# Soils of the Hamama District

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## Introduction

The fifth year of soil mapping in the Golden Bay district was undertaken between September 2009 and May 2010 and was centred on the Hamama district. This followed previous soil surveys of the Lower Takaka Valley (2005/06), the Puramahoi district (2006/07), East Takaka (2007/08) and the Kotinga districts (2008/09). The purpose of these surveys was to update basic soils information and land-use potential, as no systematic soil surveys had been undertaken since the original 1950's Reconnaissance Survey of the Golden Bay district (Soil Map of Takaka County; unpublished, Cawthron Institute). The area mapped in the present survey is about 1800 ha covering predominantly terrace lands between the Waingaro and Takaka Rivers and extending southwards from Paynes Ford to Craigieburn Road.

The main geomorphic feature of the area is a prominent stony terrace formed from accumulation of outwash gravels, primarily from the Waingaro River, with lower level terrace sets and flood plain surfaces formed by river downcutting of the Waingaro and Takaka Rivers subsequent to the terrace gravel aggradation. Smaller streams (Stoney Creek and Craigieburn Creek) in the southern part of the area have similar but less distinctive sets of terraces, while remnants of terraces from earlier glacial outwash events occur in patches at higher levels along the valley sides.

## Survey Methods

Field work was carried out over 39 days between September 2009 and May 2010 during which time 755 observations were recorded. This included 675 observations from auger holes and 80 observations from excavated pits and some cutting sections, resulting in an observation frequency of 1 per 2.3 ha. Examinations were made primarily from cross-terrain traverses over the landform units. Landform identification was assisted by the use of 1943 and 1984 aerial photographs as well as 1:5,000 modern satellite images. Where possible, soil boundaries were drawn in the field from the auger observations, assisted by field observations of soil-landform changes and aerial photo interpretation. Soil from the auger borings was described in terms of the soil horizon sequences, the soil colours, textures and mottle patterns, as well as the stoniness and depth to gravel. Soil pits were excavated to confirm soil properties, particularly when the presence of gravel at shallow depths restricted observations of horizon sequences by augering. The observations from the soil pits allowed a more detailed assessment of the soil properties including soil structure, consistence, soil strength, weathering depth and drainage assessment as well as plant root distribution characteristics.

The locations of all observations were recorded by GPS and plotted on the 1:5,000 field sheets. A digital photo record was also made of the soil material examined at each of the observation sites. The soil data were later assessed to provide details relating to the properties of each soil unit and to the variability encountered within the mapping units. Criteria used for description of the soils are those given in the Soil Description Handbook (Milne et al. 1995), which is the accepted standard for New Zealand soils. The soil boundaries plotted on the field sheets were transferred by TDC Staff into a digital image for reproduction of the soil map.

Previous soil surveys of the Hamama area.

The earliest known soil survey of the Hamama district is an unpublished and undated *Soil Reconnaissance Map of Takaka County* at a scale of one mile to one inch (1:63,360). This map on a cadastral base was probably compiled by Chittenden of the Cawthron Institute in the 1950's and had five soil types identified within the present survey area. Included were Takaka gravels and stony loams for the soils on the main terrace surface, Takaka sands for the low river terraces, miscellaneous coarse sands and gravels for the floodplain surfaces, Tadmor loams for hilly land where sedimentary rock was present and Pikikiruna loams for hilly and steep land soils on Arthur Marble. In the 1:250,000 General Survey of the Soils of South Island (Soil Survey Staff 1968), four soils were separated. All of the floodplain and lower terrace areas were shown as Karamea soils, the main terrace surface soil was given the name Hamama, Kotinga soils were identified on an area of stream outwash terrace land and Pikikiruna soils were mapped on areas of Arthur Marble. The later Land Use Capability Survey provided a more detailed subdivision of the landscape at 1:63,360 scale but a soil survey was not undertaken. A brief review of the soils of Lower Takaka Valley was undertaken by O'Byrne (1983) but did not include any new soils information.

Reliability of the information

Soils are intrinsically related to the landforms on which they occur so that within the soil map units, soil variation will be encountered in relationship to differences in the parent materials or drainage characteristics etc. across the landscape. The soil types depicted by the map units can be expected to have a range of properties in response to differences in features such as minor terracing, land undulations, surface drainage etc. Not withstanding the intensive observation frequency, separation of the soils into mapping units depicting uniform depth, texture or drainage classes was seldom possible due to the variation encountered in these properties over short distances. This is largely because the river systems are predominantly high energy in character giving rise to much variability in sedimentation over short distances.

The assessment of the differing textural types, depth classes and drainage classes etc that are given in the following soil descriptions are derived as percentages of the total observations that were made for each individual soil type. These are intended as a guide and should not be regarded as accurate. The auger observations were sometimes biased towards moderately deep or deep soils so that overall profile morphology and horizon sequences could be adequately assessed, which is not possible when augering in shallow stony soils.

The land use ratings given below are based on the Classification System for Productive Land in the Tasman District (Agriculture New Zealand 1994) and considers a range of attributes for each of the soils that have been identified.

The soil landscape of the Hamama district

The signature of past major climate changes in the Golden Bay region through Late Quaternary geological time is well expressed by the soil and landscape relationships in the area. The coarse gravelly terrace deposits are indicative of past extensive outflows of water and a supply of coarse sediment that probably coincided with the retreat of glaciers during in mountains to the immediate south in the later stages of the last glacial period.

The main geomorphic feature of the Hamama district is the distinctive planar surface (Hamama Terrace Surface) that forms the largest undissected area of flat land in the Golden Bay region. This surface has a fall of approximately 9 m/km and the direction of flow channels on its surface, aligned dominantly in an easterly direction, indicates that it has been formed, at least in the latter stages, by sedimentation largely from the Waingaro River. Gravels forming this terrace commonly have boulder sized clasts (up to 250 mm) to the ground surface and are indicative of extensive water flows across a broad plain. Larger boulders > 1m also occur in gravel deposits and suggest a glacial origin, possibly reworked moraine deposits, The Hamama Terrace Gravels were mapped by Grindley (1971) as Bainham Formation, Otirian Stage (Last Glaciation).

The Last Glacial Cold Period (LGCP) is believed to been between 28,000 and 18,000 years before present with warmer intervening phases (Alloway et al. 2007). It is likely that the Hamama terrace was constructed by outpouring of gravels following glacial retreat at the end of the Last Glacial Cold Period. During the LGCP, it is possible that glacial ice in the Waingaro catchment reached the present lowland plain, judged by the large boulders seen in gravels in exposures below the Hamama Terrace surface. If terminal moraine was present on the valley floor, it is likely to have been destroyed by later aggradation and degradation of the terrace gravels. Terraces below the Hamama Terrace (Ikamatua and Uruwhenua soils) have younger and less weathered soils than occur on the Hamama Terrace and have predominantly very stony surfaces. These may represent the degradation that took place between 18,000 and 11,500 years, perhaps with some intermittent aggradation relating to cooling intervals (Last Glacial Interglacial Transition, Alloway et al. 2007).

An older terrace >15 metres above the Hamama Terrace (Kaituna Formation deposits-Waimean Glaciation, Grindley 1971) occurs as a remnant south of Waingaro Road and also in patches along the valley side west of State Highway 60. In places, this surface is veneered with a fine textured deposit that is probably loess, which may have originated from that aggrading Hamama Terrace surface surface.

Smaller valleys in the Hamama area (Stony Creek and Craigieburn Creek) likewise show similar terrace sequences with coarse bouldery gravel deposits on the higher terraces. These deposits are also indicative of climatic related aggradation and degradation and major changes in precipitation and the extent of snow or ice cover during the Late Quaternary period in the higher elevation areas of these small catchments are indicated.

As with other parts of the lower Takaka Valley, numerous sink holes are scattered around the terrace surfaces and indicate the presence of calcareous rocks, either Arthur Marble or Takaka Limestone, beneath the gravel deposits. The largest sinkholes are commonly found on the older terraces and younger surfaces generally have smaller sinkholes. Sinkhole development is probably progressive and while nothing was observed suggesting that some had formed recently, sudden collapses remain a possibility.

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Soils of Hamama District: Legend

| | | |
|---|---|---|
| Soils of the river floodplain and low surfaces | | Use Rating |
| Well drained | | |
| Takaka soils | Tk, Tksh, Tkst, Tkr | B, F, H |
| Imperfectly drained | | |
| Harihari soils | Hh | F |
| Soils of the low river terraces | | |
| Well drained | | |
| Karamea soils | Km, Kmsh, Kmst | A, C |
| Imperfectly drained | | |
| Waingaro soils | Wa | C |
| Soils of the intermediate river and stream terraces | | |
| Well drained | | |
| Ikamatua soils | Ik, Iksh Ikb | A, B, F |
| Uruwhenua soils | Ur, Ursh Urst | A, C |
| Imperfectly drained | | |
| Paton soils | Pt | D |
| Soils of fan surfaces | | |
| Moderately well drained | | |
| Rototai soils | Ro | B |
| Soils of the higher terraces and outwash surfaces | | |
| Well drained shallow soils | | |
| Hamama soils | Hash Hast HaR | A, C, E |
| Well drained deeper soils | | |
| Puramahoi soils | Pm, Pmsh | A |
| Pigville soils | Pg, PgH | A, E |
| Imperfectly drained stony soils | | |
| Kotinga soils | Kt, Ktbd | F |
| Poorly drained soils | | |
| Onahau soils | On, OnR, OnH | E, F |
| Kongahu soils | Kg | E |
| Poorly drained organic soils | | |
| Kini soils | Ki | F (H) |
| Soils of the dissected terrace land and scarps | | |
| Milnthorp hill soils | MnH, MnS | F, H |
| Soils of the hilly and steep land | | |
| Otere soils | OtH | E |

| | | |
|---|---|---|
| Waitapu soils | WtH | F |
| Pikikiruna Soils | PkR, PkH, PkS | C, H, F |

## Soil name and map symbol: Takaka (Tk, Tksh, Tkst, Tkr)

### Concept and overview

Takaka soils (Tk) cover 330 ha and occur on the lowest surfaces of the Takaka and Waingaro Rivers and also on low surfaces of Stony and Craigieburn Creek. They are the soils formed on the youngest alluvial surfaces of these fluvial systems where flooding and sediment deposition may frequently occur. Larger areas of Takaka soils occur in the lower reaches of the Takaka and Waingaro Rivers but further up-stream, valley narrowing and river downcutting restrict their occurrence to small patches. In Stony Creek and Craigiburn Creek, Takaka soils occur as narrow sinuous patches alongside the streams. Takaka soils vary in depth and are commonly shallow or stony and sometimes bouldery, but include some deep and moderately deep soils. Also included are raw soils on the river berms where there is negligible soil development

### Relationship to previously named soils

In the unpublished Survey of the soils of Takaka County, Takaka soils were mapped over most of the terrace land in the East Takaka district as Takaka loam, Takaka sands and Takaka gravel and stony loams, while in the General Survey of the Soils of South Island (Soil Bureau Staff 1968) they were included with Karamea soils. They were mapped in the recent surveys of the survey of the lower Takaka Valley and the Puramahoi East Takaka and Kotinga districts.

