastic, dilatent, Soft. Massive.	Saturated	LAKE SEDIMENTS
		2.8				
		3.2				
		3.6				
				Total Depth = 3.6 m		
		4.0				
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT: Groundwater seeping slowing into hole at 2.2m	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 5**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	344m m	DIMENSIONS:		HOLE STARTED: 29-Aug-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 29-Aug-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.4		TOPSOIL and gravelly fill.	Moist	
	Groundwater @ 1.9 m	0.8		Brownish grey, Clayey SILT. Slightly plastic, dilatent, Firm. Massive.	Moist	LAKE SEDIMENTS
		1.2				
		1.6				
		2.0				
		2.4		Blue grey, Clayey SILT. Slightly plastic, dilatent, Soft. Massive. Organic colour.	Saturated	LAKE SEDIMENTS
		2.8				
		3.2				
		3.6		Total Depth = 3.2 m		
		4.0				
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 6**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	341m m	DIMENSIONS:		HOLE STARTED: 29-Aug-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 29-Aug-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
				TOPSOIL.		
		0.4		Brown, Clayey SILT. Slightly plastic, dilatent, Stiff. Massive.	Moist	LAKE SEDIMENTS
		0.8		Brown grey, Clayey SILT. Slightly plastic, dilatent, Firm to stiff. Massive.	Moist	LAKE SEDIMENTS
	▽Groundwater @ 2.7 m	1.2				
		1.6				
		2.0				
		2.4				
		2.8		Blue grey, Clayey SILT. S.V. at 3.0m. Peak=17, Residual=2; Peak=11, Residual=2. Slightly plastic, Soft to very soft. Laminated-thinly bedded. Horizontal. Organic colour.	Moist	LAKE SEDIMENTS
		3.2				
		3.6				
		4.0		Total Depth = 3.8 m		
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 7**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	343m m	DIMENSIONS:		HOLE STARTED: 29-Aug-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 29-Aug-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
				TOPSOIL.		
		0.4		GRAVEL with some sand and silt. Gravel is fine to medium.		BEACH DEPOSITS
				Brown, Clayey SILT. Slightly plastic, Stiff. Massive.	Moist	LAKE SEDIMENTS
		0.8		Brownish grey, Clayey SILT. Slightly plastic, Firm to stiff. Massive.	Moist	LAKE SEDIMENTS
		1.2				
		1.6				
		2.0				
	▽Groundwater @ 3.2 m	2.4				
		2.8				
		3.2				
		3.6		Blue grey, Clayey SILT. S.V. at 3.2m. Peak=14, Residual=2; Peak=18, Residual=3. Slightly plastic, Soft. Laminated-thinly bedded.	Saturated	LAKE SEDIMENTS
		4.0		Total Depth = 3.8 m		
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 8**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator	OPERATOR: Nick
NORTHING:	See site plan mN	INFOMAP NO.	COMPANY: Wilson's Contracting
ELEVATION:	339m m	DIMENSIONS:	HOLE STARTED: 29-Aug-07
METHOD:	Site countour plan	EXCAV. DATUM:	HOLE FINISHED: 29-Aug-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.0		TOPSOIL.		
		0.4		Brown, Clayey SILT. Slightly plastic, Stiff. Massive.	Moist	LAKE SEDIMENTS
		0.8				
		1.2		Brownish grey, Clayey SILT. Slightly plastic, Stiff to firm. Laminated-thinly bedded.	Moist	LAKE SEDIMENTS
	◁Groundwater @ 2.8 m	1.6				
		2.0				
		2.4				
		2.8				
		3.2		Grey with occasional brown laminae, Clayey SILT. Slightly plastic, Soft. Laminated-thinly bedded.	Saturated	LAKE SEDIMENTS
		3.6				
		4.0				
		4.4		Total Depth = 4.3 m		
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT: Some oxidised laminae below 2.8m	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 9**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator	OPERATOR: Nick
NORTHING:	See site plan mN	INFOMAP NO.	COMPANY: Wilson's Contracting
ELEVATION:	353m m	DIMENSIONS:	HOLE STARTED: 30-Aug-07
METHOD:	Site contour plan	EXCAV. DATUM:	HOLE FINISHED: 30-Aug-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		TOPSOIL.		
		0.4		Grey, Sandy GRAVEL. Gravel is fine to medium. Loose.	Moist	BEACH DEPOSITS
		0.6		Yellowish grey, Silty SAND. Sand is fine. Medium dense.	Moist	LAKE SEDIMENTS
		0.8				
		1.0				
		1.2		Grey, Sandy GRAVEL. Gravel is fine to meidum, subangular to subrounded. Sand is medium to coarse. Loose to medium dense. Cross-bedded.	Moist	DELTAIC DEPOSITS
		1.4				
		1.6				
		1.8				
		2.0				
		2.2				
		2.4				
		2.6				
		2.8				
	NO SEEPAGE	3.0				
				Total Depth = 3 m		
		3.2				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 10**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	350m m	DIMENSIONS:		HOLE STARTED: 30-Aug-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 30-Aug-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		TOPSOIL.		
		0.4		Sandy GRAVEL. Gravel is fine to coarse, subangular to subrounded. Sand is medium to coarse. Loose to medium dense. Cross-bedded.		DELTAIC DEPOSITS
		0.6				
		0.8				
		1.0				
		1.2				
		1.4				
		1.6				
		1.8				
		2.0				
		2.2				
		2.4				
		2.6				
		2.8				
	NO SEEPAGE	3.0				
				Total Depth = 3 m		
		3.2				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 11**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	344m m	DIMENSIONS:		HOLE STARTED: 30-Aug-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 30-Aug-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		TOPSOIL.		
		0.4		Grey, Interbedded sandy GRAVEL and SAND. Gravel is fine to medium. Sand is fine to medium. Beds about 300mm thick, Loose. Horizontally bedded.	Moist	DELTAIC DEPOSITS / BEACH DEPOSITS
		0.6				
		0.8				
		1.0				
		1.2				
		1.4				
		1.6				
		1.8				
		2.0				
		2.2				
		2.4				
		2.6				
		2.8				
	NO SEEPAGE	3.0				
		3.2		Total Depth = 3 m		

