Project KEA

Land Use Capability (LUC) Assessment

for: South Island Resource Recovery Ltd

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2				

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Cover photo: Project Kea Logo

EXECUTIVE SUMMARY

Babbage Consultants Limited ("**Babbage**") has been engaged by South Island Resource Recovery Limited ("**SIRRL**") to prepare a resource consenting application for the establishment of an Energy from Waste ("**EfW**") facility, known as Project KEA.

As part of the resource consent application, under the National Policy Statement Highly Productive Land 2022, an assessment of the Land Use Capability (LUC) is required to assess if the proposed industrial development occurring on high-productive land.

A site investigation was carried out using the LUC methodology on 2 November 2022. The investigation showed that the main constrains for land-based production at the site are soil related.

Based on the methodology and investigation results, the LUC Class for most of the site is class 4s, due to the soils being considered shallow as they become very stony within 20 cm. One small part of the site is classed 2s, although deep, the soil is hard to work and imperfectly drained. Another small part of the site is classed 3s, becoming very stony at 30 cm.

Based on the mapping guidance in the National Policy Statement Highly Productive Land 2022, the entirety of the Project Kea site is deemed not to be classified as "highly productive land", and therefore, ensures that highly productive land is protected for use in land-based primary production, both now and into the future.

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1 INTRODUCTION

1.1 Background

Babbage Consultants Limited ("Babbage") has been engaged by South Island Resource Recovery Limited ("SIRRL") to prepare a resource consenting application for the establishment of an Energy from Waste ("EfW") facility (known as Project Kea) at Morven-Glenavy Road in Glenavy, Waimate District, Canterbury (the "Site").

The proposed use of the Site for an industrial facility needs to be aligned with the National Policy Statement for Highly Productive Land 2022 (NPS-HPL), to guarantee that there are no loss of highly productive land.

1.2 National Policy Statement for Highly Productive Land 2022

The NPS-HPL came into force on 17 October 2022. The objective of NPS-HPL is to ensure that "Highly productive land is protected for use in land-based primary production, both now and for the future".

The NPS-HPL requires every regional council (no later than 3 years after the commencement date) to map as highly productive land any land in its region that:

- Is in general rural zone or rural production zone; and
- Is predominantly LUC 1, 2, or 3; and
- Forms a large and geographically cohesive area.

Noting the very recent commencement of the NPS-HPL, a transitional definition of highly productive land applies until the councils complete the process of mapping highly productive land at a regional level. Under clause 3.5(7) of the NPS-HPL, the transitional definition of highly productive land is:

"(a) is

(i) zoned general rural or rural production; and

(ii) LUC 1, 2 or 3 land; but

(b) is not:

(i) identified for future urban development; or

(ii) subject to a Council initiated, or an n adopted, notified plan change to rezone it from general rural or rural production to urban or urban lifestyle."

As the Project Kea site is zoned rural, it is partially captured in the transitional definition under (a)(i). The second part of the definition relates to the Land Use Capability classes. The NES-HPL defines LUC 1, 2 and 3 land as:

> *"means land identified as Land Use Capability Class 1, 2, or 3, as mapped by the New Zealand Land Resource Inventory or by any more detailed mapping that uses the Land Use Capability classification". (underlined for emphasis).*

The definition of "LUC 1, 2 and 3 land" enables the use of the Land Use Capability classification to inform a more detailed mapping to be completed. In accordance with this definition, a Land Use Capability Assessment has been completed for the Project Kea site.

1.3 Land Use Capability Assessment

Land Use Capability (LUC) assesses an area's capacity for sustained productive use, taking into account physical limitations, soil type, management requirements, and soil conservation needs. A Land Use Capability assessment is a systematic arrangement of the different types of land according to those properties that affect its capacity for long term and sustained production. It is a system that primarily assesses the land for arable (cropping) use.

The LUC assessment is based on a "most limiting factor" system and areas within the same main class (from Class 1 – minimal limitations, to Class 8 – very severe to extreme limitations) are suitable or unsuitable for arable land use to a similar level. The subclass indicates which is the most limiting factor, including erodibility, wetness, soil, and climate. The LUC map is completely covered by mapped units with boundaries where the main class changes.

This report details the methodology used, and results of the Land Use Capability assessment caried out for the Project Kea Site.

2 SITE DETAILS

2.1 Site Location

The Site is located between Carrolls Road and Morven Glenavy Road in Waimate, South Canterbury. As shown in Figure 1, the site is bounded by the Morven Glenavy Road to the east, an irrigation race (from Morven Glenavy Ikawai Irrigation Company Limited) and the South Island Main Trunk railway (SIMT) line to the west, Carrolls Road to the south, and by Whitney's Creek to the north. The surrounding land use, including the Site, is pastoral farming, predominately dairy.

Other significant locations in the area are the State Highway 1 approximately 1.5 km to the west, the Oceania Dairy Limited dairy processing plant 1.5 km to the northwest, the township of Glenavy 2 km to the south, the Waitaki River approximately 3 km to the south, and the Pacific Ocean 4 km to the east.

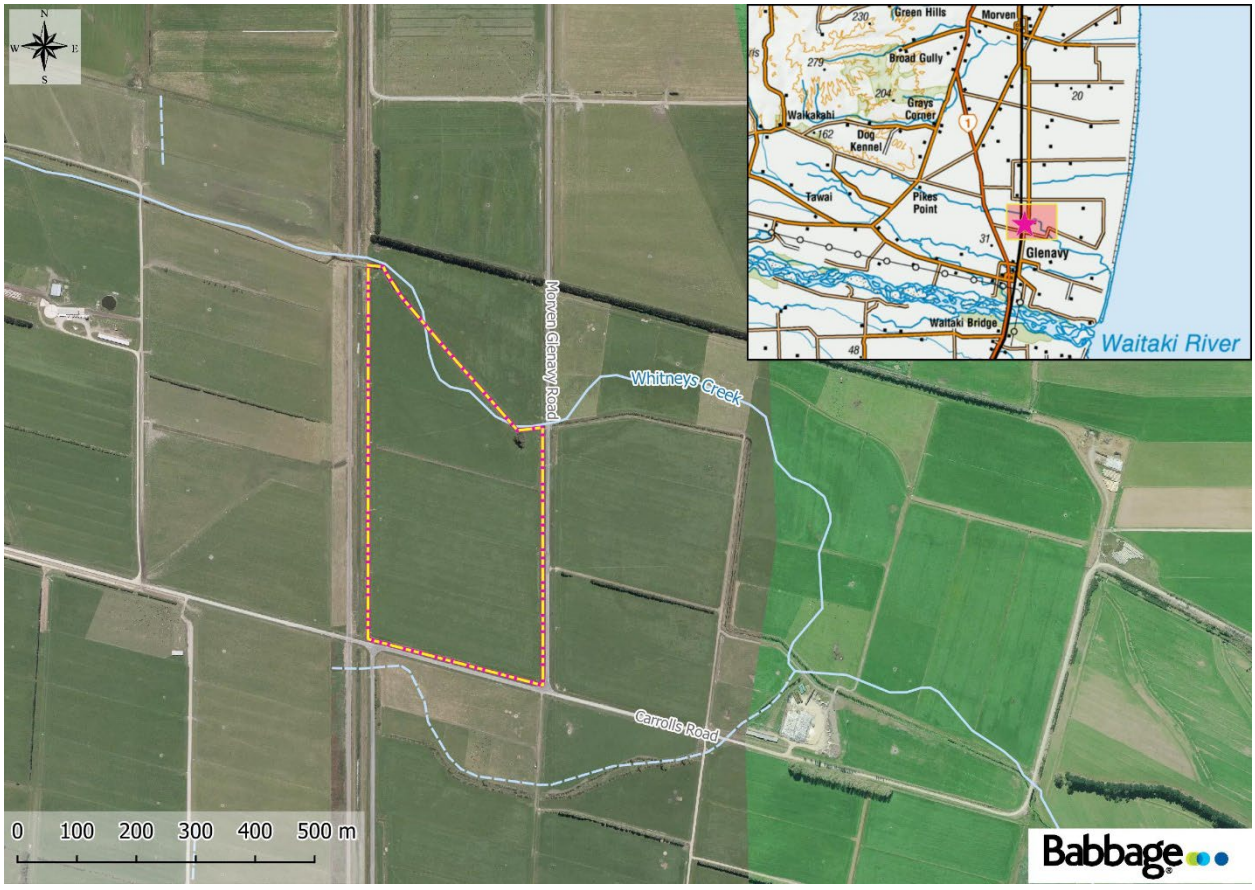


Figure 1: Site Location

2.2 Property Details

The legal description of the site is Rural Section 22268, Title reference CB27B/314 with the owner being Murphy Farms Limited. The total area of the site is 14.85 hectares (ha).

3 EXISTING ENVIRONMENT

3.1 Topography and Land Use

The existing ground surface on the site generally slopes down from west to east with a very minimal gradient of approximately 0.3% (1 v to 300 h). The railway line elevation varies between approximately RL 29.0 m and RL 27.4 m (northern site boundary and southern site boundary respectively), while the site is generally between RL 27.0 m and RL 26.0 m (western and eastern boundary respectively). The railway line is also elevated above the land to the east. The existing ground surface on the site is generally 1.5-2 m below the top of the railway line.

The Site is presently used as pastoral farming with improved pasture used for livestock grazing. Some trees and shrubs are present at the margins of Whitneys Creek at the northern boundary and at some paddock divisions.