### Landform origin and history

The floodplain zones of the Waingaro and Takaka Rivers are relatively unstable areas with surfaces that are often crossed by old river overflow channels. Comparison of old 1940’s aerial photos shows that channel migration has in places eroded floodplain surfaces on one side of the river while aggrading and widening the floodplain on the other side. The changes appear to be due to migration of meander channels rather than to active aggradation of the river bed. River bank protection has stabilized the main channel in places but large floods sometimes result in widespread overflows. Channel migration is also active in the smaller streams.

### Key soil features

Takaka soils range from shallow stony to deep and are well drained well but have weak soil horizon development and weakly developed soil structures. Buried A horizons, indicative of recent flooding, were found in 15% of the observation sites. The topsoil colour is predominantly brown to dark brown and the subsoil olive brown. Soil texture is sandy loam or silt loam in the topsoil but predominantly sandy in the subsurface horizons. Soil structure is weakly developed. The depth to gravel in the majority of observations was <45cm. In about 40% of the observations, light brownish grey and yellowish red mottles were observed in or just below the topsoil and may represent either winter pugging of the weakly structured topsoil or anaerobic conditions associated with flooding and sediment deposition.

Identified variants

Included with Takaka soils are Takaka stony (Tkst) with stones and sometimes boulders at the soil surface (20%) and Takaka shallow soils (Tksh) (< 45 cm to gravel, 30% of observations) and Takaka moderately deep and deep soils (Tk) (46% of observations, depth to gravel is 45cm to >90 cm). Takaka raw soils (Tkr) are the stony soils on river berms with little or no top soil development.

Associated and similar soils

Takaka soils occur together with Karamea soils which are somewhat older and less frequently flooded soils occurring on more elevated parts of the flood plain. In low lying flood channels and older river courses, small strips of Harihari soils occur with Takaka soils.

Key physical properties

Topsoils are predominantly sandy loam textured and average 10cm in thickness. B horizons are seldom present and are scarcely distinguishable from the underlying C horizon material which is olive brown or olive sandy loam or sand. There are no impediments to deep rooting but moisture storage is limited, particularly in the shallower soils, where gravel is closer to or at the surface.

Soil versatility and land use rating

Moderately deep and deep Takaka soils are moderately versatile but their potential (land use class B) is restricted by susceptibility to flooding and summer moisture deficiency but these limitations could be overcome by flood protection measures and by irrigation. The stony and shallow Takaka soils have more severe limitations (stoniness, low AWC, excessively drained, rapid permeability, difficult to work, shallow rooting depth) and are included in class D. Takaka raw soils are included in class H.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-12 cm | dark brown (10YR 3/3) sandy silt loam; weakly developed fine polyhedral structure; very weak soil strength; very friable; many fine and few medium roots; |
| AC | 12-20cm | dark yellowish brown (10YR 3/4) loamy sand; weakly developed fine polyhedral structure; very weak soil strength; very friable; 5% very fine stones; many fine roots |
| C1 | 20-34cm | light olive brown (2.5Y 4/4) fine sand; apedal; weak soil strength; very friable; 5% medium and coarse stones; very few fine roots |
| C2 | 34-60cm+ | light olive brown (2.5Y 4/4) sand; apedal; loose; 65% medium to coarse stones and boulders; very few fine roots |

## Soil name and map symbol: Harihari (Hh)

### Concept and overview

Harihari soils occur in a few small areas covering 6 ha in low-lying areas of the river floodplains. They occur chiefly in narrow strips in river overflow channels that formed by the concentration of river flows on the floodplain surface during flood events. Harihari soils are generally found alongside the scarp of a low terrace, that acts as a border for overflow waters, and against which flood flows are concentrated. The overflow channels are commonly marked by swamp vegetation and sometimes willow trees with water lying either temporally or permanently in the floor of the channel.

### Relationship to previously named soils

Harihari soils were not identified in the Takaka district in the unpublished soil survey of Golden Bay County and the later 1:250,000 of the district. In the General Survey of the Soils of South Island (Soil Bureau Staff 1968), Harihari soils were mapped as alluvial soils from schist alluvium supporting swamp forest (set 91) and were later described by Mew (1980) as imperfectly drained soils from recent alluvium. Small areas have been mapped in the recent surveys of the Takaka district.

### Landform origin and history

During periods of flooding, floodplain overland flows may be concentrated into narrow channels that leave low lying sinuous strips in which Harihari soils are found. These channels are often reoccupied by overland flows in subsequent floods. Drainage varies according to proximity to the watertable.

### Key soil features

Harihari soils are imperfectly to poorly drained. Soil development is weak due to their youthful age and the subsoil colours are mainly grey with reddish mottles, the abundance of which is dependent on the proximity of the watertable and oxidation and reducing conditions.

### Associated and similar soils

Harihari soils are associated with Takaka soils on the same surface but on slightly higher ground. Waingaro soils are similar soils to Harihari soils occurring in low lying areas but are associated with Karamea soils on higher terraces that are predominantly flood free.

### Identified variants

Harihari soils include a range of depth classes from stony, shallow (<45 cm to gravel) moderately deep (45-90 cm to gravel) and deep. Textures vary from silt loams to sand and drainage from imperfectly drained to poorly drained.

### Key physical properties

Harihari soils have a thin or topsoil (average 9 cm) with reddish brown mottles sometimes present and it overlies unweathered greyish silty to gravelly alluvium commonly with reddish or brownish mottles. Organic accumulations are sometimes present at the soil surface. A watertable may be present, more especially during the wet season.

Soil versatility and land use rating

Harihari soils have low versatility They have severe drainage, permeability, trafficability and workability limitations along with  susceptibility to flooding and ponding. They are included in class F of the Tasman District Council land classification scheme.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-9 cm | dark brown (10YR 3/3) slightly peaty loam; weakly developed fine polyhedral structure; weak soil strength, very friable |
| Cg1 | 9-45 cm | dark greyish brown (10YR 4/2) silt loam; weakly developed medium blocky structure; weak soil strength; brittle; 25% fine to coarse red prominent (2.5YR 5/8) mottles; few fine and few medium roots |
| Cg2 | 45-80 cm | greyish brown (2.5Y 5/2) silt loam; apedal; earthy; 30%  olive brown (2.5Y 5/6) fine distinct mottles; weak soil strength; brittle; few fine and few medium roots |

# Soil name and map symbol: Karamea (Km, Kmmd, Kmsh Kmst)

## Concept and overview

Karamea soils (315 ha) are mapped on low terrace surfaces of the Takaka and Waingaro Rivers and on the low terraces of Stony Creek and Craigieburn Creek. These soils are formed on surfaces that lie just above the main floodplain surface and are essentially flood free except in rare and extreme flood events. They have a deeper and somewhat more distinct topsoil than Takaka soils with a weakly developed B horizon that is commonly slightly browner than the underlying material. Evidence of recent flooding in the form of buried topsoils is typically absent.

## Relationship to previously named soils

Karamea soils were not distinguished in the initial unpublished soil survey of Takaka County but were instead mapped principally as Takaka sands. In the 1:250,000 General Survey of the soils of South Island (Soil Bureau Staff 1968), they were included with all of the soils on the lower terraces as Karamea set (99c). Karamea soils have been mapped in the recent soil surveys of the Takaka district.

## Landform origin and history

The low terraces of the Waingaro and Takaka Rivers have formed as part of the river downcutting that took place subsequent to the extensive aggradation and terrace formation that occurred towards the end of the last Glaciation. The surfaces on which Karamea soils are mapped are generally stepped with several minor terracettes, often with risers of greater than a metre. Old overflow channels, formed at times of flooding, are present, and give the land an undulating rather than a smooth planar surface. Soil profile development increases with increasing height above river level but the overall degree of soil development is predominantly weak and indicates that the low terrace surfaces are of a very recent age. In some places, flood overflows have resulted in a mixture of Takaka soils with Karamea soils occurring in slightly higher ground that escaped inundataion.

## Key soil features

Karamea soils are predominantly moderately deep (36% 45-90 cm over gravel) with about 40% shallow (< 45 over gravel, or stony with gravel and sometimes boulders at the surface) while deep soils >90 cm were found in 24% of the observations. The depth of fine material over gravel varies however over short distances. The topsoil is dark yellowish brown or brown silt loam and averages around 16 cm in thickness The B horizon is weakly developed, about 22 cm thick and is varied in colour but is mainly light olive brown silt loam. On the slightly higher terrace surfaces, the B horizons are a little more distinct and may have yellowish brown to olive brown colours. C horizons are mainly sandy to loamy textured.

## Identified variants

Soils that are predominantly moderately deep (Kmmd), shallow (Kmsh) or stony (Kmst) are shown separately in several places. In some old flood channels, small areas of Waingaro moderately well drained to imperfectly drained soils are present but were not mapped separately.

Associated and similar soils

Karamea soils are associated with Takaka soils on the lower floodplain surfaces where flooding may occur. Waingaro soils occur on the same land surface as Karamea soils in sites that have poor surface drainage although are not mapped in the present survey. Anatoki soils, which were mapped in the Kotinga district, are somewhat similar to Karamea soils. They are characterised by a dominance of olive colours in the subsoil and have been found only in the Go Ahead Creek catchment.

Key physical properties

Karamea soils are predominantly moderately deep or deep and well drained with silt loam texture passing into sandy loam then gravel in the lower horizons. They have moderately deep rooting depth but weak soil subsoil strength and weakly developed subsoil structures.

