

Hydric soils – field identification guide

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Hydric soils - field identification guide

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Summary

This guide is to help the identification of hydric soil features in the field. 'Hydric soils' is a general term for soils that are poorly or very poorly drained and have a water table above, at, or near the surface long enough during the growing season to develop anaerobic conditions in the upper layers. Gley soils and Organic soils are the two main orders of hydric soils. Gley soils have pale subsoils often with reddish mottles. These colours are indicators of saturated low oxygen conditions. Organic soils are also formed in saturated conditions and have at least 30 cm of peaty material.

This guide provides explanations and descriptions of soil characteristics that help identify hydric soil features in the field. There is also a field identification key for hydric soil features and a list of New Zealand's hydric soils.

Drainage has altered the water regime of many wet soils, but they are often still saturated during wet periods because of slow soil permeability and fluctuating water tables that can rise to the surface. In some cases the soil has hydric features but because of land drainage is no longer saturated. Confirmation of the saturated status of the soil, and hydric soil features, are both required for identification of a hydric soil where land has been drained.

The methods used in this field guide are based on the Pocket Guide to Hydric Soil Field Indicators (Wetland Training institute 2017), the New Zealand Soil Description Handbook (Milne et al. 1995) and New Zealand Soil Classification (Hewitt et al. 2010).

1 Background

1.1 Wetland identification

The New Zealand Resource Management Act (1991) defines wetlands as 'permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions'. This definition is very broad and has proved difficult to apply consistently in the field. As the identification of wetlands is an important part of resource management in New Zealand, regulatory agencies require a consistent set of criteria to define wetlands on the ground for consent and planning purposes.

The United States of America has developed a scientifically robust wetland delineation system (Environment Laboratory 1987, and updates, including US Army Corps of Engineers 2008, 2010) that is applied widely and could be adapted for New Zealand wetlands. In the USA three diagnostic environmental characteristics or criteria are used for wetland delineation:

- wetland vegetation
- hydric soils and
- wetland hydrology.

Under USA legislation (section 404 Clean Water Act and regulations promulgated therefrom), all three criteria are required to classify a site as a wetland.

In New Zealand, the availability of simple guidelines and criteria for wetland delineation, similar to those used in the USA, would be extremely useful. This requires development of the three major characteristics of wetlands that are suitable for New Zealand conditions as follows:

- <u>Vegetation Tool</u> Categorise New Zealand wetland plant species (hydrophytes) and set decision rules regarding species abundance in relation to meeting the wetland threshold (completed; Clarkson 2014).
- <u>Soil Tool</u> Define and provide a field guide for identification of hydric soils and how they relate to the New Zealand soil classification system.
- <u>Hydrology Tool</u> Define the hydrological conditions that would be required for wetland criteria (yet to commence).

This project covers Stage 2 on the Hydric Soil Tool. It adapts New Zealand soils and conditions to the latest approach to identifying wet soils in the field as outlined in the 'Pocket Guide to Hydric Soil Field Indicators' (Wetland Training Institute 2017).

1.2 Hydric soils

Hydric soils can be defined as:

Soils that have formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic (low oxygen) conditions in at least the upper 30 cm of the soil (based on Federal Register 1994).

Hydric soils can be the result of soil or site characteristics. Often low soil porosity results in slow drainage, causing the soil to be wet for prolonged periods. The other cause of hydric soil is being located in low areas of the landscape that have a high water table. Such locations can be near rivers or where drainage water accumulates on its way downslope. Hydric soils can occur on flat or sloping land.

Drainage of agricultural land has reduced the extent of wet soils but the inherent properties that cause slow drainage still cause them to be wet, particularly in periods of prolonged rainfall. In these circumstances they can still pond and their water table can rise to the surface.

Wet, saturated conditions permanently alter the colour of the soil. Prolonged wet conditions can also result in the formation of black peaty or humic material. These features can be used to identify hydric soils in the field.

Generally hydric soils are peaty or humic, or have pale light grey subsoil colours caused by saturation and a lack of oxygen. Blotches (mottles) of redder colour can occur in the topsoil or subsoil where air can get into the soil and oxidises iron minerals to form redder colours.

The New Zealand Soil Classification groups the main hydric soils into either Gley or Organic Soil Orders. These soils are poorly or very poorly drained (see Milne et al. (1995) for definitions of soil drainage classes) and have features that indicate periodic or prolonged saturation at or near the soil surface. Other Soil Orders in the New Zealand Soil Classification can have soils that cover a range of drainage classes (defined at the group and sub-group level) but they are usually not as wet as Gley or Organic soils, however, there can be groups and sub-groups within other Soil Orders that are poorly or very poorly drained and are covered in this guide.

2 Features of hydric soils

The first steps in identifying hydric soils are to assess the site for features that indicate the likely presence of wet soil conditions. This would cover:

- 1 landscape position
- 2 vegetation type

3 drainage and wetness

The second step is to assess the soil for characteristics that indicate anaerobic conditions such as:

- 4 soil colours
 - matrix
 - mottles

2.1 Position in the landscape

Wet soil conditions are clues to the presence of hydric soils. The positions in the landscape that are most likely to be wet are low lying areas adjacent to open water such as lakes, ponds, rivers, and the sea. Other areas on sloping land can also have wet conditions. These include areas at the base of slopes or valleys where seepage water accumulates and drains away (Figs 1-3).

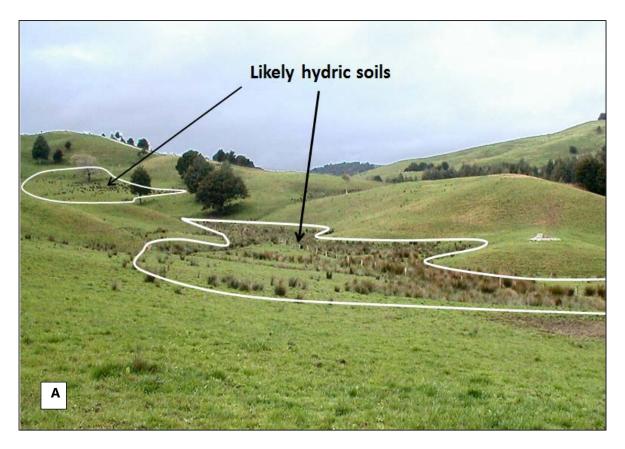




Figure 1A, B. Low areas in the landscape receive drainage water from the surrounding slopes and the presence of rushes are both indicators of possible hydric soils.

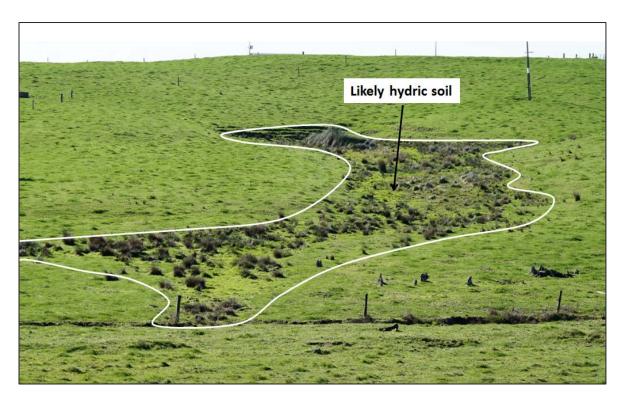


Figure 2. An area on a hill side where groundwater emerges as seepage.

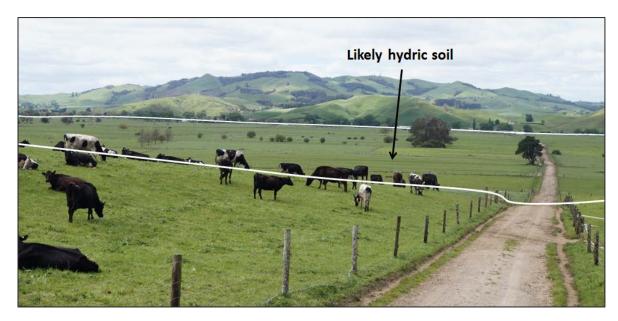


Figure 3. Flat low areas in the landscape can have high water tables. This is an area of peatland.

2.2 Vegetation pattern

Changes in vegetation are often associated with wetter soil conditions. This can result in differences in leaf colour or plant composition (Figs 4, 5 & 6). The vegetation aspect of hydric soil identification is covered in Clarkson (2014).



Figure 4. Vegetation at the base of a slope indicating the presence of hydric soils.



Figure 5. Vegetation on a flat area indicating the likely presence of hydric soils.



Figure 6. Boggy ground formed by water perching on a compact slow permeability subsoil pan.

2.3 Drainage and wetness

Another sign of hydric soil conditions is the drainage pattern. Closely spaced open drains often indicate poorly drained conditions. The drains may not always be successful in draining the soil. For example, in low lying areas there may not be enough fall and water tables can remain high, or the soil has low porosity and cannot drain easily so remains wet even if drains are nearby (Figs 7 & 8).

In some cases, the soil can be wet and soft underfoot or there are signs of pugging damage from cattle or damage from vehicles (Figs 6 & 9).



Figure 7. Even though an area is drained it may still be wet because there is little fall and the water table remains high.



Figure 8. A persistent high water table, despite being drained.



Figure 9. Rough pugged ground formed by hoof prints in wet soft soil.

2.4 Soil colour

It is important to remember that not all hydric soils are permanently wet – sometimes water tables are low and the soil is quite dry. Under these conditions, there may be some clues to wet soil condition in the vegetation, surface pugging, or position in the landscape. However, in these cases it is necessary to inspect the soil in detail.

Fortunately, saturation can permanently alter the colour of the soil in characteristic ways. These colour changes are significant clues for identifying hydric soils.

Under saturated conditions, decomposition and other soil chemical processes can use all the available oxygen. This causes removal of iron in the soil and produces pale light grey (low chroma) colours instead of the usual yellowish and brownish (high chroma) colours. These changes are most obvious in the subsoil (Fig. 10). As topsoils are often dark due to humus, these changes are not observable. Instead topsoils may have what are termed mottles. Mottles form where the air can enter the soil. This is usually along pores or cracks. Oxygen in the air causes iron to oxidise to yellowish, reddish and brownish colours. These often take the form of lines along root channels (such as in the topsoil) or blotches in the paler subsoil. These differences in colour are known as mottles (Figs 11 & 12). Appendix 1 explains these colour changes and the common terms that refer to the process.

There can be an accumulation of organic material as soils become progressively wetter. Topsoils become humic and as wetness increases, peat can form. These soils are

characteristically black and are formed from predominantly decomposed or partly decomposed plant material (Fig. 13).

While subsoil colour is one of the main indicators of hydric soils, not all soils with pale low chroma subsoils are hydric. Young soils formed from pale low chroma parent materials such as pumice and alluvium from mudstone, or highly leached soils where iron minerals have been removed may have low chroma colours not associated with saturated anaerobic conditions. These 'uncertain' soils are dealt with in Section 6.



Figure 10. The dramatic difference in subsoil colour between a poorly drained soil (A) and a well-drained soil (B).

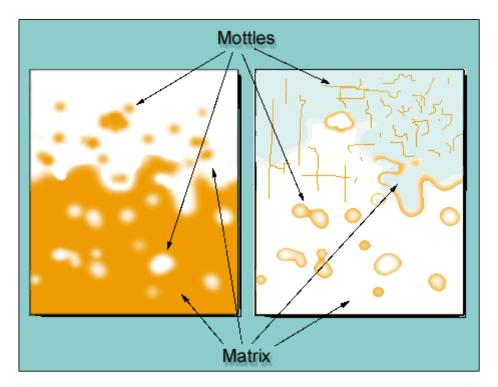


Figure 11. Mottles in a soil can be lines or blotches.



Figure 12. Reddish mottles and the pale matrix in a sample of subsoil.



Figure 13. The dark colours of organic soil. The organic material has stained the lower subsoil dark brown.

3 Definitions of hydric soil features

The New Zealand Soil Classification uses several terms to describe soil features that form in wet low oxygen conditions. These terms refer either to the layers or horizons within the soil or to the depth or profile of the soil (Fig. 14).

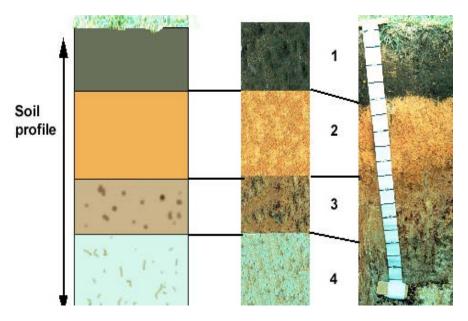


Figure 14. Example of a soil profile showing how it is composed of soil horizons.

To describe soil colour soil scientists use a soil colour book (e.g. Munsell Soil Color Book 2009) that contains pages with a range in colour chips, rather like a paint chart. These are used to distinguish colour characteristic features of hydric soils. Describing a colour requires three components: hue, value, and chroma. Hue refers to the colour (e.g. red, orange, yellow), value describes how light or dark the colour is, and chroma rates how bright or vibrant the colour is. An individual colour can be identified using a colour chart and assigned a code (e.g. 10YR 8/1, Fig. 15) that uses these three colour attributes. Colour is always assessed using moist soil.

The nature of the water table is indicated by the association of low and high chroma colours. If subject to reduction by perched water, the low chroma colours are likely to be at ped or pore surfaces and the high chroma colours are likely to be within the soil matrix. If the soil is subject to reduction by groundwater, the low chroma colours are likely to be within the soil matrix and the high chroma colours are likely to be at ped or pore surfaces. This relates to the duration of anaerobic conditions: perched water tends towards intermittent anaerobic conditions causing reduction of iron minerals on surfaces, but not within the matrix, while groundwater tends towards more prolonged anaerobic conditions with the matrix iron reduced while intermittent drying allows oxygen to penetrate down pores and oxidise just the ped faces.

3.1 Reductimorphic Horizon

A reductimorphic horizon is a horizon strongly affected by reducing conditions as indicated by greyish colours consistent with long saturation by water (Fig. 16). The prolonged wetness may be caused by a water-table perched on a slowly permeable layer (for example figure 31) within the soil profile or by a high groundwater-table.

A reductimorphic horizon has a slightly peaty texture class, or has low chroma colours (moist chroma 2 or less, or moist chroma 3 with value 6 or more – Fig. 15) that occupy 50% or more of the matrix exposed in a cut face of the horizon or are dominant on ped faces. A reductimorphic horizon includes any subjacent layers or interlayers of peaty soil material.

3.2 Gley Profile Form

A gley profile form is defined by the presence of a reductimorphic horizon with an upper boundary within either 15 cm of the base of the A horizon (topsoil horizon) or 30 cm of the mineral soil surface.

Soils with a gley profile form have usually been recognised as poorly or very poorly drained soils.

3.3 Redox-mottled horizon

A redox-mottled horizon is a horizon affected in parts by reducing conditions, indicated by the presence of redox-segregations. These usually indicate intermittent saturation of the soil by water.

A redox-mottled horizon has 2% or more redox segregations. If low chroma colours (moist chroma 2 or less, or moist chroma 3 with value 6 or more) occur, they must occupy less than 50% of the matrix exposed in a cut face of the horizon and are not dominant on ped faces.

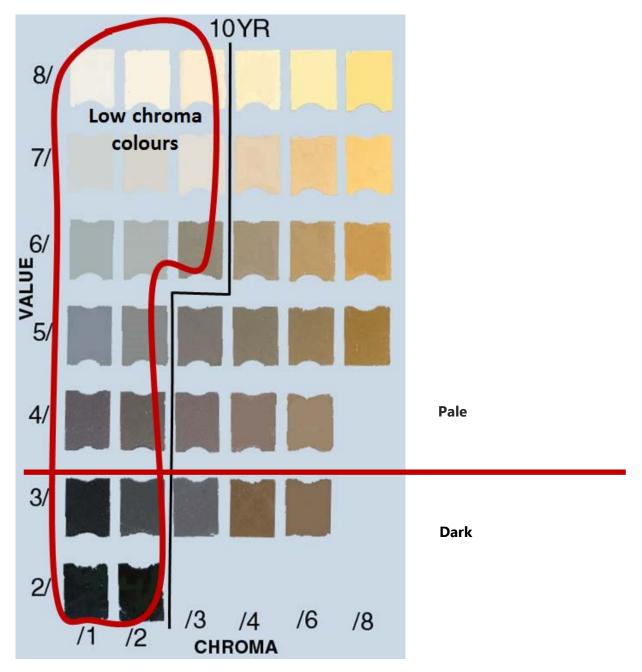


Figure 15. Example of the 10YR hue page from a soil colour chart showing the low chroma colours typical of hydric soils. Note that dark topsoil colour values of 3 or less are not good indicators of hydric soils as many topsoils have colours in this range.

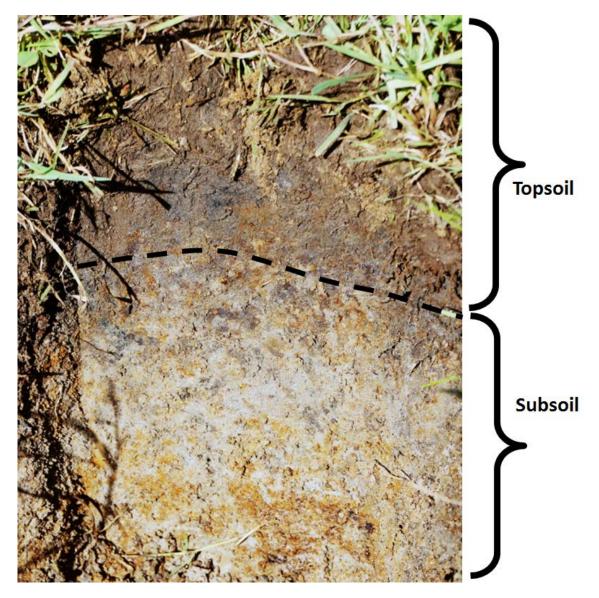


Figure 16. Mottled topsoil and subsoil typical of reductimorphic soil conditions.

3.4 Redox segregations

Redox segregations are mottles or concretions formed as a result of the reduction and solubilisation of iron and/or manganese, their translocation, concentration, and their oxidation and precipitation in the form of oxides (Clayden & Hewitt 1989). They may occur as low or high chroma colours, or both.

3.5 Organic soil material

Organic soil material is soil material dominated by organic matter, excluding fresh litter (L horizons) and living plant material. Organic soil material has 18% or more organic carbon (approximately 30% organic matter) but is defined here using morphology and simple analyses for easier recognition. (For most New Zealand soils, organic carbon may be estimated by total carbon.)