3.2 Surface Water

The Site is bordered by an irrigation race on the west boundary, running north to south along the rail line, and by Whitneys Creek, which abuts the northern boundary of the site flowing west to east. Besides the main irrigation races, the Site is irrigated by border dike irrigation, and smaller irrigation channels are present at the paddocks boundaries.

The Whitneys Creek is a small local stream that runs from the hills at Pikes Point, over 12km northwest of the Site, to the Waitaki River mouth and the Pacific Ocean approximately 6km to the southeast of the Site. The creek is approximately 2.5m wide and 0.25m deep at the point where it crosses State Highway 1, upstream from the Site.

The Waitaki River is a significant surface water body in the region, flowing west to east approximately 3km to the south of the Site, into the Pacific Ocean.

3.3 Groundwater

The Site is underlain by the unconfined Waitaki Gravel Aquifer and is within the Whitney's Creek Groundwater Allocation Zone.

The Waitaki Gravel Aquifer receives recharge from the Waitaki River Catchment. Furthermore, groundwater levels in the aquifer are influenced by the MGI irrigation scheme, through soil drainage from irrigated fields and leakage from channels (main races and border dike). Environment Canterbury Regional Council (ECan) identified that "*losses from irrigation races in the [...] region amounts to about 26% of the total groundwater recharge in that area*".

Based on monitoring data from nearby locations (Project Kea, Surface and Groundwater Assessment[1]), groundwater levels vary seasonally, with seasonal high (less than 2 mbgl) during the peak of irrigation season and a seasonal low (more than 7 mbgl) just before the irrigation restarts.

3.4 Existing soil classification

Local soils have formed in the Burnham Formation sedimentary river deposits as part of the Waitaki River fluvial fan, one of the large fluvial fans that forms the Canterbury Plains. The fluvial nature of the Canterbury Plains and the sediments at the site are important as the geomorphology of fluvial fans and braided riverbeds are directly linked to soil depth and distribution, which is used in drawing boundaries between LUC classes (Section 4.2). With the Waitaki River originating on the Eastern side of the Southern Alps most sediments are derived from Greywacke sandstone, a hard sandstone that breaks down predominantly into gravel, sand and silt, with a relatively low clay content.

S-Map[2] (Manaaki Whenua, 2019) classes the Site area predominantly as Darnley soils, however with a low confidence. Several siblings of this soil type are listed for this site within S-Map (as shown in Figure 2,) all very similar. Soil Map and Soil Reports for the Site are provided in Appendix B.

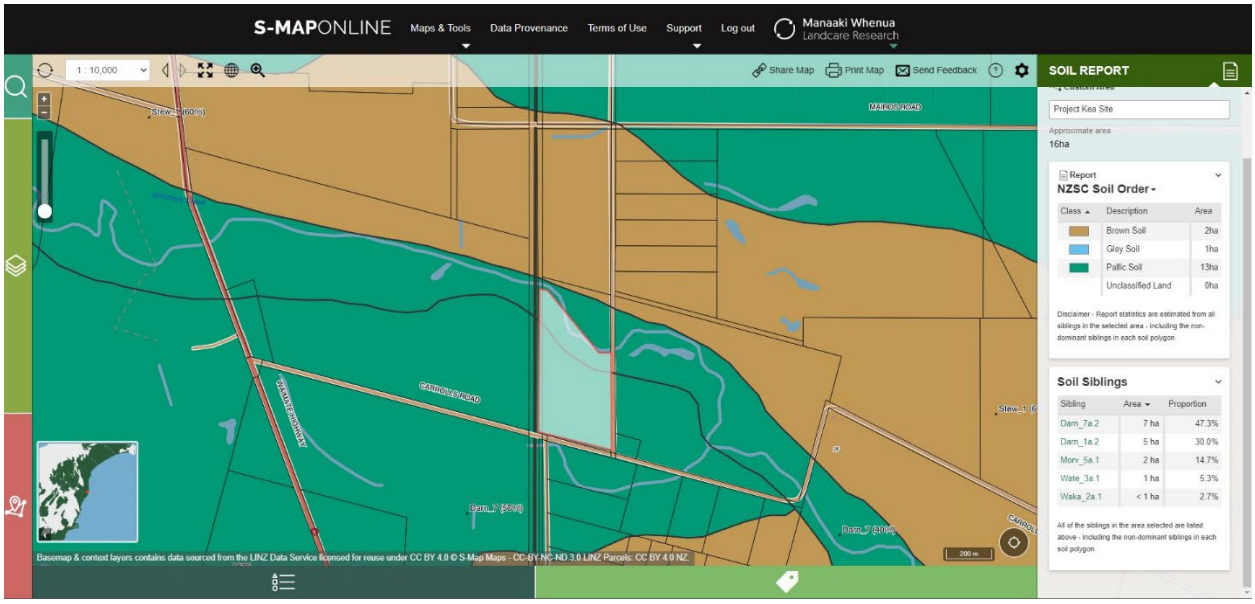


Figure 2. Soils at the Site (S-Map Online[2])

Darnley soils are Typic Argillic Pallic Soils, they are low in iron and clay, causing the subsoil to have weak structure and therefore high density making them hard to work. These soils become very gravelly at depths ranging from approximately 45 cm to 100 cm.

[1] Babbage 2022. *Project Kea Surface and Groundwater Assessment*. Report prepared for South Island Resource Recovery Limited by Babbage Consultants Limited. November 2022
[2] https://smap.landcareresearch.co.nz/

S-Map is considered to be based on too large a scale to be confidently used for a small "farm" scale project such as the KEA project. Therefore, soil profiles have been described as part of the Land Use Capability classification field assessment.

3.5 Existing LUC Classification

The New Zealand Land Use Capability Map as available on Our Environment[3] (Manaaki Whenua, 2021), shown in Appendix C, classify the whole Site, south of Whitney's Creek, as LUC class 3 and the area north of the creek as class 4. This New Zealand scale map is deemed unsuitable to be confidently used for a small "farm" scale project. Therefore, a field assessment was carried out to create a site Land Use Capability map.

[3] https://ourenvironment.scinfo.org.nz/maps-and-tools/app/Land%20Capability/lri_luc_main

4 SITE INVESTIGATION

A site investigation was carried out on 2 November to determine the Land Use Capability classes, subclasses, and distribution at the Site.

4.1 Methodology

The Land Use Capability Assessment was carried out using methods based on the national land classification system used by soil conservators for farm planning since the 1950s. A detailed description of the system can be found in Land Use Capability Survey Handbook (Lynn et al., 2009, 3rd edition)[4].

The LUC assessment is based on a "most limiting factor" system and areas within the same main class are unsuitable for arable land use to a similar level, ranging from class 1 to 8, with 1 being highly suitable and 8 being extremely unsuitable for arable land use.

The suitability is based on slope, soil stoniness, depth and workability, soil texture and drainage, erosion severity and erosion types, salinity, elevation and annual rainfall. The LUC system works with subclasses that indicate the most limiting factor. The subclasses include erodibility (e), wetness (w), soil (s) and climate (c).

The low slope, average rainfall (low rainfall, but currently irrigated), elevation and drainage of the site indicated that soils would be the main limiting factor throughout the Site. Therefore, soil profile descriptions were done at 6 locations, shown in Figure 3, throughout the site to a depth of 60 cm or any layer that was the main limiting factor (i.e. very gravelly, mottled/imperfectly drained).

The data collected was collated into a completely covered map with all areas classed and subclassed, with boundaries between different classifications based on observed landscape contours and characteristics.

The soil survey and assessment were based on the Land Use Capability Survey Handbook[4] and the Soil Description Handbook (Milne et al., 1995, revised edition)[5].

[4] Lynn, I.H.; Manderson, A.K.; Page, M.J.; Harmsworth, G.R.; Eyles, G.O.; Douglas, G.B.; Mackay A.D.; Newsome PJ.F. 2009: *Land Use Capability Survey Handbook – a New Zealand handbook for the classification of land*. 3rd edition. Hamilton, AgResearch, Lincoln, Landcare Research, Lower Hutt, GNS Science. 163p.
[5] Milne, J.D.G. 1995: *Soil description handbook*. Revised edition. Lincoln. Manaaki Whenua Press. 157p.

