

REPORT

PIONEER PROPERTY TRUST
LIMITED

WESTERN ROAD, NGONGOTAHA

STAGE THREE GEOTECHNICAL
COMPLETION REPORT

Report prepared for:
PIONEER PROPERTY TRUST LIMITED

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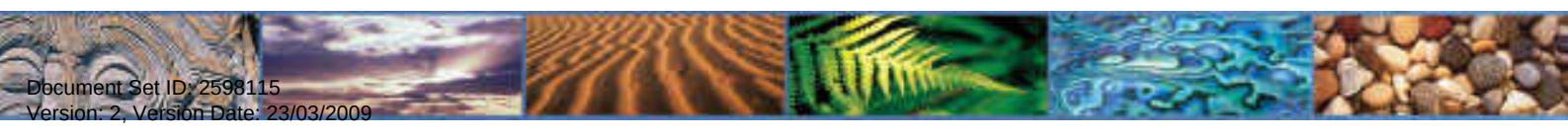


Table of Contents

1	Introduction	1
1.1	Background	1
1.2	Scope of this Report	1
2	Site Topography & Landform	2
2.1	Pre Subdivision Landform	2
2.2	Subdivision Modified Landform	2
3	Ground & Groundwater Conditions	3
3.1	Ground Conditions	3
3.2	Groundwater Conditions	3
4	Discussion of Results of Investigations	4
5	Land Stability	5
5.1	Introduction	5
5.1.1	Slope Geology	5
5.1.2	Geomorphology	5
5.2	Visual Assessment of Land Stability & Erosion	6
5.2.1	Land Stability	6
5.2.2	Erosion	6
5.3	Quantitative Slope Stability Assessment	6
5.3.1	Cross Section 1	7
5.3.2	Cross Section 2	7
5.4	Conclusions regarding Slope Stability	7
5.5	Conclusions regarding Erosion	8
6	Requirements for Building Development	9
6.1	General	9
6.2	Dwelling Foundations	9
6.2.1	Lots 24, 25, 26 and 63	9
6.2.2	Lots 27, 55, 56, 58 to 62:	9
6.2.3	Lots 28 to 30, 32 to 34, 43 to 47, 50 to 54 & 57	10
6.2.4	Additional Notes regarding Lots with Soft Ground	10
6.2.5	Lots 35 to 42, 48 and 49	11
6.2.6	Note regarding Lot 58	11
6.3	Groundwater Control	11
6.4	Building Restriction Lines & Construction on Sloping Sites (Lots 35, 36 and 38 to 42)	12
6.5	Erosion Control Measures for Lot 36	13
6.6	Silt Pond at Lots 35 and 36	13
6.7	Stockpiling of Material	13
6.8	Impact on Adjacent Areas	14
7	Conclusions	15
8	Applicability	16

Appendix A: Certification

Appendix B: Figures

Appendix C: Borehole Logs and Scala Penetration Test Results for Northern Slopes



1 Introduction

1.1 Background

This report deals with Stage Three of the property owned by Pioneer Property Trust Limited ('PPT') at Western Road, Ngongotaha. It comprises 39 residential sections plus two reserve areas (Lots 31 and 88). The layout of Stage Three, and the previously completed Stages One and Two of the subdivision, are shown on Figure 1 (see Appendix B). The legal description of the Stage Three area is Lot 96, DP 389915. It is proposed to complete development of a Stage Four area, located to the north, at some time in the future.

Subsequent to the completion of Stages One and Two, the presence of soft compressible silts at the site was brought to the attention of subdivision Engineers (MTEC Consultants Ltd) and Rotorua District Council. Tonkin & Taylor Ltd ('T&T') were engaged by PPT to assess the implications of the presence of the compressible silts for Stage Three and the lots on Stage Two which have not yet been built on. Details of the investigations and monitoring carried out and the conclusions of the assessment are presented in the 'Geotechnical Assessment Report' for the site, prepared by T&T, dated March 2009.

1.2 Scope of this Report

This report is intended to provide advice to the purchasers of lots located in Stage Three of the subdivision. For further detailed information relating to the presence of soft ground and high groundwater levels, it will be necessary to refer to the above referenced Geotechnical Assessment Report. A separate report, relating to the compaction of fill on Stage Three of the subdivision, has been prepared by the subdivision engineers and surveyors, MTEC Consultants Ltd ('MTEC'). The Earthworks Completion Report prepared by MTEC includes details of Scala Penetrometer Testing and other testing undertaken by them in the Stage Three area.

The lot titles should be referred to for any further restrictions and requirements.

2 Site Topography & Landform

2.1 Pre Subdivision Landform

Prior to the subdivision works, the landform in Stage Three consisted of low-lying ground to the south, which rises steeply to a lake terrace at the northern end.

2.2 Subdivision Modified Landform

Only minor modification of the landform has taken place in Stage Three. The extent of the modification is depicted on the Cut/Fill Plan presented as Figure 2. At the southern end, the ground has been cut down by up to a maximum of 1m. Fill has been placed on the western side of the site to a depth generally less than 0.5m, but up to 1m in places. Up to 2.5m of fill has been placed on Lot 88, which is to be a reserve area. A maximum depth of 1.5m of cutting has occurred at the north east corner of the site, at the base of the steep slopes. The as-built contours indicate that the majority of Stage Three varies in elevation from around 285.5 to 287.5m above Moturiki Datum (AMD), with the far northern lots rising steeply to in excess of 300m AMD.

The fill has been obtained principally from the elevated area located to the north of Stage Three (future Stage Four area), with a limited amount of imported material.

3 Ground & Groundwater Conditions

3.1 Ground Conditions

Detailed ground investigations and monitoring have been carried out by T&T to assess the soil and groundwater conditions at the site. The investigations relating to all stages of the subdivision are detailed in the Geotechnical Assessment Report. In addition, five Window Sample boreholes have been completed near the top of the steep slopes immediately to the north of Stage Three, in order to permit a detailed stability assessment. The results of these investigations are discussed in Section 5. The borehole logs are included in Appendix C.

The ground profile deduced from the investigations are shown on the Geological Cross Sections A and C, presented as Figures 3 and 4, respectively. The locations of the cross sections are indicated on Figure 1.

The general sequence of strata encountered comprises topsoil overlying up to approximately 1m of predominantly sandy fill, which rests on a variable depth of loose silty sands/sandy silts. These are, in turn, underlain by soft, organic, compressible silt horizon. Where this compressible horizon is present, the overall thickness of the fill and/or in situ silty sand/sandy silt ('cover') typically varies between 1 and 4m.

The thickness of the compressible materials (excluding any sand layers present) varies from non-existent in the northern area, where the ground elevation rises above the valley floor, to approximately 7.5m at the south-east corner, with an average thickness of around 3m. These are underlain by medium-dense to dense sands.

The very soft to soft, organic, compressible silt horizon is considered to be a mixture of shallow lake and river alluvium, deposited at a time when the lake level varied from its present elevation.

3.2 Groundwater Conditions

Groundwater levels recorded in the standpipes installed in the boreholes and Cone Penetration Test (CPT) holes during the winter period (July 2008) vary across the site, ranging from around 0.1m to in excess of 3m below ground level (285 to 287m AMD), but were typically less than 1m. This variation is partly controlled by the topography of the site, the depth to groundwater typically increasing in the higher northern sections of the site. There are, however, some areas where the elevation of the groundwater does not correlate with this general trend, which may suggest the presence of springs and/or surface water inputs from beyond the site perimeter.

Further details of the observed groundwater levels are included in the Geotechnical Assessment Report.

4 Discussion of Results of Investigations

Following the identification of potentially poor ground conditions in Stage Two, MTEC undertook a number of deeper investigations, including hand auger boreholes and CPT holes, in February and March 2008. These confirmed the presence of a thick soft compressible silt horizon within all stages of the subdivision, including the majority of Stage Three. As a result, further investigations, monitoring and assessment was subsequently undertaken by T&T, as the presence of the compressible silts was considered to have a number of potential detrimental effects on the future development of the subdivision, as follows:

- Possible damage to dwellings due to excessive total and/or differential settlement, caused by loading from the placed fill and future house construction;
- Possible damage to site infrastructure (including roads and buried services) resulting from ongoing settlement beneath the filled areas; and
- Possible effects of the soft subgrade on the long-term performance of the road pavements.

During the course of these additional works, the presence of high groundwater levels across much of the Stage Three area was confirmed. It was considered that the seasonal variation in groundwater levels could have a detrimental effect on the damp proofing of dwellings, the utility of garden areas and reduce the strength of the road pavement subgrade during prolonged wet periods.

The testing, monitoring and assessment undertaken to determine the potential impact of these issues is described in detail in the Geotechnical Assessment Report. This includes specific recommendations regarding the construction of future dwellings at the site (including Stages One, Two and Three). Those recommendations that relate to Stage Three are summarised in Section 6 of this report.

It is proposed to install a system of subsoil drains to limit the peak winter groundwater levels. Details of the proposed subsoil drainage system are shown on Figure 5 in Appendix B. The purpose of the subsoil system is to limit the impact of high winter groundwater levels on the future dwellings and their occupants. At the time of writing, the subsoil drainage works were being installed, with completion anticipated prior to winter 2009.

5 Land Stability

5.1 Introduction

Investigations have been undertaken to assess the stability of the slopes above and adjacent to Lots 35, 36 and 38 to 44. These investigations have comprised:

- Analysis of stereographic aerial photographs held by Rotorua District Council ('RDC');
- A site walkover survey with geological/geomorphologic mapping;
- Five window sample boreholes to 7m below ground level;
- Installation of four standpipes to monitor groundwater levels in the slope;
- Five Scala Penetrometer Tests; and
- Slope stability analysis.

The window sample boreholes and Scalas were carried out during 15 and 16 January 2009.

5.1.1 Slope Geology

Published geological data of the area suggests that the site is underlain by lake terrace and fan deposits, with more recent alluvial materials in the lower areas. These are likely to be interbedded with volcanic ash deposits. The window samples on the slope generally confirmed this geology.

The slopes themselves comprise a lake terrace which formed when Lake Rotorua was higher than its current elevation. The lake deposits generally comprise interbedded silts and fine sands with occasional gravel layers. A pumiceous gravel layer was observed in the window samples WS1, 2, 3 and 4. This is thought to be the Rotorua Ash, a volcanic lapilli (gravel) layer derived from the Lake Okataina area. This horizon was not observed in WS5, and may have been removed by the site earthworks operations. The Rotorua Ash is believed to have been deposited around 13,080±50 years ago (Froggatt and Lowe¹). Our interpretation of the slope geology is shown on cross sections 1 and 2 in Figure 7. The positions of the cross sections are indicated on Figure 6.

Standpipes were installed in WS1, 2, 3 and 5 to check for the presence of groundwater. The standpipes were installed to depths of between 5 and 7m below ground level. All of the standpipes were found to be dry six days after installation.

5.1.2 Geomorphology

The geomorphology of the site is shown on Figure 8. It is dominated by a lake terrace that is approximately 20 to 23m high. The slopes on this terrace are between 20° and 25° above Lots 40 and 41 and mostly 20° elsewhere. A large arcuate landform is present between Lots 36 to 44, which possibly represents a relic landslide feature. This feature, with others along the lake terrace, were most likely formed due to erosion and undercutting of the slope by the Ngongotaha Stream when it flowed along a more northerly course when the

¹ Froggatt, P.C. and Lowe, D.J. (1990) A review of late Quarternary silicic and some other tephra formations from New Zealand: their stratigraphy, nomenclature, distribution, volume and age. New Zealand Journal of Geology and Geophysics, v33, p89-109.

base level of the stream was higher than at present. These larger features are now considered to be inactive.

A number of smaller, shallow landslide features are present on the slopes above Lots 35 and 36 and 40 to 42. These are indicated on Figure 8.

Hummocky ground and two shallow landslide features are present to the northwest of Lots 35 and 36 beyond the western site boundary. The run out of the debris from these landslides does not appear to greatly affect the lots, but intersects the site part way along the boundary of Lot 35 and further north (see Figure 8).

Historic shallow landslide features are also present on the slope above Lots 40 to 42. Debris from these features forms lobes on the slope, but these do not appear to extend to the base of the slope.

Shallow erosion channels are present on Lot 36. These channels deepen upslope into Stage Four and have formed in sand and gravel deposits eroded by surface water run-off. These sand and gravel deposits have been exposed by earthworks. The material eroded from Stage Four has been deposited downslope, predominantly on Lots 36 and 38. Minor rilling was observed in some of the other lots at the northern end of Stage Three. This rilling is likely to be prevented by planting in association with development of the lots.

5.2 Visual Assessment of Land Stability & Erosion

5.2.1 Land Stability

The geomorphology of the site delineates one main, inactive feature and a number of shallow features. These shallow features may affect Lots 35 and 36 and 40 to 42. The slope above Lots 38 and 39 has been significantly unloaded due to earthworks in the area of Stage Four. Landsliding into Lots 38 and 39 is considered to have a low probability.

5.2.2 Erosion

Erosion of material from Stage Four and subsequent deposition of this material on the northern lots of Stage Three is a significant issue, particularly with regard to Lot 36. Shallow erosion channels are also present on Lot 36. The effects of this may be prevented by topsoiling and grassing of Stage Four. Installation of Enkamat or a similar geotextile beneath the topsoil could further reduce the amount of erosion in Stage Four. Runoff from Stage Four should also be directed into the reticulated stormwater system installed in Stage Three.

5.3 Quantitative Slope Stability Assessment

Quantitative slope stability analyses have been carried out using the ground conditions indicated on cross sections 1 and 2, using the software package Slope/W (Version 7.12), produced by Geoslope International Ltd. Slope stability is measured relative to a global factor of safety. A factor of safety less than 1.0 indicates that a slope is unstable. A factor of safety of 1.5 or greater is necessary to provide adequate assurance that a slope will remain stable during the design life of the structures associated with it (50 years). The following material parameters were adopted for the analyses:

A design seismic horizontal ground acceleration of 0.32g was used to simulate ground conditions under a 1 in 500 year earthquake. Possible ground displacements of the slope

caused by such an earthquake have been estimated following a method outlined by Ambraseys and Menu².

The analyses assumed that no significant loads would be placed on the slopes.

