Soil quality sampling, Tasman District, August 2005

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Summary

Project and Client

Landcare Research undertook soil quality sampling and analysis for Tasman District Council as part of a programme to increase coverage of the soil types and land uses in Tasman District.

Objectives

- To describe and sample soils at 5 sites on 3 different soil types in Tasman District.
- Analyse samples for key soil quality indicators.
- Interpret the results in terms of established soil quality assessment procedures.

Methods

- Tasman District Council identified 5 sites on 4 different soil types (Stanley silt loam, Stanley hill soil, Karamea and Dovedale soils) for sampling.
- A site and soil profile description was made at each site.
- Soils were sampled for analysis of total C and N, pH, Olsen-P, potentially mineralisable N, macroporosity, total porosity, dry bulk density, particle density, and aggregate stability.
- SINDI was used for soil quality assessment.

Results

- Morphology of the soils matched published descriptions, except for one site mapped as Stanley silt loam which was a deep silty, stone-free, imperfectly drained soil.
- The sampled Dovedale soil was classed as Immature Orthic Brown rather than Acidic-weathered Fluvial Recent.
- One Stanley silt loam had very low Olsen-P and high pH.
- The Karamea soil had very high Olsen-P and mineralisable-N.
- The Stanley and Karamea soils had good physical properties for plant growth.
- The Dovedale soil had the poorest physical properties with a relatively high bulk density, low porosity, and very low aggregate stability.
- The SINDI analysis rated the soils has having OK-excellent physical quality and organic resources, acidity was optimal, and fertility was good except for the Stanley silt loam at site 1.

Conclusions

- The control site for the N-fertiliser trial had very different physical properties (soil texture, water holding capacity, and permeability) to the soils in the trial area.
- Of the sampled soils the Dovedale soil had the poorest physical properties for plant growth.
- Soil fertility ranged from very low in the Stanley silt loam soil at site 1 to very high for the Karamea soil.
- The SINDI analysis identified low fertility in the Stanley soil at site 1 as the only significant soil quality issue.

Recommendations

- Repeat monitoring at these sites should be considered at 5-yearly intervals.
- Olsen-P levels are excessively high in the Karamea soil at the Takaka dairy factory and this should be discussed with the landowner.
- The poor physical properties of the Dovedale soil should be discussed with the landowner.
- The soil quality results from the Stanley soils should be integrated with other data being collected at this site as part of the N-fertiliser trial. The differences between the soils in the control and trial areas should be discussed with the farmer and AgResearch and investigated further.

1. Introduction

Tasman District Council has initiated a programme of soil quality monitoring using the "500 Soils" project methodology (Sparling and Schipper 2002). Ten sites were sampled in Tasman District during the "500 Soils" project. This included eight soil types sampled under 3 land uses: market gardens, orchards and dairy farms (van der Weerden *et al.* 2001). Additional sites are being sampled to provide a more complete coverage of soil types and land use in Tasman District.

2. Background

Soil quality is defined as how well the properties of a particular soil match up with the land use (Pierce and Larson 1993), and is crucially important in assessing the long-term sustainability of land use. Soil characteristics vary depending on where and how the soil has been formed, and different characteristics are needed for different land uses. Many soil properties need to be considered when assessing soil quality and the "500 Soils" project defined a minimum data set for New Zealand to assess soil quality and set target values for different soils and land uses (Sparling and Schipper 2002, Lilburne *et al.* 2004). The minimum dataset includes:

- chemical attributes: pH, Olsen-P, total C and N;
- physical attributes: bulk density, macroporosity;
- biological attributes: anaerobically mineralisable N

SINDI, an interactive Web-based interpretive tool (http://sindi.landcareresearch.co.nz), was developed to provide assistance in interpreting results of soil quality measurements (Lilburne *et al.*, 2004).