Organic soil material has EITHER

- 1 All the following:
 - a Colour value moist of 3 or less (after exposure to air) and colour value dry of 4 or less, and
 - b Deformable failure, and
 - c Weight loss of 65% or more by oven-drying a field-saturated sample;

OR

2 More than 20% (by volume) unrubbed fibre content

OR

More than 35% (by weight) loss on ignition except in materials dominated by allophanic soil material or by limestone.

OR

4 18% or more total carbon.

Organic soil materials that have accumulated under wet conditions are subdivided into three classes, based on evidence of decomposition (Clayden & Hewitt i989). These classes are used to distinguish soil groups of Organic Soils.

Fibric soil material (Of horizon) consists mainly of well-preserved plant remains that are readily identifiable in terms of botanical origin. The fibre content after rubbing is at least 75% by volume.

Fibres are pieces of plant tissue large enough to be retained on a 100-mesh (0.15 mm) sieve, except for wood fragments that cannot be crushed or shredded in the hand and are larger than 2 cm in the smallest dimension.

Rubbed fibre is the fibre that remains after rubbing a wet sample 10 times between the thumb and forefinger, or kneading a ball in the palm 10 times using firm pressure.

Mesic soil material (Om horizon) consists mainly of partially decomposed plant remains (semi-fibrous peat or hemic soil material) and does not meet the requirements of either fibric soil material or humified soil material.

Humified soil material (Oh horizon) consists of strongly decomposed organic material (humified peat or sapric soil material) with few or no identifiable plant remains other than resistant woody fragments >20 mm that cannot be reduced to fibres by crushing and shredding between the fingers. The fibre content is less than 15% after rubbing.

3.6 Perch-gley features

Perch-gley features are the morphologic indicators of saturation and reducing conditions caused by a water-table perched on a slowly permeable layer within the soil profile.

A horizon with perch-gley features EITHER

has redox-segregations that occur mainly within peds, or in the case of an apedal soil, mainly within the soil matrix. Macro-void surfaces, either partings or pores, are dominated by greyish colours (moist chroma 2 or less, or moist chroma 3 and value 6 or more). Iron and manganese precipitates occur either adjacent to the greyish void surfaces as a selvedge (edge) or as discrete mottles within the soil mass

OR

• overlies a horizon that is less gleyed (e.g. less redox-segregations) with a matrix that is not dominated by greyish colours.

4 Examples of hydric soil

Wetness can strongly affect the growth and types of plants by limiting the availability of oxygen to roots. The duration and depth to wetness is indicated by accumulation of organic matter and soil colours. Peat indicates permanent wetness, dominant grey colour indicates prolonged wetness, and rust-coloured mottles in normal brown or yellow matrix indicates intermittent wetness. Large areas of Gley and Organic Soils are now drained for farming but the wetness indicators persist as evidence of the former extent of wetlands prior to European settlement. Examples of Gley Soils and Organic Soils are shown in Figures 17 and 18.

4.1 Gley soils

Gley soils are strongly affected by waterlogging and have been bio-chemically reduced.

They have light grey subsoils, usually with reddish brown or brown mottles (Fig. 17). The grey colours usually extend to more than 90 cm depth. Waterlogging occurs in winter and spring, and some soils remain wet all year. The soils occur throughout New Zealand in low parts of the landscape where there are high water tables, or in hill slopes where there are seepages.



Figure 17. Low chroma colours and redox mottles typical of a gley profile form.

Large areas of Gley Soils have been artificially drained to form agricultural land. Drained soils are still regarded as Gley Soils if they have the required colour indicators. They cover 3% of New Zealand.

The rooting depth of Gley Soils may be limited for many plants by oxygen deprivation below the water table. This can be exacerbated by higher bulk density. Trafficability is limited when soils are wet. Drainage is necessary for most agricultural development and when drained the soils can be very productive. Organic matter content is usually high in topsoils.

4.2 Organic soils

Organic Soils are peat soils that are located in wetlands and wet throughout the year. They have formed in the decomposed remains of wetland plants (peat) or forest litter.

Peat or litter has accumulated because decomposition rates of fresh organic matter have been less then accumulation rates in wet anaerobic conditions. Organic Soils have at least 30 cm depth or more of peat compromising the partly decomposed remains of wetland plants (peat), or at least 40 cm depth of forest litter (Fig. 18). Some mineral material may be present but the soil is dominated by organic matter.

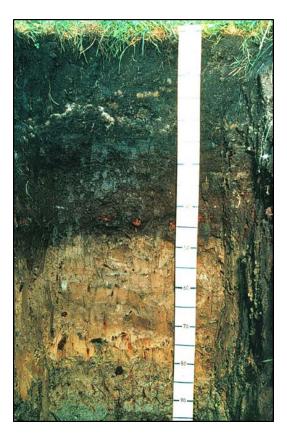


Figure 18. Peat soils have at least 30 cm of material within the top 60 cm that contain 18% of more C.

Organic Soils can be highly productive soils when drained and fertilised. However, their use is not likely to be sustainable in the long term because drainage dries out the organic matter. Decomposition rates increase markedly and the soils begin to shrink.

Organic Soils serve as sponges in the landscape, and can hold up to 20 times their weight in water. Organic Soils occur in most parts of New Zealand, or under forests that produce acid litter in areas with high precipitation. They cover 1% of New Zealand.

The soils have very low bulk densities, low bearing strength, high shrinkage potential when dried, very low thermal conductivity, and high total available-water capacity. The soils also have high cation exchange capacities, and in New Zealand are commonly strongly acid. Nutrient deficiencies are common. High carbon/nitrogen ratios indicate slow decomposition rates. Many soil organisms have restricted activity because of anaerobic conditions.

4.3 Other Soils

Hydric soils occur in other soil orders of the New Zealand Soil Classification. They are mainly the result of a slowly permeable or impermeable lower subsoil layer impeding downward drainage of water. This causes the water to perch on the slow permeability layer and saturate the upper soil. These Perch-gley soils occur in most soil orders.

5 Field Identification Procedure and key

Identifying hydric soils in the field requires a spade and/or soil auger, soil colour charts (e.g. Munsell Soil Color Book 2009), the New Zealand Soil Description handbook (Milne et al. 1995), copies of the wetland soil data form (Appendix 2), and a laminated copy of the field identification guide sheet (Appendix 3). Worked examples from field testing the hydric soil tool are provided in Appendix 4, along with a summary of the field trial sites.

Existing soil maps/information may be useful particularly to identify soils that may be difficult to assess. Soils may be difficult to assess if low chroma colours are not due to reductimorphic features and are the result of pale parent materials or highly leached horizons – refer to Section 6.

The steps are:

Landscape assessment

- Assess the topography. Are you in an area likely to be receiving drainage water from up slope, or on a flat low lying area by a lake, river or the sea? If you are, the soil is likely to be wet at some time of the year.
- Are there changes in vegetation that indicate a difference in conditions from the immediate higher areas? If so, this may indicate a different soil type.
- 3 Is it an area with drains and is the surface rough and pugged? If so, the soil is likely to be wet at some time of the year.

Soil assessment

- 4 Remove any plant litter to expose the soil surface
- 5 Dig a hole to at least 50 cm depth.
- While digging observe any changes in colour or layering in the soil. Keep the removed material as intact as possible and do not mix layers or samples.
- 7 Is water running into the hole? If so, this can indicate hydric soil.
- 8 Inspect the topsoil carefully for reddish mottles along root channels. These can indicate a hydric soil.
- 9 Smell the soil. Does it smell of rotten eggs? If so, this can indicate hydric soil.
- 10 Does the topsoil have black manganese concretions? If present, the soil is likely to be wet at some time of the year.
- 11 Inspect the subsoil. Is it peaty or mineral soil? If peaty and wet, then it's a hydric soil.
- 12 If the soil is mineral, is the matrix low chroma and mottled? If these are present within the top 30 cm and the soil is wet, it's a hydric soil.
- 13 Dig or auger deeper to see if there are any pans or firmer subsoil layers causing perching, or if there is a reductimorphic layer between 30 and 40 cm. These features, if present, are clues to help determine if it is a hydric soil.

Figure 19 below is a simple guide for inspecting the top 30–50 cm of the soil to determine if it has hydric features. Further confirmation of wetness and its duration may be needed before determining whether or not it is a hydric soil. Note that the definition of low chroma colours is divided into 'pale' or 'dark' low chroma colours (Fig. 15).

Simple key to identify hydric soil features

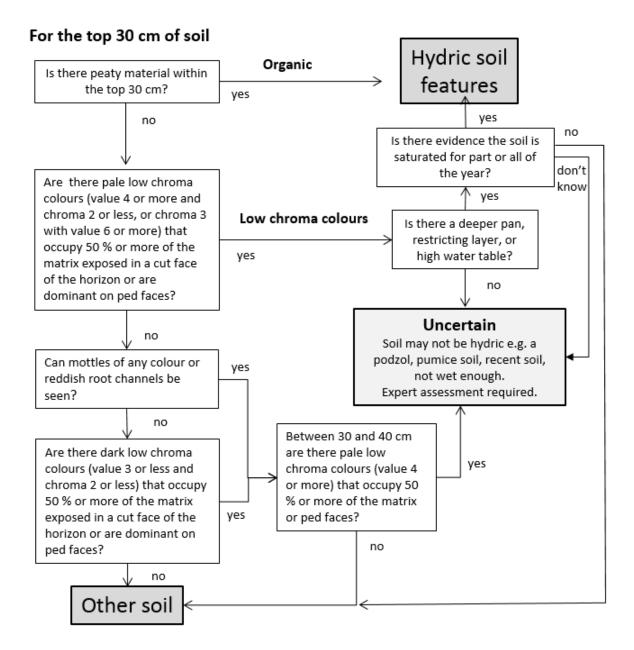


Figure 19. Simple key to identifying hydric soil features.

6 Uncertain Soils

Most hydric soils will be identified by having signs of wetness within their soil profile. These signs include mottles, wet and plastic soil material, and water flowing into the soil pit and pugged ground. However, there are some soils that are not hydric but have colours that could place them in the hydric category. They may not have mottles or other signs of wetness, but they do have low chroma colours and it can be difficult to determine if they are hydric or not.

A pale parent material is one of the main reasons for low chroma colours in non-hydric soils. Another is podzolised soils where bleaching of the soil by acid leaching removes iron, and in some cases, only white silt/sand remains.

6.1 Pale Parent Material

Examples of pale parent material include rocks such as siltstone, sandstone, mudstone, or recent sand and pumice. Younger soils formed from these materials, either in place or redeposited as alluvium, are naturally pale (Fig. 20, a and b). There hasn't been sufficient time for soil forming processes to weather the rock and form high chroma subsoils indicative of better drainage.

These Recent Soils can be found on eroded slopes where the underlying material is exposed, on downslope areas where erosion debris is deposited, or where the material has deposited on alluvial flats. Recent Soils show only incipient marks of soil forming processes. Landscape position can help in determining if these soils are likely to be wet or not.





Figure 20. A. Pale mudstone material. B. Recent Soil developed in pale alluvium.

Pumice is another example of a pale soil parent material that is young and so still retains the light colour of the pumice (Fig. 21). The lumps of pumice when cut through are technically mottles of a lighter colour but they are not formed by reductimorphic soil conditions.



Figure 21. Pumice Soil.

6.2 Podzols and Ultic Soils

Podzols develop under acid vegetation and form quickly in easily leached material such as sand, or over a long time in material such as clay. High rainfall and well drained conditions accelerate the process. Kauri and rimu vegetation types are often associated with Podzols. The humic acids from the forest litter strip clay and iron from the soil and redeposit it lower down in the subsoil. Typical Podzols have a bleached sandy or silty layer (E horizon) over a layer of black often cemented humus stained material (Bh horizon), and/or a reddish Bs horizon (Fig. 22). Some Ultic soils (Densipan Ultic, Albic Ultic) also have bleached E horizons similar to Podzols, but lack the darker coloured podzolic horizons (Bh, Bs) of Podzols (Fig. 23).

The challenge in Podzols and Ultic Soils is to determine if the bleached layer is wet or not. No iron remains for the reductimorphic process to form mottles. There can be a dense layer with depth, but this is no guarantee of wet conditions. In many cases water table measurements will be needed.

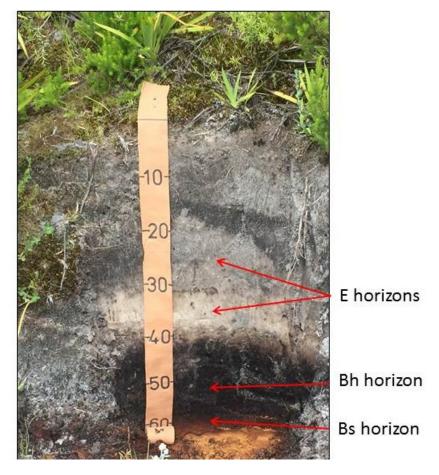


Figure 22. Podzol showing pale E horizons over black Bh horizon over reddish Bs horizon.



Figure 23. Ultic Soil showing pale A and E horizons over high chroma subsoil.

7 New Zealand hydric soils

The New Zealand Soil Classification groups soil based on common sets of soil characteristics. In the Classification, Gley and Organic Soils are those soil orders that have features that match those of hydric soils. Other soil orders also contain hydric soils but those in the Gley and Organic orders are the most abundant.

Appendix 5 lists the common New Zealand hydric soils based on the NZ Soil Classification and its classification codes. It is a simplified guide to the groups and subgroups within the Gley, Organic and other soil orders that have hydric soils.

8 Limitations

This guide covers the most common forms of hydric soils but saturation does not always result in characteristic peaty or reductimorphic features. Iron accumulation, organic staining and relic soil drainage features can all confuse the inexperienced observer. There are also situations where well-drained soils can look like hydric soils because of pale parent material with weathered reddish gravel fragments.

The greatest source of error could occur where the soils are artificially drained. The colour features of hydric soils can remain but the soil is no longer poorly drained. This can occur in both mineral and organic soils.

Soil colour is just one clue for identifying hydric soils. Not all soils that have pale low chroma colours are hydric. Not all hydric soils (soils formed under wetland conditions) will still be wetland soils, particularly if land has been artificially drained. Wetness needs to be confirmed This can be confirmed by revisiting the site in winter, talking to the land user or measuring the water table.

The drainage class can also change naturally. Some peat soils around the margins of peat bogs in the Waikato have drained naturally as gully systems propagated in sandy alluvium prior to human development, while more recently some land has become poorly drained due to land subsidence after the Canterbury earthquakes.

It is advisable to have some training by a soil expert experienced in mapping soils. In this way identification can be tailored to the location of interest and to local peculiarities in the soils expression of saturated conditions.

9 Conclusions

The effects of prolonged or intermittent saturation at or near the surface alter the soils colours and can form peat or organic rich material. This group of wet soils are collectively known as hydric soils.

Hydric soils can be identified in the field by features such as being in low, poorly drained or very poorly drained landscape positions, changes in vegetation, soft ground, and characteristic colour features of the soil.

The notes in this guide, along with training and practice, should enable non-experts to be able to identify common hydric soils.

10 Acknowledgements

We thank Rob Smith, Trevor James (both Tasman District Council), Lisa Forester (Northland Regional Council), Lois Easton (Gisborne District Council) and Alan Johnstone (Marlborough District Council) for their support in developing the Tools proposal. We also thank the landowners for permission to test the field sampling protocols on private land, and council staff and others for field assistance. Anne Austin edited the report, and Charlie Newling, US Wetlands Training Institute, provided support and advice on adapting the hydric soil tool to New Zealand conditions. Funding was provided by an Envirolink Tools Grant (led by Tasman District Council) and an earlier Envirolink Medium Advice Grant (led by Gisborne District Council) under contract numbers C09X1702 and C09X1328 respectively.

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12 Glossary

Argillic horizon. A soil layer enriched in clay.

Bh horizon. Dark coloured horizon enriched in organic matter as a result of it leaching from above and depositing as a layer.

Bs horizon. Ochreous horizon enriched in iron and/or aluminium as a result of it leaching from above and depositing as a layer.

Blocky structure. A soil ped that is approximately square in shape.

Calcareous horizon. A soil horizon containing calcium carbonate that can have been formed in the soil or from the material making up the soil.

Colour. Colour is described using a Munsell Soil Colour Book. This book contains pages of colours rather like a paint chart. The soil is matched to the colour, and the colour name and colour code are recorded, e.g. 10YR 8/8 and the colour name is 'Yellow'.

Consistence. A general term for the field-assessed behaviour of soil materials.

Cutanoxidic. Sticky very plastic clayey material with fine soil structure.

Duripan. A layer cemented by silica (duric horizon).

E horizon. A layer leached of organic matter, iron or clay.

Fragipan. A dense compact non-cemented layer with few cracks and few roots.

Humus-pan. A firm layer coloured dark by organic matter.

Indurated. Soil particles held tightly together by cementation or close packing.

Massive: Material having no partings at spacing of less than 200 mm such as some clayey or silty material.

Nodular. An irregular shaped concentration of iron or carbonate.

Ortstein-pan. A firm or strong reddish cemented layer with a sharp upper boundary.

Pedal. Aggregates formed in the soil that are separated from other similar aggregates by an obvious pattern of cracks or partings; or have distinct surfaces over at least one-half of

the aggregate; or have coatings over at least one-half of its surface. They may be an aggregation of smaller peds (aggregates).

Perched. Water that sits on top of an impermeable or slowly permeable soil layer.

Placic horizon. A thin iron pan.

Prismatic soil structure. A soil ped that is taller than it is wide and has a flattish top and bottom.

Redox segregations. Mottles or concretions formed by the reduction of iron and manganese and their precipitation to form oxides. This produces a pattern of high and low chroma colours.

Appendix 1 – Mottle formation and terms

In the presence of oxygen, iron forms iron oxides (Fe ³⁺⁾. These oxides produce the yellowish and reddish soil colour common in many subsoils. In wet conditions air in the soil is replaced by water. Oxygen moves slowly in water and can be depleted by microorganisms and chemical reactions. Under these low oxygen conditions iron is reduced (Fe ²⁺) and is virtually colourless and more soluble. This causes soil colour to be pale. The reduced iron can move in the soil and is either lost in drainage or oxidises in places where air is trapped or enters the soil.