Stratum	Bulk Unit Weight (γ)	Cohesion (c')	Angle of Internal Friction (ϕ')
	(kN/m ³)	(kPa)	(°)
Silt	16	2	28
Sandy silt	16	1	30
Sand	16	0	32
Gravel	16	2	36

Table 5.1: Summary of material parameters used in stability analysis

5.3.1 Cross Section 1

Cross section 1 runs upslope from Lot 40. A factor of safety of 1.2 was achieved under static loading conditions. The critical slip surface was on the upper portion of the slope where the slope angle reaches 25°. The factor of safety reduces to below 1.0 during seismic loading. Calculations suggest that displacements of approximately 150mm may occur during a 1 in 500 year earthquake.

5.3.2 Cross Section 2

Cross section 2 runs to the northwest of Lot 36. A factor of safety in excess of 1.5 was indicated for this slope under static loading conditions. Under earthquake loading the factor of safety decreased to less than 1.0. Displacements on the slope of between 20 and 90mm may be expected during a 1 in 500 year earthquake.

5.4 Conclusions regarding Slope Stability

The slope stability analyses indicate that the slope above Lots 40 and 41 does not have an adequate factor of safety (>1.5). The factor of safety for the slopes above Lots 36, 40 and 41 reduces to less than 1.0 under seismic loading conditions. However, the geological evidence suggests that deep seated failure has not occurred on the slope for at least the last 13,000 years. The risk of deep-seated failure on the slopes at the northern end of Stage Three is considered to be low.

Geomorphic evidence indicates the presence of local shallow failures that may impact on development located on Lots 35, 36, 40, 41 and 42. Possible measures to mitigate the risks presented by such shallow failures are detailed in Section 6.4.

Significant earthworks in Stage Four of the development have unloaded the slope above Lots 38 and 39. The risk of landsliding affecting these lots is considered to be low.

² Ambraseys, N.N. and Menu, J.M. (1988) Earthquake Induced Ground Displacements. Earthquake Engineering and Structural Dynamics, v16, p985-1006.

5.5 Conclusions regarding Erosion

Erosion and subsequent deposition of eroded materials is a significant issue, especially with regards to the development of Lots 36 and 38. Sand and gravel exposed during earthworks in Stage Four are being eroded by surface water runoff. Shallow erosion channels have also formed on Lot 36. Erosion in Stage Four may be prevented by topsoiling and planting the exposed sand. Enkamat or similar erosion protection may be installed under the topsoil. In addition, the stormwater run-off from Stage Four should be directed to the reticulated stormwater system in Stage Four. A temporary bund may also be constructed along the boundary between Stages Three and Four.

6 Requirements for Building Development

6.1 General

A review of the site conditions, as detailed in the Geotechnical Assessment Report and in this document, has confirmed that a dwelling and/or other residential buildings can be constructed on each lot. Because of the geotechnical constraints at the site, it is recommended that each of residential lots should be subject to Specific Engineering Design of foundations, unless stated otherwise below. The designs should be undertaken by a Chartered Professional Engineer competent in the field of geotechnical engineering, with the qualifications MIPENZ, CPEng (Geotechnical), hereafter referred to as a geotechnical engineer, who will, with the aid of the information presented in the Geotechnical Assessment Report, the Earthworks Completion Report, and in this report, determine the extent of any additional investigations that may be required.

Recommendations for indicative foundation options are provided below. These should be considered as advisory, the detailed design shall be determined by the geotechnical engineer undertaking the Specific Engineering Design

A summary of the main requirements for each lot is included in Schedule A (see Appendix A). This report should be referred to for detailed requirements.

6.2 Dwelling Foundations

6.2.1 Lots 24, 25, 26 and 63

These lots are located in the south east corner of Stage Three and are underlain by up to 7.5m of soft, compressible silts and a variable depth of placed fill. Lot 25 has been included as it has fill on adjacent lots. This combination of thick compressible materials and loading from fill plus future houses dictates that there is a risk of significant future settlements.

If a conventional brick clad dwelling is proposed, pre-loading of the house site will be the preferred option. The required depth of the preload and the length of time that it should be in place can be determined with the assistance of the trial load monitoring information and the laboratory testing data presented in the Geotechnical Assessment Report.

The use of a cellular raft foundation (such as a 'Ribraft' manufactured by Firth Industries Ltd or similar) is recommended. The foundation will need to be specifically designed to enable the structure to withstand the effects of the anticipated settlements.

Other options may also be considered, such as the combination of lightweight construction and a cellular raft, without the need for a pre-load, replacement of the near-surface fill and/or in situ materials with a lightweight fill to achieve a limited or zero increase in net load with a cellular raft or alternatively, piled foundations. With all options the possible effects of post-construction settlements of the dwelling and the surrounding ground will need to be considered with regard to the minimum floor levels required for flood protection, the required minimum step between the floor level and the surrounding ground, and the possible effects on services entering the building.

6.2.2 Lots 27, 55, 56, 58 to 62:

These lots are in areas which are generally at-grade or have been cut by up to 1m and are underlain by up to approximately 6m of soft, compressible silts. The use of specifically

designed cellular raft foundations for conventional brick clad construction is likely to be acceptable on these lots. The raft foundation will need to be specifically designed to enable the structure to withstand the effects of the anticipated settlements. Due to the thickness of the compressible materials, the use of lightweight roofing and cladding materials may be considered to assist in limiting settlements.

Other options may also be considered, including the use of lightweight construction and a standard raft, replacement of the near-surface fill and/or in situ materials with a lightweight fill to achieve a limited or zero increase in net load with a standard raft or alternatively, piled foundations. Where cut has been carried out a fully-compensated foundation may be possible.

The possible effects of post-construction settlements on the dwelling and the surrounding ground will need to be addressed with regard to the minimum floor levels required for flood protection, the required minimum step between the floor level and the surrounding ground and the possible effects on services entering the building.

6.2.3 Lots 28 to 30, 32 to 34, 43 to 47, 50 to 54 & 57

These lots are in areas where up to 1m of fill has been placed at some locations, but is generally less than 0.5m thick. The lots are generally underlain by up to 3m of soft, compressible silts. The use of specifically designed cellular raft foundations for conventional brick clad construction is likely to be acceptable on these lots. The raft foundation will need to be specifically designed to enable the structure to withstand the effects of the anticipated settlements.

Other options may also be considered, including the use of lightweight construction and a standard raft, replacement of the near-surface fill and/or in situ materials with a lightweight fill to achieve a limited or zero increase in net load with a standard raft or alternatively, piled foundations.

Depending on the option chosen, specific review by a geotechnical engineer may show that only small changes to a NZS 3604:1999 type development may be possible on some of these lots.

With all options the possible effects of post-construction settlements of the dwelling and the surrounding ground will need to be addressed with regard to the minimum floor levels required for flood protection, the required minimum step between the floor level and the surrounding ground and the possible effects on services entering the building.

6.2.4 Additional Notes regarding Lots with Soft Ground

In undertaking the specific design of foundations for lots with soft ground, any settlement caused by existing fill or additional fill placement within or immediately surrounding the dwelling should be taken into account. Further placement of fill around the perimeter of buildings should be avoided where possible, but where necessary should be assessed by a geotechnical engineer as part of the Specific Engineering Design.

Design must take into account the existing ground elevations and potential magnitude of post-construction settlements, to ensure that the minimum required floor levels are maintained in the long term. The minimum 1% AEP (Annual Exceedance Probability) floor levels have been set in Schedule A (see Appendix A). These include a 50mm future settlement allowance. The geotechnical engineer shall determine if a greater settlement allowance is required.

The minimum step between floor level and external ground level, as indicated in NZS 3604:1999, shall be maintained in the long term.

6.2.5 Lots 35 to 42, 48 and 49

Our investigations in this area indicate very limited or no soft compressible silt materials at these lots. Specific Engineering Design is required on Lots 35, 37, 41, 42, 48 and 49. Following further investigations of the proposed house sites, it might be possible to adopt standard shallow foundations on these lots providing the near-surface fill or in situ materials have adequate bearing capacity, as assessed by a geotechnical engineer.

Specific Engineering Design of foundations is not required for Lots 36 and 38 to 40 for single storey houses conforming to NZS 3604:1999, if a stiffened or cellular raft, such as a 'Ribraft' or similar, is used. Due to the gradient of the building areas on these lots it may be necessary to construct a cut/fill platform, which may require Specific Engineering Design. Refer to Section 6.4 of this report for requirements regarding this and other issues relating to construction on lots with sloping ground.

6.2.6 Note regarding Lot 58

Part of Lot 58 has been utilised for a trial load area. A depth of around 1m of fill has been placed over an area of approximately 15m x 15m with resulting settlements of up to 35mm in five months. To limit the risk of unacceptable differential settlements resulting from any future building loads, any building to be constructed on this lot shall remain entirely within or completely outside of the footprint of the loaded area (see coordinates on Table 6.1 below). Alternatively, if a structure is designed which spans this area then the specific design of foundations shall take this effective 'preload' into account when determining the likely magnitude of differential settlements and design the foundations accordingly.

Position	Eastings	Northings
South East Corner	376797.575	764308.576
South West Corner	376782.805	764308.466
North West Corner	376783.193	764322.952
North East Corner	376797.063	764322.792

Table 6.1: Coordinates for trial load area at Lot 58. This is shown as area marked UH on DP 393131.

6.3 Groundwater Control

As outlined in Section 4, a subsoil drainage system has been proposed and is currently being installed within Stage Three, to depress the winter high groundwater levels. Measures which are to be installed at the time of construction, include:

- Enhanced Damp Proof Membrane (double layer);
- Capillary-break layer with perforated pipe connected into stormwater disposal system.

The proposed measures are those required by NZS 3604:1999 with the addition of the second DPM layer and a drainage connection for the capillary layer and are the minimum

required. These shall be detailed by the geotechnical engineer for each habitable building. Indicative details, where a raft foundation is to be adopted, are shown on Figure 10.

The lots to which this requirement applies are listed in Schedule A (see Appendix A).

The requirement for an enhanced DPM and a perforated pipe may be dispensed with for Lots 36 to 44, 48 and 49, upon application to the Building Consent Authority. This will be dictated by the location of the dwelling on the lot, the proposed form of foundation construction and elevation of the finished floor level.

6.4 Building Restriction Lines & Construction on Sloping Sites (Lots 35, 36 and 38 to 42)

Lots 35, 36 and 38 to 42: As outlined in Section 5 above, some areas of the steeper sloping ground at the northern end of Stage Three are considered to be potentially vulnerable to shallow slipping and erosion. To ensure that dwellings are constructed on stable ground, and to prevent excavation into the sloping topography, parts of Lots 36, 40, 41 and 42 have been designated as Building Restriction Areas. These are shown on Figure 9 of this report and as areas RA to RD on DP 393131. Any construction within the Building Restriction Areas shall be subject to Specific Engineering Design by a geotechnical engineer. To avoid surface erosion and subsequent deposition of materials forming the slope, the ground covered by the Building Restriction Areas shall not in any way be disturbed unless subject to Specific Engineering Design and should maintain a strong vegetative cover or appropriate alternative methods established to limit surface erosion to the satisfaction of the District Engineer.

To address the issue of potential damage to buildings from shallow seated slip material, debris interception fences or bunds shall be constructed on Lots 35, 40 and 41 and possibly on Lots 36 and 39, depending on the chosen building location. For Lots 40 and 41 the location of the debris fence or bund shall be determined by a geotechnical engineer once the proposed house location has been chosen. The debris fence or bund shall be located and configured to ensure that slip debris does not reach the proposed building and is not diverted onto adjacent lots. On Lots 35 and 36 there is potential for slip debris to enter the lots from the steep ground beyond the site boundary to the northwest. In the case of Lot 36, the necessity for a debris fence or bund will depend on the chosen building location and this will need to be determined by a geotechnical engineer prior to the Building Consent application. In the case of Lot 35, the debris fence or bund should extend from the northwest corner of the lot at least 10m along the western boundary and 10m along the northern boundary. A debris fence will be required at Lot 39 if it is proposed to construct a building within 10m of the northern boundary.

The debris fences or bunds shall be at least 1.5m high and shall be designed to resist an impact force of at least 20kN/m (unfactored), with a point of application 0.5 m above ground level.

All excavations shall be retained and all retaining walls are to be designed by a geotechnical engineer. To avoid potential instability, excavations within 10m of Building Restriction Lines shall not exceed 2m in height.

At Lot 41, the dwelling shall be proportioned to limit the height of excavations to 2m. Where more than one level of excavation is proposed, the excavations shall be at least 10m apart. This lot would suit a pole or stepped house style of construction.

As indicated in Section 6.2.5, Specific Engineering Design of foundations is not required on Lots 36 and 38 to 40 under certain circumstances. However, there is a cross fall in the building areas on these lots and the construction of a cut to fill platform may be required to form a level building area. No platform should be constructed prior to a Building Consent being issued. Before any fill is placed, a suitably qualified geotechnical specialist shall inspect the excavations to ensure that the topsoil has been removed and the ground has been appropriately benched.

The suitably qualified geotechnical specialist shall inspect/test the fill and natural ground and ensure that any loose soil is removed or compacted. The fill platform shall project at least 2.5m outside the building footprint and shall have a slope no steeper than 1 vertical to 2 horizontal.

All lots which have sloping ground or are adjacent to sloping areas are vulnerable to erosion from stormwater flows. Measures to avoid the effects of erosion, such as the use of stormwater deflection bunds or paved areas close to building foundations shall be used where necessary, and shall be detailed on the Building Consent drawings. These measures shall be assessed by the Local Authority as part of the Building Consent process.

6.5 Erosion Control Measures for Lot 36

Stormwater runoff from Stage Four has resulted in a number of erosion channels on Lot 36. No building shall be constructed on Lot 36 until the cause of the erosion has been effectively dealt with. The measures shall be specified by a geotechnical engineer who will supervise the work and certify that it has been correctly constructed.

6.6 Silt Pond at Lots 35 and 36

During the earthworks operations a temporary silt pond was established across the boundary of Lots 35 and 36. This has not yet been backfilled. No construction shall take place on these lots until the silt pond has been backfilled. The work shall be carried out under the direction of a geotechnical engineer, who will ensure that all of the collected silt is removed and that the fill is properly compacted. Once the work is complete the geotechnical engineer will be required to certify that the ground is suitable for construction.

6.7 Stockpiling of Material

This applies to all lots except Lots 36, 38, 39, 40 and 41. As detailed in the Geotechnical Assessment Report, the speed and magnitude of the immediate and primary consolidation settlements of the soft compressible silt horizon present beneath much of Stage Three, indicates that any uncontrolled loading of the ground could have a detrimental effect. Such uncontrolled loading could result from, for example, the temporary stockpiling of stripped topsoil, imported fill materials or concentrations of heavy construction materials.

