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PROJECT REPORT

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Soils and land suitability of Inkerman West and Central sections Burdekin River Irrigation Area North Queensland

T. E. Donnollan
Land Use and Fisheries

DPI QUEENSLAND
DEPARTMENT OF PRIMARY INDUSTRIES

Queensland Government Technical Report

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Department of Primary Industries
Queensland

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SUMMARY

Water Resources of the Department of Primary Industries, Queensland, is responsible for the design and implementation of the Burdekin River Irrigation Scheme in North Queensland. Land Use and Fisheries of the same Department are providing officers of Water Resources with land resource information based on high intensity surveys, to assist in developing an irrigation layout for the area served by the scheme (Burdekin River Irrigation Area, BRIA).

A 1:25 000 soil survey and land suitability evaluation were undertaken over 9297 ha in Inkerman West and Central Sections of the BRIA. This area, adjoining the Delta lands on the Right Bank or Home Hill side of the Burdekin River is about five kilometres wide and extends from the eastern side of Stokes Range in the west to Yellow Gin Creek in the east. The lands of the study area slope very gently in a north-easterly direction from the lower slopes of the hills and ranges towards the Burdekin Delta.

Apart from being used to assist in re-subdivision and irrigated farm design, the results from the study will be useful to extension officers, agribusiness, agronomists, cane inspectors and farmers for the development and operation of subsequent farms.

Eighty five mapping units, consisting of 72 soil types and 11 variants and phases were identified and mapped. The 825 individual mapping units or unique map areas are shown on the accompanying soils map. Cracking clays occupy about 4400 ha and sodic duplex soils about 2300 ha of the area. Non-sodic duplex soils, gradational and uniform fine-textured soils are the major soils of the remaining 2600 ha.

The morphology of the soil types for each landscape unit are described. Twenty soil profiles representing 11 soil types were sampled and analysed in the laboratory. The chemical and physical properties of these soils as well as those analysed from previous surveys are discussed.

Land suitability classifications using a five class system were used to evaluate the suitability of each unique map area for furrow irrigation of sugar-cane and a range of field and horticultural crops, flood irrigation of rice and low volume irrigation of mangoes and avocados. A total of 5759 ha was suitable (classes 1 - 3) for sugar-cane, 5189 ha for maize, 1255 ha for capsicums, 1806 ha for rice and 1322 ha for low volume irrigation of mangoes. Management options to overcome or reduce the effects of soil or land limitations which cause less than optimum conditions for a particular land use are given for broad soil management groups.

Over 300 ha are already affected by secondary salinisation and a further 470 ha have the potential to become salinised. Extreme care will need to be taken in locating farms to avoid exacerbating the salinity problems. Means of lowering the water table to acceptable levels will need to be developed to ensure long-term stability of resources. About 730 ha are affected by severe erosion and are unsuitable for cropping.

INTRODUCTION

When fully developed, the Burdekin River Irrigation Area (BRIA) adjoining the present irrigated Delta lands of the Lower Burdekin Valley, is expected to provide an additional 50 000 ha or 500 new farms for irrigation. The development of the scheme is under the control of Water Resources of the Department of Primary Industries (DPI). Detailed information on the land resources of the area is required to assist in re-subdivision and farm design for the project.

Land Use and Fisheries Group of the Department of Primary Industries has therefore been conducting 1:25 000 soil surveys and land suitability evaluations in the BRIA for this purpose. Reports on Leichardt Downs Section (Donnollan *et al.* 1986 and 1990) and Mulgrave Section (McClurg *et al.* 1988 and 1993) have been published. Maps and reports for other sections of the BRIA are in various stages of production.

The area of the BRIA, east of Stokes Range, on the Right Bank or Home Hill side of the Burdekin River will be developed when the Elliot Main Channel (EMC) is extended beyond Stokes Range. A 1:25 000 soil survey and land suitability evaluation were therefore undertaken in Inkerman West and Central Sections to assist in the project layout in this area. The information provided will also assist landholders and extension officers to develop suitable management strategies in order to develop sustainable viable farming systems for the area.

These two Sections extend from the lower slopes of Stokes Range in the west to Yellow Gin Creek in the east. The southern boundary lies just upslope of the proposed EMC which will be located near the 35 m contour. The northern boundary adjoins the present cropped lands of the Burdekin Delta. A plan showing the location of the area in respect to other sections in the BRIA is shown in Figure 1.

PHYSICAL RESOURCES

The study areas consists of alluvial plains and gently undulating rises on mixed granitic intrusive rocks. From the lower slopes of the hills and ranges, the lands slope very gently in a north-easterly direction towards a level alluvial plain which adjoins the Burdekin Delta.

Much of the original vegetation of the area has been removed. Woody weeds have invaded the naturally treeless plains of the area.

Channels of the major creeks of the area terminate near the easterly flowing drainage system on the northern boundary. However, many of the minor creeks of the area spread runoff water onto the gilgaied cracking clays further upslope of the major drainage system.

Groundwater levels fluctuate considerably, depending on seasonal influences, and have reached the surface in some of the lower lying areas resulting in secondary salinisation.

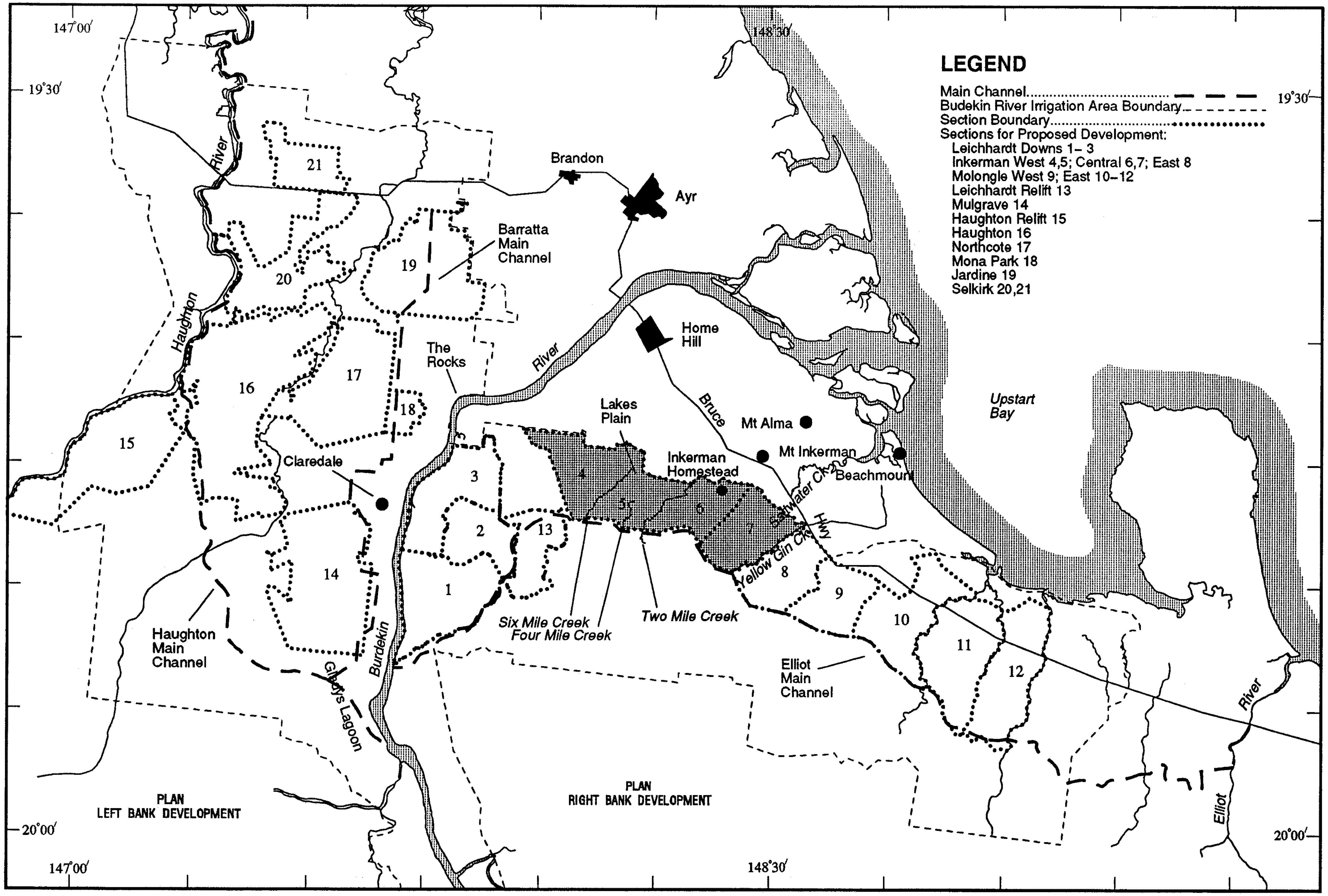

Figure 1. Burdekin River Irrigation Area general layout and location of Inkerman West and Central Sections (shown by shading)

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Climate

The BRIA, which is part of the Lower Burdekin District, lies in the region which is often termed the dry tropics. The climate may be described as warm and subhumid with well defined wet and dry seasons. The wet season extends from December to March.

More specific aspects of the climate of the Lower Burdekin District has been described in a number of publications including Christian *et al.* (1953), Australian Bureau of Meteorology (1970), Burdekin Project Committee (1977), Thompson (1977), Reid and Baker (1984), Donnollan *et al.* (1990) and Thompson *et al.* (1990).

An official rainfall recording station, Inkerman Homestead, (latitude 19.46°S, longitude 147.27°E) lies within the survey area and the mean monthly rainfall over a period of 105 years is shown in Figure 2. The mean annual rainfall of 915 mm is lower than at Ayr (1082 mm) but similar to Claredale (874 mm).

Rainfall variability is high. Figure 3 shows the monthly rainfall in mm likely to be equalled or exceeded 10%, 50% and 90% of occurrences.

Geology

Gregory (1969) mapped and described the geology of the 1:250 000 Ayr sheet while Paine (1972) described and mapped the regional geology of the Burdekin and Townsville areas. Geomorphology of the Burdekin Delta was described by Hopley (1970). More recently, Ellis (1983) described the geology of the Leichardt Downs Section. Evans (personal communication) also studied the geology of the Burdekin Right Bank and a brief summary of his study is in Donnollan *et al.* (1990). Thompson *et al.* (1990) postulated the chronology and morphogenesis of the landscapes of the Lower Burdekin Valley.

Stokes Range, the western boundary of the survey area is part of the Upper Carboniferous-Lower Permian Dioritic Complex (C-Pd) (Gregory 1969). The range of plutonic rocks within this unit includes diorite, quartz diorite, tonalite, gabbro and norite with minor granodiorite, adamellite and granite. The C-Pg unit (adamellite, granite, some granodiorite, and minor fined grained variants) is exposed just south of Inkerman Homestead.

Dykes have intruded the C-Pd unit and are located in a north-north west direction, often at about 330°. The dykes are of varying composition (Gregory 1969, Ellis 1983). Basic to intermediate dykes (microdiorites and dolerites) are the most widespread. The acid dykes (felsites, microgranites, granophyres and porphyries) are generally much thicker than the basic to intermediate dykes.

Gregory (1969) identified the Inkerman Shear Zone which extends from Mount Inkerman, north of the survey area to Stokes Range. This zone consists of coarse grained, plutonic rocks that have been sheared and recrystallised to gneiss, garnet, epidote and tremolite. The three kilometre wide shear zone lies perpendicular to the general regional structure.

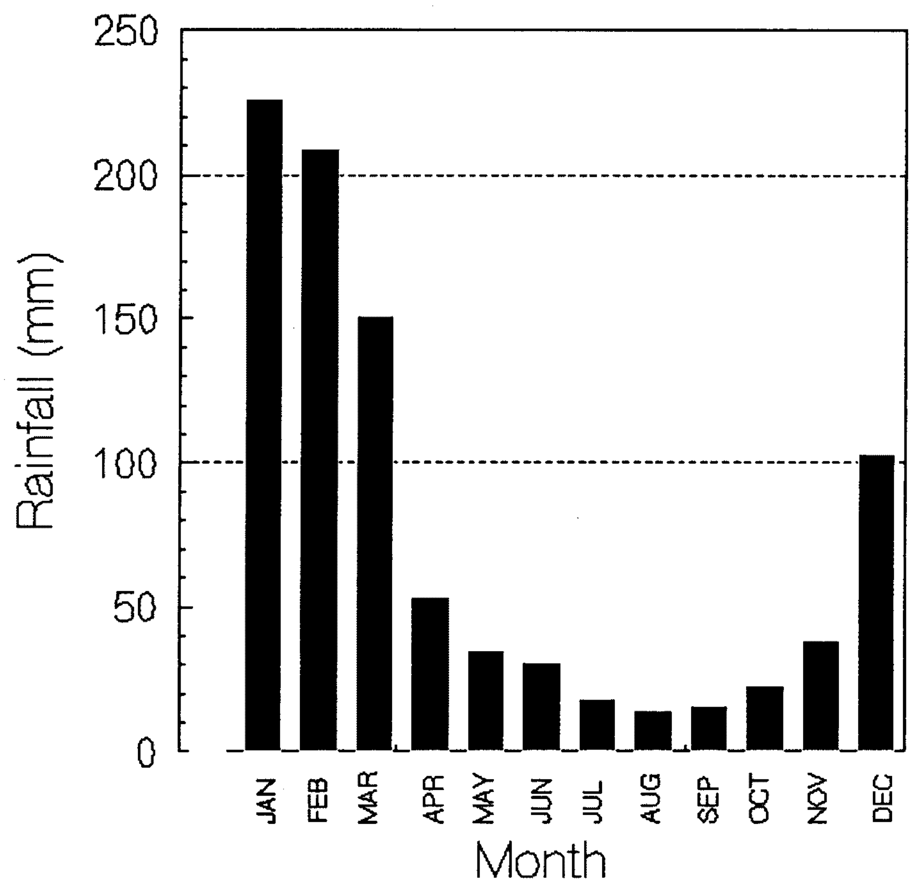


Figure 2 Mean monthly rainfall at Inkerman Homestead

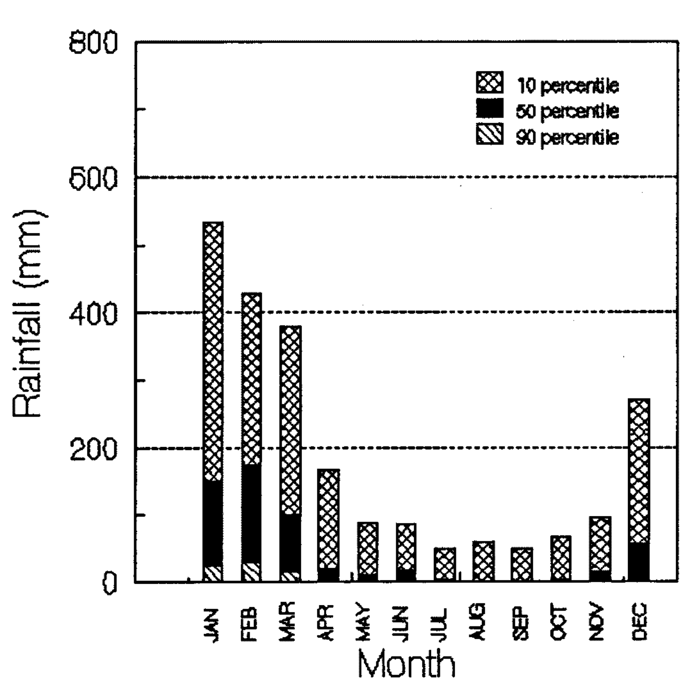


Figure 3 Monthly rainfall figures likely to be equalled or exceeded in 10, 50 and 90 percent of occurrences for Inkerman Homestead

The remainder of the area is of alluvial origin and mapped as Czs or Cza on the 1:250 000 map. However the soil survey has found that the alluvial deposits are not as widespread as indicated on the map. The intrusive rocks extend discontinuously to Inkerman Homestead.

Evans (1988) through his hydrosalinity investigations in the western part of the survey area interprets the geology of the area differently. He proposes that the bedrock of the area consists of a Precambrian metamorphic unit consisting mainly of amphibolites, schists and gneisses. This unit has been subsequently deformed and intruded by igneous dykes of many phases. The composition of these dykes vary from acidic to basic. Andesitic dykes are dominant but other lithologies including rhyolites, felsites, dacites, dolerites, microgranites, diorites, granites, granodiorites and monzonites are present.

Evans (1988) proposes that a number of folding events have occurred and major faulting is evident in the area. He states that the 'Inkerman Shear Zone' is an area of strongly deformed high grade regional metamorphic rocks bounded by two subparallel faults.

Landscape units

Thompson (1977) divided the Right Bank of the Burdekin River on relief characteristics and identified six topographic forms based on differences in geology or geomorphology. Landscape unit (LU) (adapted from Thompson and Moore 1984) has replaced the term topographic form in the more recent surveys in the BRIA. A landscape unit is a natural unit of land in which a particular soil or association of soils is developed from a single rock type (consolidated or unconsolidated) or complex of rock types.

Six landscape units are present in this area and are defined briefly below:

Landscape unit 1: Local alluvial plains and associated pediments
Landscape unit 2: Burdekin River alluvial plains
Landscape unit 3: Local alluvial plain
Landscape unit 4: Gently undulating rises on acid intrusive rocks, pediments and prior streams
Landscape unit 5: Gently undulating rises on an intrusive rock complex
Landscape unit 6: Miscellaneous alluvial landforms
- A Creek and relict alluvial landforms
- B Burdekin Delta

Landscape unit 1 (LU1)

The local alluvial plains and associated pediments are considered to have been derived from the erosion of nearby hills during the Pleistocene interglacial (Hopley 1970). Areas of LU1 extend in a north-easterly direction from the southern and western boundaries, usually adjoining the lower lying areas of LU3.

Landscape unit 2 (LU2)

Large areas of the Left Bank of the Burdekin River below Gladys Lagoon are occupied by the Burdekin River Alluvial Plain (LU2) with about 2000 ha in Leichardt Downs Section on the Right Bank. These plains of low relief are associated with fine material deposited by the Burdekin or Haughton Rivers.

Since the Burdekin River was diverted through The Rocks (Holocene transgression), Hopley (1970) provided evidence to show that former major distributary systems have migrated around the present Delta area. The Lake Plain - Inkerman system commenced just below The Rocks (near Mt Kelly) and flowed along the southern edge of the Burdekin Delta. This system entered a lagoon between Mount Inkerman and Beachmount, either through the gap between Mt Inkerman and Mt Alma or through an incision in the Inkerman dune about 1.6 km south of Mt Inkerman. Hopley (1970) states that each of these systems have well defined channels, several hundred metres wide with coarse sands and fine gravels similar to the load of the present channel. These channels still act as floodways during periods of high river flow.

Evidence on the left bank shows that a considerable proportion of the alluvial deposits of LU2 has been deposited since the Burdekin was diverted through The Rocks (Reid and Baker 1984). Similar soils to those on the Left Bank are found on areas adjoining the Burdekin Delta, suggesting deposition from the Lake Plain - Inkerman distribution system.

Landscape unit 3 (LU3)

Thompson (1977) and Thompson *et al.* (1990) have described LU3 as plains of very low relief. They postulated that the black earths of these plains were developed from fine textured sediments locally derived from the uplands under lacustrine conditions. These conditions may have existed in the Lake Plain area in Inkerman West Section and in the Leichardt Downs Section. However, evidence suggests that these conditions did not exist in the Inkerman Central Section.

Slopes between 0.5 and 1% are found on the upper slopes in the Inkerman Central Section in contrast to the Lake Plain area which has slopes < 0.25%. Soils often have about 10% of subrounded pebbles throughout the profile, a feature not common in the Lake Plain area or Leichardt Downs Section except when adjoining other landscape units. This feature is also not common in lacustrine derived soils. Clay content of the soils is from 15-25% lower than that of the Leichardt Downs and Lake Plain areas. The natural vegetation of a tussock grassland of cane grass and blue grass is similar between both areas although sparse trees of carbeen *(Eucalyptus tessalaris)* and poplar gum *(Eucalyptus alba)* are present in some areas in Inkerman Central Section.

The features of the landscape and soils therefore suggest that the soils of LU3 in Central Section are locally developed from alluvium from the neighbouring hills. Lacustrine conditions were absent.

Landscape unit 4 (LU4)

The gently undulating rises on acid intrusive rocks, pediments and prior streams of LU4 were not mapped in the 1:100 000 survey of the area by Thompson (1977). However, the underlying rock of a ridge originating in the higher slopes, just east of Two Mile Creek and extending discontinuously in a north-easterly direction to Inkerman Homestead is of acidic composition. The soils developed on this ridge have a coarse textured surface and fit the suite of soils developed on LU4 in other areas of the BRIA. This ridge has been truncated by erosion with alluvial deposits separating the ridge into three distinct areas. This ridge lies within the Inkerman Shear Zone as described by Gregory (1969).

Hillcrests, hillslopes and pediments are the only landform elements present in this area. Prior streams are absent.

Landscape unit 5 (LU5)

Gently undulating rises on an intrusive rock complex are found on the higher slopes along the western and part of the southern boundaries. A prominent ridge also extends from the southern boundary between Six Mile Creek and Four Mile Creek in a north-easterly direction towards the Burdekin Delta. An island of this landscape unit, surrounded by alluvial deposits, is found in the south-eastern part of the area. Less prominent relict ridges are located in the north-western corner adjoining LU3 and just to the west of the prominent ridge in the middle of the survey area.

Basic dykes have intruded randomly throughout these ridges indicated by the development of black earths and presence of rock outcrop.

Landscape unit 6 (LU6)

The Burdekin Delta extends into the survey area along the northern boundary. This area is part of the Burdekin Delta of the Ayr region which Hopley (1970) describes as an area consisting of coalescing levees of former distributaries of the Burdekin River with intervening narrow marshy tracts of fine grained floodplain deposits. This description is appropriate to the section of the Delta, especially east of Inkerman Homestead and near the Lake Plain area. A number of open or closed depressions within the low sloping plain is present in these areas with deeper channel dissection occurring near 'the Lake'. Fewer depressions occur in the Delta, west of 'the Lake'.

The Creek and relict alluvial landforms of LU6 are widespread throughout the survey area. A wide range of landform elements including levees, back plains, stream channels, fans, floodouts, prior streams and depressions have formed from local erosion and deposition.

Local alluvia from the nearby hills and ranges has been distributed over other landscape units within the area. Age of the alluvia varies considerably with very young, shallow deposits on the higher slopes on the western and southern boundaries. Prior streams are present in the older alluvial fans which overlie soils of LU3 on lower slopes. These fans are located east of Six Mile Creek, between Four Mile and Two Mile Creeks and between Inkerman Homestead and Salt Water Creek.

Vegetation

An open woodland to woodland of eucalyptus species are the major vegetation formations in the study area, although the cracking clay plains of LU3 are naturally treeless. Major trees on the alluvial plains included poplar gum, (*Eucalyptus alba*) and carbeen (*E. tessellaris*). Narrow leaved ironbark *(E. drepanophylla*) and red bloodwood (*E. erythrophloia*) were the major trees of the undulating rises. Much of the original vegetation has now been removed. Woody weeds have invaded the naturally treeless plains of LU3.

Soil-vegetation associations have been described in the BRIA reports on the low intensity surveys of Thompson (1977), Reid and Baker (1984), and Thompson *et al.* (1990) as well in the reports on the more detailed surveys of Donnollan *et al.* (1990) and McClurg *et al.* (1993). These publications provide general vegetation and soil relationships as well as the main vegetation species associated with each soil type. These relationships also apply to the undisturbed vegetation of this area although isolated trees do occur in LU3 usually only occupied by grassland.

Changes in vegetation composition have occurred in a large part of the area due to poisoning of the original tree population, clearing for cultivation and from infestations of introduced species. Thick eucalypt regrowth has occurred on many parts of Portion 108 from where the original woody vegetation was destroyed by poisoning.

Trees have been cleared from Portion 325. Some of the western area of Portion 329 is also free of trees. At the time of survey, the natural grassland of Portions 304, 305 and 308 had heavy infestations of prickly acacia *(Acacia nilotica)*, mimosa bush *(A. farneseana)* and chinee apple *(Ziziphus mauritiana)*, with prickly acacia the most dominant. Portions 306, 307 and 311 were heavily infested by chinee apple with the other species less dominant. Lower infestations occurred on 309 and 310 and the natural grassland areas of 329.

Rubber vine *(Cryptostegia grandiflora)* is common along creeks, especially at the mouths of the creeks which terminate in the low lying cracking clays. Heavily infested areas include areas along the lower reaches of Six Mile, Four Mile, Two Mile and Salt Water Creeks and an unnamed major creek, just west of Salt Water Creek. Heavily infested areas are often totally inaccessible.

Black tea tree is common near salinised areas of the major unnamed creek just west of Salt Water Creek. Isolated trees of black tea tree are also present near the salinised areas west of Lake Plain.

Hydrology

Surface hydrology

The survey area is surrounded by ranges or hills in the south and west. All runoff water from both sections, flows in a north-easterly direction towards the low lying areas bordering the Delta on the northern boundary of the area. Runoff water is either conveyed to this drainage basin directly by well-defined channels as in the major creeks of Six Mile, Four Mile and Two Mile Creeks or indirectly by less well-defined drainage ways fed by runoff water from shorter, minor creeks which terminate further upslope. Often these drainage paths are the gilgaied cracking clays of LU1 and LU3.

Most of the runoff water from Inkerman West Section enters 'the Lake' in the Lake Plain area. This water then, either flows out of the study area into a series of lagoons within the Delta, or continues flowing eastwards in the low lying areas of LU3 entering another series of lagoons near Inkerman Homestead. These series of lagoons are linked to Salt Water Creek or Yellow Gin Creek. Outflow from 'the Lake' is severely restricted in large flows, causing water to back up, inundating the lower lying areas to the west.

Runoff from Inkerman Central Section either flows into the drainage basin adjacent to the Delta (as described above) or directly into Salt Water or Yellow Gin Creek.

Subsurface hydrology

Hydrological investigations have been undertaken in the survey area by officers of Water Resources. A number of bores have been positioned to monitor groundwater movement and quality in the area. The results of this investigation, especially from Inkerman West Section, have been reported by Evans (1988).

Groundwater levels fluctuate considerably depending on rainfall events. In some areas, groundwater has risen to the surface during a series of wet seasons, salinising some areas. The groundwater in one bore near one salinised area rose six metres to near the ground surface after a series of wet seasons. The level then receded slowly, before stabilising at six metres below ground level, after a number of below average wet seasons.

Evans (1988) showed that groundwater was less than 10 m below ground level over most of the lower alluvial area of Inkerman West Section at the end of 1988 when levels were low after a prolonged dry period. Groundwater levels would therefore be expected to be much closer to the surface than this level after a series of years of above average rainfall or from irrigation practices upslope.

Doherty (1993) used a groundwater model to simulate a range of irrigation scenarios that could be applied in the Lake Plain area to test the affects on groundwater levels. The model showed that levels will rise, the greatest rise being near the presently salinised area. He concluded that groundwater extraction must be part of the irrigation strategy to keep the groundwater at manageable levels.

SOIL SURVEY METHOD

Similar mapping procedures to those used for previous 1:25 000 soil surveys and land suitability assessment studies in the BRIA (for instance Donnollan *et al.* 1990, McClurg *et al.* 1993) were used to survey this area. The methods employed are described below.

Survey procedures

Coloured aerial photographs at a scale of 1:10 000 were used in the field as an aid in defining soil boundaries. The position of 250 x 100 m grids, which were established by Water Resource officers as part of a topographic survey, were inked onto the aerial photographs to assist in field location. The free survey method (Beckett 1968) was used to identify soil boundaries which were then marked on the aerial photographs. Over 1800 mapping sites were described throughout the area at a site intensity of about 1 site per 5 ha. This site intensity is slightly greater than the maximum recommended for 1:25 000 mapping but less than that required for 1:10 000 mapping (Reid 1988).

A description of the soil profile as well as pertinent information of the surrounding area were recorded at each mapping site using the terminology and codes of McDonald *et al.* (1984). This information is stored on computer in the land resource data base of the DPI. Australian Map Grid (AMG) coordinates were also determined and added to the data base.

Soil types

The DPI soil classification system used in other BRIA surveys, was used to classify soils in this area. This alphanumeric system uses the subdivision of the primary profile form of Northcote (1979), a number for the landscape unit and a letter to separate different soil types within the landscape unit and primary profile form subdivision. For example, 3Uga denotes a cracking clay (Ug) in landscape unit 3. The letter 'a' separates this soil type from other cracking clays of LU3 based on morphology or management differences.

Variants were used to distinguish those soils which were similar to an existing soil type in most respects but differed in one or more of those soil properties which had important land use significance. Variants were distinguished by a number after the soil type symbols. For instance, 6Gna2 shows that the soil type is similar to 6Gna but underlies a buried soil or D horizon not normally associated with 6Gna, that is, variant 2. The variants are listed and described on the soil map legend.

Mapping units

During the mapping phase, soil profiles described at the mapping sites were assigned to the appropriate soil type or variant of the DPI soil classification system. Soil boundaries were marked onto aerial photographs. The closure of a soil boundary defined an individual mapping unit. Each occurrence of a mapping unit is termed a unique map area, UMA (after Basinski 1978).

Two types of mapping units were used. A simple UMA defined an area in which a particular soil type occupied more than 70 percent of that mapping unit. A compound or complex UMA defined an area with less than 70 percent of one soil type. The simple mapping unit was identified by the code of the dominant soil type. The compound or complex UMA was identified by the codes for the two most common soil types, with the one occupying the largest area named first. For example 1Uge - 1Dyd contains soil types 1Uge and 1Dyd but soil type 1Uge is in greater proportion than 1Dyd.

Phases were used to separate those mapping units where land attributes not normally associated with mapping units of the same soil type significantly influenced the land use or management of that unit. Phases are distinguished by the appropriate capital letter after the soil type symbol. Areas with large quantities of surface stone or rock exposures (R), those affected by severe erosion (E), those affected by salinity (S), and those affected by excessive wetness (W) were mapped as phases of the dominant soil type. For instance, 4DyhS denotes a saline phase of soil type 4Dyh and 6E denotes an eroded phase within landscape 6. All the phases are listed and described on the soils map legend.

Each UMA was given a number. The UMA name and number were added to the site description file on the land resource database. Information for each UMA, including its number, the dominant and/or co-dominant soil type, minor soil types, land suitability classes for sugar-cane, rice, mangoes and avocados as well as the subclasses for the limitations used to determine land suitability were recorded on UMA data sheets and subsequently filed on computer. The UMA name and number provided the link between the site description file and the UMA file.

The UMAs were digitised from the aerial photographs onto the Geographic Information System (GIS) of the DPI and each given the appropriate number. A link with the UMA file provided the name to the numbered UMA as well as land suitability for the range of crops assessed. The areas of each UMA were generated by the GIS. The mapping units, areas of mapping units and the number of UMAs in each mapping unit are presented in Table 1.

Table 1 Mapping units, areas of mapping units (ha) and the frequency of UMAs in each mapping unit, Inkerman West and Central Sections, BRIA.