Areas of oxidation and reduction produce a mottled colour pattern of blotches of pale and yellowish and reddish colour (Fig. 24). The more reduced the soil, the greater the predominance of pale low chroma colours. As reducing conditions increase, pale colours become dominant. When this occurs, the term gleyed is often used to describe the soil. In some literature the term 'depleted' is also used to refer to dominantly a pale reduced horizons.

Mottles: Mottling is the name given to spotted or streaked areas of colour (mottles) in soil. Mottling is usually associated with periodic wetting.



Dark topsoil from accumulated organic matter

Upper subsoil - high degree of fluctuation in water table, lots of mottling

Lower subsoil - less fluctuation in water table, wetter for longer, less mottling.

Figure 24. A mottled profile form showing a redox mottled horizon between 20 and 50 cm depth.

Appendix 2: Wetland determination data Form – Soil

Owner/address: Land management: Date: MZTM ((F): Landform: Local relief: Slope (*): Altitude (m): Investigator: Altitude (m): Phydrologic conditions on the site typical for this time of year? Yes No_ If needed, explain in Remarks Is the soil disturbed or problematic? Are cinamal circumstances' present Yes No_ If needed, explain in Remarks Is the soil disturbed or problematic? Are 'normal circumstances' present Yes No_ If needed, explain in Remarks Is the soil disturbed or problematic? Mottles Matrix Mottles Matrix Mottles Matrix (cm) Colour (moist) Oolour (moist) Not Size Location Material* Comments Tuse % area charts; *Use size classes; *Ped face, pore, within ped, along roots, within matrix; *Organic (peaty), humic, miner Hydric soil indicators: Organic layers Concretions Gley OR Managemese concretions Mottled Mott	
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Appendix 3: New Zealand Hydric Soils – Field Identification Guide Sheet

Descriptors follow Milne et al. (1995) and Hewitt (2010)

Land Management: Beef cattle, dairy cattle, sheep, forestry, protected area, natural, urban, etc.

Landform *at whole-site scale*: Hill country (steep, gently rolling, etc.), gully, floodplain, valley, terrace, oxbow, old river channel, sand dune, moraine, swamp, bog, fen, etc.

Local Relief at sampling point/plot scale. flat, depression, bank, gentle/steep slope/toe slope, etc.

Soil Drainage: W well drained; MW Moderately well drained; I Imperfectly drained; P Poorly drained; VP Very poorly drained

Land Cover vegetation: forest, manuka shrubland, exotic grassland, herbaceous freshwater veg, etc.

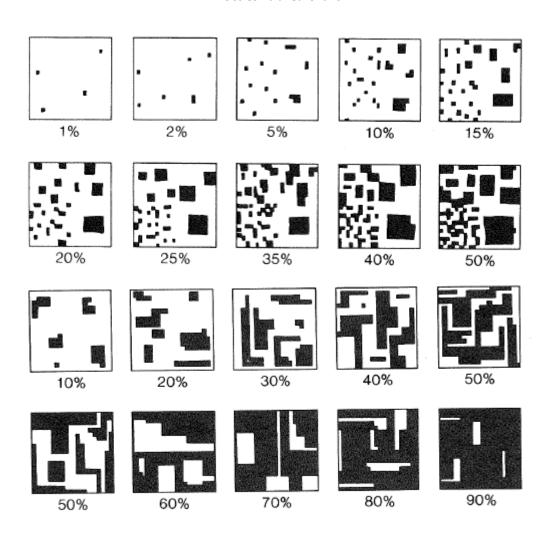
Hydrologic Features *near sampling point:* drain, local ponding, seep, pools, etc.

Is the Site Drained? Looks for drains, diversions, stop banks, etc., which would lower water table

Normal Circumstances: Undisturbed conditions: typical soils and hydrology at the site

Size Classes for mottles:<1 mm, 1–2 mm, 2–6 mm, 6–10 mm, 10–20 mm, 20–60 mm, 60–100 mm, 100–200 mm

Mottles % area chart

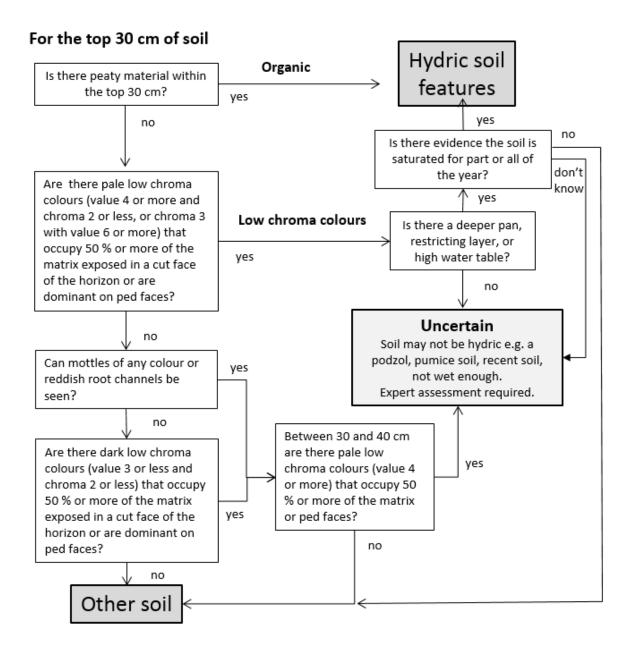


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Simple key to identify hydric soil features



Appendix 4: Field trials

The hydric soil tool, based on the US hydric soil determination protocols (Environment Laboratory 1987; Wetland Training Institute 2017), was developed and trialled in a range of putative wetland and non-wetland situations around New Zealand. The trial sites were selected on the basis of representativeness according to wetland type, land use, landform, slope, vegetation cover and soil wetness.

A description of ten trial sites, together with the field soil data forms are presented below.

1 Fraser Gully (S1, S2)

This is a small sinuous gully system located on a lifestyle farm block under extensive dry stock management. The gully floor is very wet (not sampled), fenced off from stock and overall dominated by exotic grey willow (*Salix cinerea*) which is gradually being removed. The edge of the gully floor outside the fence has a mix of *Carex* sedges, and exotic herbs and grasses, which are occasionally grazed by sheep. This area is wet in winter and dries out occasionally in summer (sampling point S1). A steep bank in pasture grasses rises from the gully floor to a height of about 5 m (sampling point S2). Sampling point S1 was a hydric soil and very close to the wetland margin. The wetland margin coincided with a change in slope/topography from the flat gully floor (wetland) to a relatively steep grassy bank (non-wetland). Sampling point S2 on the grassy bank was not a hydric soil. We also investigated (using an auger) the soils located towards the middle of the gully and these were all Gley, i.e. hydric, soils.

2 Stone Farm (S3-S5)

Stone Farm comprises an intensive dairy farm on mainly flat terraces and floodplains associated with the Waikato River. We tested the soils at two sites with a total of three sampling points. The first site was a grassed paddock. Sampling point S3 was on flat terrain, just inside the putative edge of a wetland as indicated by ponding and wetland vegetation, and S4 was on a very gentle rise a few metres upslope of S3. The prolonged ponding in the lower part of the paddock is unusual and probably a result of the recent very wet growing season (S. Fraser, pers. comm.). We determined S3 to be a hydric soil but not S4. All soils augered within the adjacent ponded area were Gley, i.e. hydric soils. A distinctive iron pan was present about 50 m south of the site adjacent to Te Kowhai Rd (Fig. 25).

The second site was an old former river channel floor bounded by low banks and with drains on both edges of the channel. The topography was flat with local ponding and dominated overall by freshwater herbaceous plants and pasture grasses. Sampling point S5 was determined to be a hydric soil: comprising a gley soil in the upper layers (0–18 cm), overlying an older peaty/organic layer (18–70 cm).



Figure 25. Excavation for a buried power cable reveals the transition from a redox mottled Brown Soil (foreground) to a Gley Soil. Note the summertime water table in the distance and the grey colours mid-photo indicating the extent of the winter time water table. An iron pan was present in the transition zone between Brown and Gley Soils.

3 Mitchel Farm (S6)

This is an intensive dairy farm on flat to gently undulating terraces and floodplains of the Waipa and ancestral Waikato Rivers. The soil sampling site was in a paddock of exotic pasture grasses, located on a slight rise above a lower ponded area dominated by freshwater herbs. Sampling point S6 had a moderately well-drained, non-hydric mineral soil. However, investigations using an auger revealed peaty hydric soils in the flatter ponded area nearby.

4 Waikoha Station (S7–S12)

Waihoka Station is a large extensive dry stock farm on steep hillcountry of the Kapamahunga Ranges forming the divide between the western Hamilton basin and Raglan Harbour. The Kapamahunga Ranges comprise Triassic/Jurassic greywacke overlain by Tertiary mudstone, sandstone and limestone. Small sinuous wetlands are common in this faulted landscape where seepages and drainage patterns are influenced by differing permeability of the various lithologies and mass movement. Two sites were sampled, each with three sampling points. The first site (Fig. 26) was in and around a gently-sloping seep in a gully floor. This comprised relatively flat wet terrain, demarcated by clumps of *Juncus*

rushes, and bounded by high producing pasture grasses on gentle slopes of $5-10^{\circ}$. We sampled downslope along a transect from the pasture on gentle hillslope (S7 – non-hydric soil) to the edge of the exotic grassland (S8 – non-hydric soil), into the rush-dominated wet terrain (S9 – hydric soil). Investigations using an auger revealed the hydric/non-hydric soil boundary coincided with prevalence of rushes in the vegetation, i.e. about 1 m downslope of sampling point S8.



Figure 26. Changes in vegetation correspond to changes from mottled to gley profile form.

The second site (Figs 27 and 28) was a seep 20–30 m wide originating from beneath a limestone outcrop, and flowing into a relatively broad, wet valley floor. We sampled along a short transect from the adjoining hillslope, through the seep margin, to the middle of the seep (Fig. 27). The vegetation of the hillslope was pasture grasses, and the seep was dominated by a variety of freshwater herbs and grasses. Sampling point S10 soil was determined to be non-hydric, site S11 on the seep margin was hydric, and S12 was also hydric. The S11 soil was interesting as although the top 30 cm was hydric, the 30–50 cm horizon revealed a mottled profile form with high chroma colours at depth (Brown Soil). This indicates the wetland had recently 'grown out' over the adjoining hillslopes slopes, probably a result of cattle pugging and trampling.



Figure 27. Evidence of a recently expanding wetland seen in the relict mottled profile (at the position of the spade) underlying a recently formed perched gley horizon.



Figure 28. Steepland seepages associated with more permeable limestone overlying less permeable mudstone.

5 Whitehills (W1)

Whitehills is located about 15 km northwest of Kerikeri just off SH10 on a roadside cutting bordered by manuka scrub, typical of gumland in Northland. The soils have developed in siliceous mudstone of the Whangai Formation of late Cretaceous/Paleocene age. These soils are highly weathered and leached Podzols, which have a very firm pan that restricts rooting depth and most likely water infiltration. The profile consists of a shallow greyish brown topsoil over a white E horizon on a very firm pan. As most minerals have leached out of the soil there is no evidence of mottling and while the pale colours are clearly a result of intense leaching, without understanding the hydrology it was not possible to confirm that these soils are hydric. The soil was keyed out to be an Orstein Pan Podzol (Fig. 29).



Figure 29. Orstein Pan Podzol.

6 Kerikeri Airport (KA2)

An extensive protected gumland reserve administered by DOC and located adjacent to Kerikeri Airport was investigated. Most of the reserve was relatively dry and dominated by tall manuka, however the site described here was wetter with shorter peatland plants. The underlying geology is mapped as basalt of the Kerikeri Volcanic Group and the site may be part of a depression within a low angle lava flow causing water to pond giving rise to the peatland vegetation. While the soil was described as an Acid Fibric Organic soil, the top 30 cm of the profile did have mineral soil material present also (Fig. 30). This was

possibly due to runoff from adjacent land carrying alluvium into the peatland. This site had a water table close to the soil surface and was clearly a hydric soil (Acid Fibric Organic).



Figure 30. Fibric (fibrous) peat with some mineral material intermixed.

7 Matawhero Loop (M1)

This is a loop of the Waipaoa River, cut off 60-70 years ago as part of the Waipaoa River flood control scheme near Gisborne. Matawhero Loop is a Wildlife Management Reserve owned by Nga Uri o te Kooti. The oxbow area is undergoing restoration with abundant plantings of native species such as kahikatea, cabbage tree and harakeke growing above exotic herbs, rushes and grasses. The oxbow has high water tables with several ponds present, and soils are Typic Recent Gley, i.e. hydric.

8 Jamestown (Jt1)

This site, dominated by tall kānuka and mānuka scrub, was about 3 km west of Collingwood in Golden Bay in the lower Aorere River valley. The soils have formed on Middle Pleistocene aggradation terraces. This land surface predates the last interglacial which has allowed significant time for podzolisation to occur. The profile colours are low chroma; however, evidence of pale uncoated sand grains in topsoil and subsoil are consistent with illuviation and an E horizon, while brighter 7.5YR colours at depth are consistent with a podzolic B horizon. This soil was classified as a Humic Orthic Podzol and no evidence of hydric soil indicators were found.

9 Dobbie (Dob1)

This was a lifestyle block mostly in natural vegetation of manuka and sedges at Puponga near Farewell Spit. The site was on a low hill overlooking Golden Bay. The geology is a complex of Late Cretaceous to Pleistocene sediments including sandstone, siltstone, conglomerate and coal (there were remains of a railway embankment on the property that leads to a disused coal mine further up the valley). The base of the hills is surrounded by

Holocene sediments. The geology on the hills is deeply weathered and soils are predominantly highly leached Podzols. Coarse blocky sub-soil high in clay restricts permeability leading to perch-gley conditions. Due to this slow permeability, hydric features can be observed on hill slopes that would otherwise be expected to be well drained. The highly leached upper profile (A/E horizon) masks the hydric features, although redox mottles are still evident in root channels.



Figure 31. Road cutting near site Dob1 showing perch-gley features due to coarse blocky structured sub-soil. Note iron concretions at base of Bs horizon.

10 Lake Sedgemere, Molesworth Station (S62, S63, S65)

Molesworth Station, administered by DOC, is New Zealand's largest farm (180,000 ha) and is managed by Landcorp Farming Ltd. Lake Sedgemere is on the north-west boundary of the farm adjacent to the Wairau River. There are a series of small lakes and extensive wetlands, both permanent and ephemeral, in this area. The surrounding mountains have been eroded through glaciation and wide valleys in this area consist of glacial gravel deposits. Movement of the Awatere fault during the Quaternary has disrupted local drainage leading to the formation of wetlands and lakes. The Sedgemere area experiences cold winters with high snowfall on surrounding hills, which feed into the wetlands when snow melts in spring. Many of the wetlands around Sedgemere are fed only from snow melt and as this area can have extended dry summers, many wetlands are only wet for short periods each year.



Figure 32. Ephemeral wetland near Lake Sedgemere, Molesworth Station, showing transect from well-drained Brown soils (crowbar, far left), through Mottled Brown on the wetland margin (auger), to poorly drained Gley soil (green spade middle right). This wetland is fed from a small ephemeral stream that originates from gravels at the base of Mt Tarndale.

Owner/addr Landform: _ Soil drainage Investigator	ser Gully ress: S Frascr, Gully floor e (circle) W M' : SF, PS	W I P VP	Local Land Hydro	management: relief: Flat cover: Herbace ologic features	ous feshwater Minor poe	vegetation	Sampling Point/ID: S Date: 29/5 17 Slope (°): O NZTM (E): 1790253 NZTM (N): 58/8936 Altitude (m): 29 the site drained? Yes No V		
							If needed, explain in Remarks		
Profile desc	ription: (Describe	to the depth nee	ded to	document the	indicator or c	onfirm absen	ce of indicators, 30 cm default)		
Depth (cm)	Matrix Colour (moist)	Colour (moist)	M %¹	ottles Size ²	Location ³	Material ⁴	Comments		
0-15	10 YR 4/2	54R 4/4	10	2-6 mm		Mineral	Seopage, gully margin		
15-30	104R 3/2				4 (5.52	Mineral	, J		
50-60	5 BG 4/1					Mineral	Sandy, no structure		
							AND THE RESIDENCE OF THE PROPERTY OF THE PROPE		
							Typic Reant Glay GRT		
	***************************************	classes; ³ Ped face,	pore,	within ped, alo	ong roots, with	nin matrix; 40	rganic (peaty), humic, mineral soil		
Hydric soil indicators: Organic layers									
Valley Gully		Perched w Seepage	vater ta		onstone-pan Jensipan	-	Depth to restrictive layer (cm)		
Slope		Lithic conf	tact	[F C	ouripan ragipan Orstein-pan Depth to pan (c		urface features Pugged Ponding		
Sketch of sit	te/soil:					,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	WARRIED TO THE TOTAL TOTAL TO THE TOTAL TO T		
52 grass Sm Sedges Sm Sedges 2m from slope									
Remarks: Photo numb	-	or margin,	a bon	+ 5m &	om sampl	e point	52 (on grass bank)		
153-1	manam#3 (* V	N.a.		linearte	in NITE	C Cubaroun I	if Imaum) CPT		

	ier Gully				o (Te Kow		Sampling Point/ID: 52				
Owner/addr	ess: S Fraser, Fo	allerton Rd	Land	management:	Extensive-d	ny stock	Date: 29/5/17 Slope (°): 10				
Landform:	Top of bank e (circle) (W) M	A/ 1 D \/D	Local	relief: Gent	ie slope ic grasslan		NZTM (E): 1790257				
	: <u>5F, Ps</u>		Hvdn	cover: <u>Exot</u> ologic features	s: None vi	šible.	NZTM (N): 5818947 Altitude (m): 34				
iii congacoi	*		11,40,1	ologie rediai e.	7	3100	Articoloc (1817)				
Are climatic/hydrologic conditions on the site typical for this time of year? Yes No Is the site drained? Yes No											
is the soil disturbed or problematic? Are 'normal circumstances' present Yes 🗸 No If needed, explain in Remarks											
n		<u> </u>	-116-		4	<i>r</i> ;	f: 1:				
Depth	ri ption : (Describe Matrix	to the depth nee		document the lottles	ngicator or c	onfirm absen Material ⁴	ce of indicators, 30 cm default) Comments				
оерил (cm)	Colour (moist)	Colour (moist)		Size ²	Location ³	iviateriai	Comments				
	104R 5/6	10 YR 5/8	1		Within ped	Mineral					
		10 1K 218	<u> </u>	1 ~ ~ ~ ~ ~ ~	ANTHURY DEST	Mineral					
14-30	7.54R 618					mineral					
			-								
			ļ	<u> </u>							
		AP ANNIA DE LA COLUMN DE LA COL									
		· · · · · · · · · · · · · · · · · · ·									
				a recommendation of the second]						
MULTINO	**************************************	classes; ³ Ped face	, pore,	within ped, al	ong roots, with	nin matrix; 40	rganic (peaty), humíc, mineral soil				
Hydric soil i		_									
Organic laye	•		ncretio				Profile form either:				
Organic Peaty to	soil material (gen	erai)		oncretions anese concret	ione	Gi€ _ V Mo	y OR ttled				
					.10113	<u>*</u> (VIC	actied .				
	Peaty subsoil Nodular Horizon										
Fibric Consistence Reductimorphic											
Mesic		***************************************	Plasti				fox mottled				
Humic			_ Sticky	r		Red	dox segregations				
			Fluid			Per	ch-gley features				
Cause of we	tness										
Location	·	<u>Water table</u>		<u>Pans</u>) <i>(</i>		ayers				
Depress	₹ON	Depth to			an (general) Iumus-pan		Slow/ restricted permeability				
Flat Valley		High grou Perched v			ronstone-pan		Argillic layer				
Gully		Seepage	שמנכו נפ		ensipan		Depth to restrictive layer (cm)				
Slope		Tidal)uripan	S	urface features				
					ragipan	<u>*</u>	Pugged				
		Lithic con	tact		Orstein-pan		Ponding				
Depth to pan (cm)											
Sketch of site/soil: S2											
gully S graywillow											
G grass											
5m Strank SI Sedges											
		- (No. of Street, or other Persons	"21"	y W						
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			2 m	from slope	2						
				. •			·				
Domasion	6.5 . 1.1			Ank I.	udes enil	(enul					
Remarks:	Mothed orth	ic brown s	اباراا∨ ⊶ک	nore K	yanc son	+ el Cin	aulu)				
	On grass be	ank, about	2W	From Se	impie poin	, SICIN	3~"37				
Photo numb	oers:										
Hydric soil p		s V No)	Uncerta	ain NZS	C Subgroup (if known) BOM				