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 12**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	338m m	DIMENSIONS:		HOLE STARTED: 30-Aug-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 30-Aug-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.4		TOPSOIL.		
		0.8		Brownish grey, Clayey SILT. Slightly plastic, stif to firm. Laminated-thinly bedded. Subhorizontal. Subvertical open joints with slickensides closely spaced; down to 1.3m..	Moist	LAKE SEDIMENTS
		1.2				
		1.6				
		2.0				
		2.4				
		2.8				
		3.2				
	▽Groundwater @ 3.8 m	3.6		Grey, Silt-clayey SILT. Slight plastic to non-plastic, Soft. Laminated.	Wet	LAKE SEDIMENTS
		4.0		Total Depth = 3.8 m		
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT: Watertable probably just below base of hole	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 13**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	353m m	DIMENSIONS:		HOLE STARTED: 30-Aug-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 30-Aug-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.4		TOPSOIL.	Wet	
		0.8		Brown, SILT with minor sand. Sand is fine. Non-plastic, Soft to firm. Massive.	Moist	LAKE SEDIMENTS
	▽Groundwater @ 3 m	1.2		Brownish grey, SILT with minor sand. Sand is fine. Non-plastic, Soft to firm. Massive.	Moist to wet	LAKE SEDIMENTS
		1.6				
		2.0				
		2.4				
		2.8				
		3.2		Brown and grey, Silt-clayey SILT. Non to slightly plastic, Firm. Laminated. Horizontal bedded.	Moist	LAKE SEDIMENTS
		3.6				
		4.0		Total Depth = 3.7 m		
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT: Seepage into hole with slumping of sides at 3.0m, appear to be a minor perched watertable on top of the laminated Silt-clayey SILT	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 14**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator	OPERATOR: Nick
NORTHING:	See site plan mN	INFOMAP NO.	COMPANY: Wilson's Contracting
ELEVATION:	354m m	DIMENSIONS:	HOLE STARTED: 30-Aug-07
METHOD:	Site contour plan	EXCAV. DATUM:	HOLE FINISHED: 30-Aug-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		TOPSOIL.	Moist	
		0.4				
		0.6		Sandy GRAVEL with minor boulders. Gravel is fine to coarse; subangular to subrounded, greywacke, schist, quartz. Boulders max 0.7m. Sand is medium to coarse. Medium dense.	Moist	OUTWASH GRAVEL
		0.8				
		1.0				
		1.2				
		1.4				
		1.6				
		1.8				
		2.0				
	NO SEEPAGE	2.2				
		2.4		Total Depth = 2.3 m		
		2.6				
		2.8				
		3.0				
		3.2				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 15**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	352m m	DIMENSIONS:		HOLE STARTED:	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED:	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.4		TOPSOIL.		
	NO SEEPAGE	0.8		Interbedded sandy GRAVEL and SAND. Gravel is fine to medium. Sand is medium. Sand is fine. Loose. Horizontal bedded, beds 200-500mm thick.	Moist	DELTAIC DEPOSITS
		1.2				
		1.6				
		2.0				
		2.4				
		2.8				
		3.2				
		3.6		Total Depth = 3.4 m		
		4.0				
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 16**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	351m m	DIMENSIONS:		HOLE STARTED: 30-Aug-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 30-Aug-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	0.0		TOPSOIL.		
		0.4		Tan brown, SILT. Uniform non-plastic, Stiff. Sub-horizontal.	Moist	LAKE SEDIMENTS
		0.8				
		1.2		Grey brown, Sandy GRAVEL with zones with higher sand and gravel composition. Sand is fine to coarse. Gravel is fine to coarse. Poorly graded, Loose. Sub-horizontal.	Moist	DELTAIC GRAVEL
		1.6				
		2.0		Light tan brown, SAND with minor gravel, rare gravel from 2.0m. Sand is fine to coarse. Gravel is fine (Subrounded). Uniform, Loose. Sub-horizontal.	Dry to moist	DELTAIC DEPOSITS
		2.4				
		2.8				
		3.2				
		3.3		Total Depth = 3.3 m		
		3.6				
		4.0				
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 17**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator	OPERATOR: Nick
NORTHING:	See site plan mN	INFOMAP NO.	COMPANY: Wilson's Contracting
ELEVATION:	350m m	DIMENSIONS:	HOLE STARTED: 30-Aug-07
METHOD:	Site contour plan	EXCAV. DATUM:	HOLE FINISHED: 30-Aug-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.2		TOPSOIL.		
		0.4		SILT with minor sand. Scala at 0.4m. Uniform, non-plastic, Firm to stiff.	Moist	LAKE SEDIMENTS
		0.6				
		0.8		SILT with rare clay. Uniform, non-plastic, Stiff.	Moist	LAKE SEDIMENTS
		1.0				
		1.2				
		1.4		SILT with minor clay. Scala at 1.9m. Uniform, non to slightly plastic, Stiff.	Moist	LAKE SEDIMENTS
		1.6				
		1.8				
		2.0				
		2.2		Grey and brown, SILT with silty SAND to sandy SILT lenses. Sand is fine. Uniform, Stiff. Sub-horizontal.	Moist	LAKE DEPOSITS
		2.4		Grey brown, Sandy GRAVEL with minor silt cobbles, rare boulders. Sand is fine to coarse. Gravel is fine to coarse. Boulders and cobbles to 250mm. Subangular to subrounded clasts. Moderately well graded, Dense.	Moist	GLACIAL TILL
	NO SEEPAGE	2.6				
		2.8				
		3.0				
		3.2		Total Depth = 3.1 m		

COMMENT:	Logged By: FAW
	Checked Date:
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TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 18**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	353m m	DIMENSIONS:		HOLE STARTED: 30-Aug-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 30-Aug-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	0.0		TOPSOIL.		
		0.4		Grey brown, SAND. Sand is fine. Uniform, Loose. Sub-horizontal.	Moist to wet	LAKE DEPOSITS
		0.8		Grey, SILT with minor clay to clayey SILT. Shrink swell fissures with seepage within. Sample at 2.8m. Scala at 0.7m. Uniform, Firm. Sub-horizontal. Fissures saturated.	Moist to wet	LAKE SEDIMENTS
		1.2				
		1.6		Clayey SILT. Sample at 2.8m. Organic odour and content from 3m. Sample at 3.5m. Scala at 1.6m. Uniform. Slightly to moderately plastic, Soft to firm (See scala). Sub-horizontal.	Wet	LAKE SEDIMENTS
		2.0				
		2.4				
		2.8				
		3.2				
		3.6				
		4.0		Total Depth = 3.8 m		
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT: No seepage apart from in fissures	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 19**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: Southeast corner of paddock	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	m	DIMENSIONS:		HOLE STARTED: 5-Sep-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 5-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	0.0		Brown, Organic SILT with minor sand and gravel.		TOPSOIL
		0.4		Brown, Sandy GRAVEL. Sand is fine to coarse. Gravel is find to coarse. Subrounded to subangular clasts. Moderately well graded, Medium dense. Unit dips 5° to 10° to north.	Moist	BEACH DEPOSITS
		0.8		Red brown, Sandy GRAVEL. Sand is fine to coarse. Gravel is find to coarse. Clasts are subrounded with some subangular. Well graded, Dense to very dense. Hard to excavate due to iron cementation. Unit dips 5° to 10° to north.	Moist, iron oxidised	BEACH DEPOSITS
		1.2				
		1.6		Grey, Sandy SILT. Sand is fine. Uniform, Stiff (See scala). Sub-horizontal. No bedding.	Dry to moist	LAKE SEDIMENTS
		2.0				
		2.4		Grey, Sandy GRAVEL with rare cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse. Cobbles, boulders up to 200mm. Clasts are subangular to subrounded. Well graded, Dense. Uint dips slightly to north.	Moist	GLACIAL TILL
		2.8				
		3.2				
		3.6				
		4.0				
		4.4		Total Depth = 4.1 m		
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 20**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: Southwest corner of paddock	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	m	DIMENSIONS:		HOLE STARTED: 5-Sep-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 5-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	Gr ou	0.0		Brown, Organic SILT.		TOPSOIL
		0.4		Grey, SILT to SILT with some clay from 1.3m. Saturated in fissures in silt. Uniform, Firm. Sub-horizontal. No bedding.	Moist, saturated with seepage	POST GLACIAL LAKE SEDIMENTS
		0.8				
		1.2				
		1.6				
		2.0		Dard grey, Clayey SILT to SILT with minor clay. Sample at 2.0m. Scala at 1.7m. Organic odour from 1.9m to 2.8m. Uniform, Soft to firm (See scala). Unit sub-horizontal. No bedding.	Wet	POST GLACIAL LAKE SEDIMENTS
		2.4				
		2.8				
		3.2		Light grey, SILT to SILT with minor clay. Uniform, Stiff. Unit sub-horizontal. No bedding.	Moist	LAKE SEDIMENTS
		3.6		Brown with red staining, Sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse. Clasts subangular to soubrounded. Iron oxidised. Well graded, Medium dense. Unit sub-horizontal.	Moist	GLACIAL OUTWASH/TILL
		4.0		Total Depth = 4 m		
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT: Water on surface adjacent to TP due to impermeable silt surface and recent rainfall. Seepage perched water at topsoil/silt contact at 0.3m	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 21**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: Northwest corner of paddock	Inclination:	Direction:

