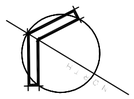
Appendix A

Development Site

A2



LEGEND

- SPOTHEIGHT
- POWER POLE
- OVERHEAD POWERLINES
- FENCE

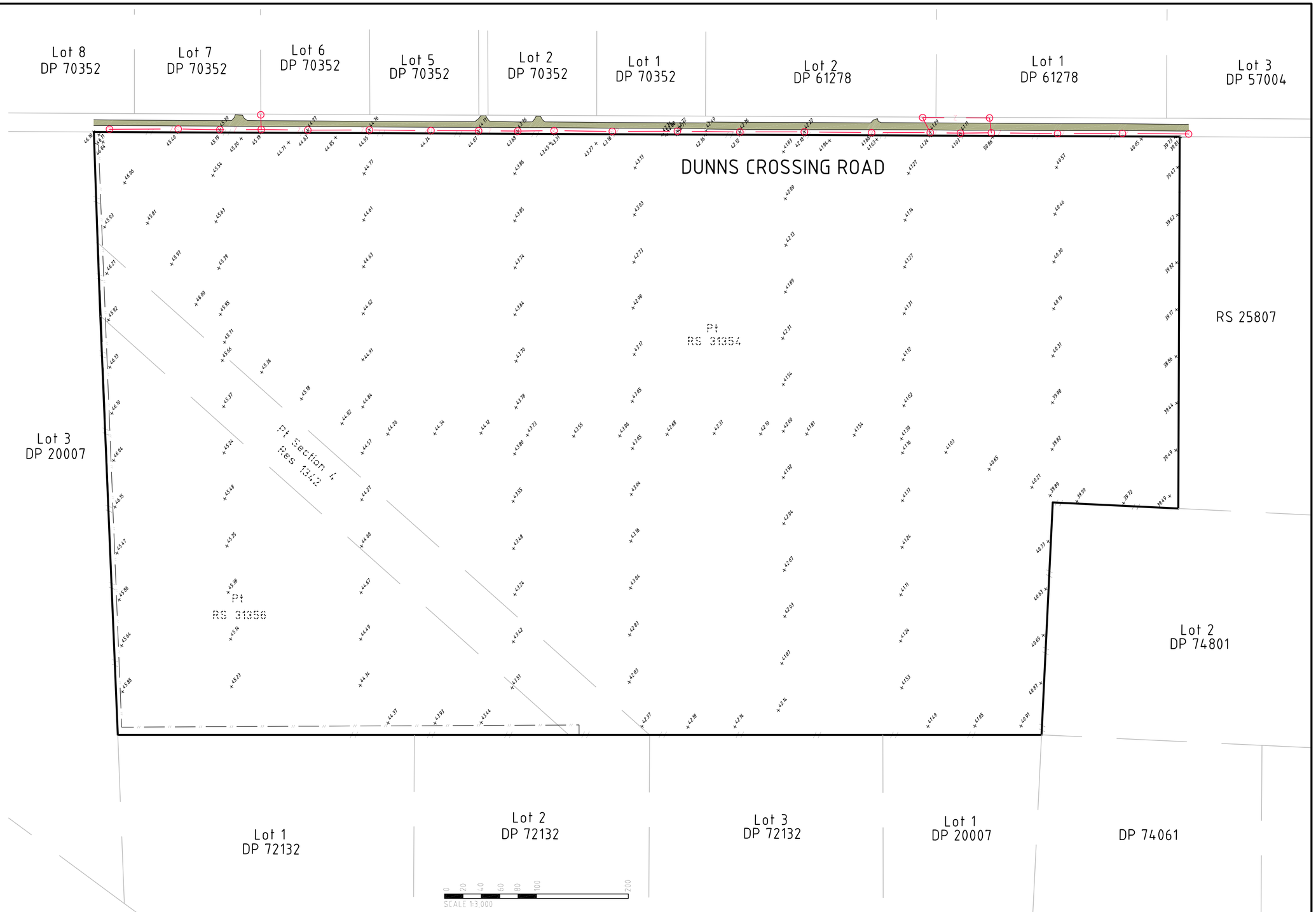
DATA QUALITY STATEMENTS

PROPERTY DATA
The property data has been sourced from Land Information New Zealand (LINZ) and is current as at August 2008.

SURVEYED DATA
Surveyed data has been captured using survey equipment, to a relative accuracy within approximately 30mm (horizontal and vertical).