Site: Stone Owner/addi Landform: _ Soil drainage Investigator	ress: <u>T. S</u> <i>Floodp</i> e (circle) N	<u>lain</u> W M\	Te Kowha N I P	VP	Land Local	management: relief: Flatar	(Te Kowna Intensive - d ea on edge fw veg/ex :: Ponding o	lairy of ponding	Sampling Point/ID: 53 Date: 29/5/17 Slope (°): 0 NZTM (E): 179 3238 NZTM (N): 5820577 Altitude (m): 40		
									he site drained? Yes / No If needed, explain in Remarks		
Profile desc	ription: (D	escribe	to the dep	th nee	ded to	document the	indicator or c	onfirm absen	ce of indicators, 30 cm default)		
Depth	Matr	ix			M	ottles		Material ⁴	Comments		
(cm)	Colour (n	noist)	Colour (m	ioist)	% ¹	Size ²	Location ³				
0-10	10 YR	3/2	7.5 YR	3/4	10	2-6 mm	Ped face	Mineral			
10-28	ioyr		5YR	4/6	5	< 1 mm	Roots	Mineral			
28-30	104R		5YR	46	10	1-2 mm	Roots	Mineral			
×-0 - 50	10 16	_V [4		118		, ~ later	10001-	(Circle 1	T-0 50		
			mranmananan				voor		Fron pan 50 m away		
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***************************************	***************************************						out of the state o		2m into pond has		
							avenovanie		definite hydric soil		
							****		Typic Orthic Gley GOT		
¹Use % area	charts; ² U	se size (classes; ³ Pe	d face	pore,	within ped, al	ong roots, witl	, hin matrix; ⁴ Oı	rganic (peaty), humic, mineral soil		
Hydric soil i						reasement records a committee of the com					
Organic layers Concretions Colours Profile form either:											
Organic soil material (general)Iron concretions✓ Gley OR											
Peaty topsoil Manganese concretions Mottled											
Peaty subsoilNodular											
								<u>Horizon</u>			
Fibric Consistence											
Mesic					Plastic				lox mottled		
Humic					_Sticky				lox segregations		
					Fluid			Per	ch-gley features		
Cause of we	tness										
<u>Location</u>			<u>Water t</u>			<u>Pans</u>			ayers		
Depress	ilon				water (an (general)		✓ Slow/ restricted permeability		
Flat						er		_	Argillic layer		
Valley	•				ater ta		ronstone-pan		Depth to restrictive layer (cm)		
Gully				page		·	ensipan	c.	unfa a a fa a taura a		
Slope			Tid	aı			Ouripan		urface features ✓ Pugged		
			1 (+L	nic con	taot		ragipan Orstein-pan		✓ Ponding		
				ne con	Laci		Depth to pan (- Fortuning		
Sketch of si	te/soil·		***************************************				septil to pari (C(1)			
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					Ø	y	W Ly	dric soil	je Kowhai Rd		
									¬~/ /		
								7	Prain		
									r with		
Remarks:	Season	has	been	unu	sually	wet (sp	ving + summ	ver)			
	Grass	padde	ock with	n fla	t to	undulating	topograph	y. Mosaic	of hydric and non-hydric soils.		
	yose	to s	ample po	nt s	s4 (no	on-hydric) "	• •		- 50 (fs.		
Photo numi	ers:						·				
Hydric soil p	resent?	V Ye	25	No	ı	Uncert	ain NZS	SC Subgroup (i	fknown) GOT		

ner/address: T. Stone, Te Kowhai Rd dform: Floodplain drainage (circle) W MW (1) P VP estigator: SF PS					Region: Waikato (Te Kowhai) Land management: Intensive - doing Local relief: Flat - gentle slope Land cover: Exotic grassland Hydrologic features: Pending 10 m away Nampling Point/ID: Stanpling Point/I						
climatione soil di	c/hydrologic o isturbed or p	ondit robler	ions on the site t matic? Are	ypical f e 'norm	for this time of nal circumstan	f year? Yes <u>V</u> ces' present Y	_ No Is t es No	he site drained? Yes V No If needed, explain in Rema			
file desc	ription: (Des	cribe	to the depth nee	ded to	document the	indicator or c	onfirm absen	ce of indicators, 30 cm defaul			
oth	Matrix			M	lottles		Material ⁴	Comments			
)	Colour (mo	ist)	Colour (moist)	% ¹	Size ²	Location ³					
-14	10 yr.	2/2									
-12	loye	5/6	54R 4/6	12	2-6 mm	Within ped	Mineral	Moist			
-30	WYR	616	7.5 YR 5/8	25	2-6 mm	Roots, ped	Mineral	Moist			
								Mottled Orthic Brown 1			
Indiana and the second second	***********	size o	classes; ³ Ped face,	pore,	within ped, al	ong roots, with	in matrix; ⁴Oı	rganic (peaty), humic, minera			
anic laye	soil materia opsoil	l (gen		_	oncretions anese concret	ions	Gle Mo	ttled			
Fibric			Cor	scicton	ce		Horizon	luctimorphic			
Mesic			<u>co</u>	<u>nsisten</u> Plasti				lox mottled			
Humic				Sticky Fluid			Rec	lox segregations ch-gley features			
ise of we	etness										
ation Depress Flat Valley Gully	sion		Water table Depth to v High grou Perched v Seepage	ndwate	er	Pan (general) Humus-pan ronstone-pan Densipan		<u>ayers</u> Slow/ restricted permeabl Argillic layer Depth to restrictive layer (
_, Slope			Tidal	tact	F	Ouripan Fragipan Orstein-pan Depth to pan (c		urface features Pugged Ponding			
tch of si	te/soil:	Tennan tina-tina terna	***************************************		· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·					
			S4 ************************************	\$	3		. water lea tydric soi	Table 1988			

narks: Spring + summer season has been unusually wet. Grass paddock with flat to undula pography. Mosaic of hydric and non-hydric soils. Close to sampling point S3 (hydric

Landform: <u>O</u> Soil drainage	ie Favm ess:T. Stone,Te Id Waikato Ru e(circle) W MI	rer channel	Land management: <u>Intensive</u> - dairy Local relief: <u>Flat</u> - channel floor Land cover: <u>Herbac</u> . fw veg fevotic grassld				Sampling Point/ID:S5 Date: 29 5 17				
							he site drained? Yes V No No If needed, explain in Remarks				
Profile desc	r <mark>iption: (</mark> Describe	to the depth need	ded to	document the	indicator or co	onfirm absen	ce of indicators, 30 cm default)				
Depth	Matrix			ottles		Material ⁴	Comments				
(cm)	Colour (moist)	Colour (moist)	% ¹	Size ²	Location ³						
0 - 8	10 YR 3/2	7.5 YR 7/6	10	<1 mm	Roots	Mineral	Humic?				
8-16	7.5 YR 4/2	5 YR 3/4	25	2-6 nm	Roots, Ped Fac	Mineral					
	54 7/1	10 yr 6/8	40	2-6 mm	Rocts, Ped face	Mineral					
16-18	54R 4/4	,			, ,	Mineral	Fe3+ accumulation leat layer				
18-30	1048 2/1					Organic	Peat Laures				
30 - 70	113					Organic	3				
70 +	5 GY 5/1	7.5 YR 6/6	30	10	Within ped	Mineral					
	3 6 1 91.	,, <u> </u>			wind feet	ME at	Mesic Humic Organic OHM				
¹Use % area	charts: ² Use size o	classes: ³ Ped face.	pore.	r within ped. ak	ong roots, with	in matrix: 40i	ganic (peaty), humic, mineral soil				
Hydric soil is			<u>,</u> ,	, p = = 7 = = -		······································	8				
Organic laye		<u>Cor</u>	cretio	<u>ns</u>		<u>Colours</u>	Profile form either:				
	✓ Organic soil material (general) ✓ Iron concretions ✓ Gley OR										
Peaty topsoil Manganese concretions Mottled											
Peaty subsoil Nodular Horizon											
Horizon Fibric Consistence Meductimorphic											
Mesic			Plastic				lox mottled				
✓ Humic			Sticky				lox segregations				
			Fluid			PerPer	ch-gley features				
Cause of we	tness) # f = 4 = 1		D		ī.					
Location	ion elderner diam	<u>Water table</u> <u>-2≲</u> Depth to v	water (Pans cm) P	an (general)		<u>ayers</u> Slow/ restricted permeability				
Flat	TOTT SECUTION	✓ High groun	•		lumus-pan	vana	Argillic layer				
Valley		Perched w			onstone-pan	_	Depth to restrictive layer (cm)				
Gully		Seepage			ensipan	******					
Slope		Tidal		C	uripan	<u>S</u> 1	urface features				
					ragipan		Pugged				
Lithic contactOrstein-panPonding											
Sketch of sit	o/coit			U	epth to pan (c	m)					
SKELLII OI SII	e/son.										
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and the second s											
2-3 m Ditch Ditch Ditch Pasture/Wetland herbs											
		2-3 m	E			itch					
		ر ،، جد	14.de >	CIV S COL	pasture/W	etland he	4bs				
		- <u>.</u>	· · · · · · · · · · · · · · · · · · ·	\$ 041) \$	-1.0.1						
			······································								
Remarks:	Drain 4m c	away running	alo	ng margin	of chann	iel					
		- y		· ·	-						
Photo numb	ers:										
	resent? 1/Va	oc No		Uncerta	in NIZS	C Subgroup (i	fknown) OHM				

site: Mitc	hel Farm	1		Regio	n: Waii	kato	(Whata who	ita)	Sampling Point/ID: S6
			Robson Rd	Land	manage	ment:	Taleasing -	dava	Date: 29/5/17 Slope (°): 1-2
Landform:				Local	relief:F	(a+-/	rently and	ulation	Date: 29/5/17 Slope (°): 1-2 NZTM (E): 1790 999 NZTM (N): 580 9756
Soil drainag	NZTM (N): 580 9756								
Investigator			N) I P VP	Hydro	ologic fe	atures	s: Nil		Altitude (m): 35
J				,					
Are climatic	/hydrologic	condi	tions on the site t	ypical f	or this t	time of	f year?Yes_ 🗸	Nols t	he site drained? Yes No
									If needed, explain in Remarks
y				TOTAL INCOME METAWAREN AND PART					
}	A court of at at at the tax dates of the		to the depth nee	ded to	docume	ent the	indicator or o		ce of indicators, 30 cm default)
Depth	Matri	************			ottles			Material⁴	Comments
(cm)	Colour (m	oist)	Colour (moist)	% ¹	Size ²		Location ³		
0-16	IOYR	2 2						Mineral	Organic?
16-30+	5 YR	,					1	Mineral	7 -
, 0 , 50 1	J 15							ara aa	

									- 7
					-				
									Humic Orthic Podzol ZOH?
		e size i	classes; ³ Ped face	, pore,	within p	oed, ald	ong roots, wit	hin matrix; 40	rganic (peaty), humic, mineral soil
Hydric soil i	ndicators:							•	
Organic laye				ncretio	<u>ns</u>			Colours	Profile form either:
Organic	soil materia	al (gen	eral)	_lron c	oncretic	ons		Gle	y OR
Peaty to				_ Mang	anese c	oncret	ions	Mo	ttled
Peaty su	ubsoil			_ Nodui	lar				
								<u>Horizon</u>	
Fibric			<u>Co</u> 1	<u>nsisten</u>	<u>ce</u>			Rec	luctimorphic
Mesic			-	_ Plastic	C			Rec	lox mottled
Humic				_Sticky				Rec	lox segregations
				Fluid				Per	ch-gley features
Cause of we	tness								
<u>Location</u>			<u>Water table</u>			<u>Pans</u>			ayers
Depress	ion		Depth to				an (general)		Slow/ restricted permeability
Flat			High grou				lumus-pan	· <u>-</u>	Argillic layer
Valley			Perched v	vater ta	ıble		onstone-pan		Depth to restrictive layer (cm)
Gully			Seepage			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	ensipan		
Slope			Tidal				uripan	S	urface features
							ragipan		Pugged
			Lithic con	tact			rstein-pan	_	Ponding
			***************************************			D	epth to pan (cm)	
Sketch of sit	te/soil:								
							on A		
							56		
							1	fence i	
			•	<u> </u>		a politica de la companya della companya della companya de la companya della comp	<u> </u>	/	Robson /
							W		Rd /
								" ditch	
Remarks:	سر عدام رس	η.	Ca (10 x 2			***************************************			
wending.	x0 H 16	Kap	n Series?						
									}
Photo numb	arc.								1
Hydric soil n		 V <i>c</i>	s V No			Incarto	in N79	C Subgroup (i	fknown) ZOH?

Owner/addi Landform: _	oha Station ess: Waikoha Steep fillcour e (circle) W M : SF	Rd Itry	Land Local Land	management: relief:	(Te Pahu) Extensive - a slope roducing exotin	dry stock c grassland	Sampling Point/ID: \$7 Date: 30 5 17 Slope (°):5-10 NZTM (E): 178 4317 NZTM (N): 5806086 Altitude (m): 233
Are climatic, is the soil di	/hydrologic cond sturbed or proble	itions on the site t ematic? Are	ypical f e 'norm	for this time of al circumstand	year? Yes <u>//</u> ces' present Ye	_No Is t esNo	he site drained? Yes V No If needed, explain in Remarks
Profile desc	r iption : (Describe	e to the depth nee	ded to	document the	indicator or co	onfirm absen	ce of indicators, 30 cm default)
Depth	Matrix			ottles		Material ⁴	Comments
(cm)	Colour (moist)	Colour (moist)		Size ²	Location³		
0-19		7.5 YR 518	*************	•	Root channels	Mineral	
19-30		2.5 4 6 3	l	6-10 mm	Matrix	Mineral	
11 30	10 1K 210	-3 7 013	~3		1-14-11-12	1-1141461 211	
	- TROCOCCOCCE ECTRONICA INVALIDADE I FOCUMA NOCOCCI INVALIDADE I						
	-						
	· · · · · · · · · · · · · · · · · · ·		***************************************				
				:			Motted Orthic Brown BOM
		classes; ³ Ped face,	pore,	within ped, alo	ong roots, with	in matrix; 40	rganic (peaty), humic, mineral soil
Hydric soil i	ndicators:						
Organic laye	<u>rs</u>	<u>Cor</u>	ncretio	<u>ns</u>		<u>Colours</u>	Profile form either:
Organic	soil material (gei	neral)	Iron c	oncretions		Gle	y OR
Peaty to	psoil	***********	Mang	anese concret	ions	_ ∠ Mo	ttled
Peaty su	ıbsoil	***************************************	Nodul	lar			
						Horizon	- Anna Anna Anna Anna Anna Anna Anna Ann
Fibric		Cor	nsisten	<u>ce</u>		Rec	luctimorphic
Mesic			Plastic				lox mottled
Humic		***************************************	Sticky				lox segregations
			Fluid				ch-gley features
Cause of we	tness			···		ALTO ALTO ALTO ALTO ALTO ALTO ALTO ALTO	
Location		Water table		Pans		1 :	ayers
Depress	ion	∠ <u>~30</u> Depth to v	water li		an (general)	_	Slow/ restricted permeability
Flat	1011			erH			Argillic layer
Valley		Perched v			onstone-pan	_	Depth to restrictive layer (cm)
Gully			rater to		ensipan		Deput to restrictive layer (city)
		Seepage				C.	urfana faaturaa
Slope		Tidal			uripan		urface features
		lithia anno	le ana ana dia		ragipan		Pugged
		Lithic con	lact		rstein-pan		Ponding
Cl		·		<u> </u>	epth to pan (c	m)	
Sketch of sit	e/son:	<	57				
		•	Ì.		Tin	cus rushes	-
		,	V Pa	isture			
		-7	Ø	4-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1	28 W W	Yt 10 11	10 drain
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					4	lov	2->
						20m	
							•
	· · · · · · · · · · · · · · · · · · ·			- p ₁ ,			
Remarks:	ligh producing	pasture speak	s cu	that-gently	stoping li	ana. Mudi	stone hillcountry
и	pslope of we	et terrain do	minaf	ied by ru	shes (June	is spp.). To	to the sample points to the drain.
r	learby: 58	(non-hydric)	and	sq C'hydr	tic). Both a	re closer	to the drain.
Photo numb	ers:	energicalization programme programme			талага газала положна газалија газат		
Hydric soil n	resent? V	es 1/No		Uncerta	in N79	C Subgroup <i>l</i> i	fknown) BOM

