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PATTLE DELAMORE PARTNERS LTD

Infiltration Testing Results for Akaroa Treated Wastewater Disposal Via Irrigation – Thacker Land

Beca/CCC

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Infiltration Testing Results for Akaroa Treated Wastewater Disposal Via Irrigation – Thacker Land

Prepared for

CH2M Beca/CCC

March 2017

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Quality Control Sheet

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Limitations:

This report has been prepared by Pattle Delamore Partners Limited (PDP) on the basis of site investigations at discrete locations, and mapped ground slope information provided by CH2M Beca. The results from the site investigations, observations and deductions may not truly represent the entire area identified as being suitable for irrigation of treated wastewater to land. PDP has not independently verified the provided information from CH2M Beca and has relied upon it being accurate and sufficient for use by PDP in preparing the report. PDP accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

This report has been prepared by PDP on the specific instructions of CH2M Beca for the limited purposes described in the report. PDP accepts no liability if the report is used for a different purpose or if it is used or relied on by any other person. Any such use or reliance will be solely at their own risk.

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1.0 Introduction

Mr Murray Thacker and Mr Luis Thacker has offered to sell to Christchurch City Council a 114 hectare block of land (the Thacker property) at 11 Sawmill Road, located in the upper Robinsons Bay Valley. This block of land was included in the wider investigation of the suitability of land in Robinsons Bay for the irrigation of treated wastewater from the proposed new Akaroa wastewater treatment plant.

Christchurch City Council has requested that CH2M Beca/Pattle Delamore Partners Limited carry out a more detailed investigation of the Thacker land to determine if it could be used for drip irrigation of trees, along with the location of a storage pond. Tests had been carried out at three locations on this property as part of the previous investigation of the wider Robinsons Bay area.

Presented in this report are the results gathered during site investigations carried out in February 2017 along with the previous results for the property.

The impacts of the measured infiltration rates for the potential irrigation options, in conjunction with the other factors, have not been discussed within this report.

1.1 Previous Site Investigations

Pattle Delamore Partners Limited (PDP) carried out an initial desktop analysis in May 2016 to identify suitable land for disposal of wastewater to land. This analysis was discussed in the Council consultation report 'Akaroa Treated Wastewater Disposal Options (May 2016)'. Infiltration tests were undertaken on land within the Takamatua Valley and the results were reported to Council in the report 'Infiltration Testing Results for Akaroa Wastewater Disposal via Irrigation PDP, June 2016'. CH2M Beca undertook geotechnical investigations alongside the infiltration testing and they determined that the land was geotechnically unstable where slopes downhill of the irrigation area are steeper than 15 degrees (Akaroa Wastewater Upgrade Irrigation - Preliminary Geotechnical Assessment (CH2M Beca, June 2016).

Following this, another desktop analysis was carried out to identify alternative land options that were further from the proposed treatment plant and could be suitable for the disposal of treated wastewater. PDP carried out site investigations at eight sites within Robinsons Bay (Sites 1 – 5) and Pompeys Pillar (Sites 8 – 10) to assess their suitability for discharge of treated wastewater to land (Infiltration Testing Results for Akaroa Treated Wastewater Disposal via Irrigation – Robinsons Bay and Pompeys Pillar (PDP, November 2016). The results of this investigation indicated that irrigation of Robinsons Bay sites would be possible. The depth to groundwater was high in some areas, and some underlying low permeability subsoils could limit irrigation at certain times of the year.

1.2 Thacker Property

Sites 3 – 5, investigated in September 2016 sit within the 114 ha Thacker property in Robinsons Bay. Following the offer of sale, further investigation of this land was carried out owing to a large available area, suitable land slopes, and possible suitable areas for wastewater irrigation and storage ponds.

Prior to the field investigations, a site walkover was carried out with the owner to help assess the land, sub-soil materials and identify any potential areas or issues that would limit irrigation during winter. The lower slopes (up to approximately the 200 m contour) were characterised by gentle slopes and ridge lines separated by gullies. The owner identified two gullies that carry water in winter (but are normally dry over summer), and a number of springs (either seasonal or permanent) on the upper slopes, both of which would limit any irrigation. The owner also noted that the land on the upper slopes gets saturated during winter and remains so, indicating poorly draining materials. The ground cover was a mixed sward of grass over the ridge lines with kanuka (predominantly), manuka and other natives in the gullies.

The purpose of the field investigations are to assess the soil suitability and characteristics to enable the development of a site-specific concept and to confirm the overall suitability of the land. Twelve test pits were excavated to characterise the soil and sub-soil conditions on the property (particularly on the land below the 200 m contour). Seven infiltration tests were carried out to confirm the suitability of the land for the irrigation of treated wastewater.

The results of the field work indicated that the field parameters of the soils are consistent with previous observations and results within Robinsons Bay.

2.0 Method

Site investigations were carried out from 1 - 3 February 2017 and involved:

- assessing the soil type at each location (including the depth of the topsoil, presence and depth of any low permeability layer);
- measuring the depth of root penetration to assist in estimating the Profile Available Water; and
- measuring the infiltration rate at the ground surface and low permeability layers.

The test pit, hand auger and infiltration test locations are shown in Figure 1, Appendix A. Investigated sites within the Thacker property (the previously tested locations (Sites 3 – 5) and most recent sites (Sites 100 – 111)) and the preferred and less preferred irrigable areas are depicted in Figure 2, Appendix A.

Twelve test pits (TP 100 – TP 111) were machine excavated within the potentially irrigable land to a target depth of 4 m. Seven infiltration tests were carried out using a double ring infiltrometer for a target minimum period of 90 minutes. Two infiltration tests, one in the surface soils and one in the less permeable sub-surface soils, Photographs 1 – 11 (Appendix B), were carried out at three locations (Sites 101, 107 and 109). Another infiltration test was carried out in the sub-surface soils at Site 111 to determine a representative infiltration rate for the potentially irrigable land. Two holes were drilled using a hand auger between the test pits to identify any variations in the materials.

2.1 Test Pitting

The site investigations were observed by a PDP and CH2M Beca Engineer. All soil and rock logging has been undertaken in general accordance with New Zealand Geotechnical Society Guidelines (NZGS, 2005). Test Pit logs have been recorded by CH2M Beca, some photographs of the sub-surface materials observed in the test pits are presented in Appendix B. The locations have been surveyed using Fulcrum, the altitudes of these points were confirmed using ECan's Canterbury 10 m DEM.