Many regional councils participated in the "500 Soils" project as part of their responsibility under the Resource Management Act to monitor the state of the environment and promote the sustainable management of the soil resource. Tasman District Council sampled 10 sites in 2000/01, with the longer term intention to develop a network of soil quality sites to characterise spatial patterns and temporal trends in soil quality throughout the district (Andrew Burton, pers. comm. 2005). This report details results from soil quality analysis of Karamea, Stanley, Stanley hill, and Dovedale soils. Previous analysis of Karamea soils is given in van der Weerden *et al.* (2001) and the National Soil Database (NSD; SB10079). There is very little physical or chemical information available for the Stanley and Dovedale soils (Chittenden *et al.* 1966).

3. Objectives

The objectives of this study were:

- To describe and sample soils at 5 sites on 3 different soil types in Tasman District;
- Analyse samples for key soil quality indicators;
- Interpret the results in terms of established soil quality assessment procedures.

4. Methods

Tasman District Council identified 5 sites in two areas (Takaka, Dovedale) for soil quality sampling (Table 1). Sample sites were selected in the field to be representative of the mapped soil types by checking that the observed characteristics (morphology, landform, rainfall, geology) matched previous descriptions of the soil mapping unit from Chittenden *et al.* (1966) and the NSD.

A Karamea soil was sampled on the dairy factory farm at Takaka. It is intended to set up a medium to long term soil health monitoring programme on this farm, primarily using the Visual Soil Assessment (VSA) technique (Shepherd 2000) to demonstrate soil health assessment for the dairy industry. The more detailed soil health analysis reported here will back up the VSA assessment. The site also compliments soil quality sites in dairy areas on other soils (Ikamatua, Onahau, and Hokitika soils; van der Weerden *et al.* 2001). This is the only soil quality site in the Takaka Valley, and there is one other on the same soil type (also under dairying, near Collingwood).

Stanley and Dovedale soils were sampled on a sheep and beef farm near Dovedale. This is a New Zealand Meat and Wool Board Monitor farm that has an intensive management regime, including bull beef farming. The farm is intensively monitored for production and recently has become the site for a "Wise Use of N-Fertiliser on Hill Country" project funded by the Sustainable Farming Fund and supported by AgResearch. The soil health assessment will back up the existing project which monitors soil fertility, pasture and animal production, fertiliser usage and soil moisture. The area is typical of a large proportion of hill country sheep and beef farming in Tasman District on Moutere Gravels. Four sites were sampled. Three were in the hill country on Stanley and Stanley Hill soils, and one on terraces in the valley on Dovedale soils. All were supporting sheep and beef farming.

Table 1 Soil types, land uses and management at the sampling sites

Site ID	Soil type	Soil class	Land use; management
Stanley site 1	Stanley silt loam	Acidic Firm Brown	Pasture; long-term sheep and beef grazing; control site not receiving N fertiliser
Stanley site 2	Stanley silt loam	Acidic Firm Brown	Pasture; long-term sheep and beef grazing; trial site receiving N fertiliser
Stanley site 3	Stanley hill soil	Acidic Firm Brown	Pasture; long-term sheep and beef grazing; trial site receiving N fertiliser
Karamea site 4	Karamea	Weathered Fluvial Recent	Pasture; long-term dairying
Dovedale site 5	Dovedale gravelly loam	Immature Orthic Brown	Pasture; bull beef grazing

At each sample site a site and soil profile description was made (Appendix 1). A small soil profile pit was dug to describe the profile down at least 70 cm. Augering was used at sites 1 and 4 to characterise the deeper soil horizons. Site and soil descriptions followed Milne *et al.* (1995) and soils were classified using the New Zealand soil Classification (Hewitt 1992).