Mapping Unit	Area (ha)	Frequency	Total Area (ha)
1Dba - 1Ugc	28.6	1	
1Dbb - 1Ugc	23.0	2	56.7
1Dbb	5.1	2	
1Dda	7.3	1	7.3
1Dya	23.4	2	
1Dyb	1.6	1	
1Dyc	154.2	17	
1Dyc5	3.2	1	396.6
1DycS	7.7	3	
1Dyd - 1Uge	201.9	20	
1DydS	4.6	1	
1Uga	465.6	27	
1Uga - 1Dba	15.0	2	
1UgaE	38.5	7	
1UgaS	34.5	1	
1Ugc - 1Dya	2.2	1	
1Ugc	79.1	15	
1Ugc1	0.9	1	
1Ugc2	7.5	2	1008.2
1UgcE	17.9	4	
1Ugd	14.7	2	
1UgdS	8.4	3	
1Uge - 1Dyd	73.0	4	
1Uge	229.6	15	
1UgeE	0.7	1	
1UgeS	6.3	2	
1Ugf	14.3	3	
LU1	1468.8	134	1468.8
2Dyb	3.2	2	8.8
2Dyc	5.6	1	
2Ugc	219.0	7	
2UgcS	22.4	1	
2Ugd	4.1	1	
2Ugd2	18.3	1	
2Uge	67.0	2	
2Uge - 6Dyg	3.3	1	421.1
2Uge1	5.2	1	
2Ugf1	3.3	1	
2Ugg	2.3	1	
2UghE	43.3	1	
2UghS	29.9	1	
2UghW	3.0	1	
LU2	429.9	19	429.9

Mapping Unit	Area (ha)	Frequency	Total Area (ha)
3Uga	45.2	3	
3Uga3	12.7	1	
3Uga8	520.3	8	
3Uga9	311.9	4	
3UgaE	39.4	4	
3UgaR	1.1	2	
3UgaS	92.0	1	
3UgaW	43.6	2	
3Ugb	10.5	1	
3Ugc	66.1	2	2483.0
3UgcW	34.5	1	
3Ugd	177.1	2	
3Ugd9	9.6	1	
3UgdE	12.2	1	
3Uge	49.7	2	
3Uge1	159.4	1	
3Uge8	778.1	6	
3UgeE	42.6	5	
3UgeS	32.7	2	
3Ugk	44.3	2	
LU3	2483.0	51	2483.0
4Dga	5.7	1	5.7
4Dya	6.4	1	
4Dyd	1.6	1	
4Dye	29.1	3	
4Dyf	107.5	8	
4Dyf5	38.1	1	
4Dyg	95.6	8	
4Dyg3	8.5	1	
4DygE	1.3	1	
4DygR	2.2	1	591.5
4Dyh	49.4	5	
4DyhR	1.8	1	
4DyhS	9.5	1	
4Dyj	10.9	1	
4Dyl	205.6	11	
4Dyl - 4Dbb	6.4	1	
4Dyl1-4Dyh1	8.4	1	
4Dyl1	9.2	1	
LU4	597.2	48	597.2

Table 1 (continued)

Mapping Unit	Area (ha)	Frequency	Total Area (ha)
5R - 5Dral	7.2	1	28.8
5R	21.6	4	
5Dra - 5Dyb	1.8	1	
5Dra - 5Uga	0.9	1	
5Dra	624.2	32	
5Dra1	8.5	1	654.5
5Dra5	2.8	1	
5Dra6	5.4	1	
5DraE	10.9	4	
5Dya - 5Ugb	19.0	1	
5Dya	116.5	7	
5Dya3	10.3	1	
5Dyb	125.0	9	
5Dyb - 5Ugb	31.8	2	
5DybE	7.9	1	
5DybS	4.5	1	
5Dyc - 5Ugb	11.2	2	
5Dyc	70.8	13	509.6
5Dyc5	12.0	3	
5DycE	7.5	3	
5DycS	2.6	1	
5Dyd	5.1	1	
5Dye - 5Uga	4.8	1	
5Dye	44.0	4	
5Dye3	3.3	1	
5Dyf - 5Ugc	33.3	5	
5Uga - 5Dra	19.7	2	
5Uga - 4Dyl	0.9	1	
5Uga - 5Dra	19.7	2	
5Uga	15.2	6	100.6
5Ugb	53.4	11	
5Ugb1	9.8	1	
5Ugb5	1.6	1	
LU5	1293.5	126	1293.5

Mapping Unit	Area (ha)	Frequency	Total Area (ha)
6P	8.7	1	8.7
6E	280.0	6	280.0
6SP	8.1	4	8.1
6Dba	254.8	22	
6Dba2-6Gna2	6.6	1	
6Dba2	14.5	4	
6DbaE	1.4	1	
6DbaS	1.5	1	
6Dbb	15.5	6	426.7
6Dbe	2.3	1	
6Dbf -6GnaE	19.3	1	
6Dbf	41.2	3	
6Dbf2	62.8	16	
6DbfE	0.6	1	
6Dbh	6.1	2	
6Dda - 6Dbd	5.8	1	
6Dda - 1Ugc	23.6	2	
6Dda - 6Uga	5.2	1	
6Dda - 6Dyg	13.7	1	
6Dda	120.7	37	
6Dda2-6Uga2	5.3	1	206.8
6Dda2	20.8	5	
6Dda3	3.2	1	
6DdaE	1.4	1	
6Ddb	5.8	3	
6DdbS	1.3	1	
6Dra	2.6	2	
6Dra - 6Gne	4.2	1	
6Dra2-6Gna2	2.5	1	
6Dra2	6.4	3	
6DraE	7.8	1	
6Drb	2.1	1	102.5
6Drb2-6Dbf2	21.3	1	
6Drb2	11.2	4	
6Drc	19.2	2	
6Drc2	16.5	4	
6Drc3	8.7	2	

Table 1 (continued)

Mapping Unit	Area (ha)	Frequency	Total Area (ha)
6Dyb2- 6Ucc	4.0	1	
6Dye	3.8	1	
6Dyf	5.2	3	
6Dyg - 6Dda	16.7	1	
6Dyg - 6Gna	6.2	1	
6Dyg - 6Ugc	38.8	1	
6Dyg - 6Drc	7.0	1	
6Dyg - 6Dbb	14.1	1	
6Dyg - 1Uga	1.8	1	
6Dyg	399.1	40	708.8
6Dyg2	44.6	8	
6Dyg3	7.8	2	
6Dyh	19.4	5	
6Dyh - 6Dyg	34.3	1	
6Dyh2	5.4	2	
6Dyj	66.6	21	
6Dyj - 6Dda	12.5	1	
6DyjS	21.5	2	
6Gna - 6Ufd	15.0	1	
6Gna - 6Ufc	31.7	1	
6Gna - 6Dyg	11.8	1	
6Gna	70.4	14	
6Gna2-6Dra2	25.1	2	
6Gna2	230.3	34	
6Gna2- 6Uga	4.1	1	
6Gna2-6Dyb2	4.9	1	496.8
6Gna2- 6Dda	31.3	1	
6Gna5	5.4	1	
6GnaE	37.3	9	
6GnaE-6Ucc2	5.0	1	
6Gnd2	1.7	1	
6Gne	22.8	2	
6Ucc - 6Dbf	4.2	1	
6Ucc	6.0	4	12.2
6Ucc2	2.0	2	

Mapping Unit	Area (ha)	Frequency	Total Area (ha)
6Ufa	109.6	18	
6Ufa - 6Gna	21.4	1	
6Ufa2- 6Ucc	10.7	1	
6UfaS	5.5	2	
6Ufb	16.2	5	
6Ufb2	4.4	2	
6UfbE	8.4	1	
6Ufc - 6Ucc	7.0	1	
6Ufc - 6Dyg	7.0	1	365.7
6Ufc	35.0	5	
6Ufc5	1.5	1	
6UfcE	12.7	1	
6Ufd	38.4	11	
6Ufd2	1.6	1	
6UfdE	64.9	2	
6Ufe	6.5	3	
6UfeE	14.9	3	
6Uga - 6Ufe	4.9	1	
6Uga -6Gna2	4.0	1	
6Uga	261.2	37	
6Uga2	30.1	7	
6Uga2-6Gna2	10.1	1	405.3
6Uga5-6Gna2	3.6	1	
6Uga5	32.6	2	
6UgaE	25.8	4	
6UgaS	17.3	3	
6UgaW	15.7	6	
6Umb2	3.6	1	3.6
LU6	3026.1	449	3025.2
Total	9297.6	825	9297.6

SOIL MORPHOLOGY AND DISTRIBUTION

A general description of the soil type and its location in the landscape is given under the appropriate landscape unit. A high proportion of the survey area is occupied by soil types modified by a variant or phase. These variants and phases are also discussed under the appropriate landscape unit heading.

Seventy two soil types as well as 11 variants and phases were identified in the survey area. A brief description of the major distinguishing attributes of each soil type is shown on the reference of the soils map which accompanies this report. Detailed morphological descriptions, showing the full range of attributes of the soil types, can be found in Loi *et al.* (1994).

Landscape unit 1 (1468.8 ha)

Black earths and grey clays (1Uga, 1Ugc, minor 1Ugd and 1Ugf) are located in low lying flats and drainage depressions, mainly in Inkerman West Section. The presence of normal gilgai and their position in the landscape, indicate that these soils are seasonally waterlogged and subjected to local flooding in some areas. Soil type 1Ugc has a light clay A horizon and the surface is usually hard setting or weakly self mulching while 1Uga is heavier (medium clay) and the surface has a stronger self mulch. Soil type 1Ugd is always grey and mottled, indicating wetter conditions. Soil type 1Ugf always has a bleached A2 horizon.

Soil type 1Uge is located on pediments with slopes usually greater than 1%. Linear gilgai with mound and depression has developed on these pediments. A shelf component is often associated with this linear gilgai and is occupied by 1Dyd (solodic soil - solodized solonetz). Soil type 1Dyd has properties similar to soil type 1Dyc which is described below.

Solodic soils and solodized solonetz (soil types 1Dyc, 1Dbb and minor 1Dba, 1Dda, 1Dya and 1Dyb) are present on pediments and the slightly elevated flats which are between 0.5 and 1 m higher than the low lying flats and drainage depressions. These soil types are strongly sodic by 0.3 m - 0.6 m and often have high levels of salt. The A horizons are from 0.1 m - 0.15 m thick and usually have clay loam texture. However, the texture of the A horizon of 1Dbb is usually sandier (SCL) and up to 0.2 m thick. Soil type 1Dyb has a sandy textured D horizon underlying the clay B horizon.

A number of eroded and salinity phases are associated with these soils. Variants 1, 2 and 5 are also present.

Landscape unit 2 (429.9 ha)

Grey clays (2Uga, 2Uge and minor 2Ugd, 2Ugf and 2Ugg) are located on low lying areas adjacent to the Burdekin Delta and are subjected to seasonal waterlogging and flooding. Eroded, saline or wetness phases of soil type 2Ugh have also been mapped.

A minor area of soil type 2Dyb is on slightly higher flats.

Landscape unit 3 (2483 ha)

The soils of LU3 vary depending on location. Black earths and minor grey clays 3Uga, 3Ugd and 3Ugc, dominate the low lying drainage areas between LU2 and LU1 in the Lake Plain area. Soil type 3Uge, has brown light clay D horizons which are similar to the D horizons of the soils of the Burdekin River alluvial plain. A grey clay, 3Ugk, borders part of landscape unit 5. Soil type 3Ugb occupies a small area adjacent to LU6. These soils all have self mulching surfaces and are at least medium clay texture throughout.

Landscape unit 3 in the eastern part of the survey area is occupied by variants of 3Uga, d and e. The soils in this area often contain small pebbles within the B horizon, which is defined as variant 8. Soil types 3Uge1 and minor 3Uga1 with buried decomposing granite before 1.5 m, are found near the relict rises of LU5. Soil type 3Uga9 with mottled lower B horizons have been mapped on the lower slopes, often adjoining areas that have been salinised and mapped as saline phases (S). These mottled lower B horizons suggest that high periodic watertable rises may be responsible for this uncommon feature in these soils. Often these soils also contain small pebbles in the B horizon. Soil type 3Uga3 which has a lighter clay surface texture occupies UMA 814.

Gully heads are still progressing in this landscape unit and serious erosion has developed, especially in areas draining to Salt Water Creek. These areas have been mapped as eroded phases (E). UMAs 790 and 818 identify areas of 3Uga with rock outcrop (3UgaR).

Landscape unit 4 (597.2 ha)

The soils of this landscape unit usually have sandy loam to sandy clay loam A horizons although those on the lower slopes may have finer textured A horizons. Podzolic soils, 4Dyl and 4Dyd, occupy the crests, upper and mid slopes while soil types 4Dye, 4Dyf, 4Dyj (solodic soils - solodized solonetz) are found on mid and lower slopes. Soil types 4Dyg and 4Dyh, which are higher in salts, occupy lower slopes.

Soil type 4Dga which has affinities with a gleyed podzolic soil occupies UMA 543. Variants 1, 3 and 5 of soils of landscape unit 4 indicate shallower depth of soil to rock, different depths and textures of the A horizon and different B horizon colours to that of the modal soil type, respectively.

Phase R, indicates a greater abundance of stone, within UMAs 516 and 529, than that usually found on soil types 4Dyg and 4Dyh respectively. UMA 534 identifies an eroded phase of soil type 4Dyg while UMA 426 identifies a saline phase of soil type 4Dyh.

Landscape unit 5 (1293.5 ha)

Contrasting soils associated with acidic and basic rocks have developed on the mixed geology of LU5. Soil type 5Dra is usually found on the upper slopes. It is also found on relict ridges such as UMAs 45 and 778. These relict ridges are not much higher than the alluvial areas which surround them. Isolated areas of 5Dra are also found on crests surrounded by soil types of LU4. The alkaline soils within UMA 58 (5Dra6) have a higher pH than normally associated with 5Dra.

Soil type 5Dya is a minor soil associated with 5Dra on the upper and mid slopes. This soil is often very deep in the study area and decomposing rock is not encountered before 1.5 m in some areas. Soil types 5Dyb and 5Dye are usually found on mid and lower slopes. Soil type 5Dyb in UMAs 39 and 285 exhibit atypical characteristics such that the B horizon slumps, allowing the development of tunnel erosion.

Soil type 5Dyc (solodic soil - solodized solonetz) occurs on lower slopes, usually associated with potential secondary salinisation. Restrictions to the seasonal downslope movement of groundwater may cause upward water movement in this soil type with subsequent accumulation of salts by evapotransportation. Soil type 5Dyd of minor occurrence, has developed in similar positions.

Small areas of soil types 5Uga and 5Ugb are scattered within areas of soil types 5Dra, 5Dya, 5Dyb, 5Dyc and 5Dye and are usually developed on basic dykes which have intruded the acidic or intermediate base rock. Larger, more uniform areas of soil type 5Ugb are mapped as UMAs 274 and 275. The soils of UMA 275 are very shallow (5Ugb1).

A complex soil formation with linear gilgai occurs in limited areas on mid to lower slopes. Soil type 5Dyf, (solodic soil - solodized solonetz) has developed on the shelf of the linear gilgai, 5Ugc (black earth) in the depression and 5Ugd (grey clay) on the narrow mound.

Rock (R), eroded (E) and saline (S) phases of some of the soils of landscape unit 5 are present, as well as soil variants 1, 3, 5 and 6.

Landscape unit 6 (3025.2 ha)

The miscellaneous alluvial deposits of LU6 have been divided into creek and relict alluvial landforms and the Burdekin Delta. Some soil types occur on both landforms. They are listed on the map reference under the landform that they are either most common or occupy the largest areas.

On the Burdekin Delta, soil types 6Gna, 6Gne, 6Dyg and 6Dyj are common. The solodic soils - solodized solonetz (6Dyg and 6Dyj) are strongly sodic and highly saline. Slopes are very low.

Numerous floodouts, fans and levees have developed from alluvia deposited from the ranges and hills on the western and southern sides of the survey area. The size of the alluvial area developed, the age of sediment, the depth of present soil developed and the complexity of the area varies considerably.

Small, narrow levees and fans are associated with the streams rising in the hills, especially in the west, and which terminate in the alluvial areas of LU1. Soils developed on these deposits are shallow and overlie buried soils. These soils are distinguished by soil variant 2. The gradational soil, 6Gna2, is a common soil developed in these situations. Broader, lower fans have developed from deposition from the hills in the south-east or from overflow from Yellow Gin Creek. Cracking clay 6Uga and gradational soil 6Gna are common.

The alluvial areas associated with major creeks such as Six Mile, Four Mile and Two Mile Creeks and other unnamed creeks are much larger. Deposition is still occurring at the mouth of these present creeks which terminate in landscape unit 3. Solodic soils, 6Dba, 6Drc and 6Dyg are common soils associated with these deposits on the upper slopes. The alluvial deposits are often finer, further down the slope, and uniform, non cracking clays and cracking clays such as soil types 6Ufa, 6Ufd, 6Ufc and 6Uga have developed.

Older sediments associated with prior streams have encroached over landscape unit 3 with gradational soil 6Gna2 and non-sodic duplex soil 6Dbf2 being common soils on the levees of the prior streams. Soil type 6Ucc is often found in the infilled channels of the prior streams, but these old channels are often so narrow that they cannot be mapped at the 1:25 000 scale. Soil types 6Dda, 6Dyg (solodic soil - solodized solonetz) and 6Ufa and 6Uga are often found in the lower depressions.

A number of eroded phases (E), wet phases (W), and some saline phases (S) are associated with the soils of landscape unit 6. The area excavated for a large farm dam has been mapped as 6P.

SOILS - CHEMICAL AND PHYSICAL ATTRIBUTES

Introduction

Twenty soil profiles, representing 11 soil types were sampled and analysed in this survey area. Profiles were sampled to 1.5 m either from pits, 0.15 m cores or from a number of 0.05 m cores. Each profile was usually sampled in 0.1 m intervals, but when an important soil horizon boundary occurred within these intervals, the depth of sampling was adjusted accordingly to avoid sampling across horizons.

Analytical results from selected profiles from sample area two (Thompson 1977), which lies within the survey area, have also been included with the data from this survey to increase the range of data used in the discussions of the attributes.

Soil chemical and physical properties were analysed by Agricultural Chemistry, DPI at intervals 0-0.1, 0.2-0.3, 0.5-0.6, 0.8-0.9 and 1.1-1.2 m or at other intervals if the 0.1 m intervals coincided with an important soil horizon boundary. The standard suite of analyses was undertaken according to methods described by Baker (1991). A bulk sample from a number of surface samples to 0.1 m depth was collected near each site for nutrient analyses using a foot operated core sampler.

For comparison purposes, the analysed soil profiles were divided firstly into two broad soil groups based on soil morphology. These groups corresponded to the primary profile forms or their subdivisions of Northcote (1979), namely cracking clays (Ug) and duplex soils (D). Within these two broad divisions, the soil types were then placed into more homogeneous groups based on position in the landscape, and similarities of morphology, chemical and physical attributes and management requirements. Table 2 lists the soil types and groups with the survey and site number, as well as a brief description. Some of the soil groups contain only one soil type but are left as a group for ease of discussion and illustration. These groups either correspond with the soil subgroups as described in Donnollan (1991), or have been split further to highlight differences.

The more important chemical and physical attributes of the soils that affect irrigated crop production are discussed. These attributes include nutrients, pH, sodicity, salinity and plant available water capacity. Some attributes of soil type 6Dyg sampled from the Burdekin Delta and also from the Creek and Relict Alluvial Deposits are shown, to highlight the differences that can occur on the same soil type from different alluvial areas. Some attributes of soil types from different terrain in landscape unit 3 are also compared to highlight their differences.

Detailed morphological and analytical data for the analysed soil profiles for this survey are presented in Appendix I.

Table 2 A brief description of the soil groups with the soil type, survey and site number used for comparison of some chemical and physical attributes for Inkerman West and Central Sections, BRIA.

Soil group	Soil types	Soil subgroup[1]	Survey[2] and	site number	Brief description
1	1Uga m[3]	1A	BRB	1A	Cracking clays with normal gilgai on landscape unit 1
	1Uga d[4]		BRB	1B	
	1Ugc m		BRB	3A	
	1Ugc d		BRB	3B	
2	1Uge d	1D	BRB	5A	Cracking clays with linear gilgai on the slopes of landscape unit 1
	1Uge d		IMC	13	
3	3Ugc m	1B	BRB	21A	Cracking clays of landscape unit 3 in an embayed position
	3Ugc d		BRB	21B	
	3Uga m		BRB	19A	
	3Ugd m		BRB	22A	
4	3Uga 9m	1B	IMC	S01A	Cracking clays on sloping lands of landscape unit 3 with significant amounts of small pebbles throughout the B horizon (variant 8) and/or with mottled B horizons at depth (variant 9)
	3Uga 9d		IMC	S01B	
	3Uge 9m		IMC	S02A	
	3Uge 9d		IMC	S02B	
	3Uga 8m		IMC	S04	
	3Uga 8d		IMC	S05	
	3Uge 8m		IMC	S06	
	3Uge 8d		IMC	S07	
	3Uga 9m		IMC	S08	
	3Uga 9d		IMC	S09	
5	1Dyc	2A	BRB	8C	Solodic soil - solodized solonetz of landscape unit 1
6	1Dda	2B	BRB	12C	Solodic soil - solodized solonetz of landscape unit 1
	1Dyd		IMC	S12	
7	6Dda	2B	IMW	S01	Solodic soil - solodized solonetz of landscape unit 6
	6Dyg		IMW	S02	
8	6Dba	2B	IMW	S05	Solodic soil of landscape unit 6
9	4Dyf	2B	IMC	S11	Solodic soil on landscape unit 4
10	5Dye	2C	IMW	S03	Alkaline duplex soil of landscape unit 5
11	5Dya	3B	IMW	S04	Duplex soils with neutral pH on undulating rises
	4Dyl		IMC	S10	

[1] Soil subgroups of Donnollan (1991)
[2] BRB Burdekin Right Bank (Thompson 1977)
IMW Inkerman West Section
IMC Inkerman Central Section
[3] Mound
[4] Depression

Table 3 Ratings[1] for nutrients and carbon/nitrogen ratio (C/N) in the bulk surface sample (0-0.1 m) for the soil types or soil groups in Inkerman West and Central Sections, BRIA

Soil type or group	Extractable P Bicarb P	Extractable potassium	Exchangeable potassium	Total nitrogen	Organic carbon	C/N Ratio	Total S	Zinc	Copper	Manganese
Group 1	low	medium	medium	low	low	15.4	low	---[3]	---	---
Group 2	very low	low	low-medium	low	low	12.5	low	low	medium	high
Group 3[2]	medium	high	high	low	low	18.5	low	---	---	---
Group 4	very low	medium	medium-high	low	low	14.9	low-medium	low	medium	medium
Group 5	very low	low	low	low	low	15.0	low	---	---	---
Group 6	very low	low	low	low	low	14.8	low	very low	medium	high
Group 7	low	medium	medium-high	low	medium	14.3	low-medium	medium	medium	high
Group 8	low	medium	medium	low	low	11.7	low	medium	medium	high
Group 9	very low	very low	medium	low	low	14.0	low	very low	medium	medium
Group 10	very low	medium	medium	low	low	13.7	low	medium	medium	high
Group 11	very low	low-medium	medium	low	low	16.7	low	low (4Dyl) medium (5Dya)	medium	high
6Dyg[4]	high	high	very high	low	medium	14.0	medium	medium	medium	medium
6Gna[4]	high	high	high	low	medium	22.0	low	---		---

[1] Ratings are from Bruce and Rayment (1982)
[2] Data only available from 3Ugc in this group
[3] Data unavailable
[4] Profiles from the Delta and alluvial fans respectively

Nutrients

An adequate supply of nutrients is required by plants for their growth, development and reproduction. Table 3 shows the levels of nutrients in the 11 soil groups; for comparative purposes Table 3 also includes the nutrient levels of soil type 6Gna sampled from an alluvial fan position of LU6A and 6Dyg from the Delta lands of LU6B. The ratings, low, medium and high are those from Bruce and Rayment (1982).

Rayment and Bruce (1984), although recommending that these ratings should be taken as a guide only, suggest that when very low or low ratings for phosphorus, potassium, zinc and copper are recorded, the fertiliser rate required usually equals the highest normally recommended in the district for the specific crop, tree or pasture.

Phosphorus

Most soils have low to very low levels of phosphorus ranging from 1-15 mg kg^{-1}. However, soil types 3Ugc in the Lake Plain area, 6Dyg on the Burdekin Delta and 6Gna on the older alluvial fans of LU6 have levels from 27 to 115 mg kg^{-1}. The low levels are consistent with those from other areas of the BRIA (Donnollan 1991). Applications of phosphatic fertilisers will therefore be required over most of the area. The rates of P will also have to be sufficient to counteract the effects of high P sorption characteristics of many of these soils. Elliot and McDonald (1987) have shown that the Gaynor soil, solodic soil - solodized solonetz of LU1, has a high P sorption capacity. Maltby and McShane (1988) have also shown that the subsurface horizons of some cracking clays in the BRIA when exposed on levelling will require higher rates of P fertiliser to counteract the greater P sorption characteristics of these horizons.

Potassium

Both extractable and exchangeable potassium are at medium to high levels in most of the soils analysed. However, the solodic soils - solodized solonetz and the cracking clays on the pediments (1Uge) of LU1 often have low levels (< 0.2 m. equiv. 100 g^{-1}) and responses to potassium fertiliser should be expected. The soils of LU4 with coarse textured A horizons have low levels of the acid soluble fraction (extractable) (0.07 - 0.16 m. equiv. 100 g^{-1}) but medium levels of exchangeable K (0.23 - 0.4 m. equiv. 100 g^{-1}). The highest levels are in soil type 6Dyg of the Delta, 6Gna on the older fan deposits of LU6 and the cracking clays of LU3 in the Lake Plain area (group 3). These levels are all greater than 0.8 m. equiv. 100 g^{-1}.

Organic carbon and nitrogen

Measurements of organic carbon and total nitrogen give some indication of the response by plants to nitrogen. The ratio C/N gives an indication of whether microbial conversion of organic N to mineral N or the reverse is likely (Baker 1991). Values <15 especially in soils of medium to fine textures, usually indicate that N is released to the soil and plant systems. If the C/N values are wider there may be a tie up of mineral N in the soil.

All analysed soils are low in both organic carbon (<1.5%) and total N (<0.15%) except for 6Dyg (Delta), group 7 (6Dda and 6Dyg), and soil type 6Gna of the alluvial fan deposits which have medium levels of organic carbon (>1.5%). The C/N ratios range from about 11 to 22. Most are between 14 and 16 with 6Gna and 3Ugc the highest at 22 and 18.5 respectively. Some nitrogen immobilisation may occur in the two latter soil types. Soil type 3Ugc was carrying a heavy cover of paragrass which would explain the relatively high organic carbon level.

Sulphur

Total S is regarded as a poor indicator of soil S deficiency but Andrew *et al.* (1974) has suggested that soils with <0.013 percent of total S may respond to sulphur applications.

Using this criteria, the solodic soils - solodized solonetz of LU1 and the soils of LU4 (groups 5, 6, 9 and 4Dyl of group 11) may respond to sulphur.

In most soils, total S decreased down the profile, except in soil types 6Dyg (Delta) and one of the sites in soil group 2 (BRB5A). Gypsum occurred at depth in these two soils.

Trace elements - copper, manganese and zinc

The levels of copper and manganese are adequate and responses to these elements would not be expected. Most soils have values between 1 and 2 mg kg^{-1} for copper and between 35 and 135 mg kg^{-1} for manganese. However, the cracking clays of group 4 have lower manganese levels of between 7 and 20 mg kg^{-1}.

Low to very low levels of zinc were found for the cracking clays of the sloping lands of LU3 (group 4), the solodic soils - solodized solonetz and the cracking clay (1Uge) of the pediments of LU1 (groups 2, 5 and 6) and the soils of LU4. Most soils of group 4 were below 0.4 mg kg^{-1}, some as low as 0.11 mg kg^{-1}. Soil type 4Dyf (group 9) had a level of 0.05 mg kg^{-1}. Viets and Lindsay (1973) suggest that responses to zinc may occur at levels below 0.5 mg kg^{-1} although Bruce and Rayment (1982) suggest that deficiencies may occur at pH >7.0 below the 0.8 mg kg^{-1} level. All the above soils should respond to zinc applications.

Zinc availability is very dependant on pH as the solubility of this element decreases approximately 100 fold for each unit increase in pH (Bruce 1983). Mikkelsen and Kuo, (1976) have also shown that zinc deficiencies are common in alkaline or calcareous soils with pH of 7.4 or higher. Responses to zinc are therefore expected to be more widespread when levelling is undertaken, especially if this operation exposes subsoils with pH >7.4. All cracking clays may therefore require zinc applications.

Soil pH

Soil pH has a major influence on the availability of nutrients and the presence or absence of toxic elements can be inferred from it. Soil pH profile values have been graphed for the soil groups and are shown in figures 4, 5 and 6.

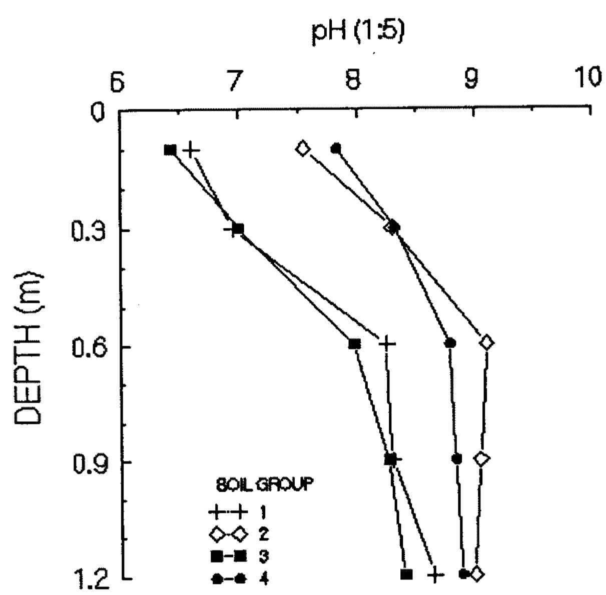


Figure 4 pH profiles for soil groups 1, 2, 3 and 4 (cracking clays) for Inkerman West and Central Sections, BRIA.

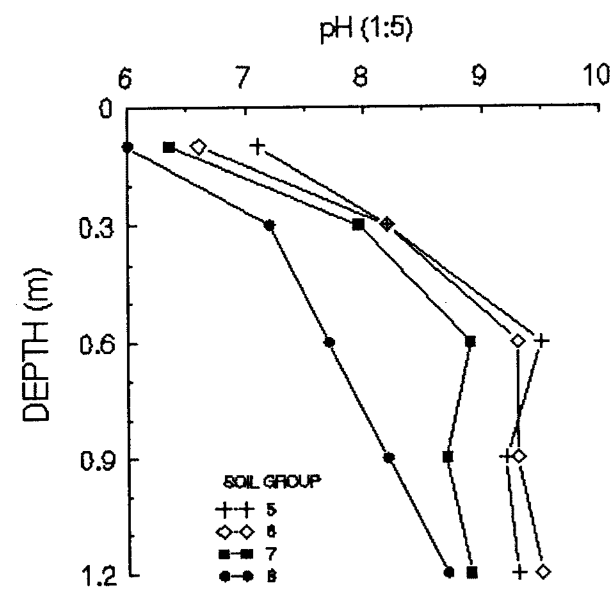


Figure 5 pH profiles for soil groups 5, 6, 7 and 8 (solodic soil - solodized solonetz of the alluvial landscapes) for Inkerman West and Central Sections, BRIA.

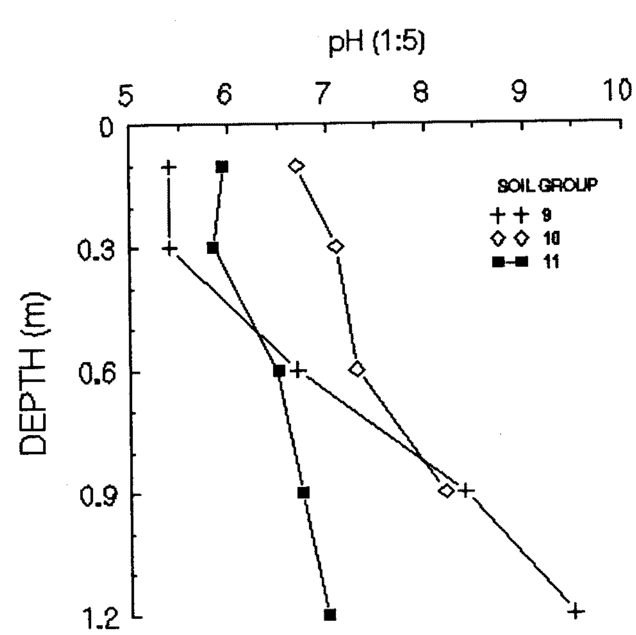


Figure 6 pH profiles for soil groups 9, 10 and 11 (duplex soils of the undulating rises) for Inkerman West and Central Sections, BRIA.

The cracking clay groups (groups 1, 2, 3 and 4) have a similar pH trend with an increase of about one and a half pH units from the surface to 0.6 m and then remaining similar to depth. The groups, however, fall into two categories, with soil groups one and three being lower than soil groups two and four by about one pH unit from the surface to 0.6 m, with this difference decreasing slightly to depth.

For the solodic soil - solodized solonetz of the alluvial landscape units, soil groups 5, 6 and 7 have similar pH trends, increasing by two to two and a half pH units from at 0.1 m to 0.6 m and then remaining similar to depth. However, soil type 6Dba (group 8) does not have a maximum pH at 0.6 m but increases almost linearly from pH 7 at 0.3 m to pH 8.5 at 1.2 m.

The pH of the duplex soils of the undulating rises, as shown in figure 6, also increases gradually down the profile with no maximum pH at 0.6 m. Soil type 4Dyg (group 9) has an acid pH in the sandy A horizon which increases by about four units to strongly alkaline from the top of the B horizon to 1.2 m. Soil types 5Dya and 4Dyl (group 10) have a neutral pH trend while 5Dye increases from pH 6.7 at 0.1 m to pH 8.2 at 0.9 m.