2.2 Double Ring Infiltrometer Test Methodology

A double ring infiltration test involves a small ring positioned inside a larger outer ring. Each ring is sunk into the ground to provide a preferential flow path for water. When both rings are filled, water infiltrates both laterally and vertically from the outer ring leaving infiltration in the vertical direction as the prominent flow path for water in the inner ring. Measurements of the water level in the inner ring are taken periodically and the drop in water level against time is plotted. If necessary, water may need to be added to the rings until a stable infiltration rate is measured. The measured infiltration rate for design purposes is the stabilised rate measured over a minimum duration of 30 minutes. The photographs of the tests are shown in Photographs 1 - 11, Appendix B.

The double ring infiltrometer was deemed to be the most suitable method of testing the infiltration rate because of the relatively low permeability materials. The infiltration test results are sufficiently accurate to be used for the assessment of the suitability of the site for irrigation. It can be impractical to maintain static water level when the infiltration rate is so low.

2.3 Hand Auger

A 100 mm diameter hand auger was used to drill two holes for observation purposes. These were carried out between the test pits to check the soil conditions and to help confirm the extent of different sub-soil conditions.

3.0 Soil Description

The test pit results are discussed in detail in Section 4 below. The soils were assessed to be Barry Soils, Pawson Hills Soils and Takahe Soils. Pawson Hills Soils and Takahe Soils are the same soils that were found during the first round of infiltration testing in Takamatua Valley. Table 1 provides a detailed description of the Barry Soils, Pawson Hills Soils and Takahe Soils. These descriptions are from "General Survey of the Soils of South Island, New Zealand" (DSIR, 1968). All soils are derived from the parent material of greywacke loess and basalt. Barry Soils are granular, and the main difference in the profile of Pawson Hills Soils and Takahe Soils is the pale olive grey layer directly beneath the topsoil. Barry Soils are vulnerable to some stream bank erosion. Pawson Hills Soils and Takahe Soils are vulnerable to sheet erosion, slumps on hills or slips on steeper slopes.

Movement of groundwater through the loess can cause tunnel gullies to form and also contribute to land instability. This is consistent with the description of liability of soil erosion of Pawson Hills Soils and Takahe Soils (DSIR, 1968).

Table 1: Soil Description

Soil Name	Parent Material	Topography	Representative Profile(s)	Liability to Soil Erosion
Barry Soils (mostly silt loams)	Alluvium from reworked greywacke loess and basic igneous rocks	Flat to gently sloping Up to 50 feet (153 m)	150 mm dark brown nutty/granular silt loam; firm, On olive mottled dark brown silt loam – clay loam; firm. **Also** from more basaltic alluvium: 200 mm dark brown granular/crumb heavy silt loam; friable, on brown-red brown blocky/granular clay loam; firm.	Some stream bank.
Pawson Hill Soils (mostly silt loams)	Greywacke loess (with minor basalt)	Moderately steep with rolling ridges; few short steep	150 mm dark grey brown crumb/nutty silt loam; friable,	Sheet if cultivated; slumps on hills; trees

Table 1: Soil Description

Soil Name	Parent Material	Topography	Representative Profile(s)	Liability to Soil Erosion
		slopes with rock outcrops Up to 1,200 feet (370 m)	75 mm pale olive grey lightly mottled orange crumb/nutty silt loam; friable, 200 mm pale yellow brown lightly mottled orange nutty/blocky silt loam; firm, on pale yellow brown (grey veins) prismatic silt loam; very firm.	survive in gullies and provide protection
Takahe Soils (silt loams, fine sandy loams)	Greywacke loess of varying thickness overlying basalt	Rolling to easy rolling broad spurs with narrow strips of moderately steep sides Up to 1,000 feet (305 m)	(150 mm dark grey brown crumb silt loam; friable 250 mm yellow mottled orange blocky silt loam; friable 300 mm olive grey lightly mottled orange crumb/nutty silt loam; friable on pale yellow brown (grey veins) prismatic silt loam; very firm.	Sheet and tunnel gully; slips on steeper slopes.

4.0 Test Pit Results

Table 2 summarises the materials observed in the test pits including, depth and soil type. Figure 1, Appendix A shows the locations of the test pits. Photographs of the test pits and the materials are included in Appendix B. CH2M Beca has included logs of the test pits within their report.

Table 2: Test Pits and Hand Augers

Site ID	Test Pit/Hand Auger ID	Depth of Excavation (m)	Depth of Topsoil (m)	Soil Type[1]	Elevation[2] (m above sea level)
Site 100	TP100	1.2	0.08	Barry Soils	76
Site 101	TP101	4.0	0.10	Barry Soils	88
Site 102	TP102	4.0	0.10	Takahe Soils	196
Site 103	TP103	4.0	0.12	Pawson Hills	158
Site 104	TP104	4.0	0.12	Takahe Soils	152
Site 105	TP105	4.0	0.10	Takahe Soils	148
Site 106	TP106	3.6	0.12	Takahe Soils	126
Site 107	TP107	4.0	0.12	Takahe Soils	116
Site 108	TP108	3.9	0.12	Takahe Soils	63
Site 109	TP109	4.1	0.10	Barry Soils	45
Site 110	TP110	4.0	0.10	Barry Soils	40
Site 111	TP111	4.0	0.09	Pawson Hills	149
Site 112	AUGER1	1.8	0.10	Takahe Soils	134
Site 113	AUGER2	1.8	0.10	Takahe Soils	87

Note:

1. *Soil types from Sheet 9 of "General Survey of Soils of the South Island" DSIR (1968).*
2. *Elevations were recorded using Fulcrum, and confirmed using ECan's Canterbury 10 m DEM.*

During the site walkover with the owner, it was noted in an existing cutting on a lower slope that the soil was a loess based clayey silt which was light brown in colour. Another cutting close to the base of the upper slope, exposed a clearly visible low permeability soil layer (fragipan) several hundred millimetres below the ground surface which extended to and below the depth of the cutting so was at least 0.5 m deep. On the upper slopes the soils appeared to be a darker brown and have a nutty texture based on cuttings observed.

These observations were consistent with the materials that were observed at the excavated test pits. This light brown loess based silt was directly beneath the topsoil. The depth of topsoil was 100 – 120 mm and there was typically some root penetration within this layer. Typically a light grey mottled vein was first observed at a depth of 0.5 – 0.6 m below ground level (bgl), and intermittently through the test pit. The first sighting of the light grey vein layer was typically 0.2 – 0.3 m thick, a good example of this layer can be seen in Photograph 11, Appendix B. It appeared that the light grey mottled orange material ran both vertically and horizontally.

4.1 Test Pit Descriptions

Site 100 is a flat area, close to the stream that runs along Robinson Bay Valley Road amongst large volcanic rocks washed off the hills. The test pit (TP100) was excavated approximately 30 m from the stream. The soils encountered in TP100 were consistent with the Barry Soil description. The topsoil at this site was silty, dispersed with the subsurface layer, and there was good root penetration through the topsoil with continuation into the light greyish brown, blocky, silty loess. Specks of orange were seen 0.5 m bgl. Cobbles were encountered at 1.2 m bgl, and the test pit was ended because the digger could not excavate further.