Soil versatility and land use rating

Karamea soils have easy slopes with some surface undulations due to river terracing and they are relatively stone free except in sites of old river bars or flow channels. Trafficability is unlikely to be restricted for significant periods, as waterlogging over winter months is not prolonged. A summer soil moisture deficit is relatively short and can be corrected by irrigation while flood risk where present, can be overcome by flood control measures. Karamea soils are included in class A of the Tasman District Council land classification scheme.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-19 cm | brown yellowish brown (10YR3/4) silt loam; weakly developed fine polyhedral structure; weak soil strength; friable; abundant fine and few medium roots |
| AB | 19-30 cm | brown to dark brown and light olive brown (10YR 4/3+2.5Y 5/6) silt loam; weakly developed fine polyhedral and blocky structure; slightly firm soil strength; friable; many fine roots |
| B | 30-52 cm | light olive brown (2.5Y 5/6) silt loam; weakly developed medium blocky structure; slightly firm soil strength; few fine roots |
| C1 | 52-85 cm | light olive brown (2.5Y 6/2) fine sandy loam; apedal; earthy; very weak soil strength; loose very friable; very few fine roots |
| C2 | on | olive brown (2.5Y 4/4) sandy gravel |

## Soil name and map symbol: Ikamatua (Ik, Iksh, Ikst, Ikbd)

### Concept and overview

Ikamatua soils cover 139 ha and are mapped mainly on terraces of the Waingaro River and to a lesser extent on Takaka River terraces and Stoney Creek and Craigieburn Creek terraces. They are well drained soils formed above the flood plain and low river terraces on surfaces that are in most places stony or bouldery. Ikamatua soils have a distinct weathering profile but the weathering depth is usually <60 cm deep.

### Relationship to previously named soils

Ikamatua soils were not identified in the early unpublished survey of the soils of Takaka County but were mapped as Takaka gravel and stony loams (subsequently Hamama soil). In the General Survey of the soils of South Island (Soil Bureau Staff 1968) Ikamatua soils were likewise not separated and were included with Karamea set (99c). They were mapped in places in the recent surveys of the Takaka district (Campbell 2006, 2007, 2008, 2009 unpublished).

### Landform origin and history

Glacial activity in the Waingaro and Takaka catchments was extensive during the last glacial period with glaciers possibly reaching the valley floors. Following glacial retreat at the end of the Last Glacial Cold Period about 18,000 years ago, outpourings of coarse gravelly sediments resulted in formation of the Hamama Terrace (Bainham Formation deposits, Grindley 1971) in the river valleys. As glaciation receded and the supply of gravels diminished rivers, which probably still had extensive flows, progressively cut down into the terrace gravel sediments forming a stepped surface, often channelised and with bouldery risers. Short severe cold intervals after the end of the Last Glacial Cold Period may have added further outwash gravel that contributed to the bouldery nature of the Ikamatua soil surface.

### Key soil features

Ikamatua soils are predominantly stony or bouldery (65%) with boulders or stones at or close to the soil surface. Shallow soils (<45 cm to gravel) and moderately deep soils (45-90 cm to gravel) were found in only 25% of the observations. The A horizon is dark yellowish brown silt loam or sandy loam and averages 17 cm in thickness. The B horizon is yellowish brown silt loam or sandy loam around 25 cm thick and passes through a transitional olive brown sandy BC horizon, then into unweathered gravel at around 60 cm.

### Identified variants

Ikamatua bouldery soils (Ikb) are mapped in places where there are appreciable concentrations of surface boulders along with Ikamatua stony soils (Ikst). Ikamatua moderately deep or deep soils (Ik) were found in a few places.

### Associated or similar soils

Uruwhenua soils also occur on the degradational river terraces but at a slightly higher elevation. They have somewhat deeper weathering profiles with oxidation extending to around 70cm. sometimes with sandy horizons found in the lower subsoil. Kotinga soils are also shallow and stony or bouldery soils but they are somewhat more weathered and may have a weakly developed pale coloured podzolic horizon present just below the surface.

Key physical properties

Ikamatua soils are well drained, predominantly stony or bouldery soils with silt loam or sandy loam textures passing into sandy loam or sand. They have a moderate potential rooting depth, rapid permeability and low to moderate available water capacity.

Soil versatility and land use rating

The versatility of Ikamatua stony and bouldery soils is limited by somewhat uneven topography, stony profiles, and seasonal soil moisture deficiency. They have good drainage, minimal restrictions on trafficability but workability is severely restricted by the presence of surface boulders or stones at the surface. Extensive removal of surface coarse clasts has taken place on some farms with boulders being used for the construction of stone fences. Ikamatua moderately deep soils are included in class A of the Tasman District Council land classification scheme and the bouldery and stony soils where cultivation is impractical, in class F.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-18 cm | dark yellowish brown (10YR 3/6) sandy silt loam; strongly developed fine polyhedral structure; weak soil strength; friable; 15% medium to very coarse stones; abundant fine and few medium roots |
| AB | 18-23 cm | dark yellowish brown and yellowish brown (10YR 3/6 + 10YR 5/6) sandy loam; strongly developed medium polyhedral structure; very friable; 30% medium to very coarse stones; many fine roots |
| Bw | 23-40 cm | yellowish brown (10-YR 5/6) sandy loam; moderately developed medium polyhedral structure; 30% medium to very coarse stones; many fine roots |
| BC | 40-50 cm | light olive brown (2.5Y 5/6) coarse sand; apedal; loose; 40% medium to coarse stones and some boulders; few fine roots |
| C | 50-75+ cm | light olive brown (2.5Y 4/4) coarse sand; apedal; loose; medium to very coarse stones; very few fine roots |

## Soil name and map symbol Uruwhenua (Ur, Ursh, Urst)

### Concept and overview

Uruwhenua soils (Ur, Ursh, Urst) cover 103 ha and are predominantly mapped on a terrace surface chiefly associated with the Waingaro River and in smaller patches elsewhere. This surface lies just below the Hamama aggradational terrace and is separated from it by a prominent circa 10m terrace scarp. They are well drained mostly stony soils, somewhat similar to Ikamatua soils, but with weathering profiles that extend to a greater depth.

### Relationship to previously named soils

Uruwhenua soils were not separated in the early unpublished survey of the soils of Takaka County where they were included with Takaka undifferentiated gravels and stony loams (subsequently Hamama soils). in the 1:250,000 In the 1:250,000 General Survey of the Soils of South Island (Soil Bureau Staff 1968) Uruwhenua soils were included with Karamea soils (99c). They were first separated in the Survey of the Soils of the East Takaka District and also mapped in the Kotinga district soil survey (Campbell 2008, 2009 unpublished).

### Landform origin and history

Uruwhenua soils occur just below the main Takaka Valley aggradational terrace surface (Hamama Terrace), which was formed as a result of outpourings of gravels from late Last Glaciation activity in the mountains at the head of the contributory rivers. At the end of the Last Glacial Cold Period, river entrenchment was marked by extensive water flows, which left a predominantly stony or bouldery surface that is uneven because of the existence of old flow channels.

### Key soil features

Uruwhenua soils are predominantly stony or bouldery with only about 25% shallow and moderately deep and (<90 cm over gravel). The A horizon is dark yellowish brown silt loam and has an average thickness of 18 cm and overlies a yellowish brown sandy loam or silt loam B horizon with an average thickness of 42 cm. The B horizon passes into a transitional BC horizon of approximately 20 cm, which is yellowish brown to light olive brown with predominantly sandy texture. This in turn overlies little weathered light olive brown sandy gravel.

### Identified variants

The main variations found are related to the depth to gravel with both Uruwhenua shallow soils (Ursh) and Uruwhenua stony soils (Urst) being separated. During heavy rainfall periods, surface runoff may be concentrated in old flow channels and a few mottles are present in the subsoil.

### Associated and similar soils

Uruwhenua soils are associated with Ikamatua soils, which occur on the same degradational surface but at a few metres lower elevation. They have similar, predominantly stony or bouldery profiles, but the weathering depth is shallower. Hamama soils are somewhat similar to Uruwhenua soils and likewise are predominantly shallow or stony but the weathering depth commonly extends to around a metre.

Key physical properties

Uruwhenua soils are well drained, occur on slightly undulating near level surfaces, have a moderate available water capacity, have a moderately deep to deep rooting depth but are stony. They are likely to have moderate permeability. Trafficability may be slightly restricted in wetter months but in most places, workability is restricted by stoniness and presence of boulders. In some places, removal of surface boulders has taken place to improve soil workability

Soil versatility and land use rating

Areas of moderately deep Uruwhenua soils have few physical limitations for intensive use apart from a period of summer moisture deficiency, which could be corrected with irrigation. They are included in class A of the Tasman District Council land classification scheme. Cultivation is restricted where the soils are stony or bouldery to the surface and these soils are included in class E of the Tasman District Council land classification scheme.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-18 cm | dark yellowish brown (10YR3/4) silt loam; strongly developed fine polyhedral structure; very weak soil strength; very friable; 30% medium to very coarse stones; profuse fine roots |
| AB | 18-28 cm | dark yellowish brown and yellowish brown (10YR 3/4 + 10YR 5/6) silt loam; strongly developed fine polyhedral structure; very weak soil strength; 35% fine to very coarse stones; many fine roots |
| Bw1 | 28-40 cm | yellowish brown (10YR 5/8) sandy loam; moderately developed fine polyhedral structure; very friable; 45% fine to very coarse stones; many fine roots |
| Bw2 | 40-60 cm | yellowish brown (10YR 5/6) loamy sand; weakly developed fine polyhedral structure; very friable; 50% fine to very coarse stones; few fine roots |
| BC | 60-75 cm | yellowish brown to light olive brown (10YR 5/6-2.5Y5/4) sand; loose; 50% fine to very coarse stones; very few fine roots |
| C | 75-80 cm+ | light olive brown (2.5Y 5/4) sand; loose; 50% fine to very coarse stones |

## Soil name and map symbol Paton (Pt)

### Concept and overview

Paton soils cover just 13 ha and they occur in small patches, typically in foot-slope situations and in gullies alongside adjacent hilly or steep land where surface runoff gives rise to wet ground conditions. They are formed from sediments accumulated on small fans or hill toe slopes from erosion on adjacent hilly or steep land. The soil materials are mainly derived from sediments from nearby silty to gravelly rocks of the Motupipi Coal Measures Formation (Grindley 1971). Paton soils have greyish and mottled subsoil colours typical of imperfectly drained soils with slow permeability.

