SOIL SURVEY
WESTERN PORT BAY
CATCHMENT

By

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Introduction

This report o the soils of the Westernport Bay catchment forms part of an environmental study, known as the Westernport Bay Environmental Study, which aims to provide detailed information over a wide range of subjects relating to both the Westernport Bay catchment and the bay itself. This combined information will provide a basis for development and management policies for the bay its catchment.

The soils survey is a sub-program of the program on physical characteristics of the catchment and was made by the Soil Section of the Division of Agricultural Chemistry, Department of Agriculture, with some assistance from the State Rivers and Water Supply Commission.

Two separate soil survey reports have been compiled, one of a general nature, the other more detailed. This is the more general report and it is to be read in conjunction with the accompanying Soil Association Maps at approximate scale 1:123,000 1 cm:1.23 km. The more detailed report contains more specific information on the soils, geology, landscape and vegetation, and a detailed Soil Association Map at a scale of 1:50,000.

The soil survey was carried out at the request of the Westernport Bay Environmental Study. An abridged version was published in the "Westernport Bay Environmental Study 1973-1974 Ministry for Conservation Victoria, Australia".

The Soil Survey

The objectives of this soil survey are to describe the soils of the Westernport Bay catchment in terms of mapping units, and to provide a soil map showing their distribution. Most mapping units used here are called Soil Associations. These are described in terms of the landscape and the soils occurring within the landscape. The legend to the soil map gives the symbols, geology and land form for each association, together with topography, classification and drainage class for major soils within each association. Table 1 shows the area of each of these associations and other mapping units, over the whole of the Westernport Bay catchment and for each subcatchment. The soils groups are based on the Great Soil Groups given in Stace et al[*], but the soloths are subdivided into yellow soloths and brown soloths, and the additional terms calcareous fine sands and peaty fine calcareous sands are used.

Usually a soil survey gives detailed complementary information on topics such as geology, land use, flora, and climatic details, as well as general information on the area. In this report this is not so, as such specific studies are given in reports compiled by others involved in the Westernport Bay Environmental Study.

In conducting this soil survey the majority of holes were augered on farm properties, occasionally on road reserves, and all were spaced at intervals depending on the complexity of the landscape and the general soil pattern. The depth of the auger hole was generally between 1 m and 1.8 m, and the soil horizons were described in terms of thickness, texture, colour, structure, friability, iron concretions and hard pan.

Although there was an average of one recorded site to 2180 ha over the whole catchment, the site density excluding the relatively uniform mapping units of the granitic highlands in the north and Strezelecki ranges in the east, was one site to 230 ha.

Soil samples were taken from 31 sites for detailed chemical, physical and mineralogical analysis. To date, these analyses have not been completed, and will be published later in the detailed report. However, determinations of pH, and analyses for NaCl, available potassium and available phosphorus have been completed and are given in Table 2.

Auger hold hydraulic conductivity measurements (Table 3) were made at 22 sites in conjunction with Mr S Bridley of the State Rivers and Water Supply Commission.

[*] Stace et al (1968) - "A Handbook of Australian Soils" (Rellim: Glenside, SA)

The Soil Associations

Athlone Association (A)

The Athlone Association occurs as a broad strip of country towards the eastern and south-eastern flank of the Westernport Bay catchment, extending from near Bass in the south to Jindivick in the north-east. Although underlying rocks are generally Cretaceous sediments, they are rarely exposed, and much of the association is regarded as early Tertiary terrain. The landscape is gently undulating with deeply incised valleys, thus giving a quite hilly overall impression.

The area was formerly an open forest with small areas of wet sclerophyll forest in the deep gullies, with heath species*, hakea and prickly tea-tree on the forest floor. The predominant eucalypts were messmate, narrow-leaf peppermint and broad-leaf peppermint, with some silver-leaf stringy bark. Swamp gum and manna gum probably grew in the valleys. The soils of this association have been regarded in the past as being among the poorer soils because they are very acid, and clearing of the remnants of the former forest is still occurring. These soils are sown to pastures which are predominantly grazed by cattle.

Most soils are within two groups, one occurring on the broad, gently undulating areas, and the other on the more steep topography. The soils of the gently undulating areas are dark grey fine sandy loam to very fine sandy clay loams with a bleached zone occurring from about 10 cm. Mottled yellow-brown and light grey very fine sandy loams or very fine sandy clay loams, frequently cemented, occur at about 30 cm. Mottled yellow-brown and light grey light or medium clays occur at about 70 cm.

On the slopes, the surface soils are grey or brownish grey loams to very fine sandy clay loams, overlying, at about 15 cm, brownish grey or light brownish grey very fine sandy clay loams. This horizon may or may not be bleached. The mottled clay subsoils occur at about 60 cm

Bass Delta (BD)

This association is confined to a small crescent-shaped area near the mouth of the Bass River. The landscape is almost level, with a number of very low dunes running approximately parallel to the coastline. The surface soils of the low dunes are dark grey very fine sandy loams high in organic matter, overlying lighter grey loamy very fine to fine sands which contain shell fragments at variable depths. In the slightly lower areas, the surface soils are generally clay loams or very fine sandy clay loams with high amounts of peat. The deep subsoils are similar to those of the dunes.

The soils have little native vegetation remaining on them and carry improved pastures.

Bittern Association (B)

Although the Bittern Association is quite extensive on French Island and hear Hastings, only small areas occur elsewhere in the Westernport Bay Catchment. The sediments on which these soils occur are generally unconsolidated or weakly cemented clays or sandy clays deposited during the Tertiary and overlying Silurian or Ordovician sediments. The late Tertiary surface is now dissected and the landscape is gently undulating with deeply incised depression lines. Frequently, these depression lines expose the underlying older sediments.

Originally the soils of this association supported an open shrub woodland. Eucalypt species included messmate and narrow-leaf peppermint, with some manna gum and silver-leaf stringybark. Heath, silver banksia and prickly tea-tree were common shrubs. Most of the area is now cleared and supports improved pastures.

Near Hastings the soils of the Bittern Association are highly regarded for apple growing, but as land speculators acquire areas of these soils under orchard, the orchards are being abandoned or grubbed out.

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* See Appendix 1: Common names of plant species with corresponding botanical names

Most surface soils are dark brownish grey fine sandy clay loams, overlying a bleached similarly-textured zone generally containing iron oxide concretions. Mottled yellow-brown, light brownish grey and red-brown heavy clays appear abruptly below the bleached horizon. Clays or sandy clays continue to at least 1.8 m.

Bittern Sand Association (B_s)

Near Balnarring and Flinders the surface and bleached soil horizons are deeper and more sandy. Such areas are denoted by the subscript "s".

Bittern-Nyora Association Complex ($B\text{-}N^y$)

On the north eastern part of French Island the soils of the Bittern and Nyora Association occur together and are inseparable at the present scale of mapping. In general the Nyora Association soils tend to be in the lower landscape position. Such areas are mapped as the Bittern-Nyora Association complex.

Cerberus Association (C^e)

This association includes the geologically recent sand dunes adjoining parts of the coastline within the Westernport Bay Catchment. The dunes may or may not be stable. All of the soils are sands, and variations in surface colour are mainly due to organic matter differences. The subsoil sands generally range in colour from pale grey-brown to yellow-brown with occasionally reddish shade of light brown. Although the surface soils are generally non-calcareous, the subsoils at about 90-120 cm are always alkaline and frequently highly calcareous.

The soils are generally unused or used for recreational purposes. Some housing development on these soils occurs at Balnarring, Somers and on Phillip Island. Originally the association supported a coast banksia open forest, with manna gum, coast tea-tree, coastal sword sedge and bracken.

Cranbourne Association (C^r)

Within the Westernport Bay Catchment the Cranbourne Association is restricted to a triangular area from Cranbourne to near Tooradin in the south-east, and to near Tyabb in the south-west.

The soils are formed on Quaternary sands which occur as sheets and dunes on the uplands from the north to west of Pearcedale, and on sandy blowouts from the former watercourses which rose in these upland and flowed to the south-east.

Most of the soils carried a shrub woodland containing manna gum, and coast and silver banksia, with paper barks in lower situations. Coast tea-tree, heath, hakea, dwarf sheoak and bracken formed part of the understorey. A large area of this association, located in the Botanic Gardens Reserve, Cranbourne, is retained in its natural state.

The main soil types within this association is a deep sandy soil named Cranbourne sand which occurs on the dunes and deep sand sheets. The surface soils are dark grey sands becoming light grey sands at about 30 cm. Dark brown and yellow-brown cemented sands (termed coffee rock) usually occur at about 1 m. Mottled light yellow-brown and light grey sands occur under the coffee rock, and generally mottled yellow-brown and light grey clays occur at depth.

