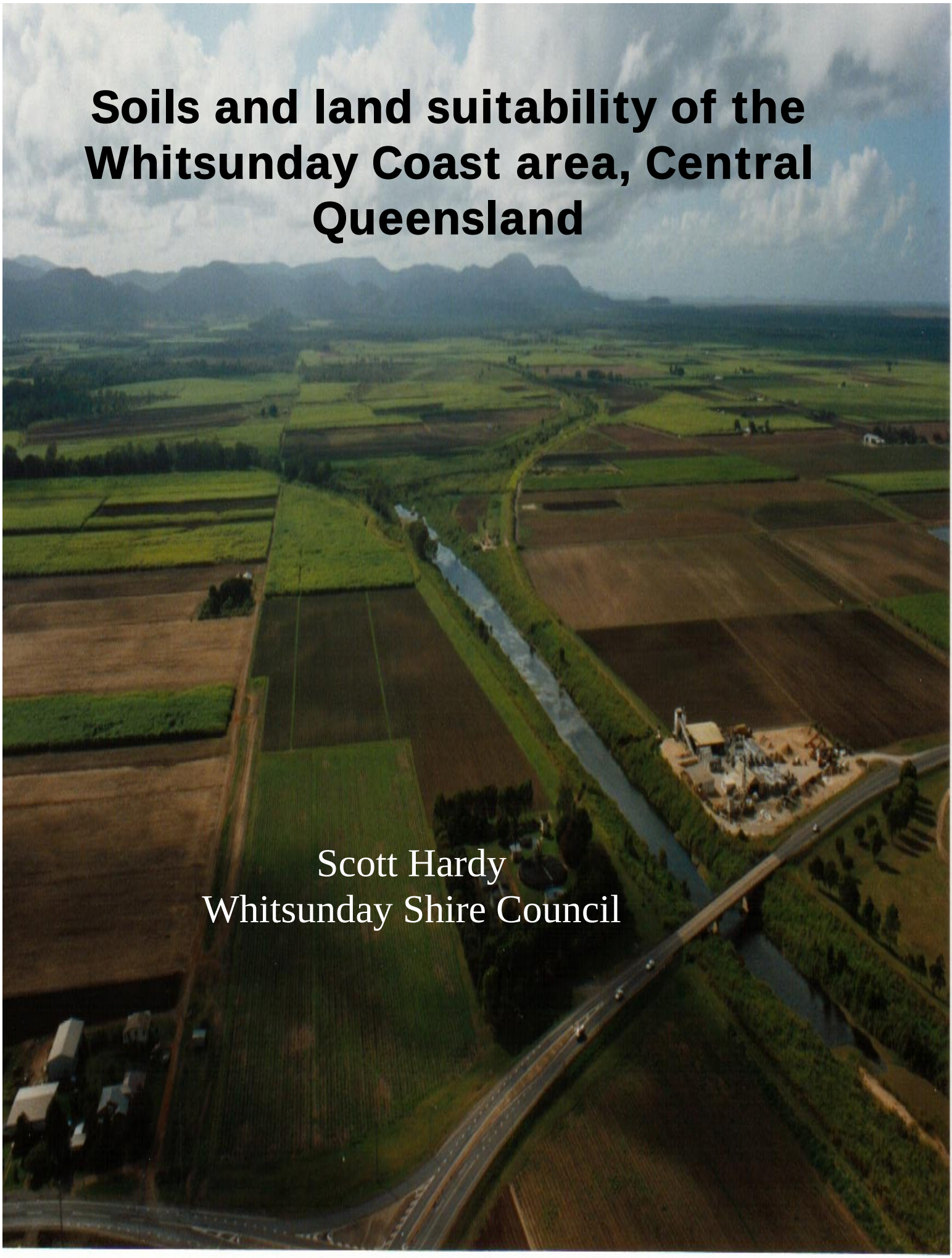
Soils and land suitability of the Whitsunday Coast area, Central Queensland



Scott Hardy
Whitsunday Shire Council

The Whitsunday Coast survey is jointly funded by Local, State and Commonwealth Governments as well as local industry bodies. Contributions from the following organisations are gratefully acknowledged for the operation of the project and the preparation of this report:

- National Heritage Trust,
- Proserpine Canegrowers Association,
- Department of Natural Resources
- Proserpine Co-operative Sugar Milling Association Limited, and,
- Whitsunday Shire Council.

This publication was prepared to assist with land resource planning in the Whitsunday Coast area. Digital data suitable for incorporation into a Geographic Information System has been produced in conjunction with this report. Enquires regarding the availability of this digital data should be directed to the Planning and Environment Officer, Resource Management, Department of Natural Resources, Mackay, or the Natural Resource Information Management Officer, Resource Management, Department of Natural Resources, Rockhampton. Enquires regarding the Whitsunday coast project or this report should be directed to the Director of Planning and Development, Whitsunday Shire Council.

Whitsunday Shire Council
Po Box 104
Proserpine,
4800

CONTENTS

List of Figures

List of Tables

List of Plates

List of Maps

Summary

The aim of the Whitsunday Coast report is to describe the soils and land suitability for local and regional planners and landholders to assist with land management decisions. The Whitsunday Coast report covers 327,200 ha from Bowen to Elaroo along the central Queensland coast. The survey joins the Mackay caneland study to the south and the Bowen-Elliot river survey to the north.

The Whitsunday Coast report uses soil and land use suitability data gathered from the Proserpine Integrated Land Use Study (PILUS) and the Whitsunday Integrated Land Use Study (WILUS). The PILUS and WILUS projects gathered land resource and land suitability data in 14 areas within the Whitsunday Coast area. The Whitsunday Coast report collates the data from the two projects into one report and soil map.

The Whitsunday Coast report describes 111 soils and thirteen variants. The soils are mapped at a scale of 1:50,000. The report also describes the location and extent of existing and potential land degradation.

The soils and landform information has been used to assess land use suitability for twelve land uses; spray irrigated sugarcane, furrow irrigated sugarcane, horticultural small crops, mangoes, avocadoes, lychee, citrus, improved pasture, ponded pasture, commercial timber, urban development and rural residential development. Land use suitability was used to determine good quality agricultural land.

Soil erosion, soil salinity and acid sulfate soils are the main land resource issues identified in the Whitsunday Coast survey. There are 15,468 ha of land which may have acid sulfate soil layers below the surface. The main areas of acid sulfate soils occur in Goorganga plains and the mouth of Yeates creek and Duck creek.

Most of the survey area is used for cattle grazing and sugarcane is grown on approximately 28,000 ha. The survey has identified approximately 140,524 ha suitable for spray irrigated sugarcane (not taking into account vegetation management legislation). There are 84,845 ha which are suitable for spray irrigated sugarcane and have sodic subsoils.

Over 62 % of the survey is mapped as good quality agricultural land. The survey has classified 141,024 ha of class A and 64,148 ha of class B agricultural land. Most of the good quality agricultural land is located on the alluvial plains and terrace plains in the survey. The information contained in this report will be useful in guiding ecologically sustainable development in the Whitsunday Coast region.

1. Introduction

The Whitsunday region is known world wide mainly for the offshore marine environment as a valued holiday destination, and the mainland has a reputation for producing high quality sugar and beef cattle. Both the mainland and offshore environments require wise management of the natural resources to support the local economy. To assist in the management of the natural resources in the mainland areas of the Whitsunday region, a knowledge of the natural resources is essential. More specifically, a knowledge and understanding of the functional limitations of our soils for a range of agricultural uses is essential to ensure sustainable management, a reduction in land degradation and to encourage a prosperous economy. With these goals in mind, the Whitsunday region Local Governments and the Queensland State Government together with the Proserpine region sugarcane industry developed two Natural Heritage Trust projects to gather land resource data and determine land use suitability.

The Whitsunday Coast survey aimed to describe the soil, geology and vegetation from the town of Bowen south to Elaroo and west to the coastal spur of the Clarke range (Figure 1). The southern boundary of the survey is the northern boundary of the Mackay caneland survey (Holz and Shields, 1985). The northern boundary of the survey corresponds to the southern boundary of the land resource survey conducted by Aldrick (1988). The report covers approximately 327 200 ha and incorporates the fourteen surveys conducted by the Proserpine Integrated Land Use Study (PILUS) and the Whitsunday Integrated Land Use Study (WILUS) from 1994 to 2002.

The PILUS and WILUS were established by the Whitsunday Shire Council, Department of Natural Resources, Proserpine Sugar Mill and the Proserpine Canegrowers Association. The PILUS and WILUS were funded by the Natural Heritage Trust and the project stakeholders. The purpose of the Whitsunday Coast report is to provide land resource and land suitability information for local and regional planning in the Bowen, Whitsunday and Mackay City Shires.

Previous mapping in the area was conducted by the Christian *et al.* (1953) as part of the CSIRO 1:250 000 land system surveys. In the early 1970's the Burdekin – Townsville area, including the Whitsunday Coast area was mapped by the CSIRO at a scale of 1:1 000 000 (Isbell and Murtha, 1970). The data compiled by these surveys were intended to provide an indication of the broad soil-geological resources in the region. The data compiled by the previous surveys are too coarse to be used for local, regional and property planning. In 1981, Thompson *et al.* conducted a land resource survey and agricultural assessment of approximately 36 000 ha on the north and south sides of the Proserpine River. The survey conducted by Thompson *et al.* was conducted at a scale of 1:100 000. The data gathered from the Proserpine River lowlands study was valuable for the planning of sugarcane expansion and irrigation in this area. However, detailed soil and land suitability data has been requested to provide advice to the expansion of the sugarcane industry and other agricultural enterprises and for local strategic planning. The purpose of the land resource surveys which comprise the Whitsunday Coast area is to gather land resource data such as soil, geology and vegetation at a scale of 1:50 000.

The soil data collected from the WILUS and PILUS land resource surveys will be used to determine the suitability of ten agricultural land uses common in the region and urban and rural residential land uses. The information contained in this report will be useful to guide sustainable land management and regional and local planning in the Whitsunday Coast area.

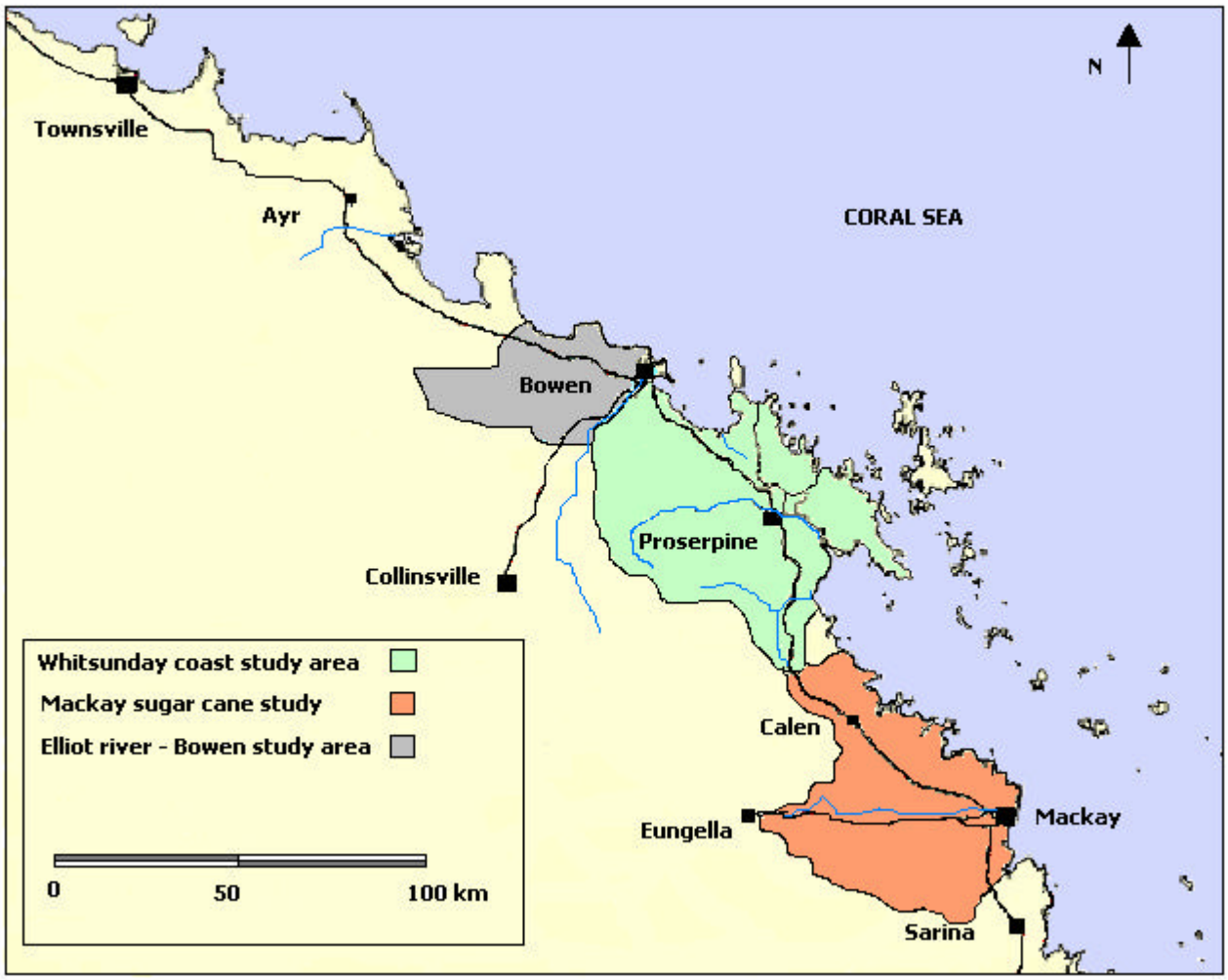


Figure 1. The location of the Whitsunday Coast area.

2. Physical environment

2.1. Climate

The two main weather stations in the Whitsunday Coast area are located at Proserpine and Bowen. The Bowen Post Office has recorded weather from 1870 to 1987 while the Proserpine Post Office has recorded climate data from 1886 to 1989. These data are used to describe the rainfall and temperature for the Whitsunday Coast area.

2.1.1 Rainfall

Most of the rainfall in the Whitsunday Coast area occurs in the months from November to April, where tropical low pressure systems direct warm moist wind onto the coast. The mean annual rainfall for Proserpine is 1794 mm a year and Bowen is 1013 mm a year (Figure 2). The rainfall in the survey area is higher in the coastal Conway Range and Dryander Range which receive between 1800 and 2400 mm per year (QDPI, 1993). The north - western areas adjacent to the Don River generally receive a mean annual rainfall of 800 to 1000 mm per year. The mean annual rainfall for a number of other areas have been collected. Bloomsbury has a mean annual rainfall of 1506 mm (station 033005), Preston has 2329 mm (station 033015), Kelsey Creek has 1489 mm (station 033127), Lethebrook has 1685 mm (station 033041) and Longford Creek (Gleneden) has 1056 mm (station 033043).

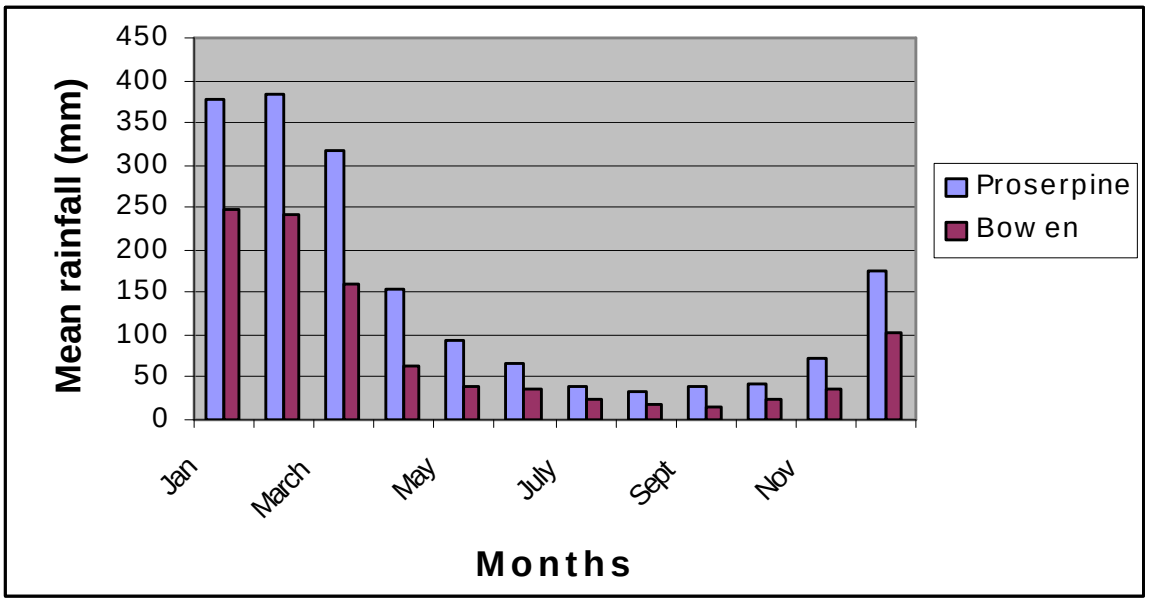


Figure 2. The mean monthly rainfall at Proserpine and Bowen.

2.1.2. Other climatic factors

The most central weather station that records temperature is the Proserpine post office. The mean daily maximum temperature at Proserpine in January is 31.5^{0} C and the mean daily maximum temperature in July is 24.3 ^{0} C (Figure 3). Frost is common in most inland areas west of Proserpine. Severe "black" frosts have been known to occur in areas such as Kelsey Creek south to Bloomsbury.

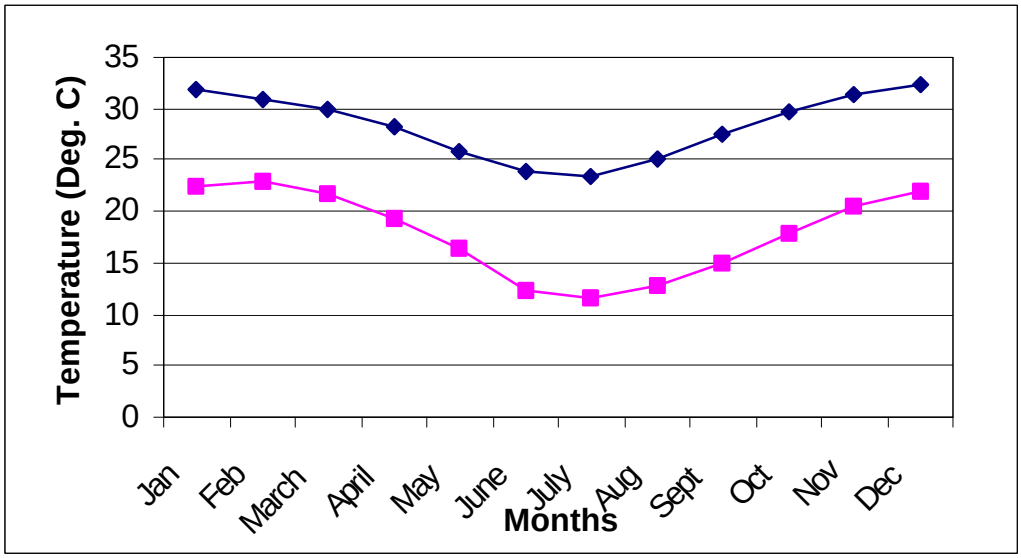


Figure 3. The mean daily maximum and minimum temperatures for Proserpine.

2.2. Geology

Paine and Cameron (1972) have described the geology of the Whitsunday Coast area. The geology of the Whitsunday Coast is diverse and has undergone periods of intense tectonic activity such as faulting which has influenced the shape of the current landscape. The geology of the area comprises of:

- Devonian – Carboniferous Campwyn Beds (DCc)
- Lower Carboniferous Edgecumbe Beds (Cle)
- Upper Carboniferous intrusive intermediate to basic rocks (Cud),
- Upper Carboniferous – Permian intrusive rocks (CPg)
- Permian Carmila beds (PLa),
- Permian Airlie volcanics (Pll)
- Lower Cretaceous Urannah igneous complex (Ckr)
- Lower Cretaceous Granite (PKg)
- Lower Cretaceous Hecate Granite (Kh),
- Lower Cretaceous Whitsunday Volcanics (Kw)
- Lower Cretaceous Proserpine Volcanics (Kp)
- Tertiary sedimentary rocks (To),
- Tertiary - Pliocene consolidated sediments (TQas)
- Cainozoic alluvium (Cz),
- Quaternary alluvium (Qa),
- Quaternary marine sediments (Qm),
- Quaternary beach ridges (Qr) (See Figure 4 for a generalised cross-section of the area).

The oldest geology of the Whitsunday Coast area is the Campwyn and Edgecumbe beds. The Campwyn beds were formed during the Devonian – Carboniferous period (360 to 408 million years ago) and are located south of the O'Connell river and form most of the coastal or near coastal rises and hills. These ancient coastal deposits include acid to intermediate volcanic rocks and some sedimentary rocks.

The Edgecumbe beds comprising acid to intermediate volcanic rocks and sedimentary rocks were formed during the upper Devonian or lower Carboniferous period (286 to 360 million years ago). The near coastal hills east and north east of Proserpine that include Mount Julian north-east to the Gregory River are formed from the Edgecumbe beds.

The oldest intrusive rocks are located in the north to north west of the Whitsunday Coast area. The Upper Carboniferous intrusive intermediate to basic rocks (Cud) form the undulating rises and hills west of the Bruce highway from Mookara to the Don River. The Upper Carboniferous acid to intermediate rock form the undulating rises from Longford Creek to Mount Buckley to Bowen. Structural movements of these plutons have caused metamorphosed areas such as the Bodes Range shear, Mt Williams shear and the Mount Challenger shear. The Carmila beds overlie these intrusive rocks in the north of the Whitsunday Coast area.

The Carmila beds were deposited during the Permian period (250 to 290 million years ago) and consist of acid and intermediate volcanic rocks, sandstones and volcanic ash beds. The sandstone layers represent periods of volcanic inactivity. The Carmilla beds form a band of undulating rises to hills from Mount Bramston and Brisk Bay south east to beyond Mackay. The strata of the Carmilla beds have been uplifted and tilted by periods of tectonic movements, particularly during the Tertiary period.

The coastal mainland hills from Repulse Creek north west to near Earlando tourist resort are formed by the Airlie Volcanics. The Airlie Volcanics were formed during the Permian period (250 to 290 million years ago) about the same time as the Carmilla beds but by different volcanic sources. The composition of the Airlie volcanics are primarily acid to intermediate volcanic rocks.

The Lower Cretaceous period was an active period of tectonic activity. This period saw the emplacement of numerous intrusive bodies, particularly in the western areas of the survey. The Urannah igneous complex (Ckr) comprises the hills and mountains in the south west of the survey. The Hecate Granite (Kh) represents a different batholith and forms the hills west and north-west of the Proserpine dam. The emplacement of these acid to intermediate intrusive rocks possibly contributed to the intensive tectonic period of the late Cretaceous to early Tertiary period.

The Whitsunday Volcanics (Kw) and Proserpine Volcanics (Kp) were both formed during the Lower Cretaceous period (65 to 141 million years) and are mainly acid to intermediate volcanic rocks. The source of the flows is probably offshore granite stocks which compose Shaw, Pentecost and Hayman islands. The Proserpine volcanics is suspected to have formed from a different period and source of volcanic activity to the Whitsunday Volcanics.

Block faulting in the region commenced in the late Cretaceous or early Tertiary period (60 to 70 million years ago), and formed the Hillsborough Basin (Paine, 1972). The Hillsborough basin covers the area from approximately Bowen south-east to the Cumberland islands. The Hillsborough basin represents an area where the land mass has fractured and sunken to more than 1600 m in the Goorganga plains area. This period of tectonic movement caused the Carmilla beds to dip at 15 to 40 degrees with a north-south strike and further deformed the Edgecombe and Campwyn beds.

The faulting during the Tertiary period further transformed the landscape and formed basins for sediment accumulation. Some of the early sediment is still present in the survey area and is classified as Tertiary sandstone (To), Tertiary – Pliocene consolidated and semi-consolidated sediments (TQas) and unconsolidated Cainozoic alluvium (Cz). The more recent alluvium is classified as Quaternary alluvium (Qa), Quaternary marine sediments (Qm) and Quaternary beach ridges (Qr).

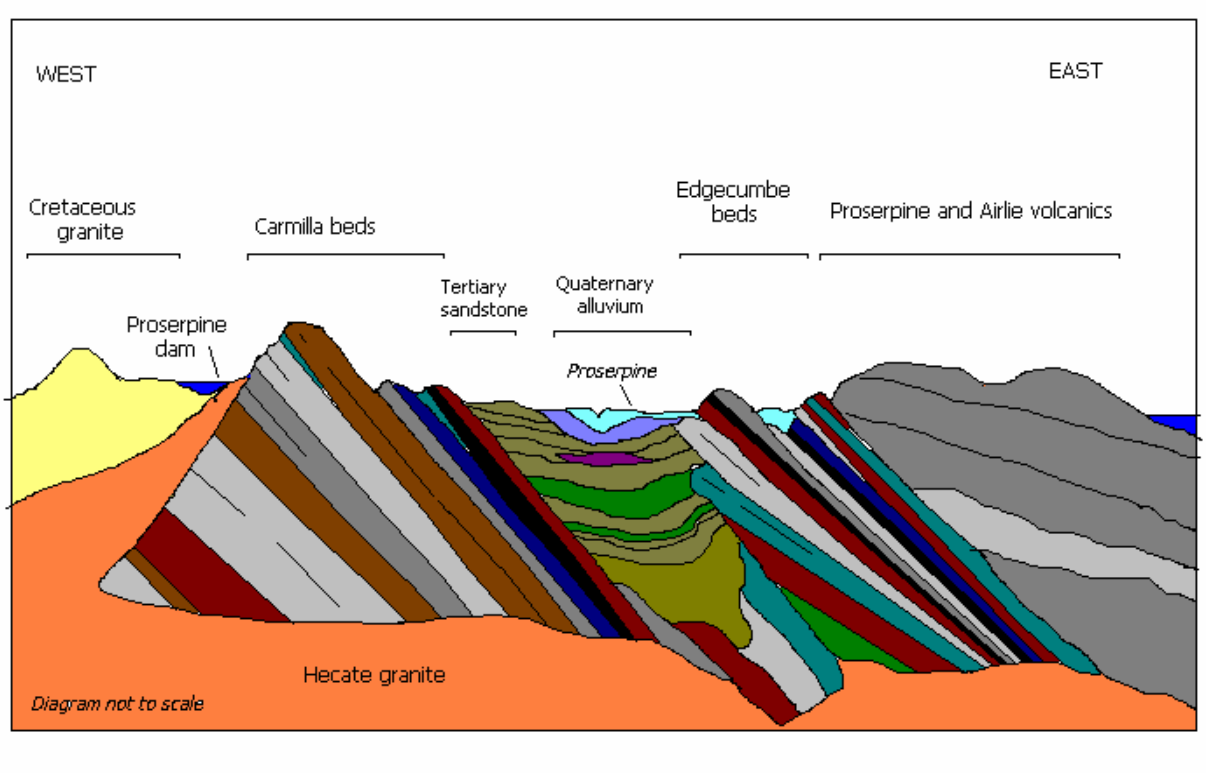


Figure 4. A schematic representation of the main geological units in the Whitsunday Coast area

The Tertiary sedimentary rocks (To) consist of fine and coarse grained sandstones with some shale deposits. The shale deposits are located close to the coast and appear to be of marine origin. The shale outcrops near the Proserpine airport and north near Debella. The Tertiary sandstone deposits are located in isolated deposits throughout the survey with the main deposits found in central to northern areas. These sedimentary rocks have been uplifted and faulted during the late Tertiary period and occur as low rolling rises in the area. The Tertiary sedimentary rocks represent isolated remnants of a previous landscape which has been extensively eroded and weathered.

The Tertiary - Pliocene consolidated and semi-consolidated sediments (TQas) have been formed by outwash from hills and mountains. This younger Tertiary landscape may also have formed from the weathering of the Tertiary landscape. These deposits generally occur as flat to undulating rises with thick hardened silica pans or sandstones above the present floodplains. which are in places deeply dissected but have not been altered by tectonic movements. Some semi-consolidated sedimentary layers may underlie the Pliocene silica pans and sandstones.

The unconsolidated Cainozoic alluvium is generally found adjacent to the Tertiary sandstones and Tertiary - Pliocene consolidated sediments. The Cainozoic alluvium is found in elevated flood free areas or dissected peneplains. This sediment was formed by fluvial and colluvial processes which no longer operate or are less active. The Cainozoic alluvium could have been formed under different climatic conditions to the more recent Quaternary alluvium. The Cainozoic alluvium consists of sand, gravel and clay and may represent alluvial - colluvial material derived from the Tertiary sediments.

Quaternary alluvium is found in areas which experience periodic or frequent flooding. This alluvium is usually interbedded with a variety of sediment including clay, silt, sand and gravel. The Quaternary marine sediments represent areas that have been formed from estuarine and nearshore sediments. Large areas of these marine sediments are found in the Goorganga Plains area. Beach ridges occur adjacent to the Quaternary marine alluvium.

The Quaternary beach ridges (Qr) include inland and coastal dunes formed in the Pleistocene and Holocene epochs. The most extensive area of Quaternary beach ridges occurs in the Goorganga plains area with a series of parallel ridges.

2.3. Geomorphology

There were eight main landform patterns described in the survey (McDonald *et al.*, 1984);

- Mountains
- Low hills and hills
- Undulating rises
- Alluvial fans
- Cainozoic terraces
- Quaternary alluvial plain
- Coastal beach ridge systems
- Delta

The highest mountain in the survey area is Mount McCartney at 980m which is close to the south western boundary of the survey. Other mountains of note include Mount Dryander at 820m, Mount Challenger at 516m, Mount McGuire at 738m, Mount Hector at 890m and Mount Quandong at 792m.

The hills and low hills in coastal areas are mostly formed by acid to intermediate volcanic rocks from various sources and ages. The low hills and undulating rises directly west of Proserpine are formed by the Carmilla beds and are composed of volcanic and sedimentary rocks. Undulating low hills in the north of the survey are composed of acid to intermediate intrusive and volcanic rocks of varying ages. These hills have been formed by tectonic uplift and have been fractured and faulted. The fracturing and faulting of the Carmilla beds have pushed some parts of the geological strata upwards while other parts have been tilted downwards. The resulting effect of these processes is the outcropping of the geological strata on the surface. The composition of the Carmilla beds is highly variable consisting of acid and intermediate volcanic rock, pyroclastic rock, sandstone and siltstone. In situations where a variety of rock types outcrop and have been exposed to soil formation processes, a wide variety of soils will occur.

Tectonic uplift and millions of years of active erosion has weathered most of the Tertiary landscape to form undulating rises. The erosion of the Tertiary landscape has contributed towards the formation of the level to undulating rises of the Tertiary-Pliocene landscape.

The Tertiary - Pliocene landscape probably formed between 2 and 6 million years ago during the Pliocene epoch when the area had a wetter climate and the Tertiary landscape was being subjected to extensive erosion. The landscape is now deeply dissected.

The rise of the sea level approximately 125 000 years ago and more recently 6 500 years ago deposited large amounts of sediment in coastal and near coastal areas. Alluvial fans have also deposited sediment in areas adjacent to the Tertiary landscape has been deeply and extensively eroded.

The weathering of the low hills and undulating rises have formed a complex assemblage of alluvial fans. The colluvial fans are soil and gravel deposits which have been eroded from the upper slopes and deposited at the base of the hill. The fans represent periods of erosion caused by high intensity rainfall events such as cyclones. The largest fans occur adjacent to the steeper hills such as Mt Challenger.

The floodplains of the Whitsunday Coast survey have had a complex depositional history. In some areas adjacent to the Don River, O'Connell River and coastal creeks, remnants of an ancient floodplain exist in the form of terrace plains and flats.

The terrace flats are composed of Quaternary alluvium, older consolidated and semi-consolidated Pliocene sediments and Cainozoic alluvium. These elevated areas are located well above existing or modern flood levels. The older sediments are easily distinguished from the more recent Quaternary alluvium. The sediments of some of the older Quaternary alluvium in drier areas may have some degree of consolidation.

The Quaternary alluvial sediments are found in large areas adjacent to the Proserpine River and in small pockets in the lower parts of the landscape associated with local creeks. These alluvial plains and floodouts are flat to very gently undulating. The soils formed from the flood events usually have layers of buried material from clay to gravel.

The Quaternary beach ridge system is located adjacent to estuarine and coastal areas. The dune systems have formed in the deltas of Greta, Yeates and Duck creeks. The Goorganga Plains area have up to four sets of beach ridges of varying ages. The coastal ridges are most likely of Holocene age formed in the last 6,500 years. The inland sand ridges may be Pleistocene in age and formed during a previous sea level high about 125,000 years ago .

The Proserpine and O'Connell rivers delta have formed in the Holocene epoch and extends from the O'Connell River north to Mt Julian and Conway, and west of the Bruce highway to the town of Proserpine. The Proserpine - O'Connell River delta can be described as a lobate high constructive delta produced by tidal and river processes (Lewis and McConchie, 1994). The features of the delta are the Holocene alluvial plain, the chenier plain and the tidal flats.

2.4. Water resources

2.4.1 Surface water

The O'Connell, Proserpine, Gregory and Don Rivers are the main coastal water courses in the Whitsunday Coast area. The Proserpine dam is located 57 kilometres up stream of the Proserpine River mouth and has a capacity of 500,000 megalitres and construction was completed in 1991. The Proserpine River flows for 80 kilometres with its source being near Mount Quandong (Queensland Department of Primary Industries, 1993). The Proserpine River has a mean discharge of 630,000 megalitres per annum with a catchment area of approximately 1060 square kilometres (Queensland Department of Primary Industries, 1993). The mean annual discharge of the Proserpine River at Peter Faust dam is approximately 414 815 megalitres. The mean annual discharge of the Gregory River over a twenty year period is approximately 137 000 megalitres a year (Queensland Department of Primary Industries, 1993). The O'Connell River mean stream discharge is approximately 235 178 megalitres a year.

Other notable coastal creeks include Goorganga, Yeates, Greta and Duck creeks. Most of the coastal creeks are ephemeral and flow during the summer and autumn months which correspond to the summer dominant rainfall of the region.

2.4.2. Sub surface water

The groundwater resources of the Whitsunday Coast area are utilised for the irrigation of sugarcane and horticultural crops in the drier northern parts of the study area.. According to the Queensland Department of Primary Industries (1993), the Proserpine River catchment area may have a groundwater yield of 21,200 megalitres per annum. The groundwater supplies associated with the Proserpine River are estimated to have less than 3000 milligrams per litre (total dissolved solids) (electrical conductivity of 4.7 dSm-1). It is estimated that 70% of the groundwater in the Proserpine River alluvium groundwater sources have low salinity levels.

However the QDPI (1993) has estimated that the coastal aquifers associated with the Tertiary rock will be salty and probably have pumping rates less than 10 litres a second. The groundwater supplies associated with the Carmilla beds are expected to have low salt levels and low pumping rates.

2.5. Natural Vegetation

2.5.1. Introduction

The structural form and main species of vegetation were described at each site of the Whitsunday Coast area. Most of the lowlands and alluvial flats in the survey area have been cleared for sugarcane and cattle grazing. Vegetation has been generally retained in areas which are steep or where lower quality soils occur. Vegetation communities are strongly correlated to soil type and climate. The vegetation list for the survey area are in Appendix I.

2.5.2. Vegetation communities

Most of the vegetation in the mountains remain undisturbed. The more elevated and wetter slopes in higher rainfall areas support notophyll or microphyll subtropical rainforest communities. The mountains formed from the intermediate volcanic rocks of the Carmilla beds support mainly Notophyll rainforest communities which consist of quandong (*Elaeocarpus grandis*), bumpy ash (*Flindersia schottiana*), white cedar (*Melia azaradarach)*, and hoop pine *(Araucaria cunninghamii)* with an understorey including cryptocarya (*Cryptocarya triplinervis*) and red kamala (*Malliotis phillipenensis).* Where the community has been either logged in the past or disturbed by selective clearing, the vegetation community is dominated by Moreton Bay ash (*Corymbia tessellaris*), Clarkson's bloodwood (*Corymbia clarksoniana*), pink bloodwood (*Corymbia intermedia*) and narrow-leaved ironbark *(Eucalyptus crebra).* The understorey of these areas often consists of cocky apple (*Planchonia careya*) and may also include rainforest pioneer species such as pink tamarind (*Jagera pseudorhus*), red kamala, white cedar, bumpy ash and swizel bush (*timonius timon*). Where the substrate is acid volcanic rocks, open eucalypt woodlands are found. These woodlands are dominated by narrow leaved iron bark, pink bloodwood and occasionally poplar gum (*Eucalyptus platyphylla*) with a broad leaved tea tree (*Melaleuca viridiflora*) understorey.

Plate 1. Tropical rainforest associated with undulating coastal hills

The mountains and hills formed from acid intrusive rocks such as granite and adamellite generally support dry microphyll rainforest communities. Some of the species which are found in these communities include broad leaved bottle tree (*Brachichiton australis*), white cedar, *Alixyia ruscifolia*, white flowered bauhinia (*Lysiphillum hookeri*), Mackay cedar (*Paraserianthes toona*), bleeding heart (*Omalanthus populifolius*) banana bush (*Tabernaemontana orientalis*), *Acacia fasculifera*, native elm (*Aphananthese phillipenensis*), D*rypetes peplanchei*, rock fig (*Ficus platypoda*), smooth barked ironwood (*Austromyrtus bidwillii*), Burdekin plum (*Pleiogynium timorense*) and red ash (*Alphistonia excelsa*).

Plate 2. Dry rainforest associated with drier coastal hill areas

The vegetation on the undulating low hills and rises vary considerably due to soil type and degree of clearing. The soils formed on the acid volcanic rocks tend to be low in fertility and support a vegetation community dominated by narrow-leaved ironbark and pink bloodwood with an understorey dominated by broad-leaved tea-tree. The vegetation community found on the acid volcanic rocks is similar to those found on soils formed from quartz dominated sedimentary rocks.

Soils formed on intermediate volcanic rocks support vegetation communities with an upper storey consisting of Moreton Bay ash, Clarkson's bloodwood and blue gum (*Eucalyptus teretitcornis*). The lower storey may consist of cocky apple and pioneer rainforest species. In footslope positions poplar gums may be included in the upperstorey and the broad leafed tea-tree in the understorey.

The undulating rises formed from Tertiary sediments are composed of a wide range of sediments from shale to fine and coarse grained sandstone. The type of sedimentary rock influences the type of vegetation. The highly weathered coarse grained sandstones produce shallow sandy soils with very low fertility and support vegetation communities dominated by narrow-leaved ironbark, pink bloodwood, *Acacia leptocarpa*, Townsville wattle *(Acacia leptostachya), Acacia julifera*, pretty wattle (*Acacia decora*), *Hakea suberea*, and bull oak (*Allocasuarina leuhmannii)*. Closer to the coast the coastal she-oak *(Allocasuarina littoralis)* is also found on these rises. The fine grained sandstone produce relatively deep sands and yellow earths which support vegetation communities dominated by Clarkson's bloodwood and pink bloodwood with cocky apple and broad leafed tea tree understorey with occasionally rainforest pioneer species and vines. The soils formed from the shale tend to be texture contrast (duplex) soils and support vegetation communities dominated by pink bloodwood and narrow-leaved ironbark with broad leaf tea tree understorey.

The peneplains and gently undulating rises of Tertiary - Pliocene consolidated sediments have different vegetation to the younger Quaternary alluvium flats. The vegetation consists of narrow-leaved ironbark and pink bloodwood with broad leaved tea tree, wattle (*Acacia leptostachya* and *Acacia leptocarpa* and *Acacia simsii*), Quinine (*Petalostigma pubescens*), beef wood *(Grevillea striata), Grevillia parallela*, poplar gum and bull oak understorey. The ground cover at these sites is sparse and is dominated by tussocky sporabolis (*Sporabolis diandrus*) and in places grader grass (*Themeda quadrivalis*).

Plate 3. The vegetation found on the Tertiary - Pliocene soils

The soil on the Quaternary alluvium flood plain flats are generally more fertile and support a different assemblage of vegetation communities. The frequency of flood events and soil drainage were found to influence the species present on these alluvial flats. In general, the backplains which are poorly drained and are flooded relatively more frequently support eucalypt woodlands dominated by Poplar gums with a broad leaved tea-tree understorey. Soils which are flooded less frequently support a Eucalypt woodland dominated by Clarkson's bloodwood, narrow leaved ironbark, Moreton Bay ash, and pink bloodwood. In relatively undisturbed areas the creek flats tend to support a rainforest community with eucalypt emergents such as blue gums and Moreton Bay ash and occasionally river blackbutt *(Eucalyptus ravetianna).* Most of these river flats have been cleared for cattle grazing or sugarcane.

The riverine vegetation along the mid to lower reaches of the coastal creeks are dominated by weeping tea tree (*Melaleuca leucadendra*), *Melaleuca fluviatilis*, paper barked tea tree (*Melaleuca nervosa*), Alexander palm (*Archontophoenix alexandrae),* blue gum, bottle brush (*Callistomon viminalis*), sovereignwood (*Terminalia sericocarpa*), milky pine *(Alstonia scholaris*), river blackbutt and river oak *(Casuarina cunninghamiana).* The riparian vegetation in the smaller creek tributaries are dominated by swamp mahogany (*Lophostemon suaveolens*), Northern swamp box (*Lophostemon grandis)* and paper barked tea-tree. The creeks which occur in steep sided valleys usually have riverine rainforest with eucalypt and Melaleuca emergents and occasionally Alexander palms.

Plate 4. The riverine vegetation found upstream in coastal creeks.

The Whitsunday Coast study has identified some declared weeds. The main weeds identified in the survey include prickly acacia (*Acacia nilotica*), sickle pod (*Cassia obtusifolia*), giant rats tail grass *(Sporobolis piramidalis)*, parthenium *(Parthenium hysterophorus)*, chinee apple (*Ziziphus mauritiana*), mimosa (Acacia farnesiana), lantana (*Lantana camara*) and rubber vine (*Cryptostegia grandiflora*). Prickly acacia occurs in thick infestations on the floodplain of Duck creek in the north of the survey. This weed is also found in lower densities on footslopes adjacent to the Duck creek floodplain. Chinee apple is found on hillslopes and alluvial fans throughout most of the survey from Longford creek north to Bowen. In general, the infestations of chinee apple are relatively sparse. Similarly, the infestations of mimosa are relatively sparse and occur in isolated sites in the survey. Lantana occurs throughout the survey area in very low to moderate infestations. Thick infestations of rubber vine occur along creek beds and floodplains. Minor infestations of rubber vine occur on footslopes. The release of a rust to reduce the infestations of rubber vine appears to have slowed and reduced infestations in some areas. There are outbreaks of sickle pod in the Andromache - O'Connell River systems and isolated areas in the Cannon Valley and lower Proserpine River area. Parthenium has been identified in very small areas in the upper Andromache river and a quarry near the Proserpine dam. Giant rats tail grass has been identified in the Bloomsbury area and the Crystalbrook area.

Plate 5. Infestations of rubber vine are common along the coastal creeks in the Bowen Shire.

3.0. Methods

3.1. Survey methods

The Whitsunday Coast area was separated into 14 individual areas. Land resource mapping was undertaken at a scale of 1:50 000 for 13 of the 14 surveys conducted as part of the WILUS and PILUS. The first eight surveys were completed as part of the PILUS and the remaining six as part of the WILUS. The Clarke range survey was conducted at a scale of 1:100,000 and used airborne radiometric data to assist with delineating map units. The areas deemed to be high priority areas by the project stakeholders were completed first.

The methods used to map the soils and land resources follow the guidelines described in Gunn *et al.* (1988) and McDonald *et al.* (1990). Initial soil and landform patterns were identified using a stereoscope and air photographs with a scale of approximately 1:25,000. Preliminary mapping units are then formulated using the stereoscope and field description sites are chosen. The field sites are positioned close to the centre of the mapping units to ensure they are representative of a particular landform. The soil morphology, geology and vegetation are described at each site.

The soil data collected at each site is used to allocate the soil profile to a suitable soil profile class. The soil profile class is the basic mapping unit used to group soil profiles with similar characteristics (Isbell, 1996).

The soil profile classes used in the Whitsunday Coast area are derived from the Mackay Sugar Cane Land Suitability Study (Holz and Shields, 1985), the soils of the Proserpine Lowlands (Thompson *et al.*, 1980), Soils of the Elliot River - Bowen area (Aldrick, 1988) and surveys completed as part of the PILUS or WILUS.

The land resource surveys described 1780 soil profiles as part of the WILUS and 1917 soil profiles as part of the PILUS. The site intensity of the 1:50 000 scale surveys range from 1:30 to 1: 80 ha. The data collected at these sites have been entered into a Microsoft ACCESS computer database. Final mapping units or Unique Mapping Areas (UMAs) are drawn on the air photographs based on data gathered from the observation sites and other field observations. Each UMA is named after the dominant soil profile class in the UMA and represents an area of uniform soil, geology and landform. Data on soil, geology, vegetation, land degradation and reference information such as site location are coded and recorded in a UMA database. There are 4590 UMAs recorded for the Whitsunday Coast study. The coded UMA information is used to determine the suitability of each UMA for the twelve land uses.

3.3. Soil chemistry analyses

The soil samples collected from the land resource surveys were analysed by the Agricultural chemistry lab at the Department of Natural Resources (Resource Science Centre) in Brisbane. The chemical analyses which were conducted on the topsoil samples include phosphorus (acid and bicarbonate), organic matter, aqueous cations (calcium, magnesium, sodium and potassium), DTPA extractable micro-nutrients (iron, manganese, copper and zinc), total nitrogen, particle size, pH, electrical conductivity and chlorine. The chemical analyses that were conducted on the subsoil samples included pH, electrical conductivity, chlorine, aqueous cations (calcium, magnesium, sodium and potassium), and particle size. The chemistry data collected was then used to determine the exchangeable sodium percentage (ESP), Effective Cation Exchange Capacity (ECEC) and Calcium : Magnesium ratios for each soil sample.

The electrical conductivity and soil pH were measured in the field for each horizon at each site. The conductivity was measured at each site using a 1:5 soil-water solution and a conductivity meter. The pH was measured using a field kit which included raupach indicator and barium sulfate except where acid sulfate soils were described. Acid sulfate soils were measured using a pH meter in a 1:3 soil and water solution. The acid sulfate soil samples were collected using the QASSIT methodology (DNR, 1997). The process of collecting and transporting the acid sulfate soils involved freezing the soil on site and sending the samples by courier the next day to the Department of Natural Resources labs in Brisbane. The tests conducted on the samples included sulfur, total oxidisable sulfur and POCAS.

3.4. Mapping reliability

The land resource survey of 13 of the 14 surveys were conducted at a scale of 1:50 000 while the Clarke Range survey was conducted at a scale of 1:100 000. Airborne radiometric data were used to improve soil boundary delineation in the Clarke range survey and improve accuracy. Gun *et al* (1988) states that land resource surveys conducted at a scale of 1:50 000 are appropriate for local and regional planning and should have a site intensity of one per 25 to 100 ha. The site intensity of the surveys range from 1:30 ha for the Lethebrook (Hardy, 1998) to 1: 72 ha for the Gregory River area (Hardy, 1998). The smallest mappable unit at 1:50 000 scale is 5 to 10 ha. It is recognised that the UMAs will be composed of a number of soil profile classes. For most UMAs the dominant soil profile class will comprise 60 – 90% of the UMA, with the remaining area of the mapping unit composed of associated soils.

4.0 Soils

4.1. General

The land resource surveys identified 111 soils and thirteen variants in the Whitsunday Coast surveys. The geology and rainfall patterns have influenced the range of soils. In general, the drier northern areas have soils similar to those described by Aldrick (1988), whereas the southern areas have soils with some affinity with the Proserpine lowlands survey (Thompson, *et al.*, 1981) and the Mackay Caneland Study (Holz and Shields, 1985). There are 20 soil profile classes that are unique to the Whitsunday Coast survey and have been described by the PILUS and WILUS (Hardy, 2000).

The soils are grouped according to the material they overlie. The discussion of each soil includes morphology and some chemistry. Soil morphology refers to the physical structure and horizonisation attributes of the soil. The morphological features of the soil include soil depth, horizons, surface and profile rockiness, texture and colour. The chemical features of the soil include pH, electrical conductivity, dispersion and sodicity. The surface fertility characteristics of some of the soils are mentioned.

The pH of the soil is an expression of the proportion of hydrogen and hydroxl ions in the soil and reflects the acidity and alkalinity of the material. The optimum pH range is between 5.5 to 8, where the majority of nutrients are available to plants (Baker and Eldershaw, 1991). Soils with very acid or alkaline pH restrict the nutrients available for plant growth. The electrical conductivity of the soil indicates the amount of free salt in the soil and is a measure of salinity. The salts which may be present in the soil include sodium chloride ions and soluble anions such as sulfates, nitrate and bicarbonates (Baker and Eldershaw, 1991). Subsoil sodicity has also been included in the description of soil chemistry. Baker and Eldershaw (1991) describe sodicity as a measure of the proportion of sodium ions in the soil. Sodic soils are generally dispersive and therefore prone to erosion. Soils that are described as sodic are not necessarily saline. The electrical conductivity data in the following graphs were complied by averaging the field data for each soil. Detailed soil chemistry for each soil is located in Appendix V.

4.2. Soils formed on acid to intermediate intrusive rocks

Upperslopes of steep mountains to undulating rises

Soil morphology and classification

The acid to intermediate intrusive rocks mainly occur as rises, low hills and mountains in the south western, central west and northern areas of the survey. The soils formed on acid to intermediate intrusive rock form shallow gravelly soils in the upper slopes and duplex soils on the mid to lower slopes (Table 1). Ten soils have been described.

Table 1. The description and classification of soils formed on the upperslopes of steep mountains to undulating rises on acid to intermediate intrusive rocks

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Soils on coarse grained acid granitic rocks				
Cy	Caley	Shallow to moderately deep, uniform to gradational soil with a coarse sand topsoil, conspicuously bleached, grading into a neutral, pale brown, coarse sand BC horizon.	Leptic Rudosol	Uc2.21

Wn	Woonton	Moderately deep, gradational soil with a loamy sand to sandy loam topsoil, over a neutral, yellowish-grey, mottled, sandy loam to clay loam fine sandy subsoil.	Grey to Yellow Kandosol	Gn2.62, Gn2.65
Soils on fine grained granitic rocks				
Bk	Buckley	Moderately deep, duplex soil with a sand topsoil, conspicuously bleached A2 over an alkaline, grey, mottled, light to medium clay subsoil.	Grey Sodosol	Dy3.43 Dy3.42 Dy2.43
Du	Dunwold	Moderately deep, duplex soil, with a sandy loam topsoil, over a neutral, grey, sandy light to medium clay subsoil.	Grey Sodosol	Dy2.42
Gr	Glenroc	Moderate to deep, sodic duplex soil with a pale grey, loamy sand topsoil, bleached, over an alkaline, brown to greyish brown, clay subsoil.	Yellow Sodosol	Dy3.12, Dy3.13, Dy3.33, Dy3.22
Hc	Hector	Shallow uniform soil with a coarse sand to sandy loam topsoil, over a shallow sandy BC horizon.	Leptic Rudosol	Uc1.21
Soils on acid-intermediate intrusive rocks				
Fl	Finley	Moderate to deep, duplex soil with a loamy sand to sandy clay topsoil, over an acid to neutral, brownish red to red clay subsoil.	Red Chromosol	Dr4.12
Ka	Kailla	Moderately deep, duplex soil with a sandy loam topsoil, over a neutral, brown to greyish brown, sandy light to medium clay subsoil.	Brown Sodosol	Dy5.61, Dy3.61, Dy5.52,
Nt	Netherdale	Moderately deep, gradational soil with a clay loam topsoil over an acid to neutral brown clay subsoil.	Brown Dermosol	Uf6.4
Ub	Uruba	Moderately deep, duplex soil with a sandy loam to sandy clay loam topsoil, over a neutral, brown to greyish brown, clay subsoil.	Brown Chromosol	Dy3.32
Ub2	Uruba (sandy A horizon variant)	Moderately deep, duplex soil with a loamy sand to sandy loam topsoil, over an acid, greyish brown to brown clay subsoil.	Grey Chromosol	Dy4.42

The coarse grained acid granites mainly occur in the hills and mountains south west of Bowen. The upperslopes form **Caley** soils that are very sandy and are generally less than 0.30 m deep. The pale grey to black loamy sand to clay loam textured surface usually has 20 to 90% boulders and cobbles. The profile has an acid to neutral pH and very low levels of salinity and sodicity (Figures 5 and 6). The **Hector** soil is a shallow variation of Caley.

In some mid-slope positions on undulating rises, the Caley soil grades into deeper sandy **Woonton** soils that are generally 0.30-1.10 m deep. The grey loamy sand to sandy loam 0.10 to 0.20 m thick topsoil overlies a very well drained, yellowish grey, massive, acid to neutral, sandy loam to clay loam fine sandy subsoil that has very low levels of salinity and sodicity. The subsoil overlies a deep layer of decomposing granite.

Plate 6. The Woonton and Caley soils have a high sand content and are well drained.

The fine-grained granites such as tonalite and microgranite (less silica and more feldspar) form sodic texture contrast soils and mainly occur on mid slopes south west of Bowen. The sodic nature of these soils is derived from the weathering of sodium plagioclase. Two soils occur on upper slopes. **Dunwold** has a loamy sand to sandy loam surface 0.20-0.45 m thick over a mottled (10-50%) grey to greyish-brown, acid to neutral, sodic (exchangeable sodium percentage of 6 to 14 in the first 0.10 m) light medium to medium clay subsoil with weak to moderate prismatic structure. The subsoil has low amounts of salinity (electrical conductivity levels 0.1 to 0.3 dSm^{-1}). There may be up to 30% surface and profile rock. The **Glenroc** soil is morphologically similar Dunwold soils with a pale grey, acid to neutral surface 0.10 to 0.25 m thick over a brown to greyish brown, alkaline, sodic (exchangeable sodium percentage of 6 to 14 in the first 0.10 m) clay subsoil that may contain some gravel. The subsoil has low to moderate salinity levels (electrical conductivity levels 0.3 to 0.6 dSm^{-1}).

On mid-slopes, the **Dunwold** and **Glenroc** soils grade into the **Buckley** soil. Buckley is an acid to neutral loamy sand to sandy loam topsoil overlies a grey, poorly structured, alkaline, light to medium clay subsoil that is usually gravely. The subsoil usually has moderate to high amounts of soluble salt (electrical conductivity levels 0.3 to 1.0 dSm^{-1}) and is sodic to strongly sodic (exchangeable sodium percentage of 6 to 23) in the first 0.10 m of the subsoil. The higher levels of subsoil salt compared to upper-slope positions is due to the less permeable sodic subsoils. The Buckley soil is very dispersive and prone to severe gully erosion.

Where the underlying rock is more intermediate in mineral composition such as tonalite, granodiorite, and syenite, brown to red soils occur on upper to mid-slope positions. On steep upper-slopes, the **Netherdale** soil is shallow soil with a deep weathering front, or B3 horizon. The topsoil is generally a dark brown to black clay loam with moderate to strong subangular to polyhedral structure and large amount of boulders and cobbles. The **Finley** soil also occurs on more gently sloping upper-slopes and is usually less than 1.2 metres deep. The acid to neutral loamy sand to sandy clay loam topsoil 0.10 to 0.20 m thick overlies a well drained, acid to neutral, brownish-red to red, strongly structured medium to heavy clay which is low in salts may show signs of subplasticity. There is often 20 to 50% surface and profile rock.

On mid-slope positions, the **Finley** soil grades into the **Uruba** soil which has a dark grey to grey sandy loam to sandy clay loam usually 0.15 to 0.30 m thick over a moderately well drained, brown to greyish brown, well structured, non-sodic light medium to medium heavy clay subsoil to 0.60-0.90 m. There is often 20 to 50% surface and profile rock. The profile pH is acid to neutral and usually has low levels of salinity. The **Uruba (sandy A horizon variant)** soil is sometimes found in association with Uruba. This soil is usually less than 1 metre deep with a 0.20 to 0.55 m thick loamy sand to sandy loam topsoil with a bleached A2 horizon over a greyish-brown to brown, weak to moderate structured light medium to medium clay subsoil. There is often 5 to 20% surface and profile rock. The profile chemistry of Uruba (sandy A horizon variant) is similar to Uruba.

The **Kailla** soil is a sodic version of Uruba on mid-slope positions. Kialla has a brown to greyish brown, acid to neutral, sodic to strongly sodic (exchangeable sodium percentage of 6 to 22 in the first 0.10 m of the subsoil) subsoil with moderate amounts of salinity (electrical conductivity levels 0.3 to 0.6 dSm^{-1}).

Plate 7. The Finley soil formed on acid to intermediate intrusive rock.

Soil chemistry

The Caley and Woonton soils are rapidly drained sandy soils with an acid to neutral pH throughout the profile. These two soils have low sodicity and electrical conductivity levels (Figures 5 and 6). The Woonton soil has low topsoil fertility and the addition of fertiliser would be rapidly lost through the profile (Table 2).

Table 2. Selected topsoil soil chemistry for the soils formed on the upperslopes of steep mountains to undulating rises on acid to intermediate intrusive rocks

Soil Profile Class	**Phosphorus (bicarb (ppm)**	**Exchangeable K (meq/100g)**	**Iron (Fe) ppm**	**Copper (Cu) ppm**	**Zinc (Zn) ppm**	**Manganese (Mn) ppm**	**Organic Carbon (%)**
Buckley	4	0.08	29	0.1	0.1	3	0.4
Dunwold (c)	21	0.49	156	0.5	1.5	42	1.3
Finley	13	0.3	74	0.56	2.3	58	2.5
Glenroc	6	0.2	62	0.6	0.2	22	0.8
Kailla	2	-	59	0.1	0.4	1	0.4
Netherdale	10	0.32	65	0.9	0.7	13	1.6
Uruba	12	0.41	63	0.5	2.0	26	2.3
Uruba (sandy A horizon variant)	15	0.3	86	1	2.2	70	1.4
Woonton	3	0.26	56	1.2	0.2	26	0.4

Note (c) - Sample taken from sugarcane land

The Buckley and Dunwold both have low surface fertility. The subsoil sodicity of Dunwold ranges from an ESP of about 6 in the top of the subsoil to more than 10 in the lower profile. The sodicity of the Buckley soil exceeds an ESP of 25 below 0.6 m. The subsoil pH of Dunwold is acid to neutral and the subsoil pH of Buckley is strongly alkaline. The Glenroc and Kialla soils both have sodic subsoils and low surface fertility. The Kialla subsoil is acid to neutral while the Glenroc subsoil is alkaline. The soils formed on the more intermediate intrusive rocks have slightly higher soil fertility and low subsoil sodicity and salt (Figures 5 and 6). The subsoils of the Uruba, Netherdale and Finley soils have an acid to neutral pH.

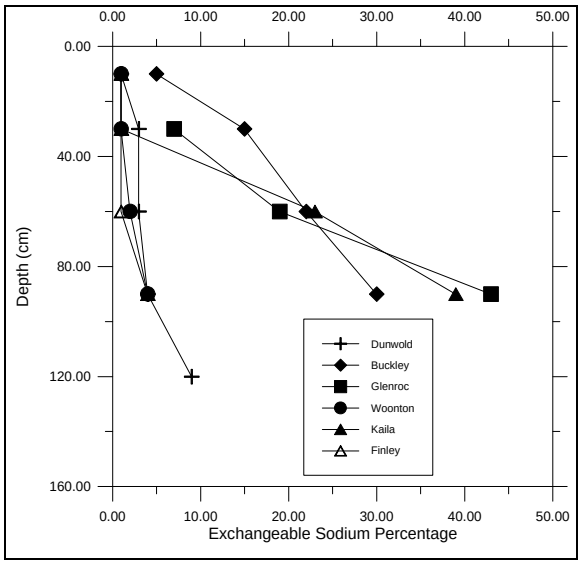


Figure 5. The mean sodicity of the soils formed from of acid to intermediate intrusive rocks and dykes

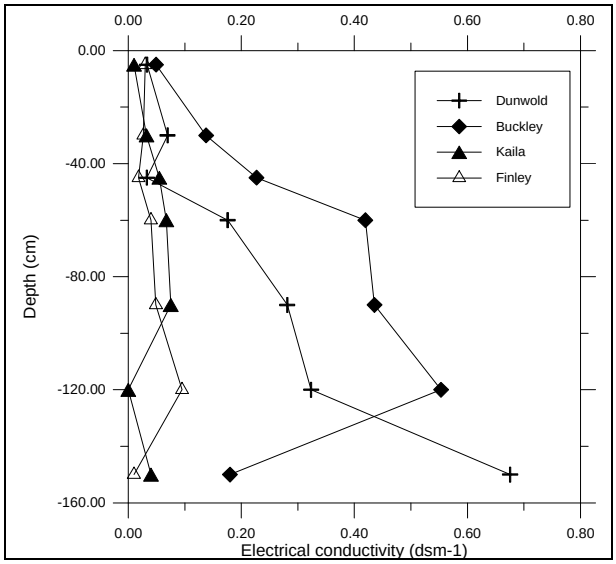


Figure 6. The mean electrical conductivity the soils formed from acid to intermediate intrusive rocks and dykes

The subsoil CEC:clay describes the activity of the clay and reflects the ability of the soil to hold nutrients. The activity of the sub soil clays in this soil group indicate that the subsoils are dominated by illite and minor smectite clay types (Figure 7). The illite clay present in the duplex soils has a moderate ability to hold nutrients. The most chemically active subsoils in this group is Glenroc and Buckley.

The Ca:Mg of Kailla and Buckley are much lower than the other soils in this group which could reflect the age of these duplex soils. The Ca:Mg reflects the dispersive nature of the Kailla and Buckley subsoils. The other soils in this group have Ca:Mg greater than 1.0 which generally indicates that the subsoil aggregates have a level of resistance against erosion (Figure 8).

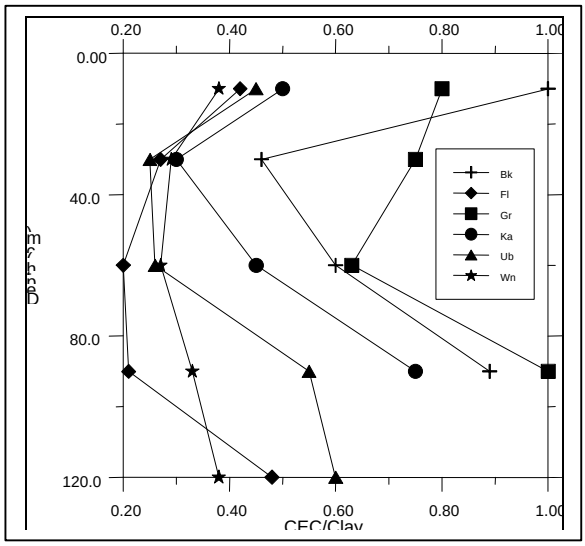


Figure 7. The CEC:Clay for the soils formed on the acid to intermediate intrusive rocks

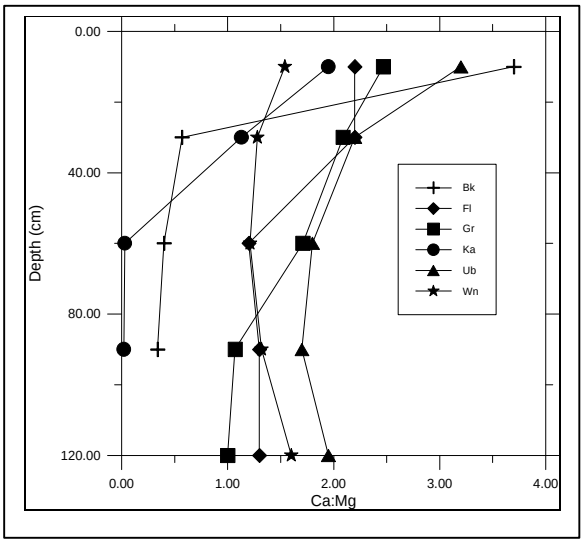


Figure 8. The Ca:Mg for the soils formed on the acid to intermediate intrusive rocks

Undulating to gently undulating footslopes and colluvial fans

Soil morphology and classification

The undulating footslopes and colluvial fans derived from acid to intermediate intrusive rocks occur at the base of some mountain and hill areas in the northern areas of the survey. These soils are formed by the transportation of material downslope by gravity and water. The colluvial soils have variable subsoil textures and include a range of buried material from clay to large rocks. Five soils have been described (Table 3).

Table 3. The description and classification of soils formed on the undulating footslopes and colluvial fans of acid to intermediate intrusive rocks

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Soils derived from coarse grained acid granitic rocks				
Ga	Gargett	Moderate to deep, duplex to gradational soil with a loamy sand to sandy loam topsoil, over an acid to neutral, grey to greyish brown, sandy clay loam to sandy light clay subsoil.	Grey Chromosol Grey Dermosol	Dy3.4.2
Qd	Quandong	Moderate to deep, sandy duplex to gradational soil with a loamy sand to sandy loam topsoil, over an acid to neutral, yellowish-grey to yellowish-brown, sandy clay loam to sandy light clay subsoil. This soil overlies layers of buried gravel to cobbles and may have an iron manganese pan in the profile.	Yellow Dermosol	Gn2.75
Soils derived from fine grained acid granitic rocks				
Hr	Hillrise	Deep, sodic duplex soil with sandy loam to sandy clay loam topsoil, bleached, over an alkaline, grey to greyish brown, clay subsoil.	Grey Sodosol	Dy3.23
Kw	Kowari	Shallow to moderately deep, gradational to duplex soil with loamy sand to sandy clay loam topsoil, over an acid to neutral, grey to greyish brown, sandy clay loam to sandy medium clay subsoil. This soil overlies layers of buried gravel to cobbles.	Grey Dermosol Grey Chromosol	Gn2.42
Rb	Roundback	Moderate to deep, duplex soil with a bleached, loamy sand to sandy clay loam topsoil, over an alkaline, greyish-brown clay subsoil.	Grey to Brown Sodosol	Dy2.42, Dy2.43, Dy3.43, Db2.32, Db2.43
Ub1	Uruba (alluvial variant)	Moderately deep to deep, duplex soil with a loamy sand to sandy loam topsoil, over an acid, greyish brown clay subsoil.	Grey Chromosol	Dy4.42

Where the upperslope is mainly composed of coarse grained intrusive rock, deep to moderately deep sandy soils occur on the footslopes and colluvial fans. The **Quandong (Qd)** soil is formed from a consolidated sandy gravel or cobbly pan. In some profiles the underlying pan consists of iron - manganese concretions. The pan is encountered at a depth of 0.6 to 1.5 m. The topsoil is 0.15 to 0.25m thick with a loamy sand to sandy loam texture and a neutral pH. The subsoil is a yellowish-grey to yellowish-brown, weakly structured, sandy clay loam to sandy light clay, with an acid to neutral pH.

The deeper sandy soils that occur at the footslope and colluvial fan have been placed in the Garget profile class. **Gargett (Ga)** is formed from unconsolidated colluvial material and possibly indicates relatively young debris flows from the coarse grained acid intrusive rocks. The topsoil is normally pale grey with a 0.25 to 0.55 m thick loamy sand to sandy loam texture with an acid to neutral pH. The subsoil is grey to greyish-brown with a sandy clay loam to sandy light clay texture, and a weak to moderate prismatic structure, and a neutral pH.

The soils formed downslope from fine grained acid intrusive rocks tend to be duplex soils. **Hillrise (Hr)** is a deep duplex soil with a 0.20 to 0.50 m thick, acid to neutral pH topsoil. The texture of the topsoil is a sandy loam to sandy clay loam with a bleached A2 horizon. There is often up to 10% rounded surface and profile rock and gravel. The subsoil is grey to greyish-brown, weakly to moderately well structured, and light medium to medium heavy clay texture with the pH increasing with depth. **Roundback (Rb)** is a strongly sodic duplex soil with moderate to abundant surface rock. The topsoil is 0.1 to 0.25 m thick with a sandy loam to sandy clay loam texture. There is often carbonate nodules below 1.0 m. The Roundback subsoil is more saline in the drier areas in the north of the study area. The **Uruba (alluvial – colluvial variant) Ub1** soil is an acid to neutral form of Hillrise.

The **Kowari (Kw)** duplex to gradational soil is usually less than 1 metre deep and overlies buried layers of gravel and cobble. The topsoil is 0.10 to 0.20m thick with a loamy sand to sandy clay loam texture. There is often 30 to 70% surface and profile rock. The subsoil is a grey to greyish-brown, weakly to moderately well structured, sandy clay loam to sandy medium clay with an acid to neutral pH.

Soil chemistry

The Quandong and Gargett soils are rapidly drained sandy soils with an acid to neutral pH throughout the profile. These two soils have low sodicity and electrical conductivity levels (Figures 5 and 6). The two sandy soils have low topsoil fertility and the addition of fertiliser would be rapidly lost through the profile (Table 4).

Table 4. Selected topsoil soil chemistry for the soils formed on the upperslopes of steep mountains to undulating rises on acid to intermediate intrusive rocks

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Quandong	6	0.22	59	0.6	0.34	82	1.1
Gargett	3	0.17	35	0.1	0.5	17	0.76
Hillrise	8	0.2	48	0.32	0.47	23	0.95
Roundback	2	0.13	23	25	0.2	25	0.3

The soil formed on the footslopes and colluvial fans on acid intrusive rocks all have low to very low surface fertility. The Hillrise and Roundback soils have strongly sodic clayey subsoils, while the more sandy soils have low subsoil sodicity. The sodic subsoils also have an alkaline pH and higher soluble salt levels (Figures 9 and 10).

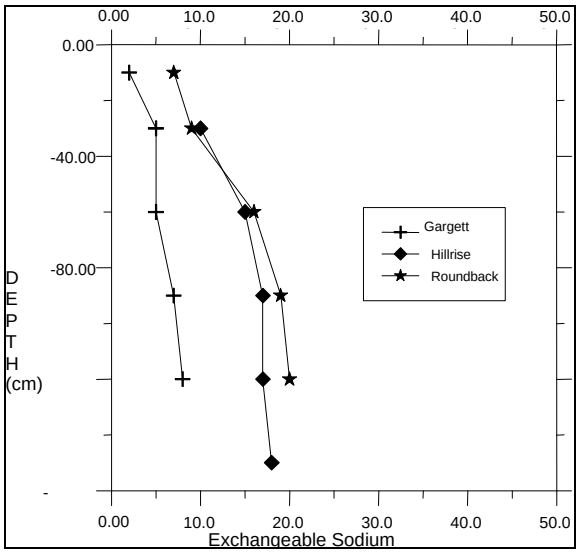


Figure 9. The mean electrical conductivity on flat to undulating footslopes and colluvial fans formed from acid to intermediate intrusive rock

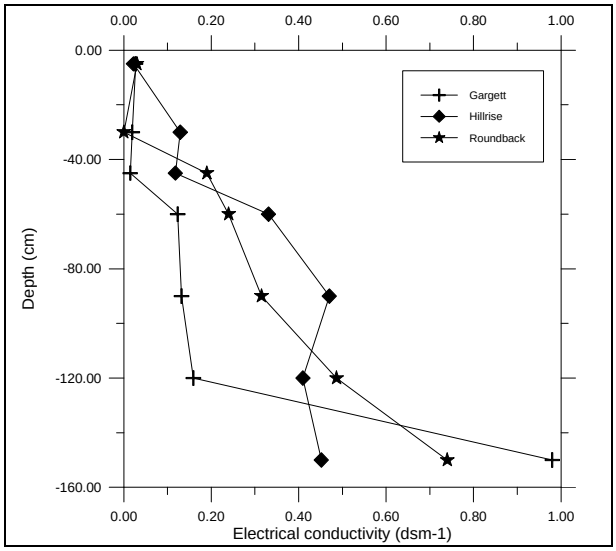


Figure 10. The mean sodicity of the soils formed of soils formed on the flat to undulating footslopes and colluvial fans of acid intermediate intrusive rock to rock

The clay activity of the Hillrise and Roundback sub soils indicate that the presence of illite and minor smectite clay types (Figure 11). The illite clay present in the duplex soils has a moderate ability to hold nutrients. The more sandy subsoils of Gargett and Quandong are dominated by kaolinitic clays with a low level of chemical activity.

The Ca:Mg of Kailla and Buckley are much lower than the other soils in this group which could reflect the age of these duplex soils. The Ca:Mg reflects the dispersive nature of the Kailla and Buckley subsoils. The other soils in this group have Ca:Mg greater than 1.0 which generally indicates that the subsoil aggregates have a level of resistance against erosion (Figure 12).

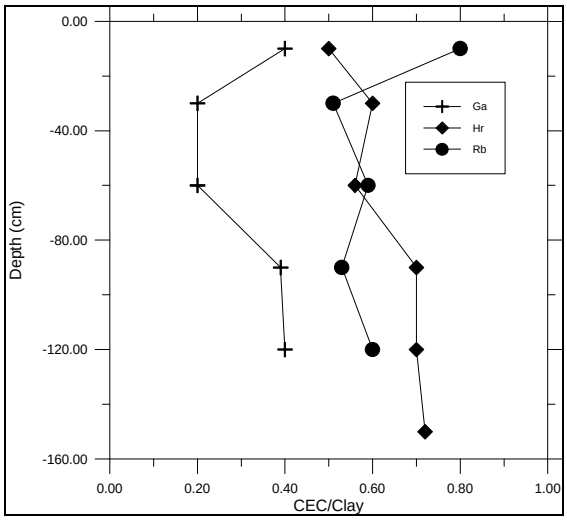


Figure 11. The CEC:Clay for the soils formed on the acid to intermediate intrusive rocks

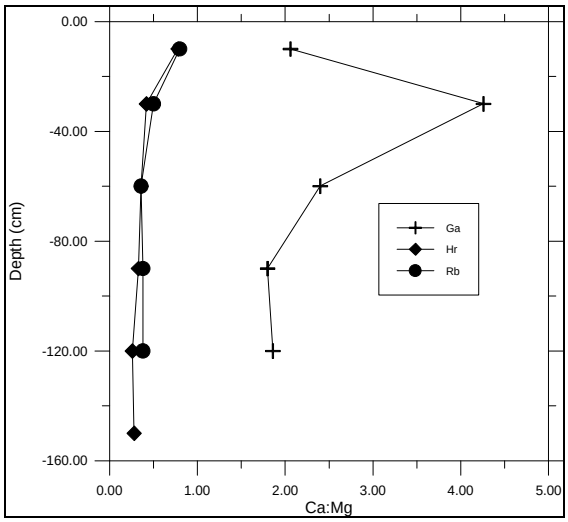


Figure 12. The Ca:Mg for the soils formed on the acid to intermediate intrusive rocks

4.3. Soils formed on intermediate to basic intrusive rocks

Upperslopes of steep mountains and hills

The intermediate to basic intrusive rocks mainly occur as rises, low hills and mountains in the western, and northern areas of the survey. The hills which are formed from basic intrusive rocks include Mt Lee and Mt Cavana. The soils formed on intermediate to basic intrusive rock form moderately deep reddish soils in the upper slopes (Table 5). Four soils have been described.

Table 5. The description and classification of soils formed on the upperslopes of steep mountains to undulating rises on intermediate to basic intrusive rocks.

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Ar	Armstrong	Moderate to deep, uniform clay soil with a self-mulching topsoil, over an alkaline, grey clay subsoil. Some carbonate. Occurs on gilgai mounds only.	Black Vertosol	Ug5.16
Wy	Wygong	Moderate to deep, uniform clay soil with a self - mulching clay topsoil, over an alkaline, black to dark brown, clay subsoil, over weathering rock.	Black Vertosol	Ug5.12
Fn	Finch Hatton	Moderate to deep, duplex to gradational soil with a clay loam to light clay topsoil, over an acid to neutral, brownish red to red, clay subsoil.	Brown or red Dermosol	Gn4.12
Pc	Pinnacle	Moderately deep to deep, gradational soil with a clay loam topsoil over a reddish brown subsoil.	Brown to red Dermosol	Uf6.31

On undulating rises or midslopes dominated by basic rocks such as Gabbro and Dolerite, the Armstrong and Wygong soils are formed. The **Wygong (Wy)** soils are moderately deep cracking clays with a dark brown to black subsoil and tend to occur in more convex sites. Downslope from the Wygong soils or in more flat to concave locations where site drainage is poor, the Armstrong soil is formed. **Armstrong (Ar)** is a moderately deep cracking clay with an alkaline grey subsoil.

Where the underlying rock is dominated by granodiorite or diorite, the Finch Hatton soil is formed. **Finch Hatton (Fn)** is a duplex to gradational soil that is usually less than 1.2 metres deep. The topsoil is 0.1 to 0.25m thick which is dark brown to red-brown in colour, and has a clay loam to light clay texture. The subsoil is brownish red to red, and is well structured with a medium to medium heavy clay texture with an acid to neutral pH. There is often up to 50 % surface and profile rock in the form of cobbles.

In the higher rainfall areas in the Eungella range and other elevated areas of the Clarke range, soils formed on intermediate intrusive rocks such as syenite and diorite form the Pinnacle soil. **Pinnacle (Pc)** is a non-cracking clay to gradational soil with a red-brown light clay topsoil which is 0.1 to 0.25m thick. The subsoil is bright red with a light medium to medium heavy clay texture which is subplastic. The Pinnacle soil is strongly structured and well drained.

Soil Chemistry

The Pinnacle soil has been highly leached with most subsoil cations removed from the subsoil due to deep drainage. These highly leached soils are acid. The dark clay soils such as Wygong and Armstrong have a high amount of calcium in the soil which is derived from the weathering of calcite and calcium plagioclase in the basic rocks. The excess calcium in the soil is a contributing factor to the alkaline pH of these soils. The two clay soils have moderate to low topsoil fertility (Table 6).

Table 6. Selected topsoil soil chemistry for the soils formed on the upperslopes of steep mountains to undulating rises on intermediate to basic intrusive rocks

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Armstrong	3	-	32	1.6	0.2	10	0.8
Wygong	9	0.42	33	2.2	0.4	50	0.8
Finch Hatton	20	0.41	92	1.5	1.0	60	1.8
Pinnacle	23	0.26	33	1.1	0.5	121	2.1

The Armstrong subsoil salinity ranges from moderate to high (electrical conductivity levels 0.2 to 0.5 dSm^{-1}) and the sodicity is low to moderate with the exchangeable sodium percentage of 3 to 10 in the first 10 cm of the subsoil (Figures 13 and 14). The Armstrong soil generally has a very high subsoil cation exchange capacities (CEC of 30 to 40) which are dominated by calcium (Aldrick, 1988). The Wygong subsoil salinity ranges from moderate to high (electrical conductivity levels 0.1 to 0.4 dSm^{-1}) and the sodicity is low to moderate with the exchangeable sodium percentage of 3 to 10 in the first 10 cm of the subsoil. The Wygong soil generally have very high subsoil cation exchange capacities (CEC of 30 to 40) which are dominated by calcium (Aldrick, 1988). The salinity and sodicity in the Pinnacle and Finch Hatton soils are very low.

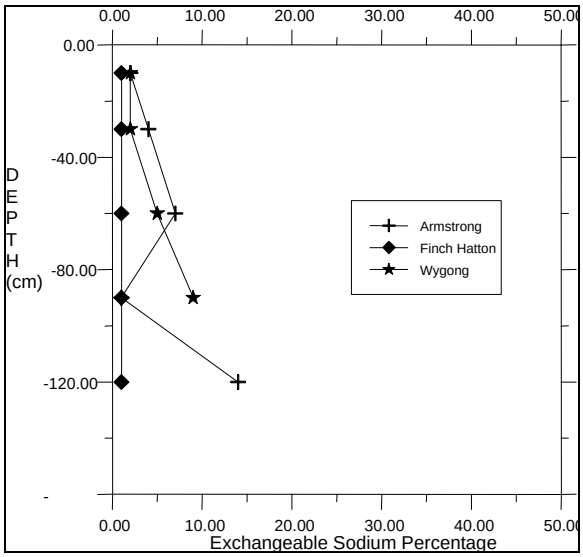


Figure 13. The mean sodicity of the soils formed on intermediate to basic intrusive rock in upland areas

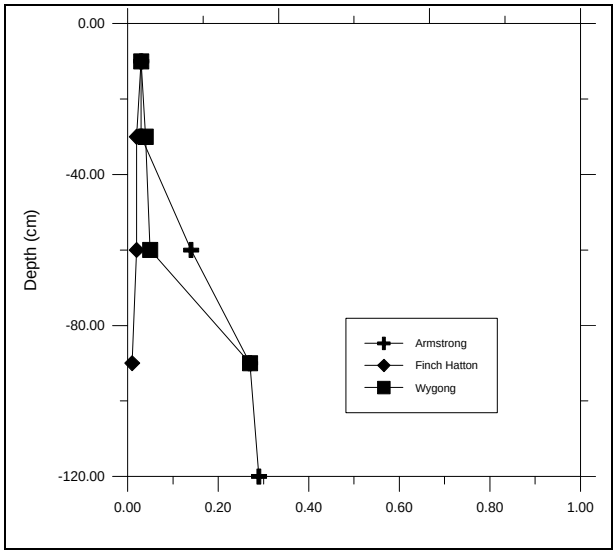


Figure 14. The mean electrical conductivity of soils formed on intermediate to basic intrusive rock in upland areas

The subsoil CEC:clay describes the activity of the clay and reflects the ability of the soil to hold nutrients. The activity of the sub soil clays in this soil group indicate that the subsoils are dominated by illite and minor smectite clay types (Figure 15). The most chemically active subsoils in this group is Armstrong and Wygong wile the least chemically active soil is the deeply weathered Pinnacle.