### Relationship to previously named soils

Imperfectly to poorly drained alluvial soils are of limited extent Takaka Valley and were not separately mapped in either the early unpublished survey of the soils of Takaka County or the 1:250,000 General Survey of the Soils of South Island (Soil Bureau Staff 1968). Paton soils were mapped in the survey of the soils of the Puramahoi district (Campbell 2007 unpublished) when they were separated as part of a sequence of soils where drainage impediment became increasingly greater (Puramahoi soils-well drained, Tukurua soils moderately well drained, Paton soils imperfectly drained). Clifton soils, mapped in the survey of the soils of Lower Takaka Valley (Campbell unpublished 2006) occur in similar topographic situations but they are formed from materials of mixed lithology rather than from quartzitic alluvium.

### Landform origin and history

Paton soils occur adjacent to hilly or steep land on small fans or gully floor deposits that have spilled out onto the Hamama Terrace surface. Their parent materials have accumulated as colluvium, or sediment derived as from erosion of materials washed from adjacent hilly land in late glacial times.

### Key soil features

Paton soils are deep to moderately deep with greyish brown to very dark greyish brown silt loam topsoils that average 17 cm thick. B horizons have clay to silt loam textures and are predominantly olive grey to light brownish grey and become mottled with increasing depth. A watertable is sometimes present.

### Identified variants

Paton soils are mostly deep (>90 cm of silty or clayey alluvium) and imperfectly drained but drainage varies and some soils are moderately well drained. Dogan soils (similar to Paton soils but with poor drainage with accumulations of organic materials) were found at one location. A small area of Waitui soils and also some soils on sandy sediments with features similar to Onahau soils were also noted.

### Associated and similar soils

Paton soils are associated with Tukurua soils (not mapped in the present survey), which have somewhat better drainage.

Key physical properties

Paton soils occur on level to gently sloping ground, have clayey subsoil textures, are imperfectly drained, remain wet for considerable periods and are generally stone free. Permeability is likely to be slow with some waterlogging and there are likely to be significant trafficability and workability restrictions.

Soil limitations and land use rating

Intensive use of Paton soils is restricted by imperfect drainage and heavy subsoil texture which restrict root growth. They are included in class D of the Tasman District Council land classification scheme.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-15 cm | greyish brown (10YR 5/2) clay loam; moderately developed fine polyhedral structure; weak soil strength; friable; many fine roots |
| Br | 15-20 cm | light olive grey (5Y 5/2) clay; moderate developed medium blocky structure; slightly firm soil strength; semi deformable; 2% fine distinct (2.5YR 4/8) mottles; few fine roots |
| Bg1 | 20-40 cm | light olive grey (5Y 5/2) clay; moderately developed medium blocky structure; slightly firm soil strength; semi deformable; 20% light olive brown (2.5Y 5/4) fine distinct mottles; few fine roots |
| Bg2 | 40-60 cm | olive (5Y 5/4) clay loam; weakly developed coarse blocky structure; firm soil strength; semi deformable; 2% dark brown (10YR 3/6) soft fine concretions |
| BC | 60-90 cm | olive (5Y 4/3) sandy clay; weakly developed coarse blocky structure; firm soil strength; brittle; 5% dark brown (10YR 3/6) fine distinct mottles |

## Soil name and map symbol: Rototai (Ro)

### Concept and overview

Rototai soils occur in a few small areas and cover approximately 14 ha in the southern part of the survey area. They occur on gently sloping land that forms indistinct terrace or fan surfaces near the mouths of gullies cut into adjacent hill country with marble bedrock. They are formed from sediments derived from the erosion of marble and remnants of older terrace gravel deposits. They are moderately well drained and moderately deep to deep soils.

### Relationships to previously named soils

Rototai soils were first separated as Clifton soils (clay loam) in the earlier Cawthron Institute unpublished survey of the soils of Takaka County but were not mapped in the 250,000 General Survey of the Soils of South Island (Soil Bureau Staff 1968). They were mapped in the Rototai area in the survey of the soils of Lower Takaka Valley and again in small area in the East Takaka district (Campbell 2006, 2008 unpublished).

### Landform origin and history

Arthur Marble occurs in the terrain immediately to the west of the survey area and patches of old terrace gravels (Kaituna Formation or older) are present on the west side of Takaka Valley. Scattered quartzitic boulders around the lower hill slopes are remnants of the older terrace gravel formations and the sediments of gullies that are cut into the hills to the north and south of Stony Creek are derived from these older terrace gravels and Arthur Marble. Deposition probably took place towards the end of the Last Glacial Cold Period and in places, the surfaces have been subsequently dissected by small streams.

### Key soil features

Rototai soils are predominantly deep (>1 m) with a moderately deep topsoil (20 cm) and with silt loam to clayey textures. The subsoils are dominantly olive brown with a few brownish or greyish mottles in the upper subsoil but which increase in the lower subsoil. Sandy or gravelly layers may be present at greater depths.

### Identified variants

Rototai soils vary in respect of their subsoil drainage features with mottle patterns indicating drainage conditions ranging from well drained to moderately well drained. Some shallow to moderately deep well drained soils were found in a few observations.

### Associated and similar soils

Where the soil parent material for Rototai soils has been deposited on the Hamama Terrace surface, Rototai soils merge with Hamama soils. Motupipi soils occur in similar topographic situations on small fans and are well drained.

### Key physical properties

Rototai soils are moderately well drained and deep soils with clay loam to clayey subsoil textures and a deep rooting depth. A few brown and greyish mottles are commonly present in the upper B horizon and some fine gravel may be present in places. They have moderately developed soil structure and slightly firm subsoil strength.

Soil limitations and land use rating

Intensive use of Rototai soils is limited by their distribution in small areas. Their versatility is restricted by clayey subsoil textures and seasonally impeded drainage. They are included in class B of the Tasman District Council land classification scheme.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-20 cm | brown to dark brown (10YR 4/3) silt loam; moderately to strongly developed fine polyhedral structure; weak soil strength; very friable; manyfine roots |
| AB | 20-28 cm | brown to dark brown and light olive brown (10YR 4/3 + 2.5Y 5/6) heavy silt loam; moderately developed fine polyhedral and blocky structure; weak soil strength; friable; many fine roots |
| Bw1 | 28-38 cm | light olive brown (2.5Y 5/6) clay loam; weakly developed medium blocky structure; slightly firm soil strength; brittle; 15% light yellowish brown and 15% strong brown (7.5YR 5/8) fine distinct mottles; 2% fine to medium stones; few to many fine roots |
| Bw2 | 38-63 cm | light olive brown to yellowish brown (2.5Y 6/4-10YR 5/6) sandy loam; weakly developed medium blocky structure; slightly firm soil strength; brittle; 7% fine to medium stones; few fine roots |
| BC | 63-90 cm+ | light olive brown (2.5Y 5/6) sandy clay loam; weakly developed medium blocky structure; weak soil strength; brittle; very few fine roots |

## Soil name and map symbol: Hamama (Ha)

### Concept and overview

Hamama soils (Ha) are mapped over 582 ha of the Hamama district and are the most widespread soil type of the present survey area. They are dominantly stony and shallow soils, at times bouldery, having formed on the prominent Takaka Valley terrace surface (Hamama Terrace). Soil weathering extends to about a metre depth, compared to around 60 cm for Ikamatua soils and 80 cm for Uruwhenua soils. Hamama terrace gravels are largely quartzitic and those derived from the Waingaro and Craigieburn catchments are somewhat coarser than the gravels from the Takaka catchment.

### Relationship to previously named soils

Hamama soils were identified in the unpublished Cawthron Institute soil survey of the soils of Takaka County as Takaka gravel and stony loams. They were mapped separately in the 1:250,000 General Survey of the soils of South Island (Soil Bureau Staff 1968) and given the name, Hamama set (43a). In the 2005 survey of the soils of Lower Takaka Valley, East Takaka and Kotinga districts, they have been mapped as predominantly shallow soils (Campbell 2005, 2008, 2009 unpublished).

### Landform origin and history

The Hamama Terrace is formed from gravels of the Bainham Formation (Otirian Glaciation, Grindley 1971) and represents the deposits of outwash gravels probably corresponding with the end of the Last Glacial Cold Period. Flow channel lines on the terrace surface suggest that at least in the latter stages of aggradation, most of the outflow was from the Waingaro River towards the Takaka River. In the gravels that are derived from the Waingaro River, surface boulders become more common in an up-valley direction. The Craigieburn Creek Hamama Terrace likewise has a predominantly bouldery surface that attests to extensive cold climate related activity in its catchment during the Last Glacial Cold Period. To the south, a number of sink holes are present on the Hamama Terrace surface and indicate the presence of calcareous rocks beneath the surface.

### Key soil features

Hamama soils are predominantly stony and well drained with a moderately deep A horizon (average depth 19cm) commonly with stones or boulders to the soil surface. Upper horizon textures are mainly silt loam and the subsoils yellowish brown sandy loam to sandy gravel.

### Identified variants

Hamama stony soils with stony or bouldery gravel at the soil surface were found in 62% of observations and Hamama shallow soils (<45 cm to gravel) in 25 % of observations. Hamama moderately deep soils (45-90 cm over gravel) were found in 3% of the observations. In some drainage channels that concentrate surface runoff, soils with subsoil mottles are sometimes present. In places where sinkhole subsidence has occurred Hamama Rolling soils have been mapped.

Associated and similar soils

Puramahoi soils are formed from alluvial sediments of similar age and are common in the Puramahoi district and typically have reddish mottles in the subsoil horizons and are mostly moderately deep or deep soils.

Key physical properties

Hamama soils are stony or shallow soils, commonly with stones to or just below the soil surface. Textures in the upper horizons are predominantly silt loam (sandy loam where there is a higher proportion of coarse clasts present) with sandy loam or sand texture at greater depth. The B horizon extends to around 75 cm with a transition of about 20 cm before passing into unweathered gravel.