On the lower parts of the landscape the colour of the surface soils is similar, but the textures may be sandy loam or fine sandy loam. The sandy bleached zone is present but instead of coffee rock, iron concretions are present above the mottled yellow-brown and light grey clays. The depth to clay is between 45 and 90 cm.

Where the Cranbourne Association meets the saltmarsh there is generally a narrow, dense, pure stand of swamp paperbark running parallel to the shoreline. This zone is generally between 10 and 30 metres wide, but on Quail Island it is broader, forming a large part of the south-east corner. The surface soils of this zone are dark grey loamy sands or sandy loams, generally high in both coarse and fine organic matter, and overlying slightly clayey sands ranging in colour from yellow-brown to reddish brown. These sands generally continue to at least 180 cm.

Areas of deep sand are quarried and the surface soil is widely used for the topdressing of bowling greens and suburban lawns and gardens. The topsoil sand is used in the building industry and for concrete production.

These soils are also highly productive under irrigation, and a large proportion of Melbourne's vegetables are grown under irrigation in this area. As the pressure of urban development increases the greater will be the conflict between this activity and agricultural, recreational and sand mining enterprises. As the Soil Map shows, this important soil association is limited in extent.

Dalmore Association (D)

This soil association is confined to part of an area of swamp sediments laid down in the late quaternary and recent geological periods. These sediments represent the terminal deposits of the Cardinia, Ararat, Toomuc and Deep Creeks. The original vegetation was probably confined to reeds, rushes and marsh-loving species of tussock grass.

Two types of soil are mapped, both having very dark grey medium or heavy clay surface soils These have strong fine crumb structure and are high in organic matter. Although the profiles remain dominantly grey to 180 cm, they generally become yellowish and slightly mottled and yellow-brown with depth.

In the normal phase of Dalmore clay, heavy clay textures continue throughout the profile, but in the peaty phase highly friable peaty clays occur from about 60 to 80 cm. The peaty phase is highly sought after for market gardening as it is not only better drained internally but it has a more friable surface. The normal phase of Dalmore clay is considered inferior for vegetables and is used as a pasture soil. In addition, the normal phase is frequently moderately saline, with some extremely saline areas near the shoreline.

Flinders Association (F)

Much of the undulating to hilly country north of Flinders and on Phillip Island is mapped into the Flinders Association. All of the soils overlie early tertiary basalts.

The original vegetation was an open forest to woodland, comprised mainly of messmate and silver-leaf stringybark, with manna gum, narrow-leaf peppermint and blackwood. Paperbarks and various acacia species were also present. Although most of the soils of this association now carry improved pastures, some in the Red Hill area are used for apple and cherry orchards, as are the generally more productive soils of the Red Hill association.

Most of the surface soils are dark brownish grey clay loams or very fine sandy clay loams. At about 20 cm a bleached zone occurs generally with some iron concretions. Mottled grey-brown and yellow-brown heavy clays occur at 30 to 40 cm. These clays become mottled with red-brown at depth, and usually continue to deeper than 2 m before rock is encountered.

On some crests or steep slopes more friable and browner clay loam surface soils occur, generally containing small ironstone concretions. A bleached zone may or may not be present above the dominantly brown heavy clay. Subsoils occur at about 30 cm. Rock is frequently encountered before 180 cm.

Flinders Clay Association (F_c)

Some areas mapped into the Flinders Association have grey clay surface soils These are denoted by the subscript "c". Such occurrences are limited to a few small areas along parts of the southern coastline of French and Phillip Islands, and near Berwick, Cranbourne and Jindivick. The underlying basalt is frequently encountered before 1.8 m, suggesting that these soils have been more erosion prone than other basaltic soils in the catchment. However, at Cranbourne this soil occurs in a low level, gently undulating, clay plain.

Most of the soils have dark grey light or medium clay surfaces grading into yellowish grey mottled with yellow-brown medium or heavy clay subsoils. Small areas of brownish grey clay loam surface soils, as described under the Flinders Association, may also occur, in which case the underlying basalt is generally cheaper.

The soils originally carried a grassland which is now improved and generally used for grazing.

French Island Association (FI)

Most of this association occurs on French Island. The landscape is an undulating lowland of quaternary aeolian sand, with small but numerous permanent swamps, and depressions. These depressions are generally grassland with sedges and rushes, with the undulating country supporting a low shrubland of heath species, twa-tree and occasional manna gum. Silver banksia, bracken, heath, dwarf sheoak, rushes and sedges are components of the ground cover. Most of area is uncleared.

The soils on the low areas and semipermanent swamps have very dark grey sandy loam or loamy sand surfaces with a bleached, similarly-textured sand or coffee rock, occurs at about 60 cm above the mottled yellow-brown and light grey medium or heavy clay subsoil. The better drained soils have dark grey sandy loam or loamy sand surface soils, with light brownish grey loamy sands from about 20 cm. Coffee rock occurs at about 80 cm passing to light grey and yellow-brown mottled sands, or occasionally clayey sands.

Garfield Association (G)

The Garfield Association comprises the soils of the granite foothills of the eastern highlands. Most of the former open forest of messmate with narrow-leaf peppermint, longleaf box, and silver-leaf stringy bark and manna gum has been cleared and the land sown to permanent pasture. There are also a number of apple orchards on these soils,

Most of the soils are deeper than 180 cm but there are some rocky outcrops. The surface soils are generally brownish grey gritty or sandy clay loams with bleached subsurfaces occurring at about 10 cm. Slight amounts of small iron concretions generally occur just above the mottled yellow-brown, light grey and yellowish grey clay subsoils. These clays occur at about 40 cm and may be medium or light clays. Medium or heavy clays, usually gritty, occur at about 60 cm and generally continue to at least 180 cm.

In the valleys, the surface soils are dark brownish grey sandy clay loams or clay loams over a bleached subsurface, with mottled clays occurring at about 50 cm. These soils are described in more detail under the Tynong Association.

Hallam Association (H)

Most of the Hallam Association occurs on the hilly country near Pakenham and Pearcedale, but there are small areas near Red Hill and Hastings. The underlying rock is a Silurian sedimentary rock, usually mudstone, generally occurring at between 1 and 2 m depth.

Most of the soils of this Association originally carried an open forest or shrub woodland. However, north of Pakenham there are areas of wet sclerophyll forest. Although most of the land is cleared, there are sufficient areas of relatively natural vegetation present to identify the original plant communities. The predominant eucalypts are messmate and silver-leaf stringybark, with longleaf box, narrow-leaf peppermint and occasional manna gum.

The surface soils are generally brownish grey or grey very fine sandy clay loam to silty clay loams, and at about 10 cm a bleached zone occurs, similar in texture to the above layer. Yellow-brown mottled with light heavy clays occur at 40 to 60 cm with a zone of ironstone concretions above the clay. Variations in colour and texture of the surface soils, as well as depth to rock, occur with landscape position.

On the steeper slopes the soils are subject to sheet erosion. Consequently, the depth of surface soil is much less on the steeper slopes, the depth of surface soil is much less on the steeper slopes, and mostly shallow, rocky soils occur. These soils are delineated "stoney" on the detailed Soil Association Map, and are regarded as non-agricultural soils, apart from grazing on the relatively sparse grass cover.

Where slopes are not excessive, the soils are quite well suited to apples and peaches. Pears and cherries are grown to a lesser extent. Vegetable crops such as cabbages, cauliflowers and Brussels sprouts, and cut flowers, mainly jonquils, daffodils and chrysanthemums are also grown. Otherwise the soils are sown to pasture for grazing.

Jindivick Association (J)

All of this association occurs in the highlands in the northern part of the Westernport Catchment where the topography is mountainous and the slopes are steep.

Because of the topography and the consequent erosion hazards the area is largely uncleared. However, the area is important for its timber and its potential as a recreational area. The predominant eucalypt is messmate, with some mountain ash on the wetter south-east slopes. Mountain grey gum, narrow-leaf peppermint and Victorian blue gum also occur, with manna gum and swamp gum on the valley floors.

The soils are formed on Devonian granite, and decomposing rock generally occurs before 2 m. At the surface, the soils are dark brownish grey or grey sandy loams, or occasionally sandy clay loams, with the sand fraction generally containing coarse angular sand and small gravel. At about 20 cm yellowish grey-brown or yellowish greyish brown similar textured soils occur. Below this occur yellow-brown to reddish brown sandy clay loams if the soils are shallow, or sandy clays if otherwise.

In the valleys, the soils are generally deeper than 2 m and are mainly comprised of clayey fine gravels and coarse angular sands. A cemented zone generally occurs at about 90 cm.