EASTING: See site plan mE	EQUIPMENT: 20T Excavator	OPERATOR: Nick
NORTHING: See site plan mN	INFOMAP NO.	COMPANY: Wilson's Contracting
ELEVATION: m	DIMENSIONS:	HOLE STARTED: 5-Sep-07
METHOD: Site contour plan	EXCAV. DATUM:	HOLE FINISHED: 5-Sep-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	Gr ou ▽	0.0		Brown, Organic SILT.		TOPSOIL
		0.4		Grey with orange staining, SILT. Uniform, Firm. Unit sub-horizontal. No bedding.	Moist. Saturated with seepage	LAKE SEDIMENTS
		0.8		Grey, SILT with minor clay. Uniform, Stiff. Unit sub-horizontal. No bedding.	Moist	LAKE SEDIMENTS
		1.2				
		1.6				
		2.0				
		2.4				
		2.8				
		3.2				
		3.6		Grey, brown with minor orange staining, Sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse. Well graded, Dense to hard to excavate. Unit sub-horizontal.	Moist	GLACIAL TILL
		4.0		Total Depth = 3.9 m		
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT: Seepage at topsoil/silt contact at 0.3m	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 22**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: Northeast corner of paddock	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	m	DIMENSIONS:		HOLE STARTED: 5-Sep-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 5-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
				Brown, Organic SILT with minor sand and gravel.		TOPSOIL
	Groundwater @ 1.8 m	0.4		Grey brown with red iron staining, Interbedded sandy GRAVEL to gravelly SAND. Sand is medium to coarse. Gravel is fine to medium, rare coarse. Clasts are subrounded to subangular. Poorly graded, Loose (TP sides collapsing), medium dense with iron cementation. Dense lenses, created through iron cementation. Dips slightly to north. See topo contours.	Moist to wet	BEACH DEPOSITS
		0.8				
		1.2				
		1.6				
		2.0		Grey, SILT. Uniform, Stiff. Unit dips slightly to north. No bedding.	Moist. Saturated at contact to beach deposits	LAKE SEDIMENTS
		2.4				
		2.8		Grey, Sandy GRAVEL with minor cobbles. Sand is fine to coarse. Gravel is fine to coarse. Cobbles to 200mm. Clasts are subangular to subrounded. Well graded, Dense. Unit dips slightly to north.	Moist	GLACIAL TILL
		3.2				
		3.6		Total Depth = 3.4 m		
		4.0				
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT: Perched water at 1.80m at beach deposit/silt contact. Seepage from TP sides at 200-300l/min	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 23**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	m	DIMENSIONS:		HOLE STARTED: 5-Sep-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 5-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
				Topsoil.		TOPSOIL
	NO SEEPAGE	0.4		Grey, brown with red iron staining, SAND with lenses of GRAVEL with minor sand (Interbedded sands and gravels). SAND has minor gravel in lenses. Sand is medium to coarse. Gravel is fine to medium, rare coarse. Clasts subrounded to subangular. Sand is mostly sugar sized particles. Poorly graded (Uniform bands of sand), Loose. Dips 5° to northwest (toward lake inlet, see contours).	Moist, not wet. But wet in loose sand (fine to medium) bands possibly liquefiable	BEACH DEPOSITS
		0.8				
		1.2				
		1.6				
		2.0				
		2.4				
		2.8				
		3.2				
		3.6				
		4.0		Total Depth = 3.7 m		
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 24**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	m	DIMENSIONS:		HOLE STARTED: 5-Sep-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 5-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	0.0		Brown , Organic SILT.		TOPSOIL
		0.4		Grey brown, GRAVEL with some/minor sand. Sand is medium to coarse. Gravel is fine to coarse. Clasts subangular to subrounded. Poorly graded, Loose. Dips slightly to west-northwest.	Moist	BEACH DEPOSITS
		0.8				
		1.2		Grey, Sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse. Clasts subrounded to moderately subangular. More schist clasts in metasediment. Well graded, Medium dense. Unit sub-horizontal.	Moist	ALLUVIAL FAN GRAVEL
		1.6				
		2.0				
		2.4		GRAVEL with some sand with lenses of coarser and finer gravels. Loose. Sub-horizontal bedding, to beds dipping slightly to west.		ALLUVIAL FAN GRAVEL
		2.8				
		3.2				
		3.6		Total Depth = 3.4 m		
		4.0				
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 25**

PROJECT: Jacks Point, Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING: See site plan mE	EQUIPMENT: 20T Excavator	OPERATOR: Michael	
NORTHING: See site plan mN	INFOMAP NO.	COMPANY: Wilson's Contracting	
ELEVATION: 366 m	DIMENSIONS:	HOLE STARTED: 24-Sep-07	
METHOD: Site Plan Contours	EXCAV. DATUM: Ground level	HOLE FINISHED: 24-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.1		Dark brown, organic SILT. Uniform. Soft. Sub-horizontal.	Moist	TOPSOIL
		0.2				
		0.3				
		0.4				
		0.5		Tan brown, SILT. Uniform. Firm. Sub-horizontal.	Moist	ALLUVIAL DEPOSIT
		0.6				
		0.7				
		0.8				
		0.9		Light grey, sandy SILT. Sand is fine. Uniform. Firm. Sub-horizontal.	Moist to wet	ALLUVIAL DEPOSIT
		1.0				
		1.1		Tan brown, SILT with minor gravel. Uniform. Firm. Sub-horizontal.	Moist	ALLUVIAL DEPOSIT
		1.2				
		1.3		Grey brown, SILT with minor sand and gravel. Sand is fine, gravel is fine to medium. Poorly graded. Stiff. Sub-horizontal.	Moist	ALLUVIAL DEPOSIT
		1.4				
		1.5				
		1.6				

Log continued on next page

COMMENT: Minor seepage from 1.7 to 1.8m. Moist area at surface with bullrushes.	Logged By: FAW/KGG
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 25**

