SOIL SURVEY OF COOLUM FIELD STATION, SOUTH-EASTERN QUEENSLAND

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SUMMARY.

An area typical of much of the wallum country which extends along a large part of the south-eastern coast of Queensland was surveyed. The soils mapped have been divided into three great soil groups—Lateritic–Podzolic Soils; Aeolian and Marine Alluvial Sands; and Acid Swamp Soils.

The geological complexity of the area complicates any endeavour to interpret the genesis of the soil groups encountered.

All soils are chemically infertile and with the exception of the acid swamp soils possess poor moisture-retaining properties.

I. INTRODUCTION.

The Coolum Field Station of the Queensland Department of Agriculture and Stock was established in 1952 in an area typical of much of the wallum country of south-eastern Queensland.

"Wallum" is an aboriginal word for *Banksia serratifolia,* a tree commonly known as bottle-brush. Conventional usage has obscured the original meaning and the term "wallum" is now used loosely in reference to a long, relatively narrow strip of infertile lowlying coastal country which extends in an almost unbroken line from the southern border of Queensland to Bundaberg and intermittently further north.

Various species of *Banksia,* including *B. serratifolia,* constitute a distinct plant society on portions of the wallum, but it is not the dominant society. Large areas of poorly drained soils are characterised by dense stands of tea-tree, of which *Melaleuca leucadendra* is the most important.

The surveyed area is approximately 2,000 acres in extent and consists of Portions 470 and 610, Parish of Maroochy, County of Canning, as shown in the locality map (Fig. 1). The survey (10 chain grid) was frequently interrupted by adverse weather and the main time spent in the field occupied part of September 1953 and parts of December 1954 and January 1955. Accurate delineation of soil boundaries was aimed at, but the uneven nature of the surface of drainage lines made estimation of distances across these areas particularly difficult.

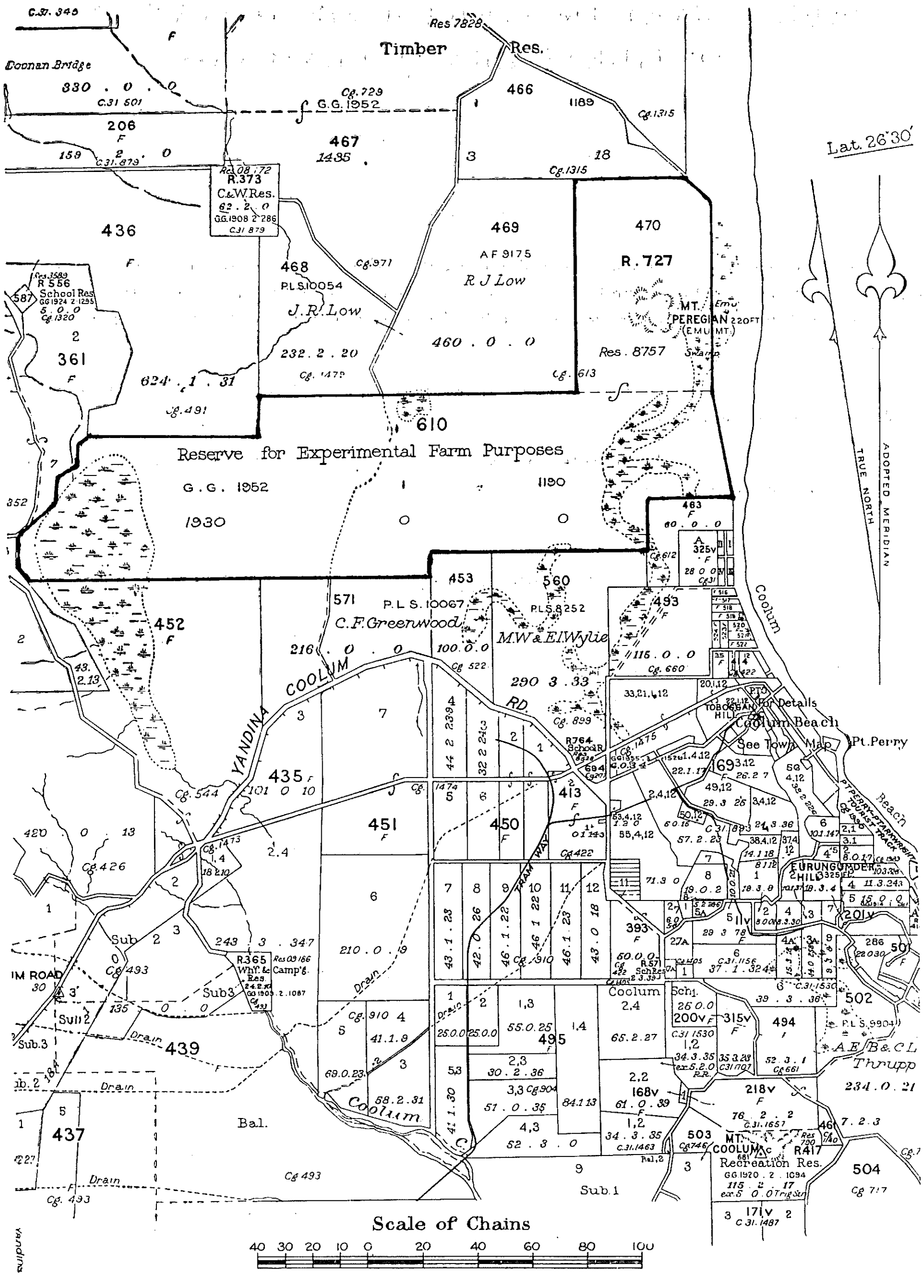

Fig. 1.

Locality Map Showing Coolum Field Station.