The Ca:Mg of the Finch Hatton soil is the highest within this soil group. The Armstrong and Wygong soils have a high quantity of calcium present in the clay exchange sites but also a high level of magnesium which reduces the Ca:Mg of these two soils. The Ca:Mg of the Pinnacle soil is quite high considering the relatively low CEC. This high Ca:Mg of the Pinnacle soil is probably due to either the chemical composition of the parent material or the magnesium is more prone to leaching than calcium in the high rainfall areas. (Figure 16).

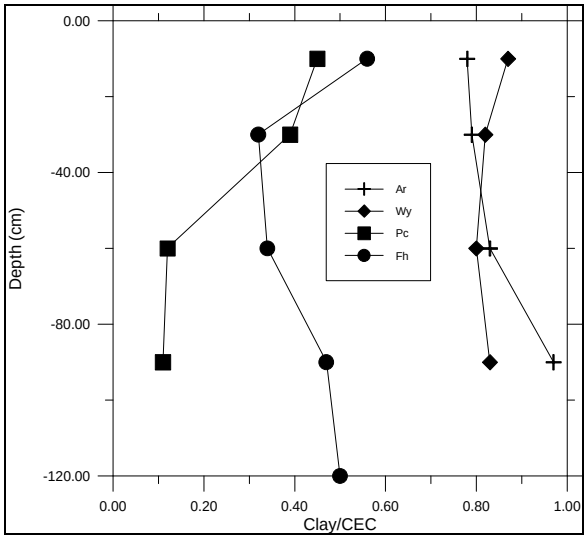


Figure 15. The CEC:Clay for the soils formed on the intermediate to basic intrusive rocks

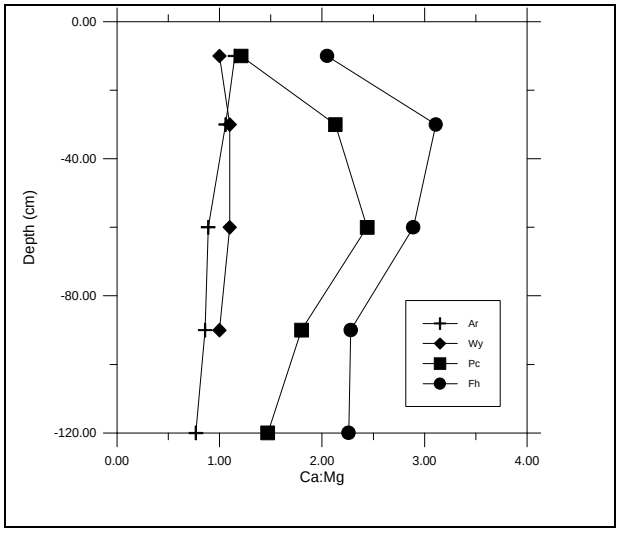


Figure 16. The Ca:Mg for the soils formed on the intermediate to basic intrusive rocks

Undulating to gently undulating footslopes and colluvial fans

The footslopes and colluvial fans derived from intermediate to basic intrusive rocks occur at the base of some mountain and hill areas in the north and western areas of the survey. These soils are formed by the transportation of material downslope by gravity and water. The colluvial soils have variable subsoil textures and include a range of buried material from clay to large rocks. Five soils have been identified (Table 7).

Table 7. The description and classification of soils formed on the upperslopes of steep mountains to undulating rises on intermediate to basic intrusive rocks

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
At	Abbot	Deep, uniform clay soil with a self-mulching clay topsoil, over an alkaline black to dark grey, clay subsoil. Minor carbonate.	Black Vertosol	Ug5.1
Fh1	Finch Hatton, alluvial-colluvial variant	Moderately deep, gradational soil with a clay loam topsoil, over a neutral to alkaline, brown, clay subsoil.	Brown Dermosol	Uf6.33
Lu	Luce	Moderate to deep, duplex to gradational soil with a sandy loam to sandy clay loam topsoil, over a red to reddish brown, sandy light clay to medium clay subsoil. Usually overlies a red-brown pan or consolidated pan composed of gravel and cobble.	Red Dermosol	Gn4.12

Pr	Pring	Moderate to deep, duplex to gradational soil with a sandy clay loam to clay loam topsoil, over an alkaline, greyish brown to reddish brown, clay subsoil.	Brown Dermosol	Gn3.12, Uf6.31
Ta	Tannallo	Deep, gradational to duplex soil with a loamy sand to sandy clay loam topsoil, over an acid to neutral, reddish brown to brown, clay subsoil.	Brown Dermosol	Gn2.42

The colluvial fans found adjacent to hills dominated by basic intrusive rocks such as Gabbro and diorite are deep gradational to duplex soils with dark to red subsoils. The **Finch Hatton (alluvial - colluvial variant) (Fn1)** is moderately deep to deep non-cracking clay, with a 0.1 to 0.2 m thick topsoil which is occasionally bleached. The subsoil is greyish-brown with moderate prismatic to lenticular structure and a light medium to medium heavy clay texture. The subsoil often has orange mottles caused by the slow movement of water through the soil. The **Pring (Pr)** is a deep duplex to gradational soil that is mostly found in the north of the study area between Mt Buckley and Mookarra and south to Mt Lee. The subsoil usually overlies semi-consolidated layers which have hardened to form red-brown pans. The topsoil is usually 0.15 to 0.35 m thick with a sandy clay loam to clay loam texture. The Finch Hatton and Pring soils are similar with the main difference being the consolidated pan benefit the Pring soil which is probably a function of the drier climate in the northern areas of the study area. The Pring soil also tends to have more surface rock than the Finch Hatton variant.

Deep colluvial soils derived from gabbro which have a self mulching topsoil are grouped as the Abbot soil profile class. The dark topsoil of **Abbot (At)** is thin (0.05 to 0.15 m) with a medium clay texture. The subsoil of Abbot is black to dark grey with strong lenticular structure. The Abbot soil occurs in isolated pockets in the north of the study area.

The more sandy soil profiles are grouped into the Tannallo or Luce classes and occur downslope of areas dominated by syenitic or tonolitic rock. **Tannallo (Ta)** is a duplex to gradational soil which is usually deeper than 1.5 metres, with a 0.15 to 0.35 m thick sandy loam topsoil. There is up to 10% surface and profile rock. The subsoil is brown to red-brown in colour, with weakly to moderately well structured, sandy light clay to medium clay and an acid to neutral pH.

Luce (Lu) is a gradational to duplex soil that occurs in drainage depressions on colluvial fans. The Luce soil is commonly less than 1.2 metres deep and usually overlies either a red-brown pan or a consolidated pan composed of gravel and cobble. The topsoil is hardsetting and is a reddish brown sandy loam to sandy clay loam texture. The subsoil is usually red to reddish brown in colour with a sandy light clay to medium clay texture with a neutral pH.

Soil Chemistry

The Finch Hatton variant, Pring and Abbot soils have different soil chemistry to the more sandier Tannallo and Luce soils due to higher subsoil clay contents and the mineralogical composition of the parent materials. The topsoil fertility is generally higher in the clay soils where nutrients can be stored on the clay particles and less is lost through deep drainage (Table 8).

Table 8. Selected topsoil soil chemistry for the soils formed on the upperslopes of steep mountains to undulating rises on intermediate to basic intrusive rocks

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Abbot	6						1.4
Pring	8	0.52	40	1.4	1.7	59	1.3
Tannalo	22	0.27	60	0.3	1.5	36	0.86

The difference in subsoil clay content and parent material influence the conductivity of the soils. The Abbott, Finch Hatton variant and Pring soils have moderate to high subsoil electrical conductivity (electrical conductivity levels 0.4 to 1.5 dSm^{-1}) and low to moderate subsoil sodicity (Figures 17 and 18). In comparison the Tannalo and Luce soils have very low subsoil conductivity and sodicity.

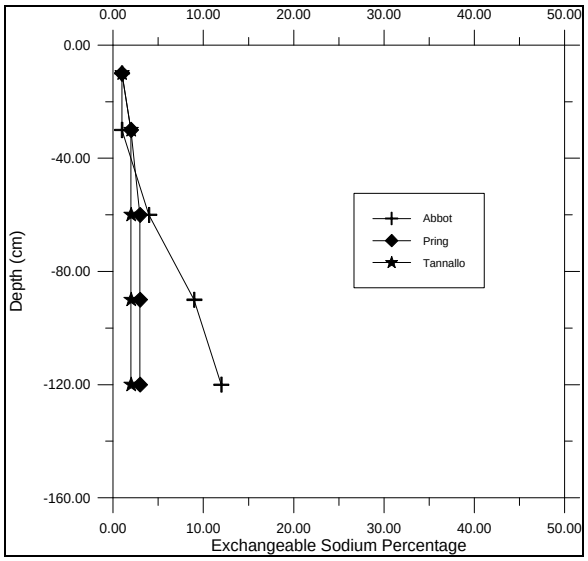


Figure 17. The mean sodicity of the soils formed on flat to undulating footslopes and colluvial fans formed from intermediate to basic intrusive rock.

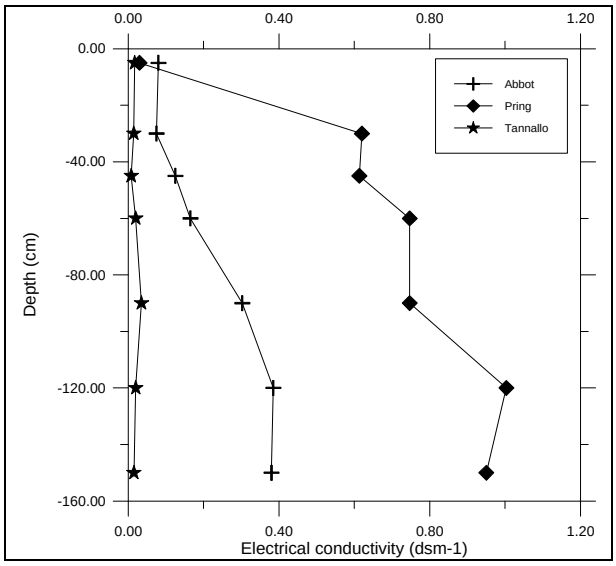


Figure 18. The mean electrical conductivity of soils formed on flat to undulating footslopes and colluvial fans on intermediate to basic intrusive rock

The CEC:clay describes the activity of the clay and reflects the ability of the soil to hold nutrients. The activity of the sub soil clays in this soil group indicate that the subsoils are dominated by illite and minor smectite clay types (Figure 19). The illite clay present in the duplex soils has a moderate ability to hold nutrients. The Pring soil is more chemically active than the more sandier Tannallo soil and will have a greater ability to store cations and minerals that are essential for plant and crop growth.

The Ca:Mg of the Tannalo and Pring soils are both relatively high which indicate that the parent material is high in calcium. The high proportion of calcium to magnesium reflects the soil aggregate stability and indicates that these soils have a high resistance to water erosion (Figure 20).

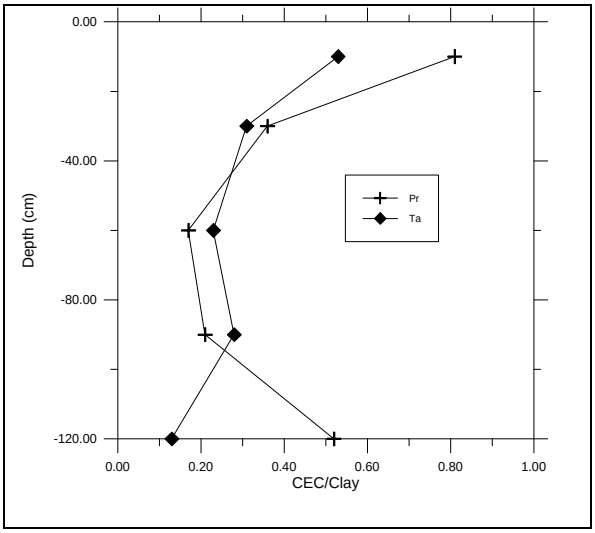


Figure 19. The CEC:Clay for the soils formed on the acid to intermediate intrusive rocks

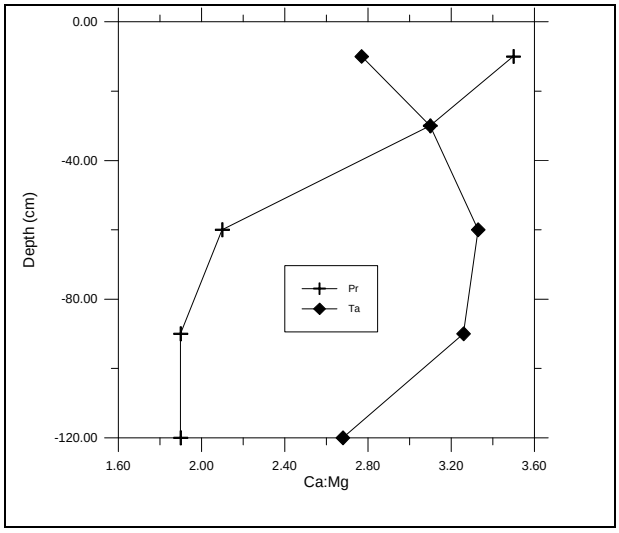


Figure 20. The Ca:Mg for the soils formed on the acid to intermediate intrusive rocks

4.4. Soils formed from acid to intermediate metamorphic rock

Metamorphic rocks occur in the vicinity of Bodes shear, Mt Challenger shear and Mt Williams shear in the north of the study area. The rocks associated with the areas of metamorphism include schist, gneiss and hornfels. The schist and gneiss rocks can be identified by distinct mineral banding. The duplex soils formed from acid to intermediate metamorphic rocks have been grouped into the Bode soil profile class (Table 9).

Table 9. The description and classification of soils formed on the upperslopes of steep mountains to undulating rises on metamorphic rocks

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Bo	Bode	Moderate to deep, duplex soil with a loamy sand to sandy clay loam topsoil, over an acid to neutral, greyish-brown to brownish-red, clay subsoil.	Red Dermosol	Gn4.12

The **Bode (Bo)** soil occurs on the undulating rises associated with the acid to intermediate metamorphic rocks. This soil is a duplex soil that is usually 0.5 m to 1.2 metres deep. The topsoil is 0.1 to 0.2 m thick with a loamy sand to sandy clay loam texture, and an acid to neutral pH. The subsoil is greyish-brown to brownish-red and is moderate to strongly structured with an acid to neutral pH. The texture of the subsoil is a light to medium clay and is usually moderately well drained. The surface usually has between 20 and 50% surface rock.

Soil chemistry

The Bode soils are moderately well drained duplex soils with an acid to neutral pH throughout the profile. The topsoil has low to moderate fertility levels (Table 10).

Table 10. Selected topsoil soil chemistry for the soils formed on the upperslopes of steep mountains to undulating rises on acid to intermediate metamorphic rocks

Soil Profile Class	Phosphorus (bicarb) (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Bode	19	0.5	40	0.4	3.2	57	2.1

Subsoil field tests indicate that the Bode subsoil has low levels of conductivity (Figure 22). Soil samples taken of the subsoil indicate low levels of exchangeable sodium (Figures 21). The low salt levels in the soil indicate that the metamorphic rocks were probably an intermediate intrusive rock prior to the processes of metamorphism such as diorite.

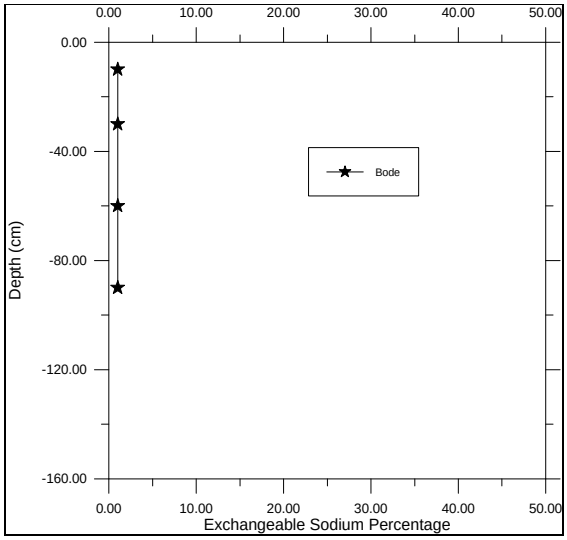


Figure 21. The mean sodicity of the soils formed on undulating rises formed from acid to intermediate metamorphic rock

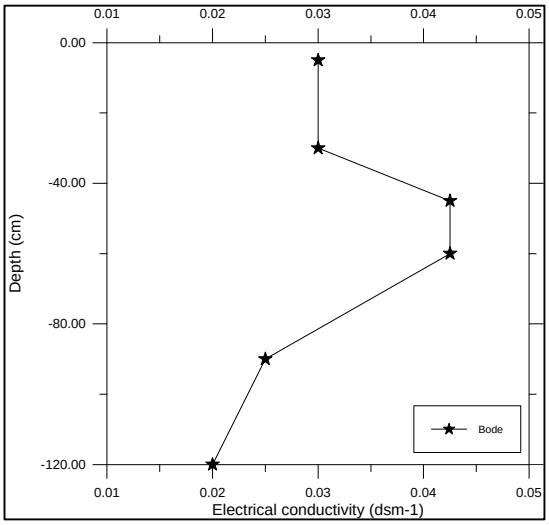


Figure 22. The mean electrical conductivity of soils formed on the undulating rises of acid to intermediate metamorphic rock

The subsoil CEC:clay describes the activity of the clay and reflects the ability of the soil to hold nutrients. The activity of the sub soil clays in this soil group indicate that the subsoils are dominated by illite and minor smectite clay types (Figure 23). The illite clay present in the Bode soils has a moderate ability to hold nutrients.

The Ca:Mg of Bode is relatively high which supports the notion that the parent material prior to metamorphism was probably a rock such as diorite (Figure 24). The high Ca:Mg reflects the observed relative stability of these soils to water erosion.

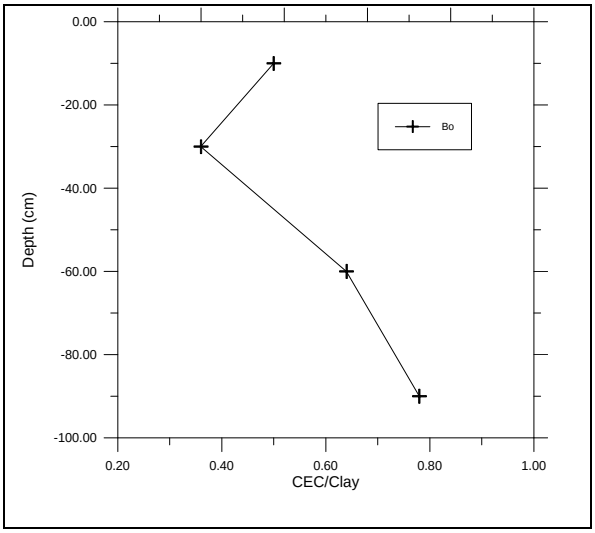


Figure 23. The CEC:Clay for the soils formed on the acid to intermediate metamorphic rocks

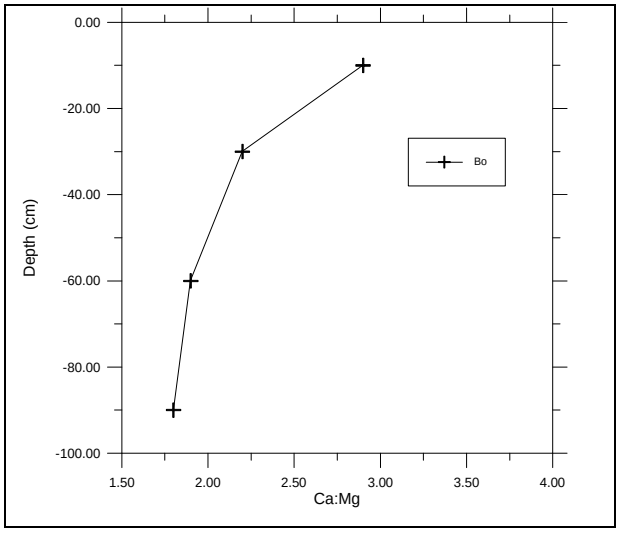


Figure 24. The Ca:Mg for the soils formed on the acid to intermediate metamorphic rocks

4.5. Soils formed on acid to intermediate tuff

Tuff is consolidated volcanic ash and is found in relatively narrow bands associated with volcanic flows. The acid to intermediate tuff rocks mainly occur as outcrops within rises and low hills in the western, and southern areas of the survey. Most of the tuff has been identified in the Carmilla beds and Edgecumbe beds (Table 11). Four soils have been described.

Table 11. The description and classification of soils formed on the upperslopes of steep mountains to undulating rises on acid to intermediate tuff rocks

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF class.
Soils formed from acid tuff				
Ex	Exmoor	Shallow, acid to neutral, bleached, greyish-brown, gravelly sandy loam soil.	Leptic Rudosol	Uc1.21
Me	Mentmore	Shallow to moderately deep, sodic duplex soil with a bleached, gravelly, sandy loam to sandy clay loam topsoil, over an acid, grey to yellowish-brown, clay subsoil.	Subnatric, Grey Sodosol	Dy3.31
Me 1	Mentmore (sandy topsoil var.)	Shallow to moderately deep, sodic duplex soil with a thick, bleached, gravelly, loamy sand to sandy loam topsoil, over an acid, clay subsoil.	Subnatric, Grey Sodosol	Dy3.31
Rf	Redfern	Shallow to moderately deep, sodic duplex soil with a bleached, gravelly, sandy loam to sandy clay loam topsoil, over an acid, grey to yellowish-brown, clay subsoil.	Mesonatric, Grey Sodosol	Dy3.31
Soils formed from intermediate tuff				
Mn	Munbura	Shallow to moderately deep, duplex soil with a bleached, gravelly, sandy loam to sandy clay loam topsoil, over an acid, grey to yellowish-brown, clay subsoil.	Grey Chromosol	Dy3.31

The soil which is formed on the hill crests and upperslopes of acid tuff beds is Exmoor. **Exmoor (Ex)** is a shallow soil with a very rocky surface. This soil has a grey, sandy loam texture which is weakly structured. The soils which commonly occur downslope from Exmoor and are formed on acid volcanic tuff are Mentmore and Mentmore (sandy topsoil variant). **Mentmore (sandy topsoil variant) (Me1)** is duplex soil which is usually less than 1 metre deep. The pale grey topsoil is 0.2 to 0.35 m thick with a loamy sand to sandy loam texture with a bleached A2 horizon. The subsoil is normally grey with prismatic or columnar structure and a light medium to medium heavy clay texture. The lower profile may have some orange mottling caused by the slow movement of subsurface water through the profile. There is often 20 to 50% surface rock consisting of cobbles and gravel.

Where the tuff rock is less acid the Mentmore soil is formed. **Mentmore (Me)** is a duplex soil which is usually less than 1 metre deep. The pale grey topsoil is 0.15 to 0.25 m thick with a sandy clay loam texture with a bleached A2 horizon. The subsoil is normally greyish-brown with prismatic structure and a light medium to medium heavy clay texture with an acid to neutral pH. The lower profile may have some mottling caused by the slow movement of subsurface water through the profile. There is often 20 to 50% surface rock consisting of cobbles and gravel. This soil is usually imperfectly drained and prone to erosion.

When the volcanic ash beds are more intermediate in mineralogy the Munbura soil is formed. **Munbura (Mn)** is a duplex soil which is usually less than 1 metre deep. The topsoil is pale grey and is 0.15 to 0.25 m thick with a sandy clay loam texture with a bleached A2 horizon. The subsoil is normally brown to red-brown with prismatic structure and a light medium to medium heavy clay texture with an acid to neutral pH. The lower profile may have some orange mottling caused by the slow movement of subsurface water through the profile. There is often 20 to 50% surface rock consisting of cobbles and gravel. This soil is usually imperfectly drained and prone to erosion.

In lower slopes and footslopes of hills dominated by mostly acid tuff, the Redfern soil is formed. **Redfern (Rf)** is a sodic duplex soil which is usually less than 1 metre deep, with a 0.15 to 0.25 m thick loamy sand to sandy clay loam topsoil with a bleached A2 horizon. The topsoil is pale grey colour with weak structure. The surface normally has 20 to 50% surface rock. The subsoil is grey to greyish-brown with moderate to strong prismatic to columnar structure and a medium to medium heavy clay texture and an alkaline pH. This soil is usually imperfectly drained and prone to erosion.

Soil chemistry

The topsoil fertility of the soils formed from acid tuff is relatively low (Table 12). The parent material associated with these soils tends to be high in silica and sodium plagioclase which results in a sandy topsoils and sodic subsoils. The surface phosphorus levels are very low.

Table 12. Selected topsoil soil chemistry for the soils formed on the upperslopes of steep mountains to undulating rises on acid to intermediate intrusive rocks

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Mentmore	12	0.3	186	0.4	1	25	2.2
Munbura	7	0.38	66	1.9	1.2	122	1.2
Redfern	16	0.6	120	0.42	1.2	33	5.1

The Redfern and Mentmore (sandy variant) soils have strongly sodic clayey subsoils, while the Mentmore and Munbura soils have low subsoil sodicity. The subsoil of Redfern and Mentmore (variant) are dispersive and prone to erosion (Figure 25).

The subsoil conductivity in the redfern soil ranges between 0.2 and 0.5 dSm^{-1}. The other soils in this group have low conductivity values (less than 0.2 dSm^{-1}) (figure 26). Salinity outbreaks may occur below these soils.

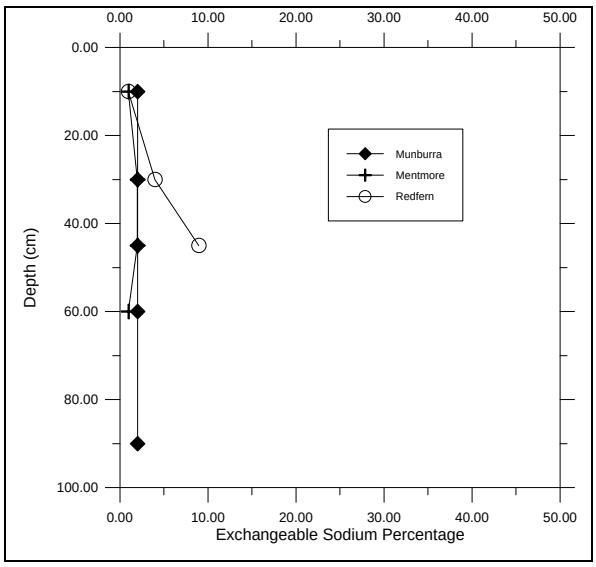


Figure 25. The mean sodicity of the soils formed on acid to intermediate tuff

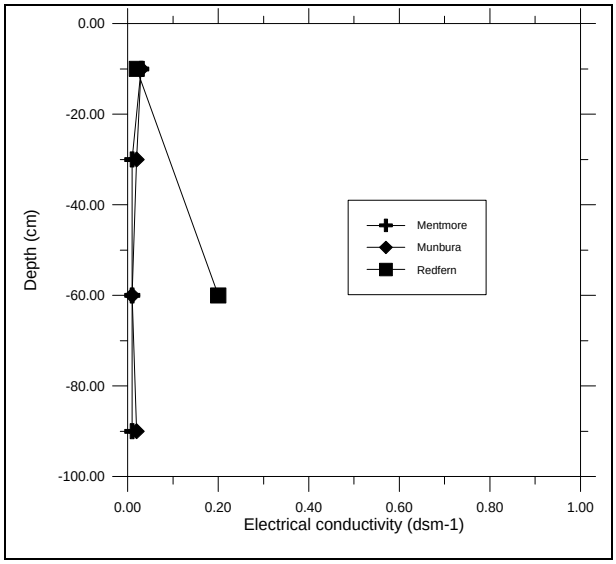


Figure 26. The mean electrical conductivity of soils formed on acid to intermediate tuff

The subsoil CEC:clay describes the activity of the clay and reflects the ability of the soil to hold nutrients. The activity of the sub soil clays in this soil group indicate that the subsoils are dominated by kaolinite, illite and minor smectite clay types (Figure 27). The Munbura CEC:clay indicates that the subsoil is dominated by kaolinitic clay and the Mentmore subsoil is dominated by illite clay.

The Ca:Mg of Mubura is much lower than Mentmore which reflects the mineralology of the parent material. The low Ca:Mg of Munbura also indicates that this soil is prone to erosion (Figure 28). From field observations the Redfern soil is also prone to erosion. The removal of trees from these soils should be kept to a minimum.

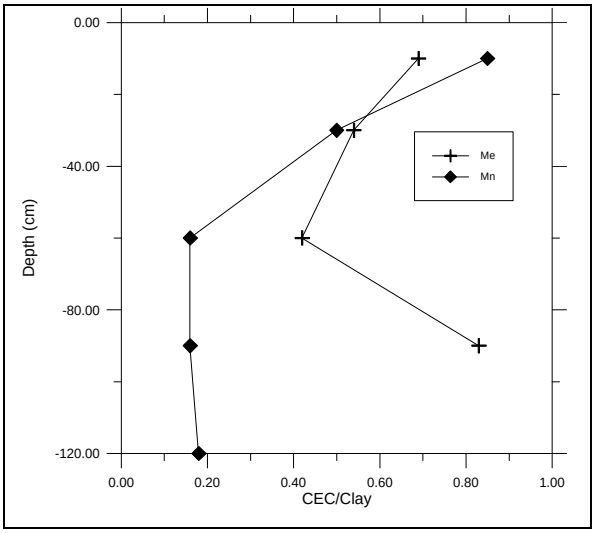


Figure 27. The CEC:Clay for the soils formed on the acid to intermediate intrusive rocks

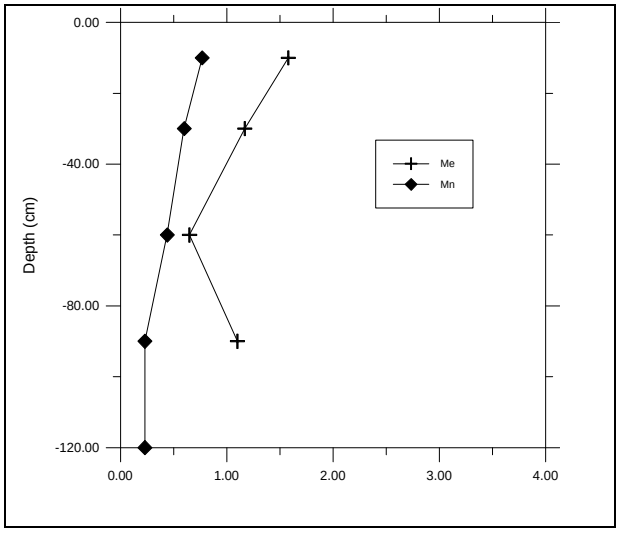


Figure 28. The Ca:Mg for the soils formed on the acid to intermediate intrusive rocks

4.6. Soils formed from acid to intermediate volcanic rock

Upperslopes of steep hills to rolling rises

The acid to intermediate volcanic rocks mainly occur as rises, low hills and mountains in the south western, central and coastal areas of the survey. The soils formed on acid to intermediate volcanic rock form shallow gravelly soils in the upper slopes and duplex soils on the mid to lower slopes (Table 13). Eight soils have been described.

Table 13. The description and classification of soils formed on the upperslopes of steep mountains to undulating rises on acid to intermediate volcanic rocks

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Soils formed from acid volcanic rocks				
Ci	Carmilla	Moderately deep, sodic duplex soil with a gravelly, bleached, sandy loam topsoil, over an alkaline, grey, clay subsoil.	Subnatric, Grey Sodosol	Dy3.33
Cd	Condor	Shallow to moderately deep, sodic duplex soil with a bleached, gravelly, sandy loam to sandy clay loam topsoil, over an acid, grey to yellowish-brown, clay subsoil.	Mesonatric, Grey Sodosol	Dy3.31
Di	Dittmer	Shallow, acid to neutral, bleached, greyish-brown, gravelly sandy loam soil which is 10-30 cm deep.	Leptic Rudosol	Uc1.21
Sn	Sunter	Shallow to moderately deep, gradational soil with a bleached, gravelly, sandy loam to sandy clay loam topsoil, over an acid, grey to yellowish-brown, loamy subsoil.	Grey Kandosol	Gn2, Dy3.12
Soils formed on more intermediate volcanic rock				
Ed	Edgecumbe	Moderately deep, duplex soil with a gravelly, sandy loam to sandy clay loam topsoil, over an acid, grey to yellowish-brown, clay subsoil.	Grey Chromosol	Dy3.31
Pt	Preston	Shallow to moderately deep, duplex soil with a bleached, gravelly, sandy loam to sandy clay loam topsoil, over an acid, grey to yellowish-brown, clay subsoil.	Grey Chromosol	Dy3.31
Wh	Whiptail	Moderately deep, sodic duplex soil with a bleached, sandy clay loam topsoil, over an acid, brownish-grey, clay subsoil.	Subnatric, Brown Sodosol	Dy3.31

In mid to upperslopes composed of rhyolite the soil is very shallow and the surface extremely rocky. Where the parent material is highly siliceous such as rhyolite, the **Dittmer (Di)** soil is formed and is less than 0.2 m in depth and consists of a gravelly sandy loam texture with an acid to neutral pH. Where the parent material is more intermediate such as dacite or trachyte, then the Dittmer soil is slightly deeper and tends to have a more sandy clay loam texture. The soils that are formed below Dittmer on the more siliceous material are normally Conder, Carmila or Sunter.

Conder (Cd) is an acid sodic duplex soil formed from rocks such as rhyolite and dacite. This soil is usually less than 60 cm deep with a rocky 0.1 to 0.2 m thick sandy loam to sandy clay loam topsoil with a bleached A2 horizon. In some areas the surface rock covers over 50% of the surface.

The subsoil is grey to yellowish-brown with a light medium to medium heavy clay texture. The subsoil often has prismatic or columnar structure and is prone to erosion. The **Carmila (Ci)** soil is often found associated with the Conder soil but tends to be found in more concave positions on the footslopes. The subsurface movement of groundwater influences the subsoil chemistry of the Carmila soil. The subsoil of Carmila is often a grey to greyish brown light to medium heavy clay. Where the parent material is composed of banded rhyolite, the Sunter soil is formed.

Sunter (Sn) is a gradational soil and is mainly confined to the Preston - Conway area. This soil is usually 0.4 m to 1 metre deep. The topsoil is pale grey and 0.15 to 0.30 m thick with a sandy loam to sandy clay loam texture. The soil often has 10 to 40% surface cobble. The subsoil is light grey to yellowish-grey in colour with a sandy clay loam to light clay texture. The Sunter soils are susceptible to water erosion.

In mid to lowerslope positions where the parent material is composed of more intermediate rock such as trachyte, a different assembledge of soils are found. The Edgecumbe and Preston soils are formed in the mid to lower slope areas and are mostly confined to the Edgecumbe beds east of Proserpine. The formation of the Edgecumbe and Preston soils and their chemistry is partly attributed to the wetter climate of the Cannon Valley area and possibly some unique mineralogy of the Edgecumbe bed Trachyte. The **Preston (Pt)** soils is a non-sodic duplex soil that is usually 0.4 to 0.6 m deep. The topsoil is grey to dark brown and 0.2 to 0.3 m thick with a sandy clay loam to clay loam texture. The soil often has 10 to 40% surface cobble. The subsoil is brown to yellowish-brown in colour with a light medium to medium heavy clay texture. The **Edgecumbe (Ed)** soil occurs downslope of Preston and is essentially a deeper version of the latter soil. The Preston and Edgecumbe soils are prone to water erosion. The non-sodic duplex soils that have a dark subsoil and are found in the Cannon Valley area are grouped as the Marlow soil class. The **Marlow (Mo)** soil is usually 0.4 m to 1 metre deep. The topsoil is grey to dark brown and 0.2 to 0.3 m thick with a sandy clay loam to clay loam texture. The subsoil is greyish black to greyish -brown in colour with a light medium to medium heavy clay texture.

The **Whiptail (Wh)** is an acid sodic duplex soil that is usually 0.6 m to 1 metre deep. The topsoil is grey to dark brown and 0.2 to 0.3 m thick with a sandy clay loam to clay loam texture. The soil often has 5 to 20% surface cobble. The subsoil is brown to yellowish-brown in colour with a light medium to medium heavy clay texture. The topsoil is moderately erodible and these soils have a moderate to high risk of water erosion depending on slope and ground cover. The Whiptail soil is not as sodic or erodible as the Conder soil.

Soil chemistry

Most of the soils formed on acid to intermediate rock have acid to neutral subsoil pH except the Carmila soil. The general fertility of the this soil is low (Table 14). The Carmila, Conder and Whiptail soils have sodic subsoils and higher levels of soluble salts than the non-sodic soils (Figures 29 and 30).

Table 14. Selected topsoil soil chemistry for the soils formed on the upperslopes of steep mountains to undulating rises on acid to intermediate intrusive rocks

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Carmillia	2	0.05	64	0.2	0.9	150	0.84
Conder	5	0.21	222	0.12	0.65	7.4	1.4
Dittmer	5	0.41	54	0.2	0.8	20	0.81
Edgecumbe c)	24	0.52	315	0.73	2.1	129	2.7
Sunter	4	0.35	170	0.13	0.2	1.5	1.9
Whiptail	8	0.32					2.1

Note: (c) indicates sample collected from cultivated site

The subsoil conductivity ranges are highest for the Carmila soils with the higher levels being found in the drier areas in the west of the survey area. Subsoil conductivity levels of the Carmila soil are typically 0.3 to 1.1 dSm^{-1} (Figure 30). The subsoil conductivity levels of the Preston, Edgecumbe, Marlow and Sunter soils is usually less than 0.1 dSm^{-1}. In some locations the subsoil conductivity of the Conder soil may exceed 0.6 dSm^{-1} and the Whiptail 0.3 dSm^{-1}. The subsoil sodicity is highest in the Conder soils with ESP levels often exceeding 30 in the profile (Figure 29). The Whiptail and Carmila soils are also sodic.

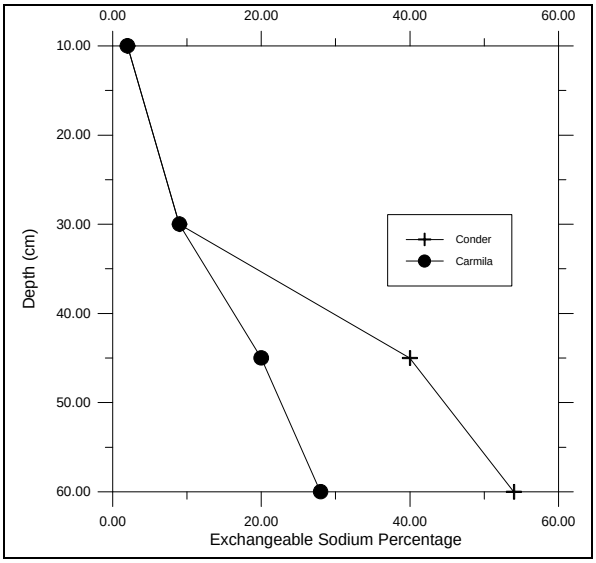


Figure 29. The mean sodicity of the soils formed from acid volcanic rock on upperslopes

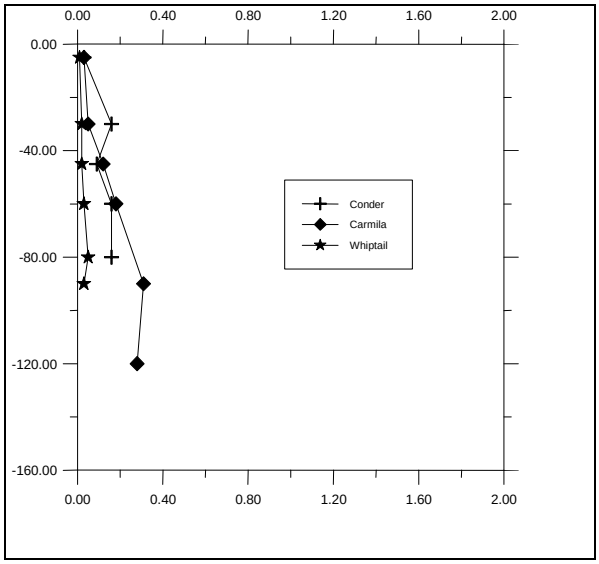


Figure 30. The mean electrical conductivity of soils formed from acid volcanic rock on upperslopes

The subsoil CEC:clay activity of the sub soil clays in this soil group indicate that the subsoils are dominated by illite and minor smectite clay types (Figure 31). The illite clay present in the duplex soils has a moderate ability to hold nutrients. The most chemically active subsoils in this group is Carmila. The Sunter soil is dominated by kaolinitic clays and has a low ability to hold nutrients.

The Ca:Mg of the soils in this group are all less than 1.0 except for Edgecumbe (Figure 32). Soils that have low Ca:Mg tend to be more susceptible to erosion. This soil chemistry data supports field observations where these soils are prone to gully erosion. The Sunter soil has the lowest Ca:Mg which is less than 0.1 in the profile.

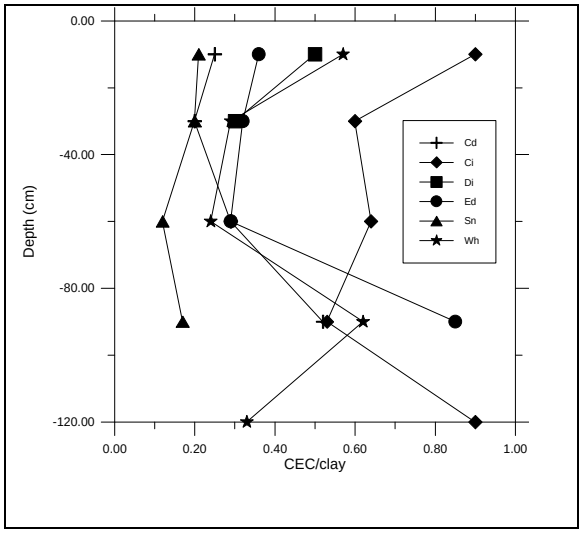


Figure 31. The CEC:Clay for the soils formed on the acid to intermediate intrusive rocks

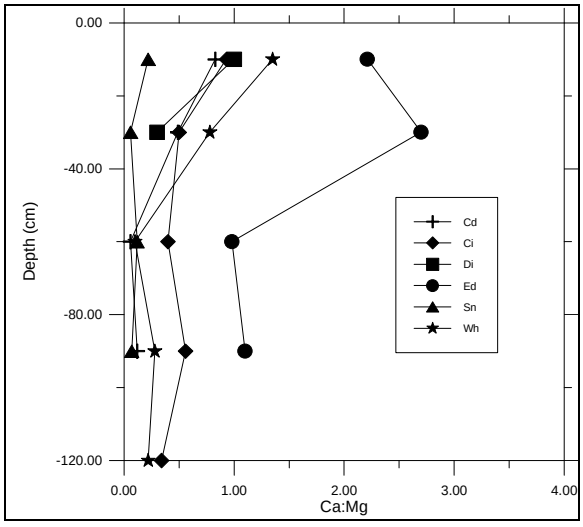


Figure 32. The Ca:Mg for the soils formed on the acid to intermediate intrusive rocks

Undulating to gently undulating footslopes and colluvial fans

Downslope of areas dominated by acid to intermediate volcanic rocks, a range of colluvial soils are formed. The soils formed on the undulating footslopes and colluvial fans range from shallow gravelly soils to duplex soils (Table 15). Seven soils have been described.

Table 15. The description and classification of soils formed on the undulating footslopes and colluvial fans downslope of acid to intermediate intrusive rocks

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Soils that overlie consolidated or semi-consolidated layers				
Bb	Balbera	Moderately deep, sodic duplex soil with a bleached, loamy sand to sandy loam topsoil, over an acid, grey, clay subsoil.	Mesonatric, Grey Sodosol	Dy3.41
Os	Ossa	Moderately deep, duplex soil with a gravelly, bleached, sandy loam topsoil, over an acid, grey, clay subsoil. These soils overlie buried layers of cobble.	Grey Sodosol	Dy3.31
Os1	Ossa, cobbly variant	Moderately deep, duplex soil with a cobbly, bleached, sandy clay loam topsoil, over an acid, grey, clay subsoil. These soils overlie buried layers of cobble.	Grey Sodosol	Dy3.31
Soils that overlie unconsolidated colluvium				
Et	Etowrie	Deep, duplex soil with buried gravel layers and a gravelly, bleached, sandy clay loam topsoil, over an alkaline, grey clay subsoil.	Grey Sodosol	Dy3.33
Et1	Etowrie (neutral variant)	Deep, duplex soil with buried gravel layers and a gravelly, bleached, sandy clay loam topsoil, over a neutral, grey, clay subsoil.	Grey Chromosol	Dy3.32
Kp	Kunipipi	Moderate to deep, duplex soil with a very gravelly, bleached, sandy clay loam to clay loam fine sandy topsoil, over an alkaline, grey to greyish brown, clay subsoil. This soil has buried layers of gravel and clay.	Subnatric, Grey Sodosol	Dy3.33
Wo	Wollingford	Moderately to deep, sodic duplex soil with a bleached, gravelly, sandy loam to sandy clay loam topsoil, over an acid, grey to yellowish-brown, clay subsoil.	Mesonatric, Grey Sodosol	Dy3.31

The soils formed from colluvium derived from acid to intermediate rock can be grouped into moderately deep soils that form over pans or consolidated colluvium or deep soils that overlie layers of unconsolidated buried colluvium. The Balbera, Ossa and Ossa (cobbly variant) are all moderately deep soils that overlie consolidated layers of colluvium. These three soils tend to be found in slopes ranging from 2 to 6%. The most common of these soils in the Whitsunday Coast area is the Ossa (cobbly variant). The **Balbera (Bb)** and **Ossa (cobbly variant) (Os1)** have between 10 and 50% surface cobble. The topsoil texture in both these soils is sandy clay loam to clay loam and both have an acid to neutral pH throughout the profile. The Balbera soil has a greyish yellow to greyish brown subsoil and overlies a gravelly pan of consolidated colluvium. The Ossa (cobbly variant) subsoil is mostly greyish yellow.

The main difference of these two soils is subsoil chemistry with the Balbera soils having higher sodicity levels than the Ossa variant. The topsoil of the Balbera soil is also often deeper than the Ossa variant. The **Ossa (Os)** soil occurs on relatively weathered colluvial fans with consolidated cobbly pans at depth. The main difference between the Ossa and the Ossa (cobbly variant) is the topsoil texture and minor subsoil chemistry differences. The Ossa soil has a loamy sand to sandy loam topsoil and is more gravelly than cobbly and tends to be up to 0.45 m deep compared to 0.15 to 0.3m for the variant. The three colluvial soils in this group are formed on landforms that represent quite old mass movement events such as debris flows and earthslides.

The other deeper soils in this group such as Etowrie, Etowrie (neutral variant), Wollingford, and Kunipipi occur on slopes generally less than 2% and are composed of finer material than the soils formed upslope. These four soils form at the outer margins of the colluvial fans and their formation are often are influenced by over bank flow or alluvium. These soils have formed from a mixture of flood events, sheet flow and events such as mudflows. Typically, these soils form on the boundary between soils formed from terrestrial processes and those that are formed from fluvial processes. The **Etowrie (Et)** soil is a deep alkaline sodic duplex soil with a sandy loam topsoil over a grey to greyish brown light medium to medium heavy clay subsoil. The **Etowrie (neutral variant) (Et1)** is similar morphologically to the Etowrie soil but has an acid to neutral subsoil pH. The **Wollingford (Wo)** soil is a deep, alkaline, sodic duplex soil with a sandy loam topsoil over a medium to medium heavy greyish yellow to yellowish brown subsoil (Plate 8). The **Kunipipi (Kn)** soil is a deep, alkaline strongly sodic duplex soil that occurs in the drier parts of the study area. The topsoil is 0.1 to 0.25 m thick with a gravelly, sandy loam texture. The subsoil of Kunipipi is grey to yellowish grey with strong columnar structure.

Plate 8. An example of the Wollingford soil

The soils formed on the outer fringes of colluvial fans in the drier areas are **Kunipipi (Kp)**. These soils are usually deeper than 1.2 metres and have a 0.1 to 0.2 m thick, grey, loamy sand to sandy loam topsoil with an acid pH. The subsoil is grey to yellowish brown in colour, alkaline, and some fine gravel may be present. The subsoil may become consolidated at depth. The surface is hardsetting with fine gravel and occasionally some cobble. The subsoil salinity ranges from moderate to high (electrical conductivity levels 0.4 to 1.2 dSm^{-1}) and the sodicity is moderate to very high with the exchangeable sodium percentage of 14 to 35 in the first 0.1 m of the subsoil and generally increases with depth. The Kunipipi soils tend to represent older fans which grade into soils formed from Cainozoic alluvium.

Soil chemistry

The surface fertility of these soils are quite low (Table 16). The surface phosphorus, micro-nutrients and organic matter for all soils are low. The surface pH for all soils is slightly acid and the subsoil pH varies depending on groundwater influence and the age of the soil.

Table 16. Selected topsoil soil chemistry for the soils formed on the upperslopes of steep mountains to undulating rises on acid to intermediate intrusive rocks

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Balbera	6	0.16	82	0.6	0.8	48	1.3
Ossa	6	0.15	64	0.1	2.9	46	1.1
Ossa (variant)	12	0.3	71	0.61	0.75	69	2.4
Etowrie (c)	35	0.35	114	2.0	1.7	75	1.2
Etowrie (variant)	8	0.3	150	0.91	1.9	130	3.1
Wollingford	3	0.26	56	1.2	0.2	26	0.4

Note (c) - Sample taken from sugarcane land

The soils in this group all have sodic subsoils and elevated subsoil salinity levels. In general, the drier the areas of the study the subsoil sodicity and salinity increases in these soils. The subsoil sodicity is highest in the Kunipipi, Wollingford and Balbera soils (Figure 33) with ESP levels commonly between 10 and 25 in the first 0.1 m of the subsoil. The subsoil conductivity is highest in the Kunipipi, Wollingford and Etowrie soils (Figure 34).

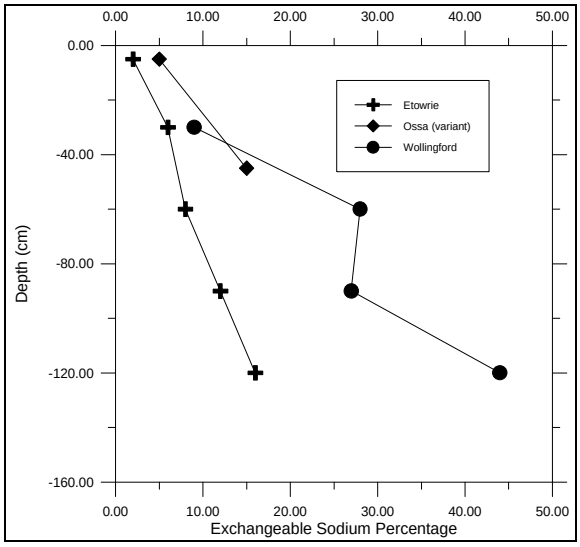


Figure 33. The mean sodicity of the soils formed on flat to undulating footslopes and colluvial fans formed from acid volcanic rock.

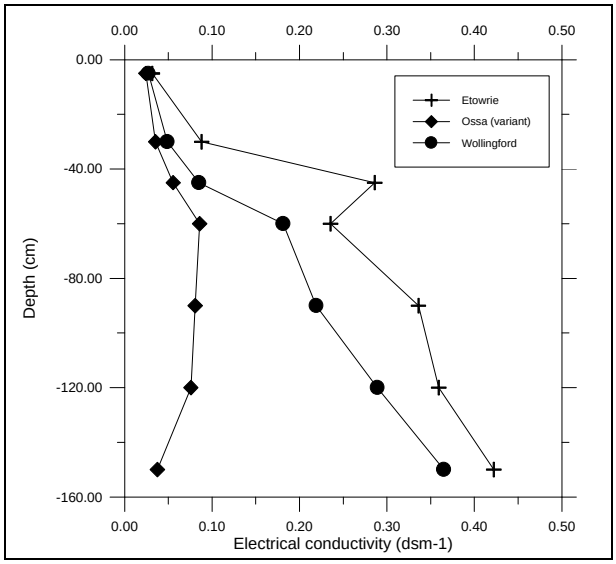


Figure 34. The mean electrical conductivity of soils formed on the flat to undulating footslopes and colluvial fans of acid volcanic rock.

The subsoil CEC:clay data for this soil group indicates that most are dominated by illite clays and have a moderate ability to hold nutrients (Figure 35). The subsoil chemistry of these soils indicates that many of the exchange sites are occupied by the sodium and magnesium cations (Figure 36 and 33).

The Ca:Mg of the soils indicate that moderate amounts of calcium and magnesium are present in the subsoil cation exchange sites on the clay (Figure 36). From field tests the subsoils of these soils are dispersive and observations indicate that these soils are prone to gully erosion . The Wollingford soil often has calcium carbonate concretions at depth which tends to be reflected in the Ca:Mg.

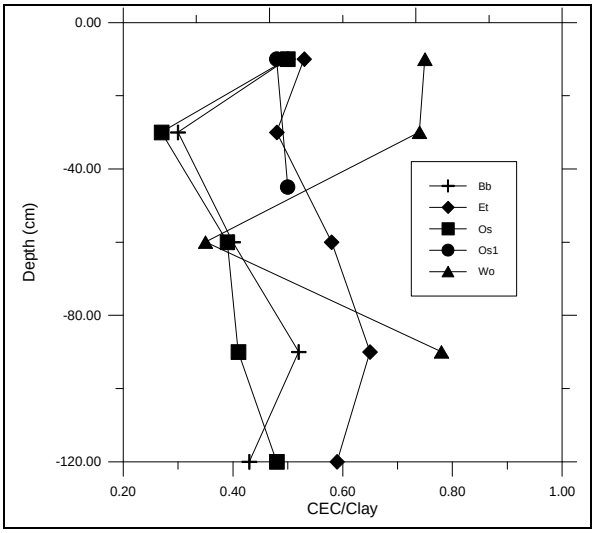


Figure 35. The CEC:Clay for the soils formed on the acid to intermediate intrusive rocks

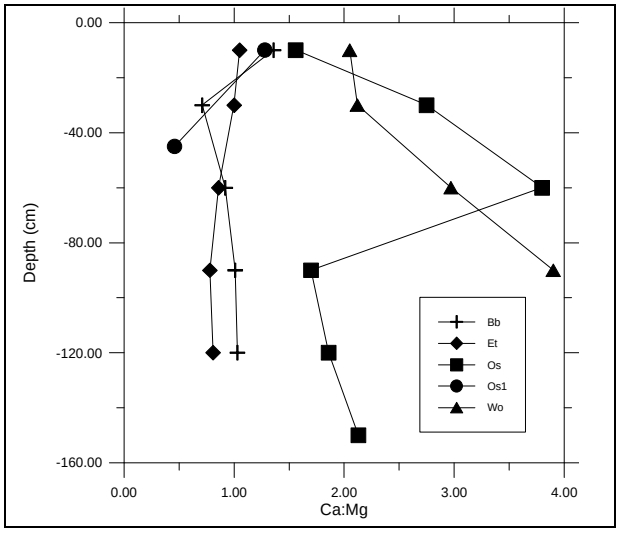


Figure 36. The Ca:Mg for the soils formed on the acid to intermediate intrusive rocks

4.7. Soils formed from intermediate to basic volcanic rocks

Upperslopes of steep hills to rolling rises

The intermediate to basic volcanic rocks mainly occur as rises, and low hills in the south western, central and coastal areas of the survey. The soils formed on intermediate to basic volcanic rock form red to brown duplex or uniform soils (Table 17). Six soils have been described.

Table 17. The description and classification of soils formed on the upperslopes of steep mountains to undulating rises on intermediate to basic volcanic rocks

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Hb	Habana	Shallow to moderately deep, gradational to uniform soil with a 20-30 cm thick, clay loam to light clay topsoil, over an acid to neutral, brown to reddish-brown, clay subsoil.	Brown Dermosol	Uf6.4
Jl	Julian	Shallow, neutral, reddish-brown, non-cracking clay soil which is 10-30 cm deep.	Red Rudosol	Uf1.21
Na	Nabilla	Shallow to moderately deep, gradational soil with a clay loam to light clay topsoil with abundant iron-manganese concretions, over an acid to neutral, brown to reddish-brown, clay subsoil.	Brown Dermosol	Gn3.72
Rv	Riordanvale	Moderately deep, duplex soil with a 15-30 cm thick, clay loam topsoil, over an acid to neutral, brownish-red, clay subsoil.	Brown Chromosol	Dy3.22
Sd	Strathdickie	Moderately deep, gradational soil with a clay loam to light clay topsoil, over an alkaline, greyish-brown, clay subsoil.	Brown Dermosol	Gn3

Wr	Wagoora	Moderate to deep, gradational to uniform soil with a clay loam to light clay topsoil, over an acid, brownish-red, clay subsoil.	Brown Dermosol	Uf6.33

The soil found on upperslopes and hill crests formed from trachyte, andesite and basalt is Julian. **Julian (Jl)** is a shallow soil found on steep slopes greater than 20%, or rocky ridges. The Julian soil is shallowest and most rocky when formed on trachyte, and deepest when formed on basalt. This soil is often less than 0.3 m deep with a dark clay loam to light clay topsoil over a brownish-red BC or B3 horizon. The BC or B3 horizon is generally deeper when formed from basalt. The surface is well structured with strong subangular blocky to polyhedral peds. The Julian soils grade into the deeper Habana soils.

The **Habana (Hb)** soil formed downslope of the Julian soil on slopes generally between 6 and 20%. This soil is a gradational soil which is usually less than 0.6 m deep. The topsoil is dark brown to brown and is 0.2 to 0.3 m thick with a light to light medium clay texture, with a neutral pH. The surface often has a 20 to 50% cover of cobbles. The subsoil is dark brown to red-brown with a light medium to medium heavy clay texture, which is strongly structured with polyhedral peds and a neutral pH. There is usually a deep weathering front or B3 horizon into decomposing andesite.

The soils which are formed downslope from Julian and Habana soils are Riordanvale where the substrate in trachyte and andesite and Wagoora where the substrate is more basic such as andesite to basalt. **Riordanvale (Rv)** is a duplex soil which is usually 0.5 to 0.9 m deep. The topsoil is dark brown and is 0.15 to 0.3 m thick with a clay loam texture with a neutral pH. The subsoil is brown to brownish-red, with medium to medium heavy clay texture, and is well structured with subangular blocky to polyhedral peds, with a neutral pH. The **Wagoora (Wr)** soil is a non-cracking clay found on slopes generally less than 6%. This soil is 0.6 m to 1.2 m deep with a 0.2 to 0.3 m thick topsoil with a light to light medium clay texture and a neutral pH. The surface is firm and strongly structured with polyhedral or subangular blocky peds. The subsoil is brown to red-brown, with a strongly structured medium to heavy clay texture and a neutral pH. Wagoora is considered one of the more fertile hill slope soils in the study area.

Nabilla (Na) is similar to Riordanvale except that the B1 horizon has a high concentration of iron - manganese concretions. The concretions are formed by the groundwater transporting dissolved iron and manganese downslope which is then precipitated when the water evaporates or drains from the soil. This soil is also found on slopes less than 10% and is usually less than 0.9 m deep. The topsoil is rocky with a 0.2 to 0.3 m thick clay loam to light clay texture. The subsoil is red-brown with a medium to medium heavy clay texture, with moderate to strongly structured polyhedral peds.

The **Strathdickie soil (Sd)** occurs on some undulating rises formed from trachyte or andesite rocks and is a non-cracking clay soil formed on slopes less than 6%. This soil is usually greater than 1 metre in depth with some surface rock. The topsoil is dark brown to black and is 0.2 to 0.3 m thick with a light clay texture and is strongly subangular blocky to prismatic structure. The subsoil is yellowish brown to red-brown in colour with medium to heavy clay texture.

Soil chemistry

The soils formed from intermediate to basic volcanic rocks tend to be well to moderately drained with an acid to neutral profile pH trend except for Strathdickie. The subsoil of Strathdickie is alkaline. The surface fertility of the soils in this group is quite high for coastal areas (Table 18).

Table 18. Selected topsoil soil chemistry for the soils formed on the upperslopes of steep mountains to undulating rises on acid to intermediate intrusive rocks

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Julian	59	0.52	183	2.3	4.4	135	5.3
Habana	31	0.33	75	1.7	2.6	84	3.2
Nabilla (c)	32	0.3	92	2.9	1.3	182	0.88
Riodanvale	14	0.34	71	1.8	2.1	96	1.2
Strathdickie	12	0.29	82	1.3	1.9	90	1.3
Wagoora	31	0.33	75	1.7	2.6	84	3.2

Note (c) - Sample taken from sugarcane land

The soils formed from the intermediate to basic volcanic rocks are low in soluble salt and have a low subsoil sodicity (Figures 37 and 38). Being well drained together with a relatively high proportion of calcium on the clay exchange sites ensures a high level of pedality and low salt retention in the soils.

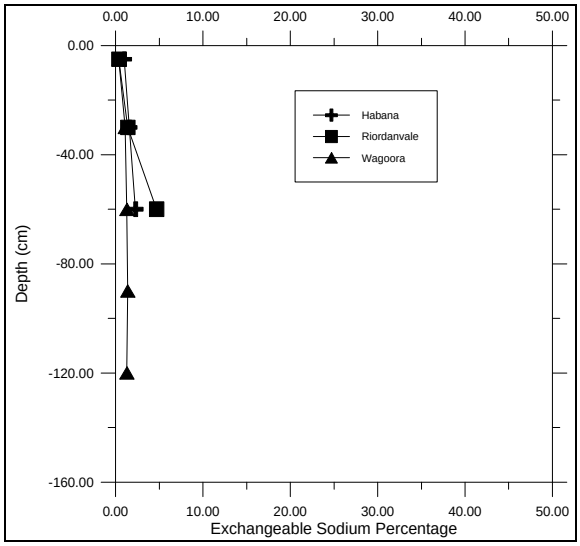


Figure 37. The mean sodicity of the soils formed from intermediate to basic volcanic rocks on upper slopes.

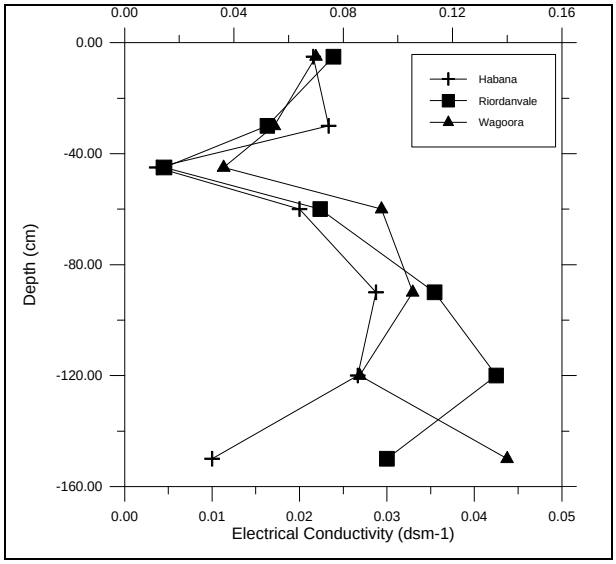


Figure 38. The mean electrical conductivity of soils formed from intermediate to basic volcanic rocks on upperslopes.

The soils formed on intermediate to basic volcanic rocks have a high subsoil cation exchange capacity (Figure 39). The subsoil clay is dominated by montmorillonite type clay which has a greater ability to hold nutrients than materials such as illite or kaolinite. The most chemically active subsoils in this group is Wagoora and Riodanvale.

The relatively high proportion of calcium on the exchange sites of the clay is reflected in the Ca:Mg. Most of the soils in this soil group have a Ca:Mg greater than 1.0 which indicates that these soils have good structure and have a level of resistance against erosion (Figure 40).

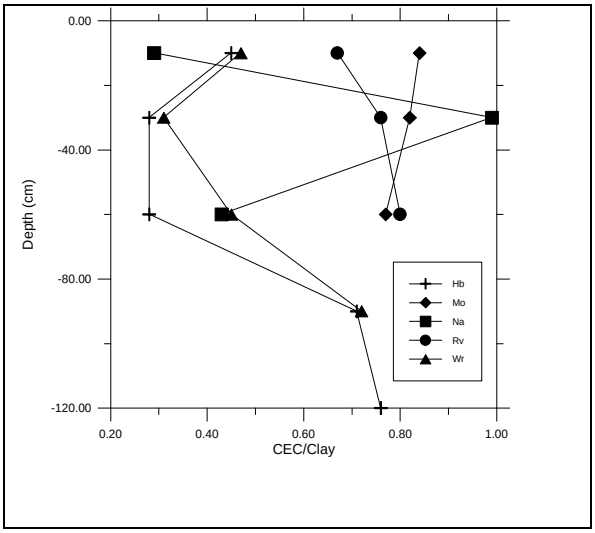


Figure 39. The CEC:Clay for the soils formed on the acid to intermediate intrusive rocks

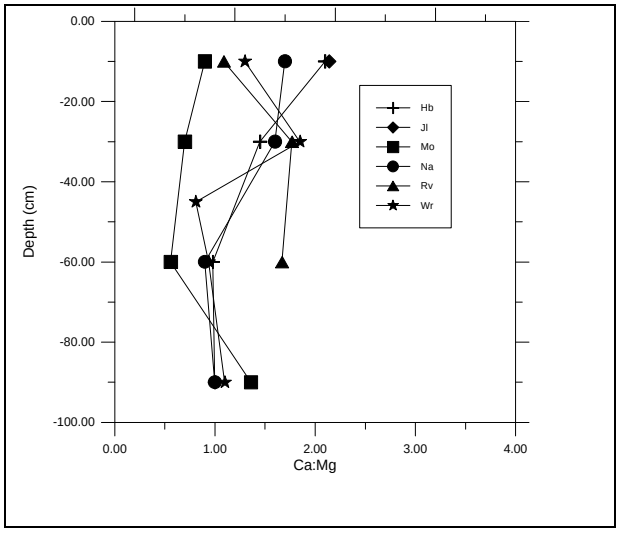


Figure 40. The Ca:Mg for the soils formed on the acid to intermediate intrusive rocks

Undulating to gently undulating footslopes and colluvial fans

Downslope of areas dominated by intermediate to basic volcanic rocks, a range of colluvial soils are formed. The soils formed on the undulating footslopes and colluvial fans range from duplex soils to clays (Table 19). The colluvial soils have variable subsoil textures and may contain a range of buried material from clay to large rocks. These soils have been formed by ancient and possibly more recent debris flows and mass movement events triggered by high rainfall events such as cyclones. Two soils have been described.

Table 19. The description and classification of soils formed on the undulating footslopes and colluvial fans downslope of intermediate to basic volcanic rocks.

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Dy	Dryander	Deep, duplex soil with a gravelly, bleached, sandy clay loam to clay loam topsoil, over an alkaline, brownish-grey, clay subsoil.	Grey Sodosol	Dy3.33
Sg	Silent Grove	Deep, uniform, cracking, clay soil with a self-mulching, clay topsoil, over an alkaline, dark to greyish-brown, clay subsoil.	Black Vertosol	Ug5.16

When the rocks upslope is dominated by andesite and trachyte the most common colluvial soil is Dryander. **Dryander (Dy)** is a sodic duplex soil which is usually deeper than 1 metre with a rocky surface. The topsoil is grey or dark brown, and is 0.15 to 0.3 m thick, with a gravelly clay loam texture with an acid pH. The subsoil is brown to yellowish-brown with a medium to heavy clay texture, and a prismatic or lenticular structure, with an alkaline pH. These soils tend to grade into the Etowrie soils.

The colluvial soils formed from andesite to basalt rocks produce cracking clay soils. **Silent grove (Sg)** is a deep cracking clay formed on slopes less than 2%. The topsoil is dark and is 0.10 to 0.2 m thick with a light medium to medium clay texture and a neutral pH.

The surface is usually hardsetting and may be self mulching. The subsoil is dark to greyish brown with an alkaline pH. These soils often grade into the Victoria plains and Carew alluvial soils.

Soil chemistry

The Dryander and Silent grove soils are imperfect to poorly drained. These two soils have low levels of surface fertility in their natural condition. However, the organic carbon levels are in the moderate range (Table 20).

Table 20. Selected topsoil soil chemistry for the soils formed on the upperslopes of steep mountains to undulating rises on acid to intermediate intrusive rocks

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Dryander (c)	12	0.33	289	1.7	1.1	186	3.1
Silent grove	7	0.17	154	3.8	0.82	58	2.4

Note (c) - Sample taken from sugarcane land

The soil formed on the footslopes and colluvial fans on intermediate to basic volcanic rocks have varying degrees of subsoil sodicity. Depending on the rainfall, soil and slope drainage the subsoil sodicity could be low or strong (Figure 41). In general, where these soils occur in the more drier parts of the survey the subsoil sodicity is increased. Similarly, in drier parts of the catchment, the subsoil salinity increase too. The subsoil salinity of Dryander and Silent grove may exceed 1.1 dSm^{-1} at depth when associated with the Carmila beds west of Proserpine (Figure 42). These two soils are sites where salinity outbreaks have and will occur in the study area.

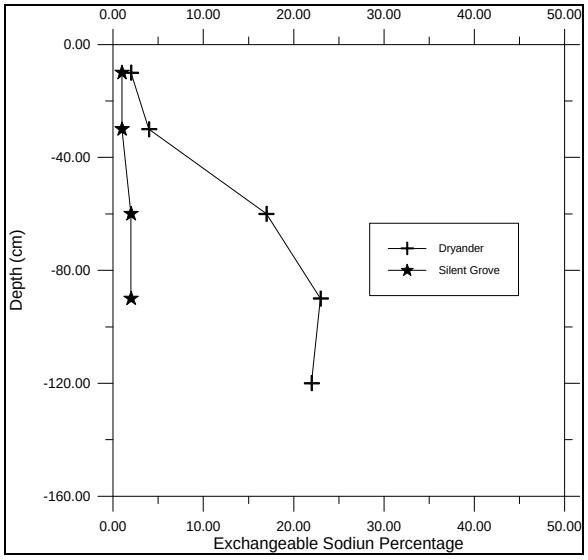


Figure 41. The mean sodicity of the soils formed from intermediate to basic volcanic rock on the undulating footslopes and colluvial fans.

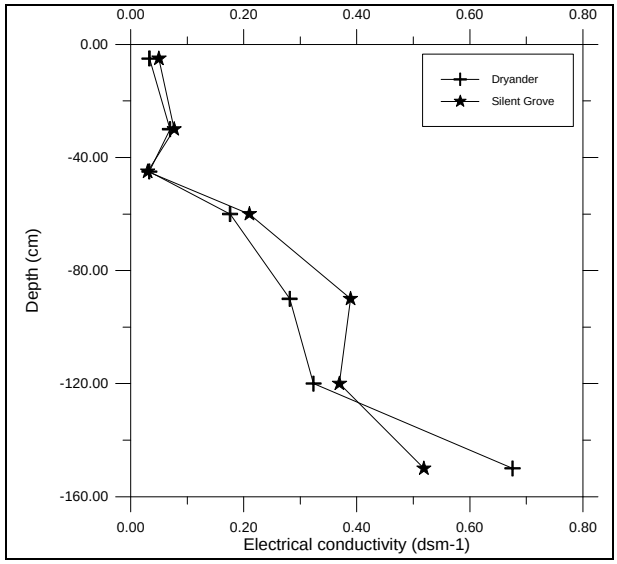


Figure 42. The mean electrical conductivity of the soils formed from intermediate to basic volcanic rocks on undulating footslopes and colluvial fans

The subsoil clay activity is greater in the Silent grove soil than Dryander (Figure 43). The subsoil CEC:clay for the Silent grove soil is usually montmorillonite which exhibits shink-swell characteristics and has a high ability to hold nutrients. The Dryander soil usually his dominated by the illite clays and has a lesser ability to retain nutrients.

Depending on the source material and ground water influences, the Silent grove soil often has calcium carbonate concretions at depth and a relatively high amount of free calcium. In the Silent grove soil sampled, the soil had a very amount of magnesium compared to other soils sampled (up to 25 meq/100g). Consequently, the Ca:Mg of the Silent grove soil is low. The Ca:Mg of the Dryander soil is less than 1.0 and reflects the relatively higher abundance of the magnesium and sodium cations compared to calcium (Figure 44).

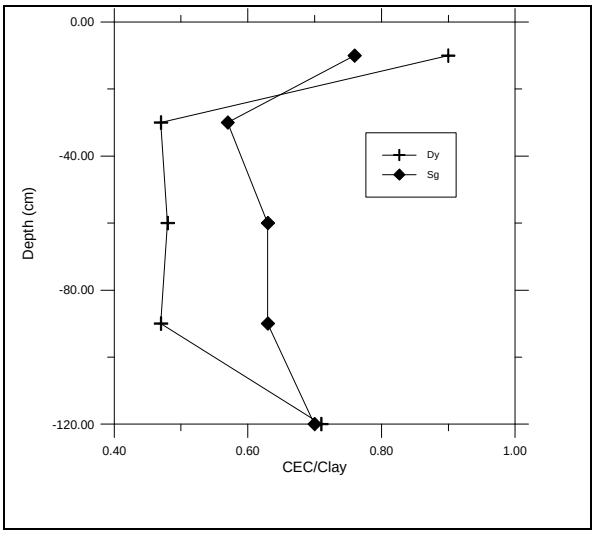


Figure 43. The CEC:Clay for the soils formed on the acid to intermediate intrusive rocks

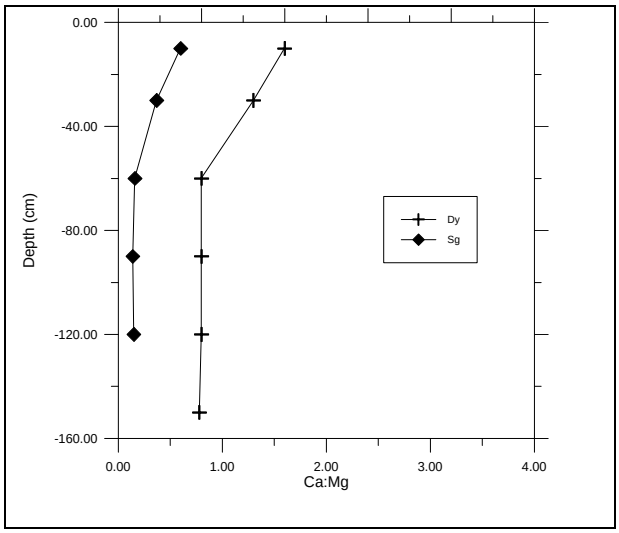


Figure 44. The Ca:Mg for the soils formed on the acid to intermediate intrusive rocks

4.8. Soils formed from Permian sedimentary rocks

The older Permian sedimentary rocks (251 to 298 million years) associated with the Carmilla beds have been separated from the Tertiary sedimentary rocks. The Permian sedimentary rocks generally produce soils with different soil morphology and chemistry to those formed from Tertiary sediments. The Permian sedimentary rocks occur as outcrops in the low hills formed by the Carmilla beds. Five soil have been described (Table 21).

Table 21. The description and classification of soils formed on the upperslopes of steep mountains to undulating rises on sedimentary rocks

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Ca	Campwyn	Moderate to deep, gradational soil with a sandy loam to sandy clay loam topsoil, over a neutral, yellowish-brown, sandy clay subsoil.	Yellow Dermosol	Gn2.34
Dr	Drakon	Shallow, acid to neutral, bleached, greyish-brown, gravelly sandy loam soil which is 0.1-0.3 m deep.	Leptic Rudosol	Uc1.21
Jm	Jumper	Moderate to deep, sodic duplex soil with a gravelly, bleached, sandy loam to sandy clay loam topsoil, over an alkaline, greyish-brown, clay subsoil.	Subnatric, Grey Sodosol	Dy3.31

Lo	Lomond	Moderately deep, uniform brown to black clay, with a self mulching topsoil	Brown Vertosol	Ug5.15
Pa	Palmyra	Shallow to moderately deep, sodic duplex soil with a gravelly, bleached, sandy loam to sandy clay loam topsoil, over an acid, greyish-brown, clay subsoil.	Subnatric, Grey Sodosol	Dy3.31
Pi	Pindi	Moderate to deep, sodic duplex soil with a gravelly, bleached, sandy loam to sandy clay loam topsoil, over an acid, greyish-brown, clay subsoil.	Subnatric, Grey Sodosol	Dy3.31

The **Drakon (Dr)** soils form on hill crests and upperslopes on Permian sedimentary slopes and are shallow and gravelly. These soils are less than 0.2 m deep with an acid to neutral pH trend. The soils that occur downslope of Drakon in footslope positions tend to be duplex soils with sodic subsoils. The **Palmyra (Pa)** soil is a sodic duplex soil which is usually less than 0.6 metres in depth. The topsoil is pale grey and is 0.1 to 0.25 m thick with a gravelly, sandy loam to sandy clay loam texture, with a bleached A2 horizon. The subsoil is grey to greyish-yellow colour with a gravelly, light medium to medium heavy clay texture. The sodic duplex soils which have an alkaline subsoil are grouped into the **Jumper (Jm)** soil class. The Jumper soil tends to be deeper than the Palmyra soil and occurs in more concave locations in the landscape or where the lithology is higher in sodium. The **Pindi (Pi)** sodic duplex soil has a gravelly B1 horizon and an acid to neutral pH trend. The topsoil texture of the Pindi soil is sandy clay loam to sandy loam and the subsoil is medium to medium heavy clay.

Where the substrate is composed of more coarse sedimentary rock material the **Campwyn (Ca)** soil is formed. This soil occurs as small isolated pockets which are caused by the uplifted and tilted strata of the Carmila geological units. The topsoil of the Campwyn soil is usually grey and is 0.1 to 0.2 m thick with a sandy loam to sandy clay loam texture with a bleached A2 horizon. The subsoil is greyish-yellow in colour and has a clay loam to light medium clay texture.

Limestone was identified at one location at the base of Mount Lomond. The **Lomond (Lo)** soil is formed on the limestone and is a moderately deep uniform clay with a self mulching topsoil.

Soil chemistry

The soils formed on Permian sedimentary rock have low surface fertility (Table 22). In most cases the sedimentary rocks in which these soils are formed have undergone some degree of weathering and leaching before and in some cases post the deposition and cementation processes.

Table 22. Selected topsoil soil chemistry for the soils formed on the upperslopes of steep mountains to undulating rises on Permian rocks

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Campwyn	16	0.18	41	0.8	1.1	296	2.0
Jumper	9	0.1					1.9
Palmyra	12	0.4	207	0.7	1.5	49	2.1
Pindi	6	0.11					0.5

The soils formed from the Permian sedimentary rocks have sodic clayey subsoils, except for the Campwyn and Drakon soils (Figures 45). The clayey subsoils of the duplex soils are dominated by magnesium and sodium cations which cause these soils to be poorly structured and dispersive. The Drakon and Campywn soils are non-sodic and have low subsoil salinity levels.

The subsoil salinity levels of the Jumper soils may exceed 1.0 dSm^{-1} in the more drier parts of the study area. The Palmyra and Pindi soils may also have moderately high subsoil salinity levels which may exceed 0.6 dSm^{-1} (Figure 46) .

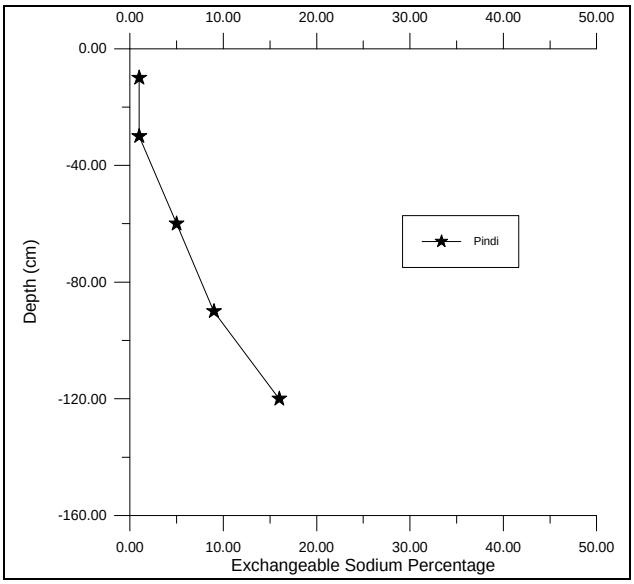


Figure 45. The mean sodicity of the soils formed from Permian sedimentary rock

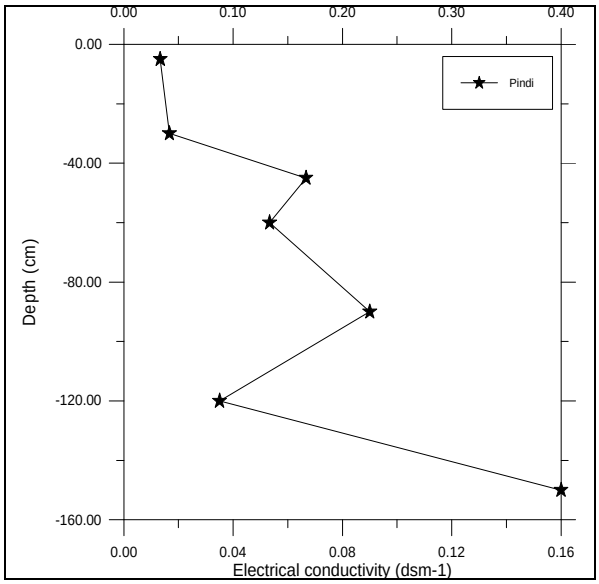


Figure 46. The mean electrical conductivity of the soils formed from Permian sedimentary rock

The subsoil of the duplex soils are dominated by the illite and kaolinitic clays (Figure 47). The clay subsoils have a limited ability to retain nutrients and are dispersive. The Campywn soil is quite leached but still has an illite clay in the subsoil. The most chemically active subsoils in this group is Pindi.