Soils were sampled for chemical and physical analysis. A 50-m transect was laid out (centred on the soil pit) and samples were collected for soil chemical analyses at 2-m spacing along the transect. Twenty five samples (2.5 cm diameter, 10 cm depth) were collected and bulked for analysis. Three undisturbed soil cores (100 mm diameter, 75 mm depth) were taken at 15-, 30- and 45-m along the transect for soil physical analysis (bulk density, macroporosity), and 3 spade samples were taken at the same locations for aggregate stability analysis. Each end of the transect was located by GPS for future sampling at the same sites.

Samples were sent to the Landcare Research Environmental Chemistry and Physics Laboratory in Palmerston North for analysis. The following analyses were undertaken using methods detailed in Blakemore *et al.* (1987) and Claydon (1997): total C and N (using high temperature combustion methods), pH, Olsen-P, potentially mineralisable N (by the anaerobic incubation method), total porosity, macroporosity (estimated from the difference between total porosity and water content at -10kPa), dry bulk density, particle density, and aggregate stability. Aggregate stability results are expressed as mean weight diameter (MWD).

5. Results

5.1 Soil morphology

The Takaka site was on a flat floodplain with a Karamea soil formed from deep, fine textured silty alluvium. There was no morphological evidence of sedimentary stratification with uniform colours and texture in the subsoil, and no mottling or limiting horizon within 1.20 m of the surface. It has a weakly developed weathered-B horizon and was classed as a Weathered Fluvial Recent soil. Permeability is rapid over moderate and the soil is well drained.

At the Dovedale site 3 soils were sampled in hilly Moutere Gravels terrain. Two were on rolling slopes mapped as Stanley silt loam and a third on steeper slopes mapped as Stanley hill soils. All are classed as Acidic Firm Brown soils. Sites 2 (Stanley silt loam) and 3 (Stanley hill soil) had a similar A_h/B_w profile morphology, were moderately stony, and well drained with moderate permeability. By contrast the soil at site 1 (Stanley silt loam) was stone free to at least 120 cm, and the B horizon was mottled indicating slow permeability and imperfect drainage. This soil may have been formed from loess rather than Moutere Gravel. As a control site for the N fertiliser trial it has very different physical properties and moisture retention to the areas where N fertiliser has been applied.

The Dovedale soil sampled on a low terrace in the Dovedale valley had 0.6 m of relatively stone free alluvium over a very gravelly subsoil, and is well drained. It was classed as an Immature Orthic Brown soil. Chittenden *et al.* (1966) do not provide a description of a

Dovedale soil so it is hard to be certain how well this soil represents the mapping unit (note that the NSD classifies this mapping unit as an Acidic-weathered Fluvial Recent soil). This was the only soil that had poorly developed topsoil structure and was damaged by pugging.

5.2 Soil chemistry

The three Stanley soils had a wide range of chemical properties (Table 2). The two Stanley silt loam soils (sites 1 and 2) tend to have lower organic matter and P than the Stanley Hill soil (site 3). Site 2 which has been receiving N fertiliser has higher total N but lower anaerobically mineralisable-N compared to site 1. Olsen-P is very low to medium, and is highest in the Stanley Hill soil. It is lower in the Stanley soils than the Karamea and Dovedale soils. Site 1 has a very high pH compared to all other sites.

Table 2 Results of soil chemical analysis

Site	pH (water)	Total C (%)	Total N (%)	C/N	Anaerobic mineralisable-N (mg/kg)	Olsen-P (mg/kg)
Stanley site 1	6.46	3.51	0.26	13.7	126	9
Stanley site 2	5.79	4.02	0.34	12.0	105	18
Stanley site 3	5.62	6.33	0.52	12.2	172	28
Karamea site 4	5.77	5.25	0.52	10.2	262	132
Dovedale site 5	5.49	3.37	0.26	12.8	89	61

The most notable feature of the Karamea site is very high Olsen-P and anaerobically mineralisable-N. Organic matter levels also tend to be quite high. The Dovedale soil has the lowest pH, organic matter, and anaerobically mineralisable-N of all the soils sampled, but has very high Olsen-P.

