



Falcons Landing
Geotechnical Subdivision Report
GW Rolleston Limited

16 February 2017
Revision: 2
Reference: 254246

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to life*

Document control record

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Executive Summary

Introduction

GW Rolleston Limited is proposing to develop an approximately 60 hectare block of rural land in Rolleston around Brathwaite Drive into the Falcons Landing residential subdivision. When completed it will contain approximately 600 lots with associated subdivision infrastructure such as drainage and internal roads. GW Rolleston Limited has engaged Aurecon New Zealand Limited (Aurecon) to assess the suitability of the land for residential development from a geotechnical perspective and complete an assessment against Section 106 of the Resource Management Act.

Geotechnical Investigations

Aurecon has undertaken geotechnical testing across the site comprising a review of readily available published information, review nearby Environmental Canterbury (ECan) borehole logs, soakage pit tests from PDP as part of the stormwater design, and excavating 26 test pit excavations into the underlying gravel and 21 hand auger boreholes.

Based on the results of our geotechnical investigations the site is underlain by shallow gravel (0.2m to 1.5m depth) which ECan boreholes indicate extends to at least 200m depth.

Groundwater was not encountered in any of the test pit or hand auger investigation but information from nearby ECan boreholes suggest it is in the order of 10m depth at the development site

Liquefaction Assessment

Given the ground conditions comprising silt to sandy silt underlain by non-liquefiable gravel, a deep groundwater table (at least 10m depth) and the lack of evidence of liquefaction ground damage across the site following the 4 September 2010 Darfield Earthquake, liquefaction is not a credible hazard on this site. Hence a detailed liquefaction hazard assessment has not been carried out

Technical Category Classification


The site is considered consistent with a MBIE TC1 classification and therefore it is likely that standard NZ3604 type foundations outlined in NZS3604 '*Timber Framed Buildings*' and NZS4229 '*Concrete Masonry Buildings not requiring Specific Engineering Design*' type foundations will be suitable at the site provided sufficient shallow bearing capacity is achieved. Lot specific shallow geotechnical investigations will be required for detailed house design.

RMA Section 106 Assessment

The site is not susceptible to falling debris or slippage due to the gently sloping topography. No erosion was observed on the site and the risk of subsidence and inundation from liquefaction is low due to the relatively deep groundwater table and ground conditions encountered.

As such, the site will essentially be geotechnically stable land. **Thus in our opinion, the proposed development will generally be free of "erosion," "falling debris," "subsidence," "slippage," and "inundation" and the proposed development satisfies the intent of RMA Section 106 1(a).**

Provided that appropriate investigation and design inputs are made, as recommended in this report, subsequent use of the land following development is unlikely to accelerate, worsen, or result in material damage to the land, other land, or structures. **In our opinion therefore, the development will comply with the requirements of Clause 106 1(b) RMA.**



Our Limitations are attached as Section 7 of this report. This report shall be read as a whole.

This Revision 2 report incorporates the results from additional geotechnical testing on three additional life style properties that have been incorporated into the proposed development following the preparation and issuing of the Revision 1 report.

1 Introduction

GW Rolleston Limited is proposing to develop approximately 60 hectare block of rural land on the southeastern edge of Rolleston around Brathwaite Drive. This development will be known as Falcons Landing and when completed the residential subdivision will contain approximately 600 residential lots with associated subdivision infrastructure such as drainage and internal roads.

GW Rolleston Limited has engaged Aurecon New Zealand Limited (Aurecon) to assess the suitability of the land for residential development from a geotechnical perspective and complete an assessment against Section 106 of the Resource Management Act.

The scope of the work undertaken for this current assessment was as follows:

- A detailed desk study of readily available geological and geotechnical information for this site.
- A preliminary site walkover and reconnaissance.
- Excavate and log a nominal 32 test pit excavations.
- Drill and log 21 hand augers boreholes.
- Make recommendations for additional geotechnical testing, if required.
- Assess the site from a geotechnical perspective for residential development including assessing a likely residential land liquefaction hazard Technical Category (TC) classification in accordance with the principles of the MBIE Guidance.
- Undertake an assessment against the RMA Section 106 1a and 1b.
- Provide comments on development options and geotechnical constraints.
- Prepare this factual and interpretive geotechnical report outlining the above.

This report presents the results of our geotechnical investigation and recommendations for residential development. Our work was carried out under an IPENZ Short Form Agreement with GW Rolleston Ltd dated 7 November 2016. Approval to proceed was given by Hamish Wheelans on 7 November 2016.

This report does not address civil engineering aspects of the development such as drainage, storm water disposal, and pavement and bulk earthworks. We understand this is being addressed by others as part of the land development process.

Our Limitations are attached as Section 7 of this report. This report shall be read as a whole.

This Revision 2 report incorporates the results from additional geotechnical testing on three additional life style properties that have been incorporated into the proposed development following the preparation and issuing of the Revision 1 report.

2 Site Conditions

2.1 Site Features

The site is located on the southeastern edge of Rolleston township, as shown on Figure 1 in Appendix A. The main site features are:

- The site currently comprises of 17 individual life style blocks of land with different ownership and legal titles. The total area proposed for residential development is approximately 60 hectares.
- The area comprises a number of residential houses along with fenced paddocks containing livestock, crops and horses.
- Drainage is inferred to be via direct soakage into the ground.
- The Branthwaite Drive site and the Rolleston area has the current MBIE Technical Category Classification of *N/A – Rural & Unmapped*.

2.2 Regional Geology and Seismicity

The regional geology of the site is described by Forsyth and Barrel (2008) as ‘*Grey river alluvium beneath plains or low level terraces (Q1a)*.’ The underlying geology changes approximately 500m west of the site where it is described as “*Brownish-grey river alluvium (Q2a)*”.

The site lies close to the epicentres of recent significant earthquakes as summarised in Table 1 below.

Table 1 Recent Earthquake Activity

Earthquake	Distance to Epicentre	Moment Magnitude (M _w)	Median PGA on Site ⁽¹⁾	Equivalent mean PGA for M _w 7.5 Event ⁽²⁾
Darfield Earthquake 4 September 2010	17km west to the eastern end of the Darfield fault trace	7.1	0.36g	0.32g
Christchurch Earthquake 22 February 2011	8km east	6.2	0.15g	0.11g

(1) Peak Ground Accelerations (PGA) on site based on O'Rourke et. al. (2012) (as shown on the NZGD, 2016).

(2) Calculated using the magnitude scaling factor based on the method of Idriss and Boulanger (2008).

2.3 Recorded Earthquake Damage

Based on the GNS Science report “Review of liquefaction hazard information in eastern Canterbury, including Christchurch City and parts of Selwyn, Waimakariri and Hurunui” (GNS, 2012), there was no observed liquefaction induced damage after the 4 September 2010 or 22 February 2011 earthquakes.

3 Geotechnical Investigation

The geotechnical investigation comprised the following:

- A review of publically available geotechnical information from Environment Canterbury and the New Zealand Geotechnical Database.
- Review of soakage pit logs from PDP undertaken as part of the stormwater design for the Falcons Landing development.
- Test Pit excavations undertaken by Mangers and supervised by geotechnical engineers from Aurecon.
- Hand auger boreholes conducted by Aurecon geotechnical engineers.

This section of the report describes the results of our geotechnical review and additional testing.

3.1 New Zealand Geotechnical Database

A review of the Canterbury Geotechnical Database did not identify any relevant geotechnical information near the site.

3.2 Environment Canterbury Database

A review of the Environment Canterbury GIS Database (ECan, 2016) indicated two Environment Canterbury boreholes with logs on the site and a further 16 logs immediately adjacent to the site. These boreholes range from 25m to over 200m depth. The borehole logs typically indicate 1m to 2m of soil overlying predominately gravels to depth. The ECan borehole logs from the site are attached in Appendix B and locations shown on Figure 2 in Appendix A.

3.3 PDP Investigation

As part of the stormwater assessment for the Falcons Landing development PDP have undertaken six groundwater soakage test across the site. These test were undertaken in test pit excavations 3.5m to 3.9m deep. Logs of these tests indicate the site is typically underlain by 0.8m to 1m of silty-sand and silt, overlying gravel and sandy-gravel to depth.

The PDP logs from the site are attached in Appendix C and locations shown on Figure 3 in Appendix A.

3.4 Aurecon Investigations

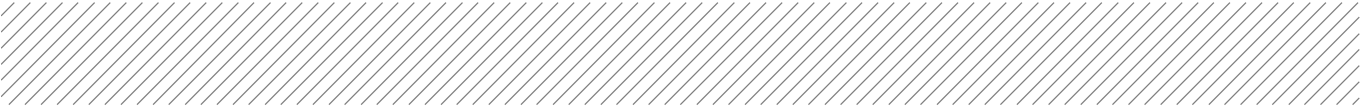
A geotechnical investigation was carried out across the Falcons Landing site to determine the upper ground conditions and the depth of the underlying gravel layer. The geotechnical investigation comprised the following:

- Twenty six test pit excavations;
- 21 hand auger boreholes.

These are described below.

3.4.1 Test Pits

Twenty six test pit investigations were carried out across the Falcons Landing site in areas that were accessible with a 7 tonne, wheeled excavator. The test pits were undertaken by Mangers and supervised by Aurecon geotechnical engineers on the 22 and 23 November 2016. The test pits were extended into the gravel layer underlying the site to a maximum depth of 2.2m.



The test pit logs generally indicate a layer of topsoil (0.2m to 0.5m depth) underlain by light brown silt to sandy-silt extending 0.2 to 1.5m depth. The silt layer is underlain by gravel with minor to some sand. The test pit excavations were terminated in the gravel layer which geological maps indicate extends to several hundreds of meters depth with occasional sand and silt layers. The test locations are shown on Figure 3 in Appendix A and the test pit logs are presented in Appendix D.

3.4.2 Hand Auger Boreholes

Aurecon conducted nine hand auger boreholes (HA1 to HA9) in locations where the excavator was unable to access on 25 November 2016. A further 12 hand auger boreholes (HA101 to 112) were drilled on 9 February 2017 in three additional life style blocks that have been incorporated into the wider development subsequent to November 2016. The hand augers were advanced to the surface of the underlying gravel layer at a maximum of 1.1m depth. The ground conditions encountered in the hand auger boreholes were similar those encountered in the test pit excavations with topsoil overlying silt to sandy-silt before terminating on the gravel layer. The hand auger borehole test locations are shown in Figure 3 and the logs are presented in Appendix D.

3.5 Ground Water

Groundwater has been recorded from the following sources:

- Groundwater was not encountered in any of the Aurecon or PDP geotechnical investigation.
- ECan borehole log M36/0328 located immediately east of the site, indicates a recorded groundwater around 14mbgl.
- The ECan GIS Databases (ECan, 2016) indicates a likely depth to groundwater at the site in the order of 10mbgl.

4 Engineering Considerations

4.1 General

GW Rolleston Ltd is proposing to subdivide a 60 hectare block of land in Rolleston around Branthwaite Drive, resulting in approximately 600 residential lots to be known as Falcons Landing.

Based on the favourable ground conditions across the Rolleston area for residential development, lack of earthquake induced ground damage, and presence of non-liquefiable soils, following discussions with the geotechnical reviewer for the Selwyn District Council, Mr Ian McCahon, a reduced density of testing, relative to MBIE guidance, has been carried out. The deep ground conditions have been based on the ECan boreholes located on, or near, the site. Considering the favourable and consistent ground conditions the level of testing carried out is considered appropriate to geotechnically categorise the site form at resource consent stage of residential development.

This section of the report presents our interpretation of the ground conditions at the site, details our liquefaction assessment, and presents our geotechnical recommendations for site development.

4.2 Ground Model

Based upon the results of the geotechnical site investigations we infer a ground profile presented in Table 2 below.

Table 2 Inferred Ground Model

Unit	Top of Layer	Thickness	Soil Description
1	Surface	0.2m to 0.5m	Topsoil comprising SILT with some sand with minor rootlets.
2*	0.2m to 0.5m	0.2m to 1.5m	SILT to sandy SILT; light brown. Dry to moist, low plasticity.
3	0.2m to 1.5m	*90m +	GRAVEL with minor to some sand; greyish brown. Dry to moist, subrounded to rounded.

Note: * ECan borehole M36/4680 located on the site indicates that the underlying gravel layer extends to at least 90m depth.

For the purposes of this report we assumed that the ground water table is at least 10m below ground level across the site. It should be noted that water levels may change over time and will be subject to seasonal variation.

4.3 Site Subsoil Classification

We have assessed the site flexibility based on the following:

- Logs indicate underlying ground conditions consist of predominately sands and gravels to a depth of 90m below ground level.
- Forsyth and Barrel (2008) indicate the depth to rock in the Rolleston Area is likely hundreds of metres.
- Table in Clause 3.1.3.2 of NZS 1170.5:2004.

We consider the site subsoil category in terms of NZS 1170.5:2004 Clause 3.1.3.2 is **Class D (Deep Soil Site)**.

4.4 Liquefaction Assessment

4.4.1 Introduction

Under cyclic loading loose, non-plastic materials such as gravel, sand and silt tend to decrease in volume. If these soils are saturated and rapid loading occurs under un-drained conditions, the soil densification causes pore water pressure to increase. The increase in pore water pressure results in a loss of soil strength due to a decrease in effective stress, and eventually leads to liquefaction once effective stress drops to near zero. Liquefaction can lead to large displacements of foundations, flow failures of slopes, ground surface settlement, sand boils, and post-earthquake stability failures.

4.4.2 Liquefaction Assessment

The three primary factors that contribute to liquefaction potential are:

- High groundwater table.
- Loose, non-plastic soils.
- Sufficiently high, earthquake induced ground acceleration and sustained shaking (i.e. sufficient load cycles).

Each of these is considered below together with conclusions on the site liquefaction potential.

Groundwater

Based on our site investigations and accounting for seasonal variation in ground water level, we assumed a groundwater level of 10mbgl. Therefore soils within the upper 10m of the soil profile are not considered liquefiable based on a saturation criterion.

Soil Character and Density

The geotechnical investigation across the site indicated silt and sandy-silty material in the upper 1.5m underlain by gravelly soils to over 90m depth. Liquefaction potential is assessed as being low based upon a soil grading and density criteria.

Earthquake Intensity

The level of ground shaking is one of the key factors in determining whether liquefaction will or will not occur. The design earthquakes for Residential developments in Canterbury have been provided in the MBIE Guidelines for *Repairing and rebuilding houses affected by the Canterbury earthquake sequence* (MBIE, 2012) as:

- SLS-a $M_w 7.5 / 0.13g$
- SLS-b $M_w 6.0 / 0.19g$
- ULS $M_w 7.5 / 0.35g$

4.4.3 Liquefaction Potential Assessment

When comparing the estimated ground shaking at the site during the 4 September 2010 Darfield Earthquake (see Table 1 above) the site has likely gone through ground shaking levels similar to that of a ULS earthquake event with no observed ground damage.

Considering the composition of the underlying soils (non-liquefiable gravels to depths) and the lack of any observed ground damage during the 4 September 2010 Darfield Earthquake (which had levels of shaking similar to that of a ULS design earthquake) we infer that the site has minimal, if any, risk of seismically induced liquefaction. Hence no further liquefaction hazard assessment work is required or has been carried out.

4.5 Technical Categorisation

The MBIE guidelines divide flat land into three technical categories that reflect both the liquefaction experience to date and future performance expectations. The categories and corresponding criteria are summarised as follows:

- **Technical Category 1 (TC1)** – Future land damage from liquefaction is unlikely, and ground settlements are expected to be within normally accepted tolerances.
- **Technical Category 2 (TC2)** – Minor to moderate land damage from liquefaction is possible in future large earthquakes.
- **Technical Category 3 (TC3)** – Moderate to significant land damage from liquefaction is possible in future large earthquakes.

As the Bradley and Hughes (2012) ground shaking model does not extend into Rolleston, we have considered the O'Rourke et. al. (2012) PGA model. Based on the MBIE Guidelines (2012) the site has been 'sufficiently tested' as the median value for the PGA for the 4 September 2010 event exceeded 170% of the SLS PGA (i.e. $1.7 \times 0.13g = 0.22g$). No liquefaction damage was observed on the site after the 4 September 2010 earthquake event.

Based on the underlying ground condition, i.e. gravel from shallow depths and groundwater at depths in the order of 10mbgl, and our liquefaction hazard assessment detailed above we consider the site is consistent with a classification of **Technical Category 1 (TC1)**.

4.6 Recommendations

4.6.1 House Foundations

This section provides generic foundation advice for the wider subdivision development. It *does not constitute* detailed design of foundations, and additional investigations will be required at the building consent stage for each house to determine the appropriate foundations and to support a building consent application.

The site is considered consistent with a MBIE TC1 classification and therefore it is likely that standard NZ3604 type foundations outlined in NZS3604 '*Timber Framed Buildings*' and NZS4229 '*Concrete Masonry Buildings not requiring Specific Engineering Design*' type foundations will be suitable at the site provided that the required shallow bearing capacities are sufficiently high to obtain 'Good Ground' on a lot by lot basis.

Due to the requirement for future earthworks as part of the subdivision development the upper soils are likely to be disturbed as part of the development process. Therefore, the bearing capacity of the upper silt and sandy silt layers will need to be confirmed with shallow, site specific geotechnical testing. This should be done following the completion of bulk earthworks on each lot, prior to or at the building consent stage to confirm the applicability of NZ3604 type foundations and to determine adequate founding depths on a lot by lot basis.