The low Ca:Mg of the soils in this group reflect the weathered nature of the parent material and the dominance of the magnesium cations on the clay exchange sites (Figure 48). The subsoil should be protected from the action of water to reduce erosion.

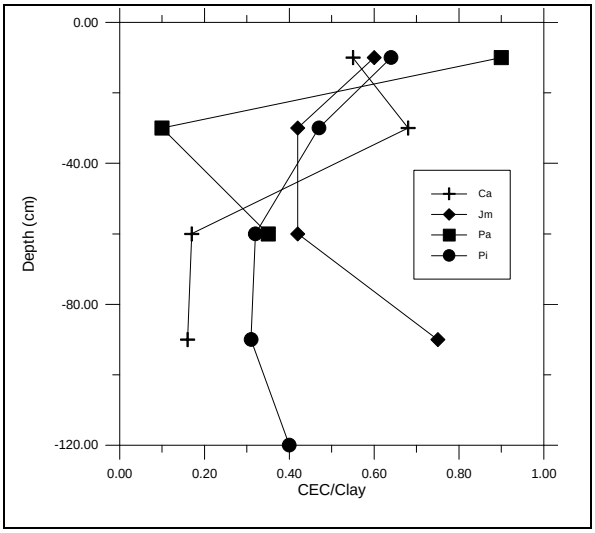


Figure 47. The CEC:Clay for the soils formed on the Permian sedimentary rocks

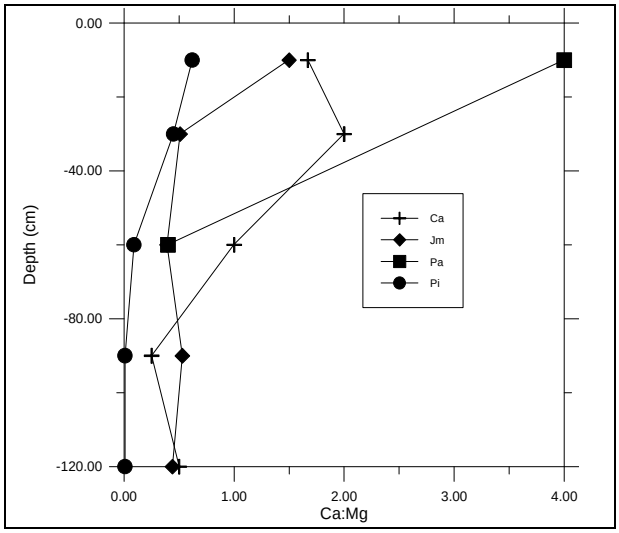


Figure 48. The Ca:Mg for the soils formed on the Permian sedimentary rocks

4.9. Soils formed from Tertiary sedimentary rocks

The Tertiary sedimentary rocks consist of a wide range of material from conglomerates, fine grained sandstones and shale. This group of soils are mostly found in undulating areas in the central and north-eastern parts of the survey area. The Tertiary consolidated sediments appear to be older than the Tertiary – Pliocene sediments which will be discussed latter. Six soils have been described (Table 23).

Table 23. The description and classification of soils formed on undulating rises on tertiary sedimentary rocks

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Soils formed from coarse grained sandstone				
De	Debella	Shallow, uniform to gradational soil, with a thick, sandy loam topsoil.	Leptic Rudosol	Uc1.21
De1	Debella cobbly variant	Shallow, uniform to gradational soil, with a sandy loam topsoil.	Leptic Rudosol	Uc1.21
Up	Up River	Moderate to deep, uniform soil with a sand to loamy sand topsoil, with an acid, yellow to yellowish grey, loamy sand to sandy loam subsoil.	Yellow Kandosol	Uc2.21
Soils formed from finer grained sandstone				
Pl	Pluto	Moderately deep, duplex to gradational soil with an acid, sandy loam topsoil, over an acid, grey to yellowish brown, clay subsoil.	Grey Sodosol	Dy3.41, Dy3.42, Dy3.32
Wa	Wandarra	Moderate to deep, gradational soil with a sandy loam to sandy clay loam topsoil, over an acid, yellowish-grey to yellow, sandy clay loam to light clay subsoil.	Yellow Dermosol	Gn2.34
Soils formed from shale				
Lp	Lillypool	Moderately deep, sodic duplex soil with a gravelly, bleached, sandy loam topsoil, over an acid, grey, clay soil. These soils are formed from weathered shale or fine grained sedimentary rocks.	Mesonatric, Grey Sodosol	Dy3.31

The tertiary sandstone areas identified in the study represent remnants of a once more extensive prior landscape which covered most of the coastal plains. This tertiary landscape is now deeply incised and weathered. The most common Tertiary sedimentary rock is a coarse grained sandstone (quartz arenite). This rock is found on undulating rises close to the Bruce highway from Six mile creek north to Bowen. The soil which is commonly formed on the coarse grained sandstone is Debella. **Debella (De)** is a shallow soil with a pale grey to yellowish-grey 0.2 to 0.4 m thick topsoil with a sandy loam to loamy sand texture (Plate 4). There is often a zone of decomposing sandstone below the topsoil which may be 0.1 to 0.25 m thick with prominent red mottles. Where the substrate is composed of conglomerate, **Debella (cobbly variant) (De1)** is formed. This soil is similar to Debella but has rounded cobbles within the profile and on the surface.

Plate 9. The Debella soil overlying Tertiary sandstone.

The deeper Debella soils are grouped into the Up river soil profile class. The **Up river (Up)** soil is a moderately deep to deep uniform sand with a 0.2 to 0.4 m thick sand to loamy sand topsoil with an acid to neutral pH. The subsoil is yellow to yellowish-grey in colour with a loamy sand to sandy loam texture, with an acid pH.

Where the substrate is composed of finer grained sandstone the Wandarra and Pluto soils are formed. The **Wandarra (Wa)** soil has a higher clay content throughout the profile than Up river. This soil is a deep gradational soil with a 0.2 to 0.3 m thick topsoil with a sandy loam to sandy clay loam texture and an acid to neutral pH. The subsoil is yellowish-grey to yellow with a sandy clay loam to light clay texture, and an acid pH. The **Pluto (Pl)** soil is formed from sandstone which has a higher proportion of finer clay material in the matrix. The topsoil is usually 0.1 to 0.25 m thick with a sandy loam topsoil with an acid pH. The subsoil is grey to yellowish brown with a light to medium clay texture and an acid pH.

Tertiary shale outcrops in small areas in the central and northern parts of the study area. This material is composed of consolidated old marine clay and associated deposits. Most of the material represents old coastal deposits such as estuarine muds. The **Lillypool (Lp)** soil is formed from marine shale and is a moderately deep to deep duplex soil. The topsoil is 0.2 to 0.3 m thick with a gravelly, sandy loam to sandy clay loam texture with a bleached A2 horizon and an acid pH. The subsoil is usually a greyish-brown to yellowish-grey with a medium to medium heavy clay texture and a strongly acid pH. The substrate is usually found below one metre and is often whitish in colour with a green tinge. When hydrogen peroxide is applied to a sample of the decomposing shale in a 1:3 solution, the pH drops from 4 to 5 down to as low as 2.5 to 3. In some profiles near the Proserpine airport an iron - manganese pan has formed between the topsoil and subsoil.

Soil chemistry

The soils formed on tertiary sandstone have the lowest surface fertility in the study area (Table 24). Topsoil samples collected from soils formed from tertiary sediments indicate organic carbon levels range from 0.55 to 0.98% and are considered very low (Bruce and Rayment, 1982). The surface phosphorus and sulfur levels for Wandarra, Pluto, Debella and Up river are very low. The more sandy soils sustain sparse Eucalypt forests with grasslands dominated by *sporabolus* grass. The Debella, Up river and Wandarra soils are rapid to well drained while the Pluto and Lillypool soils are imperfectly drained.

Table 24. Selected topsoil soil chemistry for the soils formed on Tertiary sedimentary rocks

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Debella	1			<0.2			0.7
Debella (variant)	1			<0.2			0.72
Up river	3	0.08	43	0.02	0.33	6.7	0.85
Pluto	2	0.07	56	0.2	0.4	10	0.92
Wandarra	4	0.09	78	0.1	0.2	1	0.97
Lillypool	3	0.1	59	0.12	0.37	19	1.3

The Debella soils have very low sodicity and salinity levels but the decomposing sandstone may have moderate to high concentrations of salt (Figure 49 and 50). When the coarse sandstone weathers, the finer material disperses and moves through the soil to lower parts of the landscape. The Up river and Wandarra soils are also low in salt. The Pluto duplex soil may be mildly sodic in the subsoil with conductivity levels up to 0.3 dSm^{-1} at depth. The most sodic soil is Lillypool with subsoil sodicity levels ranging from 6 to 20 in the first 0.1 m of the B horizon. The Lillypool soil also has moderate to high subsoil conductivity with levels ranging from 0.2 to 1.4 dSm^{-1}.

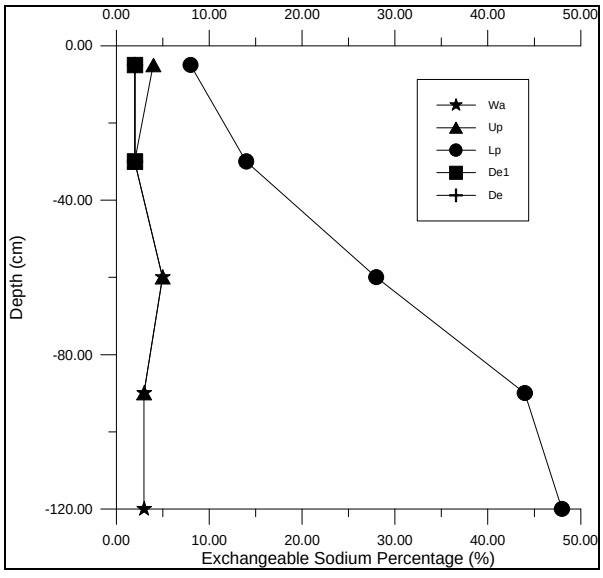


Figure 49. The mean sodicity of the soils formed on the undulating plains to undulating rises of Tertiary sedimentary rocks

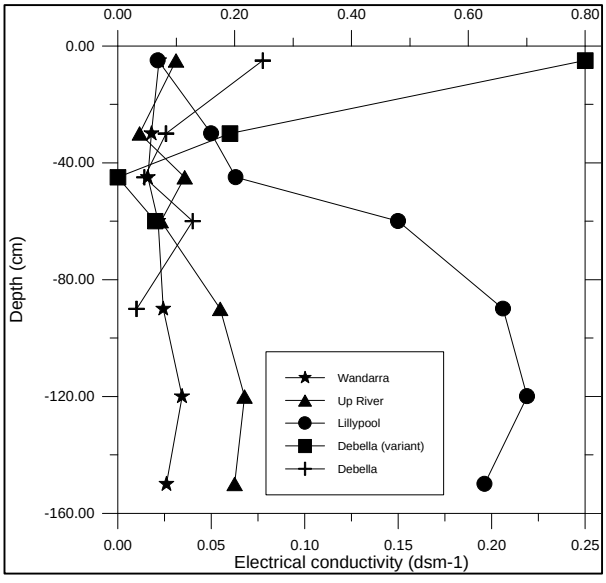


Figure 50. The mean electrical conductivity of the soils formed on the undulating plains to undulating rises of Tertiary sedimentary rocks

The soils formed from Tertiary sediments are dominated by the illite and kaolinite clay types (Figure 51). The clay type reflects the highly weathered nature of the parent material and the soils. The low CEC:clay causes these soils to have a low ability to hold nutrients. The most chemically active subsoils in this group are the two duplex soils, Pluto and Lillypool.

The Tertiary sedimentary rocks are probably low in calcium due to the long exposure to weathering processes. The low proportion of calcium in the rocks is transferred to the soils formed from these tertiary sediments. Ca:Mg in each soil class is well below 0.3 with most of the exchange sites on the clay dominated by magnesium with very little calcium (Figure 52).

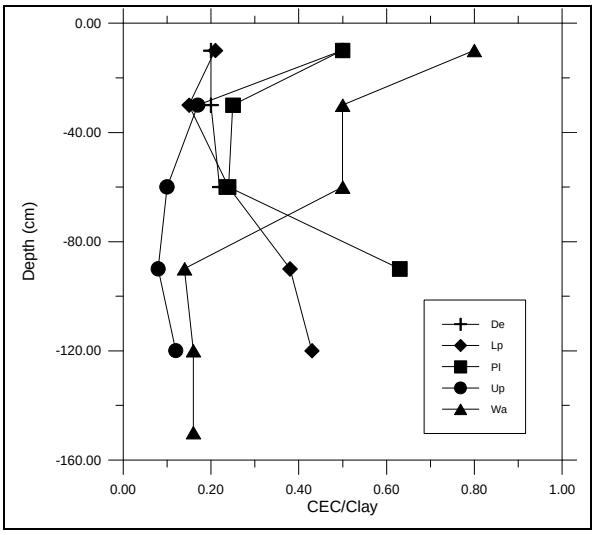


Figure 51. The CEC:Clay for the soils formed on the Tertiary sedimentary rocks

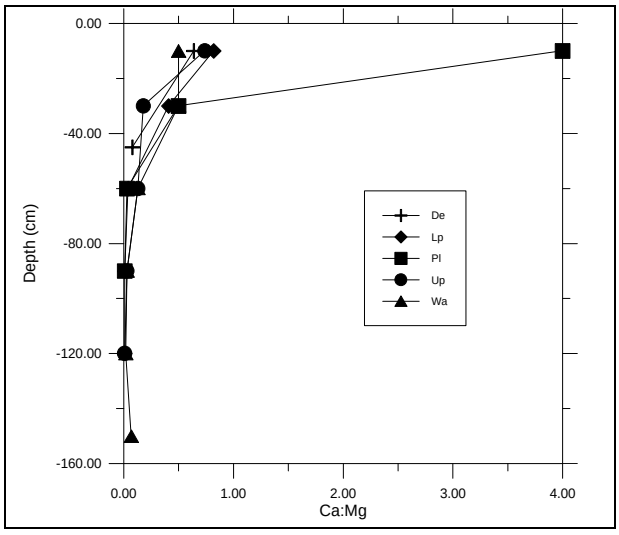


Figure 52. The Ca:Mg for the soils formed on the Tertiary sedimentary rocks

4.10. Soils formed from Tertiary-Pliocene consolidated sediments

The Tertiary-Pliocene landscape occurs in elevated flood free areas throughout the survey area. This landscape is predominantly flat to undulating and is usually deeply dissected. The Pliocene landscape is younger than the Tertiary consolidated sedimentary deposits and has been described by Aldrick (1988), Thompson *et al.* (1981) and Holz and Shield (1985). The distinguishing feature of this landscape is the hard consolidated sandstone rock-like formation between 0.6 m and 1.5 m below the surface. The rock formation is in most cases a silica pan which is 0.5m to more than 5 m thick. The deeper silica pans can be regarded as a Pliocene sandstone. In some areas there may be semi-consolidated material below the silica pan or sandstone. The Pliocene sandstone or silica pan is commonly seen in gullies in the Tertiary-Pliocene landscape and underlies large parts of the study area. The silica pan is usually formed when dissolved silica in the groundwater is precipitated by fluctuating groundwater tables. The precipitation of the silica binds the gritty subsoil layers and hardens after drying. The formation of the pan often allows the formation of perched water tables and causes subsoils to be poorly to imperfectly drained. The source of the sediments and groundwater is probably the acid volcanic rocks of the Carmila beds and acid intrusive rocks found in the more northern areas of the study area. Eight soils have been described (Table 25).

Table 25. The description and classification of soils formed on the undulating rises on Tertiary - Pliocene sedimentary rocks

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Gradational soils				
Dg	Dingo	Moderately deep, uniform to gradational soil with a 20-40 cm thick, acid, sandy loam to coarse sand topsoil, over an acid, pale grey to pale yellow, sandy loam to clay loam sandy subsoil.	Yellow Kandosol	Uc2.21
Mk	Mookara	Moderate to deep, duplex to gradational soil with a clay loam topsoil, over an alkaline, greyish brown to reddish–brown, clay subsoil formed on a silica-carbonate pan.	Brown Dermosol	Uf6.13
Duplex soils				
Gs	Grasstree	Shallow to moderately deep, sodic duplex soil with a rocky surface and a grey, acid, sandy loam topsoil, over an acid, sandy clay subsoil.	Brown Sodosol	Dy5.41
Kr	Kangaroo	Shallow to moderately deep, sodic duplex soil with a sandy loam topsoil, over an alkaline, grey, sandy clay subsoil.	Grey Sodosol	Dy3.42, Dy3.43, Dy2.32, Dy2.33
Ko	Koolachu	Moderately deep, duplex soil with a bleached, sandy loam topsoil, over an acid, grey, clay subsoil.	Mesonatric, Grey Sodosol	Dy3.31
Ko1	Koolachu (Saline variant)	Moderately deep, duplex soil with a bleached, sandy loam topsoil, over an acid, grey, clay subsoil.	Mesonatric, Grey Sodosol	Dy3.31
Tm	Tenmile	Moderately deep, sodic duplex soil, with a bleached, loamy sand to sandy clay loam topsoil, over an alkaline, grey to yellowish-grey, clay subsoil.	Mesonatric, Grey Sodosol	Dy3.33

Five duplex soils are formed on the Tertiary – Pliocene landscape. The most common soil is the Koolachu soil. **Koolachu (Ko)** is a sodic duplex soil which is usually 0.7 to 1.2m deep. The topsoil is 0.15 to 0.35 m thick with a loamy sand to sandy loam texture which is massive. The surface is normally hardsetting and the topsoil has a bleached A2 horizon and an acid pH. The subsoil is grey to yellowish-grey in colour with a sandy light to medium heavy clay texture, and an acid to strongly acid pH. The subsoil has weak prismatic structure and distinct orange mottles caused by perched water tables and the slow movement of water through the soil. The **Koolachu (saline variant) (Ko1)** is a saline version of the Koolachu soil and is restricted to only a few locations in the study area. The **Grasstree (Gs)** sodic duplex soil is similar in morphology and chemistry to Koolachu but has a cobbly surface and profile. The **Tenmile (Tm)** soil is morphologically similar to Koolachu with a sandy loam topsoil which is 0.15 to 0.3 m thick over a grey clay but has an alkaline subsoil. The Tenmile soils tend to occur in more concave areas associated with the undulating plains. The **Kangaroo (Kr)** soils tend to be shallower and rockier than the Tenmile soils with an alkaline subsoil. The Grasstree and Kangaroo soils are found in the more northern areas of the study area while, the Koolachu and Tenmile soils are found in the central and southern areas.

Plate 10. The Ten mile soil formed on Tertiary - Pliocene sandstone.

In isolated patches in the northern parts of the study area adjacent to hills dominated by basic intrusive rocks the silica pan has a high amount of calcium. The soil formed from the silica-calcium pan is Mookara. **Mookara (Mk)** is a gradation soil which is 0.6 to 1.1 m deep with a clay loam topsoil over an alkaline clay subsoil. One Mookara sites occurs south of Bowen near the railway line and has been mined for calcium carbonate.

The Dingo and Koolachu (sandy variant) soils are both gradational soils formed from old coarse colluvium. The **Dingo (Dg)** soil represents relict alluvial – colluvial material from tertiary sandstone or Granite areas. Dingo is a moderately deep uniform to gradational sandy soil which overlies a silica pan. The topsoil is usually pale grey and is 0.2 to 0.4 m thick with a sandy loam to coarse sand texture with an acid pH. The subsoil is normally pale grey to pale yellow with a sandy loam to clay loam sandy texture with an acid pH.

Soil chemistry

Topsoil samples were collected from the sodic duplex soils formed on the undulating plains formed from Tertiary – Pliocene consolidated and semi-consolidated sediments. The soil samples collected from the sodic duplex soils indicate that organic carbon levels range from 0.8 to 1.4% and are considered low (Bruce and Rayment, 1982). The surface phosphorus levels for the soils are very low (Table 26). The surface sulfur levels for Koolachu is very low while the amounts for Tenmile are medium. Surface nitrogen and copper levels for all three soils are in the very low range (Bruce and Rayment, 1982).

Table 26. The topsoil fertility of the duplex soils formed on Tertiary - Pliocene sediments

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Dingo	4	0.3	33	0.13	0.35	4.2	0.7
Koolachu	2	0.07	35	0.02	0.09	1.7	0.55
Kangaroo	3	0.08	26	0.1	0.1	5	0.3
Tenmile	3	0.08	45	0.19	0.2	35	0.8

The Koolachu, Grasstree, Kangaroo and Ten mile soils all have strongly sodic subsoils but have a low subsoil cation exchange capacity (5 to 14). The quantity of sodium on the exchange sites is not often high but proportionally to other cations it may account for up to 40% or more of the cations present (Figure 53). The Dingo and Koolachu sandy variant soils have low sodicity levels which is linked to the better drainage these soils exhibit and lower clay content. The Mookara soils may have a low to moderate subsoil sodicity level.

The subsoil salinity levels of these soils are higher in the drier northern parts of the study area with some Kangaroo and Grasstree subsoils having conductivity levels over 1.0 dSm $^{-1}$. The Tenmile and Koolachu soils typically have subsoil conductivity levels between 0.2 and 0.7 dSm $^{-1}$ in the subsoil (Figure 54). The subsoil conductivity levels of the Dingo and Koolachu sandy variant are usually less than 0.1 dSm $^{-1}$.

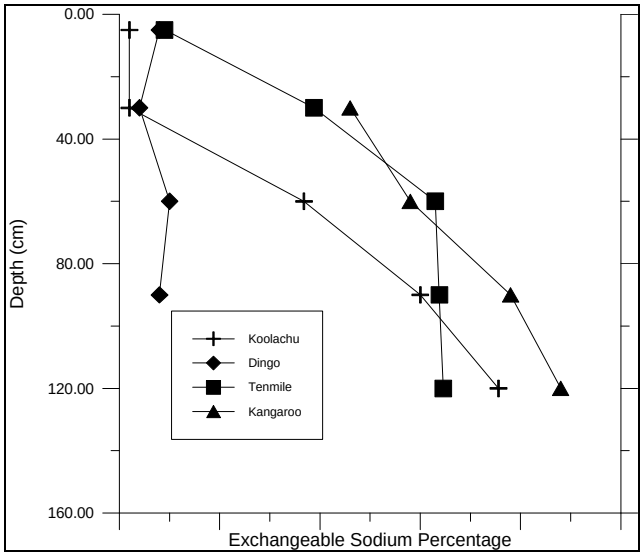


Figure 53. The mean sodicity of the soils formed on the gently undulating plains of Tertiary-Pliocene sediments

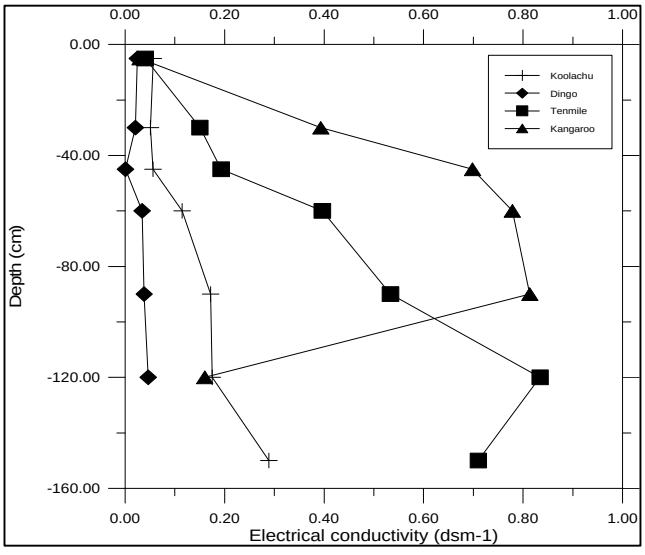


Figure 54. The mean electrical conductivity of the soils formed on the gently undulating plains of Tertiary – Pliocene sediments

The subsoil of the sodic duplex soils is dominated by illite and kaolinitic clay (Figure 55). The clay type reflects the highly weathered nature of the sandstone and the soils. The Koolachu soils are strongly dominated by the kaolinitic clays while the Kangaroo soils have mostly illite clays. The kaolinitic and illite clays have a low ability to retain nutrients because of the small number of exchange sites on the clay.

Most of the soils formed from Pliocene sandstone have very low to low Ca:Mg with the Koolachu soil having subsoil values less than 0.1. The Tenmile soil has the highest subsoil Ca:Mg with a range of 0.4 to 1.0. The low Ca:Mg and relatively high subsoil sodicity of these soils reflect their susceptibility to water erosion (Figure 56).

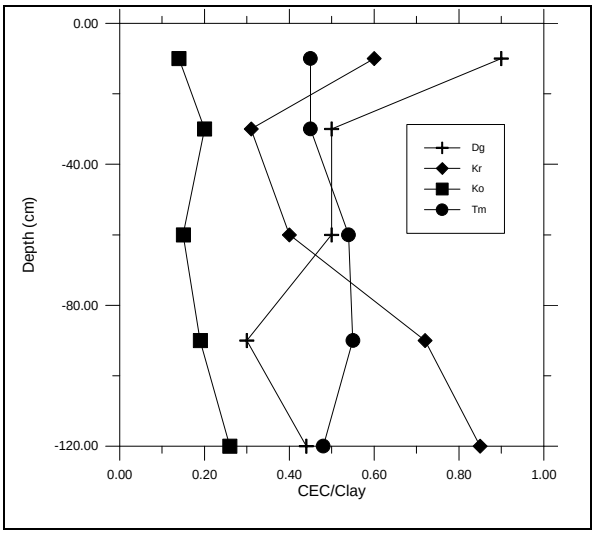


Figure 55. The CEC:Clay for the soils formed on the acid to intermediate intrusive rocks

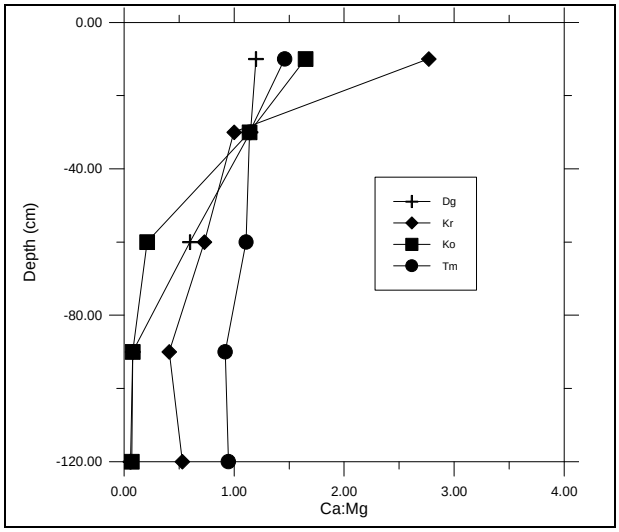


Figure 56. The Ca:Mg for the soils formed on the acid to intermediate intrusive rocks

4.11. Soils formed on the gently undulating plains of unconsolidated Cainozoic alluvium

Cainozoic alluvium is material derived from relict fluvial and colluvial processes. This material often forms extensive flat to slightly undulating plains that are no longer subjected to floods. The Cainozoic alluvium material is distinctly more weathered than the more recent Quaternary alluvium. The soils formed from Cainozoic alluvium have significantly different soil chemistry and morphology to the more recent alluvium. In the Whitsunday Coast area, Cainozoic alluvium is mainly found on upper terrace flats and peneplains. Four soils have been described (Table 27).

Table 27. The description and classification of soils formed on the undulating plains of unconsolidated Cainozoic alluvium

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Bc	Billy's Creek	Deep, sodic duplex soil with a sandy loam to loamy sand topsoil, bleached over an alkaline, pale grey to yellowish-grey, mottled, clay subsoil.	Mesonatric, Grey Sodosol	Dy3.33

Lc	Lascelles	Deep, sodic duplex soil with a sandy loam to clay loam sandy topsoil, bleached over an acid, grey to yellowish-grey, clay subsoil. These soils have an iron - manganese pan between the topsoil and subsoil.	Subnatric, Grey Sodosol	Dy3.84
Lc1	Lascelles (shallow variant)	Shallow to moderately deep, sodic duplex soil with a bleached, sandy loam to clay loam sandy topsoil, over an acid, grey to yellowish-grey, clay subsoil. These soils have an iron - manganese pan between the topsoil and subsoil. The soil depth is usually less than 0.6 m.	Subnatric, Grey Sodosol	Dy3.84
Lc 2	Lascelles (alkaline variant)	Deep, sodic duplex soil with a sandy loam to clay loam sandy topsoil, bleached over an alkaline, grey to yellowish-grey, clay subsoil. These soils have an iron - manganese pan between the topsoil and subsoil.	Subnatric, Grey Sodosol	Dy3.84
Sk	Slater	Moderate to deep, sodic duplex soil, with a loamy sand to sandy clay loam topsoil, bleached over an acid to neutral, pale grey, clay subsoil.	Subnatric, Grey Sodosol	Dy3.31
Ti	Tailing	Deep, sodic duplex soil with a clay loam topsoil, bleached over an alkaline, pale grey to yellowish-grey, mottled, clay subsoil.	Mesonatric, Grey Sodosol	Dy3.33

The Slater soil is found on relict terrace plains, peneplains and colluvial areas adjacent to Koolachu soils. **Slater (Sk)** is a sodic duplex soil and may have a silica pan or strongly cemented layers below 1.2 metres. The topsoil is pale grey and is 0.2 to 0.35 m deep with a loamy sand to sandy clay loam texture with a bleached A2 horizon, and an acid pH. The subsoil is pale grey with an acid to neutral, light medium to medium heavy clay texture and a moderate prismatic structure. The subsoil has orange to brownish-yellow mottles caused by perched water tables and the slow movement of water through the soil.

The **Billy creek (Bc)** soil is found on extensive peneplains in the coastal north of the study area and are subjected to saline groundwater tables. This strongly sodic duplex soil is usually 1 to 1.5 metres deep. The topsoil has a sandy loam or loamy sand texture and is often shallow (less than 10 cm deep) due to surface erosion. The subsoil is generally pale grey to yellowish-grey with an alkaline pH. There is usually abundant prominent orange mottling caused by the slow movement of water through the subsoil and shallow water tables.

The other soil that occurs in drainage depressions on peneplains or downslope from Koolachu soils is Tailing. **Tailing (Ti)** is a sodic duplex to gradational soil and is usually greater than 1.5 metres in depth. The topsoil is 0.1 to 0.2 m thick with a sandy clay loam to light clay texture, and the surface is hard setting with a bleached A2 horizon. The subsoil is yellowish-grey to pale grey with medium to medium heavy clay texture with an alkaline pH.

The **Lascelles (Lc)** soil is formed on old terrace flats adjacent to the low hills or on the outer extensions of relict colluvial fans. Lascelles is a sodic duplex soil which is usually deeper than 1.0 metre and has a strongly to weakly cemented iron- manganese pan between the topsoil and subsoil. The thickness of the pan ranges from approximately 0.05m to more than 0.2 m. The pan is formed from groundwater high in iron and manganese ions. The topsoil is 0.15 to 0.3 m thick with a sandy loam to clay loam sandy texture with a bleached A2 horizon and an acid pH. The subsoil is grey to yellowish-grey with a medium to medium heavy clay texture and an acid pH.

Soil chemistry

The topsoil samples collected from the Cainozoic sodic duplex soils indicate that organic carbon levels range from 0.3 to 1.4% and are considered very low to low (Bruce and Rayment, 1982). The surface phosphorus, sulfur, copper and nitrogen levels for Billy creek, Slater and Ten mile are very low (Bruce and Rayment, 1982) (Table 28). The low surface fertility is caused by the prolonged exposure to the processes of weathering and that the source material is also highly weathered.

Table 28. The topsoil fertility of the duplex soils formed on Cainozoic alluvium

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Billy creek	3	0.15	30	0.28	0.32	48	0.9
Lascelles	12	0.34	85	0.96	0.42	160	1.9
Slater	2	0.07	33	0.2	0.23	122	0.85
Tailing	13	0.1	0.8	0.77	0.5	51	1.3

The four soils formed from Cainozoic alluvium have moderate to strongly sodic subsoils. The Billy creek soils have the highest subsoil sodicity with levels reaching an exchangeable sodium percentage of up to 40 (Figure 57). The Slater soils have ESP levels that range from about 8 to 22 in the first 0.1m of the subsoil and gradually increase. The sodicity of the Slater soils is less in the wetter areas just north and west of Proserpine. The Lascelles and Tailing soils commonly have sodicity levels greater than 25 in the subsoil.

The Billy creek and Tailing soils are affected by shallow saline water tables. The subsoil conductivity levels in the Billy creek and Tailing soils often exceed 1.0 dSm $^{-1}$. The least saline soil is Slater with conductivity levels generally less than 0.4 dSm -1 (Figure 58). The Lascelles soil may have subsoil conductivity levels between 0.4 and 0.8 dSm $^{-1}$ but may occasionally exceed 1.0 dSm $^{-1}$.

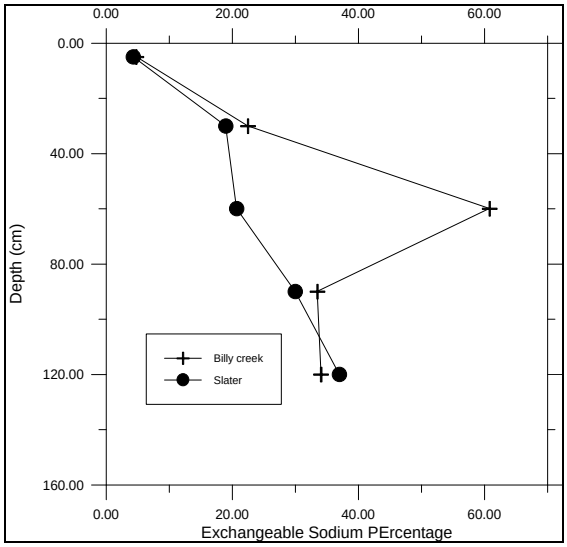


Figure 57. The mean sodicity of the soils formed from Cainozoic alluvium

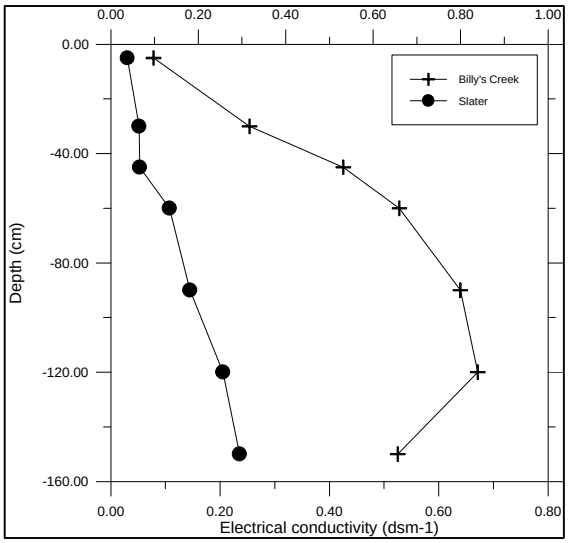


Figure 58. The mean electrical conductivity of soils formed from Cainozoic alluvium

The Slater, Tailing and Lascelles soils are dominated by kaolinitic clay which has a low ability hold and retain nutrients. The Billy creek soil is dominated by illite clay and has a greater capacity to retain nutrients (Figure 59). The Cation Exchange Capacity (CEC) of these soils is quite low with values rarely exceeding 15.

The Slater and Lascelles soils have very low Ca:Mg which indicate that these soils are highly weathered. The presence of small amounts of calcium carbonate in the subsoil of Tailing and Billy creek indicate is reflected by the relatively higher Ca:Mg in these soils. The low Ca:Mg and high subsoil sodicity indicates that the Slater and Lascelles soils have dispersive subsoils and are prone to erosion. The presence of calcium in the subsoil of Tailing and Billy creek will provide some resistance to water erosion (Figure 60).

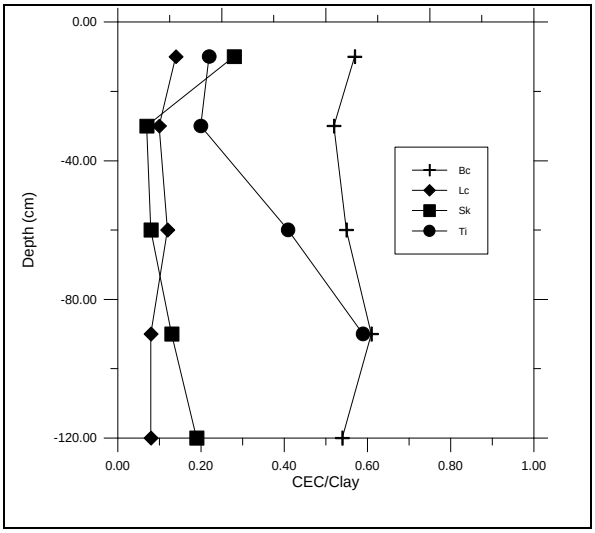


Figure 59. The CEC:Clay for the soils formed from Cainozoic alluvium

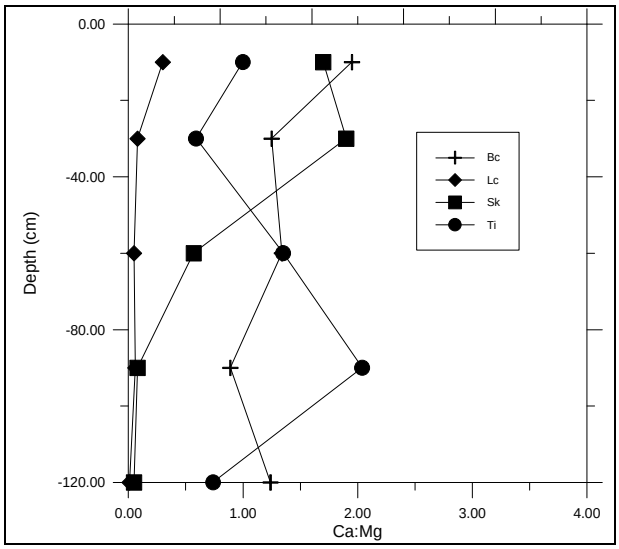


Figure 60. The Ca:Mg for the soils formed from Cainozoic alluvium

4.12. Soils formed on Quaternary alluvium

Quaternary alluvium is material derived from recent flooding from rivers and creeks. Some of the most fertile soils in the Whitsunday Coast study area are formed from Quaternary alluvium. There are nine levee soils, ten uniform cracking clay soils, sixteen sodic duplex soils and four non sodic duplex soils derived from Quaternary alluvium.

4.12.1.Relict and active levees

Levee systems are found adjacent to rivers and creeks. The frequency of flood events and the material transported in the floods influence the size of the levees and floodouts and the soils that are formed on them. Nine soils have been described (Table 29).

Table 29. The description and classification of soils formed on the relict and active levees on Quaternary alluvium

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Shallow to moderately deep levee soils				
Cm	Cameron	Moderate to deep, duplex to gradational soil with a clay loam to sandy clay loam topsoil, over an acid to neutral, brown to greyish-brown, clay subsoil.	Stratic Rudosol	Um1.43

Cm1	Cameron (gleyed phase)	Moderate to deep, duplex to gradational soil with a clay loam to sandy clay loam topsoil, over an acid to neutral, greyish-brown and gley, clay loam to clay subsoil.	Stratic Rudosol	Um1.43
Ms	Moosie	Moderate to deep, sandy duplex to gradational soil with a fine loamy sandy to sandy loam topsoil, over a neutral greyish-brown to reddish-brown, sandy loam to clay loam subsoil.	Brown Dermosol	Gn4.32, Db1.12
Mu	Murray	Shallow to moderately deep, duplex to gradational soil with a sandy loam to clay loam topsoil, over an acid to neutral, brown to greyish brown, sandy clay loam to sandy light clay subsoil.	Stratic Rudosol	Uc1.22
Mu1	Murray (colluvial variant)	Shallow, gradational soil with a sandy loam to clay loam topsoil, over an acid to neutral, brown to greyish-brown, sandy clay loam to sandy light clay subsoil.	Stratic Rudosol	Uc1.22
Deep levee soils				
Ad	Andromache	Deep, gradational to uniform soil with a fine loamy sand to sandy loam topsoil, over an acid to neutral, greyish-brown to brown, sandy loam to sandy clay loam subsoil.	Stratic Rudosol	Uc1.44
Do	Don	Deep, gradational soil with a sandy clay loam to clay loam sandy topsoil, over an alkaline, greyish-brown to brown, light to medium clay subsoil.	Grey Dermosol	Dd1.13, Gn4.43
Pn	Pioneer	Deep, duplex to gradational soil with a sandy clay loam to clay loam topsoil, over an acid to neutral, brown to red-brown, clay subsoil.	Brown Dermosol	Dy3.32
Po	Proserpine	Deep, gradational to uniform soil with a sandy loam to sandy clay loam topsoil, over an acid to neutral, greyish-brown clay loam to medium clay subsoil. These soils overlie buried layers of sand to light clay alluvium.	Stratic Rudosol	Uc1.44
St	St Helens	Moderately deep, duplex to gradational soil with a clay loam to sandy clay loam topsoil, over an acid to neutral, brown to greyish brown, clay subsoil.	Brown Dermosol	Gn3.92

The soils commonly found in levee or floodout landforms in the mid to upper reaches of the catchment are the more shallow and often rocky Murray, Moosie and Cameron soils. The Murray soils are cobbly soils that form either on prior stream channels or depositional areas where rock accumulates. **Murray (Mu)** is a duplex to gradational soil which is usually less than 0.6 m in depth and is often underlain by gravel and cobble layers. The topsoil is 0.15 to 0.3 m thick with a sandy loam to clay loam texture and normally has a rocky surface with an acid to neutral pH. The subsoil is brown to greyish-brown sandy clay loam to sandy light clay with an acid to neutral pH.

The **Moosie (Ms)** soil is found in the drier parts of the study area. This soil is commonly found on levees of smaller creeks in the mid to upper catchments dominated by acid to intermediate intrusive rocks. Moosie is a sandy duplex to gradational soil which is usually 0.6 to 1.1 m in depth. The topsoil is 0.15 to 0.25 m thick with a fine loamy sand to sandy loam texture and a weak to massive structure. The subsoil is greyish-brown to reddish - brown, with a sandy loam to clay loam sandy texture. The subsoil of Moosie becomes consolidated at depth and may form a red-brown pan.

The Cameron soil is found in floodouts or levees which experience frequent flooding and is composed of mostly sandy sediments and very little rock. **Cameron (Cm)** is a duplex to gradational soil which is 0.6 to 1.2 metres in depth and is often underlain by gravel layers. The topsoil is 0.15 to 0.3 m thick with a sandy loam to clay loam texture with an acid to neutral pH. The subsoil is brown to greyish-brown in colour and usually has a clay loam to sandy light medium clay texture with an acid to neutral pH. The Cameron soils grade into the St Helens soils which are also found in frequently flooded areas.

The St Helens soil has a higher topsoil and subsoil clay content than Cameron. **St Helens (St)** is a duplex to gradational soil which is usually more than 1.2 metres in depth and is often underlain by gravel layers. The topsoil is 0.15 to 0.3 m thick with a clay loam to sandy clay loam texture with an acid to neutral pH. The subsoil is brown to greyish-brown with a light medium to medium clay texture, with moderate subangular blocky to prismatic structure with an acid to neutral pH.

The Proserpine soil is formed on channel benches or more frequently flooded levees. **Proserpine (Po)** is a gradational soil which is usually more than 1.5 metres in depth. The topsoil is 0.10 to 0.3 m thick with a sandy loam to sandy clay loam texture, and a massive to weak structure with an acid to neutral pH. Buried layers of sand to light clay often occur below 0.4 m with an acid to neutral pH.

In the upper catchments which are dominated by acid to intermediate intrusive rocks such as granite and diorite, the Andromache soil is found on levees. **Andromache (Ad)** is a sandy duplex to gradational soil which is usually more than 1.5 metres in depth. The topsoil is 0.15 to 0.45 m thick with a fine loamy sand to sandy loam texture and a weak to massive structure. The subsoil is greyish-brown to brown, with a sandy loam to sandy clay loam texture.

On the older levee systems which rarely flood, Pioneer and Don soils are found. **Pioneer (Pn)** is a duplex to gradational soil which is usually more than 1.5 metres in depth. The topsoil is 0.20 to 0.30 m thick with a sandy clay loam to clay loam texture with a moderate sub-angular blocky structure with an acid to neutral pH. The subsoil is brown to red-brown with a light medium to medium heavy clay texture and minor mottling with an acid to neutral pH. The **Don (Do)** is a deep gradational soil. The topsoil of the Don is mostly 0.2 to 0.35 m thick with a sandy clay loam to clay loam sandy texture with an acid to neutral pH. The subsoil is greyish-brown to brown with a light to medium clay texture with an alkaline pH.

The soil associated with the drainage lines in the mountains and hills is **Murray (alluvial - colluvial variant) (Mu1)**. This soil is a shallow gradational soil which is formed on channel benches and drainage depressions close to some creeks on colluvial footslopes which are commonly between 6 and 20%. The Murray variant is usually less than 0.5 m deep and is often underlain by gravel and cobble layers. The topsoil is 0.15 to 0.3 m thick with a sandy loam to clay loam texture and has a rocky surface with an acid to neutral pH. The subsoil is a brown to greyish-brown, sandy clay loam to sandy light clay.

Soil chemistry

The topsoil samples collected from the levee soils indicate that organic carbon levels range from 0.4 to 1.4% and are considered very low to low (Bruce and Rayment, 1982). The surface phosphorus levels are elevated in most soils due to the addition of fertiliser to cropping areas (Table 30).

In general, the deeper levee soils are naturally quite fertile and are considered some of the more fertile soils on the floodplain. These levee soils tend to be well drained but not highly leached or weathered with nutrients being added to these areas during flood events.

Table 30. The topsoil fertility of the soils formed on relict and active levees

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Cameron	35	0.29	62	1.8	1.9	38	0.86
Murray (c)	127	0.3	48	0.4	0.8	24	0.4
Don	69	0.59	72	1.9	1.2	42	1.4
Pioneer (c)	65	0.36	130	1.1	1.6	75	1.0
St Helens (c)	74	0.36	94	0.9	2.1	30	1.4

Note: (c) – sample taken from cropping area

The subsoil sodicity and conductivity of the soils formed on levees and floodouts is low to very low (Figures 61 and 62). The soils that form on levees are usually well drained and are relatively young. These young soils have not been exposed to the processes which aid the accumulation of salt in the profile. Additionally, when salt is added to the soil profile due to rainfall or groundwater, it will be dissolved and removed from the soils during flood events.

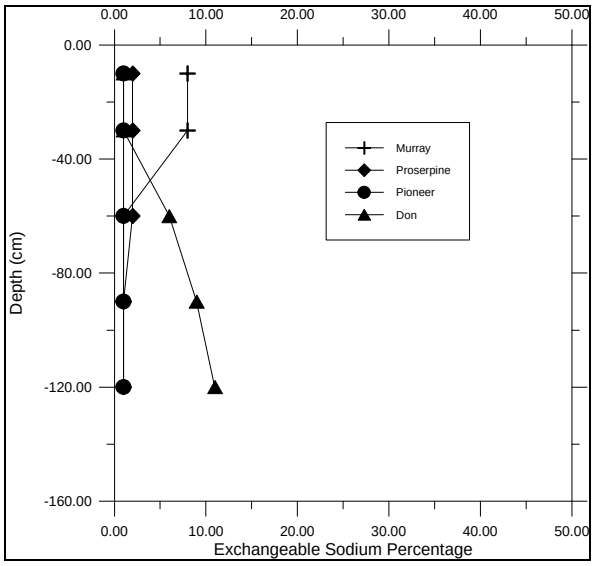


Figure 61. The mean sodicity of the soils formed on relict and active levees

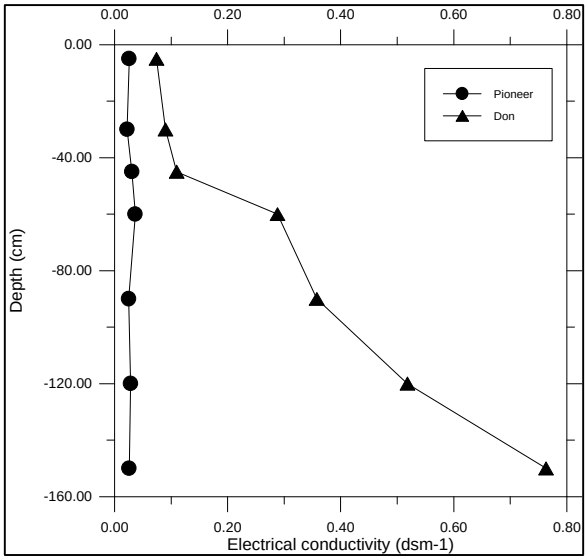


Figure 62. The mean electrical conductivity of soils formed on relict and active levees

The soils formed on the levees and floodouts have a high CEC:clay which reflects the minimal amount of time that the soils have been exposed to the processes of weathering. The clay type in the levee soils is predominantly illite and montmorillonite (Figure 63). The Murray and Cameron soils are dominated by montmorillonite whereas the deeper soils formed from finer alluvium have more illite clay.

The cation exchange sites in all the subsoils are dominated by calcium rather than by magnesium (Figure 63). The Ca:Mg is highest for the young shallow and gravelly soils with values over three. The deeper duplex to gradational soils have Ca:Mg between one and two. The relatively high proportion of calcium in the soils promote strong pedality and will provide some resistance to erosion.

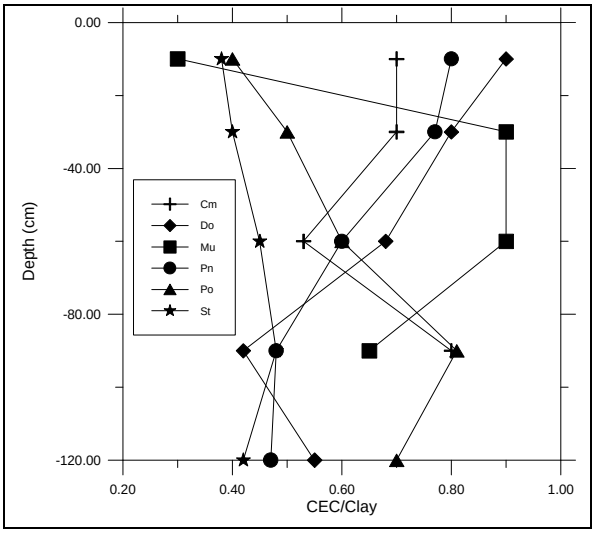


Figure 63. The CEC:Clay for the soils formed on relict and active levees

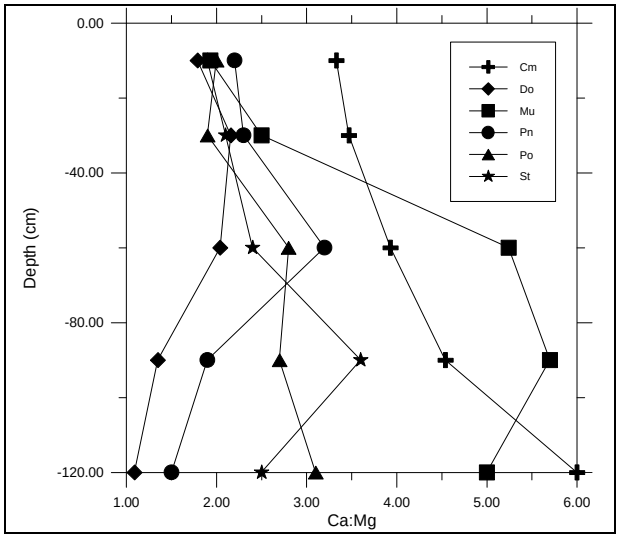


Figure 64. The Ca:Mg for the soils formed on relict and active levees

4.12.2. Non-sodic duplex soils on level active backplains and relict terraces

There are five non-sodic duplex soils that occur on terrace flats, terrace plains and backplain positions in the Whitsunday Coast landscape. These duplex soils tend to occur in areas that can expect flooding about every five to ten years. The non-sodic duplex soils are more sort after cropping because of the greater soil water retention and nutrient exchange capacity (Table 31).

Table 31. The description and classification of the non - sodic duplex soils formed on the relict and active backplains on Quaternary alluvium

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Am	Ameliavale	Deep, duplex to gradational soil with a clay loam topsoil over an alkaline, brownish black clay subsoil.	Brown Chromosol	Dy3.33
Co	Conway	Deep, duplex soil with a bleached, clay loam topsoil over a neutral, reddish-brown clay subsoil.	Brown Chromosol	Dy3.32
Ma	Marian	Deep, duplex soil with a sandy clay loam topsoil over an acid to neutral brown clay subsoil.	Brown Chromosol	Dy2.32
Mi	Mirani	Deep, acid, grey to brownish grey, duplex soil with a sandy clay loam to loamy sand topsoil over a greyish brown subsoil.	Grey Chromosol	Dy2.31
Th	Thompson	Deep, acid, brown to reddish brown, duplex to gradational soil with a sandy loam to sandy clay loam topsoil.	Brown Dermosol	Dy4.12

The **Amelia vale (Am)** is a deep gradational soil and is found in small alluvial plains where the catchment is dominated by intermediate intrusive rocks. The topsoil is usually 0.3 to 0.45 m thick with a clay loam sandy to clay loam texture with an acid to neutral pH. The subsoil is greyish-brown to brown with a light to medium clay texture with an alkaline pH.

The Marian and Mirani soils are found in similar landscape positions. Marian appears to occur on floodplains where the catchment is dominated by intermediate rocks and Mirani will form where the catchment is dominated by more acidic rocks. **Marian (Ma)** is a deep soil formed on relatively more active backplains adjacent to levees. The topsoil is usually pale grey and is 0.15 to 0.25 m thick with a sandy clay loam to clay loam texture with a bleached A2 horizon with an acid to neutral pH. The subsoil is yellow to brownish-grey, with a light medium to medium heavy clay texture and an acid to neutral pH. The subsoil has moderate to strong prismatic to subangular blocky structure. **Mirani (Mi)** is also a deep soil with a pale grey topsoil which is 0.2 to 0.45 m thick with a sandy loam to loamy sand texture with a bleached A2 horizon with an acid to neutral pH. The colour of the subsoil is grey to yellowish-grey, with a light medium to medium clay texture. The subsoil is dominated by moderate prismatic structure with an acid to neutral pH

The **Conway (Co)** is a deep soil formed on relatively more active backplains adjacent to levees. These soils are mostly associated with the Proserpine River and Myrtle creek. The topsoil is usually grey to black and is 0.2 to 0.35 m thick with a sandy clay loam to clay loam texture and an acid to neutral pH. The subsoil is brownish-grey to reddish-brown, with a light medium to medium heavy clay texture and an acid to neutral pH. The subsoil has moderate to strong prismatic to subangular blocky structure.

The Thompson soil is found on floodplains in the upper catchments dominated by intermediate intrusive rocks. **Thompson (Th)** is a duplex to gradational soil which is similar to Marian and often occurs adjacent to Pioneer or Andromache soil types. The topsoil is 0.2 to 0.35 m thick with a sandy loam to sandy clay loam texture and an acid to neutral pH. The subsoil is brown to brownish-red with a light clay to light medium clay texture and an acid to neutral pH. Thompson may grade into the Tannallo and Gargett colluvial soils which are formed from intermediate intrusive rocks.

Soil chemistry

The topsoil samples collected from the non-sodic duplex soils indicate that organic carbon levels range from 0.9 to 1.7% and are considered low to moderate (Bruce and Rayment, 1982). The surface phosphorus levels range from 16ppm and low for Conway to 40 ppm for Thompson which is moderate especially for coastal floodplain soils (Table 32). The micro-nutrients status for all soils is moderate. The moderate fertility of these soils is attributed to the deposition of infrequent alluvium from flood events.

Table 32. The topsoil fertility of the soils formed on non-sodic duplex soils on active and relict floodplains

Soil Profile Class	Phosphorus (bicarb (ppm)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic Carbon (%)
Amelia vale	37	0.6	189	3.0	2.5	123	2.4
Conway	16	0.27	57	0.7	0.6	102	0.94
Marian	37	0.33	220	1.0	2.2	40	1.3
Thompson	40	0.3	121	0.67	1.3	46	1.7

Note: (c) – sample taken from cropping area

The subsoil sodicity of the soils in this group is low for all except Amelia vale. The subsoil sodicity of Amelia vale increases to an ESP of up to 15 in the lower profile. The conductivity of the non-sodic duplex soils is also very low with all soils having levels less than 0.2 dSm^{-1} in the subsoil. Occasionally, the subsoil conductivity of the Amelia vale soil may approach 0.3 dSm^{-1} at depth.

The non-sodic duplex soils are dominated by illite clay. The Mirani soil appears to be dominated by a mixture of illite and kaolinite which may be traced to the more acidic source rock in the upper catchment. The Thompson is dominated by mostly illite but some of the clay may be montmorillonite (Figure 65). The soils in this group have moderate CEC:clay which indicates that they have a reasonable ability to store nutrients.

The Ca:Mg of all soils in this group are between 1.0 and 2.5 (Figure 66). The relatively high proportion of calcium is reflected by the well structured subsoils found in these soils. The presence of well structured subsoils will be advantageous in reducing water logged crops.

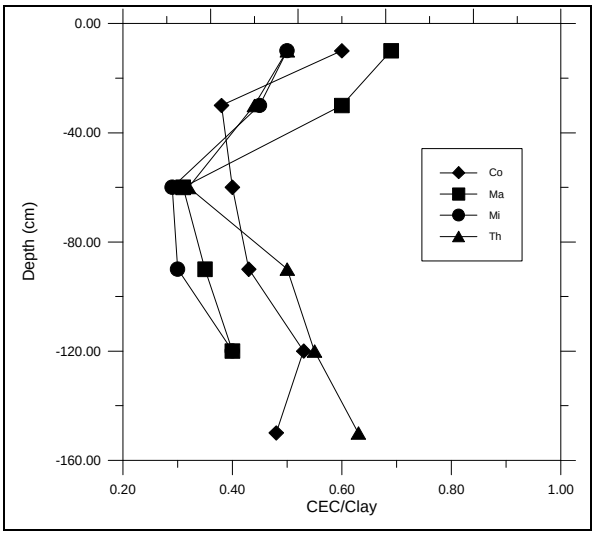


Figure 65. The CEC:Clay for the soils formed on the acid to intermediate intrusive rocks

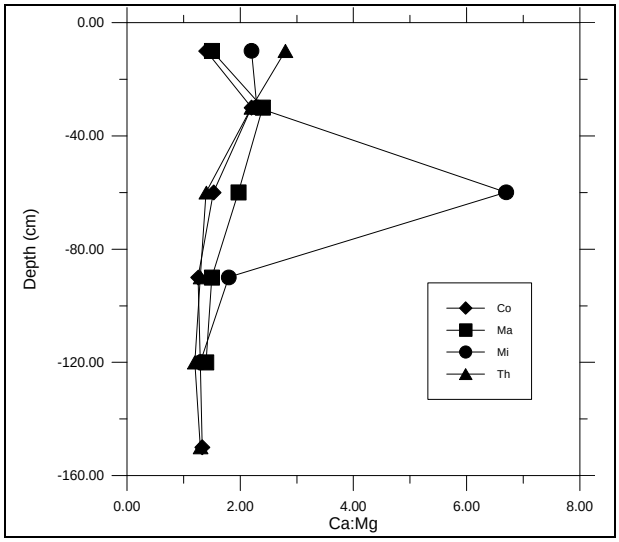


Figure 66. The Ca:Mg for the soils formed on the acid to intermediate intrusive rocks

4.12.3. Sodic duplex soils on level active backplains and relict terraces

The sodic duplex soils are found on elevated terraces and older alluvial plains which generally experience less frequent flooding. Some of the sodic duplex soils formed in the backplains in the drier northern parts of the study area are underlain by consolidated subsoil layers. The hard subsoil layers are often described as red-brown pans. Fifteen soils have been described (Table 33).

Table 33. The description and classification of the sodic duplex soils formed on the relict and active backplains on Quaternary alluvium

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Soils with consolidated lower profiles				
Ak	Anakey	Moderate to deep, duplex soil with a sandy loam topsoil over an acid to neutral, grey to dark grey, light medium to medium heavy clay subsoil.	Grey Sodosol	Dy2.33

Gd	Goodbye	Moderate to deep, duplex soil with a sandy loam topsoil over an acid to neutral, dark to dark grey, light medium to medium heavy clay subsoil. Subsoil becomes consolidated.	Grey Sodosol	Dd2.33, Dd2.13, Uf3, Gn3.03
Ns	Nessvale	Deep, sodic, duplex soil with a 25-45 cm thick, dark greyish loamy sand topsoil over an alkaline, reddish-brown, mottled, medium to medium heavy clay subsoil.	Brown Sodosol	Db2.22, Db2.23, Dr3.22
Pe	Pennsfield	Deep, duplex to gradational soil with a sandy loam to sandy clay loam topsoil over an alkaline reddish-brown, light medium to medium heavy clay subsoil.	Brown Sodosol	Db1.43, Db1.33, Dr2.43
Pe1	Pennsfield shallow variant	Moderate deep, duplex soil with a sandy loam topsoil, over a reddish brown, medium clay subsoil.	Brown Sodosol	Db1.43
Deep soils				
Bv	Bonavista	Deep, alkaline, brownish-grey, duplex soil with a 15-30 cm thick, bleached, clay loam topsoil.	Brown Sodosol	Dy3.33
Ce	Calen	Deep, alkaline, brownish-grey, duplex soil with a bleached, clay loam topsoil.	Brown Chromosol / Brown Sodosol	Dy3.33
Eo	Eton	Deep, alkaline, bleached, grey, sodic duplex soil with a sandy clay loam topsoil.	Mesonatric, Grey Sodosol	Dy3.33
Fo	Foxdale	Deep, duplex to gradational soil with a clay loam topsoil over an acid to neutral, grey to dark grey, light medium to medium heavy clay subsoil.	Grey Chromosol	Dy3.12, Gn4
Nr	Narpi	Deep, sodic duplex soil with silty loam, bleached, topsoil, over an alkaline clay subsoil.	Subnatric, Grey Sodosol	Dy3.33
Sa	Sandiford	Deep, sodic duplex soil with sandy loam, bleached, topsoil, over an acid to neutral clay subsoil.	Subnatric, Grey Sodosol	Dy3.33
Sa1	Sandiford (silty loam topsoil variant)	Deep, sodic duplex soil with silty loam, bleached, topsoil, over an acid to neutral clay subsoil.	Subnatric, Grey Sodosol	Dy3.33
Su1	Sunnyside (sandy loam topsoil)	Deep, sodic duplex soil with sandy loam, bleached, topsoil, over an alkaline clay subsoil.	Subnatric, Grey Sodosol	Dy3.33
Su	Sunnyside	Deep, sodic duplex soil with fine sandy clay loam, bleached, topsoil, over an alkaline clay subsoil.	Subnatric, Grey Sodosol	Dy3.33

The soils with a high soil consistency tend to be found on terrace flats adjacent to most of the larger creeks in the drier northern parts of the study area. The **Anakey (Ak)** soil is usually 0.8 to 1.2 metres deep, with a 0.05 to 0.2 m thick grey, sandy loam topsoil with an acid to neutral pH. The subsoil is grey to dark grey with a light medium to medium heavy clay texture with an acid to neutral pH. The **Goodbye (Gd)** soil is similar to Anakey except that the subsoil is dark to dark grey.

The Terrace plains located adjacent to the Don River in the west of the survey are dominated by the Pennsfield soils. These terrace plains represent an old floodplain which is now being dissected because the Don River has cut into its bed and the volume of water in the Don is less than in the past.

The **Pennsfield (Pe)** soil is a duplex to gradational soil which is usually 0.8 to 1.4 m deep. The subsoil becomes consolidated at depth. The topsoil is often 0.1 to 0.3 m thick with a sandy loam to sandy clay loam texture with an acid to neutral pH. The subsoil is often a reddish brown colour with a light medium to medium heavy texture with an alkaline pH. The **Pennsfield (shallow variant) (Pe1)** is a duplex soil which is normally 0.5 m to 0.8 m in depth. The topsoil is usually 0.1 to 0.2 m thick with a sandy loam texture and the subsoil is normally a reddish brown in colour with a medium texture.

The sodic duplex soils found in the wetter areas in the south of the survey in general do not have consolidated subsoils. The higher rainfall in the southern areas of the survey may leach excess silica and carbonates from the profile which prevent or slows the process of subsoil consolidation. The ten deep sodic duplex soils formed from Quaternary alluvium are Bonavista, Calen, Eton, Foxdale, Narpi, Nessvale, Sandiford, Sandiford (silty topsoil variant), Sunnyside and Sunnyside (sandy loam topsoil variant).

The most common sodic duplex soils are Calen and Eton. The **Calen (Ce)** soil is deep and found on the older floodplains. The topsoil is pale grey with a 0.15 to 0.3 m thick sandy clay loam to clay loam texture with a bleached A2 horizon with an acid to neutral pH. The subsoil is brown to greyish-brown with a light medium to medium heavy clay texture with an alkaline pH. The lower subsoil horizons have prismatic structure and also have some orange mottling. The **Eton (Eo)** soil is found in poorly drained positions in the backplain of older terraces or floodplains. The topsoil is pale grey and is 0.15 to 0.25 m thick with a sandy clay loam to clay loam texture with a bleached A2 horizon with an acid to neutral pH. Occasionally, the topsoil texture is sandy loam. The subsoil is grey, with a orange mottled, medium to medium heavy clay texture with some quartz gravel. This soil has weak to moderate prismatic or columnar subsoil structure with an alkaline pH.

The Narpi soil is similar to Eton. **Narpi (Nr)** soils are deep and normally found in drainage depressions on the older terrace plains. The surface is pale grey with a 0.2 to 0.35 m thick silty clay loam to silty loam texture with a bleached A2 horizon with an acid to neutral pH. The subsoil is pale grey to yellowish-grey and often overlies layers of buried layers of gravel alluvium. These soils tend to have strongly mottled subsoils with a moderate to strong, prismatic and occasionally lenticular structure with an alkaline pH.

The **Sandiford** soil is also a grey sodic duplex soil, but it has an acid pH trend. The topsoil of Sandiford is 0.2 to 0.3 m thick, bleached, with a sandy clay loam texture. Some Sandiford sites have a silty topsoil. This silty variation of the Sandiford soil is called a variant (Sandiford silty topsoil variant). The **Sandiford (silty topsoil variant)** will often have prominent red mottles in the subsoil and a neutral soil pH reaction trend. The subsoil structure of Sandiford soils normally has prismatic structure.

The sodic duplex soils which have an olive to yellowish-grey colour subsoil with a medium to medium heavy clay texture are grouped as **Sunnyside (Su)**. The topsoil of Sunnyside is 0.2 to 0.3 m thick, bleached, with a sandy clay loam texture. The **Sunnyside (sandy loam variant) (Su1)** has a sandy loam textured topsoil which is 0.15 to 0.25 m thick over an olive subsoil. These sandy loam variants are mostly found on the Andromache river floodplain.

The sodic duplex soils which have reddish brown subsoils and occur on relict terrace flats are the Nessvale soils. **Nessvale (Ns)** is a deep, sodic duplex soil with a loamy sand topsoil over a medium to medium - heavy clay subsoil with an alkaline pH.

The **Foxdale (Fo)** soil is a deep soil found in poorly drained positions in the backplain of older terraces or floodplains. These soils indicate old swamps or drainage depressions. The topsoil is grey to black and is 0.25 to 0.50 m thick with a clay loam sandy to clay loam texture with an acid to neutral pH. The subsoil is grey, with a light medium to medium heavy clay texture with some quartz gravel. This soil has weak to moderate prismatic or columnar subsoil structure with an alkaline pH.

The lower profile often has moderate amounts of orange or brown mottling which is caused by the slow movement of water through the profile and shallow water tables.

Soil chemistry

Topsoil samples have been collected from the sodic duplex soils formed on the backplains. The results of the analysed soil samples indicate that these soils have a low surface fertility (Table 34). The organic carbon levels in the sodic duplex soils range from 0.5 to 1.7% and are considered very low to medium (Bruce and Rayment, 1982). The surface phosphorus levels for unfertilised soils range from 3 to 8 which is very low. The topsoil copper levels are medium for Goodbye and low for the other unfertilised soils (Bruce and Rayment, 1982).

Table 34. The topsoil fertility of the sodic duplex soils formed on Quaternary alluvium

Soil	Phosphorus (mg/kg)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic carbon (%)
Bonavista (c)	31	0.45	182	0.39	0.74	52	1.4
Calen	7	0.09	95	1.4	1.4	14	1.1
Eton (c)	30	0.31	121	1.9	0.7	70	1.1
Goodbye*	3	0.25	26	2.1	0.2	42	0.5
Narpi	4	0.19	65	0.58	1.2	52	1.2
Nessvale*	20	0.68	75	1.4	4.3	51	1.1
Pennsfield	8	0.24	34	0.5	2.9	17	0.90
Sandiford (c)	33	0.3	128	0.5	0.5	30	0.8
Sunnyside (c)	18	0.19	286	2.6	1.3	204	1.7

- Phosphorus – Extractable P using Bicarbonate

* Chemistry data from Aldrick (1988)

(c) - sample from a cultivated paddock

The subsoil sodicity levels in the sodic duplex soils vary between soils and within soil classes. The variation in subsoil sodicity within soil classes is due to the chemistry and depth of groundwater together with the location of the site on the backplain. Soils that occur in depressions on the floodplain will have different subsoil chemistry to those found closer to the levees. The climate also has a bearing on the sodicity of the soils with the more sodic soils occurring in lower rainfall areas. The high rainfall in the Cannon Valley and Conway areas leach the sodium from the profile. The groundwater in the higher rainfall areas may also be lower in salts due to the dilution effect.

The Goodbye and Pennsfield soils have the highest subsoil sodicity in this soil group (Figure 67). There is no chemistry data for the Anakey soil but field dispersion and conductivity tests indicate that these soils have similar sodicity levels to the Goodbye soil. The subsoil sodicity of the Goodbye soil starts with an ESP of about 10 to 15 and increases to up to 30 by 1.5 m. The Pennsfield soil follows a similar sodicity profile to the Goodbye soil with a relatively slight increase in sodicity levels at depth. The Pennsfield variant may have sodicity levels in the first 0.1 m of subsoil which exceed an ESP of 20.

The Eton soils have a slightly lower subsoil sodicity profile compared to the Goodbye soils. The subsoil sodicity of Eton often begins between 8 and 12 and increases to about 15 to 20 at depth. The Narpi soil has a similar sodicity profile to that of Eton. The Calen, Sandiford, Nessvale, Foxdale and Sunnyside soils all have lower sodicity profiles. In some Calen profiles the sodicity of the first 0.1 m have ESP levels of between four and six and then increase to between 10 and 16 at depth.

The soils found in the drier areas in the north of the study area generally have higher subsoil salinity than those found in the wetter areas. The Anakey and Goodbye soils have low to moderately high subsoil conductivity levels that range from 0.3 to 1.1 dSm^{-1} (Figure 68). The Pennsfield subsoil conductivity ranges from low to moderate (electrical conductivity levels 0.3 to 1.5 dSm^{-1}) while the shallow variant may have subsoil conductivity levels that exceed 1.5 dSm^{-1}.

The Eton, Narpi and Nessvale soils have low to moderate conductivity where the levels range from 0.3 to 0.9 dSm^{-1} (Figure 68). The Calen, Sandiford, Foxdale and Sunnyside soils have subsoil conductivity levels which rarely exceed 0.5 dSm^{-1}. The Sunnyside (sandy loam topsoil variant) subsoil conductivity is slightly higher with levels ranging from 0.2 to 0.8 dSm^{-1}.

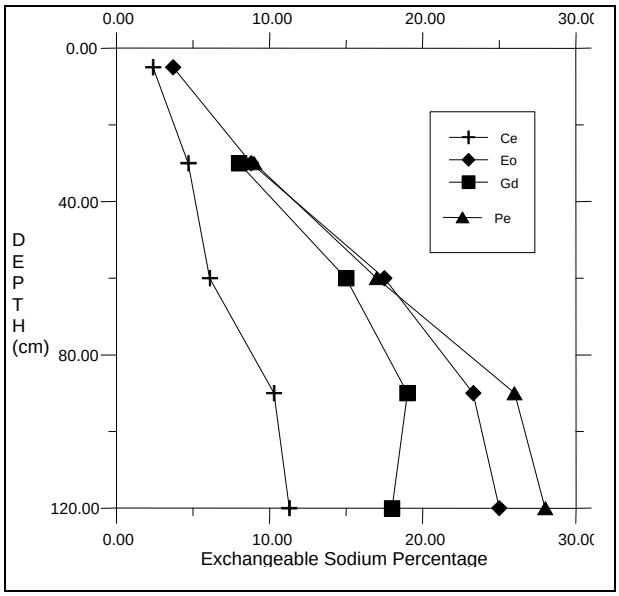


Figure 67. The mean sodicity of the sodic duplex soils of the formed on backplains

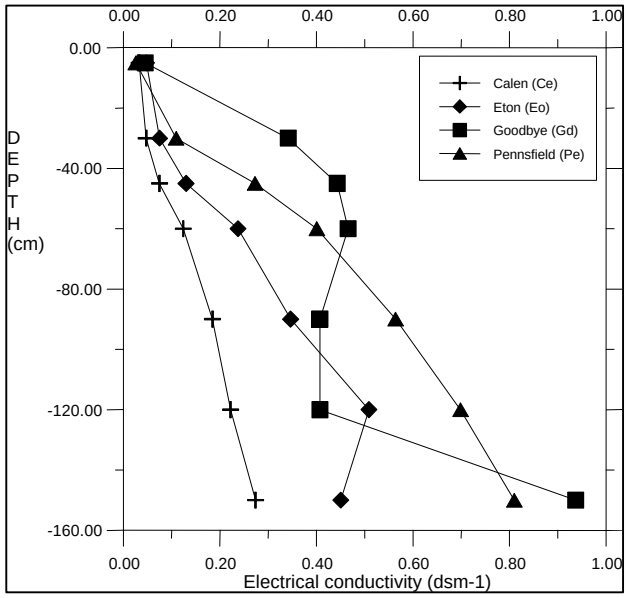


Figure 68. The mean electrical conductivity sodic duplex soils formed on backplains

The sodic duplex soils all have CEC:clay in the 0.3 to 0.7 range which indicate a dominance of the illite clay type (Figure 69). The Eton and Goodbye subsoils have the most chemically active clay types with relatively high cation exchange capacities and a moderate ability to retain and exchange cations. The Sunnyside and Bonavista soils have the lowest CEC:clay but are still dominated by the illite clay and have a reasonable ability to retain nutrients.

The Bonavista and Goodbye soils have Ca:Mg less than 1.0 while the other soils have levels greater than 1.0 (Figure 70). Calcium carbonate nodules and concretions are common in the sodic duplex soils which will influence the Ca:Mg. The calcium carbonate is derived from the groundwater where the calcium precipitates out of solution when the water recedes.

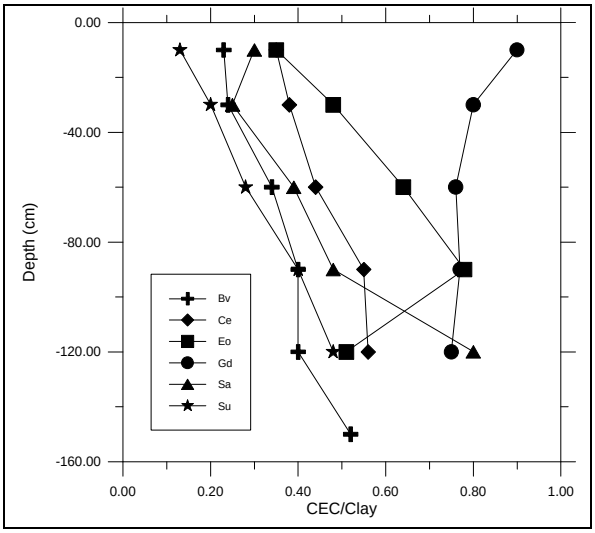


Figure 69. The CEC:Clay for the sodic duplex soils on formed on the relict to active backplains

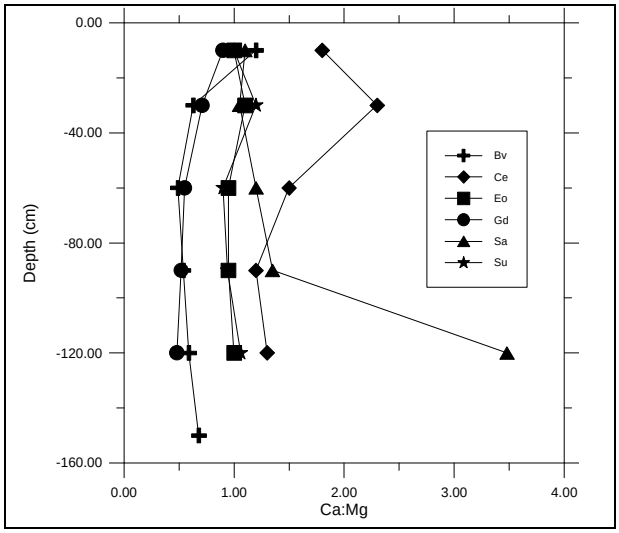


Figure 70. The Ca:Mg for the soils formed the relict to active backplains

4.12.4. Cracking and non-cracking clay soils on level active backplains and relict terraces

The clay soils are generally found in drainage depressions or level land on the floodplain. These soils have slow water infiltration and are either imperfectly or poorly drained. Nine soils have been described (Table 35).

Table 35. The description and classification of the clay soils formed on the relict and active backplains on Quaternary alluvium

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Soils with a weak to strong self mulching surface				
Bg	Brightley	Deep, alkaline, greyish brown, cracking, clay soil.	Black Vertosol	Ug5.15
Cw	Carew	Self-mulching topsoil over neutral to alkaline very dark grey heavy clay subsoil	Black Vertosol	Ug5.15, Ug5.16
Vc	Victoria Plains	Deep, cracking clay with a self-mulching clay topsoil over alkaline black heavy clay, over dark brown heavy clay.	Black Vertosol	Ug5.15
Grey cracking and non-cracking clays				
Ab	Albert	Deep, acid to neutral, grey, cracking, clay soil.	Grey Vertosol	Ug5.16
Bh	Benholme	Deep, alkaline, grey, cracking, clay soil	Grey Vertosol	Ug5.16
Cb	Crystalbrook	Moderately deep, non-cracking clay soil with a light clay topsoil over an alkaline clay subsoil.	Grey Vertosol	Ug5.16

Mz	Merinda	Deep, cracking clay with an alkaline dark grey medium clay over alkaline dark grey heavy clay subsoil.	Grey Vertosol	Ug5.24
My	Myrtle	Deep, non-cracking clay soil with a light clay topsoil over an acid to neutral clay subsoil.	Grey Dermosol	Ug5.16
Tb	Tabletop	Deep, cracking clay with a self-mulching clay topsoil over neutral to alkaline black heavy clay, over dark brown heavy clay.	Brown Vertosol	Ug5.15

The three soils in this group which have self mulching surfaces are Brightly, Carew and Victoria Plains. These soils are found in depressions on active backplains where the catchment geology is dominated by intermediate to basic rock. These three soils are poorly to imperfectly drained and when dry large cracks occur. The **Brightley (Bt)** soil a dark grey topsoil which is 0.1 to 0.3 m thick with an acid to neutral pH. The subsoil is a mottled, brown to greyish-brown, medium to heavy clay with mainly lenticular structure with an alkaline pH. The **Carew (Cw)** has a black topsoil which is 0.1 to 0.2 m thick over a dark brown to greyish-brown with a medium to heavy clay texture with an alkaline pH. The surface may have low mounds called gilgai which is partially caused by the poor surface and sub-surface drainage and soil swelling. The **Victoria Plains (Vc)** soil is similar to the Carew with a black topsoil which is 0.1 to 0.2 m thick except that the subsoil becomes grey to yellowish grey at depth. Both the Carew and Victoria Plains soils have alkaline subsoils which often has calcium carbonate concretions.

The grey cracking clays are usually found on alluvial backplains where the catchment is dominated by acid to intermediate rock. The most common grey cracking clay is Benholme. **Benholme (Bh)** is found in the backplain position of floodplains and in drainage depressions. This soil is deep with a dark grey topsoil which is 0.1 to 0.3 m thick with an acid to neutral pH. The subsoil is a mottled, grey, medium to heavy clay with mainly lenticular structure with an alkaline pH. The Merinda soil is mostly associated with the floodplain of the Don River. The **Merinda (Mz)** soil is a moderately deep hardsetting clay. The alkaline subsoil of Merinda is dark to dark grey and overlies hardened subsoil layers below 0.8 m to 1 metre. The **Albert (Ab)** soil is found in backplain positions of terrace plains. This soil is deep with a dark grey topsoil which is 0.1 to 0.25 m thick with an acid to neutral pH. The subsoil is a mottled, grey, medium to heavy clay with mainly lenticular structure with an acid to neutral pH. The **Tabletop (Tb)** soil is found more active floodouts and floodplains in the north of the study area. This soil is deep clay with a hardsetting topsoil over an alkaline, dark brown mottled, clay subsoil. **Crystalbrook (Cb)** is found in the backplain position of floodplains and in drainage depressions near the Proserpine River. This soil is moderately deep with a dark grey topsoil which is 0.1 to 0.3 m thick with an acid to neutral pH. The subsoil is a mottled, dark grey to black, medium to heavy clay with mainly lenticular structure with an acid to neutral pH. These soils have formed where floods have scoured out large areas to expose the Tertiary sandstone and subsequent floods have deposited recent fine alluvium.