Site 101 was carried further up the slope on an old track, approximately 50 m from the stream. The soils encountered in TP101 were also consistent with the Barry Soil description. Beneath the topsoil was a dry medium silty loam, there was some root penetration (0.3 m). The stiff, light grey vein was encountered 0.7 m bgl, with a thickness of 0.2 m. For the most part the sub-soils were a yellow brown nutty silt loam with intermittent appearances of a very stiff light grey vein mottled orange. The light grey vein consisted of a fine silt loam, with trace clay. From 0.7 m bgl the materials were damp, from 1.6 m bgl the soils became wet.

The test pit at Site 102 was excavated at the top of a steep slope and located close to the 200 m contour. Friable dark brown topsoil with some root penetration continuing through the subsoil was observed. The materials encountered were more consistent with the Takahe Soil description. The soil beneath the topsoil is a yellow brown friable silty loam. The damp, stiff, light grey vein mottled orange was encountered 0.5 m bgl, with a thickness of 0.2 m. At approximately 1.2, 2.2 and 3.3 m bgl very stiff, light grey veins mottled orange were encountered.

Sites 103 – 113 were very similar to TP102, indicative of Takahe/Pawson Hills Soils. Dark brown – greyish brown, fine, silty, friable topsoil to a depth of approximately 100 mm. Underlying the topsoil was a dry yellow brown silty loam. It was evident that there some to good root penetration through the topsoil and into the yellow brown silty loam. The stiff, light grey vein mottled orange was typically first encountered at 0.5 m bgl, with a thickness of 0.2 – 0.4 m and then intermittently through to 4 m. The moisture content varied, with TP105 being particularly dry due to its proximity to large eucalypt trees on the neighbouring property and tree roots were seen just beneath the topsoil.

5.0 Infiltration Test Results

Seven infiltration tests were carried out at the locations shown in Figure 1, Appendix A. The previous test locations (IT4 and IT5) and current sites (Sites 100 – 111) within the Thacker Land are depicted in Figure 2, Appendix A. To enable a comparative analysis of the sites, the tests were carried out within intermediate (loess colluvium) (Site 100 and 101) up to the 100 m contour, and high (loess) (Sites 107, 109 and 111) areas between the 100 m and 200 m contour.

Over the week infiltration testing was carried out, no rain was recorded at the Akaroa EWS station (36593) (Cliflo, 2016) however there was some light rainfall within Robinsons Bay Valley.

Table 3: Infiltration Test Results Thacker Land

Infiltration Test ID	Location	Depth Below Ground Level (m bgl)	Test Duration (minutes)	Infiltration Rate (mm/hr)
IT4 – surface[1]	Site 4 ‘Preferred area’	0	132	15
IT4 - sub-surface[1]		0.35	108	4
IT5 - surface[1]	Site 5, outside of ‘Preferred area’ and ‘Less preferred area’	0	134	44
IT5 - sub-surface[1]		0.48	110	11
IT101 - surface	Site 101 - 50 m from stream, 90 m asl ‘Preferred area’	0	149	19
IT101 – sub-surface		0.30	102	10
IT107 - surface	Site 107 - 130 m asl ‘Preferred area’	0	127	65
IT107 - sub-surface		0.30	116	55

Table 3: Infiltration Test Results Thacker Land				
IT109 - surface	Site 109 - 40 m from stream, 40 m asl, 'Preferred area'	0	93	158
IT109 - sub-surface		0.45	167	7
IT111 – sub-surface	Site 111 - 145 m asl, 'Less preferred area'	0.35	76	75

The double ring infiltrometer was sunk in 100 mm at ground level or at the base of an infiltration pit. The depth of the infiltration pits are recorded in Table 3. The infiltration pits excavated at the infiltration test locations indicated the presence of a lower permeability layer directly below the topsoil. The sub-surface infiltration testing was carried out within this lower permeability layer. The topsoil depth varied slightly from location to location.

The locations and plots of the infiltration rates are presented in Appendix A, the photographs of these tests are included in Appendix B.

5.1 Summary

Overall, the February 2017 results indicate a slightly higher infiltration rate than what was recorded in September 2016. The surface and sub-surface materials were significantly drier than what was encountered during the previous round of investigations.

Site 100 and 101 were located close to the stream that runs through Robinsons Bay Valley and sub-surface soils were indicative of loess colluvium. The stabilised infiltration rates at Sites 107 and 111 were significantly faster than those measured in the sub-soils at Sites 101 and 109.

There is some variance of infiltration rates between the sites below the 100 m contour (IT4, Sites 101 and 109) and the lower slopes between 100 m and 200 m asl (IT5, Sites 107 and 111). This may be a reflection of the higher moisture content of the materials at Sites 101 and 109 rather than any differences of the makeup of the sub-soils.

For the assessment of the suitability of the site for irrigation the most critical infiltration rates are those from the sub-surface tests ranging from 4 to 55 mm/hr. At this stage, given the potential variability of infiltration across the site the assessment of the irrigation requirements for the land will be based on the lowest rate of all the tests carried out on this property.

6.0 Bore Results

Logs of the hand augered holes have been included in Appendix C, the materials seen in these holes were consistent with the description of materials discussed in Section 4.1 for Sites 103 – 113 and are indicative of Takahe/Pawson Hills Soils. Fine; silty; dark brown, friable topsoil to a depth of approximately 100 mm. Underlying the topsoil was a dry yellowish brown silty loam. The stiff, light grey vein mottled orange was typically first encountered at 0.6 m bgl and then intermittently through to 1.8 m. AUGER2 was particularly dry due to its proximity to the tree line.

7.0 References

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PDP. (2016). Infiltration Testing Results For Akaroa Wastewater Disposal via Irrigation.

