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Soils and Land Suitability The Kilcoy – Woodford Area

South East Queensland

J.K. Loi, and D.T. Malcolm
Resource Sciences Centre

Department of Natural Resources,
Brisbane Queensland 1998

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This publication is for limited distribution. It is intended as an aid for strategic planning by local councils in south-eastern Queensland. The information in this report is derived from 1:50 000 scale land resource mapping which is an adequate scale for planning purposes. In assessing individual applications for subdivision a detailed assessment of land resources is usually necessary. Explicit evaluation of economic factors such as the size of production units or crop viability have not been included in the suitability assessment as they are not considered relevant to the quality of the land resource (State Planning Policy 1/92). This study has been funded by treasury special funds, with additional contributions from the Beaudesert Shire Council.

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Summary

The Kilcoy–Woodford area of 18 700 ha was surveyed at a medium intensity level at 1:50 000 scale from February to August 1996. The area is located to the south west of Maleny and north of Somerset Dam in the Sunshine Coast hinterland.

The study area covers the low-lying plains and terraces of the parts of the Stanley River and other creeks draining into Somerset Dam, and the adjoining undulating and rolling rises.

The soil and land characteristics of some 525 sites were described in detail and this information was stored on computer file. These and other, less detailed field site observations together with aerial photograph interpretation, identified and mapped 436 unique map areas (UMAs). Two broad groups of soils: *soils developed on alluvial plains and terraces* and *soils developed on undulating rises* are described in detail; the distribution of 38 soil types found in the area is shown in the Soils and Landform map at 1:50 000 scale which is included in this report.

Each unique map area (UMA) was assessed for its suitability for the climatically suitable crops: sorghum, maize, crucifers, potatoes, macadamia, citrus and rye grass. A total of 33–37% of the area is suitable for sorghum, maize, crucifers and potatoes. Only 20% and 13% of the area is suitable for citrus and macadamia respectively. Rye grass, being less demanding, can be grown on 74% of the area. Land suitability maps for these crops are available on request to Department of Natural Resources.

Severe limitations (subclasses 4 and 5) of each UMA for the crops considered in the area are shown in Appendices 2 and 3. UMAs not listed on these appendices are suitable for the crops considered. This list of severe limitations allows the land users to determine if any of the marginal mapping units (class 4) can be ameliorated and the estimated costs involved. Introduction of any new technology, land pressure and price of commodity may have an impact on such a decision.

With reference to the *Planning Guidelines* (DPI/DHLGP, 1993) no Class A land (**Crop land**) was found in the area. Class B land (**Limited crop land**) occupies the bulk of the area at about 8860 ha or 47%. Class C land (**Pasture land**) and class D (**non agricultural land**) each occupy about 26% of the area. Agricultural land classes of the Kilcoy–Woodford area in the order of UMA number are shown in Table 8. This information is also depicted on the Agricultural Land Classes map at 1:50 000 which accompanies this report.

Land assessment information of this area was compiled from coloured 1:25 000 aerial photographs supplemented with ground observation. The information is accurate at the scale of mapping of 1:50 000 which is generally sufficient for planning purposes. In assessing an individual application for subdivision, a more detailed land investigation is usually necessary.

1. INTRODUCTION

The SEQ2001 project was an initiative of the Regional Planning Advisory Group (1993). This initiative involved the collection of land resource information including soil, land suitability and vegetation of priority areas of south east Queensland, and providing appropriate information to address the planning and management needs for sustainable land use. The project was to assist the strategic planning by shire councils in south east Queensland to tackle concerns such as:

- rapid population growth,
- rezoning of rural land to non-productive uses,
- conflict between agriculture and other land uses,
- degradation of rural lands,
- need for land uses to be ecologically and economically sustainable, and
- over-exploitation of natural resources.

Land resource information and interpreted products were to be provided in a GIS form and maps available at 1:50 000 scale for resource planning and management. Other users of the information include sub-regional organisations of Councils, State Government agencies, agricultural industries and the development industry.

The medium intensity land resource survey at 1:50 000 scale was also to provide an understanding of the physical constraints on land use and the criteria by which land suitability for specific land uses are determined. Land use patterns with maximum community benefit and least economic, environmental and social cost will result when all stakeholders understand the constraints on land use. The project was funded by Treasury special funds.

The Kilcoy–Woodford area was identified by the Kilcoy Shire Council as requiring more detailed land resource information for planning purposes. The Kilcoy–Woodford area is the sixth in a series of land assessment reports of the south east Queensland SEQ2001 project.

It covers an area of about 18 700 ha and is located to the south west of Maleny and north of Somerset Dam. The area saddles part of both Kilcoy and Caboolture shires in the Sunshine Coast hinterland (Figure 1). The Kilcoy–Woodford area covers the low-lying plains and terraces of the parts of the Stanley River and other creeks draining into the Somerset Dam, and the adjoining undulating and rolling low rises. The surrounding steeper areas are not included in this study as they are mainly pasture land or non-agricultural land.

The field work in the area on soils, topography and vegetation was conducted from February to August 1996. Results of the land resource survey and assessment of the area for selected climatically suitable crops are presented in this report and its accompanying maps.

2. METHODOLOGY

1:25 000 coloured aerial photographs were interpreted to delineate slope and landform pattern. A free survey method (Reid, 1988) of field investigation was followed with observation sites based on predicted soil and landform variability as interpreted from aerial photographs, and accessibility. Land and soil characteristics of some 525 sites were fully described using the terminology of McDonald *et al.* (1990). From these observations and further aerial photograph interpretation, 436 mapping units or unique map areas (UMAs) were identified and mapped. Soils were assessed for their suitability for selected climatically suitable crops. Methodology for assessment of land suitability followed the guidelines in Land Resource Branch Staff (1990). A soils and landform map at a scale of 1:50 000 accompanies this report. Land suitability information for climatically suitable crops is stored on computer and can be retrieved as required. Based on land suitability information, agricultural land classes (DPI/DHLGP, 1993) were established and an Agricultural Land Classes map was compiled at 1:50 000 scale.

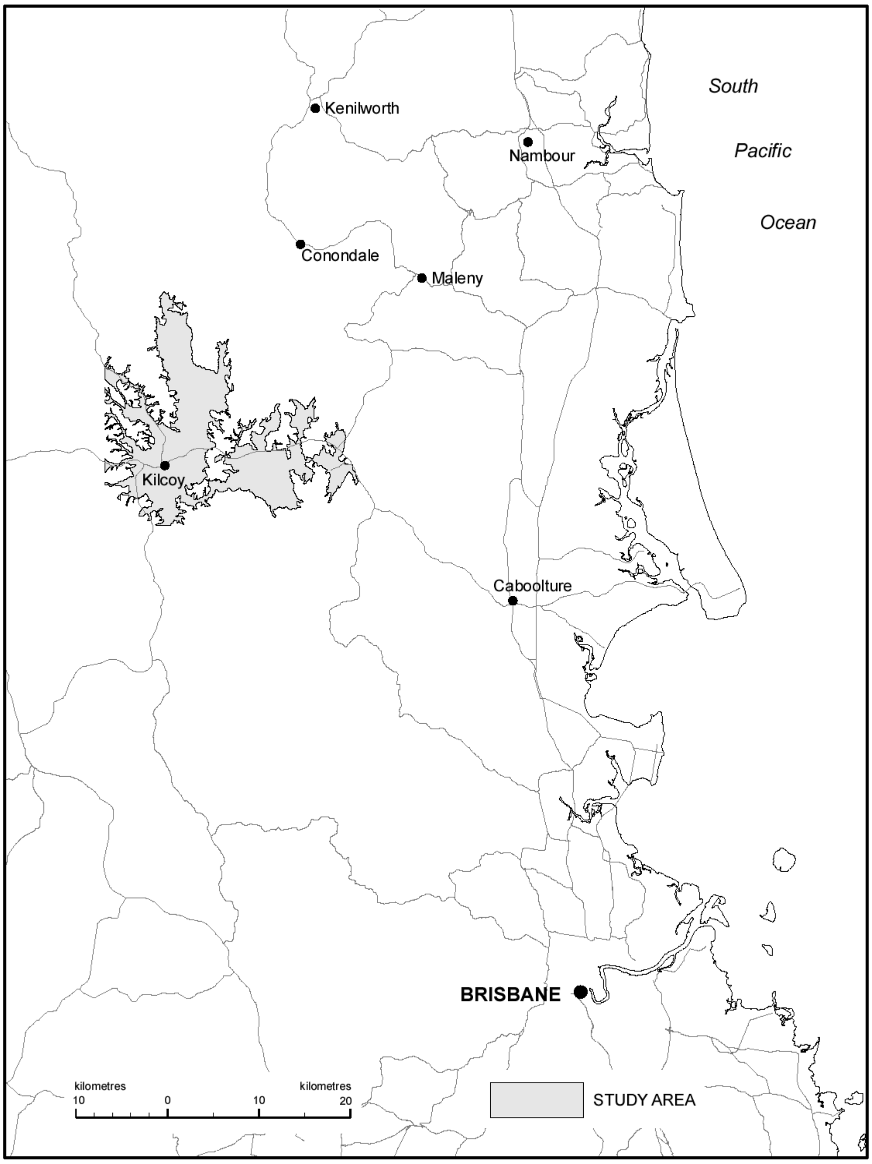

Figure 1. Location of Kilcoy–Woodford area

3. PHYSICAL ENVIRONMENT

Geology and terrain

The geology of the Kilcoy–Woodford area is depicted in the 1:100 000 Nambour sheet which was modified from 1:250 000 Gympie sheet by Martin *et al.* (1976–77). This information is reproduced in Figure 2 with boundary of the alluvium (Qa unit) modified as a result of this survey. The geological units and lithology in the area are summarised in Table 1.

Table 1. Geology of Kilcoy–Woodford area

Origin of parent material	Geological unit	Lithology	Age
Alluvium	Quaternary alluvium (Qa)	Clay, silt, sand and minor gravel	Quaternary
Sedimentary rocks	Northbrook Beds (Pn)	Mudstone, siltstone and shale	Early Permian
	Undifferentiated (Pz)	Shale, mudstone, slate, chert and greywacke	Carboniferous
Acid igneous and volcanic rocks	Neurum Tonalite (Rm)	Tonalite, granodiorite, porphyritic tonalite	Early to Middle Triassic
	Mount Bryon Volcanics (Rb)	Rhyolite, trachyte and basalt	
Intermediate and basic igneous and volcanic rocks	Neara Volcanics (Rtn)	Agglomerate and andesitic tuff	Early to Middle Triassic
Metamorphic rocks	Rocksberg Greenstone (Pzr)	Basic meta-volcanics and some schist	Permo-Carboniferous

Source: Martin, J.E., Willmott, W.F. and O'Flynn, M.L. (1976–77)

The present landform is mainly the result of geomorphological processes in the Pleistocene. Subsequent pedogenesis resulted in the current suite of soils. For simplicity, soils in the area are grouped according to the origin of their parent material.

The Quaternary alluvium comprises clay, silt, sand and minor gravel (Fig 2). Pedogenesis of this rather variable alluvium has produced a range of varied soil types which cover the level to gently undulating terraces formed by the drainage system in this area. The most extensive soils here are *Basel* (Black or Brown Dermosols*), *Bellbird* (Brown or Red Dermosols) and *Harper* (Grey or Black Dermosols), suggesting that fine sediments predominated in the original deposition in a low energy environment in the development of the low-lying area.

The sedimentary geological units of Northbrook Beds (Pn) and undifferentiated shale, mudstone, slate and greywacke (Pz) occur mainly in the western portion of the area. They give rise to *Kilcoy* (Brown Chromosols), *Jonlyn* (Grey Chromosols), *Kamerigo* (Red Chromosols or Red Kurosols) and *Kenilworth* (Brown Dermosols) soils.

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* Isbell, 1996

The acid igneous rocks units of Neurum Tonalite (Rm) and Mount Bryon Volcanics (Rb) mainly occur in the eastern portion of the area. The most common soils developed from these units are *Durundur* (Brown or Yellow Chromosols) and *Glenfern* (Grey Chromosols or Grey Kurosols).

The intermediate and basic igneous rocks units are represented by Neara Volcanics (Rtn). These rocktypes are not extensive and occur only in the western portion of the area. The common soils developed on these units are *Deer* (Brown Dermosols), *Dunwich* (Brown Chromosols), *Jimna* (Grey or Black Vertosols) and *Paddy* (Brown Chromosols).

The metamorphic rocks unit of Rocksberg Greenstone (Pzr) is a minor geological unit on which *Bunya* (Red Chromosols or Red Kurosols) have developed.

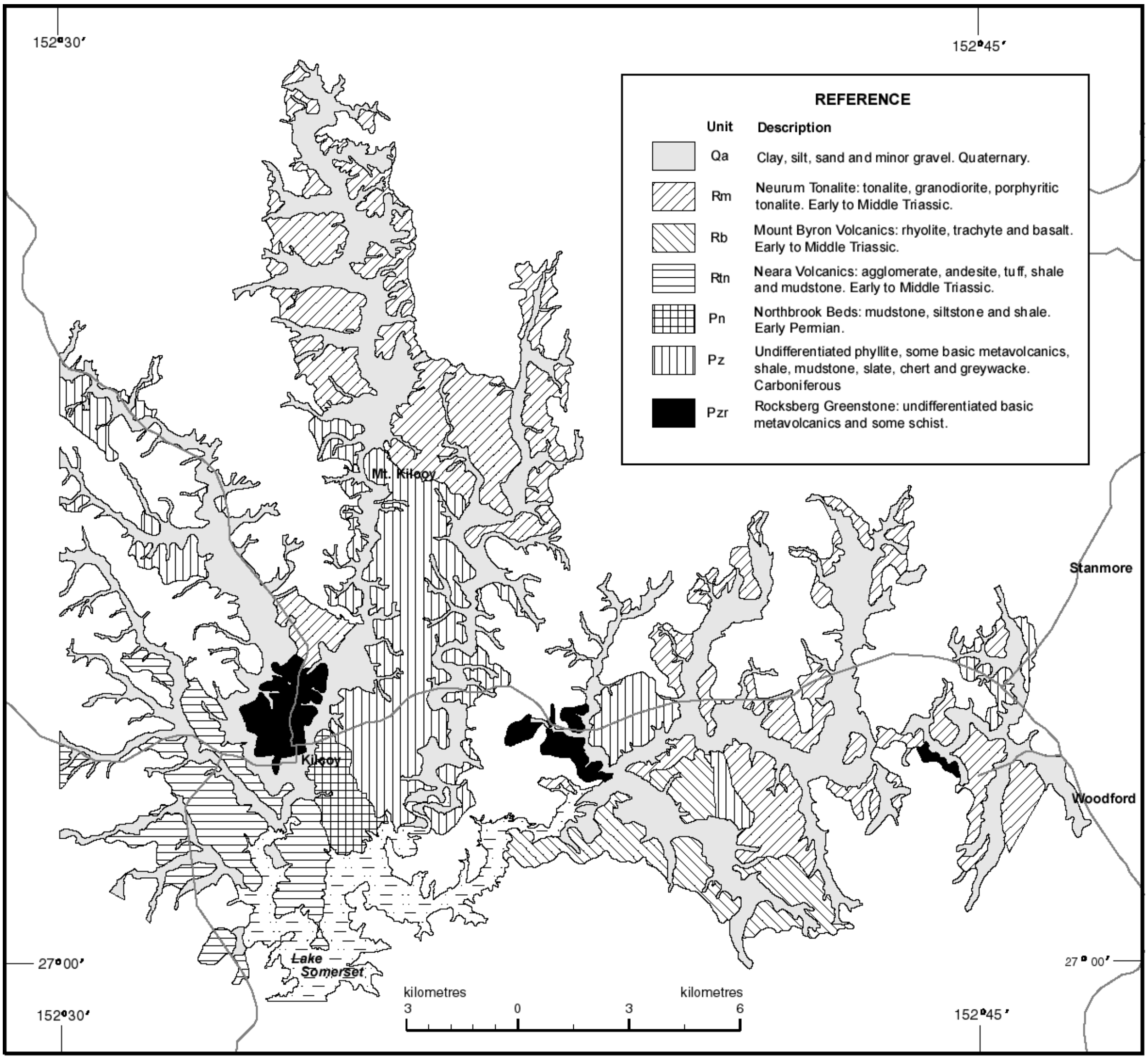

Figure 2. Geology of Kilcoy–Woodford area

Climate

The monthly rainfall at Kilcoy for the period 1990−1993 is shown in Table 2 (Bureau of Meteorology, 1995). The mean monthly rainfall at Kilcoy for the period 1890−1993 ranges from 32 mm to 141 mm with a mean annual rainfall of 971 mm. The long-term (1958–1993) mean monthly rainfall data at Kirkleagh south of Kilcoy show a similar trend (Table 2). The period from April to October is comparatively drier with a mean monthly rainfall of less than 80 mm. The driest months of May to September have less than 60 mm mean monthly rainfall. The wettest months of December to February have a mean monthly rainfall of 115–140 mm. Although monthly rainfall is generally consistently low in the dry months, the wet months can also have low rainfall in certain years as indicated by the data from 1990−1993 in Kilcoy.

The estimated evaporation at Maleny, north east of the area, is shown in Table 2. The mean monthly evaporation is higher than the mean rainfall, and significantly so from September to April. Depending on the soil moisture status, rainfed crops may experience moisture deficits and irrigation in some form may be necessary.

The number of monthly raindays for the period 1890−1993 is shown in Table 2 (Bureau of Meteorology, 1995). It ranges from 4 to 10 raindays per month. As expected, the lesser number of raindays corresponds with the drier months. June to September have only 6 to 7 mean raindays per month. This trend is also supported by the long-term record from 1954–1994 at Kirkleagh (Table 2).

The nearest temperature recording station, Kirkleagh, south of Kilcoy, recorded the mean daily maximum temperature of about 29–31^{o}C from November to March and 20–22^{o}C from June to August (Table 3) (Bureau of Meteorology, 1995). The intervening months have temperatures in between these values. The mean daily minimum temperature is 17–20^{o}C from November to March and 8–9^{o}C from June to August. Mean temperatures and percent humidity at 9 am and 3 pm are also shown in Table 3.

Occurrences of extreme temperatures at Kirkleagh are not common. Data for a 21-year period from 1970 to 1990 are shown in Appendix 5. Heatwaves (screen temperatures >38^{o}C) only occurred in October to March with December having the most heatwaves of 9 days within this period. On the other hand, frosts (screen temperatures <2^{o}C) only occurred in June to August. Frosts occurred most frequently in July, with a total of 8 days within the 21-year period.

Hydrology

Three major creeks with tributaries arising from ranges and mountains of 500−600 m above Australian Height Datum (AHD) drain the area. Two of these creeks, Kilcoy Creek and Sandy Creek, flow south through the area to the Somerset Dam, just south of the area. The other major creek, Sheep Station Creek, flow south east to the dam having originated from the north west region, outside the area. Shorter creeks, such as Scrubby Creek, Mary Smokes Creek and Stony Creek are found in the eastern portion of the area and drain into the Standley

River which eventually flow into the Somerset Dam. The other short creek, the Oaky Creek, originates from the north west region and drain directly into the dam.

The Mary Smokes Creek and the Neurum Creek, which comes from the south, form the shire boundary between Kilcoy and Caboolture within the area.

The drainage system is fairly mature with slow to very slow creek flow, particularly in the lower portion of the creeks, before entering into the Somerset Dam. The tributaries in the upper reaches are still erosive with rapid flows after heavy downpours, but most of these is outside the area.

As in any other rural area in this region, there are many local dams of various sizes excavated by farmers. According to the farmers the water quality is generally good. There are, however, no records of channel flow, and capacity and quality of underground water in the area.

Table 2. Climate – rainfall, evaporation and raindays

Month→ Year ↓	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1990*	68	282	161	95	143	28	35	12	7	65	96	66	1058
1991*	117	80	17	0	43	32	21	0	6	69	46	310	741
1992*	110	273	230	98	92	6	18	18	38	3	97	55	1038
1993*	77	62	78	10	40	14	52	35	35	27	107	61	598
Mean (1890–1993)*	**141**	**138**	**120**	**77**	**60**	**56**	**47**	**32**	**38**	**67**	**79**	**116**	**971**
Mean (1958–1993)**	**136**	**114**	**92**	**59**	**52**	**47**	**54**	**36**	**34**	**76**	**86**	**117**	**903**
Mean Evapo-ration⁺	**165**	**140**	**135**	**110**	**80**	**75**	**80**	**95**	**125**	**145**	**170**	**190**	**1510**
Mean No. raindays⁺⁺	**10**	**10**	**10**	**7**	**7**	**6**	**5**	**4**	**5**	**6**	**7**	**8**	**85**
Mean No. raindays⁺⁺⁺	**11**	**13**	**11**	**8**	**10**	**6**	**7**	**6**	**5**	**9**	**10**	**10**	**106**

* Monthly rainfall (mm) for the period 1990–1993 and mean monthly rainfall (mm) for the period 1890-1993 at Kilcoy (Lat. 26° 56' S & Long. 152° 34' E)

** Mean monthly rainfall (mm) at Kirkleagh (1958–1993) (Lat. 27° 2' S & Long. 152° 34' E)

⁺ Mean evaporation (mm) estimated at Maleny (Lat. 26° 45' & Long. 152° 50')

⁺⁺ Mean No. of raindays recorded at Kilcoy (1890–1993) (Lat. 26° 56' S & Long. 152° 34" E)

⁺⁺⁺ Mean No. of raindays recorded at Kirkleagh (1953–1994) (Lat. 27° 2' S & Long. 152° 34' E)

Table 3. Climate – temperatures

Month	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Mean temp (9 a.m.)	25.5	24.5	23.2	19.9	16.4	13.1	12.1	13.8	17.9	21.2	23.5	25.1	19.7
% Humidity	71	76	77	80	80	81	80	74	67	65	66	68	74
Mean temp (3 p.m.)	28.5	27.6	27.2	24.8	21.9	19.2	18.9	20.7	23.5	25.1	27.1	28.5	24.4
% Humidity	59	63	59	57	56	54	51	44	43	49	51	54	53
Mean daily maximum	30.3	29.0	28.6	26.3	23.0	20.4	19.9	21.8	24.8	27.1	29.0	30.5	25.9
Mean daily minimum	20.6	20.5	19.2	16.0	12.7	9.2	8.0	8.9	11.9	15.1	17.4	19.4	14.9

Mean temperatures (°C) and mean daily minimum and maximum temperatures (°C) for Kirkleagh (Lat. 27° 2’ S Long. 152° 34’ E) for the period 1978–1993

4. SOILS

The soils in the area can be broadly grouped according to the two landform units they occupy: *soils on level to gently undulating terraces* derived from alluvial parent material and *soils on undulating to rolling rises* derived from a range of rocktypes listed in Table 1. Many of the soils described in the Kenilworth–Conondale area (Loi *et al.*, 1997) are present in this area. However, the larger areal extent and more complex geology in the area resulted in the identification of more soil types. Wherever possible, soil names described in the Brisbane Valley survey (Harms and Pointon, in preparation) to the west of the study area were used. New soil names have been created when necessary. Soils on residual parent material have been primarily separated on the different groups of rocktypes they developed from: sedimentary rocks, acid igneous and volcanic rocks, intermediate and basic igneous and volcanic rocks, and metamorphic rocks. The normal application of morphological and physico-chemical properties were than used as key criteria for their classification. The detailed characteristics of the soils described below are distinctive to this area. Some of the criteria used in establishing new soil types are thickness and texture of A horizon, bleached or unbleached nature of A2 horizon, colour of upper B horizon, profile texture, texture contrast between A and B horizons, and pH trend.

