Soil name: Caroline

Overview

Caroline soils occupy about 6,400ha on the flood plains and low terraces of the Oreti River between Lumsden and Wallacetown. They are formed in alluvium derived from greywacke and schist rock. These soils are shallow to moderately deep, poorly drained, and have heavy silt loam to silty clay textures. A key feature of the Caroline soils is the presence of a thick, cemented ironstone pan in the subsoil. They are used for intensive pastoral farming for sheep, deer and dairy, with some cropping. The climate is cool temperate with regular rain, although more inland soils can be seasonally dry in some years.

Soil classification

NZ Soil Classification (NZSC): Ironstone Orthic Gley; with stones; silty over skeletal.
Previous NZ Genetic Classification: Moderately to strongly gleyed yellow-grey earth

Classification explanation

Caroline soils have been reclassified in this survey as the soil properties are consistent with Gley soils, rather than Pallic soils. This is because the poor drainage of Caroline soils is due to a high groundwater table, rather than water perching on a dense subsoil layer. The accumulation of sediment has been sufficiently slow that subsoils show structural development, and have developed a thick, cemented ironstone pan. Caroline soils typically have gravel between 45 and 90cm depth, and heavy silt loam textures.

Soil phases and variants

Identified units in the Caroline soils are:

- Caroline undulating moderately deep (CeU2): has gravel between 45 and 90cm; occurs on slopes of 0–7°
- Caroline undulating shallow (CeU3): has gravel within 45cm; occurs on slopes of 0–7°

The soil properties described in this Technical Data Sheet are based on the most common phase, Caroline undulating moderately deep (CeU2). Values for other phases and variants can be taken as being similar.

Associated soils

Some soils that commonly occur in association with Caroline soils are:

- Dipton: occurs on terraces; shallow soil, poorly drained due to water perching on clay pan
- Gore: occurs on low terraces; shallow, well drained soil
- Winton: well drained, moderately deep to deep soil
- Northope: imperfectly drained, moderately deep to deep soil

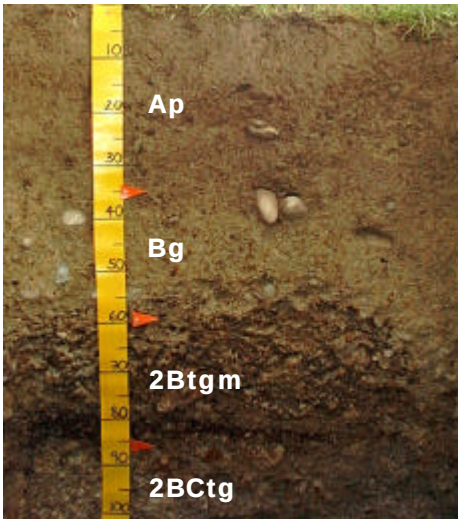
Similar soils

Some soils that have similar properties to Caroline soils are:

- Lumsden: shallow soil, with no ironstone pan and silty textures
- Makarewa: moderately deep to deep soil, with no ironstone pan and silty clay textures
- Jacobstown: moderately deep to deep soil, with no ironstone pan and silty textures

Typical profile features

The following is a 'generic' or composite profile description representing the most common combination of characteristics for this soil type. The actual profiles for which descriptions and data are available are listed at the end of this Technical Data Sheet.

Caroline profile	Horizon	Depth (cm)	Description
	Ap	0–30	Yellowish-brown very slightly gravelly silt loam; weak soil strength; moderately developed medium polyhedral structure; many roots
	Bg	30–65	Light grey moderately gravelly silt loam; common bright yellowish-brown mottles; common worm casts; weak soil strength; moderately developed medium to coarse polyhedral structure; many roots
	2Btgm	65–80	Light grey extremely gravelly clay loam; abundant reddish black iron and manganese concentrations; cemented, very dense particle packing; massive structure; gravel rounded and slightly weathered; no roots
	2BCtg	80–90	Light grey very gravelly clay loam; common reddish brown mottles; weak soil strength; compact particle packing; massive structure; gravel rounded and slightly weathered; no roots

Key profile features

Caroline soils have a topsoil 25–35cm deep with a moderately developed structure. Subsoil structure is moderate above a cemented ironstone pan. The dominance of grey colours throughout the subsoil reflects the poor drainage of the soils.

Typical physical properties

Note: values in Italics are estimates

Horizon	Depth (cm)	Bulk density	Permeability	Texture	Gravel content
Ap	0–30	Moderate – High	*Moderate*	Silt loam	Very slightly gravelly
Bg	30–65	Moderate – High	*Moderate*	Silt loam	Moderately gravelly
2Btgm	65–80	—	*Slow*	Clay loam	Extremely gravelly
2BCtg	80–90	—	*Moderate*	Clay loam	Very gravelly

Profile drainage: Poor

Plant readily available water: *Moderate*

Potential rooting depth: Moderately deep

Rooting restriction: Cemented ironstone pan

Key physical properties

Caroline soils have a moderately deep rooting depth, with moderate plant available water, that is limited by the ironstone pan. The rooting depth may also be limited by poor aeration during wet periods due to the poor drainage and slow subsoil permeability. Textures are heavy silt loam to silty clay, with topsoil clay content of 25–30%. Topsoils are slightly gravelly, while subsoils are moderately to very gravelly above the extremely gravelly iron pan.