Owner/addi Landform: S	coha Station ress: Waikoha Steep hillcount e (circle) W M : SF	M	Land Local Land	ntleslope of	Pahu) ve -dy stock n gully floor cland wetland edge	NZTM (E): 118 NZTM (N): 850	_Slope (°): <u>5~</u> 0 <u>↓ </u>	
Are climatic Is the soil di	/hydrologic condi sturbed or proble	tions on the site t matic? Are	ypical 1 e 'norm	for this tim nal circums	e of year? Ye tances' prese	s <u>V</u> No ent Yes <u>V</u> No	Is the site drained? Yes	s_√_No in in Remarks
Profile desc	ription: (Describe	to the depth nee	ded to	document	the indicator	or confirm ab	sence of indicators, 30	cm default)
Depth	Matrix			ottles		Material	·	
(cm)	Colour (moist)	Colour (moist)			Location	Andrewson and the second second		
0-18	104R 413	7.54R 7/6			m Roots		1	
						- 1		
18-30	1.216 218	1048 5 3	30	6-10,	nm Wilhin m	atrix Minera	4	***************************************
	·							
				-			. TOTAL DE MINISTER MANAGEMENT COMPANION COMPA	
300000000000000000000000000000000000000	•		<u> </u>					ananananananananananananananananan
						000000		
						O DO	Mottled Octhi	C Rows BOM
¹Use % area	charts: ² Use size	classes: ³ Ped face	. pore.	within ped	along roots	. within matrix:	⁴ Organic (peaty), hum	ic. mineral soil
Hydric soil i		,	, , , , ,	· · · · · · · · · · · · · · · · · · ·	, 210118 10020	, , , , , , , , , , , , , , , , , , , ,	organita (pearly) hatti	ic, marcs ar oor
Organic laye		Coi	ncretio	ns		Colo	urs Profile form either:	
1	soil material (gen			oncretions			Gley OR	'
Peaty to				anese con			Mottled	
Peaty su			Nodu				Wioteica	
: cacy sc	203011		_,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	i Ca i		Hori	70n	
Fibric		Cou	nsisten	CO			<u>zon</u> Reductimorphic	
Mesic		<u>C01</u>	Plasti				<u>-</u>	
							Redox mottled	
Humic			_ Sticky				Redox segregations	
	A		_Fluid_				Perch-gley features	
Cause of we	rtness	V6 to 1. o. o. t o 7. l o					•	
<u>Location</u>	•	Water table			<u>ins</u>	6 \	Layers	X 147.
Depress	ion	∠ <u>-3</u> 0Depth to			Pan (gener		Slow/ restricted	permeability
Flat		High grou			Humus-pa		Argillic layer	
Valley		Perched v	vater ta	able	Ironstone-	pan	Depth to restrict	ive layer (cm)
Gully		Seepage			Densipan			
Slope		Tidal			Duripan		Surface features	
				*****	Fragipan		Pugged	
enconcordon		Lithic con	tact	*******	Orstein-pa		Ponding	
					Depth to p	an (cm)		
Sketch of sit	:e/soil:							
			~		58			
		,	>7 ρα	sture		Juncus rush	es	
		~ <u></u>	بن نيخ	<u> </u>	V_{\sim}	$\sim \sim 59$	ich drain	
		(X		A	<u> </u>		
					₩,	W	OM	
					<	20 m		
						- , ,		
·								
							·	
Remarks:	Mudstone st	eep hillcount	ry					
Righton	borderline	of wetland. Di	rain	20m au	vay at	bottom of	gully depression.	two other
samplina	points nearbu	: 57 Chon-hua	etric)	upland o	(S8. and	a sq Chydria	:) into the wetle	and
Photo numb	ers:				, -, ···		,	•
Hydric soil p		es 🗸 No	,	Unc	ertain	NZSC Subgrou	p (if known)BC	M

Site: Waikoha Station Owner/address: Waikoha Rd Land management: Extensive - dry stock Landform: Steep hillcountry Soil drainage (circle) W MW I P VP Investigator: SF Are climatic/hydrologic conditions on the site typical for this time of year? Yes V No Is the site drained? Yes V No										
Is the soil di	sturbed or I	proble	matic?	Are	'norm	al circumstan	ces' present Y	es No	If needed, explain in Remarks	
			to the dep	th need			indicator or c		ce of indicators, 30 cm default)	
Depth (cm)	Matri: Colour (m		Colour (m	oist)	M %¹	ottles Size²	Location ^a	Material ⁴	Comments	
0-13	10 YR 1	4/2	7.5 YR	5 8	15	21 mm	Root	Mineral		
13-25	10YR S	5/1	7.5 YR	58	5	21 mm	Pore, led face	Mineral		
25-30	10 YR	6 2	7.54R	6 2	20	10-20 mm	Pore	Mineral	Water seepage	
-45			- construction of the second o	1						
COMPANIES TO SECURE COMPANIES COMPAN			- Incommunication							
***************************************			· · · · · · · · · · · · · · · · · · · ·					**************************************		
**************************************			77777						Trace Cather Glass Com	
¹Use % area	charts ^{, 2} Us	e size d	lasses: ³ Pe	d face	nore v	within ned alo	ong roots with	in matrix: 40	Typic Outhic Gley GOT ganic (peaty), humic, mineral soil	
Hydric soil i	***************************************			u (uuu,	porc,	within pea, an	0.16 (00(3) With	ini iiidain, O	iganic (peary), name, minerar son	
Organic laye				Con	cretion	<u>15</u>		Colours	Profile form either:	
Organic	soil materia	al (gen	eral)		Iron co	oncretions		✓ Gle		
Peaty to				***********		anese concret	ions	Mo	ttled	
Peaty su	liosdu				Nodul	ar				
Eibric				Can	oint on a			Horizon	`	
Fibric Mesic					<u>isistenc</u> Plastic				luctimorphic lox mottled	
Wiesic					Sticky	•			lox mottled lox segregations	
				_ - _	Fluid				ch-gley features	
Cause of we	tness							ann na salkal talah salah sala		
<u>Location</u>			Water to			<u>Pans</u>		<u>L</u> :	ayers	
Depress	ion		<u>-40</u> Dep				an (general)	1000	Slow/ restricted permeability	
Flat				~	ndwate		lumus-pan	_	Argillic layer	
Valley Gully					ater ta		ronstone-pan		Depth to restrictive layer (cm)	
Slope			See Tida	page)ensipan)uripan	Çı	urface features	
510pc			(100				ragipan		✓ Pugged some	
			Lith	ic cont	act		Orstein-pan		Ponding	
							epth to pan (c		•	
Sketch of site/soil:										
				S~	7	ſ.	Juncus	59		
				, 	7 pas	rure	S8 rushes	. V	drain	
				次)		TA Y	M XI XI	on one	
				-			\otimes	WE TO M.	\searrow	
							<- <u>2</u>	Om	7	
Remarks: 1	Net at su	vface	: low po	21mea	bilihu	soils, Wal	fer table .	still risma	in hole , Mudstone country.	
Two of	her samp	le po	ints (ST	7,58)	up)	and of Se	7. Both a	ue non-l	hydrie.	
Photo numb	ers:			_						
Hydric soil p		✓ Ye	S	No	***************************************	Uncerta	nin NZS	C Subgroup (i	f known) GのT	

Site: Wai	koha Station				o(Te Pahu)		Sampling Point/ID: SIO					
Owner/address: Walkolm Rd Land management: Extensive - dry stock Date: 30 5 17 Slope (°): 15-20												
Landform: ≤	steep hillcount	<u> </u>	Local	relief: hilstop	e-upland margin	of guly seep	NZTM (E): 1784328					
	e (circle) W M	W) I P VP	Land	cover: ۴×0	tic grassla	<u>na</u>	NZTM (N): 580 7172					
Investigator	;		Hyara	ologic teatur	es: NI - see	o nearby	Altitude (m): 228					
Are climatic	/hydrologic condi	tions on the site t	vnical f	or this time	of vear? Yes✓	No is i	the site drained? Yes No					
							If needed, explain in Remarks					
	,	, , w -			in a second							
Profile desc	ription: (Describe	to the depth nee	ded to	document tl	ne indicator or o	confirm absen	ce of indicators, 30 cm default)					
Depth	Matrix		M	ottles		Material ⁴	Comments					
(cm)	Colour (moist)	Colour (moist)	% ¹	Size ²	Location ³							
0-12	104R 2/2											
12-30	104R 5/6											
				***************************************			Dad nother at 500 and door					
							Red mottles at 50 cm depth					
		<u> </u>					=Mottled orthre brown soil					
							BOM					
¹ Use % area	charts: 21 Ise size.	classes: ³ Ped face	nore :	within ned :	along roots wit	hin matrix: 40	rganic (peaty), humic, mineral soil					
Hydric soil i		crasses, a carace,	pore,	within peu,	aiong roots, wit	initiliatila, O	rganic (peary), norme, mineral son					
Organic laye		Cor	ncretio	ns		Colours	Profile form either:					
	soil material (gen			oncretions			y OR					
Peaty to			_	anese concr	etions	✓ Mo						
Peaty su			Nodul			microsco.						
						Horizor	1					
Fibric		Cor	isisten	ce			ductimorphic					
Mesic		***************************************	Plastic				dox mottled					
Humic			Sticky				dox segregations					
			Fluid				ch-gley features					
Cause of we	tness											
<u>Location</u>		Water table		<u>Pan</u>	NATE OF THE PARTY	L	<u>avers</u>					
Depress	ion	Depth to v	vater (cm)	Pan (general)		Slow/ restricted permeability					
Flat		High grou	ndwate	er	Humus-pan	_	Argillic layer					
Valley		Perched w	ater ta	ıble	Ironstone-pan		Depth to restrictive layer (cm)					
Gully		Seepage			Densipan							
Slope		Tidal			Duripan	<u>s</u>	urface features					
					Fragipan		Pugged					
		Lithic cont	act		Orstein-pan	•	Ponding					
					Depth to pan (cm)						
Sketch of sit	-											
		hillslope sic)									
		Dusture			, h.1)	slope						
			rus	hes, exotic g	rasses, herbs pe	asture						
		No.	SIL	, W S12	Vir la y							
		∞	W.		Seep floor							
			Ø		>							
			<	20	m							
Remarks: 1	Mudstone ma	inly, with lin	neston	le outeroi	os nearby (Tortieru)						
,	Mersiane PM		سان مرحم نمس	malina ani	ale at som	ייי בייי אימיני אי	s 11 and S12. Both hydric					
Sampling	point upslop	e of two on	er sa	יידייינין דייויי	rus (VI >-ee	h meriavai						
Photo numb	ers:						Séils,					
Hydric soil p		es 🗸 No		Uncer	tain NZ	SC Subgroup (if known) BOM					

Site: Wat Owner/addr Landform: Soil drainage Investigator	ress: <u>Wa</u> Steep e (circle)	ikoha hillo	Rd untry) VP	Land Local Land	management: relief: <u>Gentle</u> cover: <u>Herbac</u>	CTE Pahu' Extensive - slope -gully eous freshwa ::laside maga	Sampling Point/ID: SII Date: 30 5 17 Slope (°):5-10 NZTM (E): 17 8 4327 NZTM (N): 5807168 Altitude (m): 232				
Are climatic, Is the soil di	/hydrolog sturbed o	gic condi or proble	tions on t matic?	he site t Are	ypical f e 'norm	or this time of	f year? Yes <u>~</u> ces' present Y	_NoIs esNo	the site drained? Yes No/ If needed, explain in Remarks			
Profile desc	ription: (Describe	to the de	pth nee	ded to	document the	indicator or c	onfirm abse	nce of indicators, 30 cm default)			
Depth	Ma	and the second second second second				ottles	7	Material ⁴	Comments			
(cm)	Colour	(moist)	Colour (moist)	% ¹	Síze ²	Location ³					
0-25	104R	4/1	IOYR	5 8	2	6-10 mm	Roots	Mineral				
25-30	1048	5/2	104R	5 6	10	6-10 mm	Roots, pores	Mineral				
				,			, ,					
3 <i>0−</i> 50	IOYR	5 8	1086	6 2	20	10-20 mm	Pores	Muserai	High chroma colours-intense			
	- I	•		•								
									gleying in mothes Mothed fluvial recent			
									Soil = RFM			
									5011 = KF1M			
111000/ 0700	abauta 2	llee sine	alaaana 3t	3 a d d a a a		Lithia and al		le establiste 46	Durania (manta) hamin minanal nait			
¹ Use % area charts; ² Use size classes; ³ Ped face, pore, within ped, along roots, within matrix; ⁴ Organic (peaty), humic, mineral soil												
Hydric soil indicators: Organic layers Colours Profile form either:												
Organic layers Concretions Colours Profile form either: Organic soil material (general) Iron concretions ✓ Gley OR - ωρρεί ρου file												
Organic soil material (general) Iron concretions Gley OR - upper profile Peaty topsoil Mottled _ below 25-30 cm												
Peaty subsoil Nodular												
<u>Horizon</u>												
FibricReductimorphic												
Mesic				· ·	Plastic				edox mottled			
Humic					≤Sticky Fluid				edox segregations erch-gley features			
Cause of we	tnecc				_ FIGIU				icir-giey leatures			
Location			Water	table		Pans			Layers			
Depress	ion			epth to	water (an (general)		Slow/ restricted permeability			
Flat				igh grou			łumus-pan		Argillic layer			
Valley			L _Pe	erched v	vater ta	ableI	ronstone-pan		Depth to restrictive layer (cm)			
<u></u> ✓ Gully F	loor			eepage			Densipan					
Slope			Ti	dal			Duripan		Surface features			
			15	thic con	hact		ragipan Pretoin pan		✓ Pugged ✓ Ponding			
			Li	thic con	iaci		Orstein-pan Depth to pan (c	·m)	FOSIGING			
Sketch of sit	e/soil:	•	1				repair to pair (t	2010)				
	,		hillslope		SI	ž	b .	dslope				
			w Pa	Sture								
				کسندی	10 '	ushes, exotic	hochs of	ashure				
				Ŕ	N	y w/ w/	Var Var					
				_	(X)	(X) S	eep floor					
						ć	<u>·</u>					
	20m											
Remarks: /	1 brupt	bound	ary fro	m pas	hive e	on slope o	n brown so	ils to rus	hes and Olyceria on gley soils			
On bound	any beti	ween b	retland	and u	oland.	Recently:	formed we	tland at	sampling point - wetland			
		ised by	CAME.	1660 0 13 Au	ፈሎዬና ' «አንድድ •	sampling pe	ints nearby	y: 510 up	slope (non-hydric) and			
	Photo númbers: S12 deeper into Seep wetland (hydric) Hydric soil present? Vyes No Uncertain NZSC Subgroup (if known) REM											

Site: <u> Ma</u>	Site: Waikuha Station Region: Waikato (Te Pahu) Sampling Point/ID: 512											
Owner/addi	ress: <u>Waikoha</u>	i Rd			management:			Date: 30 5 17 Slope (°): 1-5				
Landform: _	Steep hillcour	itry			relief: Flat-ga			Date: 30 5 17 Slope (°): 1-5 NZTM (E): 178 4327				
Soil drainage	e (circle) W M	w 1 (P)	VP	Land	cover: Herbac	yous freshwa	iter vegetn.	NZTM (N): 5807166				
Investigator					ologic features			Altitude (m): 232				
						3 3		, ,				
								he site drained? YesNo				
is the soil di	sturbed or proble	matic?	Are	e 'norm	nal circumstan	ces' present Y	es 🗸 No _	If needed, explain in Remarks				
_j						TO THE CONTRACT OF THE CONTRAC		22002000 - 200000				
		to the dep	th nee			indicator or c		ce of indicators, 30 cm default)				
Depth	Matrix				ottles		Material⁴	Comments				
(cm)	Colour (moist)	Colour (n	noist)	% ¹	Size ²	Location ³						
0-10	104R 4/2						Mineral	speaty orthic -gley G-00/				
10-40	(04R 4/1		Mineral	2Fluid Gley Raw WGF								
\	1		i Wiki mi	CI MIN OTCY POLICE NO.								
	E/_ (()		_ i	 								
40+	56 6/1	OYR	5 8	40.	10-20 mm	Within Ped	Mineral	1-10-10-00-00-00-00-00-00-00-00-00-00-00				
	7	***************************************										
1	311	1 30	1.0	L	1.		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1					
		classes; "Pe	ed face,	, pore,	within ped, ale	ong roots, with	nin matrix; "O	rganic (peaty), humic, mineral soil				
Hydric soil i			_	.,			- 1					
Organic laye			Cor	<u>ncretio</u> i				Profile form either:				
	soil material (gen	eral)			oncretions	-	_ ✓ Gle					
	✓ Peaty topsoil Manganese concretions Mottled											
Peaty subsoil Nodular												
Horizon Control of the Control of th												
Fibric Mesic			Cor	nsisteno				luctimorphic				
				_ Plastic _ Sticky			Kec	lox mottled				
Humic				_ Sticky ^Fluid			Rec	lox segregations was oveginally ch-gley features perch-gley				
Cause of we	tnocc	<i></i>					rerrer	cn-gley reacures percin-gley				
Location	tiless	Water t	tahla		Pans		1.5	wore				
Depress	ion	<u>-2</u> De		water l	TATTOTATATA	an (general)		ayersSlow/ restricted permeability				
Depress Flat	1031		gh groui			umus-pan		Slow/ restricted permeablinty Argillic layer				
Valley					iblet			Arguit layer Depth to restrictive layer (cm)				
Gully F	lanc	See		rate: ta		ensipan	Name of the State	Depth to restrictive layer (citi)				
Slope		Tid				uripan	S.	urface features				
51000		1,0	u,			ragipan		<u>∠Pugged</u>				
		1 ith	nic cont	ract		rstein-pan		✓ Ponding				
			,,,,	76.00		epth to pan (c		V / Silding				
Sketch of sit	e/soil:											
		hillslope			C.00	L	Helena					
	24.	_, post	hure		512	De	usiope					
		The same of the sa	& S	(0 ,	michae lovot	ic arasses.	nasture					
				. !</td <td>h</td> <td>1-65 V</td> <td></td> <td></td>	h	1-65 V						
			Ø	1311	NAAM	X III						
				8	(X) ≤	eep flocr						
hillstope i posture Sio rushes, exotic grasses, pasture Silin W W W III Seep floor												
20 m												
Remarks: N	Aiddle of seep	that :	slopes	dow	nhill at 5-	-10°. Two	other sa	upling points nearby:				
SH Chuc	tric) near we	Handa	dos	and	sin (no	n-hudred.	unstane c	t well and				
5-	(A)	HAIW C	<i>v</i> g~)	COUN	5,0		-(pp-	of median.				
Photo numb												
Hydric soil n	resent? \ \ Ye	٠,	No		Uncerta	in NZS	C Subgroup /i	fknown) 600 /W GF				