If such loads were to be placed on or immediately adjacent to future building platforms they could increase the risk of differential settlements by effectively pre-loading part of the building platform. In addition, any loading placed on or immediately adjacent to underground services could result in settlements which have the potential to cause unacceptable deflections of the pipelines, with possible cracking or localised 'low spots'. The Stage Three sewer and stormwater reticulation have been designed and constructed

with minimal gradients and therefore even relatively limited deformations could have a significant impact and care will be required to ensure this does not occur on site.

No stockpiling of materials over 1m high and/or covering an area greater than 4m² shall be placed on or adjacent to proposed building footprints or existing underground services. Any stockpiles within the dimensions given above shall be at least 2m from any adjacent stockpiles. Any larger stockpiles shall be subject to assessment as part of the Specific Engineering Design of the foundations. The location, dimensions and duration of any stockpiles larger than the dimensions given above shall be provided to Rotorua District Council to record on the property files.

6.8 Impact on Adjacent Areas

Development of the Stage Three area of the subdivision, including construction of buildings (and debris fences where necessary) on individual lots, the installation of a subsoil drainage system and the potential effects of any ongoing settlement on the site infrastructure within Stage Three, will not have a detrimental impact on the surrounding environment, including Stages One and Two, so long as the recommendations detailed in this report and the Geotechnical Assessment Report are followed.

7 Conclusions

This report confirms that a residential building can be constructed on each residential lot in Stage Three of the subdivision, provided that the recommendations presented in this report are followed. Reference should be made to the conditions on the title of each lot, to the Earthworks Completion Report for Stage Three produced by MTEC and to the Geotechnical Assessment Report by T&T.

A Certificate 1B 'Statement of Professional Opinion as to Suitability of Land for Building Development' signed by a Chartered Professional Engineer is included in Appendix A of this report.

A summary of the main requirements for each lot is provided as Schedule A in Appendix A.

8 Applicability

This report has been prepared for the benefit of Pioneer Property Trust Limited 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.

TONKIN & TAYLOR LTD

Environmental and Engineering Consultants

Report prepared by:



Michael O'Brien / David Milner

Senior Geotechnical Engineering / Senior Engineering Geologist

Authorised for Tonkin & Taylor by:



David Bouma

Group Manager

Appendix A: Certification

- **Certificate 1B: Statement of Professional Opinion as to Suitability of Land for Building Development**
- **Schedule A: Summary Table of Individual Lot Requirements**

		1B
To:	The District Engineer	
	Rotorua District Council	
	Private Bag 3029	
	Rotorua Mail Centre	
	ROTORUA	
1B - STATEMENT OF PROFESSIONAL OPINION AS TO THE SUITABILITY OF LAND FOR BUILDING DEVELOPMENT		
Subdivision:	Stage Three - Western Road, Ngongotaha	
Owner/Developer:	Pioneer Property Trust	
Location:	Western Road, Ngongotaha, Rotorua	
I,	Michael O'Brien of Tonkin & Taylor Ltd, Level 1, 36 Grey Street, Tauranga 3140	
hereby confirm that:		
1.	I am a Chartered Professional Engineer experienced in the field of soils engineering and was retained by the owner/developer as the Soils Engineer on the above subdivision, relating specifically to settlement, slope stability and high groundwater level issues.	
2.	Construction observation and certification of fill has been carried out by others and is to be certified by them.	
3.	In my professional opinion, not to be construed as a guarantee, I certify that:	
a)	The completed works give due regard to land slope and foundation stability considerations.	
b)	The lots are suitable for the erection thereon of residential buildings, provided that:	
i)	All foundations are specifically designed by a Chartered Professional Engineer with qualifications MIPENZ CPEng (Geotechnical) unless it is not required by Tonkin & Taylor's Geotechnical Completion report dated March 2009.	
ii)	The recommendations contained in Tonkin & Taylor's Geotechnical Completion Report dated March 2009 are implemented in full.	
4.	This professional opinion is furnished to the Council and the owner/developer for their purposes alone on the express condition that it will not be relied upon by any other person and does not remove the necessity for the normal inspection of foundation conditions at the time of erection of any dwelling.	
Signed on behalf of Michael O'Brien by: David Bouma, Tonkin & Taylor Ltd Group Manager:		Date: 20/3/09
		

Western Road, Ngongotaha
Stage Three Geotechnical Assessment Report
Schedule A: Summary Table of Individual Lot Requirements

This table is provided as a summary of the main geotechnical requirements at each of the lots. It is based on the conclusions and recommendations contained in the "Stage Three Geotechnical Completion Report" prepared by Tonkin & Taylor Ltd (ref: 851126/Version 2.2, dated March 2009). **The full report must be referred to.** Where any apparent inconsistency between the report and this table occurs, then the report text shall prevail.

Lot Number	Minimum Finished Floor Level (above Moturiki Datum)	Cut/Fill undertaken at Lot as part of Subdivision Development		Summary of Ground Conditions relevant to Foundation Requirements						Requirement for Enhanced Damp proofing of Foundations	Building Restriction Lines & Construction on Sloping Sites	Requirements regarding stockpiling of material	Lots where Specific Engineering Design is NOT required if raft foundation is used. Certification of fill may be required.
		Fill	Cut	(Refer to Section 6.2.1)	(Refer to Section 6.2.2)	(Refer to Section 6.2.3)	(Refer to Section 6.2.4)	(Refer to Section 6.2.5)	(Refer to Sections 6.2.6)				
24	287.50	✓		✓			✓			✓		✓	
25	287.40	✓	✓	✓			✓			✓		✓	
26	287.30	✓	✓	✓			✓			✓		✓	
27	287.05	✓	✓		✓		✓			✓		✓	
28	286.95	✓	✓			✓	✓			✓		✓	
29	286.90	✓				✓	✓			✓		✓	
30	286.80	✓				✓	✓			✓		✓	
32	286.75	✓				✓	✓			✓		✓	
33	286.75	✓				✓	✓			✓		✓	
34	286.80	✓				✓	✓			✓		✓	
35	286.90	✓						✓		✓		✓	
36	287.20	✓						✓		✓	✓		✓
37	286.70	✓						✓		✓		✓	
38	288.60	✓	✓					✓		✓			✓
39	288.70		✓					✓		✓			✓
40	288.85		✓					✓		✓	✓		✓
41	288.20		✓					✓		✓	✓		
42	287.50		✓					✓		✓	✓	✓	
43	286.60		✓			✓	✓			✓		✓	
44	286.40	✓	✓			✓	✓			✓		✓	
45	286.40	✓	✓			✓	✓			✓		✓	
46	286.60	✓				✓	✓			✓		✓	

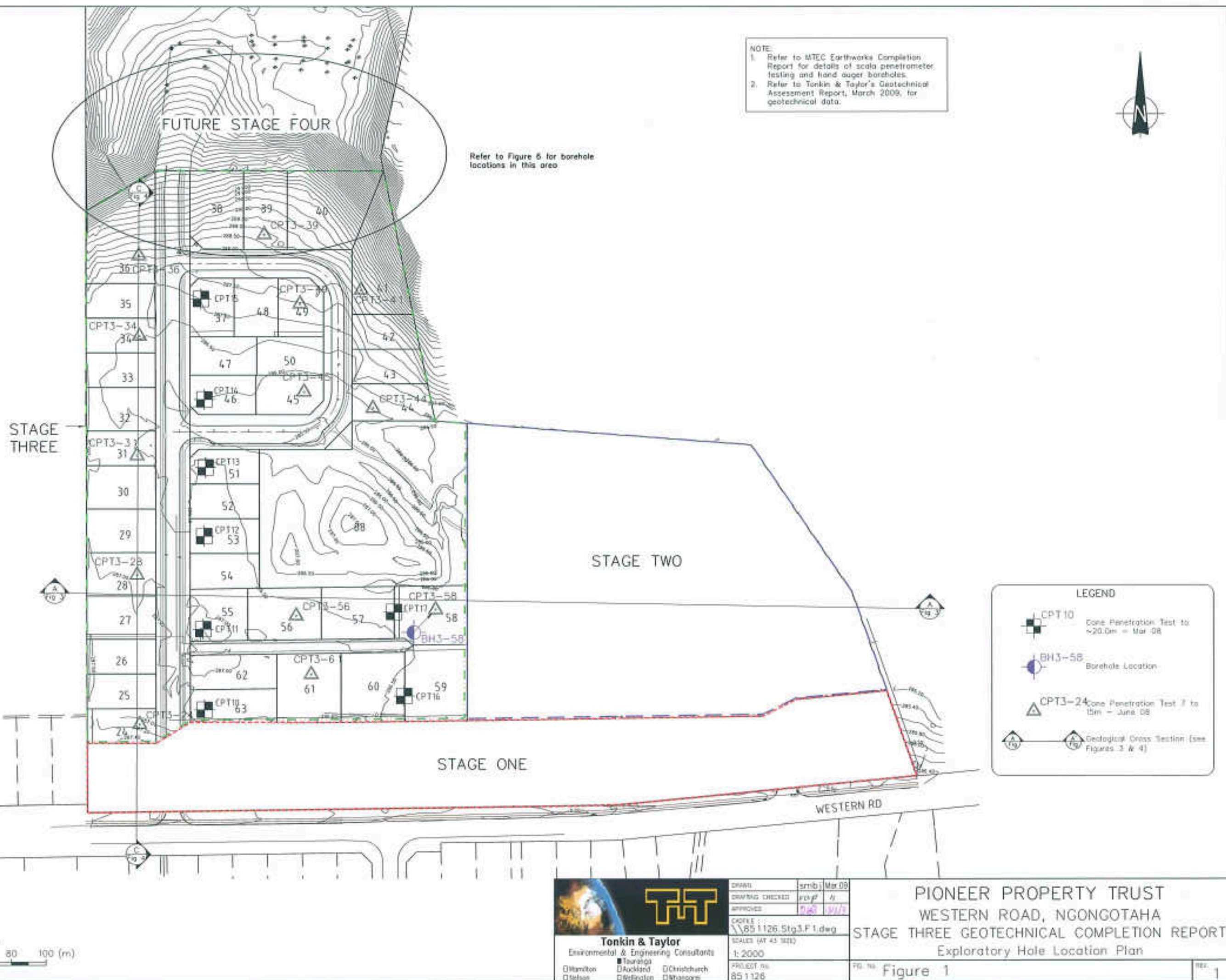
Western Road, Ngongotaha
Stage Three Geotechnical Assessment Report
Schedule A: Summary Table of Individual Lot Requirements

This table is provided as a summary of the main geotechnical requirements at each of the lots. It is based on the conclusions and recommendations contained in the "Stage Three Geotechnical Completion Report" prepared by Tonkin & Taylor Ltd (ref: 851126/Version 2.2, dated March 2009). **The full report must be referred to.** Where any apparent inconsistency between the report and this table occurs, then the report text shall prevail.

Lot Number	Minimum Finished Floor Level (above Moturiki Datum)	Cut/Fill undertaken at Lot as part of Subdivision Development		Summary of Ground Conditions relevant to Foundation Requirements						Requirement for Enhanced Damp proofing of Foundations	Building Restriction Lines & Construction on Sloping Sites	Requirements regarding stockpiling of material	Lots where Specific Engineering Design is NOT required if raft foundation is used. Certification of fill may be required.
		Fill	Cut	(Refer to Section 6.2.1)	(Refer to Section 6.2.2)	(Refer to Section 6.2.3)	(Refer to Section 6.2.4)	(Refer to Section 6.2.5)	(Refer to Sections 6.2.6)				
47	286.60	✓				✓	✓			✓		✓	
48	286.80	✓	✓					✓		✓		✓	
49	287.40	✓	✓					✓		✓		✓	
50	286.55	✓	✓			✓	✓			✓		✓	
51	286.60	✓				✓	✓			✓		✓	
52	286.60	✓				✓	✓			✓		✓	
53	286.70	✓				✓	✓			✓		✓	
54	286.70	✓				✓	✓			✓		✓	
55	286.70	✓	✓		✓		✓			✓		✓	
56	286.60	✓	✓		✓		✓			✓		✓	
57	286.45	✓	✓			✓	✓			✓		✓	
58	286.30	✓	✓		✓		✓		✓	✓		✓	
59	286.60		✓		✓		✓			✓		✓	
60	286.70		✓		✓		✓			✓		✓	
61	286.90		✓		✓		✓			✓		✓	
62	287.10		✓		✓		✓			✓		✓	
63	287.10	✓	✓	✓			✓			✓		✓	

Appendix B: Figures

- **Figure 1: Exploratory Hole Location Plan**
- **Figure 2: Cut / Fill Plan**
- **Figure 3: Cross Section A**
- **Figure 4: Cross Section C**
- **Figure 5: Proposed Subsoil Drainage Plan**
- **Figure 6: Ground Investigation Locations for Northern Slopes**
- **Figure 7: Geological Cross Sections of Northern Slopes**
- **Figure 8: Geomorphic Features of Northern Slopes**
- **Figure 9: Building Restriction Areas Northern Lots**
- **Figure 10: Indicative Foundation Design**





NOTE:
Cut and fill thickness are approximate.