Kooweerup Association (K)

This association occurs in the north-eastern part of the Kooweerup lowland on quaternary alluvium deposited by a complex distributary stream system. Most of this alluvium originated from the granite uplands. The dominant soil type, Kooweerup peaty clay, has about 30 cm depth of dark grey-brown clay loam surface soil with high amounts of peat or organic matter. This peat, which was originally deeper, accumulated in the marshes fed by the slow-moving flood waters. Since drainage, much peat has disappeared through shrinkage, burning and blowing. Below the peat layer, dominantly dark grey medium or heavy clays occur, passing at about 50 cm to mottled grey, light grey and yellow-brown medium or heavy clays. Clays continue to at least 180 cm.

The levees and beds of the streams are characteristically gravelly, and gravels may persist in the soils some distance from the streams.

The high-peat soils mostly carry improved pastures, with smaller areas planted to potatoes. Many of the stream levees have been exploited for road making, and as a source of ground water, but as the gravelly soils dry too quickly because of their light deep substrate, they are not suited to intensive non-irrigated agriculture.

Merricks Association (M^e)

The valley floors near Red Hill and Flinders, and on Phillip Island are mapped into the Merricks Association. Generally, the surface soils are dark grey very fine sandy clay loams or clay loams overlying, at a depth of 10 cm, a strongly bleached similarly-textured layer. Strongly mottled yellow-brown to yellow-grey and light grey medium or heavy clays generally occur between 40 and 60 cm, with some ironstone concretions above and below the clay. Clays continue into the deep subsoil, and are deeper than 180 cm over the entire Merricks Association.

Most of this unit is now cleared and carries pasture. Where native vegetation remains it is mainly swamp paperbark. Black wattle, swamp gum and manna gum may also be present. Some areas of this association near the coast and on Phillip Island are showing signs of salting.

Merricks Clay Association (M^e_c)

Some areas are heavier in texture than the above description, with dark grey light clay surface soils and less conspicuous bleaches, or no bleaches at all. The medium or heavy clay layers then generally occur before 30 cm. Such areas have the subscript "c" on the Detailed Soil Map. Vegetation and land use are similar to the Merricks Association.

Monomeith Association (M^m)

Most of the flat country east of Kooweerup and near the Lang Lang River comprises soils on alluvium derived from the Cretaceous uplands, and to a lesser extent, from the older basalt cappings near Warragul.

The plain is traversed by meandering stream courses generally with pronounces levees. Originally the levees and watercourses carried swamp paperbark and swamp gums, but the broad floor plains were largely treeless and mainly carried grasses.

80 to 90 percent of the soils are on the almost level plains. The surface soils are grey or brownish grey clay loams or light clays overlying, at about 20 cm to 30 cm, grey slightly mottled with yellow-brown, medium clays. Mottled clays continue to at least 180 cm.

On the levees the surface soils are lighter textured, and are generally grey brown very fine sandy clay loams or very fine sandy loams. At 20 cm the colour becomes paler and is frequently bleached. Buckshot may or may not be present just before the mottled brownish grey and yellow-brown mottled medium or heavy clay subsoils.

The soils of the Monomeith Association mainly carry improved pastures grazed by cattle. In wet winters stock may pug the soil badly, leaving a very hard and uneven surface in summer.

Narre Association (N^r)

This association occurs on the almost level plains adjoining the granite foothills in the northern part of the Westernport Bay Catchment. These soils are developed on quaternary fluviatile and swamp deposits, originating from erosion of the granite foothills and uplands, and minor ares of Silurian sediments. Smaller areas classified into the Narre Association also occur towards the north-western flank of the catchment.

Most of the surface soils are dark brownish grey clay loams overlying, at about 25 cm, brownish grey mottled with light grey and rusty brown light clays or clay loams. This horizon may or may not be bleached. Mottled grey and yellow-brown clays occur from about 40 cm to at least 180 cm.

Some of the soils, particularly those which are low-lying, have similarly coloured but slightly heavier-textured surfaces of the clay loam or light clay. Between 15 and 40 cm the soils are dominantly grey with rusty mottling, and the textures light or medium clay. Clay textures then continue as above.

External drainage is generally poor on soils of the Narre association, and in some situations ponding may occur. These soils are rarely cultivated and are mainly used for grazing cattle on sown pastures.

Originally this association probably carried a mosaic of wet grassland and swamp paperbark, with emergent swamp gum.

Nyora Association (N^y)

This association occurs on the uplands in the south-eastern part of the catchment and on French Island. Over most of these uplands there is an extensive sheet of Upper Tertiary gravels, sands and clays. In general the soils on these deposits are leached sands, but on French Island more clayey soils also occur. However, during the Quaternary, redistribution of these sands occurred resulting in dune formation, and sandy infilling of gullies and other low areas. The more clayey sediments of the Upper Tertiary gave rise to the soils of the Bittern Association, and on French Island these two associations occur together as a complex.

Most of the soils of the Nyora Association have grey or dark grey loamy fine sand or loamy sand surfaces with low to moderate amounts of organic matter. A pronounced bleached zone occurs near 30 cm, and at about 90 cm a coffee rock layer is encountered. This layer, comprised of dark brown mottled with light grey and light yellow-brown cemented sands, is generally impenetrable to the soil auger. Below the coffee rock paler-coloured but mottled sands generally occur although in lower areas there may be mottled clays or sandy clays.

Originally the area was a low open woodland of messmate and manna gum, with prickly tea-tree, banksia, bracken, heath and grass-tree. Frequently, the vegetation form is best described as a low shrubland with emergent manna gum and messmate.

These soils are infertile and require trace elements as well as superphosphate and potash in order to grow good pasture. It is only comparatively recently that pasture establishment has been successful, and large areas of this association still remain uncleared.

Red Hill Association (RH)

The "red" soils near Red Hill and on Phillip Island are included in this association. The topography is rolling to hilly and originally supported an open forest with manna gum and messmate dominant, with occasional narrow-leaf peppermint, blackwood and black wattle. Most of this vegetation is now cleared or other wise modified by man. Apples are the main horticultural crop near Red Hill, but there is a range of other horticultural and vegetable crops. On Phillip Island almost all of this association supports pastures.

About half the soils are krasnozems, which are friable red porous soils. The remainder of the soils have clay loam surfaces overlying heavy clays, which continue to the decomposing rock, generally deeper than 180 cm. Almost one half of the latter soils have grey brown or reddish grey-brown fine sandy clay loam or clay loam surfaces, and the rest are much greyer, with dark brownish grey fine sandy clay loam surfaces.
The surface soils of the krasnozems are reddish grey-brown light clays or clay loams with a strong fine crumb structure, grading at about 20 cm, into reddish greyish brown light clays, or occasionally medium clays with some ironstone concretions. From about 60 cm mottled reddish brown and yellow-brown medium clays occur, and these continue until decomposing rock is encountered, generally deeper than 180 cm. Odd floaters (small pieces of basalt) and large ironstone concretions may be scattered throughout the profile.

The soils with grey-brown or reddish grey-brown fine sandy clay loam or clay loam surfaces overlie, at about 20 cm, greyish or reddish greyish brown light clays or clay loams with slight amounts of small ironstone concretions. Mottled greyish or reddish greyish brown and yellowish grey-brown medium or heavy clays occur from 40 cm. From about 100 cm the soils are dominantly brown with yellow-brown heavy clays. Mottled yellow-brown and grey heavy clays with an increasing red-brown mottle continue to the decomposing basalt.

Ripplebrook Association (R^b)

This association comprises soils which are developed on Quaternary unconsolidated alluvium and colluvium which form the valley floors in the eastern part of the Westernport Bay Catchment. These valleys were originally forested with swamp and manna gum with some swamp paperbark, black wattle and hazel, but are now largely cleared and grow improved pastures.

The surface soils are all grey and usually clay loam in texture, but occasionally may be very fine sandy clay loams or light clays. At about 60 cm there is a weak increase in texture, the clay loam surface soils changing to light or medium clays, and the light clay surface soils to medium clays. These clays are generally mottled light brownish grey and yellow-brown and continue to at least 180 cm.

Strzelecki Association (S)

On the south-eastern flank of the Westernport Bay Catchment is a continuous arc of strongly dissected upland which once carried a wet sclerophyll forest. The soils of this area comprise the Strzelecki association, and are developed on Cretaceous mudstones and sandstones, uplifted in the early Tertiary.

Generally the depth to bedrock is less than 1 m, but there are deeper soils in the valleys and on colluvial slopes.

Most of the soils are on steep slopes and have brownish grey clay loam surfaces which grade into yellowish grey-brown clay loams or light clays at 35 cm. At 60 cm greyish yellow-brown light, or occasionally, medium clays are encountered, which become yellow-brown mottled with light brownish grey at depth. Fragments of rock generally appear by about 90 cm and continue until about 120 cm when rock become impenetrable.