A total of 38 soil types have been mapped in the area with 17 of them occurring on level to gently undulating terraces, and the remainder on undulating to rolling rises. The landform, vegetation and detailed soil characteristics can be assessed through the land resource data base at the Resource Sciences Centre in Indooroopilly. The distribution and areal extent of the soils in this area are shown on the Soils and Landform map at 1:50 000 scale which accompanies this report.

Soils on level to gently undulating terraces

Soils developed on level to gently undulating terraces are classified into 17 soil types indicating the rather varied nature of the alluvial deposits. The variability in different materials laid down in the past was a result of the combined effect of the fluvial processes, Pleistocene sea level changes and subsequent erosional and depositional processes. A whole spectrum of uniform fine, medium, coarse-textured, gradational and texture contrast soils occur on level to gently undulating terraces. The soil depth indicated in the discussion below is the depth to weathered rock, pan or impermeable layer and generally reflects the rooting depth of natural vegetation. Soils on level to gently undulating terraces occupy about 8860 ha or 47 percent of the total area.

The main characteristics of the soils of alluvial origin are shown in Table 4 and briefly described below.

Uniform fine textured soils

Basel (Bs). (Black or Grey Dermosols).* The *Basel* soils occur on level to gently undulating terrace plains of 0.5–1.5% slope. This is the most extensive soil type and occupies 3640 ha or about 41% of the low-lying terraces. These non-cracking uniform clay soils have 0.1–0.2 m of silty light clay to light medium clay over dark or grey light medium clay to medium clay. The surface runoff is very slow and permeability is slow to moderate. The *Basel* soils are imperfectly to moderately well drained. They are neutral to alkaline and subsoil pH ranges from 7.0 to 9.5. The depth of soil is more than 1.2 m.

Cooeeimbardi (Cb). (Black Vertosols). The *Cooeeimbaardi* soils are of minor occurrence with only about 260 ha in the area. They occur on level to gently undulating terrace plains of 0.5–2% slope, and may be associated with *Basel* and *Conondale* soils. These cracking clay soils have 0.1–0.2 m dark light clay to light medium clay over dark medium clay to medium heavy clay. Both the surface runoff and permeability are slow. They are imperfectly drained with surface pH of 6.0–8.0 and subsoil pH of 7.5–8.5. The depth of soil is more than 1.3 m.

Toogoolawah (Tw). (Grey Vertosols). Another minor soil type on the gently undulating terrace plains of 1–2% slope is *Toogoolawah* which occupies only 136 ha. It has 0.1 m dark light medium clay over grey medium clay with common orange mottles. The surface runoff is very slow to slow and permeability is slow. The soil type is imperfectly drained with surface pH of 5.8–6.0 and subsoil of 5.5–6.0. The soil depth is more than 1.5 m.

Uniform medium textured soils

Honey (Hy). (Grey or Brown Dermosols; Stratic Rudosols). The *Honey* soils occur on level to gently undulating terrace plains with slopes of 0.5-1.5%. The generally uniform loamy soil profile has 0.2-0.4 m of dark sandy clay loam surface over grey or yellow-brown sandy clay loam to clay loam. The surface runoff is generally very slow. Soil permeability is moderate and the soils are well drained. The soil pH is acid to neutral and ranges from 6.0 to 7.0 throughout the profile. The *Honey* soils are more than 1.1 m deep.

Uniform coarse textured soils

Cressbrook (Cr). (*Stratic Rudosols*). This soil type occupies 280 ha on level to undulating terrace plains of up to 4% slope. The *Cressbrook* soils may be associated with *Honey* and less commonly with *Basel*, *Bellbird* and *Harper* soils. The soil profile has 0.1–0.4 m dark or brown loamy sand to sandy loam surface over yellow-brown or yellow layered loamy sand to sandy loam with few medium rounded pebbles in the subsoil. Surface runoff is very slow to slow but the coarse-textured soils are highly permeable and well drained. The *Cressbrook* soils are acidic to neutral with pH ranges from 5.8–6.5 in the surface and 5.6–6.8 in the subsoil. They are more than 1.3 m deep.

Gradational soils

Bellbird (Bd). (Brown or Red Dermosols). The *Bellbird* soils are quite extensive and occupy about 1240 ha of the level to gently undulating terrace plains of 0.5–2% slope. They are commonly associated with *Basel* and less commonly with *Cressbrook* and *Harper* soils. The surface of the *Bellbird* soil profile has 0.1–0.3 m of dark sandy clay loam to clay loam. This is underlain by brown or red light clay to medium heavy clay with a few mottles at some sites. Runoff on the land surface is slow to very slow. The *Bellbird* soils are moderately permeable and moderately well drained. The soil pH is acid to neutral and ranges from 5.7 to 6.5 in the topsoil, and 6.0–6.8 in the subsoil. The depth of soil is more than 0.8 m.

Harper (Hp). (Grey or Black Dermosols). The *Harper* soils, which occupy about 950 ha, are developed on level to gently undulating terrace plains of 0.5–2% slope. They may be associated with *Basel* and less commonly with *Bellbird*, *Conondale, Cressbrook* and *Grigor* soils. The soil profile comprises 0.1–0.3 m dark fine sandy clay loam to clay loam over grey or dark fine sandy light clay to light medium clay with occasionally common orange mottles. The surface runoff is slow to very slow, and the soil is moderately permeable and moderately well drained. The soil reaction is acid to neutral with pH ranges from 5.8–6.5 and subsoil 6.0–7.0. The soil depth is more than 1.5 m.

Texture contrast soils

Beausang (Bg). (Grey Chromosols). The *Beausang* soils occupy about 290 ha of level to gently undulating terrace plains of up to 2% slope. The soil type is commonly associated with *Bellbird*, *Conondale*, *Harper*, *Ottaba* and *Smokes* soils. The soil profile is characterised by 0.2–0.45 m occasionally bleached dark, fine sandy loam to fine sandy clay loam surface over grey sandy light clay to medium clay with common orange mottles. Surface runoff is very slow. Permeability is moderate and the soils are imperfectly drained. The surface pH is 5.8–6.5 and subsoils are neutral with pH of 6.8–8.0. The soil depth ranges from 0.8 to more than 1.5 m.

Conondale (Cn). (Grey Chromosols). This soil type occupies about 350 ha of the level to gently undulating terrace plains of 0.5–3% slope. The soil type is occasionally associated with *Basel* and *Bellbird* soils. The soil profile has 0.2–0.3 m dark over light grey sandy clay loam to clay loam, over grey light medium clay to medium clay with common orange mottles. Surface runoff of the *Conondale* soils is very slow, permeability is slow and they are imperfectly to moderately well drained. The soil pH is variable and can range from 5.5–7.5 in the surface, 5.5–8.5 in the subsoil and 8.0–9.3 in deep subsoil. The *Conondale* soils are more than 1.4 m deep.

Table 4. Main characteristics of the soils in the Kilcoy–Woodford area

Soil	A Horizon		B Horizon		pH		Soil
type	Depth(m)	Texture**	Colour*	Texture**	A Hor.	B Hor.	depth(m)
Soils on level to gently undulating terraces							
Uniformed fine textured soils							
Basel (Bs)	0.1-0.2	LC-LMC	Dk, Gy+	LMC-MC	5.8-7.5	7.0-9.5	>1.2
Cooeeimbardi (Cb)	0.1-0.2	LC-LMC	Dk	MC-MHC	6.0-8.0	7.5-8.5	>1.3
Toogoolawah (Tw)	0.1	LMC	Gy	MC	5.8-6.0	5.5-6.0	>1.5
Uniform medium textured soils							
Honey (Hy)	0.2-0.4	SCL	Gy, YBr	SCL-CL	6.0-7.0	6.0-7.0	>1.1
Uniform coarse textured soils							
Cressbrook (Cr)	0.1-0.4	LS	YBr, Y	Layered LS-SL	5.8-6.5	5.6-6.8	>1.3
Gradational soils							
Bellbird (Bd)	0.1-0.3	SCL-CL	Br	LC-MHC	5.7-6.5	6.0-6.8	0.8->1.5
Harper (Hp)	0.1-0.3	SCL-CL	Gy, Dk	FSLC-LMC	5.8-6.5	6.0-7.0	>1.5
Texture contrast soils							
Beausang (Bg)	0.2-0.45	FSL-FSCL	Gy	SLC-MC	5.8-6.5	6.8-8.0	0.8->1.5
Conondale▲ *(Cn)*	0.2-0.3	SCL-CL	Gy	LMC-MC	5.5-8.5	8.0-9.3	>1.4
Cookes (Co)	0.15-0.25	SCL-CL	YBr	LMC	5.5-5.8	5.7-5.8	1.1-1.5
Grigor (Gr)	0.15-0.25	FSL-CL	Dk	LMC-MC	6.0	6.2-6.8	>1.3
Gunyah (Gy)	0.1-0.2	CL	Gy, YBr	LMC-MC	6.5-8.3	8.0-8.5	>1.5
Ottaba (Ot)	0.2-0.3	SCL	YBr	MC-MHC	6.0	5.5-5.8	>1.0
Smokes (Sk)	0.3-0.5	SL-FSL	YBr, Br	SLC-MC	5.5-7.0	5.5-6.3	>1.7
Spencer (Sp)	0.2-0.3	CL	YBr	MC	6.0-9.0	7.0-9.0	>1.7
Gradational or texture contrast soils							
Gallanani (Gl)	0.2-0.4	FSCL	Dk, YBr, Br	FSLMC-LMC	6.5-7.0	6.5-8.0	>1.0
Obi (Ob)	0.2-0.4	SL	Gy	SMC	7.0	8.5-9.2	>1.5

Table 4. Cont…

Soils on undulating to rolling rises							
Soils developed on sedimentary rocks							
Horse (Hs)	0.1-0.3	FSL	Gy	FSMC-MHC	5.2-6.0	5.0-5.5	>0.6
Jonlyn (Jl)	0.1	CL	Gy	MHC	6.2	6.2	<0.5
Kamerigo (Ka)	0.1-0.25	L-CL	RBr, R	MC	5.0-6.2	5.0-7.0	0.6-1.5
Kenilworth (Kl)	0.1-0.2	LC	Br	LMC-MC	6.5-6.8	5.8-7.0	0.6-1.5
Kilcoy (Ky)	0.1-0.45	FSCL-CL	Br	LMC	5.8-6.0	6.7	0.4-0.9
Noon (Nn)	0.1-0.2	CL	YBr, Y	LC-LMC	5.5-6.5	5.5-7.0	0.5->1.5
Soils developed on acid igneous rocks							
Berrima (Be)	0.15-0.35	SL-SCL	Br, YBr	SCL-SLMC	5.5-5.8	5.3-5.5	>0.5
Boolumba (Bo)	0.1-0.2	CL-LC	Br, YBr	LC-MHC	5.5-6.0	5.5-6.5	0.4-1.1
Durundur (Dd)	0.15-0.35	FSL-FSCL	YBr, Y	FSLMC-MHC	5.5-6.7	6.0-7.0	0.6-1.7
Esk (Ek)	0.1-0.4	SL	Gy, YBr	SL	5.5-6.5	5.5-6.5	0.2-0.7
Glenfern (Gf)	0.3-0.45	FSL	Gy	MC-MHC	5.5-6.7	5.0-7.0	0.5-1.6
Royston (Rt)	0.2-0.3	SCL-CL	Gy	LMC-MHC	5.5-7.0	5.5-6.3	0.6-1.0
Scrubby (Sc)	0.15-0.3	CL-SLC	R, RBr	LC-SLMC	5.5-6.5	5.5-6.5	0.9-1.6
Winya (Wn)	0.25-0.35	SL-FSL	RBr, Br	MC	6.0-6.3	6.0-7.0	1.1-1.4
Soils developed on intermediate and basic igneous rocks							
D'Aguilar (Dg)	0.25	CL	-	Bedrock	6.0	-	0.25
Deer (Dr)	0.2-0.3	LC	Br	MC-MHC	6.0-7.0	5.5-7.5	0.4-1.5
Dunwich (Dw)	0.3	CL	Br	MC	5.7-7.7	7.0-8.7	0.6-1.6
Jimna (Jn)	0.1-0.3	LC-LMC	Gy, Dk	MC	6.5-7.5	6.5-8.5	>1.1
Moore (Mo)	0.15	CL	YBr	MC	7.3	7.3	0.5
Paddy (Pd)	0.1-0.2	L-CL	YBr	MC	5.7	5.3-5.5	0.8-0.9
Soils developed on metamorphic rocks							
Bunya (Bu)	0.1-0.35	FSCL	R	LMC-MC	6.0-7.0	4.5-6.0	0.5-1.1

*Colour classes as McDonald in Donnollan *et al.* (1990) **Texture classes according to McDonald *et al*. (1990).
+ Br = brown, Dk = dark, Gy = grey, R = red,
RBr = red-brown, Y = yellow, YBr = yellow-brown ▲ has bleached A2 horizon

Cookes (Co). (Brown Chromosols). The *Cookes* soils are of minor occurrence and comprise only 125 ha of the level terrace plains of <1% slope. The soil profile is characterised by 0.15–0.25 m dark over grey sandy clay loam to clay loam surface, over yellow-brown light medium clay with few to common mottles. The surface runoff is very slow and permeability is slow. The *Cookes* soils are imperfectly drained. They have a acid soil reaction trend with pH of 5.5–5.8, and vary in depth from 1.1 to 1.5 m.

Grigor (Gr). (Black Chromosols). The *Grigor* soils, occupying about 290 ha, occur on level to gently undulating terrace plains of 0.5–3% slope. The soil profile is characterised by 0.15–0.25 m dark fine sandy loam to clay loam surface over dark light medium clay to medium clay. The surface runoff is very slow, permeability moderate and the soils are moderately well drained. The soil reaction is acid to neutral with surface pH of 6.0 and subsoil 6.2–6.8. The *Grigor* soils are deep, extending to more than 1.3 m.

Gunyah (Gy). (Grey or Brown Chromosols). The *Gunyah* soils, occasionally associated with *Beausang* soils, occupy about 235 ha of level terrace plains. The soil profile is characterised by 0.1–0.2 m dark clay loam surface over grey or yellow-brown light medium clay to medium clay. The surface runoff is very slow and the soil is slowly permeable and imperfectly drained. The surface soil pH is 6.5–8.3 and subsoil 8.0–8.5. The depth of soil is more than 1.5 m.

Ottaba (Ot). (Brown Chromosols). Only 125 ha of *Ottaba* soils are found on the gently undulating terrace plains. The soil profile is characterised by 0.2–0.3 m dark over grey sandy clay loam surface, over yellow-brown medium clay to medium heavy clay with occasionally common orange mottles.

The surface runoff is very slow and the soil is moderately permeable and imperfectly drained. The soil has an acid reaction with surface pH of 6.0 and subsoil 5.5–5.8. The *Ottaba* soils are deep, extending to more than 1.0 m.

Smokes (Sk). (Brown Chromosols). The *Smokes* soils cover about 360 ha of level to gently undulating terrace plains of 1–2% slope. They may be associated with *Cooeeimbardi* soils. The soil profile is characterised by 0.3–0.5 m dark over grey sandy loam to fine sandy loam surface, over yellow-brown or brown sandy light clay to medium clay with common grey or red mottles. The surface runoff is very slow to slow, and the permeability is slow to moderate. The *Smokes* soils are imperfectly to moderately well drained. The surface pH is 5.5–7.0 and subsoil 5.5–6.3. The *Smokes* soils are deep and extend to more than 1.7 m.

Spencer (Sp). (Brown Chromosols; Brown Sodosols). This soil type is minor and occurs in pockets on level to gently undulating terrace plains of 0.5–1% slope. It is commonly associated with *Basel*, *Bellbird*, *Conondale* and *Harper* soils. The soil profile has 0.2–0.3 m dark over bleached grey clay loam surface, over yellow-brown medium clay with occasional grey mottles. The surface runoff is very slow and the permeability is slow. The soils are imperfectly to moderately well drained. The soil reaction is neutral to alkaline with pH of 6.0–9.0 in the surface and 7.0–9.5 in the subsoil. The *Spencer* soils are more than 1.6 m deep.

Soils with texture contrast or gradational profile

Gallanani (Gl). (Black or Brown Chromosols, Brown Dermosols). This is a very minor soil type which occurs at the western boundary of the area. The soil profile has 0.2–0.4 m dark to yellow-brown fine sandy clay loam surface over dark, yellow-brown or brown fine sandy light medium clay to light medium clay. The surface runoff is slow and permeability is moderate. The soils are moderately well drained with surface pH of 6.5–7.0 and subsoil 6.5–8.0. The depth of soil is more than 1.0 m.

Obi (Ob). (Grey Sodosols). This is another soil type with very minor distribution in the area. The soil profile has 0.2–0.4 m dark over grey sandy loam surface, over grey sandy medium clay with common yellow bottles. The surface runoff is very slow and the permeability is slow. The soils are imperfectly drained with surface pH of 7.0 and subsoil 8.5–9.2. The depth of soil is more than 1.5 m.

Soils on undulating to rolling rises

The soils on undulating to rolling rises are developed on a range of rocktypes from sedimentary, acid, intermediate and basic igneous rocks and minor metamorphic rocks (see Section 3 and Table 1). The soils on the rises represent about 9850 ha or 53% of the total area. Twenty-one soil types have been mapped. The *Kilcoy* developed on sedimentary rocks, and *Durundur*, *Glenfern* and *Royston* on acid igneous rocks are the major soil types on this landform commanding a significant areal extent. The main characteristics of these soils are shown in Table 4. They are briefly summarised below.

Soils developed on sedimentary rocks

Horse (Hs). (Grey Kurosols). This is a minor soil type and occurs on undulating rises of 4–7% slope. It is often associated with *Kenilworth* soils and occasionally with *Jonlyn* soils. The soil profile has 0.1–0.3 m dark over grey fine sandy loam, over grey fine sandy medium clay to medium heavy clay with common orange mottles. The surface runoff is slow and permeability is moderate. The *Horse* soils are moderately well drained with surface pH of 5.2–6.0 and subsoil 5.0–5.5. They are more than 0.6 m deep.

Jonlyn (Jl). (Grey Chromosols). The *Jonlyn* soils, commonly associated with *Horse* soils, occupy about 380 ha of the undulating rises of about 10% slope. The soil profile has 0.1 m dark clay loam over grey medium heavy clay with common orange mottles and common to many shale fragments throughout the soil profile. The surface runoff is slow and permeability is moderate. They are moderately well drained with pH of 6.2. The *Jonlyn* soils are shallow with a soil depth of less than 0.5 m.

Kamerigo (Ka). (Red Chromosols; Red Kurosols). The 400 ha of *Kamerigo* soils, which may be associated with *Kilcoy* soils, occur on undulating to rolling rises and low hills of 5–14% slope. The soil profile has 0.1–0.25 m dark over grey or yellow-brown loam to clay loam, over red-brown or red medium clay with common grey mottles. The surface runoff is slow to moderately rapid and the soils are moderately permeable. The *Kamerigo* soils are moderately to well drained with surface pH of 5.0–6.2 and subsoil 5.0–7.0. The depth of soils ranges from 0.6 to 1.5 m.

Kenilworth (Kl). (Brown Dermosols). The *Kenilworth* soils, commonly associated with the *Kilcoy* soils, occupy about 450 ha of the undulating to rolling rises of 4–18% slope. The soil profile has 0.1–0.2 m dark light clay surface over brown light medium clay to medium clay. The surface runoff is slow to moderately rapid and the soil is moderately permeable and moderately well drained. The soil reaction is acid to neutral with pH ranges from 5.8 to 7.0 in the surface and 5.8–7.0 in the subsoil. The *Kenilworth* soils are fairly shallow and range from 0.3 to 0.6 m deep.