Versatility and land use rating

The principal limitation for use of Hamama soils is the presence in most places of stones to the soil surface which restricts cultivation. A moderate to low water holding capacity due to the gravely subsoil is restrictive, but for current dairying, this is overcome by irrigation. In a few places, removal of larger surface stones has allowed cultivation for fodder crops. Hamama stony soils are included in class C of the Tasman District Council land classification scheme.

| Horizon | Depth | Description |
|---|---|---|
| A | 0-12 cm | dark yellowish brown (10YR 4/4) silt loam; weakly developed fine polyhedral structure; weak soil soil strength; friable; 2 % fine stones; abundant fine roots |
| AB | 12-18 cm | dark yellowish brown and brownish yellow (10YR4/4 +10YR 6/6) silt loam; weakly developed fine polyhedral and fine blocky structure; slightly firm soil strength; 15% medium stones; friable; many fine roots |
| Bw1 | 18-40 cm | yellowish brown (10YR 5/8) sandy loam; strongly developed fine polyhedral structure; friable; 35% medium to very coarse stones; abundant fine roots |
| Bw2 | 40-60 cm | yellowish brown (10YR 5/6) sandy loam; moderately developed fine polyhedral structure; very friable; 40% medium to very coarse stones; many fine roots |
| Bw3 | 60-84 cm | yellowish brown (10YR 5/8) sand; weakly developed fine polyhedral structure; very friable; 60% medium stones and some boulders; few fine roots |
| BC | 84-110 cm | light olive brown (2.5Y 5/6) sand; apedal; loose; 60 % medium stones and small boulders; few fine roots |
| C | 110 cm+ | olive brown (2.5Y 4/4) sandy gravel; loose; few |

fine roots

## Soil name and map symbol Puramahoi soils (Pm)

Concept and overview

Puramahoi soils are mapped in one small area of 12 ha a little south of Waingaro Road. They are deep to moderately deep, well drained brown soils formed on fine textured sediments and on a land surface that is the same as for Hamama soils. The alluvium from which Puramahoi soils are formed, thins over a short distance before passing into Hamama soils and may represent local stream alluvium that was deposited from Pigville Gully.

Relationship to previously named soils

Puramahoi soils were mapped extensively on the alluvial plain of the Puramahoi district in the early unpublished survey of the soils of Takaka district. They were likewise separated in that area in the 1:250,000 General Survey of the Soils of South Island (Soil Bureau Staff 1968). They were mapped in the recent soil survey of the Puramahoi district (Campbell 2007 unpublished) and also in a few small areas in the Kotinga district (Campbell 2009 unpublished).

Landform origin and history

Puramahoi soils in the present survey occur in a small area near Takaka River margin of the Hamama Terrace. In the Kotinga district, Puramahoi soils occurred at the terrace edge near the Waingaro River, it was considered that they may have been formed from locally derived aeolian material. A similar origin is possible for the Hamama soils mapped in this survey, although the presence of some small gravels towards the base of the profile suggests a fluvial origin. In places, Puramahoi soils overlie what appear to be partly weathered sediments so the soil age would post-date that of the terrace gravels.

Key soil features

Puramahoi soils are deep to moderately deep well drained soils. Topsoils are dark yellowish brown silt loam with an average depth of 19 cm while the B horizon is yellowish brown silt loam passing into clay loam at greater depth. A few stones are sometimes present. Yellowish red mottles are sometimes present in the lower horizons.

Identified variants

Puramahoi deep soils (>90 cm to gravel) were found in 60%f the observations, with Puramahoi moderately deep soils (45-90 cm over gravel) in 40% of the observations..

Associated and similar soils

Puramahoi soils merge with Hamama soils as the alluvial material from which they are formed becomes thinner.

Key physical properties

Puramahoi soils are formed on level ground, they are deep and well drained, with a high available water capacity and minimal stone content. The rooting depth is deep and trafficability and workability restrictions are likely only for short periods. The reddish subsoil mottles suggest that subsoil transmission of water may at times be somewhat restricted.

### Soil versatility and land use rating

Puramahoi soils are versatile soils with few limitations to intensive use, although the small area of irregular shape which they cover might limit their intensive use limit. Workability may be restricted during months of higher rainfall while there may be a small soil moisture deficit in the drier months. year. Puramahoi soils are included in class A of the Tasman District Council land management scheme.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-19 cm | dark yellowish brown (10YR 4/6) silt loam; moderately developed fine polyhedral structure; weak soil strength; very friable; abundant fine roots |
| AB | 19-25 cm | dark yellowish brown and yellowish brown (10YR 4/6+ 10YR 5/8) silt loam; moderately developed fine polyhedral structure; weak soil strength; friable; many fine roots |
| Bw1 | 25-57 cm | yellowish brown (10YR 5/8) clay loam; strongly developed fine polyhedral and medium blocky structure; slightly firm soil strength; brittle; few fine roots |
| Bw2 | 57-80 cm | yellowish brown to light olive brown (10YR 5/6-2.5Y 5/6) sandy silt loam; strongly developed medium blocky structure; slightly firm soil strength; brittle; 2% fine stones; few fine roots |
| BC | 80-90 cm + | brownish yellow (10YR 6/6) silt loam; apedal; loose; 40% medium stones; very few fine roots |

Soil name and map symbol Pigville (Pg, PgH)

Concept and overview

Pigville soils, not previously identified, cover 52 ha and are mapped on older surfaces and slightly dissected gently undulating terrace land terrace scarps, which occur as terrace remnants to the east of the survey area, between Waingaro Road and Craigieburn Road. Pigville soils are moderately deep to deep well drained brown soils formed with a thin cover deposit of loess. They are underlain by compact gravels that are partly weathered. On associated hilly land around the terrace margins, they are mostly formed from gravelly materials.

Relationship to previously named soils

Pigville soils were not previously separated in the early unpublished survey of the soils of Takaka County and in 1:250,000 General Survey of the Soils of South Island (Soil Bureau Staff 1968) were included with Hamama and Karamea soils.

Landform origin and history

Pigville soils occur on the terrace surface of the Kaituna Formation deposits, which are remnants of the earlier (Oturian) glacial aggradational outwash gravels. During that glacial period, an extensive outwash plain was formed throughout the Takaka Valley but those deposits were mostly removed by subsequent river downcutting prior to the outpouring of the gravels associated with the last glacial period (Otirian Glaciation). The remnants of the Kaituna Formation terrace surface have been partly dissected leaving in some places a gently undulating surface. On the terrace surface, the material from which Pigville soils are formed averages around 60 cm thick and is probably aeolian in origin (loess).

Key soil features

Pigville soils are deep to moderately deep well drained soils with a weathering depth that extends to > 1 m). Topsoils are dark yellowish brown silt loam with an average depth of 18 cm while the B horizon is deep, yellowish brown heavy silt loam to clay loam or clay. A few stones are sometimes present through the profile which passes into partly weathered, at times oxidised stones, at variable depth. On hilly land, stones are usually present to the soil surface. Yellowish red mottles are sometimes present in the lower horizons.

Identified variants

Pigville hill soils occur on sloping land on the terrace scarps and where remnants of the terrace gravels remain on the valley sides. In a few places, the lower subsoils are pale coloured due to impeded drainage.

Associated and similar soils

Pigville soils resemble Puramahoi soils but their subsoil textures are clayey, they have a greater weathering depth and stones within the soil or at the base are moderately altered. On the higher terraces associated with Craigieburn Stream, Pigville soils occur alongside Hamama soils from younger aggradational gravels.

Key physical properties

Pigville soils are formed on gently sloping surfaces, they are deeply weathered with good structure and commonly have some stones or gravel between 35 and 90 cm. They have a high available water capacity and there are few restrictions for plant roots.

Soil versatility and land use rating

Pigville soils are versatile soils (with the exception of the hill slopes where topography is limiting) with few limitations to intensive use. Although the subsoil textures are clayey, soil drainage is aided by good soil structure. Workability may be restricted during months of higher rainfall and there may be a small soil moisture deficit in the drier months. year. Pigville soils are included in class A of the Tasman District Council land management scheme and Pigville Hill soils in class E.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-15 cm | dark yellowish brown (10YR 4/4) silt loam; moderately developed fine polyhedral structure; weak soil strength; very friable; abundant fine roots |
| AB | 15-22 cm | dark yellowish brown and yellowish brown (10YR 4/4 + 10YR 5/8) silt loam; moderately developed fine polyhedral structure; weak soil strength; very friable; many fine roots |
| Bw1 | 22-58 cm | yellowish brown (10YR 5/8) clay loam; strongly developed fine and medium polyhedral structure; slightly firm soil strength; friable; few fine roots |
| Bw2 | 58-80 cm | brownish yellow (10YR 6/6) clay loam; moderately developed medium polyhedral and blocky structure; slightly firm soil strength; brittle; few fine roots |
| Bw3 | 80-90 cm | light olive brown (2.5Y 5/6) clay loam; moderately developed fine polyhedral and medium blocky structure; slightly firm soil strength; brittle; 2% yellowish red (5YR 4/8) fine concretions; 5% very coarse stones; few fine roots |
| Bw4 | 90-110+ | yellowish brown (10YR 5/8) clay loam; strongly developed polyhedral structure; 5% yellowish red (5Y 5/8) medium distinct mottles on partly weathered stones; 25% medium to very coarse partly weathered stones; very few fine roots |

## Soil name and map symbol Kotinga (Kt)

### Concept and overview

Kotinga soils are mapped mainly in the Stoney Creek area and cover 58 ha. They are found on a lower gently sloping terrace of Stony Creek, the surface of which is predominantly stony. Kotinga soils are stony or shallow, sometimes bouldery, with a moderately deep weathering profile. They are characterised by weakly developed podzolic features which are expressed by a greyish horizon below the topsoil and reddish mottles or oxidised stone fragments, or occasionally, a weakly developed iron pan.

### Relationship to previously named soils

In the unpublished survey of the soils of Takaka County, Kotinga soils were not recognised and were included with soils mapped as Pakahi fine sandy loams and peaty loams. In the 1:250,000 General Survey of the Soils of South Island (Soil Bureau Staff 1968) Kotinga soils (59a) were separated from those mapped as Pakahi fine sandy loams as soils formed from quartzose greywacke alluvium and with weakly developed podzolic features and brownish mottled subsoils. They were mapped in the Kotinga area in the recent soil survey of that district (Campbell 2009 unpublished). In the present survey, the area mapped as Kotinga soils was included with Hamama soils in the earlier surveys.

### Landform origin and history

Stony Creek and its tributary Dry Creek comprise a small catchment of approximately <10 $km^2$ but remnants of older bouldery terraces and the younger terraces indicate that there have been extensive accumulations of outwash gravels in the valley. The deposits from which Kotinga soils are formed are less deeply weathered than those of Hamama soils and may relate to aggradation in intense cold periods that occurred subsequent to the Last Glacial Cold Period which ended about 18,000 years ago.