The remaining soils on colluvium or on higher flatter sites have brownish grey clay loam or very fine sandy clay loam surfaces, with an abrupt change at about 50 cm to mottled light brownish grey and yellow-brown light, or occasionally, medium clays. Bedrock occurs much deeper.

Almost all of the original vegetation has been removed and the soils carry improved pastures, utilised by beef and dairy cattle.

On the Detailed Soil Map (1:50,000), some areas of the Strzelecki Association have been denoted colluvial slopes. The soils on these slopes are formed on material from further up-slope, transported either by water or under the action of gravity. The soils are similar to those of the Strzelecki association, but differ in that the depth to hard rock is considerably greater. At depth greater than 100 cm the clay subsoil frequently has the appearance of soft mudstone.

Tarago Association (T^r)

This association occurs near Neerim South and Jindivick in the north-eastern part of the Westernport Bay Catchment. Much of the association is regarded as early Tertiary terrain underlain by Silurian sediments. This terrain is now deeply dissected, 4xposing the Silurian sediments in the lower parts of the valleys. Near Jindivick, two hilly areas composed of Silurian sediments are mapped into the Tarago association.

The area was formerly an open forest comprising messmate, and narrow and broad leaf peppermint, but it is mostly cleared and carried improved pastures.

Most of the soils are on moderately steep slopes and have dark grey very fine sandy clay loam surfaces overlying, at about 15 cm, light brownish grey very fine sandy clay loams. Mottled light brownish grey and yellow-brown light clays occur at about 40 cm, passing to yellow-brown with light grey-brown medium or heavy clays at about 50 cm. With depth, light clays may reappear, and on steep slopes parent material may be encountered before 180 cm.

On the hilltops and gently sloping area the soils are similar to those described above, but the surface soils are slightly deeper and lighter in texture, and there are more pronounced bleaches above the clays. The surface soils are dark grey, very fine sandy loams which overlie very light brownish grey, very fine sandy loams at about 10 cm. At about 50 cm the clay content increases and textures become light clay by about 80 cm. Dominantly yellow-brown medium or heavy clays occur from 100 cm.

Toomuc Association (T^o)

Most of this soil association occurs in the Pearcedale to Pakenham area on the lower parts of the sand dune landscape, or on the gently undulating plains east of Cranbourne. The sediments from which these soils are derived are Quaternary sands and sandy clays.

Originally this association was a wet heath to wet scrub on the dune landscape, and a lightly timbered grassland on the sandy plain. The wet heath was comprised of silver banksia, scrub sheoak, swamp an scented paperbark, prickly tea-tree, heath, sedges and grasses, with occasional manna gum. The sandy plains were probably grassland with scattered swamp paperbark, manna gum and swamp gum.

The surface soils are grey or dark grey loamy sands to sandy loams about 25 cm deep, overlying a bleached layer of similar texture. Mottled light yellow-grey, grey and yellow-brown heavy clays occur from about 60 cm, and clays or sandy clays continue to at least 180 cm. The zone just above the clay generally contains iron concretions.

Most of this association carries pasture utilized mainly by beef and dairy cattle, but some sheep are also grazed. Where soils of the Toomuc Association occur within or near the soils of the Cranbourne Association some vegetable crops may be grown. These soils are very prone to waterlogging, and the "spewy" nature of the bleached zone when saturated makes cultivation difficult.

Tynong Association (T^y)

This association is mapped in the northern part of the Westernport Bay Catchment and occurs on the comparatively narrow valley floors fingering into the uplands. The sediments from which these soils are derived are Quaternary alluvium, but in the upper valleys there is some colluvium. Mountain grey gum, manna gum and occasional swamp gum are the main timber species, with tea-tree, paperbark and dogwood among the main shrub species.

The soils fall into two broad groups, one containing mostly clay, the other mostly gravel. The first group has dark brownish grey clay loam or loam surfaces about 20 cm deep, often with slight amounts of grit, overlying a bleached layer of similar texture. Mottled yellow-brown and light grey medium or heavy clays, often gritty, occur from about 50 cm, and apart from variations in grittiness, continue with little change to 180 cm.

The other group occurs generally in the narrow and upper parts of the valleys, and is much less extensive than the above soils. It has dark grey gravelly loam surfaces passing to light grey gravelly loams at about 15 cm. At about 60 cm mottled light grey and yellow-brown clayey gravels occur which are frequently cemented and too impenetrable to auger. Less cemented but mottled light grey, yellow-brown and red-brown gravels or gravelly clays occur from about 90 cm.

Warragul Association (W^g)

Perhaps the most attractive soils of the Westernport Bay Catchment occur in the area near Warragul. Here the topography is strongly undulating to hilly, the landform being a maturely eroded basalt plain. These basalts are early Tertiary in age, and are referred to as the "Older Basalts". The many road cuttings give an overall impression that the soil profiles are all quite red, and the surface soils are friable and porous.

The original sclerophyll forest which has been completely cleared, probably consisted of blue gum and messmate, with manna and swamp gums, as well as hazel, blackwood and tree fern. The area is now sown to pasture grazed mainly by dairy cattle.

Potatoes are an important vegetable crop, and some peas, carrots and swedes are also grown.

Broadly, there are three main types of soil within this association, the red, brown and yellow friable soils.

About half of the soils have dark reddish greyish brown very friable clay loam surface grading into crumbly red-brown clay loams or light clays at about 20 or 30 cm. Textures generally increase to medium clay at 100 cm. In the deeper subsoil, between 100 and 180 cm, the soil may remain red-brown, or may be mottled red-brown, brown and yellow-brown. The textures are usually medium clay.

About one third of the soils have dark reddish grey-brown or dark brownish grey clay loam surface soils about 20 to 30 cm deep, passing to yellowish greyish brown light clays or clay loams. By about 50 cm the colour is generally yellowish brown and the texture has increased to medium clay. With depth the colour may remain yellowish brown but usually becomes mottled reddish brown and yellow-brown. The soil remains crumbly throughout the profile.

Yellow friable soils occur in areas of slightly impeded drainage such as saddles and gentle slopes. The surface soils are yellowish brownish grey or yellowish grey-brown clay loams with a good crumb structure, grading at about 20 cm into yellowish brown light or medium clays. By about 40 cm the soils become mottled yellowish brown and brownish yellow medium clays with a red-brown mottle appearing at about 70 cm. Similar soils continue to at least 180 cm. The soils are more clayey and sticky than the redder and browner soils described earlier.

Woolamai Association (W^m)

This association is restricted to Cape Woolamai on the south-east of Phillip Island. The Cape slopes upwards from an unstable dune system connecting it to the rest of the Island, and ends abruptly with steep cliffs to seaward. Although the underlying rock is granite, there is a mantle of brown sand rather than a soil profile developed in situ. The soils are deep sands with the surface colours ranging from dark reddish grey-brown to dark grey. The subsoils variably coloured, with light grey, red-brown and yellow-brown colours being usual.

The vegetation comprises low coastal shrubs such as tea-tree and heath, as well as rushes, sedges and tussocks. Mutton birds next in great numbers on the Cape, where they find the sand easy digging for their nesting burrows.

Unclassified Sandy Rises (usr)

In the Cardinia area there are several low ridges about 6 m above the surrounding plain. These comprise medium to coarse sands and gravels, although some thin clay bands are present. Such ares are denoted Unclassified sandy rises on the soil map.

Variable Soils in drainage ways (dv)

In the Pearcedale area there are a number of shallow drainage ways running from the uplands south east of Frankston to Westernport Bay. Many of these traverse areas mapped into the Cranbourne Association, and some of the sand dunes are believed to be sandy blow-outs from these drainage ways.

The dark grey surface soils are variable in texture, ranging from clay loams to sandy loams. Generally a mottled clay horizon is encountered before 50 cm which continues to at least 180 cm. At greater depths sandier layers sometimes occur.