Kilcoy (Ky). (Brown Chromosols). This soil type is the most extensive of the soils developed on the sedimentary rocks in the area. It occupies about 1880 ha of undulating to rolling rises of 5–16% slope and is commonly associated with *Kamerigo* soils. The soil profile has 0.1–0.45 m dark to grey fine sandy clay loam to clay loam over brown light medium clay. The surface runoff is slow to moderately rapid and permeability is moderate. The soils are well drained with surface pH of 5.8–6.0 and subsoil 6.7. They vary from 0.4 to 0.9 m in depth.

Noon (Nn). (Brown Dermosols). This is a minor soil type found on the gently undulating to undulating rises of 2–5% slope. It is commonly associated with *Kilcoy* and less commonly with *Kamerigo* soils. The soil profile has 0.1–0.2 m of dark over grey clay loam surface, over yellow-brown or yellow light clay to light medium clay with few quartz pebbles throughout the profile. The surface runoff is slow, permeability moderate and the soil profile is moderately drained. The soil reaction is acid to neutral with surface pH of 5.5–6.5 and subsoil 5.5–7.0. The soil depth ranges from 0.5 to more than 1.5 m.

Soils developed on acid igneous rocks

Berrima (Be). (Brown Kurosols). This soil type occupies 120 ha of the undulating rises and low hills of 3–9% slope. It may be associated with *Durundur* and *Scrubby* soils. The soil profile has 0.15–0.35 m sandy loam to sandy clay loam surface over brown or yellow-brown sandy clay loam to sandy light medium clay. The surface runoff is slow to moderately rapid and the soil has a moderate permeability. The *Berrima* soils are moderately well drained with surface pH of 5.5–5.8 and subsoil 5.3–5.5. They are more than 0.5 m deep.

Boolumba (Bo). (Brown Chromosols; Brown Dermosols). Only about 120 ha of this soil type is found on the undulating to rolling rises of 3–16% slope. It is often associated with the *Scrubby* soils. The soil profile has 0.1–0.2 m dark clay loam to light clay surface over brown or yellow-brown light clay to medium heavy clay. Common rock fragments are present in shallower soils on the steep end of the slope range. The surface runoff is moderately rapid and permeability is slow to moderate. The *Boolumba* soils are moderately well to well drained with surface pH of 5.5–6.0 and subsoil 5.5–6.5. The depth of soil ranges from 0.4 to 1.1 m.

Durundur (Dd). (Brown or Yellow Chromosols). This is the most extensive soil type of the rises and occupies about 2630 ha of the undulating to rolling rises and low hills of 4–22% slope in the area. It may be associated with *Glenfern, Royston* and *Winya* soils. The soil profile has 0.15–0.35 m dark over grey fine sandy loam to fine sandy clay loam, over yellow-brown or yellow fine sandy light medium clay to medium heavy clay with common grey and orange mottles. Common rock fragments in the soil profiles have been observed at a few sites. The surface runoff is moderately rapid and permeability is slow to moderate. The soils are moderately well drained with surface pH of 5.5–6.7 and subsoil 6.0–7.0. The depth of soil ranges from 0.6 to 1.7 m.

Esk (Ek). (Leptic Rudosols). The *Esk* soils are very minor and occur on undulating rises of 8–10% slope. The soil profile has 0.1–0.4 m dark sandy loam surface over grey or yellow-brown sand loam. The surface runoff is moderately rapid and the soil highly permeable and moderately well drained. The soil pH is acid at 5.5–6.5 throughout the profile. The *Esk* soils are rather shallow with a soil depth of 0.2 to 0.7 m.

Glenfern (Gf). (Grey Chromosols; Grey Kurosols). This is another dominant soil type on the rises and occupies about 1420 ha of the undulating to rolling rises and low hills of 3–15% slope. It is commonly associated with *Durundur* and *Royston* soils. The soil profile has 0.3–0.45 m dark over grey fine sandy loam, over grey medium clay to medium heavy clay with common orange mottles. The surface runoff is slow to moderately rapid and the soil moderately permeable and moderately well drained. The soil reaction is acid to neutral with surface pH of 5.5–6.7 and subsoil 5.0–7.0. The depth of soil ranges from 0.5 to 1.6 m.

Royston (Rt). (Grey Chromosols). This is a fairly extensive soil type which occupies about 620 ha of undulating to rolling rises and low hills of 5–14% slope. The *Royston* soils may be associated with *Durundur* and *Glenfern* soils. The soil profile has 0.2–0.3 m dark over grey sandy clay loam to clay loam, over grey light medium clay to medium heavy clay with common orange mottles. The surface runoff is moderately rapid and the soil is slow to moderately permeable. The soil is imperfectly to moderately well drained with surface pH of 5.5–7.0 and subsoil 5.5–6.3. The depth of soil is 0.6 to 1.0 m.

Scrubby (Sc). (Red Ferrosols; Red Dermosols). The *Scrubby* soils occur on undulating to rolling rises and low hills of 9–18% slope and occupy about 310 ha. They may be associated with *Durundur* and *Royston* soils. The soil profile has 0.15–0.3 m dark clay loam to sandy light clay surface over red or red-brown light clay to sandy light medium clay. The surface runoff is slow to moderately rapid and the soil is moderately permeable and moderately well drained. The soil reaction is acid with pH of 5.5 to 6.5 throughout the profile. The soil depth ranges from 0.9 to 1.6 m.

Winya (Wn). (Red Chromosols). The 150 ha of *Winya* soils occur on undulating to rolling rises and low hills of 10–25% slope. The soil profile has 0.25–0.35 m dark over brown sandy loam to fine sandy loam, over red-brown or brown medium clay with common yellow mottles. The surface runoff is moderately rapid and the soil is moderately permeable and moderately well drained. The surface soil pH is 6.0–6.3 and subsoil 6.0–7.0. The soils range from 1.1 to 1.4 m in depth.

Soils developed on intermediate and basic igneous rocks

D'Aguilar (Dg). (Leptic Rudosols). This is a very minor soil type and occurs only as an association with *Moore* soils on undulating rises of about 6% slope. The shallow soil profile has 0.25 m dark over grey clay loam with few rock fragments grading to bedrock. The surface runoff is moderately rapid and the soil is highly permeable and well drained. The shallow soil profile of less than 0.5 m has a pH of about 6.0.

Deer (Dr). (Brown Chromosols). This soil type which may be associated with *Jimna* soils occupies about 415 ha of the undulating to rolling rises of 4–15% slope. The soil profile has 0.2–0.3 m dark over grey light clay, over brown medium clay to medium heavy clay with few rock fragments. The surface runoff is slow and the soil is moderately permeable and moderately well drained. The surface soil pH is 6.0–7.0 and subsoil 5.5–7.5. The soil depth ranges from 0.4 to 1.5 m.

Dunwich (Dw). (Brown Chromosols). This soil type occurs on undulating to rolling rises of 4–16% slope and occupies about 230 ha of the area underlain by intermediate to basic igneous rocks. The soil profile has dark over grey clay loam, over brown medium clay. The surface runoff is slow to moderately rapid and the soil is moderately permeable and well drained. The surface soil pH is 5.7–7.7, subsoil 7.8–8.7 and 9.0–9.2 at depth. The *Dunwich* soils range from 0.6 to 1.6 m in depth.

Jimna (Jn). (Grey or Black Vertosols). This soil type occurs on about 210 ha of the undulating to rolling rises and low hills of 5–14% slope. It may be associated with *Durundur* soils. The soil profile has 0.1–0.3 m dark light clay to light medium clay over grey or dark medium clay. The surface runoff is slow and the soil is slow to moderately permeable and well drained. The surface soil pH is 6.5–7.5 and subsoil 6.5–8.5. The *Jimna* soils are more than 1.1 m deep.

Moore (Mo). (Brown Chromosols). This is a very minor soil type and occurs on the undulating rises of about 7% slope. The soil profile has 0.15–0.35 m dark over bleached clay loam, over yellow-brown medium clay with few rock fragments. The surface runoff is slow and the soil is moderately permeable and well drained. This comparatively shallow soil of about 0.5 m has pH of 7.3.

Paddy (Pd). (Brown Chromosols). The 120 ha of this soil type occurs on undulating and rolling rises of 6–11% slope. The soil profile has 0.1–0.2 m dark over bleached loam to clay loam surface, over yellow-brown medium clay to medium heavy clay with few rock fragments. The surface runoff is slow and the soil is moderately permeable and moderately well drained. The surface soil pH is 5.7 and subsoil 5.3–5.5. The *Paddy* soils have a moderate depth of 0.8 to 0.9 m.

Soils developed on metamorphic rocks

Bunya (Bu). (Red Chromosols; Red Kurosols). This is the only soil type found on the minor extent of metamorphic rocks in the area. It occurs on undulating to rolling rises of 5–18% slope and covers an area of about 130 ha. The soil profile has 0.1–0.35 m dark over bleached grey fine sandy clay loam, over red light medium clay to medium clay. The surface runoff is moderately rapid to rapid and the soil is moderately permeable and well drained. The surface soil pH is 6.0–7.0 and subsoil 4.5–6.0. The depth of soil ranges from 0.5 to 1.1 m.

Chemical properties

Due to funding and time constraints, soil samples have not been collected for analysis. However due to the proximity of this area to the Kenilworth–Conondale area (Loi *et al*., 1997), both with comparable geology, soils bearing similar names to the later area are expected to have similar chemical properties. A summary of the chemical properties of the sampled soils in the Kenilworth–Conondale area which occur in the study area is given below.

Surface fertility

Table 5 gives levels and ratings for major soil nutrients and trace elements in the surface of three soil types found in the Kenilworth–Conondale are which also occur in the study area. The *Basel* represents the uniform fine textured soils, and *Conondale*, the texture contrast soils on the level to gently undulating terraces. The *Scrubby* represents soils on the undulating or rolling rises. The data indicate that the major nutrients, especially phosphorus and potassium, are sufficient. The levels of trace elements in these soils are sufficient for plant growth. The generally high level of organic carbon (2.8–4.9%) and a favourable C:N ratio (10–14) all point to the good condition of the surface soils. Electrical conductivity and chloride are very low in all the soils sampled indicating the absence of soluble salts, which is desirable.

Soil profile chemical properties

Some chemical attributes of *Basel*, *Conondale,* and *Scrubby* soils are given in Table 6.

Exchangeable calcium is generally above 'sufficiency' level (>2.0 cmol(+)/kg) (Baker and Eldershaw, 1993) in all the soil profiles except the subsoil of *Scrubby*. However when it is expressed as a ratio of the CEC, calcium (<65% of CEC) is found to be deficient in all the soil profiles except the surface horizons. Magnesium and sodium, on the other hand, are well above the 'sufficiency' level to the extent that they are detrimental to crop growth. The comparatively high level of magnesium is a contributory factor to the relatively low calcium ratio. These soils would benefit from the addition of calcic fertilisers.

Table 5. Fertility and rating* of surface soils of the Kenilworth–Conondale area, north of Kilcoy–Woodford

Soil type	Bicarb. P (mg/kg)	Extrac. K (meq/ 100g)	DTPA-Extractable (mg/kg)			Org C %	Total N	C:N
			Manganese	Copper	Zinc			
Basel (site 753)	28 (M)	0.34(M)	38(M)	4.80(M)	1.2(M)	2.9(H)	0.30(H)	10
Conondale (site 759)	170(VH)	0.88(H)	15(M)	3.90(M)	5.4(H)	4.9(H)	0.46(H)	11
Scrubby (site 736)	35 (M)	0.98(H)	40(M)	0.98(M)	1.3(M)	2.8(H)	0.20(M)	14

* VH = Very high, H = High, M = Medium, L = Low and VL = Very low. General rating according to Bruce and Rayment (1982)

Exchangeable potassium is ‘sufficient’ (>0.2 cmol(+)/kg) in the surface horizon of these soils but is deficient in the subsoils. The presence of a large amount of magnesium would generally restrict the uptake of both calcium and potassium. The presence of high amounts of exchangeable magnesium and sodium, in the absence of equivalent high amounts of calcium, is detrimental to the physical properties of these soils.

The *Basel* and *Conondale* soils tend to be sodic in the subsoils with an exchangeable sodium percentage (ESP) of 8 to 14 percent. The subsoil below 0.8 m is sodic with an ESP of 8 to 12 percent. Where the ESP is high, the dispersion ratio is above 0.8 indicating the highly dispersive nature of these soils in the horizons with high ESP. This is exacerbated by the presence of high amount of magnesium and low Ca/Mg ratio with the exchange complex dominated by magnesium and sodium.

Table 6. pH, exchangeable cations, cation exchange capacity (CEC) and clay content of soils in the Kenilworth–Conondale area, north of Kilcoy–Woodford

Soil type and depth (m)	pH	Exchangeable cations (meq/100g)				Exch Ca:Mg	CEC (meq/ 100g)	ESP %	Clay %	CEC/ clay ratio
		Ca	Mg	Na	K					
Basel (site 753) (Mottled, Self-mulching, Grey Vertosol; non-gravelly, fine, medium fine, very deep)*										
0-0.1	6.4	4.1	9.1	0.92	0.43	0.5	32	3	33	1.0
0.2-0.3	7.5	7.5	19.0	2.40	0.21	0.4	31	8	56	0.6
0.5-0.6	8.4	6.4	20.0	4.30	0.09	0.3	30	14	52	0.6
0.8-0.9	8.4	7.7	26.0	4.50	0.13	0.3	39	12	ND	NA
1.1-1.2	8.7	5.9	22.0	3.30	0.10	0.3	28	12	42	0.7
Conondale (site 759) (Haplic, Eutrophic, Brown Chromosol; thick, non-gravelly, clay loamy, clayey, very deep)*										
0-0.1	6.1	6.8	4.2	0.19	0.60	1.6	27	1	28	1.0
0.2-0.3	6.3	6.5	6.4	0.40	0.21	1.0	24	2	37	0.6
0.5-0.6	7.6	10.0	13.0	1.30	0.10	0.8	27	5	47	0.6
0.8-0.9	8.1	11.0	15.0	2.10	0.10	0.7	26	8	40	0.7
1.1-1.2	8.5	8.4	12.0	2.30	0.10	0.7	20	12	36	0.6
Scrubby (site 736) (Haplic, Eutrophic, Red Ferrosol; medium, non-gravelly, clayey, clayey, moderate)*										
0-0.1	6.2	3.9	2.0	0.11	1.00	2.0	7	2	33	0.2
0.2-0.3	5.8	2.7	1.5	0.09	0.31	1.8	5	2	50	0.1
0.5-0.6	5.9	1.8	2.6	0.09	0.20	0.7	6	2	60	0.1
0.8-0.9	5.7	1.3	2.7	0.09	0.29	0.5	5	2	58	0.1
1.1-1.2	5.3	0.54	1.8	0.08	0.10	0.3	3	3	53	0.1

* Isbell, 1996

5. LAND EVALUATION

Land suitability for agriculture

A five-class land suitability classification, with suitability decreasing progressively from class 1 to class 5, was used in evaluating the lands of the Kilcoy–Woodford area. The land is assessed on the basis of a specified land use which allows optimum production with minimal degradation to the land resource in the long-term (Land Resource Branch Staff, 1990). The five classes of land suitability classification are briefly defined below:

Class 1	Suitable land with negligible limitations
Class 2	Suitable land with minor limitations
Class 3	Suitable land with moderate limitations
Class 4	Marginal land, presently unsuitable due to severe limitations
Class 5	Unsuitable land with extreme limitations that preclude its use

Lands of the Kilcoy–Woodford area were assessed for a selected range of climatically adapted crops. To determine the suitability of any parcel of land for a particular land use, it is necessary to consider the requirements for each land use. Soil and land attributes which cause less than optimum conditions for a particular land use are known as limitations. The main land use requirements and limitations for the selected crops are shown in Table 7.

The limitations of soil and land attributes of each mapping unit were matched with the requirements of each land use to depict, on the suitability map, the suitability of each mapping unit for a particular land use. The critical limits of soil and land attributes used to determine subclasses for each land use are generally based on Wilson (in press), Fisher and Baker (1990) and Capelin (1987).

In this study, lands on the terrace plains and adjoining low undulating rises of the Kilcoy–Woodford area were evaluated using the above procedure. The study area encompasses the lands with agricultural potential. The evaluation assesses the suitability of the lands for crops that are climatically suitable and also determines the agricultural land classes (DPI/DHLGP, 1993) which will impact on future land use and the protection of good quality agricultural land.

Limitations and land suitability assessment

Each unique map area (UMA) was assessed for its suitability for the climatically suitable crops: sorghum, maize, crucifers, potatoes, macadamia, citrus and rye grass. Suitability of each land use on each UMA is determined by the limitations (Table 7) in the subclass scale of 1 to 5. The limitations and critical limits used to determine their subclasses for each land use are detailed in Appendix 1.

The limitations and criteria in Appendix 1 were applied to each UMA in the land suitability assessment of the Kilcoy–Woodford area. The suitability of each UMA of the survey area for the range of crops considered is shown in Table 8. Areas of suitable land for the crops considered are shown in Table 9. A total of 33–37% of the area is suitable for sorghum, maize, crucifers and potatoes. Only 20% and 13% of the area is suitable for citrus and macadamia respectively. Rye grass, being less demanding, can be grown on 74% of the area. Land suitability maps for these crops are available on request to Department of Natural Resources. Table 8 should be consulted for the suitability of each UMA for the various crops considered.

Table 7. Land use requirements and limitations for crops considered in Kilcoy–Woodford area

Land use requirements	Limitations
Frost-free	frost (cf)
Adequate soil water supply	soil water availability (m)
Adequate soil aeration	wetness (w)
Adequate nutrient supply	nutrient deficiency (n)
Adequate soil depth for physical support	soil depth (d)
Minimum soil loss from erosion	water erosion (e)
Rock-free soil profile	rockiness (r)
Absence of damaging floods	flooding (f)
Land surface of acceptable slope for safe and efficient machinery use	slope (ts)

Severe limitations (subclasses 4 and 5) of each UMA for the crops considered in the area are shown in Appendices 2 and 3. UMAs not listed in these Appendices are considered suitable for the crops assessed. This list of severe limitations allows the land users to determine if any of the marginal mapping units (class 4) can be ameliorated and the estimated costs involved. Decisions may be affected by one or more of: introduction of any new technology, land pressure and price of commodity.

The suitability of the climatically adaptable crops in the Kilcoy–Woodford area listed in alphabetical order of the soil names is shown in Appendix 4.

In general, soils on the low terraces plains, *Basel, Bellbird, Cooeeimbardi, Conondale, Grigor and Harper,* are suitable for all the crops considered except tree crops. Because of impeded drainage, *Beausang, Cookes, Ottaba, Smokes, Spencer* and *Toogoolawah* soils are unsuitable for all crops except rye grass. The *Cressbrook* soils are unsuitable for most crops because of low moisture holding capacity and at some sites, stoniness.

Soils on undulating to rolling rises are not suitable for sorghum, maize, crucifers and potatoes mainly because of erosion hazard on the steep slope gradients. *Berrima, Bunya, Durundur, Deer, Glenfern, Kamerigo, Kenilworth, Kilcoy* and *Scrubby* soils are generally suitable for macadamia, citrus and rye grass. However, individual mapping units with excessive slope may render them unsuitable for these crops. *Boolumba, Jimna* and *Royston* soils generally occur on steep slopes and are unsuitable for all crops except rye grass.