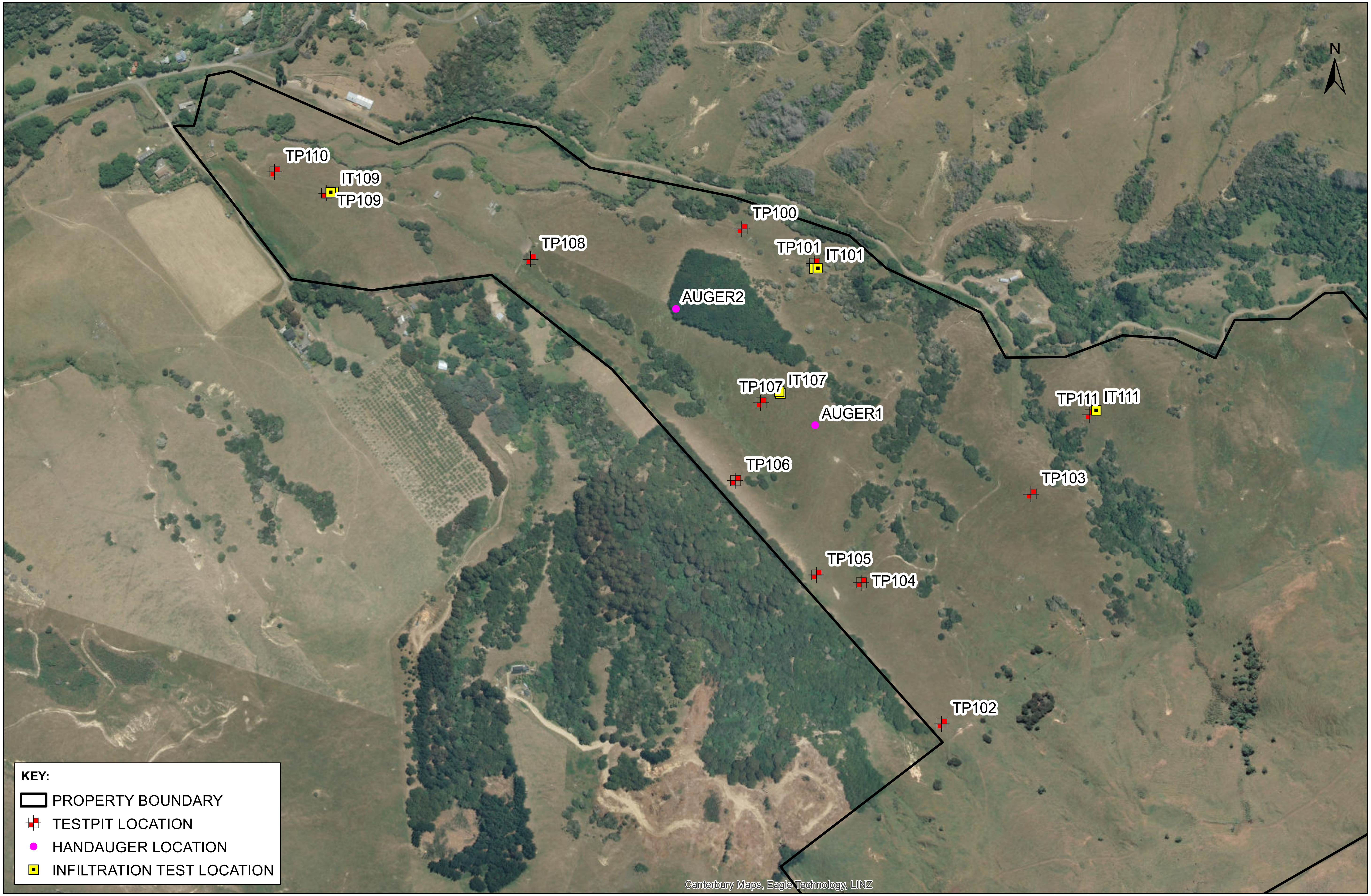
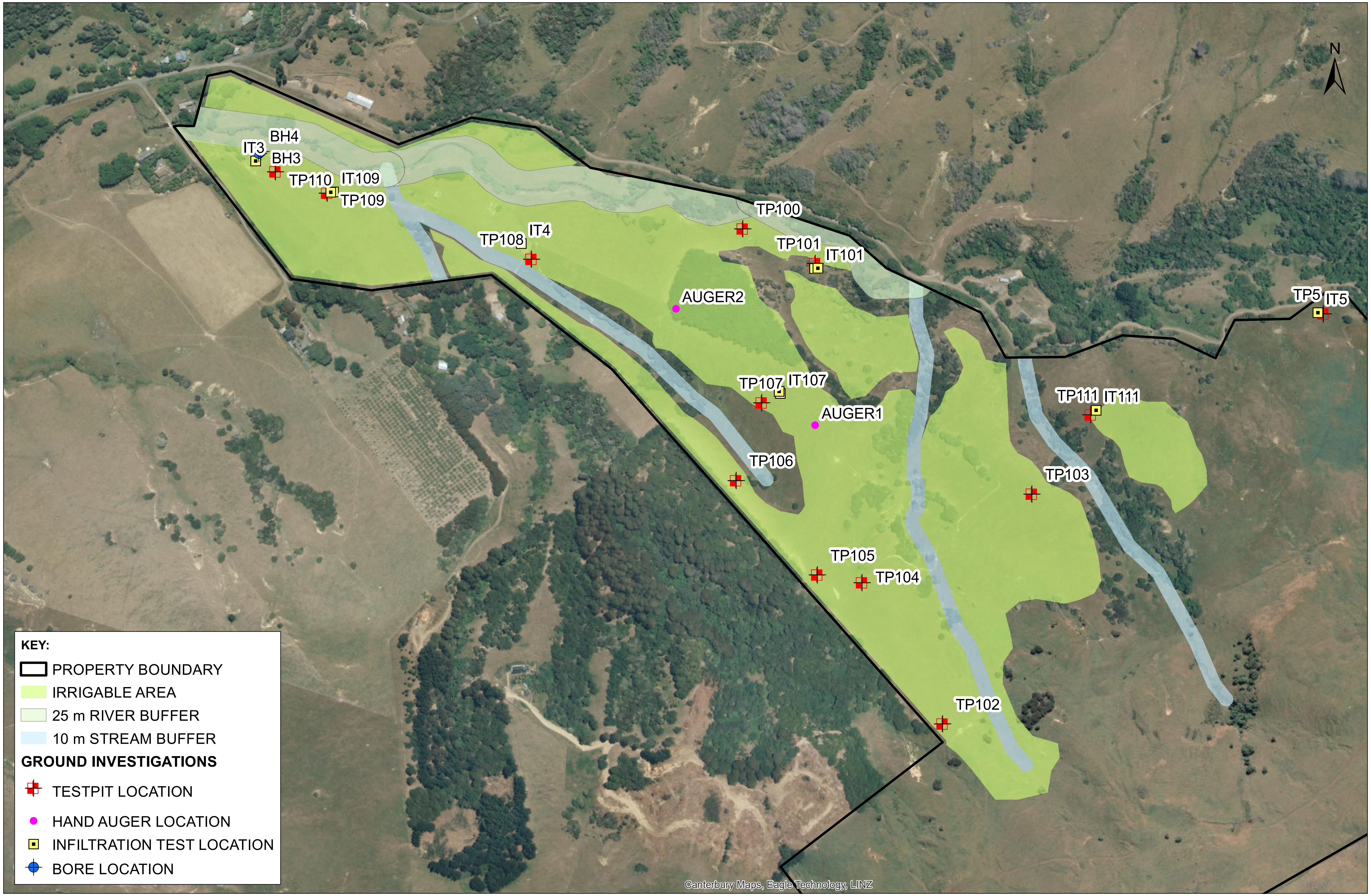


FIGURE 1: TEST PIT, INFILTRATION TEST AND HAND AUGER LOCATIONS
(FEBRUARY 2017 TESTING LOCATIONS)

SOURCE:
1. AERIAL IMAGEYRY SOURCED FROM CANTERBURY MAP PARTNER (ADMINISTERED BY ECAN). MAY NOT BE SPATIALLY ACCURATE
2. GPS LOCATIONS WERE SURVEYED USING FULCRUM.