SERVICES DATA
Where services have features visible on the surface, their positions have been verified by field survey. The accuracy of unverified services is unknown. Also, there may be services for which no records were provided and which are not shown on this plan. In all cases, if the location of a service is considered important, the relevant service provider should be consulted.

SURVEY ORIGIN DATA
Vertical elevations are in terms of Christchurch Drainage Datum .
The origin of levels is ..... RL .....m.
The origin of survey is



Rev.	Date	Revision Details	RS	BDT	BDT
A	08.08	FOR CLIENT	RS	BDT	BDT

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Project:
SELWYN PLANTATION BOARD LIMITED
PROPOSED PLAN CHANGE
ROLLESTON

Drawing Title:
SITE SURVEY
SKELLERUP BLOCK

	Signed	Date
Surveyed	SE	07.08
Designed		
Drawn	RS	08.08
Verified	BDT	08.08
Approved	ANG	08.08

C.W. Project No. 36951
Scale 1:3,000@A2
Drawing No. SU-02.2 Rev. A

Appendix B

Geotechnical Report

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Geotechnical Investigation Report Proposed Plan Change at Rolleston Selwyn Plantation Board Ltd

25 September 2008
Reference 36951/001
Revision 0

Connell Wagner

Document Control

Connell Wagner

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0	25 September 2008	Issue	CG	CG	AK	MDF

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Contents

Appendix D

Test Pit Logs and Explanatory Notes – Skellerup Block

Appendix E

Results of Soak Tests – Skellerup Block

1. Introduction

1.1 General

Connell Wagner has been engaged by the Selwyn Plantation Board Ltd (SPBL) to provide surveying, planning and engineering services in respect of the potential plan change request of two sites off Dunns Crossing Road on the southern side of Rolleston. The two sites are herein referred to as the Holmes Hub Site, and the Skellerup Block.

As part of the engineering services, it has been necessary to undertake a preliminary ground investigation comprising test pits and soakage tests to support the proposed plan change.

This is the geotechnical factual report following the ground investigation undertaken by Connell Wagner on 12 September 2008. The report summarises the geological, geotechnical and hydrological conditions at the two sites.

2. Summary and Conclusions

- Connell Wagner has been engaged by the Selwyn Plantation Board Ltd (SPBL) to provide surveying, planning and engineering services in respect of the potential plan change request of two sites off Dunns Crossing Road on the southern side of Rolleston.
- As part of the engineering services, it was necessary to undertake a preliminary ground investigation comprising test pits and soak tests to support the proposed plan change.
- The object of the geotechnical investigation was to determine the geological, geotechnical and hydrological properties of the ground.
- The two sites are located approximately 2km southwest of the township of Rolleston.
- The geology of the site is shown on the Institute of Geological and Nuclear Sciences (GNS) geological map sheet 21: Christchurch, scale 1:250,000. The map indicates the site is underlain by the Burnham Formation for the Otiran Stage of the Hawera Series.
- Test pit excavations were carried out on 12 September 2008 by Connell Wagner.
- Groundwater was not encountered in any of the test pits and it is therefore inferred to be deeper than 1.5m below ground level (mbgl).
- The underlying geology comprises 1-3m thick stratal sets of gravel, intercalated with sand and loess-silt layers. The seepage rates through the gravelly silt were observed to be slightly lower than those measured in the gravels.
- Typical design soakage rates were in the order of $3x10^{-4}$ m^3/sec to $5x10^{-5}$ m^3/sec

3. Scope of Work

3.1 Objectives

The object of the geotechnical investigation was to determine the geological, geotechnical and hydrological properties of the ground under the two sites.

3.2 Scope

The scope of the work for this investigation comprised of a geotechnical walk-over and assessment of the two sites, the intrusive ground investigation including test pitting and the subsequent preparation of this report.

3.3 Field Investigations

The ground investigations were undertaken on 12 September 2008 and comprised of a site walk over by an engineering geologist and the excavation of three test pits on each site, with associated soak tests. The results of these investigations are discussed in this report.

3.4 Report

This report has been divided into two sections, assessing each site separately. Section 4 presents the data obtained for the Holmes Hub Site, whilst section 5 present the data obtained for the Skellerup Block.

4. Site Conditions – Holmes Hub Site

4.1 Site Description

The site is located approximately 2km southwest of Rolleston as shown in Figure 1, in Appendix A. The site is bounded to the north by State Highway 1, to the east by Dunns Crossing Road and to the south the site is bounded by Burnham School Road, to the west is agricultural pasture land.