Table 8. Suitability of UMAs for selected crops in the Kilcoy–Woodford area

UMA	Soils	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
1	Dd	4	4	4	4	3	3
2	Cn	3	3	3	5	4	3
3	Dd	5	5	5	4	4	4
4	Bd	3	2	2	5	5	2
5	Bd-Hp	3	3	3	5	5	3
6	Cr-Bd	4	3	4	5	5	3
7	Bd-Hp	3	2	3	5	5	2
8	Dd	5	5	5	4	4	4
9	Dd	5	5	5	3	3	3
10	Sk	4	4	4	5	5	3
11	Cr	4	3	4	4	3	3
12	Sc	5	5	5	4	4	4
13	Cr	4	3	4	5	4	3
14	Bd	3	2	2	5	5	2
15	Dd	5	5	5	3	3	3
16	Bd	3	3	2	5	5	3
17	Cb	3	3	3	5	5	3
18	Dd	5	5	5	3	3	3
19	Dd	5	5	5	5	5	5
20	Bd	3	3	3	5	5	2
21	Sk	4	4	4	5	5	3
22	Dd	5	5	5	3	3	3
23	Dd	5	5	5	5	5	5
24	Dd	4	4	4	4	3	3
25	Bd	3	2	2	5	5	2
26	Bd	3	3	3	4	4	2
27	Wn3-Dd	5	5	5	3	3	3
28	Bd	3	3	2	5	5	3
29	Hp	3	3	2	5	5	3
30	Dd	4	4	4	4	3	3
31	Dd	5	5	5	4	4	4
32	Dd2	5	5	5	5	5	5
33	Bd	4	4	4	4	3	3
34	Gf2	4	4	4	4	3	3
35	Bd	4	4	4	4	3	3
36	Dd	5	5	5	4	4	4
37	Bd-Bg3	4	4	4	5	5	2
38	Dd	5	5	5	3	3	3
39	Bd	3	3	3	4	4	2
40	Dd	4	4	4	4	3	3
41	Gf2-Dd2	5	5	5	5	5	5
42	DAM	0	0	0	0	0	0
43	Bd	3	3	3	5	5	2
44	Dd	4	4	4	4	3	3
45	Dd	5	5	5	4	4	4
46	Bd	3	3	3	5	5	2
47	Gr	3	3	3	4	4	2
48	Wn2	5	5	5	4	4	4
49	Hp	3	3	3	5	5	2
50	Bg	4	4	4	5	5	3
51	Cr	4	3	4	5	4	3
52	Gf2	5	5	5	3	3	3

Table 8. Cont…

UMA	Soils	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
160	Ka2	5	5	5	3	3	3
161	D AM	0	0	0	0	0	0
162	Bs-Cb	3	3	3	5	5	3
163	Ky2-Kl2	5	5	5	3	3	3
164	Ky3-Ka3	5	5	5	3	3	3
165	DAM	0	0	0	0	0	0
166	Bd-Sp	4	4	4	5	5	3
167	Ky3-Kl3	5	5	5	3	3	3
168	Ot	4	4	4	5	5	2
169	Bs-Bd	3	3	3	5	5	3
170	Gr	3	3	3	5	4	3
171	Ky3	4	4	4	4	3	2
172	Bg	4	4	4	5	5	3
173	Ky	4	4	4	2	2	2
174	Ky2-Kl2	5	5	5	4	4	4
175	Ky-Kl	5	5	5	3	3	3
176	Ky-Ka2	5	5	5	3	3	3
177	Ky-Kl	5	5	5	3	3	3
178	Bs-Bd	3	3	3	5	5	3
179	Ky	4	4	4	4	3	2
180	Gl	2	3	2	5	4	3
181	Bd	3	2	2	5	5	2
182	Bu	4	4	4	4	3	3
183	Bd	3	2	2	5	5	2
184	Ky2	5	5	5	5	5	5
185	Bs-Hp	3	3	3	5	5	3
186	Ky	4	4	4	4	3	2
187	Hp2-Sp	4	4	4	5	5	3
188	Bu3	5	5	5	4	4	4
189	Hp	3	3	2	5	5	3
190	Ky-Ka3	5	5	5	3	3	3
191	Sp	4	4	4	5	5	3
192	Hp	3	2	2	5	5	2
193	Gy	3	3	3	5	4	3
194	Sp	4	4	4	5	5	3
195	Sp	4	4	4	5	5	3
196	Ka3	4	4	4	4	3	3
197	Bs	3	3	3	5	5	3
198	Ky1	5	5	5	4	4	4
199	Hy2	3	3	3	4	4	2
200	Hy1	4	4	4	4	4	3
201	Nn	4	4	4	4	3	2
202	Bd	3	3	2	5	5	3
203	Ky	4	4	4	4	3	2
204	Hp	3	2	2	5	5	2
205	Bs-Bd	3	3	3	5	5	3
206	Ka3-Nn1	5	5	5	4	4	4
207	Sp	4	4	4	5	5	3
208	Kl1	5	5	5	4	4	3
209	DAM	0	0	0	0	0	0
210	Bs	3	3	3	5	5	3
211	Bd	3	2	2	5	5	2
212	Rt2	5	5	5	5	5	3

Table 8. Cont…

UMA	Soils	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
213	Cb	3	3	3	5	5	3
214	Bs-Cb	3	3	3	5	5	3
215	Dr1	4	4	4	4	4	3
216	Bs	3	3	3	5	5	3
217	Dr3	4	4	4	3	3	2
218	Dr2-Jn3	5	5	5	3	3	3
219	Bd	3	2	2	5	5	2
220	Ky-Kl	5	5	5	4	4	4
221	Bd	3	2	2	5	5	2
222	DDE	0	0	0	0	0	0
223	Dr	3	3	4	4	3	2
224	Dr3	5	5	5	3	3	3
225	Bs	3	3	3	5	5	3
226	Cn-Cb	3	3	3	5	5	3
227	Dr3-Dw2	5	5	5	5	5	5
228	Dw2	4	3	4	4	3	3
229	Bs	3	3	3	5	5	3
230	Dr2	5	5	5	4	4	4
231	Jn3	4	4	4	5	5	3
232	Hp-Bg	4	4	4	5	5	3
233	Dr	4	4	5	3	3	2
234	Dw2	5	5	5	5	5	5
235	Dw	4	4	5	4	3	3
236	Rt3	4	4	4	5	5	2
237	Dr2	5	5	5	3	3	3
238	Bs-Bd	3	3	3	5	5	3
239	Kl2	4	4	5	3	3	2
240	Bs-Hp	3	3	3	5	5	3
241	DAM	0	0	0	0	0	0
242	Ky-Kl	5	5	5	3	3	3
243	Bs-Sp	4	4	4	5	5	3
244	Bs	3	3	3	5	5	3
245	Pd3-Dw	5	5	5	4	4	4
246	Dw	4	4	5	4	3	3
247	Dw	5	5	5	5	5	5
248	Bs-Cn	3	3	3	4	4	3
249	Mo2-Dg1	4	4	4	4	4	3
250	Jn-Dr	4	4	4	5	5	3
251	Jn	4	4	4	5	5	3
252	Dr	3	3	4	4	3	2
253	Cn	3	3	3	5	4	3
254	Ot3	4	4	4	5	5	2
255	Kl-Hs	5	5	5	4	4	4
256	Dd3	5	5	5	4	4	4
257	Bs-Bd	3	3	3	5	5	3
258	Ky-Kl2	4	4	4	4	3	3
259	Bs	3	3	3	5	5	3
260	Kl2	4	3	4	4	3	2
261	Bs	3	3	3	5	5	3
262	Dd3	5	5	5	3	3	3
263	Hp	3	2	2	5	5	2
264	Bd3	4	3	2	5	5	3
265	Gf	4	4	4	4	3	3

Table 8. Cont…

UMA	Soils	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
266	Sc	4	5	5	4	4	2
267	Sc	5	5	5	3	3	3
268	Cn-Hp2	3	3	3	5	4	3
269	Dd	5	5	5	3	3	3
270	Dd	4	4	4	4	3	3
271	Dd-Sc	5	5	5	4	4	4
272	Dd3	5	5	5	4	4	4
273	Cn	3	3	3	4	4	3
274	Dd	4	4	4	4	3	3
275	Dd3	5	5	5	4	4	4
276	Hp-Cr	4	3	4	4	4	3
277	Dd3	5	5	5	3	3	3
278	Cr	4	3	4	5	4	3
279	Cr3	4	3	4	4	3	3
280	Cr-Hp	4	5	5	4	4	3
281	Dd	5	5	5	3	3	3
282	Dd2	5	5	5	5	5	5
283	Dd	4	4	4	4	3	3
284	Gy-Cn	4	4	4	5	5	3
285	Ek2-Gf2	4	4	5	5	5	3
286	Dd2	5	5	5	4	4	4
287	Dd2	5	5	5	3	3	3
288	Dd	4	4	4	4	3	3
289	Hy-Hy1	4	4	4	4	4	3
290	Gf2	4	4	4	4	3	3
291	Dd2	5	5	5	3	3	3
292	Bg3	4	4	4	5	5	3
293	Gf3	5	5	5	3	3	3
294	Ot-Bg	4	4	4	5	5	3
295	Sc	3	3	4	4	3	2
296	Hp-Bd	2	3	3	5	4	3
297	Ot	4	4	4	5	5	3
298	Cn2-Bg3	4	4	4	5	5	3
299	Gf-Rt2	5	5	5	5	5	4
300	Hy3	4	3	2	5	4	3
301	Bg	4	4	4	5	5	3
302	Bs	3	3	3	5	5	3
303	Bg	4	4	4	5	5	3
304	Cr1	4	4	4	4	4	3
305	Sk	4	4	4	5	5	3
306	Bg	4	4	4	5	5	3
307	Cr	4	3	4	5	4	3
308	Bg	4	4	4	5	5	3
309	Cr	4	3	4	5	4	3
310	Hy	3	3	2	5	4	3
311	Sc-Be	4	4	4	4	3	3
312	Co	4	4	4	5	5	2
313	Bs	3	3	3	5	5	3
314	Hy3	4	2	3	4	4	2
315	Co	4	4	4	5	5	2
316	Ky	4	4	4	4	3	2
317	Ky	5	5	5	3	3	3
318	Sc-Bo	4	4	4	4	3	2

Table 8. Cont…

UMA	Soils	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
319	Co	4	4	4	5	5	2
320	Bs	3	3	3	5	5	3
321	Kl3-Hs	4	4	4	4	3	3
322	DAM	0	0	0	0	0	0
323	Jl2-Hs2	4	4	5	5	5	2
324	Ky-Nn	5	5	5	4	4	4
325	Ky	4	4	4	4	3	2
326	Ky-Nn	5	5	5	4	4	4
327	Tw3	4	4	4	5	5	3
328	Ky-Nn	5	5	5	4	4	4
329	Ky	4	4	4	4	3	2
330	Tw3	4	4	4	5	5	2
331	Hy3	4	3	2	5	5	3
332	Rt2-Dd	4	4	4	5	5	3
333	Hy3	4	2	2	4	4	2
334	Ka2	5	5	5	3	3	3
335	Ka	4	4	4	4	3	3
336	Ka2-Ky	5	5	5	4	4	4
337	Bs-Bd	3	3	3	5	5	3
338	Gf	4	4	4	4	3	3
339	Bd-Cn	3	3	3	5	5	3
340	DAM	0	0	0	0	0	0
341	Hs-Jl1	5	5	5	5	5	3
342	DAM	0	0	0	0	0	0
343	Bs	3	3	3	5	5	3
344	Gf2	5	5	5	3	3	3
345	Cn	3	3	3	4	4	3
346	Gf2	4	4	4	4	3	3
347	Be3	5	5	5	3	3	3
348	DAM	0	0	0	0	0	0
349	Rt3	5	5	5	5	5	3
350	Gf2-Dd2	5	5	5	4	4	4
351	Ek2-Gf2	5	5	5	5	5	4
352	Gf2-Rt3	4	4	4	5	5	3
353	Cb	3	3	3	5	5	3
354	Dd2	5	5	5	3	3	3
355	Hp	3	3	2	5	5	3
356	Sk	4	4	4	5	5	3
357	Bg-Gy	4	4	4	5	5	3
358	DAM	0	0	0	0	0	0
359	Be	5	5	5	4	4	4
360	Dd2	5	5	5	4	4	4
361	Gf2	5	5	5	3	3	3
362	Cr	4	3	4	4	3	3
363	Sk	4	4	4	5	5	3
364	Gf	5	5	5	3	3	3
365	Ob	4	4	4	5	5	3
366	Gf2	5	5	5	3	3	3
367	Sk	4	4	4	5	5	3
368	Gf3-Dd2	5	5	5	3	3	3
369	Sk	4	4	4	5	5	3
370	Dd2-Gf3	5	5	5	4	4	4
371	Bs	3	3	3	5	5	3

Table 8. Cont…

UMA	Soils	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
372	DDE	0	0	0	0	0	0
373	Dd-Gf	5	5	5	3	3	3
374	PRISON	0	0	0	0	0	0
375	Pd3-Rt2	5	5	5	5	5	3
376	Gf2-Dd3	5	5	5	3	3	3
377	Cb-Sk	4	4	4	5	5	3
378	Bd-Cr	4	3	4	5	5	3
379	Gr	3	3	3	4	4	2
380	Dd	5	5	5	3	3	3
381	Bd	3	2	2	5	5	2
382	Bs-Bd	3	3	3	5	5	3
383	DAM	0	0	0	0	0	0
384	Dd2-Be2	5	5	5	4	4	4
385	Bd	3	2	2	5	5	2
386	Gy-Sp	4	4	4	5	5	3
387	Be2	4	4	4	4	3	3
388	Rt2	5	5	5	5	5	3
389	Jn2	4	4	5	5	5	3
390	Jn	4	4	4	5	5	3
391	Jn2	4	4	5	5	5	3
392	Jn	4	4	4	5	5	3
393	Tw	4	4	4	5	5	2
394	Bs	3	3	3	5	5	3
395	Rt3	4	4	4	5	5	2
396	Gf	4	4	4	5	5	3
397	SWAMP	0	0	0	0	0	0
398	Rt	4	4	4	5	5	2
399	Bs-Hp	3	3	3	5	5	3
400	Tw	4	4	4	5	5	2
401	Bo	4	4	4	4	3	2
402	Sc-Bo3	5	5	5	3	3	3
403	Tw	4	4	4	5	5	2
404	SWAMP	0	0	0	0	0	0
405	Dd2	4	4	4	4	3	3
406	Tw	4	4	4	5	5	2
407	Bs	3	3	3	5	5	3
408	Bo	5	5	5	3	3	3
409	Bo	4	4	4	4	3	2
410	Bs-Gr	3	3	3	5	5	3
411	DDE	0	0	0	0	0	0
412	Rt	4	4	4	5	5	2
413	Co3	4	4	4	5	5	3
414	Dr3	4	4	5	3	3	2
415	Dd2	5	5	5	3	3	3
416	Bd	3	2	2	5	5	2
417	Rt2	5	5	5	5	5	4
418	Bd	3	3	2	5	5	3
419	Hy-Cr	4	3	4	5	4	3
420	Sk1	4	4	4	5	5	3
421	Bo1	5	5	5	4	4	3
422	Dd3-Ek1	4	4	4	4	4	3
423	Cn-Sp	4	4	4	5	5	3
424	Dd	5	5	5	3	3	3

Table 8. Cont…

UMA	Soils	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
425	Bs-Cr	4	3	4	5	4	3
426	Sp	4	4	4	5	5	3
427	Cr	4	3	4	4	3	3
428	Dd2	5	5	5	5	5	5
429	Bd	3	2	2	5	5	2
430	Bd	3	2	2	5	5	2
431	Dd	4	4	4	4	3	3
432	DAM	0	0	0	0	0	0
433	Ky2-Ka2	5	5	5	5	5	5
434	Jl1-Ek2	5	5	5	5	5	5
435	DDE	0	0	0	0	0	0
436	DAM	0	0	0	0	0	0

Table 9. Areas suitable for sorghum, maize, crucifers, potatoes, macadamia, citrus and rye grass in the Kilcoy–Woodford area (ha)

Suitability	sorghum maize	crucifers	potatoes	macadamia	citrus	rye grass
2	117.3	947.1	1655.7	31.7	31.7	3069.3
3	6079.5	5968.9	4660.5	2365.8	3617.2	10 475.0
Total Suitable	**6196.8**	**6916.0**	**6316.2**	**2397.5**	**3648.9**	**13 814.3**
(% Total Area)	(33)	(37)	(34)	(13)	(19)	(74)
4	4981.2	4270.7	4599.6	5398.3	4764.7	3465.1
5	7528.5	7519.7	7790.6	10 910.7	10 292.9	1427.1

Agricultural land classes

Four classes of agricultural land have been defined for Queensland (DPI/DHLGP, 1993); for convenience these are reproduced here:

Class A	**Crop land -** Land suitable for current and potential crops with limitations to production which range from none to moderate levels.
Class B	**Limited crop land -** Land that is marginal for current and potential crops due to severe limitations; and suitable for pastures. Engineering and/or agronomic improvements may be required before the land is considered suitable for cropping.
Class C	**Pasture land -** Land suitable only for improved or native pastures due to limitations which preclude continuous cultivation for crop production; but some areas may tolerate a short period of ground disturbance for pasture establishment.
Class D	**Non-agricultural land -** Land not suitable for agricultural uses due to extreme limitations. This may be undisturbed land with significant habitat, conservation and/or catchment values or land that may be unsuitable because of very steep slopes, shallow soils, rock outcrop or poor drainage.

With reference to the *Planning Guidelines* (DPI/DHLGP, 1993) no class A land (**Crop land**) was found in the area. Class B land (**Limited crop land**) occupies the bulk of the area at about 8860 ha or 47%. Class C land (**Pasture land**) and class D (**Non agricultural land**) each occupy about 26% of the area. Agricultural land classes of the Kilcoy–Woodford area in the order of UMA number are shown in Table 10. This information is also depicted on the Agricultural Land Classes map at 1:50 000 which is included in this report

In assigning the agricultural land classes for each UMA all the crops considered in the previous section on land suitability assessment are considered. The main reason for having a large area of class B land is that soils on plains and terraces are unsuitable for the tree crops considered because of flooding hazard. If tree crops are not considered, most of the Class B land would be Class A.

The assessment and assignment of the agricultural land classes arrived at is from a medium intensity survey at the scale of 1:50 000 which is sufficient for planning purposes. In assessing individual applications for subdivision, a more detailed survey is usually necessary.

Table 10. Agricultural land classes of soils and UMA in the Kilcoy–Woodford area

UMA	Soils	Ag class
1	Dd	C
2	Cn	B
3	Dd	D
4	Bd	B
5	Bd-Hp	B
6	Cr-Bd	C
7	Bd-Hp	B
8	Dd	D
9	Dd	B
10	Sk	C
11	Cr	B
12	Sc	D
13	Cr	C
14	Bd	B
15	Dd	B
16	Bd	B
17	Cb	B
18	Dd	B
19	Dd	D
20	Bd	B
21	Sk	C
22	Dd	B
23	Dd	D
24	Dd	C
25	Bd	B
26	Bd	B
27	Wn3-Dd	B
28	Bd	B
29	Hp	B
30	Dd	C
31	Dd	D
32	Dd2	D
33	Bd	C
34	Gf2	C
35	Bd	C
36	Dd	D
37	Bd-Bg3	C
38	Dd	B
39	Bd	B
40	Dd	C
41	Gf2-Dd2	D
42	DAM	
43	Bd	B
44	Dd	C
45	Dd	D
46	Bd	B
47	Gr	B
48	Wn2	D
49	Hp	B
50	Bg	C
51	Cr	C
52	Gf2	B
53	Bg3	C
54	Wn	B
55	Hp	B
56	Cr	B
57	Bs-Bd	B
58	Dd-Gf	B
59	Dd2-Gf2	D
60	Hp	B
61	Dd	C
62	Dd-Gf	C
63	Dd-Gf	B
64	Dd-Gf	D
65	Dd-Gf	D
66	Bd	B
67	Dd-Gf	B
68	Bd	B
69	Bd	B
70	Bd	B
71	Bd	B
72	Dd	D
73	Sk-Bg3	C
74	Wn	D
75	Dd3	D
76	Cn	B
77	Bd-Bs	B
78	Dd	D
79	Gf	B
80	Hy-Cr	C
81	Hy	B
82	Ky	B
83	Rt3	C
84	Dd-Rt3	D
85	Rt-Gf	C
86	Bd	B
87	Bd	B
88	Bd	B
89	Ky	B
90	Kl	B
91	Bs	B
92	Kl	B
93	Kl2	B
94	Bs	B
95	Kl	B
96	Cn	B
97	Bd	B
98	Dd3	D
99	Gf3	C
100	Sk	C
101	Dd2	B
102	Gf3	B
103	Dd3	D
105	Bd	B
106	Dd	D
107	Bd	B
108	Rt-Gf	C
109	Rt-Gf	C
110	Rt3	C
111	Bd	B
112	Gf3-Dd3	D
113	Gf3	B
114	Dd	D
115	Dd	B
116	Bd	B
117	Dd	B
118	Dd	D
119	Bd	
120	Hp	B
121	Dd	D
122	Dd1	D
123	Bs	B
124	Rt	C
125	DAM	
126	Ky	B
127	Ky-Kl	D
128	Ky-Kl	C
129	Bd	B
130	DAM	
131	Rt-Sc	C
132	Ky-Kl	D
133	DAM	
134	Kl1	C
135	Bd	B
136	Ky-Kl	C
137	Bs-Cb	B
138	Cr-Ot	C
139	Ky-Kl	C
140	Ky-Kl	D
141	DAM	
142	DAM	
143	Ky-Kl3	D
144	Ky-Kl	B
145	Ky	C
146	Nn	C
147	Bs	B
148	Ky	B
149	Bg	C
150	Ky	C
151	Ky	C
152	Ky	B
153	Cn	B
154	Gr-Hp	B
155	Ka2	C
156	Ka2-Ky1	C
157	Bs	B
158	Bg	C
159	Ky1	C
160	Ka2	B
161	DAM	
162	Bs-Cb	B
163	Ky2-Kl2	B
164	Ky3-Ka3	B
165	DAM	
166	Bd-Sp	C
167	Ky3-Kl3	B
168	Ot	C
169	Bs-Bd	B
170	Gr	B
171	Ky3	C
172	Bg	C
173	Ky	B
174	Ky2-Kl2	D
175	Ky-Kl	B
176	Ky-Ka2	

Table 10. Cont…

UMA	Soils	Ag class
177	Ky-Kl	B
178	Bs-Bd	B
179	Ky	C
180	Gl	B
181	Bd	B
182	Bu	C
183	Bd	B
184	Ky2	D
185	Bs-Hp	B
186	Ky	C
187	Hp2-Sp	C
188	Bu3	D
189	Hp	B
190	Ky-Ka3	B
191	Sp	C
192	Hp	B
193	Gy	B
194	Sp	C
195	Sp	C
196	Ka3	C
197	Bs	B
198	Ky1	D
199	Hy2	B
200	Hy1	C
201	Nn	C
202	Bd	B
203	Ky	C
204	Hp	B
205	Bs-Bd	B
206	Ka3-Nn1	D
207	Sp	C
208	Kl1	C
209	DAM	
210	Bs	B
211	Bd	B
212	Rt2	C
213	Cb	B
214	Bs-Cb	B
215	Dr1	C
216	Bs	B
217	Dr3	B
218	Dr2-Jn3	B
219	Bd	B
220	Ky-Kl	D
221	Bd	B
222	DDE	
223	Dr	B
224	Dr3	B
225	Bs	B
226	Cn-Cb	B
227	Dr3-Dw2	D
228	Dw2	B
229	Bs	B
230	Dr2	D
231	Jn3	C
232	Hp-Bg	C
233	Dr	B
234	Dw2	D
235	Dw2	D
236	Rt3	C