PROJECT: Jacks Point, Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Michael	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	366 m	DIMENSIONS:		HOLE STARTED: 24-Sep-07	
METHOD:	Site Plan Contours	EXCAV. DATUM: Ground level		HOLE FINISHED: 24-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		1.7		Grey brown, SILT with minor sand and gravel. Sand is fine, gravel is fine to medium. Poorly graded. Stiff. Sub-horizontal.	Moist	ALLUVIAL DEPOSIT
	→	1.8		Grey brown, silty sandy GRAVEL. Sand is fine to coarse, gravel is fine to coarse. Poorly graded. Medium dense. Unit dips slightly (5°) to northwest.	Satuated	ALLUVIAL DEPOSIT
		1.9		Grey brown, SILT with minor sand. Sand is fine. Uniform. Stiff. Unit dips slightly (5°) to northwest.	Moist	ALLUVIAL DEPOSIT
		2.0				
		2.1				
		2.2				
		2.3		Grey brown with orange staining, sandy silty GRAVEL with minor cobbles and boulders. Sand is fine to coarse, gravel is fine to coarse. Clasts are angular to sub-rounded schist and metamorphic sediment. Poorly graded. Dense, hard to excavate. Sub-horizontal.	Moist	GLACIAL TILL
		2.4				
		2.5				
		2.6				
		2.7		Total Depth = 2.6 m		
		2.8				
		2.9				
		3.0				
		3.1				
		3.2				

COMMENT: Minor seepage from 1.7 to 1.8m. Moist area at surface with bullrushes.	Logged By: FAW/KGG
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 26**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: Northeast of admin building	Inclination:	Direction:

EASTING: See site plan mE	EQUIPMENT: 20T Excavator	OPERATOR: Nick
NORTHING: See site plan mN	INFOMAP NO.	COMPANY: Wilson's Contracting
ELEVATION: m	DIMENSIONS:	HOLE STARTED: 5-Sep-07
METHOD: Site contour plan	EXCAV. DATUM:	HOLE FINISHED: 5-Sep-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.4		Brown, Organic SILT with minor sand and gravel.		TOPSOIL
		0.8		Grey brown, Sandy GRAVEL with rare cobbles/boulders. Sand is medium to coarse. Gravel is fine coarse. Cobbles and boulders to 250mm. Poorly graded, Loose. Sub-horizontal.	Moist	ALLUVIAL FAN GRAVEL
	▽Groundwater @ 2.3 m	1.2		Grey, Sandy GRAVEL with rare silty zones and rare boulders. Sand is fine to coarse. Gravel is fine to coarse. Clasts are schist and metaled, most subangular, some subrounded. Drop boulders to 500mm, subrounded to subangular 2-3m. Well graded, Medium dnese to dense. Dips slightly to west. Bedded. Seepage zone from 2.3-2.8m perched above fine sands/silts.	Moist, saturated at seepage	ALLUVIAL FAN GRAVEL
		1.6				
		2.0				
		2.4				
		2.8				
		3.2		Light brown and grey, Silty SAND with bedded SILT lenses, rare drop boulders at upper contact. Sand is fine. Some fine sand lenses, wet, prove to liquefaction. Uniform, Loose firm, soft where saturated. Sub-horizontal, some sub-horizontal bedding in silts and sands. Bedding are 1cm-5cm bedding planes.	Moist, saturated at seepage contact	LAKE DEPOSITS
		3.6				
		4.0				
		4.4		Total Depth = 4 m		
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT: Seepage at 2.3-2.8m, approx. 200l/min from TP back wall, at alluvial fan/lake sediments contact	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 27**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	m	DIMENSIONS:		HOLE STARTED: 5-Sep-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 5-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	0.0		Topsoil.		TOPSOIL
		0.4		Light brown, SILT. Uniform, Firm. Sub-horizontal.	Moist	ALLUVIAL FLOOD PLAIN DEPOSITS
		0.8		Grey, Sandy GRAVEL with minor cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse. Boulders to 300mm. Clasts subangular to subrounded. Metased, some schist. Well graded, Medium dense. Sub-horizontal. Gravel unit thiches to the east in the test pit. Iron oxidised zones.	Moist to wet	ALLUVIAL FAN GRAVEL
		1.2				
		1.6				
		2.0				
		2.4		Brownly grey, SILT with rare/minor clay. P.P. = 3 against bedding plane. P.P.=2 with bedding plane. Uniform, Firm to stiff. Sub-horizontal, laminated bedding 3mm-5mm spacing.	Moist	LAKE SEDIMENTS
		2.8		Grey, SILT. P.P. = 1.5 to 1.75 with bedding plane. P.P. = 1.25 against bedding plane. Uniform, Firm. Sub-horizontal, laminated bedding, 2mm to 5mm spacing.	Moist	LAKE SEDIMENTS
		3.2				
		3.6		Total Depth = 3.5 m		
		4.0				
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 28**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator	OPERATOR: Nick
NORTHING:	See site plan mN	INFOMAP NO.	COMPANY: Wilson's Contracting
ELEVATION:	m	DIMENSIONS:	HOLE STARTED: 5-Sep-07
METHOD:	Site contour plan	EXCAV. DATUM:	HOLE FINISHED: 5-Sep-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
				Topsoil.		TOPSOIL
		0.4		Tan brown, SILT with minor sand. Sand is fine. Uniform, Firm to stiff. Sub-horizontal.	Moist	ALLUVIAL FLOOD PLAIN DEPOSITS
		0.8				
		1.2				
		1.6		Grey, Sandy GRAVEL with minor cobbles and gravel, some cobbles/gravel from 2.4m. Sand is fine to coarse. Gravel is fine to coarse. Boulders to 400mm. Clasts subangular to sburounded. Well graded, Medium dense. Sub-horizontal.	Moist	ALLUVIAL FAN GRAVEL
		2.0				
		2.4				
		2.8				
		3.2				
		3.6				
	NO SEEPAGE	4.0				
		4.4		Total Depth = 4 m		
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 29**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Nick	
NORTHING:	See site plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	m	DIMENSIONS:		HOLE STARTED: 5-Sep-07	
METHOD:	Site contour plan	EXCAV. DATUM:		HOLE FINISHED: 5-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
				Topsoil.		TOPSOIL
		0.4		Grey, SILT. Uniform, Firm. Sub-horizontal.	Moist	ALLUVIAL FLOOD PLAIN DEPOSITS
		0.8		Sandy GRAVEL (lenses). Sand is medium to coarse. Gravel is fine. Uniform, Loose. Sub-horizontal.	Moist	ALLUVIAL FLOOD PLAIN DEPOSITS
		1.2		Grey, Sandy SILT. Sand is fine. Uniform, Firm (See scala). Sub-horizontal.	Moist	LAKE SEDIMENTS
		1.6				
		2.0				
		2.4				
		2.8		Grey brown, SILT. P.P. = 2.5 - 3.0. Uniform, Stiff. Sub-horizontal.	Moist	LAKE SEDIMENTS
	NO SEEPAGE	3.2		Grey brown, Sandy GRAVEL. Sand is fine to coarse. Gravel is fine to coarse. Well graded, Loose to medium dense. Sub-horizontal.	Moist	ALLUVIAL FAN GRAVEL
		3.6				
		4.0		Total Depth = 3.8 m		
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 30**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator	OPERATOR: Nick
NORTHING:	See site plan mN	INFOMAP NO.	COMPANY: Wilson's Contracting
ELEVATION:	m	DIMENSIONS:	HOLE STARTED: 5-Sep-07
METHOD:	Site contour plan	EXCAV. DATUM:	HOLE FINISHED: 5-Sep-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	0.0		Topsoil.		TOPSOIL
		0.4		Brown grey with iron staining, Sandy GRAVEL with rare cobbles and boulders towards the base of the uint. Layers of higher gravel/sand composition. Sand is medium to coarse. Gravel is fine to coarse. Boulders to 200mm. Clasts are mainly metasediment, minor schist, clasts subangular to subrounded. Moderately well graded, Loose. Dips 5°-10° to west, contact dips to west.	Moist	BEACH DEPOSITS
		0.8				
		1.2		Grey, Sandy GRAVEL with minor cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse. Boulders to 600mm. Clasts are subangular to subrounded. Well graded, Medium dense. Unit dipping to west.	Moist	ALLUVIAL FAN GRAVEL
		1.6				
		2.0				
		2.4				
		2.8				
		3.2				
		3.6		Total Depth = 3.5 m		
		4.0				
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT:	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 31**