Results from the Karamea soil sampled at the Takaka dairy factory can be compared with previous soil quality analyses from Collingwood (also under dairying) and the NSD (in a kiwifruit orchard). Both soil quality sites tend to have higher pH and organic matter than the NSD site. The major difference between the two soil quality sites is that the Takaka dairy farm has far higher Olsen-P and anaerobically mineralisable-N.

Table 3 Comparison of soil chemistry of 3 Karamea soils

	Takaka dairy farm, 2005	Collingwood dairy farm 2001	NSDB (SB10079)
pH	5.77	5.85	5.3
Total C	5.25	4.54	2.6
Total N	0.52	0.56	0.22
C/N	10.2	8.1	12
Olsen-P	132	46	
Anaerobic mineralisable-N	262	97	

5.3 Soil physical properties

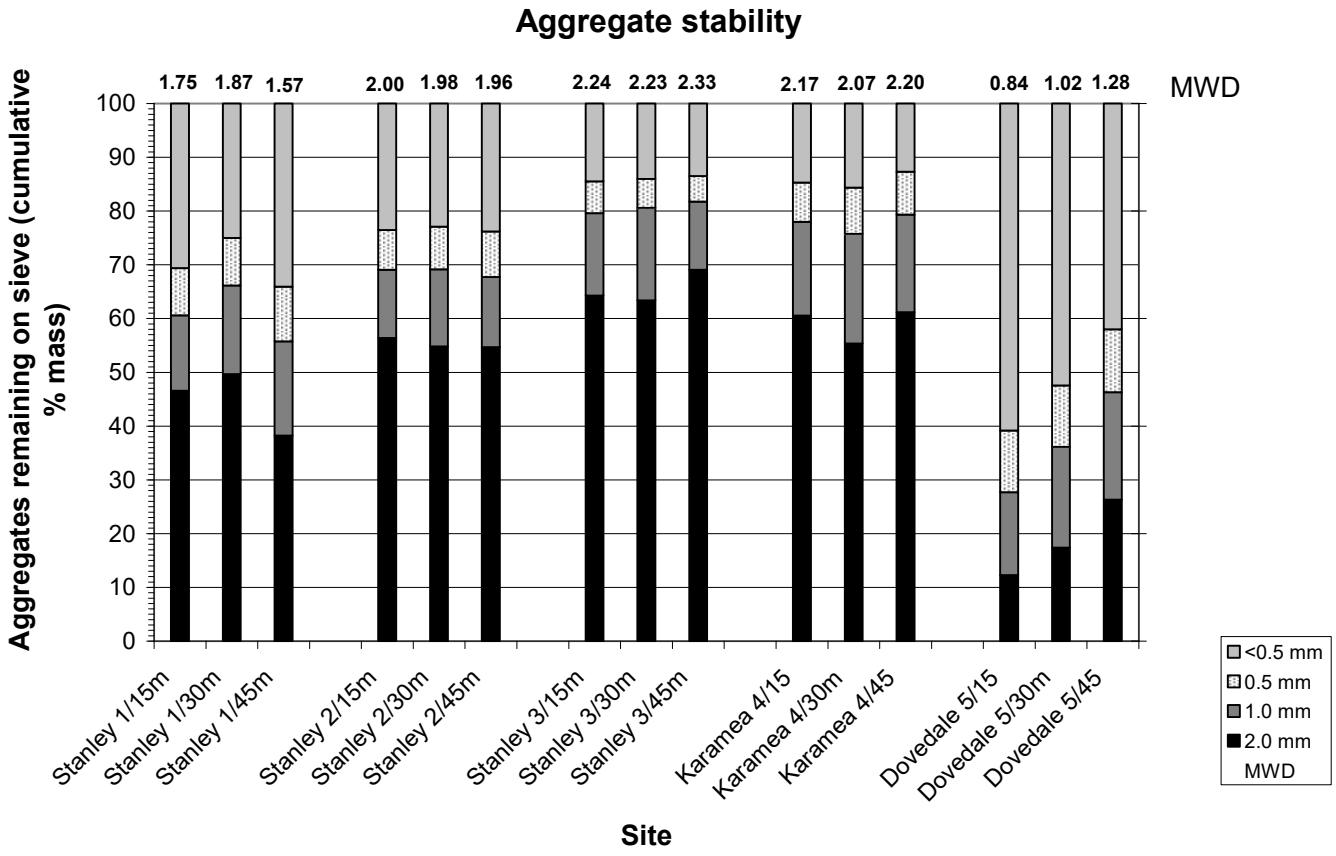
Soil bulk density and total porosity values were very similar at the three Stanley soil sites at slightly less than 1 g/cm^3 and 61% respectively (Table 4). The Stanley hill soil (site 3) had higher macro-porosity and aggregate stability than the Stanley silt loam soils. The bulk density values are average for soils under long-term pastoral use, but the porosity and aggregate stability values are very good indicating the soils have good physical properties for plant growth.