The site is approximately 92ha and generally flat lying with a gradual slope towards the south and south east. In the recent past the site was a wooded plantation, however the trees have been removed and the roots were also raked out; no evidence of tree roots was observed during our investigations. The site is currently divided into paddocks and used for agricultural dairy pasture purposes.

4.2 Regional Geology

The geology of the site is shown on the Institute of Geological and Nuclear Sciences (GNS) geological map sheet 21: Christchurch, scale 1:250,000. The map indicates the site is underlain by the Burnham Formation for the Otiran Stage of the Hawera Series. The unit comprises a sandy matrix-supported massive gravel, often with long-axis pebble alignment and stratal sets 1 to 3m thick, intercalated with minor lenticular sand and loess-silt layers (Browne, 2002). Our site investigations essentially confirmed the published geology.

4.3 Regional Earthquake Hazard

During our site investigation we observed no signs of active faulting and published information indicates that no active faults cross the site. GNS indicates peak ground acceleration, expected at 10% probability in the next 50 years for this site to be 0.2 to 0.3 g.

4.4 Subsurface Investigations

4.4.1 Test Pits

Three test pits were excavated at the site on 12 September 2008 by Connell Wagner. The test pit logs are included in Appendix B. The test pits showed a thin layer of silty and sandy topsoil overlaying sandy gravel. The gravel was logged as '*Sandy GRAVEL with cobbles and minor boulders. Mid brown, medium to coarse grained, rounded, gap graded, near horizontal long-axis pebble alignment. Moist*'.

The test pits were terminated at between 1.4 - 1.5m and soak tests were carried out.

4.5 In-situ Testing

4.5.1 Soak Tests

The Department of Building and Housing describes a field soak test procedure in clause E1: surface water of the building code. The method requires a borehole 100-150mm diameter to be drilled in which the soakage test is then carried out. The test requires the hole to be filled with water and the level maintained for a minimum of four hours after which the rate of the drop in water level is recorded.

The soak tests carried out on the Holmes site were not done according to this standard method; due to underlying gravel strata, it would not have been possible to drill a borehole 100-150mm diameter due to the cobbles and boulders present, many of which were greater than 100mm, also the borehole would not have remained open without support from a casing. The flow rate of water out from the gravels meant that it would not have likely been possible to keep the water level constant for the 4 hours required.

The soak tests were instead carried out in the test pit excavations. The dimensions of the pit were recorded prior to 0.5 to 1.0m of water being pumped into the pit. The rate of water seepage out from the pit was then recorded.

The time was recorded for each 100mm drop in the level of water in the pit. The detailed results are presented in Appendix C, and summarised in Figure 4 and Table 1 below:

Table 1: Flow Rates observed in the soak tests

Test	Depth of water (m)	Observed Flow Rate (m^3/sec)	Design soakage rate (m^3/sec)
H-1	1.0	5.10×10^{-4} (L) 4.49×10^{-3} (U)	1×10^{-5}
H-2	0.5	2.00×10^{-3} (L) 3.08×10^{-3} (U)	
H-3	0.5	1.65×10^{-3} (L) 3.50×10^{-3} (U)	

(L) Lower limit (U) Upper Limit

4.6 Groundwater

Groundwater was not encountered in any of the test pits and it is therefore inferred to be deeper than 1.5m below ground level (mbgl). Our previous investigations in the overall Rolleston area indicated that groundwater is generally located at depth.

5. Site Conditions – Skellerup Block

5.1 Site Description

The site is located approximately 2km southwest of Rolleston as shown in Figure 1, in Appendix A. The site is bounded to the east by Dunns Crossing Road; to the west, north and south there is agricultural pasture land.

The site is approximately 73ha and generally flat lying with a gradual slope towards the south and south east. In the recent past the site was a wooded plantation, however the trees have been removed and evidence of tree roots was observed during our investigations. The site is currently divided into paddocks and used for agricultural dairy pasture purposes.

5.2 Regional Geology

The geology of the site is shown on the Institute of Geological and Nuclear Sciences (GNS) geological map sheet 21: Christchurch, scale 1:250,000. The map indicates the site is underlain by the Burnham Formation for the Otiran Stage of the Hawera Series. The unit comprises a sandy matrix-supported massive gravel, often with long-axis pebble alignment and stratal sets 1-3m thick, intercalated with minor lenticular sand and loess-silt layers (Browne, 2002). Our site investigations essentially confirmed the published geology.