PROJECT: Jacks Point Henley Downs		Job Number: 880054
LOCATION: See site plan	Inclination:	Direction:

EASTING:	See site plan mE	EQUIPMENT: 20T Excavator	OPERATOR: Nick
NORTHING:	See site plan mN	INFOMAP NO.	COMPANY: Wilson's Contracting
ELEVATION:	m	DIMENSIONS:	HOLE STARTED: 5-Sep-07
METHOD:	Site contour plan	EXCAV. DATUM:	HOLE FINISHED: 5-Sep-07

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
				Topsoil.		TOPSOIL
		0.4		Grey, Sandy GRAVEL with rare cobbles and boulders. Sand is fine to coarse. Gravel is fine to coarse. Well graded, Dense. Sub-horizontal with slope profile.	Moist, saturated at seepage zone	GLACIAL OUTWASH
	▽ Groundwater @ 1.8 m	0.8				
		1.2				
		1.6				
		2.0				
		2.4		Grey, SILT with minor clay. P.P. = Can't get reading, too hard. Uniform, Very Stiff. Sub-horizontal. Contact to gravel dips to northwest.	Moist	GLACIAL POND SEDIMENT
		2.8				
		3.2				
		3.6		Total Depth = 3.5 m		
		4.0				
		4.4				
		4.8				
		5.2				
		5.6				
		6.0				
		6.4				

COMMENT: Seepage at 1.8-2.2m in a conduit in the TP side wall, 50-100l/min at contact of gravel and silt	Logged By: FAW
	Checked Date:
PHOTO REF.:	Sheet: 1 of 1

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 32**

PROJECT: Jacks Point, Henley Downs		Job Number: 880054
LOCATION: See Site Plan	Inclination:	Direction:

EASTING:	See Site Plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Michael	
NORTHING:	See Site Plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	371 m	DIMENSIONS:		HOLE STARTED: 24-Sep-07	
METHOD:	Site Plan Contours	EXCAV. DATUM: Ground level		HOLE FINISHED: 24-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.1		Dark brown, organic SILT. Uniform. Soft. Sub-horizontal.	Moist	TOPSOIL
		0.2				
		0.3		Light brown, silty SAND with rare gravel and roots. Sand is fine. Uniform. Firm. Dips with slope profile.	Moist	COLLUVIUM
		0.4				
		0.5				
		0.6		Orange brown, sandy GRAVEL. Sand is fine to coarse, gravel is fine to coarse. Clasts are sub-angular to sub-rounded. Poorly graded. Loose. Dips with slope profile.	Moist	COLLUVIUM
		0.7				
		0.8				
		0.9				
		1.0				
		1.1				
		1.2				
		1.3				
		1.4				
		1.5				
		1.6		Light grey, sandy GRAVEL with rare boulders. Sand is fine to coarse, gravel is fine to coarse. Clasts are sub-angular to sub-rounded. Well graded. Medium dense. Dips with slope profile.	Moist	GLACIAL OUTWASH

Log continued on next page

COMMENT: No seepage	Logged By: FAW/KGG
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 32**

PROJECT: Jacks Point, Henley Downs		Job Number: 880054
LOCATION: See Site Plan	Inclination:	Direction:

EASTING:	See Site Plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Michael	
NORTHING:	See Site Plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	371 m	DIMENSIONS:		HOLE STARTED: 24-Sep-07	
METHOD:	Site Plan Contours	EXCAV. DATUM: Ground level		HOLE FINISHED: 24-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	1.7		Light grey, sandy GRAVEL with rare boulders. Sand is fine to coarse, gravel is fine to coarse. Clasts are sub-angular to sub-rounded. Well graded. Medium dense. Dips with slope profile.	Moist	GLACIAL OUTWASH
		1.8				
		1.9		Light grey, sandy GRAVEL with rare cobbles and boulders. Sand is fine to coarse, gravel is fine to coarse. Clasts are sub-angular to sub-rounded. Sub-rounded boulders to 300mm. One angular boulder to 500mm. Well graded. Dense, moderately hard to excavate. Dips with slope profile.	Moist	GLACIAL OUTWASH
		2.0				
		2.1				
		2.2				
		2.3				
		2.4				
		2.5				
		2.6		Total Depth = 2.5 m		
		2.7				
		2.8				
		2.9				
		3.0				
		3.1				
		3.2				

COMMENT: No seepage	Logged By: FAW/KGG
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 33**

PROJECT: Jacks Point, Henley Downs		Job Number: 880054
LOCATION: See Site Plan	Inclination:	Direction:

EASTING:	See Site Plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Michael	
NORTHING:	See Site Plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	388 m	DIMENSIONS:		HOLE STARTED: 24-Sep-07	
METHOD:	Site Plan Contours	EXCAV. DATUM: Ground level		HOLE FINISHED: 24-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.1		Dark brown, organic SILT. Uniform. Soft.	Moist	TOPSOIL
		0.2				
		0.3				
		0.4		Reddish brown, gravelly SILT with some sand and cobbles. Sand is fine, greywacke clasts are sub-rounded to sub-angular. Cobbles up to 100mm. Poorly graded. Loose. Dips with slope profile.	Moist	COLLUVIUM
		0.5				
		0.6				
		0.7				
		0.8		Grey brown, sandy GRAVEL. Sand is medium to coarse. Quartz clasts are sub-angular to sub-rounded. Poorly graded. Medium dense.	Moist	GLACIAL OUTWASH
		0.9				
		1.0				
		1.1				
		1.2				
		1.3				
		1.4				
		1.5				
		1.6		Light brown, silty SAND. Sand is fine to medium. Uniform. Dense.	Moist	GLACIAL POND SEDIMENT

Log continued on next page

COMMENT: No seepage	Logged By: FAW/KGG
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 33**

PROJECT: Jacks Point, Henley Downs		Job Number: 880054
LOCATION: See Site Plan	Inclination:	Direction:

EASTING:	See Site Plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Michael	
NORTHING:	See Site Plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	388 m	DIMENSIONS:		HOLE STARTED: 24-Sep-07	
METHOD:	Site Plan Contours	EXCAV. DATUM: Ground level		HOLE FINISHED: 24-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		1.7		Light brown, silty SAND. Sand is fine to medium. Uniform. Dense.	Moist	GLACIAL POND SEDIMENT
	NO SEEPAGE	1.8		Grey brown, sandy GRAVEL with cobbles. Sand is medium to coarse, gravel in fine to medium. Clasts are sub-angular to sub-rounded. Poorly graded. Dense, hard to excavate.	Moist	GLACIAL TILL
		1.9				
		2.0				
		2.1				
		2.2				
		2.3				
		2.4		Total Depth = 2.3 m		
		2.5				
		2.6				
		2.7				
		2.8				
		2.9				
		3.0				
		3.1				
		3.2				