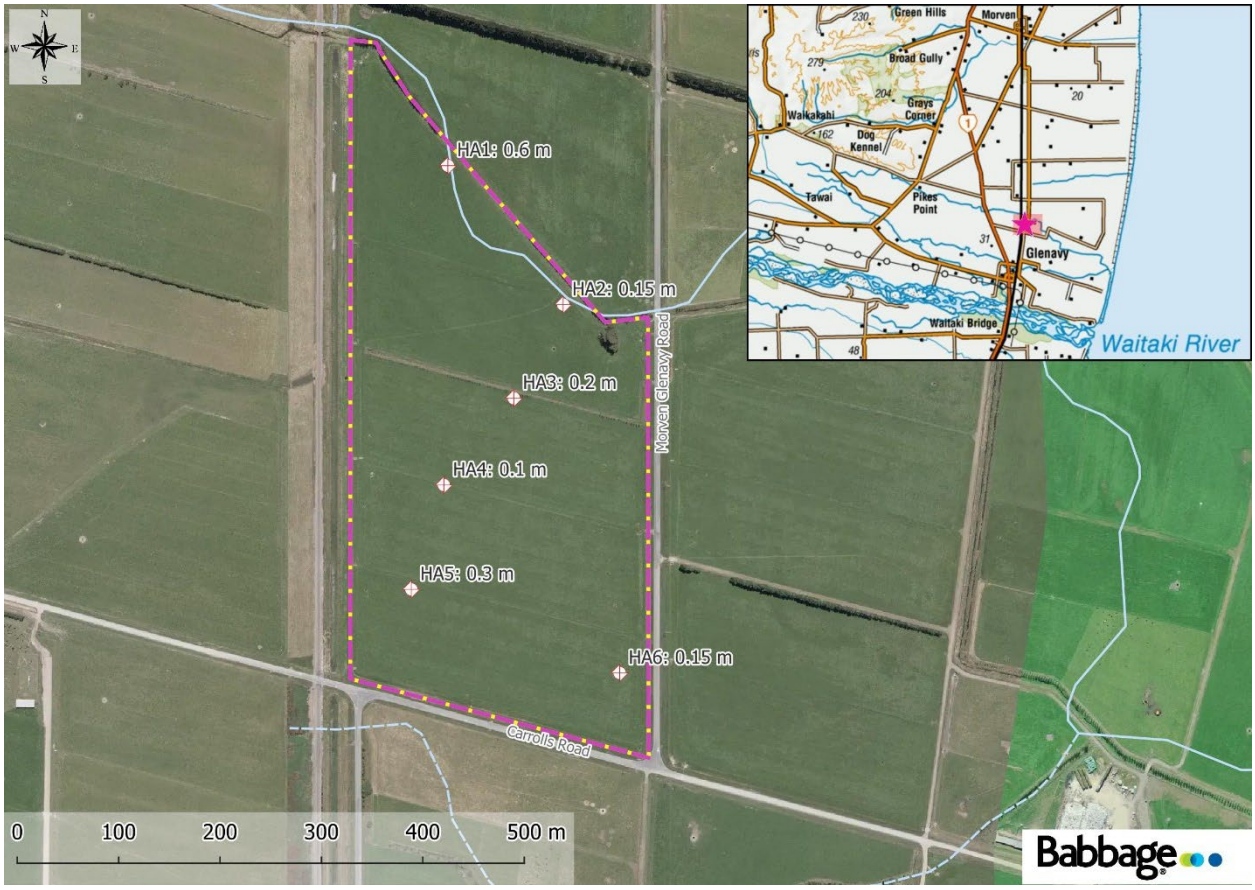


Figure 3. Soil investigation locations and depths to limiting factors.

4.2 Findings and observations

Full soil descriptive data as collected in the field can be found in Appendix A, locations and depths are shown in Figure 3. In general, soils at the Site are very stony, as shown in Figure 4.

Figure 4. Stoney soils, typical of the area, at the banks of Whitneys Creek at the Site.

The soil profile at Auger location 1 was described to 60 cm and consisted predominantly of silt loam with a moderate to strong structure in the topsoil and a weakly structured to structureless subsoil (>30 cm). Below 20 cm the soil was hard to penetrate with the auger, typical for pallic soils, and showed mottling, which is an indication of imperfect drainage. This puts the soil profile in LUC class 2s. It is assumed that the higher elevated north-west corner of the site (south of the creek) indicates the distribution of these deeper soils, in line with the geomorphology of fluvial fans and braided riverbeds. Class 2s has slight limitations for arable use.

The soil profile at Auger location 5 existed of 30 cm of slightly gravelly (5-15% gravel) loamy silt on top of very gravelly (35-70% gravel) loamy silt. This puts this profile in LUC class 3s. This south-west corner of the site was slightly elevated (to a lower extent than the north-west corner described above) and it is assumed that the LUC class 3s soils only exist in that corner. Class 3s has moderate limitations for arable use.

The soil profiles at Auger location 2, 3, 4 and 6 existed of slightly gravelly silt loam on top of very gravelly silt loam, with the very gravelly layer within 20 cm of the surface. This sets these four soil profiles as LUC class 4s, with “significant limitations for arable use or cultivation”.

Based on the soil investigations described above, and the observed landscape at the Site, it is assumed that apart from the north-west corner classed 2s and the south-west corner classed 3s, the rest of the site should be classed 4s, presenting severe limitations for arable use (very stony soils at depths of 20 cm or less). The assumed distribution of LUC Classes at the Site is shown in Figure 4, areas are presented in Table 1.

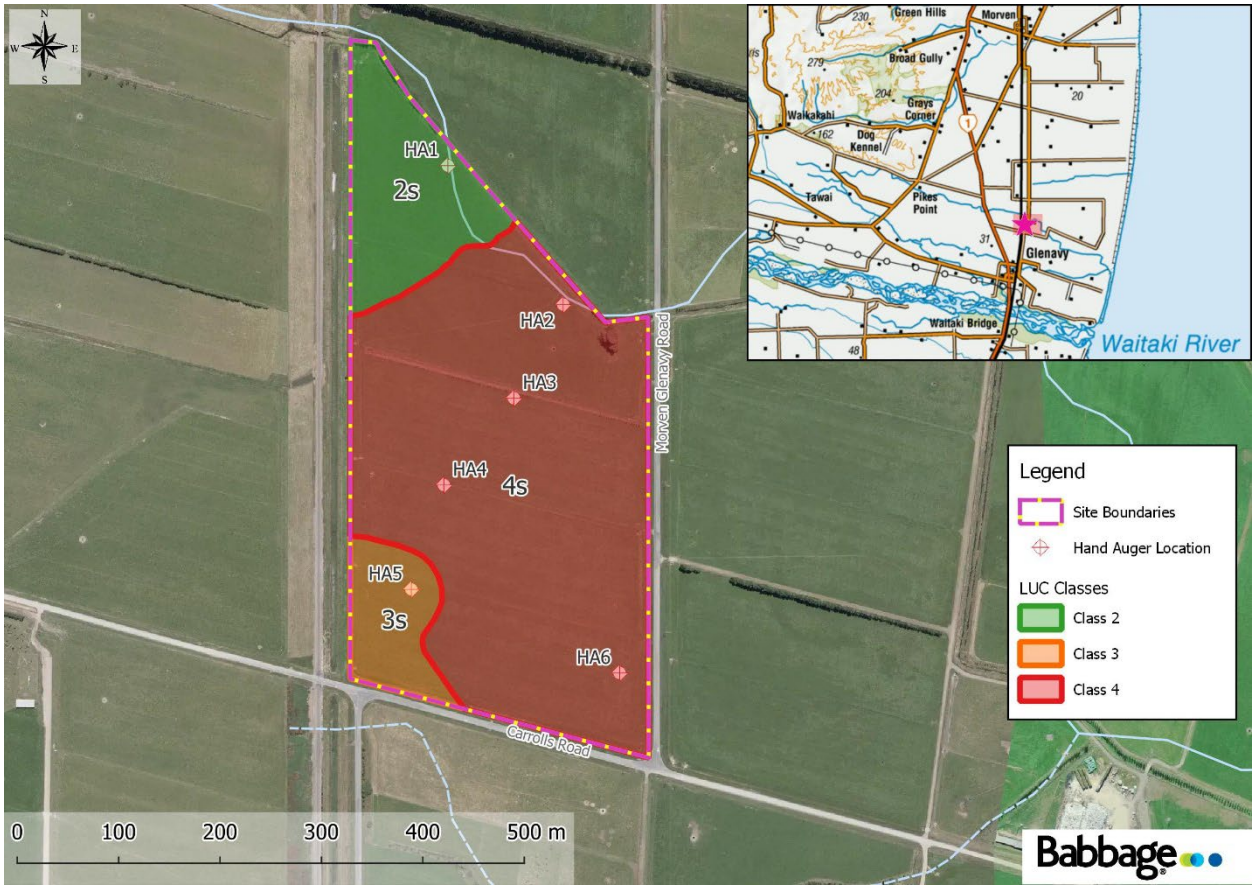


Figure 5. LUC Classes distribution based on site investigation.

Table 1. LUC Class distribution at the Site

LUC Class	LUC subclass	Area (m^2)	Area (ha)	Percentage of the Site (%)
2	S	24,153	2.42	16
3	S	12,171	1.22	8
4	S	114,760	11.48	76

While the significant majority of the Project Kea site is assessed to contain LUC class 4 soils, it also contains small areas of LUC classes 2 and 3. Clause 3.4(5) of the NPS-HPL sets out the guidance for the purposes of mapping of the LUC where there may be multiple LUC classes on areas of land:

- Clause 3.5(b) states that "where possible, the boundaries of large and geographically cohesive areas must be identified by reference to natural boundaries (such as the margins of waterbodies, or legal or non-natural boundaries (such as roads, property boundaries, and fence-lines".
- Clause 3.5(c) states that "small, discrete areas of land that are not LUC 1, 2 or 3, but are within a large and geographically cohesive area of LUC 1, 2, or 3 land, may be included; and
- Clause 3.5(d) states that "small, discrete areas of LUC 1, 2, or 3 need not be included if they are separated from any large and geographically cohesive area of LUC 1, 2, or 3 land".

In particular clauses 3.5(b) and (d) are of relevance to the Project Kea site. The small parcels of LUC classes 2 and 3 soils on the Project Kea site are separated from the adjoining sites by the railway line, Whitneys Creek, legal property boundary and a road. In accordance with clause 3.5(d), these "small and discreet areas" of LUC classes 2 and 3 soils on the Project Kea site should not be included in the mapping of "highly productive land", as these are "separated from large and geographically cohesive LUC 1, 2, or 3 land". Therefore, the entirety of the Project Kea site is deemed not to be classified as "highly productive land".

5 CONCLUSIONS

LUC classification for most of the Site (over 75 %) is LUC class 4s, as the soil becomes very gravelly within the top 20cm of the soil. This means the site has severe limitations for arable use. Based on the mapping guidance in the NPS-HPL, the entirety of the Project Kea site is deemed not to be classified as "highly productive land".