5.3 Regional Earthquake Hazard

During our site investigation we observed no signs of active faulting and published information indicates that no active faults cross the site. GNS indicates peak ground acceleration, expected at 10% probability in the next 50 years for this site to be 0.2 to 0.3 g.

5.4 Subsurface Investigations

5.4.1 Test Pits

The test pit logs are included in Appendix D. The test pits showed a thin layer of silty and sandy topsoil overlaying sandy gravel. The main soil stratum was logged as '*Gravelly silt and silty sandy gravel with cobbles and minor clay and boulders. Light brown, cohesive. Gravel is medium to coarse grained, rounded, gap graded, near horizontal long-axis pebble alignment. Sand is angular. Moist'. Large tree roots in the upper part.'*

The test pits were terminated at between 1.4 - 1.5m and soak tests were carried out.

5.5 In-situ Testing

5.5.1 Soak Tests

The Department of Building and Housing describes a field soak test procedure in Clause E1: surface water of the building code. The method requires a borehole 100-150mm diameter to be drilled in which the soakage test is then carried out. The test requires the hole to be filled with water and the level maintained for four hours after which the rate of the drop in water level is recorded.

The soak tests carried out on the Holmes site were not done according to this standard method; due to mainly gravel strata. It would not have been possible to drill a borehole 100-150mm diameter due to the cobbles and boulders being present, many of which were greater than 100mm, also the borehole would not have remained open without support from a casing. The flow rate of water out from the gravels meant that it would not have likely been possible to keep the water level constant for the 4 hours required.

The soak tests were instead carried out in the test pit excavations. The dimensions of the pit were recorded prior to 0.5m of water being pumped into the pit. The rate of water seepage out from the pit was then recorded.

0.5m of water depth was pumped into the pits and the time was recorded for each 100mm drop in the level of water in the pit. The results are presented in Appendix E, in Figure 4 in Appendix A and summarised in Table 1 below:

Table 2: Flow Rates observed in the soak tests

Test	Depth of water (m)	Observed Flow Rate (m^3/sec)	Design soakage rate (m^3/sec)
S-1	0.5	4.80×10^{-4} (L) 6.50×10^{-4} (U)	5.0×10^{-5}
S-2	0.5	1.40×10^{-4} (L) 1.40×10^{-4} (U)	1.0×10^{-5}
S-3	0.2	5.26×10^{-3} (L) 8.33×10^{-3} (U)	5.0×10^{-4}

(L) Lower limit (U) Upper Limit

5.6 Groundwater

Groundwater was not encountered in any of the test pits and it is therefore inferred to be deeper than 1.5m below ground level (mbgl). Our previous investigations in the overall Rolleston area indicated that groundwater is generally located at depth.

6. Summary

6.1 Holmes Hub Site

The geology encountered in the test pits was generally sandy gravel and the soak tests were therefore undertaken in these materials. As described in Section 4.2, the Burnham Formation comprises 1-3m thick stratal sets of gravel, intercalated with sand and loess-silt layers. The inferred seepage rates through the sandy gravels were fairly consistent across the site. It is inferred however, that there may be lenses of loess silt within the areas in which storm water management is proposed, if this is the case the soakage rates are likely to be lower than those observed on site. For this reason, a factor of safety has been added to the calculated rates to provide a preliminary design soakage rate of $1x10^{-5}$ m^3/sec.

6.2 Skellerup Block

The geology encountered in the test pits was generally gravelly silt with some silty sandy gravel. The geology was found to vary across the site and this is reflected in the range of inferred seepage rates. The observed rates through the gravels were faster than those through the silts. A lower bound design soakage rate of $1x10^{-5}$ m^3/sec has therefore been adopted to account for the variability of the ground across the site.

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 shallow test pits 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.

8. References

1 Institute of Geological and Nuclear Sciences (1992) Geological Map 1, scale 1:25,000: Geology of the Christchurch Urban Area.

2 http://www.gns.cri.nz (accessed on 02/09/2008)

3 Browne, G H (2002), A large-scale flood event in 1994 from the mid-Canterbury Plains, New Zealand, and implications for ancient fluvial deposits. Spec. Publs Int. Ass. Sediment. 32, 99-109.

4 Dept of Building and Housing (2006) Compliance Document for New Zealand Building Code Clause E1, Surface Water.