The Karamea soil has even better physical properties with lower bulk density, higher porosity, and high aggregate stability. By contrast the Dovedale soil has poor physical properties with a high bulk density, lower porosity and very low aggregate stability (see Fig. 1).

Table 4 Results of soil physical analysis

Site	Replicate	Particle density (g/cm3)	Bulk density (g/cm3)	Porosity (%)	Macro-porosity (%)	Aggregate stability MWD (mm)
Stanley site 1	1	2.49	0.94	62	16	1.75
Stanley site 1	2	2.52	1.01	60	14	1.87
Stanley site 1	3	2.48	0.97	61	13	1.57
Mean site 1		**2.50**	**0.97**	**61.0**	**14.3**	**1.73**
Stanley site 2	1	2.48	0.98	60	13	2.00
Stanley site 2	2	2.49	0.95	62	15	1.98
Stanley site 2	3	2.50	1.02	59	10	1.96
Mean site 2		**2.49**	**0.98**	**60.3**	**12.7**	**1.98**
Stanley site 3	1	2.46	0.89	64	22	2.24
Stanley site 3	2	2.42	0.90	63	18	2.24
Stanley site 3	3	2.49	1.10	56	18	2.33
Mean site 3		**2.46**	**0.96**	**61.0**	**19.3**	**2.27**
Karamea site 4	1	2.54	0.92	64	7	2.17
Karamea site 4	2	2.55	0.88	65	9	2.07
Karamea site 4	3	2.54	0.80	69	12	2.20
Mean site 4		**2.54**	**0.87**	**66.0**	**9.3**	**2.15**
Dovedale site 5	1	2.52	1.27	50	11	0.84
Dovedale site 5	2	2.55	1.25	51	14	1.02
Dovedale site 5	3	2.50	1.14	54	11	1.28
Mean site 5		**2.52**	**1.22**	**51.7**	**12.0**	**1.045**

Figure 1 Comparison of aggregate stability at the 5 sites



5.4 Assessment of soil quality

Results of soil quality assessment using SINDI are shown in Table 4. The main features of this analysis are:

- Very low fertility for the Stanley silt loam at site 1,
- Low total C and N in the Stanley silt loam at site 1,
- Low total N and mineralisable N in the Stanley silt loam at site 2,
- Low total C and N and mineralisable N in the Dovedale soil at site 5,
- Compacted topsoil in the Dovedale soil at site 5.

Overall the soils are rated as having excellent physical quality and organic resources, acidity was optimal, and fertility was good (apart from site 1).

The assessment of soil quality, I think, was used using the parameters set out in Landcare Research Technical Report LC9900/118. 6 June 2000. Using this assessment some of the results from the five soils would indicate that rankings vary from that indicated below in the SINDI derived rankings. For instance the min-N results for site 3 and 4 rank as excessive in the environmental criteria and for olsen P sites 1,2and3 rate outside the target range for both production and environmental criteria. Could you have a look at the results in

relation to those rankings. I believe that Graham Sparling may have upgrade the data in the technical report since then.