Sodicity

High levels of sodium can affect plant growth by direct toxicity, and by reducing the availability of, and causing imbalances between calcium and magnesium. However, the greatest effect of high sodicity is the development of poor soil physical conditions. Reduced aggregation and clay dispersion results in surface crusting with subsequent decreased water infiltration and the development of poor seedbed conditions. Poor aeration, lower permeability, reduced water storage and increased soil strength results from high levels of sodicity in the subsoil.

Sodicity is usually expressed as exchangeable sodium percentage (ESP) which is defined as:

$$ESP = \frac{Exchangeable\ Sodium\ (Na)\ x\ 100}{Cation\ Exchange\ Capacity\ (CEC)}$$

Northcote and Skene (1972) developed three sodicity classes based on ESP. These classes are non-sodic (ESP<6), sodic (ESP 6-14), and strongly sodic (ESP >15). These three classes are widely used to assess sodicity in soils.

Figures 7, 8 and 9 show the ESP profiles for the cracking clay and duplex soil groups.

The cracking clay groups are non-sodic in the upper depths increasing gradually, becoming sodic to strongly sodic at depth. Soil type 1Uge (group 2) has the highest levels, becoming strongly sodic by 0.6 m increasing to about 25 at 1.2 m. Group 4 which had a similar pH trend to that of group 2, had the lowest ESP levels. The pH/ESP relationship for the soils of group 4 is much closer to that developed by Baker *et al.* 1983

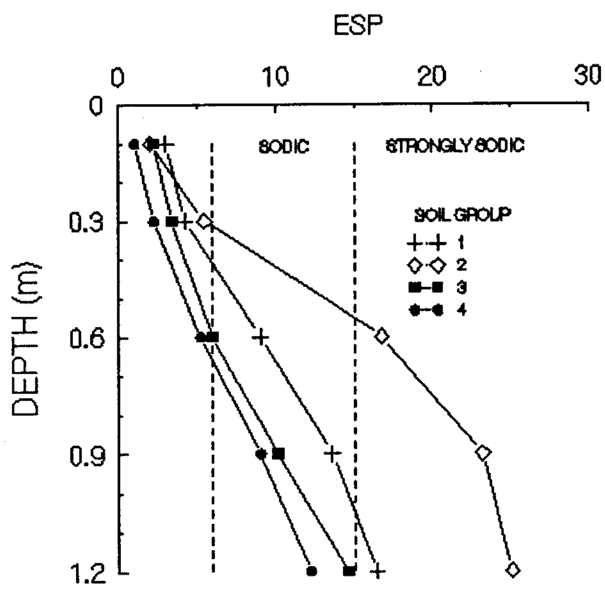


Figure 7 ESP profiles for soil groups 1, 2, 3 and 4 (cracking clays) for Inkerman West and Central Sections, BRIA.

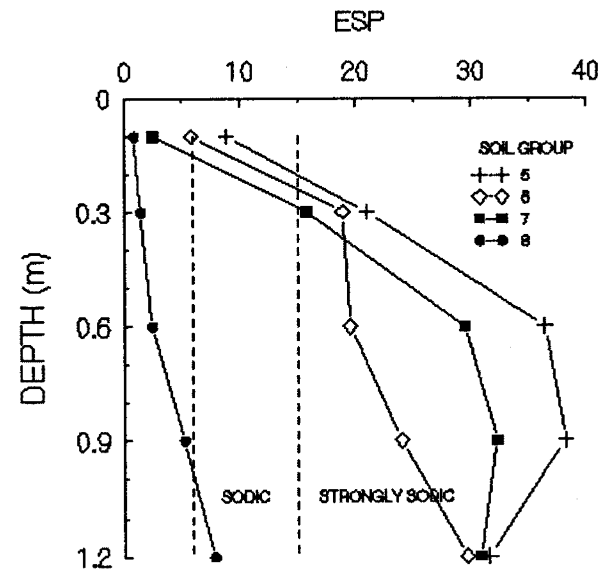


Figure 8 ESP profiles for soil groups 5, 6, 7 and 8 (solodic soils - solodized solonetz) for Inkerman West and Central Sections, BRIA.

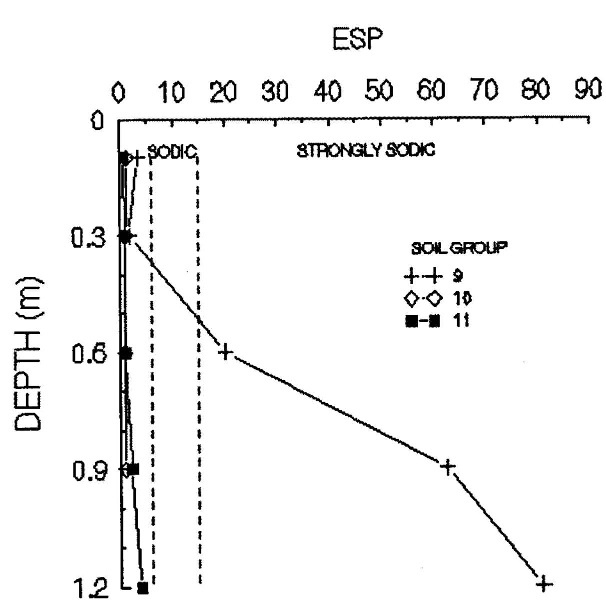


Figure 9 ESP profiles for soil groups 9, 10 and 11 (duplex soils of the undulating rises) for Inkerman West and Central Sections, BRIA.

for the cracking clays of the Left Bank of the BRIA than that for group 2. The ESP trend of soil type 1Uge is more like that shown by solodic soils - solodized solonetz which it is often associated with, in particular soil type 1Dyd.

Figure 8 shows the typical ESP trend of the strongly sodic duplex soils in the BRIA (groups 5, 6 and 7), with a relatively sharp increase from the surface to 0.3 m to 0.6 m and then remaining at similar levels to depth. Soil type 1Dyc is the most sodic with levels of 21 at 0.3 m, increasing to about 40 ESP.

The two soil types in group 6, (that is soil types 1Dda and 1Dyd) have different ESP levels at 0.3 m, 24 for 1Dda and 14 for 1Dyd but reach similar levels by 0.6 m. Soil type 6Dba (group 8), has much lower ESP levels than 6Dda and 6Dyg, only becoming sodic at 1.2 m. Soil types 6Dda and 6Dyg (group 7) have levels of 16 at 0.3m increasing to about 30 at lower depths.

The duplex soils of the undulating rises have different ESP trends to those of the alluvial plains. Soil type 5Dye (group 10), and soil group 11 (5Dya, 4Dyl) were non-sodic throughout. Soil type 4Dyf, a solodic soil also has a different trend to the solodic soils of the alluvial plains, by not having a peak ESP but increasing down the profile to extremely high levels of 80 at depth.

Salinity

Excessive quantities of total soluble salts affect crop growth by reducing water availability to the plant through osmotic pressure effects and also by toxicity effects on plant metabolism.

Total soluble salt content was determined by electrical conductivity of a 1:5 soil:water extract ($EC_{1:5}$). Although $EC_{1:5}$ is a convenient laboratory measurement, the electrical conductivity of a saturation extract (EC_{se}) is a more useful determination to relate to plant response. The EC_{se} measurements were therefore converted to EC_{se} values using the mathematical model developed by Shaw *et al.* (1986).

The EC_{se} and %Cl profiles for the cracking clay groups are shown in figures 10 and 11.

The salt levels of all the groups increase down the profile. Similar trends occur but the salt levels below 0.3 m for each group are different. Soil type 1Uge (group 2) becomes highly saline (> 4.5 ds/m) at 0.9 - 1.2 m, the other groups have low to medium levels by 1.2 m. Both soil groups of LU1 (groups 1 and 2) have higher levels than those of LU3 (groups 3 and 4).

The trend for the %Cl profiles for the cracking clays are similar, with groups 1 and 2 higher than soil groups 3 and 4. However, the difference between soil groups 1 and 2 is not as pronounced, indicating that salts other than chloride are in a greater proportion in group 1. The difference in salt composition has been influenced by the presence of gypsum which was observed in one of the soil profiles in group 1.

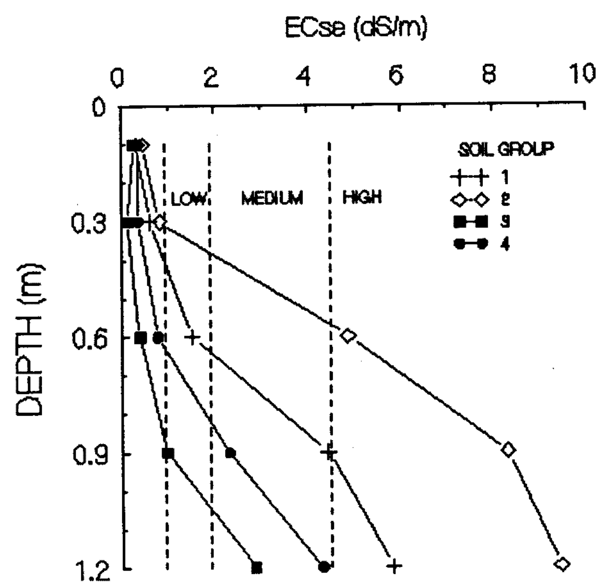


Figure 10 EC_{se} profiles for soil groups 1, 2, 3 and 4 (cracking clays) for Inkerman West and Central Sections, BRIA.

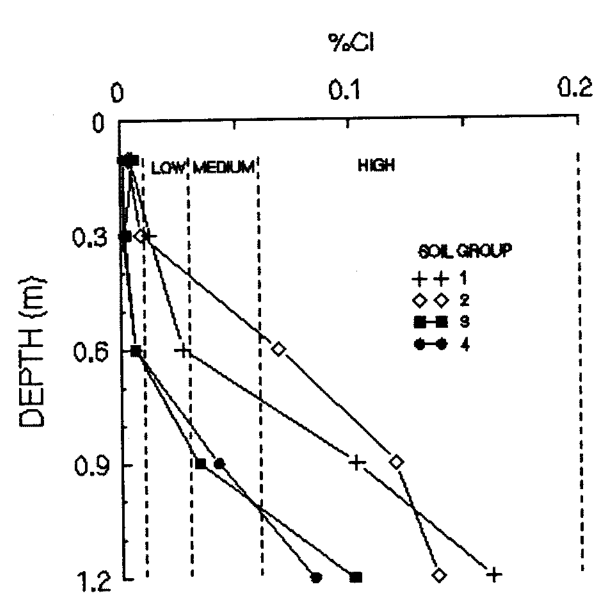


Figure 11 % Cl profiles for soil groups 1, 2, 3 and 4 (cracking clays) for Inkerman West and Central Sections, BRIA.

The EC_{se} and %Cl profiles for the duplex soils are shown in figures 12, 13, 14 and 15. Groups 5, 6 and 7 show the typical salt bulge associated with most solodic soils - solodized solonetz. These soil groups become highly saline and peak at the 0.6-0.9 m depth. The solodic soil 6Dba (group 8) has very low levels of salt throughout the profile, atypical for this group of soils.

The other duplex soils on the undulating rises also have low levels of salts throughout, except for 4Dyf (group 9) which increases at depth to the high level.

The %Cl profiles show similar trends to the EC_{se} profiles, with soil groups 5, 6, and 7 reaching peaks at 0.6 - 0.9 m. However, the shape of the profiles suggest that group 5 has a higher proportion of salts as chloride than groups 6 and 7.

Plant available water capacity (PAWC)

Plants require an adequate water supply for optimum growth. Any restriction of the soil water supply to the plant imposes a limitation to potential crop yield. Under irrigation a reduced plant available water storage capacity (PAWC) means more frequent irrigations to attain optimum yield.

PAWC can be determined by measuring the difference between the upper soil water storage limit (field capacity) and the lower storage limit (permanent wilting point). However, as direct field measurements of PAWC are difficult and costly, PAWC is usually estimated by the use of predictive mathematical relationships. Regression equations developed by Shaw and Yule (1978) using -1500 kPa moisture potential are the most suitable for estimation of PAWC for a range of soils in the BRIA (Ahern 1988).

Depth of wetting for soils with restrictive subsoil wetting has to be considered when using this equation. McCowan *et al.* (1976) showed that ESP and salt profiles were closely related to depth of wetting and rooting depth.

The mean predicted PAWC and rooting depth for the soil groups analysed for this survey are given in Table 4. These values show that due to the restricted rooting depth of some of the solodic soils-solodized solonetz (groups 5, 6, 7 and soil type 6Dyg [Delta]), the PAWC is reduced by about half of that of the cracking clays. This predicted PAWC for these soils may also be an overestimation as the rooting depth may not be as deep as 0.6 m as very high ESP levels occur by 0.3 m.

Soil type comparisons

Soil type 6Dyg from landscape 6A and 6B

Representative profiles of soil type 6Dyg were sampled and analysed from within UMAs on the Burdekin Delta (LU6B) and from an alluvial fan area on the creek and relict alluvial landforms (LU6A). The soil morphology of both sites was within the properties specified in the soil type description of 6Dyg for the BRIA except that the Delta site contained gypsum at depth. However, important differences in the chemical and physical attributes were shown by the results of the analyses. Graphs of pH, sodicity, EC_{se} and chloride are shown in figures 16, 17, 18 and 19.

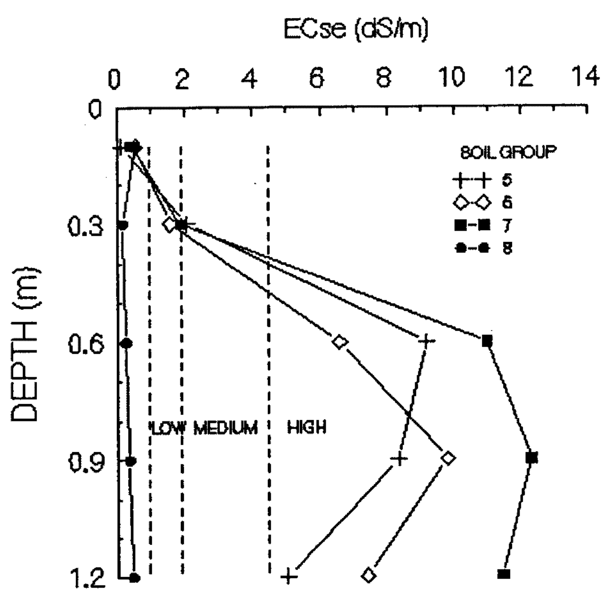


Figure 12 EC_{se} profiles for soil groups 5, 6, 7 and 8 (solodic soil - solodized solentz) for Inkerman West and Central Sections, BRIA.

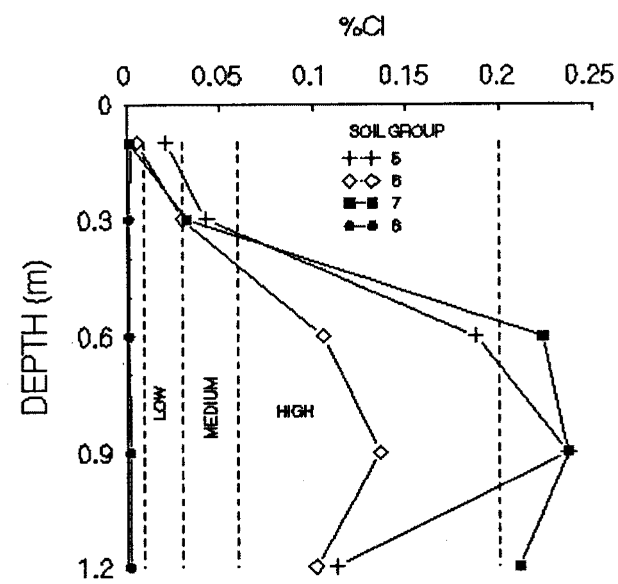


Figure 13 % Cl profiles for soil groups 5, 6, 7 and 8 (solodic soil - solodized solonetz) for Inkerman West and Central Sections, BRIA.

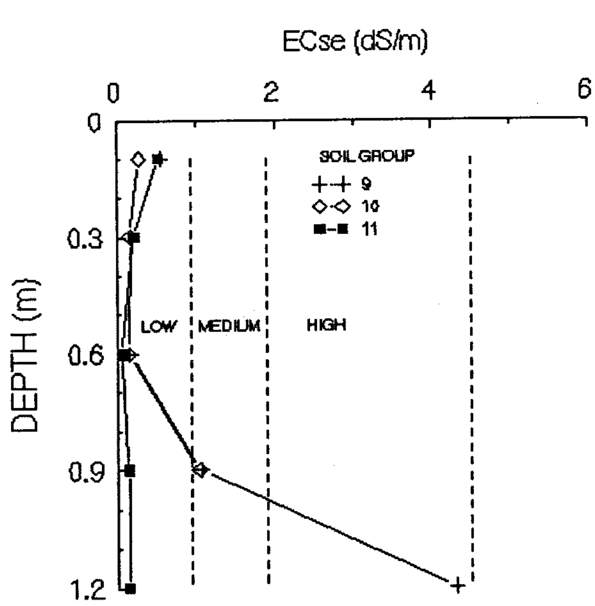


Figure 14 EC_{se} profiles for soil groups 9, 10 and 11 (duplex soils of the undulating rises) for Inkerman West and Central Sections, BRIA.

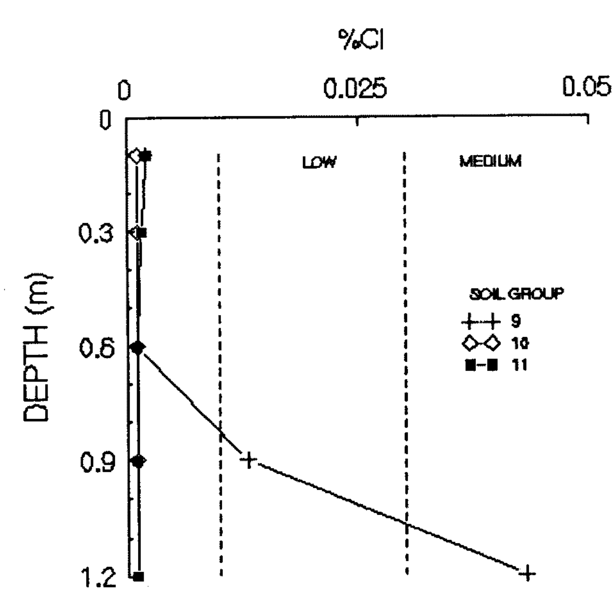


Figure 15 % Cl profiles for soil groups 9, 10 and 11 (duplex soils of the undulating rises) for Inkerman West and Central Sections, BRIA.

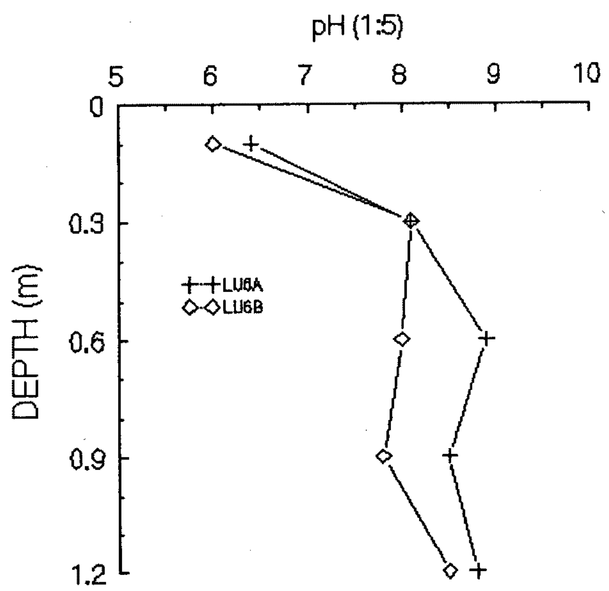


Figure 16 pH profiles for soil type 6Dyg from landcape unit 6A and the Delta lands of landscape unit 6B for Inkerman West and Central Sections, BRIA.

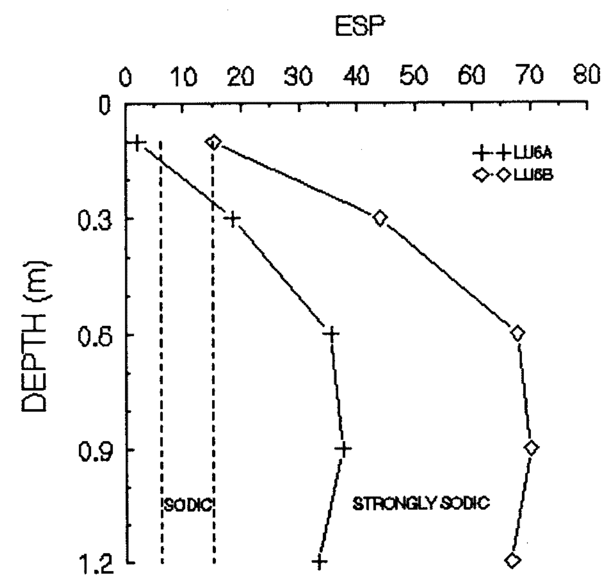


Figure 17 ESP profiles for soil type 6Dyg from landscape unit 6A and the Delta lands of landscape unit 6B for Inkerman West and Central Sections, BRIA.

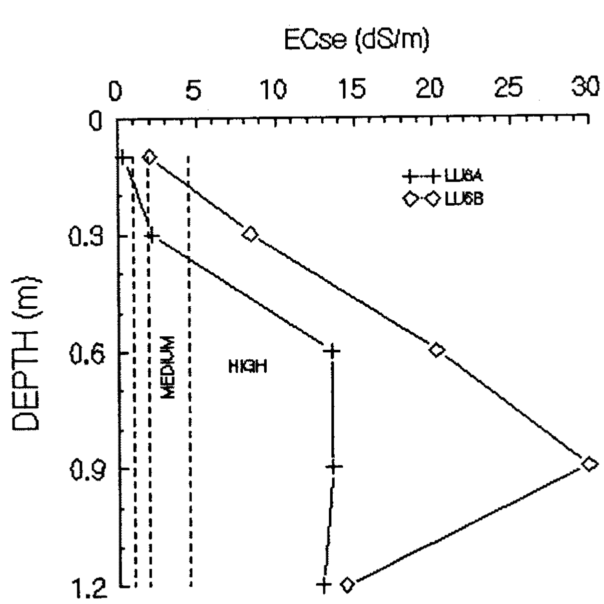


Figure 18 EC_{se} profiles for soil type 6Dyg from landscape unit 6A and the Delta lands of landscape unit 6B for Inkerman West and Central Sections, BRIA.

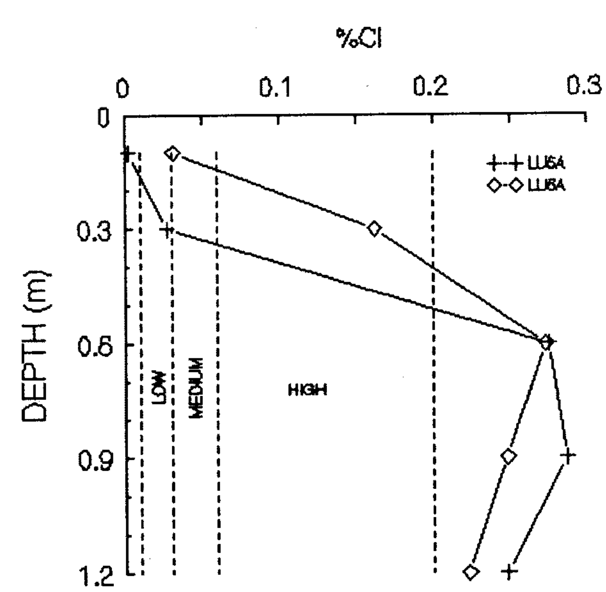


Figure 19 % Cl profiles for soil type 6Dyg from landscape unit 6A and the Delta lands of landscape unit 6B for Inkerman West and Central Sections, BRIA.

Table 4 Mean predicted PAWC and rooting depths for the soil groups or soil types sampled in Inkerman West and Central Sections, BRIA.

Soil group or type	PAWC (mm)	Predicted rooting depth (m)	Soil group or type	PAWC (mm)	Predicted rooting depth (m)
1	97.3	0.9	7	56.6	0.6
2	96.0	0.9	8	91.0	0.9
3	100.4	0.9	9	79.0	0.9
4	98.2	0.9	10	93.2	0.9
5	55.8	0.6	11	89.4	0.9
6	56.3	0.6	6Dyg (Delta)	57.0	0.6

The pH of the Delta soil was slightly lower at 0.6 and 0.9 m than that from the alluvial fan area. The ESP trend of both soil profiles is similar with both sites increasing in ESP until 0.6, then remaining near that level to depth. However, 6Dyg (Delta) has an ESP which is 25 higher at 0.3 m increasing to greater than 30 at lower depths. Even in the top 0.1 m, 6Dyg (Delta) is strongly sodic.

Both profiles are very highly saline at 0.6 m and below, but 6Dyg (Delta) has greater values. The presence of gypsum at 0.9 m has also influenced the level of salts. The Cl% profiles are remarkably similar with 6Dyg (Delta) having greater chloride levels in the upper profile but 6Dyg (alluvial fan) reaching the same very high levels at 0.9 m and remaining a little higher below. This trend indicates the higher proportion of chloride ions contributing to the soluble salts in the alluvial fan area than in the Delta soil.

Cracking clays of LU3 in an embayed position and on sloping lands

The cracking clays of landscape unit 3 in an embayed position (group 3) such as in the Lakes Plain area or in the Leichardt Downs area (Donnollan *et al.* 1990) have some different attributes from those of the sloping plains in Inkerman Central (group 4).

The mean clay percentage profiles are shown in figure 20. Clay content of the soils on the sloping lands are about 20% to 30% lower as they usually contain coarse fragments. Soils with 40% to 60% clay, similar to the clay content of the soils of the sloping lands are most likely to accumulate salts due to their lower porosity with subsequent reduced leaching properties (Shaw *et al.* 1986). The lower horizons of these soils presently have slightly higher salt levels from those in the embayed position.

Exchangeable cations (Na^+, Ca^{++} and Mg^{++}) are shown for these two groups of soils in figures 21 and 22. Sodium remains low and is similar throughout the profile for the two groups. However, magnesium becomes dominant over calcium below 0.3 m for the soils of the sloping lands. The Ca/Mg ratio nears 0.5 at 1.2 m, a ratio which Emerson (1977) associates with dispersion.

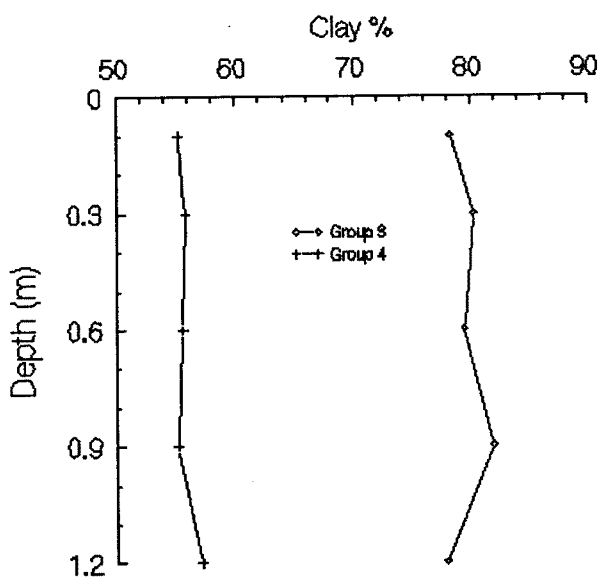


Figure 20 Percentage clay profiles for cracking clays of landscape unit 3 in an embayed position (group 3) and on sloping lands (group 4).

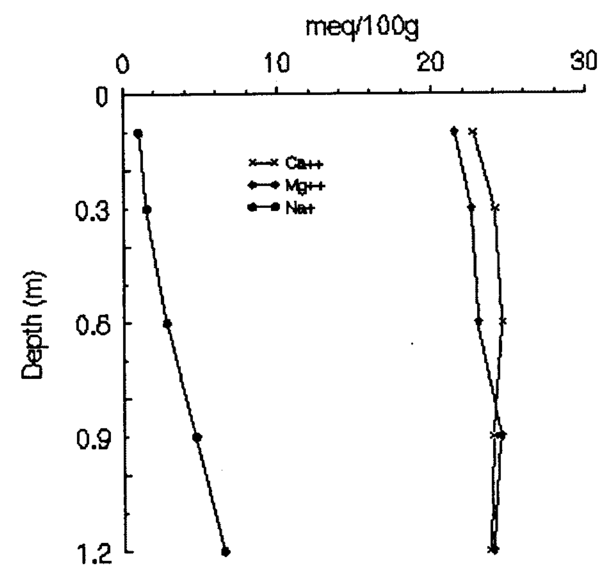


Figure 21 Exchangeable calcium, magnesium and sodium for cracking clays of landscape unit 3 in an embayed position (group 3).

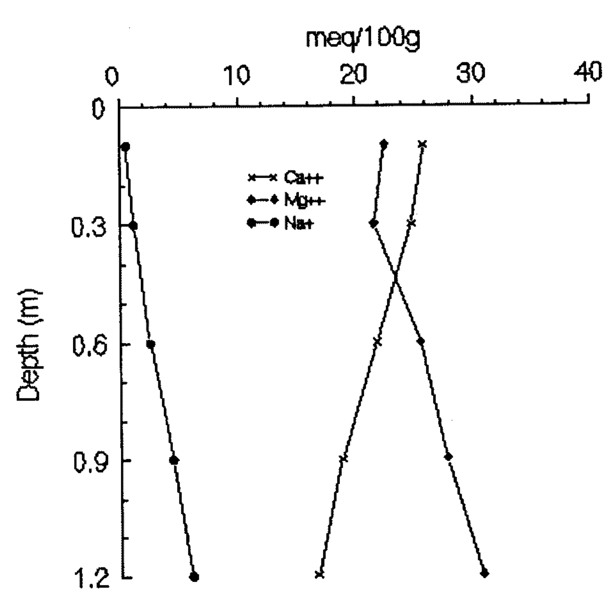


Figure 22 Exchangeable calcium, magnesium, and sodium for cracking clays of landscape unit 3 on sloping lands (group 4).

LAND USE

Present land use

Most of the survey area is used for the grazing of cattle on native pastures. Woody weeds, including prickly acacia (*Acacia nilotica*), mimosa bush (*Acacia farneseana*) and chinee apple (*Ziziphus mauritiana*) have spread over the natural treeless plain of landscape unit 3 in the western half of the area, severely lowering carrying capacity. Rubber vine (*Cryptostegia grandiflora*) has colonised creeks and run-on areas severely restricting grass growth and accessibility. Uncontrolled regrowth, on areas where the original vegetation was poisoned, has also lowered productivity in the western portion of the area.

Some dryland cropping was undertaken on Inkerman Station in the 1970's and 1980's, but these areas have been returned to native pastures.

Small areas have been developed recently in the Lake Plain area for irrigation, as have small areas on the Delta.

Land suitability assessment

Land suitability assessment involves determining the potential of land for alternative forms of land use. In this survey, each UMA was assessed for growing sugar-cane and a number of field and horticultural crops under furrow irrigation, rice under flood irrigation, and mangoes and avocados under trickle or low volume irrigation. The field crops for which suitability was assessed included maize, sorghum, sunflower, soybean kenaf, cotton and legume seeds (that is mungbeans, chickpeas, pigeon peas and dolichos). The horticultural crops were cucumbers, rockmelons, squash, zucchini, pumpkins and beans. Three classification systems based on those developed by Donnollan and Day (1986) were used for the assessments. These classifications are explained in detail in Donnollan *et al.* (in preparation).

The first step in developing the land suitability classifications involved the determination of the crop requirements for each land use. Any soil and land characteristics which caused land to have less than optimum conditions for a particular land use were recognised as limitations. Land and soil attributes to measure and estimate the effects of each limitation were then selected and were ranked in terms of an increasing degree of severity for those land uses.

The overall land suitability class ranging from the best to the worst on a one to five scale was determined, usually by the most severe limitation. The standard definition of the suitability classes as adopted by Department of Primary Industries and given in Land Resources Branch staff (1990) are as follows:

Class 1 Suitable land with negligible limitations
Class 2 Suitable land with minor limitations
Class 3 Suitable land with moderate limitations
Class 4 Marginal land which is presently considered unsuitable due to severe limitations
Class 5 Unsuitable lands

The five classes are described more fully in Appendix II.

Appendix III shows the suitability and area of each UMA for furrow irrigation of sugar-cane, maize and capsicums, flood irrigation of rice and low volume or trickle irrigation of mangoes. For ease of illustration, maize and capsicums were selected as representative crops for field crops and horticultural crops respectively. These crops are the more common of the field and horticultural crops grown in the BRIA and their requirements are 'average' for their group. The areas of each suitability class are shown in Table 5.