SCALE: 1:5,000 (A3)

0 75 150 225 300
METRES



SOURCE:
1. AERIAL IMAGEYRY SOURCED FROM CANTERBURY MAP PARTNER (ADMINISTERED BY ECAN). MAY NOT BE SPATIALLY ACCURATE
2. GPS LOCATIONS WERE SURVEYED USING FULCRUM.
3. IRRIGABLE AREA, RIVER AND BUFFER AREAS SOURCED FROM BECA LTD 13/02/2017.

FIGURE 2: GROUND INVESTIGATION LOCATIONS AND POTENTIALLY IRRIGABLE AREAS
(BOTH SEPTEMBER 2016 AND FEBRUARY 2017 TESTING LOCATIONS)

SCALE: 1:5,000 (A3)

0 75 150 225 300
METRES

Infiltration Test Plots

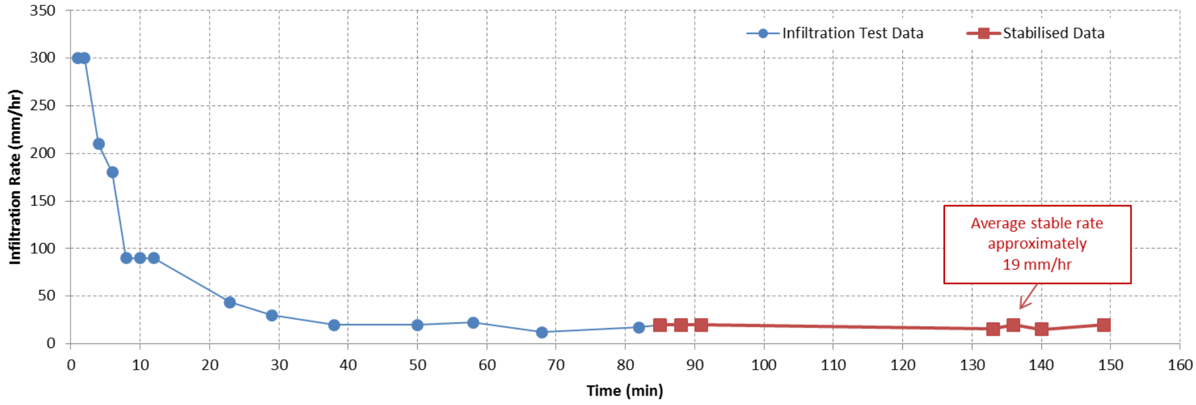


Figure 3: Infiltration Rate during Test IT101:surface.

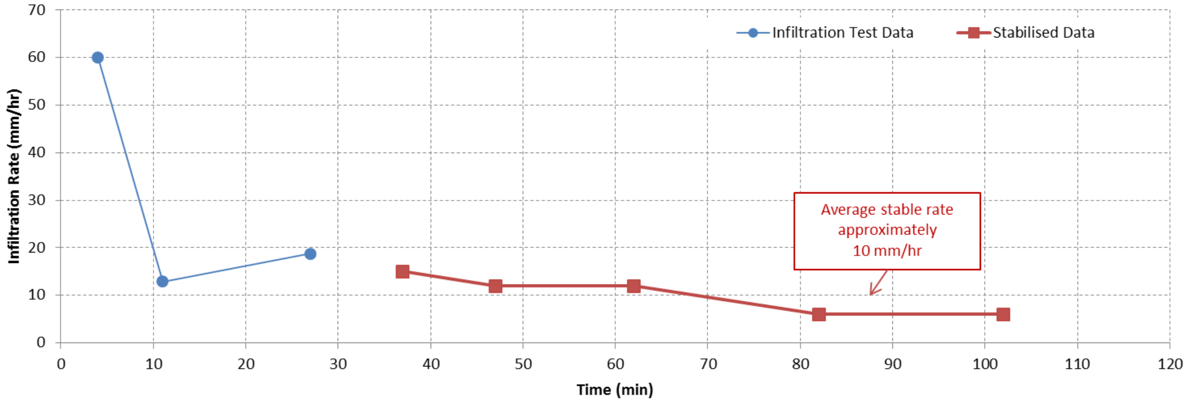


Figure 4: Infiltration Rate during Test IT101:sub-surface.

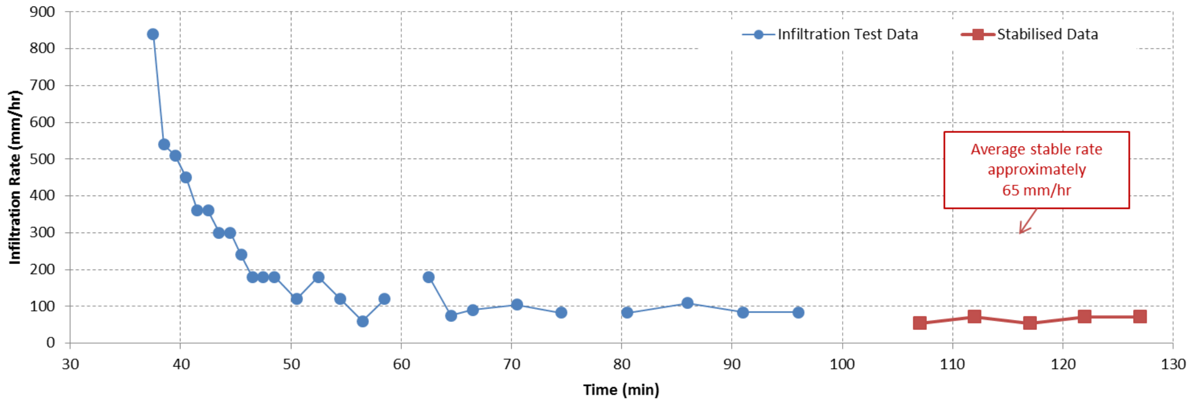


Figure 5: Infiltration Rate during Test IT107:surface.