4.6.2 Civil Engineering Design

Stormwater disposal, road pavement design, and earthworks associated with the development will need to be addressed by appropriate civil engineering design at the detailed design stage of the project.

5 Assessment Against RMA Section 106

Section 106 of the Resource Management Act (RMA) states *inter alia*

... “a consent authority may refuse to grant a subdivision consent, or may grant a subdivision consent subject to conditions, if it considers that:

- a) *the land in respect of which a consent is sought, or any structure on the land, is or is likely to be subject to material damage by erosion, falling debris, subsidence, slippage, or inundation from any source; or*
- b) *any subsequent use that is likely to be made of the land is likely to accelerate, worsen, or result in material damage to the land, other land, or structure by erosion, falling debris, subsidence, slippage, or inundation from any source; or*
- c) *sufficient provision has not been made for legal and physical access to each allotment to be created by the subdivision.”*

The site is not susceptible to falling debris or slippage due to the gently sloping topography. No erosion was observed on the site. However the silty soils that directly underlie the site are inferred to be potentially susceptible to erosion by run-off or wind if vegetation cover is removed for prolonged periods of time. The erosion of the silty soils can be minimised by using appropriate industry standard runoff control and dust mitigation measures during construction. The risk of subsidence and inundation from liquefaction is low due to the relatively deep groundwater table and ground conditions encountered. We understand the stormwater discharge is being dealt with in the detailed civil engineering design by others and any potential “inundation” susceptibility due to stormwater is being addressed as part of the detailed subdivision civil engineering design.

The proposed subdivision development therefore generally complies with the intent of Section 106 (a).

Subsequent use of the land following development is unlikely to accelerate, worsen, or result in material damage to the land, other land, or structures. In our opinion therefore, the development will comply with the intent of section 106 (b).

Section 106 (c) is not directly relevant to a geotechnical appraisal and therefore has not been considered in detail in this report.

6 References

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7 Limitations

We have prepared this report in accordance with the brief as provided. The contents of the report are for the sole use of the Client and no responsibility or liability will be accepted to any third party. Data or opinions contained within the report may not be used in other contexts or for any other purposes without our prior review and agreement.

The recommendations in this report are based on data collected at specific locations and by using appropriate investigation methods with limited site coverage. Only a finite amount of information has been collected to meet the specific financial and technical requirements of the Client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgment and it must be appreciated that actual conditions could vary from the assumed model.

Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

Subsurface conditions, such as groundwater levels, can change over time. This should be borne in mind, particularly if the report is used after a protracted delay.

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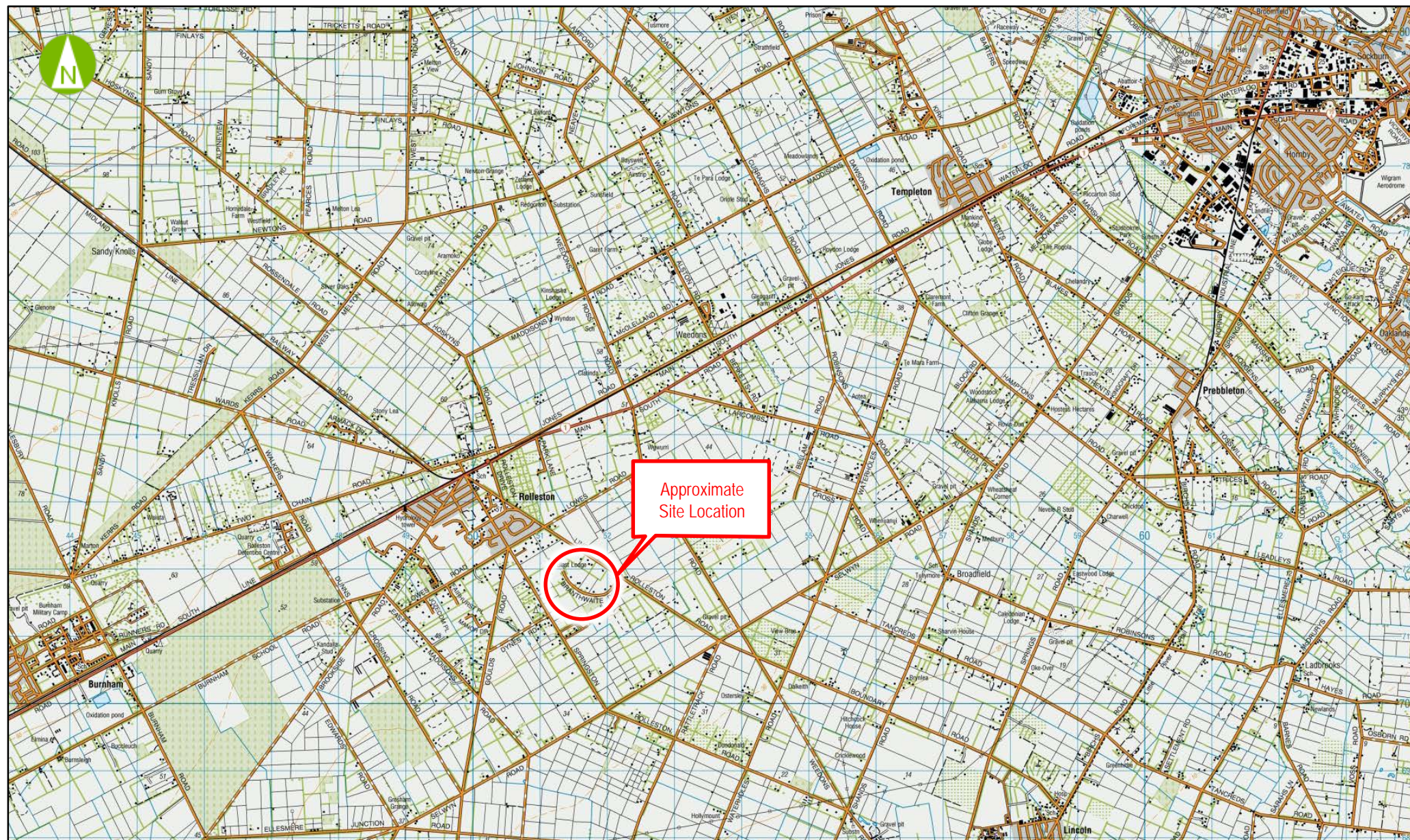
Appendices





Appendix A

Figures



CLIENT

PRELIMINARY NOT FOR CONSTRUCTION

ALL DIMENSIONS APPROXIMATE ONLY

SCALE

SIZE

TITLE

REGIONAL LOCATION PLAN

NTS

A4

BY

J. MARTIN

APPROVED

D. MAHONEY

REFERENCE

BACKGROUND IMAGE SOURCED FROM LINZ CROWN
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DATE

16 FEBRUARY 2017

FIGURE No.

PROJECT

254246

WBS

001

TYPE

FIG

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NUMBER

01

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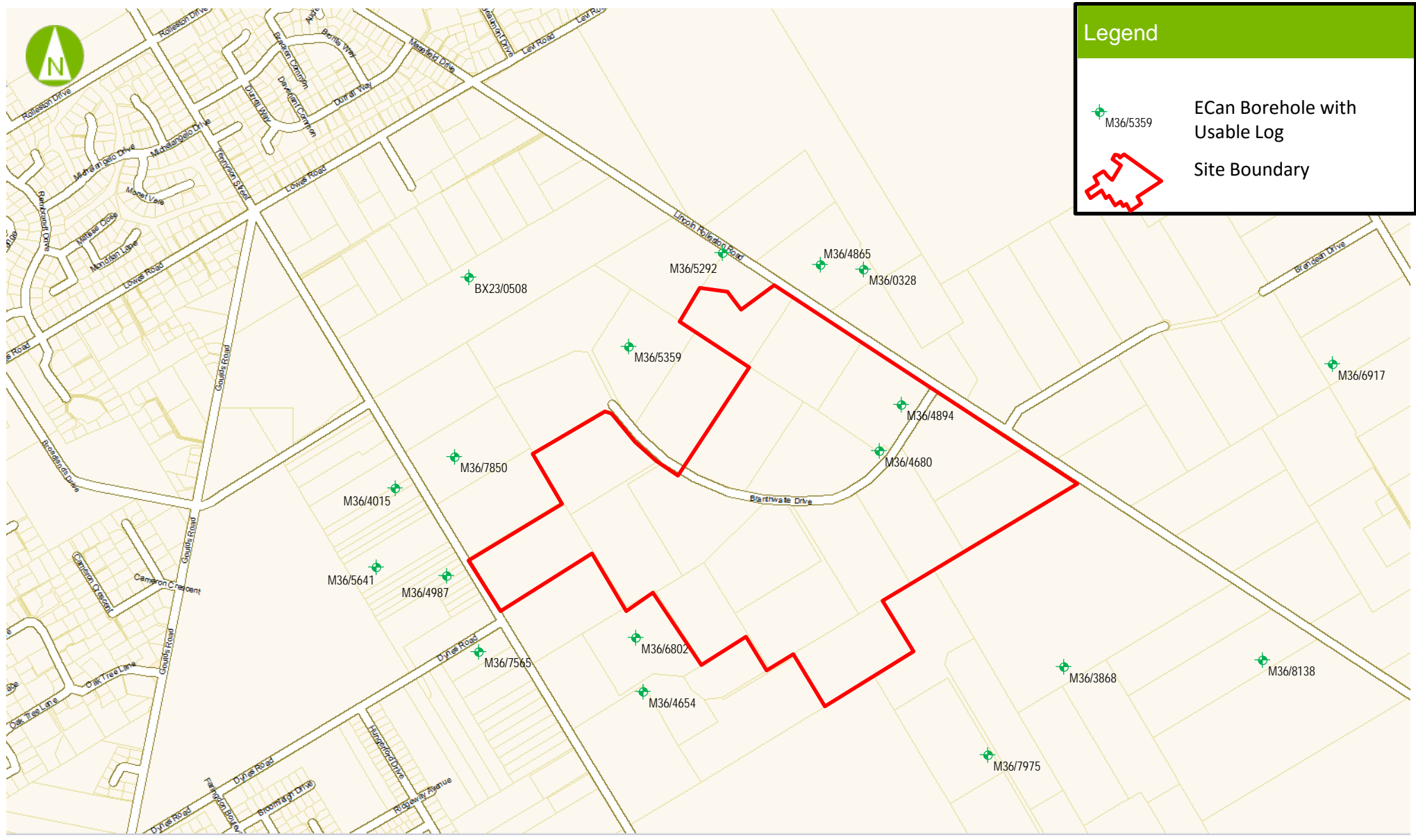
B

FIGURE


FIGURE 1

PROJECT


FALCONS LANDING



Legend

 M36/5359




ECan Borehole with Usable Log

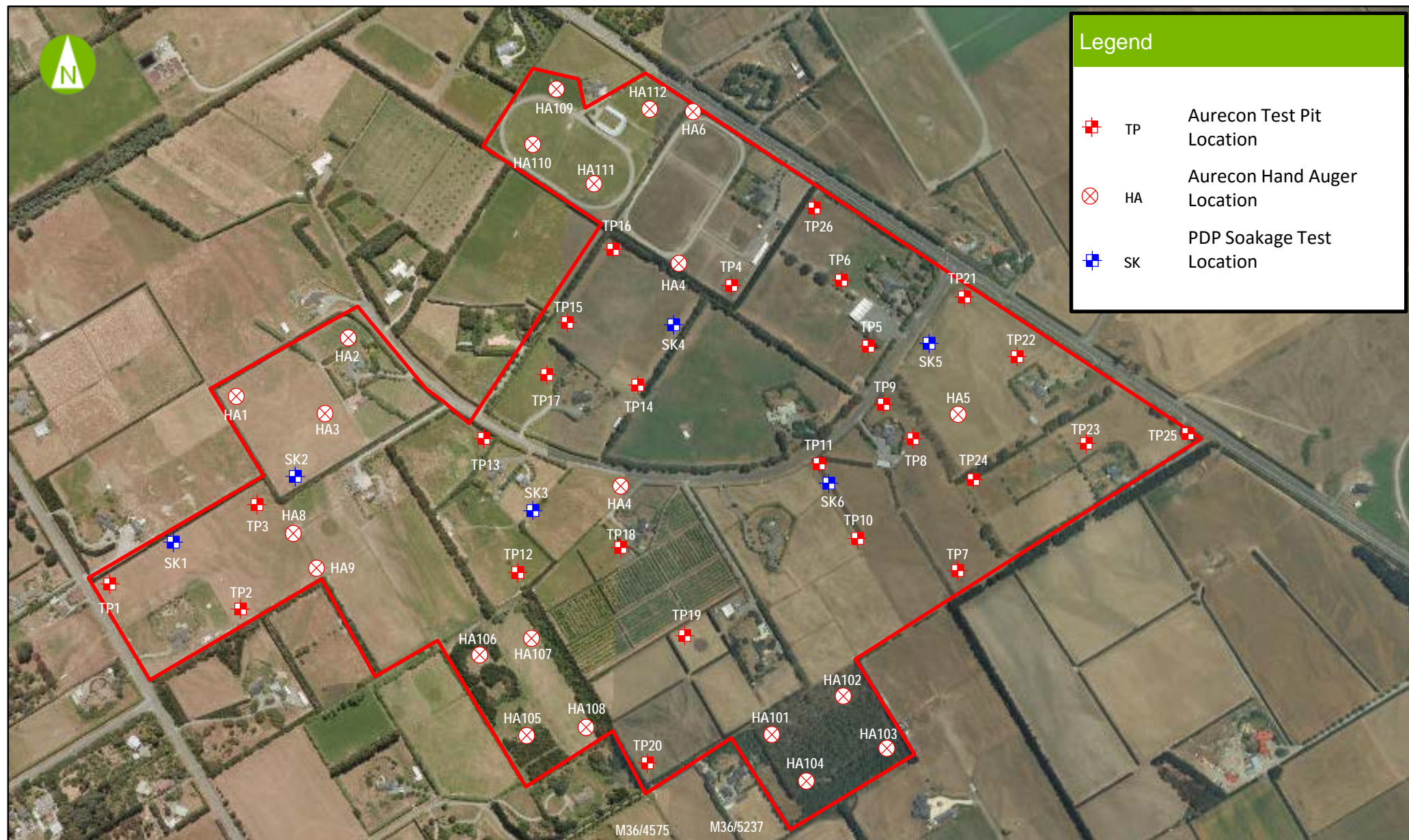



Site Boundary



Legend

-  TP Aurecon Test Pit Location
-  HA Aurecon Hand Auger Location
-  SK PDP Soakage Test Location



CLIENT		PRELIMINARY NOT FOR CONSTRUCTION	ALL DIMENSIONS APPROXIMATE ONLY	SCALE NTS	SIZE A4	TITLE	INVESTIGATION LOCATION PLAN						
 GILLMAN WHEELANS Residential Subdivisions	FIGURE	FIGURE 3		BY J. MARTIN	REFERENCE	BACKGROUND IMAGE SOURCED FROM CANTERBURY MAPS	FIGURE No.	PROJECT 254246	WBS 001	TYPE FIG	DISC INF	NUMBER 03	REV B
	PROJECT	FALCONS LANDING		APPROVED D. MAHONEY									
					DATE 16 FEBRUARY 2017								



Appendix B

ECan Borehole Logs

[Click here for a printable BoreLog](#)

Borelog for well M36/5359

Grid Reference (NZTM): 1551437 mE, 5171990 mN
 Location Accuracy: 50 - 300m
 Ground Level Altitude: 43.7 m +MSD Accuracy: < 2.5 m
 Driller: East Coast Drilling
 Drill Method: Unknown
 Borelog Depth: 34.0 m Drill Date: 19-Dec-1997



Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
			Topsell, clay, boulders	SP
5		4.00m	Sandy gravels, damp	RI
10		10.00m	Sandy claybound gravels	RI
15		16.00m	Sandy claybound gravels	RI
20		23.00m	Free gravels between 23-24, 25-27	BR?
25		24.00m	Sandy claybound gravels	BR?
		25.00m	Free gravels	BR?
		27.00m	Sandy claybound gravels	BR?
		28.00m	Hard stained stones	LI-1
30		29.00m	Large stained stones	LI-1
		34.00m		

[Click here for a printable BoreLog](#)

Borelog for well M36/5292

Grid Reference (NZTM): 1551672 mE, 5172222 mN
 Location Accuracy: 2 - 15m
 Ground Level Altitude: 44.4 m +MSD Accuracy: < 2.5 m
 Driller: Smiths Well Drilling
 Drill Method: Rotary Rig
 Borelog Depth: 52.0 m Drill Date: 15-Sep-1997