Soil chemistry

The topsoil samples indicate that organic carbon levels range from 0.4 to 4.4% and are considered very low to high (Bruce and Rayment, 1982). The surface phosphorus levels for the clay soils are very low to low (Table 36). The topsoil copper levels are medium for all four soils (Bruce and Rayment, 1982).

Table 36. The topsoil fertility of the clay soils formed on Quaternary alluvium

Soil	Phosphorus (mg/kg)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic carbon (%)
Albert	4	0.11	163	0.72	0.74	86	1.7
Benholme	8	0.21	109	3.0	1.1	127	2.3
Carew	6	0.49	17	1.6	0.3	19	0.7
Merinda	2	0.12	7	0.4	0.1	4	0.4
Tabletop	6	0.54	54	2.7	0.6	43	1.0
Victoria Plains	12		52	1.9	0.84	15	4.4

- Sulfur as So4 – S
- Phosphorus – Extractable P using Bicarbonate

* Chemistry data from Aldrick. (1988)

(c) - sample from a cultivated paddock

The subsoil sodicity of the clay soils vary depending on site drainage and chemistry of the groundwater. The Myrtle soil has a low subsoil sodicity while the Merinda soil has the highest (Figure 71). The Benholme soil has a wide range of subsoil sodicity levels with the soils found in the wetter areas having a lower level of sodicity than those found in drier parts of the study area. In the drier areas the subsoil sodicity of Benholme soils may reach between an ESP of 18 and 25. The Albert soils also have a high ESP which may reach levels between 15 and 20 at depth. The Carew, Victoria Plains, Brightley, Crystalbrook and Tabletop soils have low sodicity levels (between 6 and 10) in the first 0.1 m of the subsoil and reach an ESP of between 10 and 20 at depth.

The subsoil conductivity of the soils vary depending on groundwater, sub surface geology, climate and position in the landscape. Some clay soils that occur adjacent to footslopes and colluvial fans may have elevated subsoil conductivity because they impede the flow of groundwater. The clay type in the clay soils also has the ability to retain sodium cations. The clay soils that occur in the wetter areas usually but not always have lower subsoil conductivity levels. The Myrtle soils have low conductivity level (0.1 to 0.3 dSm^{-1}) and the Merinda soils have the highest average subsoil conductivity with levels exceeding 1.0 dSm^{-1}at depth. Some Benholme and Victoria plains soils that are found adjacent to footslopes have subsoil conductivity levels that exceed 1.0 dSm^{-1}. The Carew soils are found in small drainage depressions on terrace plains and generally have relatively lower subsoil conductivity levels (0.3 to 0.5 dSm^{-1}) because they are affected by localised surface and subsurface water. The Albert soils occur on more relict terrace plains where the soils have been exposed to weathering processes for a longer period of time. The subsoil conductivity of Albert soils is moderate to high (0.4 to 1.1 dSm^{-1}) possibly caused by the accumulation of salt over time and the influence of groundwater high in salt.

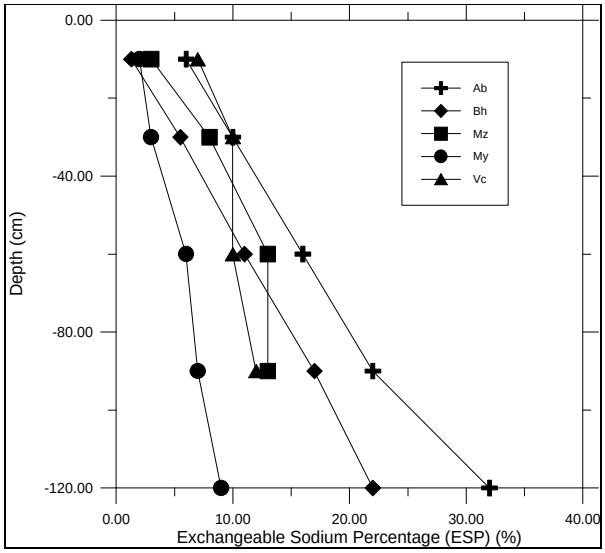


Figure 71. The mean sodicity of the soils formed on relict and active backplains

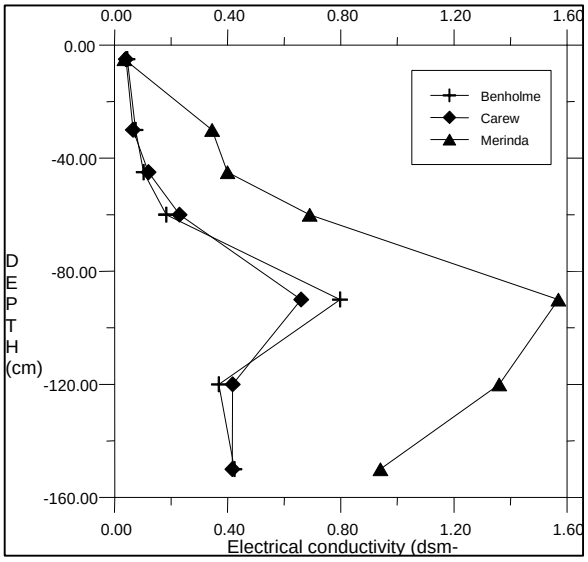


Figure 72. The mean electrical conductivity of soils formed on relict and active backplains

The CEC:clay for the cracking and non-cracking clay soils is high (Figure 73). The shrink swell nature and lenticular structure of the Carew, Brightly and Victoria Plains soils indicates that the clay type is dominated by montmorillonite clay and this is supported by the high (0.8) CEC:Clay. The Myrtle soil also has lenticular structure at depth but is mostly dominated by illite and some montmorillonite clay. The cracking and non cracking clay soils have relatively high cation exchange capacities (30 to 50) which assist in the retention of cations.

The cation exchange sites on the clay is mostly dominated by calcium rather than magnesium (Figure 74) Most soils in this group have Ca:Mg greater than 1.0 which assists to improve soil structure and drainage. Calcium carbonate concretions are often found in these soils at depth.

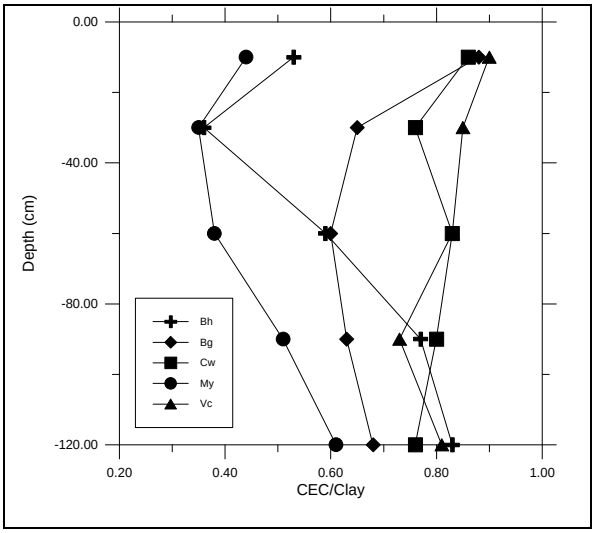


Figure 73. The CEC:Clay for the clay soils formed on the relict and active backplains

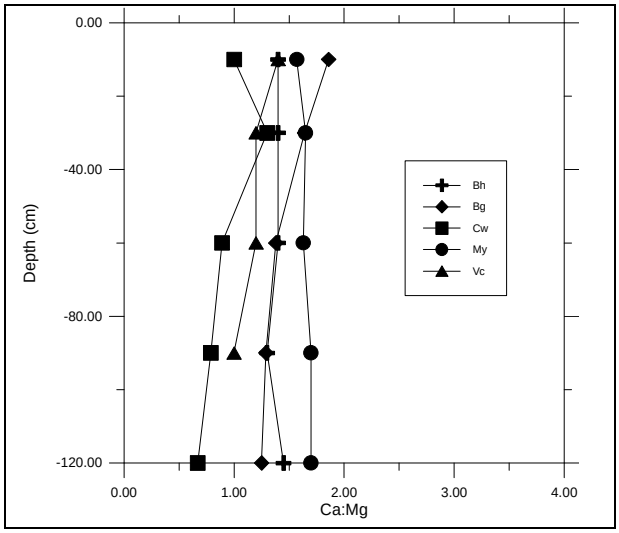


Figure 74. The Ca:Mg for the clay soils formed on the relict and active backplains

4.13. Soils formed on Quaternary (Holocene) marine sediments

4.13.1 Level active backplains of marine sediment

The soils overlying the Holocene marine sediments on the active backplains are formed by floods and estuarine processes and are composed of freshwater, estuarine and marine sediments. The soil properties vary depending upon the degree of freshwater or marine influence. Seven soils have been described (Table 37).

Table 37. The description and classification of the soils formed on the active backplains on Quaternary marine alluvium

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
Soils with pyrite at depth				
Go	Goorganga	Very deep, cracking to non-cracking clay soil with a clay topsoil over a very acid grey clay subsoil. These soils have a water logged (gleyed) subsoil with pyrite.	Aquic Vertosol, Sulfuric Extratidal Hydrosol	Ug5.16, Ug5.28
Dn	Dundula	Very deep, cracking clay with a light clay topsoil over a grey, alkaline subsoil. These soils have a water logged (gleyed) subsoil. Pyrite may be present below 150 cm.	Aquic Vertosol, Sulfuric Extratidal Hydrosol	Ug5.16, Ug5.28
Soils found in seasonally water logged areas with a low likelihood of pyrite present at depth				
Gi	Glen Isla	Very deep, duplex to gradational soil with a clay loam to light clay topsoil over a grey clay subsoil. These soils have a water logged (gleyed) subsoil and often overlie buried layers of sand and silt.	Extratidal Hydrosol, Redoxic Hydrosol	Dg2.11, Uf6.41

Hs	Hillsborough	Very deep, cracking clay with a light clay topsoil over a grey, alkaline subsoil. These soils have a water logged (gleyed) subsoil. Pyrite may be present below 150 cm.	Aquic Vertosol, Sulfuric Extratidal Hydrosol	Ug5.16, Ug5.28
Ni	Nilotica	Moderate to deep, duplex or gradational soil with a sandy loam to clay loam topsoil over an alkaline, dark, light clay to medium heavy clay subsoil.	Grey Dermosol	Gn4.43, Dd1.13, Uf6.11
Soils adjacent to salt flats				
Cp	Campbell Plains	Deep, sodic duplex soil with clay loam to sandy clay loam topsoil over an alkaline grey clay subsoil. Usually saline.	Mesonatric Grey Sodosol	Dy3.13
Wi	Wilmington	Moderate to deep, non-cracking clay to gradational soil with a sandy loam to clay loam topsoil over buried soil material, mainly very dark neutral heavy clay, over layered estuarine deposits.	Oxyaquic Hydrosol	Uf6.32, Um6.21, Um6.41

The main features of the Holocene clay soils is the presence of acid sulfate soils, saline soils and poorly drained soils. The **Goorganga (Go)** soil is a grey, hardsetting cracking to non-cracking clay with acid sulfate layers at depth. The topsoil is 0.2 to 0.3 m thick with a moderate to high amount of organic matter (2.5 to 5 %) and has a light to medium clay topsoil with an acid pH. The typical subsoil profile of the Goorganga includes an oxidised layer between 0.4 and 1.0 m with red and orange mottles (haematite and goethite), followed by a narrow partly oxidised layer with yellow mottles (jarocite) then a light greyish green unoxidised layer which is usually below the water table. Pyrite is present in variable amounts in the Goorganga soils. The amount of pyrite was tested in the field using a 1:3 to 1:5 soil-hydrogen peroxide solution and a pH meter. The 30% hydrogen peroxide solution used in the test was buffered to a pH of 5. The purpose of using the hydrogen peroxide is to oxidised the soil. The oxidised pH of many Goorganga subsoils range from 2.5 to as low as 0.3. Soil samples analysed confirm the variable presence of pyrite in these soils. .If excavation or development is proposed on these soils an acid sulfate investigation is recommended (DNR, 1997).

The other soils which may overlie acid sulfate layers include Dundula and Hillsborough. **Dundula (Dn)** soil is a deep, grey clay formed in backplain positions on marine alluvium. The topsoil is a light to medium clay, while the subsoil is a grey medium to heavy clay with an alkaline pH. In some profiles the subsoil pH starts to become neutral to acid below 1.2 m which may indicate small amounts of pyrite below 1.5 m. The **Hillsborough (Hs)** soil is a deep, poorly drained hardsetting cracking to non-cracking clay. The dark topsoil is 0.15 to 0.25 m thick, with a light to light medium clay texture and has a high organic matter content. The subsoil is a pale grey with a green to blue colouring due to the reduction of iron below the water table. This soil is also affected by shallow water tables for most of the year. In some Hillsborough profiles gypsum crystals and minor amounts of shell grit are present which acts to neutralise any acid produced from oxidising pyrite. It is postulated that pyrite may occur in the Hillsborough soils below 1.5 m.

The soils that occur adjacent to salt flats are typically poorly drained with high subsoil salt levels. The three soils that occur adjacent to salt flats or are impacted by extreme tidal influences include Campbell plains, Nilotica and Wilmington. **Campbell Plains (Cp)** is a duplex soil with a 0.2 to 0.35 m thick sandy clay loam to clay loam topsoil over a grey, light to medium heavy clay with an alkaline pH. The subsoil of Campbell plains has poor to moderate structure and has shallow salty water tables. The **Nilotica (Ni)** soils are duplex to gradational and are found in areas where the Quaternary alluvium meets the marine sediments. The topsoil of Nilotica is usually 0.2 to 0.5 m deep with a sandy loam to clay loam texture with an acid to neutral pH. The subsoil is usually a dark, dark-brown or dark grey in colour with a light clay to medium heavy clay texture with an alkaline pH.

Wilmington (Wi) soils are generally a non-cracking clay to a gradational. The topsoil of Wilmington is 0.15 to 0.3 m deep with a clay loam to light clay texture an acid to neutral pH. The subsoils tend to have very saline dark subsoils with an alkaline pH.

The interface between the marine and freshwater environments and the complex depositional processes that can occur in these areas can be reflected in the soil stratigraphy. Buried layers of sand and clay indicate either a dominance of freshwater or marine processes at a given time. Buried layers of sand may indicate a drier than normal climate with wind blown sand deposits accumulating as sheets across the marine plain. Thick fine clay layers may indicate periods of high flood and sediment deposition. These transitional areas can be seen in most Glen Isla soil profiles. **Glen Isla (Gi)** is a duplex to gradational soil with a clay loam topsoil over a grey clay subsoil with an acid to neutral pH. Buried layers of sand to light clay occur below 0.6m. This soil is also affected by shallow water tables for most of the year.

Soil chemistry

The topsoil samples collected from the sodic duplex soils indicate that organic carbon levels range from 0.5 to 2.65% and are considered very low to medium (Bruce and Rayment, 1982). The duplex soils which overlie consolidated subsoils tend to have lower amounts of organic carbon. The surface phosphorus levels for Calen and Narpi are medium, while the other soils have low to very low levels (Table 38). The surface sulfur levels for Calen, Eton, Marian and Narpi are low. Surface nitrogen levels for all soils are in the very low range. The topsoil copper levels are medium for Goodbye and low for the other soils (Bruce and Rayment, 1982).

Table 38. The topsoil fertility of the clay and duplex soils formed on Quaternary marine alluvium

Soil	Phosphorus (mg/kg)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic carbon (%)
Campbell Plains	10	0.14	214	0.07	0.41	4.7	1.7
Dundula (c)	43	0.82	248	3.9	3.0	48	2.6
Goorganga	37	0.3	234	2.4	1.2	44	2.4
Nilotica *	19	0.32	50	2.3	4.7	40	1.0
Wilmington*	15	0.47	95	2.2	1.0	81	2.1

- Sulfur as So4 – S
- Phosphorus – Extractable P using Bicarbonate

* Chemistry data from Aldrick. (1988)
(c) - sample from a cultivated paddock

The subsoil sodicity levels of the clay soils formed on marine plains is variable. The soils with the highest subsoil sodicity are those that occur adjacent to salt flat such as Campbell Plains (Figure 75). The Goorganga and Glen Isla soils have low subsoil sodicity in the first 0.1m but then gradually increases with depth. The Dundula, Nilotica and Wilmington soils have moderate to high subsoil sodicity in the first metre of the profile which also increases with depth.

The salinity levels in the clay soils vary depending upon the chemistry of the shallow groundwater tables. The Campbell Plains soils may have surface conductivity levels between 1.0 and 3.0 dSm^{-1} which may increase with depth (Figure 76). The Dundula, Wilmington and Nilotica soils have subsoil conductivity levels which range from 0.5 to 2.5 dSm^{-1}. Occasionally the lower profile of the Goorganga, Glen Isla and Hillsborough soils may be affected by shallow salty water tables which may cause the conductivity levels to be in the 1.0 to 2.5 dSm^{-1} range. Normally, the subsoil conductivity levels of the Glen Isla, Hillsborough and Goorganga soils are in the 0.4 to 1.0 dSm^{-1} range.

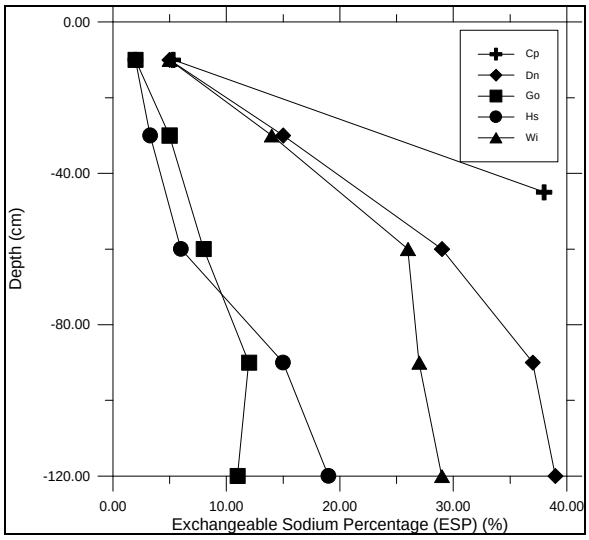


Figure 75. The mean sodicity of the soils formed from Quaternary marine alluvium

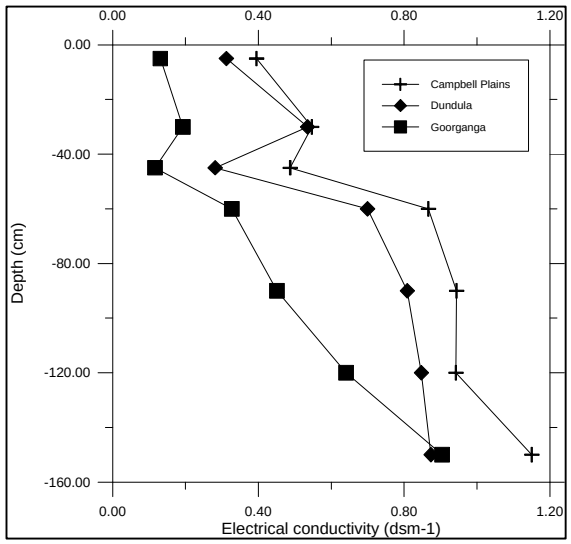


Figure 76. The mean electrical conductivity of soils formed from Quaternary marine alluvium.

The clay soils formed from marine sediments have a moderate cation exchange capacity. The Wilmington and Nilotica soils have the highest CEC:clay in this group which indicates the presence of illite and possibly montmorillonite clay (Figure 77). The montmorillonite clay has a high ability to hold nutrients. The other soils appear to be dominated by illite clay.

The Ca:Mg of all soils in this group is generally below 1.0 (Figure 78). The amount of calcium in the soil is quite high but magnesium is present in unusually high amounts which reduces the Ca:Mg. The source of the magnesium could be from the groundwater.

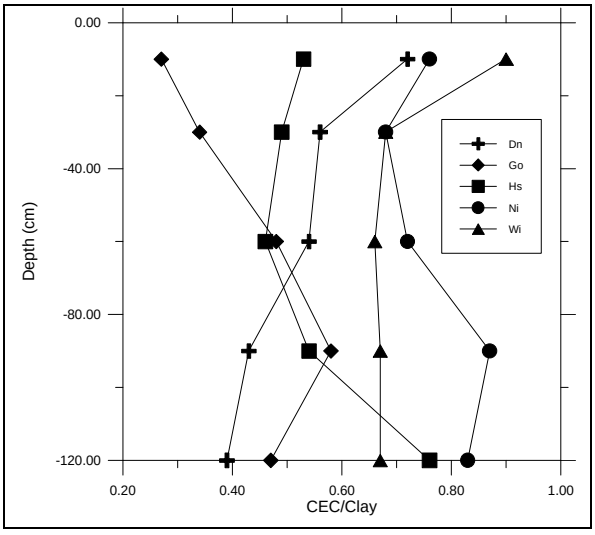


Figure 77. The CEC:Clay for the clay soils formed on marine plains

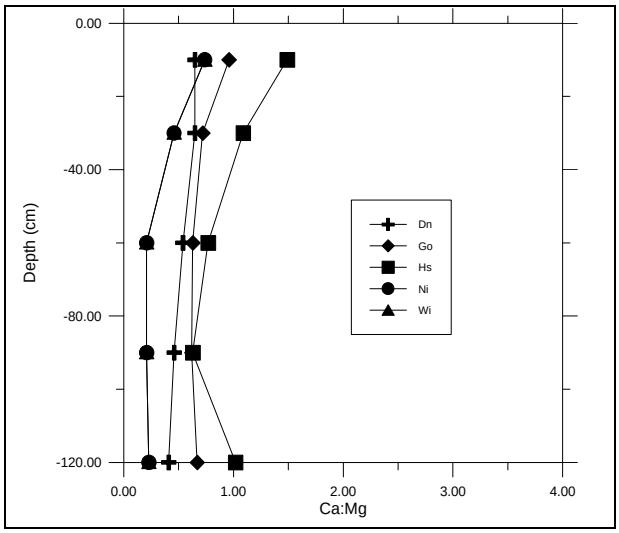


Figure 78. The Ca:Mg for the clay soils formed on marine plains

4.13.2. Soils formed on inland relict and coastal beach ridges

Beach ridge systems have been mapped along the Edgecumbe bay coast and Goorganga Plains. The estuarine areas of Duck Creek, Yeates Creek, Greta Creek and the Proserpine River have a number of parallel sand dunes. The outer sand dunes are most likely Holocene in age and lack profile development. The inland dunes have varying degrees of profile development and some may have formed during the Pleistocene epoch. Three soils have been described (Table 39).

Table 39. The description and classification of the soils formed on the inland relict and coastal beach ridges

Soil Code	Soil Profile Class	Description	Australian Soil Classification	PPF classification
An	Andergrove	Very deep, uniform soil with a sand to loamy sand topsoil over buried layers of sand.	Arenic Rudosol	Ug1.21, Uc2.21
An3	Andegrove shallow variant	Shallow to moderately deep, uniform soil with a sand to loamy sand topsoil over buried layers of sand. These soils usually overlie buried estuarine sediments.	Arenic Rudosol	Ug1.21, Uc2.21
Nl	Neils	A deep, uniform to gradational soil with a bleached sandy topsoil over a yellowish grey, fine sandy loam subsoil.	Arenic Rudosol	Dy5.81, Dy5.82, Dg4.81

The soils formed on the younger beach ridges are mostly grouped as the Andergrove soil profile class. **Andergrove (An)** is a deep, sandy soil with a sand to loamy sand topsoil over buried layers of sand. The topsoil is usually 0.2 to 0.3 m thick and brown in colour with an acid to neutral pH. The less developed or smaller beach ridges have been grouped as the **Andergrove (shallow variant) (An3**). These beach ridges are often less than one metre in depth and overlie buried layers of clay and other sand material.

The soils formed on the older beach ridges have form the Neils soil class. **Neils (Nl)** is a very deep sandy soil with a 0.2 to 0.5 m thick loamy sand topsoil with an acid to neutral pH. The subsoil is a yellow to greyish yellow colour with some mottles and iron-manganese concretions with an acid to neutral pH.

Soil chemistry

The topsoil samples collected from the soils formed on beach ridges indicate that organic carbon levels range from 0.6 to 0.9% and are considered very low (Bruce and Rayment, 1982). The general fertility of the beach ridge soils is very low because of the low clay content and rapid draining of these soils (Table 40).

Table 40. The topsoil fertility of the soils formed on beach ridges

Soil	Phosphorus (mg/kg)	Exchangeable K (meq/100g)	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm	Organic carbon (%)
Andergrove (c)	28	0.16	18	0.2	0.2	4	0.66
Neils	8	0.11	82	0.2	0.1	32	0.9

- Sulfur as So4 – S
- Phosphorus – Extractable P using Bicarbonate

* Chemistry data from Aldrick. (1988)
(c) - sample from a cultivated paddock

The soils formed on the beach ridges have very low subsoil sodicity and conductivity. The sodium cations do not accumulate in these soils because of the absence of clay particles to hold them.

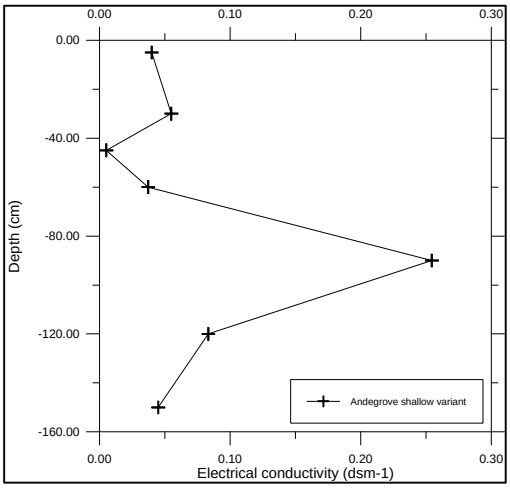


Figure 79. The mean electrical conductivity coastal sand dunes.
of the soils formed on coastal

The little clay that does occur in the soils formed on beach ridges is mostly kaolinite (Figure 80). This clay has a low ability to hold nutrients, therefore if fertiliser is added to these soils most will be lost through deep drainage. Most of the cations on the exchange sites of the clay is calcium. The presence of shell grit in the subsoil of Andegrove and Neils is reflected by the Ca:Mg (Figure 81).

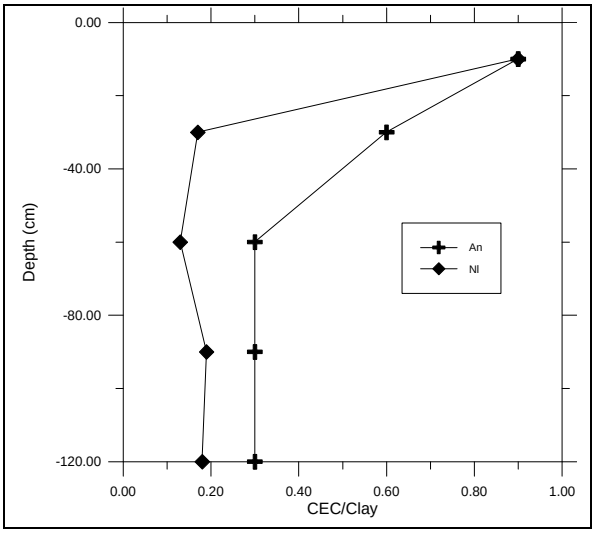


Figure 80. The CEC:Clay for the soils formed on on beach ridges

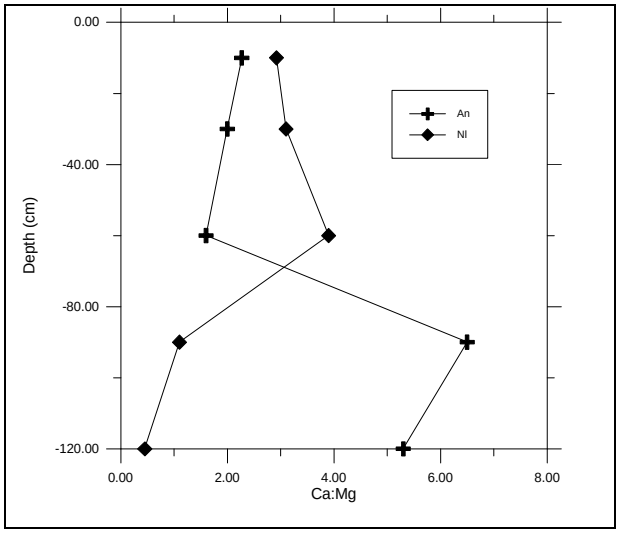


Figure 81. The Ca:Mg for the soils formed on beach ridges

4.14. Available soil water capacity

The amount of soil water which is held by the soil between the field capacity and wilting point over the rooting depth is known as the plant available water capacity (PAWC). The amount of potentially available soil water is influenced by the type of clay, soil structure and rooting depth. The rooting depth takes into account impermeable layers, high sodicity and high salt levels. High subsoil sodicity often leads to poor internal drainage caused by dispersion and reduced porosity. The dispersion of clay and reduced pore spaces in the subsoil reduce the capacity of plant roots to expand through the soil and extract nutrients and water (Powell and Aitken, 1996). Soils which have a high PAWC are preferred for agriculture.

Soil profile samples collected from the PILUS and WILUS and other adjacent surveys were analysed for particle size and water content at 1500 kPa to estimate the wilting point of each sample. The PAWCER pedometric computer program was used to estimate the PAWC of soil profiles (Littleboy, 1995). The calculated PAWC range for each soil type is listed in Table 41.

Table. 41. The calculated and estimated PAWC range for selected soils mapped in the Whitsunday Coast survey.

Soil profile class	Rooting depth (cm)	PAWC range (mm)	Soil profile class	Rooting depth (cm)	PAWC range (mm)
Caley	20	20 - 30	Debella	30	20 - 40
Buckley	45	45 - 60	Lillypool	45	50 – 65
Dunwold	50	55 - 65	Up river	60	55 – 65
Finley	80	75 - 85	Pluto	50	50 - 65
Netherdale	50	55 - 65	Wandarra	80	75 – 85
Uruba	60	60 - 70			
Woonton	60	45 - 55	Dingo	45	45 - 55
			Grasstree	30	45 - 60
Gargett	70	60 – 75	Kangaroo	30	45 - 60

Quandong	50	45 – 60	Koolachu	30 - 60	45 – 75
Hillrise	50	55 – 65	Mookara	55	55 - 70
Kowari	60	55 – 65	Ten mile	45	50 – 60
Roundback	50	45 - 60			
			Billy creek	30	20 - 40
Armstrong	70	70 – 85	Lascelles	40	45 – 55
Finch Hatton	90	75 – 85	Slater	50	55 – 65
			Tailing	45	50 – 60
Pinnacle	80	75 – 90			
Wygong	70	75 – 90	Andromache	100	60 – 75
			Cameron	100	70 – 80
Abott	60	75 – 90	Don	50	55 – 70
Finch Hatton (variant)	60	65 – 80	Murray	50	55 – 70
Luce	50	50 – 65	Moosie	55	55 – 70
Pring	70	75 – 85	Pioneer	100	90 –110
Tannallo	100	80 – 95	Proserpine	100	70 – 80
			St Helens	100	75 - 85
Bode	50	55 – 70			
			Ameliavale	90	75-90
Mentmore	55	55 – 70	Conway	100	90 – 100
Munbura	55	55 – 70	Marian	100	100 - 110
Redfern	45	50 – 65	Mirani	90	90 – 100
			Thompson	100	85 – 95
Dittmer	30	25 - 40			
Conder	45	45 – 55	Anakey	30 - 60	60 – 70
Carmilla	45	55 – 70	Calen	60	60 – 75
Edgecumbe	70	75 – 90	Eton	45 - 60	60 – 70
Preston	45	45 – 60	Foxdale	60	65 - 75
Marlow	55	55 – 70	Goodbye	30 - 60	60 – 70
Sunter	50	45- 55	Narpi	55	60 – 75
Whiptail	60	60 – 70	Nessvale	50	60 - 70
			Pennsfield	55	60 – 75
Balbera	45	50 – 60	Pennsfield (variant)	45	45 – 55
Etowrie	60	70 – 80	Sandiford	60	65 – 75
Etowrie (neutral variant)	70	75 – 90	Sunnyside	60	65 – 75
Kunipipi	45	45 – 55	Sunnyside (sandy loam variant)	50	60 – 70
Ossa	45	50 – 65			
Ossa (cobbly variant)	50	55 – 70	Albert	50	55 – 65
Wollingford	45	45 – 60	Benholme	45 - 70	90 – 110
			Brightley	60	85 – 100
Julian	45	45 - 60	Carew	45 - 70	90 – 110
Habana	55	55 – 70	Crystalbrook	60	70 – 80
Nabilla	65	70 – 80	Merinda	50	60 – 70
Riodanvale	65	70 – 85	Myrtle	80	90 – 105
Strathdickie	65	70 – 85	Tabletop	70	80 - 95
Wagoora	100	100 – 120	Victoria Plains	70	100 – 110
Dryander	60	75 - 85	Campbell plains	30	35 – 50

Silent grove	90	80 - 95	Dundula	45	50 – 65
			Glen Isla	70	70 – 80
Campwyn	60	75 – 85	Goorganga	60	65 – 80
Drakon	25	30 – 40	Hillsborough	70	70 – 80
Jumper	45	40 – 60	Nilotica	40	55- 65
Palmyra	45	45 – 60	Wilmington	40	45 - 55
Pindi	55	55 - 70			
			Andergrove	100	35 - 50
			Neils	100	40 – 50

4.15.Miscellaneous units

The miscellaneous mapping units include; mountains, hills, stream beds, creeks, dams and swamps. There are 6728 ha of hills, 67164ha of mountains, 6623 ha of stream channels and creeks. Mangroves occupy 8742 ha in the survey with a further 2118 ha of salt flats. The study has mapped 404 ha of severe gully erosion.

5. Land degradation

5.1. Salinity

Dryland salinity

Small outbreaks of secondary salinity have been identified in the Whitsunday Coast area. Outbreaks occur on gentle footslopes and alluvial fans.

The salinity outbreaks mainly occur as seepage areas on some footslopes and alluvial fans associated with the Carmilla beds (Pla) and acid granite rock of the Hecate granite (Kh) and Upper Carboniferous – Lower Permian intrusive rocks (CPg). Salinity is influenced by landscape position, lithology, climate, local and regional hydrology. The secondary salinity varies depending on the season and rainfall patterns. The rock types associated with these seepage's are mainly acid to intermediate volcanic rocks, sedimentary rocks, granite and microgranite rocks. The Dryander, Etowrie and Kunipipi soils are associated with the small saline seepage's from the Carmilla beds. The Buckley, Roundback and Hillrise are affected by saline seepages from hillslopes formed from acid intrusive rocks. The salinity levels (1:5 soil water) measured in these seepage areas range from 0.6 dSm^{-1} (low to moderate) to more than 2.0 dSm^{-1} (high to very high) in the soil profile. The high surface salinity causes bare areas and poor grass growth and accelerates erosion, particularly in cleared areas. Clearing should be limited on these soil types to reduced the likelihood of increases in salinity.

Natural salinity occurs in the Whitsunday Coast and is found in some drainage depressions on backplains and older terrace flats. Highly saline subsoils are often found in the Wilmington, Nilotic, Benholme and Victoria Plains soils. The Wilmington and Nilotica soils found in the coastal areas of the survey have very high subsoil salinity levels (1.4 to 3 dSm^{-1}). From measuring the subsoil electrical conductivity at each site in the study, 65,722 ha had a maximum subsoil EC of 0.9 to 1.5 dSm^{-1}, 1,553 ha had a maximum EC of 1.5 to 3 dSm^{-1} and 2,674 ha had a maximum EC of 3 to 6 dSm^{-1}.

Surface water salinity

The salinity levels of water found in creeks and rivers are influenced by land use patterns, catchment geology, catchment hydrology and amount of tree clearing. The recommended salinity level for human consumption according to the world health organisation and the National dryland salinity program (Martin and Metcalf, 1998) is 2.0 dSm^{-1}. The upper limits for stock drinking water is approximately 9.0 dSm^{-1}.

The salinity of some creeks were measured to determine the quality of the water for stock, irrigation and human consumption. The salinity measurements were taken in the drier months of June to December. Most of the smaller creeks in the area are ephemeral and only flow during the wet season. The salinity of Acacia Creek near the Bruce highway in the north of the study area ranged from 1.75 dSm^{-1} to 3.6 dSm^{-1}. The salinity at two sites on Greta Creek south of Bowen were measured and ranged from 1.2 to 2.05 dSm^{-1}. The mid to upper reaches of Yeates Creek measured 0.4 to 0.6 dSm^{-1}. One of the tributaries of Yeates creek had moderate to high salinity levels at 2.6 dSm^{-1}. The water in Kangaroo Creek at the highway measured a moderate to high level of salinity at 2.75 dSm^{-1}.

The creeks in the north-western areas of the study also had moderate to high salinity levels. These creeks source their water from the acid intrusive rocks of the Hecate granite. The Menilden Creek and tributary system salinity ranged from 1.6 to 2.12 dSm^{-1}. Wards creek had a salinity level of 1.65 dSm^{-1}. Some of the smaller creek associated with the Carmilla beds between Billy Creek and Greta Creek had salinity levels of 0.3 to 1.1 dSm^{-1}. The salinity levels in some of the minor creeks in the Kelsey Creek and Silver Creek area had salinity levels in the range of 0.4 to 3.0 dSm^{-1}.

In the south-western areas the O'Connell River and Boundary Creek have low levels of salinity (less than 0.3 dSm^{-1}. The salinity levels of creeks flowing from Mt Millar between Cedar Creek and Boundary Creek had salinity levels between 0.95 and 1.2 dSm^{-1} in the month of June.

The salinity of creeks flowing in an easterly direction into Boundary Creek had salinity levels between 0.95 and 1.33 dSm^{-1}. The water at the mouth of Baldwin Creek recorded a salinity level of 2.1 to 3.2 dSm^{-1}, with a nearby spring having 3.8 dSm^{-1}. The upper reaches of Horse Creek in the State Forest had very low salinity levels of 0.1 dSm^{-1}. In general, most of the creeks that flow from the Carmila beds can expect salinity levels between 1 and 3 dSm-1. The relatively high salinity of these creeks is probably due to these creeks receiving groundwater during the dry season which is high in salts.

5.2. Soil erosion

Sheet, rill, gully and stream bank erosion have been identified in the Whitsunday Coast area. The factors which influence soil erosion include the slope, type and amount of vegetation, land use, rainfall (duration and intensity) and soil erodibility (Wischmeier and Smith, 1978). The erodibility of the topsoil depends largely on topsoil properties such as the amount of sand, silt and clay, together with soil structure and amount of organic matter (Murphy, 1984).

The severity and type of soil erosion at each field site was recorded during the land resource surveys. The assessment of erosion severity is based on the size and extent of the occurrence as outlined in McDonald *et al.* (1990). Erosion mostly occurs on sodic soils formed from acid intrusive rocks, acid volcanic rocks, sedimentary rocks and Cainozoic alluvium because of slow soil permeability and dispersible subsoils. The slow permeability of water into sodic soils enables the action of surface runoff transport soil downslope. Once the sodic subsoils are exposed to the action of flowing water erosion occurs at a rapid rate.

In higher landscape areas, soils formed from acid volcanic rocks and acid intrusive rocks are erodable. The soils formed on acid volcanic rocks which are moderately to severely susceptible to gully erosion include Conder, Whiptail and Carmila. Of the soils formed from acid intrusive rocks, Buckley, Dunwold, Kailla, Glenroc, Uruba and Woonton soils are prone to erosion. The Finley and Bode soils are also prone to erosion after extensive tree clearing. The risk of erosion on these soils is increased on steep slopes after vegetation clearing. If these soils are targeted for development, soil conservation works will be necessary to reduce soil loss.

The alluvial - colluvial footslope and colluvial fan soils such as Balbera, Dryander, Roundback and Hillrise, Quandong, Ossa, Kunipipi, Etowrie and Wollingford are usually affected by sheet and in some cases gully erosion. The surface of these soils are very susceptible to water erosion because of the low clay content, low amounts of organic matter and poor structure, together with a slope of 2 to 4%.

The soils formed from Tertiary – Pliocene consolidated and semi-consolidated sediments are also prone to erosion. The Koolachu, Tenmile, Kangaroo and Grasstree sodic duplex soils have high levels of subsoil sodicity which cause dispersion. When the subsoils are exposed to water, these sodic duplex soils are easily eroded. Extensive soil erosion in the form of gully erosion is found in areas underlain by Tertiary – Pliocene sediments.

The older terrace flats formed from Cainozoic alluvium generally have erodible soils. The Slater and Tailing soils which occur on slopes greater than 2% are particularly prone to sheet, rill and gully erosion. Moderate occurrences of gully erosion occur in these older Cainozoic soils. The subsoils in this group are very dispersible and their exposure to running water should be avoided. Soil conservation works and techniques are recommended for these soils if cleared and used for cropping.

The terrace flats and plains formed from Quaternary alluvium generally have more stable top and subsoils. However, the Pennsfield, Pennsfield (shallow variant), Goodbye and Anakey soils have sodic and dispersible subsoils. There are some areas of moderate to severe gully and stream bank erosion where these soils are found. Most of the more recent alluvial plains are generally free from soil erosion. Stream bank erosion generally occurs most where creeks and rivers are deeply incised.

The Whitsunday Coast survey has identified 6597 ha affected by moderate to severe sheet and rill erosion and approximately 13,870 ha affected by moderate to severe gully erosion. Most of the upland erosion has been accelerated by the removal of trees and poor management of pastures.

Plate 11. Severe gully erosion in Tertiary - Pliocene consolidated sediments.

5.3. Acid drainage

Acid sulfate soils are mostly found in low lying coastal areas. The mineral which is one of the distinguishing feature of the acid sulfate soils is the presence of pyrite. The pyrite is formed bacteria where there is a supply of organic matter, iron from sediments and sulfur from seawater. Pyrite becomes unstable when exposed to oxygen where the reaction produces sulfuric acid and releases aluminium. The release of the acid and heavy metals (or acid drainage) to the water ways can cause detrimental affects to the aquatic ecosystems. The amount of acid produced is mainly determined by the amount of pyrite present.

The study has mapped approximately 4276 ha where acid sulfate soils occur within the first 1.5 m of the surface in coastal lowland areas. There are a further 9,160 ha in coastal lowland areas where the acid sulfate soil layers are probably located below 1.5 m. Additionally, pyrite is expected to be present in areas mapped as mangroves and salt pans (10,860 ha) .

Plate 10. Testing for the presence of pyrite using hydrogen peroxide.

The Lillypool soil is formed on Tertiary shale and covers approximately 2,032 ha in the central areas of the survey. The consolidated shale is probably formed from estuarine or marine sediments and may contain pyrite. Field tests using the hydrogen peroxide indicate a drop in pH in the decomposing shale layers from 5 - 6 to as low as 2 in some profiles. If these soils are excavated, it is recommended that further tests be conducted to determine the amount of pyrite for management purposes.

6.0 Land use and land use suitability

6.1. Introduction

The study aimed to assess the suitability of the land for the dominant agricultural, urban and rural residential land uses. Land use suitability is useful to local and regional planners and landholders for resource planning land management decision making. The suitability assessment matches soil and land attribute data collected from land resource surveys with land use requirements. Land use suitability assessment is a method of determining the management required to maintain productivity while avoiding degradation. The steps involved were:

- Determine the dominant existing or potential land uses
- Map the soil and land attributes
- Determine the limitations applicable to the study area
- Develop limitation classes for each soil and land attribute based on local knowledge and research
- Develop a land suitability classification scheme describing the aspects of the limitations on plant growth, machinery use and land degradation
- Determine the suitability of each land use for each Unique Mapping Area (UMA).
- Generate land suitability maps

6.2. Land uses selected for the suitability assessment

The dominant existing and potential agricultural land uses together with urban and rural residential were selected for the land suitability assessment. Potential crops were assessed to give landholders information on alternative landuses. The agricultural land uses include:

- Sugarcane (spray irrigated)
- Sugarcane (furrow irrigated)
- Horticultural crops (tomatoes)
- Commercial timber (*Pinus caribacea*)
- Improved pasture
- Ponded pasture
- Avocado
- Mango
- Lychee
- Citrus

6. 2.1. Sugarcane

Sugarcane covers approximately 28000 ha in the Whitsunday Coast area. The main methods used to grow sugarcane are rainfed, furrow irrigated and spray irrigated. In general, areas which receive less than a mean of 1600 mm of rain will need to supplement the rainfall with irrigation in most years. In some areas which receive 1600 to 2000 mm some supplementary irrigation may be required for new sugarcane crops and during uncharacteristically drier years.

Furrow irrigation involves the pumping and transport of water to the field using aluminium pipes and its release at the start of the furrow. This technique of irrigation is mainly used to irrigate flat land with a clay subsoil. Furrow irrigation is a useful method of applying water to sugarcane crops but has a relatively low water application efficiency compared to spray irrigation methods. It is expected that in sandy soils large amounts of water are lost to the crop by water percolating past the roots.

This technique of delivering irrigation water to sugarcane crops works best on areas with a relatively uniform soil type and slope gradient. The furrow irrigation of sugarcane on slopes greater than 2 % is not recommended due to the potential soil erosion (McClurg, 1994).

Spray irrigation is the application of supplementary irrigation water using machinery such as a water cannon and overhead low pressure booms. This technique has a higher level of water application efficiency compared to furrow irrigation. Spray irrigation is best used in calm conditions and conditions of lower evaporation such as in the early morning or at night. The greater control over the amount of water applied to the crop allows this method to be used on land with > 2% slope.

6. 2.2. Horticultural tree crops

The four horticultural tree crops assessed in the Whitsunday Coast are avocado, citrus, lychee and mango. The tree crops are assessed as commercial plantations and not as isolated trees. The suitability assessment of the horticultural tree crops makes the assumption that irrigation water is available in drier months to assist flower and fruit development. The soil and land requirements of each tree crop vary.

In general, avocado is more sensitive to water logging than the other crops and these differences are built into the suitability framework. Avocados may be susceptible to fungal and insect problems in the wetter and humid parts of the Whitsunday Coast. Avocado is generally more suited to the drier (< 2000 mm) and well drained soils of the Whitsunday Coast. Citrus is also susceptible to fungal and insect problems in the wetter and more humid part of the Whitsunday Coast and is best suited to the northern drier parts of the area. Lychee are grown commercially in small operations in the wetter parts (>1600 mm) of the Whitsunday Coast. Fruit bats often plunder lychee crops so netting is often an associated expense with this land use. Mangos are susceptible to fungal and insect problems in the wetter and more humid part of the Whitsunday Coast but are highly suited to a range of soil types in the northern drier areas.

6. 2.3. Vegetable small crops

Commercial vegetable small crops are grown in the northern parts of the Whitsunday Coast particularly on the floodplain of the Don River. Rainfall and frost has an influence on the commercial viability of vegetable small crops. The Whitsunday Coast experiences a wide range of climatic factors such as a mean rainfall range between 1000 and 2500mm, and some areas affected by severe frosts on an annual basis. Most commercial vegetable crops are grown in winter in northern drier coastal areas. The main commercial vegetable crops grown in the northern areas include tomatoes, egg plants and capsicums. The land suitability assessment has grouped these three crops into the one category. The assessment also makes the assumption that supplementary irrigation water is available for irrigation.

6. 2.4. Pasture

Grazing on native pastures is a dominant land use in the Whitsunday Coast area. The main native pastures include Blady grass, spear grass and wire grass. Introduced species of grass and legumes are used in some areas. The most common improved pasture species in the wetter areas is pangola, signal grass and Indian couch. In the areas subjected to annual flooding, ponded pasture grazing is common. The dominant species used in ponded pastures are pangola, hymenachne and para grass. However, hymenachne does have the potential to choke seasonal water holes and freshwater creeks.

6. 2.5. Commercial timber

Commercial timber includes selected tree species grown specifically for timber products. Commercial timber plantations occur in very small isolated plots on farms or in State managed plantations. Most of the smaller private forestry ventures have a number of different soft and hardwood species. The largest commercial pine plantation occurs at Cathu State forest, 50 kilometres south of Proserpine. The timber species chosen to be assessed in Whitsunday Coast is *Pinus caribacea* because it covers the largest area.

6.2.6. Urban development

Urban development is described as land used for industry or for building houses on blocks less than 1 ha with town water, sewerage, electricity and road services. Urban development is common in pockets along the coast. There is a trend for urban development to expand into land previously used for agriculture due to limited land available for urban expansion.

6.2.7. Rural residential development.

Rural residential development is defined as land used for residential purposes on blocks ranging between 1 and 10 ha with on site waste water and water supplies. Rural residential developments usually occur on the urban fringe. This land use is common in the higher rainfall areas of the Whitsunday Coast.

6.3. Land suitability classes

The five class land suitability classification scheme outlined by the Queensland Department of Primary Industries (Land Resources Staff, 1990) was used for the Whitsunday Coast study. A brief definition of each class is as follows:

* Class 1 Suitable land with negligible limitations.
* Class 2 Suitable land with minor limitations.
* Class 3 Suitable land with moderate limitations.
* Class 4 Marginal land - presently unsuitable with severe limitations.
* Class 5 Unsuitable land with extreme limitations that preclude its use.

Appendix III provides a more detailed description of each class.

The same five class system was used to develop the limitation subclasses for the limitation attributes. The land use suitability assessment of each land use for each UMA relies on the suitability rules outlined in the classification scheme. The land suitability scheme was developed from local knowledge and research as well as previous land suitability projects such as Wilson (1998), Ross (1997) and Hardy (1998c). The overall suitability class for each land use for a UMA is determined by the most severe limitation subclass.

6.4. Soil and land limitations

The soil and land limitations (Land Resources Staff, 1990) identified for the Whitsunday Coast study include:

* Climate (rainfall)
* Flooding
* Climate (Frost)
* Landscape complexity
* Microrelief
* Recharge potential
* Discharge potential
* Rockiness
* Salinity
* Slope (for machinery use)
* Soil depth (rooting depth)
* Soil surface condition
* Soil swelling
* Soil workability
* Water availability (PAWC)
* Water erosion
* Wetness

Attributes for each soil and land limitation were developed by following the QDPI guidelines (Land Resources Staff, 1990).

6.5. Land use suitability classification scheme

6.5.1. Climate (rainfall) (C)

The amount and seasonal distribution of rainfall influences crop growth and yield. Low lying areas in high rainfall areas risk crop losses due to excessive water logging, floods and disease. The rainfall distribution in the Whitsunday Coast varies from approximately 1000 mm to over 2500 mm. Most of the rainfall occurs from November to April due to tropical low pressure systems in the Coral sea. The seasonal distribution of the rainfall will influence the choice of crops grown. Table 42 describes the climate limitation attributes. The limitation subclasses used to assess land use suitability are shown in Table 43.

Table 42. The climate limitation attributes.

Code	Description of attributes
C1	Mean annual rainfall > 2000mm
C2	Mean annual rainfall 1600 - 2000 mm
C3	Mean annual rainfall 1200 - 1600 mm
C4	Mean annual rainfall 800 - 1200 mm

Table 43: Climate limitation sub classes

	Limitation sub class									
Attribute Code	Avocado	Citrus	Lychee	Mango	Commercial Pine	Veg. crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Sugarcane (Furrow irr.)
C1	4	2	3	3	1	1	1	1	1	1
C2	4	1	2	3	1	1	1	2	1	1
C3	2	1	1	2	2	1	1	3	1	1
C4	1	1	1	1	4	1	1	3	1	1

6.5.2. Flooding (F)

Flooding is the inundation of land by river or creek overflow. Flood events are seasonal in the Whitsunday Coast area and usually occur between November and May. The factors which influence the frequency and duration of flooding include; catchment size and shape, quantity and velocity of runoff, amount and type of catchment ground cover, position in the landscape, and the presence of water retainers such as dams and weirs up - stream. The duration, depth and frequency of floods are important for land use planning. Table 44 describes the flooding limitation attributes. The limitation subclasses used to assess land use suitability to flooding are shown in Table 45.

Table 44. The flooding limitation attributes

Code	Description of attributes
F1	Not flooded
F2	Flooded 1 in 50 - 100 years
F3	Flooded 1 in 10 - 50 years, depth usually < 1 metre.
F4	Flooded 1 in 10 - 50 years, depth usually > 1 metre.
F5	Flooded 1 in 1 to 10 years, depth usually < 1 metre.
F6	Flooded 1 in 1 to 10 years, depth usually > 1 metre.
F7	Flooded on an almost annual basis.
F8	Subject to severe erosive flooding, such as stream beds and gullies.

Table 45. Flooding limitation sub classes

	Limitation sub class											
Attribute Code	Avocado	Citrus	Lychee	Mango	Comm. Pine	Vege crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Sugarcane (Furrow)	Rural Residential	Urban
F1	1	1	1	1	1	1	1	1	1	1	1	1
F2	1	1	1	1	1	1	1	1	1	1	1	3
F3	2	2	2	2	2	1	1	1	1	1	4	5
F4	2	2	2	2	2	1	1	1	2	2	4	5
F5	4	4	4	3	3	1	1	1	2	2	5	5
F6	4	4	4	4	3	1	1	1	2	2	5	5
F7	5	5	5	5	5	1	1	1	3	3	5	5
F8	5	5	5	5	5	5	4	5	5	5	5	5

6.5.3. Frost (Cf)

Frost may reduce crop growth and yield for sensitive plants particularly during flowering and fruit development. The occurrence of frosts may also. Light frosts generally correspond to a screen temperature of 2°C and heavy frosts generally correspond to a screen temperature of 0°C. Table 46 describes the frost limitation attributes. The limitation subclasses used to assess land use suitability to frost are shown in Table 47.

Table 46. The frost limitation attributes.

Code	Description of attributes
Cf1	Frost free
Cf2	Rare frosts
Cf3	Mainly light frosts - less than five frosts.
Cf4	Mainly heavy frosts - more than five

Table 47: Frost limitation sub classes

	Limitation sub class									
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Sugarcane (Furrow irr.)
Cf1	1	1	1	1	1	1	1	1	1	1
Cf2	2	1	2	2	2	1	1	1	1	1
Cf3	4	2	3	3	3	1	1	1	2	2
Cf4	5	4	4	5	3	1	1	1	3	3

6.5.4. Recharge and discharge potential (Ss)

Well drained soils high in the landscape usually act as water recharge areas for local and regional groundwater. Water infiltration into these soils may transport salts and nutrients to the groundwater. Management of recharge areas will help to limit secondary salinisation downslope and pollution of groundwater resources. A discharge area is the point in the landscape where groundwater from nearby recharge areas rise to the surface which allow salts to accumulate through evaporation. These areas tend to be wet for extended periods and may have high salinity levels in the soil and ground water. In urban and rural residential areas, waste water disposal on intake areas may contribute to the pollution of groundwater over time.

Furrow irrigation and ponded pastures are not recommended on intake areas because they will raise the water tables which may have high salt levels. Table 48 describes the recharge and discharge limitation attributes. The limitation subclasses used to assess land use suitability to groundwater intake and discharge areas are shown in Table 49.

Table 48. The recharge and discharge limitation attributes.

Code	Description of attributes
Ss1	Unlikely to be an intake area.
Ss2	Has been identified as a possible intake area.
Ss3	Unlikely to be a discharge area.
Ss4	Site has been identified as an existing salinity discharge area.. These areas should not be developed.

Table 49: Recharge and discharge limitation sub classes

	Limitation sub class											
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Furrow irrigation	Rural Res.	Urban
Ss1	1	1	1	1	1	1	1	1	1	1	1	1
Ss2	2	2	2	2	1	3	3	4	3	4	3	2
Ss3	1	1	1	1	1	1	1	1	1	1	1	1
Ss4	4	4	4	4	4	4	2	2	4	4	3	3

6.5.5. Landscape complexity (X)

Some Unique Mapping Areas (UMAs) contain complex combinations of soils and landforms which can not be mapped at the publication mapping scale. Complex topography requires a revised land management strategy for most land uses. UMAs with a landscape complexity limitation contain either;
a) a complex distribution or mosaic of two or more soils which could not be mapped at the publication scale, or,
b) a diverse range of landforms,
c) or a dissected topography, for example, gullies or stream channels.

Table 50 describes the landscape complexity limitation attributes. The limitation subclasses used to assess land use suitability to landscape complexity are shown in Table 51.

Table 50. Landscape complexity limitation attributes

Code	Description of attributes
X1	Simple UMA with > 70 % one soil type. The landscape is relatively uniform.
X2	Low complexity with > 70 % one soil type with one major landform element with one or more minor landform elements. The landscape is usually dissected by small gullies.
X3	Moderately complex landscape with 50 - 70 % of one soil and a more complex combination of landform elements. The landscape is usually moderately dissected by gullies.
X4	Complex landscape with < 50 % of one soil type and a complex combination of landform elements. The landscape is strongly dissected by gullies.
X5	Very complex landscapes with < 50 % of one soil type and a wide range of landform elements. The landscape is very strongly dissected by gullies.

Table 51. Landscape complexity limitation sub classes

	Limitation sub class									
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Sugarcane (Furrow)
X1	1	1	1	1	1	1	1	1	1	1
X2	2	2	2	2	2	1	1	2	1	2
X3	3	3	3	3	3	2	2	4	3	4
X4	4	4	4	4	4	4	3	5	4	5
X5	5	5	5	5	4	4	3	5	4	5

6.5.6. Microrelief (Tm)

Microrelief refers to surface features up to a few metres above the surrounding land surface (McDonald *et al*., 1990). The main pedogenic types of microrelief found in the Whitsunday Coast area are; normal gilgai, debil debil, swamp hummocks and mass movement. Termite mounds are a form of biotic microrelief. The dimensions of the microrelief vary from centimetres in height to metres in height and diameter. Pedogenic microrelief in the form of gilgai are caused by the shrinking and swelling of clay (Hicks, 1991). The levelling of some forms of gilgai for irrigation may expose sodic subsoils and reduce rooting depth and therefore the amount of water available to plants. Table 52 describes the microrelief limitation attributes and the limitation subclasses used to assess land use suitability to microrelief are shown in Table 53.

Table 52. The microrelief limitation attributes.

Codes	Description of attributes
TM0	No surface microrelief
TM1	Microrelief with a vertical interval < 0.3 m
TM2	Microrelief with a vertical interval 0.3 - 0.6 m
TM3	Microrelief with a vertical interval 0.6 - 1 m
TM4	Microrelief with a vertical interval > 1m.

Table 53. Microrelief limitation subclasses

	Limitation sub class									
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Sugarcane (Furrow)
TM0	1	1	1	1	1	1	1	1	1	1
TM1	2	2	2	2	1	3	1	1	2	2
TM2	4	4	4	4	1	4	1	2	4	4
TM3	5	5	5	5	2	5	2	3	5	5
TM4	5	5	5	5	3	5	2	4	5	5

6.5.7. Rockiness (R)

Cobbles (coarse fragments between 60 and 200 mm in diameter) and stones (200mm to 600 mm in diameter) in the top 0.25 m of soil can affect machinery operations such as ploughing and harvesting. Crops grown in rocky soils usually require rock picking to reduce the wear on harvesters. The presence of rocks in the furrows will also disrupt irrigation by slowing flow and diverting irrigation water. Rocky subsoils may become a limitation for urban and rural residential services which require the excavation of the soil for underground services. Table 54 describes the rockiness limitation attributes and the limitation subclasses used to assess land use suitability to rockiness are shown in Table 55.

Table 54. The rockiness limitation attributes.

Code	Rock size	Description of attribute
R0		No rock outcrop or surface gravel, cobble, stones or boulders.
Rg1	(20 - 60 mm)	Less than 20 % surface gravel.
Rg2	(20 - 60 mm)	20 - 50 % surface gravel.
Rg3	(20 - 60 mm)	50 - 90 % surface gravel.
Rg4	(20 - 60 mm)	> 90 % surface gravel.
Rc1	(60 - 200 mm)	< 2 % surface cobble.
Rc2	(60 - 200 mm)	2 - 10 % surface cobble.
Rc3	(60 - 200 mm)	10 - 20 % surface cobble.
Rc4	(60 - 200 mm)	20 - 50 % surface cobble.
Rc5	(60 - 200 mm)	> 50 % surface cobble.
Rs1	(200 - 600 mm)	< 2 % surface stone.
Rs2	(200 - 600 mm)	2 - 10 % surface stone.
Rs3	(200 - 600 mm)	10 - 20 % surface stone.
Rs4	(200 - 600 mm)	20 - 50 % surface stone.
Rs5	(200 - 600 mm)	> 50 % surface stone.
Rb1	(> 600 mm)	< 2 % surface boulder.
Rb2	(> 600 mm)	2 - 10 % surface boulder.
Rb3	(> 600 mm)	10 - 20 % surface boulder.
Rb4	(> 600 mm)	20 - 50 % surface boulder.
Rb5	(> 600 mm)	> 50 % surface boulder.
Ro1		< 2 % rock outcrop.
Ro2		2 - 10 % rock outcrop.
Ro3		10 - 20 % rock outcrop.
Ro4		20 - 50 % rock outcrop.
Ro5		Greater than 50 % rock outcrop.

Table 55. Rockiness limitation sub classes

Limitation sub class												
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Furrow irrigation	Rural Res.	Urban
R0	1	1	1	1	1	1	1	1	1	1	1	1
Rg1	1	1	1	1	1	1	1	1	1	1	1	1
Rg2	2	2	2	2	2	3	2	1	3	3	2	2
Rg3	3	3	3	3	3	4	3	3	4	4	2	2
Rg4	4	4	4	4	5	5	4	4	5	5	4	4
Rc1	1	1	1	1	1	2	1	1	2	2	1	1
Rc2	1	1	1	1	1	3	2	2	2	3	2	2
Rc3	2	2	2	2	2	4	2	2	3	3	2	2
Rc4	3	3	3	3	3	5	4	4	4	4	3	3
Rc5	4	4	4	4	4	5	5	5	5	5	4	4
Rs1	1	1	1	1	1	1	2	1	2	2	1	1
Rs2	2	2	2	2	2	4	4	4	3	3	2	2
Rs3	3	3	3	3	3	5	4	4	4	4	2	2
Rs4	4	4	4	4	4	5	5	5	5	5	3	3
Rs5	5	5	5	5	5	5	5	5	5	5	4	4
Rb1	2	2	2	2	2	4	3	3	3	3	1	1
Rb2	3	3	3	3	3	5	4	4	4	4	2	2
Rb3	4	4	4	4	4	5	5	5	5	5	2	3
Rb4	5	5	5	5	5	5	5	5	5	5	3	4
Rb5	5	5	5	5	5	5	5	5	5	5	4	5
Ro1	2	2	2	2	2	3	2	2	3	5	3	3
Ro2	4	4	4	4	3	4	3	3	5	5	3	3
Ro3	4	4	4	4	4	5	4	4	5	5	5	5
Ro4	5	5	5	5	5	5	5	5	5	5	5	5
Ro5	5	5	5	5	5	5	5	5	5	5	5	5

6.5.8. Salinity (Sa)

Salt naturally accumulates in soil from either cyclic salt, weathering of rock and / or groundwater movement. Soil salinity restricts rooting depth and uptake of water and nutrients by plant roots. It is assumed that pasture species are chosen based on their tolerance of salinity levels in the soil. Table 56 describes the salinity limitation attributes. The limitation subclasses used to assess land use suitability to salinity are shown in Table 57.

Table 56. The salinity attributes.

Codes	Description of attributes
SA1	Electrical Conductivity 1:5 < 0.6 dSm^{-1} to 1.5 m depth.
SA2	Electrical Conductivity 1:5 0.6 - 1 dSm^{-1} at > 0.6 m depth.
SA3	Electrical Conductivity 1:5 > 1.0 dSm^{-1} > 0.6 m depth.
SA4	Electrical Conductivity 1:5 0.6 - 1.0 dSm^{-1} at 0.3 to 0.6 m depth.
SA5	Electrical Conductivity 1:5 > 1.0 dSm^{-1} at 0.3 to 0.6 m depth.
SA6	Electrical Conductivity 1:5 > 1.0 dSm^{-1} at < 0.3 m depth.
SA7	Subject to sea water influence, indicators usually mangroves and salt marshes.

Table 57. Salinity limitation sub classes

Limitation sub class												
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Furrow irrigation	Rural Residential	Urban
SA1	1	1	1	1	1	1	1	1	1	1	1	1
SA2	1	1	1	1	4	1	1	1	1	1	1	1
SA3	1	1	1	1	5	1	1	1	1	1	1	1
SA4	2	2	2	2	4	2	1	1	2	2	2	2
SA5	4	4	4	4	5	3	2	1	3	3	2	2
SA6	4	4	4	4	5	4	3	2	4	4	3	3
SA7	5	5	5	5	5	5	5	5	5	5	5	5

6.5.9. Slope (for machinery use) (Ts)

This limitation reflects the relative difficulties involved in machine stability for a given land use on certain slopes. The topographic effect of slope on machinery is assessed by considering the size, height and width of machinery used for different land uses. Tall narrow based machinery will have a lower slope tolerance than a shorter wider based vehicle. Table 58 describes the slope limitation attributes. The limitation subclasses used to assess land use suitability to slope for machinery use are shown in Table 59.

Table 58. Slope limitation attributes.

Code	Description of attributes
Ts1	Slopes < 2 %.
Ts2	Slopes 2 - 5 %.
Ts3	Slopes 5 - 12 %.
Ts4	Slopes 12 - 20 %.
Ts5	Slopes 20 - 30 %.
Ts6	Slopes > 30 %, or complex to very complex areas.

Table 59. Slope (for machinery use) limitation sub classes

	Limitation sub class											
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Sugarcane (Furrow)	Rural Res.	Urban
TS1	1	1	1	1	1	1	1	1	1	1	1	1
TS2	1	1	1	1	1	2	1	4	1	1	1	1
TS3	1	1	1	1	1	2	1	5	2	2	2	2
TS4	3	3	3	3	3	4	1	5	4	4	4	4
TS5	5	5	5	5	4	5	4	5	5	5	5	5
TS6	5	5	5	5	5	5	5	5	5	5	5	5

6.5.11. Rooting depth of soil (Pd)

Soils formed on the upperslopes of hills are generally shallower than those of the lower slopes because of gravity and runoff transporting material downslope. Soils formed from the deposition of flood material and surface wash are generally deep. Rooting depth influences the physical support for plants and is the expressed as the depth to an impermeable layer such as rock or high ESP or salt. Soil depth is also beneficial for building house foundations and hinders the laying of underground pipes and is important for waste water disposal. Table 60 describes the soil depth limitation attributes. The limitation subclasses used to assess land use suitability to climate are shown in Table 61.

Table 60. The rooting depth / soil depth limitation attributes.

Code	Description of attributes
PD1	Soil depth > 150 cm.
PD2	Soil depth 100 - 150 cm.
PD3	Soil depth 60 - 100 cm.
PD4	Soil depth 20 - 60 cm.
PD5	Soil depth 0 - 20 cm.

Table 61. Rooting depth / soil depth limitation sub classes

	Limitation sub class											
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Furrow irrigation	Rural Res.	Urban
PD1	1	1	1	1	1	1	1	1	1	1	1	1
PD2	1	1	1	1	1	1	1	1	1	1	1	1
PD3	2	2	2	2	2	1	1	1	1	1	2	3
PD4	3	3	3	3	4	2	1	1	2	2	4	4
PD5	5	5	5	5	5	5	4	4	5	5	5	4

6.5.12. Soil surface condition (Ps)

The soil surface physical condition is important for seedling germination and emergence. Soils with a hardsetting surface or a coarse surface structure have adverse conditions for seedling emergence or seed germination. Hardsetting soils may also reduce soil porosity and reduce water infiltration. Table 62 describes the soil surface condition limitation attributes. The limitation subclasses used to assess land use suitability to soil surface condition are shown in Table 63.

Table 62. The soil surface condition limitation attributes.

Code	Description of attributes
Ps1	Loose or soft soil surface.
Ps2	Firm surface horizon, usually clay loam texture.
Ps3	Hardsetting surface, sandy loam to clay loam.
Ps4	Clay soils, hardsetting.
Ps5	Cracking soils, self - mulching A horizon with ped size < 5 mm.
Ps6	Soils with large surface aggregate size (> 5mm).

Table 63. Soil surface condition limitation sub classes

	Limitation sub class									
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Furrow irrigation
Ps1	1	1	1	1	1	1	1	1	1	1
Ps2	1	1	1	1	1	2	2	2	1	1
Ps3	2	2	2	2	1	2	3	2	2	2
Ps4	2	2	2	2	1	3	2	2	2	2
Ps5	1	4	1	1	1	3	2	2	2	2
Ps6	1	1	1	1	1	3	3	2	2	2

6.5.13. Soil swelling (Psw)

Shrink-swell properties influence building foundations. Soils which contain more than 15 % clay can be prone to soil movement (Hicks, 1991). The swelling and shrinkage of some clays (>35%) is attributed to clay mineralogy. The mineralogy of the parent material will usually determine soil clay type. Montmorillonite and illite clay types derived from intermediate to basic volcanic rocks swell and shrink, whereas kaolinite does not. The presence of swelling clays can be overcome by engineering techniques. Table 64 describes the soil swelling limitation attributes. The limitation subclasses used to assess land use suitability to soil swelling are shown in Table 65.

Table 64. The soil swelling attributes

Code	Description of attributes
Psw1	Low swelling soil CEC:Clay < 0.4
Psw2	High swelling soil high CEC > 0.4

Table 65. Soil shrink and swelling properties limitation sub classes

Attribute	Limitation sub class	
Code	Rural Residential	Urban
Psw1	1	1
Psw2	3	3

6.5.14. Soil workability (Pm)

The soil workability limitation refers to the soil surface physical properties which influence the ability to plough and prepare the soil to generate soil structure suitable for seed germination and establishment. Heavy clay soils require specialised methods of preparation. If the clay soils are too wet or dry, ploughing is more difficult and tends to create large clods. Table 66 describes the soil workability limitation attributes. The limitation subclasses used to assess land use suitability to soil workability are shown in Table 67.

Table 66. The soil workability limitation attributes.

Code	Description of attributes
Pm1	No restriction to cultivation, such as loose sands.
Pm2	Firm to hardsetting surface, moderate to strong subangular - blocky to angular blocky structured A horizon, usually clay loam texture.
Pm3	Hardsetting surface, massive loam to sandy loam A horizon with a very firm dry consistency (2 - 4) (sandy bulldust soils)
Pm4	Hardsetting surface, massive to weakly structured sandy clay loam to clay loam A horizon, firm to very firm dry consistence (2 - 4) (bulldust soils).
Pm5	Hardsetting surface, massive strong to rigid sandy clay loam to clay loam A horizon.
Pm6	Clay soils, cracking or non - cracking pedal but do not have a self mulching surface.
Pm7	Cracking soils, self - mulching A horizon with ped size < 5 mm.
Pm8	Heavy clays with a narrow moisture range for ploughing.
Pm9	Gravelly abrasive soils.

Table 67. Soil workability limitation sub classes

	Limitation sub class									
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Furrow irrigation
Pm1	1	1	1	1	1	1	1	1	1	1
Pm2	1	1	1	1	1	2	1	1	1	1
Pm3	1	1	1	1	1	3	1	1	2	2
Pm4	1	1	1	1	1	3	2	2	2	2
Pm5	1	1	1	1	1	3	2	2	2	2
Pm6	1	1	1	1	1	2	2	2	1	2
Pm7	1	1	1	1	1	3	1	1	2	2
Pm8	1	1	1	1	1	3	2	2	2	2
Pm9	1	1	1	1	1	4	3	3	4	4

6.6.15. Water availability (M)

Soil water availability for crops depends on rainfall or irrigation, soil properties and land management techniques. Other factors which influence the amount of water available to plants include effective rooting depth, soil drainage and permeability. Soil drainage is influenced by the position of the soil in the landscape. The soil factors that influence the amount of water available to the root system include the depth to a limiting layer such as bedrock, high sodicity or salinity or a layer of impermeable soil material, and the type and amount of clay. Plant Available Water Capacity (PAWC) is the amount of water held in the soil between the field capacity and wilting point over the rooting depth. Soils with high profile PAWC are usually clays with a deep rooting depth. Soils with low profile PAWC are usually rapidly drained sandy soils, shallow soils or sodic duplex soils with a shallow rooting depth. Knowledge of the soils capacity to hold water is important for irrigation scheduling. Table 68 describes the water availability limitation attributes. The limitation subclasses used to assess land use suitability to water availability are shown in Table 69.

Table 68. The water availability limitation attributes.

Code	Description of attributes
M1	PAWC > 125mm.
M2	PAWC of 100 - 125 mm.
M3	PAWC of 75 - 100 mm.
M4	PAWC of 60 - 75 mm.
M5	PAWC of 40 - 60 mm
M6	PAWC < 40 mm.

Table 69. Water availability limitation sub classes

	Limitation sub class									
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Furrow irrigation
M1	1	1	1	1	1	1	1	1	1	1
M2	1	1	1	1	1	1	1	1	1	1
M3	2	2	2	2	2	2	2	1	2	2
M4	3	3	3	3	3	2	2	1	2	2
M5	3	3	3	3	3	2	3	1	3	3
M6	4	4	4	4	4	3	4	1	4	4

Notes: * Estimated PAWC for tree crops rooting depth 1.2 metres
* Estimated PAWC for vegetables and pasture rooting depth to 0.5 metres
* Estimated PAWC for sugarcane rooting depth 0.9 metres.
* If depth to bedrock, high salt concentration, high sodicity or impermeable layers is less than crop rooting depth, PAWC is estimated to depth of limiting layer.

6.5.16. Water erosion (E)

Water erosion is a form of land degradation which in the long term may lead to productivity decline. Erosion can lead to decreasing water quality and cause difficulties in operating machinery. Sheet, rill and gully erosion are forms of water erosion. The factors that influence erosion include slope steepness and length, the amount and type of surface cover, intensity and duration of rainfall events and soil erodibility. Some soils are more susceptible to water erosion than others such as sodic duplex soils with a fine sandy topsoil. Surface water runoff can remove fine sand more easily than clays and coarse sand. Once the fine sandy topsoils are eroded by surface runoff, the sodic subsoils are easily eroded due to their dispersible nature caused by poor structure and low infiltration rates. Table 70 describes the water erosion limitation attributes and the limitation subclasses used to assess land use suitability to water erosion are shown in Table 71.

Table 70. The erosion limitation attributes

Code	Description of attributes
En1	Depositional or low energy environment, no or minimal erosion eg swamps and mangroves.
Eb1	Stream beds or areas subject to stream bank erosion.
Ew1	Gradational and uniform soils, slope < 1%.
Ew2	Gradational and uniform soils, slope 1 - 2 %.
Ew3	Gradational and uniform soils, slope 2 - 4 %.
Ew4	Gradational and uniform soils, slope 4 - 8 %..
Ew5	Gradational and uniform soils, slope 8- 14 % .
Ew6	Gradational and uniform soils, slope 14 - 20 %..
Ew7	Gradational and uniform soils, slope 20 - 30 %.
Ew8	Gradational and uniform soils, slope > 30 %.
Ed1	Non sodic duplex soil < 1%.
Ed2	Non - sodic duplex soils, slope 1 - 2 %.
Ed3	Non - sodic duplex soils, slope 2 - 4 %.
Ed4	Non - sodic duplex soils, slope 4 - 10 %.
Ed5	Non - sodic duplex soils, slope 10 - 14 %.
Ed6	Non - sodic duplex soils, slope 14 - 20 %.
Ed7	Non - sodic duplex soils, slope 20 - 30 %.
Ed8	Non - sodic duplex soils, slope > 30 %.
Es1	Sodic duplex soils, slopes < 1%.
Es2	Sodic duplex soils, slopes 1 - 2 %.
Es3	Sodic duplex soils, slopes 2 - 4 %.
Es4	Sodic duplex soils, slopes 4 - 10 %.
Es5	Sodic duplex soils, slopes 10 - 20 %.
Es6	Sodic duplex soils, slopes > 20 % .
Es7	Highly erosive sodic duplex soils, slopes 1 - 4 % .
Es8	Highly erosive sodic duplex soils, slopes > 4 %.

Table 71. Water erosion hazard limitation sub classes

	Limitation sub class											
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Furrow irrigation	Rural Res	Urban
En1	1	1	1	1	1	1	1	1	1	1	1	1
Eb1	5	5	5	5	5	5	5	5	5	5	5	5
Ew1	1	1	1	1	1	1	1	1	1	1	1	1
Ew2	1	1	1	1	1	1	1	1	1	2	1	1
Ew3	1	1	1	1	1	2	1	3	2	4	1	1
Ew4	2	2	2	2	2	4	2	4	3	5	1	1
Ew5	3	3	3	3	3	4	3	4	3	5	1	1
Ew6	3	3	3	3	3	5	4	5	5	5	2	2
Ew7	4	4	4	4	4	5	5	5	5	5	4	4
Ew8	5	5	5	5	5	5	5	5	5	5	4	4
Ed1	1	1	1	1	1	1	1	1	1	1	1	1
Ed2	1	1	1	1	1	1	1	1	1	2	1	1
Ed3	1	1	1	1	1	3	1	1	2	4	1	1
Ed4	2	2	2	2	2	4	2	3	3	5	1	1
Ed5	3	3	3	3	3	5	4	5	4	5	2	1
Ed6	4	4	4	4	4	5	4	5	5	5	2	2
Ed7	5	5	5	5	5	5	4	5	5	5	4	4
Ed8	5	5	5	5	5	5	5	5	5	5	4	4
Es1	1	1	1	1	1	1	1	1	1	1	1	1
Es2	1	1	1	1	1	2	1	2	1	3	1	1
Es3	2	2	2	2	2	4	3	4	3	5	1	1
Es4	3	3	3	3	3	5	4	5	4	5	1	1
Es5	5	5	5	5	4	5	5	5	5	5	2	2
Es6	5	5	5	5	5	5	5	5	5	5	3	3
Es7	5	5	5	5	5	5	4	5	5	5	3	3
Es8	5	5	5	5	5	5	5	5	5	5	4	4

6.5.17. Wetness (W)

Soil drainage describes both internal and external local soil wetness conditions (McDonald *et al*., 1990). The internal soil attributes which influence soil drainage include soil structure, type of clay, permeability, texture and water holding capacity (Crouch *et al*., 1991). The external factors influencing drainage include position in the landscape, catchment configuration, source and quantity of water, the gradient and length of slope and evapotransporation. Crop tolerance has been used to determine limitation subclasses. Excessively wet soils could cause foundation problems for housing. Table 72 describes the wetness limitation attributes. The limitation subclasses used to assess land use suitability to wetness are shown in Table 73.

Table 72. The wetness limitation attributes

Class	Class name	Class description
W1	Rapidly drained	Water is removed rapidly in relation to supply. These soils often occur on steep slopes. The soil is usually shallow and coarse textured. No horizon is normally wet for more than several hours after water addition.
W2	Well drained	Water is removed readily from soil. Soil is often medium textured, and some horizons may remain wet for several days after water addition.
W3	Moderately well drained	Water is removed slowly from the soil due to low permeability, shallow water table, lack of gradient or a combination of these. Soils are usually medium to fine in texture. Soils remain wet for more than one week after water addition.
W4	Imperfectly drained	Water is removed slowly in relation to supply. Some horizons may be mottle or have orange or rusty linings of root channels and are wet for periods of several weeks.
W5	Poorly drained	Water is removed very slowly in relation to supply. Seasonal ponding occurs. Soils often have gleyed or mottled sub - soils, or possess orange or rusty linings of root channels. All horizons remain wet for periods of several months.
W6	Very poorly drained	Water is removed from the soil so slowly that the water table remains at or near the surface for most of the year. Soils often occur in drainage depressions. Most soils have strongly gleyed sub - soil and accumulation of surface organic matter.

Table 73. Wetness limitation sub classes

	Limitation sub class											
Attribute Code	Avocado	Citrus	Lychee	Mango	Pine	Vegetable crops	Improved Pastures	Ponded pastures	Sugarcane (Spray)	Furrow irrigation	Rural Res	Urban
W1	1	1	1	1	1	1	1	5	1	1	1	1
W2	2	1	1	1	1	1	1	4	1	1	2	1
W3	4	3	2	3	3	3	1	4	1	1	2	2
W4	5	4	3	3	3	4	1	3	2	2	3	3
W5	5	5	4	5	5	5	1	1	3	3	4	4
W6	5	5	5	5	5	5	1	1	4	4	5	5

Assumptions:
1. Wetness is assessed to the rooting depth of the agricultural crop as indicated in Table 71 and to 1.5 m for urban and rural residential land uses.
2. Sugarcane is affected by a watertable within 0.5 m of the surface.
3. Improved and ponded pasture species selected for wetness conditions.

6.6. Agricultural land classes

Agricultural land classes provide a scheme for mapping the general quality of land for agriculture (DPI and DHLGP, 1993). There are four classes which are used to express the severity of limitations for agriculture.

The classes utilise land use suitability information for the cropping and pasture assessed in this study. The four classes are;

- Class A Crop land with no to moderate limitations.
- Class B Limited crop land, marginal for crops and suitable for pastures.
- Class C Pasture land. Land suitable only for improved pastures due to limitations which preclude continuous cultivation for crop products.
- Class D Non Agricultural Land. Land not suitable for agricultural uses due to extreme limitations, eg steepness and shallow soils.

Land assessed as Class A and B are considered areas of good quality agricultural land (GQAL) in the Whitsunday Coast survey area. A more detailed description of each agricultural land class is provided in Appendix III. The agricultural land classification has been recorded in the UMA database. The agricultural land class map can be created using the data in the accompanying database.