II. TOPOGRAPHY.

The dominant topographical feature of the area surveyed is Mt. Peregian (Emu Mt.) a trachy-rhyolite plug rising to a height of 220 ft. in the south-eastern corner of Portion 470. Dissected open sclerophyll forest ridges form the western boundary of Portion 470 and the western half of the northern boundary of Portion 610. Portion 610 is bisected by one of these ridges which runs north-west to south-east, and on the southern point of which is found a small outcrop of a ''granophyric aplite.'' To the west, Portion 610 is bounded by the swampy foothills of Middle Ridge, often known locally as the Valdora Range. The country to the south of the forest ridges mentioned above is lowlying and consists of numerous small wind-blown sand dunes which are slightly more elevated than the flat sandy heath. Crossing the dune and heath sands to form an intricate pattern are the extensive hummocky-surfaced drainage lines which in a large part take the form of tea-tree swamps.

III. GEOLOGY.

The geology of the Coolum area is complex. Members of the Science Students Association of the University of Queensland have studied the area from time to time and their observations have confirmed, and elaborated on, the surveys of the area carried out by Jensen (1906) and Richards (1938). The basal rocks of the area are thought to be the Mesozoic freshwater sediments (Richards 1938) and it seems likely that the ''relict sandy lateritic soils'' (Hubble 1954) of the open sclerophyll forest ridges, mapped at the series level as Peregian Loamy Sand and Maroochy Loamy Sand, were formed from these sediments.

The Mesozoic sediments have been intruded by numerous igneous bodies, one of which is a coarse-grained aplite, or to use Jensen's phrase, ''granophyric aplite.'' This rock is exposed on the cliff face at Pt. Perry, just south of Coolum Beach, and the rocky outcrop mapped on the ridge bisecting Portion 610 is considered to be part of the same intrusion.

Mt. Peregian is a tertiary volcanic plug which probably formed an island (Richards 1938) until the last fall in sea level. The rock is a fine-grained trachy-rhyolite containing sanadrine, hornblende and some biotite (Daniels 1950).

The lowlying dunes and heath were below sea level until the last emergence and the parent material of soil types found here would certainly seem to be of marine origin. At depths of between 2 ft. and 3 ft. 6 in. below most of the heath sand is encountered a black to brownish-black indurated layer of variable thickness. It is impenetrable at times to a soil auger but can be broken with difficulty by using a mattock or a pick. When lumps of this material are removed they crumble readily to give the texture of a loamy sand.

In a pit dug on Portion 610 the indurated layer was found between 2 ft. and 5 ft. Entry of water into the pit prevented investigation at this time to greater depths.

IV. CLIMATE.

The climate is best described as humid subtropical. The average annual rainfall of 69 in. shows a decided summer incidence. Table 1 gives the rainfall distribution for the years 1953-1957.

Table 1.

RAINFALL AT COOLUM FIELD STATION, 1953–1957, IN INCHES.

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1953	11·96	11·42	6·34	5·37	1·82	·34	·43	4·06	2·33	5·66	6·97	2·55	59·19
1954	5·24	20·67	3·87	2·53	5·53	1·54	18·07	4·70	3·10	5·94	3·42	2·34	75·95
1955	1·59	7·41	19·95	8·21	11·09	3·14	2·10	nil	2·25	4·42	1·72	7·18	69·06
1956	5·12	15·31	21·56	4·19	6·39	3·52	4·31	·27	1·85	1·84	5·38	12·26	82·00
1957	7·65	3·59	4·74	·14	·18	2·30	8·42	3·29	·13	1·92	2·04	·69	35·09
1958	4·99	11·07	9·80	22·29	3·27	22·62	nil	1·32	·99	·72	3·24	4·15	84·46

V. VEGETATION.

Vegetation is fairly closely correlated with soil type, which in turn seems to be largely dependent on topography.

The dominant species on Peregian Loamy Sand and Maroochy Loamy Sand are scribbly gum (*Eucalyptus micrantha*), red bloodwood (*E. intermedia*) and a stringybark (*E. phaeotricha*), with occasional tea-tree (*Melaleuca leucandendra*) and grasstree (*Xanthorrhoea hastile*). There is generally a fairly good ground cover of kangaroo grass (*Themeda australis*).

Banksia serratifolia, previously known as *B. aemula,* is the dominant species of the wind-blown dune sands (Wallum Sand). This tree proved to be an excellent indicator of soil type. On only one occasion was it found growing where the black indurated sand horizon was encountered at a depth of less than 3 ft. 6 in. Grasstree is sometimes co-dominant with *B. serratifolia* in the dune sands, while odd tea-trees are also present. A sparse ground cover of kangaroo grass may or may not be found.

The typical vegetation of the heath is the small banksia (*Banksia robur*) and grasstree co-dominant, with occasional *Banksia oblongifolia.* A wide range of proteaceous plants and numerous sedges are found in smaller quantities. Areas of heath having a peaty surface on occasions support a dense stand of the proteaceous shrub *Hakea gibbosa* and the tea-tree *Melaleuca nodosa.*

Drainage lines are characterised by the dominance of the tall-growing and closely packed tea-tree (*M. leucandendra*). The tea-trees *Melaleuca nodosa* and *Callistemon pachyphyllus,* the proteaceous shrubs *Hakea gibbosa* and *Petrophila shirleyae* and the she-oak or forest oak (*Casuarina littoralis*) are frequently found in association with *Melaleuca leucandendra.*