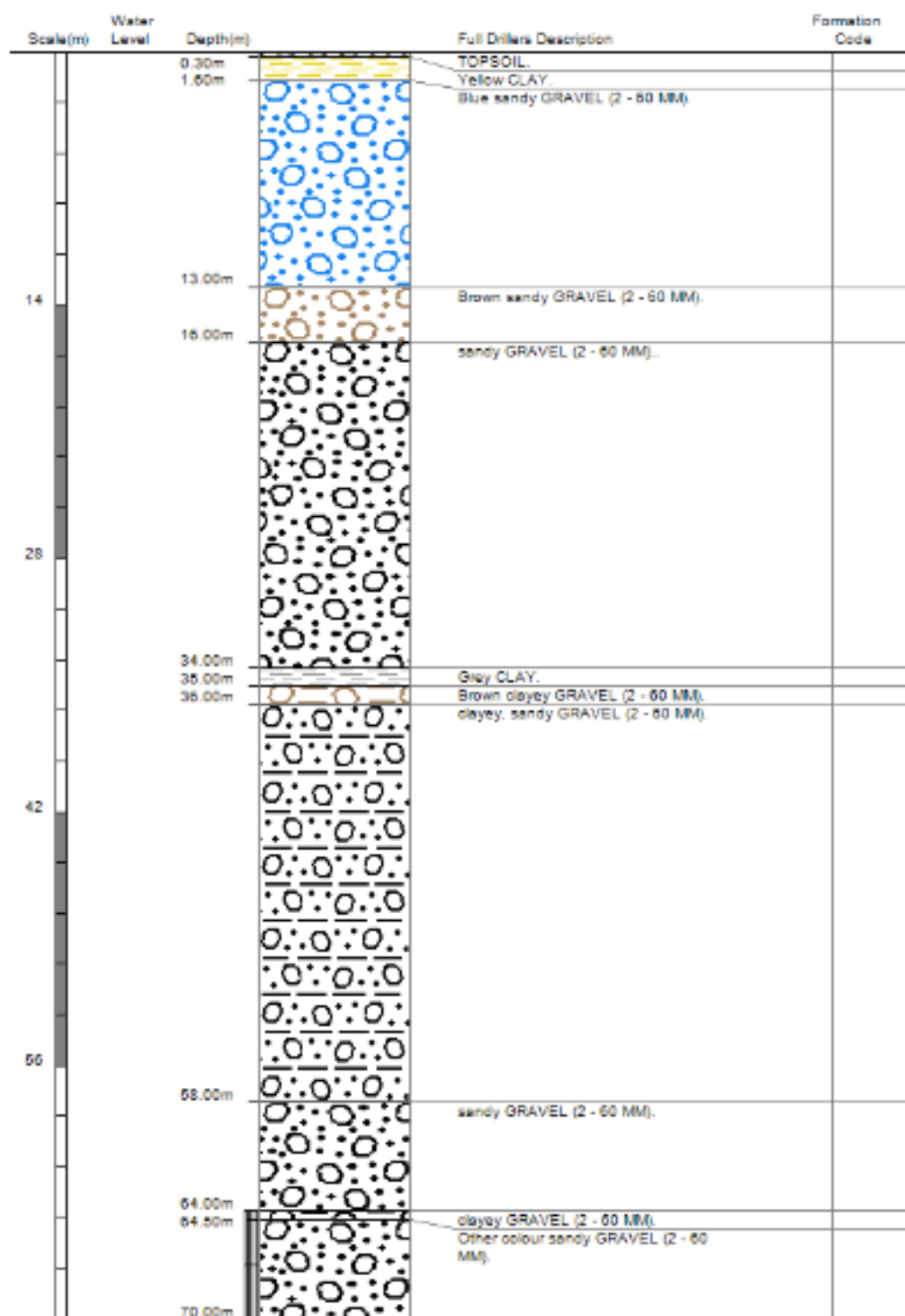


Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
		0.25m	Soil	SP
			Sandy gravel	SP
		4.50m		
			Claybound gravel	RI
10				
		14.00m		
			Claybound sandy gravel	RI
21				
		22.00m	Sandy gravel	BR?
		25.00m		
			Claybound gravel	LI
31				
		32.00m	Sandy gravel	LI
		35.00m		
			Claybound sandy gravel	LI
42				
		48.00m		
			Free sandy gravel	LI
		52.00m		

[Click here for a printable BoreLog](#)

Borelog for well M36/4885

Grid Reference (NZTM): 1540833 mE, 5159272 mN
 Location Accuracy: 10 - 50m
 Ground Level Altitude: 38.2 m +MSD Accuracy: < 2.5 m
 Driller: Smiths Welldrilling
 Drill Method: Rotary/Percussion
 Borelog Depth: 70.0 m Drill Date: 02-Dec-1996



[Click here for a printable BoreLog](#)

Borelog for well M36/0328

Grid Reference (NZTM): 1552007 mE, 5172190 mN

Location Accuracy: 50 - 300m

Ground Level Altitude: 42.6 m +MSD Accuracy: < 0.5 m

Driller: McMillan Drilling Ltd

Drill Method: Cable Tool

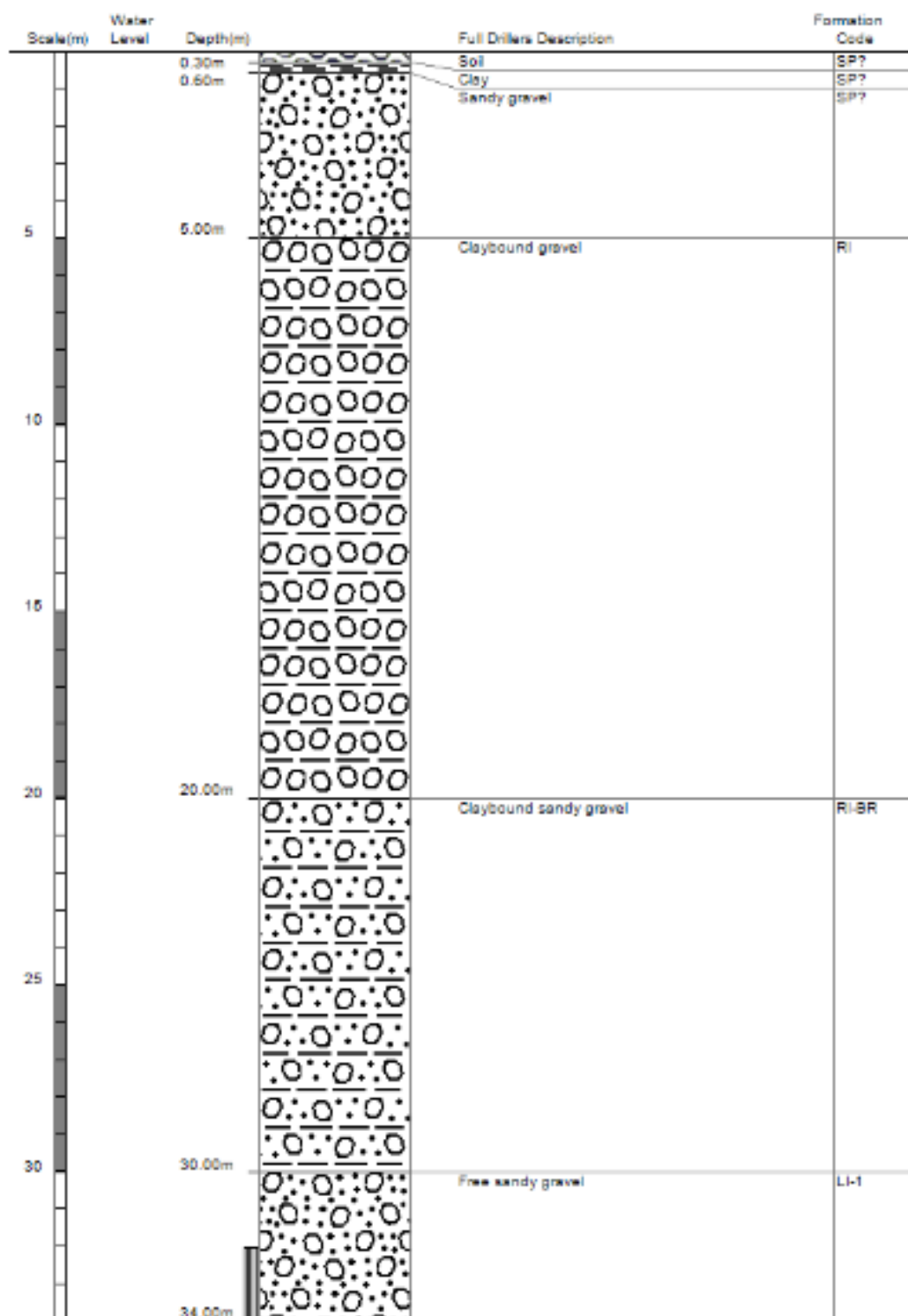
Borelog Depth: 28.6 m Drill Date: 20-Aug-1980



[Click here for a printable BoreLog](#)

Borelog for well M36/4894

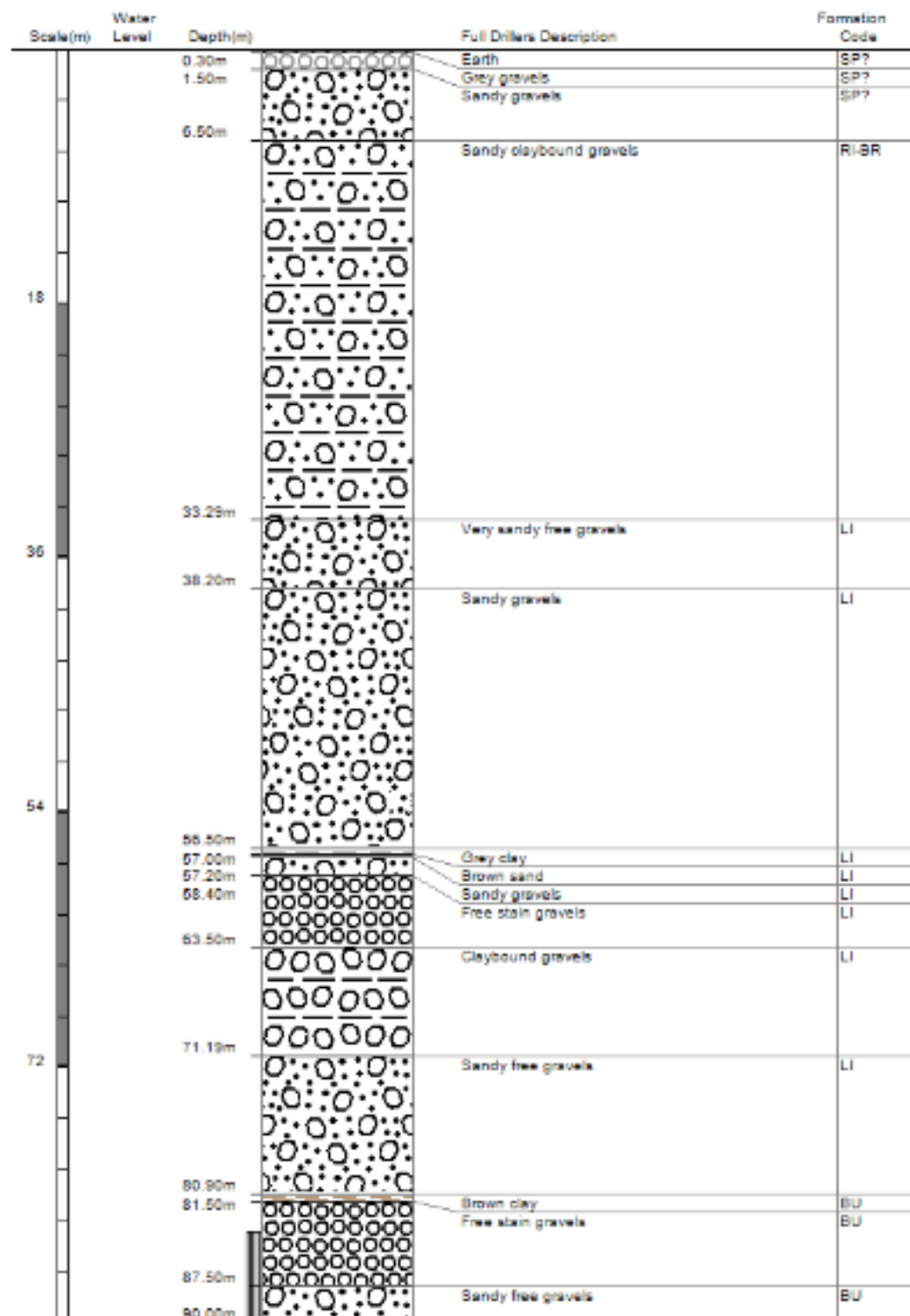
Grid Reference (NZTM): 1552087 mE, 5171830 mN
 Location Accuracy: 50 - 300m
 Ground Level Altitude: 40.5 m +MSD Accuracy: < 2.5 m
 Driller: Smiths Welldrilling
 Drill Method: Rotary Rig
 Borelog Depth: 34.0 m Drill Date: 16-Mar-1995



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Borelog for well M36/4680

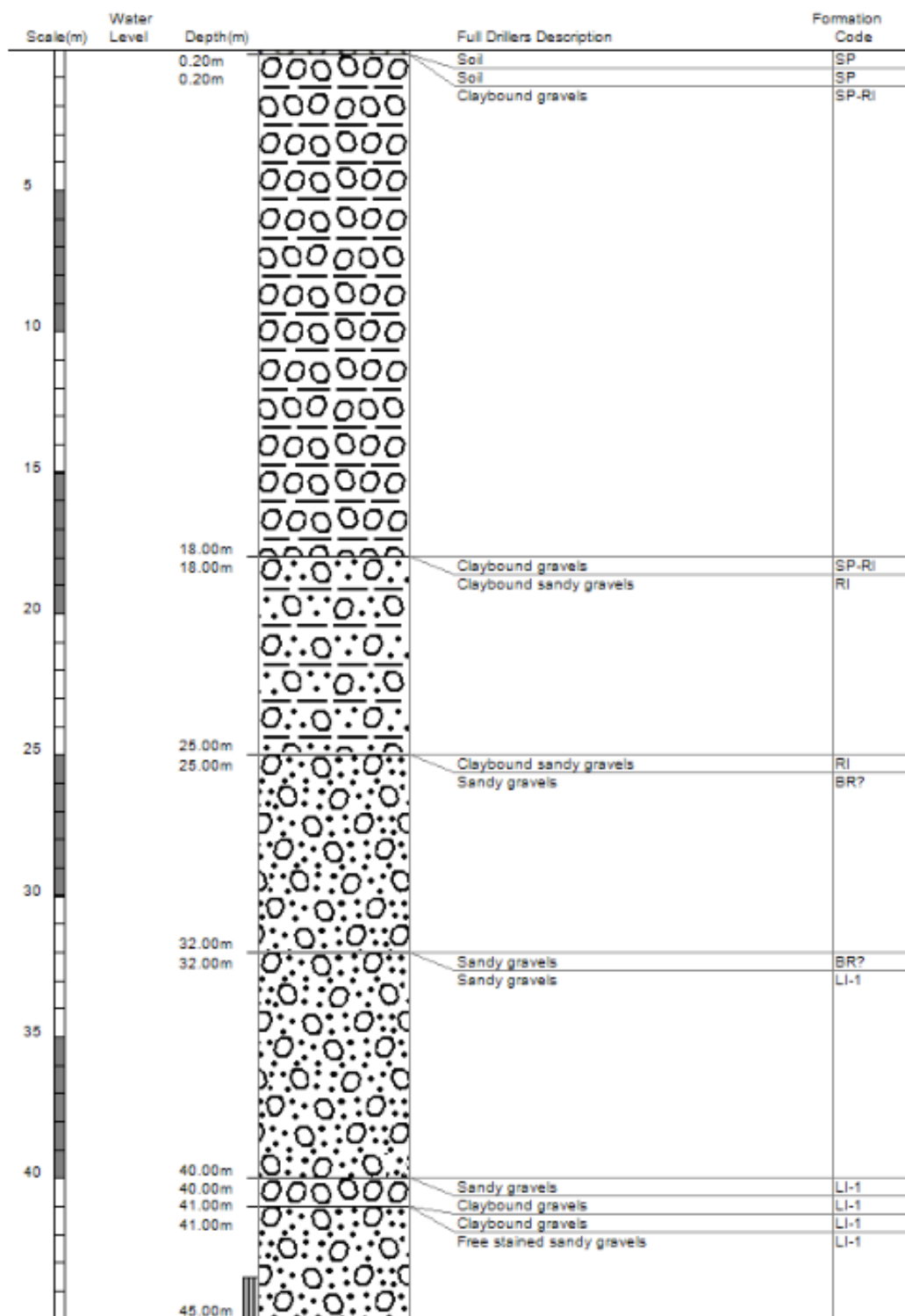
Grid Reference (NZTM): 1552060 mE, 5171738 mN
 Location Accuracy: 1 - 2m
 Ground Level Altitude: 40.3 m +MSD Accuracy: < 2.5 m
 Driller: McMillan Drilling Ltd
 Drill Method: Rotary/Percussion
 Borelog Depth: 90.0 m Drill Date: 11-Mar-1994



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Borelog for well M36/6917

Grid Reference (NZTM): 1553217 mE, 5171820 mN
 Location Accuracy: 10 - 50m
 Ground Level Altitude: 38.1 m +MSD Accuracy: < 0.5 m
 Driller: Smiths Welldrilling
 Drill Method: Rotary Rig
 Borelog Depth: 45.0 m Drill Date: 18-May-2001