6.7. Land use suitability assessment of the soils

The land use suitability of each soil is discussed in alphabetical order under geology/landform groups as they appear on the soil map and in the earlier soil section. The discussion includes a summary of the main limitations which affect the suitability of a soil for spray irrigated sugarcane and urban development. The general suitability of each soil for the twelve land uses is summarised in Tables 74 - 93. It should be noted that the suitability classes listed in the table are to be used as a guide only because limitations for a soil may differ between UMAs due to site specific factors. For details concerning the land use suitability of a particular UMA, the database or agricultural land use class map should be consulted.

6.7.1. Soils overlying acid to intermediate intrusive rocks

Upperslopes of steep mountains and rises

The **Buckley** soil is marginal for most agricultural land uses (Table 74). This soil usually occurs on slopes less than 10% and has a low to moderate plant available water capacity. The surface often has small to moderate amounts of surface rock. The subsoil usually has moderate to high levels of sodicity which will reduce water availability and increase the soils susceptibility to erosion. The topsoil and subsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Buckley is generally marginal for sugarcane and other crops. This soil is also suitable for urban development where the slope is not excessive. Buckley soil is usually class “B” agricultural land.

The **Caley** soil is unsuitable for most agricultural land uses. This soil usually occurs on slopes greater than 10% and is shallow with a low plant available water capacity (PAWC). The surface may have large amounts of surface rock and rock outcrops. The soil is commonly unsuitable for sugarcane and other cropping. The Caley soil may be marginal for urban development because of excessive slopes (>20%) and surface rock. This soil is generally class “D” agricultural land.

The **Dunwold** soil is suitable for some agricultural land uses. This soil usually occurs on slopes less than 10% and has a moderate plant available water capacity. The surface often has small to moderate amounts of surface rock. Dunwold is generally suitable for sugarcane where the slope is suitable and the surface rock is not excessive. The subsoil may have moderate sodicity levels which increases the soils susceptibility to erosion.

The topsoil and subsoil are susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. This soil is also suitable for urban development where the slope is not excessive (<20%). Dunwold soil is usually class "A" or "B" agricultural land.

The **Finley** soil is suitable for most agricultural land uses. This soil usually occurs on slopes between 4 and 15% and has a moderate to high plant available water capacity. The surface often has small to moderate amounts of surface rock. Finley is generally suitable for sugarcane where the slope is suitable and the surface rock is not excessive. This soil is also suitable for urban development where the slope is not excessive (<20%). Finley soil is mostly class "A" agricultural land.

The **Glenroc** soil is suitable for some agricultural land uses. This soil commonly occurs on slopes less than 10% and has a low to moderate plant available water capacity. The surface has small to moderate amounts of surface rock. The subsoil may have moderate sodicity levels which will reduce the amount of water available to crops and increase the soils susceptibility to erosion. Glenroc is generally suitable for sugarcane where the slope is suitable and the surface rock is not excessive. The topsoil and subsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. This soil is also suitable for urban development where the slope is not excessive (<20%). Glenroc soil is class "A" or "B" agricultural land.

The **Kailla** soil is suitable for some agricultural land uses. This soil occurs on slopes less than 10% and has a moderate plant available water capacity. The surface often has small to moderate amounts of surface rock. The subsoil may have moderate sodicity levels. Kailla is generally suitable for sugarcane where the slope is suitable and the surface rock is not excessive. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. This soil is also suitable for urban development where the slope is not excessive (<20%). Kailla soil is usually class "A" or "B" agricultural land.

The **Netherdale** soil is marginal or not suitable for most agricultural land uses. This soil usually occurs on slopes 10 to 25% and may have moderate amounts of surface rock. This soil is shallow to moderately deep and has low to moderate plant available water capacity (PAWC). The soil is usually marginal for sugarcane. However, where this soil occurs on slopes less than 10% and has a deep B3 or BC horizon, spray irrigated sugarcane can be grown provided that soil conservation strategies are used. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. The Netherdale soil may be suitable for urban development depending on slope and surface rock. This soil is generally class "B" agricultural land.

The **Uruba** soil is suitable for most agricultural land uses. This soil usually occurs on slopes less than 12% and has a moderate plant available water capacity. The surface often has moderate amounts of surface rock. Uruba is generally suitable for sugarcane where the slope is suitable and the surface rock is not excessive. In general, these soils occur on slopes too steep for horticultural cropping. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks.

This soil is also suitable for urban development where the slope is not excessive. Uruba soil is mostly class "A" agricultural land.

The **Uruba (sandy A horizon variant)** soil is suitable for most agricultural land uses. This soil occurs on slopes less than 6% and has a moderate plant available water capacity. There is often has moderate amounts of surface rock. Uruba (sandy A horizon variant) is generally suitable for sugarcane where the slope is suitable and the surface rock is not excessive. This soil is also suitable for urban development where the slope is not excessive (<20%). Uruba (sandy A horizon variant) soil is usually class "A" agricultural land.

The **Woonton** soil is marginal or not suitable for most agricultural land uses and usually occurs on slopes 5 to 25% and may have moderate amounts of surface rock. This soil is shallow to moderately deep and has low to moderate plant available water capacity (PAWC). The soil is usually marginal for sugarcane. However, where this soil occurs on slopes less than 10% and has a deep B3 or BC horizon, spray irrigated sugarcane can be grown provided that soil conservation strategies are used. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. The main limitations for urban development are excessive slopes, susceptibility to erosion and surface rock. This soil is generally class "B" agricultural land.

Table 74. The general land use suitability of soils overlying the upperslopes of steep mountains and hills of acid to intermediate intrusive rocks.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Buckley	5	4	4	3-4	3-4	5	3-4	3-4	3-4	A-B
Caley	5	5	5	4-5	5	5	4	4	4	D
Dunwold	5	3-4	4	3	3	5	2	2	2	A-B
Glenroc	5	3-4	4	3	3	5	2	2	2	A-B
Hector	5	5	5	5	5	5	5	4 -5	4 -5	D
Kailla	5	3-4	3-4	3	3	5	3	3	3	A-B
Finley	4	2	2-4	2	2	5	2	2	2	A
Netherdale	5	3-4	4	3	3	5	3	3	3	A-B
Uruba	5	3	4	3	3	5	3	3	3	A
Uruba (sandy A variant)	4	2	3	3	2	5	2	2	2	A
Woonton	5	4	4	3-4	3-4	5	3-4	3-4	3-4	A-B

Undulating to gently undulating footslopes and colluvial fans

The **Gargett** soil is suitable for some agricultural land uses (Table 75). This soil usually occurs on slopes less than 3%. The plant available water capacity is moderate and there is often small amounts of surface rock. Shallow water tables may be a limitation for tree crops. Gargett is generally suitable for spray irrigated sugarcane. This soil is usually class "A" agricultural land.

The **Hillrise** soil is suitable for some agricultural land uses. This soil usually occurs on slopes less than 4%. The plant available water capacity is moderate and there is often has small amounts of surface rock. The subsoil may have moderate sodicity levels which will reduce the amount of water available to crops and increase the soils susceptibility to erosion. Hillrise is generally suitable for spray irrigated sugarcane. This soil is mostly class "A" agricultural land.

The **Kowari** soil is suitable for some agricultural land uses. This soil occurs on slopes less than 6% and has a low to moderate plant available water capacity depending on the amount of profile rock and soil depth. The surface often has moderate amounts of surface rock.

Kowari is generally suitable for sugarcane where the slope is suitable and the surface rock is not excessive. This soil is also generally suitable for urban development. Kowari soil is usually class "A" agricultural land.

Quandong is generally marginal or unsuitable for agricultural land uses. This soil usually occurs on slopes less than 6% and has a low to moderate plant available water capacity depending on soil depth. This soil occurs in small and narrow zones in footslope positions. The surface often has small to moderate amounts of surface rock. Quandong may be suitable for spray irrigated sugarcane where the slope is suitable and the landscape complexity is not excessive. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. This soil is also suitable for urban development. The Quandong soil is usually class "A" or "B" agricultural land.

The **Roundback** soil is marginal for most agricultural land uses. This soil usually occurs on slopes less than 6%, has a low to moderate plant available water capacity and moderate amounts of surface rock. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Roundback is generally suitable for spray irrigated sugarcane and urban development and is usually class "B" agricultural land.

The **Uruba (alluvial - colluvial variant)** soil is suitable for some agricultural land uses. This soil usually occurs on slopes less than 6% and has a moderate plant available water capacity. Uruba (alluvial - colluvial variant) is generally suitable for sugarcane and urban development and is usually class "A" agricultural land.

Table 75. The general land use suitability of soils overlying the gently undulating to gently undulating footslopes of acid to intermediate intrusive rocks.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Gargett	4	3-4	4	3	3	5	3	4	4	A
Hillrise	4	3	4	3	2	4	3	3	3	A
Kowari	4	3-4	4	3	2	5	3	3	3	A-B
Quandong	4	3-4	4	3	3	5	3	3-4	3-4	A-B
Roundback	5	3-4	5	4	4	5	3-4	3-4	3-4	B
Uruba (alluvial - colluvial variant)	4	3	3	3	2	4	3	2	2	A

6.7.2. Soils overlying intermediate to basic intrusive rocks

Upperslopes of steep mountains and rises

Armstrong is suitable for some agricultural land uses (Table 76). This soil usually occurs on slopes greater than 6% but less than 30% and often has moderate to large amounts of surface rock This soil has a moderate to high plant available water capacity. Armstrong is usually marginal for sugarcane because of steep slopes and excessive surface rock. Where surface rock and slopes are not limiting, this soil is suitable for sugarcane and vegetable crops.

This soil is also suitable for urban development where the slope is not excessive and measures are taken to accommodate for the shrink-swell subsoil clay. Armstrong soil is usually class "A" agricultural land.

Finch Hatton is suitable for some agricultural land uses. This soil usually occurs on slopes greater than 6% but less than 20% and often has moderate amounts of surface rock This soil has a moderate to high plant available water capacity. Finch Hatton is usually marginal for sugarcane because of steep slopes and excessive surface rock. Where surface rock and slopes are not limiting, this soil is suitable for sugarcane and urban development. Finch Hatton soil is usually class "A or B" agricultural land.

The **Pinnacle** soil is suitable for most agricultural land uses. This soil usually occurs on slopes between 6 and 20% and has a moderate plant available water capacity. The surface often has moderate amounts of surface rock. Pinnacle is generally suitable for sugarcane where the slope is suitable, and where landscape complexity and the surface rock are not excessive. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. This soil is also suitable for urban development where the slope is not excessive. Uruba soil is usually class "A" agricultural land.

Wygong is suitable for some agricultural land uses. This soil usually occurs on slopes greater than 6% but less than 20% and often has moderate to large amounts of surface rock. This soil has a moderate to high plant available water capacity. Wygong is usually suitable for spray irrigated sugarcane except where the slope and surface rock become excessive. This soil is also suitable for urban development where the slope is not excessive and measures are taken to accommodate for the shrink-swell subsoil clay. Wygong soil is usually class "A" agricultural land.

Table 76. The general land use suitability of soils overlying the upperslopes of steep mountains and hills of acid to intermediate intrusive rocks and dykes.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Armstrong	4	3	3-4	3-4	3-4	5	3	3-4	3-4	A
Finch Hatton	4	2-4	3-4	2	2	5	2	3	3	A-B
Pinnacle	5	2-4	2-4	2-4	2-4	5	2	3	3	A-B
Wygong	4	3	3-4	3-4	3-4	5	3	3-4	3-4	A

Undulating footslopes and colluvial fans

The **Abbot** soil is suitable for most agricultural land uses and usually occurs on slopes less than 4% (Table 77). Abbot has a moderate to high plant available water capacity depending upon rooting depth. The surface often has small to moderate amounts of surface rock. If the surface rock can be removed cheaply, these soils can be quite productive for commercial vegetable crops where the slope is not excessive. These soils may be suitable for vegetable crops during the drier months if mounding practises are used and slopes are adequate to remove surface water from rainfall events. Abott is generally suitable for sugarcane. This soil is usually class "A" agricultural land.

The **Finch Hatton (alluvial – colluvial variant)** soil is suitable for most agricultural land uses and usually occur on slopes less than 4% and often has small to large amounts of surface rock. The Finch Hatton variant has a moderate to high plant available water capacity depending upon rooting depth. In some circumstances the removal of surface rock is a major economic consideration for agricultural land uses.

If the surface rock can be removed cheaply, these soils can be quite productive for commercial vegetable crops. The Finch Hatton variant is generally suitable for sugarcane and horticultural crops and is usually class "A" agricultural land.

The **Luce** soil is marginal for most agricultural land uses and usually occurs on slopes less than 4%. Luce has a moderate plant available water capacity depending upon the depth to consolidated layers. The surface often has small to moderate amounts of surface rock. These soils form in drainage depressions so the size of the area alone maybe too small to be economically viable. Some part of the Luce mapping units may be subject to infrequent flooding. If the surface rock can be removed cheaply, these soils can be quite productive for commercial vegetable crops. Luce is generally suitable for sugarcane. This soil is usually class "A-B" agricultural land.

The **Pring** soil is suitable for most agricultural land uses and usually occurs on slopes less than 4%. Pring has a moderate to high plant available water capacity depending upon the rooting depth. The surface often has small to large amounts of surface rock. In some circumstances the removal of surface rock is a major economic consideration for agricultural land uses. If the surface rock can be removed cheaply, these soils can be quite productive for commercial vegetable crops. Pring is generally suitable for spray irrigated sugarcane. This soil is usually class "A" agricultural land.

The **Tannalo** soil is suitable for most agricultural land uses. This soil usually occurs on slopes less than 4%, has a moderate plant available water capacity and is free of surface rock. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Tannalo is generally suitable for spray irrigated sugarcane and urban development. Tannalo soil is class "A" agricultural land.

Table 77. The general land use suitability of soils overlying the undulating to gently undulating footslopes and colluvial fans of intermediate to basic volcanic rocks.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Abbot	4	3	3-4	3	3	5	3	3	3	A
Finch Hatton (alluvial–colluvial var.)	4	3	3	3	3	5	3	3	3	A
Luce	5	4	4	3	3	5	3	3-4	3-4	A-B
Pring	4-5	3	3-4	3	3	5	3	3	3	A
Tannalo	3-4	3	3	3	2	5	2	3	2	A

6.7.3. Soils overlying acid to intermediate metamorphic rocks

The **Bode** soil is suitable for some agricultural land uses (Table 78). This soil usually occurs on slopes between 4 and 15% and has a moderate plant available water capacity. The surface often has small to moderate amounts of surface rock. Bode is generally suitable for sugarcane where the slope is suitable and the surface rock is not excessive. Bode soil is usually class "A" agricultural land.

Table 78. The general land use suitability of soils overlying the acid to intermediate metamorphic rocks.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Bode	4	3-4	3-5	3	3	5	3	3	3	A-B

6.7.4. Soils formed from acid to intermediate tuff

The **Exmoor** soil is unsuitable for most agricultural land uses (Table 79). This soil usually occurs on slopes greater than 10% and often has large amounts of surface rock. Exmoor is very shallow and has a low plant available water capacity. This soil is generally unsuitable for sugarcane and is considered marginal for urban development because of shallow soil depth, excessive surface rock and steep slopes, and is usually class "D" agricultural land.

The **Mentmore** soil is suitable for some agricultural land uses. This soil is moderately deep with moderate amounts of surface rock, and mainly occurs on slopes 4 to 12%. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Mentmore is generally suitable for spray irrigated sugarcane and urban development. This soil is usually class "A or B" agricultural land.

The **Mentmore (sandy topsoil variant)** soil is marginal for most agricultural land uses. This soil is moderately deep with moderate amounts of surface rock, and occurs on slopes 4 to 12%. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Mentmore (sandy variant) is generally suitable or marginal for spray irrigated sugarcane and urban development. This soil is usually class "A or B" agricultural land.

The **Munbura** soil is suitable for some agricultural land uses. This soil is moderately deep with moderate amounts of surface rock and occurs on slopes 4 to 15%. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Munbura is generally suitable for spray irrigated sugarcane and urban development. This soil is usually class "A" or "B" agricultural land.

The **Redfern** soil is suitable for some agricultural land uses. This soil is moderately deep but and has a low to moderate plant available water capacity caused by moderate to high levels of sodicity in the subsoil. The surface often has moderate amounts of surface rock and occurs on slopes less than 6%. Redfern is generally suitable for spray irrigated sugarcane and urban development. This soil is usually class "A" or "B" agricultural land.

Table 79. The general land use suitability of soils overlying acid to intermediate tuffs.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Exmoor	5	5	5	4	5	5	4	4	4	D
Mentmore	4-5	3-4	4	3	3	5	3	3	3	A
Mentmore (variant)	4-5	3-4	4	4	3-4	5	3-4	3	3	B
Munbura	4-5	3-4	4	3-4	3-4	5	3	3	3	A-B
Redfern	5	3	4	4	3	5	4	3	3	A- B

6.7.5. Soils overlying acid volcanic rocks

Upperslopes of steep hills to rolling low hills

Carmila is suitable for some agricultural land uses and occurs on slopes greater than 4% (Table 80). This soil has a moderate to low plant available water capacity caused by subsoil sodicity and soil depth. The surface often has moderate amounts of surface rock. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Carmila is generally suitable or marginal for sugarcane, but may be suitable for urban development. This soil is usually class "A" or "B" agricultural land.

Conder is marginal or unsuitable for most agricultural land uses. This soil usually occurs on slopes greater than 10%. This soil has a low plant available water capacity caused by subsoil sodicity and soil. The dispersible subsoil makes this soil susceptible to gully erosion. Conder is generally marginal for sugarcane, but may be suitable for urban development. This soil is usually class "B" agricultural land.

Dittmer is unsuitable for most agricultural land uses and usually occurs on slopes greater than 10%. This soil is very shallow (<0.2m) and has a low plant available water capacity and often has large amounts of surface rock. Dittmer is generally unsuitable for sugarcane. Dittmer may be marginal for urban development because of shallow soil depth, excessive surface rock and steep slopes. This soil is usually class "D" agricultural land.

Edgecumbe is suitable for some agricultural land uses and usually occurs on slopes greater than 4%. This soil has a moderate plant available water capacity and often has moderate amounts of surface rock. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Edgecumbe is usually suitable for sugarcane and urban development, and is generally class "A" agricultural land.

Marlow is suitable for some agricultural land uses and usually occurs on slopes greater than 4%. This soil has a moderate plant available water capacity and often has moderate amounts of surface rock. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Marlow is generally suitable for sugarcane and urban development, and is class "A or B" agricultural land.

Preston is suitable for some agricultural land uses and usually occurs on slopes greater than 4%. This soil has a moderate plant available water capacity and often has moderate amounts of surface rock. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Preston is usually suitable for sugarcane and urban development, and is class "A or B" agricultural land.

Sunter is suitable for some agricultural land uses and usually occurs on slopes between 2 and 6%. This soil has a low to moderate plant available water capacity and often has moderate amounts of surface rock. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture.

The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Sunter is usually suitable for sugarcane and urban development, and is generally class "A or B" agricultural land.

Whiptail is suitable for some agricultural land uses and occurs on slopes greater than 4 %. This soil has a moderate plant available water capacity and often has moderate amounts of surface rock. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Whiptail is usually suitable for sugarcane and urban development, and is generally class "A or B" agricultural land.

Table 80. The general land use suitability of soils overlying the upperslopes of the steep hills to rolling low hills of acid volcanic rocks.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Belmunda	5	3-4	4	3	3	5	3	3	3	B
Carmila	5	3-4	4	3	3	5	3	3	3	B
Conder	5	4	5	5	4	5	4	3	3	B
Dittmer	5	5	5	5	5	5	5	4	4	D
Edgecumbe	5	3	4	3	3	5	3	3	2	A
Marlow	5	3-4	4	3	3	5	3	3	2	A-B
Preston	5	3-4	4	3	3	5	3	3	2	A-B
Sunter	5	3-4	4	3	3	5	3	3	2	A-B
Whiptail	5	3-4	4	3	3	5	3	3	2	A-B

Undulating to gently undulating footslopes

Balbera is suitable for some agricultural land uses and usually occurs on slopes between 2 and 4% (Table 81). Balbera has a low to moderate plant available water capacity caused by high subsoil sodicity and moderate amounts of surface and subsoil gravel. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Balbera is generally marginal for sugarcane but could be suitable for urban development. This soil is considered class "B" agricultural land.

Etowrie is suitable for some agricultural land uses and usually occurs on slopes less than 4% and has a low to moderate plant available water capacity. The surface often has small to moderate amounts of surface rock. Etowrie is generally suitable for sugarcane and urban development, and is usually class "A" agricultural land.

The **Etowrie (neutral variant)** soil is suitable for some agricultural land uses and usually occur on slopes less than 4%. Etowrie (neutral variant) has a moderate plant available water capacity. The surface often has low amounts of surface rock and gravel. Etowrie (neutral variant) is usually suitable for sugarcane. This soil may be suitable for urban development in areas which do not get flooded. This soil is class "A" agricultural land.

Kunipipi is suitable for some agricultural land uses and usually occurs on slopes between 2 and 4%. Kunipipi has a low to moderate plant available water capacity caused by high subsoil sodicity and moderate amounts of surface and subsoil gravel. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture.

The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Kunipipi is generally marginal for sugarcane but could be suitable for urban development. This soil is considered class "B" agricultural land.

Ossa (cobbly variant) is suitable for some agricultural land uses. This soil usually occurs on slopes between 2 and 10 % and has a moderate plant available water capacity. The surface often has moderate amounts of surface rock. Ossa (cobbly variant) is mostly suitable for sugarcane and tree crops. This soil is often suitable for urban development and is usually class "A or B" agricultural land.

Wollingford is suitable for some agricultural land uses and usually occurs on slopes between 2 and 4%. This soil has a low to moderate plant available water capacity caused by high subsoil sodicity and moderate amounts of surface and subsoil gravel. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Wollingford is generally suitable for sugarcane and urban development and is considered class "A" agricultural land.

Table 81. The general land use suitability of soils overlying the undulating to gently undulating footslopes of acid volcanic rocks.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Balbera	5	3-4	4	4	4	5	3	3	3	A-B
Etowrie	5	3-4	4	3	3	5	3	3	2	A-B
Etowrie (variant)	5	3	4	3	3	5	3	3	2	A
Kunipipi	5	3-4	4	3	3	5	3	3	2	A-B
Ossa (variant)	5	3	4	3	4	5	3	3	3	A
Wollingford	5	3	4	3	4	5	3	3	3	A

6.7.6. Soils overlying intermediate to basic volcanic rocks

Upperslopes of steep hills to rolling low hills

The **Julian** soil is marginal or unsuitable for agricultural land uses (Table 82). This soil usually occurs on slopes greater than 10 % and has moderate to large amounts of surface rock. Julian is usually marginal for sugarcane and urban development because of excessive slopes and large amounts of surface rock. In some steeper areas Habana soils may be prone to landslides. This soil is generally class "B or C" agricultural land.

The **Habana** soil is suitable for some agricultural land uses. This soil usually occurs on slopes greater than 6 % and has moderate to large amounts of surface rock. Habana has a moderate plant available water capacity. Sugarcane can be grown on this soil where slopes and surface rock are not excessive. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. This soil is usually marginal for urban development because of excessive slopes and large amounts of surface rock. In some steeper areas Habana soils may be prone to landslides. This soil is generally class "A or B" agricultural land.

The **Nabilla** soil is suitable for most agricultural land uses. This soil usually occurs on slopes less than 10 % and often has moderate amounts of surface rock. This soil has a moderate plant available water capacity. Nabilla is generally suitable for sugarcane where the slope is suitable and the surface rock is not excessive. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. This soil is also suitable for urban development where the slope is not excessive. Nabilla soil is usually class "A" agricultural land.

The **Riordanvale** soil is suitable for most agricultural land uses. This soil usually occurs on slopes less than 10 % and often has moderate amounts of surface rock. This soil has a moderate plant available water capacity. Riordanvale is generally suitable for sugarcane where the slope is suitable and the surface rock is not excessive. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. This soil is also suitable for urban development. Riordanvale soil is usually class "A" agricultural land.

The **Strathdickie** soil is suitable for most agricultural land uses. This soil usually occurs on slopes less than 10 % and often has moderate amounts of surface rock. This soil has a moderate plant available water capacity. Strathdickie is generally suitable for sugarcane where the slope is suitable and the surface rock is not excessive. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. This soil is also suitable for urban development. Strathdickie soil is usually class "A" agricultural land.

The **Wagoora** soil is suitable for most agricultural land uses. This soils usually occurs on slopes less than 8% and often has moderate amounts of surface rock. Wagoora has a high plant available water capacity. Wagoora is generally suitable for sugarcane and urban development. This soil is usually class "A" agricultural land.

Table 82. The general land use suitability of soils overlying the upperslopes of the steep hills to rolling low hills of intermediate to basic volcanic rocks.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Julian	5	4-5	5	4	4	5	3-4	3-4	3-4	B
Habana	5	3-4	4	3	4	5	3	4	4	A - B
Nabilla	5	3-4	3-4	3	3	5	3	3	3	A
Riordanvale	5	3-4	3-4	3	3	5	3	3	3	A
Strathdickie	5	3-4	3-4	3	3	5	3	3	3	A
Wagoora	5	2	4	2	2	4	3	3	3	A

Undulating to gently undulating footslopes and colluvial fans

The **Dryander** soil is suitable for some agricultural land uses (Table 83). These soils usually occur on slopes less than 4 % and often has small to moderate amounts of surface rock. Dryander has a moderate plant available water capacity caused by moderate subsoil sodicity levels.

Dryander is usually suitable for sugarcane and urban development. This soil is usually class “A or B” agricultural land.

The **Silent grove** soil is suitable for most agricultural land uses and usually occur on slopes less than 4%. Silent grove has a high plant available water capacity. The surface often has small amounts of surface rock. Silent grove is generally suitable for sugarcane. These soils have shrink - swell subsoils which are a minor limitation to urban development. This soil is usually class “A” agricultural land.

Table 83. The general land use suitability of soils overlying the undulating to gently undulating footslopes of intermediate to basic volcanic rocks.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Dryander	5	3	4	3	3	5	3	3	3	A
Silent Grove	4	2-3	4	3	2	4	3	4	4	A

6.7.7. Soils overlying low rolling hills to undulating rises of Permian sedimentary rocks

The **Campwyn** soil is suitable for some agricultural land uses (Table 84). This soil usually occurs on slopes between 6 and 15% and has moderate amounts of surface rock and gravel. The Campwyn soil has a low to moderate plant available water capacity. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. Campwyn is generally suitable or marginal for sugarcane and suitable for urban development where slope and surface rock are not excessive, and is usually class “A or B” agricultural land.

The **Drakon** soil is unsuitable for agricultural land uses. This soil usually occurs on slopes greater than 10% and has moderate to large amounts of surface rock. Drakon is usually unsuitable for sugarcane and urban development because of excessive slopes and large amounts of surface rock. This soil is generally class “D” agricultural land.

The **Jumper** soil is suitable for some agricultural land uses. This soil usually occurs on slopes less than 10% and has moderate amounts of surface rock and gravel. The Jumper soil has a low to moderate plant available water capacity caused by moderate subsoil sodicity levels. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Jumper is generally suitable to marginal for sugarcane and suitable for urban development where slope and surface rock are not excessive, and is usually class “A or B” agricultural land.

The **Palmyra** soil is marginal for most agricultural land uses. This soil usually occurs on slopes from 4 to 15% and has moderate amounts of surface rock and gravel. The Palmyra soil has a low to moderate plant available water capacity caused by moderate sodicity levels. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Palmyra is generally marginal for sugarcane and suitable for urban development where slope and surface rock are not excessive, and is usually class “B” agricultural land.

The **Pindi** soil is suitable for some agricultural land uses. This soil usually occurs on slopes less than 10% and has moderate amounts of surface rock and gravel. The Pindi soil has a low to moderate plant available water capacity caused by moderate subsoil sodicity levels. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Pindi is generally marginal for sugarcane and suitable for urban development where slope and surface rock are not excessive, and is usually class "A or B" agricultural land.

Table 84. The general land use suitability of soil formed on Permian sedimentary rock.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Campwyn	5	3-4	4-5	3-4	3	5	3	3	3	B
Drakon	5	5	5	5	5	5	4-5	4	4	D
Jumper	5	3-4	4-5	4	3-4	5	3-4	3	3	B
Palmyra	5	4	4-5	4	3-4	5	3-4	3	3	B
Pindi	5	3-4	4-5	4	3	5	3-4	3	3	B

6.7.8. Soils overlying the gently undulating plains and rises of Tertiary sediments

The **Debella** soil is marginal or unsuitable for most agricultural land uses occurs on slopes between 1 and 5% (Table 85). This soil is very shallow and has a low plant available water capacity. Debella is generally marginal for sugarcane because of a shallow soil depth, low water holding capacity, soil erodibility and in some areas poor site drainage. The main limitations of this soil for urban development include shallow soil depth, excessive surface rock, soil erodibility and poor site drainage. This soil is usually class "B" agricultural land.

The **Debella (cobbly variant)** soil is marginal or unsuitable for most agricultural land uses occurs on slopes between 1 and 5%. This soil is very shallow and has a low plant available water capacity. Debella (cobbly variant) is generally marginal for sugarcane because of shallow soil depth, low water holding ability, soil erodibility, and in some areas poor site drainage. The main limitations of this soil for urban development include shallow soil depth, excessive surface rock, soil erodibility and poor site drainage. This soil is usually class "B" agricultural land.

The **Lillypool** soil is suitable for some agricultural land uses and occurs on slopes less than 10%. The Lillypool soil type has a low to moderate plant available water capacity caused by moderate sodicity levels. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Lillypool is generally marginal for sugarcane and suitable for urban development, and is usually class "A or B" agricultural land.

The **Pluto** soil is suitable for some agricultural land uses and occurs on slopes less than 6%. The Pluto soil type has a low to moderate plant available water capacity caused by moderate subsoil sodicity levels. The surface often has moderate amounts of surface rock and gravel. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Pluto is generally suitable or marginal for sugarcane and suitable for urban development where slope and surface rock are not excessive, and is usually class "A or B" agricultural land.

The **Up river** soil is suitable for some agricultural land uses and occurs on slopes less than 6%. The Up river soil type has a low to moderate plant available water capacity. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. The irrigation of these soils may contribute to rising water tables in adjacent areas. Up river is generally suitable to marginal for sugarcane depending on slope and soil depth and is usually class "A" agricultural land.. This soil is normally suitable for urban development.

The **Wandarra** soil is suitable for some agricultural land uses and occurs on slopes less than 6 %. The Wandarra soil type has moderate plant available water capacity. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. The irrigation of these soils may contribute to the rising of adjacent water tables. Wandarra is generally suitable for sugarcane but these soils have been identified as possible groundwater intake areas so the monitoring of groundwater tables in adjacent land is recommended. This soil is normally suitable for urban development, and is usually class "A" agricultural land.

Table 85. The general land use suitability of soil formed on Tertiary sedimentary rock.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Debella	5	4-5	5	4	4	5	3-4	3	3	B
Debella (cobbly variant)	5	4-5	5	4	4	5	3-4	3	3	B
Lillypool	5	3-4	4	4	3-4	5	3	3	3	B
Pluto	5	3-4	3-4	3	3	5	3	3	3	A-B
Up river	5	3 - 4	3-4	3	3	5	3	3	3	A - B
Wandarra	5	3	3	2-3	3	5	3	3	3	A

6.7.9. Soils overlying the gently undulating plains of Tertiary - Pliocene sandstone

The **Dingo** soil is suitable to marginal for most agricultural land uses (Table 86). This soil usually occurs on slopes less than 3 %, and has a low to very low plant available water capacity, and is rapidly drained. Dingo is usually prone to water erosion. These soils occur in small isolated pockets which by themselves may be too small to be economically viable for cropping. This soil may be suitable for spray irrigated sugarcane but is marginal for furrow irrigated sugarcane on slopes greater than 2% because they are prone to erosion. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. This soil is usually suitable for urban development. Dingo soil is class "A" agricultural land.

The **Grasstree** soil is marginal to unsuitable for agricultural land uses. This soil usually occurs on slopes less than 3%. Grasstree has a low plant available water capacity caused by high subsoil sodicity and is imperfectly drained. These soils have small to large amounts of surface and subsoil gravel. This soil is generally marginal to unsuitable for spray irrigated sugarcane on slopes greater than 2% because they are prone to erosion.

This soil is usually suitable to marginal for urban development. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development. Grasstree soil is class "B or C" agricultural land.

The **Kangaroo** soil is marginal to unsuitable for agricultural land uses. This soil usually occurs on slopes less than 3%. Kangaroo has a low plant available water capacity caused by high subsoil sodicity and is imperfectly drained. These soils have small to moderate amounts of surface and subsoil gravel. This soil is generally marginal to unsuitable for spray irrigated sugarcane on slopes greater than 2% because they are prone to erosion. This soil is usually suitable to marginal for urban development. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development. Kangaroo soil is class "B or C" agricultural land.

The **Koolachu** soil is suitable for some agricultural land uses. This soil usually occurs on slopes less than 3 %, and has a low to very low plant available water capacity caused by high subsoil sodicity, and is imperfectly drained. Koolachu is free of surface rock, and is usually prone to water erosion. This soil is generally suitable for spray irrigated sugarcane but is marginal for furrow irrigated sugarcane on slopes greater than 2% because they are prone to erosion. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. This soil is usually suitable for urban development. Koolachu soil is class "A" agricultural land.

The **Mookara** soil is suitable to marginal for agricultural land uses. This soil usually occurs on slopes less than 3%. Mookara has a moderate to high plant available water capacity depending upon rooting depth. These soils have small to moderate amounts of surface and subsoil gravel. This soil is generally suitable to marginal for spray irrigated sugarcane. This soil is usually suitable for urban development. Mookara soil is class "A or B" agricultural land.

The **Ten mile** soil type is suitable for some agricultural land uses. This soil usually occurs on slopes less than 3%. Ten mile has a low plant available water capacity caused by high subsoil sodicity and is imperfectly drained. These soils have small to moderate amounts of surface and subsoil gravel. This soil is generally suitable for spray irrigated sugarcane, but is marginal for furrow irrigated sugarcane on slopes greater than 2% because they are prone to erosion. This soil is usually suitable for urban development. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for cropping. The strategies which should be considered for cropping include contour ploughing, retention of surface ground cover such as surface mulch, incorporation of grassed water ways for water runoff and contour banks. Ten mile soil is class "A" agricultural land.

Table 86. The general land use suitability of soils overlying the gently undulating plains of Tertiary - Pliocene sediments.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. Trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Dingo	4	3-4	4	3	3	5	3-4	3-4	3-4	A-B
Koolachu	5	3-4	4	4	3	4	3-4	3	3	A-B
Grasstree	5	4-5	4-5	4-5	4	5	4-5	4-5	4-5	B-C
Kangaroo	5	4-5	4-5	4-5	4	5	4	4-5	4-5	B-C
Mookara	4	3-4	3-4	3-4	2-3	5	2	3	3	A - B
Ten mile	4	3-4	4	4	3	4	3-4	3	3	A - B

6.7.10. Soils overlying the gently undulating plains of unconsolidated Cainozoic alluvium

The **Billy creek** soil is marginal for most agricultural land uses (Table 87). This soil usually occurs on slopes less than 2 % and has a low to very low plant available water capacity caused by high subsoil sodicity, and is imperfectly drained. Billy creek is usually prone to water erosion. This soil is generally marginal for spray irrigated sugarcane because of very low plant available water capacity caused by very high subsoil sodicity. The topsoil is susceptible to water erosion, therefore soil conservation strategies must be implemented if these soils are cleared for development or used for agriculture. This soil is usually suitable for urban development. Billy creek soil is class "B" agricultural land.

The **Lascelles** soil is suitable to marginal for some agricultural land uses and usually occurs on slopes less than 2%. Lascelles has a very low to moderate plant available water capacity depending on the depth and thickness of the iron-manganese pan. The iron - manganese pan may limit rooting depth which will reduce the water available to crops. This soil often has low amounts of surface gravel and is imperfectly drained. Lascelles is generally suitable to marginal for spray irrigated sugarcane and is marginal for furrow irrigated sugarcane. This soil is usually suitable for urban development and is class "A" agricultural land.

The **Slater** soil is suitable for some agricultural land uses. This soil usually occurs on slopes less than 3%. Slater has a low to moderate plant available water capacity caused by subsoil sodicity and is imperfectly drained. These soils are free of surface rock. Slater soils may be prone to water erosion. Slater is generally suitable for spray and furrow irrigated sugarcane. This soil is usually suitable for urban development. Slater soil is class "A" agricultural land.

The **Tailing** soil is suitable for some agricultural land uses depending on subsoil salt. This soil usually occurs on slopes less than 2%. Tailing has a low to moderate plant available water capacity caused by subsoil sodicity and is imperfectly drained. These soils are free of surface rock. Tailing is generally suitable for spray and furrow irrigated sugarcane in some areas. This soil is usually suitable for urban development. Slater soil is class "B" agricultural land.

Table 87. The general land use suitability of soils overlying the gently undulating plains of unconsolidated Cainozoic alluvium.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. Trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Billy creek	5	4	4	4	3	5	4	3-4	3-4	B
Lascelles	4	3-4	4	4	3	4	3-4	4	3- 4	A-B
Slater	4	3	3-4	3-4	3	4	3	3	3	A
Tailing	3	3	4	4	3	3	4	4	4	A - B

6.7.11. Soils derived from Quaternary alluvium

Relict and active levees

The **Andromache** soil is suitable for most agricultural land uses and usually occurs on slopes less than 2% (Table 88). This soil has a low to moderate plant available water capacity depending upon the amount of clay in the subsoil, and is rapid to well drained. Andromache is suitable for spray irrigated sugarcane, but is marginal or unsuitable for urban development because of periodic flooding. This soil is class "A" agricultural land.

The **Cameron** soil is suitable for most agricultural land uses and occurs on slopes less than 2%. This soil has a low to moderate plant available water capacity depending upon the amount of clay in the subsoil, and are well to moderately well drained. Cameron is suitable for spray and furrow irrigated sugarcane, and is generally marginal for urban development because of periodic flooding. This soil is class "A" agricultural land.

The **Don** soil is suitable for some agricultural land uses and occurs on slopes less than 2%. The Don soil has a low to moderate plant available water capacity depending upon the amount of clay in the subsoil, and are well to moderately well drained. Don is suitable for spray and furrow irrigated sugarcane, and is generally marginal for urban development because of periodic flooding. This soil is class "A" agricultural land.

The **Moosie** soil is suitable for some agricultural land uses. This soil occurs on slopes less than 2% and has a low to moderate plant available water capacity depending upon the degree of subsoil layer consolidation, and are moderately well drained. These soils are found in small isolated areas which may make it difficult to use for cropping. These soils may be affected by low frequency flood events. Moosie is generally suitable for spray irrigated sugarcane and is class "A" agricultural land. This soil is marginal or unsuitable for urban development because of periodic flooding.

The **Murray** soil is suitable for some agricultural land uses. This soil occurs on slopes less than 2%. This soil has a low to moderate plant available water capacity depending upon the amount of clay and rock in the subsoil, and are well to moderately well drained. Murray is generally suitable for spray irrigated sugarcane. There is usually too much surface rock for furrow irrigated sugarcane. Murray soil is class "A" agricultural land. This soil is marginal or unsuitable for urban development because of periodic flooding.

The **Murray (alluvial - colluvial variant)** soil is marginal to unsuitable for agricultural land uses and occurs on slopes between 2 and 10%. This soil has a low to moderate plant available water capacity depending upon the amount of clay and rock in the subsoil, and are rapid to well drained. Murray (alluvial - colluvial variant) is generally marginal for spray irrigated sugarcane because of excessive surface and profile rock, and frequent flooding. There is usually too much surface rock for furrow irrigated sugarcane. This soil is marginal or unsuitable for urban development because of periodic flooding. Murray (alluvial - colluvial variant) soil is class "C" agricultural land.

The **Pioneer** is suitable for most agricultural land uses. This soil usually occurs on slopes less than 2%. This soil has a moderate to high plant available water capacity depending upon the amount of clay in the subsoil, and are well to moderately well drained. Pioneer is generally suitable for spray and furrow irrigated sugarcane, and is marginal or unsuitable for urban development because of periodic flooding. Pioneer soil is class "A" agricultural land.

Proserpine is suitable for most agricultural land uses and is class "A" agricultural land. This soil usually occurs on slopes less than 2 %, has a low to moderate plant available water capacity depending upon the amount of clay in the subsoil and are rapidly to well drained. Proserpine is suitable for spray irrigated sugarcane, but is marginal or unsuitable for urban development because of periodic flooding.

The **St Helens** soil is suitable for most agricultural land uses and occurs on slopes less than 2%. This soil has a moderate to high plant available water capacity depending upon the amount of clay in the subsoil, and are well to moderately well drained. St Helens is suitable for spray and furrow irrigated sugarcane, but is generally marginal or unsuitable for urban development because of periodic flooding. St Helens soil is class "A" agricultural land.

Table 88. The general land use suitability of soils overlying the relict and active levees

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Andromache	3	2-3	2	2	2	5	2	5	5	A
Cameron	3	2	2	2-3	2	5	2-3	4	4	A
Cameron (Phase)	3	2	2	3-4	2	5	3	4	4	A
Don	3	3	3	3	3	4	3	4	3	A
Moosie	3-4	3	3-4	3-4	3	5	3	4	4	A
Murray	3-4	3	3-4	3-4	3	5	3-4	4	4	A
Murray (alluvial - colluvial variant)	5	4-5	5	4-5	4	5	4	5	5	B-C
Pioneer	2	2	2	2	2	4	2	5	4	A
Proserpine	3	2	2-3	3	2	5	3	5	5	A
St Helens	3	2	3	3	3	5	3	4	4	A

Level active backplains and relict terraces

Cracking clay soils

The **Benholme** soil is suitable for most agricultural land uses and usually occurs on slopes less than 2% (Table 89). This soil has a moderate to very high plant available water capacity depending upon subsoil sodicity. These soils are imperfectly drained. Benholme is suitable for spray and furrow irrigated sugarcane, but is marginal or unsuitable for urban development because of periodic flooding. These soils may be suitable for vegetable crops during the drier months if mounding practises are used and slopes are adequate to remove surface water from rainfall events. Benholme soil is class “A” agricultural land.

Brightley soil is suitable for most agricultural land uses and usually occurs on slopes less than 2%. This soil has a moderate to very high plant available water capacity depending upon the rooting depth. These soils are imperfectly drained. Brightley is suitable for spray and furrow irrigated sugarcane, but is marginal or unsuitable for urban development because of periodic flooding. These soils may be suitable for vegetable crops during the drier months if mounding practises are used and slopes are adequate to remove surface water from rainfall events. Brightley soil is class “A” agricultural land.

The **Carew** soil is suitable for most agricultural land uses and usually occurs on slopes less than 1%. This soil has a moderate to very high plant available water capacity depending upon the rooting depth. These soils are imperfectly drained. Carew is suitable for spray and furrow irrigated sugarcane, but is marginal or unsuitable for urban development because of periodic flooding. These soils may be suitable for vegetable crops during the drier months if mounding practises are used and slopes are adequate to remove surface water from rainfall events. Carew soil is class “A” agricultural land.

The **Merinda** soil is suitable for most agricultural land uses and usually occurs on slopes less than 2%. This soil has a moderate to very high plant available water capacity depending upon the level of subsoil sodicity. These soils are imperfectly drained. Merinda is suitable for spray and furrow irrigated sugarcane, but is marginal or unsuitable for urban development because of periodic flooding. These soils may be suitable for vegetable crops during the drier months if mounding practises are used and slopes are adequate to remove surface water from rainfall events. Merinda soil is class “A” agricultural land.

The **Tabletop** soil is suitable for most agricultural land uses and usually occurs on slopes less than 1%. This soil has a moderate to very high plant available water capacity depending upon the rooting depth and are imperfectly drained. Tabletop is suitable for spray and furrow irrigated sugarcane, but is marginal or unsuitable for urban development because of periodic flooding.

These soils may be suitable for vegetable crops during the drier months if mounding practises are used and slopes are adequate to remove surface water from rainfall events Tabletop soil is class “A” agricultural land.

The **Victoria plains** soil is suitable for most agricultural land uses and usually occurs on slopes less than 1%. This soil has a moderate to very high plant available water capacity depending upon the rooting depth. These soils are imperfectly to poorly drained. Victoria plains is suitable for spray and furrow irrigated sugarcane, but is marginal or unsuitable for urban development because of periodic flooding. These soils may be suitable for vegetable crops during the drier months if mounding practises are used and slopes are adequate to remove surface water from rainfall events. This soil is class “A” agricultural land.

Table 89. The general land use suitability of clay soils of the level active backplains and relict terraces

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Benholme	2	2	3-4	3-4	2	3	4	5	5	A
Brightley	2	2	3-4	3-4	2	2	4	5	5	A
Carew	2	2	3-4	3-4	2	2	4	4-5	4-5	A
Merinda	2	3	3-4	3-4	2	3	4	4-5	4-5	A
Tabletop	2	2	3-4	3-4	2	3	3	5	5	A
Victoria plains	2	2	3-4	3-4	2	2	4	5	5	A

Non sodic duplex soils

The **Amelia vale** soil is suitable for most agricultural land uses and usually occurs on slopes less than 2% (Table 90). This soil has a moderate to high plant available water capacity depending upon the rooting depth, and are usually moderately well drained to imperfectly drained. Amelia vale is suitable for spray irrigated sugarcane, but is marginal for urban development because of periodic flooding, and is class “A” agricultural land.

Conway is suitable for most agricultural land uses and usually occurs on slopes less than 2%. This soil has a moderate to high plant available water capacity, and are well to moderately well drained, and is suitable for spray irrigated sugarcane. Conway is marginal for urban development because of periodic flooding and is class “A” agricultural land.

Marian is suitable for most agricultural land uses and usually occurs on slopes less than 2%. Marian has a moderate to high plant available water capacity, and are well to moderately well drained, and is suitable for spray irrigated sugarcane. This soil is marginal for urban development because of periodic flooding. Marian soil is class “A” agricultural land.

Mirani is suitable for most agricultural land uses and usually occurs on slopes less than 2%. Mirani has a moderate available water capacity and is usually imperfectly drained. This soil is suitable for spray irrigated sugarcane and is class “A” agricultural land. This soil is marginal for urban development because of periodic flooding.

The **Thompson** soil is suitable for most agricultural land uses and usually occurs on slopes less than 2%. Thompson has a moderate plant available water capacity, and are well drained to moderately well drained. This soil is suitable for spray irrigated sugarcane but is marginal for urban development because of periodic flooding. The Thompson soil is class “A” agricultural land.

Table 90. The general land use suitability of duplex soils overlying the active backplains and relict terraces of Quaternary alluvium.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Amelia vale	2	2	3	4	2	3	3	4	4	A
Conway	2	2	4	4	2	3	4	4	4	A
Marian	2	2	3	2	2	4	3	5	4	A
Mirani	2-3	2	3	2	3	4	3	5	4	A
Thompson	2-3	2-3	3	2	2	5	3	5	4	A

Sodic duplex soils

Anakey is suitable to marginal for most agricultural land uses and usually occurs on slopes less than 2% (Table 91). This soil has a low to moderate plant available water capacity depending upon the level of subsoil sodicity and depth to consolidated subsoil layers. These soils tend to be imperfectly drained. Anakey is suitable for spray irrigated sugarcane where the subsoil salinity is not too excessive. This soil may be affected by secondary salinisation. The Anakey soils are usually class "A or B" agricultural land. This soil is marginal for urban development because of periodic flooding.

Calen is suitable for most agricultural land uses. This soil usually occurs on slopes less than 2%. Calen has a moderate to high plant available water capacity depending upon the level of subsoil sodicity. This soil is moderately well drained to imperfectly drained. Calen is suitable for spray irrigated sugarcane and is class "A" agricultural land. This soil is marginal for urban development because of periodic flooding.

Eton is suitable for most agricultural land uses and usually occurs on slopes less than 2%. Eton has a low to moderate plant available water capacity depending upon the level of subsoil sodicity and are imperfectly drained. Eton is suitable for spray irrigated sugarcane and is class "A" agricultural land. This soil is marginal for urban development because of periodic flooding.

Goodbye is suitable to marginal for most agricultural land uses and usually occurs on slopes less than 2%. This soil has a low to moderate plant available water capacity depending upon the level of subsoil sodicity and depth to consolidated subsoil layers. These soils tend to be imperfectly drained. Goodbye is suitable for spray irrigated sugarcane where the subsoil salinity is not too excessive. This soil may be affected by secondary salinisation.. The Goodbye soils are usually class "A" agricultural land. This soil is marginal for urban development because of periodic flooding.

Narpi is suitable for sugarcane and usually occurs on slopes less than 2%. Narpi has a low to moderate plant available water capacity depending upon the level of subsoil sodicity, and are imperfectly drained. This soil is marginal or unsuitable for urban development because of periodic flooding. Narpi soil is class "A" agricultural land.

Sandiford is suitable for most agricultural land uses and is class "A" agricultural land. This soil usually occurs on slopes between 1-2 %, has a moderate to high plant available water capacity depending upon the level of subsoil sodicity and is usually prone to waterlogging. Sandiford is suitable for spray irrigated sugarcane, but is marginal for urban development because of periodic flooding.

Sandiford (silty topsoil variant) is suitable for most agricultural land uses and is class "A" agricultural land. This soil usually occurs on slopes between 1-2 %, has a moderate to high plant available water capacity depending upon the level of subsoil sodicity and is usually prone to water logging. Sandiford (silty topsoil variant) is suitable for spray irrigated sugarcane, but is marginal for urban development because of periodic flooding.

The **Sunnyside** soil is suitable for most agricultural land uses and usually occurs on slopes less than 2%. Sunnyside has a low to moderately high plant available water capacity depending upon the level of subsoil sodicity, and are imperfectly drained. Sunnyside is suitable for spray sugarcane but is marginal for urban development because of periodic flooding. Sunnyside soil is class "A" agricultural land.

Table 91. The general land use suitability of sodic duplex soils overlying the active backplains and relict terraces of Quaternary alluvium.

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Anakey	3-4	3-4	3-4	3-4	3	3	4	4-5	4-5	A-B
Calen	3	2	3	3	3	3	3	5	4	A
Eton	3	2-3	3-4	3-4	3	3	4	5	5	A
Goodbye	3-4	3-4	3-4	3-4	3	3	4	4-5	4-5	A-B
Narpi	3	2-3	4	4	2	3	4	5	5	A
Sandiford	3	2	3-4	4	2	3	4	4	4	A
Sandiford (variant)	3	2	3-4	4	2	3	4	4	4	A
Sunnyside	3	2-3	3-4	3-4	3	3	3-4	4-5	5	A

6.7.12. Soils overlying Quaternary marine sediments

Level backplains on marine sediments

Campbell plains is marginal to unsuitable for agricultural land use and is classified as class "C" agricultural land (Table 92). The main soil limitations of Campbell Plains is a moderate to very high subsoil salinity, low plant available water capacity and frequent waterlogging. Campbell Plains is marginal to unsuitable for spray irrigated sugarcane and urban development.

Dundula is suitable for some agricultural land uses and is classified as class "A" or "B" agricultural land. The main soil limitations include a sodic subsoil, moderate to very high subsoil salinity, low plant available water capacity, poor drainage and flooding. Dundula is suitable for spray irrigated sugarcane where the drainage and flooding limitation is not too excessive. Urban development is marginal to unsuitable on this soil.

Glen Isla is suitable to marginal for some agricultural land uses and is classified as class "A or B" agricultural land. The main soil limitations of this soil is a low to moderate plant available water capacity, poor drainage and flooding. Glen Isla is suitable to marginal for spray irrigated sugarcane. Urban development is not recommended on this soil due to shallow water tables and frequent flooding.

Goorganga is suitable for some agricultural land uses and is classified as class "A" or "B" agricultural land. The main soil limitations of this soil include, moderate subsoil salinity levels, low plant available water capacity, very acid subsoils and poor drainage. Goorganga is suitable for spray irrigated sugarcane provided subsoil salinity levels are within acceptable levels, the drainage and flooding limitations are not too excessive, and the subsoil layers which contain pyrite will not be oxidised. This soil is marginal to unsuitable for urban development due to shallow water tables and frequent flooding.

Hillsborough is suitable to marginal for some agricultural land uses and is classified as class "B" agricultural land. The main soil limitations of Hillsborough are a moderate to very high subsoil salinity, low plant available water capacity, poor drainage and flooding. Hillsborough is generally marginal for spray irrigated sugarcane but could be grown on sites which are not subjected to frequent and prolonged flood events. This soil is not recommended for urban development due to shallow water tables and frequent flooding.

Nilotica is marginal to unsuitable for agricultural land use and is classified as class "B" or "C" agricultural land. The main soil limitations of Nilotica is a very sodic subsoil, moderate to very high subsoil salinity, low plant available water capacity and poor drainage. Nilotica is marginal to unsuitable for spray irrigated sugarcane and unsuitable for urban development.

Wilmington is unsuitable for agricultural land use and is classified as class "B" or "C" agricultural land. The main soil limitations of Wilmington is a very sodic subsoil, moderate to very high subsoil salinity, low plant available water capacity and poor drainage. Wilmington is marginal to unsuitable for spray irrigated sugarcane and unsuitable for urban development. The imperfect drainage is a major limitation to horticultural tree crops.

Table 92. The general land use suitability of soils of the level backplains of Quaternary marine sediments

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Campbell Plains	5	4-5	5	5	4	4	5	5	5	B-C
Dundula	3-4	3-4	5	5	2	2-3	5	5	5	A-B
Glen Isla	3-4	3-4	5	5	2	2-3	5	5	5	A-B
Goorganga	3-4	3-4	5	5	2	2-3	5	5	5	A-B
Hillsborough	3-4	3-4	5	5	2-3	2-3	5	5	5	A-B
Nilotica	4	4-5	5	5	4	4	5	5	5	B-C
Wilmington	4	4-5	5	5	4	4	5	5	5	B-C

Coastal beach ridges

Andergrove is marginal for most agricultural land uses and is classified as class "B" agricultural land. The main soil limitation of Andergrove is the low plant available water capacity and subsoils prone to nutrient leaching. Andergrove is marginal for spray irrigated sugarcane and is suitable for urban development, however check storm surge mapping for the area (Table 93).

Andergrove (shallow variant) is marginal for most agricultural land uses and is classified as class "B" agricultural land. The main soil limitation of Andergrove (shallow variant) is the low plant available water capacity and the subsoils prone to nutrient leaching. Andergrove (shallow variant) is marginal for spray irrigated sugarcane and is suitable for urban development, however check storm surge mapping for the area.

Neils is marginal for most agricultural land uses and is classified as class "B" agricultural land. The main soil limitation of Neils is the low plant available water capacity and subsoils prone to nutrient leaching. Neils is marginal for spray irrigated sugarcane.

Table 93. The general land use suitability of soils developed on beach ridges

Soil Profile Class	Furrow irr.	Cane spray	Hort. crops	Hort. trees	Pasture imp.	Pasture ponded	Com. timber	Urban	Rural res.	Ag. Land Class
Andergrove	5	4	4	4	3	5	4	3-4	3-4	B
Andergrove (variant)	5	4	4	4	3	5	4	4	4	B
Neils	5	4	4	3-4	3-4	5	4	3-4	4	B

6.7.13. Miscellaneous units

The miscellaneous units are unsuitable for most agricultural land uses. These areas are usually classified as class "C" or "D" agricultural land.

6.8. Suitability assessment results for each land use

The suitability of each land use has been assessed for each UMA in the Whitsunday Coast survey. The suitability is determined using the land suitability framework. Table 94 lists the results of the suitability assessment for each land use. It should be noted that land identified as suitable for a particular land use may not necessarily be used for that purpose as other issues also need to be considered.

Table 94. The suitability assessment results for each land use in the Whitsunday Coast survey.

Landuse	Class 1 (ha)	Class 2 (ha)	Class 3 (ha)	Class 4 (ha)	Class 5 (ha)
Spray irrigated sugarcane	1116	50063	89345	64566	121706
Furrow irrigated Sugarcane	0	20284	42261	36229	228021
Urban	3304	4268	130728	31776	183718
Rural residential	1000	24274	86027	56772	158722
Avocado	0	784	9394	76229	240388
Citrus	47	2645	60838	132394	130871
Lychee	0	5911	91128	101085	128672
Mango	0	783	93067	95153	137792
Commercial Timber	0	783	117909	79635	128467
Improved pasture	17	56587	96144	73921	100334
Ponded pasture	0	7031	4752	10547	166765
Vegetable crops	0	7758	19610	120121	179301

6.8.1. Spray irrigated sugarcane

Sugarcane is presently grown on approximately 28000 ha in the study area. The study has identified approximately 140524ha of land suitable for spray irrigated sugarcane. The area mapped as suitable for sugarcane does not take into account the Queensland Vegetation Management Act (1999). Of the area suitable for spray irrigated sugarcane approximately 56105 ha have sodic subsoils (ESP 6-15), and 28740 ha have strongly sodic subsoils (ESP > 15). The sodicity levels will influence the amount of water available to the sugarcane crops.

Most of the area suitable for sugarcane is located on the floodplain or on the undulating rises of intermediate volcanic rock in the central area of the survey. Large areas suitable for sugarcane expansion are located south-west of Proserpine. Most of the area suitable for spray irrigated sugarcane is classified as suitable with moderate limitations. The spray irrigated sugarcane suitability map can be created using the data in the accompanying database.

6.8.2. Furrow irrigated sugarcane

There are 62454 ha suitable for furrow irrigated sugarcane in the study area. The main land use limitations for furrow irrigated sugarcane include rapidly drained soils and slopes greater than 2%. The use of furrow irrigation should be avoided in groundwater recharge areas because of the potential for deep drainage to raise local and regional water tables.

The furrow irrigation of sodic duplex soils with slopes between 1 and 2% should adopt soil conservation measures such as stubble retention to reduce surface soil loss and increase water infiltration. Furrow irrigation on the contour is recommended on sloping land (McClurg, 1994). The areas suitable for furrow irrigated sugarcane are located on the alluvial flats in the west of the survey.

6.8.3. Urban

There is approximately 111300 ha suitable for urban land use. The main land use limitations for urban land use include frequent flooding (< 1:50), poorly drained soils, slope, salinity and shallow soils. Large areas of land mapped as suitable for urban land use are classified as good quality agricultural land.

6.8.4. Rural residential

There is approximately 111301 ha suitable for rural residential land use. The main land use limitations for rural residential land use include frequent flooding (< 1:50), poorly drained and shallow soils, slope and salinity. The density of septic tanks is an issue in some areas with relatively high concentrations of dwellings. The cumulative impact of septic tanks need to be considered where there is a relatively high concentration of septic tanks, especially where there are shallow rapidly drained soils because of the risk of contaminating local groundwater. Some areas of land mapped as suitable for rural residential land use are good quality agricultural land.

6.8.5. Avocado

There are approximately 10178 ha suitable and 76229 ha which are marginal for irrigated avocado. The main land use limitations for avocados are excessive flooding, poor soil drainage and high humidity which may cause disease problems. Most of the suitable land is located in the drier areas with deep well drained soils.

6.8.6. Citrus

Citrus tree crops such as lemons and oranges can be grown on approximately 63530 ha. The main land use limitations for citrus are flooding, shallow and poorly drained soils. Excessive rainfall and high humidity cause poor fruit quality and disease problems.

6.8.7. Lychee

There are approximately 97039 ha suitable for irrigated lychee. Flooding, shallow and poorly drained soils are the main limitations. Excessive rainfall and high humidity are other variables which limit the suitability of Whitsunday Coast area for lychee.

6.8.8. Mango

There are approximately 93850 ha suitable for irrigated mango. Poor soil drainage, shallow soils and excessive flooding are the main limitations. Excessive rainfall and high humidity causing disease and flowering and fruit development problems limit the suitability of the Whitsunday Coast area for Mango.

6.8.9. Commercial timber (pine)

The main area of Caribbean pine occurs in Cathu State forest. There are approximately 118684 ha suitable for commercial timber (*Pinus caribeacea var hondurus*). The main land use limitations for commercial timber is low rainfall, steep slopes, low soil water holding capacity, flooding and poor soil drainage.

6.8.10. Improved pasture

There are approximately 152748 ha suitable for improved pasture. The main land use limitations for improved pasture are steep slopes, rocky surfaces, erodible soils and prolonged flooding. Pasture species should be selected based on their wetness tolerance.

6.8.11. Ponded pasture

There are approximately 11783 ha suitable for ponded pastures. In some areas the soils suitable for ponded pastures are used to grow rice. The main limitations for ponded pasture are steep slopes, rapidly to well drained soils because of recharge potential and excessive or prolonged flooding. The areas suitable for ponded pastures are mainly on the clay alluvial soils.

6.8.12. Vegetable crops

The vegetable crop used as the reference crop in this assessment is tomato. The suitability assessment could be used to indicate the suitability for other crops with similar land use requirements such as capsicums and egg plants. There are approximately 27368 ha suitable for irrigated vegetable crops grown in the drier months. The main land use limitations for vegetable crops are flooding, poor soil drainage and low water retention. The areas most suitable for vegetable crops are on the well drained levee soils.

6.9. Assessing good quality agricultural land

The agricultural land classes have been classified for each UMA and are used to identify areas of good quality agricultural land (GQAL). In the Whitsunday Coast survey 199689 ha are classified as GQAL. The area of each agricultural land class and the area of GQAL is shown in Table 95.

Table 95. The agricultural land classes mapped in the Whitsunday Coast survey.

Agricultural land class	Area (ha)	Good quality agricultural land
A1	51695	YES
A2	89329	YES
B1	26744	YES
B2	31921	YES
B3	5483	NO
B4	0	YES
C1	735	NO
C2	5808	NO
D1	45942	NO
D2	68447	NO
D3	999	NO
Total	***327 103***	

7.0. Conclusion

One hundred and eleven soils and thirteen variants were mapped over the 327200 ha of the Whitsunday Coast area. The soils of the survey are formed from a wide range of parent material and geomorphic processes. Soil erosion and soil salinity are the main land degradation issues identified in the Whitsunday Coast survey. The soils which have the highest incidence of gully erosion are those formed from acid volcanic rocks, sedimentary rocks, Tertiary – Pliocene consolidated sediments and unconsolidated Cainozoic alluvium. Small areas of salinity outbreaks occur on some colluvial fans formed from acid to intermediate volcanic rocks, acid intrusive rocks, Tertiary shale, and sodic duplex soils formed on terrace flats. Soil salinity levels are also moderate to high on some soils formed in upland areas on acid volcanic rocks. From the soils mapping, there are 15468 ha of land which may have acid sulfate soil layers below the surface. The main areas of acid sulfate soils occur in Goorganga plains and the delta of Yeates Creek and Duck Creek. The Tertiary shale which outcrops in the central areas of the survey may have the mineral pyrite which if exposed may produce sulfuric acid. The 10,860 ha of mangroves and salt pan will also have varying concentrations of pyrite at depth.

Most of the survey area is used for cattle grazing with sugarcane grown on approximately 28000 ha. The survey has identified approximately 140524 ha suitable for spray irrigated sugarcane. There are 84845 ha of sodic soils suitable for spray irrigated sugarcane. This area suitable for further sugarcane expansion does not take into account recent vegetation management legislation.

Over 62 % of the survey is mapped as good quality agricultural land. The survey has classified 141024 ha of class A and 64148 ha of class B agricultural land. Most of the good quality agricultural land is located on the alluvial plains and terrace plains in the survey.

8.0 Acknowledgments

The author would like to thank the Whitsunday Shire Council, Proserpine Canegrowers Association, the Proserpine Sugar Mill Co-operative, Department of Natural Resources and Mines and the National Heritage Trust for sponsoring this project. Other people who have contributed to the project whose contribution is appreciated and should be recognised are:

- Mr Chris Kiernan, Ms Alexandra James, Alistair Coutts and Alison Oost for assistance with field work and data entry,
- Mr Peter Wilson of the Department of Natural Resources and Mines (DNRM) in Bundaberg for editorial comments, and technical assistance,
- Mr Peter Muller of the Department of Natural Resources and Mines (DNRM) in Mackay for editorial comments and technical assistance,
- Mr Peter Wilson and Ms Seonaid Philip and other staff of the GIS section of the Mareeba DNRM for digitising and GIS support,
- Mr Jim McClurg for soils advice in the first two years of the project,
- Mr John Simpson and Ken Adsett of the GIS section of the Rockhampton DNRM for digitising and GIS support
- Ms Jeanette Kemp for assistance in identifying some plant species, and,
- Mr Ian Grant and Graham Wobke and staff at the Agricultural Chemistry Section of the DNRM for the chemical analysis.

9.0. Glossary of terms

Acid	Refers to soils with a pH < 6.5 throughout the subsoil.
Alkaline	Refers to soils with a pH > 8.0 in the subsoil.
Alluvial	Soil deposited by stream flood events.
CEC	Cation exchange capacity. Measures the quantity of soil nutrients held in a soil.
Cracking clay	Refers to clay soils which develop cracks to the surface on a regular pattern during the dry season.
Duplex soil	Soil which has a texture contrast from the topsoil to the subsoil, eg a sandy or loam topsoil directly over a clay subsoil.
ESP	Exchangeable Sodium Percentage. Measures the percentage of exchangeable sodium ions relative to the total amount of exchangeable cations.
Gradational soil	Refers to soil profiles where the soil texture changes gradually with depth, for example, loam topsoil grading to a clay subsoil.
Holocene	Epoch of time from 10,000 years before present to present day
Land suitability	The fitness of a given land to support a given land use.
Microrelief	Relief of up to a few metres above the soil surface. This may include gilgai and debil debil, mass movement or hummocky ground.
Neutral	Refers to soils with a pH in the subsoil between 6.5 and 8.0.
Non-sodic	Refers to the soils with an Exchangeable Sodium Percentage (ESP) less than 6 % throughout the subsoil.
PAWC	Plant Available Water Capacity. The amount of water a soil can hold which is potentially available to a plant.
Pliocene	Period of geological time from 1.8 to 5 million years before the present.
Quaternary	Period of geological time from 1.8 million years to the present day.
Self mulching	Soil condition where the soil aggregates form large crumbly peds which can be easily broken down into finer aggregates. This soil is usually black cracking clays in the Whitsunday Coast creek survey.
Sodic	Refers to the soils with an Exchangeable Sodium Percentage (ESP) greater than 6 % in the subsoil. These soils usually have alkaline subsoils and may have a range of physical limitations to agricultural use. Strongly sodic soils have ESP greater than 14.

10.0. References

Aldrick, J.M. (1988). *Soils of the Elliot river - Bowen area.* Queensland Department of Primary Industries, Land Resources Bulletin QV88002.

Baker, D. E., and Eldershaw, V.J. (1993). *Interpreting soil analysis: for agricultural land use in Queensland.* Department of Primary Industries, Project report QO93014.

Bruce, R.C. and Rayment, G.E., (1982). *Analytical methods and interpretations used by the agricultural chemistry branch for soil and land use surveys.* Qld Dept. Primary Industries, Bulletin QB82004.

Christian, C.S, Paterson, S.J., Perry, R.A., Slatyer, R.O., Stewart, G.A., and Traves, D.M., (1953), *Survey of the Townsville - Bowen region, North Queensland*, CSIRO, Melbourne.

Crouch, R.J., Reynolds, K.C., and Hicks, R.W., (1991). Soils and their use for earthworks. In, P.E.V. Charman and B.M. Murphy, (Eds), *Soils: their properties and management*, Oxford University Press, Melbourne.

Department of Primary Industries (DPI) and Department of Housing , Local Government and Planning (DHLGP), (1993*). Planning guidelines: The identification of Good Quality Agricultural Land.* DHLGP, Brisbane.

Department of Natural Resources, (1997). *Sampling and analysis procedure for lowland acid sulfate soils (ASS) in Queensland (version 3.47*).

Gunn, R.H., Beatie, J.A., Reid, R.E., and Van de Graff, R.H.M. (1988). *Australian Soil and Land Survey Handbook: guidelines for conducting surveys.* Inkata Press, Sydney.

Hardy, S. M. (1998a*). Soils and land suitability of the Lethebrook area, Central Queensland,* Project report. Queensland Department of Natural Resources.

Hardy, S. M. (1998b*). Soils and land suitability of the Gregory River area, Central Queensland,* Project report. Queensland Department of Natural Resources.

Hardy, S. M. (1998c*). Land suitability framework for the Proserpine Integrated Land Use Study, Central Queensland.* Project report. Queensland Department of Natural Resources.

Hardy, S. M. (2000*), Soils and land suitability of the Debella area, Central Queensland.* Project report. Queensland Department of Natural Resources, DNRQ00065.

Hicks, R.W., (1991). Soils and urban land use. In, P.E.V. Charman and B.M. Murphy, (Eds), *Soils: their properties and management*, Oxford University Press, Melbourne.

Holz, G.K. and Shields, P.G. (1985). *Mackay Sugar Cane Land Suitability Study*, Department of Primary Industries, QV85001.

Isbell, R.F., and Murtha, G.G., (1970). *Soils of the Burdekin - Townsville region*. Resource series. CSIRO, Canberra.

Isbell, R.F. (1996). *The Australian Soil Classification.* CSIRO publishing, Collingwood, Victoria.

Land Resource Staff (1990). *Guidelines for Agricultural land evaluation in Queensland.* Queensland Department of Primary Industries, Information Series Q19005.

Lewis, D.W and McConchie, D. (1994). *Practical sedimentology*. Chapman and Hall, New York.

Littleboy, M. (1995). *PAWCER and PPAWCER (version 2.10) - Computer programs to estimate plant available water capacity from soil survey data.* RMI. QDPI.

Martin, L., and Metcalfe, J., (1998). *Assessing the causes, impacts, costs and management of dryland salinity.* Occasional Paper no 20/98, Land and Water Research and Development Corporation, Canberra.

McClurg, J.I. (1994). *Soils and land suitability of Northcote Section, Burdekin River Irrigation Area, North Queensland.* Queensland Department of Primary Industries. QO95016

McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J., and Hopkins, M.S. (1990*). Australian Soil and Land Survey Field Handbook (2nd Edition).* Inkata Press, Melbourne.

Murphy, B.W. (1984). *A scheme for the field assessment of soil erodibility for water erosion.* Tech. Pap. 19/84, Wellington Research Centre, Soil Conservation Service of NSW, Sydney.

Paine, A.G.L. and Cameron, R.L., (1972). *1:250,000 geological series explanatory notes for Proserpine, Queensland* (Sheet SF/55-3 international index). Australian Government Publishing service, Canberra.

Queensland Department of Primary Industries (1993). *Overview of water resources and related issues: The Mackay - Whitsunday region.* Qld Department of Primary Industries, Qld Govt., Brisbane.

Queensland Government (Office of Economic and Statistical Research), (1999). *Regional profile - Mackay statistical division*. OESR, Brisbane.

Ross, D.J., (1997). *Draft land suitability framework for Central Queensland coast horticultural lands*. Dept. Natural resources, project report.

Thompson, W.P., Baker, D.E., and Cannon, M.G. (1981). *The soils of the Proserpine lowland. North Queensland*, Queensland Department of Primary Industries, Technical Report 18.

Wilson, P.R. (1998). *Soils and land suitability of the Childers area, Queensland.*. Queensland Department of Natural Resources, Land Resources Bulletin (in press).

Wischmeier, W.H. and Smith, D.D. (1978). *Predicting rainfall erosion losses - a guide to conservation planning.* Agriculture Handbook 537, United States Department of Agriculture, Washington, DC.

11.0 Appendix

Appendix I: Vegetation list for the Whitsunday Coast area.

Scientific name	Common name
Allocasuarina leuhmannii	Bull oak
Allocasuarina littoralis	Coastal she-oak
Acacia decora	Pretty wattle
Acacia julifera	
Acacia leptocarpa	
Acacia leptostachya	Townsville wattle
Albizia procera	Forest sirus
Alstonia scholaris	Milky pine
Archontophoenix alexandrae	Alexander palm
Austromyrtus bidwilli	Native guava
Araucaria cunninghamii	Hoop pine
Callistomon viminalis	Bottle brush
Casuarina cunninghamiana	River oak
Chionanthus ramiflora	Native olive
Corymbia clarkinsonianna	Bloodwood
Corymbia dallichiana	Ghost gum / Cabbage gum
Corymbia intermedia	Pink bloodwood
Corymbia tesselaris	Moreton Bay ash
Cupaniopsis anacardioides	Tuckeroo
Cryptocarya triplinerva	Brown laurel
Eucalyptus crebra	Narrow-leaved ironbark
Eucalyptus platyphylla	Poplar gum
Eucalyptus teriticornis	Blue gum
Ficus racemosa	Cluster fig
Hakea suberea	
Jagera pseudohorus	Pink tamarind
Lophostemon suaveolens	Swamp mahogany
Lophostemon grandis	
Melia azaradarach	White cedar
Melaleuca dealbata	
Melaleuca leucadendra	Weeping tea tree
Melaleuca nervosa	Black tea tree
Melaleuca viridiflora	Broad leaved tea tree,
Pandanus whitei	Pandanus
Parianthese toona	Mackay cedar
Planchonia caryea	Cocky apple,
Terminalia sericocarpa	Sovereignwood
Trema orientalis	Peach cedar

Appendix II: A detailed description of the land suitability classes used in the Whitsunday Coast creek survey.

Class 1 Suitable land with negligible limitations. This is highly productive land requiring simple management practices to maintain economic agricultural production, or can be easily utilised for urban or rural residential uses.

Class 2 Suitable land with minor limitations which either reduce production or require more than the simple management practices to maintain economic agricultural production or is more difficult to utilise for urban or rural residential than class 1 land.

Class 3 Suitable land with moderate limitations which either further lowers production or requires more strategic management practices than Class 2 land to maintain economic agricultural production, or is moderately difficult to utilise for urban or rural residential use than class 2 land.

Class 4 Marginal land - presently unsuitable with severe limitations. Further special studies are required to determine if it is capable of sustained economic production. This land is:

a) Land on which crop growth would be poor without intensive reclamation measures.
b) Land with attributes, such that satisfactory crop establishment and growth cannot be achieved with current management techniques.
c) Land which requires such a degree of land modification, for example levelling, stone picking, drainage, in preparation for cropping that it will not be economically feasible with current technology.
d) Land which cannot be used for continuous crop production due to excessive soil loss even with conservation measures applied. The potential for secondary salinisation or other forms of land degradation is high.
e) Land which will require such a degree of land modification for urban or rural residential development that it would not be economically feasible using current technologies. This land may also be prone to natural hazardous events such as excessive flooding and land degradation which may cause unacceptable infrastructure or building damage or loss.

Class 5 Unsuitable land with extreme limitations that preclude its use.

Appendix III: The classification scheme for agricultural land classes used in the Whitsunday Integrated Land Use Study.

A. Agricultural Land

A1 Spray irrigated sugarcane classes 1or 2
A2 Spray irrigated sugarcane class 3.

B. Limited cropping land

B1 Spray irrigated sugarcane class 4 and horticultural tree crops (mango) classes 1 to 3.
B2 Spray irrigated sugarcane class 4 and horticultural tree crops (mango) class 4.
B3 Spray irrigated sugarcane class 4 and horticultural tree crops (mango) class 5.
B4 Spray irrigated sugarcane class 5 and horticultural tree crops (mango) class 1 to 3.

C. Pasture land

C1 Spray irrigated sugarcane class 5, horticultural tree crops (mango) class 4 or 5 and improved pasture classes 1 to 3.
C2 Spray irrigated sugarcane class 5, horticultural tree crops (mango) class 4 or 5, and improved pastures class 4.

D. Non Agricultural land

D1 Spray irrigated sugarcane class 5, horticultural tree crops (mango) class 5, and improved pastures classes 5.
D2 Land committed to non agricultural uses, eg quarries, urban.

Good quality agricultural land (GQAL) includes classes A1, A2, B1, B2 and B4. The B3 class is not considered GQAL.

Appendix IV: Thematic maps produced from the accompanying database

The following is a list of maps that can be produced with the land resource database and digital coverage of the Whitsunday Coast area at a scale of 1:50,000.

- Soil
- Lithology
- Geology formations
- Permeability (hydraulic conductivity)
- Recharge potential
- Soil loss hazard (erosion)
- Landzone
- Discharge potential
- Acid sulfate soil
- Soil complexity
- Vegetation communities
- Existing erosion
- Climate (rainfall)
- Frost
- Erosion potential
- Flooding frequency
- Plant Available Water Capacity
- Soil depth
- Soil workability
- Surface condition
- Soil swelling capacity
- Surface rockiness
- Soil salinity
- Soil sodicity
- Slope
- Site drainage (wetness)
- Cation exchange capacity
- Unified Soil Class
- Clay CEC and sodicity
- Spray irrigated sugarcane suitability
- Agricultural land class
- Topsoil texture

Appendix V: Soil Chemistry data

The following soil chemistry results includes some data from Thompson *et al.* (1981), Aldrick (1988) and Holz and Shield (1984).

Abbot

Location: 611800mE 7800200mN Zone 55
Landform element: Pediment
Landform pattern: Gently undulating plains
Slope: 4%
Principal Profile Form: Ug5.15
Australian Soil Classification: Endocalcareous, Epipedal, Black Vertosol
Disturbance:
Vegetation: Very tall sparse shrubland of *Acacia salicina*

Site No: S17
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Well drained
Substrate lithology: Gabbro Gabbro
Surface coarse fragments: Many stones, subrounded gabbro
Surface condition: Periodic cracking, self mulching

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Black (2.5Y2/1); medium clay; very few medium pebbles, subrounded gabbro, strong, dispersed; strong 2-5mm granular; dry loose. Clear to -
B21	0.10 to 0.70 m	Black (2.5Y2/1); heavy clay; very few medium pebbles, subrounded gabbro, strong, dispersed; strong 20-50mm angular blocky; dry very firm. Gradual to -
B22	0.70 to 2.00 m	Black (10YR2/1); heavy clay; few medium pebbles, subrounded gabbro, strong, dispersed; strong 20-50mm angular blocky; dry very firm; very few medium carbonate nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	% P	% K	% S	ESP	Ca:Mg
10	7.2	.04	.003					46	27	15	.64	.15	22					1	1.8
30	8.2	.07	.002					45	31	14	.62	.18	22					1	2.2
60	8.8	.15	.008					41	24	15	1.7	.07	22					4	1.6
90	8.9	.29	.031					41	23	18	3.6	.11	24					9	1.3
120	8.7	.71	.084					41	18	18	5.1	.05						12	1.0
150	8.7	.81	.094																

Depth (cm)	% Org. C	% Tot. N	P mg/kg Acid	Bic	meq% Rep. K	mg/kg Fe	Mn	Cu	Zn	mg/kg SO4-S
10	1.4	0.12	4	6						

Albert

Location: 661908mE 7735486mN Zone 55
Landform element: Terrace flat
Landform pattern: Flood plain
Slope: 1%
Principal Profile Form: Uf6.12
Australian Soil Classification: Grey Vertosol to Grey Sodosol
Disturbance: Extensive clearing
Vegetation:

Site No: PS32 (AN06)
Microrelief description: Normal gilgai
Microrelief component: Mound
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Absent
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.12 m	Greyish yellow-brown (10YR5/2) moist; silty light clay; moderate 5-10mm prismatic; weak. Clear to -
A2e	0.14 to 0.40 m	Dull yellowish orange(10YR7/2) moist, light grey (10YR8/1) dry; few medium faint brown mottles; silty light clay; weak 5-10mm prismatic; dry weak; few medium manganiferous soft segregations. Clear to -
B1	0.42 to 0.51 m	Dull yellow(2.5Y6/3) moist; common medium faint brown mottles; medium clay; moderate 5-10mm prismatic; dry firm; common medium manganiferous soft segregations. Abrupt to -
B21	0.52 to 0.81 m	Dull yellow (2.5Y6/3) moist; common medium faint brown mottles; medium heavy clay; very few medium gravelly rounded coarse fragments; strong 10-20mm prismatic; dry very firm. Clear to -
B22	0.83 to 1.15 m	Yellowish grey (2.5Y6/1) moist; common medium distinct brown mottles; medium clay; strong 10-20mm prismatic; dry very firm; few medium manganiferous veins. Clear to -
B23	1.18 to 1.65 m	Light grey (2.5Y7/1) moist; many coarse distinct brown mottles; medium clay; moderate 5-10mm prismatic; dry very firm; few medium manganiferous veins.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	% P	% K	% S	ESP	Ca:Mg
10	6.0	.05	.002	6	31	44	20	4	2.4	1.7	.21	.07	6	.72	.013	.206	.019	5.3	1.41
30	6.2	.03	.001	7	29	44	24	3	1.7	1.5	.26	.03	6	.75	.008	.195	.013	8.7	1.13
60	5.9	.03	.001	6	12	25	59	10	4.5	4.5	.94	.11	16	.50	.007	.336	.016	9.4	1.00
90	6.0	.03	.001	8	22	27	42	10	4.5	4.0	.95	.13	19	.46	.007	.361	.013	9.5	1.13
120	5.9	.03	.001	14	34	21	31	7	3.8	2.7	.74	.12	15	.67	.008	.409	.011	10.6	1.41
150	5.7	.05	.004																

Depth (cm)	% Org. C	% Tot. N	P mg/kg Acid	Bic	meq% Rep. K	mg/kg Fe	Mn	Cu	Zn	mg/kg SO4-S
Bulk 10	1.4	0.09	11	10	0.18	134	43	0.57	0.80	9.9

Albert

Location:	664914mE 7737230mN Zone 55	Site No:	PS33 (AN07)
Landform element:	Terrace plain	Microrelief description:	Absent
Landform pattern:	Flood plain	Permeability:	Slowly permeable
Slope:	0.5%	Drainage:	Moderately well drained
Principal Profile Form:	Uf6.12	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Grey Vertosol to grey Sodosol	Surface coarse fragments:	Absent
Disturbance:	Grazing	Surface condition:	Hardsetting
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
A1j	0 to 0.15 m	Greyish yellow-brown (10YR5/2) moist, light grey (10YR7/1) dry; light clay; strong 2-5mm subangular blocky; dry firm. Clear to -
B1	0.17 to 0.31 m	Greyish yellow-brown (10YR6/2) moist; common fine faint brown mottles; light medium clay; moderate 5-10mm subangular blocky; dry firm; few medium manganiferous soft segregations. Abrupt to -
B21	0.32 to 0.41 m	Greyish yellow (2.5Y6/2) moist; few medium faint brown mottles; medium clay; moderate5-10mm prismatic; dry very firm. Clear to -
B22	0.43 to 1.30 m	Brownish grey (10YR6/1) moist; few medium faint brown mottles; fine sandy medium clay; strong 20-50mm lenticular; dry strong; very few medium ferromanganiferous concretions. Clear to -
B23	1.32 to 1.68 m	Greyish yellow (2.5Y6/2) moist; common medium distinct brown mottles; fine sandy light medium clay; moderate 2-5mm platy, moderate 2-5mm prismatic; dry firm.