APPLICABILITY AND LIMITATIONS

Restrictions of Intended Purpose

This report has been prepared solely for the benefit of South Island Resource Recovery Ltd as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such party's sole risk.

Legal Interpretation

Opinions and judgements expressed herein are based on our understanding and interpretation of current regulatory standards, and should not be construed as legal opinions. Where opinions or judgements are to be relied on they should be independently verified with appropriate legal advice.

Maps and Images

All maps, plans, and figures included in this report are indicative only and are not to be used or interpreted as engineering drafts. Do not scale any of the maps, plans or figures in this report. Any information shown here on maps, plans and figures should be independently verified on site before taking any action. Sources for map and plan compositions include LINZ Data and Map Services and local council GIS services. For further details regarding any maps, plans or figures in this report, please contact Babbage Consultants Limited.

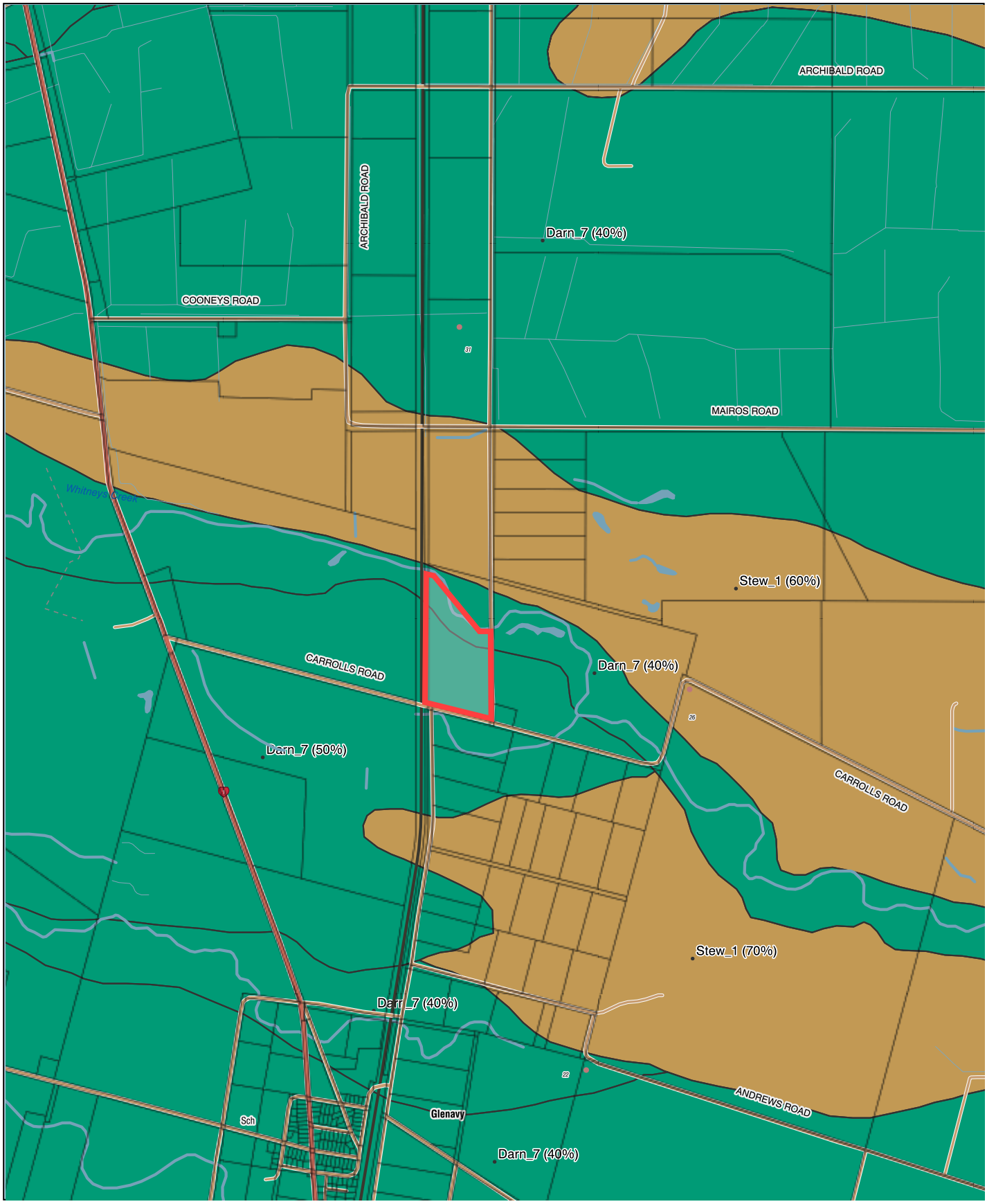
Appendix A

Soil descriptive data

Auger site	Depth	Soil Texture	Soil Structure			Coarse fragments		Soil Colour	Mottles		LUC
	(cm)		Degree	Shape	Size	Size	Abundance		Abundance	Colour(s)	Class
1	**10**	silt loam	moderate-strong	spheroidal	microfine - very fine		-	10YR2/1			Hard to work + mottling indicates imperfect drainage
	20	silt loam	moderate-strong	spheroidal	microfine - very fine		-	10YR2/1			
	30	silt loam	moderate	polyhedral	very fine		-	2.5Y5/3	y	7.5YR5/8	
	40	loamy silt	weak	blocky	very fine - fine		-	2.5YR5/4	y	7.5YR5/8	
	50	silt loam	structureless	cloddy	-		-	10YR7/2	y	7.5YR5/8	
	60	silt loam	structureless	cloddy	-		-	10YR7/2	y	7.5YR5/8	**2s**
2	**10**	silt loam	strong	spheroidal	microfine - very fine	fine – medium	slightly gravelly	10YR2/1	-		couldn't auger deeper >10cm very gravelly
	15	silt loam	strong	spheroidal	microfine - fine	fine – medium	very gravelly	10YR2/1	-		
3	**10**	silt loam	strong	spheroidal	microfine - very fine	fine	slightly gravelly	2.5Y4/3	-		couldn't auger deeper >10cm very gravelly
	20	silt loam	strong	spheroidal	microfine - very fine	medium - coarse	very gravelly	2.5Y4/3	-		
4	**10**	silt loam	strong	spheroidal	microfine - very fine	medium - coarse	very gravelly	2.5YR4/3	-		couldn't auger deeper >5cm very gravelly
5	**10**	loamy silt	moderate - strong	spheroidal	microfine - very fine	medium	slightly gravelly	2.5YR4/3	-		couldn't auger deeper >30cm very gravelly
	20	loamy silt	moderate - strong	polyhedral	extremely fine - fine	medium	slightly gravelly	2.5YR4/3	-		
	30	loamy silt	moderate	polyhedral	extremely fine - fine	medium	slightly gravelly	2.5YR4/3	-		
6	**10**	silt loam	moderate - strong	spheroidal	microfine - very fine	fine – medium	slightly gravelly	2.5YR4/3	-		couldn't auger deeper >15cm very gravelly
	15	silt loam	moderate	spheroidal	microfine - very fine	fine – medium	very gravelly	2.5YR4/3	-		

Appendix B

S-Map and Soil Reports



S-MAPONLINE

Scale: 1:25,000

0 200 400 600 800m

Manaaki Whenua
Landcare Research

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Printed: 15:57:54 PM Tue, 15 Nov 2022

Legend

NZSC Soil Order

- Allophanic Soil
- Anthropic Soil
- Brown Soil
- Gley Soil
- Granular Soil
- Melanic Soil
- Organic Soil
- Oxidic Soil
- Pallic Soil
- Podzol Soil
- Pumice Soil
- Raw Soil
- Recent Soil
- Semiarid Soil
- Ultic Soil

Polygons & Labels

- S-map soil data

S-MAPONLINE

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Darnley_1a.2

Report generated: 15-Nov-2022 from https://smap.landcareresearch.co.nz

Darn_1a.2

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks. S-map correlates soils across New Zealand. Both the old soil name and the new correlated (soil family) name are listed below.

Soil Classification

Soil Classification:
Typic Argillic Pallic Soils (PJT)

Family Name:
Darnley (Darn)

Sibling Name:
Darnley_1a.2 (Darn_1a.2)

Soil profile material
Rounded stony soil

Depth class (diggability)
Shallow (20 - 45 cm)

Profile texture
silt

Parent Material

Stones/rocks
hard sandstone rock

Soil material
hard sandstone rock

Origin
Alluvium

Soil Sibling Concept

This soil belongs to the Pallic soil order of the New Zealand soil classification. Pallic Soils have pale coloured subsoils, due to low contents of iron oxides, have weak soil structure and high density in subsurface horizons. Pallic Soils tend to be dry in summer and wet in winter. It is formed in alluvial sand silt or gravel deposited by running water, from hard sandstone parent material.

The topsoil typically has silt texture and is slightly stony. The subsoil has dominantly silt textures, with a very gravelly layer from less than 45 cm mineral soil depth to more than 100 cm. The plant rooting depth is 65 - 100 (cm), due to an extremely gravelly horizon with extremely low water storage capacity.

Generally the soil is moderately well drained with low vulnerability of water logging in non-irrigated conditions, and has moderate soil water holding capacity. Inherently these soils have a high structural vulnerability and a moderate N leaching potential, which should be accounted for when making land management decisions.