Table 5 Areas of the five land suitability classes of Inkerman West and Central Sections, BRIA, for furrow irrigation of sugar-cane, maize and capsicums, flood irrigation of rice and low volume irrigation of mangoes.

Land suitability class	Area of land (ha) assessed within each land suitability class				
	Sugar-cane	Maize	Capsicums	Rice	Mangoes
1	-	-	-	-	-
2	1411	90	52	749	1108
3	4354	5105	1203	1057	214
Total suitable	**5765**	**5195**	**1255**	**1806**	**1322**
4	2746	3316	7256	2879	6512
5	787	787	787	4613	1464
Total	**9298**	**9298**	**9298**	**9298**	**9298**

Only 62 percent of the survey area is suitable (classes 1 to 3) for sugar-cane, 56 percent for maize, 13 percent for capsicums, 19 percent for rice and 14 percent for mangoes. The relatively high proportion of unsuitable lands in the Inkerman West and Central Sections is due to large areas affected by severe erosion and secondary salinisation. These degradation factors are discussed more fully in a later section. In addition, about 1900 ha are occupied by LU4 and 5 on the gently undulating rises. Generally, the soils on these rises are regarded as class 4 for furrow irrigation as the permeable soils of the upper and mid slopes act as intake areas with resultant losses to deep drainage downslope which can also cause secondary salinisation. As well, the lower slopes are prone to secondary salinisation and are therefore regarded as class 4.

Other limitations which cause areas to be unsuitable for furrow irrigation of sugar-cane, field crops and horticultural crops are soil complexity, sodicity, slope, wetness and rockiness.

The soil complexity limitation considers the difficulties in achieving optimum production from a complex area of marginally different soils. Many of the alluvial fan areas of LU6 have a complex pattern of soils of contrasting management requirements which would prevent optimum production being achieved with normal management inputs. These UMAs have been rated as class 4. Similar ratings on the basis of soil complexity have been given to UMAs in LU5 where soil types 5Uga or 5Ugb are closely associated with soil types such as 5Dra, 5Dya and 5Dyb.

The sodicity limitation considers the affects of high sodicity levels in the upper part of the soil on crop growth. High levels of ESP (>6) can directly affect plant growth, but more importantly creates unfavourable soil physical conditions which affects water infiltration and therefore plant available water, seedling emergence and plant root penetration. High ESP and the associated high pH (>8.0) also affects the availability of some nutrients.

Some sodic duplex soils have thin A horizons and high ESP levels in the upper B horizon. Cultivation and any levelling will mix surface soil and subsoil material creating undesirable seedbed conditions. The effects on water entry and root proliferation due to high ESP will have further undesirable effects on plant growth. Soil types with such a severe limitation include most UMAs of 1Dba, 1Dbb, 1Dyc, 6Dbh, 6Dyj and soil type 6Dyg on the Delta.

Slopes over one percent on sodic duplex soils, and two percent for other soils are regarded as class 4 for field crops and horticultural crops. Excessive soil losses from erosion, furrow overtopping and lower infiltration can occur on higher slopes. The increased cover afforded by sugar-cane allows higher slopes (up to 4%) to be used before detrimental affects occur.

Minor areas are affected by excessive surface wetness associated with closed depressions or swamps.

Excessive rock outcrop or surface stone is the major limitation in minor areas.

The area suitable for furrow irrigation of horticultural crops in the study area is reduced due to the high proportion (48%) of cracking clays. The low permeability and poor drainage characteristics of most cracking clays is considered undesirable for horticultural crops unless high management inputs are employed.

The major limitations affecting rice production in the area are deep drainage (dd) and slope (s). Deep drainage considers the permeability of the soil profile and losses to deep drainage. As rice is more successfully grown in ponded bays, soils with very low permeability and low infiltration rate are the most suitable. Many of the soils in the area especially those of LU4, LU5 and LU6 are highly permeable and are therefore unsuitable.

Slopes greater than 0.5% prevent adequate sized bays being established on the natural slope, or necessitates major costly earthworks in order to decrease the slope to establish suitable bays for ponding water to the optimum depth for rice growing. As many of the otherwise suitable soils for rice are on slopes greater than 0.5 percent, the availability of soils suitable for rice is low.

Most horticultural tree crops require well-drained, salt-free soils. These crops are therefore limited to the freely drained soils of the undulating rises and some soil types of LU6.

Further explanation of all the limitations and their effects on land use are contained in Donnollan *et al.* (in preparation).

Management

Donnollan (1991) divided the soil types in the BRIA into 13 subgroups within four broad soil groups based on similarities of morphology, chemical and physical attributes and management requirements. A brief description of those subgroups found in Inkerman West and Central Sections is given in Table 6. The range of land suitabilities and limitations associated with these soil subgroups, and remarks on the management options to decrease the effects of these limitations for the various crop groups and land uses are given in Table 7. Further information on management options to reduce the effects of a range of limitations can be obtained from Donnollan *et al.* (1990) and Donnollan (1991).

Table 7 is not appropriate for obtaining information on specific UMAs, as only the suitabilities and limitations normally associated with the soil types and general management comments associated with these broad soil groups are given. Land suitability for the major crops of the area for a specific UMA can be obtained from Appendix III. Information on the suitability for other crops and a list of the limitations specific for a UMA can be accessed in digital form at the DPI office in Ayr.

Table 6 A brief description of the soil subgroups of the BRIA (Donnollan 1991), occuring in Inkerman West and Central Sections.

Subgroups	Brief description
	Group 1 - Cracking clays
1A	Cracking clays of alluvial plains on slopes usually <0.5% with normal gilgai, with light to light medium clay A horizons, usually with hardsetting surfaces.
1B	Cracking clays of alluvial plains on slopes usually <0.5% with normal gilgai, with medium to heavy clay A horizons, usually with self-mulching surfaces.
1D	Cracking clays with linear gilgai on the pediments of landscape unit 1 and the mid to lower slopes of landscape unit 5.
1E	Cracking clays of landscape unit 5 usually on the crests and slopes less than 1%.
	Group 2 - Sodic duplex soils
2A	Duplex soils which are moderately to strongly alkaline (pH 7.9 - 9.0) and strongly sodic (ESP >15) by 0.3 m and usually with thin A horizons (<0.15 m).
2B	Duplex soils which are usually moderately to strongly alkaline (pH 7.9 - 9.0) and strongly sodic (ESP < 15) by about 0.6 m with intermediate A horizon depths (0.15 - 0.3 m).
2C	Duplex soils which are usually moderately to strongly alkaline (pH 7.9 - 9.0) and sodic (ESP 6-14) to strongly sodic (ESP >15) below 0.9 m with thick A horizons.
	Group 3 - Non-sodic duplex soils
3A	Non sodic duplex soils of the alluvial plains.
3B	Non sodic duplex soils of the undulating rises.
	Group 4 - Gradational and uniform non-cracking soils
4A	Fine textured uniform soils without seasonal cracking (Uf) and gradational soils (Gn), with alkaline or neutral soil reaction trend.
4B	Medium textured uniform soils (Um) and gradational soils (Gn), usually with acid to neutral soil reaction trend.
4C	Coarse textured uniform soils (Uc) and gradational soils (Gn) and duplex soils (D) with a very deep coarse textured A horizon.

Table 7 Irrigated land suitability classes[1], subclasses of limitations affecting production and broad management remarks for five irrigated land uses for soil subgroups of Inkerman West and Central Sections, BRIA.

Soil subgroup[2]	Sugar-cane Furrow irrigation	Grain crops (maize) Furrow irrigation	Horticulture crops (capsicum) Furrow irrigation	Rice Flood irrigation	Mangoes, avocados Trickle irrigation
Cracking clays 1A Soil types 1Ugc, 1Ugf, 2Ugc, 2Ugd, 2Uge, 3Ugb, 6Uga	**Land suitability:** 2-3 **Limitations:** n2-3, pd1 (2-4) id2, g2, e1-2, p2, t1-3, so1-2	**Land suitability:** 3 **Limitations:** n2-3, pd1 (2-4), id2, ps3, t2-3, g2, p2-3, so2-3	**Land suitability:** 4 (3) **Limitations:** n2-3, id2, ps3, t2-3, g2, p4(3), so3-4	**Land suitability:** 2 (4-5) **Limitations:** n2-3, so1-2, t2-5, g2, pd1-4	**Land suitability:** 4-5 **Limitations:** so3, sa1-3, id4-5, w2-4
Cracking clays 1B Soil types 1Uga, 1Ugd, 2Ugf, 2Ugg, 2Ugh, 2Ugk, 3Uga, 3Ugc, 3Ugd, 3Uge, 3Ugk	**Management remarks:** High yields of sugar-cane and grain crops can be expected from cracking clays if management strategies appropriate to this group of soils are used. Some management techniques associated with this group of soils are discussed below. Nitrogen and phosphorous applications are required. Potassium level will usually be adequate initially. Zinc and sulphur may have to be applied, especially on areas which after levelling will expose subsoils with pH >7.5. Land will need to be levelled to remove gilgai. Laser levelling, especially on very low slopes, will increase the efficiency of irrigation and decrease water logging problems. Some variations in crop growth may be experienced due to levelling. Cracking clays, due to their high water holding capacities and slow internal drainage characteristics present problems with access and the timing of mechanical operations such as cultivation and harvesting during after rain. Short irrigation duration times are more effective on this group of soils as water entry is rapid while cracks are open but decreases to extremely low levels after cracks close. Adjacent areas with soils of contrasting management requirements present problems in managing an area efficiently, often with decreasing productivity. Some small UMAs adjacent to unsuitable UMAs have been regarded as unsuitable due to extreme management difficulties. Germination, seedling emergence and crop establishment problems[3] may occur on these soils due to coarse self mulch (group 1B) or hardsetting characteristics (group 1A). The degree of difficulty will depend on the crop being planted, generally with increasing difficulty as seed size decreases. Planting into dry soil and then irrigating is a technique that has been successful in lessening these problems (Smith and McShane 1981).		**Management remarks:** Generally, cracking clays are unsuitable for furrow irrigation of most horticultural crops on low slopes as these crops are very susceptible to waterlogging. Soils with light clay surfaces without bleached A2 or mottled horizons (some UMAs of 1Ugc, 6Uga) which have slightly lower waterholding capacities and better drainage characteristics are the least susceptible. If UMAs are regarded as suitable, the management requirements to decrease the effects of other limitations associated with these soils are similar to those described for grain crops. With specific management techniques such as high beds, accurate gradients and effective tail drainage, pumpkin, egg fruit, capsicum and watermelon may be grown successfully using furrow irrigation on all the cracking clays (Shannon personal communication). Tomatoes have also been grown successfully on cracking clays on higher slopes (> 0.5%) and with short runs. However, if horticulrual crops are to be grown on cracking clays, the use of plastic mulch with trickle irrigation is a more appropriate management technique.	**Management remarks:** Nitrogen and phosphorous applications will be required. Zinc and sulphur may have to be applied, especially on areas which after levelling will expose subsoils with high pH (>7.5). Slopes on soil types of landscape unit 1 may be greater than 0.5%. This prevents adequate sized bays being established on the natural slope or necessitates major costly earthworks to decrease the slope to establish suitable bays for ponding water to the optimum depth for rice growing. Some mapping units especially in the Lake Plain area have very low slopes (< 0.1%) which will cause problems with flushing and draining. Land will need to be levelled to remove gilgai. A soil complexity limitation may be present depending on the size of the mapping unit and/or associated adjoining soils.	**Management remarks:** Cracking clays are unsuitable for mango and avocado production as these crops require well drained soils and are very susceptible to waterlogging.

Table 7 (continued)

Soil subgroup[2]	Sugar-cane Furrow irrigation	Grain crops (maize) Furrow irrigation	Horticulture crops (capsicum) Furrow irrigation	Rice Flood irrigation	Mangoes, avocados Trickle irrigation
Cracking clays 1D Soil type 1Uge	**Land suitability:** 3 **Limitations:** n2-3, pd 2-3 (if associated with 1Dyd) id2, g2, e2-3, r3(1), p2, t3, so2	**Land suitability:** 3 **Limitations:** n2-3, pd1-3, id2, ps3, t3, g2, e2-3, r1-2, p2-3, so2-3	**Land suitability:** 4(3) **Limitations:** n2-3, id2, pd3, t3-4, g2, e2, r2-3, p4(3), so3-4	**Land suitability:** 4-5 **Limitations:** n3, so2, r2-3, t4-5, g2, dd2	**Land suitability:** 4-5 **Limitations:** so3, sa1-3, id4-5, w2-4
	Management remarks: Similar management techniques are required as for the other cracking clay subgroups. However, this soil is on greater slopes (1%+) and rocks are usually present on surfaces. Potassium is low and will usually be required. On most UMAs, furrows may have to be positioned across the slope to decrease furrow slope to less than 1%. Simple conservation practices such as cover cropping and contour cultivation will be required on most UMAs to reduce erosion, and in addition, graded banks to reduce slope length will be necessary on slopes greater than 2% (UMAs 2, 31, 40, 63 and 90). Most UMAs of this soil type have a rockiness limitation. This will necessitate stone picking, especially for sugar-cane or soybean production. UMAs 137, 140, 151, 560, 750 and 752, are exceptions. UMAs 63, 40 and 752 are associated with a large percentage of soil type 1Dyd which will cause some difficulties in efficient irrigation management due to soil variability.		**Management remarks:** Similar management remarks to that for the other cracking clay subgroups are applicable to this soil type, although the steeper gradient associated with this soil type allows for better surface drainage. In addition, rocks are usually present on the surface and may have to be removed. For suitable UMAs, management techniques to decrease the effects of the other limitations associated with this soil are similar to those for grain crops.	**Management remarks:** This soil occurs on slopes of 0.5% and often much greater, so is unsuitable for the production of rice These slopes prevent adequate sized bays being established on the natural slope or necessitates major costly earthworks to decrease the slope to establish suitable bays for ponding water to the optimum depth for rice growing.	**Management remarks:** Cracking clays are unsuitable for mango and avocado production as these crops require well drained soils and are very susceptible to waterlogging.
Cracking clays 1E Soil types 5Uga, 5Ugb	**Suitability:** 3-4 **Limitations:** n2-3, pd 1 and 4, id2, ps3, t2-3, g1(2), e2, r1-2, p2-3, so2-3.	**Suitability:** 3-4 **Limitations:** n2-3, pd1 and 4, id2, ps3, t3, e1-2, r1-2, p2-3, so2-3	**Suitability:** 4(3) **Limitations:** n2-3, id2, ps3, t3, g1-2, e1-2, pd 1 or 4	**Suitability:** 4-5 **Major limitations:** t4-5, dd5	**Suitability:** 4-5 **Limitations:** so3, sa1-3, dd4-5, w2-4
	Management remarks: Similar management techniques to that for group 1D are required. However, slopes are generally lower and rocks are less abundant. The major limitation associated with this group of soils (50% of UMAs) is that of soil complexity. These UMAs are usually small and often adjoin soils with contrasting management requirements which causes major problems with effective irrigation management.		**Management remarks:** Similar remarks as that for group 1D are applicable to this group. Soil complexity is a major problem and similar remarks to that for growing grain crops are appropriate.	**Management remarks:** Excessive slope and the present of decomposing rock in the soil profile allowing excessive drainage losses from ponded bays makes these soils unsuitable for rice production.	**Management remarks:** Cracking clays are unsuitable for mango and avocado production as these crops require well drained soils and are very susceptible to waterlogging.

Table 7 (continued)

Soil subgroup	Sugar-cane Furrow irrigation	Grain crops (maize) Furrow irrigation	Horticulture crops (capsicum) Furrow irrigation	Rice Flood irrigation	Mangoes, avocados Trickle irrigation
Sodic duplex soils 2A Soil types 1Dba, 1Dbb, 1Dya, 1Dyc, 4Dyh, 5Dyd, 6Dbh, 6Dyj	**Land suitability:** 4(3) **Limitations:** n3, m3, id3, t3, e2-3, ss1 or 4, p3, so4, sa2-3	**Land suitability:** 4 **Limitations:** n3, m3, id3, ps3-4, t3-4, e2-4, ss1 or 4, p3, so4, sa2-3	**Land suitability:** 4 **Limitations:** n3, m3, id3, ps3-4, t3-4, e2-3, ss1 or 4, p3, so4, sa2-3	**Land suitability:** 4-5 **Major limitations:** n3, so2-4, ss1 or 4, t4-5, pd1(4), dd1(3-5)	**Land suitability:** 4-5 **Limitations:** so4, sa2-4, d3-4, id4-5, w2-4, ss1 or 4
	Management remarks: Most of the soils in this group are marginal (class 4) for sugar-cane. However, some UMAs of 1Dbb and 1Dyc have been rated as Class 3 and the management remarks for soil subgroup 2B are appropriate for these UMAs. These soils are usually rated as class 4 due mainly to the adverse properties of these soils such as shallow A horizons, high pH and high sodicity levels close to the surface. These soil properties severely restrict water infiltration, PAWC, ease of crop establishment and nutrient availability with subsequent poor crop growth. Rehabilitation of these soils is expensive and high management inputs are required. High applications of gypsum, deep ripping, high rates of fertiliser and specific crop establishment and water application methods are needed. In addition, some soils types (4Dyh, 5Dyd, 5Dyc and sometimes 1Dyc), are situated in discharge areas or in lower slope positions below recharge areas. Secondary salinisation of these areas is likely with irrigation development on the upper slopes.	**Management remarks:** These soils are regarded as class 4 for grain and horticultural crops. The adverse physical and chemical properties of these soils, costly rehabilitation requirements, and high management inputs as described for sugar-cane are factors which limit their usefulness. The potential secondary salinisation threat of some soils such as 4Dyh, 5Dyd, 5Dyc and sometimes 1Dyc, will exclude these soils from long term sustainability.		**Management remarks:** Only UMA 117 has been rated as Class 3. The remainder have been rated as Class 4 or 5. Many of the soils of this group are found on slopes greater than 0.5% which prevent manageable bays for ponding water to the optimum depth for rice growing being established without costly earthworks. The extreme levels of sodicity close to the surface in some soils (for example, 6Dbh, 6Dyj) will limit their cropping potential due to nutritional disorders and establishment problems. In addition, other areas have problems with potential secondary salinisation outbreaks (4Dyh, 5Dyd, 5Dyc and 1Dyc). Small areas less than the manageable size for a rice block also limits the usefulness of some UMAs.	**Management remarks:** These soils are unsuitable for mango and avocado production as these crops require deep, well drained soils which are low in salts. These crops are also very susceptible to waterlogging.

Table 7 (continued)

Soil subgroup	Sugar-cane Furrow irrigation	Grain crops (maize) Furrow irrigation	Horticulture crops (capsicum) Furrow irrigation	Rice Flood irrigation	Mangoes, avocados Trickle irrigation
Sodic duplex soils 2B Soil types 1Dda, 1Dyb, 1Dyd, 2Dyb, 2Dyc, 4Dyg, 4Dyf, 4Dye, 5Dyf, 6Dba, 6Dyg, 6Dda, 6Ddb	**Land suitability:** 3(4) **Limitations:** n2-3, m3, id3, (r3) g1(2) (pd2-3), e2-3, p3, t2-3, g1(2), so2-3(4)	**Land suitability:** 3(4) **Limitations:** n3, m3, ps3, id3, (r3), (pd2-3), e2-3, p3, t2-3, g1(2), so2-3(4)	**Land suitability:** 3-4 **Limitations:** n3, m3, pd2-3, id3, ps3, (r2-3) t2-3(4), e2-3, (pd2-3) p3, so3-4, so2-3	**Land suitability:** 4-5 (2-3) **Major limitations:** n3, so2-4, (r2) t4-5, (g2) dd2(5)	**Land suitability:** 4-5 **Limitations:** so4, sa3-4, d3-4, id4-5, w3-5
	Management remarks: This group of sodic duplex soils are suitable for sugar-cane and most grain crops, but high management levels will be needed to achieve optimum productivity. However, soil type 6Dyg on the Burdekin Delta lands, unlike 6Dyg occupying other areas of landscape unit 6, is rated as class 4, due to extreme sodicity levels near the surface and high salinity levels. The management remarks given for Group 2A are therefore appropriate for UMAs 587, 654, 658, 659, 661, 663, 667, 668 and 670. Nitrogen and phosphorus applications will be required. High phosphorus applications are often necessary to overcome high sorption capacities in some of these soils. Potassium should be adequate initially, except for the soils of the uplands (4Dyg, 4Dyj, 4Dyf, 4Dye, 5Dyf) and also 1Dyd which have low levels. Zinc and sulphur applications may be necessary, especially on areas, which after levelling will expose subsoils with pH >7.5. Soil type 2Dyc, 1Dyd and 5Dyf will require levelling to remove gilgai. Levelling may also have to be carried out to remove undulations and improve furrow irrigation efficiency on other soils. Extreme care must be taken in performing this operation, so as to avoid exposing the subsoil with high exchangeable sodium percentage. Stockpiling the A horizon for later redistribution may be necessary. Deep ripping, especially under dry conditions will improve water infiltration and thus PAWC on these soils. Combining deep ripping with gypsum will prolong the beneficial effects of deep ripping. The texture of the A horizons of 4Dyj, 4Dyf and 4Dye is usually coarse sandy loam and up to 0.4m thick, consequently with lower PAWC than the other loamy surface soils. Germination, seedling emergence and crop establishment problems may occur on these soils. Planting into dry soil on ridges and then irrigating reduces these problems. Applying gypsum by broadcasting or through a dissolvenator is also beneficial. Incorporating crop residues and using minimum tillage will assist in improving structure of these surface soils and lessen the problems with establishment.		**Management remarks:** These soils can be either Class 3 or 4 with moderate or severe limitations depending on the crop being grown. Tomatoes, pumpkins and melons may be grown successful with specific management treatments on raised beds. Care must be taken to avoid exposing sodic clay in the furrows when forming these beds. Those soils with either deeper A horizons or sandy textures (4Dyf, 4Dyj, 4Dye, 6Dba) are usually more suitable than the other soils, depending on the absences of other limitations such as excessive slope. Other management remarks as for sugar-cane and grain crops are also appropriate. Trickle irrigation with plastic mulch is the best method for growing horticultural crops on these soils.	**Management remarks:** This group of soils is usually suitable for rice (class 2-3). However, in this area only UMAs 112, 250, 254, 435 and 447 are regarded as suitable (Class 2-3). Excessive slope (>0.5%) is the major limitation affecting suitability as it prevents suitable bays for ponding water to the optimum depth for rice growing without costly earthworks. Extreme sodicity levels close to the surface and high salinity of soil type 6Dyg on the Burdekin Delta limits the rice growing potential on this soil type.	**Management remarks:** These soil types are unsuitable for mangoes and avocados as these crops require deep well drained soils which are low in salts. These crops are also very susceptible to waterlogging.

Table 7 (continued)

Soil subgroup	Sugar-cane Furrow irrigation	Grain crops (maize) Furrow irrigation	Horticulture crops (capsicum) Furrow irrigation	Rice Flood irrigation	Mangoes, avocados Trickle irrigation
Sodic duplex soils 2C Soil types 4Dya, 5Dyb, 5Dye, 6Drc, 6Dbb, 6Dyf.	**Land suitability:** 3 **Limitations:** n1-3, m2, id2-3, t3, e2, p2 (r3)	**Land suitability:** 3-4 **Limitations:** n1-2, m2, id2-3, t3-4, e2-3, p2, ps2-3, (r2)	**Land suitability:** 3-4 **Limitations:** n1-2, m2, id2-3, t3-4, p2-3, e2-3, ps2-3, (r2)	**Land suitability:** 4-5 **Major limitations:** n2, t4-5, dd3-5, (r2)	**Land suitability:** 2-5 **Limitations:** so3-4, d2-4, id3-5, w2-4
	Management remarks: The limitations associated with these soils are usually not difficult to overcome and so are favourable soils for irrigation. However, slopes greater than 2% in some areas cause some UMAs to be marginal (class 4) for grain crops due to the difficulties in recharging the water deficit and also preventing erosion. The soils of landscape unit 6 usually have sufficient phosphorus, but the other soils will usually require both phosphorus and nitrogen. Soils types 4Dya, 5Dyb and 5Dye are usually found in midslope positions of the undulating rises and non-saline seeps may develop if irrigation on the upper slopes is undertaken. Drainage may be necessary. Rocks are present on most UMAs of 5Dyb and 5Dye and stone picking will be necessary, especially for sugar-cane. Areas on slopes greater than 1% will need to have furrows directed across the slopes, as well as conservation practices implemented to reduce erosion. Difficulties may occur with germination, seedling emergence and crop establishment for grain crops. Dry planting on ridges and then irrigating may decrease the problems. Also incorporating crop residues will improve the structure of the surface soil and reduce emergence problems.		**Management remarks:** These soils are generally suitable for horticultural crops. Slope may be excessive in some areas but by using shorter runs, this limitation may be overcome. Similar remarks to that for grain crops are also relevant for horticultural crops. Trickle irrigation under plastic mulch is the best method for growing horticultural crops on these soils.	**Management remarks:** In this area, these soils are marginal or unsuitable (classes 4-5) for rice. Excessive slopes (>0.5%) and excessive losses to deep drainage in the soils of the undulating rises are the major limitations affecting their suitability.	**Management remarks:** These soils are regarded as unsuitable for avocados due to their requirement for a very well drained soil. The potential development of a high watertable in the soils of the uplands (LU4 and 5) creates a risky environment for mangoes. UMAs of soil types 6Drc and 6Dyf are usually adequately drained to grow mangoes although associated soils will determine their overall suitability. For instance, UMAs 500, 723 and 733 are regarded as marginal due to the presence of other unsuitable soils associated within or adjacent to these UMAs.

Table 7 (continued)

<table>
<tr><th>Soil subgroup</th><th>Sugar-cane
Furrow irrigation</th><th>Grain crops (maize)
Furrow irrigation</th><th>Horticulture crops (capsicum)
Furrow irrigation</th><th>Rice
Flood irrigation</th><th>Mangoes, avocados
Trickle irrigation</th></tr>
<tr><td rowspan="2">Non-sodic duplex soils
3A
Soil types
6Dbf, 6Dra, 6Drb, 6Dye.</td><td>Land suitability: 2-3.
Limitations: n1-2, m2, (pd3-4), id1-2, t3, e1-2.</td><td>Land suitability: 3-4.
Limitations: n1-2, m2 (pd3-4), id1-2, ps2-3, t3-4, e1-2.</td><td>Land suitability: 3-4.
Limitations: n1-2, m2, id1-2, ps2-3, t3-4, e1-2, pd3-4.</td><td>Land suitability: 4-5
Major limitations: t4-5, dd4-5.</td><td>Land suitability: 2-5.
Limitations: id1-5, w2-4.</td></tr>
<tr><td colspan="3">Management remarks:
These soils are highly favourable soils for irrigation being well drained and salt-free.

Steepness of slope is often a limitation on these soils. Furrows may have to be positioned across the slop to decrease furrow gradients below 1%. Erosion control measures will also be necessary to reduce soil losses on high slopes.

Some problems may be experienced with germination and plant establishment as the surfaces may slake and seal, especially those with high proportions of sand and silt. Adding gypsum through a dissolvenator will decrease slaking and will improve infiltration. Incorporating residues to increase organic matter levels will improve structure and decrease the severity of crusting.

Small UMAs and their proximity to other soils with widely different management requirements will create problems for effective management in some areas.</td><td>Management remarks:
These soils are unsuitable for ponding water for rice growing as they are freely draining.</td><td>Management remarks:
These soils are generally suitable for mangoes and avocados due to their freely draining characteristics, low salt content and sufficient slope to drain surface water off quickly. However, some UMAs, especially those with buried clay below the present soil (that is soil variant 2) are poorly drained and are unsuitable.</td></tr>
<tr><td rowspan="2">Non-sodic duplex soils
3B
Soil types
5Dra, 5Dya, 4Dyl, 4Dyd.</td><td>Land suitability: 4.
Limitations: n2-3,m2, id4, t3(4), e3-4, r3(1)</td><td>Land suitability: 4
Limitations: n2-3, m2, id4, t4(3), e2-3, ps3, r2(1)</td><td>Land suitability: 4
Limitations: n2-3, m2, id4, t4(3), e2-3, ps3, r2(1)</td><td>Land suitability: 5
Limitations: n2-3, r2, t5, dd5.</td><td>Land suitability: 2-4
Limitations: r1-2, d1-4, id2-3, w1-2.</td></tr>
<tr><td colspan="3">Management remarks:
These soils are well drained and are associated with intake areas on the upper slopes of the undulating rises. Excessive deep drainage through these soils may cause rises in groundwater on adjacent lower slopes. These soils are therefore regarded as class 4 for furrow irrigation of all crops. Spray and trickle irrigation is recommended on these intake areas to reduce losses to deep drainage.

The major other limitations associated with these soils are slopes (usually >1%) with subsequent erosion risk. Stone picking will usually be required especially for sugar-cane on 5Dra and 5Dya and sometimes on 4Dyl.</td><td>Management remarks:
These soils are unsuitable (class 5) for rice, due to their freely internal drainage characteristics which prevent their ponding water. Slope is also excessive.</td><td>Management remarks:
These soils are usually regarded as suitable for trickle irrigation of mangoes and avocados. However, as avocados require a deeper and more freely drained soil than mangoes some UMAs may be regarded as marginal due to shallower depth of soil to decomposing rock (<1 m).</td></tr>
</table>

Table 7 (continued)

Soil subgroup	Sugar-cane Furrow irrigation	Grain crops (maize) Furrow irrigation	Horticulture crops (capsicum) Furrow irrigation	Rice Flood irrigation	Mangoes, avocados Trickle irrigation
Gradational and uniform non-cracking clays 4A Soil types 6Ufa, 6Ufb, 6Ufc, 6Ufd, 6Ufe, 6Gna, 6Gne.	**Land suitability:** 2-3(4). **Limitations:** n1-2, m2, (pd2-4), id2-3, p2, t2-3, e1-2.	**Land suitability:** 3(4). **Limitations:** n1-2, m2, (pd2-4), id2-3, ps2, t2-3, p2-3, e1-2.	**Land suitability:** 3(4). **Limitations:** n1-2, m2, (pd2-4), id2-3, ps2-3, t2-3, p2-3, e1-2, so1-3.	**Land suitability:** 4-5. **Limitations:** t4-5, dd4-5, (pd4).	**Land suitability:** 4-5(3). **Limitations:** id4-5(3), w2-4.
	Management remarks: The minor or moderate limitations associated with these soils are usually not difficult to overcome so these soils are favourable for furrow irrigation of sugar-cane, grain crops and horticultural crops. Some UMAs, however, are small and are found adjacent to soils of widely different management requirements which create difficulties in managing these soils efficiently for optimum production.			**Management remarks:** These soils are marginal or unsuitable for rice (class 4-5) due to excessive slope (>0.5%) and/or the soils freely internal drainage characteristics which on ponding allow excessive losses to deep drainage.	**Management remarks:** Generally these soils are marginal or unsuitable for mangoes and avocados as these crops require more freely draining soils and sufficient slope to remove excessive surface water off quickly. However, some UMAs of soil type 6Gna are regarded as suitable due to better drainage characteristics.
Medium textured uniform soils and gradational soils 4B Soil types 6Umb2, 6Gnd2.	**Land suitability:** 3-4. **Limitations:** n1-2, m2, (pd4), id1-2, t3-4, e3, p2.	**Land suitability:** 4. **Limitations:** n1-2, m2 (pd4), t3-4, id1-2, e3, p2, ps3.	**Land suitability:** 3-4. **Limitations:** n1-2, m2, id1-2, ps3 (pd4), t3-4, e3.	**Land suitability:** 5. **Limitations:** t5, dd5.	**Suitability:** 2-5. **Limitations:**
	Management remarks: Only two UMAs of this soil group have been mapped. UMA 539 (6Umb2) is suitable for sugar-cane, but unsuitable for grain crops and horticultural crops due to excessive slope (>2%). UMA484 (6Gnd2) is regarded as class 4 for all crops as the soils within and adjacent to this UMA have widely different management requirements which create difficulties in managing these soils effectively for optimum production.			**Management remarks:** These UMAs are both unsuitable for rice due to both steepness of slope (>0.75%) and the internal drainage characteristics of the soils which on ponding allow excessive losses to deep drainage.	**Management remarks:** UMA 539 (6Umb2) is suitable but UMA 484 with a buried clay at depth is unsuitable due to its poor internal drainage characteristics.
Coarse textured uniform soils 4C Soil types 6Ucc	**Land suitability:** 4. **Limitations:** n3, m4, pd4, id4, p4, t3.	**Land suitability:** 4. **Limitations:** n3, m4, pd4, id4, t3, ps4.	**Land suitability:** 4. **Limitations:** n3, m4, pd4(1), id4, t3, 1, p4, ps4.	**Land suitability:** 5. **Limitations:** t3-5, dd5.	**Land suitability:** 2-3. **Limitations:** id2, w2-3.
	Management remarks: Soil type 6Ucc is class 4 for furrow irrigation of crops due to rapid internal drainage, low PAWC, and problems with germination and establishment. This soil type is located on narrow UMAs with soils of different management requirements associated with adjacent UMAs. This soil may be suitable for trickle irrigation.			**Management remarks:** Soil type 6Ucc is unsuitable for rice production due to its rapid internal drainage characteristics.	**Management remarks:** Rapid internal drainage of this soil makes it suitable for mangoes and avocados. However, the narrow UMAs adjacent to unsuitable soils may create difficulties in irrigation layout.