Analytical data:

Depth	1:5 soil/water dS/m	%	Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.9	.04	.002	11	35	30	21	4	2.1	1.7	.24	.07	7	.79	.014	.189	.022	6.0	1.24
30	5.6	.04	.002	11	26	30	35	6	2.4	3.0	.60	.05	12	.64	.009	.226	.016	10.0	0.80
60	5.5	.07	.006	9	20	21	52	10	3.0	5.3	1.6	.14	18	.58	.006	.277	.016	16.0	0.57
90	5.4	.17	.021	10	27	23	42	14	4.3	6.3	3.1	.17	16	.87	.007	.290	.014	22.1	0.68
120	5.7	.33	.054	11	33	21	38	15	4.3	6.1	4.8	.17			.006	.325	.012	32.0	0.70
150	7.1	.75	.115																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.7	0.11	4	4	0.11	163	86	0.72	0.74	10.0

Amelia Vale

Location:	649891mE 772210mN Zone 55	Site No:	PS49 (1459)
Landform element:	Terrace flat	Microrelief description:	Absent
Landform pattern:	Terrace	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Imperfectly drained
Principal Profile Form:	Uf6.33	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Haplic, Mesotrophic, Black Dermosol	Surface coarse fragments:	Absent
Disturbance:	Cultivation	Surface condition:	Hardsetting
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.25 m	Brownish black (10YR3/1) moist; fine sandy light clay; moderate 5-10mm subangular blocky; dry weak. Abrupt to -
B1	0.27 to 0.38 m	Greyish yellow-brown (10YR4/2) moist; fine sandy medium clay; moderate 5-10mm prismatic; dry firm. Abrupt to -
B21	0.40 to 0.74 m	Dull yellowish brown (10YR5/3) moist; few medium faint brown mottles; fine sandy medium clay; moderate 10-20mm lenticular; dry very firm. Clear to -
B22	0.77 to 1.10 m	Dull yellowish brown (10YR5/4) moist; common medium distinct brown mottles; fine sandy medium clay; moderate 5-10mm prismatic; dry very firm; few medium manganiferous soft segregations. Abrupt to -
D1	1.12 to 1.71 m	Greyish yellow-brown (10YR5/2) moist; common medium distinct brown mottles; coarse sandy light clay; few fine gravelly subrounded quartz; weak 5-10mm prismatic; dry firm; common medium manganiferous soft segregations.

Analytical data:

Depth	1:5 soil/water dS/m	%	Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.1	.04	.002	20	25	22	28	13	8.8	3.8	.11	.44	15	.64	.052	1.65	.035	0.8	2.30
30	6.5	.02	.002	16	23	24	35	16	9.6	5.8	.28	.28	16	.65	.024	1.54	.020	1.8	1.66
60	7.2	.03	.002	23	21	17	38	20	10	7.9	.57	.26	15	.62	.016	1.42	.015	3.0	1.30
90	7.7	.06	.006	26	23	14	35	17	9.0	6.5	.72	.22	13	.78	.028	1.53	.012	4.2	1.38
120	7.7	.08	.009	32	22	11	31	14	7.5	5.1	.70	.22	12		.038	1.62	.012	4.0	1.47
150	7.1	.08	.011	37	25	11	24	12	6.3	4.7	.59	.21	11	.72	.035	1.59	.012	5.0	1.30

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.4	0.15	25.0	37.0	0.60	189	123	3.0	2.5	7.0

Andergrove

Location: 696200mE 7679300mN Zone 55
Landform element: Dune
Landform pattern: Beach ridge
Slope: 1%
Principal Profile Form: Uc2.21
Australian Soil Classification: Arenic Rudosol
Disturbance:
Vegetation:

Site No: MCL S21
Microrelief description: Absent
Permeability: Highly permeable
Drainage: Rapidly drained
Substrate lithology: Sand
Surface coarse fragments: Absent
Surface condition: Loose

Profile Morphology:

Horizon	Depth	Description
AP1	0 to 0.30 m	Brownish black (10YR3/2) moist, greyish yellow-brown (10YR4/2) dry; loamy sand; sandy; dry loose. Abrupt to -
AP2	0.30 to 0.45 m	Greyish yellow-brown (10YR4/2) moist, brownish grey (10YR6/1) dry; loamy sand; sandy; moderately moist loose. Gradual to -
A2cb	0.45 to 0.90 m	Dull yellowish brown (10YR5/3) moist, dull yellowish orange (10YR7/2) dry; sand; sandy; moderately moist loose. Diffuse to -
B21	0.90 to 1.20 m	Dull yellowish orange (10YR6/3) moist, light yellowish orange (10YR8/3) dry; sand; sandy; moderately moist loose.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.6	.02	.002												.031	1.59	.012		
10	5.6	.02	.001	30	62	3	6	5	.25	.11	.10	.13	3	.24	.031	1.58	.012	2.0	2.27
20	5.5	.01	.001																
30	5.5	.01	.001	34	58	3	9	5	.10	.05	.10	.11	3	.02	.023	1.58	.011	2.0	2.00
60	5.5	.01	.001	37	59	1	6	2	.08	.05	.10	.08	3	.05	.016	1.60	.010	5.0	1.60
90	5.8	.01	.001	42	53	1	6	2	.39	.06	.10	.08	2	.05	.012	1.60	.007	5.0	6.50
120	5.9	.01	.001	40	55	1	6	2	.52	.10	.10	.12			.010	1.63	.006	5.0	5.20

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.66	0.05	102	28	.16	18	4	0.2	0.2	
10	0.80	0.06	83	24	.14					
20	0.76	0.06	80	21	.12					

Armstrong

Location: 579500mE 7786600mN Zone 55
Landform element: Plain
Landform pattern: Level plain
Slope: 1%
Principal Profile Form: Ug5.16
Australian Soil Classification: Haplic, Epipedal, Brown Vertosol
Disturbance:
Vegetation: *Corymbia dallachiana, Grevillea striata*

Site No: S14
Microrelief description: Normal gilgai
Microrelief component: Mound
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Granodiorite
Surface coarse fragments: Absent
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Brownish black (10YR3/2); medium clay; moderate 2-5mm subangular blocky; moist moderately firm. Abrupt to -
B21	0.10 to 0.20 m	Brownish black (10YR3/2); heavy clay; moderate 10-20mm angular blocky; moist very firm. Clear to -
B22	0.20 to 0.70 m	Grey (5Y4/1); heavy clay; moderate 20-50mm lenticular; moderately moist moderately strong; very few medium carbonate nodules. Clear to -
BC	0.70 to 0.85 m	Greyish olive (5Y4/2); medium heavy clay; lenticular; moderately moist moderately strong; few medium carbonate nodules. Clear to -
C	0.85 to 1.10 m	Dark olive grey (5GY4/1); sandy clay loam; massive; dry moderately strong.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	7.0	.03	.002	15	27	11	46	36	15	13	.67	.19	19	.65	.017	0.19	.017	2	1.15
30	7.9	.03	.002	15	23	13	48	38	17	16	1.4	.18	21	.78	.011	0.17	.009	4	1.06
60	8.8	.14	.011	17	24	13	48	40	16	18	2.7	.19	20	.91	.009	0.16	.008	7	0.89
90	9.3	.27	.019	11	51	11	28	28	12	14	3.2	.11	16	.81	.071	0.48	.010	11	0.86
110	9.5	.29	.024	24	58	7	11	21	7.7	10	2.9	.09			.112	0.66	.006	14	0.77

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	0.8	.07	3	2		32	10	1.6	0.2	

Balbera

Location: 721000mE 7638800mN Zone 55
Landform element:
Landform pattern: Alluvial plain
Slope: 0%
Principal Profile Form: Dy3.42
Australian Soil Classification: Mottled-Mesonatric, Grey Sodosol
Disturbance:
Vegetation: *Lophostemon sauveolens, Eucalyptus platyphylla* and *Melaleuca viridiflora*

Site No: MCL S47
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Absent
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1sb	0 to 0.10 m	Dark greyish yellow (2.5Y5/2) moist; clay loam, fine sandy; moderately moist moderately weak . Gradual to -
A2cb	0.10 to 0.35 m	Greyish yellow (2.5Y7/2) moist; few medium faint yellow mottles; clay loam, fine sandy; moderately moist moderately weak. Clear to -
B21	0.35 to 0.65 m	Greyish yellow (2.5Y6/2) moist, dull yellow (2.5Y6/4) moist; medium clay; few subangular unspecified coarse fragments; moderately moist moderately firm. Diffuse to -
B22	0.65 to 1.00 m	Dull yellow (2.5Y6/4) moist, greyish yellow (2.5Y6/2) moist; medium clay; moderately moist moderately firm. Diffuse to -
B23	1.00 to 1.20 m	Yellowish grey (2.5Y6/1) moist; common fine distinct yellow mottles; medium clay; moderately moist moderately firm; very few manganiferous soft segregations.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.7	.02	.003																
10	6.0	.02	.002	13	54	28	14	7	1.9	1.4	.12	.13	5	.82	.011	0.43	.011	1.7	1.36
20	5.8	.01	.001																
30	5.8	.01	.001	10	51	27	20	6	.85	1.2	.30	.65	7	.87	.070	0.44	.006	5.0	0.71
60	5.7	.03	.004	9	35	14	45	18	4.5	4.9	1.3	.15	15	.85	.008	0.55	.004	7.2	0.92
90	5.8	.09	.013	6	41	23	35	18	7.1	7.0	2.1	.10	15	.99	.006	0.69	.003	11.6	1.01
120	5.7	.20	.029	9	30	24	42	18	7.5	7.3	2.8	.08			.007	0.55	.002	15.6	1.03

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.3	0.09	4	6	0.16	82	48	0.6	0.8	
10	1.1	0.09	3	8	0.13	79	52	0.6	1.5	
20	0.5	0.05	3	5	0.07					

Belmunda

Location: 706400mE 7680600mN Zone 55
Landform element:
Landform pattern: Gently undulating rises
Slope: 3%
Principal Profile Form: Db2.31
Australian Soil Classification: Mesotrophic, Yellow Dermosol to Kandosol
Disturbance:
Vegetation:

Site No: MCL S15
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Andesite
Surface coarse fragments: Few cobbles
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A11	0 to 0.10 m	Brownish black (10YR3/1) moist; sandy clay loam; dry; few manganiferous nodules. Clear to -
A12	0.10 to 0.35 m	Brownish black (10YR3/1) moist; sandy clay loam; dry; few manganiferous nodules. Gradual to -
A2sb	0.35 to 0.45 m	Brownish grey (10YR4/1) moist; sandy clay loam; moderately moist; many manganiferous nodules. Clear to -
B1sb	0.45 to 0.60 m	Dull yellowish brown (10YR5/3) moist; few fine distinct red mottles; sandy clay; moderately moist; many manganiferous soft segregations; many manganiferous nodules. Gradual to -
B22	0.60 to 1.00 m	Brown (10YR4/4) moist; few fine prominent red mottles; sandy clay; moderately moist; many manganiferous soft segregations; many manganiferous nodules. Clear to -
B23	1.00 to 1.20 m	Bright brown (7.5YR5/6) moist; few medium distinct grey mottles; medium clay; moderately moist very firm; many manganiferous soft segregations; many manganiferous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.5	.15	.007					17	2.1	2.0	0.1	.93			.078	.22	.032	1	1.05
10	5.7	.14	.008	45	25	18	14	17	2.5	2.0	0.1	.55	12	.69	.078	.22	.034	1	1.25
20	5.8	.06	.003																
30	5.9	.03	.002	44	26	16	15	12	2.1	0.2	0.1	.21	11	.70	.069	.11	.018	1	10.5
60	6.1	.03	.003	37	30	18	16	7	0.6	1.4	0.1	.05	10	.81	.061	.12	.008	1	0.42
90	6.0	.02	.002	43	27	16	16	9	0.8	1.2	0.1	.11	10	.75	.054	.09	.010	1	0.67
110	6.4	.07	.011	30	20	13	37	13	1.4	6.4	0.8	.03			.044	.17	.006	1	0.22

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.8	.14	13	15	.96	124	94	6.9	6.6	
10	2.2	.20	8	22	.58					
20	1.2	.12	5	14	.19					

Benholme

Location: 688500mE 7662100mN Zone 55
Landform element:
Landform pattern: Alluvial plain
Slope: 0%
Principal Profile Form: Ug3.2
Australian Soil Classification: Grey Vertosol
Disturbance:
Vegetation: Woodland of *Eucalyptus tessellaris*

Site No: MCL S29
Microrelief description: Gilgai
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Absent
Surface condition: Firm

Profile Morphology:

Horizon	Depth	Description
A11sb	0 to 0.10 m	Greyish yellow-brown (10YR4/2) moist, brownish grey (10YR6/1) dry; light medium clay; strong; dry moderately firm. Clear to -
A12sb	0.10 to 0.20 m	Greyish yellow-brown (10YR4/2) moist; few fine distinct brown mottles; medium clay; strong; moderately moist very firm; few manganiferous nodules. Clear to -
B21	0.20 to 0.50 m	Dull yellow (2.5Y6/3) moist; few fine faint yellow mottles, few fine faint grey mottles; heavy clay; strong; moist very firm; few manganiferous nodules. Gradual to -
B22	0.50 to 0.90 m	Yellowish grey (2.5Y5/1) moist; heavy clay; strong; moist very firm; few manganiferous nodules. Clear to -
B23	0.90 to 1.20 m	Greyish yellow (2.5Y6/2) moist; few fine faint yellow mottles; heavy clay; strong; moderately moist very firm; many carbonate nodules, many manganiferous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.7	.03	.002												.027	0.56	.029		
10	5.8	.03	.001	6	19	36	43	25	8.3	4.2	.15	.64	16	.62	.019	0.53	.021	0.6	1.98
20	6.0	.02	.001																
30	6.2	.02	.002	2	10	18	75	34	18	7.7	.95	.53	24	.69	.013	0.45	.012	1	2.3
60	6.4	.19	.031	2	9	22	72	39	25	10	2.1	.15	25	.72	.012	0.48	.008	1	2.5
90	7.9	.43	.061	2	12	26	64	37	25	11	3.1	.09	22	.82	.015	0.65	.008	1	2.4
120	8.4	.48	.064	2	20	33	51	30	19	8.7	3.0	.08			.023	0.92	.006	1	2.2

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.3	.19	4	17	.52	265	199	1.5	2.6	
10	1.6	.13	3	9	.62					
20	1.1	.09	3	4	.60					

Benholme

Location: 653233mE 7739965mN Zone 55
Landform element: Back plain
Landform pattern: Flood plain
Slope: 1.5%
Principal Profile Form: Ug6.2
Australian Soil Classification: Grey Vertosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: PS13 (416)
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Absent
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1p	0 to 0.18 m	Greyish yellow-brown (10YR4/2) moist; light medium clay; moderate 10-20mm prismatic; dry firm. Abrupt to -
B21	0.19 to 0.39 m	Greyish yellow-brown (10YR5/2) moist; few medium faint brown; medium heavy clay; strong 20-50mm prismatic; dry strong. Clear to -
B22	0.42 to 0.95 m	Dark greyish yellow (2.5Y4/2) moist; common fine faint brown; medium heavy clay; moderate 10-20mm prismatic; dry strong. Clear to -
B23	0.98 to 1.32 m	Yellowish grey (2.5Y4/1) moist; common medium distinct brown; medium clay; very abundant medium gravelly subangular unspecified coarse fragments; moderate 10-20mm prismatic; dry very firm; few medium calcareous nodules. Abrupt to -
B24	1.34 to 1.60 m.	Yellowish grey (2.5Y4/1) moist; few fine distinct brown; medium clay; very few medium gravelly subangular unspecified coarse fragments; strong 5-10mm platy; dry very firm; few medium calcareous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.2	.03	.002	3	26	37	36	8	3.9	3.6	.11	.24	10	.67	.036	.365	.015	1.3	1.1
30	6.2	.03	.002	2	20	34	47	17	8.8	7.5	.93	.22	15	.66	.036	.441	.012	5.5	1.2
60	8.1	.10	.009	1	19	32	51	30	15	12	3.3	.18	17	.87	.017	.537	.012	11.0	1.2
90	8.8	.32	.023	1	29	32	40	31	16	10	5.2	.15	16	.94	.022	.664	.009	16.8	1.6
120	8.5	.47	.057	9	20	36	36	30	13	10	6.7	.21	16	.66	.014	.837	.006	22.3	1.3

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.1	0.05	26	34	0.24	110	148	1.3	0.66	14.0

Benholme

Location:
Landform element: Plain
Landform pattern: Alluvial plain
Slope: 0.5%
Principal Profile Form: Uf6.41
Australian Soil Classification: Grey Vertosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: PS10 (57)
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Absent
Surface condition: Cracking

Profile Morphology:

Horizon	Depth	Description
A11	0 to 0.08 m	Dark brown (10YR3/3) moist; light clay; moist weak.
A12	0.08 to 0.20 m	Dull yellowish brown (10YR5/3) moist; common fine distinct brown mottles; light clay; single grained; loose. Sharp to -
B21	0.20 to 0.60 m	Very pale brown (10YR7/3) moist; common fine distinct brown mottles; medium heavy clay; very few fine manganiferous concretions. Sharp to -
B22	0.60 to 1.15 m	Medium heavy clay; massive; loose. Sharp to -
B23	1.15 to 1.60 m	Light grey (10YR7/1) moist; common fine distinct brown mottles; light medium clay; dry very firm; few coarse calcareous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.4	.07	.002	2	16	34	50	29	8.1	5.7	.26	.44	20	.55	.037	.340	.025	0.9	1.4
30	6.6	.03	.002	1	9	22	69	43	17	12	1.1	.27	24	.58	.013	.490	.013	2.6	1.4
60	7.4	.08	.008	1	10	21	69	40	20	14	2.3	.08	24	.72	.012	.507	.011	5.8	1.4
90	8.2	.15	.014	1	12	26	65	41	20	15	3.1	.08	23	.73	.013	.508	.010	7.6	1.3
120	9.0	.36	.022	1	14	28	58	36	18	13	3.4	.08						9.4	1.4
150	9.0	.37	.026																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.3	0.14	4	8	0.21	109	127	3.0	1.1	15.0

Billy Creek

Location: 652237mE 7764794mN Zone 55
Landform element: Terrace plain
Landform pattern: Peneplain
Slope: 0.5%
Principal Profile Form: Dy5.41
Australian Soil Classification: Sodic, Mesotrophic, Grey Sodosol
Disturbance: Extensive clearing
Vegetation: *Casuarina equisetifolia, Grevillea striata, Eucalyptus crebra*

Site No: PS35 (GB01)
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Moderately well drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Absent
Surface condition: Cracking, hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.04 m	Greyish red (10YR4/2) moist; sandy clay loam; moderate <2mm platy; dry weak. Abrupt to -
B21	0.05 to 0.38 m	Greyish red (10YR5/2) moist; few medium faint brown mottles; coarse sandy light medium clay; strong 10-20mm prismatic; dry very firm; few medium manganiferous veins. Clear to -
B22	0.40 to 1.02 m	Reddish brown (10YR5/3) moist; medium clay; moderate 10-20mm prismatic; very firm; few medium manganiferous veins. Clear to -
B23	1.04 to 1.58 m	Greyish red (10YR5/2) moist; light clay; moderate 5-10mm prismatic; dry very firm; few medium manganiferous veins. Abrupt to -
BC	1.59 to 1.62 m	Reddish brown (10YR4/3) moist; sandy clay loam; moderate 2-5mm prismatic; dry firm. Abrupt to -
C		Rock.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.4	.07	.006	42	31	14	14	8	4.5	2.3	.39	.11	5	.93	.014	1.05	.020	4.8	1.95
30	7.6	.43	.042	26	26	16	34	18	8.6	6.9	3.3	.14	15	.82	.008	.791	.031	18.3	1.25
60	8.8	.91	.117	19	24	21	38	21	10	8.2	5.9	.13	18	.89	.009	.850	.030	26.7	1.34
90	8.4	.78	.095	9	38	18	38	23	7.7	8.7	12	.12	19	.10	.013	1.01	.022	52.2	0.89
120	8.4	.61	.071	17	41	11	31	17	7.8	6.3	5.8	.06			.015	1.26	.021	34.1	1.24
150	8.4	.68	.083																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.9	0.04	3	3	0.15	30	48	0.28	0.32	6.8

Bode

Location:	624392mE 7763786mN Zone 55	Site No:	WILUS BO01
Landform element:	Hillcrest	Microrelief description:	Absent
Landform pattern:	Undulating rises	Permeability:	Moderately permeable
Slope:	3.5%	Drainage:	Well drained
Principal Profile Form:	Gn4.12	Substrate lithology:	
Australian Soil Classification:	Haplic, Eutrophic, Red Dermosol	Surface coarse fragments:	Few cobbles, subangular gneiss
Disturbance:	Grazing	Surface condition:	Hardsetting
Vegetation:	Open woodland of *Eucalyptus crebra, Erythrina vespertilio, Corymbia erythrophloia*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.16 m	Dark brown (7.5YR3/2) moist; fine sandy loam; few large pebbles, subangular gneiss; weak 2-5mm subangular blocky; moderately weak. Clear to -
B1	0.16 to 0.26 m	Brown (7.5YR4/3) moist; fine sandy light clay; very few medium pebbles, subangular gneiss; moderate 2-5mm subangular blocky; moderately firm. Clear to -
B21	0.26 to 0.56 m	Reddish brown (5YR4/4) moist; fine sandy medium clay; very few medium pebbles, subangular gneiss; moderate 5-10mm subangular blocky; very firm. Clear to -
B3	0.56 to 0.92 m	Brown (7.5YR5/4) moist; clay loam; fine sandy; no coarse fragments; weak 2-5mm subangular blocky; moderately weak. Clear to -
BC	0.92 to 0.96 m	

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
		dS/m	%	%				meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.1	.03	.001	14	64	7	16	8	5.2	1.8	.07	.37	8	.54	.030	.885	.011	0.9	2.9
30	6.5	.02	BQ	9	55	7	30	11	7.1	3.2	.10	.25	12	.58	.027	.9.4	.007	0.9	2.2
60	7.2	.02	BQ	21	51	17	13	20	13	6.7	.24	.13	12	.71	.103	1.24	.004	1.2	1.9
90	7.1	.02	BQ	9	46	19	27	21	13	7.4	.23	.17	15	.65	.056	1.04	.004	1.1	1.8

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.1	0.14	43	19	0.50	40	57	0.4	3.2	5.6
10	1.2	0.08	36	10			33	0.4	1.4	4.2

Bonavista

Location:	672107mE 7744616mN Zone 55	Site No:	PS53 (1715)
Landform element:	Back plain	Microrelief description:	Absent
Landform pattern:	Gently undulating flood plain	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy3.42	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Mottled-Mesotrophic, Grey Chromosol	Surface coarse fragments:	Absent
Disturbance:	Cultivation	Surface condition:	Hardsetting
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
A1j	0 to 0.08 m	Greyish yellow-brown (10YR5/2) moist; silty clay loam; massive; dry weak. Abrupt to -
A2e	0.10 to 0.29 m	Greyish yellow-brown (10YR6/2) moist; few medium faint brown mottles; silty clay loam; massive; dry weak. Abrupt to -
B21	0.30 to 0.58 m	Greyish yellow (2.5Y6/2) moist; common medium distinct brown mottles; medium heavy clay; moderate 10-20mm lenticular; dry very firm. Abrupt to -
B22	0.60 to 0.88 m	Yellowish grey (2.5Y6/1) moist; common medium distinct brown mottles; medium clay; moderate 10-20mm prismatic; dry very firm. Abrupt to -
B23	0.90 to 1.20 m	Yellowish grey(2.5Y6/1) moist; common coarse distinct brown mottles; medium clay; few rounded fine gravel; moderate 10-20mm prismatic; dry very firm; few medium manganiferous soft segregations. Abrupt to -
D1	1.22 to 1.60 m	Yellowish grey (2.5Y6/12) moist; common coarse distinct brown mottles; coarse sandy medium clay; common rounded medium gravel; weak 5-10mm prismatic; dry very firm; common medium ferromanganiferous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
		dS/m	%	%				meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.6	.10	.009	6	33	33	21	5	2.2	1.8	.34	.34	8	.76	.024	.381	.027	7.0	1.20
30	5.5	.04	.004	5	35	36	21	5	1.0	1.6	.35	.13	8	.75	.011	.376	.017	7.0	0.63
60	5.5	.03	.002	8	33	29	44	15	1.7	3.5	.82	.22	15	.66	.008	.702	.015	5.5	0.49
90	5.8	.02	.001	10	29	23	35	14	2.4	4.4	.92	.21	15	.76	.010	.708	.015	7.0	0.54
120	6.3	.03	.002	17	24	23	34	14	4.7	7.9	1.4	.21	15		.018	.659	.013	10.0	0.59
150	7.2	.06	.005	12	21	29	38	20	6.8	10	2.3	.13	18	.91	.019	.653	.011	11.5	0.68

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.4	0.09	22	31	0.45	182	52	0.39	0.74	16.0

Brightly

Location:	703200mE 7648700mN Zone 55	Site No:	MCL S53
Landform element:		Microrelief description:	Absent
Landform pattern:	Alluvial plain	Permeability:	Very slowly permeable
Slope:	0%	Drainage:	Imperfectly drained
Principal Profile Form:	Ug5.24	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Self-Mulching, Grey Vertosol	Surface coarse fragments:	Absent
Disturbance:	Cultivation	Surface condition:	Periodic cracking
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
AP	0 to 0.20 m	Brownish black (10YR3/1) moist, brownish grey (10YR5/1) dry; light clay; moderately moist moderately firm. Gradual to -
B21	0.20 to 0.40 m	Brownish grey (10YR4/1) moist; medium clay; moderately moist very firm. Diffuse to -
B22	0.40 to 1.20 m	Brownish grey (10YR4/1) moist; few fine faint yellow mottles; medium heavy clay; few subangular unspecified coarse fragments; moderately moist very firm; very few manganiferous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.5	.09	.013																
10	5.4	.08	.010	7	26	78	40	35	11	5.9	.25	.43	15	.61	.043	1.01	.018	0.7	1.86
20	5.1	.06	.007																
30	5.9	.04	.003	5	21	28	46	30	11	6.7	.38	.29	17	.69	.024	0.92	.015	1.3	1.64
60	6.9	.05	.006	3	17	22	57	34	18	13	1.3	.15	21	.86	.012	0.83	.009	3.8	1.38
90	7.3	.21	.036	4	18	21	55	35	18	14	2.5	.13	21	.83	.010	0.86	.008	7.1	1.29
120	7.5	.32	.057	5	20	20	54	37	20	16	3.1	.13	20	.83	.011	0.98	.006	8.4	1.25

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.6	0.12	140	111	0.1	162	39	4.0	1.7	
10	1.8	0.12	86	98	0.1	186	51	4.4	1.9	
20	1.6	0.11	40	34	0.5					

Buckley

Location:	622100mE 7776600mN Zone 55	Site No:	S2
Landform element:	Plain	Microrelief description:	Absent
Landform pattern:	Gently undulating rises	Permeability:	Slowly permeable
Slope:	2%	Drainage:	Imperfectly drained
Principal Profile Form:	Db2.42	Substrate lithology:	Granite
Australian Soil Classification:	Grey Sodosol	Surface coarse fragments:	Absent
Disturbance:		Surface condition:	Hardsetting
Vegetation:	Low woodland of *Allocasuarina luehmannii*, *Petalostigma pubescens* and *Melaleuca viridiflora*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Greyish yellow-brown (10YR4/2); sand; single grain; dry moderately weak. Clear to -
A2cb	0.10 to 0.25 m	Dull yellowish orange (10YR6/3), dry conspicuously bleached; sand; single grain; dry moderately weak. Clear to -
B2t	0.25 to 0.45 m	Dull yellowish brown (10YR4/3); very few faint brown mottles, few medium distinct dark mottles; sandy clay; moderate 10-20mm angular blocky; moderately moist moderately strong. Gradual to -
B3t	0.45 to 0.70 m	Dull yellowish brown (10YR5/4); very few fine faint yellow mottles; sandy clay; moderate; moderately moist very firm. Gradual to -
C	0.70 to 0.85 m	Bright yellowish brown (10YR6/6); clayey sand; massive; moderately moist very firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.0	.01	.002	72	24	1	2	2	2.5	.67	.10	.11	1	.69	.006	1.33	.005	5	3.70
30	6.0	.09	.011	56	28	2	13	6	1.9	3.2	.89	.09	5	.99	.006	1.26	.007	15	0.57
60	5.7	.32	.038	42	27	3	25	15	3.2	8.0	3.3	.13	11	.99	.004	1.23	.031	22	0.40
80	6.3	.33	.036	55	21	4	19	17	3.4	9.9	5.1	.15	11	.99	.007	1.72	.031	30	0.34

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	0.4	.04	6	4	.08	29	3	0.1	0.1	

Calen

Location: 684900mE 7685900mN Zone 55
Landform element:
Landform pattern: Undulating rises
Slope: 6%
Principal Profile Form: Gn3.52
Australian Soil Classification: Brown Chromosol to Subnatric Sodosol
Disturbance:
Vegetation: Woodland of *Eucalyptus, Corymbia intermedia*

Site No: MCL S08
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Andesite
Surface coarse fragments: Few cobbles
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A11	0 to 0.10 m	Yellowish grey (2.5Y4/1) moist, brownish grey (10YR6/1) dry; sandy clay loam; moderate 5-10mm subangular blocky; dry. Clear to -
A12	0.10 to 0.20 m	Greyish yellow-brown (10YR5/2) moist; sandy clay loam; massive; dry. Clear to -
A2cb	0.20 to 0.27 m	Light grey (10YR8/1) dry; sandy clay loam; massive; dry. Abrupt, irregular to -
B21	0.27 to 0.70 m	Dark greyish yellow (2.5Y5/2) moist; common medium distinct yellow mottles, common medium distinct gley mottles; medium heavy clay; strong; moderately moist; non-calcareous. Clear to -
B22	0.70 to 0.90 m	Bright yellowish brown (2.5Y6/6) moist; many medium distinct gley mottles; medium clay; strong; moderately moist; non-calcareous. Gradual to -
B23	0.90 to 1.00 m	Bright yellowish brown (2.5Y6/6) moist; many medium distinct gley mottles, sandy clay; moderately moist; few manganiferous nodules; non-calcareous.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %				
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.9	.02	.001	24	42	21	12	6	2.0	1.1	.12	.13	7		.023	2.16	.015	2	1.8
20	6.0	.01	.001																
27	6.4	.01	.001	23	40	23	12	5	1.6	1.0	.18	.05	7		.013	1.98	.005	3.6	1.6
60	6.9	.03	.002	17	33	20	31	12	4.0	4.0	1.1	.15	13		.015	1.96	.007	9.1	1.0
90	7.7	.03	.002	17	45	11	25	12	4.0	4.3	1.3	.15	12		.011	2.43	.003	10.8	0.9

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	1.2	.10	3	8	.16					
20	.71	.06	2	4	.10					

Calen

Location: 651709mE 7740699mN Zone 55
Landform element: Backplain
Landform pattern: Floodplain
Slope: 1.5%
Principal Profile Form: Dy3.23
Australian Soil Classification: Bleached-Mottled, Mesotrophic, Brown Chromosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: PS11 (407)
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Few medium gravel
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.29 m	Greyish yellow-brown (10YR4/2) moist; very few fine faint brown mottles; clay loam; few medium gravelly, subangular unconsolidated material; moderate 10-20mm subangular blocky; dry firm; few fine ferromanganiferous concretions. Abrupt to -
A2	0.29 to 0.35 m	Greyish yellow-brown (10YR5/2) moist; very few fine faint brown mottles; clay loam; massive; weak. Abrupt to -
B21	0.35 to 0.48 m	Dull yellowish orange (10YR6/4) moist; few medium distinct brown mottles; medium heavy clay; strong 20-50mm prismatic; dry very firm; few fine ferromanganiferous concretions. Abrupt to -
B22	0.48 to 0.73 m	Dull yellowish brown (10YR5/3) moist; few medium faint brown mottles; coarse sandy medium heavy clay; strong 20-50mm prismatic; very firm; few fine ferromanganiferous concretions. Clear to -
B23	0.73 to 1.62 m	Brownish grey (10YR5/1) moist; common medium faint brown mottles; fine sandy medium clay; strong 20-50mm prismatic; dry very firm; few medium calcareous nodules, few fine ferromanganiferous concretions. Sharp to -

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %				
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.2	.05	.003	11	51	22	19	3	1.8	1.0	.01	.28	7	.89	.048	.753	.014	0.3	1.80
30	5.2	.03	.003	8	50	25	19	3	2.0	.87	.02	.07	7	.81	.034	.678	.012	0.6	2.30
60	7.1	.04	.001	6	32	20	43	15	8.4	5.8	.79	.24	16	.60	.019	.812	.011	5.3	1.50
90	7.6	.04	.002	5	35	19	42	16	7.8	6.3	1.3	.22	16	.80	.017	.945	.008	8.15	1.24
12	8.0	.06	.004	5	37	18	40	16	7.7	6.0	1.9	.22	17	.91	.022	1.02	.007	11.9	1.28

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.95	0.04	32	40	0.20	109	75	0.83	0.71	12

Calen

Location:	661093mE 7729055mN Zone 55	Site No:	PS27 (853)
Landform element:	Terrace flat	Microrelief description:	Normal gilgai
Landform pattern:	Terrace	Permeability:	Very slowly permeable
Slope:	2.0%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy2.33	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Haplic, Eutrophic, Brown Chromosol	Surface coarse fragments:	Absent
Disturbance:	Grazing	Surface condition:	Hardsetting
Vegetation:	*Eucalyptus tereticornis, Corymbia tessellaris, Melaleuca viridiflora, Planchonia careya*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.12 m	Brownish black (10YR3/2) moist; fine sandy clay loam; moderate 10-20mm subangular blocky; dry firm. Abrupt to -
A3	0.13 to 0.24 m	Greyish yellow-brown (10YR4/2) moist; fine sandy clay loam; strong 5-10mm subangular blocky; dry firm. Abrupt to -
B21	026 to 0.52 m	Brownish grey (10YR4/1) moist; fine sandy medium heavy clay; strong 10-20mm prismatic; dry strong. Abrupt to -
B22	0.54 to 1.30 m	Dark greyish yellow (2.5Y5/2) moist; very few fine faint brown mottles; fine sandy heavy clay; strong 10-20mm lenticular; dry very strong. Clear to -
B23	1.33 to 1.68 m	Dull yellow (2.5Y6/3) moist; few medium faint brown mottles; fine sandy medium heavy clay; strong 20-50mm lenticular; dry very strong; common medium calcareous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.8	.05	.001	10	62	14	17	6	3.1	2.2	.20	.14	7	.49	.026	1.19	.029	3.3	1.40
30	6.9	.02	.000	6	51	14	32	12	5.8	3.9	.54	.10	13	.55	.018	1.03	.016	4.5	1.49
60	8.0	.04	.019	6	40	13	43	19	9.8	7.3	1.4	.09	18	.62	.016	.789	.014	7.4	1.34
90	8.3	.40	.048	8	35	14	44	24	11	9.0	2.6	.08	20	.99	.013	.632	.023	10.8	1.22
120	8.4	.55	.064	9	33	13	46	26	11	10	3.3	.09			.012	.597	.018	12.7	1.10
150	8.8	.57	.056																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.1	0.07	7	7	0.09	95	14	1.4	1.4	98.0

Cameron

Location:	687600mE 7690600mN Zone 55	Site No:	MCL S13
Landform element:		Microrelief description:	Absent
Landform pattern:	Flood-plain	Permeability:	Moderately permeable
Slope:	0%	Drainage:	Well drained
Principal Profile Form:	Um1.43	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Stratic Rudosol	Surface coarse fragments:	Absent
Disturbance:	Cultivation	Surface condition:	
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
AP	0 to 0.40 m	Brown (10YR4/4) moist, dull yellowish orange (10YR6/3) dry; sandy clay loam; earthy; moderately moist. Clear to -
D1	0.40 to 0.50 m	Brown (10YR4/4) moist; fine sandy loam; earthy; moderately moist. Abrupt to -
D2	0.50 to 1.20 m	Dull yellowish brown (10YR4/1) moist; sand; sandy; moderately moist.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.2	.07	.002					14	5.0	1.5	0.1	.25			.053	1.74	.016	0.7	3.33
10	5.3	.07	.002	14	46	23	20	14	5.2	1.5	0.1	.27	10	.73	.054	1.76	.017	0.7	3.47
20	5.3	.05	.001																
30	5.5	.03	.001	12	48	23	20	14	5.5	1.4	0.1	.18	10	.80	.053	1.71	.015	0.7	3.93
50	5.8	.02	.001	27	45	12	19	10	5.9	1.3	0.1	.13	8	.68				0.1	4.54
90	5.7	.01	.001	78	16	3	3	4	1.8	0.3	0.1	.03	3	.10	.025	1.72	.005	2.5	6.00
110	6.0	.01	.001	69	24	1	6	4	2.3	0.7	0.1	.03			.025	1.94	.006	2.5	3.29

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.86	0.07	49	35	.29	62	38	1.8	1.9	
10	0.73	0.09	65	31	.30					
20	0.81	0.09	50	34	.29					

Campbell Plains

Location: 676799mE 7741206mN Zone 55
Landform element: Terrace flat
Landform pattern: Delta
Slope: 1%
Principal Profile Form: Dy3.13
Australian Soil Classification: Sodosolic, Salic, Hydrosol
Disturbance:
Vegetation:

Site No: PILUS 1707
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology:
Surface coarse fragments: Absent
Surface condition:

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.26 m	Greyish yellow-brown (10YR4/2) moist; silty loam; massive; moderately weak. Abrupt to-
B21	0.26 to 0.84 m	Light grey (5Y7/1) moist; common medium distinct brown mottles; silty medium clay; strong 10-20mm columnar; very firm. Abrupt to-
B22	0.84 to 1.60 m	Light grey (5Y7/1) moist; silty medium clay; strong 10-20mm columnar; very firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	4.9	.07	.006					4	.92	1.0	.21	.11						5.3	0.92
45	8.0	.13	.014					12	.82	6.6	4.5	.21						37.5	0.12

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	1.7	0.12	11.0	10.0	0.14	214	4.7	0.07	0.41	10.0

Campwyn

Location: 659000mE 7738000mN Zone 55
Landform element: Mid slope
Landform pattern: Gently undulating uplands
Slope: 2%
Principal Profile Form: Gn2.64
Australian Soil Classification:
Disturbance:
Vegetation: Open forest of *Eucalyptus polycarpa* or *Eucalyptus platyphylla*

Site No: PRO3
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Moderately well drained
Substrate lithology: Acid volcanics
Surface coarse fragments:
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.05 m	Brownish black (10YR2/2); gravelly clay loam; weak fine crumb; trace amounts of manganese concretions; hard (dry). Gradual to -
A2	0.05 to 0.30 m	Dark brown (10YR3/3); gravelly clay loam; weak fine crumb; trace amounts of manganese concretions; slightly hard (dry). Gradual to -
B21	0.30 to 0.50 m	Yellowish brown (10YR5/6); gravelly light clay; moderate fine subangular blocky; small amounts of manganese concretions and soft patches; slightly hard. Gradual to -
B22	0.50 to 0.80 m	Yellowish brown (10YR5/6), 10% red mottle; gravelly light clay; moderate fine subangular blocky; small amounts of manganese concretions and soft patches; slightly hard. Clear to -
B23	0.80 to 1.00 m	Yellowish brown (10YR5/6), 20% red mottle; gravelly light medium clay; moderate fine angular blocky; large amounts of manganese concretions and soft patches; hard. Clear to -
B24	1.00 to 1.40 m	Yellowish brown (10YR5/6), 30% red mottle; gravelly light medium clay; strong medium angular blocky; trace amounts of manganese and soft patches; hard..

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.8	.04	.002	41	26	17	20	11	1.0	0.6	.05	.06	9		.070	0.08	.031	0.45	1.67
30	5.6	.02	.001	36	32	13	22	15	0.2	0.1	.05	.02	10		.044	0.07	.017	0.10	2.00
60	5.5	.02	.001	32	28	11	30	5	0.1	0.1	.05	.02	13		.049	0.11	.016	1.00	1.00
90	5.5	.02	.002	30	25	15	32	5	.05	0.2	.05	.02	15		.056	0.13	.018	1.00	0.25
120	5.4	.03	.004	26	22	13	40	5	.05	0.1	.05	.02			.073	0.15	.022	1.00	0.50

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	2.0	.10	12	16	.18	41	296	0.8	1.1	
20	.92	.07	8	9	.06					

Carew

Location: 601900mE 7790900mN Zone 55
Landform element: Plain
Landform pattern: Level plain
Slope: 0%
Principal Profile Form: Ug5.16
Australian Soil Classification: Self-Mulching, Black Vertosol
Disturbance:
Vegetation:

Site No: S35
Microrelief description: Normal gilgai
Microrelief component: Mound
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Absent
Surface condition: Periodic cracking, self mulching

Profile Morphology:

Horizon	Depth	Description
A11	0 to 0.02 m	Brownish black (10YR3/1); medium clay; moderate 2-5mm granular; dry moderately weak. Abrupt to -
A12	0.02 to 0.12 m	Brownish black (10YR3/1); heavy clay; strong 20-50mm angular blocky; dry moderately strong. Clear to -
B21	0.12 to 0.70 m	Brownish black (10YR3/1); heavy clay; strong 10-20mm angular blocky; moderately moist very firm; very few fine manganiferous concretions. Gradual to -
B22	0.70 to 1.00 m	Brownish black (10YR3/1); heavy clay; strong 10-20mm angular blocky; moist very firm; very few coarse carbonate nodules, very few fine manganiferous concretions. Gradual to -
B23	1.00 to 1.30 m	Brownish black (10YR3/1); heavy clay; strong 10-20mm angular blocky; moist very firm; few coarse carbonate nodules, very few fine manganiferous concretions. Gradual to -
B24	1.30 to 1.50 m	Greyish yellow-brown (10YR4/2); heavy clay; strong 10-20mm angular blocky; moist very firm; very few coarse carbonate nodules, very few fine manganiferous concretions.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
2	7.3	.02	.004	15	28	16	37	32	15	15	.39	.55	15	.79	.012	.48	.015	1	1.00
10	8.2	.02	.002	15	27	15	42	32	20	15	.38	.23	16	.68	.009	.45	.010	1	1.33
30	8.4	.03	.002	14	28	16	41	34	16	18	.97	.19	17	.78	.010	.45	.010	3	0.89
60	8.8	.10	.011	15	26	17	43	34	15	19	2.1	.21	17	.82	.008	.44	.009	6	0.79
90	8.9	.30	.045	13	24	16	46	35	12	18	2.7	.18	18	.84	.008	.45	.011	8	0.67
120	8.9	.66	.047	16	22	17	47	32	11	18	3.3	.19			.010	.57	.017	11	0.61
150	8.7	.98	.345																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.7	.06	8	6	.49	17	19	1.6	0.3	
10			6	3	.24	11	6	1.2	0.1	

Carmilla

Location: 654200mE 7740000mN Zone 55
Landform element:
Landform pattern: Gently undulating uplands
Slope: 5 %
Principal Profile Form: Dy3.43
Australian Soil Classification: Grey Sodosol
Disturbance:
Vegetation: Woodland of *Eucalyptus drepanophylla*

Site No: PRO7
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Volcanics
Surface coarse fragments: Present
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Dull yellowish brown (10YR4/3), 20% red mottle; gravelly sandy clay loam; weak fine subangular blocky; small amounts of manganese concretions; slightly hard. Clear to -
A2cb	0.10 to 0.20 m	Conspicuously bleached; gravelly sandy clay loam; weak fine subangular blocky; large amounts of manganese concretions; slightly hard. Clear to -
B1sb	0.20 to 0.50 m	Dull yellowish brown (10YR5/4), 40% bleach; gravelly and gritty light medium clay; moderate fine subangular blocky; small amounts of manganese concretions; dry hard. Clear to -
B21	0.50 to 0.80 m	Bright brown (7.5YR5/6), 10% red mottle; gravelly and gritty light medium clay; strong fine angular blocky; small amounts of soft carbonate patches and concretions; dry extremely hard. Diffuse to -
B22	0.80 to 1.10 m	Bright brown (7.5YR5/6); gravelly and gritty sandy clay; strong fine angular blocky; small amounts of carbonate concretions and soft patches; dry extremely hard. Diffuse to -
B23	1.10 to 1.40 m	Bright brown (7.5YR5/6); gravelly and gritty clay loam sandy; strong fine angular blocky; small amounts of soft carbonate patches and concretions; dry extremely hard. Abrupt to -
C	1.40 to 1.50 m	Bright brown rock material.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.9	.02	.002	49	24	19	8	14	1.3	1.4	0.2	.06	12		.039	0.07	.017	1.4	0.93
30	6.5	.01	.001	43	25	21	15	9	1.1	2.2	0.4	.03	17		.024	0.04	.008	4.4	0.50
60	7.4	.02	.002	46	25	13	17	11	4.4	11	3.3	.02	14		.017	0.03	.004	30.0	0.40
90	9.6	.29	.013	61	18	8	13	7	3.9	7.0	11	.02	12		.018	0.05	.004	15.7	0.56
120	9.6	.29	.025	54	26	10	11	10	2.7	7.9	13	.01			.020	0.04	.008	13.0	0.34

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	.84	.05	2	5	.05	64	150	0.2	0.9	
20	.46	.05	2	2	.04					

Carmilla

Location:	652813mE 7738083mN Zone 55	Site No:	PS21 (419)
Landform element:	Hill crest	Microrelief description:	Absent
Landform pattern:	Gently undulating rise	Permeability:	Slowly permeable
Slope:	2.5%	Drainage:	Moderately well drained
Principal Profile Form:	Dy3.42	Substrate lithology:	Rhyolite
Australian Soil Classification:	Brown Sodosol	Surface coarse fragments:	Few coarse gravelly angular rhyolite
Disturbance:	Grazing	Surface condition:	Hardsetting
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.11 m	Greyish yellow-brown (10YR4/2) moist; clay loam sandy; few medium gravelly subangular ironstone; massive; dry weak. Abrupt to -
A2e	0.12 to 0.30 m	Greyish yellow-brown (10YR6/2) moist; sandy clay loam; abundant fine gravelly subangular ironstone; massive; dry very weak. Abrupt to-
B21	0.31 to 0.58 m	Yellowish brown (10YR5/6) moist; few medium distinct brown mottles; medium clay; few medium gravelly subangular ironstone; strong 10-20mm prismatic; dry very firm; few fine ferromanganiferous concretions. Abrupt to -
B22	0.60 to 0.95 m	Yellowish brown (2.5Y5/4) moist; light medium clay; common medium gravelly subangular ironstone; strong 10-20mm prismatic; dry strong; few fine ferromanganiferous concretions. Abrupt to -
BC	0.97 to 1.02 m	Yellowish brown (2.5Y5/3) moist; coarse sand; many medium gravelly subangular rhyolite; dry firm.

Analytical data:

	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
Depth		dS/m	%		%			meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.8	.04	.002	34	30	17	20	5	2.1	2.5	.12	.25	8	.63	.053	.127	.033	2.4	0.84
30	6.1	.02	.001	27	27	5	43	5	.92	3.2	.43	.11	8	.70	.037	.143	.012	8.6	0.29
60	6.8	.13	.010	11	11	13	67	21	3.2	13	4.2	.10	22	.63	.008	.250	.015	20.0	0.25
90	8.4	.19	.017	39	14	10	37	24	4.3	13	6.8	.08	14	.61	.052	.511	.007	28.3	0.33

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	3.3	0.18	14	22	0.35	251	40	0.72	2.1	13.0

Conder

Location:	651238mE 7735852mN Zone 55	Site No:	PS25 (429)
Landform element:	Midslope	Microrelief description:	Absent
Landform pattern:	Undulating low hills	Permeability:	Slowly permeable
Slope:	7%	Drainage:	Moderately well drained
Principal Profile Form:	Dy3.43	Substrate lithology:	
Australian Soil Classification:	Bleached-Mottled, Mesotrophic, Brown Sodosol	Surface coarse fragments:	Common coarse gravelly volcanic breccia
Disturbance:	Extensive clearing	Surface condition:	Hardsetting
Vegetation:	*Eucalyptus platyphylla*, *Melaleuca spp, and* Bloodwood spp.		

Profile Morphology:

Horizon	Depth	Description
A1j	0 to 0.06 m	Greyish yellow-brown (10YR4/2) moist; sandy clay loam; few medium gravelly, angular volcanic breccia; moderate 2-5mm platy; weak. Abrupt to -
A2e	0.06 to 0.13 m	Greyish yellow-brown (10YR5/2) moist; sandy clay loam; massive; dry very weak. Abrupt to -
B21	0.13 to 0.23 m	Greyish brown (2.5Y5/3) moist; few medium distinct red mottles; fine medium heavy clay; strong 10-20mm prismatic; dry very strong. Abrupt to -
B22	0.23 to 0.42 m	Yellowish brown (10YR5/6) dry; few medium distinct brown mottles; fine medium heavy clay; strong 10-20mm prismatic; dry strong. Abrupt to -
BC	0.42 to 0.57 m	Light yellow (2.5Y7/4) moist; very few fine faint brown mottles; coarse sand; many medium gravelly, subangular volcanic breccia; weak 5-10mm angular blocky; very firm. Abrupt to -
C	0.57 to 0.61 m	Rock; very abundant medium gravelly, subangular volcanic breccia; dry very firm. Sharp to -

Analytical data:

	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
Depth		dS/m	%		%			meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.6	.05	.002	24	55	9	12	3	1.0	1.2	.05	.28	3		.019	.335	.018	1.6	0.83
30	5.4	.02	.000	28	52	10	12	2	.54	1.1	.18	.05	3	.85	.011	.318	.009	9.0	0.49
60	5.7	.21	.020	6	38	12	46	13	.40	7.2	5.2	.14	15	.89	.007	1.06	.018	40	0.06
90	6.0	.12	.010	8	56	10	27	14	.73	5.7	7.5	.13	12	.97	.005	.967	.026	54	0.12

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.4	0.08	5	13	0.21	222	7.4	0.12	0.65	8.0

Conway

Location:	662500mE 7748000mN Zone 55	Site No:	PRO24
Landform element:	Crest	Microrelief description:	Absent
Landform pattern:	Terrace	Permeability:	Moderately permeable
Slope:	1%	Drainage:	Moderately well drained
Principal Profile Form:	Dr3.12	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Brown Chromosol	Surface coarse fragments:	
Disturbance:	Cultivation	Surface condition:	Hardsetting
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
Ap	0 to 0.20 m	Brownish black (10YR3/2), loam fine sandy; weak fine subangular blocky; slightly hard (dry). Clear to -
B21	0.20 to 0.40 m	Dark reddish brown (5YR3/3); medium clay loam; strong fine prismatic; trace amounts of manganese concretions; very hard. Diffuse to -
B22	0.40 to 1.10 m	Brown (7.5YR4/4), 15% dark mottle; light medium clay; strong coarse prismatic; trace amounts of manganese concretions; very hard. Diffuse to -
B23	1.10 to 1.40 m	Brown (10YR4/4), 15% grey mottle; light medium clay; strong coarse prismatic; trace amounts of manganese concretions and soft patches; very hard. Diffuse to -
B24	1.40 to 1.50 m	Brown (10YR4/4), 15% grey mottle; light medium clay with medium sand; strong coarse prismatic; trace amounts of manganese concretions and soft patches; very hard.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.0	.04	.002	3	56	18	20	12	1.4	1.0	.05	.23	19		.036	1.27	.017	0.4	1.4
30	4.9	.09	.011	2	43	11	42	16	3.9	1.8	.05	.17	18		.029	1.01	.024	0.3	2.17
60	6.2	.02	.001	1	52	11	30	12	5.2	3.4	0.2	.17	14		.024	1.18	.017	1.7	1.53
90	6.5	.02	.001	2	59	9	26	11	4.9	3.9	0.2	.15	12		.019	1.32	.009	1.8	1.26
120	6.5	.02	.001	4	61	12	19	10	4.8	3.7	0.2	.11			.017	1.34	.007	2.0	1.30
150	6.6	.02	.001	3	60	11	25	12	6.4	4.8	0.2	.10	11		.018	1.33	.005	1.7	1.33

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	.94	.07	19	16	.27	57	102	0.7	0.6	
20	1.0	.09	19	16	.23					

Debella

Location:	648325mE 7760412mN Zone 55	Site No:	PS58 (WILUS 893)
Landform element:	Plain	Microrelief description:	Absent
Landform pattern:	Gently undulating plains	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy5.42	Substrate lithology:	Tertiary sandstone
Australian Soil Classification:	Magnesic, Mottled-Mesonatric, Grey Sodosol	Surface coarse fragments:	Common small pebbles, subangular quartz
Disturbance:	Grazing	Surface condition:	Loose
Vegetation:	*Allocasuarina luehmannii*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.20 m	Light brownish grey (10YR6/2) moist; coarse sandy loam; few small pebbles, subangular quartz; massive; moist very weak. Sharp to -
A2e	0.20 to 0.34 m	Light grey (10YR7/2) moist; coarse sandy loam; common small pebbles, subangular quartz; massive; moist very weak. Sharp to-
B21	0.34 to 0.54 m	Light brownish grey (2.5Y6/2) moist; common medium prominent brown mottles; coarse sandy light medium clay; few small pebbles, subangular quartz; weak 5-10mm prismatic; moist moderately strong. Sharp to-
B22qm	0.54 to 0.58 m	

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	6.4	.02	.001	61	30	5	5	1	.43	.34	BQ	.06			.004	.195	.010		
10	5.8	.02	.003	57	33	5	5	1	.18	.28	BQ	.04			.004	.186	.010		0.64
30	6.1	.01	.002	55	34	6	5	BQ	BQ	.34	BQ	.03			.002	.158	.007		
60	5.4	.03	.003	33	19	10	36	8	BQ	3.8	1.1	.04			.005	.087	.012	13.8	

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10										

Dingo

Location:	6mE 77mN Zone 55	Site No:	PS56 (DB03)
Landform element:	Colluvial fan	Microrelief description:	
Landform pattern:		Microrelief component:	
Slope:	2 %	Permeability:	Permeable
Principal Profile Form:		Drainage:	Well drained
Australian Soil Classification:	Yellow Kandosol or Tenosol	Substrate lithology:	
Disturbance:	Cultivation - pasture	Surface coarse fragments:	
Vegetation:	Cleared	Surface condition:	firm

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.05 m	Light brownish grey (10YR 6/2) moist; coarse loam sandy, massive, gradual to -
A2j	0.05 to 0.20 m	Light brownish grey (10YR 6/2) moist; coarse loam sandy, massive, gradual to -
B21	0.20 to 0.80 m	Light brownish grey (2.5Y 6/2); sandy clay loam, weak; gradual to -
B3	0.80 to 0.50 m	Light brownish grey (2.5Y 6/2); coarse sandy loam, weak

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.8	.07	.001	70	24	6	2	2	.61	.51	.05	.22	2	.66	.004	3.37	.010	2.5	1.20
30	5.7	.03	.001	61	32	6	2	1	.38	.33	.09	.27	2	.71	.003	3.63	.007	5.0	1.15
60	6.4	.03	.003	61	31	5	10	1	.21	.35	.16	.16	2	.99	.002	3.69	.005	9.0	0.60
90	7.1	.04	.004	58	26	5	10	3	.10	1.2	1.4	.10	4	.93	.001	3.46	.004	46.6	0.08
120	7.2	.05	.004	66	23	6	9	4	.09	1.5	2.0	.11	5	.96	.002	3.42	.005	50	0.06

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.70	0.05	7.0	4.0	0.30	33	4.2	0.13	0.35	5.9
10	0.55	0.03	5.0	5.0	0.30	48	2.4	0.13	0.33	6.0

Dittmer

Location:	656100mE 7739050mN Zone 55	Site No:	PRO8
Landform element:	Mid slope	Microrelief description:	Absent
Landform pattern:	Gently undulating uplands	Permeability:	Highly permeable
Slope:	15%	Drainage:	Well drained
Principal Profile Form:	Uc2.12	Substrate lithology:	Volcanics
Australian Soil Classification:	Leptic Rudosol	Surface coarse fragments:	Present
Disturbance:		Surface condition:	Hardsetting
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.05 m	Brownish black (10YR3/2); gravelly sandy loam; massive. Diffuse to -
A2cb	0.05 to 0.50 m	Conspicuously bleached; gravelly sandy loam; massive. Diffuse to -
BC	0.50 to 0.70 m	Dull yellowish brown (10YR5/3); gravelly sandy loam; massive.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.5	.04	.001	15	69	8	6	3	0.6	0.6	0.1	.34			.011	0.29	.010	3.3	1.0
30	5.9	.02	.001	21	58	10	9	3	0.2	0.6	.05	.07			.010	0.28	.007	1.7	0.3
60	5.9	.01	.001	20	58	8	10	3	0.2	1.2	.05	.05			.011	0.44	.007	1.7	0.2

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	.81	.05	5	4	.41	54	20	0.2	0.8	
20	.65	.04	3	2	.14					

Don

Location: 624300mE 7787700mN Zone 55
Landform element: Plain
Landform pattern: Level plain
Slope: 0%
Principal Profile Form: Dd1.13
Australian Soil Classification: Brown Chromosol
Disturbance:
Vegetation:

Site No: S48
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Well drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Nil
Surface condition: Firm

Profile Morphology:

Horizon	Depth	Description
A11	0 to 0.10 m	Black (10YR2/1); clay loam; moderate 2-5mm granular; dry very firm. Gradual to -
A12	0.10 to 0.30 m	Black (10YR2/1), light medium clay; moderate 10-20mm subangular blocky; moderately moist very firm. Gradual to -
A13	0.30 to 0.50 m	Black (10YR2/1); clay loam; moderate 20-50mm granular; moderately moist very firm. Clear to -
B2	0.50 to 0.70 m	Black (10YR2/1); medium clay; weak 10-20mm angular blocky; moderately moist moderately strong. Clear to -
BC	0.70 to 1.10 m	Dark reddish brown (5YR3/4); medium clay; weak 10-20mm angular blocky; moderately moist moderately strong. Clear to -
C	1.10 to 1.50 m	Brown (10YR4/6); light medium clay; massive; moderately moist very firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CE C	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.9	.05	.003	30	34	16	20	19	8.4	4.7	.23	.57	10	.06	.068	1.17	.016	1	1.79
30	7.2	.03	.002	21	40	17	22	18	11	5.1	.52	.16	11	.72	.057	1.10	.015	3	2.16
60	7.5	.03	.003	27	40	11	22	15	11	5.4	.59	.14	11	.92	.028	1.10	.009	4	2.04
90	7.6	.10	.009	17	34	13	36	15	10	7.4	1.0	.22	17	.69	.065	0.96	.015	7	1.35
120	8.0	.10	.009	15	49	13	22	12	7.3	6.7	.80	.07			.088	0.96	.011	8	1.09
150	8.4	.11	.012																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	1.4	.09	155	69	.59	72	42	1.9	1.2	

Dryander

Location: 662375mE 7752700mN Zone 55
Landform element: Mid slope
Landform pattern: Footslope
Slope: 2%
Principal Profile Form: Dy2.33
Australian Soil Classification: Brown Chromosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: PRO21
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Colluvium
Surface coarse fragments:
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Brownish black (10YR3/2); fine sandy clay loam; weak fine subangular blocky; slightly hard. Clear to -
A2sb	0.10 to 0.20 m	Greyish yellow brown (10YR4/2), 50% bleach; fine sandy clay loam; weak fine subangular blocky; slightly hard. Clear to -
B1sb	0.20 to 0.30 m	Greyish yellow brown (10YR4/2), 50% bleach; light medium clay; moderate medium prismatic, trace amounts of manganese concretions; hard. Abrupt to -
B21	0.30 to 0.50 m	Dull yellowish brown (10YR5/3), 10% yellow mottle; medium heavy clay; strong coarse prismatic; trace amounts of manganese concretions; hard. Diffuse to -
B22	0.50 to 1.00 m	Dull yellow orange (10YR6/4), 10% yellow mottle; medium heavy clay; strong coarse prismatic; trace amounts of manganese concretions; very hard. Diffuse to -
B23	1.00 to 1.20 m	Dull yellow orange (10YR6/3), 15% yellow and red mottle; gravelly medium clay; small amounts of manganese and carbonate concretions, very hard..

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CE C	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.7	.06	.002	20	23	33	20	18	5.2	3.3	0.3	.33	11		.040	0.60	.031	1.7	1.6
30	6.5	.04	.002	14	18	26	38	18	6.9	5.1	0.8	.19	16		.027	0.56	.014	4.4	1.3
60	7.8	.12	.020	15	16	25	42	20	7.5	9.0	3.4	.07	17		.011	0.50	.007	17	0.8
90	8.6	.27	.033	11	17	25	45	21	8.0	10	4.9	.08	17		.008	0.49	.006	23	0.8
120	9.2	.34	.033	35	19	22	24	17	5.8	7.2	3.8	.08			.016	0.47	.006	22	0.8

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	3.1	.17	12	12	.33	289	186	1.7	1.1	
20	1.2	.11	11	11	.27					

Dundula

Location: 6mE 77mN Zone 55
Landform element: Delta
Landform pattern: Back plain
Slope: 1%
Principal Profile Form:
Australian Soil Classification: Grey Vertosol
Disturbance:
Vegetation:

Site No: PS48 (CO05)
Microrelief description:
Microrelief component:
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology:
Surface coarse fragments:
Surface condition:

Profile Morphology:

Horizon	Depth	Description
	0 to 0.05 m	
	0.05 to 0.20 m	
	0.20 to 0.40 m	
	0.40 to 0.50 m	
	0.50 m	

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.0	.13	.011	8	23	34	33						15	.60					
30	7.2	.29	.034	5	26	27	43	24	7.2	11	3.6	.13	18	.81				15.0	0.65
60	8.3	1.1	.150	14	24	27	39	21	4.4	8.1	6.2	.46	16	.92				29.5	0.54
90	8.6	1.4	.188	35	18	17	32	14	2.8	6.1	5.2	.44	14	.98				37.1	0.46
120	8.3	1.2	.173	34	17	16	36	14	2.4	5.8	5.5	.35						39.2	0.41
150	IS	IS	IS																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.6	0.23	13	43	0.82	248	48	3.9	3.0	16.0

Dunwold

Location: 684400mE 7657600mN Zone 55
Landform element:
Landform pattern: Undulating rises
Slope: 4%
Principal Profile Form: Dy5.82
Australian Soil Classification: Grey Sodosol
Disturbance:
Vegetation:

Site No: MCL S30
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Moderately well drained
Substrate lithology: Granite
Surface coarse fragments: Absent
Surface condition: Loose

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Greyish yellow-brown (10YR4/2) moist, brownish grey (10YR6/1) dry; light sandy clay loam; dry loose. Clear to -
A2cb	0.10 to 0.40 m	Dull yellowish orange (10YR6/3) moist, dull yellowish orange (10YR7/2) dry; light sandy clay loam; dry loose. Abrupt to -
A3	0.40 to 0.50 m	Bright yellowish brown (10YR7/6) moist; sandy clay loam; dry very weak. Abrupt to -
B21	0.50 to 0.70 m	Bright yellowish brown (10YR7/6) moist; few fine distinct grey mottles, few fine distinct yellow mottles; medium clay; weak; moderately moist moderately weak. Clear to -
B31	0.70 to 0.95 m	Yellowish orange (10YR8/6) moist; sandy clay; dry very weak. Abrupt to -
B32	0.95 to 1.05 m	Light grey (5Y7/2) moist; common medium distinct yellow mottles; medium clay; weak; moderately moist moderately weak. Abrupt to -
C	1.05 to 1.20 m	Yellowish orange (10YR8/6) moist; sandy clay; dry loose.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	6.0	.05	.002												.027	1.25	.022		
10	5.9	.03	.001	45	31	10	16	8	2.6	1.4	.10	.30	6	.54	.024	1.26	.018	1.3	1.86
20	6.2	.02	.001																
30	6.2	.02	.001	45	32	13	16	6	1.8	1.1	.10	.29	5	.63	.015	1.42	.010	1.7	1.64
60	6.0	.03	.001	43	20	10	30	11	3.3	4.2	.15	.28	11	.72	.011	2.05	.012	1.4	0.79
90	6.8	.02	.001	60	19	5	19	9	2.6	6.5	.40	.04	6	.69	.008	2.20	.004	4.4	0.40
120	7.4	.02	.002	47	25	13	16	9	2.9	6.3	.80	.03			.010	2.26	.003	8.9	0.46

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.3	0.12	23	21	0.49	156	42	0.5	1.5	
10	1.0	0.11	26	24	0.38					
20	0.58	0.06	5	6	0.33					

Edgecumbe

Location:	673199mE 7743728mN Zone 55	Site No:	PS52 (1678)
Landform element:	Footslope	Microrelief description:	Absent
Landform pattern:	Undulating low hills	Permeability:	Moderately permeable
Slope:	5%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy3.12	Substrate lithology:	Trachyte
Australian Soil Classification:	Mottled-Mesotrophic, Grey Chromosol	Surface coarse fragments:	Common subangular cobbly andesite
Disturbance:	Cultivation	Surface condition:	Hardsetting
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.31 m	Brownish black (10YR3/2) moist; clay loam; few medium gravelly, subangular andesite; moderate 2-5mm subangular blocky; dry weak. Abrupt to -
B1	0.32 to 0.42 m	Greyish yellow-brown (10YR5/2) moist; few medium distinct brown mottles; sandy clay loam; common fine gravelly, subangular ironstone; massive; dry weak; common fine ferromanganiferous concretions. Abrupt to -
B21	0.44 to 0.67 m	Yellowish brown (2.5Y5/3) moist; few medium distinct brown mottles; medium clay; moderate 5-10 mm prismatic; dry very firm; few fine ferromanganiferous concretions. Abrupt to -
B32	0.69 to 0.80 m	Greyish yellow (2.5Y6/2) moist; common medium distinct brown mottles; light medium clay; few medium gravelly, angular andesite; weak 5-10mm prismatic; dry very firm. Abrupt to -
BC1	0.82 to 0.98 m	Yellowish grey (2.5Y6/1) moist; common medium distinct brown mottles; coarse sandy light clay; many medium gravelly, angular andesite; weak 5-10mm prismatic; dry very firm. Abrupt to -
BC2	1.00 to 1.04 m	

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.3	.13	.009	16	29	30	22	8	4.6	2.1	.34	.43	12	.62	.072	.704	.044	4.0	2.20
30	6.1	.03	.001	15	32	32	22	7	4.8	1.8	.22	.12	11	.66	.051	.547	.031	3.0	2.70
60	6.4	.04	.004	10	14	18	57	17	7.9	8.1	.71	.17	22	.57	.048	.458	.028	4.0	0.98
90	7.3	.03	.001	30	34	16	21	18	8.8	8.3	.57	.08	11	.77	.068	1.24	.014	3.0	1.10

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.7	0.18	24	59	0.52	315	129	0.73	2.1	23.0

Eton

Location:	703300mE 7647600mN Zone 55	Site No:	MCL S51
Landform element:		Microrelief description:	Absent
Landform pattern:	Alluvial plain	Permeability:	Slowly permeable
Slope:	0%	Drainage:	Imperfectly drained
Principal Profile Form:	Gn3.03	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Grey, Subnatric Sodosol	Surface coarse fragments:	Absent
Disturbance:	Cultivation	Surface condition:	
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
APsb	0 to 0.20 m	Yellowish grey (2.5Y4/1) moist, yellowish grey (2.5Y6/1) dry; clay loam, fine sandy; moderately moist moderately weak. Clear to -
B1sb	0.20 to 0.35 m	Yellowish grey (2.5Y4/1) moist; light clay; moderately moist moderately weak. Clear to -
B21	0.35 to 0.80 m	Yellowish grey (2.5Y4/1) moist; few fine faint brown mottles; medium heavy clay; moderately moist moderately firm; few manganiferous nodules. Clear to -
B22	0.80 to 1.20 m	Yellowish grey (2.5Y5/1) moist; common medium faint yellow mottles; medium heavy clay; moderately moist moderately firm; few manganiferous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.4	.02	.001																
10	5.6	.08	.001	14	36	28	23	15	5.1	3.3	.10	.56	8	.77	.026	1.32	.012	0.7	1.5
20	5.5	.02	.001																
30	5.5	.04	.004	12	33	29	27	16	6.3	3.7	.16	.22	10	.72	.015	1.36	.011	1.0	1.7
60	7.2	.13	.019	11	27	24	38	22	9.7	8.9	1.2	.18	14	.85	.012	1.38	.008	5.5	1.09
90	8.7	.33	.042	15	27	19	36	21	8.2	11	2.1	.16	13	.85	.011	1.47	.008	10.0	0.75
120	8.9	.44	.055	17	26	20	38	24	7.6	13	3.3	.15			.013	1.45	.008	13.8	0.6

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.1	.10	27	30	.31	121	70	1.9	0.7	
10	.86	.09	47	44	.54	100	66	1.7	0.8	
20	.84	.08	25	23	.50					

Eton

Location:	659537mE 7751076mN Zone 55	Site No:	PS41 (GB07)
Landform element:	Back plain	Microrelief description:	Absent
Landform pattern:	Gently undulating floodplain	Permeability:	Slowly permeable
Slope:	1.5%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy3.13	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Grey, Subnatric Sodosol	Surface coarse fragments:	Absent
Disturbance:	Cultivation	Surface condition:	Firm
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
Ap	0 to 0.18 m	Greyish yellow-brown (10YR4/2) moist; sandy clay loam; weak 5-10mm prismatic; dry weak. Abrupt to -
B21	0.20 to 0.60 m	Brownish grey (10YR6/1) moist; few medium faint brown mottles; medium clay; moderate 10-20mm prismatic; dry very firm; few medium manganiferous soft segregations. Abrupt to -
B22	0.62 to 1.65 m	Greyish yellow (2.5Y6/2) moist; few medium faint brown mottles; coarse sandy medium clay; moderate 10-20mm prismatic; dry very firm; very few medium manganiferous soft segregations.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.8	.05	.003	23	47	13	17	6	3.0	2.9	.22	.27	7	.69	.028	1.40	.019	3.7	1.00
30	6.2	.18	.011	17	34	17	34	17	7.7	7.2	1.5	.17	17	.80	.010	1.03	.016	8.8	1.07
60	7.2	.21	.022	19	37	14	31	20	8.2	8.4	3.5	.16	14	.92	.011	1.18	.012	17.5	0.95
90	8.2	.27	.034	25	43	6	27	21	8.1	8.2	4.9	.17	13	.92	.018	1.36	.015	23.3	0.95
120	8.4	.50	.059	18	26	19	41	21	12	1	8.0	.31			.012	.988	.011	25.0	1.00
150	8.5	.46	.056																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10										

Etowrie

Location:	717700mE 7670900mN Zone 55	Site No:	MCL S24
Landform element:	Fan	Microrelief description:	Absent
Landform pattern:	Undulating rises	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Imperfectly drained
Principal Profile Form:	Uf6.41	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Brown Sodosol	Surface coarse fragments:	Few cobbles
Disturbance:		Surface condition:	Firm
Vegetation:			

Profile Morphology:

Horizon	Depth	Description
AP	0 to 0.25 m	Greyish yellow-brown (10YR4/2) moist, greyish yellow-brown (10YR6/2) dry; light clay; moderate; moderately moist very firm. Clear to -
B21	0.25 to 0.50 m	Dull yellowish brown (10YR5/4) moist; many fine distinct grey mottles; heavy clay; strong; moist moderately firm; few manganiferous nodules. Gradual to -
B22	0.50 to 1.00 m	Brownish black (10YR3/1) moist; medium heavy clay; strong; moist moderately firm; few manganiferous nodules. Gradual to -
B23	1.00 to 1.20 m	Dark greyish yellow (2.5Y5/2) moist; few fine distinct yellow mottles; heavy clay; few angular unspecified coarse fragments; moderate; moist moderately firm; few carbonate nodules, few manganiferous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	6.2	.04	.003												.040	.44	.020		
10	6.2	.02	.002	7	33	30	34	18	5.9	5.4	.25	.23	13	.64	.038	.43	.015	1	1.05
20	6.1	.03	.003																
35	6.4	.11	.013	3	19	19	62	32	0.8	0.2	1.8	.03	23	.67	.015	.40	.013	5	1.00
60	7.1	.30	.048	2	12	27	62	36	18	21	4.4	.07	24	.80	.012	0.43	.009	12	0.86
90	7.7	.48	.076	3	19	26	55	36	14	18	5.3	.07	21	.92	.013	0.44	.009	15	0.78
120	8.2	.48	.072	4	22	24	56	33	13	16	5.6	.06			.012	0.43	.005	17	0.81

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.2	.11	40	35	.35	114	75	2.0	1.7	
10	.96	.09	40	31	.19					
20	.86	.07	35	30	.09					

Etowrie (neutral variant)

Location:	647207mE 7753001mN Zone 55	Site No:	WILUS 925
Landform element:	Fan	Microrelief description:	Absent
Landform pattern:	Gently undulating plains	Permeability:	Slowly permeable
Slope:	1.5%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy3.41	Substrate lithology:	
Australian Soil Classification:	Mesotrophic, Mottled-Subnatric, Grey Sodosol	Surface coarse fragments:	Few small pebbles, subangular gravel
Disturbance:	Cleared, cultivated in past	Surface condition:	Hardsetting
Vegetation:	*Melaleuca viridiflora*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.17 m	Light brownish grey (10YR6/2) moist; few medium faint brown mottles; silty loam; weak 2-5mm prismatic; moist moderately weak. Sharp to-
A2j	0.17 to 0.32 m	Light grey (10YR7/2) moist; few medium faint brown mottles; silty loam; weak 2-5mm prismatic; moist moderately weak. Sharp to-
B21	0.32 to 0.58 m	Light brownish grey (2.5Y6/2) moist; common medium distinct brown mottles; light medium clay; weak 5-10mm prismatic; moist very firm. Abrupt to-
B22	0.58 to 0.90 m	Grey (2.5Y6/1) moist; common medium distinct brown mottles; medium clay; few small pebbles, subangular gravel; moderate 5-10mm prismatic; moist very firm. Sharp to-
D1	0.90 to 0.97 m	Grey (2.5Y6/1) moist; many medium distinct brown mottles; few medium pebbles, subangular gravel; moist very firm;

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.7	.11	.009	5	16	49	20	10	4.5	4.0	.54	.34						5.4	1.13

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	3.1	0.21	7.0	8.0	0.30	150	130	0.91	1.9	10.0

Exmoor

Location:	6mE 7mN Zone 55	Site No:	PILUS 253
Landform element:	Upper slope	Microrelief description:	Absent
Landform pattern:	Rolling hills	Permeability:	Highly permeable
Slope:	15%	Drainage:	Rapidly drained
Principal Profile Form:	Um1.24	Substrate lithology:	Tuff
Australian Soil Classification:	Leptic Rudosol	Surface coarse fragments:	Abundant subangular cobbles of tuff
Disturbance:	Extensive clearing	Surface condition:	Hardsetting
Vegetation:			

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.04 m	Brownish black (10YR3/2) moist; sandy clay loam; massive; common medium gravelly, subangular andesite; weak
A1e	0.04 to 0.22 m	Brownish black (10YR3/2) moist, brownish grey (10YR6/1) dry; sandy clay loam; massive; common medium gravelly, subangular andesite; weak. Abrupt to -
C	> 0.22 m	

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.7	.02	.001						.96	.82	.16	.09							5.13

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10				1.0			4.0	0.05	0.12	3.0

Finch Hatton

Location:	677400mE 7663400mN Zone 55	Site No:	MCL S42
Landform element:	Hill	Microrelief description:	Absent
Landform pattern:	Undulating rises	Permeability:	Moderately permeable
Slope:	4%	Drainage:	Well drained
Principal Profile Form:	Uf6.31	Substrate lithology:	Granodiorite
Australian Soil Classification:	Red Dermosol	Surface coarse fragments:	Absent
Disturbance:	Cultivation	Surface condition:	
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
AP	0 to 0.20 m	Black (10YR2/1) moist, light clay; dry very firm. Gradual to -
B21	0.20 to 0.30 m	Dark reddish brown (5YR3/3) moist, dull reddish brown (5YR4/4) moist; medium clay; dry very firm; very few manganiferous nodules. Clear to -
B22	0.30 to 0.50 m	Brown (7.5YR4/6) moist; few fine distinct red mottle; medium clay; moderately moist moderately firm; few manganiferous nodules. Gradual to -
B23	0.50 to 0.80 m	Bright brown (7.5YR5/6) moist; light medium clay; moderately moist moderately firm; few manganiferous nodules. Gradual to -
BC	0.80 to 1.05 m	Orange (7.5YR6/6) moist; medium clay; moderately moist moderately firm. Gradual to -
C	1.05 to 1.20 m	Sandy clay loam; moderately moist very weak.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.2	.03	.002												.061	0.80	.025		
10	5.3	.02	.002	23	27	9	41	23	4.1	2.0	.10	.30	15	.15	.061	0.82	.022	0.4	2.05
20	5.3	.02	.002																
30	5.5	.02	.001	14	18	10	59	19	5.9	1.9	.12	.10	24	.24	.030	0.41	.022	0.6	3.11
50	5.8	.02	.001	15	18	17	53	18	5.5	1.9	.15	.08	25	.25	.022	0.27	.015	0.8	2.89
90	6.2	.01	.001	23	27	17	34	16	8.9	3.9	.21	.06	20	.23	.015	0.42	.007	1.3	2.28
120	6.3	.01	.001	36	35	7	24	17	12	5.3	.20	.05			.048	0.46	.006	1.2	2.26

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.8	0.12	17	20	0.41	92	60	1.5	1.0	
10	2.0	0.11	14	15	0.27					
20	2.0	0.11	11	12	0.13					

Finley

Location:	650975mE 7717391mN Zone 55	Site No:	PS51 (1803)
Landform element:	Footslope	Microrelief description:	Absent
Landform pattern:	Undulating rise	Permeability:	Moderately permeable
Slope:	6%	Drainage:	Moderately well drained
Principal Profile Form:	Dr4.12	Substrate lithology:	Diorite, syenite
Australian Soil Classification:	Haplic, Mesotrophic, Red Chromosol	Surface coarse fragments:	Absent
Disturbance:	Extensive clearing	Surface condition:	Firm
Vegetation:	*Corymbia tessellaris, Eucalyptus crebra*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.192 m	Brownish black (7.5YR3/2) moist; sandy loam; massive; dry weak. Abrupt to -
A3	0.21 to 0.38 m	Brown (7.5YR4/3) moist; fine sandy clay loam; weak 5-10mm prismatic; dry weak. Abrupt to -
B21	0.40 to 0.82 m	Yellowish red (5YR4/6) moist; medium clay; moderate 10-20mm prismatic; dry very firm. Abrupt to -
B3	0.84 to 1.35 m	Dull brown (7.5YR5/4) moist; light medium clay; weak 5-10mm subangular blocky; dry very firm. Abrupt to -
BC	1.37 to 1.46 m	Dull brown (7.5YR5/3) moist; coarse sandy clay loam; weak 5-10mm prismatic; weak.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.3	.02	.001	35	41	7	14	6	4.3	1.9	.05	.12	8	.53	.025	.478	.021	0.8	2.2
30	6.6	.01	.001	30	38	9	22	6	4.1	1.9	.08	.05	9	.61	.019	.536	.018	1.3	2.2
60	6.8	.03	.001	19	26	9	46	9	4.9	4.0	.21	.08	19	.43	.016	.525	.017	2.3	1.2
90	6.7	.03	.002	11	33	9	46	10	5.3	4.1	.32	.10	18	.47	.014	.540	.016	3.2	1.3
120	7.0	.02	.002	5	56	13	25	12	6.3	4.8	.38	.10	12		.013	.763	.015	3.2	1.3

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.5	0.17	6.0	13.0	0.30	74	58	0.56	2.3	4.0

Foxdale

Location: 662875mE 7743500mN Zone 55
Landform element: Levee
Landform pattern: Level plain
Slope: 0.5%
Principal Profile Form: Gn3.42
Australian Soil Classification: Grey Dermosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: PRO27
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Alluvia
Surface coarse fragments:
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Brownish black (10YR3/2), 10% red mottle; fine sandy clay loam; moderate medium angular blocky; hard. Clear to -
A3	0.10 to 0.20 m	Brownish black (10YR3/2), 40% red mottle; light clay; strong medium angular blocky; very hard. Clear to -
B21	0.20 to 0.40 m	Black (10YR2/1); light medium clay; strong fine prismatic; trace amounts of manganese concretions; hard. Clear to -
B22	0.40 to 0.60 m	Black (10YR2/1); medium clay; strong fine prismatic; trace amounts of manganese concretions; hard. Clear to -
B23sb	0.60 to 0.70 m	Greyish yellow brown (10YR5/2), 20% bleach; light medium clay; strong medium prismatic; trace amounts of manganese concretions; extremely hard. Clear to -
D1	0.70 to 0.90 m	Yellowish grey (2.5Y5/1), 15% yellow mottle; medium clay; strong medium columnar; trace amounts of manganese concretions; extremely hard (dry). Clear to -
D2	0.90 to 1.10 m	Yellowish grey (2.5Y5/1), 10% yellow mottle; medium clay; strong medium columnar continuing from D1; trace amounts of manganese concretions; hard (slightly moist). Clear to -
D3	1.10 to 1.50 m	Yellowish grey (2.5Y5/1), 20% grey mottle; medium heavy clay; strong medium columnar continuing from D1 and D2; trace amounts of manganese concretions and soft carbonate patches; hard (moist).