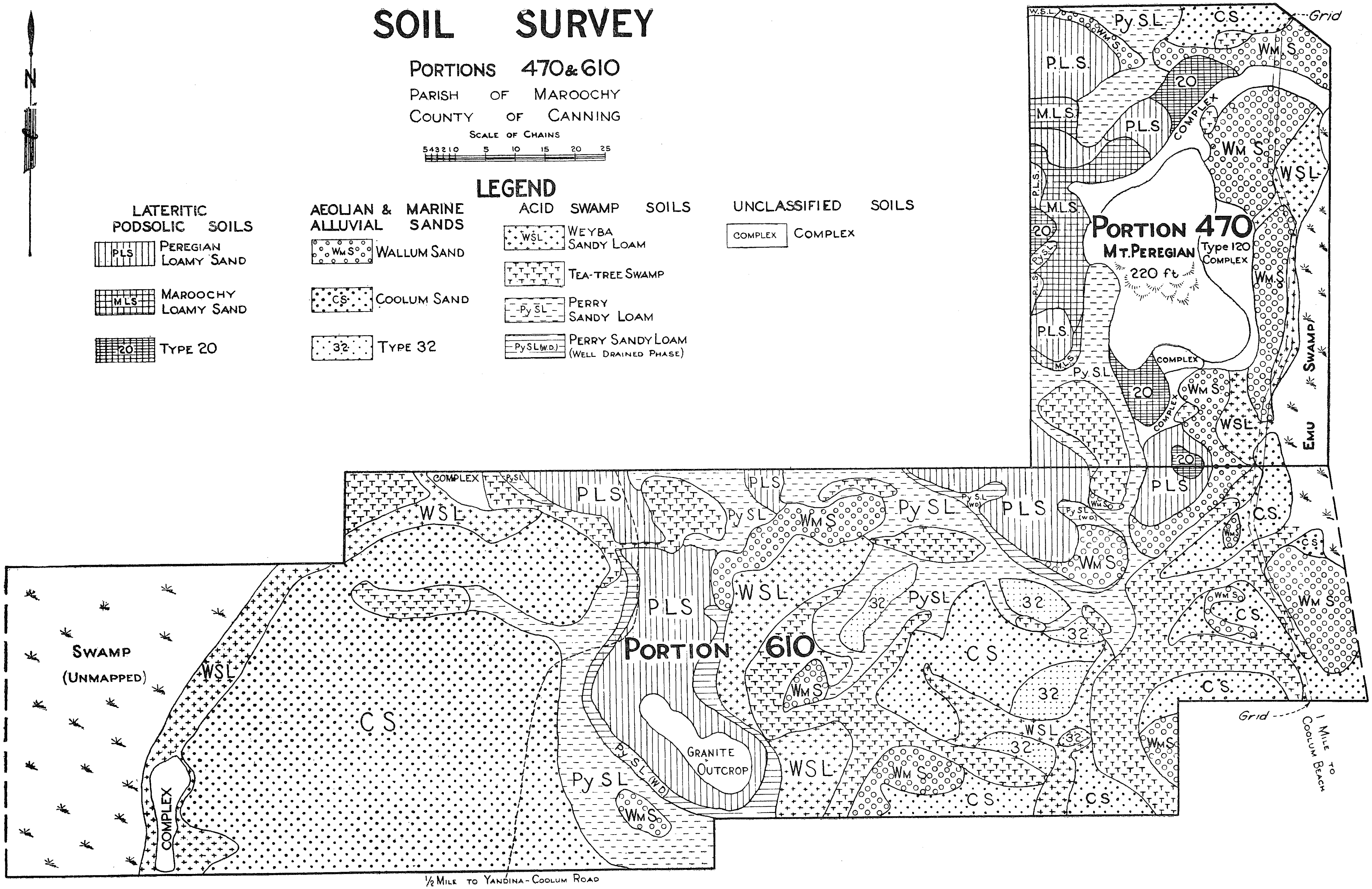
SOIL SURVEY
PORTIONS 470 & 610
PARISH OF MAROOCHY
COUNTY OF CANNING
SCALE OF CHAINS
5 4 3 2 1 0 5 10 15 20 25
LEGEND
LATERITIC PODSOLIC SOILS
PLS Peregian Loamy Sand
MLS Maroochy Loamy Sand
20 Type 20
AEOLIAN & MARINE ALLUVIAL SANDS
WmS Wallum Sand
CS Coolum Sand
32 Type 32
ACID SWAMP SOILS
WSL Weyba Sandy Loam
Tea-tree Swamp
PySL Perry Sandy Loam
PySL(W.D.) Perry Sandy Loam (Well Drained Phase)
UNCLASSIFIED SOILS
COMPLEX Complex
N
Grid
PORTION 470
MT. PEREGIAN
220 ft
Type 120 Complex
EMU SWAMP
PORTION 610
GRANITE OUTCROP
SWAMP (UNMAPPED)
1 Mile to Coolum Beach
½ Mile to Yandina-Coolum Road

Fig. 2.

VI. SOIL TYPES.

The soils of the surveyed area fall into three distinct great soil groups. These are:—

1. *Lateritic Podsolic soils*—
   (*a*) Type 100—Peregian Loamy Sand.
   (*b*) Type 10S—Maroochy Loamy Sand.
   (*c*) Type 20—Unnamed complex.
2. *Aeolian and Marine Alluvial sands*—
   (*a*) Type 30—Wallum Sand.
   (*b*) Type 31—Coolum Sand.
   (*c*) Type 32—Unnamed.
3. *Acid Swamp soils*—
   (*a*) Type 40—Weyba Peaty Sand.
   (*b*) Type 110—Perry Sandy Loam—non-peaty type—peaty type.
   (*c*) Tea-tree swamps.

Several small areas of miscellaneous soil types have not been grouped. The distribution of the soil types is shown in the inserted map.

VII. GENESIS OF SOILS.

The complex geology of the area makes it very difficult to interpret the genesis of the various soil groups encountered.

(1) Group 1.