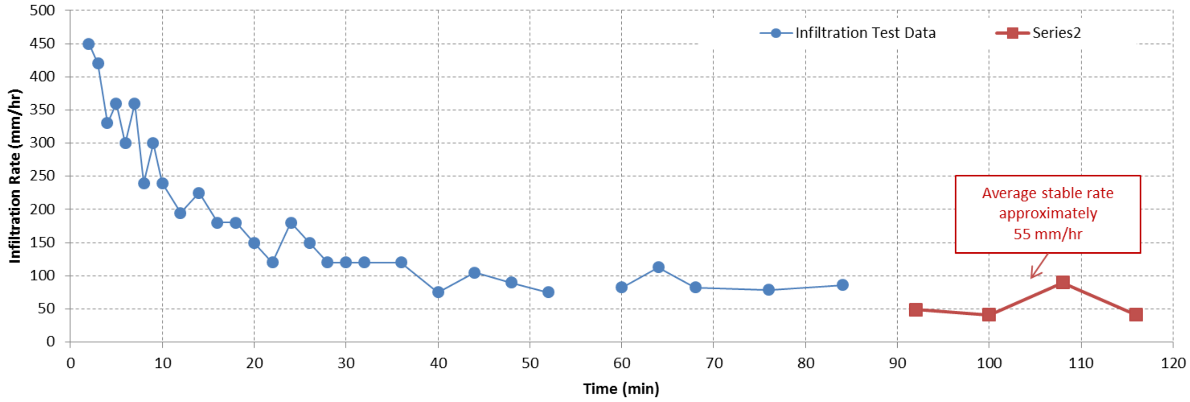


Figure 6: Infiltration Rate during Test IT107:sub-surface.

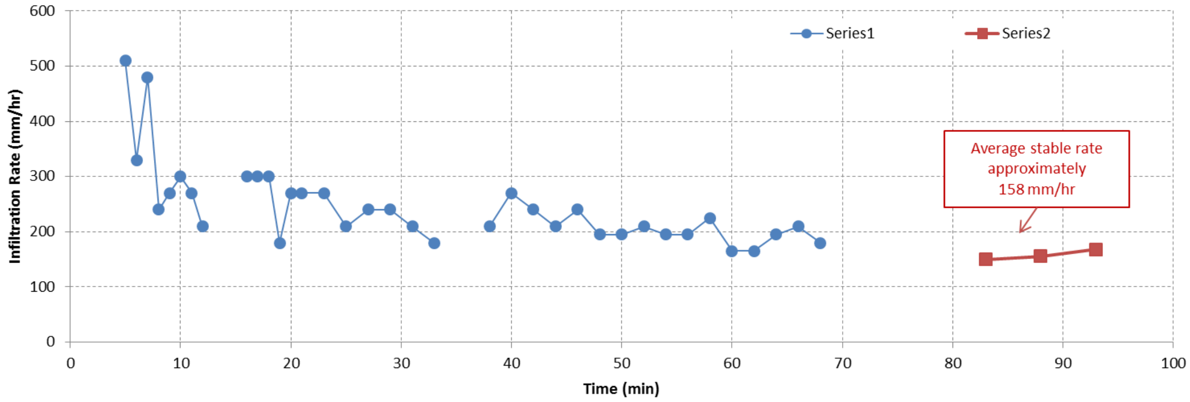


Figure 7: Infiltration Rate during Test IT109:surface.

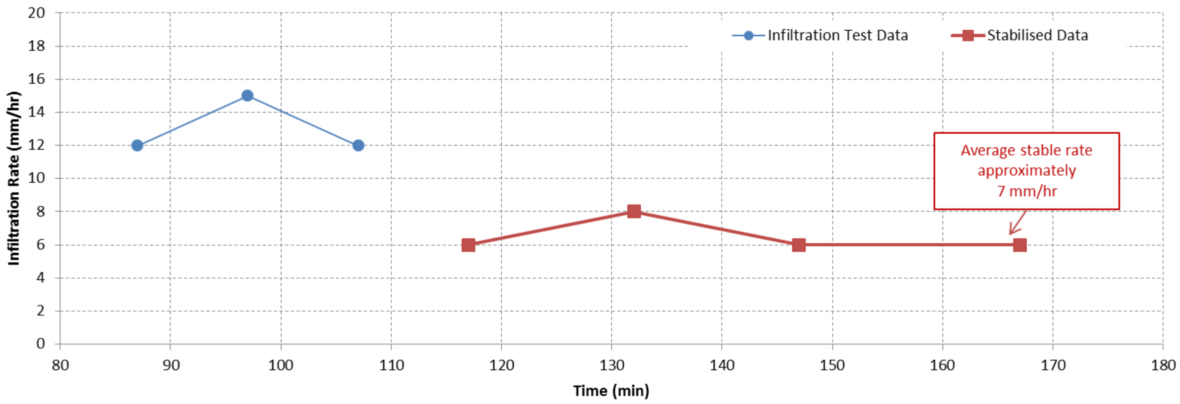


Figure 8: Infiltration Rate during Test IT109:sub-surface.

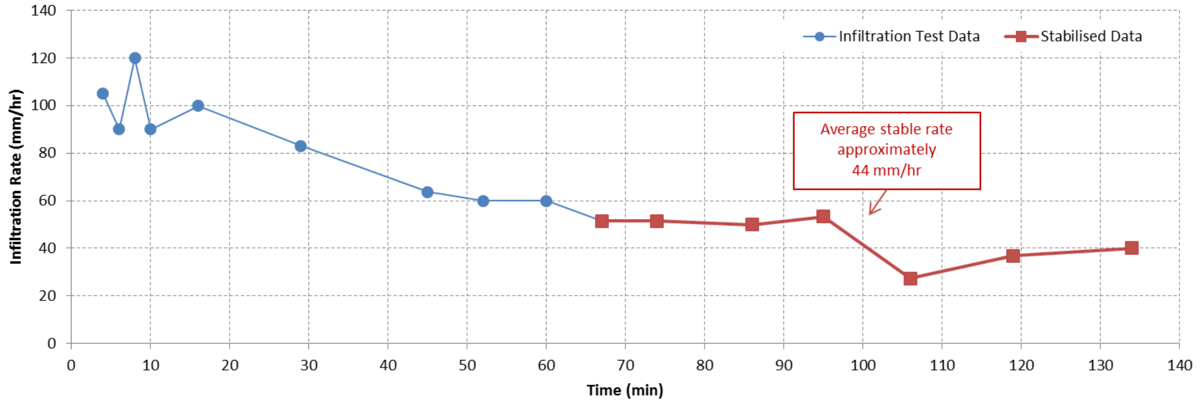


Figure 12: Infiltration Rate during Test IT5:surface.