STAGE 3

STAGE TWO

STAGE ONE

LEGEND

	>1.0m fill
	0.5m to 1.0m fill
	0m to 0.5m fill



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Dunedin Wellington Whangarei

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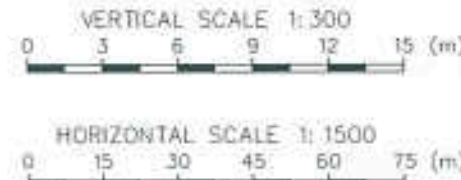
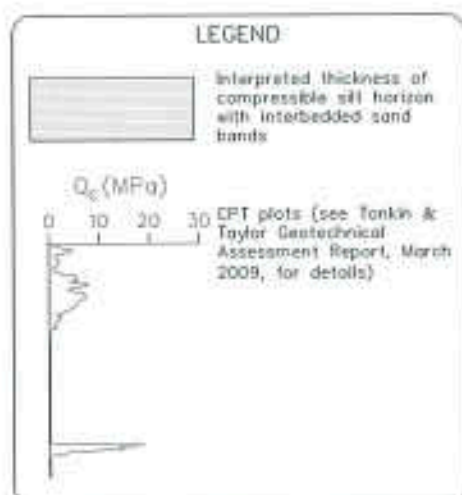
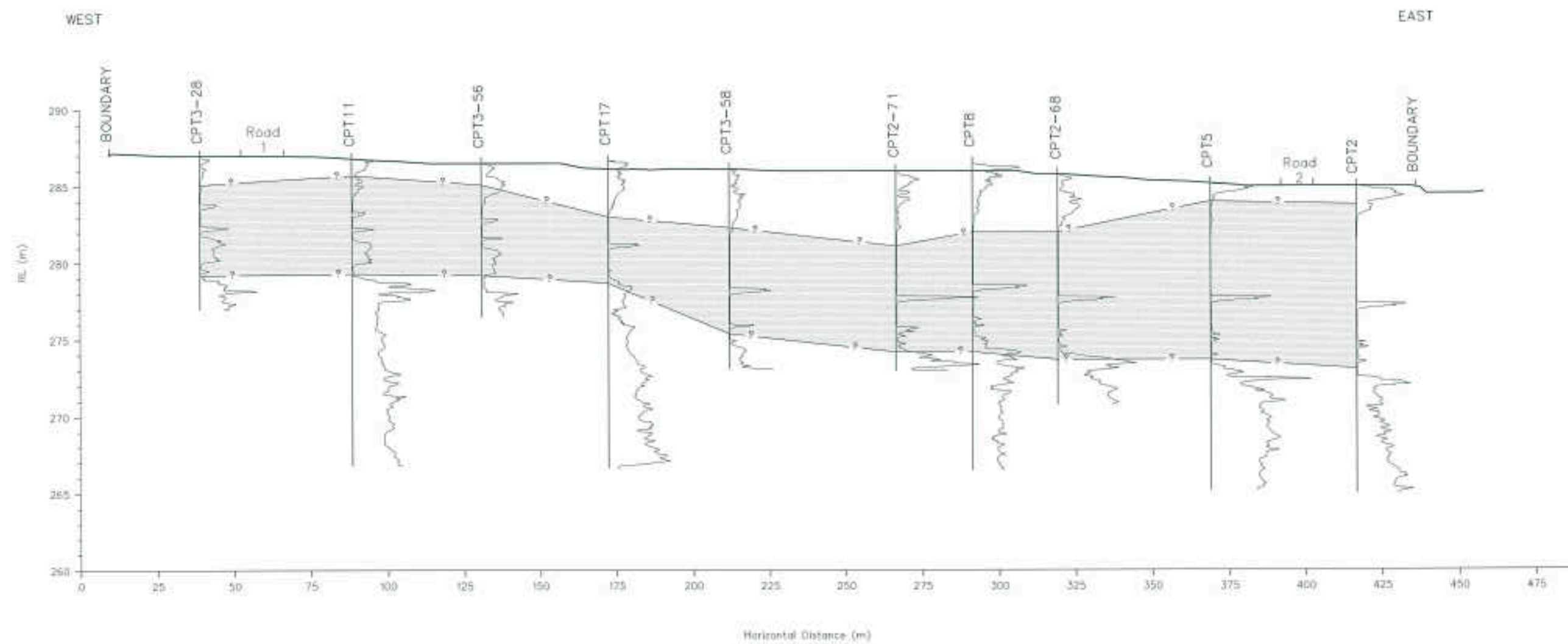
PIONEER PROPERTY TRUST
WESTERN ROAD, NGONGOTAHA
STAGE THREE GEOTECHNICAL COMPLETION REPORT
Cut/Fill Plan

FIG. No. Figure 2

Rev. 1

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- NOTES:
1. Note x5 vertical exaggeration.
 2. Interpreted thickness of compressible silt horizon is based on combination of factors, not purely on cone resistance as shown.
 3. Groundwater levels have been omitted.
 4. Note cross sections A and C drawn to equal scale.



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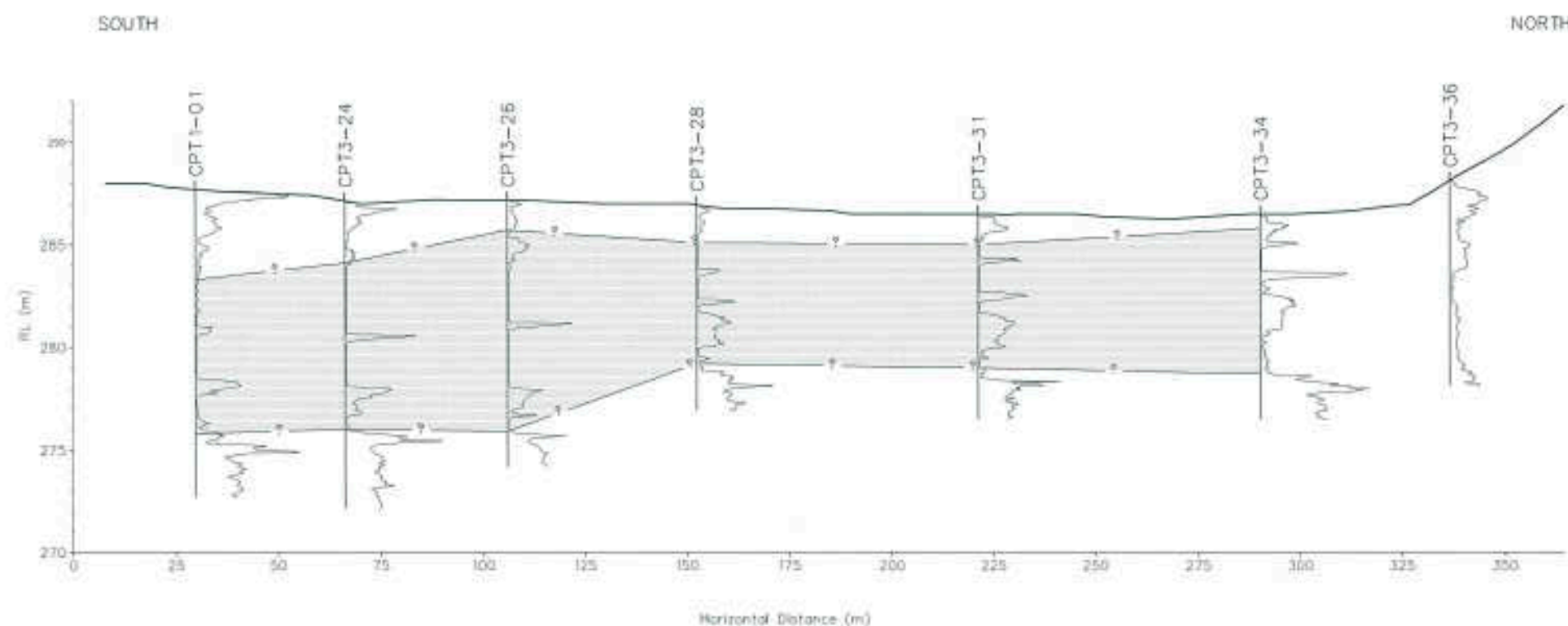
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WESTERN ROAD, NGONGOTAHA
STAGE THREE GEOTECHNICAL COMPLETION REPORT
Cross Section A

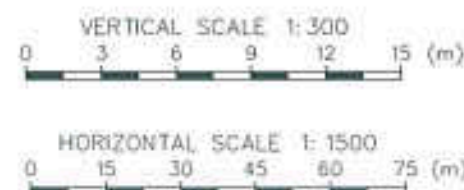
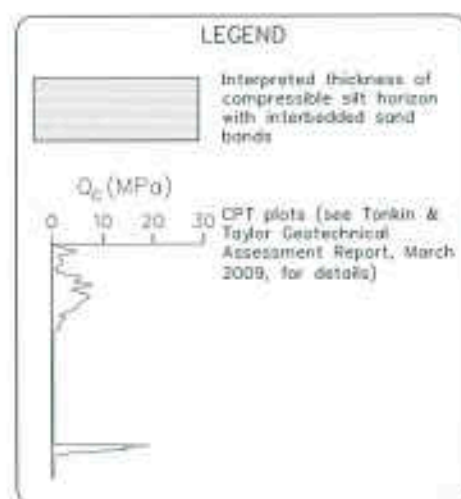
FIG. No. Figure 3

REV. 1

- NOTES:
1. Note x5 vertical exaggeration.
 2. Interpreted thickness of compressible silt horizon is based on combination of factors, not purely on cone resistance as shown.
 3. Groundwater levels have been omitted.
 4. Note cross sections A and C drawn to equal scale.



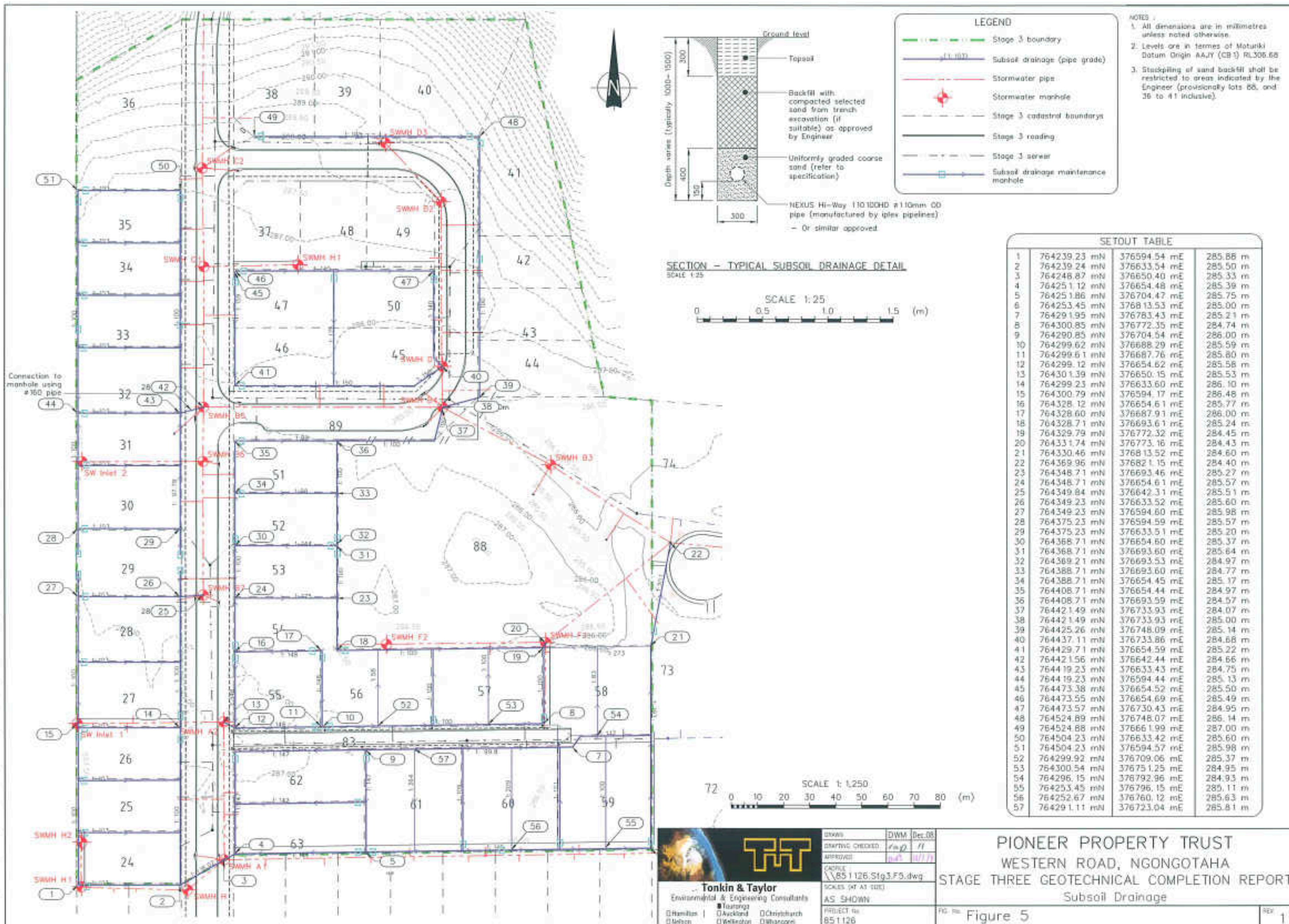
SECTION **C** CROSS SECTION
Fig 2



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WESTERN ROAD, NGONGOTAHA
STAGE THREE GEOTECHNICAL COMPLETION REPORT
Cross Section C

Figure 4





LEGEND

 WS1 Window sample position



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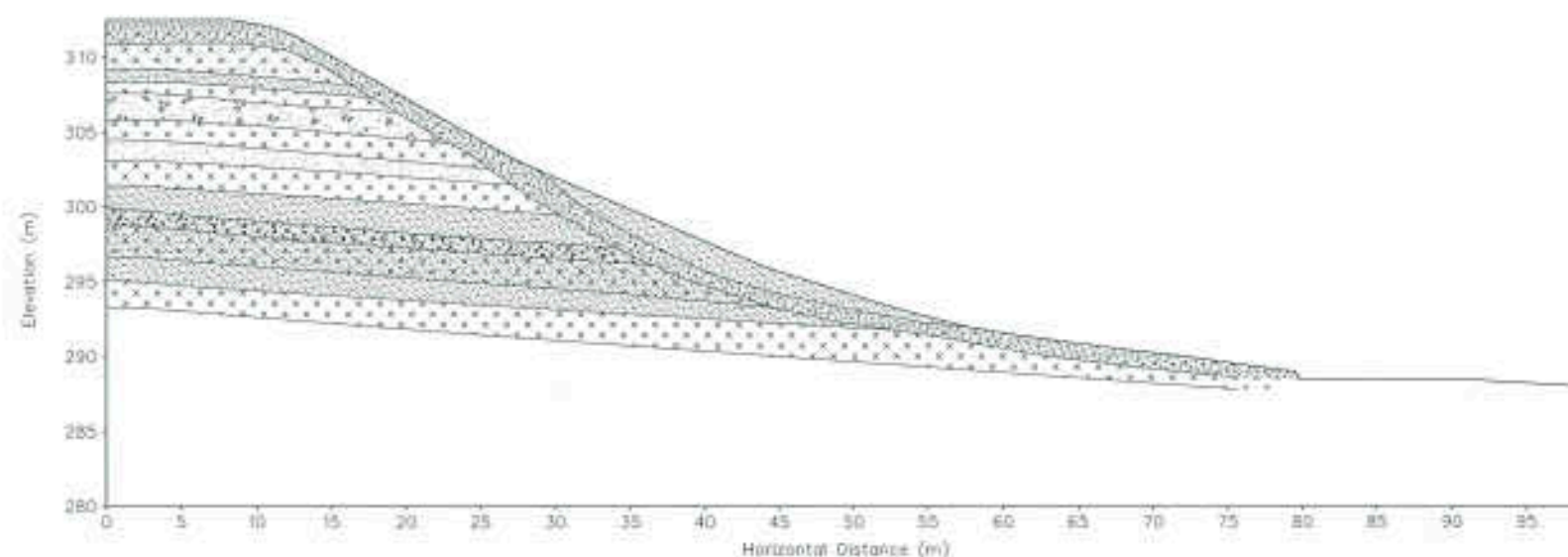
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STAGE THREE GEOTECHNICAL COMPLETION REPORT
Ground Investigation Locations at Northern Slopes