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CE C	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.5	.08	.005	13	40	24	21	22	8.8	4.6	0.4	2.5	13		.068	1.33	.050	2.0	1.9
30	5.8	.06	.005	6	16	32	41	31	6.6	5.6	0.7	5.7	21		.053	0.76	.032	2.3	1.2
60	6.9	.13	.021	12	34	22	28	13	6.2	4.4	1.8	.07	12		.010	0.70	.011	13.8	1.4
90	7.9	.47	.082	19	35	15	36	19	6.6	5.6	4.8	.06	16		.008	0.54	.006	25.0	1.2
120	8.1	.65	.108	24	25	15	32	24	5.3	4.8	5.1	.05			.006	0.51	.004	30.0	1.1
150	8.0	.94	.163	16	23	16	41	19	5.7	5.7	6.8	.15	17		.006	0.49	.007	35.7	1.0

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	3.0	.17	92	38	.32	335	174	3.2	3.1	
20	2.3	.19	75	39	.24					

Gargett

Location: 684200mE 7650300mN Zone 55
Landform element: Fan
Landform pattern: Gently undulating plains
Slope: 2%
Principal Profile Form: Dy5.82
Australian Soil Classification:
Disturbance: Cultivation
Vegetation: Cleared

Site No: MCL S37
Microrelief description: Absent
Permeability: Highly permeable
Drainage: Well drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Absent
Surface condition:

Profile Morphology:

Horizon	Depth	Description
AP	0 to 0.15 m	Brownish grey (10YR5/1) moist, brownish grey (10YR6/1) moist; sandy loam; moderately moist loose. Gradual to -
A21cb	0.15 to 0.45 m	Greyish yellow-brown (10YR6/2) moist, light grey (10YR8/1) moist; sandy loam; moderately moist loose. Clear to -
A22cb	0.45 to 0.55 m	Dull yellowish orange (10YR6/4) moist, light grey (10YR8/1) dry; sandy loam; few angular unspecified coarse fragments; moderately moist loose. Abrupt to -
B21	0.55 to 0.85 m	Yellowish grey (2.5Y7/1) moist; many fine distinct yellow mottles; medium clay; moderately moist moderately firm; few manganiferous nodules. Clear to -
D1	0.85 to 1.10 m	Light grey (2.5Y7/1) moist, light yellow (2.5Y7/4) moist; few medium distinct grey mottles, few medium distinct yellow mottles; sandy clay; few subangular unspecified coarse fragments; moderately moist moderately weak; few manganiferous nodules. Clear to -
D2	1.10 to 1.20 m	Light grey (2.5Y7/1) moist; few fine distinct gley mottles, few fine distinct yellow mottles; sandy clay; few subangular unspecified coarse fragments; wet moderately weak; few manganiferous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CE C	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.6	.01	.001												.011	1.70	.006		
10	5.5	.01	.001	37	46	8	10	4	1.4	.68	.10	.15	3	.68	.008	1.64	.005	2.5	2.06
20	5.4	.01	.001																
30	5.5	.01	.001	39	45	10	10	2	.98	.23	.10	.08	2	.63	.006	1.74	.008	5.0	4.26
55	6.1	.01	.001	36	45	8	12	2	1.2	.50	.10	.07	3	.60	.006	1.75	.006	5.0	2.40
85	6.4	.02	.001	33	39	8	23	9	4.6	2.5	.65	.10	8	.81	.006	1.65	.006	7.2	1.84
110	6.1	.02	.001	46	29	7	20	8	4.1	2.2	.36	.12			.016	1.89	.006	7.9	1.86

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.76	0.05	3	3	0.17	35	17	0.1	0.5	
10	0.58	0.05	3	2	0.13					
20	0.46	0.03	2	2	0.08					

Glenroc

Location:	568100mE 7785200mN Zone 55	Site No:	S8
Landform element:	Plain	Microrelief description:	Absent
Landform pattern:	Level plain	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Imperfectly drained
Principal Profile Form:	Gn3.43	Substrate lithology:	Igneous rocks
Australian Soil Classification:	Brown Sodosol	Surface coarse fragments:	Absent
Disturbance:		Surface condition:	Hardsetting
Vegetation:	Tall woodland of *Eucalyptus drepanophylla, Eucalyptus tessellaris*		

Profile Morphology:

Horizon	Depth	Description
A11	0 to 0.08 m	Brownish black (10YR3/2); sandy clay loam; massive; dry very firm. Clear to -
A12	0.08 to 0.25 m	Brownish black (10YR3/2); sandy clay; massive; dry very firm. Clear to -
B1	0.25 to 0.40 m	Brownish black (10YR3/2); sandy clay; moderate 10-20mm subangular blocky; moderately moist moderately strong. Gradual to -
B2t	0.40 to 0.70 m	Brownish black (10YR3/2); medium clay; strong 10-20mm angular blocky; moderately moist moderately strong. Gradual to -
BC	0.70 to 0.90 m	Dull yellowish brown (10YR5/4); medium clay; weak 20-50mm angular blocky; moderately moist moderately strong; common coarse carbonate nodules. Clear to -
C	0.90 to 1.50 m	Yellowish brown (10YR5/8); light medium clay; massive; moderately moist moderately firm; few coarse carbonate nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
08	6.6	.02	.002	47	26	7	17	13	8.4	3.4	.59	.22	7	.88	.015	0.59	.011	4.5	2.47
30	7.0	.03	.003	50	22	6	21	15	7.3	3.5	1.1	.12	10	.99	.012	0.66	.009	7.3	2.09
60	9.4	.22	.015	44	22	8	24	15	9.4	5.5	2.8	.25	11	.99	.008	0.60	.010	19	1.71
90	9.7	.48	.047	51	22	7	18	18	9.4	8.8	7.8	.21	13	.99	.013	0.84	.014	43	1.07
120	9.7	.49	.046	42	32	7	18	19	9.6	9.6	10	.15			.019	0.94	.008	53	1.00
150	9.5	.45	.048																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.8	.04	4	6	.20	62	22	0.6	0.2	

Goodbye

Location:	611300mE 7792300mN Zone 55	Site No:	S40
Landform element:	Plain	Microrelief description:	Linear gilgai
Landform pattern:	Level plain	Microrelief component:	Elongate mound
Slope:	0%	Permeability:	Slowly permeable
Principal Profile Form:	Gn3.03	Drainage:	Poorly drained
Australian Soil Classification:	Grey Sodosol	Substrate lithology:	Clay
Disturbance:		Surface coarse fragments:	
Vegetation:	*Corymbia dallachiana, Grevillea striata, Acacia salicina*	Surface condition:	Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Brownish black (10YR3/2); clay loam; massive; dry very firm. Clear to -
A2sb	0.10 to 0.20 m	Greyish yellow-brown (10YR4/2), dry sporadically bleached; very few fine faint yellow mottles; light clay; massive; dry very firm. Clear to -
B21t	0.20 to 0.50 m	Greyish yellow-brown (10YR4/2); few fine distinct yellow mottles; medium clay; moderate 10-20mm angular blocky; dry moderately strong; very few fine manganiferous concretions. Gradual to -
B22t	0.50 to 1.00 m	Black (10YR2/1); heavy clay; moderate 20-50mm angular blocky; moderately moist moderately strong; very few medium carbonate nodules. Gradual to -
BC	1.00 to 1.30 m	Dull yellowish brown (10YR4/3); heavy clay; moderate 10-20mm angular blocky; moderately moist very firm; few medium carbonate nodules. Gradual to -
C	1.30 to 1.50 m	Dull yellowish brown (10YR4/3); sandy clay; massive; moderately moist moderately firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.7	.05	.006	23	51	10	17	16	6.2	7.1	.64	.31	08	.72	.015	0.39	.018	4	0.90
30	7.7	.21	.033	31	38	10	21	17	6.0	8.4	1.3	.16	10	.85	.007	0.32	.009	8	0.71
60	8.6	.70	.101	24	31	15	34	26	8.3	15	3.9	.21	15	.98	.005	0.32	.019	15	0.55
90	8.8	1.1	.145	20	27	16	40	31	9.4	18	5.9	.16	18	.91	.006	0.30	.032	19	0.52
120	8.5	.66	.009	35	26	10	28	21	5.7	12	3.8	.17			.008	0.58	.016	18	0.48
150	8.8	.55	.073																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	0.5	.05	3	3	.25	26	42	2.1	0.2	

Goorganga

Location: 6mE 77mN Zone 55
Landform element: Back plain
Landform pattern: Alluvial plain
Slope: 1%
Principal Profile Form: Uf6.41
Australian Soil Classification: Vertic Hydrosol
Disturbance: Cleared
Vegetation: open grassland

Site No: PS47 (CO04)
Microrelief description: Nil
Microrelief component: Nil
Permeability: Slowly permeable
Drainage: Poorly drained
Substrate lithology: alluvium
Surface coarse fragments: Nil
Surface condition: hardsetting and cracking

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.15 m	Brownish black (10YR 3/2); light medium clay, very firm; clear to -
B21	0.15 to 0.45 m	Greyish yellow brown (10YR 4/2); medium heavy clay, very firm; clear to -
B22	0.45 to 0.80 m	Greyish yellow brown (10YR 6/2), medium clay; red mottles: clear to -
B23	0.80 to 1.40 m	Greyish yellow brown (10YR 6/2), medium clay; yellow mottles; clear to -

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.3	.10	.005	9	13	36	42	16	6.9	7.2	.29	.86	22	.40				2.0	0.96
30	5.6	.09	.005	3	11	31	58	20	7.2	10	.79	.35	22	.53				5.0	0.72
60	6.6	.45	.025	3	11	31	58	28	9.5	15	1.6	.49	20	.65				8.2	0.63
90	4.6	.17	.037	2	17	31	50	29	9.3	15	2.5	.49	19	.70				12.0	0.62
120	4.0	1.0	.018	3	20	32	45	21	6.6	9.8	1.9	.50						11.0	0.67

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.4	0.17	13	37	0.30	234	44	2.4	1.2	14.0

Habana

Location: 654244mE 7740073mN Zone 55
Landform element: Midslope
Landform pattern: Undulating low hills
Slope: 7%
Principal Profile Form: Uf6.13
Australian Soil Classification: Brown Dermosol
Disturbance: Limited clearing
Vegetation:

Site No: PS19 (422)
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Well drained
Substrate lithology: Andesite
Surface coarse fragments: Many coarse gravelly rhyolite
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.19 m	Brownish black (10YR3/1) moist; medium heavy clay; strong 5-10mm subangular blocky; dry firm. Abrupt to -
B1	0.19 to 0.47 m	Dull yellowish brown (10YR4/3) moist; very few fine faint red mottles; medium heavy clay; strong 5-10mm prismatic; dry firm. Abrupt to-
B21	0.47 to 0.57 m	Reddish brown (5YR4/3) moist; few medium distinct red mottles; medium heavy clay; moderate 10-20mm subangular blocky; dry very firm. Abrupt to -
B22	0.57 to 0.77 m	Bright yellowish brown (10YR6/6) moist; few medium faint brown mottles; medium heavy clay; moderate 10-20mm prismatic; dry very firm; few fine ferromanganiferous concretions. Abrupt to -
BC	0.77 to 1.02 m	Bright yellowish brown (10YR7/6) moist; fine sandy light clay; many medium gravelly, subangular unconsolidated material; massive; moist very firm. Abrupt to -

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.9	.04	.001	16	32	25	31	14	9.3	4.6	.14	.24	15	.45	.052	.100	.031	1.0	2.10
30	6.3	.03	.002	15	27	16	43	12	6.7	4.6	.20	.06	16	.53	.031	.071	.019	1.6	1.45
60	6.3	.03	.002	7	15	20	60	17	8.3	8.5	.40	.03	22	.39	.013	.032	.014	2.3	0.98
90	6.8	.02	.001	13	25	25	38	27	13	13	.74	.02	16	.61	.014	.029	.008	2.7	1.00
120	7.0	.04	.002	13	25	25	38	29	13	15	1.2	.03	17	.59	.012	.023	.007	4.1	0.87

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	3.2	0.17	10	31	0.33	75	84	1.7	2.6	7.0

Habana

Location: 650966mE 7734418mN Zone 55
Landform element: Crest
Landform pattern: Undulating low hill
Slope: 2%
Principal Profile Form: Db1.12
Australian Soil Classification: Brown Dermosol
Disturbance: Extensive clearing
Vegetation:

Site No: PS24 (439)
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Moderately well drained
Substrate lithology: Andesite
Surface coarse fragments: Common coarse gravelly rhyolite
Surface condition:

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.06 m	Brownish black (10YR3/2) moist; clay loam; few medium gravelly, subrounded unconsolidated material; weak 5-10mm prismatic; dry firm. Abrupt to -
B1	0.06 to 0.16 m	Dark greyish brown(10YR4/2) moist; few fine distinct brown mottles; light medium clay; few fine gravelly, subangular unconsolidated material; moderate 10-20mm prismatic; dry very firm. Abrupt to -
B21	0.16 to 0.22 m	Brown (7.5YR4/3) moist; few medium faint brown mottles; medium clay; few fine gravelly, subangular unconsolidated material; moderate10-20mm prismaticdry very firm. Abrupt to -
B3	0.22 to 0.36 m	Brown (7.5YR4/6) moist; common medium faint brown mottles; medium clay; weak 10-20mm prismatic; dry very firm. Abrupt to -
BC	0.36 to 0.55	Bright brown (7.5YR5/6) moist; sandy clay loam; many medium gravelly, angular unconsolidated material; dry very firm. Abrupt to -
C	0.47 to 0.55 m	Dull yellowish brown (10YR5/3) moist; coarse sand; abundant medium gravelly, angular unconsolidated material. Sharp to -
RSA		

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
		dS/m	%	%				meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.0	.04	.002	16	34	24	28	13	7.7	5.2	.16	.34	11	.61	.044	.596	.025	1.2	1.5
30	6.1	.03	.001	5	21	39	37	19	7.4	11	.51	.18	19	.52	.021	.677	.014	2.6	0.7
60	7.0	.03	.001	6	33	25	39	27	11	15	.88	.13	16	.59	.018	.776	.008	3.2	0.7
90	7.4	.03	.001	13	42	24	24	27	11	15	.87	.25	9	.67	.038	.876	.006	3.2	0.7

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.2	0.12	11	23	0.54	105	24	0.36	0.91	7.0

Hillrise

Location: 6mE 77mN Zone 55
Landform element: Fan
Landform pattern: Hill
Slope: 2 %
Principal Profile Form: Dy3.43
Australian Soil Classification: Brown Sodosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: PS55 (DB02)
Microrelief description: Nil
Microrelief component: Nil
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: alluvium
Surface coarse fragments: Common gravel
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.20 m	Greyish yellow brown (10YR 4/2); sandy loam; massive; clear to -
A2e	0.20 to 0.24 m	Greyish yellow brown (10YR 4/2); sandy loam; massive; abrupt to -
B21	0.24 to 0.90 m	Grey (10YR 6/1); medium clay; prismatic; mottled; clear to -
B22	0.90 to 1.50 m	Grey (10YR 6/1); light medium clay; prismatic; mottled

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
		dS/m	%	%				meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.1	.04	.001	30	46	16	9	5	1.4	1.8	BQ	.13	4	.85	.008	.733	.010		0.78
30	7.7	.09	.009	24	30	17	30	18	4.6	11	1.7	.13	14	.88	.005	.608	.009	9.4	0.42
60	9.0	.60	.057	25	27	12	37	21	5.2	14	3.2	.07	15	.82	.005	.763	.014	15.2	0.36
90	9.3	.59	.055	25	31	13	30	19	4.7	14	3.2	.09	13	.90	.004	.817	.021	16.8	0.33
120	9.3	.64	.065	29	33	11	27	19	3.7	14	3.3	.10			.008	1.17	.011	17.4	0.26
150	9.0	.60	.069	40	26	7	25	18	3.7	13	3.2	.09	13	.88	.012	1.42	.008	17.8	0.28

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.95	0.06	8.0	6.0	0.20	48	23	0.32	0.47	3.5
10	1.0	0.05	6.0	5.0	0.20	59	25	0.34	0.57	3.3

Hillsborough

Location:	668430mE 7738756mN Zone 55	Site No:	PS59 (WILUS 688)
Landform element:	Supratidal flat	Microrelief description:	Absent
Landform pattern:	Gently undulating plains	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Poorly drained
Principal Profile Form:	Ug5.24	Substrate lithology:	Alluvium
Australian Soil Classification:	Dermosolic, Extratidal Hydrosol	Surface coarse fragments:	Absent
Disturbance:	Cleared	Surface condition:	Periodic cracking, hardsetting
Vegetation:	*Corymbia tessellaris*, *Hibiscus tiliaceus*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.16 m	Very dark grey (10YR3/1) moist; medium clay; strong 5-10mm subangular blocky; moist moderately firm; abrupt to-
A3	0.16 to 0.36 m	Dark greyish brown (10YR4/2) moist; medium clay; strong 5-10mm subangular blocky; moist moderately firm; abrupt to-
B21	0.36 to 0.55 m	Olive grey (5Y5/2) moist; common medium distinct brown mottles; medium heavy clay; moderate 5-10mm lenticular; few fine manganiferous soft segregations; moist very firm; abrupt to-
B22	0.55 to 0.94 m	Grey (5Y6/1) moist; many coarse distinct orange mottles; medium heavy clay; moderate 5-10mm lenticular; moist very firm; abrupt to-
B23	0.94 to 1.51 m	Greenish grey (5GY6/1) moist; few medium distinct orange mottles; light medium clay; moderate 2-5mm lenticular; moist moderately firm;

Analytical data:

	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
Depth		dS/m	%		%			meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	4.9	.34	.004	11	6	35	40	21	12	7.7	.30	.52			.087	.889	.068		
10	5.1	.14	.004	8	10	35	41	20	11	7.4	.32	.30			.074	.897	.050	1.6	1.49
30	5.7	.03	.003	2	21	29	47	18	8.8	8.1	.59	.17			.042	.897	.028	3.3	1.09
60	6.5	.06	.007		41	22	39	18	7.1	9.2	1.1	.23			.014	1.08	.013	6.1	0.77
90	6.9	.39	.042	1	47	16	35	19	6.2	9.8	2.9	.21			.017	1.18	.020	15.3	0.63
120	6.7	1.8	.114	1	53	13	33	25	10	9.8	4.8	.14			.015	1.20	.130	19.2	1.02
150	5.8	2.4	.135	1	59	10	29	28	13	9.4	5.2	.13			.010	1.21	.209	18.6	1.38

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10										

Julian

Location:	669927mE 7745667mN Zone 55	Site No:	PILUS 1627
Landform element:	Upper slope	Microrelief description:	Absent
Landform pattern:	Undulating low hills	Permeability:	Slowly permeable
Slope:	15%	Drainage:	Moderately well drained
Principal Profile Form:	Uf6.3	Substrate lithology:	Andesite
Australian Soil Classification:	Leptic Rudosol to Red Dermosol	Surface coarse fragments:	Common subangular rhyolite or andesite cobbles
Disturbance:	Extensive clearing	Surface condition:	Hardsetting
Vegetation:	*Corymbia tessellaris*, *C. clarksoniania* and *Terminalia platyphylla*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.31 m	Brownish black (10YR3/1) moist; light medium clay; moderate 2-5mm subangular blocky; common medium gravelly, subangular rhyolite; firm.
B21	0.31 to 0.58 m	Brown (7.5YR4/4) moist; medium clay; moderate 5-10mm subangular blocky. Abrupt to -
BC	0.58 to 0.75 m	Dull yellowish brown (10YR5/3) moist; light medium clay; moderate 5-10mm prismatic; firm; moderately cemented discontinuous manganiferous pan;

Analytical data:

	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
Depth		dS/m	%		%			meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.1	.13	.006					28	18	8.4	.25	.46						0.9	2.14

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	5.3	0.44	56.0	59.0	0.52	183	135	2.3	4.4	11.0

Jumper

Location:	678600mE 7696100mN Zone 55	Site No:	MCL S03
Landform element:	Lowerslope	Microrelief description:	Absent
Landform pattern:	Undulating rises	Permeability:	Very slowly permeable
Slope:	4%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy3.33	Substrate lithology:	Sedimentary rock
Australian Soil Classification:	Brown to Grey Sodosol	Surface coarse fragments:	Very few medium pebbles
Disturbance:	Minor	Surface condition:	Hardsetting
Vegetation:	Woodland of *Eucalyptus platyphylla*, *Lophostemon sauveolens*, *Corymbia intermedia*, *Melaleuca nervosa*, *Themeda australis* and *Heteropogon contortus*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.22 m	Brownish black (7.5YR3/1) moist, brownish grey (10YR6/1) dry; few fine distinct brown mottles, few fine distinct grey mottles; sandy clay loam; moderate 5-10mm subangular blocky; dry moderately weak. Clear to -
A2	0.22 to 0.35 m	Greyish yellow-brown (10YR4/2) moist, greyish yellow-brown (10YR6/2) dry; sandy clay loam; many rounded unspecified coarse fragments; moderate; dry moderately weak. Clear to -
B21	0.35 to 0.70 m	Bright yellowish brown (10YR6/6) moist; common medium distinct grey mottles; medium heavy clay; strong; moderately moist very firm; few manganiferous nodules, slightly calcareous. Abrupt to -
B22	0.70 to 1.00 m	Dull yellowish orange (10YR6/6) moist; many medium distinct gley mottles; sandy clay; weak; dry very firm; many carbonate soft segregations, moderately calcareous. Abrupt to -
BC	1.00 to 1.20 m	Light grey (2.5Y8/1) moist; few fine distinct yellow mottles; light medium clay; moderate; dry very firm; many carbonate soft segregations, moderately calcareous.

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
		dS/m	%	%				meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.9	.02	.001	13	54	23	10	6	2.7	1.8	.17	.09	7		.024	0.21	.018	2.8	1.50
20	5.8	.02	.001																
30	6.1	.01	.001	18	48	20	14	6	.82	1.6	.28	.04	7		.023	0.26	.011	4.7	0.51
60	8.3	.10	.005	5	47	14	31	13	3.9	10	2.9	.09	13		.024	1.21	.008	22.3	0.39
90	9.8	.29	.020	1	59	18	20	15	5.3	10	4.9	.09	10		.005	2.02	.004	32.7	0.53
120	9.6	.44	.035	4	51	21	24	16	6.1	14	7.3	.14			.005	1.91	.006	45.6	0.44

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	1.9	.15	2	9	.10					
20	0.8	.04	2	90	.07					

Kailla

Location:	620400mE 7778800mN Zone 55	Site No:	S1
Landform element:	Plain	Microrelief description:	Absent
Landform pattern:	Level plain	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy5.11	Substrate lithology:	Granite
Australian Soil Classification:	Brown Sodosol	Surface coarse fragments:	
Disturbance:		Surface condition:	Soft
Vegetation:	Open forest of *Melaleuca viridiflora* and *Allocasuarina luehmannii*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Dark brown (10YR3/3); sand; single grain; moist moderately weak. Gradual to -
A3	0.10 to 0.35 m	Greyish yellow-brown (10YR5/2); sand; single grain; moist moderately weak. Clear to -
B2t	0.35 to 0.80 m	Greyish yellow-brown (10YR5/2); few coarse distinct red mottles; sandy clay; moderate 20-50mm angular blocky; moderately moist moderately strong. Abrupt to -
C	0.80 to 0.90 m	Dull yellowish orange (10YR6/3); massive; moderately moist moderately strong.

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
		dS/m	%	%				meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.5	.03	.003	74	21	3	1	1	.39	.20	.14	.05	1	.99	.006	0.46	.006	14	1.95
30	5.6	.01	.002	75	21	1	3	1	.26	.23	.21	.06	1	.99	.005	0.40	.002	21	1.13
60	5.9	.05	.005	51	24	3	20	9	.11	3.3	2.1	.06	9	.99	.006	0.53	.007	23	0.03
90	5.4	.15	.024	53	19	4	20	15	.14	6.4	5.8	.10	13	.99	.006	0.91	.032	39	0.02

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	0.4	.03	2	.09		59	1	0.1	0.4	

Kangaroo

Location:	598400mE 7789200mN Zone 55	Site No:	S32
Landform element:	Plain	Microrelief description:	Absent
Landform pattern:	Level plain	Permeability:	Poorly drained
Slope:	3%	Drainage:	Imperfectly to poorly drained
Principal Profile Form:	Dy3.43	Substrate lithology:	Cemented fine gravel
Australian Soil Classification:	Grey Sodosol	Surface coarse fragments:	Absent
Disturbance:		Surface condition:	Hardsetting
Vegetation:	Low open forest of *Allocasuarina luehmannii*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Dull yellowish brown (10YR4/3); light sandy clay loam; massive; dry moderately strong. Clear to -
A21cb	0.10 to 0.20 m	Dull yellowish orange (10YR6/4), dry conspicuously bleached; light sandy clay loam; massive; dry very firm. Clear to -
A22cb	0.20 to 0.35 m	Dull yellowish brown (10YR5/3), dry conspicuously bleached; light sandy clay loam; massive; dry very firm. Abrupt to -
B2t	0.35 to 0.50 m	Greyish yellow-brown (10YR5/2); few medium distinct brown mottles, few fine distinct red mottles; medium clay; moderate 10-20mm subangular blocky; moderately moist moderately strong. Gradual to -
B3t	0.50 to 0.75 m	Yellowish brown (10YR5/6); medium clay; massive; moderately moist moderately strong. Gradual to -
C	0.75 to 1.50 m	Dull yellowish brown (10YR5/4); sandy loam; massive; moderately moist moderately strong.

Analytical data:

	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
Depth (cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CE C	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.3	.01	.003	59	33	4	3	2	1.3	.47	.47	.14	02	.99	.005	1.45	.004	23	2.77
30	6.1	.08	.012	52	31	2	13	4	1.7	1.7	.93	.13	05	.99	.003	1.28	.006	23	1.00
60	5.9	.31	.040	33	35	5	25	10	2.7	3.7	2.9	.07	10	.99	.004	1.33	.014	29	0.73
90	8.7	.39	.051	33	37	10	18	13	2.4	5.8	5.1	.09	10	.65	.006	1.60	.014	39	0.41
120	9.4	.40	.043	41	30	17	14	12	2.8	5.3	5.3	.12			.008	1.36	.010	44	0.53
150	9.5	.58	.058																

Depth (cm)	% Org. C	% Tot. N	P mg/kg Acid	Bic	meq% Rep. K	mg/kg Fe	Mn	Cu	Zn	mg/kg SO4-S
10	0.3	.02	3	3	.08	26	5	0.1	0.1	

Koolachu

Location:	655589mE 7745537mN Zone 55	Site No:	PS15 (497)
Landform element:	Rise	Microrelief description:	Absent
Landform pattern:	Level plain	Permeability:	Moderately permeable
Slope:	0.5%	Drainage:	Moderately well drained
Principal Profile Form:	Dg2.31	Substrate lithology:	Tertiary sandstone
Australian Soil Classification:	Grey Sodosol	Surface coarse fragments:	Absent
Disturbance:	Extensive clearing	Surface condition:	Firm
Vegetation:	Melaleuca regrowth		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.09 m	Brownish grey (10YR4/1) moist; sandy loam; weak 10-20mm prismatic; dry weak. Abrupt to -
A2j	0.09 to 0.31 m	Light grey (10YR7/1) moist; sandy loam; weak 10-20mm prismatic; weak. Abrupt to -
B21	0.31 to 0.42 m	Greyish yellow (2.5Y7/2) moist; coarse sandy light clay; common coarse distinct orange mottles; weak 10-20mm prismatic; dry weak. Abrupt to -
B22	0.42 to 0.77 m	Light grey (2.5Y7/1) moist; coarse sandy medium clay; few medium distinct orange mottles; moderate 20-50mm prismatic; dry firm. Abrupt to -
B23	0.77 to 0.90	Light grey (2.5Y7/1) moist; coarse sandy medium heavy clay; very few medium distinct orange mottles; weak 10-20mm prismatic; dry strong. Abrupt to -
C	0.90 m to RSA	Light grey (2.5Y7/1) moist; single grain; dry weak.

Analytical data:

	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
Depth (cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CE C	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.2	.02	.002	37	48	11	7	1	.71	.43	.01	.07	1	.77	.007	.124	.012	1.0	1.65
30	6.6	.01		39	46	14	5	1	.33	.29	.01	.03	1	.83	.004	.113	.007	1.0	1.14
60	5.9	.04	.002	29	28	11	32	5	.69	3.3	.92	.03	9	.60	.006	.090	.011	18.4	0.21
90	5.8	.06	.002	25	33	13	31	6	.29	3.6	1.8	.04	12	.87	.005	.127	.011	30.0	0.08
120	5.3	.10	.009	15	37	14	34	9	.36	5.2	3.4	.05	15	.97	.005	.215	.009	37.8	0.07

Depth (cm)	% Org. C	% Tot. N	P mg/kg Acid	Bic	meq% Rep. K	mg/kg Fe	Mn	Cu	Zn	mg/kg SO4-S
Bulk 10	1.3	0.05	8	10	0.04	61	29	0.09	0.40	3.0

Koolachu

Location:	649965mE 7753958mN Zone 55	Site No:	PS37 (GB03)
Landform element:	Terrace plain	Microrelief description:	Absent
Landform pattern:	Gently undulating peneplain	Permeability:	Moderately permeable
Slope:	2%	Drainage:	Well drained
Principal Profile Form:	Dg4.41	Substrate lithology:	Tertiary sandstone
Australian Soil Classification:	Grey Sodosol	Surface coarse fragments:	Absent
Disturbance:	Extensive clearing	Surface condition:	Loose
Vegetation:	*Melaleuca viridiflora, Eucalyptus polycarpa*		

Profile Morphology:

Horizon	Depth	Description
A1j	0 to 0.05 m	Greyish yellow-brown (10YR5/2) moist; loamy sand; massive; dry very weak. Clear to -
A2e	0.07 to 0.36 m	Greyish yellow-brown (10YR6/2) moist; loamy sand; massive; dry very weak. Abrupt to -
B21	0.37 to 0.73 m	Light grey (10YR7/1) moist; few medium distinct brown mottles; coarse sandy medium clay; common fine gravelly rounded quartz; moderate 10-20mm prismatic; dry strong. Abrupt to -
BC	0.74 to 0.76 m	Dull yellowish orange (10YR7/2) moist; coarse sand; many medium gravelly rounded sandstone; weak 2-5mm prismatic; dry weak. Clear to -
C	0.76 m	

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
		dS/m	%		%			meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.8	.02	.000	46	49	2	6	1	.64	.60	.07	.10	1	.69	.006	.244	.013	7.0	1.05
30	5.6	.02	.000	56	40	2	5	1	.19	.61	.14	.07	1	.88	.003	.206	.011	14.0	0.31
60	5.6	.11	.010	37	33	5	27	7	.12	3.8	2.9	.14	11	.66	.006	.293	.016	41.4	0.03

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.55	0.02		2	0.07	35	1.7	0.02	0.09	2.4

Kowari

Location:	661500mE 7661600mN Zone 55	Site No:	MCL S41
Landform element:		Microrelief description:	Absent
Landform pattern:	Gently undulating plains	Permeability:	Moderately permeable
Slope:	3%	Drainage:	Well drained
Principal Profile Form:	Um5.52	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Brown Sodosol to Chromosol	Surface coarse fragments:	Abundant cobbles
Disturbance:		Surface condition:	Firm
Vegetation:			

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.40 m	Black (10YR2/1) moist, brownish grey (7.5YR4/1) dry; loam; many subangular unspecified coarse fragments; moderate 2mm granular; moderately moist very weak. Diffuse to -
B21	0.40 to 0.75 m	Brownish black (7.5YR3/2) moist; loam; abundant subangular unspecified coarse fragments; weak 2-5mm granular; moderately moist very weak.

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
		dS/m	%		%			meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.9	.04	.002												.172	1.38	.046		
10	5.7	.04	.003	29	35	18	31	42	8.1	2.9	.10	.71	20	.24	.224	1.30	.056	0.2	2.79
20	5.5	.02	.002																
30	5.5	.02	.002	33	26	16	29	40	6.8	1.7	.10	.71	18	.15	.224	1.25	.051	0.3	4.00
60	5.5	.01	.001	35	29	15	25	29	2.8	.69	.10	.49	16	.22	.152	1.29	.044	0.3	4.06
75	5.6	.01	.001																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	4.9	0.25	342	144	1.0	134	17	1.5	1.8	
10	6.4	0.27	318	198	0.64					
20	4.8	0.28	222	2.04	0.68					

Lascelles

Location:	665631mE 7734714mN Zone 55	Site No:	PS30 (AN04)
Landform element:	Terrace plain	Microrelief description:	Absent
Landform pattern:	Gently undulating peneplain	Permeability:	Moderately permeable
Slope:	1%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy3.43	Substrate lithology:	Unconsolidated alluvium
Australian Soil Classification:	Subnatric Sodosol	Surface coarse fragments:	Common gravelly subangular ironstone
Disturbance:	Limited clearing	Surface condition:	Firm
Vegetation:	*Corymbia tessellaris, C. intermedia, Melaleuca viridiflora, Planchonia careya*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.14 m	Greyish yellow-brown (10YR4/2) moist; clay loam; common fine gravelly subangular ironstone; weak 2-5mm subangular blocky; dry weak. Abrupt to -
A2m	0.14 to 0.61 m	Dull yellowish brown (10YR4/3) moist; fine sandy light clay; abundant fine gravelly subangular ironstone; massive; dry very weak. Abrupt to -
A22em	0.61 to 0.75 m	Greyish yellow-brown (10YR6/2) moist; coarse sandy clay loam; abundant fine gravelly subangular ironstone; massive; dry very weak. Abrupt to -
B21	0.75 to 1.02 m	Greyish yellow (2.5Y7/2) moist; many medium prominent red mottles; medium clay; common medium gravelly subangular ironstone; moderate 2-5mm prismatic; dry firm. Abrupt to -
B22	1.02 to 1.60 m	Light grey (2.5Y7/1) moist; common coarse prominent red mottles; medium heavy clay; strong 5-10mm lenticular; dry very firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.3	.06	.002	23	32	16	28	4	.84	2.8	.26	.29	11	.51	.079	.080	.040	6.5	0.30
30	5.5	.04	.001	25	29	14	31	3	.16	2.1	.45	.07	12	.46	.067	.077	.035	15.0	0.08
60	5.6	.04	.003	36	25	17	24	3	.13	2.9	.44	.02	10	.16	.070	.083	.029	14.7	0.05
90	5.3	.05	.005	23	17	14	48	4	.18	3.0	.65	.04	15	.11	.046	.102	.024	16.3	0.06
120	5.3	.04	.003	13	10	15	63	5	.05	4.0	1.1	.08			.020	.080	.017	22.0	0.01
150	5.2	.04	.003																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.9	0.12	12	12	0.34	85	160	0.96	0.42	33.0

Lillypool

Location:	655749mE 7763040mN Zone 55	Site No:	PS40 (1261) (GB06)
Landform element:	Crest	Microrelief description:	Absent
Landform pattern:	Rise	Permeability:	Slowly permeable
Slope:	1.5%	Drainage:	Imperfectly drained
Principal Profile Form:	Dg4.41	Substrate lithology:	Tertiary shale
Australian Soil Classification:	Subnatric Sodosol	Surface coarse fragments:	Many fine gravelly angular sandstone
Disturbance:	Extensive clearing	Surface condition:	Firm
Vegetation:	*Eucalyptus crebra*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.13 m	Greyish yellow-brown (10YR5/2) moist; fine sandy clay loam; few medium gravelly, angular sandstone; massive; dry very weak. Abrupt to -
A2e	0.14 to 0.38 m	Greyish yellow-brown (10YR6/2) moist, light grey (10YR8/1) moist; silty loam; common medium gravelly, angular sandstone; massive; dry very weak. Abrupt to -
B1	0.40 to 0.61 m	Greyish yellow (2.5Y6/2) moist; light medium clay; many medium gravelly, angular sandstone; weak 10-20mm prismatic; dry weak. Abrupt to -
B21	0.63 to 0.80 m	Greyish yellow (2.5Y6/2) moist; many medium prominent red mottles; medium clay; common fine gravelly, angular sandstone; weak 10-20mm lenticular; dry very firm. Abrupt to -
B22	0.82 to 1.55 m	Greyish yellow (2.5Y6/2) moist; many medium prominent red mottles; heavy clay; few fine gravelly, angular sandstone; moderate 10-20mm lenticular.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.7	.05	.003	18	44	27	14	3	1.4	1.7	.25	.13	6	.73	.017	.179	.024	8.3	0.82
30	6.1	.03	.002	12	45	33	13	2	.41	1.0	.29	.06	5	.89	.009	.170	.015	14.5	0.41
60	5.3	.23	.029	17	24	20	37	9	.24	6.4	1.7	.11	14	.89	.012	.345	.018	27.7	0.04
90	4.8	.61	.076	13	16	17	55	21	.11	11	7.2	.17	22	.96	.006	.485	.031	44.3	0.01
120	4.7	1.0	.130	4	14	24	58	25	.18	13	12	.23			.006	.607	.026	48.0	0.01
150	4.7	1.2	.186																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.3	0.08	6	3	0.10	59	19	0.12	0.37	4.1

Marian

Location: 714900mE 7660900mN Zone 55
Landform element:
Landform pattern: Alluvial plain
Slope: 0%
Principal Profile Form: Dy3.32
Australian Soil Classification: Brown Chromosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: MCL S27
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Absent
Surface condition:

Profile Morphology:

Horizon	Depth	Description
APsb	0 to 0.26 m	Brownish black (7.5YR3/1) moist, brownish grey (7.5YR5/1) dry; few faint brown mottles; sandy clay loam; moderately moist very weak. Clear to -
B1sb	0.26 to 0.40 m	Brownish grey (7.5YR4/1) moist; few fine distinct yellow mottles; light clay; moderately moist very weak; many manganiferous nodules. Abrupt to -
B21	0.40 to 0.75 m	Greyish brown black (7.5YR4/2) moist; many fine distinct yellow mottles; medium clay; strong; moderately moist moderately firm; few manganiferous nodules. Gradual to -
B22	0.75 to 1.20 m	Dull yellowish orange (10YR6/4) moist, yellowish grey (2.5Y6/1) moist; common fine distinct yellow mottles; light medium clay; strong; moderately moist moderately weak; few manganiferous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.7	.02	.001												.039	1.69	.018		
10	5.7	.02	.001	17	54	19	13	9	1.4	.94	.10	.28	6	.66	.042	1.67	.017	1	1.49
20	5.9	.01	.001																
40	6.1	.01	.001					9	2.9	1.2	.10	.07			.023	1.70	.011	1	2.41
60	6.2	.02	.001	8	37	10	48	15	6.1	3.1	.20	.14	18	.51	.029	1.45	.018	1	1.97
90	6.4	.02	.001	12	47	13	31	11	6.0	3.9	.20	.10	13	.48	.025	1.59	.009	1	1.54
120	6.7	.01	.001	4	51	17	30	12	6.8	5.0	.20	.11			.029	1.57	.006	1	1.36

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.3	.11	50	37	.33	220	40	1.0	2.2	
10	1.0	.10	70	46	.32					
20	.76	.05	11	10	.12					

Marlow

Location:
Landform element: Footslope
Landform pattern: Undulating rise
Slope: 6.0%
Principal Profile Form: Dy3.12
Australian Soil Classification: Grey Chromosol to Dermosol
Disturbance: Grazing
Vegetation: Cleared

Site No: PS09 (175)
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Well drained
Substrate lithology: Dacite
Surface coarse fragments: Many medium gravelly angular dacite
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.25 m	Brownish black (10YR3/2) moist; very few fine faint brown mottles; clay loam; few medium gravelly angular dacite; moderate 20-50mm subangular blocky; very few fine ferromanganiferous concretions. Clear to -
B21	0.29 to 0.42 m	Greyish yellow-brown (10YR4/2) moist; common medium distinct orange mottles; light medium clay; moderate 10-20mm prismatic; common fine ferromanganiferous concretions. Abrupt to -
B22	0.43 to 0.81 m	Greyish yellow-brown(10YR5/2) moist; common medium distinct brown mottles; medium heavy clay; few coarse gravelly subangular dacite; moderate 5-10mm lenticular; common fine ferromanganiferous concretions. Abrupt to -
BC	0.82 to 0.85 m	Massive.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.1	.04	.002	27	23	19	33	28	5.6	5.2	.18	.28	18	.46	.132	.149	.067	1.8	0.90
30	6.1	.02	.001	24	22	19	39	32	5.2	4.2	.17	.11	18	.52	.099	.116	.050	5.0	0.70
60	7.0	.02	.001	41	29	13	20	23	11	9.2	.44	.05	12	.66	.110	.095	.029	10.5	0.56
90	7.4	.02	.001	25	35	19	26	30	16	17	.56	.04	16	.71	.122	.247	.029	13.5	1.36

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.2	0.16		29		97	98	1.4	1.9	

Mentmore

Location: 705900mE 7678700mN Zone 55
Landform element:
Landform pattern: Undulating rises
Slope: 4%
Principal Profile Form: Dy2.41
Australian Soil Classification: Grey Sodosol to Chromosol
Disturbance:
Vegetation:

Site No: MCL S55
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Tuff
Surface coarse fragments: Few cobbles
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.1 m	Greyish yellow-brown (10YR4/2) moist, brownish grey (10YR6/1) dry; light sandy clay loam; dry moderately weak. Gradual to -
A21cb	0.15 to 0.30 m	Dull yellowish orange (10YR6/3) moist, light grey (10YR8/1) dry; sandy clay loam; dry moderately weak. Clear to -
A22cb	0.30 to 0.35 m	Dull yellowish orange (10YR6/3) moist, light grey (10YR8/1) dry; sandy clay loam; few subangular tuff; dry moderately weak. Abrupt to-
B21	0.35 to 0.60 m	Bright yellowish brown (10YR6/6) moist; medium clay; moderately moist very firm; few manganiferous nodules. Clear to -
C	0.60 to 0.90 m	Greyish yellow-brown (10YR6/2) moist; many fine distinct pale mottles; sandy clay; moderately moist moderately firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.8	.04	.003																
10	5.8	.03	.002	39	30	18	13	9	1.9	1.2	.08	.46	6	.69	.080	0.25	.016	0.9	1.58
25	5.9	.01	.001																
35	5.8	.01	.001	35	28	22	13	7	1.4	1.2	.07	.10	6	.86	.013	0.24	.009	1.0	1.17
60	5.8	.01	.001	26	16	15	43	18	3.2	4.9	.50	.15	15	.68	.008	0.40	.010	2.8	0.65
90	6.2	.03	.002	60	17	8	12	14	4.5	4.1	.20	.81	82	.30	.029	0.45	.003	1.4	1.10

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.2	0.15	7	12	0.3	186	25	0.4	1.0	
10	1.9	0.10	5	8	0.5	152	18	0.2	1.0	
20	0.8	0.05	3	4	0.2					

Merinda

Location: 621900mE 7784600mN Zone 55
Landform element: Plain
Landform pattern: Level plain
Slope: 0%
Principal Profile Form: Ug5.24
Australian Soil Classification: Grey Vertosol
Disturbance:
Vegetation: *Acacia salicina*

Site No: S38
Microrelief description: Normal gilgai
Microrelief component: Depression
Permeability: Slowly permeable
Drainage: Poorly drained
Substrate lithology: Clay
Surface coarse fragments: Nil
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A11	0 to 0.01 m	Brownish grey (10YR4/1); light medium clay; weak 2-5mm granular; dry very weak. Sharp to -
A12	0.01 to 0.10 m	Brownish grey (10YR4/1); medium heavy clay; moderate 5-10mm angular blocky; dry very firm. Clear to -
B1	0.10 to 0.50 m	Brownish grey (10YR4/1); heavy clay; strong 20-50mm lenticular; dry moderately strong. Clear to -
B2	0.50 to 0.90 m	Brownish grey (10YR4/1); heavy clay; weak 20-50mm lenticular; moderately moist very strong; very few medium carbonate nodules. Clear to -
C	0.90 to 1.50 m	Greyish olive (5Y5/2); very few fine distinct dark mottles; heavy clay; massive; moderately moist moderately strong.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	8.3	.04	.003	24	26	12	35						15	.65	.008	0.18	.011		
30	9.0	.08	.002	21	29	12	38	32	21	10	.98	.06	16	.99	.008	0.18	.019	3	2.10
60	9.1	.26	.025	18	27	11	42	35	18	13	2.8	.08	18	.83	.008	0.19	.024	8	1.38
90	8.7	.86	.100	18	25	13	43	37	18	16	4.7	.13	20	.79	.008	0.23	.025	13	1.13
120	8.2	1.2	.170	13	27	12	50	39	16	16	4.9	.26			.009	0.29	.025	13	1.00
150	7.9	1.3	.180																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	0.4	.03	3	2	.12	7	4	0.4	0.1	

Mirani

Location: 692000mE 7657400mN Zone 55
Landform element:
Landform pattern: Alluvial plain
Slope: 0%
Principal Profile Form: Dy5.82
Australian Soil Classification: Yellow Chromosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: MCL S59
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Moderately well drained
Substrate lithology: Unconsolidated substrate material
Surface coarse fragments: Absent
Surface condition:

Profile Morphology:

Horizon	Depth	Description
AP	0 to 0.10 m	Dark greyish yellow (2.5Y4/2) moist, light grey (2.5Y7/1) dry; sandy loam; dry moderately weak. Gradual to -
A2cb	0.10 to 0.40 m	Dark greyish yellow (2.5Y5/2) moist, light grey (2.5Y7/1) dry; sandy loam; dry moderately weak. Clear to -
A3cb	0.40 to 0.45 m	Dull yellow (2.5Y6/3) moist, light yellowish orange (10Y8/3) dry; few fine distinct yellow mottles; sandy clay loam; dry moderately weak; few manganiferous nodules. Clear to -
B21	0.45 to 0.65 m	Dull yellow (2.5Y6/3) moist; few fine distinct brown mottles; sandy clay; few angular unspecified coarse fragments; dry moderately firm; few manganiferous nodules. Gradual to -
B22	0.65 to 1.20 m	Bright yellowish brown (10Y6/6) moist; many fine distinct grey mottles; sandy clay; many angular unspecified coarse fragments; dry moderately firm; very few manganiferous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.2	.04	.004																
10	5.5	.07	.004	42	40	8	8	4	1.3	.59	.08	.33	3	.92	.029	1.35	.012	2.0	2.20
20	5.1	.03	.002																
30	5.0	.02	.001	43	36	14	9	4	.52	.23	.05	.15	3	.73	.025	1.48	.007	1.3	2.26
60	5.3	.02	.001	43	29	10	17	5	2.4	.36	.07	.10	6	.82	.014	1.55	.008	1.4	6.67
90	5.9	.03	.002	39	22	9	30	9	4.4	2.4	.30	.13	11	.82	.018	1.50	.008	3.3	1.83
120	6.3	.05	.003	31	30	10	27	11	5.1	3.9	.70	.12	12	.89	.019	1.47	.009	6.4	1.31

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.9	0.05	88	95	0.4	130	10	0.3	0.9	
10	0.9	0.05	108	108	0.4	144	10	0.4	1.3	
20	0.9	0.04	81	68	0.3					

Mundura

Location: 723000mE 7640800mN Zone 55
Landform element:
Landform pattern: Undulating rises
Slope: 4%
Principal Profile Form: Dr4.81
Australian Soil Classification: Brown Chromosol
Disturbance:
Vegetation:

Site No: MCL S45
Microrelief description: Absent
Permeability: Permeable
Drainage: Moderately well drained
Substrate lithology: Tuff
Surface coarse fragments: Very few gravel
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.15 m	Brownish black (7.5YR3/1) moist, brownish grey (7.5YR5/1) dry; sandy loam; few subangular quartz; moderately moist loose. Clear to -
A2cb	0.15 to 0.35 m	Dull yellowish brown (10YR5/3) moist, light grey (10YR7/1) dry; loamy sand; many subangular quartz; moderately moist loose. Abrupt to -
B21	0.35 to 0.70 m	Red (10R4/8) moist; few fine distinct yellow mottles; light clay; few subangular quartz; moderately moist moderately weak. Gradual to -
B22	0.70 to 1.10 m	Red (10R4/8) moist; few fine distinct yellow mottles; light clay; few subangular quartz; moderately moist moderately weak. Clear to -
BC	1.10 to 1.20 m	Red (10R4/8) moist; common fine distinct yellow mottles; light clay; few subangular quartz; moderately moist moderately weak.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.4	.02	.001																
10	5.6	.03	.001	59	29	4	7	6	.61	.44	.10	.19	3	.71	.014	1.14	.011	1.7	0.78
20	5.4	.02	.001																
30	5.3	.01	.001	56	30	6	6	3	.21	.04	.10	.08	2	.69	.009	1.46	.006	3.3	0.60
60	5.1	.02	.002	35	16	10	38	6	1.2	1.8	.10	.06	15	.01	.007	1.09	.009	1.7	0.44
90	5.1	.02	.002	39	21	14	38	6	.90	2.0	.10	.08	14	.04	.007	1.33	.012	1.7	0.23
120	5.1	.02	.002	24	22	14	39	7	.67	2.2	.10	.10			.006	1.70	.011	1.4	0.23

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.2	.10	5	7	.38	66	122	1.9	1.2	
10	2.0	.17	5	13	.47	110	206	2.6	1.8	
20	0.82	.07	2	4	.20					

Murray

Location: 688700mE 7681900mN Zone 55
Landform element:
Landform pattern: Flood plains
Slope: 0%
Principal Profile Form: Uc1.22
Australian Soil Classification: Stratic Rudosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: MCL S57
Microrelief description: Absent
Permeability: Highly permeable
Drainage: Well drained
Substrate lithology: Unconsolidated substrate material
Surface coarse fragments: Absent
Surface condition:

Profile Morphology:

Horizon	Depth	Description
AP	0 to 0.45 m	Brown (7.5YR4/3) moist, greyish yellow-brown (10YR6/2) dry; loam sand; moderately moist loose. Abrupt to -
2A1b	0.45 to 0.65 m	Greyish brown (7.5YR4/2) moist; clay loam, fine sandy; moderately moist moderately weak. Gradual to -
2B2b	0.65 to 1.20 m	Brown (7.5YR4/3) moist; light clay; moderately moist moderately weak.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	7.0	.02	.002																
10	5.6	.02	.002	65	27	4	2	6	2.9	1.5	.05	.13	3	1.5	.027	1.69	.007	0.8	1.93
20	5.3	.01	.001																
30	5.4	.01	.001	57	34	4	6	6	3.5	1.4	.05	.13	4	.38	.027	1.77	.008	0.8	2.50
60	4.7	.01	.001	23	43	18	15	15	8.9	1.7	.12	.12	9	.72	.040	1.79	.013	0.8	5.24
90	6.1	.01	.001	3	48	22	26	17	12	2.1	.18	.11	11	.62	.036	1.37	.014	1.1	5.71
120	6.2	.01	.001	4	45	22	29	17	14	2.8	.20	.11	13	.74	.031	1.26	.011	1.2	5.00

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.4	0.03	59	127	0.3	48	24	0.4	0.8	
10	0.3	0.03	90	36	0.2	69	21	0.4	0.9	
20	0.4	0.02	53	35	0.2					

Myrtle

Location: 668870mE 7744038mN Zone 55
Landform element: Backplain
Landform pattern: Floodplain
Slope: 1%
Principal Profile Form: Ug5.16
Australian Soil Classification: Haplic, Epipedal, Grey Vertosol
Disturbance: Grazing
Vegetation: Cleared

Site No: PS44 (1400)
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology:
Surface coarse fragments: Absent
Surface condition: Cracking, hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.08 m	Brownish black (10YR3/1) moist; light medium clay; moderate 2-5mm prismatic; firm. Abrupt to -
B21	0.08 to 0.27 m	Brownish grey (10YR4/1) moist; few fine faint brown mottles; medium clay; moderate 2-5mm prismatic; firm. Diffuse to -
B22	0.27 to 0.89 m	Brownish grey (10YR4/1) moist; few fine faint brown mottles; medium heavy clay; moderate 5-10mm lenticular; very firm; few fine ferromanganiferous concretions. Clear to -
B23	0.89 to 1.44 m	Brownish grey (10YR6/1) moist; few medium distinct brown mottles; heavy clay; strong 10-20mm lenticular; very firm; few fine ferromanganiferous concretions.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.7	.05	.002	IS	IS	IS	IS	20	11	7.0	.41	.39	21	IS				2.0	1.57
30	6.2	.03	.002	1	12	28	57	20	11	6.9	.69	.28	22	.60				3.0	1.65
60	6.4	.05	.005	1	8	21	71	27	15	9.2	1.6	.40	29	.52				6.0	1.63
90	6.6	.10	.011	1	9	25	64	33	19	11	2.3	.42	26	.73				7.0	1.70
120	7.0	.20	.025	2	12	27	57	35	19	11	3.2	.36						9.0	1.70
150	7.4	.34	.045																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	3.1	0.29	1.0	22	0.43	225	62	2.2	2.2	18.0

Nabilla

Location: 704000mE 7658100mN Zone 55
Landform element:
Landform pattern: Undulating rises
Slope: 4%
Principal Profile Form: Gn3.72
Australian Soil Classification: Brown Dermosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: MCL S50
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Well drained
Substrate lithology: Andesite
Surface coarse fragments: Absent
Surface condition:

Profile Morphology:

Horizon	Depth	Description
AP	0 to 0.25 m	Brownish black (7.5YR2/2) moist, greyish brown (7.5YR4/2) dry; clay loam; moderately moist moderately weak; many manganiferous nodules. Clear to -
A12	0.25 to 0.35 m	Brownish black (7.5YR3/2) moist; light clay; moderately moist moderately weak; many manganiferous nodules. Gradual to -
B21	0.35 to 0.70 m	Yellowish brown (10YR5/6) moist; few fine prominent red mottles, few fine distinct grey mottles; medium heavy clay; moderately moist moderately firm; few manganiferous nodules. Clear to -
BC	0.70 to 0.80 m	Yellowish orange (10YR7/8) moist, brownish grey (10YR6/1) moist; medium clay; moderately moist moderately firm; very few manganiferous nodules. Abrupt to -
C	0.80 to 0.85 m	Light clay; few angular andesite; moderately moist very weak.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CE C	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.2	.04	.001																
10	5.1	.05	.001	37	35	16	14	17	2.2	1.3	.53	.08	11	.72	.053	0.38	.013	3	1.7
20	5.0	.04	.001																
35	5.4	.02	.001	48	26	13	17	17	2.8	1.7	.55	.07	12	.65	.027	0.43	.011	3	1.6
60	6.1	.02	.001	8	13	17	64	28	8.3	9.3	.16	.12	28	.36	.013	0.11	.011	1	0.9
80	6.4	.02	.001																
85	6.7	.02	.001	35	29	24	17	24	12	12	.38	.05	14	.59	.016	0.37	.006	1	1.0

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	.88	.06	13	32	.30	92	182	2.9	1.3	
10	1.0	.07	15	44	.33	97	172	2.8	1.4	
20	.64	.07	10	31	.25					

Narpi

Location: 693100mE 7679200mN Zone 55
Landform element:
Landform pattern: Alluvial plain
Slope: 0%
Principal Profile Form: Dy3.33
Australian Soil Classification: Grey, Subnatric Sodosol
Disturbance:
Vegetation:

Site No: MCL S10
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Unconsolidated substrate material
Surface coarse fragments: Absent
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.01 m	Greyish yellow-brown (10YR4/2) moist, brownish grey (10YR5/1) dry; few fine distinct brown mottles; clay loam, fine sandy; moderate; dry. Abrupt to -
A2sb	0.01 to 0.15 m	Greyish yellow-brown (10YR4/2) moist; few fine distinct brown mottles; clay loam, fine sandy; moderate; dry; very few manganiferous nodules. Clear to -
B1sb	0.15 to 0.20 m	Dull yellowish brown (10YR5/3) moist; light clay; moderately moist; very few manganiferous nodules. Abrupt to -
B21	0.20 to 0.50 m	Dull yellowish orange (10YR6/4) moist; few medium faint yellow mottles; heavy clay; moderately moist; few manganiferous nodules. Clear to -
B22	0.50 to 0.70 m	Dull yellowish brown (10YR5/3) moist; few medium faint yellow mottles; heavy clay; moderately moist; few manganiferous nodules.
B23	0.70 to 0.90 m	Dull yellowish orange (10YR6/3) moist; few medium distinct yellow mottles; medium clay; moderately moist; very few manganiferous nodules.
B24	0.90 to 1.15 m	Dull yellowish orange (10YR6/3) moist; medium clay; moderately moist.
D1	1.15 to 1.20 m	Brownish grey (10YR5/1) moist; medium clay; moderately moist; very few carbonate soft segregations; very few manganiferous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CE C	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.5	.03	.003					18	4.4	2.9	0.1	.34			.026	.58	.021	0.5	1.5
10	5.8	.02	.002	15	22	32	35	18	3.8	2.7	0.2	.20	14		.024	.57	.014	1.0	1.4
20	5.8	.02	.002																
30	5.9	.02	.002	6	14	21	61	30	9.0	5.9	0.9	.27	22		.015	.58	.009	3.0	1.5
60	6.5	.10	.016	10	18	18	53	32	16	10	1.8	.08	21		.014	.57	.006	5.6	1.6
90	7.9	.19	.029	17	36	15	33	24	14	9.2	2.2	.06	16		.017	.98	.004	9.2	1.5
120	8.0	.38	.056	3	17	29	50	33	19	13	3.6	.10			.016	1.07	.003	10	1.5

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.8	.17	7	13	.29	172	126	1.7	1.9	
10	.98	.09	4	8	.17					
20	.59	.07	23	4	.16					

Narpi

Location:	658056mE 7727969mN Zone 55	Site No:	PS29 (AN03)
Landform element:	Drainage depression	Microrelief description:	Normal gilgai
Landform pattern:	Peneplain	Permeability:	Slowly permeable
Slope:	0.5%	Drainage:	Imperfectly drained
Principal Profile Form:	Uf6.13	Substrate lithology:	Tertiary sandstone
Australian Soil Classification:	grey Sodosol	Surface coarse fragments:	Absent
Disturbance:	Grazing	Surface condition:	Hardsetting
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.09 m	Greyish yellow-brown (10YR4/2) moist; fine sandy light clay; moderate 2-5mm subangular blocky; dry weak. Abrupt to -
A2	0.11 to 0.29 m	Greyish yellow-brown (10YR6/2) moist; fine sandy light clay; moderate 5-10mm subangular blocky; dry firm. Abrupt to -
B21	0.30 to 0.40 m	Dull yellow (2.5Y6/3) moist; fine sandy medium clay; moderate 10-20mm prismatic; dry very firm. Abrupt to -
BC1	0.41 to 0.84 m	Dark greyish yellow (2.5Y5/2) moist; many medium distinct brown mottles; heavy clay; strong 20-50mm lenticular; dry very strong; few fine ferromanganiferous concretions. Abrupt to -
BC2	0.86 to 1.68 m	Yellowish brown (10YR5/4) moist; common coarse faint brown mottles; fine sandy medium clay; moderate 10-20mm prismatic; dry very firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.3	.07	.004	14	44	18	25	4	2.3	1.6	.19	.32	9	.66	.023	1.28	.026	4.8	1.44
30	6.6	.01		19	35	18	28	5	2.3	2.2	.26	.11	9	.77	.008	1.25	.009	5.2	1.05
60	6.3	.07	.010	16	26	11	49	15	5.5	7.8	1.4	.23	17	.70	.011	1.11	.010	9.3	0.73
90	7.1	.32	.040	19	34	9	38	16	5.4	7.5	2.9	.20	19	.80	.011	1.28	.009	18.0	0.71
120	8.8	.75	.087	14	42	11	36	23	9.3	8.2	5.4	.18	15	.88	.030	1.29	.007	23.5	1.13
150	9.1	.82	.104																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.6	0.15	8	11	0.28	152	63	0.89	1.5	10.0

Narpi

Location:	660862mE 7735864mN Zone 55	Site No:	PS34 (903) (AN08)
Landform element:	Terrace flat	Microrelief description:	Normal gilgai
Landform pattern:	Flood plain	Permeability:	Slowly permeable
Slope:	1.0%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy3.43	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Grey Sodosol	Surface coarse fragments:	Absent
Disturbance:	Limited clearing	Surface condition:	Hardsetting
Vegetation:	*Eucalyptus platyphylla, E. polycarpa, Melaleuca viridiflora*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.18 m	Greyish yellow-brown (10YR5/2) moist; silty clay loam; moderate 5-10mm prismatic; dry weak. Abrupt to -
B21	0.19 to 0.61 m	Dull yellow (2.5Y6/4) moist; few medium faint brown mottles; medium heavy clay; moderate 10-20mm prismatic; dry very firm. Abrupt to-
D1	0.63 to 1.32 m	Brownish grey (10YR4/1) moist; few medium faint brown mottles; medium heavy clay; strong 10-20mm lenticular; dry strong; few medium manganiferous soft segregations. Abrupt to -
D2	1.34 to 1.62 m	Brownish grey (10YR6/1) moist; common medium distinct brown mottles; medium heavy clay; moderate 10-20mm prismatic; dry very firm; very few fine manganiferous soft segregations.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.2	.03	.001	2	45	40	14	5	2.6	1.7	.18	.15	6	.76	.014	.343	.018	3.6	1.53
30	5.7	.05	.004	2	25	30	45	13	6.0	5.3	1.1	.18	18	.89	.009	.504	.014	8.50	1.13
60	5.7	.21	.027	1	15	37	48	20	9.6	7.4	2.6	.23	19	.87	.008	.618	.014	13.0	1.30
90	6.8	.48	.067	1	11	35	52	26	12	8.3	5.0	.27	20	.73	.007	.667	.014	19.2	1.45
120	7.5	.69	.103	1	9	32	59	30	14	9.1	6.9	.26			.009	.655	.016	23.0	1.54
150	7.8	.72	.110																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.2	0.07	5	4	0.19	65	52	0.58	1.2	4.4

Neils

Location:	718300mE 7676400mN Zone 55	Site No:	MCL S22
Landform element:	Dune	Microrelief description:	Absent
Landform pattern:	Beach dune	Permeability:	Highly permeable
Slope:	3%	Drainage:	Well drained
Principal Profile Form:	Dy5.81	Substrate lithology:	Sand
Australian Soil Classification:	Arenic Rudosol to Hydrosol	Surface coarse fragments:	Absent
Disturbance:		Surface condition:	Loose
Vegetation:			

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.15 m	Brownish grey (7.5YR4/1) moist, brownish grey (7.5YR5/1) dry; loamy sand; sandy; moderately moist loose. Clear to -
A2cb	0.15 to 0.50 m	Greyish brown (7.5YR6/2) moist, light grey (10YR7/1) dry; loamy sand; sandy; moderately moist loose. Abrupt to -
A22cb	0.50 to 0.58 m	Greyish yellow-brown (10YR6/2) moist; loamy sand; sandy; moderately moist loose; many ferruginous concretions. Abrupt to -
B21	0.58 to 0.90 m	Dull yellow (2.5YR6/4) moist; few medium distinct grey mottles, few fine distinct yellow mottles; sandy clay; moderate; smooth-ped; moist very weak; few ferruginous concretions. Diffuse to -
B22	0.90 to 1.20 m	Greyish yellow (2.5Y7/2) moist; few fine distinct yellow mottles; sandy clay; weak; smooth-ped; wet very weak; few ferruginous concretions.

Analytical data:

	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
Depth		dS/m	%	%				meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.9	.02	.001												.014	0.50	.015		
10	6.1	.03	.002	16	76	6	6	5	2.1	.72	.10	.13	5	.12	.017	0.57	.018	2.0	2.92
20	6.0	.02	.002																
30	6.4	.01	.001	14	80	3	6	1	.62	.20	.10	.05	1	.39	.005	0.43	.003	10.0	3.10
60	6.5	.01	.001	14	69	4	16	2	.97	.25	.10	.09	4	.43	.006	0.56	.005	5.0	3.88
90	7.4	.02	.001	15	58	4	27	5	1.5	1.4	.10	.19	9	.02	.010	0.58	.008	2.0	1.07
120	6.8	.02	.001	14	60	5	22	4	.81	1.8	.10	.20			.010	0.58	.009	2.5	0.45

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.90	0.08	10	8	0.11	82	32	0.2	1.0	
10	0.82	0.09	17	9	0.14					
20	0.76	0.05	10	8	0.11					

Nessvale

Location:	588800mE 7796400mN Zone 55	Site No:	S24
Landform element:	Levee	Microrelief description:	Absent
Landform pattern:	Gently undulating plains	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Moderately well or imperfectly drained
Principal Profile Form:	Gn3.22	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Brown Sodosol	Surface coarse fragments:	
Disturbance:		Surface condition:	Hardsetting
Vegetation:			

Profile Morphology:

Horizon	Depth	Description
A11	0 to 0.10 m	Dark brown (10YR3/3); loamy sand; massive; dry moderately firm. Gradual to -
A12	0.10 to 0.20 m	Dull yellowish brown (10YR5/3), dry sporadically bleached; loamy sand; massive; dry moderately firm. Abrupt to -
B1	0.20 to 0.60 m	Dull yellowish brown (10YR4/3); medium heavy clay; strong 50-100mm angular blocky; dry very strong; very few fine manganiferous concretions. Clear to -
B21t	0.60 to 1.00 m	Brown (10YR4/4); heavy clay; strong 20-50mm angular blocky; moderately moist moderately strong; very few medium carbonate nodules, very few fine manganiferous concretions. Clear to -
B22t	1.00 to 1.50 m	Dark brown (10YR3/3); medium clay; weak angular blocky; moderately moist moderately strong; very few medium carbonate nodules.

Analytical data:

	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
Depth		dS/m	%	%				meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.5	.09	.009	35	42	11	10	8	5.5	2.1	.43	.56	07	.87	.038	1.72	.023	7	0.79
30	6.7	.08	.009	33	40	13	14	8	5.4	2.5	.40	.38	08	.99	.019	1.67	.011	9	0.46
60	6.8	.04	.004	25	41	12	22	12	5.5	4.0	.42	.22	10	.86	.018	1.64	.009	16	0.36
90	7.0	.05	.005	27	34	9	28	8	5.6	4.6	.54	.24	11	.66	.023	1.58	.007	19	0.38
120	7.3	.05	.006	31	33	8	24	12	5.8	4.6	.65	.26			.024	1.68	.007	20	0.38
150	7.4	.07	.008																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	1.1	.10	26	20	.68	75	51	1.4	4.3	

Netherdale

Location: 673100mE 7660800mN Zone 55
Landform element:
Landform pattern: Rolling rises
Slope: 18
Principal Profile Form: Uf6.4
Australian Soil Classification: Brown Dermosol
Disturbance:
Vegetation: Open woodland of *Corymbia intermedia*, *Eucalyptus tessellaris* and *E. crebra*

Site No: MCL S39
Microrelief description: Absent
Permeability: Highly permeable
Drainage: Well drained
Substrate lithology: Syenite rocks
Surface coarse fragments: Few gravel
Surface condition:

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Brown (7.5YR4/3) moist; light clay; strong 2-5mm granular; moderately moist moderately weak. Clear to -
B3	0.10 to 0.25 m	Dull yellowish brown (10YR5/4) moist; common fine distinct pale mottles; light clay; moderate 20-50mm prismatic weak 10-20mm angular blocky; moderately moist moderately weak. Gradual to -
C1	0.25 to 0.50 m	Sandy clay loam; moderately moist very weak. Diffuse to -
C2	0.50 to 1.05 m	Sandy loam; moderately moist loose. Diffuse to -
C3	1.05 to 1.20 m	Sandy loam; few angular quartz; moderately moist loose.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.6	.02	.002												.043	1.04	.020		
10	5.4	.02	.002	20	21	20	42	21	8.1	6.2	.15	.29	19	.58	.043	1.02	.020	0.7	1.31
20	5.5	.01	.001																
35	5.8	.01	.001	31	26	14	31	16	9.8	6.0	.25	.13	15	.49	.076	1.02	.013	1.6	1.63
60	6.3	.01	.001	44	30	10	17	11	11	5.9	.26	.10	11	.49	.105	1.02	.010	2.4	1.86
90	6.4	.01	.001	56	27	7	13	9	11	5.4	.29	.09	8	.52	.118	0.96	.007	3.2	2.04
120	6.7	.01	.001	65	22	4	10	10	11	5.2	.25	.10			.155	1.29	.007	2.5	2.12

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.6	0.11	8	10	0.32	65	13	0.9	0.7	
10	1.3	0.10	5	7	0.26					
20	0.68	0.08	6	7	0.18					

Nilotica

Location: 628200mE 7787900mN Zone 55
Landform element: Plain
Landform pattern: Level plain
Slope: 0%
Principal Profile Form: Uf6.11
Australian Soil Classification: Grey Sodosol
Disturbance:
Vegetation: Low open woodland of *Acacia nilotica*, *A. farnesiana*

Site No: S52
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Clay
Surface coarse fragments:
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A11	0 to 0.10 m	Brownish black (10YR3/2); sandy clay; strong 10-20mm subangular blocky; dry very firm. Gradual to -
A12	0.10 to 0.60 m	Black (10YR2/1), medium clay; weak 5-10mm subangular blocky; moderately moist moderately firm. Clear to -
C	0.60 to 0.90 m	Dull yellowish brown (10YR4/3); sandy clay; massive; moderately moist moderately firm. Clear to -
D1	0.90 to 1.40 m	Brownish black (2.5Y3/2); silty clay; massive; moist moderately firm. Clear to -
D2	1.40 to 1.50 m	Dark greyish yellow (2.5Y4/2); very few medium distinct yellow mottles; sandy clay loam; massive; moist moderately weak.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	7.0	.63	.078	19	51	13	21	16	4.6	5.6	3.9	.14	09	.91	.029	0.93	.026	4.8	0.74
30	8.6	1.3	.135	13	46	13	32	22	6.7	7.5	13	.22	16	.99	.014	0.72	.023	14.5	0.46
60	8.7	2.0	.235	30	36	11	25	18	3.3	5.6	13	.27	13	.99	.008	0.38	.057	26.2	0.21
90	9.0	1.1	.135	14	37	23	31	27	4.5	7.4	24	.39	23	.99	.010	0.48	.051	27.2	0.21
120	8.8	1.2	.155	3	50	21	30	25	3.7	7.1	22	.29			.008	0.54	.038	28.3	0.23
150	9.0	.06	.006																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	1.0	.08	165	19	.32	50	40	2.3	4.7	

Ossa

Location:	696200mE 7679300mN Zone 55	Site No:	MCL S17
Landform element:	Fan	Microrelief description:	Absent
Landform pattern:	Gently undulating rises	Permeability:	Slowly permeable
Slope:	3%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy3.42	Substrate lithology:	Unconsolidated substrate material
Australian Soil Classification:	Brown Sodosol	Surface coarse fragments:	Absent
Disturbance:		Surface condition:	Hardsetting
Vegetation:			

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.15 m	Greyish yellow-brown (10YR4/2) moist; loam, fine sandy; dry. Abrupt to -
A2cb	0.15 to 0.40 m	Greyish yellow-brown (10YR6/2) moist; loam, fine sandy; dry. Clear to -
B1	0.40 to 0.55 m	Dull yellowish orange (10YR6/3) moist; common medium distinct yellow mottles, common medium distinct grey mottles; light medium clay; few subangular unspecified coarse fragments, few subangular quartz; moderately moist very firm. Abrupt to -
B21	0.55 to 1.10 m	Yellowish brown (10YR5/8) moist, greyish yellow-brown (10YR6/2) moist; medium heavy clay; moderately moist moderately strong; very few manganiferous soft segregations. Clear to -
(D)	1.10 to 1.20 m	Greyish yellow-brown (10YR6/2) moist; few fine distinct yellow mottles; light medium clay; few subangular unspecified coarse fragments; moderately moist moderately strong; very few manganiferous soft segregations.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.3	.03	.003					9	1.4	0.9	0.1	.14			.015	.35	.012	1	1.56
10	5.4	.03	.002	9	65	17	12	6	1.1	0.4	0.1	.11	5	.48	.013	.33	.011	1	2.75
15	5.6	.02	.002																
30	6.0	.01	.001	6	69	16	11	3	0.8	0.2	0.1	.03	3	.72	.009	.36	.005	3	4.00
50	5.9	.03	.003	6	54	15	28	11	2.5	1.5	6.5	.11	10	.79				59	1.70
90	6.5	.12	.017	5	43	14	41	17	6.7	3.6	2.1	.05	14	.88	.010	1.07	.005	12.3	1.86
120	7.4	.17	.023	9	47	17	31	15	6.6	3.1	2.4	.05			.010	1.27	.003	16	2.13

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.1	.10	4	6	.15	64	46	0.1	2.9	
10	1.0	.09	4	4	.12					
20	.61	.05	6	6	.08					

Ossa 1 (Cobbly variant)

Location:	671634mE 7759399mN Zone 55	Site No:	WILUS 224
Landform element:	Fan	Microrelief description:	Absent
Landform pattern:	Gently undulating plains	Permeability:	Slowly permeable
Slope:	3%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy3.22	Substrate lithology:	
Australian Soil Classification:	Mesotrophic, Mottled-Subnatric, Brown Sodosol	Surface coarse fragments:	Common cobbles, subangular Rhyolite
Disturbance:	Extensive clearing	Surface condition:	Hardsetting
Vegetation:	*Eucalyptus platyphylla, Planchonia careya, Paspalum dilatatum*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.08 m	Dark greyish brown (10YR4/2) moist; sandy clay loam; few medium pebbles, subangular rhyolite; weak 2-5mm prismatic; moist moderately weak. Sharp to-
A2j	0.08 to 0.21 m	Greyish brown (10YR5/2) moist; sandy clay loam; few medium pebbles, subangular rhyolite; weak 2-5mm prismatic; moist moderately weak. Sharp to-
B1	0.21 to 0.34 m	Brown (10YR5/3) moist; common medium distinct brown mottles; fine sandy clay loam; moderate 5-10mm prismatic; very few fine manganiferous soft segregations; moist very firm. Abrupt to-
B21	0.34 to 0.58 m	Greyish brown (2.5Y5/3) moist; few medium distinct brown mottles; medium heavy clay; few small pebbles, rounded gravel; moderate 5-10mm lenticular; very few fine manganiferous soft segregations; moist very firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.6	.05	.002	15	36	28	17	9	4.6	3.6	.17	.27	8	.76	.038	.522	.022	1.8	1.28
45	7.2	.14	.017	15	16	20	51	25	7.3	15	2.9	.23	21	.83	.022	.466	.013	11.6	0.49

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	2.4	0.15	12.0	12.0	0.30	71	69	0.61	0.75	6.9

Palmyra

Location: 713600mE 7648600mN Zone 55
Landform element:
Landform pattern: Undulating rises
Slope: 3%
Principal Profile Form: Dy3.41
Australian Soil Classification: Grey Sodosol
Disturbance:
Vegetation:

Site No: MCL S52
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Moderately well drained
Substrate lithology: Sedimentary rocks
Surface coarse fragments: Few cobbles
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
APsb	0 to 0.10 m	Dark greyish yellow (2.5Y4/2) moist, light grey (2.5Y7/1) dry; few fine faint brown mottles; sandy clay loam; dry moderately weak. Clear to -
A2cb	0.10 to 0.45 m	Light grey (10YR8/1) dry; sandy clay loam; abundant subangular unspecified coarse fragments; dry. Gradual to -
A3cb	0.45 to 0.50 m	Greyish yellow-brown (10YR5/2) moist, light grey (10YR8/1) dry; sandy clay loam; abundant subangular unspecified coarse fragments; dry. Clear to -
B21	0.50 to 0.70 m	Greyish olive (5Y5/2) moist; common fine distinct grey mottles, common fine distinct yellow mottles; medium clay; many subangular unspecified coarse fragments; moderately moist moderately firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.3	.09	.003																
10	5.5	.04	.004	19	34	31	12	12	6.6	1.4	.19	.18	6	.83	.025	0.57	.020	2	4.7
20	5.4	.05	.006																
30	5.7	.01	.002	32	28	28	12	1	NS	L			6	.78	.028	0.87	.010		
60	5.2	.02	.002	17	17	24	40	14	2.1	5.7	.78	.10	14	.81	.010	0.75	.007	6	0.4

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.1	.17	10	12	.4	207	49	0.7	1.5	
10	2.0	.15	10	12	.4	200	48	0.7	1.1	
20	1.2	.05	4	6	.2					

Pennsfield

Location: 617300mE 7783000mN Zone 55
Landform element: Plain
Landform pattern: Gently undulating plains
Slope: 1%
Principal Profile Form: Dr2.43
Australian Soil Classification: Brown Sodosol
Disturbance:
Vegetation:

Site No: S28
Microrelief description: Absent
Permeability: Slowly to moderately permeable
Drainage: Well to moderately well drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments:
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Brownish black (10YR3/2); sandy loam; massive; dry moderately firm. Clear to -
A2cb	0.10 to 0.20 m	Dull yellowish brown (10YR4/3), dry conspicuously bleached; loamy fine sand; massive; dry moderately firm. Abrupt to -
B21t	0.20 to 0.40 m	Dull reddish brown (5YR4/4); medium heavy clay; strong 20-50mm angular blocky; dry very strong. Clear to -
B22tk	0.40 to 0.70 m	Dull reddish brown (5YR4/4); medium clay; strong 50-100mm prismatic; dry moderately strong; common medium carbonate nodules. Clear to -
B23tk	0.70 to 1.00 m	Brown (7.5YR4/4); light medium clay; moderate 20-50mm angular blocky; dry very firm; few medium carbonate nodules. Clear to -
C	1.00 to 1.50 m	Brown (7.5YR4/4); light medium clay; massive; moderately moist moderately firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	7.1	.03	.005	17	67	8	8	10	4.3	2.9	.10	.11	05	.36	.044	1.06	.019	1	1.50
30	7.5	.07	.008	14	54	6	25	14	4.4	7.4	1.3	.07	13	.87	.017	0.77	.011	9	0.60
60	9.2	.48	.051	10	51	10	29	18	5.3	11	3.1	.11	13	.75	.030	0.77	.022	17	0.48
90	9.5	.57	.056	11	57	10	22	15	3.5	9.7	3.9	.14	11	.98	.056	0.88	.015	26	0.36
120	9.6	.49	.042	12	59	10	18	14	3.2	9.2	4.0	.15			.058	0.98	.009	28	0.34
150	9.6	.55	.046																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	0.9	.08	81	8	.24	34	17	0.5	2.9	

Pindi

Location: 681800mE 7693400mN Zone 55
Landform element:
Landform pattern: Undulating rises
Slope: 4%
Principal Profile Form: Dy2.31
Australian Soil Classification: Grey Chromosol to Sodosol
Disturbance:
Vegetation: *Eucalyptus tereticornis*, *Corymbia intermedia*, *E platyphylla* and *Lophostemon sauveolens*

Site No: MCL S12
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Moderately well drained
Substrate lithology: Sedimentary rocks
Surface coarse fragments: Very few medium pebbles
Surface condition:

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.02 m	Brownish grey (10YR5/1) moist, greyish yellow-brown (10YR6/2) dry; sandy clay loam; dry. Abrupt to -
A2sb	0.02 to 0.25 m	Brownish grey (10YR5/1) moist; sandy clay loam; many rounded unspecified coarse fragments; dry. Abrupt to -
A3	0.25 to 0.32 m	Dull yellowish brown (10YR5/3) moist; sandy clay loam; abundant rounded unspecified coarse fragments; dry. Abrupt to -
B21	0.32 to 0.55 m	Bright yellowish brown (10YR6/6) moist; few fine distinct red mottles; medium heavy clay; few rounded unspecified coarse fragments; moderately moist moderately firm. Gradual to -
B22	0.55 to 0.95 m	Bright yellowish brown (10YR6/6) moist; common fine distinct red mottles; medium heavy clay; few rounded unspecified coarse fragments; moderately moist moderately firm. Gradual to -
B23	0.95 to 1.20 m	Bright brown (2.5YR5/8) moist; many medium distinct pale mottles; heavy clay; moderately moist very firm. Abrupt to -
B3	1.20 to 9.99 m	Bright yellowish brown (10YR7/6) moist; common coarse prominent grey mottles; medium clay; moderately moist moderately firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.5	.02	.002	29	50	10	14	9	0.8	1.3	.05	.10	4	.47				0.6	0.62
20	5.5	.01	.001	21	48	9	15	7			.05								
32	5.6	.01	.001	25	42	10	25	8	.05	1.1	.05	.03	7	.50				0.6	0.45
55	5.7	.02	.002	15	18	5	64	20	0.3	3.2	1.0	.05	22	.42				5.0	0.09
90	5.5	.06	.008	18	15	10	60	24	.05	4.6	2.2	.10	21	.62				9.2	0.01
120	5.5	.11	.017	30	17	13	43	23	.03	5.5	3.6		17	.87				15.7	0.01