COMMENT: No seepage	Logged By: FAW/KGG
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 34**

PROJECT: Jacks Point, Henley Downs		Job Number: 880054
LOCATION: See Site Plan	Inclination:	Direction:

EASTING:	See Site Plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Michael	
NORTHING:	See Site Plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	385 m	DIMENSIONS:		HOLE STARTED: 24-Sep-07	
METHOD:	Site Plan Contours	EXCAV. DATUM: Ground level		HOLE FINISHED: 24-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.1		Dark brown, organic SILT. Uniform. Soft.	Moist	TOPSOIL
		0.2				
		0.3		Red brown, gravelly SILT with some sand. Gravel is fine to coarse. Clasts are sub-rounded to sub-angular. Poorly graded. Loose. Dips with slope.	Moist	COLLUVIUM
		0.4				
		0.5				
		0.6				
		0.7		Grey brown, sandy GRAVEL with cobbles. Sand is fine to coarse, gravel is medium to coarse. Poorly graded. Medium dense. Dips with slope.	Moist	GLACIAL OUTWASH
		0.8				
		0.9				
		1.0		Red brown with iron staining, sandy GRAVEL with cobbles and boulders. Cemented cobbles/boulders up to 200mm. Well graded. Medium dense. Dips with slope.	Moist	GLACIAL OUTWASH
		1.1		Grey brown, gravelly SAND. Sand is medium to coarse, gravel is fine to coarse. Poorly graded. Medium dense. Dips with slope.	Moist	GLACIAL OUTWASH
		1.2				
		1.3				
		1.4		Grey, sandy GRAVEL with cobbles and boulders. Sand is medium to coarse, gravel is medium to coarse. Greywacke and quartz boulders up to 200mm. Well graded. Medium dense. Dips with slope.	Moist	GLACIAL OUTWASH
		1.5				
		1.6				

Log continued on next page

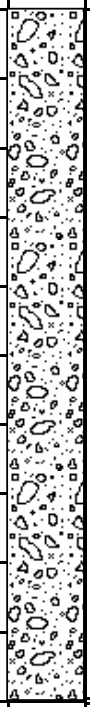
COMMENT: No seepage	Logged By: FAW/KGG
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 34**

PROJECT: Jacks Point, Henley Downs		Job Number: 880054
LOCATION: See Site Plan	Inclination:	Direction:

EASTING:	See Site Plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Michael	
NORTHING:	See Site Plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	385 m	DIMENSIONS:		HOLE STARTED: 24-Sep-07	
METHOD:	Site Plan Contours	EXCAV. DATUM: Ground level		HOLE FINISHED: 24-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	1.7		Grey, sandy GRAVEL with cobbles and boulders. Sand is medium to coarse, gravel is medium to coarse. Greywacke and quartz boulders up to 200mm. Well graded. Medium dense. Dips with slope.	Moist	GLACIAL OUTWASH
		1.8				
		1.9				
		2.0				
		2.1				
		2.2				
		2.3				
		2.4				
		2.5				
		2.6		Total Depth = 2.6 m		
		2.7				
		2.8				
		2.9				
		3.0				
		3.1				
		3.2				

COMMENT: No seepage	Logged By: FAW/KGG
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 35**

PROJECT: Jacks Point, Henley Downs		Job Number: 880054
LOCATION: See Site Plan	Inclination:	Direction:

EASTING:	See Site Plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Michael	
NORTHING:	See Site Plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	389 m	DIMENSIONS:		HOLE STARTED: 24-Sep-07	
METHOD:	Site Plan Contours	EXCAV. DATUM: Ground level		HOLE FINISHED: 24-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.1		Dark brown, organic SILT. Uniform. Soft.	Moist	TOPSOIL
		0.2				
		0.3				
		0.4		Reddish brown, gravelly SILT with some sand and cobbles. Clasts are sub-rounded to sub-angular. Cobbles up to 50mm. Poorly graded. Loose. Dips with slope.	Moist	COLLUVIUM
		0.5				
		0.6		Grey brown, sandy GRAVEL. Sand is fine to coarse, gravel is sub-rounded to sub-angular. Poorly graded. Dense.	Moist	ALLUVIAL DEPOSIT
	→	0.7				
		0.8		Grey brown with iron staining, sandy silty GRAVEL. Sand is fine to coarse. Poorly graded. Loose.	Wet	ALLUVIAL DEPOSIT
		0.9				
		1.0		Grey brown, sandy GRAVEL with boulders. Sand is fine to coarse, gravels are sub-rounded to sub-angular. Greywacke and black schist boulders to 400mm. Poorly graded (cemented). Medium dense.	Moist	GLACIAL OUTWASH
		1.1				
		1.2				
		1.3				
		1.4				
		1.5				
		1.6		Grey brown, silty SAND. Sand is fine to coarse. Uniform. Medium dense.	Moist	GLACIAL DEPOSIT

Log continued on next page

COMMENT:	Logged By: FAW/KGG
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 35**

PROJECT: Jacks Point, Henley Downs		Job Number: 880054
LOCATION: See Site Plan	Inclination:	Direction:

EASTING:	See Site Plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Michael	
NORTHING:	See Site Plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	389 m	DIMENSIONS:		HOLE STARTED: 24-Sep-07	
METHOD:	Site Plan Contours	EXCAV. DATUM: Ground level		HOLE FINISHED: 24-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	1.7		Grey brown, silty SAND. Sand is fine to coarse. Uniform. Medium dense.	Moist	GLACIAL DEPOSIT
		1.8		Grey brown, silty SAND with cobbles and boulders. Sand is fine to coarse, cobbles are sub-rounded to sub-angular. Boulders to 250mm. Poorly graded. Dense.	Moist	GLACIAL TILL
		1.9				
		2.0				
		2.1		Total Depth = 2 m		
		2.2				
		2.3				
		2.4				
		2.5				
		2.6				
		2.7				
		2.8				
		2.9				
		3.0				
		3.1				
		3.2				

COMMENT:	Logged By: FAW/KGG
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 36**

PROJECT: Jacks Point, Henley Downs		Job Number: 880054
LOCATION: See Site Plan	Inclination:	Direction:

EASTING:	See Site Plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Michael	
NORTHING:	See Site Plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	380 m	DIMENSIONS:		HOLE STARTED: 24-Sep-07	
METHOD:	Site Plan Contours	EXCAV. DATUM: Ground level		HOLE FINISHED: 24-Sep-07	