Typical chemical properties

Horizon	Depth (cm)	pH	P retention	CEC	BS	Ca	Mg	K	Na
Ap	0–30	Moderate	Moderate	Moderate	Moderate	Moderate	Low	Very low	Low
Bg	30–65	Moderate	Moderate	Low	Low	Very low	Low	Very low	Low
2Btgm	6–80	Moderate	Moderate	Low	High	Moderate	Moderate	Very low	Low
2BCtg	80–90	Moderate	Moderate	Low	High	Low	Moderate	Very low	Low

Key chemical properties

Topsoil organic matter levels range from 5 to 8%; P-retention values 20–40% with pH values moderate throughout the profile. Cation exchange values are moderate to low with base saturation moderate in the topsoil but increasing down the profile. Available magnesium and potassium values are low. Reserve phosphorus levels are low. Micro-nutrient levels are generally adequate.

Vulnerability to environmental degradation

Note: the vulnerability ratings given in the table below are generalised and should not be taken as absolutes for this soil type in all situations. The actual risk depends on the environmental and management conditions prevailing at a particular place and time. Specialist advice should be sought before making management decisions that may have environmental impacts. Where vulnerability ratings of Moderate to Very severe are indicated, advice may be sought from Environment Southland or a farm management consultant.

Vulnerability factor	Rating	Vulnerability compared to other Southland soils
Structural compaction	severe	These soils have a severe vulnerability to structural degradation by long-term cultivation, or compaction by heavy stocking and vehicles. This rating reflects the poor drainage and low to moderate P-retention.
Nutrient leaching	slight	These soils have a slight vulnerability to leaching to groundwater. This rating reflects the poor drainage, moderate water holding capacity and slow subsoil permeability. The shjallow phase has a moderate vulnerability.
Topsoil erodibility by water	slight	Due to the moderate to high clay content, the topsoil erodibility of theses soils is slight. Erodibility is highly dependent on management, particularly when there is no vegetation cover.
Organic matter loss	severe	Vulnerability to long-term decline in soil organic matter levels is partly dependent on soil properties, and highly dependent on management practices (e.g., crop residue management and cultivation practices).
Waterlogging	severe	These soils have a severe vulnerability to waterlogging during wet periods. This rating reflects the poor drainage and slow subsoil permeability.

General landuse versatility ratings for Caroline soils

Note: The versatility ratings in the table below are indicative of the major limitations for semi-intensive to intensive land use. These ratings differ from those used in the past in that sustainability factors are incorporated in the classification.

Refer to the Topoclimate district soil map or property soil map to determine which of the soil symbols listed below are applicable, then check the versatility ratings for that symbol in the appropriate table.

CeU2 (Caroline undulating moderately deep)

Versatility evaluation for soil CeU2		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Limited	Inadequate aeration during wet periods; risk of short-term waterlogging after heavy rain.
Arable	Limited	Inadequate aeration during wet periods; risk of short-term waterlogging after heavy rain.
Intensive pasture	Moderate	Inadequate aeration during wet periods; vulnerability of topsoil to structural degradation by cultivation and compaction
Forestry	Limited	Inadequate aeration during wet periods; potential flood risk.

CeU3 (Caroline undulating shallow)

Versatility evaluation for soil CeU3		
Landuse	**Versatility rating**	**Main limitation**
Non-arable horticulture	Limited	Inadequate aeration for sustained periods; restricted rooting depth
Arable	Limited	Inadequate aeration for sustained periods; risk of short-term waterlogging after heavy rain.
Intensive pasture	Limited	Risk of short-term waterlogging after heavy rain.
Forestry	Limited	Inadequate aeration for sustained periods; potential flood risk.

Management practices that may improve soil versatility

- Installation and maintenance of drainage networks with ditches, moles and tiles.
- Careful management of stocking and minimal cultivation when soils are wet
- Organic matter levels should be carefully maintained and enhanced
- Ripping of subsoil pan may be possible for deep rooting plants

Soil profiles available for Caroline soils

Soil symbol	Profile ID	Topoclimate map sheet	Profile description available	Physical data available	Chemical data available	Profile photo available
CeU2	XT02	13	✓	✓	✓	✓
CeU2	CT7	6	✓	✓	✓	✓
CeU2	DTO7	37	✓	✓	✓	✓
CeU3	XT06	13	✓	✓	✓	✓
CeU2	160/72/3	43	✓	✓		

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