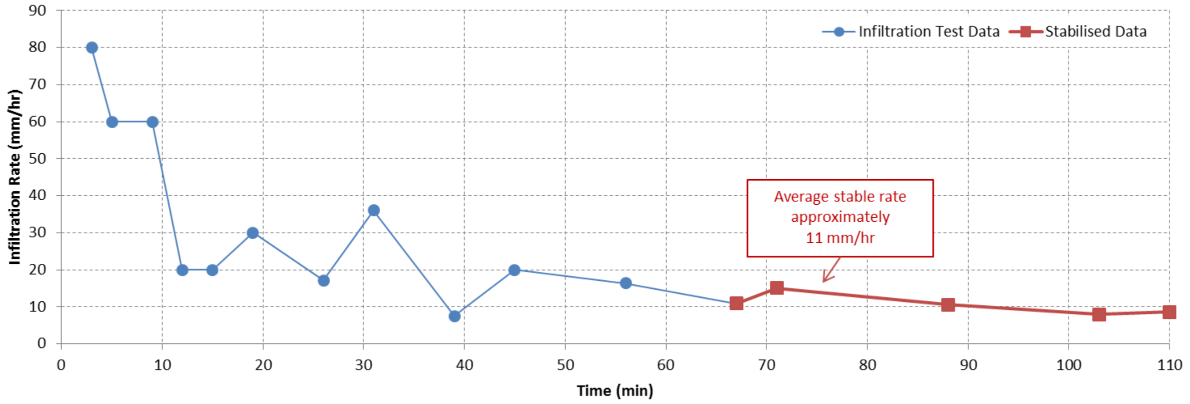


Figure 13: Infiltration Rate during Test IT5:sub-surface.

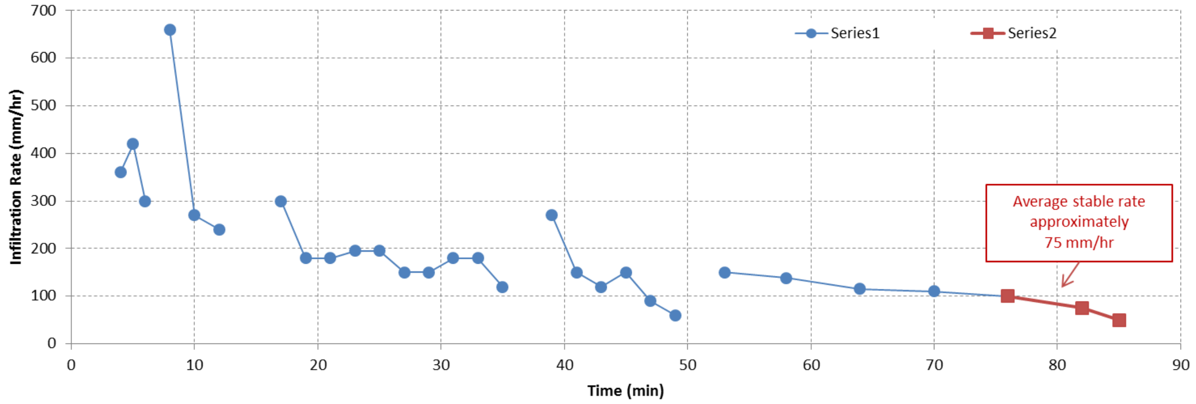


Figure 9: Infiltration Rate during Test IT111:sub-surface.

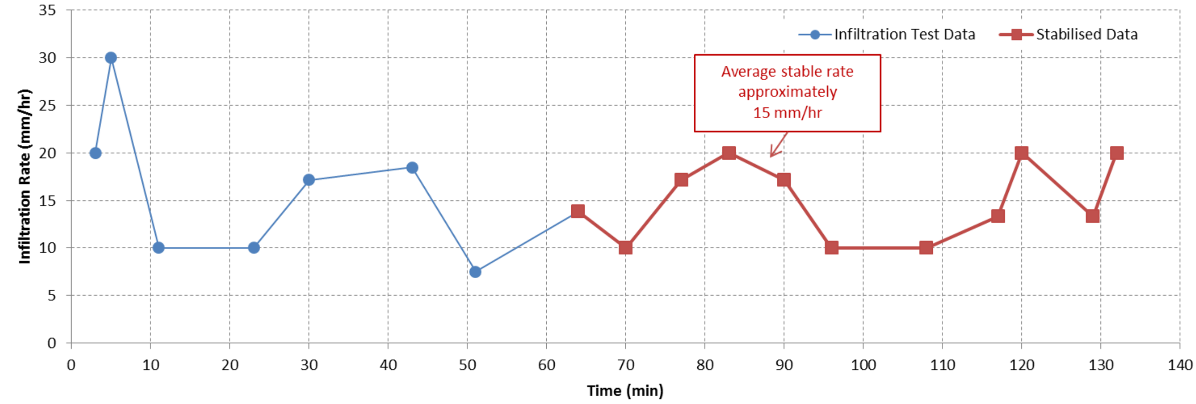


Figure 10: Infiltration Rate during Test IT4:surface.

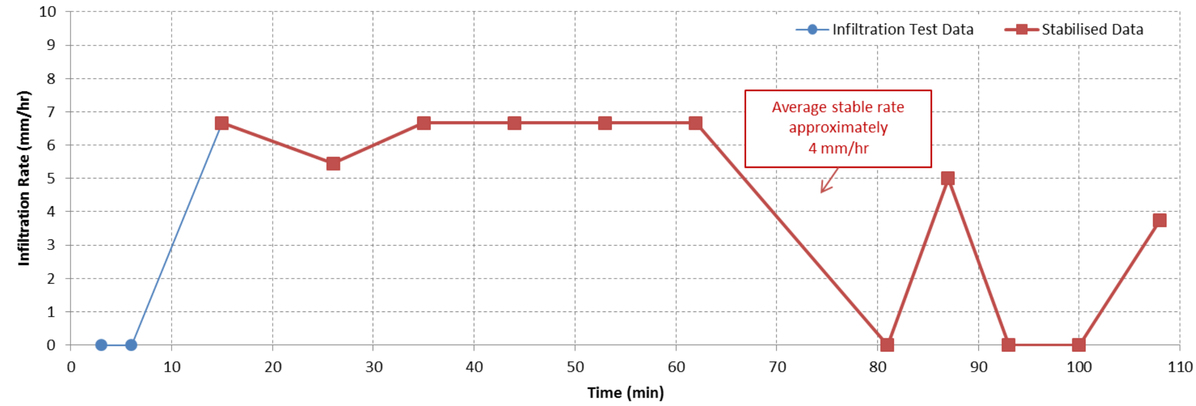


Figure 11: Infiltration Rate during Test IT4:sub-surface.