1. The range of classes and subclasses represents those for the majority of the UMAs, the numbers in the brackets denotes the range common for the remainder. Classes for specific UMAs can be obtained from Appendix III and the subclasses accessed in digital form at the DPI office in Ayr.
2. A description of the soil subgroups are given in Table 6.
3. Sugar-cane establishment should not be a problem on these soils if recommended planting techniques are used.

Irrigation planning

Long-term stability of land resources and sustained crop production are important factors to consider in the re-subdivision and farm planning stage of development. Measures to decrease the effects of potential degradation must be implemented. The distribution of soils and the suitability of land on individual farms must also be considered during sub-divisional planning to ensure farms are economically viable.

Inkerman West and Central Sections pose a number of degradation concerns, mainly secondary salinisation, erosion and flooding.

Secondary salinisation

Twenty-seven UMAs in this study area are presently affected by salinisation. Visible signs of the salinity effects as well as analysed profiles were used to distinguish these areas. A further 35 UMAs are either adjacent to salinised areas or have the potential to become salinised due to their position in the landscape. The list of these UMAs are shown in Table 8. A map showing the location of these areas is in figure 23.

The large areas of 3Uga9, UMAs 788, 789 and 811 are not yet visibly affected by secondary salinisation. However, the mottled B horizons of the soils at depth, the very saline $EC_{1:5}$ levels at 1.2 to 1.5 m and the proximity of the UMAs to presently salinised areas are indications that these areas will become salinised if irrigation farming is practised upslope.

The major concern in the area is the large areas of cracking clays affected by secondary salinisation adjacent to LU3 in the west and adjacent to the Delta lands east of Inkerman Homestead. The extremely high salt load in the lower horizons of the Delta, east of Inkerman Homestead is also of some concern.

Hydro-salinity investigations by Evans (1988) in Inkerman West section have shown that: (i) large areas of shallow, relatively saline groundwater is present in the area; (ii) regional groundwater levels fluctuate considerably depending on wet season rainfall, and (iii) the saline areas identified are the result of groundwater discharge when the regional groundwater levels were high after a series of successive wet seasons. He concluded that large areas of the Lake Plain area will be susceptible to shallow watertables and salinisation during prolonged recharge periods such as irrigated water application.

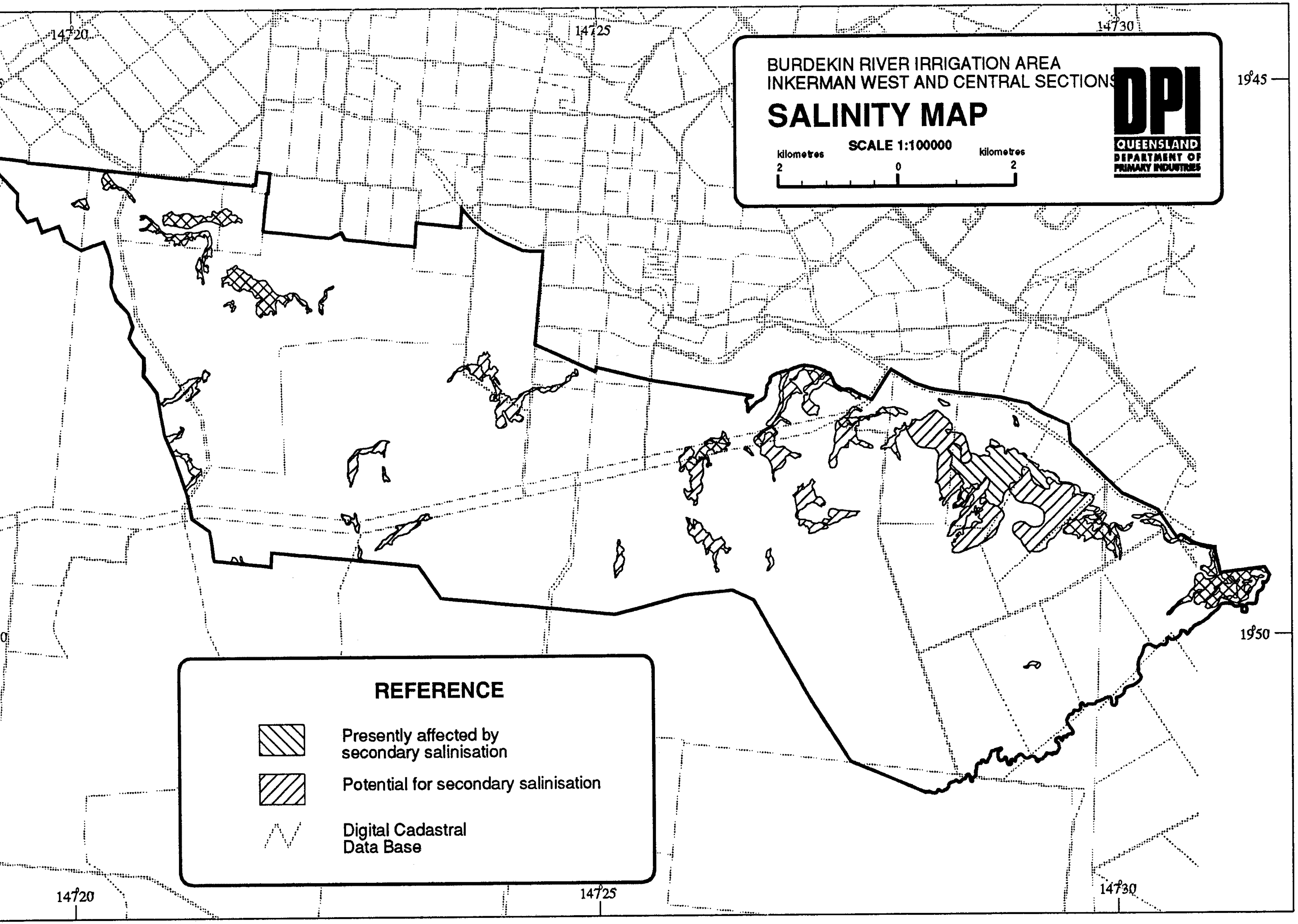
Doherty (1993), using a groundwater model to emulate groundwater movement through Inkerman West section, showed that the areas most likely to be affected by salinisation when irrigated cropping is introduced are in the vicinity of the presently affected areas. Water levels are predicted to rise in other parts of the catchment, but will not be as great. He also showed that it is imperative, if irrigation is introduced to this area, that local groundwater extraction must be a part of the irrigation strategy to keep the groundwater at manageable levels. Groundwater quality is an important issue if mixing of surface and groundwater for irrigation purposes is to be successful.

Table 8 Unique Map Areas (UMA) of Inkerman West and Central Sections, BRIA, affected by secondary salinisation*.

UMA number	UMA name	Area (ha)	UMA number	UMA name	Area (ha)
20	1DycS	2.0	596	1Dyc	13.2
546	1DycS	0.8	605	1Dyc	13.2
631	1DycS	4.9	613	1Dyc	17.9
615	1DydS	4.6	622	1Dyc	7.8
226	1UgaS	34.5	632	1Dyc	18.6
37	1UgdS	4.8	788	3Uga9	92.7
227	1UgdS	2.8	789	3Uga9	53.0
429	1UgdS	0.8	811	3Uga9	69.1
19	1UgeS	3.4	625	4Dyf	3.3
478	1UgeS	2.9	496	4Dyg	5.7
28	2UgcS	22.4	541	4Dyg	17.0
674	2UghS	29.9	623	4Dyg	16.7
810	3UgaS	92.0	425	4Dyh	19.3
678	3UgeS	13.4	626	4Dyh	14.4
685	3UgeS	19.3	647	4Dyh	6.1
426	4DyhS	9.5	826	4Dyh	1.6
44	5DybS	4.5	77	5Dyc	9.4
229	5DycS	2.6	88	5Dyc	2.7
71	6DbaS	1.5	91	5Dyc	7.7
225	6DdbS	1.3	178	5Dyc-5Ugb	1.8
212	6DyjS	3.2	268	5Dyc-5Ugb	9.4
679	6DyjS	18.3	277	5Dyc	19.4
204	6UfaS	2.4	314	5Dyc	12.4
428	6UfaS	3.1	328	5Dyc	10.3
684	6UgaS	12.1	346	5Dyc	2.3
803	6UgaS	0.8	456	5Dyc	1.8
813	6UgaS	4.4	468	5Dyc	0.4
			469	5Dyc	0.8
			483	5Dyc	1.0
			706	5Dyc	1.7
			708	5Dyc	0.9
			272	5Dyd	5.1
			270	5Dye-5Uga	4.8
			230	5Ugb	5.6
			559	6Dyj	2.2
TOTAL		**302.2**	**TOTAL**		**469.3**

* Those UMAs with a saline phase (denoted by the letter S after the soil name) are already salinised. Other UMAs are either adjacent to salinised areas or have the potential to become salinised due to their position in the landscape.

No investigations on modelling have been done in the Inkerman Central section. However, groundwater levels are expected to rise in the vicinity of the presently salinised areas when irrigation is undertaken. De-watering by underground extraction may also prove beneficial in keeping the groundwater at satisfactory levels, as expected in Inkerman West section.



e 23. Location of areas affected by secondary salinisation in Inkerman West and Central Sections, BRIA.

Erosion

About 730 ha in the area covering 68 UMAs are affected by severe erosion. Most of these UMAs define natural watercourses. A list of UMAs and the area affected by erosion is given in Table 9. A map of these UMAs is shown in figure 24. Due to the pattern of surface drainage in this area, especially in the upper slopes below Stokes Range, the density of UMAs affected by erosion is relatively high.

Erosion of LU3 in Inkerman Central in the vicinity of Salt Water Creek is cause for concern. Very deep gullies have developed and are still progressing. Steps will have to be taken to prevent their further development. All eroded areas will need to be stabilised and wide buffer zones established to minimise erosion development into farms.

Flooding

The low lying areas adjoining the Delta near the northern boundary of the study area carries most of the runoff water of the area. During large flows, restriction of 'the Lake' in the Lake Plain area causes water to back-up, inundating the lower lying areas of LU3 and LU2 to the west. In addition, overflow from the Burdekin River flows into this area during high flows. At present, many of the creeks and minor streams, empty water onto the low lying cracking clay plains, causing flooding in these areas after high rainfall events. Suitable infrastructure must therefore be put in place to minimise the duration and extent of flooding.

Other farm subdivisional considerations

The other major considerations affecting viability of farms in the area are the complex soil distribution and the high sodicity levels of some soils.

Complex soil distribution

As mentioned previously, the complex pattern of soils in many of the fan areas of LU6 presents problems in achieving optimum production due to the management difficulties associated with irrigating these areas. The soil types and the suitability of the UMAs must be an important consideration in the location and positioning of farms in the area to minimise the effects of soil complexity.

Sodicity levels

Those UMAs which are rated as class 4 due to high ESP levels at 0.3 m (that is, the sodicity limitation subclass is 4) should not be included in farms if possible. These areas should be included in infrastructure areas such as those set aside for roads, tramways, channels or waterways. If need to be included in farms, these areas should be situated at the top or end rather than within a farm to minimise problems with irrigation management.

Table 9 Unique Map Areas (UMA) of Inkerman West and Central Sections, BRIA, affected by severe erosion.

UMA number	UMA name	Area ha	UMA number	UMA name	Area ha
79	1UgaE	2.3	449	6 E	25.1
299	1UgaE	17.4	450	6 E	12.9
487	1UgaE	1.0	584	6 E	69.9
533	1UgaE	1.4	683	6 E	49.1
570	1UgaE	9.5	575	6 P	8.7
581	1UgaE	3.0	50	6DbaE	1.4
583	1UgaE	3.9	172	6Dbf- 6GnaE	19.3
486	1UgcE	2.7	508	6DbfE	0.6
505	1UgcE	5.0	532	6DbaE	1.4
545	1UgcE	1.8	498	6DraE	7.8
547	1UgeE	8.4	9	6Drb2-6Dbf2	21.3
754	1UgeE	0.7	16	6Drb2	4.1
672	2UghE	43.3	17	6Gna2	11.6
431	3UgaE	21.5	47	6GnaE	3.3
594	3UgaE	8.8	53	6GnaE	0.8
702	3UgaE	3.9	72	6GnaE	2.2
804	3UgaE	5.2	80	6GnaE	5.2
264	3UgdE	12.2	85	6GnaE	1.8
675	3UgeE	3.8	89	6GnaE	5.2
676	3UgeE	5.3	93	6GnaE	3.8
782	3UgeE	2.0	422	6GnaE-6Ucc2	5.0
783	3UgeE	7.8	472	6GnaE	9.8
785	3UgeE	23.7	488	6GnaE	5.2
534	4DygE	1.3	327	6UfbE	8.4
311	5DraE	1.1	105	6UfcE	12.7
471	5DraE	2.0	60	6UfdE	1.3
485	5DraE	4.6	185	6UfdE	63.6
510	5DraE	3.2	415	6UfeE	8.9
7	5DybE	7.9	784	6UfeE	1.1
313	5DycE	1.2	821	6UfeE	4.9
323	5DycE	3.8	70	6UgaE	7.2
452	5DycE	2.5	97	6UgaE	12.3
315	6 E	78.8	320	6UgaE	2.1
444	6 E	44.2	805	6UgaE	4.2
			TOTAL		747.4

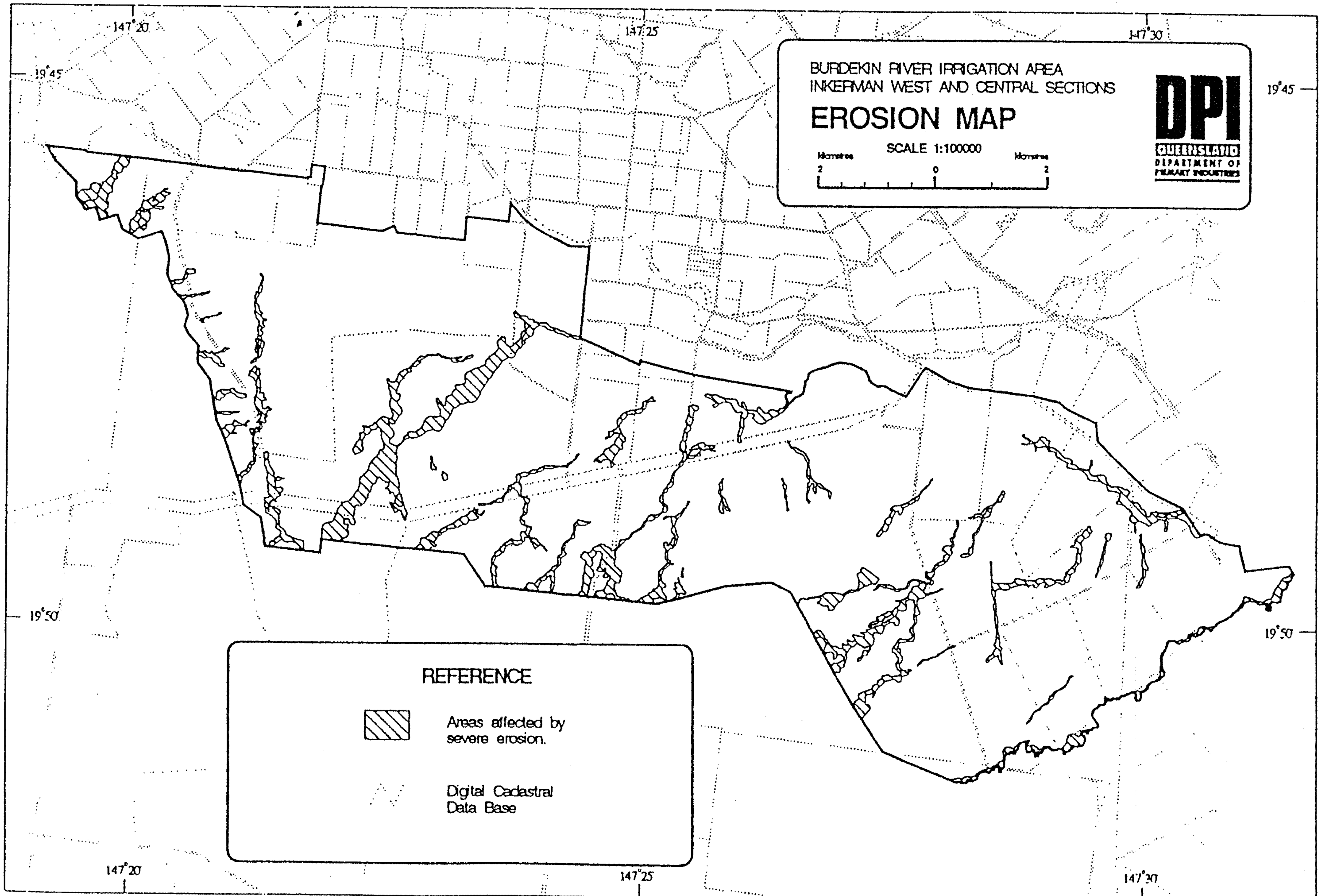


Figure 24. Location of areas affected by severe erosion in Inkerman West and Central Sections, BRIA.

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APPENDIX I - MORPHOLOGICAL AND ANALYTICAL DATA OF THE SAMPLED SOIL TYPES IN INKERMAN WEST AND CENTRAL SECTIONS

SOIL TYPE: 1Uge
SITE NO: IMC S13
PARENT MATERIAL:
A.M.G. REFERENCE: 546 510 mE 7 812 600 mN ZONE
GREAT SOIL GROUP: Black earth
PRINCIPAL PROFILE FORM: Ug5.15
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
TYPE OF MICRORELIEF: Linear gilgai
VERTICAL INTERVAL: .10 m
HORIZONTAL INTERVAL: 08 m

SUBSTRATE MATERIAL:
SLOPE: 1 %
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Eucalyptus papuana, Grevillea striata

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, self mulching

HORIZON	DEPTH	DESCRIPTION
A1	0 to .10 m	Black (10YR2/1); light medium clay; strong 2-5mm subangular blocky primary; dry; moderately strong. Clear to-
B21	.10 to .32 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular; strong 10-20mm subangular blocky primary; dry; very strong. Clear to-
B22k	.32 to .80 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular; lenticular parting to 10-20mm subangular blocky primary; moist; very firm; few fine carbonate nodules. Gradual to-
B23k?	.80 to 1.50 m	Dull yellowish brown (10YR5/4); light medium clay; common small pebbles, subangular quartz; strong lenticular tertiary, parting to 10-20mm subangular blocky primary; moist; very firm; few fine carbonate nodules, few fine ferromanganiferous nodules.

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS % @ 105C	FS	S	C	Exch. Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K	Total Elements P % @ 80C	K	S	Moistures ADM % @ 105C	33*	1500*	Disp.Ratio R1 @ 40C	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
B 0.10	6.7	.03	.002																					
0.10	6.6	.03	.002	18	29	20	35	25	7.4	9.3	.59	.47	.021	.176	.013	3.80		12	.60					
0.20	7.1	.06	.005																					
0.30	7.5	.14	.016	17	27	13	46	30	12	14	2.9	.17	.003	.124	.011	5.10		17	.69					
0.60	8.9	.81	.104	18	24	13	48	37	14	19	7.6	.30	.003	.130	.010	6.20		19	.79					
0.90	9.1	1.0	.128	21	25	11	44	33	10	17	7.9	.20	.004	.267	.005	5.50		17	.91					
1.20	9.2	.89	.105	32	26	8	37	24	7.7	13	6.0	.17	.005	.344	.033	5.10								
1.50	9.3	.81	.094																					

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	P	DTPA-extr. Fe mg/kg @ 105C	Mn	Cu	Zn	B	Extractable SO4S mg/kg @ 105C	NO3N	NH4N	P Buff Cap @ 40C	Equil ug/L	Alternative Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K
B 0.10	1.1	.07		5.2	.23			72	83	2.1	.31											

SOIL TYPE: 3Uga9
SITE NO: IMC S01A
A.M.G. REFERENCE: 551 220 mE 7 812 870 mN ZONE 55
GREAT SOIL GROUP: Black earth
PRINCIPAL PROFILE FORM: Ug5.16
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .10 m
HORIZONTAL INTERVAL: 06 m
COMPONENT OF MICRORELIEF SAMPLED: Mound
SURFACE COARSE FRAGMENTS: Few medium pebbles, subangular

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM: Very tall open shrubland
DOMINANT SPECIES: Ziziphus mauritiana, Ophiurous exaltatus, Bothriochloa species

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, self mulching

HORIZON	DEPTH	DESCRIPTION
A1	0 to .08 m	Olive black (5Y3/1); medium clay; strong 2-5mm subangular blocky primary; moist; moderately firm. Abrupt to-
B21	.08 to .50 m	Olive black (5Y3/1); medium heavy clay; very few small pebbles, subrounded; strong 5-10mm subangular blocky primary; dry; moderately strong; few coarse carbonate nodules. Clear to-
B22	.50 to .70 m	Olive black (5Y3/1); medium clay; very few small pebbles, subrounded; strong 5-10mm lenticular primary, parting to strong 5-10mm subangular blocky primary; many prominent clay skins; moderately moist; very firm; few coarse carbonate nodules. Gradual to-
B23	.70 to 1.20 m	Olive black (5Y3/1); few fine distinct yellow mottles; medium clay; very few small pebbles, subrounded; strong 5-10mm lenticular primary, parting to strong 5-10mm subangular blocky primary; many prominent clay skins; moist; very firm; few coarse carbonate nodules, few fine ferromanganiferous nodules. Gradual to-
B24	1.20 to 1.40 m	Dark greyish yellow (2.5Y4/2); common fine distinct yellow mottles; medium clay; very few small pebbles, subrounded; strong 2-5mm subangular blocky primary; many prominent clay skins; moist; very firm; few very coarse carbonate nodules, common fine ferromanganiferous nodules. Gradual to-
B25	1.40 to 1.70 m	Dark greyish yellow (2.5Y5/2); common fine distinct yellow mottles; medium clay; very few small pebbles, subrounded; strong 2-5mm subangular blocky primary; many prominent clay skins; moist; very firm; few very coarse carbonate nodules, common fine ferromanganiferous nodules.

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS % @ 105C	FS	S	C	Exch. Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K	Total Elements P % @ 80C	K	S	Moistures ADM % @ 105C	33*	1500*	Disp.Ratio R1 @ 40C	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
B 0.10	8.1	.10	.001																					
0.10	8.6	.10	.001	6	17	16	59	49	27	24	.44	.46	.025	.336	.020	7.4		23	.40					
0.20	8.9	.13	.001													7.5								
0.30	9.1	.10	.002	7	17	16	60	48	25	27	.97	.25	.018	.305	.016	8.2		23	.44					
0.60	9.2	.25	.014	8	17	15	60	48	20	31	2.4	.25	.017	.306	.016	8.6		24	.49					
0.90	9.0	.77	.101	8	17	16	60	46	13	35	4.5	.27	.015	.296	.018	7.9		25	.53					
1.20	8.9	1.1	.159	7	17	12	67	49	11	37	5.8	.26	.013	.279	.014	8.8								
1.50	9.0	1.0	.159													11.8								

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Extr. P Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	CaCl2 Extr P	DTPA-extr. Fe mg/kg @ 105C	Mn	Cu	Zn	B	Extractable SO4S mg/kg @ 105C	NO3N	NH4N	Buff Cap	P Equil ug/L @ 40C	Alternative Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K
B 0.10	0.8	.06	15	8				15	24	1.7	0.8											

SOIL TYPE: 3Uga9
SITE NO: IMC S01B
A.M.G. REFERENCE: 551 220 mE 7 812 870 mN ZONE 55
GREAT SOIL GROUP: Black earth
PRINCIPAL PROFILE FORM: Ug5.16
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .10 m
HORIZONTAL INTERVAL: 06 m
COMPONENT OF MICRORELIEF SAMPLED: Depression

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM: Very tall open shrubland
DOMINANT SPECIES: Ziziphus mauritiana, Ophiurous exaltatus, Bothriochloa species

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, self mulching

HORIZON	DEPTH	DESCRIPTION
A1	0 to .08 m	Brownish black (2.5Y3/1); medium clay; very few small pebbles, subrounded; strong 2-5mm subangular blocky primary; moist; moderately firm. Abrupt to-
B21	.08 to .42 m	Brownish black (2.5Y3/1); medium clay; very few small pebbles, subrounded; strong 5-10mm subangular blocky primary; dry; moderately strong. Gradual to-
B22	.42 to .70 m	Brownish black (2.5Y3/1); medium clay; very few small pebbles, subrounded; strong 5-10mm lenticular primary, parting to strong 5-10mm subangular blocky primary; many prominent clay skins; dry; moderately strong. Gradual to-
B23k	.70 to .95 m	Brownish black (2.5Y3/1); medium clay; very few small pebbles, subrounded; strong 5-10mm lenticular primary; many prominent clay skins; moderately moist; very firm; few medium carbonate nodules. Gradual to-
B24k	.95 to 1.25 m	Brownish black (2.5Y3/1); few medium distinct brown mottles; medium clay; very few small pebbles, subrounded; strong 5-10mm lenticular primary, parting to strong 5-10mm subangular blocky primary; many prominent clay skins; moderately moist; very firm; few medium carbonate nodules, few fine ferromanganiferous nodules. Gradual to-
B25k	1.25 to 1.55 m	Dull yellowish brown (10YR5/3); common fine distinct brown mottles; medium clay; very few small pebbles, subrounded; strong 2-5mm subangular blocky primary; many prominent clay skins; moist; very firm; few medium carbonate nodules, few fine manganiferous soft segregations. Gradual to-
B26k	1.55 to 1.80 m	Greyish yellow-brown (10YR5/2); many fine distinct brown mottles; medium clay; very few small pebbles, subrounded; strong 2-5mm subangular blocky primary; many prominent clay skins; moist; very firm; common fine manganiferous soft segregations.

Depth	1:5 Soil/Water			Particle Size				Exch. Cations					Total Elements			Moistures			Disp.Ratio		Exch	Exch	ECEC	pH
	pH	EC	Cl	CS	FS	S	C	CEC	Ca	Mg	Na	K	P	K	S	ADM	33*	1500*	R1	R2	Al	Acid		CaCl2
metres		dS/m	%	%				m.eq/100g					%			%					m.eq/100g			
	@ 40C		@105C	@ 105C				@ 105C					@ 80C			@ 105C			@ 40C		@ 105C			@ 40C
B 0.10	7.4	.06	.003																					
0.10	7.3	.05	.002	7	17	17	59	49	18	32	.55	.65	.026	.353	.021	7.0		24	.53					
0.20	7.7	.03	.001													7.5								
0.30	8.1	.04	.002	6	17	15	62	49	20	30	1.4	.21	.017	.297	.016	7.1		24	.52					
0.60	8.1	.22	.032	6	16	15	62	48	17	30	2.4	.22	.013	.289	.015	7.6		25	.57					
0.90	8.5	.89	.143	6	16	15	63	49	15	33	4.8	.22	.014	.308	.014	8.4		25	.56					
1.20	8.7	1.3	.202	6	16	15	62	49	12	34	6.0	.27	.012	.298	.016	7.2								
1.50	8.9	1.2	.169													8.3								

Depth	Org.C	Tot.N	Extr. P		HCl	CaCl2 Extr		DTPA-extr.					Extractable			P		Alternative Cations				
	(W&B)		Acid	Bicarb.	K	K	P	Fe	Mn	Cu	Zn	B	SO4S	NO3N	NH4N	Buff	Equil	CEC	Ca	Mg	Na	K
metres	%	%	mg/kg		meq%	mg/kg		mg/kg					mg/kg			Cap	ug/L	m.eq/100g				
	@ 105C	@ 105C	@ 105C		@105C	@ 105C		@ 105C					@ 105C			@ 40C		@ 105C				
B 0.10	0.9	.06	15	10				29	37	2.2	0.7											

SOIL TYPE: 3Uge
SITE NO: IMC S02A
A.M.G. REFERENCE: 553 160 mE 7 811 040 mN ZONE 55
GREAT SOIL GROUP: Black earth
PRINCIPAL PROFILE FORM: Ug5.17
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .10 m
HORIZONTAL INTERVAL: 05 m
COMPONENT OF MICRORELIEF SAMPLED: Mound

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM: Very tall open shrubland
DOMINANT SPECIES: Ziziphus mauritiana, Cryptostegia grandiflora, Heptopogon contortus, Ophiurous exaltatus

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, self mulching

HORIZON	DEPTH	DESCRIPTION
A1	0 to .08 m	Brownish black (10YR3/1); light medium clay; strong 2-5mm subangular blocky primary; moist; moderately firm; few fine carbonate nodules. Abrupt to-
B21	.08 to .32 m	Brownish black (2.5Y3/1); medium clay; strong 5-10mm subangular blocky primary; dry; moderately strong; few fine carbonate nodules. Clear to-
B22	.32 to .60 m	Brownish black (2.5Y3/1); medium clay; strong 5-10mm lenticular primary, parting to strong 5-10mm subangular blocky primary; common prominent clay skins; dry; moderately strong; few fine carbonate soft segregations. Gradual to-
B23	.60 to 1.05 m	Brownish black (2.5Y3/1); few fine distinct brown mottles; medium clay; strong 5-10mm lenticular primary, parting to strong 2-5mm subangular blocky primary; many prominent clay skins; dry; moderately strong; few fine carbonate soft segregations. Gradual to-
B24	1.05 to 1.48 m	Dull yellowish brown (10YR5/4), brownish black (2.5Y3/1); medium clay; strong 10-20mm lenticular secondary, parting to strong 10-20mm subangular blocky primary; many prominent clay skins; moderately moist; moderately strong; few fine carbonate soft segregations. Gradual to-
B25	1.48 to 1.70 m	Dull yellowish brown (10YR5/3); medium clay; strong 10-20mm lenticular secondary, parting to strong 10-20mm subangular blocky primary; many prominent clay skins; dry; moderately strong; few fine carbonate soft segregations. Gradual to-
D1	1.70 to 1.80 m	Brown (7.5YR4/4); fine sandy clay; strong 5-10mm subangular blocky primary; few clay skins; dry; moderately strong; few fine carbonate soft segregations.