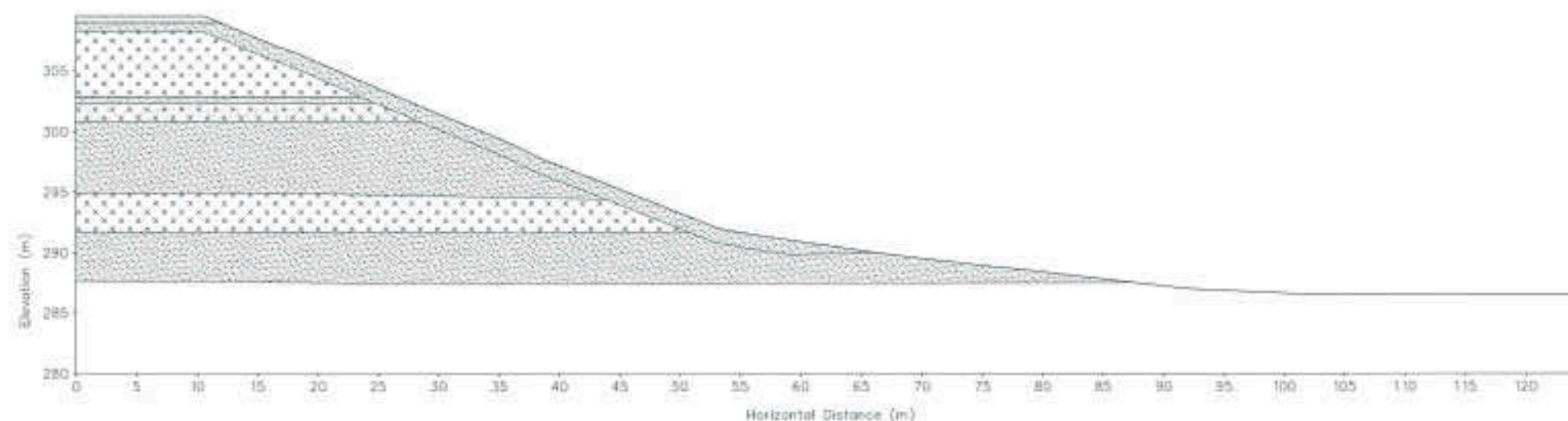
Rev. No. Figure 6

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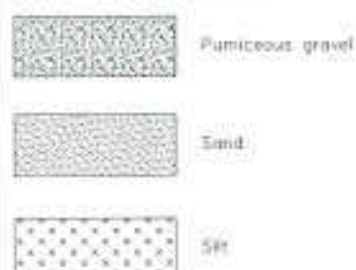


SECTION 1 GEOLOGICAL CROSS SECTION
SCALE 1:500



SECTION 2 GEOLOGICAL CROSS SECTION
SCALE 1:500

LEGEND



SCALE 1:500
0 5 10 15 20 25 (m)

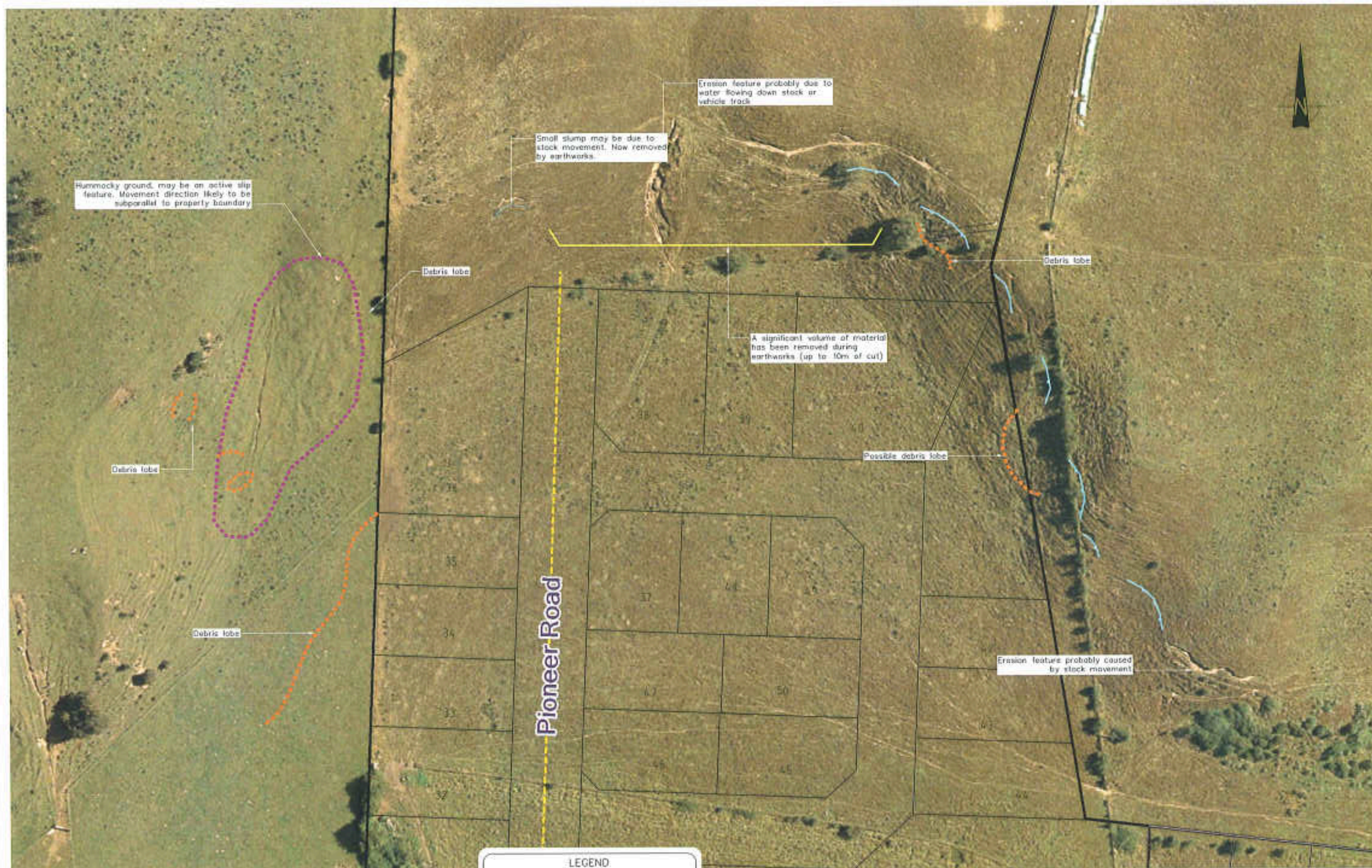


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WESTERN ROAD, NGONGOTAHA
STAGE THREE GEOTECHNICAL COMPLETION REPORT
Geological Cross Sections of Northern Slopes

FIG. No. Figure 7

REV. 1



NOTE:
Aerial image sourced from Terralink
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earthworks.

LEGEND

- Debris
- Hummocky ground
- Relic slips

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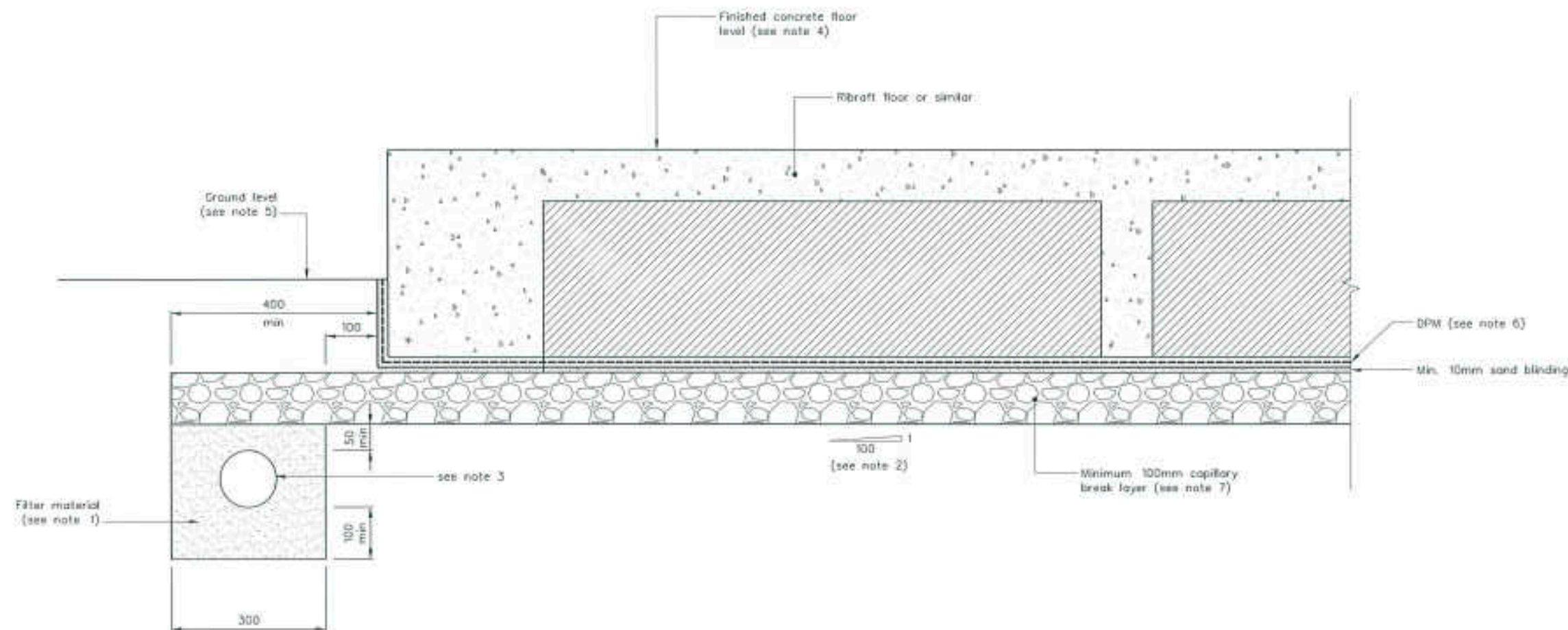
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WESTERN ROAD, NGONGOTAHA
STAGE THREE GEOTECHNICAL COMPLETION REPORT
Geomorphic Features of Northern Slopes

FIG. No. Figure 8

REV. 1

SCALE 1:1000

0 10 20 30 40 50 (m)



TYPICAL DETAIL: INDICATIVE FOUNDATION DESIGN

NOTES:

1. Drain filter material grading as indicated in Table 1.
2. Base of capillary-break layer to have a minimum fall of 1:100 towards drain from centre of foundation.
3. Capillary-break drain to extend around perimeter of building with a positive connection to stormwater system.
4. Finished concrete floor level shall be a minimum of 150mm above adjacent ground level or the minimum height given in Clause 7.5.2.1 of NZS3604:1999 (whichever is greater), dependent upon whether the ground is protected by permanent paving or not and the type of exterior wall covering. Due allowance to be made for anticipated post-construction settlements to ensure compliance with minimum dimensions required by NZS3604, in the long term.
5. A minimum fall of 1:25 to be provided for ground surface adjoining foundation for minimum 1m from the building or permanent paving with minimum 1:150 fall to 100mm wide concrete channel, in accordance with Clause 7.5.2.2 of NZS3604:1999. Allowance to be made for possible future settlement close to building.
6. DPM to generally comply with Clauses 7.5.4 to 7.5.7 of NZS3604:1999. Two layers of 0.25mm polythene to be used. Laps for each layer to be staggered. Laps to be taped.
7. Capillary-break material shall be well graded compacted hardfill with not more than 5% passing the 2.2mm sieve and 100% passing the 10mm sieve.
8. Foundation raft details are indicative only and shall be subject to specific engineering design.

Test Sieve Aperture (mm)	Percentage passing (%)
26.5	100
13.2	85-100
9.5	80-95
4.75	65-85
2.36	50-70
1.18	35-55
0.6	18-40
0.3	3-25
0.15	8 max
0.075	0

SCALE 1:100
0 1 2 3 4 5 (m)

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PIONEER PROPERTY TRUST
WESTERN ROAD, NGONGOTAHA
STAGE THREE GEOTECHNICAL COMPLETION REPORT
Indicative Foundation Design

FIG. No. Figure 10

REV. 1

Appendix C: Borehole Logs and Scala Penetration Test Results for Northern Slopes



Our Ref: 650229.001/1
Client Ref: 851126
29th January 2009
Page 1 of 3

Tonkin & Taylor Ltd
PO Box 317
TAURANGA
3140

Attention: David Milner

Dear David

SITE TEST REPORT SITE TESTING: WESTERN RD, NGONGOTAHA

Introduction

Geotechnics were requested to carry out a site investigation at the above mentioned site.

Date of Investigation

15th – 16th January 2009.

Test Location Procedure

Test locations were indicated on a location plan by the client.

Testing Locations

Please see Appendix 1.1 of this report for a location plan.

Samples

None taken.

Client's Instructions

We were instructed to –

- Drill and log 6 window sampled holes to 7m depth;
- Carry out shear vanes between 1m runs in cohesive material;
- Carry out Scalas next to the holes;
- Install a standpipe to the base of each hole;
- Take photographs of the material encountered; and
- Take samples of every different material encountered in the holes.

Specification

None issued

Test Methods

- Logging was done according to the New Zealand Geotechnical Society in 'Guidelines for the Field Description of Soils and Rocks in Engineering Use' 2005.
- NZS4402: 1986 Test 6.5.2 Dynamic Cone Penetrometer (Scala)
- NZGS – Test Method for determining the Vane Shear Strength of a Cohesive Soil using a Hand Held Shear Vane

Test Results

- Please see Appendix 1.2 of this report for bore logs.
- Please see Appendix 1.3 of this report for Scala results.
- Photographs are attached as Appendix 1.4.