The Lateritic Podsolic soils have already been described by Hubble (1954) as "Relict Sandy Lateritic soils" and considered to be formed from Mesozoic sandstones. No evidence was found at Coolum to contradict this conclusion. The extremely sandy nature of the surface horizons (84 per cent. sand) may suggest that the original laterite was eroded away to the depth of the indurated horizon and in some cases to the mottled horizon, and that the soils now found were developed from some material deposited on top of the eroded laterite. Granite outcrops do occur in Portion 610 and Portion 469 nearby, and while it is possible to think of this as a source of parent material, the fact that an auger was put down to a depth of 2 ft. 6 in. without encountering bedrock, not more than 30 yd. north of the granite outcrop on Portion 610, indicates that the granite has had very little influence on soil formation in the area. Probably marine sands have been transported by wind onto some of the areas of "Relict Sandy Lateritic soils" subsequent to the formation of the original profile, for the percentage of fine sand decreases with depth down to the B_1 horizon. Although there is no field evidence of podsolisation in the form of an ashy A_2 horizon, chemical analysis with respect to exchangeable cations does suggest slight podsolisation. The decrease in the percentage of clay in the A_2 horizon is also characteristic of podsolisation.

The Peregian Loamy Sand has been divided into two phases. One phase has a distinct horizon of ironstone pebbles very weakly cemented. This horizon, which is 2–4 in. thick, is located between the yellowish brown sandy loam to sandy clay B_1 horizon and the mottled B_2 horizon. It has been designated the nodular phase. It contains both nodules and concretions.

The significance of the nodular horizon from the point of view of soil genesis is difficult to interpret. An Army contour map does not show any marked difference in elevation between areas where the concretionary horizon is present and areas where it is absent. However, it is noticeable that the areas having a nodular and concretionary horizon are located along the western boundary of Portion 470 and in close proximity to Mt. Peregian. One possibility is that this portion of the area was previously at a lower elevation than at present, and the nodular horizon was formed there under the influence of a fluctuating water-table. When Mt. Peregian was extruded the whole profile was raised to its present level, and since that time there would have been no additions to the nodular horizon.

(2) Group 2.

The genesis of soils of group 2 would appear to be fairly straightforward. The Wallum Sands are wind-blown sand dunes of recent origin which stand higher than the surrounding heath sands by 2–10 ft. There is no profile differentiation to a depth of 3 ft. 6 in. Frequently the profile to a depth of 6 ft. is of undifferentiated sand but the depth of 3 ft. 6 in. was chosen arbitrarily in order to separate Wallum Sand from Coolum Sand. The "carbonaceous sandstone" layer was encountered at 77 in. under one area of Wallum Sand in Portion 610. It probably underlies all Wallum Sands, its depth from the surface depending upon the height of the dune relative to the adjacent heath areas.

The Wallum Sand is well drained and invariably supports the tall-growing banksia as the dominant species.

The direction of the long axis of these dunes varies throughout the area and has probably been influenced by both the direction of the prevailing winds and the position of the more elevated forest areas. Generally speaking, the long axis is parallel to the direction of the foothills of the forest areas. The dunes furthest removed from the forest areas have been wholly or partly dissected.

The Coolum Sand is lower in elevation than the Wallum Sand and the surface material is probably a mixture of both aeolian and marine alluvial sand. These horizons overlie black to very dark brown "carbonaceous sandstone," which is massive and very hard *in situ* but crumbles readily when pressed between the fingers. The thickness of this material was found by hydrologists of the Irrigation and Water Supply Commission to be 4 ft. 6 in. on Portion 610 commencing at a depth of 2 ft.

On Portion 470 the "carbonaceous sandstone" was found at a depth of 1 ft. and was 8 ft. in thickness. Below this was a brown sand which extended to approximately 20 ft., at which depth a white to grey gley clay was encountered. On Portion 493 nearby it occurred at 34 in. and was 26 in. through; at 60 in. a yellow brown sand was encountered.

A cursory comparison of the profile of the Coolum Sand and the Ground Water Podsol as described by Hubble may suggest that the Coolum Sand is a Ground Water Podsol in which the white "fragipan" has not been formed. Such is not the case. The "carbonaceous sandstone" at Coolum is considered to be a geological layer, possibly the remants of marine or freshwater swamps. Young, speaking of the "carbonaceous standstone" (which he calls black sandstone) associated with wallum soils, stated: "This black sandstone of the true wallum soil does not occur elsewhere on the coastal plain but it is interesting to note that it is to be found on Fraser Island and may possibly be a relic of a coastal uplift. On Fraser Island it is exposed in the sand-cliffs on the eastern side of the island and at sea-level on the west, and forms the bed of the freshwater lakes."

It would seem then that the swamps were covered with marine sand during a submergence and this sand was exposed as a result of the last emergence. Since then some wind-blown sand has probably been added to the marine alluvial sands. The fluctuating water-table found in the area under present-day climate may be modifying the "carbonaceous sandstone," but is not considered to be the causal agent. The following evidence is advanced to support this hypothesis:—

(1) Pieces of wood were found at a depth of 11 ft. in the brown sand beneath the carbonaceous layer by hydrologists working in the area.

(2) During the digging of the pit in Portion 610 some small pockets of white sand were encountered in the black "carbonaceous sandstone." These pockets were unconsolidated and easy to dig. Such pockets would not be expected if consolidation were resulting from fluctuations in the water-table.

(3) There are extensive outcrops of this "carbonaceous sandstone" on Coolum beach between tide levels (Fig. 2). This would seem to indicate that they are remnants of a previous geological era.

Type 32 is an unusual and somewhat variable type. At the time of the survey it was thought that the carbonaceous sandstone did not underlie it. However, later investigations by McDonald and von Stieglitz have established the fact that the carbonaceous sandstone does underlie it. In our investigations of this type we found mostly a surface horizon of 6–12 in. of golden sand overlying white sand to a depth of approximately 4 ft. Numerous ferruginous nodules occur in the golden sand in certain areas and these have the appearance of having been deposited from solution around roots or stems and so can be classified as Rhizo concretions (Bryan 1952).