Depth	1:5 Soil/Water			Particle Size				Exch. Cations					Total Elements			Moistures			Disp.Ratio		Exch	Exch	ECEC	pH
	pH	EC	Cl	CS	FS	S	C	CEC	Ca	Mg	Na	K	P	K	S	ADM	33*	1500*	R1	R2	Al	Acid		CaCl2
metres		dS/m	%	%				m.eq/100g					%			%					m.eq/100g			
	@ 40C		@105C	@ 105C				@ 105C					@ 80C			@ 105C			@ 40C		@ 105C			@ 40C
B 0.10	8.7	.13	.010																					
0.10	8.4	.11	.003	3	16	15	64	67	38	29	.55	.48	.020	.180	.020	9.2		29	.33					
0.20	8.9	.13	.001													8.8								
0.30	8.9	.14	.002	4	16	14	65	65	36	33	1.2	.27	.013	.153	.014	9.0		28	.38					
0.60	9.2	.17	.001	4	15	14	65	64	30	38	2.7	.21	.011	.155	.012	8.8		29	.43					
0.90	9.3	.31	.014	5	15	14	63	71	23	41	5.4	.22	.011	.157	.012	7.8		30	.53					
1.20	9.3	.50	.042	4	16	15	65	65	18	43	8.3	.24	.011	.165	.012	7.9								
1.50	9.2	.77	.082													7.6								
1.80	9.2	.74	.080													5.3								

Depth	Org.C (W&B)	Tot.N	Extr. P		HCl	CaCl2 Extr		DTPA-extr.					Extractable			P		Alternative Cations				
			Acid	Bicarb.	K	K	P	Fe	Mn	Cu	Zn	B	SO4S	NO3N	NH4N	Buff Cap	Equil	CEC	Ca	Mg	Na	K
metres	%	%	mg/kg		meq%	mg/kg		mg/kg					mg/kg				ug/L	m.eq/100g				
	@ 105C	@ 105C	@ 105C		@105C	@ 105C		@ 105C					@ 105C			@ 40C		@ 105C				
B 0.10	0.8	.07	19	5				10	11	1.3	0.4											

SOIL TYPE: 3Uge
SITE NO: IMC S02B
A.M.G. REFERENCE: 553 160 mE 7 811 040 mN ZONE 55
GREAT SOIL GROUP: Black earth
PRINCIPAL PROFILE FORM: Ug5.17
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .10 m
HORIZONTAL INTERVAL: 05 m
COMPONENT OF MICRORELIEF SAMPLED: Depression

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM: Very tall open shrubland
DOMINANT SPECIES: Ziziphus mauritiana, Cryptostegia grandiflora, Heptopogon contortus, Ophiurous exaltatus

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, self mulching

HORIZON	DEPTH	DESCRIPTION
A1	0 to .10 m	Brownish black (2.5Y3/1); medium clay; strong 2-5mm subangular blocky primary; dry; moderately firm. Abrupt to-
B21	.10 to .45 m	Brownish black (2.5Y3/1); medium clay; strong 20-50mm subangular blocky tertiary, parting to strong 2-5mm subangular blocky primary; dry; moderately strong. Clear to-
B22	.45 to .90 m	Brownish black (2.5Y3/1); medium clay; strong 5-10mm lenticular secondary, parting to strong 5-10mm subangular blocky primary; many prominent clay skins; dry; moderately strong. Gradual to-
B23k	.90 to 1.06 m	Brownish black (2.5Y3/1); medium clay; strong 5-10mm lenticular secondary, parting to strong 5-10mm subangular blocky primary; many prominent clay skins; dry; moderately strong; few fine carbonate nodules. Gradual to-
B24k	1.06 to 1.30 m	Brownish black (2.5Y3/1); few fine distinct brown mottles; medium clay; strong 5-10mm lenticular secondary, parting to strong 5-10mm subangular blocky primary; many prominent clay skins; dry; moderately strong; few fine carbonate nodules. Gradual to-
B25k	1.30 to 1.55 m	Brown (10YR4/4); medium clay; strong 5-10mm lenticular parting to strong 5-10mm subangular blocky primary; many prominent clay skins; dry; moderately strong; few fine carbonate nodules. Gradual to-
D1k	1.55 to 1.70 m	Brown (7.5YR4/6); fine sandy clay; strong 2-5mm subangular blocky primary; dry; very firm; few fine carbonate nodules.

Depth	1:5 Soil/Water			Particle Size				Exch. Cations					Total Elements			Moistures			Disp.Ratio		Exch	Exch	ECEC	pH
	pH	EC	Cl	CS	FS	S	C	CEC	Ca	Mg	Na	K	P	K	S	ADM	33*	1500*	R1	R2	Al	Acid		CaCl2
metres		dS/m	%	%				m.eq/100g					%			%					m.eq/100g			
	@ 40C		@105C	@ 105C				@ 105C					@ 80C			@ 105C			@ 40C		@ 105C			@ 40C
B 0.10	7.4	.06	.002																					
0.10	7.5	.05	.001	2	13	14	66	67	29	36	1.3	.43	.024	.164	.017	10.2		29	.49					
0.20	7.6	.03	.001													10.2								
0.30	7.8	.04	.001	2	13	15	68	68	30	36	2.5	.18	.018	.145	.014	10.0		30	.52					
0.60	8.0	.08	.001	2	14	13	69	68	28	36	4.0	.13	.016	.144	.013	11.5		31	.61					
0.90	8.4	.28	.037	2	13	16	69	69	26	38	7.2	.16	.013	.136	.013	9.5		31	.61					
1.20	9.0	.58	.081	2	13	15	71	67	25	43	9.9	.16	.011	.149	.012	14.4								
1.50	9.0	.91	.126													8.2								
1.70	9.2	.81	.105													5.5								

Depth	Org.C	Tot.N	Extr. P		HCl	CaCl2 Extr		DTPA-extr.					Extractable			P		Alternative Cations				
	(W&B)		Acid	Bicarb.	K	K	P	Fe	Mn	Cu	Zn	B	SO4S	NO3N	NH4N	Buff Cap	Equil	CEC	Ca	Mg	Na	K
metres	%	%	mg/kg		meq%	mg/kg		mg/kg					mg/kg				ug/L	m.eq/100g				
	@ 105C	@ 105C	@ 105C		@105C	@ 105C		@ 105C					@ 105C			@ 40C		@ 105C				
B 0.10	0.9	.08	15	8				26	18	2.1	0.4											

SOIL TYPE: 3Uga8
SITE NO: IMC S04
A.M.G. REFERENCE: 548 140 mE 7 812 260 mN ZONE
GREAT SOIL GROUP: Black earth
PRINCIPAL PROFILE FORM: Ug5.16
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .08 m
HORIZONTAL INTERVAL: 04 m
COMPONENT OF MICRORELIEF SAMPLED: Mound
SURFACE COARSE FRAGMENTS: Few medium pebbles, subangular

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Ziziphus mauritiana, Bothriochloa species

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, self mulching

HORIZON	DEPTH	DESCRIPTION
A11	0 to .01 m	Black (10YR2/1); strong 5-10mm subangular blocky primary. Clear to-
A12	.01 to .10 m	Black (10YR2/1); medium clay; few small pebbles, subangular reoriented; strong 10-20mm subangular blocky primary; dry; very strong. Clear to-
B21	.10 to .42 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular reoriented; strong 10-20mm prismatic secondary, parting to 10-20mm subangular blocky primary; moderately moist; very firm; very few fine carbonate nodules. Clear to-
B22	.42 to 1.05 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular reoriented; strong 10-20mm lenticular primary; clay skins; moderately moist; very firm; few fine carbonate nodules. Clear to-
B23	1.05 to 1.38 m	Brownish black (10YR3/1), yellowish brown (2.5Y5/3); medium clay; few small pebbles, subangular reoriented; strong 10-20mm lenticular primary; clay skins; moist; very firm; few fine carbonate nodules. Clear to-
B24	1.38 to 1.50 m	Yellowish brown (2.5Y5/3); medium clay; few small pebbles, subangular reoriented; strong 10-20mm lenticular primary; clay skins; moist; very firm; few fine carbonate nodules.

Depth	1:5 Soil/Water			Particle Size				Exch. Cations					Total Elements			Moistures			Disp.Ratio		Exch	Exch	ECEC	pH
	pH	EC	Cl	CS	FS	S	C	CEC	Ca	Mg	Na	K	P	K	S	ADM	33*	1500*	R1	R2	Al	Acid		CaCl2
metres		dS/m	%	%				m.eq/100g					%			%					m.eq/100g			
	@ 40C		@105C	@ 105C				@ 105C					@ 80C			@ 105C			@ 40C		@ 105C			@ 40C
B 0.10	7.9	.05	.003																					
0.10	8.1	.05	.001	17	25	15	48	37	30	16	.20	.51	.021	.208	.017	6.70		16	.43					
0.20	8.2	.05	.001																					
0.30	8.2	.04	.001	18	26	11	47	37	22	14	.51	.17	.015	.172	.011	5.00		16	.46					
0.60	8.8	.07	.001	18	25	12	47	38	20	16	1.3	.20	.005	.183	.008	5.60		15	.52					
0.90	8.9	.20	.014	18	26	14	47	37	18	20	2.6	.19	.006	.181	.010	5.50		17	.57					
1.20	8.7	.46	.058	14	23	15	51	43	17	23	4.1	.19	.004	.186	.013	6.70								
1.50	9.0	.69	.086																					

Depth	Org.C	Tot.N	Extr. P		HCl	CaCl2 Extr		DTPA-extr.					Extractable			P		Alternative Cations				
	(W&B)		Acid	Bicarb.	K	K	P	Fe	Mn	Cu	Zn	B	SO4S	NO3N	NH4N	Buff	Equil	CEC	Ca	Mg	Na	K
metres	%	%	mg/kg		meq%	mg/kg		mg/kg					mg/kg			Cap	ug/L	m.eq/100g				
	@ 105C	@ 105C	@ 105C		@105C	@ 105C		@ 105C					@ 105C			@ 40C		@ 105C				
B 0.10	.96	.06		7.5	.45			13	15	1.2	.11			1.1								

SOIL TYPE: 3Uga8
SITE NO: IMC S05
A.M.G. REFERENCE: 548 140 mE 7 812 260 mN ZONE
GREAT SOIL GROUP: Black earth
PRINCIPAL PROFILE FORM: Ug5.16
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .08 m
HORIZONTAL INTERVAL: 04 m
COMPONENT OF MICRORELIEF SAMPLED: Depression
SURFACE COARSE FRAGMENTS: Few medium pebbles, subangular

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Ziziphus mauritiana, Bothriochloa species

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, self mulching

HORIZON	DEPTH	DESCRIPTION
A11	0 to .01 m	Brownish black (10YR3/1); strong 5-10mm subangular blocky primary. Clear to-
A12	.01 to .10 m	Brownish black (10YR3/1); light medium clay; few small pebbles, subangular; strong 10-20mm subangular blocky primary; dry; very strong. Clear to-
B21	.10 to .35 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular; strong 20-50mm subangular blocky secondary, parting to 10-20mm subangular blocky primary; moderately moist; moderately strong. Clear to-
B22	.35 to .60 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular; strong 10-20mm lenticular primary; clay skins; moderately moist; very firm. Clear to-
B23	.60 to 1.08 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular; strong 10-20mm lenticular primary; clay skins; moist; very firm; very few fine carbonate nodules. Clear to-
B24	1.08 to 1.35 m	Brownish black (10YR3/1), yellowish brown (2.5Y5/3); medium clay; few small pebbles, subangular; strong 10-20mm lenticular primary; clay skins; moist; very firm; few fine carbonate nodules. Clear to-
B25	1.35 to 1.50 m	Dark greyish yellow (2.5Y5/2); common fine distinct yellow mottles; medium clay; few small pebbles, subangular; strong 10-20mm lenticular primary; clay skins; moist; very firm; few fine carbonate nodules.

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS % @ 105C	FS	S	C	Exch. Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K	Total Elements P % @ 80C	K	S	Moistures ADM % @ 105C	33*	1500*	Disp.Ratio R1 @ 40C	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
B 0.10	8.0	.05	.001																					
0.10	7.8	.04	.001	16	25	12	49	37	23	15	.33	.40	.018	.220	.014	6.10		16	.52					
0.20	7.8	.03																						
0.30	7.8	.03	.001	16	27	13	49	39	21	16	.62	.20	.009	.176	.008	5.90		17	.56					
0.60	8.5	.07	.003	17	26	15	47	39	20	17	1.5	.22	.004	.176	.006	6.30		17	.56					
0.90	8.5	.26	.029	17	25	15	49	40	19	19	2.6	.15	.003	.180	.008	7.20		17	.58					
1.20	8.9	.48	.055	14	24	15	52	41	18	23	3.8	.16	.004	.197	.009	8.80								
1.50	8.6	.63	.089																					

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	P	DTPA-extr. Fe mg/kg @ 105C	Mn	Cu	Zn	B	Extractable SO4S mg/kg @ 105C	NO3N	NH4N	P Buff Cap @ 40C	Equil ug/L	Alternative Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K
B 0.10	.95	.06		5.3	.48			9.5	14	1.2	.21			1.1								
0.10														1.1								

SOIL TYPE: 3Uge8
SITE NO: IMC S06
A.M.G. REFERENCE: 551 230 mE 7 810 330 mN ZONE
GREAT SOIL GROUP: Black earth
PRINCIPAL PROFILE FORM: Ug5.17
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .08 m
HORIZONTAL INTERVAL: 05 m
COMPONENT OF MICRORELIEF SAMPLED: Mound
SURFACE COARSE FRAGMENTS: Few medium pebbles, subangular

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Ziziphus mauritiana, Bothriochloa species

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, self mulching

HORIZON	DEPTH	DESCRIPTION
A1	0 to .10 m	Brownish black (10YR3/1); light medium clay; few small pebbles, subangular; strong subangular blocky tertiary; dry; very strong; few fine carbonate nodules. Clear to-
B21	.10 to .35 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular; strong 100-200mm prismatic tertiary, parting to 10-20mm subangular blocky primary; dry; very strong; few fine carbonate nodules. Clear to-
B22	.35 to 1.10 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular; strong 50-100mm lenticular tertiary, parting to 10-20mm lenticular primary; clay skins; moist; very firm; few fine carbonate nodules. Clear to-
B23	1.10 to 1.30 m	Brownish black (10YR3/1), brown (7.5YR4/3); medium clay; few small pebbles, subangular; strong 50-100mm lenticular tertiary, parting to 10-20mm lenticular primary; clay skins; moist; very firm; few fine carbonate nodules. Clear to-
D?	1.30 to 1.50 m	Brown (7.5YR4/3); light medium clay; common small pebbles, subangular; strong 20-50mm lenticular tertiary; clay skins; moist; very firm; few fine carbonate nodules, few fine ferromanganiferous nodules.

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS % @ 105C	FS	S	C	Exch. Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K	Total Elements P % @ 80C	K	S	Moistures ADM % @ 105C	33*	1500*	Disp.Ratio R1 @ 40C	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
0.10	8.5	.09	.001	9	30	15	51	40	25	17	.50	.40	.013	.191	.011	6.90		17	.46					
0.20	8.8	.11	.001																					
0.30	8.8	.14	.001	9	30	15	51	41	23	19	1.1	.24	.008	.176	.007	6.30		18	.48					
0.60	9.2	.15	.002	8	31	15	51	40	19	22	3.0	.22	.006	.175	.005	7.10		18	.56					
0.90	9.2	.28	.015	8	28	16	52	40	15	24	5.1	.27	.007	.190	.006	6.10		19	.64					
1.20	9.1	.47	.043	12	26	15	52	37	13	23	6.0	.29	.014	.257	.006	5.70								
1.50	9.3	.48	.045	28	26	11	39	26	8.8	16	4.8	.22	.023	.389	.006	4.60		14	.90					

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	CaCl2 Extr P	DTPA-extr. Fe mg/kg @ 105C	Mn	Cu	Zn	B	Extractable SO4S mg/kg @ 105C	NO3N	NH4N	Buff Cap	P Equil ug/L @ 40C	Alternative Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K
0.10	.86	.04		1.1	.30			8.6	7.5	.96	.21											

SOIL TYPE: 3Uge8
SITE NO: IMC S07
A.M.G. REFERENCE: 551 230 mE 7 810 330 mN ZONE
GREAT SOIL GROUP: Black earth
PRINCIPAL PROFILE FORM: Ug5.17
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .08 m
HORIZONTAL INTERVAL: 05 m
COMPONENT OF MICRORELIEF SAMPLED:Deprssion

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Bothriochloa species

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, self mulching

HORIZON	DEPTH	DESCRIPTION
A11	0 to .01	
A12	.01 to .12 m	Brownish black (10YR3/1); light medium clay; few small pebbles, subangular; strong 5-10mm subangular blocky primary; dry; very strong. Clear to-
B21	.12 to .30 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular; strong 100-200mm prismatic tertiary, parting to 5-10mm subangular blocky primary; dry; very strong.
B22	.30 to .50 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular; strong 50-100mm lenticular tertiary; moist; very firm. Clear to-
B23	.50 to 1.30 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular; strong 50-100mm lenticular tertiary; moist; very firm; few fine carbonate nodules. Diffuse to-
D?	1.30 to 1.50 m	Brown (7.5YR4/3); light medium clay; common small pebbles, subangular; strong 20-50mm lenticular tertiary; moist; very firm; few fine carbonate nodules.

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS % @ 105C	FS	S	C	Exch. Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K	Total Elements P % @ 80C	K	S	Moistures ADM % @ 105C	33*	1500*	Disp.Ratio R1 @ 40C	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
0.10	7.7	.03	.001	9	30	13	51	37	20	17	.47	.41	.015	.192	.013	6.40		17	.47					
0.20	8.1	.03	.001																					
0.30	8.5	.05	.001	7	31	17	51	42	24	20	1.6	.19	.007	.170	.008	7.20		18	.52					
0.60	9.1	.11	.004	10	32	15	49	39	17	18	3.1	.20	.006	.176	.007	7.70		18	.67					
0.90	9.0	.20	.018	8	29	14	50	40	16	20	4.4	.19	.007	.187	.007	6.80		19	.68					
1.20	8.9	.38	.043	6	27	16	52	43	15	22	5.9	.24	.008	.206	.008	6.50								
1.50	9.5	.34	.023	52	17	5	28	20	6.7	10	3.0	.22	.048	.440	.003	2.80		11	.90					

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	CaCl2 Extr P	DTPA-extr. Fe mg/kg @ 105C	Mn	Cu	Zn	B	Extractable SO4S mg/kg @ 105C	NO3N	NH4N	P Buff Cap	P Equil ug/L @ 40C	Alternative Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K
0.10	.96	.05		2.1	.33			13	12	1.4	.11											

SOIL TYPE: 3Uga9
SITE NO: IMC S08
A.M.G. REFERENCE: 550 150 mE 7 812 190 mN ZONE
GREAT SOIL GROUP: Black earth
PRINCIPAL PROFILE FORM: Ug5.16
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .12 m
HORIZONTAL INTERVAL: 04 m
COMPONENT OF MICRORELIEF SAMPLED:Mound

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Acacia nilotica, Ziziphus mauritiana, Bothriochloa species, Ophiurous exaltatus

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, self mulching

HORIZON	DEPTH	DESCRIPTION
A1	0 to .10 m	Brownish black (10YR3/1); medium clay; few small pebbles, subangular; strong 5-10mm subangular blocky primary; dry; very strong; very few fine carbonate nodules. Clear to-
B21	.10 to .30 m	Brownish black (2.5Y3/1); medium heavy clay; few small pebbles, subangular; strong 50-100mm prismatic tertiary; dry; very strong; few fine carbonate nodules. Clear to-
B22	.30 to 1.25 m	Brownish black (2.5Y3/1); medium heavy clay; few small pebbles, subangular; strong 20-50mm lenticular tertiary, parting to 10-20mm lenticular primary; clay skins; moderately moist; moderately strong; few fine carbonate nodules. Clear to-
B23	1.25 to 1.40 m	Yellowish grey (2.5Y4/1), yellowish brown (2.5Y5/3); medium heavy clay; few small pebbles, subangular; strong 20-50mm lenticular tertiary, parting to 10-20mm lenticular primary; clay skins; moist; very firm; few fine carbonate nodules. Clear to-
B24	1.40 to 1.50 m	Grey (5Y5/1); common fine distinct yellow mottles; medium clay; few small pebbles, subangular; strong 20-50mm lenticular parting to 10-20mm lenticular primary; clay skins; moist; very firm; few fine carbonate nodules, few fine ferromanganiferous nodules. Diffuse to-

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS % @ 105C	FS	S	C	Exch. Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K	Total Elements P % @ 80C	K	S	Moistures ADM % @ 105C	33*	1500*	Disp.Ratio R1 @ 40C	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
B 0.10	7.9	.08	.001																					
0.10	7.3	.07	.001	14	21	14	54	44	25	19	.42	.73	.042	.179	.028	7.10		20	.45					
0.20	7.6	.06	.001																					
0.30	8.3	.11	.001	12	24	12	56	43	26	18	.60	.27	.013	.095	.012	7.10		19	.45					
0.60	9.0	.16	.002	12	23	11	55	43	24	24	1.8	.19	.007	.086	.007	7.20		20	.49					
0.90	9.0	.19	.005	11	24	13	54	45	19	25	3.2	.21	.006	.092	.007	7.40		20	.54					
1.20	8.8	.46	.049	11	23	13	54	46	19	29	4.9	.27	.006	.090	.008	7.00								
1.50	8.8	.83	.109																					

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Extr. P Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	CaCl2 Extr P	DTPA-extr. Fe mg/kg @ 105C	Mn	Cu	Zn	B	Extractable SO4S mg/kg @ 105C	NO3N	NH4N	P Buff Cap	P Equil ug/L @ 40C	Alternative Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K
B 0.10	1.4	.09		8.6	.50			13	19	1.4	.32											

SOIL TYPE: 3Uga9
SITE NO: IMC S09
A.M.G. REFERENCE: 550 150 mE 7 812 190 mN ZONE
GREAT SOIL GROUP: Black earth
PRINCIPAL PROFILE FORM: Ug5.1
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
TYPE OF MICRORELIEF: Normal gilgai
VERTICAL INTERVAL: .12 m
HORIZONTAL INTERVAL: 04 m
COMPONENT OF MICRORELIEF SAMPLED:Depression

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES:

CONDITION OF SURFACE SOIL WHEN DRY: Periodic cracking, self mulching

HORIZON	DEPTH	DESCRIPTION
A11	0 to .01 m	Brownish black (2.5Y3/1); medium clay; strong 5-10mm subangular blocky primary.
A12	.01 to .10 m	Brownish black (2.5Y3/1); medium clay; few small pebbles, subangular; strong 5-10mm subangular blocky primary. Clear to-
B21	.10 to .30 m	Brownish black (2.5Y3/1); medium heavy clay; few small pebbles, subangular; strong 50-100mm prismatic tertiary. Clear to-
B22	.30 to .65 m	Brownish black (2.5Y3/1); medium heavy clay; few small pebbles, subangular; strong 20-50mm lenticular. Clear to-
B23	.65 to 1.35 m	Brownish black (2.5Y3/1); medium heavy clay; few small pebbles, subangular; strong 20-50mm lenticular; few fine carbonate nodules. Diffuse to-
B24	1.35 to 1.50 m	Olive black (5Y3/1); common fine distinct yellow mottles; medium clay; few small pebbles, subangular quartz; strong 20-50mm lenticular; few medium carbonate soft segregations, few fine ferromanganiferous nodules.

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS % @ 105C	FS	S	C	Exch. Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K	Total Elements P % @ 80C	K	S	Moistures ADM % @ 105C	33*	1500*	Disp.Ratio R1 @ 40C	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
B 0.10	7.1	.04	.002																					
0.10	7.1	.06	.001	12	21	14	55	45	24	19	.32	.67	.033	.152	.020	7.30		21	.47					
0.20	7.4	.04	.001																					
0.30	7.7	.03	.001	11	23	13	56	47	22	18	.72	.14	.014	.084	.009	8.40		20	.52					
0.60	8.8	.08	.004	12	23	14	54	46	23	23	2.4	.25	.007	.086	.007	8.50		20	.61					
0.90	8.6	.37	.045	10	23	12	55	46	24	24	3.9	.17	.006	.087	.008	7.30		21	.60					
1.20	8.6	.79	.104	8	23	11	61	47	18	29	5.3	.20	.009	.124	.007	7.70								
1.50	8.9	.78	.098																					

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Extr. P Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	CaCl2 Extr P	DTPA-extr. Fe mg/kg @ 105C	Mn	Cu	Zn	B	Extractable SO4S mg/kg @ 105C	NO3N	NH4N	P Buff Cap @ 40C	P Equil ug/L	Alternative Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K
B 0.10	1.2	.08		15	.64			29	40	1.9	.43			1.1								
0.10														1.1								

SOIL TYPE: 1Dyd
SITE NO: IMC S12
A.M.G. REFERENCE: 546 510 mE 7 812 600 mN ZONE
GREAT SOIL GROUP: Solodic soil
PRINCIPAL PROFILE FORM: Dy2.43
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
TYPE OF MICRORELIEF: Linear gilgai
VERTICAL INTERVAL:
HORIZONTAL INTERVAL: 08 m
COMPONENT OF MICRORELIEF SAMPLED: Shelf
SURFACE COARSE FRAGMENTS: Common coarse pebbles, subangular

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Eucalyptus papuana, Grevillea striata, Bothriochloa species

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .10 m	Brownish black (10YR3/1); common fine distinct brown mottles; clay loam; moderate 2-5mm subangular blocky primary; dry; very firm; few fine ferromanganiferous nodules.
A2cb	.10 to .12 m	Greyish yellow-brown (10YR4/2), dry conspicuously bleached; few fine distinct brown mottles; clay loam; moderate 2-5mm subangular blocky primary; dry; very firm; few fine ferromanganiferous nodules.
B21	.12 to .20 m	Brownish grey (10YR4/1); few fine distinct brown mottles; light medium clay; few small pebbles, subangular; strong prismatic primary, parting to 5-10mm subangular blocky primary; dry; very strong; few fine ferromanganiferous nodules.
B22	.20 to .55 m	Brownish grey (10YR4/1); light medium clay; few small pebbles, subangular; strong prismatic tertiary, parting to 5-10mm prismatic primary; dry; very strong; few fine ferromanganiferous nodules.
B23	.55 to .95 m	Yellowish grey (2.5Y4/1); light medium clay; few small pebbles, subangular; strong lenticular primary, parting to 5-10mm lenticular primary; common clay skins; moderately moist; very firm; few fine carbonate nodules.
B24	.95 to 1.50 m	Dull yellowish brown (10YR5/4); light medium clay; few small pebbles, subangular; strong 10-20mm angular blocky primary; few clay skins; moderately moist; very firm; few fine carbonate nodules, few fine ferromanganiferous nodules.

Depth	1:5 Soil/Water			Particle Size				Exch. Cations					Total Elements			Moistures			Disp.Ratio		Exch	Exch	ECEC	pH
	pH	EC	Cl	CS	FS	S	C	CEC	Ca	Mg	Na	K	P	K	S	ADM	33*	1500*	R1	R2	Al	Acid		CaCl2
metres		dS/m	%	%				m.eq/100g					%			%					m.eq/100g			
	@ 40C		@105C	@ 105C				@ 105C					@ 80C			@ 105C			@ 40C		@ 105C			@ 40C
B 0.10	6.9	.03	.002																					
0.10	6.7	.02	.001	31	43	11	20	10	3.6	4:7	.45	.18	.009	.141	.011	2.30		6	.51					
0.20	7.3	.04	.004																					
0.30	7.9	.10	.010	23	34	13	34	18	7.6	9.7	2.5	.10		.132	.008	4.00		13	.74					
0.60	9.0	.61	.073	24	33	14	35	26	7.8	13	5.6	.15		.130	.010	4.60		14	.86					
0.90	9.2	.98	.118	25	27	11	38	28	9.0	16	8.8	.21	.002	.212	.012	4.80		15	.99					
1.20	9.3	.90	.107	30	28	6	36	25	6.9	13	7.0	.19	.004	.342	.009	4.90								
1.50	9.4	.74	.083																					

Depth	Org.C	Tot.N	Extr. P		HCl	CaCl2 Extr		DTPA-extr.					Extractable			P		Alternative Cations				
	(W&B)		Acid	Bicarb.	K	K	P	Fe	Mn	Cu	Zn	B	SO4S	NO3N	NH4N	Buff	Equil	CEC	Ca	Mg	Na	K
metres	%	%	mg/kg		meq%	mg/kg		mg/kg					mg/kg			Cap	ug/L	m.eq/100g				
	@ 105C	@ 105C	@ 105C		@105C	@ 105C		@ 105C					@ 105C			@ 40C		@ 105C				
B 0.10	.72	.04		3.1	.12			29	41	1.1	.10											

SOIL TYPE: 6Dda
SITE NO:IMW S01
A.M.G. REFERENCE: 539 870 mE 7 815 380 mN ZONE 55
GREAT SOIL GROUP: Solodic soil
PRINCIPAL PROFILE FORM: Dd1.33
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE: Drainage depression
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Eucalyptus tessellaris, Eucalyptus alba, Grevillea striata, Cryptostegia grandiflora, Bothriochloa species, Panicum species

HORIZON	DEPTH	DESCRIPTION
A1	0 to .10 m	Brownish black (10YR3/2); clay loam; moderate 2-5mm angular blocky primary; dry; moderately firm; common fine roots. Abrupt to-
A2sb	.10 to .12 m	Brownish black (10YR3/2), dry sporadically bleached; clay loam; moderate 2-5mm angular blocky primary; dry; moderately weak; common fine roots. Abrupt to-
B21	.12 to .27 m	Brownish black (2.5Y3/1); medium clay; strong 10-20mm angular blocky secondary, parting to 2-5mm angular blocky primary; moderately moist; very firm; common medium roots. Clear to-
B22	.27 to .55 m	Dark greyish yellow (2.5Y4/2); medium clay; very few small pebbles, subangular; strong 10-20mm lenticular secondary, parting to 5-10mm angular blocky primary; common distinct clay skins; moist; very firm; few very fine roots. Clear to-
B23k	.55 to 1.02 m	Dark greyish yellow (2.5Y4/2); medium clay; few small pebbles, subangular; strong 10-20mm lenticular secondary, parting to 5-10mm angular blocky primary; common distinct clay skins; moist; very firm; very few fine carbonate soft segregations; few very fine roots. Clear to-
D1k	1.02 to 1.50 m	Dull yellowish brown (10YR4/3); light clay; very few small pebbles, subangular; strong 5-10mm angular blocky primary; moist; moderately firm; very few fine carbonate soft segregations, very few fine carbonate nodules. Clear to-
D2	1.57 to 1.73 m	Dull yellowish brown (10YR5/3); clay loam; very few small pebbles, subangular; weak <2mm angular blocky primary; moderately moist; very few fine carbonate nodules.

Depth	1:5 Soil/Water			Particle Size				Exch. Cations					Total Elements			Moistures			Disp.Ratio		Exch	Exch	ECEC	pH
	pH	EC	Cl	CS	FS	S	C	CEC	Ca	Mg	Na	K	P	K	S	ADM	33*	1500*	R1	R2	Al	Acid		CaCl2
metres		dS/m	%	%				m.eq/100g					%			%					m.eq/100g			
	@ 40C		@105C	@ 105C				@ 105C					@ 80C			@ 105C			@ 40C		@ 105C			@ 40C
B 0.10	5.7	.12	.001																					
0.10	6.3	.05	.002	9	38	28	26	24	5.1	9.8	.67	.33	.057	.760	.031	4.2		13	.62					
0.20	7.5	.08	.007													6.8								
0.30	7.8	.22	.038	8	21	17	56	36	8.9	24	4.8	.17	.020	.428	.020	7.2		22	.81					
0.60	8.9	1.1	.170	14	19	16	53	35	6.9	24	8.3	.11	.013	.329	.015	10.2		21	.97					
0.90	8.9	1.3	.186	18	21	17	48	32	5.6	21	8.7	.13	.010	.280	.018	6.8		19	.94					
1.20	9.0	1.2	.174	13	22	15	49	33	5.7	21	9.4	.14	.008	.275	.013	6.8								
1.50	9.1	1.1	.159													7.6								
1.70	9.0	1.0	.146	13	26	15	45	32	5.6	21	9.8	.17	.033	.561	.013	7.3								

Depth	Org.C	Tot.N	Extr. P		HCl	CaCl2 Extr		DTPA-extr.					Extractable			P		Alternative Cations				
	(W&B)		Acid	Bicarb.	K	K	P	Fe	Mn	Cu	Zn	B	SO4S	NO3N	NH4N	Buff	Equil	CEC	Ca	Mg	Na	K
metres	%	%	mg/kg		meq%	mg/kg		mg/kg					mg/kg			Cap	ug/L	m.eq/100g				
	@ 105C	@ 105C	@ 105C		@105C	@ 105C		@ 105C					@ 105C			@ 40C		@ 105C				
B 0.10	1.9	.13	16	8	.35			148	162	2.9	1.9											

SOIL TYPE: 6Dyg
SITE NO: IMW S02
A.M.G. REFERENCE: 539 700 mE 7 815 200 mN ZONE 55
GREAT SOIL GROUP: Solodized solonetz
PRINCIPAL PROFILE FORM: Dy2.43
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Eucalyptus tessellaris, Eucalyptus alba, Grevillea striata, Chloris species, Heteropogon contortus

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .13 m	Brownish black (2.5Y3/1); few fine faint brown mottles; clay loam; weak 2-5mm angular blocky primary; dry; moderately weak.
A2cb	.13 to .18 m	Brownish black (2.5Y3/2), dry conspicuously bleached; few fine faint brown mottles; clay loam; weak 2-5mm angular blocky primary; dry; moderately weak; few fine ferromanganiferous nodules. Abrupt to-
B21	.18 to .37 m	Yellowish grey (2.5Y4/1); medium clay; few small pebbles, subangular; strong 20-50mm columnar tertiary, parting to 2-5mm subangular blocky primary; dry; moderately strong. Clear to-
B22k	.37 to .85 m	Yellowish grey (2.5Y4/1); gley mottles; medium clay; very few small pebbles, subangular; strong 10-20mm subangular blocky secondary, parting to 2-5mm subangular blocky primary; few clay skins; moderately moist; very firm; few fine carbonate nodules. Gradual to-
D1k	.85 to 1.35 m	Dark greyish yellow (2.5Y4/2); few fine faint brown mottles; light clay; few small pebbles, subangular; strong 2-5mm subangular blocky primary; moderately moist; very firm; few fine carbonate nodules, few fine ferromanganiferous nodules. Gradual to-
D2k	1.35 to 1.76 m	Dark greyish yellow (2.5Y5/2); light medium clay; few small pebbles, subangular quartz; strong 5-10mm subangular blocky primary; moderately moist; very firm; few fine carbonate nodules, few fine ferromanganiferous nodules.