Table 1 - Area of each soil association, and other mapping units, for the whole Westernport Bay Catchment, and each subcatchment

Name	Whole Catchment		Sub Catchments							
	Westernport Bay		Manton Creek	Stony Creek	East Creek	Merricks Creek	Hans Inlet	Warrengine Creek	King Creek	Oliver Creek
Area (ha)	327640		1570	2490	2500	5780	3120	2860	1560	2330
Association	**Ha**	**%**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**
Athlone	22574	6.89	-	-	-	-	-	-	-	-
Bass Delta	191	0.06	-	-	-	-	-	-	-	-
Bittern	10111	3.14	-	-	-	1209	85	1337	756	1270
Bittern Sand	3090	0.94	-	-	-	413	1940	150	-	6
Cerberus	1705	0.52	-	-	-	454	99	-	-	-
Cranbourne	8992	2.74	-	-	-	-	93	-	-	100
Dalmore	9404	2.87	-	-	-	62	-	-	-	-
Dalmore peat	7530	2.30	-	-	-	-	-	-	-	-
Flinders	10435	3.18	658	1500	1128	1559	-	33	-	-
Flinders Clay	1188	0.36	-	17	-	-	-	-	-	-
French Island	8783	2.68	-	-	-	-	-	-	-	-
Garfield	19747	6.03	61	-	-	-	-	-	-	-
Hallam	9670	2.9	77	-	30	239	-	71	-	-
Jindivick	38361	11.72	-	-	-	-	-	-	-	-
Kooweerup	12175	3.72	-	-	-	-	-	-	-	-
Merricks	7854	2.40	166	421	655	1344	511	461	402	589
Monomeith	24513	7.48	-	-	-	-	-	-	-	-
Narre	21928	6.69	-	-	-	-	-	11	402	279
Nyora	10839	3.31	-	-	-	-	-	-	-	-
Red Hill	3900	1.19	608	521	687	-	-	-	-	-
Ripplebrook	14151	4.31	-	-	-	500	-	-	-	-
Strzelecki	28170	8.58	-	-	-	-	-	-	-	-
Tarago	3731	1.14	-	-	-	-	-	-	-	-
Toomuc	4959	1.51	-	31	-	-	-	-	-	-
Tynong	12653	3.86	-	-	-	-	-	-	-	86
Warragul	15631	4.77	-	-	-	-	-	-	-	-
Woolamai	61	0.02	-	-	-	-	-	-	-	-
Bittern-Bittern Sand	1080	0.33	-	-	-	-	319	761	-	-

Name	Whole Catchment		Sub Catchments							
	Westernport Bay		Manton Creek	Stony Creek	East Creek	Merricks Creek	Hans Inlet	Warrengine Creek	King Creek	Oliver Creek
Bittern-Nyora	7613	2.31	-	-	-	-	-	-	-	-
Cranbourne-Bittern	1422	0.43	-	-	-	-	-	-	-	-
Flinders-Merricks	1192	0.36	-	-	-	-	-	-	-	-
Swamp	2614	0.79	-	-	-	-	73	36	-	-
dv	1133	0.35	-	-	-	-	-	-	-	-
ucr	240	0.07	-	-	-	-	-	-	-	-

Name	Sub Catchments									
	Tyabb	Watsons Creek	Langwarrin Creek	Devon Meadows	Cannon Creek	Main Western	Muddy Gates	Cardinia	Gum Scrub Creek	Toomuc Creek
Area (ha)	1870	4410	3690	2000	5470	3580	7710	12850	4490	6710
Association	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**
Athlone	-	-	-	-	-	-	-	-	-	-
Bass Delta	-	-	-	-	-	-	-	-	-	-
Bittern	545	239	-	324	-	487	345	19	-	72
Bittern Sand	124	457	-	-	-	-	-	-	-	-
Cerberus	-	-	-	-	-	-	-	-	-	-
Cranbourne	5	1360	1910	971	2741	1217	466	-	-	-
Dalmore	-	-	-	-	870	494	2014	-	-	-
Dalmore peat	-	-	-	-	-	-	3133	261	463	135
Flinders	-	-	-	-	-	-	-	738	-	-
Flinders Clay	-	-	-	-	373	462	-	-	-	-
French Island	-	-	-	-	-	-	-	-	-	-
Garfield	-	-	-	-	-	-	-	-	-	-
Hallam	-	570	1159	201	649	35	-	1670	1892	586
Jindivick	-	-	-	-	-	-	-	-	-	-
Kooweerup	-	-	-	-	-	-	-	-	-	-
Merricks	3	-	-	-	-	-	-	-	-	-
Monomeith	-	-	-	-	-	-	-	-	-	-
Narre	-	699	166	334	183	866	434	528	913	1210
Nyora	-	699	166	334	183	-	-	-	-	-
Red Hill	-	-	-	-	-	-	-	-	-	-

Name	Sub Catchments									
	Tyabb	**Watsons Creek**	**Langwarrin Creek**	**Devon Meadows**	**Cannon Creek**	**Main Western**	**Muddy Gates**	**Cardinia**	**Gum Scrub Creek**	**Toomuc Creek**
Ripplebrook	-	-	-	-	-	-	-	-	-	-
Strzelecki	-	-	-	-	-	-	-	-	-	-
Tarago	-	-	-	-	-	-	-	-	-	-
Toomuc	34	179	-	-	854	19	1106	845	870	935
Tynong	-	-	-	-	-	-	-	1473	333	800
Warragul	-	-	-	-	-	-	-	342	-	355
Woolamai	-	-	-	-	-	-	-	-	-	-
Bittern-Bittern Sand	-	-	-	-	-	-	-	-	-	-
Bittern-Nyora	-	-	-	-	-	-	-	-	-	-
Cranbourne-Bittern	987	435	-	-	-	-	-	-	-	-
Flinders-Merricks	-	-	-	-	-	-	-	-	-	-
Swamp	-	-	-	136	-	-	120	130	-	-
dv	172	471	456	34	-	-	-	-	-	-
ucr	-	-	-	-	-	-	92	57	-	-

Name	Sub Catchments									
	Deep Creek Catch Drain	**Deep Creek**	**NWM Catch Drain**	**Bunyip River**	**Yallock Creek**	**Tarago River**	**Lang Lang River**	**Red Bluff Creek**	**Grantville**	**Bass River**
Area (ha)	3050	7590	22590	41630	34330	29920	43240	4980	6170	31360
Association	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**
Athlone	-	-	-	-	4144	2537	11214	151	1173	3353
Bass Delta	-	-	-	-	-	-	-	-	-	191
Bittern	-	290	11	-	27	-	1413	205	223	319
Bittern Sand	-	-	-	-	-	-	-	-	-	-
Cerberus	-	-	-	-	-	-	-	96	52	12
Cranbourne	-	-	129	-	-	-	-	-	-	-
Dalmore	-	-	748	113	2609	-	276	556	1064	598
Dalmore peat	2914	25	599	-	-	-	-	-	-	-
Flinders	-	115	59	-	-	45	-	-	250	514
Flinders Clay	-	-	-	-	-	-	-	-	-	-

Name	Sub Catchments									
	Deep Creek Catch Drain	Deep Creek	NWM Catch Drain	Bunyip River	Yallock Creek	Tarago River	Lang Lang River	Red Bluff Creek	Grantville	Bass River
French Island	-	-	-	-	-	-	1945	1002	673	-
Garfield	-	1798	3280	4922	-	263	-	-	-	-
Hallam	-	1076	1416	-	-	-	-	-	-	-
Jindivick	-	-	1733	26452	10176	-	-	-	-	-
Kooweerup	-	-	4816	1029	6330	-	-	-	-	-
Merricks	-	-	-	-	-	-	-	-	-	72
Monomeith	65	-	2098	-	11312	-	6004	1290	622	3122
Narre	-	3394	5255	2023	3498	1733	-	-	-	-
Nyora	-	-	-	-	663	-	2610	1680	473	774
Red Hill	-	-	-	-	-	-	-	-	-	50
Ripplebrook	-	-	-	-	2626	2169	5282	-	-	4074
Strzelecki	-	-	-	-	-	-	11997	-	-	16132
Tarago	-	-	-	-	-	3731	-	-	-	-
Toomuc	-	-	-	-	-	-	-	-	-	-
Tynong	-	524	1617	6458	-	1448	-	-	-	-
Warragul	-	348	515	633	3121	7818	2499	-	-	-
Woolamai	-	-	-	-	-	-	-	-	-	-
Bittern-Bittern Sand	-	-	-	-	-	-	-	-	-	-
Bittern-Nyora	-	-	-	-	-	-	-	-	1640	1862
Cranbourne-Bittern	-	-	-	-	-	-	-	-	-	-
Flinders-Merricks	-	-	-	-	-	-	-	-	-	-
Swamp	-	-	314	-	-	-	-	-	-	285
dv	-	-	-	-	-	-	-	-	-	-
ucr	-	-	-	-	-	-	-	-	-	-