Allan Hewitt ©

Argillic
Pallic

About this publication

- This information sheet describes the *typical average properties* of the specified soil.
- For further information on individual soils, contact Landcare Research New Zealand Ltd: www.landcareresearch.co.nz
- Advice should be sought from soil and land use experts before making decisions on individual farms and paddocks.
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- Landcare Research shall not be liable on any legal basis (including without limitation negligence) and expressly excludes all liability for loss or damage howsoever and whenever caused to a user of this factsheet.

Darnley_1a.2

Soil horizons

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay*	Sand*	Permeability
Loamy Weak	12 - 30 cm	0 - 10 %	18 - 25 %	5 - 15 %	rapid
Loamy Weak	10 - 30 cm	0 - 10 %	18 - 25 %	5 - 30 %	moderate
Very Stony Loamy Compact	15 - 50 cm	35 - 60 %	15 - 30 %	10 - 40 %	slow
Very Stony Sandy Compact	0 - 35 cm	60 - 79 %	2 - 10 %	60 - 85 %	moderate
Extremely Stony Sandy	0 - 35 cm	70 - 90 %	1 - 5 %	80 - 95 %	rapid

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

Darnley_1a.2

Soil physical properties

Depth class (diggability)
Shallow (20 - 45 cm)

Potential rooting depth
65 - 100 (cm)

Rooting barrier
Extremely gravelly

Depth to hard rock
No hard rock within 1 m

Depth to soft rock
No soft rock within 1 m

Depth to stony layer class
Shallow

Texture profile
Silt

Topsoil stoniness
Slightly stony

Topsoil clay range
18 - 25 %

Drainage class
Moderately well drained

Permeability profile
Moderate over slow

Depth to slowly permeable horizon
30 - 90 (cm)

Permeability of slowest horizon
Slow (< 4 mm/h)

Aeration in root zone
Moderately limited

Profile available water

(0 - 30cm or root barrier)	(0 - 60cm or root barrier)	(0 - 100cm or root barrier)
High (54 mm)	Moderate (83 mm)	Moderate (104 mm)

Dry bulk density

topsoil	subsoil
1.22 g/cm³	1.42 g/cm³

Soil chemical properties

Topsoil P retention
Low (19%)

Soil management factors

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability
High (0.65)

Contaminant management

N leaching vulnerability
Medium

P leaching vulnerability
not available yet

Water management

Water logging vulnerability
Moderate

Drought vulnerability - if not irrigated
Moderate

Bypass flow
Medium

SINDI - Soil quality Indicators

SINDI - Soil Quality Indicators

A suite of soil quality indicators is available from http://sindi.landcareresearch.co.nz/

- Compare your soil with information from our soils databases.
- Assess the intrinsic resources and biological, chemical and physical quality of your soil
- See how your soil measures up against current understanding of optimal values.
- Learn about the effect each indicator has on soil quality and some general management practices that could be implemented to improve soil quality.

Darnley_1a.2

Soil information for OVERSEER

The following information can be entered in the OVERSEER® Nutrient Budget model. This information is derived from the S-map soil properties which are matched to the most appropriate OVERSEER categories. Please read the notes below for further information.

Soil description page

1. Select **Link to S-map**
2. Under S-map sibling data enter the S-map name/ref: **Darn_1a.2**

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Manaaki Whenua datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.

- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.

- S-map only contains information on soils to a depth of 100 cm. The soil water estimates in the > 60 cm depth category assume that the bottom functional horizon that extends to 100 cm, continues down to a depth of 150cm. Where it is known by the user that there is an impermeable layer or non-fractured bedrock between 100 and 150 cm, this depth should be entered into OVERSEER. Where there is a change in the soil profile characteristics below 100 cm, the user should be aware that the values provided on this factsheet for the > 60 cm depth category will not reflect this change. For example, the presence of gravels at 120 cm would usually result in lower soil water estimates in the > 60 cm depth category. Note though that this assumption only impacts on a cropping block, as OVERSEER uses soil data from just the top 60 cm in pastoral blocks.

- OVERSEER requires the soil water values to be non-zero integers (even though zero is a valid value below a root barrier), and the wilting point value must be less than the field capacity value which must be less than the saturation value. The S-map water content estimates supplied by the S-map web service have been rounded to integers and may be assigned minimal values to meet these OVERSEER requirements. These modifications will result in a slightly less accurate estimate of Available Water to 60 cm (labelled PAW in OVERSEER) than that provided on the first page of this factsheet, but this is not expected to lead to any significant difference in outputs from OVERSEER .

Manaaki Whenua
Landcare Research

Darnley_7a.2

Darn_7a.2

Report generated: 15-Nov-2022 from https://smap.landcareresearch.co.nz

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks. S-map correlates soils across New Zealand. Both the old soil name and the new correlated (soil family) name are listed below.

Soil Classification

Soil Classification:
Typic Argillic Pallic Soils (PJT)

Family Name:
Darnley (Darn)

Sibling Name:
Darnley_7a.2 (Darn_7a.2)

Soil profile material
Rounded stony soil

Depth class (diggability)
Shallow (20 - 40 cm)

Profile texture
silt

Parent Material

Stones/rocks
hard sandstone rock

Soil material
hard sandstone rock

Origin
Alluvium

Soil Sibling Concept

This soil belongs to the Pallic soil order of the New Zealand soil classification. Pallic Soils have pale coloured subsoils, due to low contents of iron oxides, have weak soil structure and high density in subsurface horizons. Pallic Soils tend to be dry in summer and wet in winter. It is formed in alluvial sand silt or gravel deposited by running water, from hard sandstone parent material.

The topsoil typically has silt texture and is moderately stony. The subsoil has dominantly silt textures, with a very gravelly layer from less than 45 cm mineral soil depth to more than 100 cm. The plant rooting depth is 80 - 100 (cm), due to an extremely gravelly horizon with extremely low water storage capacity.

Generally the soil is moderately well drained with moderate vulnerability of water logging in non-irrigated conditions, and has moderate to low soil water holding capacity. Inherently these soils have a high structural vulnerability and a high N leaching potential, which should be accounted for when making land management decisions.

Allan Hewitt ©

Argillic
Pallic

About this publication

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Darnley_7a.2

Soil horizons

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay*	Sand*	Permeability
Stony Loamy Weak	12 - 30 cm	10 - 35 %	15 - 25 %	5 - 20 %	rapid
Very Stony Loamy Loose	5 - 20 cm	35 - 60 %	15 - 30 %	10 - 40 %	moderate
Very Stony Loamy Compact	20 - 40 cm	60 - 70 %	15 - 20 %	20 - 70 %	slow
Very Stony Sandy Loose	10 - 50 cm	60 - 79 %	2 - 6 %	80 - 95 %	rapid
Extremely Stony Sandy	0 - 30 cm	70 - 90 %	1 - 5 %	80 - 95 %	rapid

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

Darnley_7a.2

Soil physical properties

Depth class (diggability)
Shallow (20 - 40 cm)

Potential rooting depth
80 - 100 (cm)

Rooting barrier
Extremely gravelly

Depth to hard rock
No hard rock within 1 m

Depth to soft rock
No soft rock within 1 m

Depth to stony layer class
Shallow

Texture profile
Silt

Topsoil stoniness
Moderately stony

Topsoil clay range
15 - 25 %

Drainage class
Moderately well drained

Permeability profile
Moderate over slow

Depth to slowly permeable horizon
30 - 40 (cm)

Permeability of slowest horizon
Slow (< 4 mm/h)

Aeration in root zone
Moderately limited

Profile available water

(0 - 30cm or root barrier)	(0 - 60cm or root barrier)	(0 - 100cm or root barrier)
Moderate (40 mm)	Moderate (62 mm)	Moderate to low (79 mm)

Dry bulk density

topsoil	subsoil
1.22 g/cm³	1.42 g/cm³

Soil chemical properties

Topsoil P retention
Low (19%)

Soil management factors

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability
High (0.66)

Contaminant management

N leaching vulnerability
High

P leaching vulnerability
not available yet

Water management

Water logging vulnerability
Moderate

Drought vulnerability - if not irrigated
Moderate

Bypass flow
High

SINDI - Soil quality Indicators

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Darnley_7a.2

Soil information for OVERSEER

The following information can be entered in the OVERSEER® Nutrient Budget model. This information is derived from the S-map soil properties which are matched to the most appropriate OVERSEER categories. Please read the notes below for further information.

Soil description page

1. Select **Link to S-map**
2. Under S-map sibling data enter the S-map name/ref: **Darn_7a.2**

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Manaaki Whenua datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.

- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.

- S-map only contains information on soils to a depth of 100 cm. The soil water estimates in the > 60 cm depth category assume that the bottom functional horizon that extends to 100 cm, continues down to a depth of 150cm. Where it is known by the user that there is an impermeable layer or non-fractured bedrock between 100 and 150 cm, this depth should be entered into OVERSEER. Where there is a change in the soil profile characteristics below 100 cm, the user should be aware that the values provided on this factsheet for the > 60 cm depth category will not reflect this change. For example, the presence of gravels at 120 cm would usually result in lower soil water estimates in the > 60 cm depth category. Note though that this assumption only impacts on a cropping block, as OVERSEER uses soil data from just the top 60 cm in pastoral blocks.

- OVERSEER requires the soil water values to be non-zero integers (even though zero is a valid value below a root barrier), and the wilting point value must be less than the field capacity value which must be less than the saturation value. The S-map water content estimates supplied by the S-map web service have been rounded to integers and may be assigned minimal values to meet these OVERSEER requirements. These modifications will result in a slightly less accurate estimate of Available Water to 60 cm (labelled PAW in OVERSEER) than that provided on the first page of this factsheet, but this is not expected to lead to any significant difference in outputs from OVERSEER .