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS % @ 105C	FS	S	C	Exch. Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K	Total Elements P % @ 80C	K	S	Moistures ADM % @ 105C	33*	1500*	Disp.Ratio R1 @ 40C	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
B 0.10	5.7	.14	.004																					
0.10	6.4	.04	.002	28	33	19	22	16	3.8	5.2	.35	.83	.030	.997	.015	2.5		8	.63					
0.18	6.9	.03	.002													1.6								
0.30	8.1	.21	.027	23	25	14	38	26	8.1	14	4.8	.09	.018	.798	.019	4.8		16	.88					
0.60	8.9	1.6	.275	12	25	16	48	33	8.9	17	12	.13	.018	.649	.016	7.4		19	.95					
0.90	8.5	1.7	.287	8	29	16	51	34	8.3	17	13	.16	.016	.612	.010	6.4		20	.98					
1.20	8.8	1.5	.248	10	29	13	47	33	8.4	17	11	.12	.015	.517	.007	10.7								
1.50	9.0	1.3	.185													5.0								

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	P	DTPA-extr. Fe mg/kg @ 105C	Mn	Cu	Zn	B	Extractable SO4S mg/kg @ 105C	NO3N	NH4N	P Buff Cap	Equil ug/L @ 40C	Alternative Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K
B 0.10	1.4	.10	24	13	.63			110	135	2.0	1.3											

SOIL TYPE: 6Dba
SITE NO: IMW S05
A.M.G. REFERENCE: 542 980 mE 7 812 050 mN ZONE 55
GREAT SOIL GROUP: Solodic soil
PRINCIPAL PROFILE FORM: Db1.33
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Eucalyptus alba, Grevillea striata, Chloris species

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .15 m	Greyish brown (7.5YR4/2); sandy loam; massive; dry; very weak.
A2sb	.15 to .22 m	Greyish brown (7.5YR4/2), dry sporadically bleached; sandy loam; weak 2-5mm subangular blocky primary; dry; moderately weak.
B21	.22 to .53 m	Brown (10YR4/6); light medium clay; few small pebbles, subangular quartz; strong 10-20mm subangular blocky secondary, parting to 2-5mm subangular blocky primary; dry; moderately strong; few fine ferromanganiferous nodules.
B22n	.53 to 1.05 m	Brown (7.5YR4/6); light medium clay; few small pebbles, subangular quartz; strong 20-50mm subangular blocky tertiary, parting to 2-5mm angular blocky primary; many prominent clay skins; dry; very strong; common fine ferromanganiferous nodules.
D1	1.05 to 1.45 m	Dull brown (7.5YR5/4), greyish yellow-brown (10YR5/2); light clay; few small pebbles, subangular quartz; strong 50-100mm subangular blocky tertiary, parting to 2-5mm angular blocky primary; many prominent clay skins; dry; very strong; few fine ferromanganiferous nodules, very few fine carbonate nodules.

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS % @ 105C	FS	S	C	Exch. Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K	Total Elements P % @ 80C	K	S	Moistures ADM % @ 105C	33*	1500*	Disp.Ratio R1 @ 40C	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
B 0.10	6.0	.07	.002																					
0.10	6.0	.05	.002	43	43	6	7	6	2.1	1.7	.05	.26	.024	1.23	.012	0.6		3	.52					
0.20	6.4	.02	.001													0.8								
0.30	7.2	.02	.001	28	31	7	33	15	7.4	6.9	.21	.13	.018	.962	.010	2.2		13	.61					
0.60	7.7	.03	.001	27	36	6	30	14	7.1	7.7	.35	.09	.015	.916	.009	2.2		12	.63					
0.90	8.2	.04	.002	32	38	8	22	13	6.1	7.7	.69	.07	.019	.961	.007	1.9		9	.68					
1.20	8.7	.05	.002	28	39	12	23	14	6.0	9.9	1.1	.08	.027	1.09	.005	2.3								
1.45	8.9	.08	.006													2.4								

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Extr. P Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	CaCl2 Extr P	DTPA-extr. Fe mg/kg @ 105C	Mn	Cu	Zn	B	Extractable SO4S mg/kg @ 105C	NO3N	NH4N	P Buff Cap @ 40C	P Equil ug/L	Alternative Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K
B 0.10	0.7	.06	21	13	.28			50	76	1.1	1.3											

SOIL TYPE: 4Dyf
SITE NO: IMC S11
A.M.G. REFERENCE: 547 030 mE 7 813 960 mN ZONE
GREAT SOIL GROUP: No suitable group
PRINCIPAL PROFILE FORM: Dy2.23
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:

SUBSTRATE MATERIAL:
SLOPE: 2 %
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .20 m	Dark reddish brown (5YR3/2); few fine distinct yellow mottles; sandy loam; massive; dry; very weak.
A2	.20 to .35 m	Yellowish brown (10YR5/6); few fine distinct yellow mottles; sandy loam; massive; dry; very weak; many medium ferromanganiferous nodules.
B21	.35 to .60 m	Bright yellowish brown (10YR6/6); few fine distinct yellow mottles; light clay; few small pebbles, angular quartz; moderate 5-10mm angular blocky primary; dry; moderately weak; common medium ferromanganiferous nodules.
B22	.60 to .82 m	Dull yellowish orange (10YR6/4); few fine distinct yellow mottles; light clay; few small pebbles, angular quartz; moderate 5-10mm angular blocky primary; dry; moderately firm; many medium ferromanganiferous nodules.
B23	.82 to 1.05 m	Bright yellowish brown (10YR6/6); light medium clay; few small pebbles, angular quartz; strong 10-20mm angular blocky primary; dry; moderately strong; few medium ferromanganiferous nodules.
B24	1.05 to 1.45 m	Bright yellowish brown (10YR6/6); light medium clay; few small pebbles, angular quartz; strong 10-20mm angular blocky primary; dry; moderately strong; few fine carbonate nodules.

Depth	1:5 Soil/Water			Particle Size				Exch. Cations					Total Elements			Moistures			Disp.Ratio		Exch	Exch	ECEC	pH
	pH	EC	Cl	CS	FS	S	C	CEC	Ca	Mg	Na	K	P	K	S	ADM	33*	1500*	R1	R2	Al	Acid		CaCl2
metres		dS/m	%	%				m.eq/100g					%			%					m.eq/100g			
	@ 40C		@105C	@ 105C				@ 105C					@ 80C			@ 105C			@ 40C		@ 105C			@ 40C
B 0.10	5.2	.02	.001																					
0.10	5.4	.05	.002	47	42	4	10	2	.55	.62	.07	.23	.017	.092	.015	.700		3	.51					
0.20	5.3	.02	.001																					
0.30	5.4	.01	.001	45	41	2	13	3	.75	.65	.05	.11	.006	.067	.006	.800		3	.58					
0.60	6.7	.02	.001	36	29	4	34	6	1.2	2.5	1.2	.07	.016	.113	.006	2.30		9	.45					
0.90	8.4	.13	.013	40	29	4	31	8	.97	2.9	5.1	.08	.006	.125	.007	2.20		11	.94					
1.20	9.5	.41	.043	30	32	5	36	12	1.4	4.1	10	.13		.168	.006	3.20								
1.50	9.9	.66	.051																					

Depth	Org.C	Tot.N	Extr. P		HCl	CaCl2 Extr		DTPA-extr.					Extractable			P		Alternative Cations				
	(W&B)		Acid	Bicarb.	K	K	P	Fe	Mn	Cu	Zn	B	SO4S	NO3N	NH4N	Buff Cap	Equil	CEC	Ca	Mg	Na	K
metres	%	%	mg/kg		meq%	mg/kg		mg/kg					mg/kg				ug/L	m.eq/100g				
	@ 105C	@ 105C	@ 105C		@105C	@ 105C		@ 105C					@ 105C			@ 40C		@ 105C				
B 0.10	.70	.05		4.0	.07			120	9.1	1.3	.05			2.0								
0.10														7.0								
0.20														1.0								
1.50														1.0								

SOIL TYPE: 5Dye
SITE NO: IMW S03
A.M.G. REFERENCE: 542 340 mE 7 814 130 mN ZONE 55
GREAT SOIL GROUP: No suitable group
PRINCIPAL PROFILE FORM: Dy2.23
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:
SURFACE COARSE FRAGMENTS: Very few medium pebbles, angular

SUBSTRATE MATERIAL:
SLOPE: 1 %
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Eucalyptus alba, Eucalyptus papuana, Grevillea striata, Bothriochloa species

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
A1	0 to .15 m	Greyish yellow-brown (10YR4/2); clay loam; weak 2-5mm subangular blocky primary; moderately moist; moderately weak; very few fine ferromanganiferous nodules.
A2	.15 to .22 m	Brown (10YR4/4); clay loam; moderate subangular blocky primary; dry; moderately firm; few fine ferromanganiferous nodules.
B21	.22 to .55 m	Yellowish brown (10YR5/6); light medium clay; few small pebbles, subangular; strong 10-20mm subangular blocky secondary, parting to 2-5mm subangular blocky primary; dry; moderately strong; few fine ferromanganiferous nodules.
B22	.55 to .80 m	Dull yellowish brown (10YR5/4); few fine faint red mottles; medium clay; few small pebbles, subangular; strong 20-50mm subangular blocky secondary, parting to 2-5mm angular blocky primary; dry; moderately strong; common fine ferromanganiferous nodules.
B23k	.80 to .94 m	Dull yellowish brown (10YR5/4); few fine faint red mottles; light medium clay; few small pebbles, subangular; strong 5-10mm subangular blocky secondary, parting to 2-5mm angular blocky primary; dry; moderately strong; few fine carbonate nodules, very few fine ferromanganiferous nodules.
BC	.94 to 1.00 m	Dull yellowish brown (10YR5/4); few fine faint red mottles; light clay; common medium pebbles, angular; strong 2-5mm angular blocky primary; dry; moderately strong.
C	1.00 to 1.34 m	Fragments, granite.

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS % @ 105C	FS	S	C	Exch. Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K	Total Elements P % @ 80C	K	S	Moistures ADM % @ 105C	33*	1500*	Disp.Ratio R1 @ 40C	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
B 0.10	6.1	.14	.002																					
0.10	6.7	.03	.001	25	44	10	22	14	8.1	3.2	.18	.16	.022	.106	.020	1.5		8	.46					
0.20	6.9	.02	.001													1.6								
0.30	7.1	.02	.001	28	33	9	32	15	9.1	3.4	.15	.07	.014	.089	.010	2.0		11	.50					
0.60	7.3	.02	.001	21	34	9	37	17	11	3.7	.15	.06	.009	.101	.009	2.2		13	.47					
0.90	8.2	.13	.001	22	37	7	32	16	13	3.2	.14	.05	.015	.152	.008	2.1		12	.55					

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Extr. P Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	CaCl2 Extr P	DTPA-extr. Fe mg/kg @ 105C	Mn	Cu	Zn	B	Extractable SO4S mg/kg @ 105C	NO3N	NH4N	P Buff Cap @ 40C	P Equil ug/L	Alternative Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K
B 0.10	1.1	.08	9	7	.47			46	133	1.3	0.9											

SOIL TYPE: 5Dya
SITE NO: IMW S04
A.M.G. REFERENCE: 541 190 mE 7 812 770 mN ZONE 55
GREAT SOIL GROUP: No suitable group
PRINCIPAL PROFILE FORM: Dy2.12
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:

SUBSTRATE MATERIAL:
SLOPE: 1 %
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Eucalyptus alba, Planchonia careya, Heteropogon triticeus, Themeda australis

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
A11	0 to .20 m	Brownish black (7.5YR3/1); clay loam; weak <2mm subangular blocky primary; moderately moist; moderately weak. Clear to-
A12	.20 to .35 m	Brownish black (7.5YR3/2); common fine distinct yellow mottles; clay loam; very few small pebbles, angular quartz; moderate 2-5mm subangular blocky primary; dry; very firm; few fine ferromanganiferous nodules. Clear to-
B21	.35 to .88 m	Yellowish brown (10YR5/6); light clay; very few small pebbles, angular quartz; moderate 2-5mm subangular blocky primary; moderately moist; very firm; few fine ferromanganiferous nodules. Gradual to-
B22n	.88 to 1.14 m	Bright brown (7.5YR5/6); few fine distinct red mottles; light clay; very few small pebbles, angular quartz; strong 2-5mm subangular blocky primary; dry; moderately strong; common fine ferromanganiferous nodules. Gradual to-
B23n	1.14 to 1.70 m	Yellowish brown (10YR5/8); common medium distinct red mottles; light clay; very few small pebbles, angular quartz; strong 2-5mm subangular blocky primary; dry; moderately strong; common fine ferromanganiferous nodules.

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size % @ 105C CS	FS	S	C	Exch. Cations m.eq/100g @ 105C CEC	Ca	Mg	Na	K	Total Elements % @ 80C P	K	S	Moistures % @ 105C ADM	33*	1500*	Disp.Ratio @ 40C R1	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
B 0.10	6.1	.13	.001																					
0.10	6.0	.07	.003	41	32	10	17	12	4.5	2.3	.05	.23	.034	.104	.021	1.9		8	.42					
0.20	6.2	.04	.002													1.7								
0.30	6.3	.04	.002	33	26	8	34	12	5.0	2.3	.05	.13	.022	.107	.016	2.7		12	.34					
0.60	6.6	.01	.001	15	13	4	68	15	7.0	3.2	.07	.05	.015	.106	.010	7.0		21	.18					
0.90	6.7	.02	.001	20	17	7	56	13	5.9	2.7	.08	.04	.013	.109	.008	2.9		17	.16					
1.20	6.8	.01	.001	20	17	8	56	14	6.9	3.4	.09	.05	.010	.118	.006	3.0								
1.50	6.9	.01	.001													6.4								

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P mg/kg @ 105C Acid	Bicarb.	HCl K meq% @105C	CaCl2 Extr mg/kg @ 105C K	P	DTPA-extr. mg/kg @ 105C Fe	Mn	Cu	Zn	B	Extractable mg/kg @ 105C SO4S	NO3N	NH4N	P Buff Cap @ 40C	P Equil ug/L @ 40C	Alternative Cations m.eq/100g @ 105C CEC	Ca	Mg	Na	K
B 0.10	1.4	.08	12	8	.37			58	128	1.6	2.0											

SOIL TYPE: 4Dy1
SITE NO: IMC S10
A.M.G. REFERENCE: 547 160 mE 7 814 020 mN ZONE
GREAT SOIL GROUP: Yellow podzolic soil
PRINCIPAL PROFILE FORM: Dy2.22
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:

SUBSTRATE MATERIAL:
SLOPE: 3 %
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

HORIZON	DEPTH	DESCRIPTION
A11	0 to .18 m	Brownish black (7.5YR3/2) moist; few fine distinct brown mottles; sandy loam; massive; dry; very weak. Clear to-
A12	.18 to .26 m	Brown (7.5YR4/3); sandy loam; massive; dry; very weak. Clear to-
A2	.26 to .30 m	Brown (10YR4/4); sandy loam; few medium pebbles, angular quartz; massive; dry; very weak; very many medium ferromanganiferous nodules. Abrupt to-
B21	.30 to .90 m	Yellowish brown (10YR5/6); few fine distinct red mottles; light clay; few small pebbles, angular quartz; moderate 5-10mm angular blocky primary; dry; moderately firm; many medium ferromanganiferous nodules. Clear to-
B22	.90 to 1.18 m	Dull yellowish brown (10YR5/4); few fine distinct red mottles; light clay; few small pebbles, angular quartz; moderate 5-10mm angular blocky primary; dry; moderately firm; common medium ferromanganiferous nodules.
B23	1.18 to 1.38 m	Dull yellowish brown (10YR5/4); few fine distinct grey mottles; light clay; few small pebbles, angular quartz; strong 10-20mm angular blocky primary; dry; very firm; few medium ferromanganiferous nodules.

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS % @ 105C	FS	S	C	Exch. Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K	Total Elements P % @ 80C	K	S	Moistures ADM % @ 105C	33*	1500*	Disp.Ratio R1 @ 40C	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
B 0.10	5.6	.05	.002																					
0.10	5.9	.03	.001	46	44	4	10	4	1.1	1.0	.05	.40	.022	.166	.010	.900		3	.45					
0.20	5.6	.01	.001																					
0.30	5.4	.01	.001	44	43	2	11	4	.96	.66	.05	.11	.013	.152	.006	1.00		3	.59					
0.60	6.4	.01	.001	28	26	4	44	11	4.7	3.5	.15	.11	.010	.117	.003	3.60		13	.35					
0.90	6.8	.02	.001	42	27	1	30	9	3.8	3.2	.34	.05	.005	.116		2.40		10	.60					
1.20	7.2	.03	.001	31	29	4	38	12	6.0	4.8	.91	.11	.002	.136	.010	3.10								
1.50	7.8	.04	.002																					

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	P	DTPA-extr. Fe mg/kg @ 105C	Mn	Cu	Zn	B	Extractable SO4S mg/kg @ 105C	NO3N	NH4N	P Buff Cap @ 40C	Equil ug/L	Alternative Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K
B 0.10	.61	.04		4.0	.16			61	35	1.5	.30			13								
0.10														2.0								
0.20														1.0								
0.90														1.0								
1.20														1.0								

SOIL TYPE: 6Dyg
SITE NO: IMC S03
A.M.G. REFERENCE: 551 200 mE 7 813 825 mN ZONE
GREAT SOIL GROUP: Solodized solonetz
PRINCIPAL PROFILE FORM: Dy2.43
SOIL TAXONOMY UNIT:
FAO UNESCO UNIT:

CONDITION OF SURFACE SOIL WHEN DRY: Hard setting

SUBSTRATE MATERIAL:
SLOPE:
LANDFORM ELEMENT TYPE:
LANDFORM PATTERN TYPE:

STRUCTURAL FORM:
DOMINANT SPECIES: Acacia nilotica, Chloris species, Bothriocloa species

HORIZON	DEPTH	DESCRIPTION
Acb	0 to .12 m	Greyish brown (7.5YR4/2) moist, light brownish grey (7.5YR7/2) dry; few fine faint brown mottles; clay loam; weak 2-5mm subangular blocky primary; dry; very firm. Abrupt to-
B21	.12 to .20 m	Greyish yellow-brown (10YR4/2); few fine faint brown mottles; medium clay; strong 20-50mm prismatic secondary, parting to 5-10mm angular blocky primary; dry; very strong. Abrupt to-
B22	.20 to .52 m	Greyish yellow-brown (10YR4/2); medium clay; strong 20-50mm prismatic secondary, parting to 5-10mm angular blocky primary; few clay skins; dry; very strong. Abrupt to-
D1	.52 to .65 m	Greyish brown (7.5YR4/2); light clay; strong 5-10mm angular blocky primary; few clay skins; moderately moist; very firm; few medium gypseous crystals, very few fine carbonate nodules. Sharp to-
D2	.65 to .90 m	Brown (7.5YR4/3); light clay; strong 5-10mm angular blocky primary; few clay skins; moderately moist; very firm; common medium gypseous crystals. Abrupt to-

Depth metres	1:5 Soil/Water pH @ 40C	EC dS/m @ 40C	Cl % @105C	Particle Size CS % @ 105C	FS	S	C	Exch. Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K	Total Elements P % @ 80C	K	S	Moistures ADM % @ 105C	33*	1500*	Disp.Ratio R1 @ 40C	R2	Exch Al m.eq/100g @ 105C	Exch Acid	ECEC	pH CaCl2 @ 40C
B 0.10	5.4	.75	.102																					
0.10	6.0	.26	.031	7	19	46	33	24	2.8	5.2	3.6	1.2	.189	1.59	.024	3.50		13	.72					
0.20	7.1	.62	.080																					
0.30	8.1	1.7	.162	2	12	32	65	36	8.1	15	16	.41	.049	1.36	.086	5.50		23	.87					
0.60	8.0	4.1	.273	1	9	29	65	33	8.0	15	22	.49	.042	1.42	.320	6.20		22	1.0					
0.90	7.8	5.2	.248	1	16	33	55	32	9.8	13	22	.55	.055	1.43	.747	6.90		22	.92					
1.20	8.5	2.1	.223		38	25	43	28	6.5	11	19	.54	.084	1.44	.082	5.00								
1.50	8.4	2.0	.223																					

Depth metres	Org.C (W&B) % @ 105C	Tot.N % @ 105C	Extr. P Acid mg/kg @ 105C	Extr. P Bicarb.	HCl K meq% @105C	CaCl2 Extr K mg/kg @ 105C	CaCl2 Extr P	DTPA-extr. Fe mg/kg @ 105C	Mn	Cu	Zn	B	Extractable SO4S mg/kg @ 105C	NO3N	NH4N	P Buff Cap @ 40C	P Equil ug/L	Alternative Cations CEC m.eq/100g @ 105C	Ca	Mg	Na	K
B 0.10	1.6	.11		115	.86			209	59	1.6	2.4			2.1								

APPENDIX II IRRIGATION LAND SUITABILITY CLASSES, BURDEKIN RIVER IRRIGATION AREA

Land suitability classification is the evaluation of current knowledge of land properties based on the requirements of a specified land use. **Current technology and management are assumed and the land was assessed as it was found at the time of the survey.** Levelling and drainage will therefore improve the land suitability in some cases. The objective is sustained production with minimal land degradation. Socioeconomic factors are considered in general terms only, either at the start of the study or in the definition of the level of inputs required to overcome each limitation. The approach is qualitative in that the land suitability classes do not equate to actual costs and benefits.

Five land suitability classes have been defined with suitability decreasing progressively from Class 1 to Class 5 as follows:

Class 1 — Suitable land with negligible limitations. This is highly productive land requiring only simple management practices to maintain economic production.

Class 2 — Suitable land with minor limitations which either reduce production or require more than the simple management practices* of class 1 land to maintain economic production.

Class 3 — Suitable land with moderate limitations which either further lower production or require more than those management practices of class 2 land to maintain economic production.

Class 4 — Marginal land which is presently considered unsuitable due to severe limitations. The precise effects of these limitations on the proposed land use are unknown. The use of this land is dependent upon either undertaking additional studies to determine its suitability for sustained production or reducing the effects of the limitation(s) to achieve production.

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

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* Where more than simple management practices are required, this may involve changes in land preparation, irrigation management, the addition of soil ameliorants and the use of additional measures to prevent land degradation.

APPENDIX III LAND SUITABILITY CLASSES FOR IRRIGATION OF SUGAR-CANE, MAIZE, CAPSICUMS, RICE AND MANGOES AND AREAS OF EACH UNIQUE MAP AREA (UMA), INKERMAN WEST AND CENTRAL SECTIONS, BRIA.

Survey	UMA no.	Complex[1]	Dominant soil type	Soil type 2	Land suitability					Area (ha)
					sugar cane	maize	capsicums	rice	mango	
IMW	1	N	5Dra	5Dyc5	4	4	4	5	2	6.8
IMW	2	N	1Uge	1Dyd	3	3	3	5	4	2.9
IMW	3	N	1Dyc	5Dyc5	4	4	4	5	4	7.9
IMW	4	N	5Dra1	5Dra	4	4	4	5	2	8.5
IMW	5	N	5Dra	5Dra1	4	4	4	5	2	14.3
IMW	6	Y	5 R	5Dra1	5	5	5	5	4	7.2
IMW	7	N	5DybE	5Dyc5	5	5	5	5	5	7.9
IMW	8	N	5Dyb	5Dra	3	3	3	5	4	3.1
IMW	9	Y	6Drb2	6Dbf2	5	5	5	5	4	21.3
IMW	10	N	6Dyg		4	4	4	5	4	3.0
IMW	11	N	6Dyg		4	4	4	5	4	1.5
IMW	12	Y	1Dyd	1Uge	3	4	4	5	4	10.4
IMW	13	N	1Uge1	1Dyd	3	3	4	5	4	31.0
IMW	14	Y	1Dyd	1Uge	3	4	4	5	4	3.4
IMW	15	Y	1Dyd	1Uge	3	4	4	5	4	17.1
IMW	16	N	6Drb2	6Gna2	5	5	5	5	4	4.1
IMW	17	N	6GnaE	6Umb2	5	5	5	5	5	11.6
IMW	18	N	1Dyc	1Ugc	3	4	4	5	4	13.2
IMW	19	N	1UgeS		4	4	4	5	4	3.4
IMW	20	N	1DycS		4	4	4	4	4	2.0
IMW	21	N	6Gne		3	3	3	5	4	21.5
IMW	22	N	6Gna		2	2	2	5	3	17.2
IMW	23	N	1Uga		3	3	4	5	4	8.2
IMW	24	N	2Ugd		3	3	4	3	4	4.1
IMW	25	N	6Dyg	6Gne	3	3	4	5	4	58.7
IMW	26	N	6Gna		2	2	2	4	4	6.4
IMW	27	N	6Uga		3	3	3	4	4	1.1
IMW	28	N	2UgcS	2Uge	4	4	4	4	4	22.4
IMW	29	N	1Dyc	1Dda	3	4	4	5	4	9.8
IMW	30	N	6Gna2		4	4	4	5	4	4.7
IMW	31	N	1Uge	1Dyd	4	3	4	5	4	8.0
IMW	32	N	5Dra		4	4	4	5	2	4.1
IMW	33	N	6Dbb		3	4	4	5	4	4.9
IMW	34	N	1Dyc		4	4	4	5	4	1.6
IMW	35	N	1Dda	1Dba	3	4	4	5	4	7.3
IMW	36	N	1Uga		3	3	4	5	4	1.6
IMW	37	N	1UgdS		4	4	4	5	4	4.8
IMW	38	N	5Dra		4	4	4	5	2	12.8
IMW	39	N	5Dyb	5Dda	3	4	4	5	4	14.4
IMW	40	Y	1Uge	1Dyd	3	4	4	5	4	52.2
IMW	41	Y	1Dyd	1Uge	3	3	4	5	4	14.6
IMW	42	N	5Dye		3	3	3	5	4	2.5
IMW	43	N	5Dyb		3	3	3	5	4	2.6
IMW	44	N	5DybS		4	4	4	5	4	4.5
IMW	45	N	5Dra	5Uga	4	4	4	5	2	21.8
IMW	46	N	6Dyg2	6Dyf5	4	4	4	5	4	2.1
IMW	47	N	6GnaE		5	5	5	5	5	3.3
IMW	48	N	5Dyc5		4	4	4	5	4	4.3
IMW	49	N	5Dra		4	4	4	5	2	2.0
IMW	50	N	6DbaE		5	5	5	5	5	1.4
IMW	51	N	6Dda		3	4	4	4	4	1.9

[1] A UMA is a complex UMA (Y) when the dominant soil type occupies <70% of the UMA, and a simple UMA when the dominant soil type occupies >70% of the UMA.

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability					Area (ha)
					sugar cane	maize	capsicums	rice	mango	
IMW	52	N	1Uge	1Dyd	3	3	4	5	4	17.7
IMW	53	N	6GnaE		5	5	5	5	5	0.8
IMW	54	N	5Dra	5Dra5	5	4	4	5	2	5.2
IMW	55	N	5Dyc5	5Dyb	4	4	4	5	4	4.3
IMW	56	Y	1Dyd	1Uge	3	3	4	5	4	6.1
IMW	57	N	1Dyc	1Uge	3	4	4	5	4	5.8
IMW	58	N	5Dra6		4	4	4	5	3	5.4
IMW	59	N	5Dyc5		4	4	4	5	4	3.4
IMW	60	N	6UfdE		5	5	5	5	5	1.3
IMW	61	N	6Gna2	6Dyg	3	3	3	5	4	5.6
IMW	62	N	1Uge	1Dyd	3	3	3	5	4	21.4
IMW	63	Y	1Uge	1Dyd	3	4	4	5	4	9.8
IMW	64	Y	1Dyd	1Uge	3	4	4	5	4	9.9
IMW	65	N	1Dyc	1Uge	4	4	4	5	4	1.0
IMW	66	N	6Dba	6Dyg	3	3	4	5	4	12.5
IMW	67	N	6Dda	6Dyg	3	3	4	5	4	2.6
IMW	68	N	1Uga		3	3	4	3	4	6.7
IMW	69	N	1Uge		3	3	3	4	4	0.9
IMW	70	N	6UgaE		5	5	5	5	5	7.2
IMW	71	N	6DbaS		4	4	4	5	4	1.5
IMW	72	N	6GnaE		5	5	5	5	5	2.2
IMW	73	N	1Ugc		4	4	4	4	4	2.6
IMW	74	Y	6Dra	6Gne	4	4	4	5	3	4.2
IMW	75	N	5Dra	5Dra6	4	4	4	5	2	16.6
IMW	76	Y	5Dyf	5Ugc	4	4	4	5	4	1.9
IMW	77	N	5Dyc		4	4	4	5	4	9.4
IMW	78	N	6Gna2		3	3	3	5	4	6.0
IMW	79	N	1UgaE		5	5	5	5	5	2.3
IMW	80	N	6GnaE		5	5	5	5	5	5.2
IMW	81	N	6Dyg		4	4	4	5	4	2.7
IMW	82	Y	1Dyd	1Uge	3	4	4	5	4	4.2
IMW	83	N	6Ufa		3	3	3	5	4	2.1
IMW	84	N	1Uge	1Dyd	3	3	4	5	4	9.1
IMW	85	N	6GnaE		5	5	5	5	5	1.8
IMW	86	N	6Gna2		3	3	3	5	4	1.1
IMW	87	N	5Dra	5Dya	4	4	4	5	2	3.4
IMW	88	N	5Dyc		4	4	4	5	4	2.7
IMW	89	N	6GnaE	6Gna5	5	5	5	5	5	5.2
IMW	90	N	1Uge	1Ugel	3	4	4	5	4	10.4
IMW	91	N	5Dyc		4	4	4	5	4	7.7
IMW	92	N	5Dra		4	4	4	5	3	8.2
IMW	93	N	6GnaE		5	5	5	5	5	3.8
IMW	94	N	6Uga	6Ufd	3	3	3	5	4	1.0
IMW	95	N	6Gna2		3	3	3	5	4	2.2
IMW	96	N	1Uga		3	3	4	5	4	3.2
IMW	97	N	6UgaE	1Uga	5	5	5	5	5	12.3
IMW	98	N	6Dba		3	3	4	5	4	1.4
IMW	99	N	6Dba2		3	3	4	5	4	2.2
IMW	100	N	1Uga		3	3	4	5	4	5.0
IMW	101	Y	5Dyf	5Ugc	3	4	4	5	4	17.0
IMW	102	N	6Gna		3	3	3	5	2	1.4
IMW	103	N	5Dra		4	4	4	5	2	9.7
IMW	104	N	6Dyg	6Dba	3	3	4	5	4	3.5
IMW	105	N	6UfcE	6Ufa	5	5	5	5	4	12.7
IMW	106	N	6Drb2		3	3	3	5	2	0.5
IMW	107	N	6Drc		3	3	3	4	3	3.0
IMW	108	N	1Ugc		3	3	4	4	4	2.6