Fig. 2.
Outcrop of "Carbonaceous Sandstone" on Coolum Beach.

These concretions appear to be in the formative stage in certain locations and in others to be due possibly to a disintegration of a previously cemented layer of them.

An interesting phenomenon associated with this soil type is the fact that the vegetation in the early summer months is all of the same colour as the sand of the surface horizon, so areas of type 32 can be located by eye from the summit of Mt. Peregian. No explanation of this phenomenon will be attempted. It does not appear to be a form of chlorosis of the vegetation.

(3) Group 3.

This group comprises the soils encountered in the extensive drainage lines of the area surveyed. Two soils have been named at the series level. These are the Perry Sandy Loam and the Weyba Peaty Sand. Soils of this group have several features in common. These are:

(1) The presence of a water-table at or just below the surface for most of the year.

(2) A hummocky micro-relief produced by erosion.

(3) A peaty surface horizon in the form of a dense root mass combined with decomposing swamp vegetation.

The group as a whole and in particular the tea-tree swamp soils warrant further study to give a clear picture of soil variation existing in drainage lines. The presence of a water-table would make this a difficult

Table 2.

CHEMICAL ANALYSES OF COOLUM SOIL TYPES.

Soil Type	Horizon	Depth	pH H_2O 1 : 2·5	Available P_2O_5 B.S.E.S. ppm	Replaceable Bases									Total N	Organic Carbon	C/N
					m-equiv. per 100 g.					Percentage of Total						
		in.			Ca++	Mg++	Na+	K+	Total	Ca	Mg	Na	K	%	%	
Peregian Sandy Loam. Forest vegetation site. Portion 610	A1	0–6	5·4	8	0·55	0·50	0·11	0·08	1·24	44·35	40·33	8·87	6·45	0·05	1·02	20.5
	A2	6–18	5·6	8	0·20	0·34	0·08	0·03	0·65	30·77	52·31	12·31	4·61	0·04	0·38	9·5
	A2	18–30	5·5	12	0·20	0·61	0·09	0·05	0·95	21·05	64·21	9·47	5·27	0·04	0·18	4·5
	B1	30–36	5·5	6	0·15	0·90	0·13	0·03	1·21	12·40	74·38	10·74	2·48	0·03	0·26	8·7
		36–40	Nodular and concretionary zone													
		40–60	4·9	6	0·25	1·81	0·21	0·03	2·30	10·87	78·69	9·13	1·31	0·06	0·35	6.0
		60–72	4·9	8	0·35	2·19	0·30	0·04	2·88	12·15	76·04	10·42	1·39	0·02	0·08	4·0
Wallum Sand. Banksia area	A1	0–12	4·8	8	0·35	0·39	0·07	0·07	0·88	39·77	44·33	7·95	7·95	0·03	0·42	14·0
	A2	12–36	5·0	10	0·55	0·16	0·05	0·03	0·79	69·62	20·25	6·33	3·80	0·01	0·13	13·0
	A2	36–72	5·4	8	0·45	0·05	0·05	0·04	0·59	76·27	8·47	8·47	6·78	0·01	0·09	9·0
Weyba Sandy Loam. "Peaty heath"	A1	0–12	4·7	8	1·25	1·85	0·44	0·16	3·70	33·78	50·0	11·89	4·33	0·23	3·14	13·6
	A2	12–30	5·4	12	0·70	0·54	0·06	0·04	1·34	52·24	40·30	4·48	2·98	0·04	0·18	4·5
	B1	30–36	5·0	8	1·05	0·95	0·08	0·04	2·12	49·53	44·81	3·77	1·89	0·04	0·68	17·0
Coolum Sand. Normal heath	A1	0–4	4·8	18	0·50	0·26	0·11	0·07	0·94	53·19	27·66	11·70	7·45	0·05	0·78	15·6
	A2	4–24	5·1	10	0·60	0·34	0·06	0·03	1·03	58·25	33·01	5·83	2·91	0·07	0·12	2·0
	*	24–60	4·7	12	0·90	1·00	0·55	0·03	2·48	36·29	40·32	22·18	1·21	0·04	2·01	50·0
A Tea-tree Soil		0–12	5·0	260	5·10	8·49	2·20	0·55	16·34	31·21	51·96	13·41	3·37	0·75	17·22	22·9

* Carbonaceous sandstone layer.

assignment. An auger was put down to 72 in. in one position (see appendix) and the profile described suggests the presence of a buried soil below 42 in.

VIII. CHEMICAL PROPERTIES.

Chemical analyses (Table 2) indicate that all soil types mapped are grossly deficient in major nutrients. This is understandable considering the sandy nature of the parent material and the losses suffered by leaching from the fairly high annual rainfall. All soils are medium acid to very strongly acid in reaction, the pH ranging from 5·6 to 3·5.

Total nitrogen is low in all samples with the exception of the A_1 horizon of Weyba Sandy Loam, for which a figure of 0·23 per cent. N was recorded. For most samples total nitrogen was less than 0·05 per cent. Organic carbon is low in most samples, the maximum figure recorded being 3·14 per cent. in the A_1 horizon of the Weyba Sandy Loam. The C/N ratio is variable, ranging from 2·0:1 in the A_2 horizon to 50·0:1 in the "carbonaceous sandstone" of Coolum sand.

Available phosphorus is very low, in no case being greater than 18 p.p.m. P_2O_5 (BSES method).