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Borelog for well M36/8138

Grid Reference (NZTM): 1552947 mE, 5171201 mN

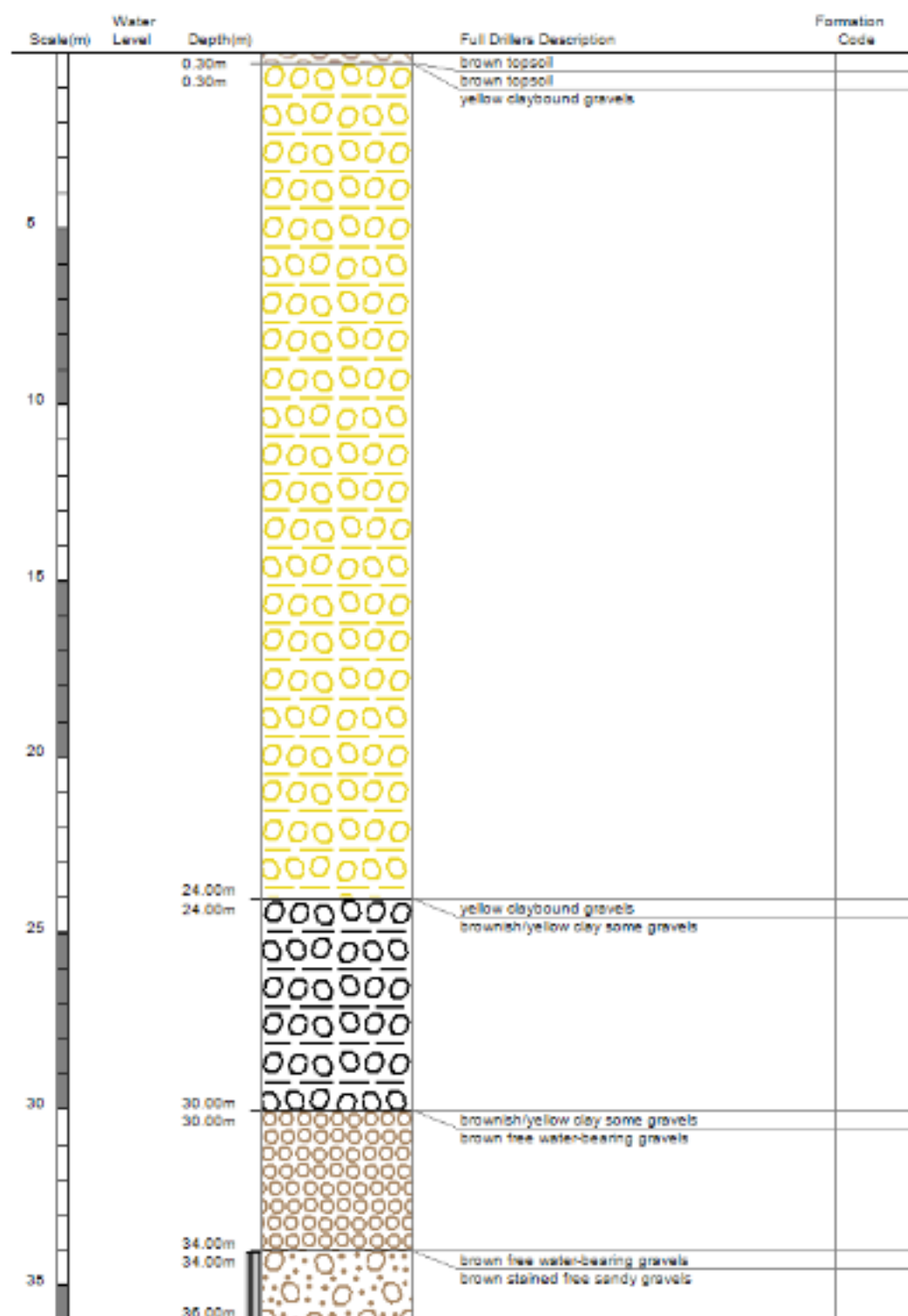
Location Accuracy: 10 - 50m

Ground Level Altitude: 35.3 m +MSD Accuracy: < 0.5 m

Driller: Daly Water Wells Ltd

Drill Method: Rotary Rig

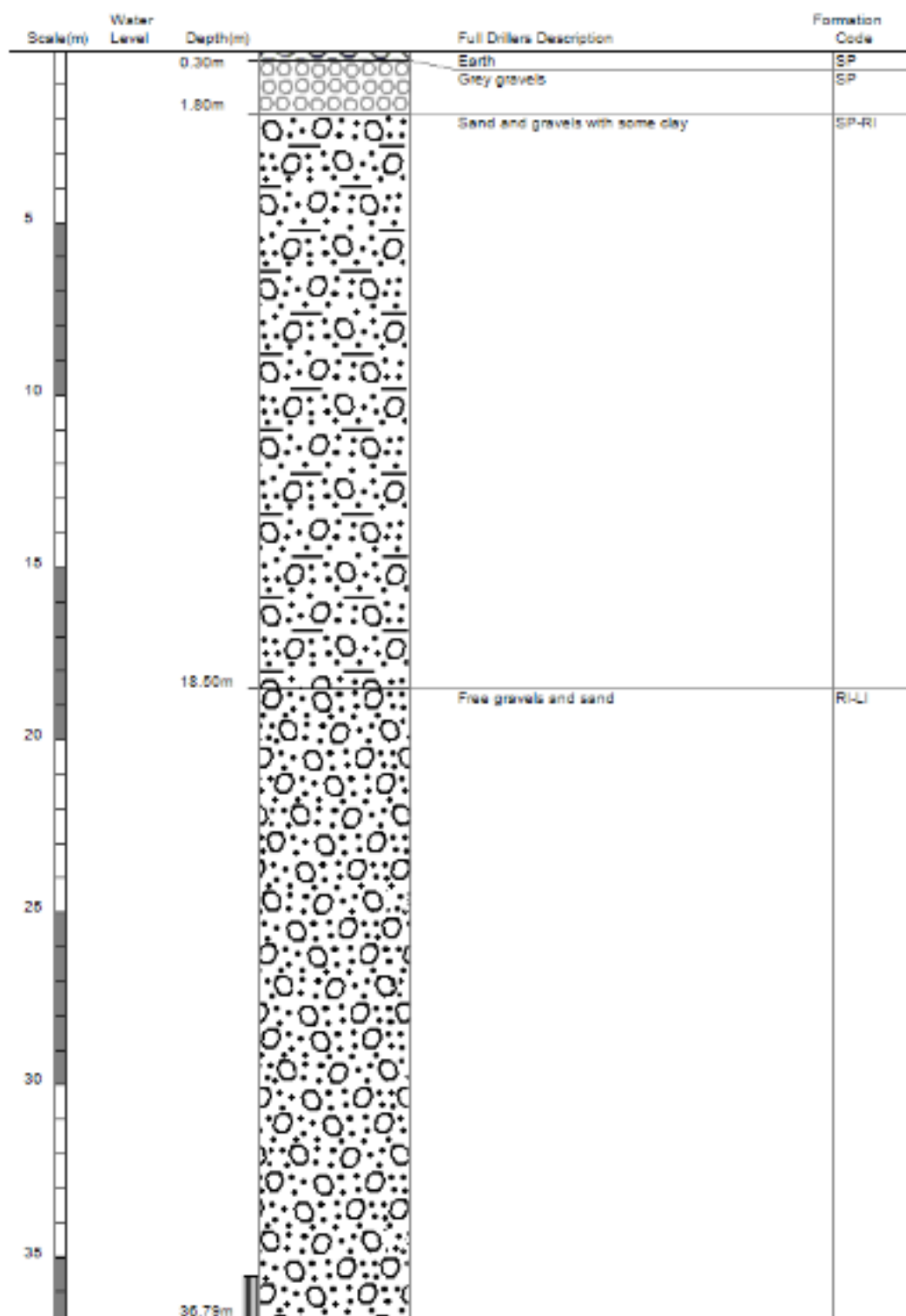
Borelog Depth: 36.0 m Drill Date: 18-Jan-2006



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Borelog for well M36/3868

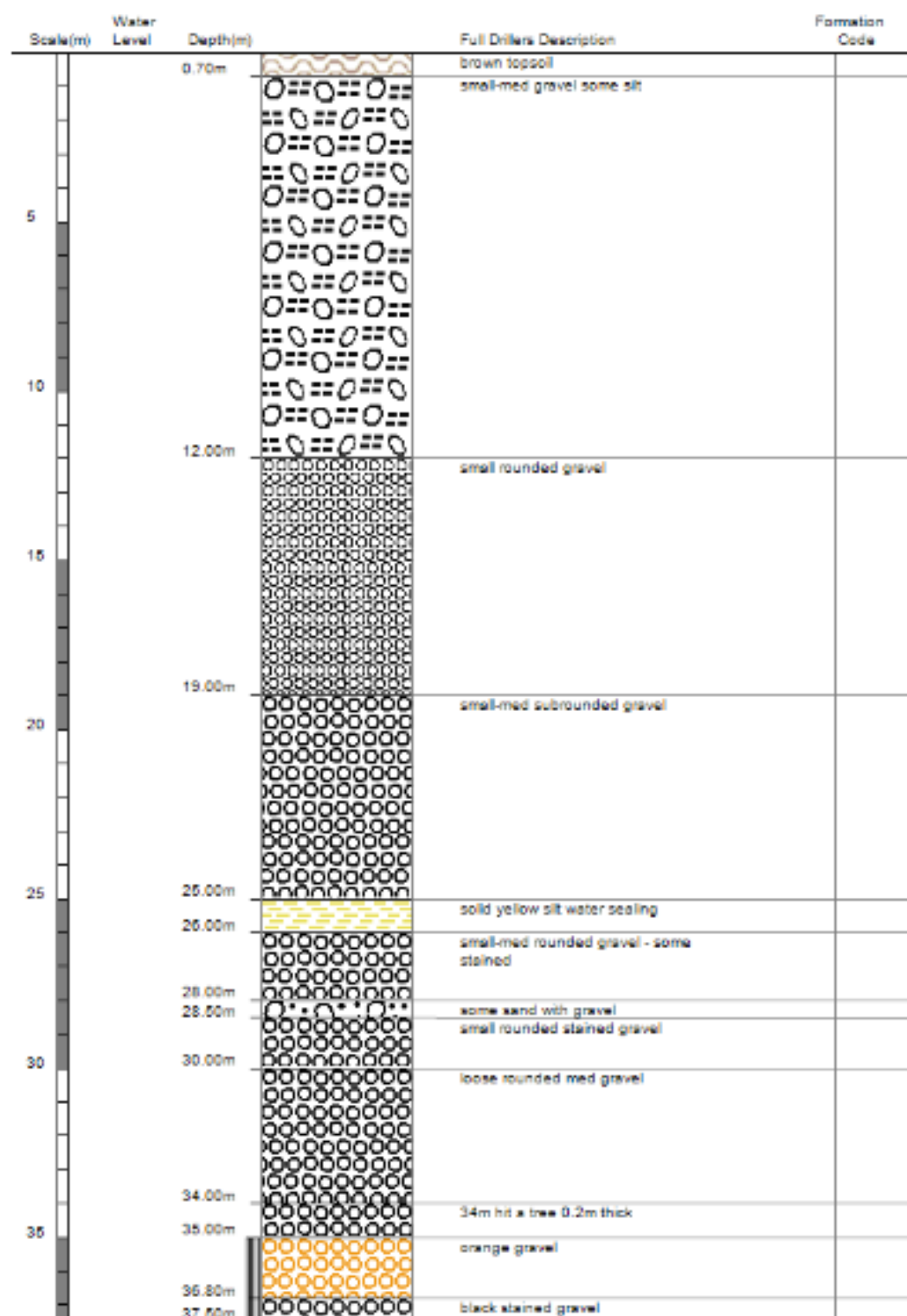
Grid Reference (NZTM): 1552494 mE, 5171203 mN
 Location Accuracy: 10 - 50m
 Ground Level Altitude: 38.4 m +MSD Accuracy: < 2.5 m
 Driller: McMillan Drilling Ltd
 Drill Method: Rotary/Percussion
 Borelog Depth: 36.8 m Drill Date: 18-Jan-1988



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Borelog for well M36/7975

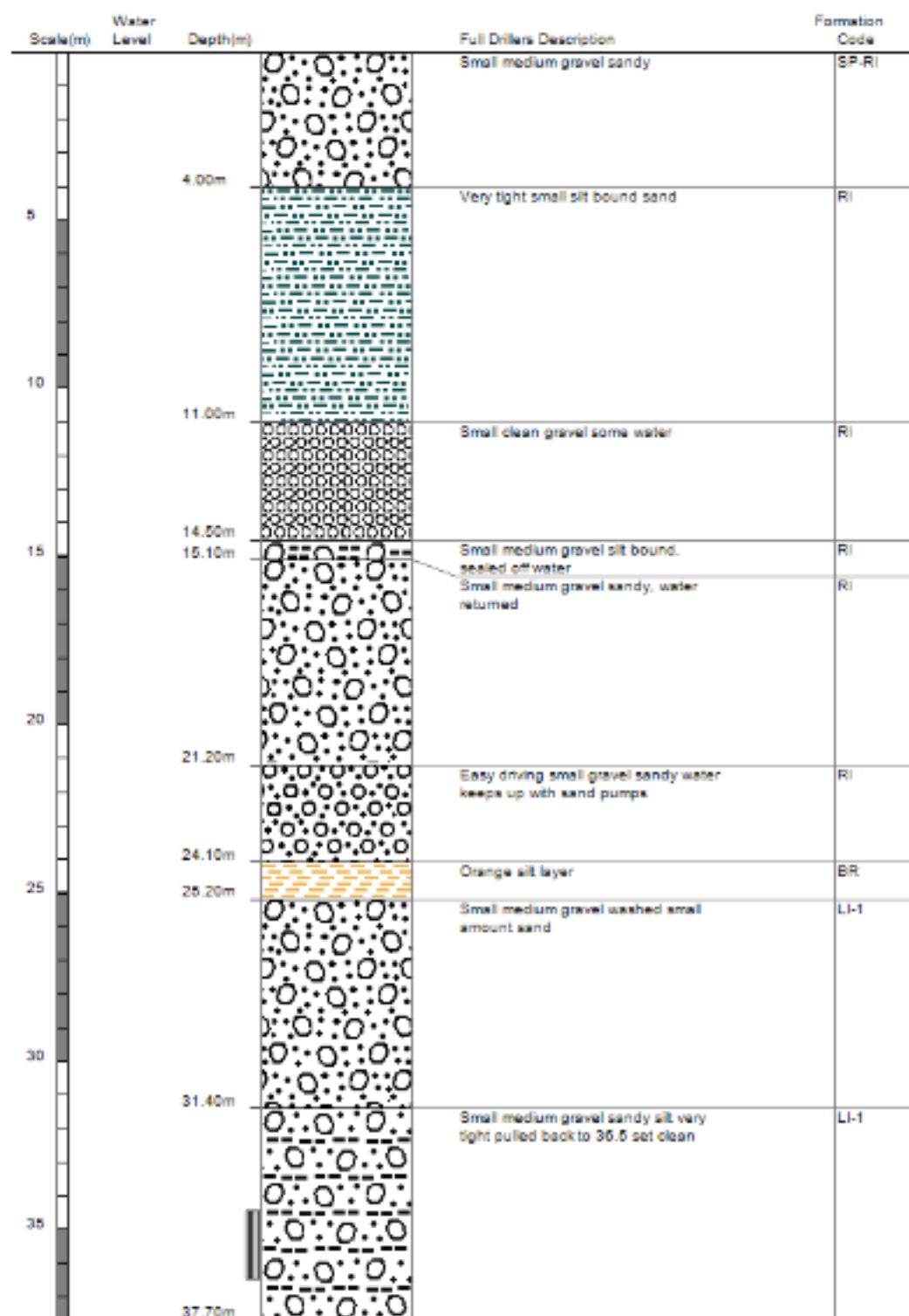
Grid Reference (NZTM): 1552317 mE, 5171001 mN
 Location Accuracy: 50 - 300m
 Ground Level Altitude: 37.7 m +MSD Accuracy: < 2.5 m
 Driller: Dynes Road Drilling
 Drill Method: Cable Tool
 Borelog Depth: 37.5 m Drill Date: 05-Sep-2005