Site: White hills Region: North and Sampling Point/ID: Will Owner/address: Road reserve Land management: Indigenous cover Date: 28[11] 17 Slope Landform: Easy hill country Local relief: Undulating slope NZTM (E): 167 8 5 4 9 Soil drainage (circle) W MW I P VP Land cover: Manuka/Lyc cern. scrub NZTM (N): 6112 9 7 8 Investigator: SF PS Hydrologic features: None Altitude (m): 224 Are climatic/hydrologic conditions on the site typical for this time of year? Yes V No Is the site drained? Yes V Is the soil disturbed or problematic? V Are 'normal circumstances' present Yes No If needed, explain in Research Matrix Mottles Material Comments Profile description: (Describe to the depth needed to document the indicator or confirm absence of indicators, 30 cm defined Colour (moist) Colour (moist) Size Location Material Comments O 7 10 18 5 2												
0-7				distribution de la constitution de				Mineral				
7-23	1048		5 YR	314	10	1-2mm	Matrix	Mineral	Many very fine mother			
23-30+	5 YR	· · · ·	•	3 4	10	1-2mm	Matrix	Mineral	Many very line mother			
17		-11=	5YR				Ped face		Many very fine mothes Organic coating			
							7-4-4-					
¹ Use % area charts; ² Use size classes; ³ Ped face, pore, within ped, along roots, within matrix; ⁴ Organic (peaty), humic, mineral soil												
Hydric soil indicators: Organic layers Concretions Colours Profile form either: _ Organic soil material (general) _ Iron concretions _ Gley OR												
<u>Horizon</u>												
Fibric												
Humic					Sticky				lox motified lox segregations			
					Fluid				ch-gley features			
Cause of we	tness					_		_				
Location Depress	ion		Water	<u>table</u> epth to v	untar (r	Pans m) P	an (general)	*****	ayers /) Slow/ restricted permeability			
Flat	1011			gh groui			umus-pan	<u></u>	Argillic layer			
Valley				erched w			onstone-pan		Depth to restrictive layer (cm)			
Gully			Se	epage		D	ensipan					
Slope			Ti	dal			uripan		urface features			
			1 11	thic cont	act		ragipan Irstein-pan		Pugged Ponding			
						7 D	epth to pan (d					
Sketch of site/soil: B fence p+w												
	Tan Pan Pan P											
4							፟ ✓	The state of the s				
	olitch											
									·			
Remarks: T	ncoin Co	thàa	to sho	ni se	ાં જ	ofte Port	demotio co	1: mele.	n pan pudzol ZXQ			
Hydrology						-tue , 1101	nematic 501	is & UISTEL	n pan puazor exy			
						Louis -	قصد مسا	outl	al- total e			
	Photo numbers: E horizon: Fe is leached so no red mottles obvious Hydric soil present? Yes No V Uncertain NZSC Subgroup (if known) Z × Q											

Site: <u>Ke</u>			ort			Jorkil.			Sampling Point/ID: KA 2			
Owner/addr							Protected	rotected Area Date: 29/11/17 Slope (°): O				
Landform:			W 1 D (10)	Local	relief	: <u>Fl</u>	101. 1.		NZTM (E): 1682308			
Investigator			N I P (VP)	Land	cover	: <u>Manuke</u> footuree	e foredic -	leble out	NZTM (N): 609 7584 Altitude (m): 125			
mvestigator	1			riyun	OIORIC	reatures	. High ware	newby	Attitude (iii)			
Are climatic, Is the soil di	/hydrologic sturbed or	condi	tions on the site matic? Aı	typical f e 'norm	for thi	s time of	f year? Yes_ ces' present	V_Nois: t Yes_v_No	the site drained? Yes No If needed, explain in Remarks			
				~~~~								
			to the depth ne			and the second of the second of	indicator c	***************************************	ce of indicators, 30 cm default)			
Depth	Matri				ottles			Material ⁴	Comments			
(cm)	Colour (m		Colour (moist)	% ¹	Size	<b>-</b>	Location ³		-			
0-30	IOYR		***************************************	ļ				Mineral	Minor component			
0-30	IOYR	2/1						Organic	Undecomposed plant material = Plant = major component			
				<u> </u>					= Peat = major component			
									9 .			
	***************************************											
							anorman management					
	***************************************			<del> </del>								
	***************************************											
14.1 04		<u>-</u>	35 16	1				7.1.4				
		e size (	classes; "Ped face	e, pore,	withir	n ped, al	ong roots, v	vithin matrix; "O	rganic (peaty), humic, mineral soil			
Hydric soil in Organic laye			Co	norotio	<b>~</b> c			Calaum	- Drafila farm aithan			
<u>✓ Organic</u>		al (gen	·	ncretio _ Iron c		tions			s Profile form either: ey OR			
Peaty to		ar (peri				concret	ions		ottled			
Peaty su	-			Nodu					^			
_			<del></del>					Horizor	1			
Fibric			<u>Cc</u>	nsisten	<u>ce</u>			Re	- ductimorphic			
Mesic				_ Plasti	С			Re	dox mottled			
Humic			-	_ Sticky	'			Re	dox segregations			
				Fluid				Pei	rch-gley features			
Cause of we	tness					_						
Location	f		Water table		الأست	<u>Pans</u>	/		ayers			
Depress	ion		20 Depth to	-			an (general		Slow/ restricted permeability			
Flat Valley			High grou				lumus-pan		Argillic layer			
Gully			Perched Seepage	water to	ine		onstone-pa ensipan		Depth to restrictive layer (cm)			
Slope			Tidal				oripan Turipan	S	urface features			
							ragipan	24	Pugged			
			Lithic cor	itact			rstein-pan		Ponding			
						***************************************	epth to par	n (cm)				
Sketch of sit	e/soil:						,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					
				L.	′00							
				۲	(A2		η	vanuka				
					ì		27 3	3 m	·			
	Gle.	dic	B	ું શું .	$\bigvee$		Y	AS IVI MAG	ter te esc			
		36	1/ 1/ 2001	<u>  [] [a6</u>	Y	11 AG		BE IN PA	te ese			
					$\langle X \rangle$							
					· · · · ·				NA THE THE RESIDENCE OF THE SECOND SE			
Remarks:	Site is a	Fen	wetland									
Photo numb	ers:							Acid Fibric	. Organic Soil OFA			
Hydric soil p		Υe	sN	)		Uncerta	in N	IZSC Subgroup (	if known) OFA			

	ress: <u>Nga</u>	V M\	W I P	(VP)	Land Local Land Hydro ypical f	relief: Flat cover: Rank pologic feature for this time c	::Welland re with gentle constane, wella is: Local point of year? Yes V	Sampling Point/ID: MI  Date: 19 10 117 Slope (°): O  NZTM (E): 2028159  NZTM (N): 570 9601  Altitude (m): 1  the site drained? Yes No V  If needed, explain in Remarks				
Profile desc	ription: (De	escribe	to the dep	oth nee	ded to	document th	e indicator or c	onfirm abser	nce of indicators, 30 cm default)			
Depth (cm)	Matri Colour (m		Colour (n	noist)	M %¹	ottles Size ²	Location ³	Material ⁴	Comments			
0-3	10 YR	2/2		•				Organic	Peaty			
3-25		<del>- 1.  </del>	7.5 YR	4/4	10	2-6 mm	Rootchannels	•				
25-30+		A	5.5 YR		20	2-6 mm	Root channel					
~5 JUT	TO TR		3,3 12	प । क	C	2 2 1	1001 Casumble	, i ilitari veci				
50+	2.5 YR	6 3							Becomes more yellow			
¹Use % area	charts; ² Us	e size	classes; ³ P	ed face	pore,	within ped, a	long roots, with	nin matrix; 40	Organic (peaty), humic, mineral soil			
Hydric soil i												
	<u>Organic layers</u> <u>Concretions</u> <u>Colours</u> Profile form either:											
Organic soil material (general) Iron concretions Gley OR												
✓ Peaty topsoil Manganese concretions Mottled												
Peaty su	IDSOII				_ Nodul	Idl		Horizo	n			
Fibric				Cor	nsisten	re			u ductimorphic			
Mesic					Plastic				dox mottled			
Humic					_ Sticky				dox segregations			
					Fluid				rch-gley features			
Cause of we	tness											
<u>Location</u>			<u>Water</u>	<u>table</u>		<u>Pans</u>		<u> </u>	<u>ayers</u>			
Depress				pth to v			Pan (general)		Slow/ restricted permeability			
<u></u> Flat ℝ	vier bed			gh grou			Humus-pan	-	Argillic layer			
Valley				rched v	vater ta		ronstone-pan		Depth to restrictive layer (cm)			
Gully				epage			Densipan	,				
Slope			Tic	lai			Duripan Eragipan	ž	Surface features			
			lit	hic con	tact		Fragipan Orstein-pan	•	Pugged ✓_ Ponding			
				1110 0011	· · ·		Depth to pan (	_	<u>v</u> i onang			
Sketch of sit	Sketch of site/soil:  Planted calobage tree											
			ħ.a	•	<b>J</b>		/					
			Ni	•		Mercer gras	s ban	k				
			, has		1	1	5 .42					
	Mercer grass bank  Marcer grass bank											
	- Maria is him											
					W	M2						
					МІ							
							····································					
Remarks:	Not clear	read	ardina :	source	01	water - in	close or	oximily t	o axbow pond			
	Site la.	`رل خماند	ال العمائلا	and ce	100	Y C	luvial bar	ent me	derials '			
	-1, - 100	~ IV (	-13 VAC. 1	-(* 1 ° \ ) ("C	te .	ioung t	Tunia	Recent	Glau Soil			
	Remarks: Not clear regarding source of water - in close proximity to 0x60w pond  Site low in the landscape. Young fluvial parent materials  Typic Recent Gley Soil  Hydric soil present? V Yes  No Uncertain NZSC Subgroup (if known) GRT											
ATVULEL MUSS C	n cacilt!	10 11	5.3	140	•	U++1.5"   3	cont this	ここ ごはいだけいけい	(III NIIC WEEF C C 1 1 1			

Landform:	ress: Nga Ox bon e (circle) \ :	Wri 1 W M ¹ condi proble escribe	o te Koofi  W ! P VP  tions on the site t matic?	Land Loca Land Hydr ypical o'norn	I relief: Toe s cover: Rank ologic feature: for this time on al circumstan	: Welland res ofe of gentl pasture, wello s: Ponding for fyear? Yes V ces' present Y	Sampling Point/ID: M2 Date: 19 10 17 Slope (°): 5 NZTM (E): 2028756 NZTM (N): 5709603 Altitude (m): 1.5 the site drained? Yes No If needed, explain in Remarks ce of indicators, 30 cm default) Comments  Peaky					
20-30+	10 YR	5/1	7.54R 5/6	35	6-10 mm	Within Matrix	Minéral Minéral					
								700000000000000000000000000000000000000				
					.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			Typic Recent Gley GRT				
¹Use % area	charts; ² Us	e size d	classes; ³ Ped face,	pore,	within ped, alo	ong roots, with	in matrix; ⁴ O	rganic (peaty), humic, mineral soil				
Hydric soil in												
Organic laye	<u>rs</u> soil materi	al (gen		icretio	<u>ns</u> oncretions		<u>Colours</u> <u>V</u> Gle	Profile form either:				
Peaty to		(0			anese concret	ions		ttled				
Peaty su	bsoil			Nodu	lar							
Fibric			Cor	ısisten	co		<u>Horizon</u>					
Mesic			<u>C01</u>	Plastic				luctimorphic lox mottled				
Humic			F1/5/40/44/4	Sticky				lox segregations				
				Fluid				ch-gley features				
Cause of we Location	tness		Water table		Dane		1 -					
Depressi	ion		> 40 Depth to v	vater (	<u>Pans</u> cm) P	an (general)		<u>ayers</u> Slow/ restricted permeability				
Flat			High grou			umus-pan		Argillic layer				
Valley			Perched w	ater ta		onstone-pan		Depth to restrictive layer (cm)				
Gully Slope			Seepage		***************************************	ensipan	<b>*</b> .					
✓ River be	d odge		Tidal			uripan ragipan	<u> 51</u>	urface features Pugged				
1406	· J		Lithic cont	act		rstein-pan	<del></del>	Ponding				
					D	epth to pan (ci	m)					
Sketch of site	e/soil:		Planted cabb	age t	ree			tenente				
			- 1/4	J		/.		opological in the control of the con				
			2.5		1	bank	<					
			l No	·wr gn	· · · · · · · · · · · · · · · · · · ·	) 						
			lu i	. iv.	12 M 15 1	M3						
	M N N											
				MI	سعير د پ			THE PARTY OF THE P				
								·				
Remarks: 7	oe slope	2 <u>2</u> 1	bank. Som	e di	ravel - sr	il is ach	rally fin	7				
•	1	Т	from	ر من 15 دم	n down . P.	de colour	ed poren	? if materials				
Photo numbe	ers.							ray down into river silt				
Hydric soil pr	7	Ye:	s No	1 -3		in N7SC						

Site:Mo Owner/addi Landform: _ Soil drainage Investigator	ress: <u>Nga</u> Oxboiu e (circle)	Uri o'	te Ko	ank	Land Local Land	relief: <u>gent</u> cover: <u>Ranj</u>	ine: Welland re le upslope k pasture s:		Sampling Point/ID: M3  Date: 19/10/17 Slope (°): 5  NZTM (E): 2028756  NZTM (N): 5709605  Altitude (m): 68			
									the site drained? Yes Nov_ If needed, explain in Remarks			
Profile desc	ription: ([	Describe	to the de	pth nee	ded to	document the	e indicator or c	onfirm absen	ice of indicators, 30 cm default)			
Depth (cm)	Mat Colour (		Colour (	moist)	M  %1	ottles Size²	Location ³	Material ⁴	Comments			
0-7	2.54	3 2						Mineral				
7-30	2.54	5/3	2.5 4	5/1	5-10	6-10 mm	Within matrix	1				
7- 00						- (0 )(0)	14. INCIA BIRRIY	Mineral				
			t L		-							
		<del></del>	-									
¹ Use % area charts; ² Use size classes; ³ Ped face, pore, within ped, along roots, within matrix; ⁴ Organic (peaty), humic, mineral soi												
Hydric soil indicators:												
Organic layers Concretions Colours Profile form either:												
Organic soil material (general)Iron concretionsGley OR												
Peaty topsoil Manganese concretions ✓Mottled												
Peaty subsoil Nodular												
. و				_				<u>Horizor</u>	<del></del> -			
Fibric				<u>Co</u> 1	nsistend				ductimorphic			
Mesic					_ Plastic				dox mottled			
Humic				********	_Sticky Fluid			***************************************	dox segregations			
Cause of we	tnocc		***************************************		FIUIU			rei	rch-gley features			
Location	111633		Water	table		Pans		1	ayers			
Depress	ion		760 De		water (	***************************************	an (general)		Slow/ restricted permeability			
Flat				igh grou			lumus-pan		Argillic layer			
Valley				erched v			ronstone-pan		Depth to restrictive layer (cm)			
Gully			S€	eepage		t	Densipan					
_✓ Slope &	entle		Ti	dal		[	Duripan	2	urface features			
							ragipan		Pugged			
			Li1	thic con	tact		Orstein-pan	_	Ponding			
## - P # P							Depth to pan (d	im)				
Sketch of sit	e/son:		Planteo	d cabl	page t	ree	,					
			- A/	1	V	Ì	and the same of th					
			$\sum_{i=1}^{n}$	7		)	, & ban	k				
			110	-		3 X	Buttercu	k p, Calystegi	a sepium			
				1,16	rungi	ass	M3	., .	•			
		-		<u>(M)</u>	NIM	LLLY(X)	. , .					
					(x)	M2						
					Mi	, .						
0							, d					
Remarks:		12 =	Recent	Gley S	Soil	- Pale c	slawed p		naterials			
Sampling Poir	it M3	•-	Mottle.	d Flu	vital 1	Recent So	IL = MORIFA	profile =	form RFM			
Photo numb	campling Point M3 - Mottled Fluvial Recent Soil = Mottled profile form RFM  Photo numbers:											
Hydric soil n		Vo		No		Incert	ain N7S	C Subgroup /	if known) DEM			