Test Remarks

Due to time and budget constraints, Window Sampled holes were prioritised and WS6 was not carried out.

Material Descriptions

Material logging and descriptions follow those prescribed by the New Zealand Geotechnical Society in 'Guidelines for the Field Description of Soils and Rocks in Engineering Use' 2005.

The borehole logs represent our best assessment of the subsurface conditions, but due to the subjective nature of geological logging, we take no responsibility for any inaccuracies or mis-interpretations. Samples are retained for further reference.

General Remarks

The inherent uncertainties of site investigation work, mean the nature and continuity of subsoil away from the test location (borehole) could vary from the data logged.

We provide the logs for your interpretation and inference.

Descriptions are enclosed for your information, but do not form part of this report. This work is conducted under our standard terms and conditions outlined on the reverse of the letterhead page.

Please reproduce this report in full when transmitting to others or including in internal reports.

If we can be of any further assistance, feel free to call us on Phone 07 571 0280

Yours faithfully
GEOTECHNICS LTD



Paul Burton
LABORATORY MANAGER

Checked by:



Encl.:	Appendix 1.1	Location Plan
	Appendix 1.2	Borehole Logs
	Appendix 1.3	Scala Results
	Appendix 1.4	Photographs (CD)

29-Jan-09
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APPENDIX 1.1

LOCATION PLAN

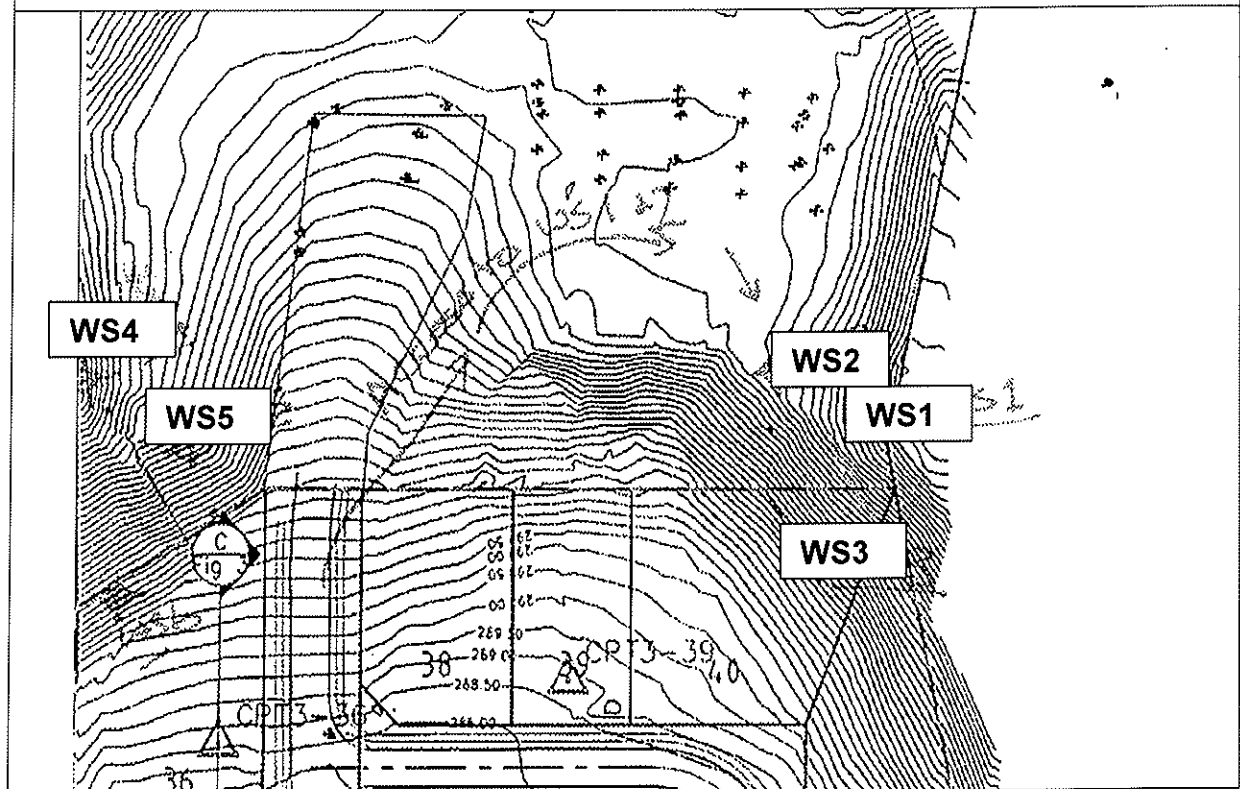
WESTERN RD, NGONGOTAHA
SITE REPORT
OUR REF: 650229.001/1



GEOTECHNICS

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LOCATION PLAN
(NTS)





APPENDIX 1.2

BOREHOLE LOGS

WESTERN RD, NGONGOTAHA
SITE REPORT
OUR REF: 650229.001/1



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BOREHOLE LOG

BOREHOLE No: WS1

Hole Location:

SHEET 1 OF 2

PROJECT: WESTERN RD, NGONGATAHA										LOCATION: ROTORUA										JOB No: 851126										
CO-ORDINATES										DRILL TYPE: 36mm Window Sample										HOLE STARTED: 15/01/09										
R.L.										DRILL METHOD: Percussion Coring										HOLE FINISHED: 15/01/09										
DATUM										DRILL FLUID: N/A										LOGGED BY: LRA/RWM CHECKED: <i>AB</i>										
GEOLOGICAL										ENGINEERING DESCRIPTION																				
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.										FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSION STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour.		ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.		
Topsoil																				ML	D	S					SILT with some fine rootlets, dark brown. Recovered as dry, soft, non-plastic, insensitive.			
Rotorua Ash/Tephra																	0.5		GSW	D	VL						Sandy, fine to medium pumice GRAVEL, yellow. Recovered as very loose, dry, well 0.5- graded. Sand is fine to coarse.			
															• 65/31kPa		1.0		MS	D-M	St						Sandy SILT, light brown. Stiff, dry to moist, non-plastic, moderately sensitive. Sand is fine, pumice.		1.0	
															• 116/45kPa		2.0			M	VSt						- 2m becomes moist		2.0	
															• 146/61kPa		3.0										- 2.7m becomes light greyish brown, slightly plastic, slightly sensitive - 2.9m sand becomes fine to medium		3.0	
																	3.5		SP	D D-M	D						Fine SAND, light greyish brown. Dense, dry, poorly graded. - 3.2m becomes light brown, dry to moist			
																			ML	M	VSt						- 3.5m becomes silty, minor sand		3.5	
															• 81/47kPa		4.0											SILT, greyish brown with orange-brown marbling. Very stiff, moist, slightly plastic, moderately sensitive.		4.0
																	4.5			MI	M-W	St						- 4.3m becomes dilatant, insensitive		
																			SP	M	VD						SILT, very light brown. Stiff, moist to wet, intermediately plastic, insensitive.		4.5	
																	5			MS	M-W	VSt						Fine SAND, light grey. Recovered as very dense, moist, poorly graded.		

BOREHOLE LOG

BOREHOLE No: WS1

Hole Location:

SHEET 2 OF 2

PROJECT: WESTERN RD, NGONGATAHA				LOCATION: ROTORUA				JOB No: 851126													
CO-ORDINATES mN mE				DRILL TYPE: 36mm Window Sample				HOLE STARTED: 15/01/09													
R.L. m				DRILL METHOD: Percussion Coring				HOLE FINISHED: 15/01/09													
DATUM				DRILL FLUID: N/A				DRILLED BY: LRA													
				LOGGED BY: LRA/RWM				CHECKED: <i>RS</i>													
GEOLOGICAL				ENGINEERING DESCRIPTION																	
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.				FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE / WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour.	ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
									• 110/50kPa			5.5		ML	M-W	VS					Sandy SILT, brown. Very stiff, moist to wet, non-plastic, insensitive, friable. Sand is fine to coarse, sub-rounded pumice.
												5.5		GMW	W	L					SILT, brownish white. Very stiff, moist to wet, slightly plastic, moderately sensitive.
												5.5		SGW	W	L					Silty, fine to medium pumice GRAVEL with some sand, brownish white with orange staining. Recovered as loose, wet, well graded, sub-angular slightly weathered.
												6.0		SM	W	MD					Fine to coarse SAND with some (trace medium to coarse) gravel, light greyish brown with black grains. Recovered as loose, wet, well graded, sub-angular.
												6.5		ML	W	S					Fine SAND, interbedded with SILT. Sand is grey, moist, medium dense, poorly graded. Silt is grey, soft, moist, intermediately plastic, slightly sensitive.
												7.0		ML	W	S					SILT, greyish/brownish white. Recovered as soft, wet, slightly plastic, moderately sensitive.
												7.0								End of borehole at 7m.	
												7.5									
												8.0									
												8.5									
												9.0									
												9.5									
												10									



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BOREHOLE LOG

BOREHOLE No: WS2

Hole Location:

SHEET 1 OF 2

PROJECT: WESTERN RD, NGONGATAHA			LOCATION: ROTORUA			JOB No: 851126															
CO-ORDINATES mN mE			DRILL TYPE: 36mm Window Sample			HOLE STARTED: 15/01/09															
R.L. m			DRILL METHOD: Percussion Coring			HOLE FINISHED: 15/01/09															
DATUM			DRILL FLUID: N/A			LOGGED BY: RWM															
CHECKED: AS																					
GEOLOGICAL			ENGINEERING DESCRIPTION																		
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.			FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION	WEATHERING CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSION STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour.	ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
Topsoil																					SILT with some rootlets, dark brown. Recovered as moist, non-plastic, insensitive.
Rotorua Ash																					Sandy, fine to medium pumice GRAVEL. Recovered as loose, dry to moist, well graded, sub-angular, moderately weathered. Sand is fine to coarse.
											0.5										- 0.8m becomes yellowish light brown, moist
											1.0										
											1.5										SILT with trace fine sand, light grey. Recovered as soft, moist to wet, slightly plastic, slightly sensitive.
											2.0										- 1.6m becomes sandy silt
											2.5										Sandy SILT. Recovered as very soft, wet, non-plastic, slightly sensitive.
											3.0										SILT, light brownish white. Recovered as soft, moist, intermediately plastic, slightly sensitive.
											3.5										- 2.1m with friable, highly weathered clast of orange-brown silt - 2.2m becomes yellowish - 2.4m becomes light grey
											4.0										Gravelly SILT, mottled/marbled grey. Recovered as moist, intermediately plastic, slightly sensitive. Gravel is fine to medium, soft, orange-brown, highly weathered clasts.
											4.5										Fine SAND, grey. Recovered as dense, moist, poorly graded. ("Chalky feel") - 3m becomes silty (slightly cohesive), some orange-brown staining
											5.0										SILT with trace sand, light brownish white. Recovered as very stiff, moist to wet, slightly plastic, moderately sensitive. ("Rubbery feel")
											5.5										Fine to medium pumice SAND with some silt, light pinkish/greyish brown. Medium dense, poorly graded.
											6.0										SILT, light brownish/orange white with some orange staining. Very stiff, moist, slightly plastic, moderately sensitive. - 4.7m thin band (0.05m) of gravelly, fine to coarse SAND with silt, dark brown

Log Scale 1:25

Document Set ID: 2598115

Version: 2, Version Date: 23/03/2009

BORELOG BOREHOLES.GPJ 29/01/09



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BOREHOLE LOG

BOREHOLE No: WS2

Hole Location:

SHEET 2 OF 2

PROJECT: WESTERN RD, NGONGATAHA				LOCATION: ROTORUA				JOB No: 851126														
CO-ORDINATES mN mE				DRILL TYPE: 36mm Window Sample				HOLE STARTED: 15/01/09														
R.L. m				DRILL METHOD: Percussion Coring				HOLE FINISHED: 15/01/09														
DATUM				DRILL FLUID: N/A				LOGGED BY: RWM CHECKED: <i>RS</i>														
GEOLOGICAL				ENGINEERING DESCRIPTION																		
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.				FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour.	
																					ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.	
									• UTP				X X X	M	M-W	H						moist. Gravel is fine, highly weathered, sub-angular. - 4.75m becomes wet - 5m becomes hard, moist to wet, non-plastic, insensitive, friable
											5.5			SP	M	D-VD						Very fine SAND, light brownish white with some orange staining. Recovered as dense 5.5 to very dense, moist, poorly graded. ("Chalky feel")
											6.0											- 6m becomes white
											6.5				D-M							- 6.5m becomes dry to moist
											7.0											End of borehole at 7m.
											7.5											
											8.0											
											8.5											
											9.0											
											9.5											
											10											

Log Scale 1:25

BORELOG BOREHOLES.GPJ 29/01/09



GEOTECHNICS LTD

BOREHOLE LOG

BOREHOLE No: WS3

Hole Location:

SHEET 1 OF 2

PROJECT: WESTERN RD, NGONGATAHA			LOCATION: ROTORUA			JOB No: 851126											
CO-ORDINATES mN mE			DRILL TYPE: 36mm Window Sample			HOLE STARTED: 16/01/09											
R.L. m			DRILL METHOD: Percussion Coring			HOLE FINISHED: 16/01/09											
DATUM			DRILL FLUID: N/A			LOGGED BY: AJM CHECKED: <i>AS</i>											
GEOLOGICAL		ENGINEERING DESCRIPTION															
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION	WEATHERING STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
Topsoil											SW	M	L				TOPSOIL.
Possible Fill?									0.5								Fine to coarse pumice SAND, orange-yellow. Recovered as loose, moist, well graded.
									1.0		SP	M	MD				Medium to coarse (some fine) pumice SAND, orange-brown. Recovered as medium dense, moist, poorly graded.
									1.5								
									2.0		SP	M	L				Medium to coarse (trace fine) pumice SAND, orange-brown. Recovered as loose, moist, poorly graded.
Rotorua Ash/Possibly re-worked.									2.5		GSW	M-W	L-MD				Sandy, fine to medium pumice GRAVEL, light orange-yellow. Recovered as loose to medium dense, moist to wet, sub-angular to sub-rounded. Sand is medium to coarse (trace fine).
									3.0		SMP	W	MD				Silty, fine to medium SAND, light greyish brown. Recovered as medium dense to dense, wet, poorly graded. Silt is slightly plastic, slightly sensitive.
									3.5								
									4.0								- 3.8m with more silt
									4.5		MSL	W	VSt				Sandy SILT. Very stiff, wet, non-plastic, moderately sensitive.
									5.0		SP						- 4.8m layer (1cm) cemented layer (possible iron staining)