Table 4 Soil quality rankings for the sampled sites (derived from SINDI)

Site	Fertility	Acidity	Organic resources				Physical quality		
				Total C	Total N	Anaerobic mineralisable-N		Bulk density	Macroporosity
Stanley site 1	Very low	Near neutral	OK	Normal-low	Low-very low	adequate	Excellent	Adequate	Adequate
Stanley site 2	OK	Optimal	OK-excellent	Normal	Low-adequate	Low-adequate	Excellent	Adequate	Adequate
Stanley site 3	Excellent	Optimal	Excellent	Normal	Normal	Adequate	Excellent	Adequate	Adequate
Karamea site 4	OK	Optimal	Excellent	Ample	Adequate	Adequate	OK	Loose-adequate	Adequate-low
Dovedale site 5	Excellent	OK-optimal	OK	Low-normal	Very low-low	Low	Excellent	Adequate-compact	Adequate

6. Conclusions

The morphology of the soils matched published descriptions, except for site 1 which was a deep silty, stone-free, imperfectly drained soil but was mapped as Stanley silt loam. As a control site for the N-fertiliser trial it has very different physical properties (including soil texture, water holding capacity, and permeability) to the soils in the trial area. The Stanley and Karamea soils had good physical properties for plant growth. The Dovedale soil has the poorest physical properties with relatively high bulk density, low porosity, and very low aggregate stability.

Soil fertility ranged from very low in the Stanley silt loam soil at site 1 to very high for the Karamea soil. The SINDI analysis rates the soils has having OK-excellent physical quality and organic resources, acidity was optimal, and fertility was good except for the Stanley silt loam at site 1.

7. Recommendations

- Repeat monitoring at these sites should be considered at 5-yearly intervals.
- Olsen-P levels are excessively high in the Karamea soil at the Takaka dairy factory and this should be discussed with the landowner.
- The poor physical properties of the Dovedale soil should be discussed with the landowner.
- The soil quality results from the Stanley soils should be integrated with other data being collected at this site as part of the N-fertiliser trial. The differences between the soils in the control and trial areas should be discussed with the farmer and AgResearch and investigated further.

8. Acknowledgements

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Appendix 1 Soil descriptions for soil quality sites sampled in Tasman District, 8 and 10 August 2005

Site 1

Location: Ashley Peter's property, Cozens Rd, Dove valley
Grid reference: 2501100E, 5988718N
Elevation: 197 m *Aspect*: 250°
Landform: easy rolling hill country, mid backslope, planar contour, planar profile
Slope: 9° *Parent material*: Moutere gravel
Annual rainfall: 1175 mm
Soil drainage: imperfectly drained
Permeability class: moderate over slow
Land use: pastoral farming (sheep and beef, control site for N trial)
Erosion: nil
Location of soil pit: 2501100E, 5988718N
Locations for ends of transect: 2501097E/5988694N (0 m), 2501108E/5988747N (50 m)
Soil series: Stanley silt loam
Soil class: Mottled Firm Brown