### Key soil features

Kotinga soils are weakly podzolised stony soils that have brown to greyish brown thin topsoils (average 14 cm) sandy loam or silt loam textured topsoil overlying a greyish brown to brown thin AE horizon (average 10 cm) with sandy to sandy loam texture. Horizons beneath may include a thin light grey or grey E horizon and a weakly cemented or discontinuous iron pan (Bfm) horizon. The subsoil weathering includes Bw and BC horizons to around 80 cm before passing into unweathered gravel. Reddish mottles or oxide stainings on rock fragments occur frequently in the upper part of the subsoil and probably represent incipient iron pan formation.

### Identified variants

The main variants recognised but not mapped separately are bouldery soils where there are high concentrations of boulders at or near the soil surface. Moderately deep soils, including some with mottled subsoils, were found in 25% of the observations. well as shallow stony soils that have up to 45 cm of fine material over gravel.

Associated and similar soils

In the Stony Creek area, Kotinga soils are associated with Onahau soils and Kongahu soils which occur on higher terrace surfaces in the valley and which have more distinctively developed podzolic features.  In the lower part of the Stoney Creek Valley, Kotinga soils merge with Hamama soils.

Key physical properties

Kotinga soils occur on gently sloping ground and their drainage varies from moderately well drained to imperfectly drained, They are stony, at times bouldery with a medium to low available water capacity and a shallow to moderately deep rooting depth. There are few limitations for trafficability but workability is restricted by stoniness.

Versatility and land use rating

Kotinga soils have a limited capacity for intensive use and are included in class F of the Tasman District Council land classification scheme.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-14 cm | greyish brown (10YR 5/2) sandy loam; weakly developed fine polyhedral structure; weak soil strength; friable; 10% medium stones and boulders; profuse fine roots |
| AE | 14-22 cm | light brownish grey (10YR 7/3) sandy loam; weakly developed medium blocky structure; weak soil strength; brittle; 15% medium and coarse stones; yellowish red (5YR 4/8) oxide stainings on rock particles in the lower horizon; profuse fine roots |
| Bw1 | 22-42 cm | yellow (10YR 7/6) silt loam; moderately developed fine polyhedral and medium blocky structure; 25% medium to coarse stones; many fine roots |
| Bw2 | 42-65 cm | yellowish brown (10YR 5/6) sandy loam; weakly developed fine polyhedral structure; 35% medium to coarse stones and boulders; many fine roots |
| BC | 65-90 cm | light olive brown (2.5Y 5/4) sand; apedal; 45% medium to coarse stones and boulders; few fine roots |
| C | 90 cm+ | olive (5Y 5/4) coarse sand; apedal; 55% medium to coarse stones and boulders |

## Soil name and map symbol Onahau (On, OnR, OnH)

### Concept and overview

Onahau soils cover 21 ha and occur on terraces and the associated hilly terrace scarps of Stoney Creek and Dry Creek and on a small area of hilly land near the mouth of Pigville Gully. In the Stony Creek area, they are formed from stony Late Last Glaciation gravel deposits but in the Pigville Gully area, they are formed on quartzitic Tertiary sedimentary rocks. Onahau soils, commonly known as Pakahi have restricted soil drainage due to the presence of an iron pan that encourages the development of wetland vegetation. A characteristic feature of the soils is the presence of a pale grey or whitish layer or E horizon, formed by the removal and downward movement of iron and silicate clay.

### Relationship to previously named soils

Onahau soils were identified in the early unpublished survey of the soils of Takaka County where they were mapped as Pakahi soils, between Takaka Valley and Puramahoi. Onahau soils (59) were first named in the 1:250,000 General Survey of the Soils of South Island (Soil Bureau Staff 1968) and again were mapped on the high terrace surfaces. In the survey of the soils of the Puramahoi district (Campbell unpublished 2007,2009) Onahau soils were mapped on some of the high terrace surfaces.

### Landform origin and history

Throughout the Golden Bay region, the higher terrace surfaces and their gravelly deposits record a history of repeated glaciations in the western mountains, through mid to late Quaternary times. Land uplift and subsequent erosion have left only remnants of the earlier terraces but the later terraces are more distinct and less strongly dissected. Although water flows in Stony Creek are today insignificant except in high rainfall events, the valley has distinct old terraces (Rockville and Kaituna Formations, Grindley 1971) with coarse bouldery gravels, the aggradation of which may have been assisted by ice spill-over from the Waingaro Valley.

### Key soil features

Onahau soils have a sandy loam or slightly peaty silt loam A or AH surface horizon that averages 11 cm in thickness and is very dark greyish brown to very dark brown. It overlies a sandy loam to silt loam textured 11 cm thick AE horizon that is dark greyish brown, greyish brown and white or light grey. This may overlie a sandy or silty textured E horizon (40%) which is light grey with brown staining, or a silty textured Eh horizon, which is light brown or brown and light grey to white. A brown coloured Bh horizon is sometimes present while an iron pan was found in 50% of the observations. In nearly all of the observations, Onahau soils were shallow (the average depth to gravel or an iron pan was 25 cm) while some were bouldery.

### Identified variants

The main variations in Onahau soils relate to the depth at which stony gravel is found which ranges from very shallow soils with stones at the surface to gravel up to 45 cm depth. On the mapped hilly land (OnH) and associated rolling ridges where the soils are formed from Motupipi Coal Measures conglomerates, the grey subsurface horizons are more variable in thickness and a brown Bw horizon is usually present.

Associated and similar soils

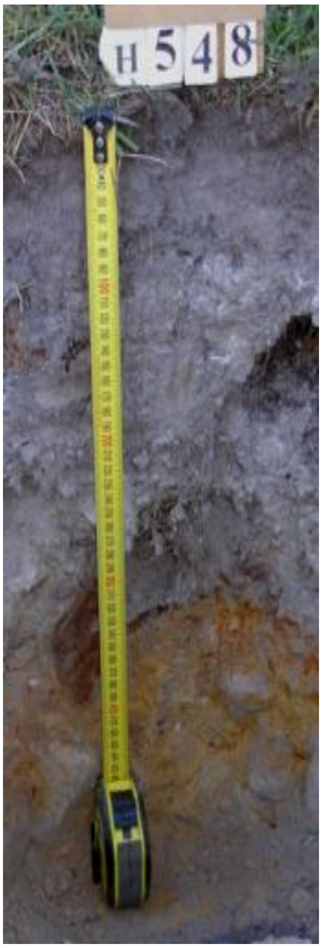
Waitui soils, which were mapped in the Kotinga district (Campbell 2009) are similar to Onahau soils but lack an AH horizon and are silt loam textured while an iron pan is often not present. Kongahu soils are similar to Onahau soils and occur on a higher and older terrace surface. They have more strongly and more consistently developed podzolic features.

Key physical properties

Onahau soils occur mostly gently sloping partly dissected land and they are imperfectly to poorly drained. Surface drainage is better on the hilly land but the iron pan restricts water movement through the soil. Available water capacity is low due to the presence of an iron pan at relatively shallow depths and somewhat massive poorly structured soil horizons above. They are predominantly shallow and stony with a shallow rooting depth. Permeability is slow and trafficability and workability are severely restricted in wetter months when waterlogging may occur.

Soil versatility and land use rating

Onahau soils have severe limitations for intensive use. Slope precludes intensive use on the hilly land where there is erosion risk. Drainage improvements that assist the removal of surface water can help to soil alleviate damage from stock treading but stoniness and shallow rooting depth, firm subsoils, poor soil drainage and are difficult limitations to overcome. Onahau soils are grouped in Class E of the Tasman District Council land classification scheme and Onahau Hill soils in Class F.




| Horizon | Depth | Description |
|---|---|---|
| Om | 0-4 cm | dark greyish brown (10YR 3/3) peaty loam; apedal; disordered; very weak soil strength; very friable; profuse fine roots |
| EH | 4-10 cm | dark greyish brown (10YR 4/2) and white (10%) (10YR 8/2) sandy loam; apedal; disordered; weak soil strength; very friable; 15% coarse stones; many fine roots |
| E | 10-30 cm | light grey and light greyish brown (10YR 5/2 + 7/2) silt loam to silt loam; moderately developed fine blocky and polyhedral structure; weak soil strength; 30 % coarse stones and small boulders; few fine roots |
| Bh | 30-35 cm | brown (10YR 5/3) sandy loam; weakly developed fine blocky structure; 40% coarse stones and fine boulders; few fine roots |
| Bfm | 35-36 cm | yellowish red (5YR 4/6) very hard iron pan |
| Bs | 36-55+ | brownish yellow (10YR 6/8) silt loam; weakly |

developed medium blocky structure; brittle; 35% coarse stones and fine boulders

## Soil name and map symbol Kongahu (Kg)

### Concept and overview

Kongahu soils are mapped over 25 ha on the remnants of some high terrace surfaces in the Stoney Creek valley. They are poorly drained podzolic soils with soil horizon sequences resembling those of Onahau soils but which are more consistently expressed across the landscape while the underlying iron pan is somewhat deeper and strongly cemented.

### Relationship to previously named soils

Kongahu soils were not recognised in previous soil surveys of the district and were mapped as Pakihi soils in the unpublished soil survey of Takaka County. Neither were they separated in the Golden Bay region in the 1:250,000 Survey of the Soils of South Island (Soil Bureau Staff 1968) where they were included with Onahau soil. In the soil survey of the Kotinga district (Campbell unpublished 2009), Kongahu soils were mapped on the highest terrace surfaces around and south of Waikoropupu River.

### Landform origin and history

The oldest terrace surfaces found in the present survey area are located in the valley of Stoney Creek and are mapped by Grindley (1971) as Rockville Formation or third last glaciation deposits extending back to Earlier Quaternary time. Subsequent erosion has left a somewhat undulating terrace surface that is separated by a distinct scarp from the next youngest surface below. The terrace deposits are mainly coarse bouldery gravels, some of which may have originated from beyond the present catchment area.

### Key soil features

Kongahu soils are poorly drained shallow soils with an average thickness of 40 cm to either an iron pan or to gravel. They have a thin 8 cm very dark brown peaty AH horizon overlying an AE horizon , average 14 cm thick, that is dark greyish brown and light grey with sandy loam texture. Underlying Eh or E horizons have predominantly brownish white to light grey colours while a Bh horizon of around 10 cm is brown to dark brown silt or sandy loam. The underlying iron pan, found in 80% of the observations, is red or yellowish red and firmly cemented. Where observed, an underlying Bs horizon was yellowish brown with sandy gravel texture.

### Identified variants

Depth to gravel varies and the soils are bouldery to the surface. Subsurface horizons vary greatly in their colour and thickness. Included are areas of Kongahu Hill soils on sloping terrace scarps where the soils are commonly very bouldery.