Name	Sub Catchments										
	Phillip Is 1	**Phillip Is 2**	**Phillip Is 3**	**French Is 1**	**French Is 2**	**French Is 3**	**French Is 4**	**French Is 5**	**French Is 6**	**French Is 7**	**French Is 8**
Area (ha)	3290	3660	3300	1260	2300	3220	2540	2480	1810	2980	750
Association	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**	**Ha**
Athlone	-	-	-	-	-	-	-	-	-	-	
Bass Delta	-	-	-	-	-	-	-	-	-	-	-
Bittern	-	-	-	273	434	-	-	-	-	-	228
Bittern Sand	-	-	-	-	-	-	-	-	-	-	-
Cerberus	185	453	354	-	-	-	-	-	-	-	-
Cranbourne	-	-	-	-	-	-	-	-	-	-	-
Dalmore	-	-	-	-	-	-	-	-	-	-	-
Dalmore peat	-	-	-	-	-	-	-	-	-	-	-
Flinders	1209	555	1165	744	48	-	-	-	-	-	115
Flinders Clay	113	-	223	-	-	-	-	-	-	-	-
French Island	-	-	-	-	134	2157	1454	716	312	390	-
Garfield	-	-	-	-	-	-	-	-	-	-	-
Hallam	-	-	-	-	-	-	-	-	-	-	-
Jindivick	-	-	-	-	-	-	-	-	-	-	-
Kooweerup	-	-	-	-	-	-	-	-	-	-	-
Merricks	1008	718	1063		244	197	-	-	-	-	-
Monomeith	-	-	-	-	-	-	-	-	-	-	-
Narre	-	-	-	-	-	-	-	-	-	-	-
Nyora	-	-	-	-	1440	614	70	201	733	1174	407
Red Hill	207	924	403	-	-	-	-	-	-	-	-
Ripplebrook	-	-	-	-	-	-	-	-	-	-	-
Strzelecki	-	41	-	-	-						
Tarago	-	-	-	-	-						
Toomuc	-	-	-	-	-	-	-	-	-	-	-
Tynong	-	-	-	-	-	-	-	-	-	-	-
Warragul	-	-	-	-	-	-	-	-	-	-	-
Woolamai	-	39	22	-	-	-	-	-	-	-	-
Bittern-Bittern Sand	-	-	-	-	-	-	-	-	-	-	-
Bittern-Nyora	-	-	-	-	-	3	716	1211	765	1416	-

Name	Sub Catchments										
	Phillip Is 1	**Phillip Is 2**	**Phillip Is 3**	**French Is 1**	**French Is 2**	**French Is 3**	**French Is 4**	**French Is 5**	**French Is 6**	**French Is 7**	**French Is 8**
Cranbourne-Bittern	-	-	-	-	-	-	-	-	-	-	-
Flinders-Merricks	568	624	-	-	-	-	-	-	-	-	-
Swamp	-	306	70	243	-	249	300	352	-	-	-
dv	-	-	-	-	-	-	-	-	-	-	-
ucr	-	-	-	-	-	-	-	-	-	-	-

Table 2 - Soil association, topographical position and classification of sites sampled for detailed analysis. pH determinations and analysis for NaCl, available K and available P at various depths

Site No.	Soil Association	Topographical Position	Classification	Depth cm	Field Texture (a)	pH (b)	NaCl (%)	Available K ppm (c)	Available P ppm (d)
1	Cranbourne	Dune crest	Podzol	0-20	LS	4.4	0.008		0.9
				20-50	S	5.0	0.004		0.3
				50-60	S	5.2	0.003	16	0.2
				60-120	S	5.1	0.002		0.1
				120-160	S	5.2	0.004		0.1
				160-180	S	5.4	0.005		0.2
2	Dalmore (peat)	Level	Humic gley	0-30	MC	4.8	0.017		30.0
				30-65	HC	5.1	0.019		6.0
				65-85	MC	5.4	0.022	408	2.3
				85-120	HC	5.5	0.014		0.9
				120-180	HC	5.6	0.018		0.8
3	Kooweerup	Level	Humic gley	0-35	CL	5.2	0.007		10.1
				35-50	MC	5.3	0.010	235	2.0
				50-90	HC	4.9	0.009		1.5
				90-130	HC	-	-		0.9
				130-180	HC	4.6	0.023		0.7
4	Monomeith	Level-Low	Gleyed podzolic	0-10	CL	5.3	0.014		27.5
				10-40	MC	5.7	0.010	228	3.4
				40-70	MC	5.8	0.014		1.8
				70-110	LC	5.6	0.018		-
				110-180	MC	5.0	0.055		0.5
5	Nyora	Dune slope	Podzol	0-30	LFS	4.7	0.006		0.7
				30-90	FS	4.7	0.007	36	0.2
				90-120	FS	4.4	0.028		0.2
				120-180	FS	4.9	0.008		0.2
6	Strzelecki	Colluvial slope	Yellow podzolic	0-25	L	5.6	0.016		13.7
				25-30	CL	5.4	0.008		13.5
				30-60	SLC	5.9	0.008	174	5.4
				60-70	LC	5.7	0.010		0.9
				70-120	LC	6.1	0.013		23.0
				120-180	Soft rock	5.8	0.009		38.0

Site No.	Soil Association	Topographical Position	Classification	Depth cm	Field Texture (a)	pH (b)	NaCl (%)	Available K ppm (c)	Available P ppm (d)
7	Strzelecki	Mid steep slope	Yellow podzolic	0-15	CL	6.1	0.007		3.0
				15-35	CL	5.8	0.011	228	1.4
				35-60	LC	5.6	0.006		0.8
				60-90	LC-MC	5.7	0.009		2.8
				90-120	MC, rock	-	-		-
8	Monomeith	Level	Gleyed podzolic	0-25	CL	5.5	0.012		11.5
				25-60	MC	5.9	0.009		1.1
				60-120	MC	6.0	0.013	108	0.3
				120-150	MC	5.7	0.026		0.9
				150-180	L-MC	5.2	0.031		0.4
9	Red Hill	Upper slope	Krasnozem	0-25	CL	6.3	0.013		3.0
				25-40	LC	6.7	0.007		1.2
				40-60	MC	6.9	0.005	565	0.7
				60-80	MC	6.8	0.011		0.5
				80-110	MC	6.3	-		0.4
10	Jindivick	Mid slope	Yellow podzolic	0-20	G SL	5.6	0.005		1.3
				20-40	G SL	5.9	0.005		0.5
				40-80	G SL	6.0	0.005	62	0.3
				80-140	G SL	6.3	0.005		0.3
				140-160	C G	6.4	0.009		0.3
				160-180	C G	6.7	0.003		0.3
11	Tynong	Level	Gleyed podzolic	0-25	CL	5.6	0.013		12.7
				25-60	LC	5.2	0.012		1.1
				60-75	MC	5.1	0.012	156	0.7
				75-120	MC	5.3	0.007		0.4
				120-180	HC	5.3	0.010		0.3
12	Ripplebrook	Level	Gleyed podzolic	0-15	CL	5.1	0.006		5.5
				15-50	LC	5.0	0.007		1.5
				50-85	HC	4.9	0.005	48	0.8
				85-150	HC	4.9	0.013		0.3
				150-180	HC	4.7	0.018		0.3
13	Warragul	Almost level	Xanthozem	0-20	CL	5.8	0.011		4.4
				20-30	LC-MC	5.0	0.012	585	1.0
				30-75	MC	4.7	0.026		0.9

Site No.	Soil Association	Topographical Position	Classification	Depth cm	Field Texture (a)	pH (b)	NaCl (%)	Available K ppm (c)	Available P ppm (d)
				75-120	HC	5.2	0.015		0.5
				120-170	HC	5.3	0.009		0.4
				170-180	HC	5.2	0.010		0.4
14	Red Hill	Upper slope	Krasnozem	0-20	LC	5.3	0.008		1.3
				20-60	MC	5.8	0.010		0.6
				60-90	MC	6.0	0.010	78	0.4
				90-110	MC	6.1	0.008		0.4
				110-150	MC	5.8	0.012		0.4
				150-180	MC	5.2	0.022		0.4
15	Red Hill	Upper slope	Red podzolic	0-20	VFSCL	5.6	0.006		1.1
				20-40	LC-CL	5.8	0.010		0.6
				40-60	MC	5.9	0.012		0.6
				60-90	MC	5.8	0.018	102	0.5
				90-110	MC	5.7	0.026		0.4
				110-130	HC	5.8	0.034		0.3
				130-160	HC	5.6	0.038		0.2
				160-180	HC	5.3	0.040		0.2
16	Flinders	Mid slope	Yellow soloth	0-15	VFSCL	5.5	0.009		4.5
				15-20	VFSCL	5.6	0.021		1.0
				20-30	FSCL	5.5	0.018		0.5
				30-50	MC	5.5	0.034	160	0.3
				50-90	HC	5.5	0.117		0.2
				90-140	HC	5.4	0.135		0.2
				140-160	SiMC	5.4	0.150		0.2
				160-180	SiMC	5.4	0.141		0.2
17	Merricks	Flat	Gleyed podzolic	0-10	VFSCL	5.7	0.013		7.5
				10-50	VFSCL	5.6	0.008		1.5
				50-70	LC	5.7	0.008	104	0.6
				70-140	MC	5.8	0.007		0.3
				140-180	HC	5.4	0.013		0.2
18	Bittern	Very gentle slope	Yellow soloth	0-20	FSL	5.5	0.004		8.5
				20-40	FSCL	5.7	0.004	94	2.0
				40-55	SCL	6.0	0.006		1.2
				55-70	HC	6.0	0.007		0.3