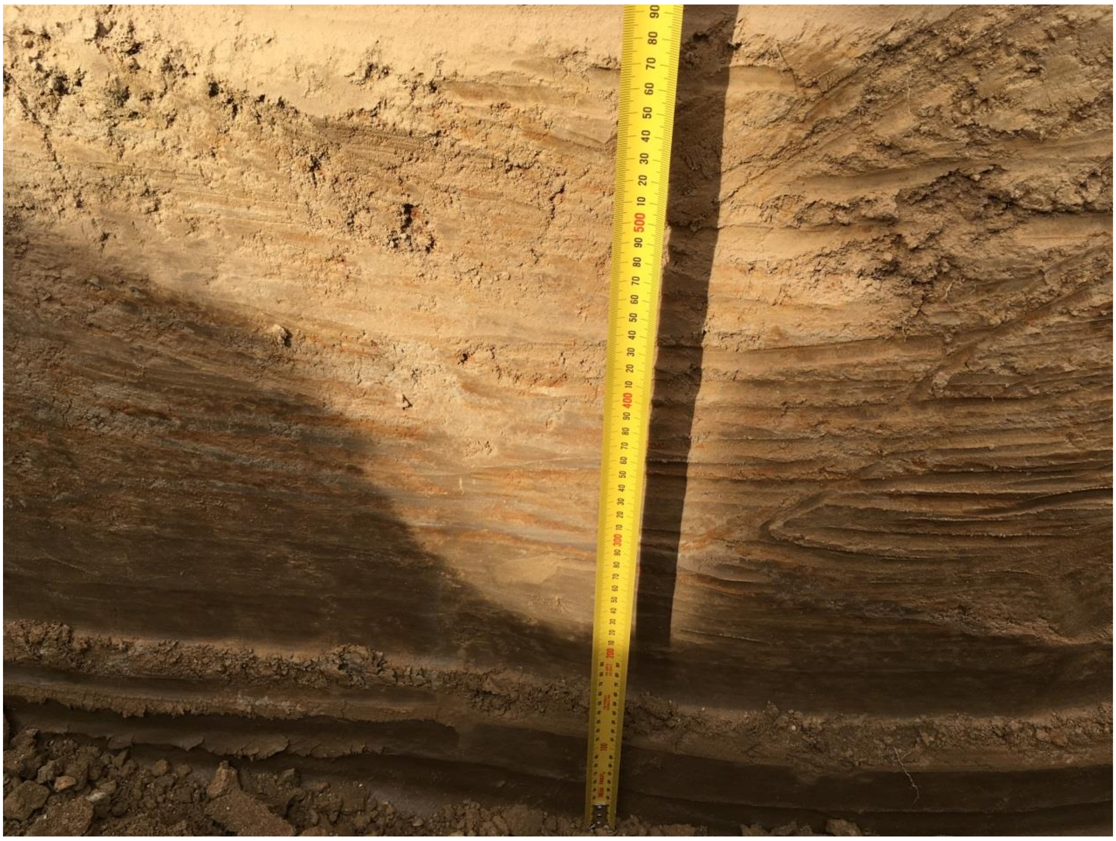
Appendix B

Photographs

Photograph 1: Exposed bank next to stream (close to Site 100).

Photograph 2: Infiltration Test IT101 surface infiltration test within Robinsons Bay (Site 101).

Photograph 10: Excavation to 1 m, TP111, the 'less preferred area' (Site 111).



Photograph 11: Close up of low permeability layer within the 'less preferred area' (Site 111).

Photograph 3: Infiltration Test IT101 sub-surface infiltration test within Robinsons Bay (Site 101).

Photograph 4: Excavation to 1 m, Test Pit TP101 (Site 101).

Photograph 4: Infiltration Test IT107 surface infiltration test within Robinsons Bay (Site 107).

Photograph 5: Infiltration Test IT107 sub-surface infiltration test within Robinsons Bay (Site 107).

Photograph 6: Excavation to 1 m, Test Pit TP107 (Site 107).

Photograph 7: Infiltration Test IT109 surface and subsurface within Robinsons Bay (Site 109).

Photograph 8: Test Pit TP109 (Site 109).

Photograph 9: Infiltration Test IT111 sub-surface within the 'less preferred area' (Site 111).

Appendix C

Auger Logs

PATTLE DELAMORE PARTNERS LTD

Log of Bore Hole
Akaroa WWTP Disposal Investigation

PIT NO. **AUGER1**
JOB NO: C02239201

CLIENT: CCC	LOCATION: 11 Sawmill Road, Robinsons Bay
DATE: 03/02/2017	DATE BACKFILLED: 03/02/2017
LOGGED BY: Emily Barton (PDP)	SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
Silty fine to medium TOPSOIL, dark brown. Soft to firm, dry.		0.0			Groundwater Not Encountered
Stiff, SILT, some fine to medium sand; light yellowish brown, dry.		0.2			
Very stiff, SILT, some fine to medium sand; light yellowish brown mottled orange, dry.		0.4			
Very stiff, SILT, some fine to medium sand; light yellowish brown mottled orange, damp to wet. Light grey vein mottled orange, SILT, some fine sand and trace clay; intermittent.		0.6 0.8 1.0 1.2 1.4 1.6			

End of Hand Auger Hole at 1.8 m bgl

Notes:

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- PID Reading (ppm)

Method: Hand Auger
CRS: EPSG:2193, NZTM
Coordinates: 1598506
5154757

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)

Log of Bore Hole
Akaroa WWTP Disposal Investigation

PATTLE DELAMORE PARTNERS LTD

PIT NO. **AUGER2**
JOB NO: C02239201

CLIENT: CCC	LOCATION: 11 Sawmill Road, Robinsons Bay
DATE: 03/02/2017 / DATE BACKFILLED: 03/02/2017	LOGGED BY: Emily Barton (PDP) / SHEET 1 OF 1

DESCRIPTION OF SOIL	GRAPHIC LOG	DEPTH (m)	SAMPLE DETAILS	TESTS	WATER OBSERVATIONS
Silty fine to medium TOPSOIL, dark brown. Soft to firm, very dry.		0.0			Groundwater Not Encountered
Stiff, SILT, some fine to medium sand; light yellowish brown, very dry.		0.2			
Very stiff, SILT, some fine to medium sand; light yellowish brown mottled orange, damp.		0.4 0.6			
Very stiff, SILT, some fine to medium sand; light yellowish brown mottled orange, damp to wet. Light grey vein mottled orange, SILT, some fine sand and trace clay; intermittent.		0.8 1.0 1.2 1.4 1.6			

End of Hand Auger Hole at 1.8 m bgl

Notes:

KEY
- Groundwater level
- Seepage inflow
- Grab sample
- × PID Reading (ppm)

Method:	Hand Auger
CRS:	EPSG:2193, NZTM
Coordinates:	1598304 5154912

Logs based on New Zealand Geomechanics Society Field Description Guidelines (2005)