Log Scale 1:25

BORELOG BOREHOLES.GPJ 29/01/09



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BOREHOLE LOG

BOREHOLE No: WS4

Hole Location:

SHEET 1 OF 2

PROJECT: WESTERN RD, NGONGATAHA			LOCATION: ROTORUA			JOB No: 851126														
CO-ORDINATES mN mE			DRILL TYPE: 36mm Window Sample			HOLE STARTED: 16/01/09														
R.L. m			DRILL METHOD: Percussion Coring			HOLE FINISHED: 16/01/09														
DATUM			DRILL FLUID: N/A			LOGGED BY: LRA														
						CHECKED: <i>AS</i>														
GEOLOGICAL			ENGINEERING DESCRIPTION																	
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.			FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION	WEATHERING STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.	
Possible Fill?													MS	D-M	F					SILT with trace sand, yellowish brown. Recovered as firm, dry to moist, non-plastic, insensitive.
											0.5									
											1.0		SGW	D-M	VL					Fine to coarse pumice SAND with some gravel, light yellowish brown. Recovered as very loose, dry to moist, well graded. Gravel is fine, sub-rounded to sub-angular.
											1.5			M	MD					- 1m gravel becomes fine to medium, becomes medium dense, moist
											2.0		GW	D-M	L					Fine to coarse pumice GRAVEL, light yellowish brown. Recovered as loose, dry to moist, well graded. - 1.8m trace silt
											2.5		MSL	M	F					SILT with trace fine sand, light greyish brown. Recovered as firm, moist, slightly plastic, insensitive.
											3.0									
											3.5			M	F-S					- 3.3m becomes firm to soft
											4.0		MSL	M	F					SILT with some fine sand, light orange-brown/white. Firm, moist, slightly plastic, moderately sensitive.
											4.5		S	M	MD					Silty, fine pumice SAND, grey. Recovered as medium dense, moist.
											5.0		MI	M	F					SILT, light grey with purple streaks. Stiff, moist, intermediately plastic, moderately sensitive.
											5.5		S		MD					Fine pumice SAND, light yellow. Recovered as medium dense, moist.
											6.0		ML	M	VSt					SILT, light greyish white. Recovered as very stiff, moist, non-plastic, moderately sensitive.
											6.5									- 4.4m some orange staining
											7.0			M-W						- 4.6m becomes moist to wet, intermediately plastic
											7.5									- 4.9m becomes orange-brown

Log Scale 1:25

BORELOG BOREHOLES.GPJ 29/01/09

PROJECT: WESTERN RD, NGONGATAHA										LOCATION: ROTORUA										JOB No: 851126									
CO-ORDINATES mN mE										DRILL TYPE: 36mm Window Sample										HOLE STARTED: 16/01/09									
R.L. m										DRILL METHOD: Percussion Coring										HOLE FINISHED: 16/01/09									
DATUM										DRILL FLUID: N/A										DRILLED BY: LRA									
										LOGGED BY: LRA										CHECKED: <i>AB</i>									
GEOLOGICAL										ENGINEERING DESCRIPTION																			
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.										FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.		
															• 120/32kPa														



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BOREHOLE LOG

BOREHOLE No: WS5

Hole Location:

SHEET 1 OF 2

PROJECT: WESTERN RD, NGONGATAHA			LOCATION: ROTORUA			JOB No: 851126													
CO-ORDINATES mN mE			DRILL TYPE: 36mm Window Sampling			BOREHOLE STARTED: 16/01/09													
R.L. m			DRILL METHOD: Percussion Coring			BOREHOLE FINISHED: 16/01/09													
DATUM			DRILL FLUID: N/A			DRILLED BY: LRA													
						LOGGED BY: AJM													
						CHECKED: <i>AB</i>													
GEOLOGICAL			ENGINEERING DESCRIPTION																
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.			FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE / WEATHERING CONDITION	STRENGTH DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	COMPRESSION STRENGTH (MPa)	DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
Topsoil																			TOPSOIL
											0.5		MSI	M	F				SILT with trace sand, light yellowish brown. Recovered as firm, moist, intermediately plastic, slightly sensitive. Sand is fine to coarse, well graded.
								• 90/14kPa			1.0		MSI	D-M	St				SILT with sand lenses, white with orange lenses and streaking. Stiff, dry to moist, non-plastic, sensitive. Sand is fine to coarse, well graded.
								• 110/44kPa			2.0		SP	M	VD				Fine SAND, light grey with occasional black and brown specks. Recovered as very dense, moist, poorly graded. Silt lense (2cm thick) at 2.2m. ("Chalky feel")
											2.5								
											3.0		SP	M	D				Fine SAND, light yellow with occasional black and brown staining. Recovered as dense, moist, poorly graded.
											3.5								
											4.0								
											4.5								- 4.5m becomes white
											5.0								

Log Scale 1:25

BORELOG BOREHOLES.GPJ 29/01/09



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BOREHOLE LOG

BOREHOLE No: WS5

Hole Location:

SHEET 2 OF 2

PROJECT: WESTERN RD, NGONGATAHA				LOCATION: ROTORUA				JOB No: 851126													
CO-ORDINATES mN mE				DRILL TYPE: 36mm Window Sampling				HOLE STARTED: 16/01/09													
R.L. m				DRILL METHOD: Percussion Coring				HOLE FINISHED: 16/01/09													
DATUM				DRILL FLUID: N/A				LOGGED BY: AJM CHECKED: <i>AB</i>													
GEOLOGICAL				ENGINEERING DESCRIPTION																	
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)		COMPRESSIVE STRENGTH (MPa)		DEFECT SPACING (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour.	
															100	200	500	1000			2000
									5.5		SP	M		D							
									6.0		SP			D-VD							Fine to medium SAND interbedded with some coarse sand (5-7cm layers). Recovered as dense to very dense, poorly graded.
									6.5												
									7.0												End of borehole at 7m.
									7.5												
									8.0												
									8.5												
									9.0												
									9.5												
									10												



APPENDIX 1.3

SCALA TEST RESULTS

WESTERN RD, NGONGOTAHA

SITE REPORT

OUR REF: 650229.001/1



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Tauranga Laboratory

56 10th Ave Tauranga

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LAB. REF.:

166/09

FILE:

650229.001

Sheet of

Dynamic Cone Penetrometer (Scala) -NZS 4402:1986 Test 6.5.2

Site: WESTERN RD, NGONGATAHA

Job Name : TONTNGONGATAHASITE

Job no: -

Test pit/BH no:

WS2

Location: ROTORUA

Depth: 3m

Material: -

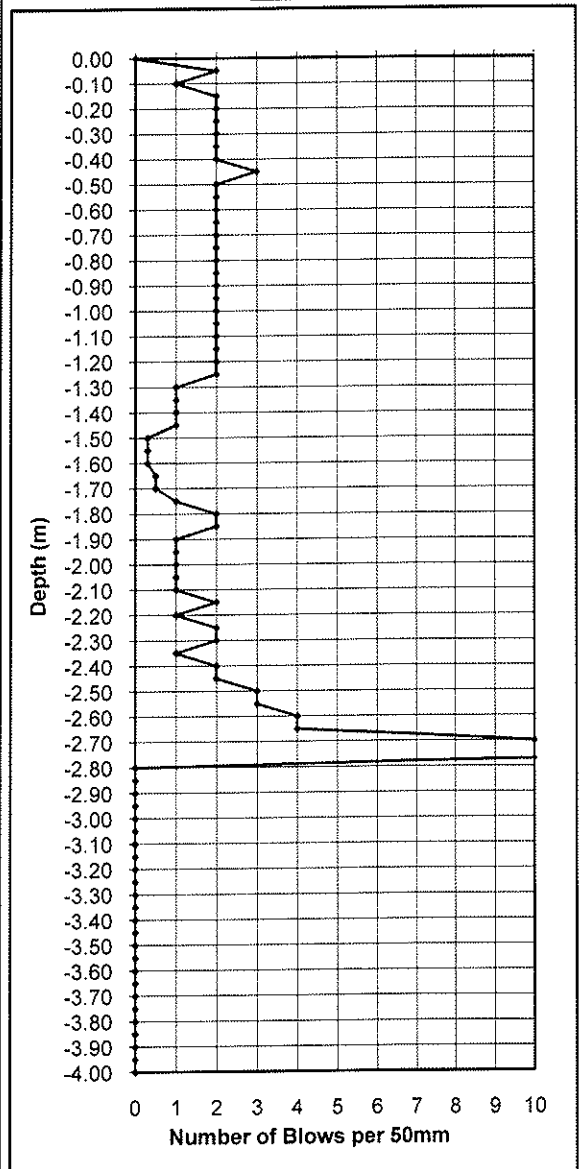
Penetrometer ID: TGO851

Test / Sample Series: NGONGO/160109/SC

New Test Site / Re Test of Site Lab Ref: WS2

Vertical distance driven (mm)	Depth (mm)	No. of Blows	Vertical distance driven (mm)	Depth (mm)	No. of Blows
50	50	2	2050	2050	1
100	100	1	2100	2100	1
150	150	2	2150	2150	2
200	200	2	2200	2200	1
250	250	2	2250	2250	2
300	300	2	2300	2300	2
350	350	2	2350	2350	1
400	400	2	2400	2400	2
450	450	3	2450	2450	2
500	500	2	2500	2500	3
550	550	2	2550	2550	3
600	600	2	2600	2600	4
650	650	2	2650	2650	4
700	700	2	2700	2700	10
750	750	2	2750	2750	17
800	800	2	2800	2800	
850	850	2	2850	2850	
900	900	2	2900	2900	
950	950	2	2950	2950	
1000	1000	2	3000	3000	
1050	1050	2	3050	3050	
1100	1100	2	3100	3100	
1150	1150	2	3150	3150	
1200	1200	2	3200	3200	
1250	1250	2	3250	3250	
1300	1300	1	3300	3300	
1350	1350	1	3350	3350	
1400	1400	1	3400	3400	
1450	1450	1	3450	3450	
1500	1500	0.3	3500	3500	
1550	1550	0.3	3550	3550	
1600	1600	0.3	3600	3600	
1650	1650	0.5	3650	3650	
1700	1700	0.5	3700	3700	
1750	1750	1	3750	3750	
1800	1800	2	3800	3800	
1850	1850	2	3850	3850	
1900	1900	1	3900	3900	
1950	1950	1	3950	3950	
2000	2000	1	4000	4000	

Depth from ground surface to commencement of penetration: 0 (m)



Tested: LRA Date: 15/01/2009

Calculated: EEK Date: 20/01/2009

Checked: PB Date: 29-1-09

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LAB. REF.:

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Sheet of

Dynamic Cone Penetrometer (Scala) -NZS 4402:1986 Test 6.5.2

Site: WESTERN RD, NGONGATAHA

Job Name : TONTNGONGATAHASITE

Job no: -

Test pit/BH no: WS3

Location: ROTORUA

Depth: 3m

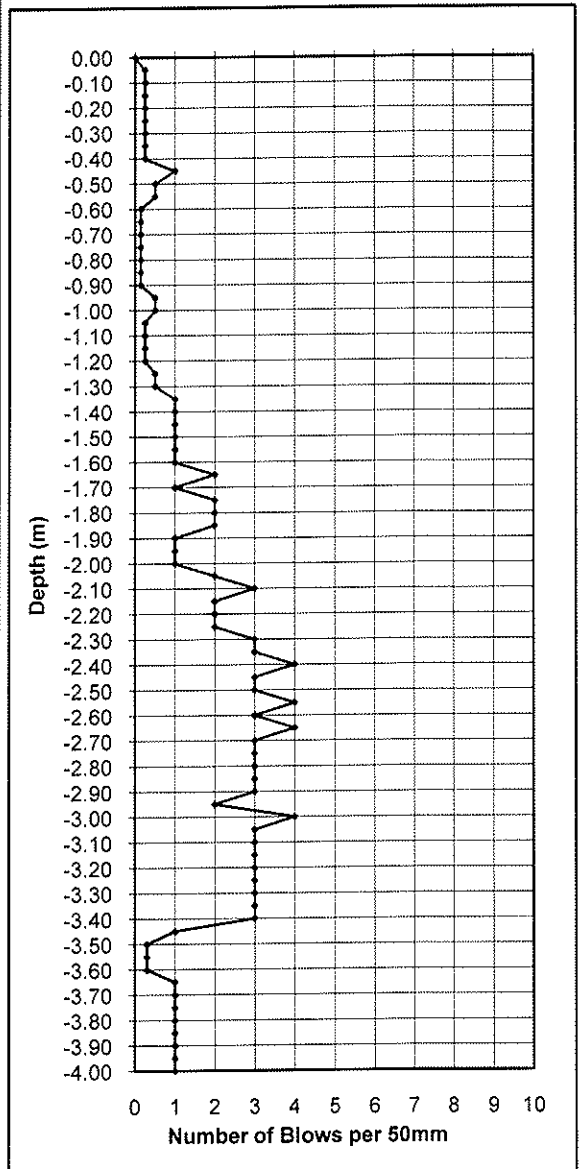
Material: -

Penetrometer ID: TGO851

Test / Sample Series: NGONGO/160109/SC

New Test Site /Re Test of Site Lab Ref: WS3

Vertical distance driven (mm)	Depth (mm)	No. of Blows	Vertical distance driven (mm)	Depth (mm)	No. of Blows
50	50	0.25	2050	2050	2
100	100	0.25	2100	2100	3
150	150	0.25	2150	2150	2
200	200	0.25	2200	2200	2
250	250	0.25	2250	2250	2
300	300	0.25	2300	2300	3
350	350	0.25	2350	2350	3
400	400	0.25	2400	2400	4
450	450	1	2450	2450	3
500	500	0.5	2500	2500	3
550	550	0.5	2550	2550	4
600	600	0.14	2600	2600	3
650	650	0.14	2650	2650	4
700	700	0.14	2700	2700	3
750	750	0.14	2750	2750	3
800	800	0.14	2800	2800	3
850	850	0.14	2850	2850	3
900	900	0.14	2900	2900	3
950	950	0.5	2950	2950	2
1000	1000	0.5	3000	3000	4
1050	1050	0.25	3050	3050	3
1100	1100	0.25	3100	3100	3
1150	1150	0.25	3150	3150	3
1200	1200	0.25	3200	3200	3
1250	1250	0.5	3250	3250	3
1300	1300	0.5	3300	3300	3
1350	1350	1	3350	3350	3
1400	1400	1	3400	3400	3
1450	1450	1	3450	3450	1
1500	1500	1	3500	3500	0.3
1550	1550	1	3550	3550	0.3
1600	1600	1	3600	3600	0.3
1650	1650	2	3650	3650	1
1700	1700	1	3700	3700	1
1750	1750	2	3750	3750	1
1800	1800	2	3800	3800	1
1850	1850	2	3850	3850	1
1900	1900	1	3900	3900	1
1950	1950	1	3950	3950	1
2000	2000	1	4000	4000	1