### Associated and similar soils

Kongahu soils are associated with Onahau soils found on lower elevation surfaces. Waitui soils, with their podzolic features, also resemble Kongahu soils.

Key physical features

Kongahu soils have undulating, in places hilly surfaces, they are poorly drained shallow soils with poor structures, low available water capacity, a shallow rooting depth that is restricted by firm to very firm subsoil horizons and an iron pan. Permeability is slow and with waterlogging occurring in wetter months, trafficability and workability are severely restricted.

Soil versatility and land use rating

Kongahu soils have severe limitations for intensive use. They are included in class E of the Tasman District Council land classification scheme.


| Horizon | Depth | Description |
|---|---|---|
| Om | 0-4 cm | very dark brown (10YR 2/2) peaty loam; apedal; disordered; very weak soil strength; very friable; profuse fine roots |
| AE | 4-20 cm | dark brown and light grey (10YR 3/3+10YR 7/2) fine sand; apedal; earthy; weak soil strength; very friable; many fine and few medium roots |
| Eh | 20-32 cm | pale brown and white (10YR 6/3 + 10YR 8/2) silty sand; apedal; earthy; firm soil strength; brittle; very few fine roots |
| E | 32-40 cm | greyish brown (10YR 5/2) silt; apedal; earthy; firm soil strength; brittle |
| Bh | 40-47 cm | brown to dark brown and white (10YR 4/3+ 10YR 8/2) silt; apedal; earthy; very firm; brittle; 20% boulders |
| Bfm | 47-49+ cm | reddish brown (5YR 4/4) iron pan; extremely hard; 40% cemented stones and boulders |

## Soil name and map symbol Kini (Ki)

### General concept and overview

Kini soils are mapped in just two small areas (1 ha ) in low-lying poorly drained areas where drainage has been ponded and swampland vegetation was the original plant cover. Although drainage of these low-lying areas has taken place, organic materials that accumulated under the wet conditions remains with peat soils being formed. The organic materials are moderately to strongly decomposed and forms fibrous peat mixed with partly decomposed woody material. Silty sediments underlie the peat deposits.

### Relationship to previously named soils

Kini soils were not separated in the unpublished survey of the soils of Takaka County but were included with Pakahi soils as peaty loams. They were not mapped in the Takaka region in the 1:250,000 General Survey of the Soils of South Island (Soil Bureau Staff 1968) but were mapped elsewhere, mainly on the West Coast where they were defined as organic soils, mainly from rushes and sedges with swamp forest and scrub. Kini soils were also mapped by Mew (1980a, b) in the Greymouth, Hokitika and Grey Valley regions where the soils comprised about 80 cm of peat over silty sediments. Some small areas of Kini soils were mapped in the Kotinga district where they occurred on low lying land on some terrace surfaces (Campbell 2009, unpublished).

### Landform origin and history

Kini soils are formed in depressions on terrace surfaces, which have been mapped as Bainham Formation (Grindley 1971). Calcareous marble (Arthur Formation or Tarakohe Limestone underlie the terrace gravels and dissolution has given rise to numerous sinkholes on the terrace surfaces in the Hamama district. Some of the sinkholes that are formed have no drainage impediment, others have small ponds or lakes while in a few, wet or swampy conditions prevail. The present vegetation is mainly grassland or weed species.

### Key soil features

Kini soils have more than 90 cm of organic material, at times with silty layers or an underlying silty substrate. The surface layer forms a topsoil of partly decomposed peat with modern organic material and overlies organic (O) horizons that vary in the extent of decomposition the amount of woody material that is present.

### Identified variants

The main variation encountered was in respect of the presence or absence of silty layers within the peat deposits.

### Associated and similar soils

Karangarua soils were mapped in the low swampy areas adjacent to estuaries in Lower Takaka Valley and Puramahoi soil surveys (Campbell 2006, 2007, Unpublished) and are similar to Kini soils but the peat accumulations are shallower and the organic accumulations are underlain by mineral horizons.

Key physical properties

Kini soils occur on level surfaces and the floors of depressions that are poorly drained. They have a high available water capacity, are free of stones, have low soil strength and have rapid permeability. Trafficability and workability are restricted by the watertable, which may rise near the surface in rainy periods.

Soil versatility and land use rating

With improved drainage, Kini soils are included in Class F of the Tasman District Council land classification scheme but without drainage they are included in class H. Redevelopment of these areas for species conservation is an alternative use that could be considered.

| Horizon | Depth | Description |
|---|---|---|
| Om1 | 0-12 cm | dark reddish brown (5YR 3/2-2/2) loamy peat; apedal; very weak soil strength; very friable; many fine roots |
| Om2 | 12-30 cm | dark reddish brown (5YR 3/2) peat; moderately decomposed; apedal; very weak soil strength; very friable; many partly decomposed wood fragments and old roots |
| Bh | 30-42 cm | reddish grey (5Y 5/2) peaty silt; apedal; disordered; weak soil strength; friable; profuse reddish brown (5YR 4/3) humus coatings; very few roots |
| Om3 | 42-70 cm | dark reddish brown (5YR 3/3) peat; strongly decomposed; apedal; very weak soil strength; very friable |
| Ch | 70-80+ cm | brown (7.5YR 5/2) sandy peat; apedal; disordered; profuse dark reddish brown humus coatings; few old wood pieces and tree roots |

Soil name and map symbol Milnthorp (MnH, MnS)

General concept and overview

Milnthorp Hill soils cover 35 ha and occur in narrow strips which form the scarps of the elevated intermediate terraces. They occur on predominantly hilly land (slopes between 16-25°) but include some steep land (>25°) where river downcutting has left terrace scarps with steep slopes. The soils are formed from terrace gravel that has been exposed at the terrace edge and subsequently reworked by down-slope earth movement.

Relationship to previously named soils

Milnthorp Hill soils were not separated in either the early unpublished survey of the soils of the Takaka district or the 1:250,000 General Survey of the Soils of South Island (Soil Bureau Staff 1968). They were first mapped in the soil survey of the Puramahoi district (Campbell 2007, unpublished) to separate the soils found on terrace scarps from those on adjacent terrace surfaces.

Landform origin and history

The terrace gravel deposits were mapped by Grindley (1971) as Late Last Glaciation or Bainham Formation. The scarp that was formed by subsequent river downcutting is approximately 5 m high to the north but increases to around 15 m further up-valley where down-cutting is greater. In places where the terrace gravels are partly consolidated, the terrace scarps are steeply sloping.

Key soil features

Milnthorp Hill soils have a deep weathering profile that is sometimes in excess of 130 cm. They have stones throughout the profile and these become more common with increasing depth. They have a moderately deep topsoil (average 18 cm) and a yellowish brown moderately structured B horizon moderately that passes into olive to olive brown coloured deeper gravelly detritus.

Identified variants

The main variation identified is in respect of soil stoniness and depth to unweathered gravel.

Associated and similar soils

Milnthorp Hill soils are associated with Hamama soils and Uruwhenua soils which occur on the terrace surfaces above the terrace scarps. In areas where the terrace scarp is steeply sloping, Milnthorp steepland soils are mapped.

Key physical properties

Milnthorp Hill soils are deep and well drained, have silt loam texture that grades to sandy loam in the lower subsoil and has variable quantities of stones throughout the soil. There is little restriction in plant rooting depth.

Soil versatility and land use rating

Use of Milnthorp Hill soils is restricted by slope, which is commonly within the range of 16-25°. Milnthorp Hill soils are included in class F of the Tasman District Council land classification scheme and the steepland soils in class H.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-20 cm | dark yellowish brown (10YR3/4) silt loam; strongly developed fine polyhedral structure; weak soil strength; very friable; 15% medium to coarse stones; profuse fine and medium roots |
| AB | 20-30 cm | dark yellowish brown and yellowish brown (10YR3/4 +10YR 5/8) silt loam; strongly developed fine polyhedral structure; very friable; 20% medium to coarse stones; many fine roots |
| Bw1 | 30-80 cm | yellowish brown (10YR 5/8) silt loam; strongly developed medium polyhedral structure; very friable; 30% medium stones and boulders; many fine roots |
| Bw2 | 80-110 cm | yellowish brown (10YR 5/8) sandy loam; moderately developed medium polyhedral structure; very friable; 30% medium to coarse stones; many fine roots |
| BC | 110-130+ cm | light olive brown (2.5Y 5/6) sandy loam; weakly developed fine polyhedral structure; friable; 40% medium to coarse stones; few fine roots |

## Soil name and map symbol Otere (OtH)

### General concept and overview

Otere soils occupy 12 ha on a small area of hill country a little north of Craigieburn Creek. They are the soils that are formed on Tertiary sedimentary rocks of the Tarakohe Mudstone Formation (Grindley 1971), which in this area occurs as an isolated outcrop on the hillsides above the Takaka Valley floor. A characteristic feature of these fine textured sedimentary beds is the intensely fracture or rubbly appearance in exposures with a land surface that is uneven and hummocky. Slopes are mainly within the range of 16-25° but some are steep (26°or greater).

### Relationship to previously named soils

Otere soils were not mapped or identified in the early unpublished survey of the soils of Takaka district. However in the 1:250,000 General Survey of the Soils of South Island (Soil Bureau Staff 1968), soils on calcareous sandstone and mudstone in the Puramahoi-Onekaka district and the Aorere Valley were mapped as Otere soils. In the soil survey of the Puramahoi district (Campbell 2007 unpublished) Otere soils were mapped where fine textured Tarakohe Mudstone rocks occurred.

### Landform origin and history

In the present survey area, the Tarakohe Mudstone Formation occurs as a small isolated occurrence and is in fault contact with the Arthur Marble on its western side. Tarakohe Mudstone was previously more extensive in this part of Takaka Valley, where it formed part of a down-faulted block of Tertiary sediments. Erosion has removed most of these Tertiary sediments, which have largely been replaced on the valley floor by gravel deposits. Owing to its intensely fractured nature, these sedimentary rocks are prone to deep-seated creep and down-slope flow which gives rise to a topography that is broadly hummocky and uneven with a ground surface that varies from rolling to hilly and steep over short distances. Evidence of down-slope mobility and past landslide activity in this material is given by the occasional presence of residual rocks from former gravel deposits that have been incorporated into the soil.