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Borelog for well M36/6802

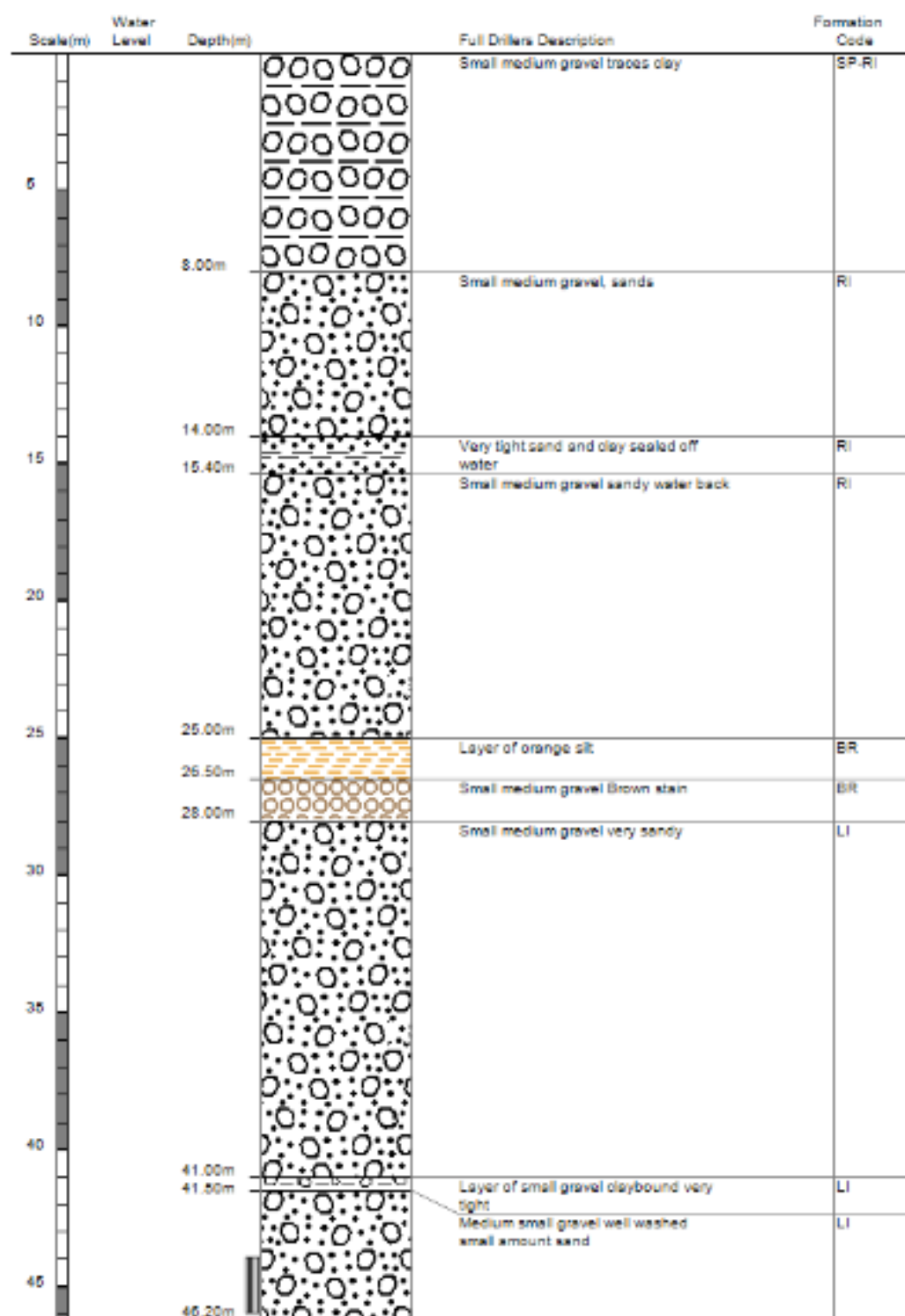
Grid Reference (NZTM): 1551451 mE, 5171282 mN
 Location Accuracy: 2 - 15m
 Ground Level Altitude: 41.1 m +MSD Accuracy: < 2.5 m
 Driller: Dynes Road Drilling
 Drill Method: Cable Tool
 Borelog Depth: 37.7 m Drill Date: 01-Sep-1994



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Borelog for well M36/4654

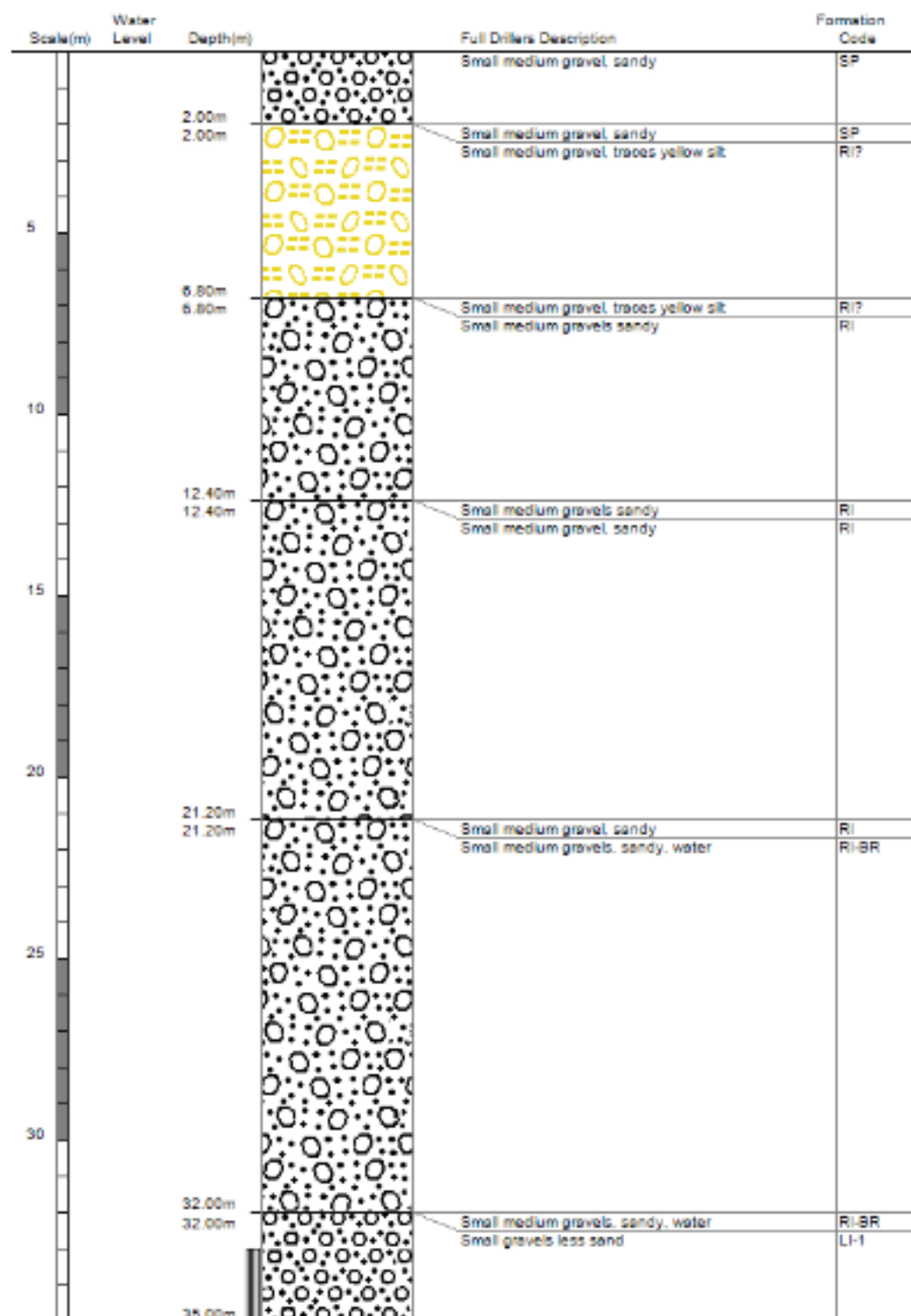
Grid Reference (NZTM): 1551472 mE, 5171149 mN
 Location Accuracy: 2 - 15m
 Ground Level Altitude: 40.3 m +MSD Accuracy: < 2.5 m
 Driller: Dynes Road Drilling
 Drill Method: Rotary/Percussion
 Borelog Depth: 46.2 m Drill Date: 01-Sep-1993



[Click here for a printable BoreLog](#)

Borelog for well M36/7565

Grid Reference (NZTM): 1551067 mE, 5171240 mN
 Location Accuracy: 50 - 300m
 Ground Level Altitude: 42.2 m +MSD Accuracy: < 0.5 m
 Driller: Dynes Road Drilling
 Drill Method: Cable Tool
 Borelog Depth: 35.0 m Drill Date: 01-Jan-2004



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Borelog for well M36/4987

Grid Reference (NZTM): 1550987 mE, 5171440 mN
 Location Accuracy: 50 - 300m
 Ground Level Altitude: 43.5 m +MSD Accuracy: < 2.5 m
 Driller: Dynes Road Drilling
 Drill Method: Cable Tool
 Borelog Depth: 26.0 m Drill Date: 01-Jun-1995

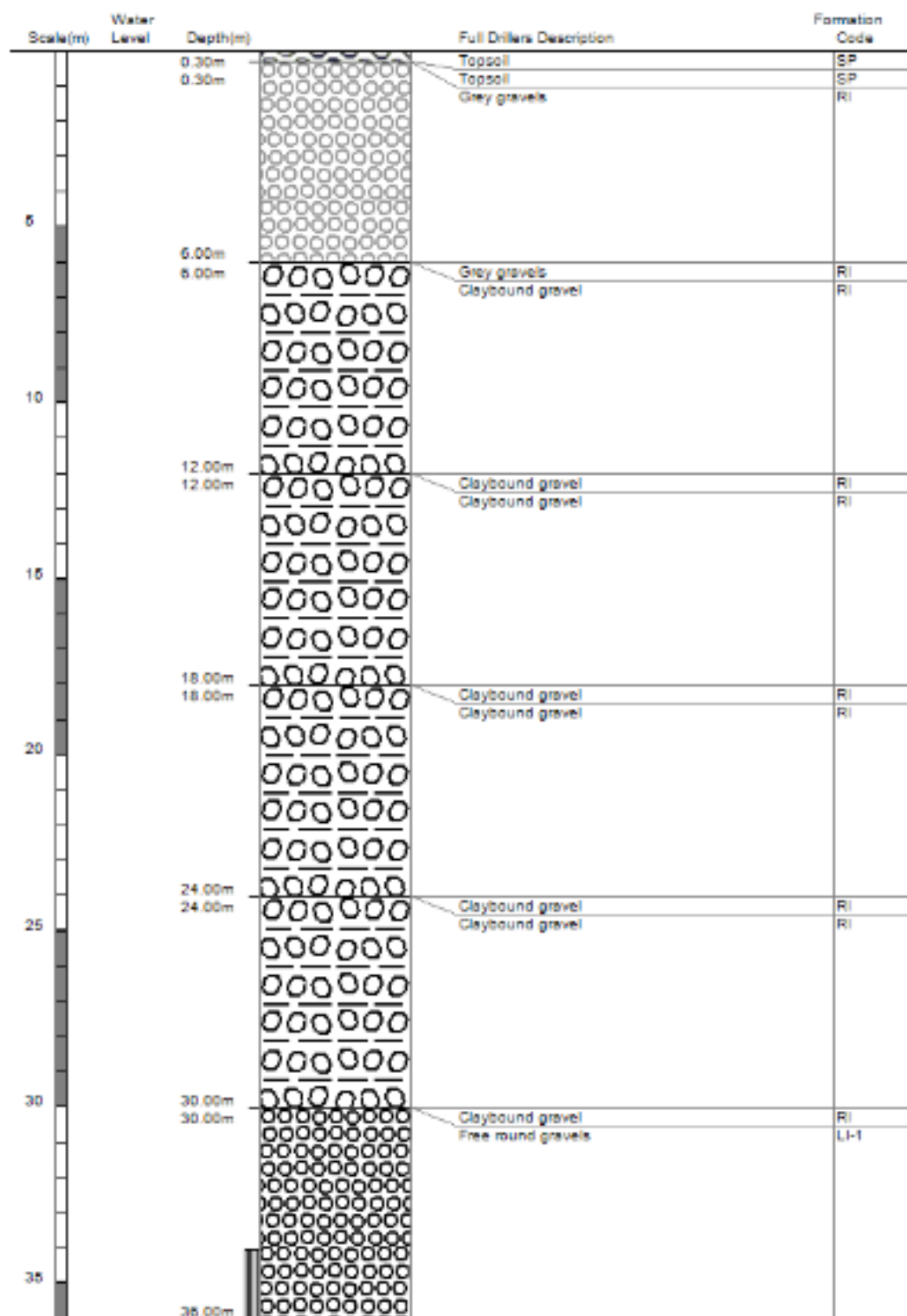


Scale(m)	Water Level	Depth(m)	Full Drillers Description	Formation Code
			Med large gravel	SP?
		2.00m	Small medium gravel silt bound	Ri
5		5.40m	Small gravel silt bound very tight	Ri
10		12.00m	Small gravel wet silt driving axsed up	Ri
15		21.50m	Casing driving easy small gravel clean Brown stain	Ri
20		26.00m		
25				

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Borelog for well M36/5641

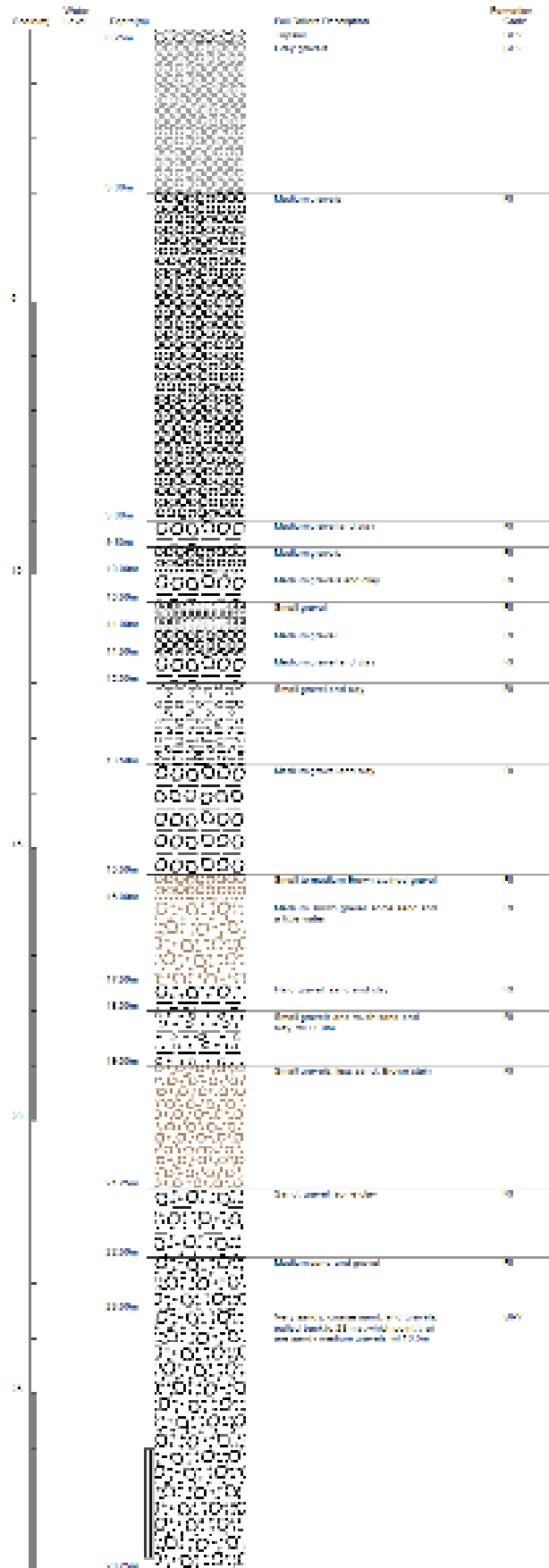
Grid Reference (NZTM): 1550817 mE, 5171460 mN
 Location Accuracy: 10 - 50m
 Ground Level Altitude: 44.0 m +MSD Accuracy: < 0.5 m
 Driller: East Coast Drilling
 Drill Method: Rotary Rig
 Borelog Depth: 36.0 m Drill Date: 29-May-1998