UMA	Soils	Ag class
237	Dr2	B
238	Bs-Bd	B
239	Kl2	B
240	Bs-Hp	B
241	DAM	
242	Ky-Kl	B
243	Bs-Sp	C
244	Bs	B
245	Pd3-Dw	D
246	Dw	C
247	Dw	D
248	Bs-Cn	B
249	Mo2-Dg1	C
250	Jn-Dr	C
251	Jn	C
252	Dr	B
253	Cn	B
254	Ot3	C
255	Kl-Hs	D
256	Dd3	D
257	Bs-Bd	B
258	Ky-Kl2	C
259	Bs	B
260	Kl2	B
261	Bs	B
262	Dd3	B
263	Hp	B
264	Bd3	B
265	Gf	C
266	Sc	C
267	Sc	B
268	Cn-Hp2	B
269	Dd	B
270	Dd	C
271	Dd-Sc	D
272	Dd3	D
273	Cn	B
274	Dd	C
275	Dd3	D
276	Hp-Cr	C
277	Dd3	B
278	Cr	C
279	Cr3	B
280	Cr-Hp	C
281	Dd	B
282	Dd2	D
283	Dd	C
284	Gy-Cn	C
285	Ek2-Gf2	C
286	Dd2	D
287	Dd2	B
288	Dd	C
289	Hy-Hy1	C
290	Gf2	C
291	Dd2	C
292	Bg3	C
293	Gf3	B
294	Ot-Bg	C
295	Sc	B
296	Hp-Bd	B

UMA	Soils	Ag class
297	Ot	C
298	Cn2-Bg3	C
299	Gf-Rt2	D
300	Hy3	B
301	Bg	C
302	Bs	B
303	Bg	C
304	Cr1	C
305	Sk	C
306	Bg	C
307	Cr	C
308	Bg	C
309	Cr	C
310	Hy	B
311	Sc-Be	C
312	Co	C
313	Bs	B
314	Hy3	B
315	Co	C
316	Ky	C
317	Ky	B
318	Sc-Bo	C
319	Co	C
320	Bs	B
321	Kl3-Hs	C
322	DAM	
323	Jl2-Hs2	C
324	Ky-Nn	D
325	Ky	C
326	Ky-Nn	D
327	Tw3	C
328	Ky-Nn	D
329	Ky	C
330	Tw3	C
331	Hy3	B
332	Rt2-Dd	C
333	Hy3	B
334	Ka2	B
335	Ka	C
336	Ka2-Ky	D
337	Bs-Bd	B
338	Gf	C
339	Bd-Cn	B
340	DAM	
341	Hs-Jl1	C
342	DAM	
343	Bs	B
344	Gf2	B
345	Cn	B
346	Gf2	C
347	Be3	B
348	DAM	
349	Rt3	C
350	Gf2-Dd2	D
351	Ek2-Gf2	D
352	Gf2-Rt3	C
353	Cb	B
354	Dd2	B
355	Hp	B

Table 10. Cont…

UMA	Soils	Ag class
356	Sk	C
357	Bg-Gy	C
358	DAM	
359	Be	D
360	Dd2	D
361	Gf2	B
362	Cr	C
363	Sk	C
364	Gf	B
365	Ob	C
366	Gf2	B
367	Sk	C
368	Gf3-Dd2	B
369	Sk	C
370	Dd2-Gf3	D
371	Bs	B
372	DDE	
373	Dd-Gf	B
374	PRISON	
375	Pd3-Rt2	C
376	Gf2-Dd3	B
377	Cb-Sk	C
378	Bd-Cr	C
379	Gr	B
380	Dd	B
381	Bd	B
382	Bs-Bd	B
383	DAM	
384	Dd2-Be2	D
385	Bd	B
386	Gy-Sp	C
387	Be2	C
388	Rt2	C
389	Jn2	C
390	Jn	C
391	Jn2	C
392	Jn	C
393	Tw	C
394	Bs	B
395	Rt3	C
396	Gf	C
397	SWAMP	
398	Rt	C
399	Bs-Hp	B
400	Tw	C
401	Bo	C
402	Sc-Bo3	B
403	Tw	C
404	SWAMP	
405	Dd2	C
406	Tw	C
407	Bs	B
408	Bo	B
409	Bo	C
410	Bs-Gr	B
411	DDE	
412	Rt	C
413	Co3	C
414	Dr3	B
415	Dd2	B
416	Bd	B
417	Rt2	C
418	Bd	B
419	Hy-Cr	C
420	Sk1	C
421	Bo1	C
422	Dd3-Ek1	C
423	Cn-Sp	C
424	Dd	B
425	Bs-Cr	C
426	Sp	C
427	Cr	B
428	Dd2	D
429	Bd	B
430	Bd	B
431	Dd	C
432	DAM	
433	Ky2-Ka2	D
434	Jl1-Ek2	D
435	DDE	
436	DAM	

Assessment for on-site sewage effluent disposal

In unsewered communities, adequate treatment of household sewerage effluent is necessary to avoid eutrophication and the health risks associated with contamination of the water by bacteria, viruses and nutrients.

There are five main methods used for on-site treatment and disposal of wastewater (Eades, 1994). These methods include:

(i) septic tank with an absorption trench,
(ii) septic tank with an evapotranspiration field,
(iii) septic tank followed by aerobic sewerage treatment and surface irrigation with the product,
(iv) septic tank followed by sand filtration and surface irrigation, and
(v) composting toilet.

The first method is the most widely used and is therefore the main method evaluated in this report. Solids and liquids are separated within the tank so that the effluent discharged from the system will have a lower level of pollutants. The breakdown of organic matter in the system relies on the action of anaerobic bacteria. Sludge and solids remaining in the tank contain high concentrations of metals, nutrients (nitrate and phosphate), grease, bacteria and viruses. This material must be periodically pumped out and disposed off-site (Eades, 1994).

Australian Standards Association (1994) requires the land capability of a proposed site for a septic tank be properly investigated. Effective on-site treatment and disposal requires suitable soil and landform characteristics.

Factors affecting land suitability for effluent disposal
A number of site characteristics influence the suitability for effluent disposal. They are:-

(i) *soil* – permeability, texture, coherence, coarse fragments content and depth to impermeable layer,
(ii) *landform* – slope, rock outcrops,
(iii) *flood hazard* – dependent upon landform, position and observation of flood events,
(iv) *groundwater conditions* – depth to watertable, and
(v) *surface water conditions* – proximity to streams or water storages.

These factors have varying importance. Soil characteristics determine the absorption ability of a site and together with landform, determines the purification ability. Soil and landform characteristics also determine the ease of excavation for tank and drainage installation. Risk of water pollution is governed by all five characteristics with the soil being the most limiting. Soil characteristics determine what kind of treatment system can be used and what additional measures must be taken to avoid long-term pollution (Eades, 1994).

Suitability criteria
Table 12 lists suitability ratings used to assess the appropriateness of a septic tank and absorption trench for effluent disposal at a given site.

Table 11. Suitability rating for on-site effluent disposal

Attribute	Suitability rating		
	Good	Fair	Poor
Slope (%)	0-8	8-15	>15
Drainage	Well drained	Imperfectly drained	Poorly drained
Flooding	None	<1 in 100 years	>1 in 100 years
Depth to seasonal water table (cm)	>120	90-120	<90
Depth to impermeable layer (cm)	>150	100-150	<100
Gravel (%)	<20	20 - 40	>40
Stones (%)	<10	10 - 30	>30
Boulders (%)	<0.2	0.2-2	>2
Rock outcrop (%) (of soil surface)	<0.1	0.1-1	>1
Dispersible clays (%)	<10	10-16	>16
Shrink-swell potential (%)	<12	12-20	>20

(all waste septic tank absorption field for single family dwelling) (after Rowe *et al.*, 1981)

In addition to the criteria listed in Table 11, soil permeability must be within the acceptable range of 5 to 60 mm/day listed in Australian Standards Association (1994). Eades (1995) recommends a more conservative range of 5 to 30 mm/day if there is a potential for groundwater contamination.

Permeability was not measured in this study due to restraints in time and resources. Instead, approximate permeability was derived from texture classes using Table 12.

Table 12. Representative soil permeability for various soil textural classes

Textural classes	Typical permeability (mm/day)
Sand	600-6000 (1200)*
Sandy loam	300-1800 (600)*
Loam	200-300 (300)*
Clay Loam	60-360 (180)*
Silty Clay	7-120 (60)*
Clay	2.4-24 (12)*

(Hansen *et al.* 1979, as quoted in Australian Standards Association, 1994) *Representative values - AS1547 - 1994

Suitability of soils for sewage effluent disposal

The 1:50 000 scale of mapping is not adequate to assess the suitability of an individual site for sewage effluent disposal. Site-percolation tests and soil descriptions must be obtained at each proposed site in accordance with Australian Standards Association (1994). The mapping scale presented in this report does give some indication of the suitability of each UMA for on-site effluent disposal, for planning purposes.

Soils on alluvial plains and terraces
Soils on the low-lying plains and terraces, *Basel(Bs), Beausang(Bg), Bellbird(Bd), Conondale(Cn), Cooeeimbardi(Cb), Cookes(Co), Cressbrook(Cr), Grigor(Gr), Gunyah(Gy), Harper(Hp), Honey(Hy), Obi(Ob), Ottaba(Ot), Smokes(Sk), Spencer(Sp)* and *Toogoolawah(Tw)* are subject to a flood frequency of greater than one in 100 years. They are generally unsuitable for effluent disposal.

Soils on undulating to rolling rises
The suitability of soils on undulating to rolling rises for effluent disposal generally depends on the slope and soil depth. The main characteristics used to consider their suitability for effluent disposal are shown in Tables 11 and 12. Individual sites should be tested before a decision can be made on the suitability for effluent disposal.

Boolumba(Bo), Glenfern(Gf) Jimna(Jn) and *Scrubby(Sc)* soils are generally suitable for effluent disposal. *Boolumba* soils being heavy textured are expected to have a permeability of less than 5 mm/day and therefore unsuitable for effluent disposal. Soils tests should be conducted to find out the true permeability. *Royston(Rt)* soils are general suitable but some sites are unsuitable because of shallow soil depth. *Berrima(Be), Durundu(Dd)r, Deer(Dr), Dunwich(Dw)* and *Bunya(Bu)* soils are suitable for effluent disposal if the slope is less than 15% and soil depth more than 1.0 m. *Kamerigo(Ka), Kenilworth(Kl), Kilcoy(Ky)* and *Winya(Wn)* soils are generally unsuitable for effluent disposal because of shallow soil depth.

The use of septic tanks followed by aerobic sewage treatment and surface irrigation may be a more satisfactory means of disposal, provided that: sufficient irrigation area is available, aerobic sewage treatment plants are regularly serviced and that the slope is <10%.

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Appendix 1. Land suitability classification for selected crops

Land suitability classification for selected crops

This classification summarises land use limitations and describes the effects of each limitation on :

- plant growth, machinery use and land degradation
- how the soil and land attributes are assessed and
- how the limitation classes are determined

Climate – frosts (cf)

Effect
Frosts may suppress growth, reduce yield and kill plants.

Assessment
The incidence and severity of frosts are used to assess affected areas.

Limitation class determination
Crop tolerance and local experience of the incidence and severity of frosts.

Attribute level		Frost limitation classes for selected land uses				
		maize, sorghum	crucifers, rye grass	macadamia	citrus	potatoes
cf0	no frosts	1	1	1	1	1
cf1	light frosts	1	1	3	1	1
cf2	moderate frosts	1	2	4	3	2
cf3	severe frosts	1	3	5	4	2

Note : seasonal adaptation is not considered, for example, summer crops are not grown in winter. Although frosts seriously effect winter crops such as potatoes, planting can usually be timed so as to avoid the stages when plants are most susceptible to frosts.

Moisture availability (m)

Effect
Plant yield will be decreased by periods of water stress during critical crop growth periods. Availability of suitable irrigation water is critical for certain crops.

Assessment
Soil morphological properties together with measured PAWC have been used to assess the amount of water in a soil available to plants over the rooting depth.

PAWC is based on predicted values, modelling information, and actual measurements.

Limitation class determination
PAWC classes relate to the frequency of irrigation for irrigation only.

m1 … >125mm plant available water per metre
m2 …100-125mm plant available water per metre
m3 …75-100mm plant available water per metre
m4 …50-75mm plant available water per metre
m5 …<50mm plant available water per metre

Attribute level		Moisture limitation classes for selected land uses			
		macadamia, citrus, crucifers	maize, sorghum	potatoes	rye grass
m1	>125mm	1	1	1	1
m2	100-125mm	1	2	2	1
m3	75-100mm	1	3	2	2
m4	50-75mm	2	4	2	2
m5	<50mm	3	4	3	3

Nutrient deficiency – (n)

Effects
A shortage (deficiency) or oversupply (toxicity) of mineral nutrients.

Assessment
Based on the need for fertiliser treatment additional to standard application rates and practices. Assessment is determined by the pH of the upper part of the B horizon. pH values less than 5.5 and greater than 8.0 can cause deficiencies and toxicities of certain nutrients. For simplicity, other nutrient indicators such as total P, cation exchange capacity and organic carbon have not been included. This assessment assumes that most of these can be ameliorated.

Limitation class determinations
Documented data relating high and low pH to nutrient deficiencies and toxicity.

Attribute level		Nutrient deficiency limitation classes for selected land uses
		All crops
n1	pH <4.5	4
n2	pH 4 .5-5.5	3
n3	pH 5.6-6.5	2
n4	pH 6.6-7.5	1
n5	pH 7.6-8.0	2
n6	pH 8.1-8.5	3
n7	pH >8.5	4

Wetness (w)

Effect
Waterlogged soils reduce plant growth and delay effective machinery operations.

Assessment
Internal and external drainage are assessed. Indicator attributes of internal drainage and permeability include texture, structure, colour, mottles, segregations and impermeable layers. Drainage class and soil permeability (McDonald *et al.*, 1990) are assessed in relation to plant rooting depth. Slope and topographic position determine external drainage. Groundwater data for selected soils is also used. The diagnostic land attributes are: drainage class, permeability and plant rooting depth requirement.

Limitation class determination
Consultation and crop tolerance information relating growth suppression to economic yield. Severity of effect concerning delays in machinery operation.

Permeability class		Drainage class	
v	very slowly permeable (<5 mm/day)	1	very poorly drained
s	slowly permeable (5-50 mm/day)	2	poorly drained
m	moderately permeable (50-500 mm/day)	3	imperfectly drained
h	highly permeable (>500 mm/day)	4	moderately well drained
		5	well drained
		6	rapidly drained

Attribute level	Wetness limitation classes for selected land uses			
	maize, sorghum	macadamia, citrus	crucifers, potatoes	rye grass
w6h	1	1	1	1
w5h	1	1	1	1
w5m	1	2	1	1
w4h	1	2	1	1
w4m	2	3	2	1
w4s	3	3	3	2
w4v	3	4	3	2
w3h	2	3	2	1
w3m	3	4	3	2
w3s	4	5	4	2
w3v	4	5	4	3
w2h	5	5	5	3
w2m	5	5	5	3
w2s	5	5	5	3
w2v	5	5	5	3
w1h	5	5	5	4
w1m	5	5	5	4
w1s	5	5	5	4
w1v	5	5	5	4

Flooding (f)

Effect
Yield reduction or plant death caused by anaerobic conditions and/or high water levels and/or silt deposition during inundation, as well as physical removal or damage by flowing water. Flowing water can also cause erosion.

Assessment
The effect of flooding on individual UMAs is difficult to predict. Flooding frequency has been used to distinguish between suitable and unsuitable land in extreme frequency situations only for intolerant crops. The diagnostic land attributes are: flooding frequency and topographic position.

Limitation class determination
Consultation with landholders.
Department of Natural Resources streamflow records.

Attribute level		Flooding limitation classes for selected land uses			
		maize, sorghum	macadamia, citrus	potatoes, crucifers	rye grass
f0	No Flooding	1	1	1	1
f1	Flooding frequency less than 1 in 10 years	2	4	1	1
f2	Flooding frequency between 1 in 10 and 1 in 5 years	3	5	1	1
f3	Flooding frequency exceeds 1 in 5 years	4	5	2	2

Landscape complexity (x)

Effect
An area of suitable land may be too small to justify its use as a separate management unit for a particular land use. This occurs where there is considerable soil complexity and/or topographic dissection.

Assessment
Once limitation classes for each UMA are determined, UMAs with one or more of the following are assessed:

- Area of contiguous suitable soil less than minimum production area
- Complex topography/soil

When the area of contiguous suitable soil in a UMA is less than a minimum production area, the area of any contiguous suitable soil in adjacent UMA is also considered on the assessment.

Limitation class determination
The minimum production areas for each land use are determined by consultation.

Minimum production area: The minimum area of land which is practicable to utilise for a particular land use.

Attribute level and Production area (ha)	Landscape complexity limitation classes for selected land uses				
	maize, sorghum	macadamia, citrus	potatoes	crucifers	rye grass
x1 >10	1	1	1	1	1
x2 5 to 10	4	1	1	1	1
x3 2.5 to 5	5	1	2	1	1
x4 1.5 to 2.5	5	3	3	1	1
x5 <1.5	5	4	4	4	2

Soil physical condition (p)

Effect
Germination and seedling development problems associated with adverse conditions of the surface soil such as hard setting, coarse aggregates and clays with strong consistency.

Difficulties in achieving favourable tilth with machinery on soils with a narrow moisture range.

Harvesting difficulty and quality of subsurface harvest material affected by soil adhesiveness.

Assessment
Soils with indicative morphological properties are evaluated in the context of local experience or knowledge of plant characteristics; for example; seed size, tuberous roots.

Local experience indicates problems associated with certain soils; for example narrow moisture range for working.

Limitation class determination
Plant tolerance limits and requirements in relation to seed germination and harvesting are matched with soil properties and supported by local experience.

Local opinion of the severity of the problem of narrow moisture range.

	Attribute level	Physical condition limitation classes for selected land uses			
		maize sorghum crucifers	macadamia citrus	potatoes	rye grass
p0	No restriction	1	1	1	1
p1	Slightly adhesive (SCL-LC)	1	1	2	1
p2	Moderately adhesive (LC-LMC)	1	1	3	1
p3	Strongly adhesive (MC-HC)	1	1	4	1
p4	Narrow moisture range (Cracking HC)	3	1	3	1
p5	Hard setting massive soil (LS-SL surface)	3	1	3	3
p6	Hard setting soils with narrow moisture range and sodic soils	4	1	4	3

Rockiness (r)

Effect
Coarse (rock) fragments and rock[1] in the plough zone interfere with the efficient use of agricultural machinery. Rock in the plough zone also causes excess wear of tillage implements and reduces the plant available water content. Surface rock interferes with the harvesting of peanuts, soybean, potatoes, below-ground vegetables and navy beans.

Assessment
Based on the size, abundance and distribution of coarse fragments in the plough layer; and with machinery and farmer tolerance of increasing size and content of coarse fragments.

Limitation class determination
Consultation, particularly related to farmers' tolerance (the latter is implicitly related to profitability and technological capability).

Attribute level			Rockiness limitation classes for selected land uses				
	Amount %	Size	maize sorghum	macadamia citrus	crucifers	potatoes	rye grass
r0			1	1	1	1	1
r1p	<2%	6-20mm	1	1	1	2	1
r1g	‘	20-60mm	1	1	2	3	1
r1c	“	60-200mm	2	1	3	4	1
r1s	“	200 to 600mm	3	1	4	5	1
r1b	“	>600mm	4	2	5	5	2
r2p	2-10%	6-20mm	1	1	2	3	1
r2g	“	20-60mm	2	1	3	4	1
r2c	“	60-200mm	3	1	4	5	1
r2s	“	200 to 600mm	4	2	5	5	2
r2b	“	>600mm	5	3	5	5	3
r3p	10 to 20%	6-20mm	2	1	3	4	1
r3g	“	20-60mm	3	1	4	5	2
r3c	“	60-200mm	4	2	5	5	2
r3s	“	200 to 600mm	5	3	5	5	3
r3b	‘	>600mm	5	4	5	5	4
r4p	20 to 50%	6-20mm	3	1	4	5	2
r4g	“	20-60mm	4	2	5	5	3
r4c	“	60-200mm	5	3	5	5	3
r4s	“	200 to 600mm	5	4	5	5	4
r4b	“	>600mm	5	5	5	5	5
r5p	>50%	6-20mm	5	5	5	5	5
r5g	“	20-60mm	5	5	5	5	5
r5c	“	60-200mm	5	5	5	5	5
r5s	“	200 to 600mm	5	5	5	5	5
r5b	“	>600mm	5	5	5	5	5

[1] Coarse fragments are particles greater than 2 mm and not continuous with underlying bedrock. Rock is defined as being continuous with bedrock.

Water erosion (e)

Effect

Land degradation and long-term productivity decline will occur on unprotected arable land because of excessive soil erosion.

Assessment

Soil loss will depend on soil erodibility and land slope for a particular crop and surface management system. For each soil type there is a maximum slope above which soil loss cannot be reduced to acceptable levels by erosion control measures.