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10			13	6	.11					
20	0.5									

Pinnacle

Location: 676300mE 7660700mN Zone 55
Landform element:
Landform pattern: Undulating rises
Slope: 4%
Principal Profile Form: Uf6.31
Australian Soil Classification: Ferrosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: MCL S38
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Well drained
Substrate lithology: Igneous rocks
Surface coarse fragments: Absent
Surface condition:

Profile Morphology:

Horizon	Depth	Description
AP	0 to 0.10 m	Dark reddish grey (2.5YR3/1) moist, dull reddish brown (2.5YR4/3) dry; light clay; moderate 2mm granular; moderately moist moderately firm. Gradual to -
A12	0.10 to 0.40 m	Dark reddish grey (2.5YR3/1) moist; light clay; moderate 2mm granular; moderately moist moderately firm. Diffuse to -
B21	0.40 to 1.00 m	Dark reddish brown (2.5YR3/6) moist; light clay; moderate 10-20mm angular blocky, strong 2-5mm subangular blocky; moderately moist moderately firm; very few manganiferous nodules. Diffuse to -
B3	1.00 to 1.20 m	Red (10YR4/8) moist; clay loam; moderate 10-20mm angular blocky strong 2-5mm subangular blocky; moderately moist moderately firm; very few manganiferous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	4.8	.06	.002												.046	0.15	.030		
10	5.1	.04	.004	20	21	10	51	23	1.1	.91	.10	.73	19	.50	.052	0.22	.030	0.4	1.21
20	5.2	.02	.002																
30	5.3	.02	.001	16	27	10	48	19	1.9	.89	.10	.25	18	.36	.038	0.09	.030	0.5	2.13
60	5.4	.01	.001	8	13	8	72	8	2.0	.82	.10	.16	25	.18	.026	0.07	.030	1.3	2.44
90	4.9	.01	.002	6	10	11	76	10	1.8	1.0	.10	.13	28	.15	.025	0.04	.029	1.0	1.80
120	5.3	.01	.003	3	9	17	75	8	1.0	.68	.10	.10			.021	0.05	.028	1.3	1.47

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.1	0.12	16	23	0.26	33	121	1.1	0.5	
10	2.6	0.15	14	18	0.63					
20	2.0	0.11	7	5	0.38					

Pioneer

Location: 715600mE 7658300mN Zone 55
Landform element: Levee
Landform pattern: Alluvial plain
Slope: 1%
Principal Profile Form: Db2.51
Australian Soil Classification: Brown Chromosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: MCL S43
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Well drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Absent
Surface condition:

Profile Morphology:

Horizon	Depth	Description
AP	0 to 0.50 m	Brownish black (7.5YR3/1) moist, brownish grey (7.5YR5/1) dry; sandy clay loam; moderately moist moderately weak. Gradual to -
A3	0.50 to 0.65 m	Greyish brown (7.5YR4/2) moist; sandy clay loam; moderately moist moderately weak. Gradual to -
B21	0.65 to 1.00 m	Brown (7.5YR4/4) moist; many medium distinct dark mottles, few fine distinct yellow mottles; light medium clay; moderately moist moderately weak; few manganiferous soft segregations. Diffuse to -
D	1.00 to 1.20 m	Dull yellowish brown (10YR5/4) moist; sandy clay; moderately moist moderately weak; few manganiferous soft segregations.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CE C	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	4.8	.04	.002																
10	4.8	.06	.003	10	55	16	17	14	2.2	1	.10	.32	8	.82	.042	1.42	.009	1	2.2
20	4.9	.06	.003																
30	4.9	.03	.002	10	55	15	18	14	1.8	.78	.10	.16	9	.75	.040	1.37	.010	1	2.3
60	5.0	.05	.002	10	58	13	20	12	3.2	1	.10	.18	10	.64	.036	1.55	.011	1	3.2
90	5.7	.03	.001	8	49	13	31	14	6.2	3.2	.15	.11	14	.34	.032	1.44	.013	1	1.9
120	6.1	.03	.002	13	57	10	20	9	5.4	3.5	.15	.08			.027	1.55	.006	1	1.5

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.0	.08	74	65	.36	130	75	1.1	1.6	
10	1.1	.08	65	64	.38	120	81	1.0	1.3	
20	1.0	.07	58	16	.28					

Pluto

Location: 648250mE 7750300mN Zone 55
Landform element: Upper slope
Landform pattern: Gently undulating plains
Slope: 3%
Principal Profile Form: Dy3.41
Australian Soil Classification: Grey, Subnatric Sodosol
Disturbance:
Vegetation: Cleared

Site No: PRO17
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Moderately well drained
Substrate lithology: Sandstone
Surface coarse fragments:
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.02 m	Brownish black (10YR3/2); coarse sand; massive. Gradual to -
A21cb	0.02 to 0.20 m	Conspicuously bleached; coarse sand; massive. Gradual to -
B11	0.20 to 0.35 m	Greyish yellow brown (10YR5/2), 10% yellow mottle; coarse sandy loam; moderate coarse prismatic; hard. Gradual to -
B12	0.35 to 0.50 m	Dull yellowish brown (10YR5/3), 20% yellow mottle; sandy clay; strong coarse prismatic; very hard. Gradual to -
B21	0.50 to 0.80 m	Greyish yellow brown (10YR5/2), 30% red mottle; sandy medium clay; strong medium angular blocky; extremely hard. Abrupt to -
B22	0.80 to 0.85 m	Greyish yellow brown (10YR5/2), 10% yellow and brown mottle; medium heavy clay; strong medium angular blocky; very hard. Abrupt to sandstone.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CE C	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.4	.02	.002	69	24	4	1	2	0.3	.05	.05	.05	2		.006	0.18	.009	3.0	6.0
30	5.5	.02	.002	65	27	1	4	1	.05	0.1	0.1	.03	1		.002	0.13	.003	10.0	0.5
60	5.4	.05	.004	46	16	2	29	7	.05	1.7	0.6	.07	11		.004	0.10	.008	9.0	0.03
90	5.3	.04	.003	33	18	10	33	21	.05	5.2	2.4	.12	16		.005	0.32	.007	11.0	0.01

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	.92	.04	3	2	.07	56	10	0.2	0.4	
20	.46	.02	3	2	.04					

Pring

Location: 578500mE 7788800mN Zone 55
Landform element: Footslope
Landform pattern: Gently undulating plains
Slope: 3%
Principal Profile Form: Gn3.12
Australian Soil Classification: Dermosol to Brown Sodosol
Disturbance:
Vegetation: Mid-high woodland of *Eucalyptus drepanophylla*

Site No: S16
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Well drained
Substrate lithology: Igneous rocks
Surface coarse fragments: Very few cobbles, angular adamellite
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.20 m	Brownish black (10YR3/2); sandy clay loam; weak <2mm granular; moist moderately weak. Clear to -
B1	0.20 to 0.40 m	Dark brown (10YR3/4); clay loam; massive; moist moderately firm. Clear to -
B21t	0.40 to 0.80 m	Dark reddish brown (2.5YR3/4); light clay; massive; moderately moist very firm. Clear to -
B22t	0.80 to 1.10 m	Dark reddish brown (2.5YR3/6); medium clay; strong 10-20mm angular blocky; moderately moist moderately strong. Abrupt to -
C	1.10 to 1.50 m	Light clay; massive; dry moderately strong.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.6	.04	.002	40	35	7	16	13	7.8	2.2	.18	.48	08	.75	.043	1.66	.027	1	3.5
30	6.7	.02	.002	34	34	6	25	9	5.6	1.8	.18	.46	10	.79	.031	1.67	.021	2	3.1
60	7.0	.02	.002	25	20	6	48	8	4.9	2.3	.26	.39	16	.44	.017	1.11	.010	3	2.1
90	7.0	.02	.003	15	17	10	58	12	7.4	3.9	.31	.18	21	.29	.012	0.57	.006	3	1.9
120	7.3	.02	.003	17	35	19	33	17	14	7.2	.45	.20			.068	0.55	.005	3	1.9

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	1.3	0.1	5	8	.52	40	59	1.4	1.7	

Proserpine

Location: 654832mE 7749919mN Zone 55
Landform element: Levee
Landform pattern: Terrace
Slope: 4%
Principal Profile Form: Uc5.11
Australian Soil Classification: Arenic Rudosol
Disturbance: Grazing
Vegetation: Cleared, isolated *Eucalyptus tereticornis*

Site No: PS22 (507)
Microrelief description: Absent
Permeability: Highly permeable
Drainage: Rapidly drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Absent
Surface condition: Firm

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.19 m	Dull yellowish brown (10YR5/3) moist; coarse sand; massive 2-5mm granular; firm. Sharp to -
D1	0.19 to 1.02 m	Greyish yellow-brown (10YR6/2) moist; sand; massive 2-5mm granular; very weak. Clear to -
D2	1.02 to 1.57 m	Greyish yellow-brown (10YR4/2) moist; sandy loam; massive 2-5mm granular; very weak. Clear to -
D3	1.57 to 1.66 m	Dull yellowish orange (10YR7/2) moist; sand; massive 2-5mm polyhedral.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	7.4	.02	.002	79	18		5	2	1.4	.70	.05	.08	2		.023	2.08	.006	2.5	2.0
30	7.2	.01	.000	86	12		2	1	.89	.46	.02	.05	1		.020	2.13	.004	2.0	1.9
60	6.3	.02	.000	19	66	7	10	6	4.5	1.6	.10	.14	4	.52	.057	1.86	.009	1.7	2.8
90	6.3	.02	.018	10	74	6	11	9	6.4	2.4	.10	.14	5	.63	.063	1.74	.010	1.1	2.7
120	6.8	.02	.001	15	61	8	17	12	8.8	2.9	.16	.14	6	.59	.061	1.57	.012	1.3	3.1
150	6.9	.02	.001																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10										

Quandong

Location:	646996mE 7714855mN Zone 55	Site No:	PILUS 1587
Landform element:	Fan	Microrelief description:	Absent
Landform pattern:	Peneplain	Permeability:	Moderately permeable
Slope:	1.5%	Drainage:	Well drained
Principal Profile Form:	Dy5.11	Substrate lithology:	
Australian Soil Classification:	Reticulate, Dystrophic, Brown Kandosol	Surface coarse fragments:	Few rounded granite cobbles
Disturbance:	Extensive clearing	Surface condition:	Firm
Vegetation:			

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.18 m	Greyish yellow-brown (10YR4/2) moist; fine sandy loam; massive; weak. Clear to -
B1	0.18 to 0.25 m	Dull yellowish orange (10YR6/3) moist; sandy clay loam; massive; weak. Abrupt to -
B21	0.25 to 0.96 m	Yellowish brown (10YR5/6) moist; common medium distinct brown mottles; light medium clay; few medium gravelly, subrounded ironstone; weak 2-5mm prismatic; weak. Clear to -
B3	0.96 to 1.40 m	Many coarse prominent red mottles; strong.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.1	.03	.003					3	1.5	1.0	.11	.21						3.7	1.50

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	1.1	0.06	6.0	6.0	0.22	59	82	0.60	0.34	5.0

Redfern

Location:	653639mE 7771489mN Zone 55	Site No:	WILUS 50
Landform element:	Hillslope	Microrelief description:	Absent
Landform pattern:	Undulating rise	Permeability:	Slowly permeable
Slope:	3%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy3.23	Substrate lithology:	
Australian Soil Classification:	Mesotrophic, Subnatric, Grey Sodosol	Surface coarse fragments:	many cobbles, subangular tuff
Disturbance:	Limited clearing	Surface condition:	Hardsetting
Vegetation:	*Eucalyptus crebra, Melaleuca viridiflora*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.18 m	Dark grey (10YR4/1) moist; sandy clay loam; few small pebbles, subangular tuff; weak 2-5mm prismatic; moist moderately weak. Abrupt to-
A2j	0.18 to 0.38 m	Grey (10YR5/1) moist; sandy clay loam; common small pebbles, subangular tuff; weak 2-5mm prismatic; moist moderately weak. Abrupt to-
B1	0.38 to 0.47 m	Grey (10YR6/1) moist; few medium distinct brown mottles; clay loam, fine sandy; common small pebbles, subangular tuff; weak 5-10mm prismatic; moist moderately weak. Abrupt to-
B21	0.47 to 0.71 m	Greyish brown (10YR5/2) moist; few medium distinct brown mottles; medium clay; weak 5-10mm prismatic; few fine ferromanganiferous concretions; moist very firm. Abrupt to-
B22	0.71 to 0.89 m	Pale olive (5YR/3) moist; few medium faint brown mottles; medium heavy clay; moderate 5-10mm lenticular; few fine manganiferous soft segregations; moist very firm. Abrupt to-
BC	0.89 to 1.02 m	Light brownish grey (2.5YR/2) moist; few medium faint brown mottles; medium clay; many medium pebbles, angular tuff.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.7	.21	.002	32	28	16	19	17	11	5.1	.28	.59	11	.63	.041	.410	.033	1.6	2.16

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	5.1	0.22	22.0	16.0	0.60	120	33	0.42	1.2	13.0

Riordanvale

Location:
Landform element: Footslope
Landform pattern: Gently undulating rise
Slope: 2.5%
Principal Profile Form: Dy3.32
Australian Soil Classification: Brown Chromosol to Dermosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: PS05 (0093)
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Poorly drained
Substrate lithology: Trachyte
Surface coarse fragments: Absent
Surface condition: Firm

Profile Morphology:

Horizon	Depth	Description
A1p	0 to 0.05 m	Brownish black (7.5YR3/2) moist; clay loam sandy; few fine gravelly subangular dacite; moderate 10-20mm subangular blocky. Sharp to-
A2j	0.05 to 0.10 m	Greyish yellow-brown (10YR4/2) moist; greyish yellow (2.5Y7/2) dry; very few fine faint orange mottles; clay loam; few fine gravelly subangular dacite; moderate 5-10mm subangular blocky. Sharp to -
B2	0.10 to 0.65 m	Yellowish brown (10YR5/6) moist; many medium distinct orange mottles; medium clay; moderate 20-50mm subangular blocky; few medium ferromanganiferous concretions. Gradual to -
C	0.70 to 1.00 m	Olive yellow (5Y6/4) moist; very abundant coarse gravelly subangular substrate material; weak 20-50mm subangular blocky.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CE C	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.1	.08	.001	20	28	29	30	22	2.4	2.2	.10	.31	14	.69	.103	.231	.046	0.5	1.09
30	6.3	.04	.002	20	17	34	33	25	8.3	4.7	.35	.12	24	.48	.053	.242	.039	1.4	1.77
60	6.2	.03	.001	18	31	30	30	42	16	9.6	.57	.09	19	.56	.070	.367	.034	2.6	1.67

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10										

Roundback

Location: 610400mE 7791800mN Zone 55
Landform element: Pediment
Landform pattern: Gently undulating plains
Slope: 1%
Principal Profile Form: Dy3.33
Australian Soil Classification: Grey Sodosol
Disturbance:
Vegetation: *Eucalyptus drepanophylla, Acacia salicina*

Site No: S23
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Imperfectly to poorly drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments:
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Dark brown (10YR3/3); loamy sand; massive; dry moderately firm. Gradual to -
A2sb	0.10 to 0.20 m	Dull yellowish brown (10YR5/3), dry sporadically bleached; loamy sand; massive; dry moderately firm. Abrupt to -
B21t	0.20 to 0.60 m	Dull yellowish brown (10YR4/3); medium heavy clay; strong 50-100mm angular blocky; dry very strong; very few fine manganiferous concretions. Clear to -
B22t	0.60 to 1.10 m	Brown (10YR4/4); heavy clay; strong 20-50mm angular blocky; moderately moist moderately strong; very few medium carbonate nodules, very few fine manganiferous concretions. Clear to -
BC	1.10 to 1.50 m	Dark brown (10YR3/3); medium clay; weak angular blocky; moderately moist moderately strong; very few medium carbonate nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CE C	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.2	.02	.003	49	34	10	6	5	1.5	1.9	.37	.09	04	.70	.009	0.94	.006	7	0.79
30	7.5	.10	.012	36	25	7	31	16	4.1	8.9	1.5	.06	14	.93	.008	0.79	.008	9	0.46
60	8.5	.41	.048	22	28	11	39	23	5.4	15	3.7	.18	16	.99	.009	0.64	.015	16	0.36
90	9.1	.70	.068	19	26	13	43	23	5.7	15	4.4	.19	17	.96	.016	0.58	.025	19	0.38
120	9.2	.56	.052	23	28	13	35	21	5.0	13	4.2	.19			.014	0.68	.021	20	0.38
150	9.3	.51	.045																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	0.3	.03	2	3	.13	23	25	0.8	0.2	

Sandiford

Location:	657633mE 7752149mN Zone 55	Site No:	PS43 (GB09)
Landform element:	Terrace flat	Microrelief description:	Absent
Landform pattern:	Gently undulating flood plain	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Moderately well drained
Principal Profile Form:	Dg2.12, Dy3.12	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Yellow Chromosol to Subnatric Sodosol	Surface coarse fragments:	Absent
Disturbance:	Cultivation	Surface condition:	Firm
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
Ap	0 to 0.26 m	Greyish yellow-brown (10YR4/2) moist; sandy clay loam; weak 5-10mm prismatic; dry weak. Abrupt to -
B21	0.28 to 0.52 m	Greyish yellow-brown (10YR6/2) moist; common medium faint brown mottles; medium heavy clay; moderate 10-20mm prismatic; dry very firm. Abrupt to -
B22	0.54 to 0.92 m	Light grey (10YR7/1) moist; few medium faint brown mottles; medium heavy clay; moderate 5-10mm prismatic; dry very firm; few medium manganiferous soft segregations. Abrupt to -
B23	0.94 to 1.60 m	Greyish yellow (2.5Y6/2) moist; common medium faint brown mottles; fine sandy medium clay; moderate 10-20mm prismatic; dry very firm; few medium manganiferous soft segregations.

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
		dS/m	%		%			meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.8	.11	.004	17	48	18	20	6	3.0	2.7	.18	.25	7	.72	.023	1.14	.021	3.0	1.11
30	5.5	.08	.007	21	36	19	28	7	3.4	3.3	.42	.16	11	.55	.015	.907	.019	6.0	1.05
60	6.0	.22	.028	16	27	16	43	17	8.2	6.7	2.3	.20	19	.68	.012	.787	.014	13.5	1.22
90	7.5	.28	.038	18	28	16	40	19	8.9	6.6	3.2	.24	17	.99	.012	.944	.012	16.8	1.35
120	8.8	.52	.042	16	27	16	40	35	24	6.9	4.0	.21			.010	1.08	.015	11.4	3.48
150	8.6	.44	.050																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10										

Sandiford (silty clay loam A)

Location:	665465mE 7735097mN Zone 55	Site No:	PS31 (AN05)
Landform element:	Terrace plain	Microrelief description:	Normal gilgai
Landform pattern:	Peneplain	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Imperfectly drained
Principal Profile Form:	Dg2.22	Substrate lithology:	Tertiary sandstone
Australian Soil Classification:	Subnatric Sodosol	Surface coarse fragments:	Absent
Disturbance:	Limited clearing	Surface condition:	Hardsetting
Vegetation:	*Corymbia intermedia, Eucalyptus platyphylla, C. tessellaris, Melaleuca leucadendron, M. viridiflora.*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.15 m	Greyish yellow-brown (10YR5/2) moist; very few fine faint brown mottles; clay loam fine sandy; moderate 2-5mm prismatic; weak.
A2	0.15 to 0.45 m	Greyish yellow-brown (10YR6/2) moist; few fine faint brown mottles; silty light clay; common medium gravelly subangular ironstone; moderate 2-5mm platy; weak.
B21	0.45 to 0.68 m	Greyish yellow (2.5Y7/2) moist; many medium distinct brown and red mottles; medium clay; very few medium gravelly subangular ironstone; strong 5-10mm prismatic; very firm.
B22	0.68 to 1.30 m	Light grey (2.5Y7/1) moist; many coarse prominent brown and red mottles; medium heavy clay; strong 10-20mm lenticular; very strong.
B23	1.30 to 1.68 m	Light grey (2.5Y7/1) moist; many coarse prominent brown mottles; medium heavy clay; strong 10-20mm prismatic; very strong; common coarse manganiferous veins.

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
		dS/m	%		%			meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.8	.06	.003	3	50	31	17	5	2.8	2.0	.23	.14	5	.68	.021	.248	.029	4.6	1.40
30	6.3	.04	.002	2	50	33	18	4	1.7	1.7	.45	.04	5	.75	.011	.225	.017	11.3	1.00
60	5.7	.05	.003	2	34	25	41	7	2.5	3.2	.98	.10	13	.63	.012	.360	.016	14.0	0.78
90	5.8	.05	.004	2	33	25	44	10	4.4	4.0	1.5	.12	14	.67	.010	.373	.014	15.0	1.10
120	6.0	.05	.005	2	35	28	38	11	5.2	3.8	1.6	.11			.009	.397	.012	14.5	1.37
150	6.1	.09	.010																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.4	0.09	11	10	0.18	134	43	0.57	0.80	9.9

Silent Grove

Location:		Site No:	PS26 (228)
Landform element:	Backplain	Microrelief description:	Absent
Landform pattern:	Flood plain	Permeability:	Very slowly permeable
Slope:	1%	Drainage:	Very poorly drained
Principal Profile Form:	Ug5.16	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Black Vertosol	Surface coarse fragments:	Absent
Disturbance:	Extensive clearing	Surface condition:	Cracking, self-mulching
Vegetation:	*Melaleuca* spp. Bloodwood spp, *Eucalyptus tereticornis*, *Planchonia careya*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.16 m	Black (10YR2/1) moist; light medium clay; strong 5-10mm granular; strong; common fine ferromanganiferous concretions. Abrupt to -
B21	0.16 to 0.41 m	Black (10YR2/1) moist; very few fine faint brown mottles; medium clay; strong 20-50mm subangular blocky; strong; few fine ferromanganiferous concretions. Abrupt to -
B22	0.41 to 0.69 m	Grey (10YR4/1) moist; very few fine faint brown mottles; medium heavy clay; moderate 5-10mm lenticular; very firm; few fine ferromanganiferous concretions. Abrupt to -
B23	0.69 to 1.27 m	Grey (10YR5/1) moist; few medium faint grey mottles; medium heavy clay; strong 10-20mm lenticular; very firm; common fine ferromanganiferous concretions. Clear to -
B24	1.27 to 1.48 m	Yellowish grey (2.5Y5/1) moist; very many coarse distinct grey mottles; medium heavy clay; strong 20-50mm lenticular; very firm; many coarse calcareous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.8	.06	.002	8	22	21	49	37	10	15	.32	.19	21	.42	.031	.086	.046	0.9	0.60
30	8.5	.19	.001	7	18	18	59	34	8.6	23	.80	.09	23	.50	.015	.066	.022	2.3	0.37
60	9.2	.29	.002	9	23	17	54	34	3.9	25	2.5	.06	22	.62	.012	.075	.014	7.4	0.16
90	9.2	.39	.008	10	22	15	55	35	3.7	26	4.2	.06	24	.75	.010	.069	.010	12.0	0.14
120	9.1	.45	.028	7	25	17	54	38	3.8	25	4.1	.04						10.8	0.15
150	8.8	.42	.035																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.4	0.19	4	7	0.17	154	58	3.8	0.82	10.0

Slater

Location:	660541mE 7745836mN Zone 55	Site No:	PS18 (566)
Landform element:	Rise	Microrelief description:	Absent
Landform pattern:	Gently undulating plain	Permeability:	Moderately permeable
Slope:	1.0%	Drainage:	Moderately well drained
Principal Profile Form:	Dy3.32	Substrate lithology:	Tertiary sandstone
Australian Soil Classification:	Grey Sodosol	Surface coarse fragments:	Absent
Disturbance:	Cultivation	Surface condition:	Firm
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
A1pj	0 to 0.12 m	Brownish grey (10YR5/1) moist, light grey (10YR7/1) moist; sandy clay loam; moderate 5-10mm platy; dry firm. Abrupt to -
B1	0.13 to 0.35 m	Yellowish grey (2.5Y5/1) moist; few medium faint brown mottles; clay loam sandy; weak 10-20mm prismatic; dry firm; few medium manganiferous soft segregations. Abrupt to -
B21	0.36 to 0.74 m	Greyish yellow (2.5Y6/2) moist; common medium distinct orange mottles; fine sandy light medium clay; moderate 10-20mm prismatic; dry firm. Abrupt to -
B22	0.75 to 1.00 m	Dull yellow (2.5Y6/3) moist; few medium distinct orange mottles; sandy clay loam; few medium gravelly subangular sandstone; weak 5-10mm prismatic; dry weak. Abrupt to -
B23	1.02 to 1.19 m	Light grey (2.5Y7/1) moist; few medium distinct orange mottles; coarse sandy light medium clay; strong 10-20mm prismatic; dry very firm. Clear to-
B24	1.22 m to 1.62 m	Light grey (2.5Y7/1) moist; few fine distinct orange mottles; coarse sandy light medium clay; moderate 10-20mm prismatic; dry very firm; very few medium manganiferous soft segregations.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.7	.04	.001	37	40	10	14	4	2.2	1.3	.03	.11	4	.62	.031	.488	.016	0.75	1.70
30	4.7	.02	.000	40	36	9	15	1	.95	.48	.01	.02	5	.58	.023	.465	.011	1.0	1.98
60	4.6	.03	.001	41	28	4	27	2	.85	1.5	.11	.03	7	.21	.011	.353	.015	5.5	0.57
90	4.9	.03	.002	40	23	5	31	4	.24	3.1	.60	.04	10	.41	.010	.413	.011	15.0	0.08
120	5.0	.03	.000	35	15	3	44	8	.24	5.3	2.4	.08	17	.99	.004	.549	.007	3.0	0.05
150	4.6	.04	.002																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.5	0.07	5	14	0.09	202	11	0.44	0.40	10.0

Slater

Location:	660076mE 7742401mN Zone 55	Site No:	PS23 (610)
Landform element:	Rise	Microrelief description:	Absent
Landform pattern:	Gently undulating plain	Permeability:	Slowly permeable
Slope:	1.5%	Drainage:	Moderately well drained
Principal Profile Form:	Dy3.32	Substrate lithology:	Tertiary sandstone
Australian Soil Classification:	Grey Sodosol	Surface coarse fragments:	Absent
Disturbance:	Grazing on improved pasture	Surface condition:	Hardsetting
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Brownish grey (10YR4/1) moist; sandy clay loam; weak 5-10mm prismatic; dry weak. Abrupt to -
A2 j	0.11 to 0.26 m	Greyish yellow-brown (10YR6/2) moist; sandy clay loam; weak 5-10mm prismatic; dry weak. Abrupt to -
B21	0.27 to 0.42 m	Greyish yellow (2.5Y6/2) moist; common medium distinct orange mottles; coarse sandy light medium clay; few medium gravelly, subangular ironstone; moderate 10-20mm prismatic; dry very firm; few medium manganiferous soft segregations. Abrupt to -
B22	0.43 to 0.77 m	Greyish yellow (2.5Y6/2) moist; few medium distinct orange mottles; coarse sandy light medium clay; moderate 10-20mm prismatic; very few medium manganiferous soft segregations. Abrupt to -
B23	0.78 to 1.20 m	Light grey (5Y7/1) moist; very few fine distinct orange mottles; coarse sandy medium clay; moderate 10-20mm prismatic; dry very strong. Abrupt to-
C	1.21 to 1.23 m	Clayey sand; massive; dry weak.

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations meq/100g					Bar	D.R	Total Elements				
		dS/m	%	%									%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.0	.03	.001	20	58	11	13	2	1.1	.93	.08	.10	3	.61	.013	.657	.017	4.0	1.2
30	5.9	.03	.001	22	50	13	17	3	1.5	1.6	.24	.06	5	.65	.007	.605	.009	8.0	0.95
60	5.9	.04	.004	17	28	9	44	8	2.7	4.4	.83	.08	14	.27	.008	.279	.012	10.4	0.61
90	5.9	.06	.005	29	28	7	34	9	2.8	4.9	1.5	.10	12	.83	.005	1.15	.006	16.7	0.57
120	5.4	.09	.010	34	22	7	35	12	3.5	6.1	2.4	.10	13	.96	.004	1.36	.005	20.0	0.57

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.0	0.06	5	9	0.04	73	25	0.24	0.19	6.0

Slater

Location:	655350mE 7758829mN Zone 55	Site No:	PS39 (1251) (GB05)
Landform element:	Terrace plain	Microrelief description:	Absent
Landform pattern:	Gently undulating peneplain	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Imperfectly drained
Principal Profile Form:	Dg2.12	Substrate lithology:	Tertiary sandstone
Australian Soil Classification:	Grey Sodosol	Surface coarse fragments:	Absent
Disturbance:	Extensive clearing	Surface condition:	Hardsetting
Vegetation:			

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.08 m	Brownish grey (10YR5/1) moist; sandy clay loam; massive; dry very weak. Abrupt to -
B1	0.09 to 0.28 m	Light grey (10YR7/1) moist; few medium faint brown mottles; coarse sandy light medium clay; weak 5-10mm prismatic; dry weak; few medium manganiferous soft segregations. Abrupt to -
B21	0.30 to 0.78 m	Light grey (10YR7/1) moist; very few faint brown mottles; medium heavy clay; moderate 10-20mm lenticular; dry very firm. Abrupt to -
B22	0.81 to 1.24 m	Brownish grey (10YR6/1) moist; few medium faint brown mottles; medium heavy clay; moderate 10-20mm prismatic; dry very firm; common fine manganiferous veins. Abrupt to -
B23	1.27 to 1.70 m	Greyish yellow (2.5Y6/2) moist; few medium faint brown mottles; coarse sandy light medium clay; moderate 10-20mm prismatic; dry very firm; common fine manganiferous veins. Abrupt to -

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations meq/100g					Bar	D.R	Total Elements				
		dS/m	%	%									%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.8	.06	.006	46	30	16	9	3	1.1	1.2	.30	.06	4	.78	.010	.481	.019	10.0	0.95
30	5.4	.18	.024	41	31	17	14	4	.92	2.3	.98	.05	6	.86	.006	.493	.016	24.5	0.40
60	5.0	.57	.072	24	21	17	40	17	3.1	8.1	5.8	.14	18	.95	.006	.399	.027	34.1	0.38
90	5.3	.71	.111	28	19	18	37	19	3.4	8.6	7.2	.16	18	.91	.005	.565	.023	37.9	0.39
120	6.2	.85	.127	24	19	18	41	23	4.1	10	8.8	.18			.006	.622	.020	38.3	0.41
150	6.7	.83	.110																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.85	0.04	1	2	0.07	33	122	0.20	0.23	8.4

St Helens

Location: 685700mE 7688800mN Zone 55
Landform element:
Landform pattern: Terrace
Slope: 0%
Principal Profile Form: Gn3.41
Australian Soil Classification: Brown Dermosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: MCL S11
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Well drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Very few cobbles
Surface condition:

Profile Morphology:

Horizon	Depth	Description
AP	0 to 0.25 m	Black (10YR2/1) moist, brownish grey (10YR5/1) dry; sandy clay loam; earthy; moderately moist; moderately firm. Gradual to -
B21	0.25 to 0.80 m	Black (10YR2/1) moist; light clay; few angular quartz; moderate; moderately moist; moderately weak. Clear to -
D1	0.80 to 0.95 m	Brown (7.5YR4/4) moist; few fine faint dark mottles; sandy clay loam; moderately moist; very weak. Clear to -
D2	0.95 to 1.00 m	Dark brown (7.5YR3/4) moist; sandy loam; moderately moist; loose. Clear to -
D3	1.00 to 1.10 m	Dark brown (7.5YR3/4) moist; sandy loam; abundant rounded unspecified coarse fragments; moderately moist; loose.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.3	.04	.004					16	2.3	1.2	0.1	.41			.056	1.66	.014	0.6	1.9
10	5.3	.06	.007	32	32	20	20	15	1.9	0.9	0.1	.37	10	.72	.051	1.68	.013	0.7	2.1
20	5.2	.03	.003	26	36	20	22	16	1.9	0.8	0.1	.23	9	.67	.043	1.70	.014	0.6	2.4
40	5.5	.01	.001																
60	5.7	.01	.011	24	35	15	27	17	2.5	0.7	0.1	.10	12	.67	.030	1.80	.011	0.6	3.6
90	5.9	.01	.001	36	33	10	20	12	2.8	1.1	0.1	.08	9	.71	.029	1.90	.007	0.8	2.5
110	5.7	.01	.001																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.4	.08	88	74	.36	94	30	0.90	2.1	
10	1.4	.07	83	69	.44					
20	1.4	.08	48	54	.25					

St Helens

Location: 652456mE 7740403mN Zone 55
Landform element: Levee
Landform pattern: Terrace
Slope: 2%
Principal Profile Form: Db2.12
Australian Soil Classification: Grey Dermosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: PS12 (406)
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Well drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Very few coarse subangular gravel
Surface condition: Firm

Profile Morphology:

Horizon	Depth	Description
A11p	0 to 0.11 m	Brownish black (10YR3/2) moist; clay loam; moderate 20-50mm subangular blocky; dry weak. Abrupt to -
A12	0.12 to 0.40 m	Brownish black (10YR3/1) moist; light clay; moderate 10-20mm subangular blocky; dry firm. Abrupt to -
B21	0.42 to 0.74 m	Dull yellowish brown (10YR4/3) moist; few fine distinct brown mottles; medium clay; moderate10-20mm prismatic; dry very firm. Abrupt to -
D1	0.75 to 1.06 m	Dull yellowish brown (10YR5/3) moist; coarse sandy light clay; many medium gravelly, subangular, unspecified coarse fragments; moderate 20-50mm subangular blocky. Abrupt to -
D2	1.07 to 1.30 m	Greyish yellow brown (10YR4/2) moist; sandy clay loam; many medium gravelly, subangular, unspecified coarse fragments; massive.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.8	.05	.003	4	42	28	29	11	7.4	3.6	.09	.30	11	.59	.066	.790	.021	0.8	2.1
30	5.7	.03	.001	4	40	29	30	12	8.4	2.9	.15	.13	12	.64	.059	.776	.016	1.2	2.9
60	7.2	.04	.002	3	34	21	44	20	13	6.2	.38	.20	15	.46	.029	.858	.016	1.9	2.1
90	7.3	.04	.004	23	29	17	33	16	10	5.5	.36	.17	11	.56	.027	1.23	.012	2.2	1.8
12	7.1	.03	.002	49	18	11	23	14	8.3	4.8	.29	.16	8	.49	.047	1.63	.008	2.1	1.73

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.4	0.07	46	65	0.35	163	58	2.2	1.8	8.0

Sunnyside

Location:	653124mE 7750809mN Zone 55	Site No:	PS42 (GB08)
Landform element:	Backplain	Microrelief description:	Absent
Landform pattern:	Gently undulating floodplain	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Moderately well drained
Principal Profile Form:	Dy3.13	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Subnatric, Yellow Sodosol	Surface coarse fragments:	Absent
Disturbance:	Cultivation	Surface condition:	Firm
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
Ap	0 to 0.14 m	Greyish yellow-brown (10YR4/2) moist; clay loam fine sandy; weak 5-10mm prismatic; dry weak. Abrupt to -
B21	0.16 to 0.38 m	Yellowish brown (2.5Y5/4) moist; common medium faint brown mottles; medium clay; moderate 5-10mm prismatic; dry firm. Abrupt to-
B22	0.40 to 1.20 m	Dull yellow (2.5Y6/3) moist; common medium faint brown mottles; medium heavy clay; moderate 10-20mm prismatic; dry very firm; few medium manganiferous soft segregations, very few medium calcareous nodules. Abrupt to -
B23	1.22 to 1.60 m	Dull yellow (2.5Y6/4) moist; common medium faint brown mottles; coarse sandy light medium clay; moderate 5-10mm prismatic; dry firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	4.7	.06	.001	15	60	12	16	2	1.1	1.1	.09	.20	5	.63	.018	1.75	.020	4.5	1.00
30	5.3	.06	.001	8	63	12	20	4	2.2	1.9	.18	.13	7	.61	.012	1.66	.018	4.5	1.16
60	5.7	.15	.011	6	37	8	51	14	5.7	6.3	1.5	.19	21	.32	.011	.918	.016	10.7	0.90
90	6.6	.16	.020	5	45	11	41	16	6.4	6.8	2.4	.20	18	.54	.011	1.10	.011	15.0	0.94
120	7.9	.24	.033	2	53	12	37	18	7.3	6.9	4.0	.20	17		.013	1.20	.011	22.2	1.06
150	8.3	.39	.041																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.7	0.14	5	18	0.19	286	204	2.6	1.3	

Sunter

Location:	677227mE 7742835mN Zone 55	Site No:	PS54 (1744)
Landform element:	Footslope	Microrelief description:	Absent
Landform pattern:	Undulating low hills	Permeability:	Moderately permeable
Slope:	4.5%	Drainage:	Imperfectly drained
Principal Profile Form:	Dy5.81	Substrate lithology:	Banded rhyolite
Australian Soil Classification:	Grey Kandosol	Surface coarse fragments:	Absent
Disturbance:	Grazing	Surface condition:	Firm
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
A1j	0 to 0.30 m	Brownish grey (10YR4/1) moist; fine sandy loam; few medium gravelly subangular rhyolite; massive; dry weak. Abrupt to -
A2e	0.31 to 0.61 m	Dull yellowish orange (10YR7/2) moist, light grey (10YR8/1) dry; fine sandy loam; few medium gravelly angular rhyolite; massive; dry weak. Abrupt to -
B21	0.62 to 0.79 m	Greyish yellow (2.5Y7/2) moist; coarse sandy clay loam; few medium gravelly angular rhyolite; dry firm. Clear to -
BC	0.82 to 0.91 m	Greyish yellow (2.5Y7/2) moist; coarse sandy clay loam; coarse medium gravelly angular rhyolite; dry weak.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.4	.04	.004	25	37	19	14	3	.23	1.1	.22	.22	8	.71	.010	.730	.023	7.0	0.22
30	5.2	.03	.003	25	38	18	14	3	.05	.90	.16	.17	7	.84	.007	.740	.019	5.0	0.06
60	5.4	.01	.001	29	34	18	17	2	.08	.63	.12	.10	8	.82	.004	.974	.012	6.0	0.12
90	5.8	.01	.002	26	29	20	24	4	.17	2.5	.24	.09	11	.79	.005	.869	.013	6.0	0.07

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.9	0.11	4.0	8.0	0.35	170	1.5	0.13	0.20	6.0

Tabletop

Location:	602800mE 7793400mN Zone 55	Site No:	S53
Landform element:	Plain	Microrelief description:	Normal gilgai
Landform pattern:	Level plain	Microrelief component:	Mound
Slope:	1%	Permeability:	Slowly permeable
Principal Profile Form:	Ug5.15	Drainage:	Imperfectly drained
Australian Soil Classification:		Substrate lithology:	Clay
Disturbance:		Surface coarse fragments:	
Vegetation:	Low open woodland of *Corymbia dallachiana*	Surface condition:	Periodic cracking, self mulching

Profile Morphology:

Horizon	Depth	Description
A11	0 to 0.05 m	Black (10YR2/1); heavy clay; strong 2-5mm granular; moist moderately firm. Clear to -
A12	0.05 to 0.20 m	Black (10YR2/1); heavy clay; strong 5-10mm angular blocky; dry very firm. Clear to -
B21	0.20 to 0.70 m	Black (10YR2/1); heavy clay; moderate 10-20mm lenticular; dry moderately strong. Gradual to -
B22	0.70 to 1.10 m	Black (10YR2/1); heavy clay; moderate 10-20mm lenticular; moderately moist moderately strong; very few medium carbonate nodules. Gradual to -
BC	1.10 to 1.30 m	Brownish black (10YR3/1); heavy clay; moderately moist moderately strong; few medium carbonate nodules. Clear to -
C	1.30 to 1.50 m	Dark brown (10YR3/4); medium clay; massive; moderately moist very firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	6.8	.13	.013	9	20	18	54	47	14	24	1.2	.58	21	.70	.017	0.40	.020	2.5	0.58
10	7.2	.04	.002	6	19	21	54	48	15	25	1.4	.32	22	.73	.011	0.35	.011	2.9	0.60
30	7.6	.07	.008	8	20	20	54	48	14	25	2.3	.19	22	.77	.009	0.32	.008	4.8	0.56
60	8.0	.50	.079	5	20	18	58	48	13	29	5.4	.24	23	.82	.008	0.33	.011	11.2	0.45
90	8.4	1.3	.185	4	21	18	61	50	11	31	8.3	.28	25	.78	.007	0.32	.027	16.6	0.35
120	8.6	1.8	.240	5	21	20	58	47	8.1	30	9.0	.28			.006	0.39	.028	19.1	0.27
150	8.5	1.5	.200																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.0	.09	5	6	.54	54	43	2.7	0.6	
10	0.6	.06	4	4	.33	43	29	2.4	0.2	

Tailing

Location:	657758mE 7747332mN Zone 55	Site No:	PS14 (496)
Landform element:	Rise	Microrelief description:	Absent
Landform pattern:	Gently undulating plain	Permeability:	Slowly permeable
Slope:	2%	Drainage:	Poorly drained
Principal Profile Form:	Dy3.13	Substrate lithology:	Tertiary sandstone
Australian Soil Classification:	Grey Sodosol	Surface coarse fragments:	Absent
Disturbance:	Grazing	Surface condition:	Firm
Vegetation:	Cleared. Melaleuca regrowth		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.14 m	Brownish grey (10YR4/1) moist; clay loam sandy; weak 5-10mm prismatic; dry weak. Abrupt to -
B21	0.15 to 0.45 m	Yellowish grey (2.5Y6/1) moist; few medium distinct orange mottles; fine sandy light clay; moderate 10-20mm prismatic; dry firm. Abrupt to -
B22	0.47 to 0.82 m	Yellowish grey (2.5Y6/1) moist; few fine faint orange mottles; fine sandy medium clay; moderate 5-10mm prismatic; dry very firm. Abrupt to -
B23	0.84 to 1.25 m	Yellowish grey (2.5Y6/1) moist; common medium distinct brown mottles; medium clay; strong 5-10mm prismatic; dry very firm. Abrupt to -
B24	1.27 to 1.65 m	Yellowish grey (2.5Y5/1) moist; few medium faint brown mottles; fine sandy light medium clay; moderate 10-20mm prismatic; dry firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.5	.10	.012	14	43	20	22	5	2.1	2.1	.44	.16	6	.73	.016	.425	.023	8.8	1.0
30	5.5	.06	.006	21	40	21	21	5	1.8	2.4	.35	.08	5	.72	.007	.354	.012	7.0	0.75
60	5.6	.29	.041	19	32	15	34	14	4.3	6.8	2.9	.12	14	.83	.007	.306	.008	20.7	0.63
90	6.5	.88	.180	22	33	12	34	20	4.6	8.0	7.1	.12	20	1.0	.006	.359	.006	35.5	0.58
120	7.7	1.6	.270	14	32	16	39	29	6.0	11	12	.14	29	.99	.006	.400	.007	41.4	0.55
150	8.2	1.5	.232																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.3	0.07	8	13	0.10	108	51	0.77	0.50	10.0

Tailing

Location: 654851mE 7745100mN Zone 55
Landform element: Rise
Landform pattern: Gently undulating plain
Slope: 1.5%
Principal Profile Form: Dy3.13
Australian Soil Classification: Mesonatric Sodosol
Disturbance: Grazing
Vegetation: Cleared, Melaleuca regrowth

Site No: PS16 (488)
Microrelief description: Debil-debil
Permeability: Slowly permeable
Drainage: Imperfectly drained
Substrate lithology: Tertiary sandstone
Surface coarse fragments: Absent
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.05 m	Greyish yellow-brown (10YR5/2) moist, light grey (10YR7/1) moist; sandy clay loam; weak 2-5mm platy; dry weak. Abrupt to -
A2j	0.06 to 0.14 m	Greyish yellow-brown (10YR5/2) moist, light grey (10YR8/1) moist; sandy clay loam; massive; dry weak. Abrupt to -
B21	0.15 to 0.26 m	Greyish yellow-brown (10YR6/2) moist; common medium distinct brown mottles; medium heavy clay; strong 10-20mm prismatic; dry strong. Abrupt to -
B22	0.27 to 0.75 m	Greyish yellow (2.5Y6/2) moist; few medium faint brown mottles; coarse sandy medium clay; few fine gravelly subangular unspecified coarse fragments; strong 10-20mm prismatic; dry very strong; few medium manganiferous soft segregations. Abrupt to -
B23	0.77 to 1.60 m	Greyish yellow (2.5Y7/2) moist; common medium distinct brown mottles; fine sandy light medium clay; moderate 10-20mm prismatic; dry strong; few medium calcareous soft segregations.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.8	.03	.000	40	34	16	12	3	1.3	1.3	.13	.14	5	1.3	.026	.399	.031	4.3	1.00
30	6.2	.09	.006	37	26	11	28	10	3.0	5.1	1.9	.11	11	.93	.008	.327	.017	19	0.59
60	9.2	.59	.053	34	30	11	27	23	9.7	7.2	5.9	.13	12	.95	.005	.444	.018	25.6	1.35
90	9.3	.85	.078	31	29	11	30	37	19	9.3	8.9	.18	14	.99	.006	.542	.015	24.1	2.04
120	9.3	.75	.072	35	28	11	27	23	6.0	8.1	8.3	.17	12	1.0	.006	.571	.012	36.1	0.74
150	8.9	.53	.063																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.5	0.08	8	12	0.23	194	13	0.27	0.37	6.0

Tannalo

Location: 682100mE 7651500mN Zone 55
Landform element: Fan
Landform pattern: Gently undulating rises
Slope: 2%
Principal Profile Form: Gn2.21
Australian Soil Classification: Brown Dermosol to Kandosol
Disturbance:
Vegetation:

Site No: MCL S36
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Moderately well drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Absent
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.20 m	Brownish black (5YR3/1) moist, brownish grey (7.5YR5/1) dry; coarse sandy loam; earthy; moderately moist very weak. Diffuse to -
A2	0.20 to 0.60 m	Dull reddish brown (5YR4/4) moist, greyish brown (7.5YR6/2) dry; coarse sandy loam; earthy; moderately moist very weak. Gradual to -
B21	0.60 to 0.85 m	Dull reddish brown (5YR5/4) moist; sandy clay loam, fine sandy; earthy; moderately moist very weak. Gradual to -
D	0.85 to 1.20 m	Dull reddish brown (5YR5/4) moist; coarse sandy loam; few subangular unspecified coarse fragments; moderately moist very weak.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	5.6	.02	.002												.030	1.86	.009		
10	5.7	.02	.001	54	28	10	13	7	2.3	.83	.10	.23	4	.77	.032	1.88	.007	1.4	2.77
20	5.6	.01	.007																
30	5.5	.01	.001	46	32	10	13	4	1.9	.62	.10	.12	4	.85	.030	1.85	.005	2.5	3.06
60	5.8	.01	.001	43	35	10	17	4	2.0	.60	.10	.28	4	.68	.031	1.89	.005	2.5	3.33
85	5.8	.01	.001	46	32	9	18	5	2.9	.89	.10	.18	6	.69	.032	1.91	.003	2.0	3.26
120	6.0	.01	.001	64	21	3	31	4	2.6	.97	.10	.13			.023	1.87	.003	2.5	2.68

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.86	0.06	46	22	0.27	60	36	0.3	1.5	
10	0.80	0.05	44	20	0.25					
20	0.72	0.06	38	17	0.16					

Tenmile

Location:	653953mE 7763560mN Zone 55	Site No:	PS36 (GB02)
Landform element:	Terrace plain	Microrelief description:	Absent
Landform pattern:	Peneplain	Permeability:	Moderately permeable
Slope:	1%	Drainage:	Well drained
Principal Profile Form:		Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:		Surface coarse fragments:	Absent
Disturbance:	Grazing	Surface condition:	Loose
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
A1e	0 to 0.09 m	Greyish red (10YR5/2) moist; sandy loam; moderate <2mm platy; dry weak. Abrupt to -
B21	0.10 to 0.36 m	Reddish grey (10YR5/1) moist; fine sandy light clay; strong 10-20mm prismatic; dry strong. Clear to -
B22	0.38 to 0.90 m	Greyish yellow (2.5Y6/2) moist; fine sandy light clay; strong 10-20mm prismatic; dry very firm. Clear to -
BC	0.92 to 1.28 m	Greyish yellow (2.5Y6/2) moist; sandy clay loam; weak 10-20mm prismatic; dry firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.9	.06	.004	16	57	17	11	5	1.9	1.3	.21	.11	5	.75	.016	.868	.021	4.2	1.46
30	7.3	.22	.024	9	41	21	31	14	6.6	5.8	2.2	.05	13	.61	.007	.665	.029	15.7	1.14
60	8.9	.81	.082	9	41	18	35	19	8.5	7.7	5.0	.11	15	.74	.008	.762	.040	26.3	1.11
90	8.9	.94	.119	9	41	14	38	21	8.6	9.3	6.6	.15	17	.85	.009	.908	.021	31.4	0.92
120	8.9	.97	.120	8	38	11	45	22	9.2	9.6	7.1	.14			.008	.844	.020	32.3	0.95

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.8	0.05	4	3	0.08	45	35	0.19	0.20	5.5

Thompson

Location:	646183mE 7718236mN Zone 55	Site No:	PS50 (1552)
Landform element:	Terrace plain	Microrelief description:	Absent
Landform pattern:	Terrace	Permeability:	Moderately permeable
Slope:	1.0%	Drainage:	Well drained
Principal Profile Form:	Dy4.12	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Haplic, Mesotrophic, Brown Dermosol	Surface coarse fragments:	Absent
Disturbance:	Completely cleared, grazing	Surface condition:	Firm
Vegetation:	*Eucalyptus platyphylla, E. teriticornis, Timoneus timon*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.22 m	Brownish black (10YR3/2) moist; fine sandy loam; massive; dry weak. Abrupt to -
B1	0.24 to 0.38 m	Dull yellowish brown (10YR4/3) moist; fine sandy clay loam; weak 5-10mm prismatic; dry weak. Abrupt to -
B21	0.40 to 0.67 m	Brown (7.5YR4/3) moist; few medium faint brown mottles; fine sandy light clay; weak 5-10mm prismatic; dry firm. Abrupt to -
B22	0.69 to 1.06 m	Brown (10YR4/4) moist; very few medium faint brown mottles; fine sandy light clay; weak 5-10mm prismatic; dry firm. Abrupt to -
D1	1.08 to 1.50 m	Greyish yellow-brown (10YR5/2) moist; coarse sandy loam; massive; dry very weak. Abrupt to -
D2	1.51 to 1.72 m	Dull yellowish brown (10YR5/3) moist; few medium distinct brown mottles; fine sandy medium clay; moderate 10-20mm prismatic; dry very firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.5	.04	.001	14	56	9	18	9	6.4	2.3	.05	.50	10	.57	.059	1.31	.026	0.6	2.80
30	6.9	.02	.001	15	54	12	18	8	5.2	2.3	.05	.28	9	.65	.037	1.32	.018	0.6	2.20
60	7.3	.02	.001	8	50	12	28	9	5.0	3.6	.08	.18	13	.63	.031	1.38	.016	0.9	1.40
90	7.5	.02	.001	14	49	15	22	11	6.1	4.6	.10	.14	11	.64	.026	1.42	.015	0.9	1.30
120	7.6	.02	.001	53	28	8	11	6	3.4	2.8	.10	.11	5		.041	1.39	.013	1.7	1.20
150	7.3	.02	BQ	48	31	7	11	7	3.8	2.9	.09	.13	8	.74	.044	1.51	.012	1.3	1.31

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.7	0.10	39.0	40.0	0.30	121	46	0.67	1.3	6.0

Up River

Location:	651366mE 7754943mN Zone 55	Site No:	PS38 (1229) (GB04)
Landform element:	Crest	Microrelief description:	Absent
Landform pattern:	Undulating rise	Permeability:	Highly permeable
Slope:	1.5%	Drainage:	Well drained
Principal Profile Form:	Uc3.21	Substrate lithology:	Tertiary sandstone
Australian Soil Classification:	Yellow Kandosol	Surface coarse fragments:	Absent
Disturbance:	Limited clearing	Surface condition:	Loose
Vegetation:	*Eucalyptus polycarpa, Melaleuca viridiflora*		

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Brownish grey (10YR5/1) moist; loamy sand; massive; dry very weak. Abrupt to -
A2j	0.10 to 0.28 m	Dull yellowish orange (10YR7/2) moist; loamy sand; massive; dry very weak. Abrupt to -
B21	0.51 to 1.10 m	Dull yellow (10YR6/2) moist; clayey sand; massive; dry very weak. Abrupt to -
B22	1.10 to 1.65 m	Bright yellowish brown (2.5Y6/4) moist; clayey sand; weak 5-10mm prismatic; dry weak. Abrupt to -
BC	1.65 to 1.69 m	Brownish grey (10YR6/6) moist; common medium distinct red mottles; coarse sandy clay loam; common fine gravelly rounded quartz; weak 5-10mm prismatic; dry weak.

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
		dS/m	%		%			meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.6	.03	.001	57	37	3	4	2	.66	.89	.08	.14	1	.83	.009	.166	.017	4.0	0.74
30	6.0	.02	.000	55	38	4	6	1	.11	.62	.02	.05	1	.92	.005	.211	.011	2.0	0.18
60	5.5	.01		69	21	2	10	1	.10	.76	.04	.08	3	.66	.005	.161	.010	4.0	0.13
90	5.2	.02		65	23	2	13	1	.03	.91	.03	.05	4	.51	.006	.146	.013	3.0	0.03
120	5.3	.02	.000	60	15	1	24	3	.03	2.6	.11	.10			.010	.155	.016	3.7	0.01

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.85	0.02	1	3	0.08	43	6.7	0.02	0.33	2.3

Uruba

Location:	669000mE 7662300mN Zone 55	Site No:	MCL S40
Landform element:	Footslope	Microrelief description:	Absent
Landform pattern:	Rolling rise	Permeability:	Moderately permeable
Slope:	16%	Drainage:	Moderately well drained
Principal Profile Form:	Dy2.72	Substrate lithology:	Granodiorite
Australian Soil Classification:	Brown Chromosol	Surface coarse fragments:	Few cobbles
Disturbance:		Surface condition:	Hardsetting
Vegetation:			

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.15 m	Greyish yellow-brown (10YR4/2) moist, brownish grey (10YR6/1) dry; sandy clay loam; dry moderately weak. Clear to -
A2sb	0.15 to 0.25 m	Dull yellowish brown (10YR5/3) moist; sandy clay loam; dry moderately weak. Clear to -
B21	0.25 to 0.55 m	Bright brown (7.5YR5/6) moist; few fine distinct pale mottles; light medium clay; weak 20-50mm angular blocky; moderately moist moderately weak. Gradual to -
C	0.55 to 1.20 m	Loamy sand; moderately moist loose.

Analytical data:

Depth	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
		dS/m	%		%			meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	6.1	.02	.002												.025	3.15	.021		
10	5.9	.02	.001	36	34	13	20	9	4.5	1.4	.10	.20	7	.56	.017	3.40	.016	1	3.2
25	5.8	.01	.001																
35	5.8	.01	.001	33	28	11	31	8	3.7	1.7	.10	.10	11	.63	.009	3.18	.010	1	2.2
55	5.9	.01	.001	31	26	14	34	9	3.8	2.1	.10	.10	13	.36	.010	2.86	.011	1	1.8
90	6.4	.01	.001	52	32	6	11	6	3.3	1.9	.10	.08	5	.53	.033	2.95	.006	1	1.7
120	6.3	.01	.001	55	30	7	10	6	3.9	2	.22	.05			.034	2.96	.006	4	1.95

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	2.3	.11	14	12	.41	63	26	0.5	2.0	
10	1.4	.09	5	4	.24					
20	.64	.06	2	2	.10					

Uruba (Sandy A horizon variant)

Location:	647603mE 7715227mN Zone 55	Site No:	PILUS 1591
Landform element:	Fan	Microrelief description:	Absent
Landform pattern:	Gently undulating plain	Permeability:	Moderately permeable
Slope:	1.5%	Drainage:	Moderately well drained
Principal Profile Form:	Dy3.42	Substrate lithology:	
Australian Soil Classification:	Mottled, Mesotrophic, Brown Chromosol	Surface coarse fragments:	Absent
Disturbance:	Grazing	Surface condition:	Hardsetting
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
A1j	0 to 0.10 m	Brownish grey (10YR4/1) moist; fine sandy loam; massive; weak. Abrupt to -
A2e	0.10 to 0.29 m	Brownish grey (10YR6/1) moist; Very few fine faint brown mottles; fine sandy loam; massive; weak; few medium manganiferous soft segregations. Abrupt to -
B21	0.29 to 1.15 m	Brown (7.5YR5/3) moist; few medium distinct brown mottles; light medium clay; strong 10-20mm prismatic; very firm; common medium ferromanganiferous concretions. Clear to -
D1	1.15 to 1.48 m	Greyish brown (7.5YR6/2) moist; clay loam coarse sandy; weak 5-10mm prismatic; few medium gravelly, subangular ironstone; weak

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.0	.06	.003					7	5.2	1.3	.07	.21						1.0	4.00
35	6.9	.02	.003					14	8.9	4.4	3.2	.41						4.6	2.02

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	1.4	0.11	18.0	15.0	0.30	86	70	1.0	2.2	4.0

Victoria Plains

Location:		Site No:	PS06 (174)
Landform element:	Flood-out	Microrelief description:	Absent
Landform pattern:	Flood plain	Permeability:	Slowly permeable
Slope:	1%	Drainage:	Imperfectly drained
Principal Profile Form:	Ug5.16	Substrate lithology:	Unconsolidated substrate materials
Australian Soil Classification:	Mottled-self-mulching, grey Vertosol	Surface coarse fragments:	Few gravelly subrounded ironstone
Disturbance:	No effective disturbance	Surface condition:	Cracking, self-mulching
Vegetation:			

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.04 m	Black (10YR2/1) moist; medium clay; strong 5-10mm lenticular; very few fine manganiferous nodules. sharp to -
A12	0.04 to 0.29 m	Black (10YR2/1) moist; medium clay; very few medium gravelly rounded ironstone; strong 5-10mm lenticular. Abrupt to -
B21	0.30 to 0.75 m	Yellowish grey (2.5Y4/1) moist; common medium faint grey mottles; medium heavy clay; common coarse gravelly subrounded ironstone; moderate 2-5mm lenticular; very few fine manganiferous nodules. Clear to -
B22	0.79 to 1.70 m	Yellowish grey (2.5Y5/1) moist; common coarse distinct brown mottles; medium heavy clay; few medium gravelly rounded ironstone; strong 20-50mm lenticular; common fine manganiferous nodules. Clear to -
B23	1.72 to 1.80 m	Grey (5Y6/1) moist; many coarse distinct grey mottles; light medium clay; common fine gravelly rounded ironstone; moderate 5-10mm lenticular; many coarse calcareous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	7.8	.04	.003	10	20	16	56	53	34	19	1.1	.12	24		.027	.111	.057	2.1	1.7
30	8.1	.23	.011	10	21	18	55	48	30	17	0.9	.10	32	.61	.020	.082	.038	1.9	1.8
60	8.6	.22	.007	10	23	19	52	43	26	16	.87	.09	23	.63	.016	.085	.028	2.0	1.6
90	8.6	.22	.007	13	20	18	49	36	32	15	.82	.08	22	.68	.017	.081	.026	2.3	2.1
120	8.6	.18	.005	14	24	19	48	39	25	14	.74	.09			.018	.093	.025	1.9	1.8

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	4.4	.26		12		52	15	1.9	0.84	

Victoria Plains

Location:
Landform element: Backplain
Landform pattern: Flood plain
Slope: %
Principal Profile Form: Ug 5.16
Australian Soil Classification: Self-mulching, black Vertosol
Disturbance: Cultivation
Vegetation: Cleared

Site No: PS07 (176)
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Well drained
Substrate lithology: Unconsolidated substrate materials
Surface coarse fragments: Few medium gravelly angular ironstone
Surface condition: Cracking, self-mulching

Profile Morphology:

Horizon	Depth	Description
A1p0	0 to 0.04 m	Black (10YR2/1) moist; medium clay; massive. Sharp to -
A1	0.04 to 0.19 m	Black (10YR2/1) moist; medium clay; strong 10-20mm subangular blocky; very few fine ferromanganiferous concretions. Abrupt to -
B21	0.20 to 0.44 m	Black (10YR2/1) moist; few very few faint brown mottles; medium heavy clay; few fine gravelly subrounded ironstone; strong 20-50mm lenticular; few fine ferromanganiferous concretions. Abrupt to -
B22	0.45 to 1.28 m	Yellowish grey (2.5Y5/1) moist; common very few faint grey mottles; medium heavy clay; very few medium gravelly subangular ironstone; strong 20-50mm lenticular; few medium ferromanganiferous concretions. Abrupt to -
B23	1.29 to 1.58 m	Yellowish grey (2.5Y6/1) moist; many very few distinct orange mottles; medium heavy clay; strong 10-20mm subangular blocky; few medium calcareous nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	7.7	.15	.018	7	12	22	63	39	18	13	2.6	.17	24	.57	.036	.209	.046	6.7	1.4
30	7.6	.46	.056	9	10	14	65	32	16	13	3.1	.06	25	.62	.020	.204	.034	9.7	1.2
60	7.7	.74	.101	13	13	14	60	34	15	13	3.1	.04	23	.64	.021	.229	.029	9.1	1.2
90	7.9	.78	.113	15	16	14	56	28	13	13	3.3	.02			.025	.279	.025	11.8	1.0
120	8.1	.83	.118																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10										

Wagoora

Location: 648970mE 7742578mN Zone 55
Landform element: Midslope
Landform pattern: Hill slope
Slope: 2.5%
Principal Profile Form: Uf6.31
Australian Soil Classification: Red Dermosol
Disturbance: Grazing
Vegetation: Isolated *Eucalyptus crebra* and *E. platyphylla*

Site No: PS20 (370)
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Moderately well drained
Substrate lithology: Andesite
Surface coarse fragments: Few coarse gravelly subangular andesite
Surface condition: Firm

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.15 m	Brownish black (10YR3/1) moist; light medium clay; strong 2-5mm subangular blocky; dry firm. Abrupt to -
B21	0.16 to 0.31 m	Dull reddish brown (5YR4/4) moist; medium clay; moderate 5-10mm prismatic; dry very firm. Abrupt to -
B22	0.32 to 0.47 m	Brown (7.5YR4/4) moist; medium clay; moderate 10-20mm lenticular; dry strong; few medium manganiferous soft segregations. Abrupt to -
B23	0.49 to 1.22 m	Brown (10YR4/4) moist; medium clay; moderate 10-20mm lenticular; dry very firm; very few medium manganiferous soft segregations. Abrupt to -
BC	1.24 to 1.62 m	Dull yellowish brown (10YR5/4) moist; sandy clay loam; moderate 20-50mm subangular blocky; dry firm.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %	%	%	%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.1	.04	.000	9	24	21	46	22	12	9.4	.10	.22	20	.36	.057	.091	.035	0.4	1.30
30	6.3	.02	.004	2	7	11	78	24	11	13	.25	.10	31	.31	.015	.063	.016	1.1	1.85
60	6.7	.02	.002	1	10	24	65	29	13	16	.39	.07	29	.31	.008	.069	.011	1.3	0.81
90	7.2	.03	.001	1	21	28	50	36	17	18	.52	.08	27	.47	.010	.085	.010	1.4	0.94
120	7.4	.02	.000	2	38	33	32	39	20	18	.49	.05	21	.52	.023	.100	.008	1.3	1.10
150	7.2	.02	.000																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	3.2	0.17	10	31	0.33	75	84	1.7	2.6	7.0

Wandarra

Location: 652025mE 7751900mN Zone 55
Landform element: Mid slope
Landform pattern: Gently undulating plains
Slope: 3%
Principal Profile Form: Gn2.34
Australian Soil Classification: Yellow to brown Dermosol
Disturbance:
Vegetation: Cleared

Site No: PRO18
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Well drained
Substrate lithology: Laterized sandstone
Surface coarse fragments:
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.05 m	Greyish yellow brown (10YR4/2); coarse sand; massive. Gradual to -
A2cb	0.052 to 0.20 m	Conspicuously bleached; coarse sand; weak coarse platy; soft. Gradual to -
B21	0.20 to 0.50 m	Yellowish brown (10YR5/6); light sandy clay loam; weak medium subangular blocky; soft. Gradual to -
B22	0.50 to 0.60 m	Yellowish brown (10YR5/6); coarse sand; weak medium subangular blocky; loose. Gradual to -
B23	0.60 to 0.90 m	Yellowish brown (10YR5/6); sandy clay; massive; dry hard. Clear to -
B24	0.90 to 1.20 m	Yellowish brown (10YR5/6), 30% red mottle; light clay; moderate medium subangular blocky; dry slightly hard. Clear to -
B25	1.20 to 1.45 m	Light grey (10YR7/1), 40% red mottle; light medium clay; moderate medium subangular blocky; dry hard. Clear to -
B26	1.45 to 1.50 m	Yellowish brown (10YR5/6); 40% red mottle; light medium clay; moderate medium subangular blocky; dry hard.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.2	.03	.002	45	46	4	1	5	.05	0.1	0.1	.07	2		.004	0.04	.006	2.0	0.5
30	5.2	.01	.001	48	41	3	4	2	.05	0.1	.05	.02	3		.003	0.02	.003	2.0	0.5
60	5.5	.01	.001	80	11	2	2	1	.05	0.4	.05	.05	2		.003	0.01	.004	5.0	0.13
90	5.5	.02	.002	67	6	1	22	3	.05	1.8	0.1	.02	9		.007	0.07	.011	3.0	0.03
120	5.5	.03	.003	50	5	2	37	6	.05	2.6	0.2	.02			.009	0.10	.019	3.0	0.02
150	4.9	.03	.003	57	7	3	25	4	.05	0.7	0.1	.02	9		.007	0.09	.028	2.0	0.07

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	.97	.04	5	4	.09	78	1	0.1	0.2	
20	.58	.03	4	2	.02					

Whiptail

Location: 676200mE 7693200mN Zone 55
Landform element:
Landform pattern: Undulating rises
Slope: 4%
Principal Profile Form: Dy3.31
Australian Soil Classification: Yellow to grey Sodosol
Disturbance:
Vegetation: Woodland of *Eucalyptus crebra, Corymbia dallichiana, C. intermedia, Melaleuca nervosa*

Site No: MCL S01
Microrelief description: Absent
Permeability: Slowly permeable
Drainage: Moderately well drained
Substrate lithology: Trachyte
Surface coarse fragments: Very few cobbles
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.05 m	Brownish black (7.5YR3/2) moist, brownish grey (10YR6/1) dry; few fine distinct mottles, few fine faint yellow mottles; sandy clay loam; weak 2-5mm platy; dry very firm. Abrupt to -
A2sb	0.05 to 0.28 m	Greyish brown (7.5YR4/2) moist, brownish grey (10YR6/1) dry; few fine distinct yellow mottles; sandy clay loam; few angular trachyte; dry very firm. Abrupt to -
B21	0.28 to 0.44 m	Bright yellowish brown (10YR7/6) moist; few fine distinct brown mottles, few fine distinct red mottles; medium clay; dry moderately strong; slightly calcareous. Clear to -
B22	0.44 to 0.95 m	Dull yellowish orange (10YR7/4) moist; common medium distinct gley mottles; light medium clay; few angular trachyte; dry moderately strong; non-calcareous. Diffuse to -
B23	0.95 to 1.20 m	Light yellow (2.5Y7/3) moist; many medium distinct yellow mottles, few medium distinct red mottles; medium clay; dry moderately strong; non-calcareous.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
5	5.8	.03	.002	14	59	12	14	8	2.7	2.0	.17	.25	7		.025	0.60	.021	7	1.35
20	5.6	.03	.002																
30	5.9	.03	.003	8	53	21	21	6	1.4	1.8	.41	.05	9		.016	0.68	.012	10	0.78
40	5.8	.15	.017																
60	6.0	.32	.042	2	34	16	50	12	.92	8.9	5.1	.11	19		.005	2.68	.006	12	0.10
90	6.1	.33	.044	2	52	18	29	81	1.3	47	97	1.0	31	2	.006	2.82	.005	15	0.28
120	5.6	.46	.063	11	46	11	30	20	.20	8.9	12	10			.012	2.99	.010		0.22

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
5	2.1	.10	8	8	.32					
20	1.1	.06	3	10	.07					

Wilmington

Location:	614100mE 7792900mN Zone 55	Site No:	S54
Landform element:	Plain	Microrelief description:	Absent
Landform pattern:	Level plain	Permeability:	Slowly permeable
Slope:	0%	Drainage:	Imperfectly drained
Principal Profile Form:	Um6.21	Substrate lithology:	Clay
Australian Soil Classification:		Surface coarse fragments:	Absent
Disturbance:		Surface condition:	Firm
Vegetation:	Open tussock grassland of *Dicanthium species*		

Profile Morphology:

Horizon	Depth	Description
A11	0 to 0.10 m	Brownish black (10YR3/2); silty clay loam; strong 2-5mm subangular blocky; dry very firm. Clear to -
A12	0.10 to 0.40 m	Black (10YR2/1), silty clay; strong 5-10mm subangular blocky; dry very firm. Clear to -
D1	0.40 to 0.70 m	Dull yellowish brown (10YR4/3); common medium distinct yellow mottles; medium heavy clay; strong 20-50mm angular blocky; moderately moist very firm; very few fine manganiferous concretions. Clear to -
D2	0.70 to 0.90 m	Brownish black (2.5Y3/2); heavy clay; massive; moist moderately firm; very few fine manganiferous concretions, very few very coarse carbonate nodules. Clear to -
D3	0.90 to 1.30 m	Brownish black (2.5Y3/2); heavy clay; massive; moist moderately firm; very few fine manganiferous concretions, very few very coarse carbonate nodules. Clear to -
D4	1.30 to 1.50 m	Olive brown (2.5Y4/3); medium clay; massive; moist moderately firm; very few fine manganiferous concretions, very few very coarse carbonate nodules.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	% P	% K	% S	ESP	Ca:Mg
10	6.9	.14	.014	14	40	23	22	23	7.2	9.7	1.1	.55	12	.72	.029	0.93	.026	4.8	0.74
30	7.7	.32	.005	16	37	15	32	22	6.5	14	3.2	.15	15	.95	.014	0.72	.023	14.5	0.46
60	7.6	1.2	.200	22	34	13	32	21	3.3	16	5.5	.14	14	.91	.008	0.38	.057	26.2	0.21
90	8.9	1.4	.350	15	25	17	43	29	4.5	21	7.9	.28	19	.99	.010	0.48	.051	27.2	0.21
120	8.9	1.2	.185	17	23	17	43	29	4.8	21	8.2	.22			.008	0.54	.038	28.3	0.23
150	8.9	1.1	.215																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	2.1	.12	16	15	.47	95	81	2.2	1.0	

Wollingford

Location:	690900mE 7650700mN Zone 55	Site No:	MCL S54
Landform element:		Microrelief description:	Absent
Landform pattern:	Undulating rises	Permeability:	Slowly permeable
Slope:	5%	Drainage:	Moderately well drained
Principal Profile Form:	Dy3.33	Substrate lithology:	Igneous rocks
Australian Soil Classification:	Grey Sodosol	Surface coarse fragments:	Few gravel
Disturbance:	Cultivation	Surface condition:	Hardsetting
Vegetation:	Cleared		

Profile Morphology:

Horizon	Depth	Description
AP	0 to 0.35 m	Greyish yellow-brown (10YR4/2) moist, brownish grey (10YR6/1) dry; sandy clay loam; weak 5-10mm subangular blocky; dry moderately weak. Clear to -
B21	0.35 to 0.50 m	Brownish grey (10YR5/1) moist, dull reddish brown (5YR5/4) moist; common fine distinct brown mottles; medium clay; moderate 50-100mm prismatic strong 20-50mm angular blocky; moderately moist very firm. Clear to -
BC	0.50 to 0.80 m	Dull yellow (2.5Y6/3) moist, grey (N6/0) moist; medium clay; few angular igneous rocks; dry very firm. Gradual to -
C	0.80 to 1.00 m	Grey (N6/0) moist, dull yellow (2.5Y6/3) moist; sandy clay; many angular igneous rocks; dry.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	% P	% K	% S	ESP	Ca:Mg
Bulk 10	6.0	.16	.016																
10	5.5	.10	.012	30	33	16	20	15	4.3	2.1	.49	.19	9	.90	.033	0.67	.012	3.3	2.05
20	5.5	.05	.005																
30	5.5	.04	.004	30	32	16	20	15	3.6	1.7	.37	.21	10	.88	.038	0.73	.011	2.5	2.12
50	5.5	.08	.010	9	12	19	57	20	11	3.7	.85	.15	18	.84	.061	6.47	.011	4.3	2.97
90	8.6	.11	.007	42	13	20	23	18	18	4.0	1.3	.06	11	.73	.030	2.29	.006	7.2	4.50

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.0	0.08	130	101	0.4	137	88	0.6	0.9	
10	0.9	0.07	113	83	0.2	150	53	0.5	1.1	
20	0.9	0.07	140	105	0.3	150	53	0.5	1.1	

Wollingford

Location: 653940mE 7743880mN Zone 55
Landform element: Rise
Landform pattern: Gently undulating plain
Slope: 1%
Principal Profile Form: Dy3.33
Australian Soil Classification: Grey Sodosol
Disturbance: Grazing
Vegetation: Cleared

Site No: PS17 (496)
Microrelief description: Crabhole gilgai
Permeability: Very slowly permeable
Drainage: Poorly drained
Substrate lithology: Rhyolite
Surface coarse fragments: Few fine gravelly subangular ironstone
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1j	0 to 0.09 m	Greyish yellow brown (10YR5/2) moist, (10YR7/1) moist; silty clay loam; few fine gravelly subangular ironstone; moderate 5-10mm prismatic; dry weak. Abrupt to -
A21j	0.10 to 0.21 m	Greyish yellow brown (10YR6/2) moist, (10YR8/1) moist; few fine distinct orange mottles; silty clay loam; moderate 5-10mm prismatic; dry weak. Abrupt to -
A22	0.22 to 0.32 m	Dull yellowish orange (10YR6/4) moist; clayey sand; very abundant fine gravelly subangular ironstone; massive; dry very weak. Abrupt to
B21	0.33 to 0.46 m	Dull yellow (2.5Y6/4) moist; common fine faint brown mottles; medium clay; moderate 10 - 20 mm prismatic; dry firm; many fine ferromanganiferous concretions. Abrupt to -
B22	0.48 to 0.91 m	Bright yellowish brown (2.5Y6/6) moist; common medium faint brown mottles; fine sandy medium heavy clay; common fine gravelly subangular ironstone; strong 10 - 20 mm prismatic; dry strong; very many fine ferromanganiferous concretions. Abrupt to -
B23	0.92 to 1.01 m	Bright yellowish brown (10YR6/6) moist; common medium faint brown mottles; fine sandy light clay; moderate 20 - 50 mm prismatic; dry very firm; few fine ferromanganiferous concretions. Abrupt to -
B24	1.02 to 1.62 m	Yellowish brown (10YR5/8) moist; common medium faint grey mottles; fine sandy medium heavy clay; strong 20-50mm lenticular; dry strong; common fine ferromanganiferous concretions.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	5.7	.05	.004	12	42	26	17	2	1.0	1.0	.27	.15	6	.57	.018	.063	.024	13.5	1.00
30	6.4	.03	.001	49	20	18	17	2	.82	1.2	.19	.07	7	1.0	.036	.080	.016	9.5	0.68
60	9.0	.19	.006	14	28	25	36	17	5.0	6.7	4.8	.08	14	1.0	.009	.125	.006	28.3	1.75
90	9.7	.43	.016	8	24	28	40	32	14	8.7	8.9	.11	16	.66	.006	.145	.012	27.8	1.61
120	9.6	.49	.031	9	26	27	41	27	5.7	9.0	12	.13	16	.99	.008	.169	.007	44.4	0.63
150	9.6	.53	.036																

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	1.5	0.07	5	14	0.09	202	11	0.44	0.40	10.0

Woonton

Location: 583700mE 7789800mN Zone 55
Landform element: Drainage depression
Landform pattern: Gently undulating plains
Slope: 1%
Principal Profile Form: Gn2.62
Australian Soil Classification: Yellow Tenosol
Disturbance:
Vegetation: Tall open woodland of *Eucalyptus drepanophylla*, *Eucalyptus platyphylla* and *Melaleuca viridiflora*

Site No: S6
Microrelief description: Absent
Permeability: Moderately permeable
Drainage: Imperfectly drained
Substrate lithology: Granite
Surface coarse fragments:
Surface condition: Hardsetting

Profile Morphology:

Horizon	Depth	Description
A1	0 to 0.10 m	Brownish black (10YR3/2); sandy loam; massive; dry moderately firm. Clear to -
AB	0.10 to 0.20 m	Dull yellowish brown (10YR4/3), sandy clay loam; massive; moderately moist moderately firm. Gradual to -
B21	0.20 to 0.80 m	Yellowish brown (10YR5/8); very few faint brown mottles; sandy clay; massive; moderately moist moderately firm. Gradual to -
B22	0.80 to 1.10 m	Yellowish brown (10YR5/6); few fine distinct grey mottles, few medium distinct brown mottles; sandy clay; massive; moderately moist moderately strong. Clear to -
B23	1.10 to 1.30 m	Yellowish brown (10YR5/6); very few fine faint red mottles, few medium faint grey mottles; sandy clay; massive; dry rigid.

Analytical data:

Depth	1:5 soil/water			Particle size %				Exch. Cations meq/100g					Bar %	D.R	Total Elements %			%	
(cm)	pH	dS/m EC	% Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
10	6.2	.02	.001	54	27	5	13	5	2.0	1.3	.21	.26	6	.29	.018	0.82	.012	4.2	1.54
30	6.3	.01	.001	46	20	4	27	8	3.2	2.5	.26	.13	9	.38	.014	0.81	.009	3.3	1.28
60	6.5	.01	.001	40	15	7	37	10	4.1	3.4	.41	.10	13	.26	.011	0.57	.007	4.1	1.21
90	6.8	.01	.001	48	16	6	27	9	3.7	2.8	.43	.08	11	.56	.009	0.68	.005	4.8	1.32
120	7.0	.02	.002	40	16	7	34	13	6.4	4.0	.60	.12			.008	0.73	.003	4.6	1.60

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
10	0.4	.04	2	3	.26	56	26	1.2	0.2	

Wygong

Location:	579500mE 7786600mN Zone 55	Site No:	S13
Landform element:	Plain	Microrelief description:	Normal gilgai
Landform pattern:	Level plain	Microrelief component:	Depression
Slope:	1%	Permeability:	Slowly permeable
Principal Profile Form:	Ug5.12	Drainage:	Imperfectly drained
Australian Soil Classification:	Black Vertosol	Substrate lithology:	Granodiorite
Disturbance:		Surface coarse fragments:	
Vegetation:	*Corymbia dallachiana*	Surface condition:	Periodic cracking, self-mulching

Profile Morphology:

Horizon	Depth	Description
A11	0 to 0.03 m	Black (10YR2/1); heavy clay; moderate 2-5mm granular; dry loose. Abrupt to -
A12	0.03 to 0.10 m	Black (10YR2/1); heavy clay; moderate 10-20mm angular blocky; moist very firm. Clear to -
B21	0.10 to 0.40 m	Black (10YR2/1); heavy clay; moderate 20-50mm lenticular; dry very strong. Clear to -
B22	0.40 to 0.70 m	Black (10YR2/1); heavy clay; moderate 20-50mm lenticular; moderately moist very strong; very few medium carbonate nodules. Clear to-
BC	0.70 to 0.80 m	Dark greyish yellow (2.5Y4/2); medium clay; massive; moderately moist very strong; very few medium carbonate nodules. Abrupt to -
C	0.80 to 0.90 m	Dark olive grey (5GY4/1); sandy clay loam; massive; dry moderately strong.

Analytical data:

	1:5 soil/water			Particle size				Exch. Cations					Bar	D.R	Total Elements				
Depth		dS/m	%		%			meq/100g					%		%	%	%	%	
(cm)	pH	EC	Cl	CS	FS	SI	CL	CEC	Ca	Mg	Na	K	15*	R1	P	K	S	ESP	Ca:Mg
Bulk 10	7.1	.03	.004	16	23	16	46	40	17	17	.64	.47	18	.65	.019	0.28	.013	2.0	1.0
10	6.8	.04	.003	16	23	15	46	38	16	15	.90	.25	18	.72	.014	0.24	.011	2.0	1.1
30	7.7	.05	.031	18	22	16	46	37	17	16	1.7	.21	19	.81	.012	0.22	.010	5.0	1.1
90	8.8	.27	.007	15	21	17	46	38	17	17	3.5	.24	19	.84	.018	0.24	.011	9.0	1.0

Depth	%	%	P mg/kg		meq%	mg/kg				mg/kg
(cm)	Org. C	Tot. N	Acid	Bic	Rep. K	Fe	Mn	Cu	Zn	SO4-S
Bulk 10	0.8	.07	16	9	.42	33	50	2.2	0.4	
10	0.5	.06	5	4	.29	42	42	2.3	0.4	