Exchangeable metal cations are low, the highest figure recorded being 3·70 m.-equiv. per 100 g. in the A_1 horizon of the Weyba Sandy Loam. Generally speaking, calcium and magnesium together comprise 80–90 per cent. of the cations, the total of which is often less than 1 m.-equiv. per 100 g. Sodium is invariably present in greater amounts than potassium, but in no case is the amount of sodium sufficiently high to have any adverse effect on plant growth. Though cyclic salt must be deposited in large quantities over the area, it is probably leached out rapidly owing to the sandy nature of the soils.

Moisture equivalent and wilting point figures have been determined (Table 3) for soil types at present being used for experimental purposes, but the inherent weakness of the methods when dealing with very sandy soils means that the figures obtained have little significance. In some cases the moisture equivalent recorded is less than the wilting point. There is little doubt that the range of available moisture is narrow on all soil types, with the possible exception of those having a peaty surface.

As stated above, these remarks refer to the "mapped" soil types. However, in the appendix are analytical figures relating to a sample of the surface 12 in. of one of the tea-tree areas. This soil, though strongly acid in reaction, is high in organic matter and well supplied with the major plant nutrients. Where it has been possible to drain such soils in the district, sugar-cane has been grown successfully.

Table 3.

MECHANICAL ANALYSES OF COOLUM SOIL TYPES.

Soil Type	Lab. No.	Depth	Mechanical Analyses							Texture	Moisture Equivalent %	Wilting Point
			Loss on acid %	Moisture %	Coarse sand %	Fine sand %	Silt %	Clay %	Total			
Peregian Sandy Loam. Forest vegetation site. Portion 610	A1	0–6	1·0	0·52	48·92	35·00	6·85	6·60	98·89	LS	4·7	4·2
	A2	6–18	0·89	0·58	52·21	30·95	12·60	3·07	100·30	LS	3·9	3·4
	A2	18–30	0·92	0·67	53·79	25·23	14·95	3·10	98·66	LS	5·5	4·7
	B1	30–36	0·92	0·76	47·96	27·41	8·50	15·35	100·90	SL	7·2	6·3
		36–40	Nodular and concretionary zone									
		40–60	1·42	2·47	19·71	16·15	31·22	29·97	100·94	SiCl	28·9	23·3
		60–72	1·60	2·4	20·00	12·61	17·40	45·80	99·81	C	33·7	23·5
Wallum Sand. Banksia area	A1	0–12	0·74	0·36	94·47	1·96	0·27	3·95	101·75	S	Values unreliable	
	A2	12–36	0·29	0·06	93·16	5·12	1·15	0·70	100·48	S		
	A2	36–72	0·29	0·06	92·34	5·11	2·07	0·80	100·67	S		
Weyba Sandy Loam. "Peaty heath"	A1	0–12	1·57	4·68	59·81	10·64	9·67	13·60	99·97	SL	Values unreliable	
	A2	12–30	0·19	0·06	93·93	2·96	0·60	3·0	100·74	S		
	B1	30–36	0·27	0·28	93·18	3·51	0·30	3·2	100·74	S		
Coolum Sand. Normal heath	A1	0–4	0·26	0·34	80·64	9·25	3·12	5·15	98·76	S	Values unreliable	
	A2	4–24	0·09	0·06	88·93	8·99	0·12	3·80	101·99	S		
	*	24–60	0·63	0·74	77·78	8·52	4·17	7·45	99·29	LS		
A Tea-tree Soil		0–12	3·57	8·42	28·35	5·59	19·7	22·35	87·98			

* Carbonaceous sandstone layer.

IX. DISCUSSION.

Any large-scale development of wallum areas is dependent upon the successful establishment of improved pastures. The factors limiting this establishment are chemical infertility and poor moisture relationships. In the soils mapped the poor moisture relationship is represented by the two extremes: inability to hold "available moisture" in the case of the Aeolian and Marine Alluvial Sands, and continuous waterlogging of the Acid Swamp soils.

In practice it is difficult to increase the water-holding capacity of soils, and until irrigation is shown to be practicable, production from the Aeolian and Marine Alluvial Sands will be closely correlated with rainfall received, irrespective of the level to which chemical fertility is raised.

The waterlogged conditions responsible for the formation of the acid swamps have resulted in the production of a group of soils whose surface horizons are loams or sandy loams high in organic matter. Such soils if drained should possess a reasonable range of "available moisture". For this reason the acid swamp soils as a group warrant more detailed investigation with a view to determining existing soil variation, and the economics of drainage and clearing. Drainage must be envisaged on the basis of whole catchments and not on the basis of individual blocks. Sugar-cane is already being grown successfully on small areas of soil of a similar nature within the wallum area.

The Lateritic-Podsolic soils, though sandy, are less "droughty" than the Aeolian and Marine Alluvial Sands and production from soils of this group should prove reasonably satisfactory if the chemical fertility can be improved economically.

X. ACKNOWLEDGEMENTS.

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APPENDIX.

The following profile descriptions cover all soil types encountered during the survey.

Lateritic Podsolic Group.

TYPE 100—PEREGIAN LOAMY SAND.

A_1 0–8″ Light grey (5Y 7/0) to grey (5Y 6/0) loamy sand, loose and friable when moist, firm when dry.

A_2 8″–20″ Pale yellow (5Y 7/3) to light yellowish brown (2.5Y 6/4) loamy sand, loose and friable when moist.

B_1 20″–26″ Yellow brown (10YR 5/6) to olive yellow (2.5YR 6/6) (with dark red (2.5YR 3/6) to red (10R 4/6) mottle), sandy loam—sandy clay loam to sandy clay. Moderately friable.

B_{21} 26″–32″ Red (2.5YR 4/6) with white (10YR 8/1) mottle, medium to heavy clay, weakly prismatic.