Limitation class determination

Slope limits are determined in consultation with soil conservation and research personnel, research and extension agronomists, farmers and the use of computer models. The implication of the limitation class for simple slopes[1] are:

- e1 Surveyed row direction only required
- e2 Conventional structures, surface management practices[2] and pastures phase
- e3 e2 measures with a predominance of pasture phase
- e4 Predominance of pasture phase with occasional cropping
- e5 Non-arable land

Attribute level	Slope %	Erosion limitation classes for selected land uses		
		maize, sorghum, crucifers	macadamia, citrus, rye grass	potatoes,
deep, well structured, uniform-textured clay soils				
e1a	0>2%	1	1	1
e2a	2>5%	2	1	3
e3a	5-8%	3	1	4
e4a	8>12%	4	2	4
e5a	12>15%	4	2	5
e6a	15>20%	5	3	5
e7a	20>30%	5	4	5
e8a	30>%	5	5	5
coarse-, medium-textured soils; gradational and non sodic texture contrast soils				
e1b	0>2%	2	1	2
e2b	2>5%	3	1	3
e3b	5>8%	4	2	4
e4b	8>12%	4	3	5
e5b	12>15%	5	3	5
e6b	15>20%	5	4	5
e7b	20>%	5	5	5
sodic texture contrast soils				
e1c	0>1%	1	1	2
e2c	1>3%	2	1	3
e3c	3>5%	3	2	4
e4c	5>8%	4	3	5
e5c	8>12%	5	4	5
e6c	12>%	5	5	5

[1] Simple slopes - slopes with a constant fall and direction. Complex slopes with variable fall and direction are not suitable for conventional erosion control structures - a topographic (T) limitation has been applied to land with complex slopes.

[2] Surface management practices. A range of options aimed at minimum soil disturbance combined with retention of harvest residue material as a surface cover.

Soil depth (d)

Effect
Shallow soils limit root proliferation and anchorage, and reduce moisture storage. Plants may be uprooted during strong winds.

Assessment
Effective soil depth: depth to weathered rock, pan or impermeable layer.

Limitation class determination
Consultation.

Attribute level		Soil depth limitation classes for selected land uses		
		macadamia, citrus	rye grass	other crops
d1	1>m	1	1	1
d2	0.6>1.0m	2	1	1
d3	0.4>0.6m	3	2	3
d4	0.3>0.4m	4	3	4
d5	<0.3m	5	4	5

Appendix 2. Main limitations of UMAs unsuitable for sorghum, maize, crucifers and potatoes

Appendix 2. Main limitations of UMAs unsuitable for sorghum, maize, crucifers and potatoes

UMA	Soils	m	w	d	r	e	x	SG MZ	w	d	r	e	CS	w	d	f	r	e	PT
1	Dd					4		**4**				4	**4**				4	4	**4**
3	Dd					5		**5**				5	**5**				4	5	**5**
6	Cr-Bd	4						**4**									4		**4**
8	Dd					5		**5**				5	**5**				4	5	**5**
9	Dd					5		**5**				5	**5**				4	5	**5**
10	Sk		4					**4**	4				**4**	4					**4**
11	Cr	4						**4**									4		**4**
12	Sc					5		**5**				5	**5**				4	5	**5**
13	Cr	4					5	**5**									4		**4**
15	Dd					5		**5**				5	**5**				4	5	**5**
18	Dd					5		**5**				5	**5**				4	5	**5**
19	Dd					5		**5**				5	**5**				4	5	**5**
21	Sk		4					**4**	4				**4**	4					**4**
22	Dd					5		**5**				5	**5**				4	5	**5**
23	Dd					5		**5**				5	**5**				4	5	**5**
24	Dd					4	5	**5**				4	**4**				4	4	**4**
27	Wn3-Dd	4				5		**5**				5	**5**					5	**5**
30	Dd					4		**4**				4	**4**				4	4	**4**
31	Dd					5		**5**				5	**5**				4	5	**5**
32	Dd2	4				5		**5**				5	**5**				4	5	**5**
33	Bd					4		**4**				4	**4**				4	4	**4**
34	Gf2	4				4		**4**				4	**4**					4	**4**
35	Bd					4		**4**				4	**4**				4	4	**4**
36	Dd					5		**5**				5	**5**				4	5	**5**
37	Bd-Bg3							**4**	4				**4**	4					**4**
38	Dd					5		**5**				5	**5**				4	5	**5**
40	Dd					4	5	**5**				4	**4**				4	4	**4**
41	Gf2-Dd2	4				5		**5**				5	**5**				4	5	**5**
44	Dd					4		**4**				4	**4**				4	4	**4**
45	Dd					5		**5**				5	**5**				4	5	**5**
48	Wn2	4				5		**5**				5	**5**					5	**5**
50	Bg		4					**4**	4				**4**	4					**4**
51	Cr	4						**4**									4		**4**
52	Gf2	4				5		**5**				5	**5**					5	**5**
53	Bg3	4	4					**4**	4				**4**	4					**4**
54	Wn	4				5		**5**				5	**5**					5	**5**
56	Cr	4						**4**									4		**4**
58	Dd-Gf					5		**5**				5	**5**				4	5	**5**
59	Dd2-Gf2	4				5		**5**				5	**5**				4	5	**5**
61	Dd					4	4	**4**				4	**4**				4	4	**4**
62	Dd-Gf					4		**4**				4	**4**				4	4	**4**
63	Dd-Gf					5		**5**				5	**5**				4	5	**5**

SG=sorghum, MZ=maize, CS=crucifers, PT=potatoes

Appendix 2. Cont…

UMA	Soils	m	w	d	r	e	x	SG MZ	w	d	r	e	CS	w	d	f	r	e	PT
64	Dd-Gf					5		**5**				5	**5**				4	5	**5**
65	Dd-Gf					5		**5**				5	**5**				4	5	**5**
67	Dd-Gf					5		**5**				5	**5**				4	5	**5**
72	Dd					5		**5**				5	**5**				4	5	**5**
73	Sk-Bg3		4					**4**	4				**4**	4					**4**
74	Wn	4				5		**5**				5	**5**					5	**5**
75	Dd3			4		5		**5**		4		5	**5**		4		4	5	**5**
78	Dd					5		**5**				5	**5**				4	5	**5**
79	Gf	4				5		**5**				5	**5**					5	**5**
80	Hy-Cr	4						**4**									4		**4**
82	Ky					5		**5**				5	**5**					5	**5**
83	Rt3		4			4		**4**	4			4	**4**	4			4	4	**4**
84	Dd-Rt3		4			5		**5**	4			5	**5**	4				5	**5**
85	Rt-Gf		4			4		**4**	4			4	**4**	4				4	**4**
89	Ky					5		**5**				5	**5**					5	**5**
90	Kl						5	**5**										4	**4**
92	Kl																	4	**4**
93	Kl2					4		**4**				4	**4**					5	**5**
95	Kl																	4	**4**
97	Bd						4	**4**											
98	Dd3					5		**5**				5	**5**				4	5	**5**
99	Gf3	4				4		**4**				4	**4**					4	**4**
100	Sk		4					**4**	4				**4**	4					**4**
101	Dd2	4				5		**5**				5	**5**				4	5	**5**
102	Gf3	4				5		**5**				5	**5**					5	**5**
103	Dd3					5		**5**				5	**5**				4	5	**5**
106	Dd					5		**5**				5	**5**				4	5	**5**
108	Rt-Gf		4			4		**4**	4			4	**4**	4				4	**4**
109	Rt-Gf		4			5		**5**	4			5	**5**	4				5	**5**
110	Rt3		4			4		**4**	4			4	**4**	4			4	4	**4**
112	Gf3-Dd3					5		**5**				5	**5**				4	5	**5**
113	Gf3	4				5		**5**				5	**5**					5	**5**
114	Dd					5		**5**				5	**5**				4	5	**5**
115	Dd					5		**5**				5	**5**				4	5	**5**
117	Dd					5		**5**				5	**5**				4	5	**5**
118	Dd					5		**5**				5	**5**				4	5	**5**
121	Dd					5		**5**				5	**5**				4	5	**5**
122	Dd1	4	4	4		5		**5**	4	4		5	**5**	4	4		4	5	**5**
124	Rt		4			4		**4**	4			4	**4**	4				4	**4**
126	Ky					5		**5**				5	**5**					5	**5**
127	Ky-Kl					5		**5**				5	**5**					5	**5**
128	Ky-Kl					4	4	**4**				4	**4**					4	**4**

SG=sorghum, MZ=maize, CS=crucifers, PT=potatoes

Appendix 2. Cont…

UMA	Soils	m	w	d	r	e	x	SG MZ	w	d	r	e	CS	w	d	f	r	e	PT
131	Rt-Sc		4			4		**4**	4			4	**4**	4				4	**4**
132	Ky-Kl					5		**5**				5	**5**					5	**5**
134	Kl1	4		4			5	**5**		4			**4**					4	**4**
136	Ky-Kl					4		**4**				4	**4**					4	**4**
138	Cr-Ot	4	4					**4**	4				**4**	4			4		**4**
139	Ky-Kl					4		**4**				4	**4**					4	**4**
140	Ky-Kl					5		**5**				5	**5**					5	**5**
143	Ky-Kl3					5		**5**				5	**5**					5	**5**
144	Ky-Kl					5		**5**				5	**5**					5	**5**
145	Ky					4		**4**				4	**4**					4	**4**
146	Nn					4		**4**				4	**4**				4	4	**4**
148	Ky					5		**5**				5	**5**					5	**5**
149	Bg		4			4		**4**	4			4	**4**	4				4	**4**
150	Ky					4		**4**				4	**4**					4	**4**
151	Ky					4	4	**4**				4	**4**					4	**4**
152	Ky					5		**5**				5	**5**					5	**5**
155	Ka2	4				4		**4**				4	**4**					4	**4**
156	Ka2-Ky1				4	5		**5**				5	**5**		4			5	**5**
158	Bg		4					**4**	4				**4**	4					**4**
159	Ky1	4		4		4		**4**		4		4	**4**		4			4	**4**
160	Ka2	4				5		**5**				5	**5**					5	**5**
163	Ky2-Kl2	4				5		**5**				5	**5**					5	**5**
164	Ky3-Ka3					5		**5**				5	**5**					5	**5**
166	Bd-Sp		4					**4**	4				**4**	4					**4**
167	Ky3-Kl3					5		**5**				5	**5**					5	**5**
168	Ot		4					**4**	4				**4**	4					**4**
171	Ky3					4		**4**				4	**4**					4	**4**
172	Bg		4					**4**	4				**4**	4					**4**
173	Ky					4		**4**				4	**4**					4	**4**
174	Ky2-Kl2	4		4		5		**5**		4		5	**5**		4			5	**5**
175	Ky-Kl					5		**5**				5	**5**					5	**5**
176	Ky-Ka2					5		**5**				5	**5**					5	**5**
177	Ky-Kl					5		**5**				5	**5**					5	**5**
179	Ky					4		**4**				4	**4**					4	**4**
182	Bu					4		**4**				4	**4**					4	**4**
184	Ky2	4				5		**5**				5	**5**					5	**5**
186	Ky					4	4	**4**				4	**4**					4	**4**
187	Hp2-Sp		4					**4**	4				**4**	4					**4**
188	Bu3	4				5		**5**				5	**5**					5	**5**
190	Ky-Ka3					5		**5**				5	**5**					5	**5**
191	Sp		4					**4**	4				**4**	4					**4**
194	Sp		4					**4**	4				**4**	4					**4**

SG=sorghum, MZ=maize, CS=crucifers, PT=potatoes

Appendix 2. Cont…

UMA	Soils	m	w	d	r	e	x	SG MZ	w	d	r	e	CS	w	d	f	r	e	PT
195	Sp		4					**4**	4				**4**	4					**4**
196	Ka3	4				4		**4**				4	**4**					4	**4**
198	Ky1	4		4		5		**5**		4		5	**5**		4			5	**5**
200	Hy1	4		4			4	**4**		4			**4**		4				**4**
201	Nn					4	4	**4**				4	**4**				4	4	**4**
203	Ky					4		**4**				4	**4**					4	**4**
206	Ka3-Nn1	4		4		5		**5**		4		5	**5**		4			5	**5**
207	Sp		4					**4**	4				**4**	4					**4**
208	Kl1	4		4		5		**5**		4		5	**5**		4			5	**5**
212	Rt2	4	4			5		**5**	4			5	**5**	4			4	5	**5**
215	Dr1	4		4				**4**		4			**4**		4			4	**4**
217	Dr3					4		**4**				4	**4**					4	**4**
218	Dr2-Jn3					5		**5**				5	**5**					5	**5**
220	Ky-Kl					5		**5**				5	**5**						**5**
223	Dr																	4	**4**
224	Dr3					5		**5**				5	**5**					5	**5**
227	Dr3-Dw2	4				5		**5**				5	**5**					5	**5**
228	Dw2	4						**4**										4	**4**
230	Dr2	4				5		**5**				5	**5**					5	**5**
231	Jn3	4	4			4		**4**	4			4	**4**	4				4	**4**
232	Hp-Bg		4					**4**	4				**4**	4					**4**
233	Dr					4		**4**				4	**4**					5	**5**
234	Dw2	4				5		**5**				5	**5**					5	**5**
235	Dw					4		**4**				4	**4**					5	**5**
236	Rt3		4			4		**4**	4			4	**4**	4			4	4	**4**
237	Dr2	4				5		**5**				5	**5**					5	**5**
239	Kl2	4				4	5	**5**				4	**4**					5	**5**
242	Ky-Kl					5		**5**				5	**5**					5	**5**
243	Bs-Sp		4					**4**	4				**4**	4					**4**
245	Pd3-Dw					5		**5**				5	**5**				4	5	**5**
246	Dw					4	4	**4**				4	**4**					5	**5**
247	Dw					5		**5**				5	**5**					5	**5**
249	Mo2-Dg1	4		4		4		**4**		4		4	**4**		4			4	**4**
250	Jn-Dr	4	4			4		**4**	4			4	**4**	4				4	**4**
251	Jn		4					**4**	4				**4**	4				4	**4**
252	Dr																	4	**4**
254	Ot3		4					**4**	4				**4**	4					**4**
255	Kl-Hs					5		**5**				5	**5**					5	**5**
256	Dd3					5		**5**				5	**5**				4	5	**5**
258	Ky-Kl2	4				4		**4**				4	**4**					4	**4**
260	Kl2	4					4	**4**										4	**4**
262	Dd3					5		**5**				5	**5**				4	5	**5**

SG=sorghum, MZ=maize, CS=crucifers, PT=potatoes

Appendix 2. Cont…

UMA	Soils	m	w	d	r	e	x	SG MZ	w	d	r	e	CS	w	d	f	r	e	PT
264	Bd3	4						**4**											
265	Gf					4		**4**				4	**4**					4	**4**
266	Sc				4	4		**4**			5	4	**5**				5	4	**5**
267	Sc					5		**5**				5	**5**				4	5	**5**
269	Dd					5		**5**				5	**5**				4	5	**5**
270	Dd					4		**4**				4	**4**				4	4	**4**
271	Dd-Sc					5		**5**				5	**5**				4	5	**5**
272	Dd3					5		**5**				5	**5**				4	5	**5**
274	Dd					4		**4**				4	**4**				4	4	**4**
275	Dd3					5		**5**				5	**5**				4	5	**5**
276	Hp-Cr	4						**4**									4		**4**
277	Dd3					5	4	**5**				5	**5**				4	5	**5**
278	Cr	4						**4**									4		**4**
279	Cr3	4						**4**									4		**4**
280	Cr-Hp	4			4			**4**			5		**5**				5		**5**
281	Dd					5		**5**				5	**5**				4	5	**5**
282	Dd2	4				5	4	**5**				5	**5**				4	5	**5**
283	Dd					4		**4**				4	**4**				4	4	**4**
284	Gy-Cn		4					**4**	4				**4**	4					**4**
285	Ek2-Gf2	4	4			4		**4**	4			4	**4**	4				5	**5**
286	Dd2	4				5		**5**				5	**5**				4	5	**5**
287	Dd2	4				5	4	**5**				5	**5**				4	5	**5**
288	Dd					4		**4**				4	**4**				4	4	**4**
289	Hy-Hy1	4						**4**		4			**4**		4				**4**
290	Gf2	4				4		**4**				4	**4**					4	**4**
291	Dd2	4				5		**5**				5	**5**				4	5	**5**
292	Bg3		4					**4**	4				**4**	4					**4**
293	Gf3	4				5		**5**				5	**5**					5	**5**
294	Ot-Bg		4					**4**	4				**4**	4					**4**
295	Sc						4	**4**									4		**4**
297	Ot		4					**4**	4				**4**	4					**4**
298	Cn2-Bg3	4	4					**4**	4				**4**	4					**4**
299	Gf-Rt2		4			5		**5**	4			5	**5**	4				5	**5**
300	Hy3	4						**4**											
301	Bg		4					**4**	4				**4**	4					**4**
303	Bg		4					**4**	4				**4**	4					**4**
304	Cr1	4		4				**4**		4			**4**		4		4		**4**
305	Sk		4					**4**	4				**4**	4					**4**
306	Bg		4					**4**	4				**4**	4					**4**
307	Cr	4						**4**									4		**4**
308	Bg		4					**4**	4				**4**	4					**4**
309	Cr	4						**4**									4		**4**

SG=sorghum, MZ=maize, CS=crucifers, PT=potatoes

Appendix 2. Cont…

UMA	Soils	m	w	d	r	e	x	SG MZ	w	d	r	e	CS	w	d	f	r	e	PT
311	Sc-Be					4		**4**					**4**				4	4	**4**
312	Co		4					**4**	4				**4**	4					**4**
314	Hy3	4						**4**											
315	Co		4					**4**	4				**4**	4					**4**
316	Ky					4		**4**				4	**4**					4	**4**
317	Ky					5		**5**				5	**5**					5	**5**
318	Sc-Bo					4		**4**				4	**4**					4	**4**
319	Co		4					**4**	4				**4**	4					**4**
321	Kl3-Hs					4		**4**				4	**4**					4	**4**
323	Jl2-Hs2	4	4			4		**4**	4		4	4	**4**	4			5	4	**5**
324	Ky-Nn					5		**5**				5	**5**				4	5	**5**
325	Ky					4	4	**4**				4	**4**					4	**4**
326	Ky-Nn					5		**5**				5	**5**				4	5	**5**
327	Tw3		4					**4**	4				**4**	4					**4**
328	Ky-Nn					5		**5**				5	**5**				4	5	**5**
329	Ky					4		**4**				4	**4**					4	**4**
330	Tw3		4					**4**	4				**4**	4					**4**
331	Hy3	4						**4**											
332	Rt2-Dd		4			4		**4**	4			4	**4**	4				4	**4**
333	Hy3	4						**4**											
334	Ka2	4				5		**5**				5	**5**					5	**5**
335	Ka	4				4		**4**				4	**4**					4	**4**
336	Ka2-Ky	4				5		**5**				5	**5**					5	**5**
338	Gf	4				4		**4**				4	**4**					4	**4**
341	Hs-Jl1	4	4	4		5		**5**	4	4	4	5	**5**	4	4		5	5	**5**
344	Gf2	4				5		**5**				5	**5**					5	**5**
346	Gf2	4				4		**4**				4	**4**					4	**4**
347	Be3	4				5		**5**				5	**5**					5	**5**
349	Rt3		4			5		**5**	4			5	**5**	4			4	5	**5**
350	Gf2-Dd2	4				5		**5**				5	**5**				4	5	**5**
351	Ek2-Gf2	4	4			5		**5**	4			5	**5**	4				5	**5**
352	Gf2-Rt3	4	4			4		**4**	4			4	**4**	4				4	**4**
354	Dd2	4				5		**5**				5	**5**				4	5	**5**
356	Sk		4					**4**	4				**4**	4					**4**
357	Bg-Gy		4					**4**	4				**4**	4					**4**
359	Be					5		**5**				5	**5**					5	**5**
360	Dd2	4				5		**5**				5	**5**				4	5	**5**
361	Gf2	4				5		**5**				5	**5**					5	**5**
362	Cr	4						**4**									4		**4**
363	Sk		4					**4**	4				**4**	4					**4**
364	Gf					5		**5**				5	**5**					5	**5**
365	Ob		4					**4**	4				**4**	4				4	**4**

SG=sorghum, MZ=maize, CS=crucifers, PT=potatoes

Appendix 2. Cont…

UMA	Soils	m	w	d	r	e	x	SG MZ	w	d	r	e	CS	w	d	f	r	e	PT
366	Gf2	4				5		**5**				5	**5**					5	**5**
367	Sk		4				4	**4**	4				**4**	4					**4**
368	Gf3-Dd2	4				5		**5**				5	**5**				4	5	**5**
369	Sk		4					**4**	4				**4**	4					**4**
370	Dd2-Gf3	4				5		**5**				5	**5**				4	5	**5**
373	Dd-Gf					5		**5**				5	**5**				4	5	**5**
375	Pd3-Rt2		4			5		**5**	4			5	**5**	4			4	5	**5**
376	Gf2-Dd3	4				5		**5**				5	**5**				4	5	**5**
377	Cb-Sk		4					**4**	4				**4**	4					**4**
378	Bd-Cr	4						**4**									4		**4**
380	Dd					5		**5**				5	**5**				4	5	**5**
381	Bd						5	**5**											
384	Dd2-Be2	4				5		**5**				5	**5**					5	**5**
386	Gy-Sp		4					**4**	4				**4**	4					**4**
387	Be2	4				4		**4**				4	**4**					4	**4**
388	Rt2	4	4			5		**5**	4			5	**5**	4			4	5	**5**
389	Jn2		4			4		**4**	4			4	**4**	4				5	**5**
390	Jn		4					**4**	4				**4**	4				4	**4**
391	Jn2		4			4		**4**	4			4	**4**	4				5	**5**
392	Jn		4					**4**	4				**4**	4				4	**4**
393	Tw		4					**4**	4				**4**	4					**4**
395	Rt3		4			4		**4**	4			4	**4**	4			4	4	**4**
396	Gf		4					**4**	4				**4**	4					**4**
398	Rt		4			4	4	**4**	4			4	**4**	4				4	**4**
400	Tw		4					**4**	4				**4**	4					**4**
401	Bo					4		**4**				4	**4**					4	**4**
402	Sc-Bo3					5		**5**				5	**5**				4	5	**5**
403	Tw		4					**4**	4				**4**	4					**4**
405	Dd2	4				4	5	**5**				4	**4**				4	4	**4**
406	Tw		4					**4**	4				**4**	4					**4**
408	Bo					5		**5**				5	**5**					5	**5**
409	Bo					4		**4**				4	**4**					4	**4**
412	Rt		4			4		**4**	4			4	**4**	4			4	4	**4**
413	Co3		4					**4**	4				**4**	4					**4**
414	Dr3					4		**4**				4	**4**					5	**5**
415	Dd2	4				5		**5**				5	**5**				4	5	**5**
416	Bd						5	**5**											
417	Rt2	4	4			5		**5**	4			5	**5**	4			4	5	**5**
419	Hy-Cr	4						**4**									4		**4**
420	Sk1	4	4	4				**4**	4				**4**	4	4				**4**
421	Bo1	4		4		5		**5**				5	**5**		4			5	**5**
422	Dd3-Ek1	4		4		4		**4**				4	**4**		4		4	4	**4**