Site: Ja	imestown		Regio	n: To	a San c	) IA		Sampling Point/ID: J+ 1				
	ress: J. Cass	i e.	_				heathland	Date: 22/1/18 Slope (°): 6				
	Terrace			relief:				NZTM (E): 1570692				
	e (circle) W M	W (I) P VP				a-mahuka	scrub	NZTM (N): 549 6059				
Investigator	:_SF					: None		Altitude (m): 3 ]				
Are climatic	/hydrologic condi	tions on the site t	ypical f	or this ti	ime of	year? Yes <u>√</u>	No Is	the site drained? YesNo_V				
is the soil di	sturbed or proble	matic?Are	e 'norm	al circur	nstanc	es' present	Yes No _	If needed, explain in Remarks				
Profile desc	ription: (Describe	to the depth nee	ded to	docume	nt the	indicator or	confirm abser	nce of indicators, 30 cm default)				
Depth	Matrix	l leganice		ottles		maicator or	Material ⁴	Comments				
(cm)	Colour (moist)	Colour (moist)	% ¹	Size ²		Location ³	wateria	COMMICHS				
0-23	104R 3/2						Mineral	Topsoil/organic matter				
	+ 1048 8/1						Mineral	Uncopied sand evenue				
23-32	4.54R 4/2						Mineral	Uncoated sand grains More uncoated sand grains				
32 -	7.54R 4/3						1 11115, 584	The Colective Sana grains				
25	1.21K 410					~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~						
								11 2 2 1 1 - 2 1				
						- Impression		Humic Orthic Podzol ZOH				
								Romination				
11100 0/ 2002	sharta, 21 lan sino	alassas, 3nod face			ا ا			Beginning of an orthic podzol				
Hydric soil i		ciasses; "Ped race,	pore, v	within p	ea, aic	ing roots, wi	thin matrix; 'C	Organic (peaty), humic, mineral soil				
Organic laye		Cor	ncretion				Colour	s Profile form either:				
	soil material (ger			므 oncretio	inc			ey OR				
			-			ons		*				
Peaty topsoil Manganese concretions Mottled Nodular												
	Peaty subsoil Nodular Horizon											
Fibric		Cor	nsistenc	<u>e</u>			<del></del>	- ductimorphic				
Mesic			Plastic	;				dox mottled				
Humic			Sticky				Re	dox segregations				
			Fluid				Pe	rch-gley features				
Cause of we	etness											
Location		<u>Water table</u>			<u>Pans</u>		_	ayers				
Depress	ion	Depth to \				an (general)		Slow/ restricted permeability				
Flat		High grou				umus-pan	<del></del>	Argillic layer				
Valley		Perched w	ater ta	ble		onstone-par	J	Depth to restrictive layer (cm)				
Gully		Seepage				ensipan		······································				
Slope		Tidal				uripan	2	Surface features				
		Lithic cont	act			agipan rstein-pan		Pugged Ponding				
		citine com	act			epth to pan	(cm) -	ronaling				
Sketch of sit	:e/soil;					cptii to pair	(6111)					
	•			power	pole	$\Omega \Omega$	; ;					
		J+	1 1	<del></del>		<i>}})</i> (	Kanuka,	some manuka all				
	AA					$\bigcup ($	5m+	all				
	$\vee$ )}	- √	//	Λ		ir	) 2					
	14				6	pten						
	kenuke	almonuka //				0811						
	kanuka/manuka											
	LLLI	11 / 1 / 1 / 1 / 1 / 1 / 1 / 1 / 1 / 1	<del>LILL</del>	<u>, 1 3</u>	·Q	, landander						
		///	ゾ	90								
Remarks: f	below 32 cm.	-dete promusi	- do	esnit	sugg	est ground	dwater or	water perching				
Evidence e	of alluviation	/eluviation	in th	e un	coate	d grain	colours	**************************************				
23-32	cm = weak 1	E horizon, sug	zgests	color	urs c	due to le	acting rath	er than waterlogging.				
rnoto numb	Remarks: Below 32 cm - gets browner - doesn't suggest groundwater or water perching  Evidence of alluviation/eluviation in the uncoated grain colours  23 - 32 cm - weak E horizon, suggests colours due to leading rather than waterlogging.  Photo numbers:  Site undisturbed for a 40-50 years  Hydric soil present?  Yes  V No  Uncertain  NZSC Subgroup (if known)  ZOH											
TIYUTUC SOII P		es <u>V</u> No		U!	ncertai	nı jiNZ	າວຕາກຂາດກຽ (	if known) ZOH				

Site: Do Owner/addi Landform: Soil drainage Investigator	ress: <u>W</u> Rounded e (circle) : SF	. spar W M\	W I P	> VP	Land Local Land Hydro	n: Tasmav management: relief: <u>Gently</u> cover: <u>Manak</u> blogic features	Natural sloping after fil st : None	rubland	Date: 23   1 NZTM (E): _ NZTM (N): _ Altitude (m)		
										ed? Yes No/_ I, explain in Remarks	
Profile desc	ription: (D	escribe	to the de	pth nee	ded to	document the	indicator or c	onfirm absen	ice of indicat	ors, 30 cm default)	
Depth	Matr				.,	ottles		Material ⁴	Comment	S	
(cm)	Colour (n	noist)	Colour (	moist)	% ¹	Size ²	Location ³				
0-25	IOYR	5/1	5YR	3/4	5	2-6 mm	Root channels	Mineral	A/E	horizon	
25-37	5YR	4/6	•		Mineral	BS sesqu	ioxide (below podzal				
	+1078								11 7	rizon). Chunks of	
w									red ma		
									7	from accumulations	
~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	10.110	6.10	100-100	1,	20	e con	Pore	Minieral	33-40 10	Hon accamatana	
37-	10 9K	pla	104R	- ( )		6-10 mm	101.6	- unerai			
······································											
<u></u>											
			classes; ³ f	ed face	, pore,	within ped, alo	ong roots, with	nin matrix; ⁴ C	rganic (peat	y), humic, mineral soil	
Hydric soil i				<b>6</b> -				Calava	n Dungila Kawa	nith nu	
	Organic layers Concretions Colours Profile form either:										
	Organic soil material (general)										
							10113		Julia		
Peaty subsoil Nodular Horizon											
Fibric				Co	nsisten	ce			 ductimorphic	:	
Mesic					_ Plastic				dox mottled		
Humic					 _Sticky				dox segregat	ions	
					_ Fluid_			_ <u> </u>	rch-gley feat	ures	
Cause of we	etness										
<u>Location</u>				<u>table</u>		<u>Pans</u>			<u>avers</u>		
Depress	ion			epth to			an (general)		Slow/ restricted permeability		
Flat						erH			Argillic la	T	
Valley				erched v	vater ta		onstone-pan	స్త	27 Depth to	restrictive layer (cm)	
Gully				eepage			ensipan	ć	Surface feets	rar	
Slope			II	dal			uripan ragipan	3	Surface featu Pugged	ies	
				thic con	tact		rstein-pan	_	Ponding		
				tine con	tast		epth to pan (	cm) -	, 0.10411.6		
Sketch of si	te/soil:		***************************************			<del></del>	1 6//				
						Dopl	0 1.0	con (manut.	e.) Im		
						^ l	. Sper	sco(manuk Lep f	7 1		
					Д	(3)	JAKY W	W Lep 7	11		
			Ran	L \	/ Y n	WIVL	WLIW	80 c	m	•	
	Bank w ledge										
				TE	5 m	-				•	
		J) ~	reway /	1							
		_ Oriv	eway/								
Remarks:	Tupic	Decel	h: gle	ns Dec	tzol	ZPT					
	17110	1,00	319	y ' '		• •					
Photo numl								NZSC Subgroup (if known) ヱPT			
Hydric soil p	resent?	Y	25	No	)	Uncerta	ain NZS	C Subgroup	(if known)	SP1	

	site: Sedgenere 1 Region: Marlborough (Molesworth)											Sampling Point/ID: 862
Owner/addr					Land management: Extensive beef Local relief: Ho Now							Date: <u>26/1/18</u> Slope (°): <u>5</u>
Landform: _					Local	relief:	Ho llor	٧			1	NZTM (E): 2502435
Soil drainage		$N \sim 10^{-1}$	N I P	VP	Land	cover:	low pro	ochucir	g po	a sture	_ 1	NZTM (N): 589 634
Investigator	:5				Hydro	ologic f	eatures	s: <u>N</u>	<u>ene</u>		#	Altitude (m): <u>1016</u>
Are climatic	/hvdrologic	c condi	tions on t	he site t	vpical f	or this	time of	f vear?	Yes V	No	Is th	ne site drained? Yes No
												If needed, explain in Remarks
	English and the second of the second of the second of		to the de	pth nee			ent the	<u>indica</u>	tor or c			e of indicators, 30 cm default)
Depth	Matr	***************************************			<del>;;,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</del>	ottles		1	_	Materia	4	Comments
(cm)	Colour (n		Colour (	moist)	%1	Size ²		Locat	ion ^a			
	10 yr	3/1						<u> </u>				
10-20	10 YR	4/4										
20-40	10 YR	3/4							I NA	***************************************	-	
		·										
1				. 1.5	-	*				<u> </u>		. ,
		se size	classes; "I	ed tace	, pore,	within	ped, ai	ong roc	ots, witr	nin matrix	; "Ur	ganic (peaty), humic, mineral soil
Hydric soil i				Car	anrotin	m.c				Cald	surc l	Profile form either:
Organic laye Organic		ial laan	arali		<u>icretio</u>	<u>us</u> oncreti	anc				Gley	
Organic		ias (Bei	ici ai)		-	anese (		ions			Mot	
5				manua			CO(101 C1	30113			,,,,,,,	
, cary s.	Peaty subsoil Nodular Horizon											
Fibric												
Mesic				ninean	Plasti							ox mottled
Humic					_ _Sticky	,				***************************************		ox segregations
					Fluid						Perc	h-gley features
Cause of we	tness											
<u>Location</u>			Water				<u>Pans</u>					<u>vers</u>
Depress	sion			epth to				an (ge				Slow/ restricted permeability
Flat				igh grou				iumus-				_ Argillic layer
Valley				erched v	vater ta	able		ronstor				_ Depth to restrictive layer (cm)
Gully		•		eepage				Densipa				
Slope			1	dal				Duripar				<u>rrface features</u>
			1:	4h:	L~ a&			ragipa				Pugged
			Li	thic con	ldli			Orstein Danth t	-pari o pan (d	-ml		Ponding
Sketch of si	te/soil:	***************************************	e				·	<i>y</i> epar c	o pan (c	-1115		
		-	S62									
		1,		<	:62	1.3	564		S6 <u>'</u>			
		-	X	the way		1 (3)	collect	led)	S63	5		
			V	(	X	11	1	1	<u> </u>			
		۳).	-	.n.	الم المقا		(X)		Ø			
TO THE PERSON NAMED IN COLUMN 1	NZSC	150	T	00	(~)	<u> </u>	OT		- GO	Τ.		
Pro	file pictur	s 46	73 ~	- 46	69	40	671		467	7 5		
Domanutan			ř.	, i -		<i>1</i> 2			د مسلت	., D.	. 0	W E 11
ŧ					W.	O\Q	i√iš\ S	.v.(1,	SIUN	y. Kai	nterl	probably c. 1100 mm/yr
Typic	Orthic.	Brow.	1 BOT	~								
Photo num	Photo numbers:											
Hydric soil r		Y	25	V No	}		Uncert	ain	NZS	C Subgro	ti) au	fknown) BST

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Are climatic Is the soil di	/hydrologic condi sturbed or proble	matic? Ar	ypical i	for this time o	f year? Yes <u>/</u> ces' present Y	No Is t es No?	he site drained? Yes No <u>_/</u> If needed, explain in Remarks				
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10-18	7.54R 3/2	57R 4/6	5	2-6 mm	Root channels	Mineral	been pugged				
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							310119 20-33 16				
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Hydric soil in	charts; -use size	ciasses; "Ped Tace	, pore,	within ped, aid	ong roots, with	in matrix; "Oi	rganic (peaty), humic, mineral soil				
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						<u>Horizon</u>					
Fibric		<u>Cor</u>	nsisten	<del></del>		Red	luctimorphic				
Mesic			Plastic				ox mottled				
Humic		· ·	Sticky	•			ox segregations				
Cause of we	tnase.		Fluid			2 Per	ch-gley features				
Location	411033	Water table		Pans		1 -	yers				
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Flat		High grou			umus-pan		Argillic layer				
Valley		Perched w			onstone-pan		Depth to restrictive layer (cm)				
Gully		Seepage			ensipan	*****					
Slope		Tidal		D	uripan	<u>Sı</u>	ırface features				
					ragipan	<u>\</u>	Pugged				
	•	Lithic cont	act		rstein-pan		Ponding				
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		S62	· • • • • • • • • • • • • • • • • • • •	S64			Paraceleona				
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***************************************							- no soil description dataform)				
Hydric soil pr	resent? Ye	sNo		✓ Uncerta	in NZSC	Subgroup (if	known) BOM				

Are climatic/hydrologic conditions on the site typical for this time of year? YesNo Is the site distained? YesNo In the edded, explain in Remarks the site of site years and the site of years and commentate. Are "normal circumstances" present YesNo In needed, explain in Remarks  Profile description: (Describe to the depth needed to document the indicator or confirm absence of indicators; 30 cm default)  Depth	Site: _Sed Owner/addi Landform: _ Soil drainag Investigator	Terr e (circle) : SF	race / W M =	W I P	VP	Land Local Land Hydro	managemen relief: <u>Ho</u> cover: <u>Lo</u> ologic feature	producing es: None	Sampling Point/ID: <u>\$65</u> Date: <u>26/1/18</u> Slope (°): <u>O</u> NZTM (E): <u>250 244 9</u> NZTM (N): <u>5896 8 22</u> Altitude (m): <u>1015</u>				
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Depth Matrix Mottles Material* Comments  Colour (moist) Colour (moist) %* Size* Location*  0-5 IOYR 3[2] So Ministral ? Lots of rocks fragenic motter  5-40 IOYR 5[1] 2.5 y 5[3] 5 6-10 fed face Ministral?  1/Use % area charts; *Use size classes; *Ped face, pore, within ped, along roots, within matrix; *Organic (peaty), humic, mineral soil Hydric soil Indicators:  Organic layers  Organic soil material* (general)	Profile desc	ription: (D	escribe	to the de	pth nee	ded to	document th	e indicator or o	confirm absen	ce of indicators, 30 cm default)			
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Hydric soil indicators:  Organic layers  Organic soil material (general)  Peaty topsoil  Peaty subsoil  Peaty subsoil  Fibric  Mesic  Humic  Sticky  Peprending of water table  Fluid  Perched water table  Valley  Perched water table  Guily  Seepage  Slope  Tidal  Duripan  Lithic contact  Orstein-pan  Depth to pan (cm)  Sketch of site/soil:  S62  S63  C06  S64  S65  C07  Remarks: Sampling  Points  S64  Remarks: Sampling  Remarks: Sampling  Points  S64  Remarks: Sampling  Points  S64  Remarks: Sampling  Points  S64  Remarks: Sampling  Remarks: Sampling  Remarks: Sampling  Points  S64  Remarks: Sampling  Remarks: Sampling  Points  S64  Remarks: Sampling  Points  S64  Remarks: Sampling  Points  S64  Remarks: Sampling  Remarks: Sampling  Points  S64  Remarks: Sampling  Remarks: Samplin	¹Use % area	charts; ² U	se size	classes; ³ P	ed face,	, pore,	within ped, a	long roots, with	hin matrix; ⁴ Oı	ganic (peaty), humic, mineral soil			
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Valley Perched water table Ironstone-pan Depth to restrictive layer (cm)  Gully Seepage Densipan  Tidal Duripan Surface features  Fragipan Pugged  Lithic contact Orstein-pan Depth to pan (cm)  Sketch of site/soil:  S62 S63 Cno data  Collected  NZSC BOT BOM GOT GOT  Profile pictures 4673 — 4669 — 4671 — 4675  Remarks: Sampling Points 564 + 565 are both Gley and clearly hydric, flo soil data description at Sampling point 564. Vegetation change between 564 + 565 - See veg. sheets.  Photo numbers: 4675, 76 However both have welland plants present.		1011			•	-	-	,		•			
Gully Slope Slope Slope Densipan Duripan Fragipan Pugged Ponding Depth to pan (cm)  Sketch of site/soil:  S62 S63 Cno date Collected  N2 SC BOT BOM GOT GOT  Profile picture 4673 4669 4671 4675  Remarks: Sampling points S64 S65 are both Gley and clearly hydric. No soil data description at Sampling point S64 Vegetation change between S64 + 565 - See veg. sheets.  Photo numbers: 4675, 76 However both have welland plants present.								•					
Slope  Tidal  Duripan  Fragipan  Orstein-pan  Depth to pan (cm)  Sketch of site/soil:  S62  S63  Cno data  Collected)  NZSC  BOT  BOM  GOT  GOT  Profile pictures 4673  4669  4671  Remarks: Sampling points  S64 + S65 are both Gley and clearly hydric. No soil data description at Sampling point S64. Vegetation change between S64 + S65 - See veg. sheets.  Photo numbers: 4675, 76  However both have welland plants present.						OLCI LO	***************************************			Deput to restrictive layer (citi)			
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Depth to pan (cm)  Sketch of site/soil:  S62 S63 Cno data Collected)  NZSC BOT BOM GOT GOT  Profile pictures 4673 — 4669 — 4671 — 4675  Remarks: Sampling points 564 + 565 are both Gley and clearly hydric. No soil data description at Sampling point 564. Vegetation change between 564 + 565 - See veg. sheets.  Photo numbers: 4675,76 However both have welland plants present.				Lit	hic cont	act		· ·					
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Photo numbers: 4675,76 However both have welland plants present.	Remarks: 5	ampling	Por	nts	564	* S(	05 are	both Gley	and clea	uly hydric. No soil data			
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### Appendix 5: New Zealand hydric soils

#### Simple guide to Gley soils

Gley Soils are poorly drained and very poorly drained soils. In their undrained state, saturation occurs during prolonged periods, oxygen is limited and reducing conditions occur (typically affecting iron, manganese, nitrates, and sometimes sulphates). Greyish colours are dominant throughout the profile or to a depth of 90 cm or more.