ENGINEERING DESCRIPTION						GEOLOGICAL
PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
		0.1		Dark brown, organic SILT. Uniform. Soft.	Moist	TOPSOIL
		0.2				
		0.3				
		0.4		Red brown, gravelly SILT with some sand and boulders. Greywacke clasts. Boulders up to 600mm long. Poorly graded. Loose. Dips with slope profile.	Moist	COLLUVIUM
		0.5				
		0.6				
		0.7				
		0.8		Grey brown, silty sandy GRAVEL. Sub-rounded to sub-angular quartz clasts. Poorly graded. Dense. Sub-horizontal.	Moist	GLACIAL OUTWASH
		0.9				
		1.0				
		1.1				
		1.2		Grey brown, sandy GRAVEL. Sand is fine to coarse, gravel is fine to coarse. Clasts are sub-angular, minor sub-rounded. Poorly graded. Dense. Sub-horizontal.	Moist	GLACIAL OUTWASH
		1.3				
		1.4				
		1.5				
		1.6				

Log continued on next page

COMMENT: No seepage	Logged By: FAW/KGG
	Checked Date:
PHOTO REF.:	Sheet: 1 of 2

TONKIN & TAYLOR LTD
EXCAVATION LOG

EXCAVATION NUMBER: **TP 36**

PROJECT: Jacks Point, Henley Downs		Job Number: 880054
LOCATION: See Site Plan	Inclination:	Direction:

EASTING:	See Site Plan mE	EQUIPMENT: 20T Excavator		OPERATOR: Michael	
NORTHING:	See Site Plan mN	INFOMAP NO.		COMPANY: Wilson's Contracting	
ELEVATION:	380 m	DIMENSIONS:		HOLE STARTED: 24-Sep-07	
METHOD:	Site Plan Contours	EXCAV. DATUM: Ground level		HOLE FINISHED: 24-Sep-07	

PENETRATION (SPT)	GROUNDWATER / SEEPAGE	DEPTH (m)	GRAPHIC LOG	ENGINEERING DESCRIPTION: SOIL / ROCK CLASSIFICATION, PLASTICITY OR PARTICLE SIZE CHARACTERISTICS, COLOUR, WEATHERING, SECONDARY AND MINOR COMPONENTS	WATER CONTENT	GEOLOGICAL: SOIL / ROCK TYPE, ORIGIN, MINERAL COMPOSITION, DEFECTS, STRUCTURE, FORMATION
	NO SEEPAGE	1.7 1.8 1.9 2.0 2.1 2.2 2.3 2.4 2.5 2.6 2.7 2.8 2.9		Grey brown, sandy GRAVEL. Sand is fine to coarse, gravel is fine to coarse. Clasts are sub-angular, minor sub-rounded. Poorly graded. Dense. Sub-horizontal.	Moist	GLACIAL OUTWASH
		3.0 3.1 3.2		Total Depth = 2.9 m		

COMMENT: No seepage	Logged By: FAW/KGG
	Checked Date:
PHOTO REF.:	Sheet: 2 of 2

Appendix C: Drill Hole Logs

TONKIN & TAYLOR LTD

DRILL HOLE LOG

DRILL HOLE No: BH 1
Hole Location:

SHEET 1 OF 2

PROJECT: JACKS POINT - HENLEY DOWNS | LOCATION: WOOLSHED ROAD, QUEENSTOWN | JOB No: 880054

CO-ORDINATES mN / mE
DIRECTION: N/A °
ANGLE FROM HORIZ.: 90°, vertical.

DRILL TYPE: UDR 650
DATUM: M.S.L.
R.L. GROUND: m
R.L. COLLAR: m

HOLE STARTED: 11/10/2007
HOLE FINISHED: 11/10/2007
DRILLED BY: McNEILL DRILLING
LOGGED BY: SCLOW CHECKED:

DESCRIPTION OF CORE

S.P.T - Logs.

GEOLOGICAL UNIT

ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);

ROCK WEATHERING: UW SW MW HW
ROCK STRENGTH: R4 R3 R2 R1 R0
PT LOAD / UCS TEST (MPa)
CORE LOSS / LIFT (%): 3 10 30 100
METHOD, CORE & CASING
TEST SYMBOL
DEPTH (m)
GRAPHIC LOG
DEFECT LOG
FRACTURE LOG spacing of natural fractures (cm): 50 10 5 1

SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS
DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING
ANGLES ARE NORMAL TO CORE AXIS
SPT LOGS

DATE / DEPTH
RQD (%)
WATER
DRILL WATER LOSS (%): 25 50 75

SPT RESULTS: 1 10 100

CORE BOX RL (m)

LAKE DEPOSITS

Core Run => 0.0 - 1.0m (0.1m loss)
dark brown organic SILT (0-0.3m) brown silty SAND (0.3-0.6m) pp = 50-150kPa
grey moist SAND (0.6-1.0) pp < 50kPa

Core Run => 1.0 - 2.0m (0.18m loss)
grey moist SAND, med-coarse, loose minor silt (1.0-1.6m) grading into sandy SILT, sl. plast., sl. dil., soft blue grey with minor clays

Core Run => 2.0-3.5m (no loss)
grey blue clayey SILT, soft sl. plast. wet, cohesive pp < 50kPa

Core Run => 3.5-5.0m (0.6m loss)
grey blue clayey SILT, extremly soft, pp = 0kPa wet, plastic, cohesive

Core Run => 5.0 - 6.5m (no loss)
grey clayey SILT, soft, wet, massive, plastic, cohesive
pp = 50-100kPa

Core Run => 6.5 - 8.0m (0.6m loss)
grey blue clayey SILT, soft-stiff, moist, plastic, cohesive. 6.5-7.8m
pp = 50-150kPa 6.5-7.5m
pp = 150kPa 7.5-8.0m
brown SAND lense 50mm @ 7.8m then laminated SILT + SAND to 8.0m

Core Run => 8.0m - 9.32m (no loss)
grey blue clayey SILT laminated <5mm plastic cohesive pp < 50kPa with silty SAND beds at 20mm intervals then grey blue silty SAND + SAND (fine) laminated, becoming most dense with occasional gravels, sl. plastic, fine gravels. from 8.8m. pp > 150kPa

Core ends 9.32m

GLACIAL TILL

HQ TT | SPT | HQ TT | SPT | HQ TT | SPT | HQ TT | SPT | HQ TT | SPT | HQ TT

core loss | core loss | core loss | core loss | no core

SPT@2.0m = grey blue clayey SILT, soft wet minor fine sands, sl. plast., sl. dil.,

SPT@3.5m = grey brown clayey SILT, soft, wet plastic, cohesive

SPT@5.0m = grey brown clayey SILT, soft wet plastic cohesive

SPT@6.5m = grey, clayey SILT, stiff, cohesive

SPT@8.0m = grey blue clayey, sandy SILT, sand = fine, sl. cohesive. wet.

Contact

SPT@9.3m = grey blue sandy SILT, occasional fine rounded gravels, cohesive, moist.

SPT@2.0m
n = 0
(dropped under hammer weight)

SPT@3.5m
n = 0
(dropped under hammer weight)

SPT@5.0m
(dropped under hammer weight)
n = 0

SPT@6.5m
(dropped under hammer weight)
n = 0

SPT@8.0m
n = 0
(dropped under hammer weight)

SPT@9.3m
4, 3, 2, 5, 15, 14
n = 36

PP = pocket penetrometer test

↑ S.P.T = Standard Penetration Test
HQTT = Core drilling.