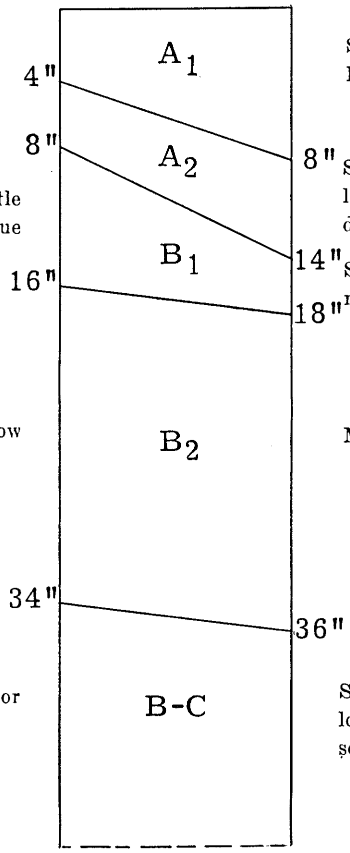
B_{22} 32″–72″ Red (10R 4/6) and white mottled medium to heavy clay, weakly prismatic.

N.B.—Mechanical analysis on B_{21} horizon places the texture erroneously in the silty clay loam class. The silt and clay fractions after agitation in the sedimentation cylinder became a flocculated gelatinous mass which remained high up in the cylinder even after overnight standing.

The analysed sample was taken from a pit situated about 40 yd. south of Portions 469-470 corner in an area which has since been bulldozed.

The nodular phase, which has not been mapped separately, contains a cemented layer of nodules and concretions approximately 4 in. thick at a depth of 36 in.

TYPE 10S—MAROOCHY LOAMY SAND.



Grey brown	A_1	Sandy loam to loamy sand; loose and friable when moist.
Yellow brown	A_2	Sandy loam to sandy clay, loose to slightly massive depending on texture.
Yellow brown with red mottle to yellow brown with blue grey and red mottle	B_1	Sandy clay to medium clay, massive to weakly prismatic.
Bluish grey with red yellow and brown mottle	B_2	Medium to heavy clay, massive.
Yellowish brown to white or grey with yellow mottle	B-C	Sandy loam to sandy clay loam; generally loose, friable, sometimes massive.

No samples of this soil type have been analysed. The depths of the horizons vary appreciably, as will be seen from the diagram. In analysis and fertility, this type would be expected to be very similar to the Peregian Loamy Sand.

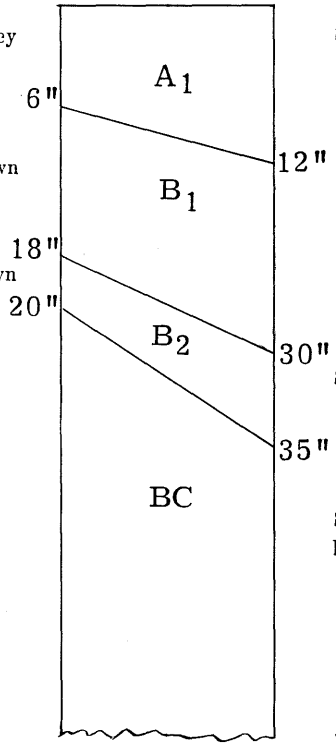
TYPE 20—UNNAMED—COMPLEX.

Light grey brown to grey brown — Sandy loam to loamy sand.

Yellow brown to yellow brown with grey mottle — Sandy clay to medium clay.

Grey to light yellow brown — Sandy clay to medium clay.

Yellow-grey-brown mottle — Sandy loam to sandy clay loam overlying parent rock.



A fair amount of variation can be expected in this soil type. The depth at which the parent rock is encountered varies from approx. 18 in. to over 6 ft. Type 20 is found fringing Mt. Peregian on the N.S. & S.

Perhaps two or three soil types could have been delineated in the area mapped as type 20. However, the acreage involved is small, and as none of the soils mapped as type 20 is likely to become of agricultural importance, it was decided to make the one soil type, allowing a fair amount of variation in the depth at which the parent material is encountered and in the texture of the horizons.

Aeolian and Marine Alluvial Sand Group.

TYPE 31—COOLUM SAND.

A_1 0–4″ Light grey (5Y 7/0) to grey (5Y 6/0) sand, loose single grain.

A_2 4″–24″ White (5Y 8/0) to light grey (5Y 7/0) sand, loose single grain.

Geological layer carbonaceous sandstone 24″–60″ Dark grey (2.5Y 4/0) to black (2.5Y 2/0) loamy sand, compact to indurated *in situ;* crumbles readily on exposure.

Analysed sample from Pit on "Big Plain" on Portion 610.

TYPE 30—WALLUM SAND.

A_1 0–12″ Light grey (5Y 7/0) sand, single grain, loose.

A_{21} 12″–36″ White (7.5YR 8/0) sand, single grain, loose.

A_{22} 36″–72″ White (7.5YR 8/0) sand, single grain, loose.

Geological layer $>$72″ As in Coolum sand.

Analysed sample taken from sand dune to east of Mt. Emu.

Acid Swamp Soil Group.

TYPE 40—WEYBA SANDY LOAM.

A_1 0–12″ Very dark grey (10YR 3/0) organic sandy loam, spongy due to dense mat of roots.

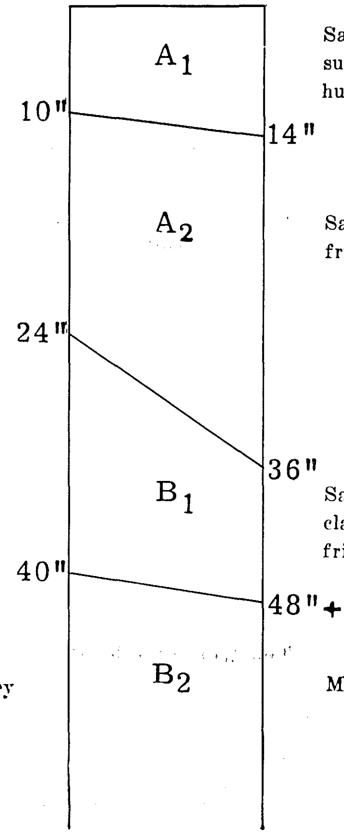
A_2 12″–30″ Light grey (5Y 7/0) with odd dark specks sand, single grain, loose.