0-22 cm	Ah	wet, silt loam, brown (10YR4/3), slightly plastic, slightly sticky, weak, deformable, weak extremely fine and very fine spheroidal structure and very fine and fine polyhedral structure, common charcoal fragments at the base of the A horizon, abundant micro-fine and extremely fine roots, distinct wavy boundary to
22-38 cm	AB	very moist, silt loam, dark yellowish brown (10YR-2.5Y4/4), few extremely fine faint olive yellow (2.5Y6/6) mottles, moderately plastic, slightly sticky, weak, deformable, moderate fine and medium blocky structure, many micro-fine and extremely fine roots, distinct smooth boundary to
38-80 cm	Bw(g)1	very moist, silty clay loam, rare highly weathered stones, olive yellow (2.5Y6/6), common very fine and fine distinct strong brown (7.5YR5/8) mottles, moderately plastic, moderately sticky, slightly firm, semi-deformable, weak fine and medium blocky structure, few extremely fine roots, distinct smooth boundary to
80-100 cm	Bw(g)2	very moist, silty clay loam, rare highly weathered stones, olive yellow (2.5Y6/6), many very fine to medium prominent strong brown (7.5YR5/8) mottles, very few prominent black manganese concretions, slightly plastic, slightly sticky, slightly firm, semi-deformable, weak medium and coarse blocky structure, distinct smooth boundary to
100-120+ cm	Bw(g)3	very moist, clay loam, rare highly weathered stones, yellow (2.5Y7/6), many very fine to coarse prominent strong brown (7.5YR5/8) mottles, very few prominent black manganese concretions, very plastic, very sticky, firm

Site 2

Location: Ashley Peter's property, Cozens Rd, Dove valley
Grid reference: 2501174E, 5988437N
Elevation: 221 m *Aspect*: 270°
Landform: easy rolling hill country, footslope. slightly concave contour, slightly concave profile
Slope: 11° *Parent material*: Moutere gravel
Annual rainfall: 1175 mm
Soil drainage: well drained
Permeability class: moderate
Land use: pastoral farming (sheep and beef, within N trial)
Erosion: nil
Location of soil pit: 2501174E, 5988437N
Locations for ends of transect: 2501150E/5988431N (0 m), 2501198E/5988453N (50 m)
Soil series: Stanley silt loam
Soil class: Acidic Firm Brown

0-18 cm	Ah1	very moist, silt loam, dark brown (10YR3/3), very slightly stony (fine and medium, slightly to highly weathered), slightly plastic, moderately sticky, very weak, very friable, weak extremely fine to fine spheroidal structure, abundant micro-fine and extremely fine roots, abrupt wavy boundary to
18-27 cm	Ah2	moderately moist, silt loam, moderately stony (fine and medium, slightly to highly weathered), dark brown (10YR3/3), slightly plastic, moderately sticky, very weak, very friable, weak extremely fine and very fine spheroidal structure and very fine and fine polyhedral structure, many micro-fine and extremely fine roots, abrupt wavy boundary to
27-70+ cm	Bw	moderately moist, silty clay loam, very stony (fine to very coarse, slightly to highly weathered), yellowish brown (10YR5/6), moderately plastic, moderately sticky, slightly firm, semi-deformable, weak very fine to coarse polyhedral structure, few micro-fine roots

Probably has brighter B horizon and higher clay content below 70 cm.

Site 3
Location: Ashley Peter's property, Cozens Rd, Dove valley
Grid reference: 2501215E, 5988216N
Elevation: 268 m *Aspect*: 300°
Landform: moderately steep hill country, mid backslope in hollow, concave contour, planar profile
Slope: 21° *Parent material*: Moutere gravel
Annual rainfall: 1175 mm
Soil drainage: well drained
Permeability class: moderate
Land use: pastoral farming (sheep and beef, within N trial)
Erosion: nil
Location of soil pit: 2501215E, 5988216N
Locations for ends of transect: 2501199E/5988198N (0 m), 2501235E/5988254N (50 m)
Soil series: Stanley hill soil
Soil class: Acidic Firm Brown