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Boeing for well N364010

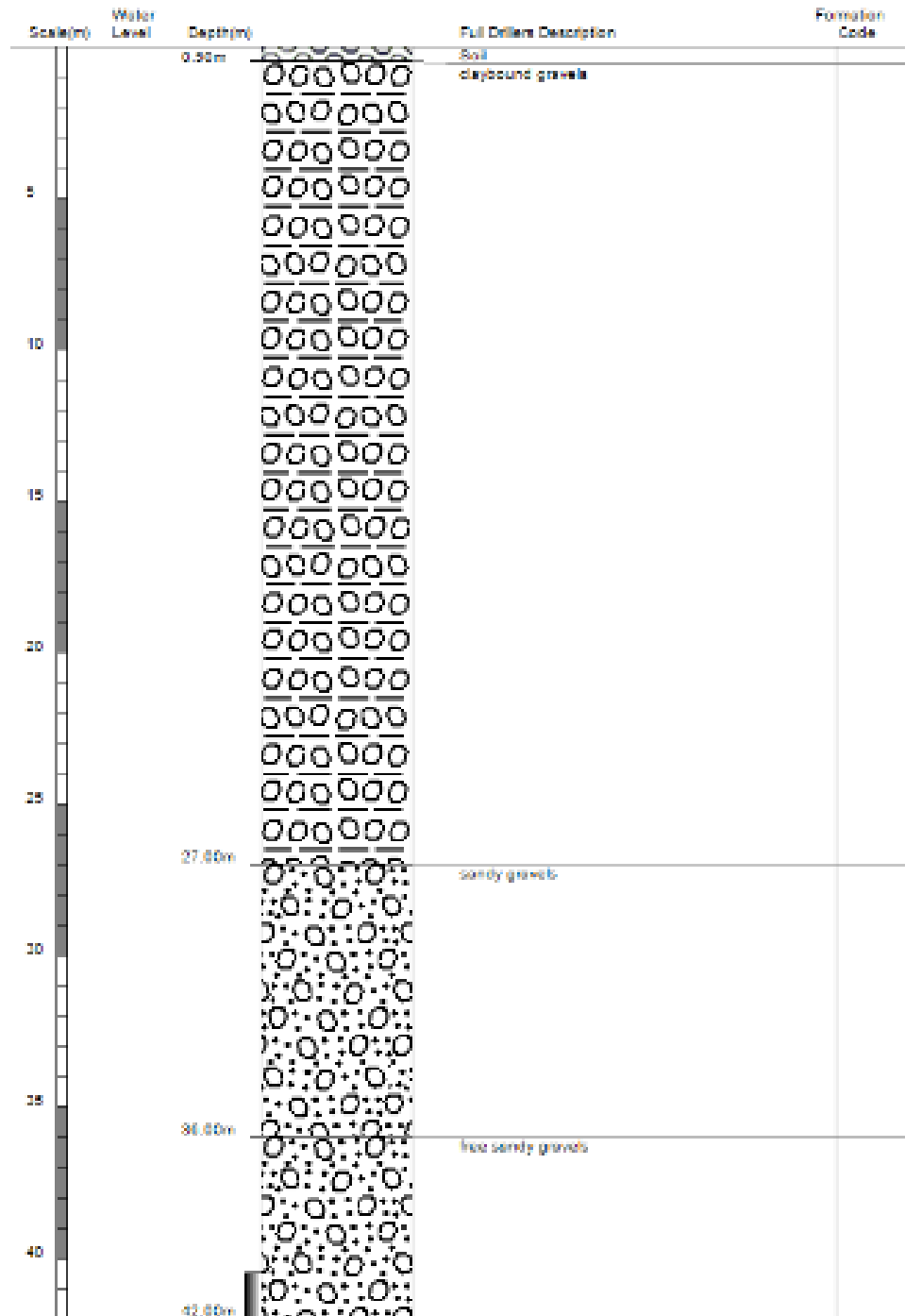
Grid Reference: 42TMA, 1580607 mE, 5171540 mN
 Location Accuracy: 50 - 100m
 Unpublished Results: 40 - 45% - about accuracy of 100m
 Filter: Faded by Fading Company
 Drill Method: Cable Tool
 Device Depth: 500 m Drill Date: 26-Mar-1959



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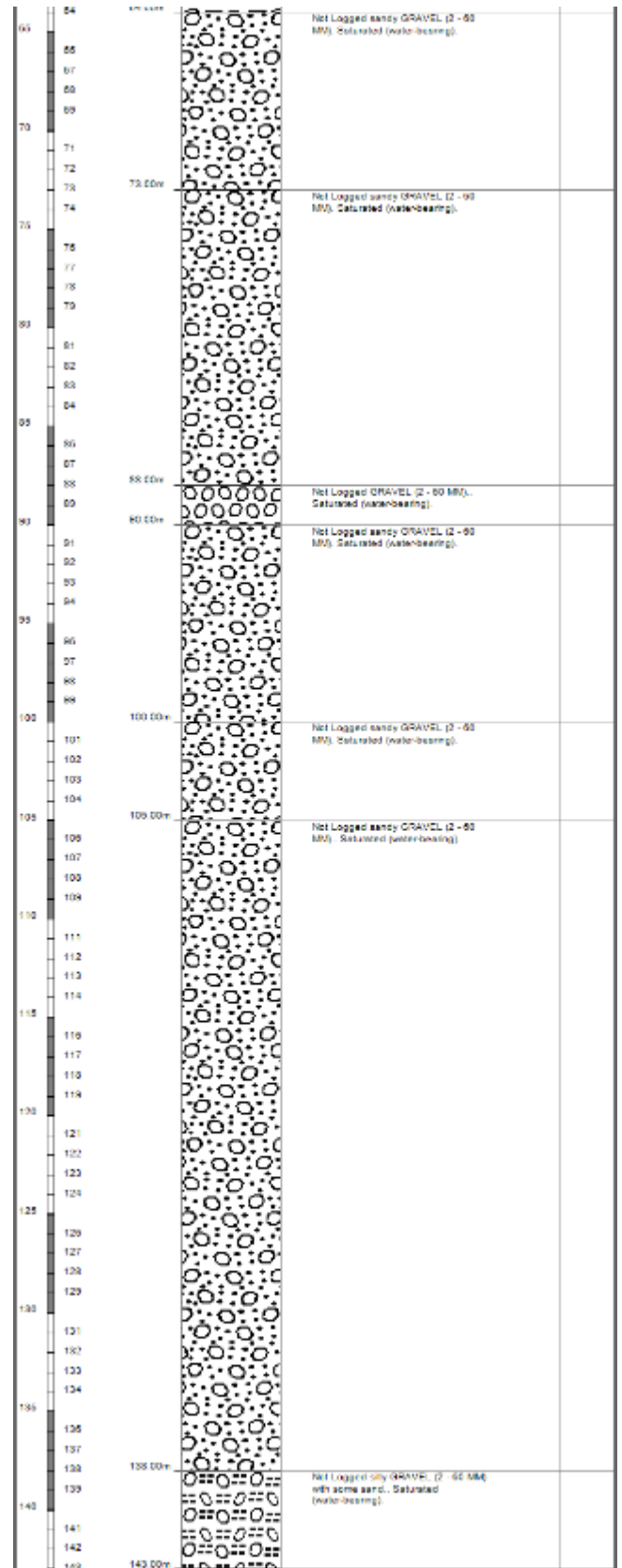
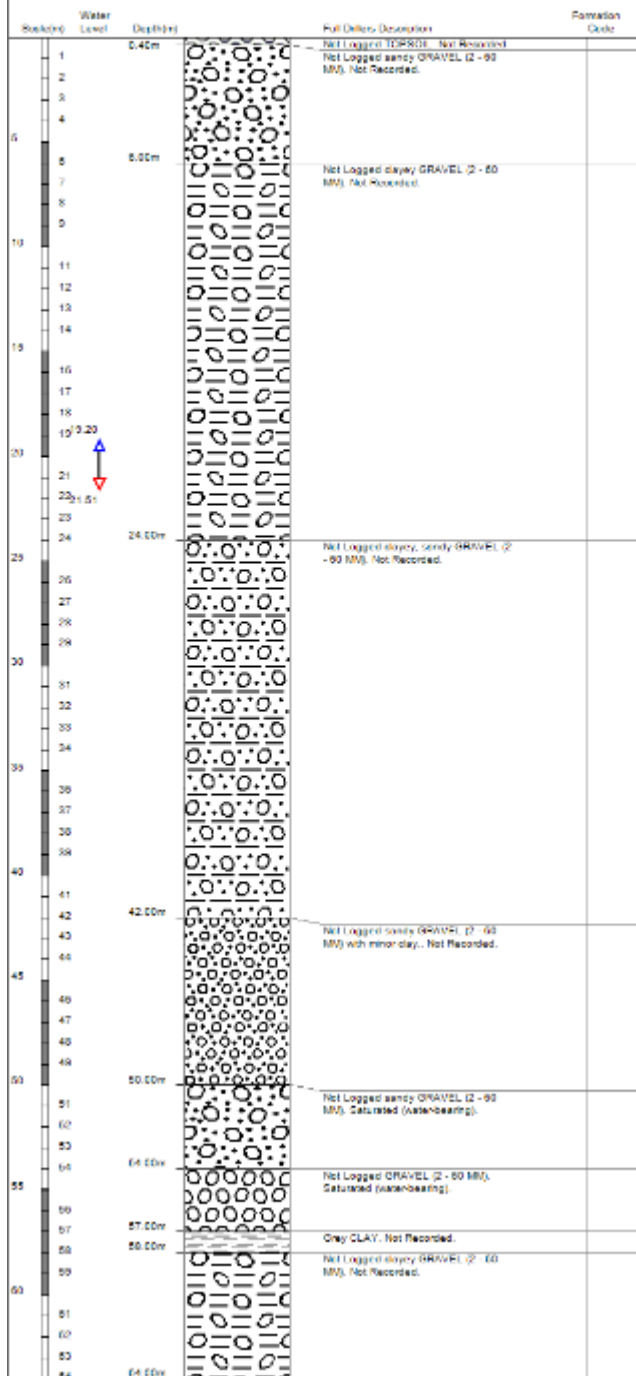
Borelog for well M36/7860

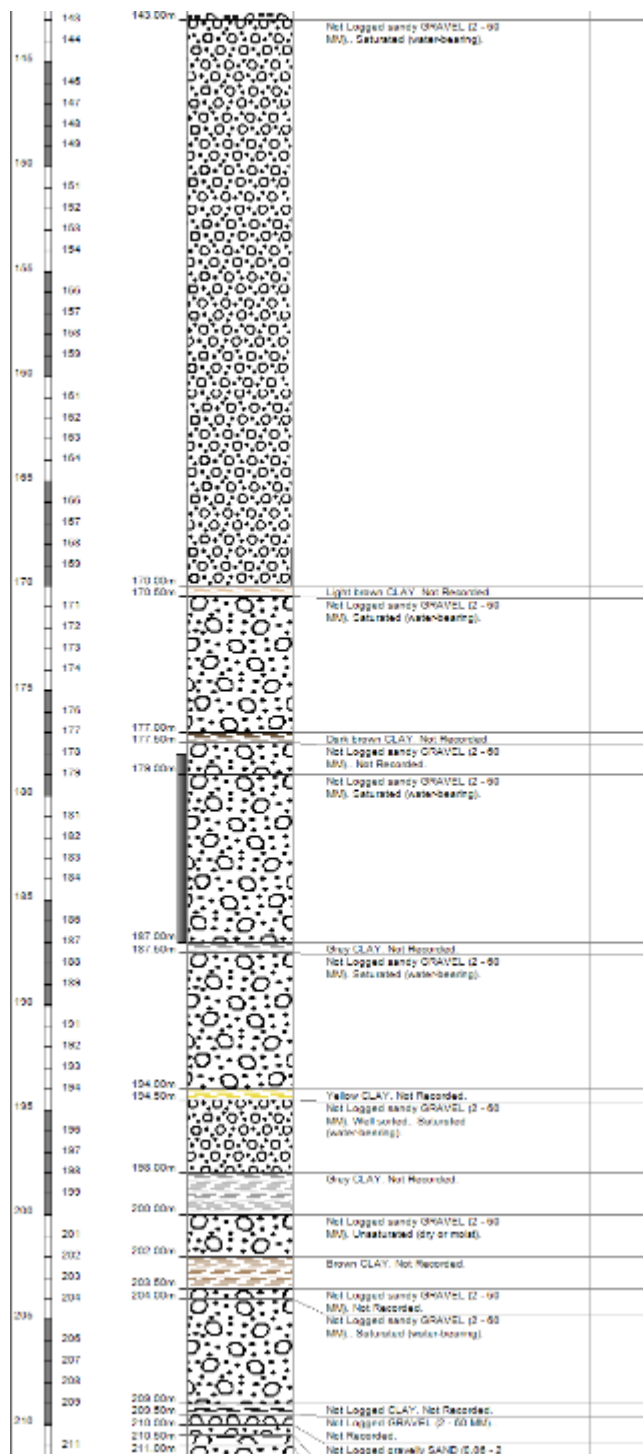
Grid Reference (NZTM): 1550977 mE, 5171720 mN
 Location Accuracy: 50 - 300m
 Ground Level Altitude: 44.7 m +MSD Accuracy: < 2.5 m
 Driller: Smiths Well Drilling
 Drill Method: Rotary Rig
 Borelog Depth: 42.0 m Drill Date: 22-Apr-2005



Borelog for well BX23/0508

Grid Reference (NZTM): 1551041 mE, 5172151 mN
 Location Accuracy: 10 - 50m
 Ground Level Altitude: m +MSD Accuracy:
 Driller: McMillan Drilling Ltd
 Drill Method: Rotary Percussion
 Borelog Depth: 211.5 m Drill Date: 02-May-2016




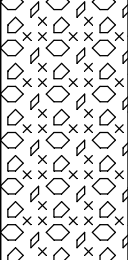
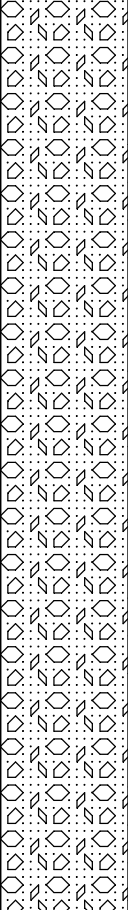









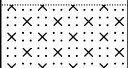
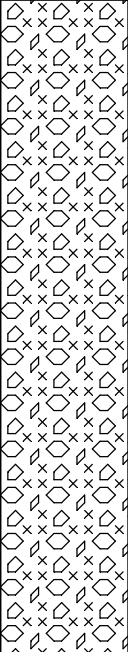
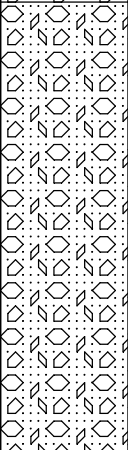








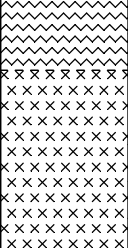









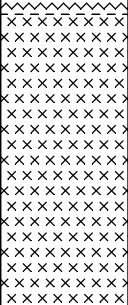
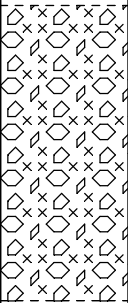
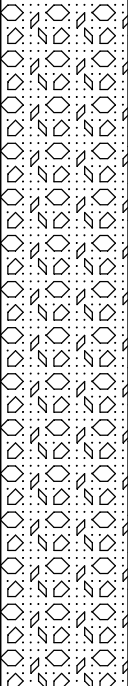




Appendix C




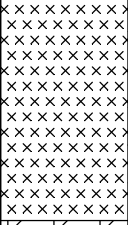
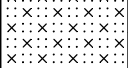
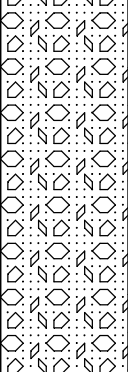




PDP Investigation Logs




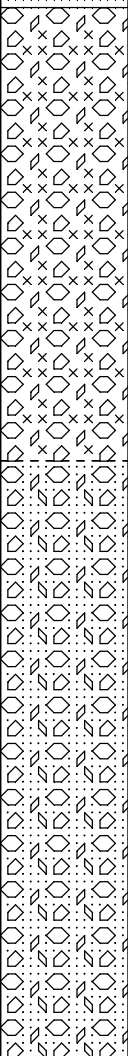
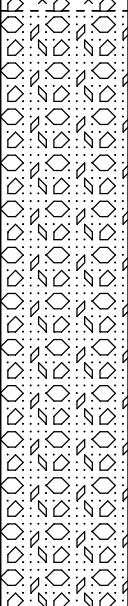




 		Log of Test Pit Branthwaite Drive Subdivision		PIT NO. TP1 JOB NO: C03533300	
CLIENT: Gillman Wheelans			LOCATION: 560 Springston Rolleston Road		
DATE: 22/11/2016		DATE BACKFILLED: 22/11/2016		LOGGED BY: Nick van Voorthuysen (PDP)	
SHEET 1 OF 1					
DESCRIPTION OF SOIL		GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS
SILTY topsoil, dark brown, homogenous, soft, dry			0.0		
			0.2		
Silty medium to coarse GRAVEL, light brown, homogeneous. Loosely packed, soft, dry; silt, fine.			0.4		
			0.6		
			0.8		
			1.0		
Sandy medium to coarse GRAVEL with some cobbles; dark grey, homogenous. Semi-loosely packed; moist; well graded; sub-angular to sub-rounded; sand, medium to coarse; minor silt.			1.2		
			1.4		
			1.6		
			1.8		
			2.0		
			2.2		
			2.4		
			2.6		
			2.8		
			3.0		
		3.2			
		3.4			
End of Test Pit at 3.44 m bgl					
Notes:		KEY  Groundwater level  Seepage inflow  Grab sample  PID Reading (ppm)		Method: Excavator CRS: EPSG:2193, NZTM Coordinates: 1551157 5171713	

 		Log of Test Pit Branthwaite Drive Subdivision		PIT NO. TP2 JOB NO: C03533300		
CLIENT: Gillman Wheelans			LOCATION: 87 Branthwaite Drive			
DATE: 21/11/2016		DATE BACKFILLED: 21/11/2016		LOGGED BY: Emily Barton (PDP)		
SHEET 1 OF 1						
DESCRIPTION OF SOIL		GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
SILTY topsoil, dark brown, homogenous, soft, dry			0.0			Groundwater Not Encountered
SILT, light grey, homogenous. Soft, dry.			0.2			
			0.4			
Silty SAND, light greyish-brown mottled orange. Firm, moist; sand, fine to medium; minor silt.			0.6			
			0.8			
Silty medium to coarse GRAVEL with some cobbles, light greyish brown, homogenous. Dry, well graded, greywacke gravel; silt; cobbles, sub-angular to sub-rounded.			1.0			
			1.2			
			1.4			
			1.6			
			1.8			
			2.0			
			2.2			
			2.4			
			2.6			
			2.8			
Sandy medium to coarse GRAVEL with some cobbles; dark grey, homogenous. Semi-loosely packed; moist; well graded; sub-angular to sub-rounded; sand, medium to coarse; minor silt.			3.0			
			3.2			
			3.4			
			3.6			
			3.8			
End of Test Pit at 3.84 m bgl						
Notes:		KEY  Groundwater level  Seepage inflow  Grab sample  PID Reading (ppm)		Method: Excavator CRS: EPSG:2193, NZTM Coordinates: 1551322 5171789		