B_1 30″–36″ Dark grey (10YR 4/0) to black (2.5Y 2/0) sand to loamy sand; frequently loose and friable but sometimes "carbonaceous sandstone."

Usually water perched on carbonaceous sandstone

This is peaty heath. Analysed sample taken from area east of Mt. Peregian and a few chains north of enclosed experimental area.

TYPE 110 (SWAMPY)—PERRY SANDY LOAM.



Dark grey to black	A_1	Sandy loam to loam; peaty surface; dense root mat; hummocky micro-relief.
White	A_2	Sand to sandy loam, loose and friable.
Light grey to white	B_1	Sandy clay loam to sandy clay, generally loose and friable.
Grey with red mottle to grey brown red mottle	B_2	Medium to heavy clay, massive.

A very small area of a better drained Perry Sandy Loam runs around the foothills of the forest areas in Portion 610. It resembles very closely the above profile but the A_1 horizon is a light grey to grey loamy sand. The A_2 horizon may go to a depth of 48 in. The more elevated topographical position results in a moderately well drained surface horizon without the hummocky micro-relief of the above profile.

Tea-tree Profile (1).

A_1	0–18″	Black loam; dense root mass and decomposing organic material; spongy.
A_2	18″–22″	Grey brown sandy loam.
B	22″–42″	Grey heavy sandy clay, massive and compact.
A?	42″–54″	Grey loamy sand, loose.
B?	54″–72″	White heavy clay, dense, massive and compact.

Only one tea-tree swamp area in true drainage lines examined. This had profile shown above. Water below 18 in.

Approximate position of this hole—Portion 610, W55 S16.

The white heavy clay horizon below 54 in. is thought to be almost pure kaolin. Few pieces of quartz found. Thought to be present-day profile superimposed on a pre-existing profile, so A? and B? can be called geological layers.

Tea-tree Profile (2).

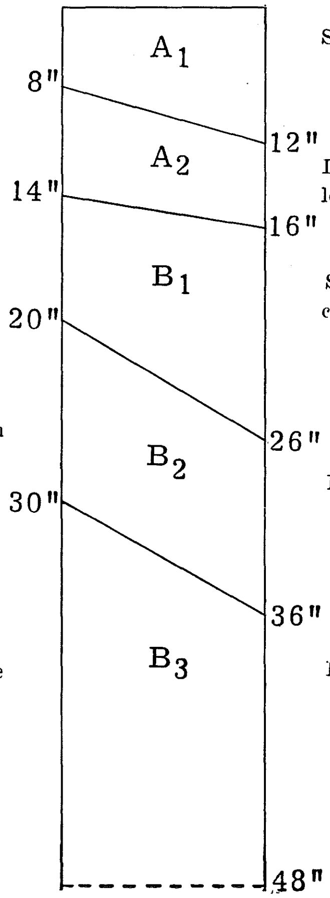
A_1	0–9″	Dark grey sandy loam to loam, fairly loose.
A_2	9″–14″	Grey to dark grey light to medium clay, loose.
B_1	14″–24″	Grey brown with yellow brown mottle medium clay, massive.
B_2	24″–32″	Blue grey with yellow brown mottle heavy clay, massive.
B_3	32″–56″	Blue grey heavy clay, massive.
B–C	56″–	Grey light clay, loose.

This profile represents soil types found in a small tea-tree area on Portion 470. South of Mt. Peregian and immediately west of pineapple area. Hole bored from top of puff. If boring from shelf, first horizon encountered is that shown above as A_2 and in this case it is very dark grey to black in colour.

Tea-tree profile (1) considered to be more representative of bulk of the tea-tree area than tea-tree profile (2). Tea-tree profile (2) would seem to be a specialised case of a perched basin which has a high water-table for only a couple of months each year.

Unclassified.

TYPE 120.



Dark grey brown	A_1	Sandy loam, loose and friable,
Light grey	A_2	Loamy sand, single grain, loose.
Light bluish grey	B_1	Sandy clay loam to sandy clay, slightly massive.
Light grey with yellowish brown mottle	B_2	Medium clay, massive.
Grey and yellow brown mottle	B_3	Heavy clay, massive.

This represents an average profile of the small area on the eastern edge of Mt. Peregian. The area is unshaded on the map and will be one of the unclassified soils.

Unclassified (2).

0–6″ Yellow brown light clay, friable.
6″–24″ Yellow brown with grey brown mottle medium clay, slightly massive.
24″–32″ Grey with yellowish brown mottle sandy clay to medium clay, massive.
32″–42″ White sand, single grain, loose.

The above soil type is found in a small area on the western edge of Portion 610. It is surrounded by areas of peaty heath and supports a vegetation of stunted apple and tumble-down grey gum.

This soil has not been classified and the area it covers is unshaded on the map.

Approximate position W195 S55.

Unclassified (3).

0–3″	Grey brown loamy sand, loose.
3″–26″	Yellow brown sandy loam.
26″–36″	White with yellow brown mottle sandy loam.
36″–42″	White with yellow brown mottle sandy clay, massive.

Another unclassified soil, the small area of it being unshaded on the map. Approximate position W143 S0 in Portion 610.

About 60 chains west of the hut on Portion 468 on the boundary of Portions 610 and 468. Of little or no importance.