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### Key soil features

Otere soils are deep and well drained with topsoils that are dark yellowish brown silt loam (5-15 cm range) and subsoils that are yellowish brown to dark brown strongly structured clay loam to clay. Partly weathered fragments of sedimentary rock are common in the subsoil and these increase in size with depth. Fragments of sedimentary rock may be present within the soil as firm oxidized clasts.

### Identified variants

Shallow and moderately deep soils occur in places, depending on past erosion history while moderately well drained soils are present in sites on lower slopes that receive surface water runoff.

### Associated and similar soils

Pikikiruna soils on nearby Arthur Marble are deep with brown-coloured subsoils that are clayey textured commonly with marble fragments. Tadmor soils are similar to Otere soils but soil structure is not as well developed and the transition into parent rock is usually abrupt. Waitapu soils have sandier textures and have mottled subsoils.

Key physical properties

Otere soils are well drained with clayey texture, well developed structure and a deep rooting depth. The soil material merges into fractured sedimentary rock with increasing depth.

Soil limitations and land use rating

The main limitations for use of Otere soils are slope (16-25º) for Otere Hill soils and >26º for Otere steepland soils. There is a moderate to high erosion risk due to earth flow or land slip under conditions of excessive rainfall. They are included in class E of the Tasman District Council land classification system.

| Horizon | Depth | Description |
|---|---|---|
| A | 0-5 cm | dark yellowish brown (10YR 4/4) silt loam; strongly developed fine polyhedral structure; weak soil strength; friable; many fine roots |
| Bw1 | 5-20 cm | yellowish brown (10YR 5/6) clay loam; strongly developed fine polyhedral and medium blocky structure; slightly firm soil strength; friable; 10% fine sedimentary rock fragments; many fine roots |
| Bw2 | 20-50 cm | yellowish brown (10YR 5/6) clay loam; strongly developed medium blocky and fine polyhedral structure; 15% fine to medium sedimentary rock fragments; many fine roots |
| Bw3 | 50-80 cm | yellowish brown to dark brown (10YR 4/6-10YR 4/4) clay loam; strongly developed medium blocky and fine polyhedral structure; firm soil strength; 10% fine and medium sedimentary rock fragments; few fine roots |
| BC | 80-100+ cm | yellowish brown to dark brown (10YR 5/6-10YR 4/4) clay; moderately developed medium polyhedral structure; firm to very firm soil strength; very friable; 50% coarse to very coarse sedimentary rock fragments |

## Soil name and map symbol Waitapu (WpH)

### General concept and overview

Waitapu soils cover 35 ha and are the soils that are formed on hilly land from rocks of the Motupipi Coal Measures Formation that borders the terrace land at the south of the present survey area. The sediments of this formation include firm sandstone, fine gravels and conglomerates.Most of the land is moderately sloping (16º and 25º) but in a few places steeper slopes occur.

### Key soil features

Waitapu soils predominantly are deep soils but shallow soils were found where harder beds within the formation are present. Topsoils (average 16 cm) vary in colour from very dark greyish brown to dark brown sandy loam with yellowish brown sandy loam textured subsoils then into paler coloured sandy loam or sandy horizons. Fine quartzitic gravels or sandstone bedrock fragments are sometimes present. The soils is well drained but on lower slopes may moderately well drained or imperfectly drained where drainage water and slope detritus are accumulated.

### Landform origin and history

The Motupipi Coal Measure Formation occurs as an isolated outlier of Tertiary sedimentary rock to the south of Waingaro Road. The formation varies greatly in its lithology and includes sands, mudstones, coal seams and conglomerates. With the dominantly coarser textures reflected in the sandy textures of the soils. These sedimentary rocks were buried by older Quaternary Glaciation outwash gravels, that have largely been removed by subsequent erosion, except for some scattered boulders which occur on some of the hill slopes.

### Relationship to previously named soils

Waitapu soils were mapped in the earlier unpublished survey of the soils of Takaka County in areas where the Motupipi Coal Measure Formation occurred. They were not however separated in this area in the 1:250,000 General Survey of the Soils of South Island (Soil Bureau Staff 1968). They are similar to the soils mapped in the survey of the soils of Lower Takaka Valley and the Puramahoi district (Campbell 2006, 2007, unpublished). Pakawau soils (62bh, Soil Bureau Staff 1968) are similar to Waitapu soils but occur on the older pebbly and arkosic Pakawau Group rocks.

### Identified variants

The depth to sandstone rock varies from shallow (<50 cm) to greater than 2 m. On lower slopes, the soil drainage is commonly impeded and mottles are present in the subsoil but deep, well drained soils were also found on some lower slopes. Where sandy conglomerate is present, the soils have very coarse texture. Soils with reddish subsoil colours from strongly weathered silty sedimentary rock were occasionally found and also some shallow gravelly soils where conglomerate was near the surface.

### Associated and similar soils

Waitapu soils are associated with Onahau soils, which occur on some ridge top and spur surfaces. Tadmor and Otere soils occur on younger Tertiary sedimentary rocks from sandy siltstone and sandy mudstone and they have clayey rather than sandy textures.

Key soil properties

Waitapu soils are deep with altered sandstone bedrock commonly occurring at depths >90 cm. Textures are mainly sandy and soil structure is weakly developed. Slopes are predominantly within the range of 16-25º for Waitapu Hill soils.

Soil limitations and land use rating

Hilly slopes are a major limitation to the use of Waitapu soils. Their weak soil structure and sandy textures mean that they are vulnerable to sheet erosion. They are included in class F of the Tasman District Council land classification system.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-17 cm | very dark greyish brown to dark brown (10YR 3/2-10YR 3/3) sandy loam; weakly developed fine polyhedral structure; weak soil strength; friable; 5% fine and coarse stones; many fine roots |
| AB | 17-26 cm | very dark greyish brown and yellowish brown (10YR 3/2 + 10YR 5/8) sandy loam; weakly developed fine polyhedral structure; weak soil strength; friable; 5% fine to coarse stones; few fine roots |
| Bw1 | 26-50 cm | yellowish brown (10YR 5/8) loamy sand; weakly developed medium blocky structure; slightly firm soil strength; brittle; 5% fine gravel; few fine roots |
| Bw2 | 50-72 cm | yellowish brown (10YR 5/6) sand; weakly developed medium blocky structure; slightly firm soil strength; brittle; 60% fine to very coarse sandstone fragments; very few fine roots |
| BC | 72-100+ cm | brownish yellow (10YR 6/8) sand; apedal; earthy; 70% medium to coarse sandstone fragments |

## Soil name and map symbol: Pikikiruna (PkH, PkS PkR)

### Concept and overview

Pikikiruna soils (PkH, PkS) occur widely on hill and steep land comprising rocks of the Arthur Marble Formation (Grindley 1971) that is adjacent to and south of the survey area. However, they are mapped over just 23 ha mainly in the vicinity of Pigville Gully and Washaway Creek at the border of the survey area. Pikikiruna hill soils occur on land where slopes are predominantly between 16º and 25º and Pikikiruna steepland soils (PkS) on slopes predominantly above 25º. On easy sloping land at the foot of some steep slopes, Pikikiruna Rolling soils are separated (slopes 8-20º). On some of the steeper slopes, there are many rocky outcrops where the soil cover is thin or absent while in other places, the weathering mantle is deep.

### Relationship to previously named soils

The soils formed on rocks of the Arthur Marble Formation were separated as Pikikiruna loams in the earlier unpublished survey of the soils of Takaka County by Cawthron Institute and mapped as Pikikiruna steepland and hill soils (74c, 74cH) in the 1:250,000 Survey of the Soils of South Island (Soil Bureau Staff 1968). Pikikiruna soils were also mapped in the survey of the soils of Waimea County (Chittenden et al. 1966). Pikikiruna soils were mapped along the eastern margin of Takaka Valley in the survey of the soils of the East Takaka district (Campbell 2008, unpublished).

### Landform origin and history

To the south of the present survey area, Arthur Marble occurs in the adjacent hill country between the Waingaro River and Craigieburn Creek. River downcutting and also faulting has resulted in a topography that borders the valley floor terrace deposits with predominantly steep slopes. Dissolution of the calcareous Arthur Marble has resulted in an uneven topography with sinkholes being formed in places.

### Key soil features

Pikikiruna soils vary in depth and range from very deep to shallow, depending on proximity to rock outcrops. On lower surfaces where there has been down-slope movement of soil materials, the soil mantle may be thick. The A horizon is moderately deep to deep (average 16 cm) dark brown silt loam or clay loam while the subsoils are also predominantly yellowish brown to dark brown coloured with clayey textures. Marble stones and small particles are commonly present and there may be an abrupt change into underlying bedrock.

### Identified variants

Pikikiruna soils range from shallow and stony to very deep. Subsoil colours are sometimes reddish where older weathered materials are present.

### Associated and similar soils

Kairuru soils, also formed from Arthur Marble Formation, occur on higher surfaces of the Pikikiruna Range mainly on rolling and hilly land and under a higher rainfall. Tarakohe soils formed from limestone have somewhat similar profiles.

Key physical properties

Pikikiruna soils are predominantly deep and well drained with clayey subsoil textures. They have moderately to strongly developed soil structure and stones are present in variable proportions. The transition into underlying rock may be either abrupt or gradual.

Versatility and land use rating

The use of Pikikiruna soils is mostly restricted by slope and the occurrence of numerous rock outcrops. They are well drained, have a medium to high available water capacity and a deep potential rooting depth. On the steeper slopes, there is a moderate to high risk of erosion in extreme climatic events. On the rolling slopes Pikikiruna soils are grouped in class E of the Tasman District Council land classification scheme with the soils on the hilly and steep slopes included in class F and H.


| Horizon | Depth | Description |
|---|---|---|
| A | 0-13 cm | dark yellowish brown (10YR 4/4) heavy silt loam; weakly developed fine polyhedral structure; weak soil strength; friable; profuse fine and few medium roots |
| AB | 13-25 cm | dark yellowish brown and yellowish brown 10YR 4/4 + 10YR 5/8) clay loam; moderately developed medium blocky and polyhedral structure; firm soil strength; friable; 1% fine stones; many fine and few coarse roots |
| Bw1 | 25-43 cm | yellowish brown (10YR 5/8) clay loam; moderately developed coarse blocky structure; firm soil strength; brittle; 1% fine stones; few fine and few coarse roots |
| Bw2 | 43-100+ cm | yellowish brown to strong brown (10YR 5/8-7.5YR 5/8) clay; strongly developed coarse blocky structure; very firm soil strength; semi-deformable; 1% fine stones; few fine and few medium roots |