  PATTLE DELAMORE PARTNERS LTD		Log of Test Pit Branthwaite Drive Subdivision		PIT NO. TP3 JOB NO: C03533300	
CLIENT: Gillman Wheelans		LOCATION: 69 Branthwaite Drive			
DATE: 22/11/2016	DATE BACKFILLED: 22/11/2016	LOGGED BY: Nick van Voorthuysen (PDP)		SHEET 1 OF 1	
DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
SILTY topsoil, dark brown, homogenous; soft.		0.0			Groundwater Not Encountered
SILT, dark brown, homogeneous. Soft to firm, moist.		0.2			
Silty medium GRAVEL with trace cobbles; dark brown, homogenous. Moist; well graded; sub-angular to sub-rounded; silt, medium; minor sand.	0.4				
	0.6				
	0.8				
	1.0				
	1.2				
	1.4				
Sandy medium to coarse GRAVEL with some cobbles; dark grey, homogenous. Semi-loosely packed; moist; well graded; sub-angular to sub-rounded; sand, medium to coarse; minor silt.	1.6				
	1.8				
	2.0				
	2.2				
	2.4				
	2.6				
	2.8				
	3.0				
	3.2				
	3.4				
	End of Test Pit at 3.47 m bgl				
	Notes:	KEY  Groundwater level  Seepage inflow  Grab sample  PID Reading (ppm)		Method: Excavator CRS: EPSG:2193, NZTM Coordinates: 1551626 5171754	

 		Log of Test Pit Branthwaite Drive Subdivision		PIT NO. TP4 JOB NO: C03533300		
CLIENT: Gillman Wheelans			LOCATION: 70 Branthwaite Drive			
DATE: 22/11/2016		DATE BACKFILLED: 22/11/2016		LOGGED BY: Nick van Voorthuysen (PDP)		
SHEET 1 OF 1						
DESCRIPTION OF SOIL		GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
SILTY topsoil, dark brown, homogenous; soft.			0.0			Groundwater Not Encountered
SILT, light greyish brown, homogeneous. Soft to firm, dry.			0.2			
			0.4			
			0.6			
			0.8			
			1.0			
Silty GRAVEL, light greyish brown. Tightly packed, dry, well graded, sub-angular to sub-rounded; silt.			1.2			
			1.4			
			1.6			
			1.8			
Sandy medium to coarse GRAVEL with some cobbles; dark grey, homogenous. Semi-loosely packed; moist; well graded; sub-angular to sub-rounded; sand, medium to coarse; minor silt.			2.0			
			2.2			
			2.4			
			2.6			
			2.8			
			3.0			
			3.2			
			3.4			
			3.6			
End of Test Pit at 3.67 m bgl						
Notes:		KEY  Groundwater level  Seepage inflow  Grab sample  PID Reading (ppm)		Method: Excavator CRS: EPSG:2193, NZTM Coordinates: 1551817 5171987		

  PATTLE DELAMORE PARTNERS LTD		Log of Test Pit Branthwaite Drive Subdivision			PIT NO. TP5 JOB NO: C03533300		
CLIENT: Gillman Wheelans			LOCATION: 215 Lincoln Rolleston Road				
DATE: 21/11/2016		DATE BACKFILLED: 21/11/2016		LOGGED BY: Emily Barton (PDP)		SHEET 1 OF 1	
DESCRIPTION OF SOIL			GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
SILTY topsoil, dark brown, homogenous. Soft, dry.				0.0			Groundwater Not Encountered
SILT, light grey, homogenous. Soft, dry.				0.2			
				0.4			
				0.6			
				0.8			
Silty medium to coarse GRAVEL with some cobbles, light greyish brown, homogenous. Dry; well graded; greywacke gravels; cobbles, sub-angular to sub-rounded; silt.				1.0			
				1.2			
				1.4			
				1.6			
				1.8			
				2.0			
							
			2.4				
Silty SAND, light greyish-brown mottled orange. Very firm, damp to moist; minor silt.			2.6				
Sandy medium to coarse GRAVEL with some cobbles; dark grey, homogenous. Semi-loosely packed; moist; well graded; sub-angular to sub-rounded; sand, medium to coarse; minor silt.			2.8				
			3.0				
			3.2				
			3.4				
				3.6			
End of Test Pit at 3.61 m bgl							
Notes:			KEY  Groundwater level  Seepage inflow  Grab sample  PID Reading (ppm)		Method: Excavator CRS: EPSG:2193, NZTM Coordinates: 1552162 5171988		

  PATTLE DELAMORE PARTNERS LTD		Log of Test Pit Branthwaite Drive Subdivision			PIT NO. TP6 JOB NO: C03533300	
CLIENT: Gillman Wheelans			LOCATION: 17 Branthwaite Drive			
DATE: 21/11/2016		DATE BACKFILLED: 21/11/2016		LOGGED BY: Emily Barton (PDP)		SHEET 1 OF 1
DESCRIPTION OF SOIL		GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
Silty TOPSOIL, dark brown. Soft to firm, dry.			0.0			Groundwater Not Encountered
SILT, light greyish brown, homogenous. Very firm, dry.			0.2			
Silty medium to coarse GRAVEL with some cobbles, light greyish brown, homogenous. Dry, well graded greywacke gravels; cobbles, sub-angular to sub-rounded. Minor silt.			0.4			
			0.6			
			0.8			
			1.0			
			1.2			
			1.4			
			1.6			
			1.8			
			2.0			
			2.2			
Sandy medium to coarse GRAVEL to gravelly SAND with some cobbles; dark grey, homogenous. Semi-loosely packed; moist; well graded; sub-angular to sub-rounded; sand, medium to coarse; minor silt.			2.4			
			2.6			
			2.8			
			3.0			
			3.2			
			3.4			
End of Test Pit at 3.58 m bgl						
Notes:		KEY  Groundwater level  Seepage inflow  Grab sample  PID Reading (ppm)		Method: Excavator CRS: EPSG:2193, NZTM Coordinates: 1552012 5171804		



Appendix D

Aurecon 2016 Investigation Logs



SOIL

> field guide sheet

FIELD DESCRIPTION OF SOIL

SEQUENCE OF TERMS – fraction – colour – structure – strength – moisture – bedding – plasticity – sensitivity – additional

GRAIN SIZE CRITERIA

TYPE	COARSE								FINE		ORGANIC
	Boulders	Cobbles	Gravel			Sand			Silt	Clay	Organic Soil
			coarse	medium	fine	coarse	medium	fine			
Size Range (mm)	200	60	20	6	2	0.6	0.2	0.06	0.002		
Graphic Symbol											

PROPORTIONAL TERMS DEFINITION (COARSE SOILS)

Fraction	Term	% of Soil Mass	Example
Major	(...) [UPPER CASE]	≥ 50 [major constituent]	GRAVEL
Subordinate	(...) y [lower case]	20 – 50	Sandy
Minor	with some ... with minor ...	12 – 20 5 – 12	with some sand with minor sand
	with trace of (or slightly)...	< 5	with trace of sand (slightly sandy)

DENSITY INDEX (RELATIVE DENSITY) TERMS

Descriptive Term	Density Index (I _D)	SPT "N" value (blows / 300 mm)	Dynamic Cone (blows / 100 mm)
Very dense	> 85	> 50	> 17
Dense	65 – 85	30 – 50	7 – 17
Medium dense	35 – 65	10 – 30	3 – 7
Loose	15 – 35	4 – 10	1 – 3
Very loose	< 15	< 4	0 – 2

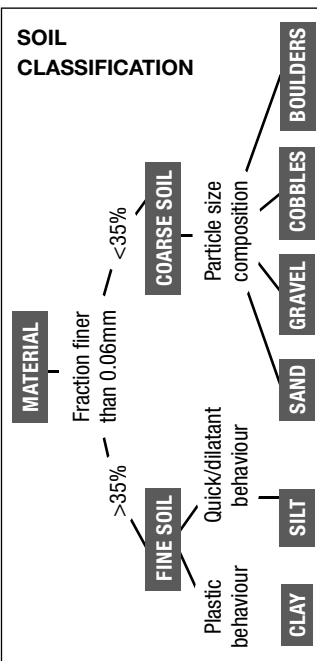
Note: • No correlation is implied between Standard Penetration Test (SPT) and Dynamic Cone Test values.
• SPT "N" values are uncorrected. • Dynamic Cone Penetrometer (Scala)

ORGANIC SOILS/ DESCRIPTORS

Term	Description
Topsoil	Surficial organic soil layer that may contain living matter. However topsoil may occur at greater depth, having been buried by geological processes or man-made fill, and should then be termed a buried topsoil.
Organic clay, silt or sand	Contains finely divided organic matter; may have distinctive smell; may stain; may oxidise rapidly. Describe as for inorganic soils.
Peat	Consists predominantly of plant remains. Firm: Fibres already compressed together Spongy: Very compressible and open structure Plastic: Can be moulded in hand and smears in fingers Fibrous: Plant remains recognisable and retain some strength Amorphous: No recognisable plant remains
Roolets	Fine, partly decomposed roots, normally found in the upper part of a soil profile or in a redeposited soil (e.g. colluvium or fill)
Carbonaceous	Discrete particles of hardened (carbonised) plant material.

PLASTICITY (CLAYS & SILTS)

Term	Description
High plasticity	Can be moulded or deformed over a wide range of moisture contents without cracking or showing any tendency to volume change
Low plasticity	When moulded can be crumbled in the fingers; may show quick or dilatant behaviour



CONSISTENCY TERMS FOR COHESIVE SOILS

Descriptive Term	Undrained Shear Strength (kPa)	Diagnostic Features
Very soft	< 12	Easily exudes between fingers when squeezed
Soft	12 – 25	Easily indented by fingers
Firm	25 – 50	Indented by strong finger pressure and can be indented by thumb pressure
Stiff	50 – 100	Cannot be indented by thumb pressure
Very stiff	100 – 200	Can be indented by thumb nail
Hard	200 – 500	Difficult to indent by thumb nail

MOISTURE CONDITION

Condition	Description	Granular Soils	Cohesive Soils
Dry	Looks and feels dry	Run freely through hands	Hard, powdery or friable
Moist	Feels cool, darkened in colour	Tend to cohere	Weakened by moisture, but no free water on hands when remoulding
Wet			Weakened by moisture, free water forms on hands when handling
Saturated	Feels cool, darkened in colour and free water is present on the sample		

GRADING (GRAVELS & SANDS)

Term	Description
Well graded	Good representation of all particle sizes from largest to smallest
Poorly graded	Limited representation of grain sizes - further divided into:
	Uniformly graded Most particles about the same size
	Gap graded Absence of one or more intermediate sizes

NZ GEOTECHNICAL SOCIETY INC

This field sheet has been taken from and should be used and read with reference to the document FIELD DESCRIPTION OF SOIL AND ROCK. Guideline For the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005. www.nzgeotechsoc.org.nz

HAND AUGER RECORD

HOLE NO. **HA1**

PROJECT NO. **254246**

PROJECT **Branthwaite Drive**

CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

SHEET **1** of **1**

METHOD **HA**

E 1551235

DATE from **25/11/2016** to **25/11/2016**

N 5171723

MACHINE & NO. **N/A**

ORIENTATION **VERTICAL**

GROUND-LEVEL **+47.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC....
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth HA 0.00		0.00		
		HA	+46.70	0.30		SILT with minor sand and trace of rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)
						End of Hand Auger at 0.30m, on 25/11/2016 Termination Reason: Too difficult to auger, unable to penetrate gravel.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **T. MITCHELL**

DATE **25/11/2016**

CHECKED **A. HILLS**

DATE **02/12/2016**

REMARKS

Groundwater not encountered.

Coordinates found using handheld GPS, likely accurate to +/- 5 m.

Ground level found using handheld GPS, likely accurate to +/- 10 m.

HAND AUGER RECORD

HOLE NO.

HA2

PROJECT NO.

254246

 PROJECT **Branthwaite Drive**

 CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

 SHEET **1** of **1**

 METHOD **HA**
E 1551391

 DATE from **25/11/2016** to **25/11/2016**
N 5171799

 MACHINE & NO. **N/A**

 ORIENTATION **VERTICAL**

 GROUND-LEVEL **+47.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC....
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth 0.00		0.00		
		HA	+46.70	0.30		SILT with minor sand and trace of rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)
						SILT with minor sand; light brown. Dry, low plasticity; sand, fine.
			+46.10	0.90		0.70m Becomes with some sand; greyish brown.
			+46.00	1.00		Sandy SILT; greyish brown. Moist, low plasticity; sand, fine to medium.
						End of Hand Auger at 1.00m, on 25/11/2016 Termination Reason: Too difficult to auger, unable to penetrate gravel.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

 LOGGED **T. MITCHELL**

 DATE **25/11/2016**

 CHECKED **A. HILLS**

 DATE **02/12/2016**

REMARKS

Groundwater not encountered.

Coordinates found using handheld GPS, likely accurate to +/- 5 m.

Ground level found using handheld GPS, likely accurate to +/- 10 m.

HAND AUGER RECORD

HOLE NO. **HA3**

PROJECT NO. **254246**

PROJECT **Branthwaite Drive**

CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

SHEET **1** of **1**

METHOD **HA**

E 1551358

DATE from **25/11/2016** to **25/11/2016**

N 5171707




MACHINE & NO. **N/A**

ORIENTATION **VERTICAL**

GROUND-LEVEL **+46.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth 0.00		0.00		
		HA	+45.70	0.30		SILT with minor sand and trace of rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)
						SILT with minor sand; brown. Dry, low plasticity; sand, fine. 0.40m Becomes light brown.
			+45.40	0.60		
						End of Hand Auger at 0.60m, on 25/11/2016 Termination Reason: Too difficult to auger, unable to penetrate gravel.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- ▼ Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- ✓ In-situ Vane Shear Test

LOGGED **T. MITCHELL**

DATE **25/11/2016**

CHECKED **A. HILLS**

DATE **02/12/2016**

REMARKS

Groundwater not encountered.

Coordinates found using handheld GPS, likely accurate to +/- 5 m.

Ground level found using handheld GPS, likely accurate to +/- 10 m.

HAND AUGER RECORD

HOLE NO. **HA4**

PROJECT NO. **254246**

PROJECT **Branthwaite Drive**

CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

SHEET **1** of **1**

METHOD **HA**

E 1551746

DATE from **25/11/2016** to **25/11/2016**

N 5171599



MACHINE & NO. **N/A**

ORIENTATION **VERTICAL**

GROUND-LEVEL **+43.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC....
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth 0.00		0.00		
		HA	+42.60	0.40		SILT with minor sand and trace of rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)
			+42.40	0.60		SILT with minor sand; brown. Dry, low plasticity; sand, fine. 0.50m Becomes light brown.
						End of Hand Auger at 0.60m, on 25/11/2016 Termination Reason: Too difficult to auger, unable to penetrate gravel.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **T. MITCHELL**

DATE **25/11/2016**

CHECKED **A. HILLS**

DATE **02/12/2016**

REMARKS

Groundwater not encountered.

Coordinates found using handheld GPS, likely accurate to +/- 5 m.

Ground level found using handheld GPS, likely accurate to +/- 10 m.

HAND AUGER RECORD

HOLE NO.

HA5

PROJECT NO.

254246

 PROJECT **Branthwaite Drive**

 CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

 SHEET **1** of **1**

 METHOD **HA**
E 1552172

 DATE from **25/11/2016** to **25/11/2016**
N 5171677




 MACHINE & NO. **N/A**

 ORIENTATION **VERTICAL**

 GROUND-LEVEL **+44.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth 0.00				
		HA	+43.80	0.20		SILT with minor sand and trace of rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)
						SILT with minor sand; light brown. Dry, low plasticity; sand, fine.
			+43.50	0.50		
						End of Hand Auger at 0.50m, on 25/11/2016 Termination Reason: Too difficult to auger, unable to penetrate gravel.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

 LOGGED **T. MITCHELL**

 DATE **25/11/2016**

 CHECKED **A. HILLS**

 DATE **02/12/2016**

REMARKS

Groundwater not encountered.

Coordinates found using handheld GPS, likely accurate to +/- 5 m.

Ground level found using handheld GPS, likely accurate to +/- 10 m.

HAND AUGER RECORD

HOLE NO.	HA6
PROJECT NO.	254246

PROJECT **Branthwaite Drive**

CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

SHEET **1** of **1**

METHOD **HA**
E 1551841

DATE from **25/11/2016** to **25/11/2016**
N 5172093




MACHINE & NO. **N/A**

ORIENTATION **VERTICAL**

GROUND-LEVEL **+48.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION
		Type Ref Depth 0.00		0.00		
		HA	+47.60	0.40		SILT with minor sand and trace of rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)
			+47.40	0.60		SILT; light brown. Dry, low plasticity; sand, fine.
			+47.20	0.80		Silty fine SAND; light brown. Dry.
						End of Hand Auger at 0.80m, on 25/11/2016 Termination Reason: Too difficult to auger, unable to penetrate gravel.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Test
- Packer Test
- In-situ Vane Shear Test

LOGGED **T. MITCHELL**

DATE **25/11/2016**

CHECKED **A. HILLS**

DATE **02/12/2016**

REMARKS

Groundwater not encountered.