Site No.	Soil Association	Topographical Position	Classification	Depth cm	Field Texture (a)	pH (b)	NaCl (%)	Available K ppm (c)	Available P ppm (d)
				70-120	HC	6.4	0.017		0.2
				120-180	HC	6.2	0.028		0.2
19	Monomeith	Level	Gleyed soloth	0-25	VFSL	4.7	0.007		14.0
				25-45	VFSL	4.9	0.012		1.7
				45-60	FSL	5.3	0.016	26	0.6
				60-80	LC-MC	5.4	0.015		0.2
				80-105	HC	5.4	0.017		0.1
				105-135	MC-LC	5.5	0.021		0.1
				135-150	LC-FSCL	5.8	0.024		0.1
20	Athlone	Level	Yellow podzolic	0-10	VFSL	4.7	0.011		8.4
				10-25	VFSL	5.0	0.006		2.0
				25-45	VFSCL	5.2	0.017	90	1.4
				45-90	VFSCL	5.5	0.015		0.5
				90-115	LC	5.5	0.019		0.2
				115-150	MC-HC	4.9	0.030		0.2
				150-180	HC	5.4	0.043		0.2
21	Ripplebrook	level	Gleyed podzolic	0-10	CL	5.7	0.008		26.0
				10-35	CL	5.4	0.006		3.4
				35-55	CL	5.8	0.005	74	2.4
				55-100	LC	5.8	0.010		1.7
				100-130	MC	5.7	0.010		1.2
				130-180	LC-MC	5.8	0.013		3.3
22	Narre	Level	Gleyed podzolic	0-20	VFSCL	5.0	0.043		7.7
				20-30	LC	5.1	0.033		1.6
				30-60	HC	5.8	0.047	80	1.3
				60-120	HC	4.5	0.087		0.7
				120-180	HC	4.4	0.169		0.2
23	Bittern	Gentle slope	Yellow soloth	0-15	FSCL	5.6	0.012		3.6
				15-30	SCL	5.8	0.012		0.8
				30-50	HC	5.7	0.018	60	0.3
				50-110	HC	5.5	0.044		0.2
				110-180	HC	6.4	0.231		0.2
24	Nyora	Dune crest	Podzol	0-20	LFS	4.5	0.004		1.5
				20-40	LFS	4.6	0.014	92	0.4

Site No.	Soil Association	Topographical Position	Classification	Depth cm	Field Texture (a)	pH (b)	NaCl (%)	Available K ppm (c)	Available P ppm (d)
				40-90	LFS	5.2	0.009		0.1
				90-110	LFS	5.3	0.009		0.1
25	Garfield	Gentle slope	Yellow podzolic	0-10	L	5.2	0.009		3.5
				10-20	VFSCL	5.4	0.010		1.2
				20-50	VFSCL	5.5	0.008	82	0.5
				50-80	LC	5.7	0.007		0.3
				80-120	MC-HC	5.9	0.013		0.1
				120-180	HC	5.2	0.015		0.1
26	Garfield	Gentle slope	Yellow podzolic	0-10	SCL	5.0	0.045		12.2
				10-25	SCL	5.3	0.009	52	1.4
				25-30	LC	5.5	0.010		0.6
27	Hallam	Moderate slope	Yellow soloth	0-10	VFSCL	5.3	0.015		6.2
				10-25	VFSCL	5.5	0.010		1.9
				25-35	VFSCL	5.5	0.009		1.2
				35-60	LC	5.9	0.015	88	1.1
				60-90	HC	6.1	0.042		0.5
				90-120	HC	6.9	0.062		0.2
				120-165	HC	7.2	0.077		0.2
				165-180	HC	7.1	0.137		0.1
28	Narre	Level	Gleyed soloth	0-14	FSCL	5.6	0.009		19.0
				14-28	FSCL	5.6	0.007		4.2
				28-60	MC	3.0	0.009	82	2.0
				60-75	HC	5.8	0.010		0.6
				75-120	HC	6.1	0.051		0.2
				120-150	HC	5.4	0.119		0.2
				150-180	HC	6.3	0.134		0.2
29	Dalmore	Level	Humic clay	0-10	HC	5.1	0.023		43.0
				10-20	HC	5.3	0.016		23.0
				20-60	HC	5.3	0.095		3.0
				60-90	HC	5.1	0.204	200	1.4
				90-120	HC	5.0	0.275		0.6
				120-150	HC	5.0	0.217		0.4
				150-180	HC	4.9	0.245		0.2

Site No.	Soil Association	Topographical Position	Classification	Depth cm	Field Texture (a)	pH (b)	NaCl (%)	Available K ppm (c)	Available P ppm (d)
30	Bittern	Very gently sloping	Yellow soloth	0-10	FSCL	5.3	0.010		2.3
				10-26	FSCL	5.6	0.018		1.3
				26-55	MC-HC	5.8	0.020	84	0.4
				55-80	HC	6.0	0.033		0.2
				80-105	HC	6.0	0.035		0.2
				105-150	HC	6.1	0.041		0.2
				150-180	HC	5.9	0.048		0.2
31	Bittern	Very gently sloping	Yellow soloth	0-1	FSL	5.5	0.010		1.1
				16-34	FSL	5.5	0.010	40	0.3
				34-42	FSL	5.7	0.006		0.2

(a) Field texture: S, sand; FS, fine sand; LS, loamy sand; LFS, loamy fine sand; CG, clayey gravel; GSL, gravelly sandy loam; L, loam; FSL, fine sandy loam; VFSL, very fine sandy loam; CL, clay loam; SCL, sandy clay loam; VFSCL, very fine sandy clay loam; LC, light clay; MC, medium clay; SiMC, silty medium clay; HC, heavy clay

(b) pH 1:5 soil: water suspension

(c) Available potassium: 1:20 soil: 0.05N HCl extract

(d) Available phosphorus: 1:20 soil: 0.05N Na_2CO_3 extract

*Table 3 - Auger Hole Hydraulic Conductivities**

Site No	Landscape position	Hydraulic conductivity ft/day	TDS ppm•	Nitrogen content µg atoms - N/lt
1	Prior stream levee	1.0	140	Less than 0.1
2	Flood plain	0.29	190	
3	Prior stream channel	0.13	340	6.7
4	Flood plain	0.23	3000	5.9
5	Old tertiary surface	0.72	115	
6	Flood plain	0.27	8000	Less than 0.1
7	Flood plain	Dry		
8	Flood plain	0.15	11700	6.4
9	Prior stream levee	0.43	3500	9.4
10	Flood plain	Dry		
11	Flood plain	0.23		
12	Flood plain	Dry		
13	Flood plain	0.12	120	
14	Gravelly levee	23		
15	Flood plain	0.009	200	
16	Gravelly levee	0.84		
17	Flood plain	0.10		
18	Valley	4.0	30	
19	Valley	5.7	30	
20	Flood plain	Dry		
21	Low levee	0.16	200	
22	Depression	dry		

* These measurements made in conjunction with Mr S Bridley, State Rivers and Water Supply Commission

• Field measurements, using electrical conductivity, not corrected for temperature
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Appendix 1 - Common names of plant species with corresponding botanical names

EUCALYPTS

Broad-leaf peppermint	*E. dives*
Longleaf box	*E. goniocalyx*
Manna gum	*E. viminalis*
Messmate	*E. obliqua*
Mountain ash	*E. regnans*
Mountain grey gum	*E. bypellocarpa*
Narrow-leaf peppermint	*E. radiata*
Sliver-leaf stringybark	*E. cephalocarpa*
Swamp gum	*E. ovata*
Victorian blue gum	*E. stjohnii*

MISCELLANEOUS FLORA

Black wattle	*Acacia mearnsii*
Blackwood	*Acacia melanoxylon*
Bracken	*Pteridium aquilinum*
Coast banksia	*Banksia integrefolia*
Coastal sword sedge	*Lepidosperma gladiatum*
Coast tea-tree	*Leptospermum lavigatum*
Dwarf sheoak	*Casuarina pucilla*
Hakea	*Hakea* spp.
Hazel	*Pomaderris aspera*
Heath species	*Luecopogon* spp.
Prickly tea-tree	*Leptospermum juniperinum*
Scented paperbark	*Melaleuca ericifolia*
Tussock grass	*Poa* spp.