0-22 cm	Ah	moderately moist, silt loam, slightly stony (fine to coarse, moderately to highly weathered), dark brown (10YR3/3), slightly plastic, slightly sticky, very weak, semi deformable, weak very fine and fine spheroidal structure, few charcoal fragments, abundant micro-fine and extremely fine roots, abrupt wavy boundary to
22-43 cm	AB	slightly moist, silt loam, moderately stony (fine to very coarse, slightly to highly weathered), dark yellowish brown (10YR4/4), slightly plastic, slightly sticky, very weak, semi deformable, weak very fine to fine spheroidal structure, abundant micro-fine and extremely fine roots, distinct smooth boundary to
43-70+ cm	Bw	slightly moist, silty clay loam, very stony (fine to very coarse, slightly to highly weathered), yellowish brown (10YR-2.5Y5/6), few extremely fine faint strong brown (7.5YR5/6) mottles, moderately plastic, moderately sticky, weak, semi-deformable, weak extremely fine and very fine polyhedral structure and fine and medium blocky structure, few micro-fine roots

Site 4

Location: Takaka, dairy farm adjacent to dairy factory
Grid reference: 2494554E, 6038746N
Elevation: 11 m *Aspect*:
Landform: flat floodplain, flood basin
Slope: 0° *Parent material*: silty alluvium
Annual rainfall: 1800 mm
Soil drainage: well drained
Permeability class: rapid over moderate
Land use: pastoral farming (dairy farm)
Erosion: nil
Location of soil pit: 2494554E, 6038746N
Locations for ends of transect: 2494540E/6038730N (0 m), 2494570E/6038768N (50 m)
Soil series: Karamea
Soil class: Weathered Fluvial Recent

0-18 cm	Ah	moderately moist, silt loam, dark brown (10YR3/3), slightly plastic, slightly sticky, weak, friable, weak very fine to medium polyhedral and extremely fine and very fine spheroidal structure, abundant micro-fine and extremely fine roots, distinct smooth boundary to
18-30 cm	AB	moderately moist, silt loam, dark brown (10YR3/3) and olive brown (2.5Y4/4), slightly plastic, slightly sticky, weak, friable, weak fine to coarse polyhedral structure, common micro-fine and extremely fine roots, distinct smooth boundary to
30-120+ cm	B(w)	moderately moist, silt loam, light olive brown (2.5Y5/4), moderately plastic, slightly sticky, slightly firm, semi-deformable, weak coarse and very coarse blocky structure, few micro-fine roots to 90 cm

Site 5
Location: Glengyle Ddowns, Dove valley
Grid reference: 2500190E, 5991896N
Elevation: 112 m Aspect:
Landform: low terrace
Slope: 0° *Parent material*: silty alluvium over gravelly alluvium
Annual rainfall: 1175 mm
Soil drainage: well drained
Permeability class: moderate over rapid
Land use: pastoral farming (bull beef)
Erosion: nil
Location of soil pit: 2500190E, 5991896N
Locations for ends of transect: 2500170E/5991906N (0 m), 2500212E/5991879N (50 m)
Soil series: Dovedale gravelly loam
Soil class: Immature Orthic Brown

0-29 cm	Ah	moderately moist, silt loam, very slightly stony (fine and medium, slightly weathered), brown (10YR4/3), slightly plastic, slightly sticky, very weak, friable, weak fine to coarse blocky structure and extremely fine and very fine polyhedral structure, abundant micro-fine and extremely fine roots, sharp occluded boundary to
29-38 cm	BA	moderately moist, silt loam, very slightly stony (fine and medium, slightly weathered), brownish yellow (10YR6/6) and brown (10YR4/3), moderately plastic, slightly sticky, weak, semi deformable, weak very fine to medium polyhedral structure, few micro-fine roots, distinct smooth boundary to
38-57 cm	Bw	moderately moist, fine sandy loam, very slightly stony (fine and medium, slightly weathered), brownish yellow (10YR6/6), slightly plastic, slightly sticky, weak, friable, weak coarse and very coarse blocky structure and fine and medium blocky structure, few micro-fine roots, sharp wavy boundary to
57-80+	2Bw	moderately moist, sandy loam, very stony (fine to very coarse, slightly weathered), brownish yellow (10YR6/8), non plastic, non sticky, very weak, very friable, apedal; (single grain)