#### **ACCESSORY PROPERTIES OF THE ORDER**

- i Segregation of iron and manganese oxides. Particles in reduced parts of the soil are not coated by secondary oxides. Redox segregations of iron and manganese oxides, however, are usually present elsewhere in the soil and may occupy large volumes.
- ii Commonly formed in alluvial or colluvial parent materials. Soils most frequently occur in relatively low parts of the landscape, in hollows or associated with flushes.
- iii Wide range of clay minerals. The clay mineralogy commonly reflects the mineralogy of the ungleyed material from which the soils are derived.
- iv Gley Soils cover a wide range of mineralogy classes with Mixed, Illitic, and Smectitic being the most common.
- v Poorly or very poorly drained. Topsoils have relatively high levels of organic matter and some are peaty. Subsurface horizons to depth are dominantly grey or bluish grey in colour with strong brown to dark brown redox segregations.
- vi High groundwater tables. Most are affected by high groundwater-tables, at least throughout winter months. Soils with slowly permeable layers may also be subject to perching.
- vii Shallow potential rooting depth. Potential rooting depth is limited by poor aeration. Even after drainage, root extension may be limited in some horizons.
- viii Relatively high bulk densities. Bulk densities are likely to be higher than well drained soils in similar soil materials.
- ix Limited trafficability. Trafficability is limited in most soils when wet and pugging damage by stock is likely.
- x Response to drainage to drainage. Crops, not adapted to wetness, respond well to drainage.
- xi Minimal erosion. Flooding or ponding of water is likely on low-lying sites, especially on floodplains. Deposition of fresh sediment is possible in these sites.
- xii Nitrogen requirement. Nitrogen requirements are likely to be higher than for associated well drained soils.

		code
Sulphuric Gley Soils		GU
Sulphuric gley soils occur in marine estuarine sites sulphuric acid or there are straw y	•	sed to for
Moderately fluid or very fluid and electrical conductivity of 0.8 mS/cm or more.	Fluid-saline sulphuric gley soils	GUFQ
Moderately fluid or very fluid.	Fluid sulphuric gley soils	GUF
Peaty topsoil or buried peat within 60 cm.	Peaty sulphuric gley soils	GUO
Mainly sand in the top 90 cm and electrical conductivity of 0.8 mS/cm or more in the top 60 cm.	Sandy-saline sulphuric gley soils	GUSQ
Other soils	Typic sulphuric gley soils	GUT
Tephric Gley Soils		GT
Tephric Gley Soils occur in unconsolidated sedir cinders, lapilli, pumice and o	_	ng ash,
Tephric Gley Soils that have a peaty topsoil either at the surface or buried with its upper surface within 60 cm of the soil surface.	Peaty Tephric Gley Soils	GTO
Other soils that have pH of less than 5.5 in some part from the bottom of the topsoil to 60 cm from the soil surface.	Acidic Tephric Gley Soils	GTA
Other soils	Typic Tephric Gley Soils	GTT
Sandy Gley Soils		GS
Sandy gley soils occur in sand deposits which ar alluvial origin. Subsoil horizons ar	-	o be of
Peaty topsoil or buried peat within 60 cm.	Peaty sandy gley soils	GSO
Electrical conductivity of 0.8 mS/cm or more within 60 cm of the surface.	Saline sandy gley soils	GSQ
More than 2% concretions in some horizon at 60 cm or less.	Concretionary sandy gley soils	GSC
pH less than 5.5 in some part between the bottom of the topsoil and 60 cm.	Acidic sandy gley soils	GSA
Other soils	Typic sandy gley soils	GST
Oxidic Gley Soils		GX
Oxidic gley soils have variable charge and low	activity clays dominated by k	aolin.
Oxidic gley soils that have a nodular horizon within 60 cm of the soil surface.	Nodular Oxcidic gley soils	GXN
Other soils	Typic Oxcidic gley soils	GXT

Soil Group	Subgroup	NZSC code	
Recent Gley Soils		GR	
, , ,	Recent gley soils occur on young land surfaces, usually in fluvial or estuarine sediments.  In many sites there is a significant flood risk.		
Peaty topsoil or buried peat within 60 cm.	Peaty recent gley soils	GRO	
Are moderately or very fluid within 60 cm of the surface	Fluid recent gley soils	GRF	
Electrical conductivity of 0.8 mS/cm or more within 60 cm of the surface.	Saline recent gley soils	GRQ	
Calcareous horizon or a shelly layer within 60 cm.	Calcareous Recent gley soils	GRC	
pH less than 5.5 in some part between the bottom of the topsoil and 60 cm.	Acid recent gley soils	GRA	
Other soils	Typic recent gley soils	GRT	
Acid Gley Soils			
Acid gley soils occur on relatively stable land su fluctuating groundwater table, or a dee Plants are susceptible to alur	ep layer of perched water.	ct to a	
Peaty topsoil or buried peat within 60 cm.	Peaty acid gley soils	GAO	
Clayey, moderately or strongly pedal with clay coatings and aggregates 20 mm or less in the majority of the subsoil to 60 cm depth.	Granular acid gley soils	GAG	
Subsoil with 10% or more clay or humus coatings and less silt than clay.	Ultic acid gley soils	GAY	
A placic (iron pan)horizon and a subsoil horizon with 10% or more dark-coloured coats on aggregates, in pores or on gravel, with moist colour value 4 or less or colour value 5 and chroma 3.	Placic-humose acid gley soils	GAPH	
A subsoil horizon with 10% or more dark-coloured coats on aggregates, in pores or on gravel, with moist colour value 4 or less or colour value 5 and chroma 3.	Humose acid gley soils	GAH	
Other soils	Typic acid gley soils	GAT	
Orthic Gley Soils		GO	
Orthic gley soils occur on relatively stable land surface Sediment deposition is unlikely if flooding occurs.  sulphuric and have no Oxc	They are not strongly acid, s		
Peaty topsoil or buried peat within 60 cm.	Peaty orthic gley soils	GOO	
Electrical conductivity of 0.8 mS/cm or more within 60 cm of the surface.	Saline orthic gley soils	GOQ	

Soil Group	Subgroup	NZSC code
Calcareous horizon within 60 cm of the surface.	Calcareous orthic gley soils	GOC
Ironstone layer at 90 cm or less from the surface.	Ironstone orthic gley soils	GOI
A subsoil with the major part to 60 cm or to its base (whichever is less) has strong structure, is sticky or very sticky and has pH 5.9 or more.	Melanic orthic gley soils	GOE
Soils with a clay rich argillic horizon.	Argillic orthic gley soils	GOJ
pH less than 5.5 in some part between the bottom of the topsoil and 60 cm.	Acidic orthic gley soils	GOA
Other soils	Typic orthic gley soils	GOT

#### Simple guide to Organic soils

Organic Soils are soils that occur in the partly decomposed remains of wetland plants (peat) or forest litter. Mineral soil material is commonly present but organic soil material is dominant. The soils occur in sites where rates of organic-matter decomposition are balanced or exceeded by rates of plant biomass production and accumulation.

Organic Soils occur in wetlands in most parts of New Zealand or under forest-produced acid litter in areas with high precipitation.

#### **ACCESSORY PROPERTIES OF THE ORDER**

- i Low bulk density. Bulk densities are very low, usually in the range of 0.03 to 0.4 mg/m3. Organic Soils may contain up to 70% organic matter. Too few data are yet available to allow mineralogy classes to be stated.
- ii High cation exchange capacity. The organic components of Organic Soils have high surface area, and high negative charge that varies markedly with pH. CEC values are very high, mostly ranging from 40 to 170 cmol/kg.
- iii High carbon/nitrogen ratios. C /N ratios range from 18 to as high as 70 in unfertilised and uncultivated Organic Soils.
- iv Low bearing strength. Construction of buildings or roads requires special foundation design.
- v Very low thermal conductivity. Soils warm and cool slowly. Bare soil surfaces, however, have high radiance.
- vi High shrinkage potential. The soils shrink markedly upon drying, and loose organic matter due to oxidation. Consequently, following drainage, the classification may change.
- vii High total available-water capacity. While total available-water capacity is high, plant-available-water capacity may only be moderate.

- viii Common nutrient deficiencies. The major nutrients nitrogen, phosphorus, potassium and sulphur, and the trace elements copper, selenium and molybdenum, are frequently deficient for crops and pasture.
- ix Peats are very poorly drained, litters are variable. Organic Soils formed in peats are very poorly drained and those formed from litters may range from well drained to very poorly drained.

Soil Group	Subgroup	NZSC code
Litter Organic Soils		OL
Litter Organic Soils occur under forest beneath a species. The organic material is derived predominormally not saturated except for a few	nantly from leaves and twigs	9
Soils in which a reductimorphic horizon, occurs at less than 30 cm beneath the upper surface of the underlying mineral soil.	Buried-gley Litter Organic Soils	OLBG
Fibric Organic Soils		OF
Fibric Organic Soils occur in sites that are saturated in sites that have been artificially drained) in which decomposed. The wetland plant constituents are so origin may be readily determined and fibres	h the peat materials are only o little decomposed that the	weakly r botanic
Organic fibres, to a depth of 60 cm from the soil surface, or to the base of organic soil material if shallower, are more than 70% <i>Sphagnum</i> species.	Sphagnic Fibric Organic Soils	OFS
Soils in which the organic soil material to a depth of 60 cm from the soil surface, or to its base if shallower, has pH of 4.5 or less throughout the major part.	Acid Fibric Organic Soils	OFA
Other soils	Mellow Fibric Organic Soils	OMF
Mesic Organic Soils	,	ОМ
Mesic Organic Soils occur in very wet sites (or in site which the peat materials are moderately decompose the original wetland plants that make up the bulk largely destroyed by rubbing be	ed. The remains of up to two of the soil are unrecognisab	-thirds of
Organic soil material to a depth of 60 cm from the soil surface, or to its base if shallower, has pH of 4.5 or less throughout the major part.	Acid Mesic Organic Soils	ОМА
Other soils	Mellow Mesic organic soils	ОММ

Soil Group	Subgroup	NZSC code
Humic Organic Soils		ОН
Humic Organic Soils occur in very wet sites (or in sites that have been artificially drained). The peat materials are strongly decomposed to the extent that the original wetland plant remains cannot be recognised throughout most of the soil profile.		
Organic soil material to a depth of 60 cm from the soil surface, or to its base if shallower, has pH of 4.5 or less throughout the major part.	Acid Humic Organic Soils	ОНА
Other soils	Mellow Humic Organic Soils	ОНМ

#### Other soils

Hydric soils occur in other soil orders of the New Zealand Soil Classification. They are mainly the result of a slowly permeable or impermeable lower subsoil layer impeding downward drainage of water. This causes the water to perch on the slow permeability layer and saturate the upper soil. These Perch-gley soils occur in most soil orders.

# **Allophanic Soils**

Soil Group	Subgroup	NZSC code
Perch-gley Allophanic Soils		LP
Perch-gley Allophanic Soils occur in sites that are periodically saturated (unless artificially drained). Wetness and associated reducing conditions are indicated by brownish or reddish mottles. The wetness is caused by the perching of water on a slowly permeable subsurface layer, although a groundwater-table may also be present.		
Perch-gley Allophanic Soils that have an ironstone-pan within 90 cm of the mineral soil surface.	Ironstone Perch-gley Allophanic Soils	LPI
Other soils	Typic Perch-gley Allophanic Soils	LPT
Gley Allophanic Soils		LG
Gley Allophanic Soils occur in sites that are periodically saturated (unless artificially drained). Wetness and associated reducing conditions are indicated by brownish or reddish mottles. The wetness is caused by a groundwater-table.		
Gley Allophanic Soils that have peaty topsoil.	Peaty Gley Allophanic Soils	LGO
Other soils	Typic Gley Allophanic Soils	LGT

# **Granular Soils**

Soil Group	Subgroup	NZSC code
Perch-gley Granular Soils		NP
Perch-gley Granular Soils occur in sites that are periodically saturated (if undrained).  Wetness and associated reducing conditions are indicated by grey colours and reddish mottles. The wetness is caused by perching of water on a clay-enriched slowly permeable layer, although a groundwater-table may also be present.		
Perch-gley Granular Soils that have a cutanoxidic horizon more than 30 cm thick with an upper boundary below 25 cm from the mineral soil surface.	Oxidic Perch-gley Granular Soils	NPX
Other soils that have pH 5.1 or less in some part of the subsoil to 60 cm from the mineral soil surface.	Acidic Perch-gley Granular Soils	NPA
Other soils	Typic Perch-gley Granular Soils	NPT

### **Melanic Soils**

Soil Group	Subgroup	NZSC code
Perch-gley Melanic Soils		EP
Perch-gley Melanic Soils occur in sites that are periodically saturated (unless artificially drained). Wetness and associated reducing conditions are indicated by grey colours in horizons subjacent to the topsoil, and is caused by perching of water on a slowly permeable subsurface layer, although a groundwater-table may also be present.		
Perch-gley Melanic Soils that have either	Vertic Perch-gley Melanic Soils	EPV
1. cracks at least 4 mm wide in some part, either in the subsoil and infilled with topsoil material, or open to a depth of 30 cm or more, from the mineral soil surface, or		
2. coefficient of linear expandability of 0.09 or more with moderate or strong, blocky or prismatic soil structure in the major part of the subsoil.		
Other soils with an argillic horizon.	Argillic Perch-gley Melanic Soils	EPJ
Other soils	Typic perch-grey Melanic soils	EPT

# **Oxcidic Soils**

Soil Group	Subgroup	NZSC code
Perch-gley Oxcidic Soils		XP
Perch-gley Oxidic Soils occur in sites that are periodically saturated (unless artificially drained). Wetness and associated reducing conditions are indicated by grey colours, and are caused by perching on a slowly permeable layer.		
Perch-gley Oxidic soils that have a nodular layer with an upper boundary within 60 cm of the mineral soil surface.	Nodular Perch-gley Oxidic Soils	XPN
Other soils	Typic Perch-gley Oxidic Soils	XPT

# **Pallic Soils**

Pallic Solls		
Soil Group	Subgroup	NZSC code
Perch-gley Pallic Soils		PP
Perch-gley Pallic soils occur in sites that are periodically saturated (if undrained) in winter and spring, but dry out in summer. The wetness and associated reducing conditions are indicated by grey colours on ped surfaces in horizons subjacent to the topsoil. Wetness is caused by perching of water on a slowly permeable subsurface layer, e.g. a fragipan, argillic horizon, duripan, some combination of these horizons or other slowly permeable layer. The reductimorphic horizons are commonly acidic (pH less than 5.5).		
Perch-gley Pallic Soils that have a duripan.	Duric Perch-gley Pallic Soils	PPU
Other soils that have both an argillic horizon and a fragipan.	Argillic-fragic Perch-gley Pallic Soils	PPJX
Other soils that have a fragipan.	Fragic Perch-gley Pallic Soils	PPX
Other soils in which the majority of the gravel is weathered and can easily be broken with a spade, and have an argillic horizon.	Weathered Argillic Perch-gley Pallic Soils	PPWJ
Other soils that have an argillic horizon.	Argillic Perch-gley Pallic Soils	PPJ
Other soils that have a horizon that is cemented to the degree that it is at least weakly indurated, within 90 cm of the mineral soil surface.	Cemented Perch-gley Pallic Soils	PPC
Other soils	Typic Perch-gley Pallic Soils	PPT

### **Podzol Soils**

Soil Group	Subgroup	NZSC code
Perch-gley Podzol Soils		ZP
Perch-gley Podzols occur in periodically or predominantly saturated sites (unless artificially drained) in which wetness is indicated by grey colours along with brownish or reddish mottles or peaty topsoils. The wetness is caused by the perching of water on a slowly permeable subsurface layer, although a groundwater-table may also be present.		
Perch-gley Podzols that have a moderately fluid or very fluid in some part above the podzolic-B horizon.	Fluid Perch-gley Podzols	ZPF
1. an E horizon that  (a) has slightly firm or greater moist soil strength, and (b) is apedal massive or has very coarse to coarse prismatic soil structure, and (c) occurs within a layer that is silty through a thickness of at least 15 cm, and 2. a peaty topsoil.	Peaty-silt-mantled Perch-gley Podzols	ZPOZ
Other soils that have an E horizon that has slightly firm or greater moist soil strength, has few cracks or has very coarse to extremely coarse prismatic soil structure, and occurs within a layer that is silty through a thickness of at least 15 cm.	Silt-mantled Perch-gley Podzols	ZPZ
Other soils that have a humus-pan.	Humus-pan Perch-gley Podzols	ZPU
Other soils that have a Bh horizon thicker than 5 cm, and an ortstein horizon.	Humose-ortstein Perch-gley Podzols	ZPHQ
Other soils that have a Bh horizon thicker than 5 cm, and a placic horizon.	Humose-placic Perch-gley Podzols	ZPHP
Other soils that have a Bh horizon thicker than 5 cm.	Humose Perch-gley Podzols	ZPH
Other soils with an ortstein-pan.	Ortstein Perch-gley Podzols	ZPQ
Other soils that have a placic horizon.	Placic Perch-gley Podzols	ZPP
Other soils	Typic Perch-gley Podzols	ZPT
Groundwater-gley podzols		ZG

Groundwater-gley Podzols occur in periodically or predominantly saturated sites (unless artificially drained) in which the wetness is indicated by brownish or reddish mottles or peaty topsoils. The wetness is caused by a groundwater-table.

Soil Group	Subgroup	NZSC code
Groundwater-gley Podzols that have a Bh horizon thicker than 5 cm.	Humose Groundwater-gley Podzols	ZGH
Other soils	Typic Groundwater-gley Podzols	ZGT

### **Pumice Soils**

Soil Group	Subgroup	NZSC code		
Perch-gley Pumice Soils		MP		
Perch-gley Pumice Soils occur in periodically saturated sites (unless artificially drained) in which wetness is indicated by grey colours along with brownish or reddish mottles. The wetness is caused by perching of water on a slowly permeable subsurface layer, although a groundwater-table may also be present.				
Perch-gley Pumice Soils with a duric horizon within 90 cm of the mineral soil surface.	Duric Perch-gley Pumice Soils	MPU		
Other soils	Typic Perch-gley Pumice Soils	MPT		

### **Raw Soils**

Soil Group	Subgroup	NZSC code		
Gley Raw Soils		WG		
Gley Raw Soils occur in sites that are periodically or permanently flooded. Wetness is expressed in the soil by grey colours with brownish or reddish mottles, by water saturation or is indicated by a chemical test for the presence of reduced iron.				
Moderately or very fluid at some depth less than 30 cm and low pH (more than 4.0 and pH in boiling hydrogen peroxide less than 3.0) within 90 cm.	Fluid-sulphidic Gley Raw soils	WGFU		
Other soils that have low pH within 90 cm from the mineral soil surface.	Sulphidic Gley Raw Soils	WGU		
Within 30 cm are moderately fluid or very fluid and electrical conductivity of 0.8 mS/cm or more.	Fluid-saline Gley Raw Soils	WGFQ		
Other soils that within 30 cm of the mineral soil surface have electrical conductivity of 0.8 mS/cm or more.	Saline Gley Raw Soils	WGQ		
Other soils that within 30 cm of the surface have moderately fluid or very fluid fluidity class.	Fluid Gley Raw Soils	WGF		

Other soils that have sand or loamy sand texture and that have less than 35% gravel (by volume) in all horizons, from the soil surface to 60 cm depth or more.	Sandy Gley Raw Soils	WGS
Other soils	Typic Gley Raw Soils	WGT

# **Ultic Soils**

Soil Group	Subgroup	NZSC code		
Perch-gley Ultic Soils		UP		
Perch-gley Ultic Soils have seasonal wetness close to the soil surface, indicated by grey colours in horizons immediately beneath the topsoil. The topsoil is clayey and strongly buffered. The wetness is caused by perching on a clayey slowly permeable layer, although a groundwater table may also occur.				
Soils that have more than 60% sand in the subsoil.	Sandy Perch-gley Ultic Soils	UPS		
Other soils that have a reductimorphic horizon with an upper boundary within either 15 cm of the base of the topsoil, or 30 cm of the mineral soil surface.	Typic Perch-gley Ultic Soils	UPT		
Densipan Ultic Soils				
Densipan Ultic Soils have a high density but un-cemented pan at shallow depth which severely limits root penetration and water movement. Surface soil horizons are seasonally wet and the soil is very susceptible to livestock treading damage.				
Soils that have a reductimorphic horizon below the densipan.	Perch-gleyed Densipan Ultic Soils	UDP		
Other soils that have a redox-mottled horizon immediately underlying the densipan.	Mottled Densipan Ultic Soils	UDM		