Manaaki Whenua
Landcare Research

Morven_5a.1

Report generated: 15-Nov-2022 from https://smap.landcareresearch.co.nz

Morv_5a.1

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks. S-map correlates soils across New Zealand. Both the old soil name and the new correlated (soil family) name are listed below.

Soil Classification

Soil Classification:
Cemented Firm Brown Soils (BFC)

Family Name:
Morven (Morv)

Sibling Name:
Morven_5a.1 (Morv_5a.1)

Soil profile material
Rounded stony soil

Depth class (diggability)
Shallow (20 - 35 cm)

Profile texture
silt

Parent Material

Stones/rocks
hard sandstone rock

Soil material
hard sandstone rock

Origin
Alluvium

Soil Sibling Concept

This soil belongs to the Brown soil order of the New Zealand soil classification. Brown Soils have a brown or yellow-brown subsoil below a dark grey-brown topsoil. The brown colour is caused by thin coatings of iron oxides weathered from the parent material. It is formed in alluvial sand silt or gravel deposited by running water, from hard sandstone parent material.

The topsoil typically has silt texture and is moderately stony. The subsoil has dominantly silt textures, with a very gravelly layer from less than 45 cm mineral soil depth to more than 100 cm. The plant rooting depth extends beyond 1m.

Generally the soil is well drained with very low vulnerability of water logging in non-irrigated conditions, and has moderate soil water holding capacity. Inherently these soils have a moderate structural vulnerability and a high N leaching potential, which should be accounted for when making land management decisions.

About this publication

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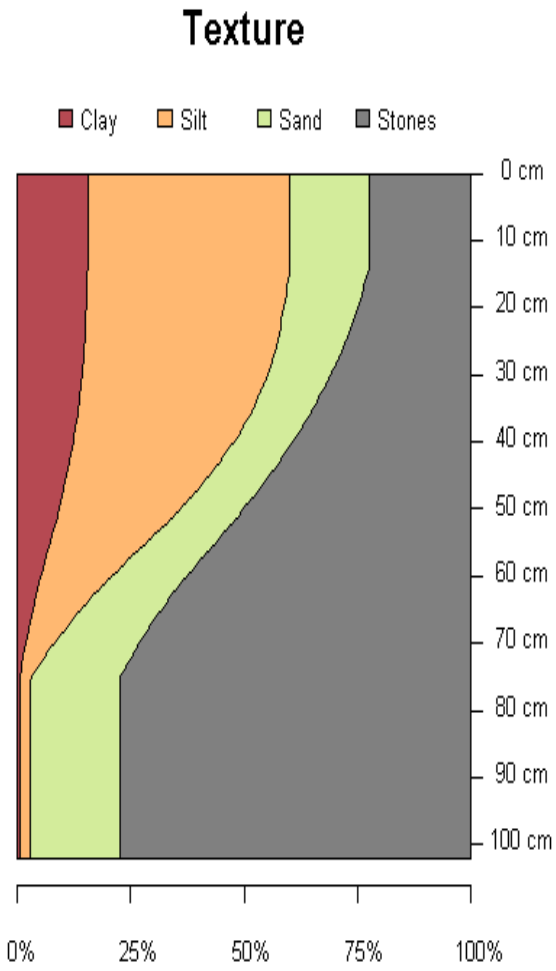
Morven_5a.1

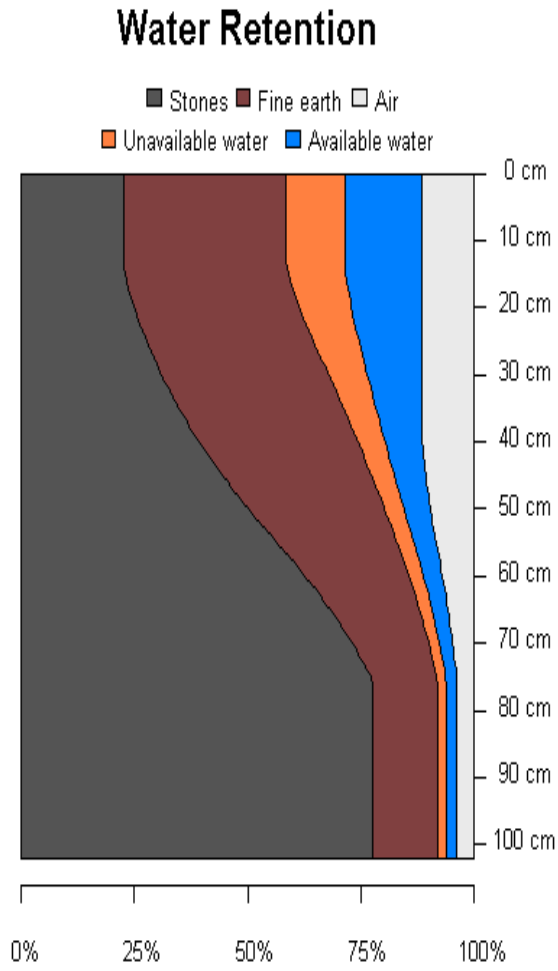
Soil horizons

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay*	Sand*	Permeability
Stony Loamy Weak	15 - 35 cm	10 - 35 %	15 - 25 %	15 - 30 %	rapid
Very Stony Loamy Loose	20 - 40 cm	20 - 60 %	15 - 25 %	15 - 30 %	rapid
Extremely Stony Sandy	30 - 65 cm	70 - 85 %	0 - 4 %	80 - 95 %	rapid

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)





The values for the graphs above have been generated from horizon and pedotransfer data. These values have then been splined to create continuous estimates of soil water holding capacity and particle size distribution the soil profile. These curves express the particle size distribution and water retention of the soil however there may be barriers to rooting depth that are not necessarily represented in these properties directly. It is advisable to check the potential rooting depth and rooting barrier fields in the soil physical properties section on page three of this factsheet.

Morven_5a.1

Soil physical properties

Depth class (diggability)
Shallow (20 - 35 cm)

Potential rooting depth
Unlimited

Rooting barrier
No significant barrier within 1 m

Depth to hard rock
No hard rock within 1 m

Depth to soft rock
No soft rock within 1 m

Depth to stony layer class
Shallow

Texture profile
Silt

Topsoil stoniness
Moderately stony

Topsoil clay range
15 - 25 %

Drainage class
Well drained

Permeability profile
Rapid

Depth to slowly permeable horizon
No slowly permeable horizon

Permeability of slowest horizon
Rapid (> 72 mm/h)

Aeration in root zone
Unlimited

Profile available water

(0 - 30cm or root barrier)	(0 - 60cm or root barrier)	(0 - 100cm or root barrier)
Moderate (50 mm)	Moderate (77 mm)	Moderate (99 mm)

Dry bulk density

topsoil	subsoil
1.09 g/cm³	1.42 g/cm³

Soil chemical properties

Topsoil P retention
Medium (43%)

Soil management factors

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability
Moderate (0.52)

Contaminant management

N leaching vulnerability
High

P leaching vulnerability
not available yet

Water management

Water logging vulnerability
Very low

Drought vulnerability - if not irrigated
Moderate

Bypass flow
Medium

SINDI - Soil quality Indicators

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Morven_5a.1

Soil information for OVERSEER

The following information can be entered in the OVERSEER® Nutrient Budget model. This information is derived from the S-map soil properties which are matched to the most appropriate OVERSEER categories. Please read the notes below for further information.

Soil description page

1. Select **Link to S-map**
2. Under S-map sibling data enter the S-map name/ref: **Morv_5a.1**

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Manaaki Whenua datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.

- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.

- S-map only contains information on soils to a depth of 100 cm. The soil water estimates in the > 60 cm depth category assume that the bottom functional horizon that extends to 100 cm, continues down to a depth of 150cm. Where it is known by the user that there is an impermeable layer or non-fractured bedrock between 100 and 150 cm, this depth should be entered into OVERSEER. Where there is a change in the soil profile characteristics below 100 cm, the user should be aware that the values provided on this factsheet for the > 60 cm depth category will not reflect this change. For example, the presence of gravels at 120 cm would usually result in lower soil water estimates in the > 60 cm depth category. Note though that this assumption only impacts on a cropping block, as OVERSEER uses soil data from just the top 60 cm in pastoral blocks.

- OVERSEER requires the soil water values to be non-zero integers (even though zero is a valid value below a root barrier), and the wilting point value must be less than the field capacity value which must be less than the saturation value. The S-map water content estimates supplied by the S-map web service have been rounded to integers and may be assigned minimal values to meet these OVERSEER requirements. These modifications will result in a slightly less accurate estimate of Available Water to 60 cm (labelled PAW in OVERSEER) than that provided on the first page of this factsheet, but this is not expected to lead to any significant difference in outputs from OVERSEER .

Manaaki Whenua
Landcare Research

Wakanui_2a.1

Report generated: 15-Nov-2022 from https://smap.landcareresearch.co.nz

Waka_2a.1

This information sheet describes the typical average properties of the specified soil to a depth of 1 metre, and should not be the primary source of data when making land use decisions on individual farms and paddocks. S-map correlates soils across New Zealand. Both the old soil name and the new correlated (soil family) name are listed below.

Soil Classification

Soil Classification:
Mottled Immature Pallic Soils (PIM)

Family Name:
Wakanui (Waka)

Sibling Name:
Wakanui_2a.1 (Waka_2a.1)

Soil profile material
Moderately deep soil

Depth class (diggability)
Moderately deep (45 - 90 cm)

Profile texture
silt

Parent Material

Stones/rocks
hard sandstone rock

Soil material
hard sandstone rock

Origin
Alluvium

Soil Sibling Concept

This soil belongs to the Pallic soil order of the New Zealand soil classification. Pallic Soils have pale coloured subsoils, due to low contents of iron oxides, have weak soil structure and high density in subsurface horizons. Pallic Soils tend to be dry in summer and wet in winter. It is formed in alluvial sand silt or gravel deposited by running water, from hard sandstone parent material.