Coordinates found using handheld GPS, likely accurate to +/- 5 m.

Ground level found using handheld GPS, likely accurate to +/- 10 m.

HAND AUGER RECORD

HOLE NO.

HA7

PROJECT NO.

254246

 PROJECT **Branthwaite Drive**

 CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

 SHEET **1** of **1**

 METHOD **HA**
E 1551813

 DATE from **25/11/2016** to **25/11/2016**
N 5171901

 MACHINE & NO. **N/A**

 ORIENTATION **VERTICAL**

 GROUND-LEVEL **+50.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth 0.00		0.00		
		HA	+49.70	0.30		SILT with minor sand and trace of rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)
						SILT with minor sand; light brown. Dry, low plasticity; sand, fine.
			+49.20	0.80		
						End of Hand Auger at 0.80m, on 25/11/2016 Termination Reason: Too difficult to auger, stiff soil encountered.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

 LOGGED **T. MITCHELL**

 DATE **25/11/2016**

 CHECKED **A. HILLS**

 DATE **05/12/2016**

REMARKS

Groundwater not encountered.

Coordinates found using handheld GPS, likely accurate to +/- 5 m.

Ground level found using handheld GPS, likely accurate to +/- 10 m.

HAND AUGER RECORD

HOLE NO. **HA8**

PROJECT NO. **254246**

PROJECT **Branthwaite Drive**

CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

SHEET **1** of **1**

METHOD **HA**

E 1551308

DATE from **25/11/2016** to **25/11/2016**

N 5171552



MACHINE & NO. **N/A**

ORIENTATION **VERTICAL**

GROUND-LEVEL **+44.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth 0.00				
		HA	+43.80	0.20		SILT with minor sand and trace of rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)
			+43.70	0.30		SILT with minor sand; light brown. Dry, low plasticity; sand, fine.
						End of Hand Auger at 0.30m, on 25/11/2016 Termination Reason: Too difficult to auger, unable to penetrate gravel.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **T. MITCHELL**

DATE **25/11/2016**

CHECKED **A. HILLS**

DATE **02/12/2016**

REMARKS

Groundwater not encountered.

Coordinates found using handheld GPS, likely accurate to +/- 5 m.

Ground level found using handheld GPS, likely accurate to +/- 10 m.

HAND AUGER RECORD

HOLE NO. **HA9**

PROJECT NO. **254246**

PROJECT **Branthwaite Drive**

CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

SHEET **1** of **1**

METHOD **HA**

E 1551345

DATE from **25/11/2016** to **25/11/2016**

N 5171493




MACHINE & NO. **N/A**

ORIENTATION **VERTICAL**

GROUND-LEVEL **+46.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth 0.00				
		HA	+45.80	0.20		SILT with minor sand and trace of rootlets; dark brown. Moist, low plasticity; sand, fine. (TOPSOIL)
			+45.60	0.40		Sandy SILT; light brown. Dry, low plasticity; sand, fine.
			+45.40	0.60		Silty fine SAND; light brown. Moist.
						End of Hand Auger at 0.60m, on 25/11/2016 Termination Reason: Too difficult to auger, unable to penetrate gravel.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **T. MITCHELL**

DATE **25/11/2016**

CHECKED **A. HILLS**

DATE **02/12/2016**

REMARKS

Groundwater not encountered.

Coordinates found using handheld GPS, likely accurate to +/- 5 m.

Ground level found using handheld GPS, likely accurate to +/- 10 m.

HAND AUGER RECORD

HOLE NO. **HA101**

PROJECT NO. **254246**

PROJECT **Falcons Landing
Rolleston**

CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

SHEET **1** of **1**

METHOD **HA**

E 1551945

DATE from **09/02/2017** to **09/02/2017**

N 5171270

MACHINE & NO. **NA**

ORIENTATION **VERTICAL**

GROUND-LEVEL **+39.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION
		Type Ref Depth 0.00		0.00		
		HA	+38.70	0.30		SILT with minor sand and trace of rootlets; dark brown. Dry, low plasticity; sand, fine to medium. (TOPSOIL)
						SILT with minor sand; light brown with orange mottles. Dry, low plasticity; sand, fine to medium.
			+38.35	0.65		End of Hand Auger at 0.65m, on 09/02/2017 Termination Reason: Too difficult to auger, gravel encountered.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Test
- Packer Test
- In-situ Vane Shear Test

LOGGED **J. MARTIN**

DATE **09/02/2017**

CHECKED **D. MAHONEY**

DATE **10/02/2017**

REMARKS

Co-ordinates were obtained from Google Earth and are approximate only.

HAND AUGER RECORD

 HOLE NO. **HA102**

 PROJECT NO. **254246**

 PROJECT **Falcons Landing
Rolleston**

 CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

 SHEET **1** of **1**

 METHOD **HA**
E 1552035

 DATE from **09/02/2017** to **09/02/2017**
N 5171315

 MACHINE & NO. **NA**

 ORIENTATION **VERTICAL**

 GROUND-LEVEL **+40.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
Type	Ref	Depth		0.00		
						SILT with minor sand and trace of rootlets; dark brown. Dry, low plasticity; sand, fine to medium. (TOPSOIL)
			+39.70	0.30		
						SILT with minor sand; light brown. Dry, low plasticity; sand, fine to medium.
			+39.35	0.65		
						End of Hand Auger at 0.65m, on 09/02/2017 Termination Reason: Too difficult to auger, gravel encountered.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

 LOGGED **J. MARTIN**

 DATE **09/02/2017**

 CHECKED **D. MAHONEY**

 DATE **10/02/2017**

REMARKS

Co-ordinates were obtained from Google Earth and are approximate only.

HAND AUGER RECORD

 HOLE NO. **HA103**

 PROJECT NO. **254246**

 PROJECT **Falcons Landing
Rolleston**

 CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

 SHEET **1** of **1**

 METHOD **HA**
E 1552100

 DATE from **09/02/2017** to **09/02/2017**
N 5171255

 MACHINE & NO. **NA**

 ORIENTATION **VERTICAL**

 GROUND-LEVEL **+39.00** m RL

STRATA DESCRIPTION

 SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION
		Type Ref Depth 0.00		0.00		
		HA				
			+38.80	0.20		SILT with minor sand and trace of rootlets; dark brown. Dry, low plasticity; sand, fine to medium. (TOPSOIL)
						SILT with minor sand; light brown. Dry, low plasticity; sand, fine to medium.
			+38.50	0.50		
						End of Hand Auger at 0.50m, on 09/02/2017 Termination Reason: Too difficult to auger, gravel encountered.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

 LOGGED **J. MARTIN**

 DATE **09/02/2017**

 CHECKED **D. MAHONEY**

 DATE **10/02/2017**

REMARKS

Co-ordinates were obtained from Google Earth and are approximate only.

HAND AUGER RECORD

 HOLE NO. **HA104**

 PROJECT NO. **254246**

 PROJECT **Falcons Landing
Rolleston**

 CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

 SHEET **1** of **1**

 METHOD **HA**
E 1551995

 DATE from **09/02/2017** to **09/02/2017**
N 5171210

 MACHINE & NO. **NA**

 ORIENTATION **VERTICAL**

 GROUND-LEVEL **+39.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth		0.00		
		HA				SILT with minor sand and trace of rootlets; dark brown. Dry, low plasticity; sand, fine to medium. (TOPSOIL)
			+38.80	0.20		SILT with minor sand; light brown with orange mottles. Dry, low plasticity; sand, fine to medium.
			+38.50	0.50		
End of Hand Auger at 0.50m, on 09/02/2017 Termination Reason: Too difficult to auger, gravel encountered.						

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

 LOGGED **J. MARTIN**

 DATE **09/02/2017**

 CHECKED **D. MAHONEY**

 DATE **10/02/2017**

REMARKS

Co-ordinates were obtained from Google Earth and are approximate only.

HAND AUGER RECORD

 HOLE NO. **HA105**

 PROJECT NO. **254246**

 PROJECT **Falcons Landing
Rolleston**

 CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

 SHEET **1** of **1**

 METHOD **HA**
E 1551616

 DATE from **09/02/2017** to **09/02/2017**
N 5171270

 MACHINE & NO. **NA**

 ORIENTATION **VERTICAL**

 GROUND-LEVEL **+40.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION
		Type Ref Depth 0.00		0.00		
		HA	+39.85	0.15		SILT with minor sand and trace of rootlets; dark brown. Dry, low plasticity; sand, fine to medium. (TOPSOIL)
			+39.65	0.35		SILT with some sand; light brown. Dry, low plasticity; sand, fine to medium.
						End of Hand Auger at 0.35m, on 09/02/2017 Termination Reason: Too difficult to auger, gravel encountered.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

 LOGGED **J. MARTIN**

 DATE **09/02/2017**

 CHECKED **D. MAHONEY**

 DATE **10/02/2017**

REMARKS

Co-ordinates were obtained from Google Earth and are approximate only.

HAND AUGER RECORD

HOLE NO. **HA106**

PROJECT NO. **254246**

PROJECT **Falcons Landing
Rolleston**

CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

SHEET **1** of **1**

METHOD **HA**
E 1551551

DATE from **09/02/2017** to **09/02/2017**
N 5171379

MACHINE & NO. **NA**

ORIENTATION **VERTICAL**

GROUND-LEVEL **+40.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC....
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth		0.00		
		HA				SILT with some sand and trace of rootlets; dark brown. Dry, low plasticity; sand, fine to medium. (TOPSOIL)
			+39.70	0.30		
						SILT with some sand; light brown with orange mottles. Dry, low plasticity; sand, fine to medium.
			+39.20	0.80		
						End of Hand Auger at 0.80m, on 09/02/2017 Termination Reason: Too difficult to auger, gravel encountered.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **J. MARTIN**

DATE **09/02/2017**

CHECKED **D. MAHONEY**

DATE **10/02/2017**

REMARKS

Co-ordinates were obtained from Google Earth and are approximate only.

HAND AUGER RECORD

 HOLE NO. **HA107**

 PROJECT NO. **254246**

 PROJECT **Falcons Landing
Rolleston**

 CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

 SHEET **1** of **1**

 METHOD **HA**
E 1551633

 DATE from **09/02/2017** to **09/02/2017**
N 5171394

 MACHINE & NO. **NA**

 ORIENTATION **VERTICAL**

 GROUND-LEVEL **+41.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth		0.00		
		HA				SILT with minor sand and trace of rootlets; dark brown. Dry, low plasticity; sand, fine to medium. (TOPSOIL)
			+40.75	0.25		SILT with some sand; light brown. Dry, low plasticity; sand, fine to medium.
						0.60m Becomes light brown with orange mottles.
			+40.30	0.70		End of Hand Auger at 0.70m, on 09/02/2017 Termination Reason: Too difficult to auger, gravel encountered.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Test
- Packer Test
- In-situ Vane Shear Test

 LOGGED **J. MARTIN**

 DATE **09/02/2017**

 CHECKED **D. MAHONEY**

 DATE **10/02/2017**

REMARKS

Co-ordinates were obtained from Google Earth and are approximate only.

HAND AUGER RECORD

 HOLE NO. **HA108**

 PROJECT NO. **254246**

 PROJECT **Falcons Landing
Rolleston**

 CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

 SHEET **1** of **1**

 METHOD **HA**
E 1551688

 DATE from **09/02/2017** to **09/02/2017**
N 5171292

 MACHINE & NO. **NA**

 ORIENTATION **VERTICAL**

 GROUND-LEVEL **+41.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth		0.00		
		HA				SILT with some sand and trace of rootlets; dark brown. Dry, low plasticity; sand, fine to medium. (TOPSOIL)
			+40.75	0.25		SILT with some sand; light brown. Dry, low plasticity; sand, fine to medium.
			+40.35	0.65		0.60m Becomes light brown with orange mottles.
						End of Hand Auger at 0.65m, on 09/02/2017 Termination Reason: Too difficult to auger, gravel encountered.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Test
- Packer Test
- In-situ Vane Shear Test

 LOGGED **J. MARTIN**

 DATE **09/02/2017**

 CHECKED **D. MAHONEY**

 DATE **10/02/2017**

REMARKS

Co-ordinates were obtained from Google Earth and are approximate only.

HAND AUGER RECORD

 HOLE NO. **HA109**

 PROJECT NO. **254246**

 PROJECT **Falcons Landing
Rolleston**

 CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

 SHEET **1** of **1**

 METHOD **HA**
E 1551657

 DATE from **09/02/2017** to **09/02/2017**
N 5172119

 MACHINE & NO. **NA**

 ORIENTATION **VERTICAL**

 GROUND-LEVEL **+43.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	
		Type Ref Depth		0.00		
						SILT with minor sand and trace of rootlets; dark brown. Dry, low plasticity; sand, fine to medium. (TOPSOIL)
			+42.75	0.25		
						SILT with some sand; light brown with orange mottles. Dry, low plasticity; sand, fine to medium.
		HA				
			+42.00	1.00		
						End of Hand Auger at 1.00m, on 09/02/2017 Termination Reason: Too difficult to auger, gravel encountered.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

 LOGGED **J. MARTIN**

 DATE **09/02/2017**

 CHECKED **D. MAHONEY**

 DATE **10/02/2017**

REMARKS

Co-ordinates were obtained from Google Earth and are approximate only.

<ul style="list-style-type: none"> Small Disturbed Sample Large Disturbed Sample SPT Liner Sample Thin Wall Undisturbed Sample U100 Undisturbed Sample Pocket Penetrometer Test Piston Sample 	<ul style="list-style-type: none"> Water Level Impression Packer Test Standard Penetration Test Permeability Test Piezometer / Standpipe Tip Packer Test In-situ Vane Shear Test 	<p>LOGGED <u>J. MARTIN</u></p> <p>DATE <u>09/02/2017</u></p> <p>CHECKED <u>D. MAHONEY</u></p> <p>DATE <u>10/02/2017</u></p>	<p>REMARKS</p> <p>Co-ordinates were obtained from Google Earth and are approximate only.</p>
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HAND AUGER RECORD

HOLE NO. **HA111**

PROJECT NO. **254246**

PROJECT **Falcons Landing
Rolleston**

CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

SHEET **1** of **1**

METHOD **HA**

E 1551728

DATE from **09/02/2017** to **09/02/2017**

N 5171996

MACHINE & NO. **NA**

ORIENTATION **VERTICAL**

GROUND-LEVEL **+42.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION
		Type Ref Depth 0.00		0.00		
						SILT with minor sand and trace of rootlets; dark brown. Dry, low plasticity; sand, fine to medium. (TOPSOIL)
			+41.75	0.25		SILT with minor sand; light brown. Dry, low plasticity; sand, fine to medium.
		HA				0.80m Becomes brown with orange mottles and moist.
			+40.90	1.10		End of Hand Auger at 1.10m, on 09/02/2017 Termination Reason: Too difficult to auger, gravel encountered.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **J. MARTIN**

DATE **09/02/2017**

CHECKED **D. MAHONEY**

DATE **10/02/2017**

REMARKS

Co-ordinates were obtained from Google Earth and are approximate only.

HAND AUGER RECORD

HOLE NO. **HA112**

PROJECT NO. **254246**

PROJECT **Falcons Landing
Rolleston**

CLIENT **GW Rolleston Ltd.**

CO-ORDINATES (NZTM)

SHEET **1** of **1**

METHOD **HA**

E 1551781

DATE from **09/02/2017** to **09/02/2017**

N 5172081

MACHINE & NO. **NA**

ORIENTATION **VERTICAL**

GROUND-LEVEL **+42.00** m RL

STRATA DESCRIPTION

SUBORDINATE FRACTION, MAJOR FRACTION, MINOR FRACTION, COLOUR,
STRUCTURE, STRENGTH, MOISTURE CONDITION
GRADING, BEDDING, PLASTICITY, ETC...
(NZ GEOTECHNICAL SOCIETY - FIELD DESCRIPTION OF SOIL AND ROCK)

Water level	Tests	Samples	Reduced Level	Depth (m)	Legend	STRATA DESCRIPTION
		Type Ref Depth		0.00		
		↑				SILT with minor sand and trace of rootlets; dark brown. Dry, low plasticity; sand, fine to medium. (TOPSOIL)
			+41.80	0.20		
		HA				SILT with some sand; light brown with orange mottles. Dry, low plasticity; sand, fine to medium.
		↓	+41.30	0.70		
						End of Hand Auger at 0.70m, on 09/02/2017 Termination Reason: Too difficult to auger, gravel encountered.

- Small Disturbed Sample
- Large Disturbed Sample
- SPT Liner Sample
- Thin Wall Undisturbed Sample
- U100 Undisturbed Sample
- Pocket Penetrometer Test
- Piston Sample
- Water Level
- Impression Packer Test
- Standard Penetration Test
- Permeability Test
- Piezometer / Standpipe Tip
- Packer Test
- In-situ Vane Shear Test

LOGGED **J. MARTIN**

DATE **09/02/2017**

CHECKED **D. MAHONEY**

DATE **10/02/2017**

REMARKS

Co-ordinates were obtained from Google Earth and are approximate only.



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Swaziland, Tanzania, Thailand, Uganda,
United Arab Emirates, Vietnam.