SG=sorghum, MZ=maize, CS=crucifers, PT=potatoes

Appendix 2. Cont…

UMA	**Soils**	**m**	**w**	**d**	**r**	**e**	**x**	**SG MZ**	**w**	**d**	**r**	**e**	**CS**	**w**	**d**	**f**	**r**	**e**	**PT**
423	Cn-Sp		4					**4**	4				**4**	4					**4**
424	Dd					5		**5**				5	**5**				4	5	**5**
425	Bs-Cr	4						**4**									4		**4**
426	Sp		4					**4**	4				**4**	4					**4**
427	Cr	4						**4**									4		**4**
428	Dd2	4	4		4	5		**5**	4		5	5	**5**	4			5	5	**5**
431	Dd					4	5	**5**				4	**4**				4	4	**4**
433	Ky2-Ka2	4				5		**5**				5	**5**					5	**5**
434	Jl1-Ek2	4	4	4		5		**5**	4	4	4	5	**5**	4	4		5	5	**5**

SG=sorghum, MZ=maize, CS=crucifers, PT=potatoes

Appendix 3. Main limitations of UMAs unsuitable for macadamia, citrus and rye grass

Appendix 3. Main limitations of UMAs unsuitable for macadamia, citrus and rye grass

UMA	**Soils**	**c**	**w**	**d**	**f**	**e**	**Macadamia**	**c**	**w**	**d**	**f**	**e**	**Citrus**	**e**	**Rye grass**
1	Dd	4					**4**								
2	Cn	5			4		**5**				4		**4**		
3	Dd					4	**4**					4	**4**	4	**4**
4	Bd	4			5		**5**				5		**5**		
5	Bd-Hp	5			5		**5**	4			5		**5**		
6	Cr-Bd	4			5		**5**				5		**5**		
7	Bd-Hp	4			5		**5**				5		**5**		
8	Dd					4	**4**					4	**4**	4	**4**
10	Sk	4	5		4		**5**		5		4		**5**		
11	Cr	4					**4**								
12	Sc					4	**4**					4	**4**	4	**4**
13	Cr	5					**5**	4					**4**		
14	Bd	4			5		**5**				5		**5**		
16	Bd	5			5		**5**	4			5		**5**		
17	Cb	4	4		5		**5**		4		5		**5**		
19	Dd					5	**5**		4		5		**5**		
20	Bd	4			5		**5**				5		**5**		
21	Sk	4	5		4		**5**		5		4		**5**		
23	Dd					5	**5**					5	**5**	5	**5**
24	Dd	4					**4**								
25	Bd	4			5		**5**				5		**5**		
26	Bd	4			4		**4**				4		**4**		
28	Bd	5			5		**5**	4			5		**5**		
29	Hp	5			5		**5**	4			5		**5**		
30	Dd	4					**4**								
31	Dd					4	**4**					4	**4**	4	**4**
32	Dd2					5	**5**					5	**5**	5	**5**
33	Bd	4					**4**								
34	Gf2	4					**4**								
35	Bd	4					**4**								
36	Dd					4	**4**					4	**4**	4	**4**
37	Bd-Bg3	4	5		4		**5**		5		4		**5**		
39	Bd	4			4		**4**				4		**4**		
40	Dd	4					**4**								
41	Gf2-Dd2					5	**5**					5	**5**	5	**5**
43	Bd	4			5		**5**				5		**5**		
44	Dd	4					**4**								
45	Dd					4	**4**					4	**4**	4	**4**
46	Bd	4			5		**5**				5		**5**		
47	Gr	4			4		**4**				4		**4**		
48	Wn2					4	**4**					4	**4**	4	**4**
49	Hp	4			5		**5**				5		**5**		
50	Bg	4	5		4		**5**		5		4		**5**		

Appendix 3. Cont…

UMA	Soils	c	w	d	f	e	Macadamia	c	w	d	f	e	Citrus	e	Rye grass
51	Cr	5					**5**	4					**4**		
53	Bg3	4	5		4		**5**		5		4		**5**		
55	Hp	5			5		**5**	4			5		**5**		
56	Cr	4					**4**								
57	Bs-Bd	5			5		**5**	4			5		**5**		
59	Dd2-Gf2					5	**5**					5	**5**	5	**5**
60	Hp	5			5		**5**	4			5		**5**		
61	Dd	4					**4**								
62	Dd-Gf	4					**4**								
64	Dd-Gf					4	**4**					4	**4**	4	**4**
65	Dd-Gf					4	**4**					4	**4**	4	**4**
66	Bd	4			5		**5**				5		**5**		
68	Bd	5			5		**5**	4			5		**5**		
69	Bd	4			5		**5**				5		**5**		
70	Bd	4			5		**5**				5		**5**		
71	Bd	4			5		**5**				5		**5**		
72	Dd					5	**5**					5	**5**	5	**5**
73	Sk-Bg3	5	5		4		**5**	4	5		4		**5**		
74	Wn					5	**5**					5	**5**	5	**5**
75	Dd3			4		4	**4**					4	**4**	4	**4**
76	Cn	5			4		**5**	4			4		**4**		
77	Bd-Bs	5			5		**5**	4			5		**5**		
78	Dd					4	**4**					4	**4**	4	**4**
80	Hy-Cr	5			4		**5**	4			4		**4**		
81	Hy	4			4		**4**					4	**4**		
83	Rt3	4	5				**5**		5				**5**		
84	Dd-Rt3		5			4	**5**		5			4	**5**	4	**4**
85	Rt-Gf	4	5				**5**		5				**5**		
86	Bd	4			5		**5**				5		**5**		
87	Bd	4			5		**5**				5		**5**		
88	Bd	5			5		**5**	4			5		**5**		
90	Kl	4					**4**								
91	Bs	4			5		**5**				5		**5**		
92	Kl	4					**4**								
94	Bs	5			5		**5**	4			5		**5**		
95	Kl	4					**4**								
96	Cn	4			4		**4**				4		**4**		
97	Bd	4			5		**5**				5		**5**		
98	Dd3					4	**4**					4	**4**	4	**4**
99	Gf3	4					**4**								
100	Sk	4			4		**4**		5		4		**5**		
103	Dd3					4	**4**					4	**4**	4	**4**
105	Bd	4			5		**5**				5		**5**		

Appendix 3. Cont…

UMA	Soils	c	w	d	f	e	Macadamia	c	w	d	f	e	Citrus	e	Rye grass
106	Dd					4	**4**					4	**4**	4	**4**
107	Bd	4			5		**5**				5		**5**		
108	Rt-Gf	4	5				**5**		5				**5**		
109	Rt-Gf		5				**5**		5				**5**		
110	Rt3	4	5				**5**		5				**5**		
111	Bd	5			5		**5**	4			5		**5**		
112	Gf3-Dd3					4	**4**					4	**4**	4	**4**
114	Dd					4	**4**					4	**4**	4	**4**
116	Bd				5		**5**				5		**5**		
118	Db					4	**4**					4	**4**	4	**4**
119	Bd	4			5		**5**				5		**5**		
120	Hp	5			5		**5**	4			5		**5**		
121	Dd					4	**4**					4	**4**	4	**4**
122	Dd1		5	4		5	**5**		5			5	**5**	5	**5**
123	Bs	5			5		**5**	4			5		**5**		
124	Rt	4	5				**5**		5				**5**		
127	Ky-Kl					4	**4**					4	**4**	4	**4**
128	Ky-Kl	4					**4**								
129	Bd	4			5		**5**				5		**5**		
131	Rt-Sc	4	5				**5**		5				**5**		
132	Ky-Kl					4	**4**					4	**4**	4	**4**
134	Kl1	4		4			**4**			4			**4**		
135	Bd	4			5		**5**				5		**5**		
136	Ky-Kl	4					**4**								
137	Bs-Cb	5	4		5		**5**	4	4		5		**5**		
138	Cr-Ot	5	5				**5**	4	5				**5**		
139	Ky-Kl	4					**4**								
140	Ky-Kl3					4	**4**					4	**4**	4	**4**
143	Ky-Kl3					4	**4**					4	**4**	4	**4**
145	Ky	4					**4**								
146	Nn	4					**4**								
147	Bs	5			5		**5**	4			5		**5**		
149	Bg	4	5		4		**5**		5		4		**5**		
150	Ky	4					**4**								
151	Ky	4					**4**								
153	Cn	4			4		**4**				4		**4**		
154	Gr-Hp	5			5		**5**	4			5		**5**		
155	Ka2	4					**4**								
156	Ka2-Ky1			4			**4**			4			**4**		
157	Bs	4			5		**5**				5		**5**		
158	Bg	5	5		4		**5**	4	5		4		**5**		
159	Ky1	4		4			**4**			4			**4**		
162	Bs-Cb	4	4		5		**5**		4		5		**5**		

Appendix 3. Cont…

UMA	Soils	c	w	d	f	e	Macadamia	c	w	d	f	e	Citrus	e	Rye grass
166	Bd-Sp	5	5		5		**5**	4	5		5		**5**		
168	Ot	4	5				**5**		5				**5**		
169	Bs-Bd	5			5		**5**	4			5		**5**		
170	Gr	5			4		**5**	4			4		**4**		
171	Ky3	4					**4**								
172	Bg	4	5		4		**5**		5		4		**5**		
174	Ky2-Kl2			4		4	**4**			4		4	**4**	4	**4**
178	Bs-Bd	5			5		**5**	4			5		**5**		
179	Ky	4					**4**								
180	Gl	5			4		**5**	4			4		**4**		
181	Bd	4			5		**5**				5		**5**		
182	Bu	4					**4**								
183	Bd	4			5		**5**				5		**5**		
184	Ky2					5	**5**					5	**5**	5	**5**
185	Bs-Hp	5			5		**5**	4			5		**5**		
186	Ky	4					**4**								
187	Hp2-Sp	4	5		4		**5**		5		4		**5**		
188	Bu3					4	**4**					4	**4**	4	**4**
189	Hp	5			5		**5**	4			5		**5**		
191	Sp	4	5		4		**5**		5		4		**5**		
192	Hp	4			5		**5**				5		**5**		
193	Gy	5			4		**5**	4			4		**4**		
194	Sp		5		4		**5**		5		4		**5**		
195	Sp	5	5		4		**5**	4	5		4		**5**		
196	Ka3	4					**4**								
197	Bs	5					**5**	4			5		**5**		
198	Ky1			4		4	**4**			4		4	**4**	4	**4**
199	Hy2	4			4		**4**				4		**4**		
200	Hy1	4		4	4		**4**			4	4		**4**		
201	Nn	4					**4**								
202	Bd	5			5		**5**	4			5		**5**		
203	Ky	4					**4**								
204	Hp	4			5		**5**				5		**5**		
205	Bs-Bd	5			5		**5**	4			5		**5**		
206	Ka3-Nn1			4		4	**4**			4		4	**4**	4	**4**
207	Sp	5	5		4		**5**	4	5		4		**5**		
208	Kl1			4			**4**			4			**4**		
210	Bs	5			5		**5**	4			5		**5**		
211	Bd	4			5		**5**				5		**5**		
212	Rt2		5				**5**		5				**5**		
213	Cb	5	4		5		**5**	4	4		5		**5**		
214	Bs-Cb	5	4		5		**5**	4	4		5		**5**		
215	Dr1	4		4			**4**			4			**4**		

Appendix 3. Cont…

UMA	Soils	c	w	d	f	e	Macadamia	c	w	d	f	e	Citrus	e	Rye grass
216	Bs	5			5		**5**	4			5		**5**		
219	Bd	4			5		**5**				5		**5**		
220	Ky-Kl					4	**4**					4	**4**	4	**4**
221	Bd	4			5		**5**				5		**5**		
223	Dr	4					**4**								
225	Bs	4			5		**5**				5		**5**		
226	Cn-Cb	4	4		5		**5**		4		5		**5**		
227	Dr3-Dw2					5	**5**					5	**5**	5	**5**
228	Dw2	4					**4**								
229	Bs	4			5		**5**				5		**5**		
230	Dr2					4	**4**					4	**4**	4	**4**
231	Jn3		5				**5**		5				**5**		
232	Hp-Bg	5	5		4		**5**	4	5		4		**5**		
234	Dw2					5	**5**					5	**5**	5	**5**
235	Dw	4					**4**								
236	Rt3	4	5				**5**		5				**5**		
238	Bs-Bd	5			5		**5**	4			5		**5**		
240	Bs-Hp	5			5		**5**	4			5		**5**		
243	Bs-Sp	5	5		5		**5**	4	5		5		**5**		
244	Bs	4			5		**5**				5		**5**		
245	Pd3-Dw					4	**4**					4	**4**	4	**4**
246	Dw	4					**4**								
247	Dw					5	**5**					5	**5**	5	**5**
248	Bs-Cn	4			4		**4**				4		**4**		
249	Mo2-Dg1	4		4			**4**			4			**4**		
250	Jn-Dr		5				**5**		5				**5**		
251	Jn	4	5		4		**5**		5		4		**5**		
252	Dr	4					**4**								
253	Cn	5			4		**5**	4			4		**4**		
254	Ot3	4	5		4		**5**		5		4		**5**		
255	Kl-Hs					4	**4**					4	**4**	4	**4**
256	Dd3					4	**4**					4	**4**	4	**4**
257	Bs-Bd	4			5		**5**				5		**5**		
258	Ky-Kl2	4					**4**								
259	Bs	4			5		**5**				5		**5**		
260	Kl2	4					**4**								
261	Bs	5			5		**5**	4			5		**5**		
263	Hp	4			5		**5**				5		**5**		
264	Bd3	5			5		**5**	4			5		**5**		
265	Gf	4					**4**								
266	Sc	4	4				**4**		4				**4**		
268	Cn-Hp2	5			4		**5**	4			4		**4**		
270	Dd	4					**4**								

Appendix 3. Cont…

UMA	Soils	c	w	d	f	e	Macadamia	c	w	d	f	e	Citrus	e	Rye grass
271	Dd-Sc					4	**4**					4	**4**	4	**4**
272	Dd3					4	**4**					4	**4**	4	**4**
273	Cn	4			4		**4**				4		**4**		
274	Dd	4					**4**								
275	Dd3					4	**4**					4	**4**	4	**4**
276	Hp-Cr	4			4		**4**				4		**4**		
278	Cr	5					**5**	4					**4**		
279	Cr3	4					**4**								
280	Cr-Hp	4			4		**4**				4		**4**		
282	Dd2					5	**5**					5	**5**	5	**5**
283	Dd	4					**4**								
284	Gy-Cn	5	5		4		**5**	4	5		4		**5**		
285	Ek2-Gf2		5				**5**		5				**5**		
286	Dd2					4	**4**					4	**4**	4	**4**
288	Dd	4					**4**								
289	Hy-Hy1	4		4	4		**4**			4	4		**4**		
290	Gf2	4					**4**								
292	Bg3	4	5		4		**5**		5		4		**5**		
294	Ot-Bg	5	5		4		**5**	4	5		4		**5**		
295	Sc	4					**4**								
296	Hp-Bd	5			4		**5**	4			4		**4**		
297	Ot	5	5		4		**5**	4	5		4		**5**		
298	Cn2-Bg3	4	5		4		**5**		5		4		**5**		
299	Gf-Rt2		5			4	**5**		5			4	**5**	4	**4**
300	Hy3	5			4		**5**	4			4		**4**		
301	Bg	4	5		4		**5**		5		4		**5**		
302	Bs	5			5		**5**	4			5		**5**		
303	Bg	4	5		4		**5**		5		4		**5**		
304	Cr1	4		4			**4**			4			**4**		
305	Sk	4	5		4		**5**		5		4		**5**		
306	Bg	4	5		4		**5**		5		4		**5**		
307	Cr	5					**5**	4					**4**		
308	Bg	4	5		4		**5**		5		4		**5**		
309	Cr	5					**5**	4					**4**		
310	Hy	5			4		**5**	4			4		**4**		
311	Sc-Be	4					**4**								
312	Co	4	5		4		**5**		5		4		**5**		
313	Bs	5			5		**5**	4			5		**5**		
314	Hy3	4			4		**4**				4		**4**		
315	Co	4	5		4		**5**		5		4		**5**		
316	Ky	4					**4**								
318	Sc-Bo	4					**4**								
319	Co	4	5		4		**5**		5		4		**5**		
320	Bs	5			5		**5**	4			5		**5**		

Appendix 3. Cont…

UMA	Soils	c	w	d	f	e	Macadamia	c	w	d	f	e	Citrus	e	Rye grass
321	Kl3-Hs	4					**4**								
323	Jl2-Hs2	4	5				**5**		5				**5**		
324	Ky-Nn					4	**4**					4	**4**	4	**4**
325	Ky	4					**4**								
326	Ky-Nn					4	**4**					4	**4**	4	**4**
327	Tw3	5	5		5		**5**	4	5		5		**5**		
328	Ky-Nn					4	**4**					4	**4**	4	**4**
329	Ky	4					**4**								
330	Tw3	4	5		5		**5**		5		5		**5**		
331	Hy3	5			5		**5**	4			5		**5**		
332	Rt2-Dd		5				**5**		5				**5**		
333	Hy3	4			4		**4**				4		**4**		
335	Ka	4					**4**								
336	Ka2-Ky					4	**4**					4	**4**	4	**4**
337	Bs-Bd	5			5		**5**	4			5		**5**		
338	Gf	4					**4**								
339	Bd-Cn	5			5		**5**	4			5		**5**		
341	Hs-Jl1		5	4			**5**		5	4			**5**		
343	Bs	5			5		**5**	4			5		**5**		
345	Cn	4			4		**4**				4		**4**		
346	Gf2	4					**4**								
349	Rt3		5				**5**		5				**5**		
350	Gf2-Dd2					4	**4**					4	**4**	4	**4**
351	Ek2-Gf2		5			4	**5**		5			4	**5**	4	**4**
352	Gf2-Rt3	4	5				**5**		5				**5**		
353	Cb	5	4		5		**5**	4	4		5		**5**		
355	Hp	5			5		**5**				5		**5**		
356	Sk	4	5		4		**5**		5		4		**5**		
357	Bg-Gy	5	5		4		**5**	4	5		4		**5**		
359	Be					4	**4**					4	**4**	4	**4**
360	Dd2					4	**4**					4	**4**	4	**4**
362	Cr	4					**4**								
363	Sk	4	5		4		**5**		5		4		**5**		
365	Ob	4	5				**5**		5				**5**		
367	Sk	4	5		4		**5**		5		4		**5**		
369	Sk	4	5		4		**5**		5		4		**5**		
370	Dd2-Gf3					4	**4**					4	**4**	4	**4**
371	Bs	5			5		**5**	4			5		**5**		
375	Pd3-Rt2		5				**5**		5				**5**		
377	Cb-Sk	5	5		4		**5**	4	5		4		**5**		
378	Bd-Cr	5			5		**5**	4			5		**5**		
379	Gr	4			4		**4**				4		**4**		
381	Bd	4			5		**5**				5		**5**		

Appendix 3. Cont…

UMA	Soils	c	w	d	f	e	Macadamia	c	w	d	f	e	Citrus	e	Rye grass
382	Bs-Bd	5			5		**5**	4			5		**5**		
384	Dd2-Be2					4	**4**					4	**4**	4	**4**
385	Bd	4			5		**5**				5		**5**		
386	Gy-Sp	5	5		4		**5**	4	5		4		**5**		
387	Be2	4					**4**								
388	Rt2		5				**5**		5				**5**		
389	Jn2		5				**5**		5				**5**		
390	Jn	4	5		4		**5**		5		4		**5**		
391	Jn2		5				**5**		5				**5**		
392	Jn	4	5		4		**5**		5		4		**5**		
393	Tw	4	5		5		**5**		5		5		**5**		
394	Bs	4			5		**5**				5		**5**		
395	Rt3	4	5				**5**		5				**5**		
396	Gf	4	5				**5**		5				**5**		
398	Rt	4	5				**5**		5				**5**		
399	Bs-Hp	5			5		**5**	4			5		**5**		
400	Tw	4	5		5		**5**		5		5		**5**		
401	Bo	4					**4**								
403	Tw	4	5		5		**5**		5		5		**5**		
405	Dd2	4					**4**								
406	Tw	4	5		5		**5**		5		5		**5**		
407	Bs	5			5		**5**	4			5		**5**		
409	Bo	4					**4**								
410	Bs-Gr	5			5		**5**	4			5		**5**		
412	Rt		5				**5**		5				**5**		
413	Co3	5	5		5		**5**	4	5		5		**5**		
416	Bd	4			5		**5**				5		**5**		
417	Rt2		5			4	**5**		5			4	**5**		**4**
418	Bd	5			5		**5**	4			5		**5**		
419	Hy-Cr	5			4		**5**	4			4		**4**		
420	Sk1	4	5	4			**5**		5	4			**5**		
421	Bo1			4			**4**			4			**4**		
422	Dd3-Ek1	4		4			**4**			4			**4**		
423	Cn-Sp	5	5		4		**5**	4	5		4		**5**		
425	Bs-Cr	5					**5**	4					**4**		
426	Sp	4	5		4		**5**		5		4		**5**		
427	Cr	4					**4**								
428	Dd2		5			5	**5**		5			5	**5**		**5**
429	Bd	4			5		**5**				5		**5**		
430	Bd	4			5		**5**				5		**5**		
431	Dd	4					**4**								
433	Ky2-Ka2					5	**5**					5	**5**	5	**5**
434	Jl1-Ek2		5	4		5	**5**		5	4		5	**5**	5	**5**