Appendix 2 - Maps

Symbol, geology and landform for each association, together with topography, classification and drainage class for major soils within each association.

*** dominant soils (70-100%) ** sub-dominant soils (30-70%) * minor soils (10-30%)

Association	Symbol	Geology	Landform	Topography	Classification		Reaction (a)	Drainage class (b)
					Soil Group (e)	Northcote (f)		
Athlone	A	Cretaceous and Tertiary, some Devonian sediments	Dissected plain	Gently rolling	**yellow soloths yellow podzolics	Dy 3.41 Gn 3.04	Strongly acid	BD/ C/D
				Moderately steep or steep	****yellow podzolics	Dy 3.21	Moderately acid	B/C, C/C
Bass Delta	BD	Quaternary	Beach deposits	Slight rises	**calcareous fine sands	Uc 1.1	Slightly alkaline acid to alkaline passing to alkaline	B/B
				Slight depressions	**peaty fine calcareous sands	-	As above	B/b
Bittern	B	Tertiary	Weakly dissected plain	Gently undulating	***yellow soloths	Dy 3.41	Moderate acid passing to slight acid	C/E
Bittern (sand)	B_s	As above	Sand splay	As above	***as above	Dy 3.41 Dy 5.42	As above	B/E
Cerberus	C^e	Quaternary	Irregular dunes and sand sheets	Gently rolling	***calcareous sands	Uc 1.1	Slightly acid passing to alkaline	A/A
Cranbourne	C^r	Quaternary	Irregular dunes and sand sheets	Gently rolling	***podzols	Uc 2.33	Very strongly acid passing to strongly acid	A/A
				Nearly level	*yellow soloths	Dy 5.41	As above	B/E
Dalmore	D	Quaternary	Level paludal plain	Level	***humic gleys	Uf 6.32	Very strong acid	C/D
Dalmore (peaty)	Dp	As above	As above	As above	As above	As above	As above	B/B
Flinders	F	Tertiary	Maturely eroded basalt plain	Upper and mid slopes	**brown soloths	Db 2.41 Db 2.21	Moderately acid	B/D
				Lower slopes	**yellow soloths		As above	C/E
Flinders (clay)	F_c	Tertiary	As above	Gently undulating	***grey soils of heavy texture	Ug 5.14 Ug 5.16	Moderately acid passing to slight acid or alkaline	C/D C/E

Association	Symbol	Geology	Landform	Topography	Classification		Reaction (a)	Drainage class (b)
					Soil Group (e)	Northcote (f)		
French Island	FI	Quaternary	Irregular dunes and sand sheets	Dunes and sand sheets	***podzols	Uc 2.33	Very strongly acid passing to strongly acid	A/A
				Interdune areas	*yellow soloths	Dy 5.41	As above	B/E
Garfield	G	Devonian granite	Foothills	Hilly with long slopes	**yellow podzolics	Gn 3.84 Dy 3.21	All strongly acid padding to moderately acid	B/D B/D B/E
					**yellow soloths	Dy 3.41		C/D C/E
Hallam	H	Silurian	Foothills	Hilly with long slopes	***yellow soloths	Dy 3.42	All strongly to moderately acid passing to slightly acid	C/E
				Crests and steep slopes	*lithosols	-	Inadequate data	B/E
Jindivick	J	Devonian granite	Maturely dissected granite massif	Crests and steep slopes	*lithosols	-	Inadequate data	B/E
				Moderately steep slopes	**yellow podzolics	Gn 4.51 Dy 3.21	Strongly acid passing to moderately acid	B/C B/D
				Lower slopes	**yellow podzolics yellow soloths	Dy 3.21 Dy 3.41	Strongly acid passing to moderately acid	C/D C/E
Kooweerup	K	Quaternary	Level paludal plain	Level	***humic gleys	Uf 6.22	Very strongly acid passing to strongly acid	A/C B/C
Merricks	M^{e}	Quaternary	Valley floor	Level	***gleyed podzolics	Gn 3.04 Dy 3.41	Moderately acid	C/E
Merricks (clay)	M^{e}_{c}	As above	As above	As above	*grey soils of heavy texture	Ug 5.28	Moderately acid to passing to slightly acid	D/D D/E
Monomeith	M^{m}	Quaternary	Nearly level alluvial plain	Gently undulating	***gleyed podzolics	Dy 3.11 Dy 3.21	Strongly to moderately acid passing to strongly to slight acid	C/D D/E
				Low levees	*yellow soloths yellow podzolics	Dy 3.41 Dy 3.21	As above	C/D
Narre	N^{r}	Quaternary	Nearly level alluvial plain	Gently undulating	***gleyed podzolics	Dy 3.11 Dy 3.21	Strongly to moderately acid passing to strongly to slight acid	C/D D/E

Association	Symbol	Geology	Landform	Topography	Classification		Reaction (a)	Drainage class (b)
					Soil Group (e)	Northcote (f)		
				Low levees	*yellow soloths yellow podzolics	Dy 3.41 Dy 3.21	As above	C/D
Nyora	N[y]	Tertiary and Quaternary	Weakly dissected sand sheet	Dunes and sand sheets Nearly level	***podzols *yellow soloths	Uc 2.33 Dy 5.41	Very strongly acid passing to strongly acid As above	A/A B/E
Red Hill	RH	Tertiary	Moderately eroded basalt plain	Well drained slopes Moderately well drained slopes	**krasnozems **red podzolics **brown soloths **brown podzolics	Gn 4.11 Dr 2.21 Db 2.41 Db 2.21	Weakly acid Moderately acid Moderately acid	B/B B/C B/C B/D C/D
Ripplebrook	R[b]	Quaternary	Valley floor	Gently undulating Gently rolling	***gleyed podzolics *yellow podzolics	Gn 3.91 Gn 4.54	Moderately to very strongly acid (d) As above	C/D D/D B/C C/D
Strzelecki	S	Cretaceous	Maturely dissected fault block	Steep to very steep Sloping	***yellow podzolics *gleyed podzolics yellow podzolics	Dy 3.21 Gn 3.91 Gn 4.81	Moderately acid As above	B/C B/C B/D
Tarago	T[r]	Silurian and Tertiary	Dissected plain	Moderately steep slopes Gently rolling	**yellow podzolics yellow soloths **yellow soloths yellow podzolics	Dy 3.21 Dy 3.41 Dy 3.41 Gn 3.04	Moderately acid As above	B/D C/D B/C C/C
Toomuc	T[o]	Quaternary	Nearly level alluvial plain	Sandy plain	**yellow soloths	Dy 5.41	Very strong acid to strongly acid	B/C
Tynong	T[y]	Quaternary	Nearly level alluvial plain	Valley floor Valley heads and abandoned channels	***gleyed podzolics *siliceous sands and gravels	Dy 3.11 Dy 3.21 Uc 2.33	Strongly acid As above	C/D D/E B/B
Warragul	W[g]	Tertiary	Maturely eroded basalt plain	Moderately steep slopes and crests	**krasnozems	Gn 4.11	Strongly to moderately acid	A/B
				As above	**brown krasnozems	Gn 4.31	As above	B/B B/C
				Elevated flatter areas and gentle slopes	*xanthozems	Gn 4.51	As above	B/C

Association	Symbol	Geology	Landform	Topography	Classification		Reaction (a)	Drainage class (b)
					Soil Group (e)	Northcote (f)		
Woolamai	W^{o}	Quaternary	Irregular dunes and sand sheets	Rolling to hilly	***calcareous sand	Uc 1.1	Slightly acid passing to alkaline	A/A

(a) Reaction: Very strongly acid, pH 4.5-4.9; Strongly acid, pH 5.0-5.5; Moderately acid, pH 5.6-6.0; Slightly acid, pH 6.1-6.9 Neutral, pH 7.0; Alkaline; above pH 7.0

(b) Drainage class: subject assessment of surface and subsoil permeability
A. rapid B. moderate C. moderately slow D. slow E. very slow

(c) Alluvium from granitic areas is more acidic. Thus areas of the Narre Association east of Deep Creek are generally more acid then west of Deep Creek.

(d) North of the Lang Lang River areas mapped into the Ripplebrook Association tend to be more acidic in reaction than those to the south.

(e) Soil Groups based on Stace et al (1968) - "A Handbook of Australian Soils: (Rellim: Glenside SA). For variants such as yellow soloths see text.

(f) Northcote, KH (1960) - A factual key for the recognition of Australian Soils. 3rd Edn (Rellim; Glenside SA)