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DRILL HOLE LOG

DRILL HOLE No: BH 1
Hole Location:

SHEET 2 OF 2

PROJECT: JACKS POINT - HENLEY DOWNS | LOCATION: WOOLSHER ROAD, QUEENSTOWN | JOB No:

CO-ORDINATES mN / mE
DIRECTION: N/A. °
ANGLE FROM HORIZ.: 90°, vertical

DRILL TYPE: UDR 650
DATUM: MSL
R.L. GROUND: m
R.L. COLLAR: m

HOLE STARTED: 11/10/2007
HOLE FINISHED: 11/10/2007
DRILLED BY: McNEILL DRILLING
LOGGED BY: SCWJ CHECKED:

DESCRIPTION OF CORE | S.P.T - Logs.

GEOLOGICAL UNIT	DESCRIPTION OF CORE	ROCK WEATHERING (UW SW MW HW)	ROCK STRENGTH (R4 R3 R2 R1 R0)	PT LOAD / UCS TEST (MPa)	CORE LOSS / LIFT (%) (3 10 30 100)	METHOD, CORE & CASING	TEST SYMBOL	DEPTH (m)	GRAPHIC LOG	DEFECT LOG	FRACTURE LOG spacing of natural fractures (cm) (50 10 5 1)	SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS; DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING; ANGLES ARE NORMAL TO CORE AXIS	DATE / DEPTH	RQD (%)	WATER	DRILL WATER LOSS (%) (25 50 75)	SPT RESULTS (1 10 100)	CORE BOX RL (m)
GLACIAL TILL	core ends 9.32m D.C. 9.32 - 10.5 = silty GRAVELS					HQTT				No Core		SPT @ 10.5m = grey silty SAND, not cohesive, wet.					SPT @ 10.5m n=50 for 50mm	
	D.C. 10.5 - 12.0m = Quartz boulder silty GRAVELS					HQTT		11		No Core								
	D.C. 12.0 - 13.5m = Sandy GRAVELS					SPT		12				SPT @ 12.0m = brown gravelly SAND with minor silt, loose, dry-moist.					SPT @ 12.0m 4S, 2Z, 1B n=50 for 120mm	
						HQTT		13		No Core								
	D.C. 13.5 - 15.0m = Sandy GRAVELS					SPT						SPT @ 13.5m = brown silty SAND, loose to mod. dense with some gravels sand = f-c gravel = f-m					SPT @ 13.5m 14, 36 n=50 for 150mm	
						HQTT		14		No Core								
	END OF DRILLHOLE @ 15.45m					SPT		15				SPT @ 15m = brown SAND, minor silts and f-m gravels, mod. dense, moist, non cohesive.					SPT @ 15m 16, 30, 4 n=50 for 150mm	
								16										
								17										
								18										
								19										

D.C. = Drillers comments

↑SPT = Standard Penetration Test
HQTT = Core drilling.

TONKIN & TAYLOR LTD

DRILL HOLE LOG

DRILL HOLE No: BH 2
Hole Location:

SHEET 1 OF 2

PROJECT: JACKS POINT - HENLEY DOWNS LOCATION: WOOLSHED ROAD, QUEENSTOWN JOB No: 880054

CO-ORDINATES mN
mE

DIRECTION: N/A °

ANGLE FROM HORIZ.: 90° vertical

DRILL TYPE: UDR 650

DATUM: M.S.L.

R.L. GROUND: m

R.L. COLLAR: m

HOLE STARTED: 10/10/07

HOLE FINISHED: 10/10/07

DRILLED BY: McNEILL DRILLING

LOGGED BY: SCOW CHECKED:

DESCRIPTION OF CORE

S.P.T - Logs.

GEOLOGICAL UNIT

ROCK OR SOIL TYPE, WEATHERING, HARDNESS, STRENGTH, COLOUR, LITHOLOGICAL FEATURES (bedding, cement, foliation, mineralogy, texture, etc...);

ROCK WEATHERING: UW SW MW HW

ROCK STRENGTH: R4 R3 R2 R1 R0

PT LOAD / UCS TEST (MPa)

CORE LOSS / LIFT (%): 3 10 30 100

METHOD, CORE & CASING

TEST SYMBOL

DEPTH (m)

GRAPHIC LOG

DEFECT LOG

FRACTURE LOG spacing of natural fractures (cm): 50 10 5 1

SIGNIFICANT JOINTS, BEDDING, CRUSHED AND SHEARED ZONES/SEAMS

DEFECT TYPE, SHAPE, ROUGHNESS, APERTURE, INFILLING, SPACING

ANGLES ARE NORMAL TO CORE AXIS

SPT LOGS

DATE / DEPTH

RQD (%)

WATER

DRILL WATER LOSS (%): 25 50 75

SPT RESULTS: 1 10 100

CORE BOX RL (m)

LAKE DEPOSITS

Core Run ⇒ 0.0-1.1m brown, organic SILT with clay, micaceous pp=150-250kPa 0.0-0.5m grey brown stiff SILT, dry micaceous pp 300-400kPa, (no core loss)

Core Run ⇒ 1.1-2.0m, mottled grey brown SILT with minor clays, stiff-v. stiff. pp 300-400kPa 1.1-1.5m pp=50-200kPa 1.5-2.0 with increasing moisture (0.2m core loss)

Core Run ⇒ 2.0-3.5m, grey blue clayey SILT, massive, soft-firm, moist pp<50kPa. (0.3m loss)

Core Run ⇒ 3.5-5.0m, grey brown clayey SILT, mottled/thinly bedded? but no change in g.size? micaceous, plastic moist pp<50kPa. (0.0m loss)

Core Run ⇒ 5.0-6.5m, grey clayey SILT, massive, plastic, soft-firm, moist-wet pp < 50kPa (0.3m loss)

Core Run ⇒ 6.5-8.0m, grey blue silty CLAY, thinly laminated (6.5-7.1m) grey silty SAND (7.1-8.0m) non plastic, non cohesive, pp<50kPa sand = f-m, minor silts + clays. (0.6m loss)

Core Run ⇒ 8.0-9.5m, alternating laminations of clayey SILT + silty SAND silt = plastic, cohesive, sand = non plast, non. cohesive pp<50kPa (0.9m loss)

Core Run ⇒ 9.5-10.0m, grey clayey SILT, occasional m-c rounded

HQTT SPT HQTT SPT HQTT SPT HQTT SPT HQTT SPT

core loss

SPT @ 2.0m - grey brown SILT with minor clay, moist

SPT @ 3.5m - grey clayey SILT, moist, stiff-v. stiff.

SPT @ 5.0m - grey blue clayey SILT, moist/wet, micaceous, firm-stiff.

SPT @ 6.5m - grey blue silty CLAY, very thinly laminated

SPT @ 8.0m - grey blue silty SAND, sand=f-c, moist, non plast, non cohesive.

SPT @ 9.5m - grey SILT, moist, sl. plastic, sl. cohesive

SPT @ 2.0m
n=0
(dropped under hammer weight)

n=0
SPT @ 3.5m
(dropped under hammer weight)

SPT @ 5.0m
1 1 1
n=3

SPT @ 6.5m
1 2 2 2
n=7

SPT @ 8.0m
3 3 5 3 2 3
n=13

SPT @ 9.5m
1 1 2 2 3 3
n=10

PP = pocket penetrometer test

↑ SPT = standard penetration test
HQTT = core drilling.