The topsoil typically has silt texture and is stoneless. The subsoil has dominantly silt textures, with a very gravelly layer that starts at or below 45 cm soil mineral depth and extends continuously to 100 cm. The plant rooting depth extends beyond 1m.

Generally the soil is imperfectly drained with high vulnerability of water logging in non-irrigated conditions, and has moderate to high soil water holding capacity. Inherently these soils have a high structural vulnerability and a moderate N leaching potential, which should be accounted for when making land management decisions.

Allan Hewitt ©

Immature Pallic

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Wakanui_2a.1

Soil horizons

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay*	Sand*	Permeability
Loamy Weak	18 - 30 cm	0 %	15 - 35 %	5 - 15 %	rapid
Loamy Fine Slightly Firm	5 - 20 cm	0 %	15 - 35 %	5 - 15 %	moderate
Loamy Coarse Firm	15 - 60 cm	0 %	15 - 35 %	0 - 25 %	slow
Loamy Weak	0 - 15 cm	0 %	8 - 18 %	15 - 50 %	moderate
Very Stony Sandy Loose	5 - 45 cm	50 - 70 %	1 - 4 %	85 - 95 %	rapid

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)

Wakanui_2a.1

Soil physical properties

Depth class (diggability)
Moderately deep (45 - 90 cm)

Potential rooting depth
Unlimited

Rooting barrier
No significant barrier within 1 m

Depth to hard rock
No hard rock within 1 m

Depth to soft rock
No soft rock within 1 m

Depth to stony layer class
Moderately deep

Texture profile
Silt

Topsoil stoniness
Stoneless

Topsoil clay range
15 - 35 %

Drainage class
Imperfectly drained

Permeability profile
Moderate over slow

Depth to slowly permeable horizon
30 - 50 (cm)

Permeability of slowest horizon
Slow (< 4 mm/h)

Aeration in root zone
Limited

Profile available water

(0 - 30cm or root barrier)	(0 - 60cm or root barrier)	(0 - 100cm or root barrier)
High (55 mm)	High (97 mm)	Moderate to high (139 mm)

Dry bulk density

topsoil	subsoil
1.22 g/cm³	1.53 g/cm³

Soil chemical properties

Topsoil P retention
Low (23%)

Soil management factors

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability
High (0.66)

Contaminant management

N leaching vulnerability
Medium

P leaching vulnerability
not available yet

Water management

Water logging vulnerability
High

Drought vulnerability - if not irrigated
Low

Bypass flow
High

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Wakanui_2a.1

Soil information for OVERSEER

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Soil description page

1. Select **Link to S-map**
2. Under S-map sibling data enter the S-map name/ref: **Waka_2a.1**

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Manaaki Whenua datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.

- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.

- S-map only contains information on soils to a depth of 100 cm. The soil water estimates in the > 60 cm depth category assume that the bottom functional horizon that extends to 100 cm, continues down to a depth of 150cm. Where it is known by the user that there is an impermeable layer or non-fractured bedrock between 100 and 150 cm, this depth should be entered into OVERSEER. Where there is a change in the soil profile characteristics below 100 cm, the user should be aware that the values provided on this factsheet for the > 60 cm depth category will not reflect this change. For example, the presence of gravels at 120 cm would usually result in lower soil water estimates in the > 60 cm depth category. Note though that this assumption only impacts on a cropping block, as OVERSEER uses soil data from just the top 60 cm in pastoral blocks.

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Manaaki Whenua
Landcare Research

Waterton_3a.1

Report generated: 15-Nov-2022 from https://smap.landcareresearch.co.nz

Wate_3a.1

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Soil Classification

Soil Classification:
Argillic Orthic Gley Soils (GOJ)

Family Name:
Waterton (Wate)

Sibling Name:
Waterton_3a.1 (Wate_3a.1)

Soil profile material
Rounded stony soil

Depth class (diggability)
Shallow (20 - 45 cm)

Profile texture
silt

Parent Material

Stones/rocks
hard sandstone rock

Soil material
hard sandstone rock

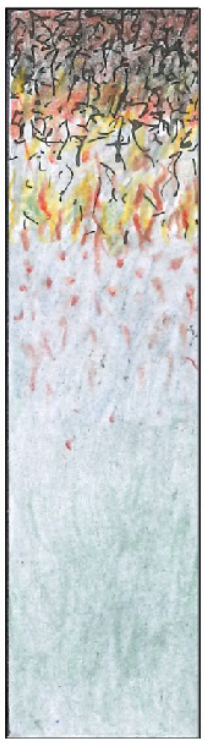
Origin
Alluvium

Soil Sibling Concept

This soil belongs to the Gley soil order of the New Zealand soil classification. Gley soils are strongly affected by waterlogging, have been chemically reduced, have light grey subsoils, and usually have reddish brown or brown mottles. Waterlogging occurs in winter and spring, and some soils remain wet all year. It is formed in alluvial sand silt or gravel deposited by running water, from hard sandstone parent material.

The topsoil typically has silt texture and is stoneless. The subsoil has dominantly silt textures, with a very gravelly layer from less than 45 cm mineral soil depth to more than 100 cm. The plant rooting depth is 70 - 100 (cm), due to an extremely gravelly horizon with extremely low water storage capacity.

Generally the soil is poorly drained with high vulnerability of water logging in non-irrigated conditions, and has moderate to high soil water holding capacity. Inherently these soils have a high structural vulnerability and a very low N leaching potential, which should be accounted for when making land management decisions.



Allan Hewitt ©

Orthic Gley

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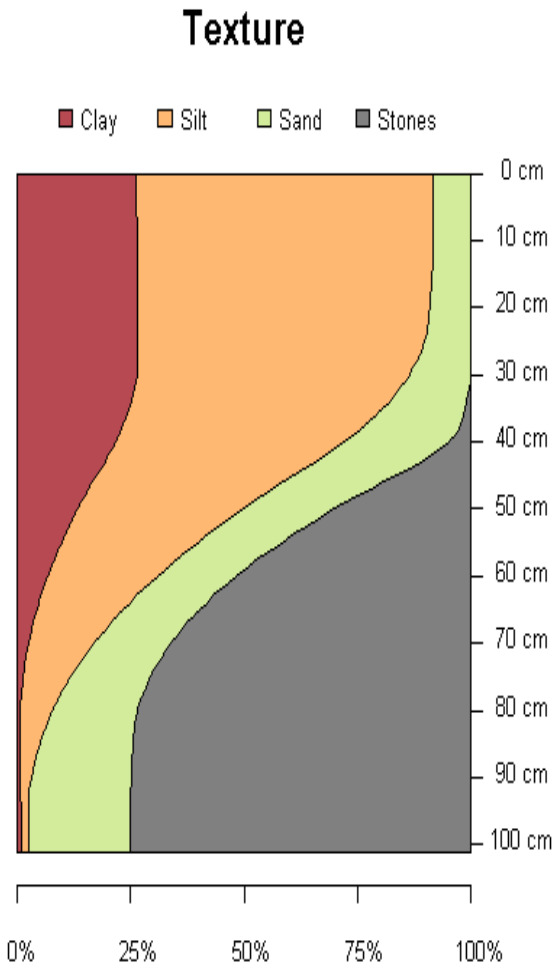
Waterton_3a.1

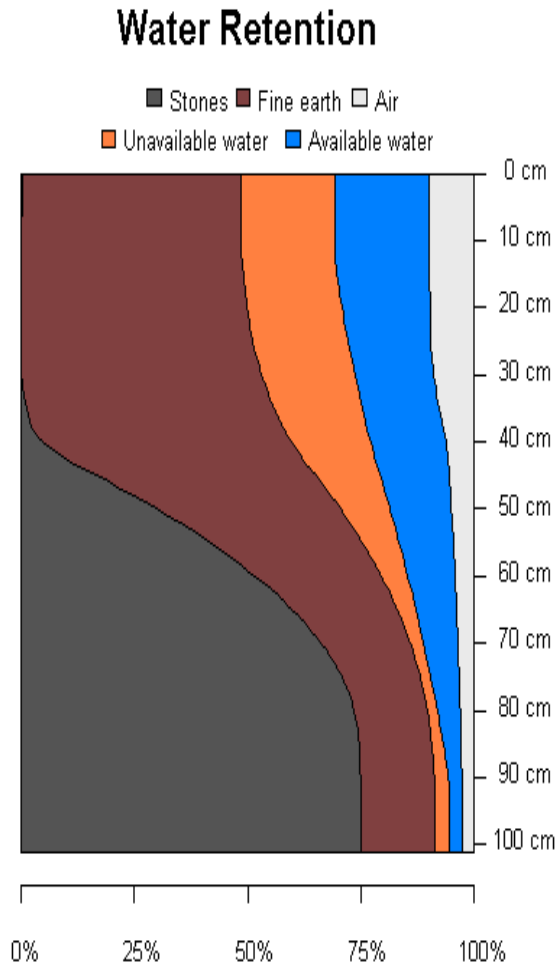
Soil horizons

Characteristics of functional horizons in order from top to base of profile:

Functional Horizon	Thickness	Stones	Clay*	Sand*	Permeability
Loamy Fine Slightly Firm	15 - 30 cm	0 %	18 - 35 %	5 - 15 %	moderate
Loamy Fine Slightly Firm	0 - 30 cm	0 %	18 - 35 %	5 - 30 %	moderate
Loamy Fine Firm	0 - 20 cm	0 - 15 %	15 - 30 %	10 - 40 %	moderately slow
Very Stony Loamy Compact	30 - 50 cm	50 - 60 %	6 - 20 %	20 - 60 %	slow
Extremely Stony Sandy	0 - 50 cm	70 - 80 %	1 - 5 %	85 - 95 %	rapid

* clay and sand percent values are for the mineral fines (excludes stones). Silt = 100 - (clay + sand)





The values for the graphs above have been generated from horizon and pedotransfer data. These values have then been splined to create continuous estimates of soil water holding capacity and particle size distribution the soil profile. These curves express the particle size distribution and water retention of the soil however there may be barriers to rooting depth that are not necessarily represented in these properties directly. It is advisable to check the potential rooting depth and rooting barrier fields in the soil physical properties section on page three of this factsheet.