Depth from ground surface to commencement of penetration: (m)

Tested:	LRA	Date:	15/01/2009
Calculated:	EEK	Date:	20/01/2009
Checked:	AB	Date:	29-1-09

**GEOTECHNICS LTD.**

Tauranga Laboratory

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LAB. REF.:

166/09

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Sheet of

Dynamic Cone Penetrometer (Scala) -NZS 4402:1986 Test 6.5.2

Site: WESTERN RD, NGONGATAHA

Job Name : TONTNGONGATAHASITE

Job no: -

Test pit/BH no: WS3

Location: ROTORUA

Depth: 3m

Material: -

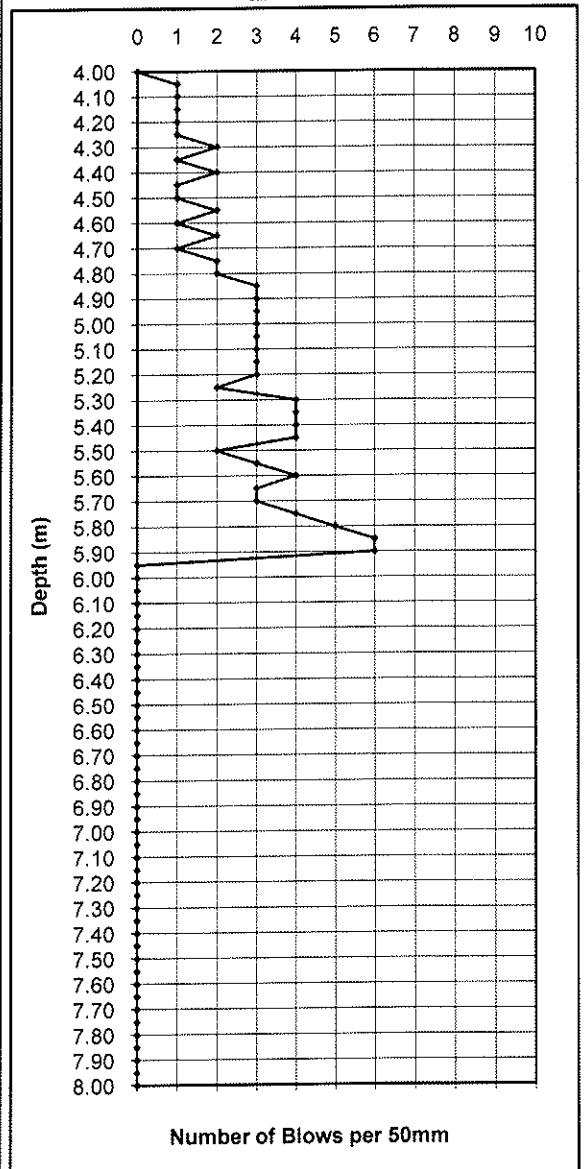
Penetrometer ID: TGO851

Test / Sample Series: NGONGO/160109/SC

New Test Site / Re-Test of Site - Lab Ref: WS3

Vertical distance driven (mm)	Depth (mm)	No. of Blows	Vertical distance driven (mm)	Depth (mm)	No. of Blows
50	4050	1	2050	6050	
100	4100	1	2100	6100	
150	4150	1	2150	6150	
200	4200	1	2200	6200	
250	4250	1	2250	6250	
300	4300	2	2300	6300	
350	4350	1	2350	6350	
400	4400	2	2400	6400	
450	4450	1	2450	6450	
500	4500	1	2500	6500	
550	4550	2	2550	6550	
600	4600	1	2600	6600	
650	4650	2	2650	6650	
700	4700	1	2700	6700	
750	4750	2	2750	6750	
800	4800	2	2800	6800	
850	4850	3	2850	6850	
900	4900	3	2900	6900	
950	4950	3	2950	6950	
1000	5000	3	3000	7000	
1050	5050	3	3050	7050	
1100	5100	3	3100	7100	
1150	5150	3	3150	7150	
1200	5200	3	3200	7200	
1250	5250	2	3250	7250	
1300	5300	4	3300	7300	
1350	5350	4	3350	7350	
1400	5400	4	3400	7400	
1450	5450	4	3450	7450	
1500	5500	2	3500	7500	
1550	5550	3	3550	7550	
1600	5600	4	3600	7600	
1650	5650	3	3650	7650	
1700	5700	3	3700	7700	
1750	5750	4	3750	7750	
1800	5800	5	3800	7800	
1850	5850	6	3850	7850	
1900	5900	6	3900	7900	
1950	5950		3950	7950	
2000	6000		4000	8000	

Depth from ground surface to commencement of penetration: 4 (m)



Tested:	LRA	Date:	15/01/2009
Calculated:	EEK	Date:	20/01/2009
Checked:	PS	Date:	29-1-09

**GEOTECHNICS LTD.**

Tauranga Laboratory

56 10th Ave Tauranga

Tel.: 07 571 0280

Fax: 07 571 0282

LAB. REF.:

166/09

FILE:

650229.001

Sheet of

Dynamic Cone Penetrometer (Scala) -NZS 4402:1986 Test 6.5.2

Site: WESTERN RD, NGONGATAHA

Job Name : TONTNGONGATAHASITE

Job no: -

Test pit/BH no:

WS4

Location: ROTORUA

Depth: 3m

Material: -

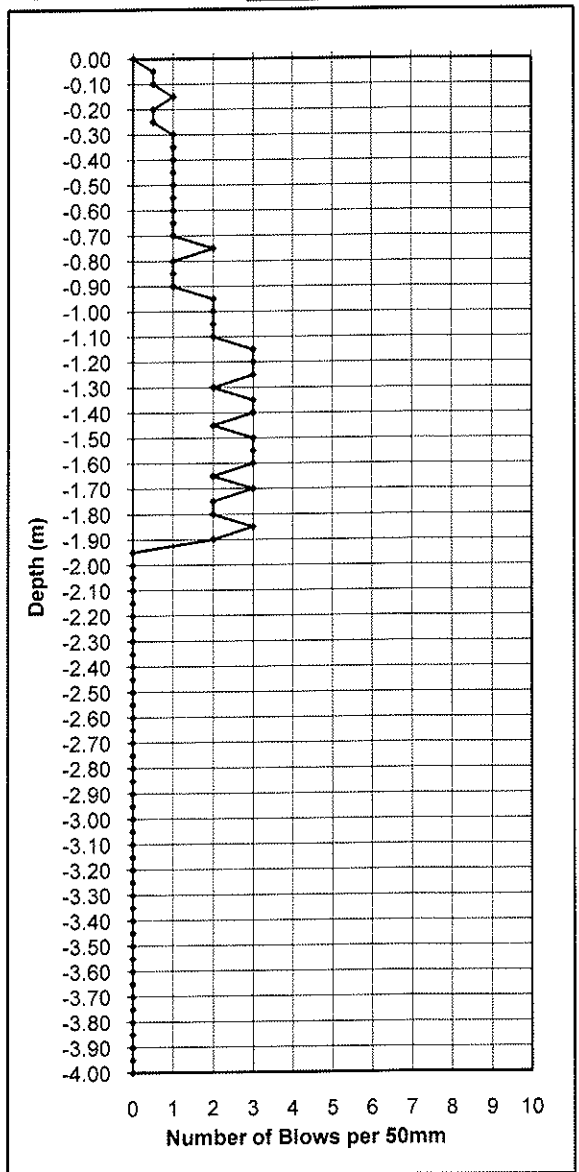
Penetrometer ID: TGO851

Test / Sample Series: NGONGO/160109/SC

New Test Site / Re Test of Site - Lab Ref: WS4

Vertical distance driven (mm)	Depth (mm)	No. of Blows	Vertical distance driven (mm)	Depth (mm)	No. of Blows
50	50	0.5	2050	2050	
100	100	0.5	2100	2100	
150	150	1	2150	2150	
200	200	0.5	2200	2200	
250	250	0.5	2250	2250	
300	300	1	2300	2300	
350	350	1	2350	2350	
400	400	1	2400	2400	
450	450	1	2450	2450	
500	500	1	2500	2500	
550	550	1	2550	2550	
600	600	1	2600	2600	
650	650	1	2650	2650	
700	700	1	2700	2700	
750	750	2	2750	2750	
800	800	1	2800	2800	
850	850	1	2850	2850	
900	900	1	2900	2900	
950	950	2	2950	2950	
1000	1000	2	3000	3000	
1050	1050	2	3050	3050	
1100	1100	2	3100	3100	
1150	1150	3	3150	3150	
1200	1200	3	3200	3200	
1250	1250	3	3250	3250	
1300	1300	2	3300	3300	
1350	1350	3	3350	3350	
1400	1400	3	3400	3400	
1450	1450	2	3450	3450	
1500	1500	3	3500	3500	
1550	1550	3	3550	3550	
1600	1600	3	3600	3600	
1650	1650	2	3650	3650	
1700	1700	3	3700	3700	
1750	1750	2	3750	3750	
1800	1800	2	3800	3800	
1850	1850	3	3850	3850	
1900	1900	2	3900	3900	
1950	1950		3950	3950	
2000	2000		4000	4000	

Depth from ground surface to commencement of penetration: 0 (m)



Tested:	LRA	Date:	15/01/2009
Calculated:	EEK	Date:	20/01/2009
Checked:	PK	Date:	27-1-09

**GEOTECHNICS LTD.**

Tauranga Laboratory

56 10th Ave Tauranga

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LAB. REF.:

166/09

FILE:

650229.001

Sheet of

Dynamic Cone Penetrometer (Scala) -NZS 4402:1986 Test 6.5.2

Site: WESTERN RD, NGONGATAHA

Job Name : TONTNGONGATAHASITE

Job no: -

Test pit/BH no:

WS5

Location: ROTORUA

Depth: 3m

Material: -

Penetrometer ID: TGO851

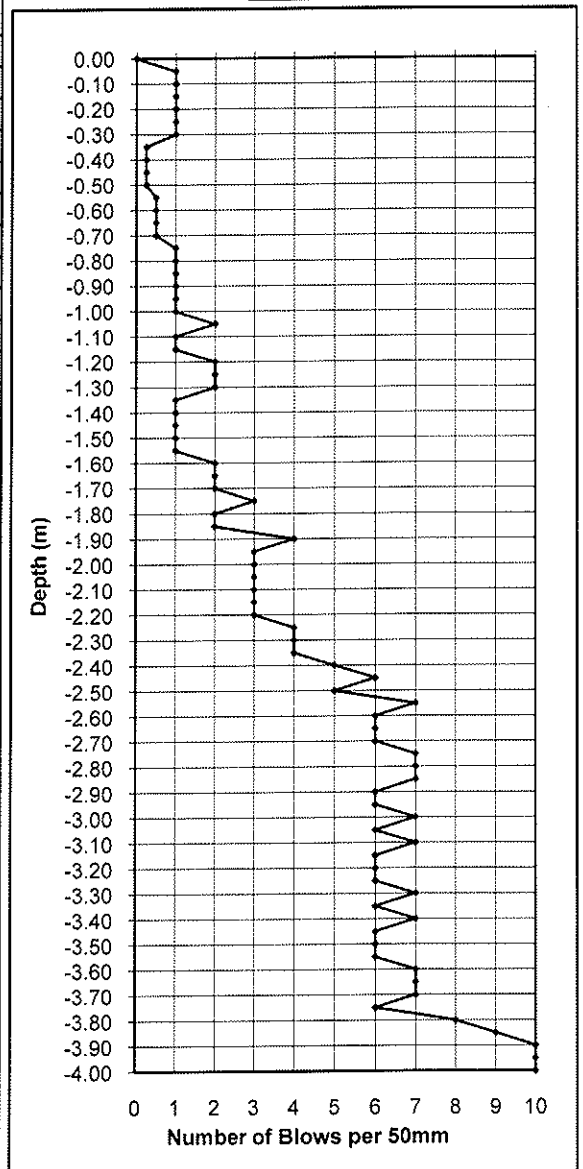
Test / Sample Series:

NGONGO/160109/SC

New Test Site / Re Test of Site Lab Ref: WS5

Vertical distance driven (mm)	Depth (mm)	No. of Blows	Vertical distance driven (mm)	Depth (mm)	No. of Blows
50	50	1	2050	2050	3
100	100	1	2100	2100	3
150	150	1	2150	2150	3
200	200	1	2200	2200	3
250	250	1	2250	2250	4
300	300	1	2300	2300	4
350	350	0.25	2350	2350	4
400	400	0.25	2400	2400	5
450	450	0.25	2450	2450	6
500	500	0.25	2500	2500	5
550	550	0.5	2550	2550	7
600	600	0.5	2600	2600	6
650	650	0.5	2650	2650	6
700	700	0.5	2700	2700	6
750	750	1	2750	2750	7
800	800	1	2800	2800	7
850	850	1	2850	2850	7
900	900	1	2900	2900	6
950	950	1	2950	2950	6
1000	1000	1	3000	3000	7
1050	1050	2	3050	3050	6
1100	1100	1	3100	3100	7
1150	1150	1	3150	3150	6
1200	1200	2	3200	3200	6
1250	1250	2	3250	3250	6
1300	1300	2	3300	3300	7
1350	1350	1	3350	3350	6
1400	1400	1	3400	3400	7
1450	1450	1	3450	3450	6
1500	1500	1	3500	3500	6
1550	1550	1	3550	3550	6
1600	1600	2	3600	3600	7
1650	1650	2	3650	3650	7
1700	1700	2	3700	3700	7
1750	1750	3	3750	3750	6
1800	1800	2	3800	3800	8
1850	1850	2	3850	3850	9
1900	1900	4	3900	3900	10
1950	1950	3	3950	3950	10
2000	2000	3	4000	4000	10

Depth from ground surface to commencement of penetration: 0 (m)



Tested:	LRA	Date:	15/01/2009
Calculated:	EEK	Date:	20/01/2009
Checked:	PK	Date:	29-1-09