Appendix 4. Suitability of soils in the Kilcoy–Woodford area for selected crops

Appendix 4. Suitability of soils in the Kilcoy-Woodford area for selected crops

Soils	UMA	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
Bd	4	3	2	2	5	5	2
Bd	14	3	2	2	5	5	2
Bd	16	3	3	2	5	5	3
Bd	20	3	3	3	5	5	2
Bd	25	3	2	2	5	5	2
Bd	26	3	3	3	4	4	2
Bd	28	3	3	2	5	5	3
Bd	33	4	4	4	4	3	3
Bd	35	4	4	4	4	3	3
Bd	39	3	3	3	4	4	2
Bd	43	3	3	3	5	5	2
Bd	46	3	3	3	5	5	2
Bd	66	3	3	3	5	5	2
Bd	68	3	3	2	5	5	3
Bd	69	3	2	2	5	5	2
Bd	70	3	2	2	5	5	2
Bd	71	3	2	2	5	5	2
Bd	86	3	2	2	5	5	2
Bd	87	3	2	2	5	5	2
Bd	88	3	3	2	5	5	3
Bd	97	3	2	2	5	5	2
Bd	105	3	2	2	5	5	2
Bd	107	3	2	2	5	5	2
Bd	111	3	3	2	5	5	3
Bd	116	3	2	2	5	5	2
Bd	119	3	2	2	5	5	2
Bd	129	3	2	2	5	5	2
Bd	135	3	2	2	5	5	2
Bd	181	3	2	2	5	5	2
Bd	183	3	2	2	5	5	2
Bd	202	3	3	2	5	5	3
Bd	211	3	2	2	5	5	2
Bd	219	3	2	2	5	5	2
Bd	221	3	2	2	5	5	2
Bd	381	3	2	2	5	5	2
Bd	385	3	2	2	5	5	2
Bd	416	3	2	2	5	5	2
Bd	418	3	3	2	5	5	3
Bd	429	3	2	2	5	5	2
Bd	430	3	2	2	5	5	2
Bd-Bg3	37	4	4	4	5	5	2
Bd-Bs	77	3	3	3	5	5	3
Bd-Cn	339	3	3	3	5	5	3
Bd-Cr	378	4	3	4	5	5	3
Bd-Hp	5	3	3	3	5	5	3
Bd-Hp	7	3	2	3	5	5	2
Bd-Sp	166	4	4	4	5	5	3

Appendix 4. Cont…

Soils	UMA	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
Bd3	264	4	3	2	5	5	3
Be	359	5	5	5	4	4	4
Be2	387	4	4	4	4	3	3
Be3	347	5	5	5	3	3	3
Bg	50	4	4	4	5	5	3
Bg	149	4	4	4	5	5	3
Bg	158	4	4	4	5	5	3
Bg	172	4	4	4	5	5	3
Bg	301	4	4	4	5	5	3
Bg	303	4	4	4	5	5	3
Bg	306	4	4	4	5	5	3
Bg	308	4	4	4	5	5	3
Bg-Gy	357	4	4	4	5	5	3
Bg3	53	4	4	4	5	5	3
Bg3	292	4	4	4	5	5	3
Bo	401	4	4	4	4	3	2
Bo	408	5	5	5	3	3	3
Bo	409	4	4	4	4	3	2
Bo1	421	5	5	5	4	4	3
Bs	91	3	3	3	5	5	3
Bs	94	3	3	3	5	5	3
Bs	123	3	3	3	5	5	3
Bs	147	3	3	3	5	5	3
Bs	157	3	3	3	5	5	3
Bs	197	3	3	3	5	5	3
Bs	210	3	3	3	5	5	3
Bs	216	3	3	3	5	5	3
Bs	225	3	3	3	5	5	3
Bs	229	3	3	3	5	5	3
Bs	244	3	3	3	5	5	3
Bs	259	3	3	3	5	5	3
Bs	261	3	3	3	5	5	3
Bs	302	3	3	3	5	5	3
Bs	313	3	3	3	5	5	3
Bs	320	3	3	3	5	5	3
Bs	343	3	3	3	5	5	3
Bs	371	3	3	3	5	5	3
Bs	394	3	3	3	5	5	3
Bs	407	3	3	3	5	5	3
Bs-Bd	57	3	3	3	5	5	3
Bs-Bd	169	3	3	3	5	5	3
Bs-Bd	178	3	3	3	5	5	3
Bs-Bd	205	3	3	3	5	5	3
Bs-Bd	238	3	3	3	5	5	3
Bs-Bd	257	3	3	3	5	5	3
Bs-Bd	337	3	3	3	5	5	3
Bs-Bd	382	3	3	3	5	5	3
Bs-Cb	137	3	3	3	5	5	3

Appendix 4. Cont…

Soils	UMA	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
Bs-Cb	162	3	3	3	5	5	3
Bs-Cb	214	3	3	3	5	5	3
Bs-Cn	248	3	3	3	4	4	3
Bs-Cr	425	4	3	4	5	4	3
Bs-Gr	410	3	3	3	5	5	3
Bs-Hp	185	3	3	3	5	5	3
Bs-Hp	240	3	3	3	5	5	3
Bs-Hp	399	3	3	3	5	5	3
Bs-Sp	243	4	4	4	5	5	3
Bu	182	4	4	4	4	3	3
Bu3	188	5	5	5	4	4	4
Cb	17	3	3	3	5	5	3
Cb	213	3	3	3	5	5	3
Cb	353	3	3	3	5	5	3
Cb-Sk	377	4	4	4	5	5	3
Cn	2	3	3	3	5	4	3
Cn	76	3	3	3	5	4	3
Cn	96	3	3	3	4	4	3
Cn	153	3	3	3	4	4	3
Cn	253	3	3	3	5	4	3
Cn	273	3	3	3	4	4	3
Cn	345	3	3	3	4	4	3
Cn2-Bg3	298	4	4	4	5	5	3
Cn-Cb	226	3	3	3	5	5	3
Cn-Hp2	268	3	3	3	5	4	3
Cn-Sp	423	4	4	4	5	5	3
Co	312	4	4	4	5	5	2
Co	315	4	4	4	5	5	2
Co	319	4	4	4	5	5	2
Co3	413	4	4	4	5	5	3
Cr	11	4	3	4	4	3	3
Cr	13	4	3	4	5	4	3
Cr	51	4	3	4	5	4	3
Cr	56	4	3	4	4	3	3
Cr	278	4	3	4	5	4	3
Cr	307	4	3	4	5	4	3
Cr	309	4	3	4	5	4	3
Cr	362	4	3	4	4	3	3
Cr	427	4	3	4	4	3	3
Cr-Bd	6	4	3	4	5	5	3
Cr-Hp	280	4	5	5	4	4	3
Cr-Ot	138	4	4	4	5	5	3
Cr1	304	4	4	4	4	4	3
Cr3	279	4	3	4	4	3	3
Dd	1	4	4	4	4	3	3
Dd	3	5	5	5	4	4	4
Dd	8	5	5	5	4	4	4
Dd	9	5	5	5	3	3	3

Appendix 4. Cont…

Soils	UMA	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
Dd	15	5	5	5	3	3	3
Dd	18	5	5	5	3	3	3
Dd	19	5	5	5	5	5	5
Dd	22	5	5	5	3	3	3
Dd	23	5	5	5	5	5	5
Dd	24	4	4	4	4	3	3
Dd	30	4	4	4	4	3	3
Dd	31	5	5	5	4	4	4
Dd	36	5	5	5	4	4	4
Dd	38	5	5	5	3	3	3
Dd	40	4	4	4	4	3	3
Dd	44	4	4	4	4	3	3
Dd	45	5	5	5	4	4	4
Dd	61	4	4	4	4	3	3
Dd	72	5	5	5	5	5	5
Dd	78	5	5	5	4	4	4
Dd	106	5	5	5	4	4	4
Dd	114	5	5	5	4	4	4
Dd	115	5	5	5	3	3	3
Dd	117	5	5	5	3	3	3
Dd	118	5	5	5	4	4	4
Dd	121	5	5	5	4	4	4
Dd	269	5	5	5	3	3	3
Dd	270	4	4	4	4	3	3
Dd	274	4	4	4	4	3	3
Dd	281	5	5	5	3	3	3
Dd	283	4	4	4	4	3	3
Dd	288	4	4	4	4	3	3
Dd	380	5	5	5	3	3	3
Dd	424	5	5	5	3	3	3
Dd	431	4	4	4	4	3	3
Dd2-Be2	384	5	5	5	4	4	4
Dd2-Gf2	59	5	5	5	5	5	5
Dd2-Gf3	370	5	5	5	4	4	4
Dd3	277	5	5	5	3	3	3
Dd3-Ek1	422	4	4	4	4	4	3
Dd-Gf	65	5	5	5	4	4	4
Dd-Gf	67	5	5	5	3	3	3
Dd-Gf	58	5	5	5	3	3	3
Dd-Gf	62	4	4	4	4	3	3
Dd-Gf	63	5	5	5	3	3	3
Dd-Gf	64	5	5	5	4	4	4
Dd-Gf	373	5	5	5	3	3	3
Dd-Rt3	84	5	5	5	5	5	4
Dd-Sc	271	5	5	5	4	4	4
Dd1	122	5	5	5	5	5	5
Dd2	32	5	5	5	5	5	5
Dd2	101	5	5	5	3	3	3

Appendix 4. Cont…

Soils	UMA	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
Dd2	282	5	5	5	5	5	5
Dd2	286	5	5	5	4	4	4
Dd2	287	5	5	5	3	3	3
Dd2	291	5	5	5	3	3	3
Dd2	354	5	5	5	3	3	3
Dd2	360	5	5	5	4	4	4
Dd2	405	4	4	4	4	3	3
Dd2	415	5	5	5	3	3	3
Dd2	428	5	5	5	5	5	5
Dd3	75	5	5	5	4	4	4
Dd3	98	5	5	5	4	4	4
Dd3	103	5	5	5	4	4	4
Dd3	256	5	5	5	4	4	4
Dd3	262	5	5	5	3	3	3
Dd3	272	5	5	5	4	4	4
Dd3	275	5	5	5	4	4	4
Dr	223	3	3	4	4	3	2
Dr	233	4	4	5	3	3	2
Dr	252	3	3	4	4	3	2
Dr1	215	4	4	4	4	4	3
Dr2	230	5	5	5	4	4	4
Dr2	237	5	5	5	3	3	3
Dr2-Jn3	218	5	5	5	3	3	3
Dr3	217	4	4	4	3	3	2
Dr3	224	5	5	5	3	3	3
Dr3	414	4	4	5	3	3	2
Dr3-Dw2	227	5	5	5	5	5	5
Dw	235	4	4	5	4	3	3
Dw	246	4	4	5	4	3	3
Dw	247	5	5	5	5	5	5
Dw2	228	4	3	4	4	3	3
Dw2	234	5	5	5	5	5	5
Ek2-Gf2	285	4	4	5	5	5	3
Ek2-Gf2	351	5	5	5	5	5	4
Gf	79	5	5	5	3	3	3
Gf	265	4	4	4	4	3	3
Gf	338	4	4	4	4	3	3
Gf	364	5	5	5	3	3	3
Gf	396	4	4	4	5	5	3
Gf-Rt2	299	5	5	5	5	5	4
Gf2	34	4	4	4	4	3	3
Gf2	52	5	5	5	3	3	3
Gf2	290	4	4	4	4	3	3
Gf2	344	5	5	5	3	3	3
Gf2	346	4	4	4	4	3	3
Gf2	361	5	5	5	3	3	3
Gf2	366	5	5	5	3	3	3
Gf2-Dd2	41	5	5	5	5	5	5

Appendix 4. Cont…

Soils	UMA	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
Gf2-Dd2	350	5	5	5	4	4	4
Gf2-Dd3	376	5	5	5	3	3	3
Gf2-Rt3	352	4	4	4	5	5	3
Gf3	99	4	4	4	4	3	3
Gf3	102	5	5	5	3	3	3
Gf3	113	5	5	5	3	3	3
Gf3	293	5	5	5	3	3	3
Gf3-Dd2	368	5	5	5	3	3	3
Gf3-Dd3	112	5	5	5	4	4	4
Gl	180	2	3	2	5	4	3
Gr	47	3	3	3	4	4	2
Gr	170	3	3	3	5	4	3
Gr	379	3	3	3	4	4	2
Gr-Hp	154	3	3	3	5	5	3
Gy	193	3	3	3	5	4	3
Gy-Cn	284	4	4	4	5	5	3
Gy-Sp	386	4	4	4	5	5	3
Hp	29	3	3	2	5	5	3
Hp	49	3	3	3	5	5	2
Hp	55	3	3	2	5	5	3
Hp	60	3	3	2	5	5	3
Hp	120	3	3	2	5	5	3
Hp	189	3	3	2	5	5	3
Hp	192	3	2	2	5	5	2
Hp	204	3	2	2	5	5	2
Hp	263	3	2	2	5	5	2
Hp	355	3	3	2	5	5	3
Hp2-Sp	187	4	4	4	5	5	3
Hp-Bd	296	2	3	3	5	4	3
Hp-Bg	232	4	4	4	5	5	3
Hp-Cr	276	4	3	4	4	4	3
Hs-Jl1	341	5	5	5	5	5	3
Hy	81	3	2	3	4	4	2
Hy	310	3	3	2	5	4	3
Hy-Cr	80	4	3	4	5	4	3
Hy-Cr	419	4	3	4	5	4	3
Hy-Hy1	289	4	4	4	4	4	3
Hy1	200	4	4	4	4	4	3
Hy2	199	3	3	3	4	4	2
Hy3	300	4	3	2	5	4	3
Hy3	314	4	2	3	4	4	2
Hy3	331	4	3	2	5	5	3
Hy3	333	4	2	2	4	4	2
Jl1-Ek2	434	5	5	5	5	5	5
Jl2-Hs2	323	4	4	5	5	5	2
Jn	251	4	4	4	5	5	3
Jn	390	4	4	4	5	5	3
Jn	392	4	4	4	5	5	3

Appendix 4. Cont…

Soils	UMA	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
Jn-Dr	250	4	4	4	5	5	3
Jn2	389	4	4	5	5	5	3
Jn2	391	4	4	5	5	5	3
Jn3	231	4	4	4	5	5	3
Ka	335	4	4	4	4	3	3
Ka2	155	4	4	4	4	3	3
Ka2	160	5	5	5	3	3	3
Ka2	334	5	5	5	3	3	3
Ka2-Ky	336	5	5	5	4	4	4
Ka2-Ky1	156	5	5	5	4	4	3
Ka3	196	4	4	4	4	3	3
Ka3-Nn1	206	5	5	5	4	4	4
Kl	90	3	3	4	4	3	3
Kl	92	3	3	4	4	3	3
Kl	95	3	3	4	4	3	3
Kl-Hs	255	5	5	5	4	4	4
Kl1	134	4	4	4	4	4	3
Kl1	208	5	5	5	4	4	3
Kl2	93	4	4	5	3	3	3
Kl2	239	4	4	5	3	3	2
Kl2	260	4	3	4	4	3	2
Kl3-Hs	321	4	4	4	4	3	3
Ky	82	5	5	5	3	3	3
Ky	89	5	5	5	3	3	3
Ky	126	5	5	5	3	3	3
Ky	145	4	4	4	4	3	2
Ky	148	5	5	5	3	3	3
Ky	150	4	4	4	4	3	2
Ky	151	4	4	4	4	3	2
Ky	152	5	5	5	3	3	3
Ky	173	4	4	4	2	2	2
Ky	179	4	4	4	4	3	2
Ky	186	4	4	4	4	3	2
Ky	203	4	4	4	4	3	2
Ky	316	4	4	4	4	3	2
Ky	317	5	5	5	3	3	3
Ky	325	4	4	4	4	3	2
Ky	329	4	4	4	4	3	2
Ky2-Ka2	433	5	5	5	5	5	5
Ky2-Kl2	163	5	5	5	3	3	3
Ky2-Kl2	174	5	5	5	4	4	4
Ky3-Ka3	164	5	5	5	3	3	3
Ky3-Kl3	167	5	5	5	3	3	3
Ky-Ka2	176	5	5	5	3	3	3
Ky-Ka3	190	5	5	5	3	3	3
Ky-Kl	127	5	5	5	4	4	4
Ky-Kl	128	4	4	4	4	3	3
Ky-Kl	132	5	5	5	4	4	4

Appendix 4. Cont…

Soils	UMA	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
Ky-Kl	136	4	4	4	4	3	3
Ky-Kl	139	4	4	4	4	3	3
Ky-Kl	140	5	5	5	4	4	4
Ky-Kl	144	5	5	5	3	3	3
Ky-Kl	175	5	5	5	3	3	3
Ky-Kl	177	5	5	5	3	3	3
Ky-Kl	220	5	5	5	4	4	4
Ky-Kl	242	5	5	5	3	3	3
Ky-Kl2	258	4	4	4	4	3	3
Ky-Kl3	143	5	5	5	4	4	4
Ky-Nn	324	5	5	5	4	4	4
Ky-Nn	326	5	5	5	4	4	4
Ky-Nn	328	5	5	5	4	4	4
Ky1	159	4	4	4	4	4	3
Ky1	198	5	5	5	4	4	4
Ky2	184	5	5	5	5	5	5
Ky3	171	4	4	4	4	3	2
Nn	146	4	4	4	4	3	2
Nn	201	4	4	4	4	3	2
Ob	365	4	4	4	5	5	3
Ot	168	4	4	4	5	5	2
Ot	297	4	4	4	5	5	3
Ot-Bg	294	4	4	4	5	5	3
Ot3	254	4	4	4	5	5	2
Pd3-Dw	245	5	5	5	4	4	4
Pd3-Rt2	375	5	5	5	5	5	3
Rt	124	4	4	4	5	5	2
Rt	398	4	4	4	5	5	2
Rt	412	4	4	4	5	5	2
Rt-Gf	85	4	4	4	5	5	3
Rt-Gf	108	4	4	4	5	5	3
Rt-Gf	109	5	5	5	5	5	3
Rt-Sc	131	4	4	4	5	5	2
Rt2	212	5	5	5	5	5	3
Rt2	388	5	5	5	5	5	3
Rt2	417	5	5	5	5	5	4
Rt2-Dd	332	4	4	4	5	5	3
Rt3	83	4	4	4	5	5	2
Rt3	110	4	4	4	5	5	2
Rt3	236	4	4	4	5	5	2
Rt3	349	5	5	5	5	5	3
Rt3	395	4	4	4	5	5	2
Sc	12	5	5	5	4	4	4
Sc	266	4	5	5	4	4	2
Sc	267	5	5	5	3	3	3
Sc	295	3	3	4	4	3	2
Sc-Be	311	4	4	4	4	3	3
Sc-Bo	318	4	4	4	4	3	2

Appendix 4. Cont…

Soils	UMA	sorghum, maize	crucifers	potatoes	macadamia	citrus	rye grass
Sc-Bo3	402	5	5	5	3	3	3
Sk	10	4	4	4	5	5	3
Sk	21	4	4	4	5	5	3
Sk	100	4	4	4	5	5	3
Sk	305	4	4	4	5	5	3
Sk	356	4	4	4	5	5	3
Sk	363	4	4	4	5	5	3
Sk	367	4	4	4	5	5	3
Sk	369	4	4	4	5	5	3
Sk-Bg3	73	4	4	4	5	5	3
Sk1	420	4	4	4	5	5	3
Sp	191	4	4	4	5	5	3
Sp	194	4	4	4	5	5	3
Sp	195	4	4	4	5	5	3
Sp	207	4	4	4	5	5	3
Sp	426	4	4	4	5	5	3
Tw	393	4	4	4	5	5	2
Tw	400	4	4	4	5	5	2
Tw	403	4	4	4	5	5	2
Tw	406	4	4	4	5	5	2
Tw3	327	4	4	4	5	5	3
Tw3	330	4	4	4	5	5	2
Wn	54	5	5	5	3	3	3
Wn	74	5	5	5	5	5	5
Wn2	48	5	5	5	4	4	4
Wn3-Dd	27	5	5	5	3	3	3
Mo2-Dg1	249	4	4	4	4	4	3

Appendix 5. Heatwaves and frosts

Appendix 5. Heatwaves and frosts

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of days maximum screen temperatures >38°C												
1970												
1971										1	1	
1972												2
1973												
1974												
1975												
1976												
1977											1	1
1978	1											
1979												5
1980	1		1									
1981												1
1982	1											
1983												
1984												
1985												
1986												
1987	1											
1988										1		
1989												
1990	1											

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
No. of days minimum screen temperatures <2°C												
1970							3					
1971						1	1					
1972							2					
1973												
1974							1	1				
1975						1						
1976												
1977								1				
1978												
1979												
1980												
1981												
1982							1	1				
1983												
1984												
1985						1						
1986												
1987												
1988												
1989												
1990												

Heatwaves (screen temperatures >38°C) and frosts (screen temperatures <2°C) recorded at Kirkleagh (27° 2’ south, 152° 34’ east)

[*] Isbell, 1996