Waterton_3a.1

Soil physical properties

Depth class (diggability)
Shallow (20 - 45 cm)

Potential rooting depth
70 - 100 (cm)

Rooting barrier
Extremely gravelly

Depth to hard rock
No hard rock within 1 m

Depth to soft rock
No soft rock within 1 m

Depth to stony layer class
Shallow

Texture profile
Silt

Topsoil stoniness
Stoneless

Topsoil clay range
18 - 35 %

Drainage class
Poorly drained

Permeability profile
Moderate over slow

Depth to slowly permeable horizon
40 - 100 (cm)

Permeability of slowest horizon
Slow (< 4 mm/h)

Aeration in root zone
Limited

Profile available water

(0 - 30cm or root barrier)	(0 - 60cm or root barrier)	(0 - 100cm or root barrier)
High (60 mm)	High (103 mm)	Moderate to high (131 mm)

Dry bulk density

topsoil	subsoil
0.94 g/cm³	1.22 g/cm³

Soil chemical properties

Topsoil P retention
Medium (38%)

Soil management factors

Vulnerability classes relate to soil properties only and do not take into account climate or management

Soil structure integrity

Structural vulnerability
High (0.61)

Contaminant management

N leaching vulnerability
Very low

P leaching vulnerability
not available yet

Water management

Water logging vulnerability
High

Drought vulnerability - if not irrigated
Low

Bypass flow
High

SINDI - Soil quality Indicators

SINDI - Soil Quality Indicators

A suite of soil quality indicators is available from http://sindi.landcareresearch.co.nz/

- Compare your soil with information from our soils databases.
- Assess the intrinsic resources and biological, chemical and physical quality of your soil
- See how your soil measures up against current understanding of optimal values.
- Learn about the effect each indicator has on soil quality and some general management practices that could be implemented to improve soil quality.

Waterton_3a.1

Soil information for OVERSEER

The following information can be entered in the OVERSEER® Nutrient Budget model. This information is derived from the S-map soil properties which are matched to the most appropriate OVERSEER categories. Please read the notes below for further information.

Soil description page

1. Select **Link to S-map**
2. Under S-map sibling data enter the S-map name/ref: **Wate_3a.1**

Considerations when using Smap soil properties in OVERSEER

- The soil water values are estimated using a regression model based on soil order, parent rock, soil functional horizon information (stone content, soil density class), as well as texture (field estimates of sand, silt and clay percentages). The model is based on laboratory - measured water content data held in the National Soils Database and other Manaaki Whenua datasets. Most of this data comes from soils under long-term pasture and may vary from land under arable use, irrigation, etc.

- Each value is an estimate of the water content of the whole soil within the target depth range or to the depth of the root barrier (if this occurs above the base of the target depth). Where soil layers contain stones, the soil water content has been decreased according to the stone content.

- S-map only contains information on soils to a depth of 100 cm. The soil water estimates in the > 60 cm depth category assume that the bottom functional horizon that extends to 100 cm, continues down to a depth of 150cm. Where it is known by the user that there is an impermeable layer or non-fractured bedrock between 100 and 150 cm, this depth should be entered into OVERSEER. Where there is a change in the soil profile characteristics below 100 cm, the user should be aware that the values provided on this factsheet for the > 60 cm depth category will not reflect this change. For example, the presence of gravels at 120 cm would usually result in lower soil water estimates in the > 60 cm depth category. Note though that this assumption only impacts on a cropping block, as OVERSEER uses soil data from just the top 60 cm in pastoral blocks.

- OVERSEER requires the soil water values to be non-zero integers (even though zero is a valid value below a root barrier), and the wilting point value must be less than the field capacity value which must be less than the saturation value. The S-map water content estimates supplied by the S-map web service have been rounded to integers and may be assigned minimal values to meet these OVERSEER requirements. These modifications will result in a slightly less accurate estimate of Available Water to 60 cm (labelled PAW in OVERSEER) than that provided on the first page of this factsheet, but this is not expected to lead to any significant difference in outputs from OVERSEER .

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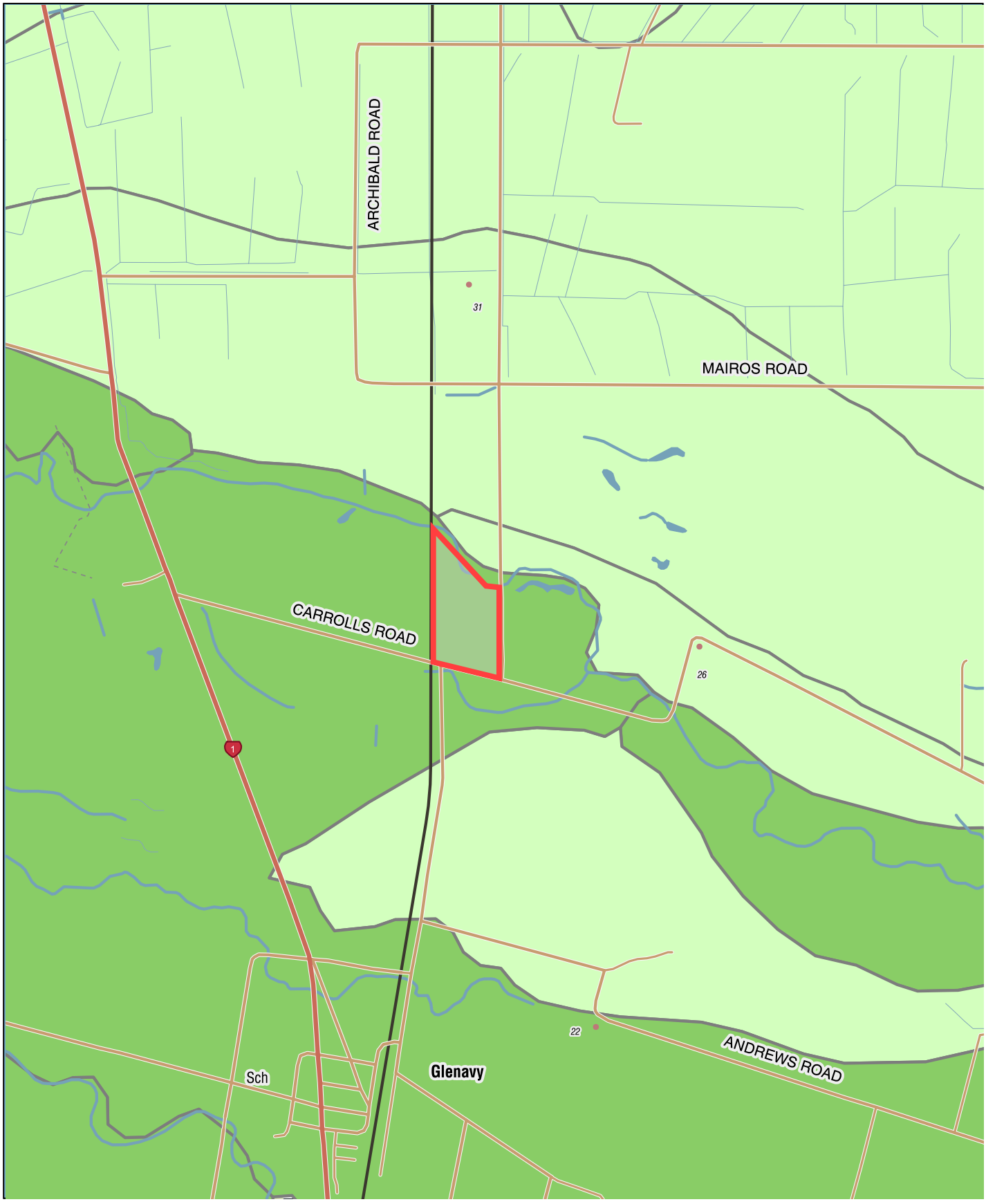
Appendix C

Landcare Research LUC Map

Land Use Capability



OURENVIRONMENT

Manaaki Whenua
Landcare Research

Scale: 1:25,000

0 200 400 600 800m

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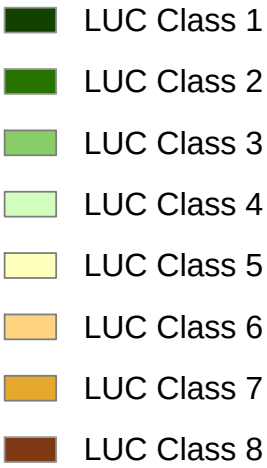
Printed: 15:29:04 PM Tue, 15 Nov 2022

Legend

Land Use Capability



OURENVIRONMENT

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