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability: sugar cane	maize	capsicums	rice	mango	Area (ha)
IMW	109	N	6Gna		3	3	3	5	2	1.0
IMW	110	N	6Dbh		4	4	4	4	4	2.3
IMW	111	N	6Ufd		4	4	4	5	4	1.2
IMW	112	N	6Dba	6Dbb	3	3	4	3	4	32.4
IMW	113	N	6Dyg2		4	4	4	4	4	3.7
IMW	114	N	6Drb2		3	3	3	5	2	1.4
IMW	115	N	1Ugc		3	3	3	3	4	8.6
IMW	116	Y	1Dyd	1Uge	3	3	4	3	4	15.8
IMW	117	N	1Dyc	1Uge	3	4	4	3	4	1.2
IMW	118	N	1Ugc		3	3	4	5	4	2.7
IMW	119	N	6Dba	6Dyg	3	3	4	4	4	53.4
IMW	120	N	6Dda2	6Uga	3	3	4	4	4	4.0
IMW	121	Y	6Dda2	6Uga2	3	3	4	4	4	5.3
IMW	122	N	1Uga	1Uge	3	3	4	4	4	4.8
IMW	123	N	6Uga	6Ufa	3	3	3	4	4	6.8
IMW	124	N	6Dra2		3	3	3	5	2	3.6
IMW	125	N	6Dyg	6Uga	4	4	4	4	4	1.8
IMW	126	N	6Uga		3	3	3	4	4	1.0
IMW	127	N	6Dra		3	3	3	5	2	0.8
IMW	128	N	6Dda	6Uga	3	3	4	5	4	2.0
IMW	129	N	6Dba	6Dyg	3	3	4	4	4	38.0
IMW	130	N	6Uga2		3	3	3	4	4	4.0
IMW	131	N	1Dbb	1Uge	4	4	4	4	4	3.9
IMW	132	Y	1Dbb	1Ugc	3	4	4	4	4	6.7
IMW	133	N	1Dbb		4	4	4	4	4	1.2
IMW	134	N	1Uga	1Ugc	3	3	4	4	4	152.8
IMW	135	Y	1Dbb	1Ugc	4	4	4	4	4	16.3
IMW	136	N	6Dyj		4	4	4	4	4	0.8
IMW	137	N	1Uge		3	3	4	4	4	9.1
IMW	138	N	6Ufd	6Dyg	3	3	4	4	4	3.1
IMW	139	N	6Gna		3	3	3	4	4	1.1
IMW	140	N	6Dyg		3	3	4	4	4	0.5
IMW	141	N	6Dyg		3	3	4	4	4	0.7
IMW	142	N	6Ufa	6Ufb	3	3	3	4	4	7.3
IMW	143	N	6Uga	6Dyg	3	3	3	4	4	20.1
IMW	144	Y	1Ugc	1Dya	4	4	4	4	4	2.2
IMW	145	N	6Dyh2		3	3	4	4	4	4.2
IMW	146	Y	1Uga	1Dba	4	4	4	4	4	4.5
IMW	147	Y	1Uga	1Dba	3	3	4	4	4	10.5
IMW	148	Y	1Dba	1Ugc	4	4	4	4	4	28.6
IMW	149	N	1Uge	1Dyd	3	3	4	4	4	15.3
IMW	150	Y	1Dyd	1Uge	3	3	4	4	4	10.1
IMW	151	N	1Uge	1Dyd	3	3	4	4	4	2.9
IMW	152	N	6Uga		3	3	4	4	4	1.1
IMW	153	N	6Dyg		4	4	4	4	4	1.3
IMW	154	Y	1Dyd	1Uge	3	3	4	4	4	6.2
IMW	155	N	6Dra		3	3	3	5	2	1.8
IMW	156	N	1Ugc	1Uga	3	3	4	4	4	0.7
IMW	157	N	6Dda		3	3	4	4	4	3.7
IMW	158	N	6Dyj		4	4	4	5	4	1.3
IMW	159	N	1Dyc		4	4	4	4	4	11.0
IMW	160	N	6Dba		3	3	4	5	4	1.5
IMW	161	N	1Ugd		3	3	4	3	4	9.8
IMW	162	N	1Dya	1Dda	4	4	4	4	4	7.5
IMW	163	Y	1Dyd	1Uge	3	3	4	4	4	6.6
IMW	164	N	1Dyb		3	3	4	4	4	1.6
IMW	165	N	1Ugc	1Uga	3	3	4	4	4	11.3

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability					Area (ha)
					sugar cane	maize	capsicums	rice	mango	
IMW	166	Y	1Dyd	1Uge	3	4	4	4	4	3.3
IMW	167	N	6Dda		3	3	4	4	4	10.6
IMW	168	Y	6Gna	6Ufd	2	2	2	4	4	15.0
IMW	169	N	6Dyg	6Ufa	3	4	4	4	4	16.0
IMW	170	N	6Dda		3	3	4	3	4	4.4
IMW	171	N	6Uga		3	3	4	3	4	2.3
IMW	172	Y	6Dbf	6GnaE	5	5	5	5	5	19.3
IMW	173	N	6Dda2		3	3	4	4	4	10.7
IMW	174	N	5Dya3		4	4	4	5	2	10.3
IMW	175	N	5Dye3	5Ugb	3	3	3	5	4	3.3
IMW	176	Y	5Dyb	5Ugb	4	4	4	5	4	28.0
IMW	177	N	5Ugb	5Dyb	3	3	3	5	4	4.4
IMW	178	Y	5Dyc	5Ugb	4	4	4	5	4	1.8
IMW	179	N	5Ugb		3	3	4	5	4	2.0
IMW	180	N	6Dra2		3	3	3	5	3	1.4
IMW	181	N	1Ugc	1Dyc	3	3	4	4	4	8.1
IMW	182	N	6Drc3		3	3	4	4	3	3.4
IMW	183	N	6Dyg	6Ufa	4	4	4	4	4	5.6
IMW	184	N	6Ufd	6Ufe	2	2	4	4	4	12.8
IMW	185	N	6Ufe	6Ufe	4	4	4	4	4	63.6
IMW	186	Y	6Gna	6Ufc	4	4	3	4	4	31.7
IMW	187	N	6Ucc2		4	4	4	5	2	1.7
IMW	188	N	6Gna	6Gna2	3	3	3	4	4	5.7
IMW	189	N	6Ufa		3	3	3	4	4	8.4
IMW	190	N	6Dda		4	4	4	4	4	2.0
IMW	191	N	6Uga		4	4	4	4	4	1.4
IMW	192	N	6Ufa	6Uga	4	4	4	4	4	1.4
IMW	193	N	6Uga	6Ufa	4	4	4	4	4	1.0
IMW	194	N	6Dyg2	6Dda	3	3	4	4	4	1.5
IMW	195	N	6Ufd	6Ufb2	4	4	4	4	4	2.9
IMW	196	N	6Gna2	6Gna	4	4	3	5	2	43.5
IMW	197	N	6Dyg	6Ufa	4	4	4	5	4	2.9
IMW	198	N	6Uga2	6Dda	4	4	4	4	4	7.9
IMW	199	N	6Dyg		4	4	4	4	4	4.7
IMW	200	N	6Dyg	6Uga	4	4	4	4	4	5.1
IMW	201	N	6Dbf2		3	3	3	4	2	1.9
IMW	202	N	6Gna2	6Gna	4	4	3	4	2	19.2
IMW	203	N	6Dyg		4	4	4	4	4	4.9
IMW	204	N	6UfaS		4	4	4	4	4	2.4
IMW	205	N	6Dyg2		4	4	4	4	4	2.6
IMW	206	N	6Ufd		3	3	3	4	4	3.3
IMW	207	N	6Uga		3	3	4	4	4	0.2
IMW	208	N	6Ufb		3	3	3	4	4	3.7
IMW	209	N	6Dda		3	3	4	4	4	1.6
IMW	210	N	1Uga		3	3	4	5	4	1.3
IMW	211	Y	6Dda	1Ugc	3	3	4	4	4	10.4
IMW	212	N	6DyjS		4	4	4	4	4	3.2
IMW	213	N	1Uga		3	3	4	5	4	0.4
IMW	214	N	1Uga		3	3	4	5	4	1.9
IMW	215	N	6Uga	6Uga2	4	4	4	4	4	3.5
IMW	216	N	6Dyg2	Dba	3	3	4	4	4	26.5
IMW	217	N	6Ucc		4	4	4	5	2	0.9
IMW	218	N	6Dyh	6Dba	3	3	4	4	4	8.1
IMW	219	N	6Dyg		3	3	4	4	4	4.6
IMW	220	Y	6Dda	1Ugc	3	4	4	4	4	13.2
IMW	221	N	6Gna2		3	3	3	4	4	1.2
IMW	222	Y	6Dyh	6Dyg	3	3	4	4	4	34.3

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability: sugar cane	Land suitability: maize	Land suitability: capsicums	Land suitability: rice	Land suitability: mango	Area (ha)
IMW	223	N	6Uga		3	3	4	4	4	1.5
IMW	224	N	1Uga		3	3	4	4	4	113.3
IMW	225	N	6DdbS		4	4	4	4	4	1.3
IMW	226	N	1UgaS	1Ugf	4	4	4	4	4	34.5
IMW	227	N	1UgdS		4	4	4	4	4	2.8
IMW	228	Y	1Dyd	1Uge	3	4	4	4	4	5.4
IMW	229	N	5DycS		4	4	4	4	4	2.6
IMW	230	N	5Ugb	5Ugc	4	4	4	5	4	5.6
IMW	231	N	5Dra	5Uga	4	4	4	5	2	1.2
IMW	232	N	1Uga		4	4	4	4	4	1.5
IMW	233	Y	5Dyb	5Ugb	4	4	4	5	4	3.8
IMW	234	N	1Dyc	1Dyc3	3	4	4	5	4	6.2
IMW	235	N	6Gna2	6Gna	3	3	3	5	2	5.0
IMW	236	N	3Ugk	3Ugb	4	4	4	4	5	32.9
IMW	237	N	2Ugc		4	4	4	4	5	1.4
IMW	238	N	2Ugc	2Ugf	2	3	4	2	5	56.1
IMW	239	N	2Ugc	2Ugd	2	3	4	2	5	16.8
IMW	240	N	6Dyg		3	4	4	4	5	1.0
IMW	241	N	6Gna2		2	2	2	4	5	1.3
IMW	242	N	6Dyj		4	4	4	4	5	4.3
IMW	243	N	6Gna2		2	2	2	4	5	3.1
IMW	244	N	6Dyg2		3	4	4	4	4	1.7
IMW	245	N	3Uga	3Ugd	2	3	4	2	5	21.9
IMW	246	N	2Ugd2	2Uge2	4	4	4	4	5	18.3
IMW	247	N	3Uge		4	4	4	2	5	16.1
IMW	248	N	3Uge		2	3	4	2	5	33.6
IMW	249	N	2Ugc	2Uge	2	3	4	2	5	109.9
IMW	250	N	2Dyb		3	3	4	3	5	1.7
IMW	251	N	3Ugd	3Uga	2	3	4	2	5	85.2
IMW	252	N	3Ugd	3Ugc	2	3	4	2	5	91.9
IMW	253	N	3Ugb		2	3	4	2	5	10.5
IMW	254	Y	6Dyg	6Ugc	3	3	4	2	4	38.8
IMW	255	N	6Dyj		4	4	4	4	4	2.1
IMW	256	N	6Dyj		4	4	4	4	5	5.9
IMW	257	N	6Dyg	6Dyg2	3	3	4	4	4	40.9
IMW	258	N	6Gna2	6Dbf2	2	2	2	4	3	9.0
IMW	259	N	6Ufc	6Dda	2	2	4	4	4	17.6
IMW	260	N	6Gna2	6Gna	3	3	3	4	3	26.4
IMW	261	N	6Gna2	6Uma	3	3	3	4	3	13.3
IMW	262	N	6Ufd		3	3	3	4	5	1.5
IMW	263	N	6Uga		3	3	4	4	5	1.3
IMW	264	N	3UgdE		5	5	5	5	5	12.2
IMW	265	N	3Uga		2	3	4	2	5	17.3
IMW	266	N	6Ufd	6Ufc	3	3	4	5	5	7.5
IMW	267	N	1Ugf		3	3	4	4	4	3.9
IMW	268	Y	5Dyc	5Ugb	4	4	4	4	4	9.4
IMW	269	N	3Ugc		2	3	4	2	5	36.7
IMW	270	Y	5Dye	5Uga	4	4	4	4	4	4.8
IMW	271	N	3Ugk		3	3	4	5	4	11.4
IMW	272	N	5Dyd	5Dye	4	4	4	5	4	5.1
IMW	273	N	5Dye	5Dyc	3	3	3	5	4	16.7
IMW	274	N	5Ugb	5Uga	3	3	4	5	4	16.3
IMW	275	N	5Ugb1	5Dye	3	3	3	5	4	9.8
IMW	276	N	5Dra		4	4	4	5	2	9.8
IMW	277	N	5Dyc		4	4	4	5	4	19.4
IMW	278	N	1Ugf	1Ugc	3	3	4	5	4	3.7
IMW	279	N	5Dra	5Dra5	4	4	4	5	2	22.2

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability					Area (ha)
					sugar cane	maize	capsicums	rice	mango	
IMW	280	N	5Dya	5Dyb	4	4	4	5	2	21.1
IMW	281	N	5Dra	5Dya	4	4	4	5	2	167.4
IMW	282	Y	5Uga	5Dra	4	4	4	5	4	17.1
IMW	283	Y	5Dyf	5Ugc	3	3	4	5	4	4.1
IMW	284	N	5Dyb	5Dya	3	3	3	5	4	30.1
IMW	285	Y	5Dya	5Ugb	4	4	4	5	4	19.0
IMW	286	N	5Uga	5Dya	4	4	4	5	4	3.3
IMW	287	N	5Ugb	5Dyb	4	4	4	5	4	1.7
IMW	288	Y	6Ufc	6Dyg	3	4	4	5	4	7.0
IMW	289	N	5Ugb	5Dyb	3	3	3	5	4	4.6
IMW	290	N	5Ugb5		3	3	3	5	4	1.6
IMW	291	N	1Uga	1Uga2	3	3	4	4	4	29.6
IMW	292	N	6Ufa	6Ufa2	3	3	4	4	4	17.5
IMW	293	N	6Dra2		4	4	4	5	2	1.4
IMW	294	Y	6Ufa2	6Ucc	4	4	4	5	4	10.7
IMW	295	N	6Uga	6Uga2	3	3	4	5	4	8.7
IMW	296	N	6Gne		3	3	3	5	4	1.3
IMW	297	N	1Uga		3	3	4	4	5	4.0
IMW	298	N	1Uga		3	3	4	4	5	42.6
IMW	299	N	1UgaE	6Uga	5	5	5	5	5	17.4
IMW	300	N	6Uga		3	3	4	4	4	1.8
IMW	301	N	1Ugc	1Ugf	3	3	4	4	4	11.8
IMW	302	N	1Uga		3	3	4	3	4	29.1
IMW	303	N	6Uga		3	3	3	4	4	1.3
IMW	304	N	6Dba		3	3	4	4	4	4.0
IMW	305	N	6Ufc	6Ucc2	3	3	3	4	4	12.5
IMW	306	N	6Uga	6Uga2	3	3	3	4	4	11.9
IMW	307	N	5Dya	5Dyb	4	4	4	5	2	38.4
IMW	308	Y	5Dra	5Uga	4	4	4	5	4	0.9
IMW	309	Y	5Uga	5Dra	4	4	4	5	4	2.6
IMW	310	N	5Uga	5Dyc	4	4	4	5	4	1.2
IMW	311	N	5DraE		5	5	5	5	5	1.1
IMW	312	N	5Dya		4	4	4	5	2	13.9
IMW	313	N	5DycE		5	5	5	5	5	1.2
IMW	314	N	5Dyc	5Dyb	4	4	4	4	4	12.4
IMW	315	N	6 E		5	5	5	5	5	78.8
IMW	316	N	6Uga2		4	4	4	5	4	1.4
IMW	317	N	6Drc	6Dra2	3	3	3	5	2	16.2
IMW	318	N	6Uga2		4	4	4	4	4	1.7
IMW	319	N	6Uga2		4	4	4	4	4	2.1
IMW	320	N	6UgaE		5	5	5	5	5	2.1
IMW	321	N	5Dra	5Dra5	4	4	4	5	2	28.4
IMW	322	N	5Dyb		3	4	4	5	4	13.7
IMW	323	N	5DycE		5	5	5	5	5	3.8
IMW	324	N	5Dra		4	4	4	5	3	10.5
IMW	325	N	5Uga	5Dyc	3	3	4	5	4	3.8
IMW	326	N	5Dya		4	4	4	5	2	1.7
IMW	327	N	6UfbE	6Ufe	5	5	5	5	5	8.4
IMW	328	N	5Dyc		4	4	4	5	4	10.3
IMW	329	N	5Dra	5Dya	4	4	4	5	2	9.0
IMW	330	N	5Dya	5Dra	4	4	4	5	2	4.9
IMW	331	N	5Dyb	5Dya	3	3	3	5	4	25.4
IMW	332	N	1Uga	1Ugc	3	3	4	4	4	9.5
IMW	333	N	5Dya	5Dra	4	4	4	5	2	29.2
IMW	334	N	6Ufb	6Ucc	3	3	4	4	4	3.4
IMW	335	N	6Dbf2	6Dbf	3	4	4	5	2	3.8
IMW	336	Y	6Dyg	6Dbb	3	4	4	5	4	14.1

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability: sugar cane	maize	capsicums	rice	mango	Area (ha)
IMW	337	N	6Dba	6Dba2	3	4	4	5	4	6.9
IMW	338	N	6Dyh		3	4	4	5	4	2.3
IMW	339	N	6Dyj		4	4	4	5	4	3.0
IMW	340	N	6Da		3	3	4	5	4	2.4
IMW	341	N	6Dda		3	3	4	5	4	1.3
IMW	342	N	6Dbf	6Dba2	3	3	3	5	2	37.4
IMW	343	N	6Dyg	6Dyj	3	4	4	4	4	33.1
IMW	344	N	1Ugc	1Uge	3	3	3	4	4	4.5
IMW	345	N	6Ufa	6Dda	3	3	3	4	4	12.3
IMW	346	N	5Dyc		4	4	4	4	4	2.3
IMW	347	N	6Ufc		2	2	3	4	4	1.5
IMW	348	N	6Ufa	6Ucc	2	2	3	5	4	5.7
IMW	349	N	6Dda		3	3	4	4	4	2.5
IMW	350	N	6Dye		3	3	3	5	4	3.8
IMW	351	N	6Ufb		3	3	4	4	4	1.8
IMW	352	N	6Gna2		3	3	3	5	3	1.3
IMW	353	N	6Uga	6Ufe	3	3	3	5	4	8.1
IMW	354	N	6Dbf2		3	3	3	5	3	1.0
IMW	355	N	6Dyj		4	4	4	5	4	3.0
IMW	356	N	6Ufa		3	3	3	5	4	2.9
IMW	357	N	6Dba	6Dba2	3	3	4	5	4	32.8
IMW	358	Y	6Dda	6Dbd	4	4	4	5	4	5.8
IMW	359	N	6Dba	6Dyg	3	3	4	5	4	5.1
IMW	360	N	6Dyg	6Dyj	3	3	4	5	4	14.9
IMW	361	N	6Dbf2		3	3	3	5	3	1.3
IMW	362	N	6Gna	6Gna2	3	3	3	5	4	5.5
IMW	363	N	6Dba		3	3	3	5	4	3.3
IMW	364	N	6Gna2	6Dbf	3	3	3	5	4	2.7
IMW	365	N	6Dda		3	3	3	5	4	1.2
IMW	366	N	6Ufa		3	3	3	5	4	0.6
IMW	367	N	6Dbf2		3	3	3	5	3	0.5
IMW	368	N	6Ufa	6Ufb	3	3	3	5	4	3.1
IMW	369	N	6Dba		3	3	3	5	4	2.2
IMW	370	N	6Dyg		3	4	4	4	4	4.8
IMW	371	N	6Dyj		4	4	4	5	4	1.8
IMW	372	N	6Dda	6Dyg	3	3	4	4	4	4.3
IMW	373	N	6Dyg		3	3	4	4	4	1.3
IMW	374	Y	6Ucc	6Dbf	4	4	4	5	3	4.2
IMW	375	N	6Dyj	6Dyg	4	4	4	4	4	3.3
IMW	376	N	6Dda		3	3	4	4	4	1.9
IMW	377	Y	6Dda	6Uga	3	3	4	4	4	5.2
IMW	378	N	1Ugc	1Ugf3	3	3	4	3	4	10.8
IMW	379	N	1Ugf		3	3	4	4	4	6.7
IMW	380	N	6Dyg	1Ugc	4	4	4	4	4	3.1
IMW	381	Y	6Dyg	1Uga	4	4	4	4	4	1.8
IMW	382	N	6Ufb2		3	3	4	5	4	0.7
IMW	383	N	6Dda		3	3	4	4	4	3.5
IMW	384	N	6Dbf2	6Dba	4	4	4	5	3	1.5
IMW	385	N	6Dda		3	3	4	4	4	0.7
IMW	386	N	6Dyg	6Dyg2	3	3	4	5	4	9.4
IMW	387	N	6Ufe	6Ufb2	3	3	3	5	4	1.9
IMW	388	N	6Dyj		4	4	4	4	4	1.3
IMW	389	N	6Ucc2		4	4	4	5	2	0.3
IMW	390	N	6Ufa		3	3	3	5	4	6.8
IMW	391	N	6Uga		3	3	3	4	4	3.1
IMW	392	N	6Dyh2		4	4	3	4	4	1.2
IMW	393	N	6Dda		3	3	4	4	4	3.0

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability					Area (ha)
					sugar cane	maize	capsicums	rice	mango	
IMW	394	N	6Dyg	6Dda	3	3	4	4	4	23.2
IMW	395	N	6Dbf2	6Ucc2	4	4	4	4	3	8.1
IMW	396	Y	6Dyb2	6Ucc	4	4	4	5	2	4.0
IMW	397	N	6Dda		3	3	4	4	4	7.8
IMW	398	N	1Uga		4	4	4	4	4	1.8
IMW	399	N	6Dda		4	4	4	4	4	6.3
IMW	400	N	6Dbe		4	4	3	5	4	2.3
IMW	401	N	6Dbf2	6Dra2	4	4	3	5	3	12.0
IMW	402	N	6Dda	6Dyg	4	4	4	4	4	3.4
IMW	403	N	6Ucc		4	4	4	5	2	2.5
IMW	404	N	6Uga		3	3	3	4	4	1.7
IMW	405	N	6Ufa		4	4	4	5	4	3.2
IMW	406	N	6Uga		4	4	4	5	4	1.6
IMW	407	N	6Gna		3	3	3	4	4	8.4
IMW	408	N	6Ufa		4	4	4	5	4	1.9
IMW	409	N	6Ufa		4	4	4	5	4	4.6
IMW	410	N	6Dda		4	4	4	5	4	2.1
IMW	411	N	6Dbb		3	4	4	5	4	3.2
IMW	412	N	6Ufa		3	3	3	4	4	4.1
IMW	413	N	6Ufd2		4	4	4	5	4	1.6
IMW	414	N	6Dyh		4	4	4	4	4	2.2
IMW	415	N	6UfeE	6Ufb2	4	4	5	5	5	8.9
IMW	416	N	6Uga		3	3	3	4	4	7.1
IMW	417	N	6Gna2		3	3	3	5	4	2.5
IMW	418	N	6Ufb	6Ufa	3	3	3	5	4	5.8
IMW	419	N	6Ucc		4	4	4	5	2	1.8
IMW	420	N	6Uga		3	3	3	5	4	36.6
IMW	421	N	6Dda		3	3	4	5	4	2.7
IMW	422	Y	6GnaE	6Ucc2	4	4	5	5	5	5.0
IMW	423	N	6Ufb		4	4	4	5	4	1.5
IMW	424	N	1Dyc5		4	4	4	5	4	3.2
IMW	425	N	4Dyh		4	4	4	5	5	19.2
IMW	426	N	4DyhS		4	4	4	5	4	9.5
IMW	427	N	4Dyf	4Dyg	3	3	3	5	4	13.2
IMW	428	N	6UfaS		4	4	4	4	5	3.1
IMW	429	N	1UgdS		4	4	4	4	4	0.8
IMW	430	N	3Uga9		2	3	4	2	4	9.6
IMW	431	N	3UgaE		5	5	5	5	5	21.5
IMW	432	N	3Uga9	3Ugd9	3	3	4	2	4	97.1
IMW	433	N	2Uge	2Ugc	3	3	4	2	5	16.6
IMW	434	N	6Dyg		3	4	4	5	4	26.9
IMW	435	N	2Dyc		3	3	4	2	4	56.
IMW	436	N	2Ugc		2	3	4	2	4	18.7
IMW	437	N	5Dye	5Dyc	3	4	4	5	4	22.9
IMW	438	N	5Dyb		3	4	4	5	4	23.1
IMW	439	N	5Dra		4	4	4	5	2	6.8
IMW	440	N	3UgcW		4	4	4	4	5	34.5
IMW	441	N	6Ufa		3	3	3	4	4	3.7
IMW	442	N	6Dyh		3	3	4	5	4	1.9
IMW	443	N	6Dyg2		3	3	4	5	4	4.3
IMW	444	N	6 E		5	5	5	5	5	44.2
IMW	445	N	5Dyf	5Ugc	3	4	4	5	4	8.2
IMW	446	N	3Ugc	3Ugd	3	3	4	3	4	29.4
IMW	447	N	2Dyb		3	4	4	3	4	1.5
IMW	448	N	6Dba	6Dyg	3	3	4	5	4	17.8
IMW	449	N	6 E		5	5	5	5	5	25.1
IMW	450	N	6 E		5	5	5	5	5	12.9

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability					Area (ha)
					sugar cane	maize	capsicums	rice	mango	
IMW	451	Y	6Gna	6Dyg	3	3	4	5	4	11.8
IMW	452	N	5DycE		5	5	5	5	5	2.5
IMW	453	N	6Dda		3	3	4	5	4	1.4
IMW	454	N	6Ucc		4	4	4	5	2	0.8
IMW	455	N	6Dyj		4	4	4	4	4	2.1
IMW	456	N	5Dyc		4	4	4	4	4	1.8
IMW	457	N	6Dda	6Dda2	3	3	4	5	4	3.1
IMW	458	N	6Dbf2		3	3	3	5	2	2.9
IMW	459	N	6Dbb	6Drc	3	3	4	4	4	3.2
IMW	460	N	6Dda		3	3	4	4	4	2.6
IMW	461	Y	5Dyf	5Ugc	3	4	4	5	4	2.1
IMW	462	N	5Dra		4	4	4	5	2	10.9
IMW	463	N	6Drb		3	3	3	5	2	2.1
IMW	464	N	6Dbf2		3	3	3	5	2	2.8
IMW	465	N	6UgaW		4	4	4	4	5	1.5
IMW	466	N	6Dba2		4	4	4	5	4	3.3
IMW	467	N	5Dra		4	4	4	5	2	1.3
IMW	468	N	5Dyc		4	4	4	5	5	0.4
IMW	469	N	5Dyc		4	4	4	5	5	0.8
IMW	470	N	5Dyb		4	4	4	5	4	2.7
IMW	471	N	5DraE		5	5	5	5	5	2.0
IMW	472	N	6GnaE		5	5	5	5	5	9.8
IMW	473	N	5Dra		4	4	4	5	2	1.7
IMW	474	Y	5Dra	5Dyb	4	4	4	5	4	1.8
IMW	475	N	5Uga		4	4	4	5	4	2.8
IMW	476	N	6Uga		4	4	4	5	4	1.1
IMW	477	N	6Dyg2		3	3	4	5	4	2.2
IMW	478	N	1UgeS		4	4	4	5	5	2.9
IMW	479	N	6Dba		4	4	4	4	4	0.5
IMW	480	N	6Uga2		4	4	4	5	4	5.6
IMW	481	N	5Dya	5Dyb	4	4	4	5	2	7.3
IMW	482	N	5Dra		4	4	4	5	2	1.4
IMW	483	N	5Dyc		4	4	4	5	4	1.0
IMW	484	N	6Gnd2	6Dda3	4	4	4	5	4	1.7
IMW	485	N	5DraE		5	5	5	5	5	4.6
IMW	486	N	1UgcE		5	5	5	5	5	2.7
IMW	487	N	1UgaE		5	5	5	5	5	1.0
IMC	490	N	6Dba	6Dyh	3	4	4	5	4	9.2
IMC	491	N	6Dyh	6Dba	3	4	4	5	4	4.9
IMC	492	N	6Dyf		4	4	4	5	3	1.2
IMC	493	N	6Gna2		3	3	3	5	3	2.0
IMC	494	N	5Dra		4	4	4	5	2	47.4
IMC	495	N	4Dyl	4Dyl3	4	4	4	5	2	28.7
IMC	496	N	4Dyg	4Dya	4	4	4	5	4	5.7
IMC	497	N	6Gna2		4	4	3	5	4	2.9
IMC	498	N	6DraE		5	5	5	5	5	7.8
IMC	499	N	6Dbf2		3	4	4	5	4	12.5
IMC	500	N	6Dyf		3	4	4	5	4	1.1
IMC	501	N	6Dbf2		3	3	3	5	4	2.0
IMC	502	N	6Gna2		3	3	3	5	4	3.1
IMC	503	N	1Ugc		3	3	4	5	4	2.2
IMC	504	N	6Dyg		3	3	4	5	4	6.5
IMC	505	N	1UgcE		5	5	5	5	5	5.0
IMC	506	Y	6Gna2	6Dra2	3	3	3	5	3	10.5
IMC	507	N	6Ufc		3	3	3	5	4	0.7
IMC	508	N	6DbfE		5	5	5	5	5	0.6
IMC	509	N	4Dyl		4	4	4	5	2	1.9

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability					Area (ha)
					sugar cane	maize	capsicums	rice	mango	
IMC	510	N	5DraE		5	5	5	5	5	3.2
IMC	511	Y	1Dyd	1Uge	3	4	4	5	4	2.8
IMC	512	N	4Dyl	4Dyf3	4	4	4	5	2	46.9
IMC	513	N	5Dra	5Dra3	4	4	4	5	2	73.3
IMC	514	N	6Gna2		4	4	4	5	3	1.3
IMC	515	Y	1Dyd	1Uge	3	4	4	5	4	8.2
IMC	516	N	4DygR		5	5	5	5	5	2.2
IMC	517	N	4Dye		3	3	3	5	4	10.2
IMC	518	N	6Dda	6Ufb	3	3	4	4	4	7.6
IMC	519	N	6Ufc	6Uga	4	4	4	4	4	2.7
IMC	520	Y	6Dba2	6Gna2	3	3	3	5	4	6.6
IMC	521	N	1Ugc1		2	3	4	5	4	0.9
IMC	522	N	6Dyg		3	3	4	5	4	1.4
IMC	523	N	6Dyg	6Dyh	3	3	4	5	4	1.9
IMC	524	N	6Ufb2		3	3	3	5	4	3.7
IMC	525	N	6Dbf2		4	4	4	5	2	1.8
IMC	526	N	6Dda2	6Dyg	3	3	4	5	4	1.4
IMC	527	N	4Dyg		3	3	4	5	4	8.0
IMC	528	N	4Dyg		3	3	3	5	4	11.2
IMC	529	N	4DyhR	4Dyh	5	5	5	5	4	1.8
IMC	530	Y	1Dyd	1Uge	5	4	4	5	4	2.0
IMC	531	N	4Dyg	4Dyf	3	3	4	5	4	19.9
IMC	532	N	6DdaE		5	5	5	5	5	1.4
IMC	533	N	1UgaE		5	5	5	5	5	1.4
IMC	534	N	4DygE		5	5	5	5	5	1.3
IMC	535	N	1Uga		3	3	4	5	4	4.6
IMC	536	Y	1Dyd	1Uge	4	4	4	5	4	1.8
IMC	537	N	6Drb2	6Umb2	3	4	4	5	4	5.2
IMC	538	N	6Dbf2		3	4	4	5	2	2.4
IMC	539	N	6Umb2		3	4	4	5	2	3.6
IMC	540	N	4Dye	4Dba	3	4	4	5	4	13.0
IMC	541	N	4Dyg		4	4	4	5	4	17.0
IMC	542	N	4Dyf5	4Dyl	3	3	3	5	4	38.1
IMC	543	N	4Dga		5	5	5	5	5	5.7
IMC	544	N	4Dyh		4	4	4	5	4	8.1
IMC	545	N	1UgcE		5	5	5	5	5	1.8
IMC	546	N	1DycS		4	4	4	4	4	0.8
IMC	547	N	1UgcE		5	5	5	5	5	8.4
IMC	548	N	1Ugc		3	3	3	4	4	4.0
IMC	549	N	1Dya	1Dyc	4	4	4	5	4	15.9
IMC	550	Y	1Dyd	1Uge	3	3	4	5	4	2.3
IMC	551	N	1Ugc		3	3	4	5	4	4.8
IMC	552	Y	1Dyd	1Uge	3	3	4	5	4	68.6
IMC	553	N	1Dyc	1Dbb	3	4	4	5	4	20.7
IMC	554	N	1Uga		3	3	4	5	4	4.9
IMC	555	N	1Dyc		3	4	4	5	4	1.2
IMC	556	N	4Dyl	4Dyl3	4	4	4	5	2	32.6
IMC	557	N	4Dyg		3	3	3	5	4	3.6
IMC	558	N	1Ugc	1Uga	3	3	3	5	4	2.9
IMC	559	N	6Dyj		4	4	4	5	4	2.2
IMC	560	N	1Uge		3	3	4	4	4	6.6
IMC	561	N	1Uga		3	3	4	4	4	1.8
IMC	562	N	1Uge		3	3	4	5	4	65.7
IMC	563	N	6Dyg3	6Dyg	3	4	4	5	4	3.4
IMC	564	N	6Dyg		3	3	4	5	4	3.2
IMC	565	N	6Drc2	6Drc3	3	3	4	5	3	5.9
IMC	566	N	5Ugb		3	3	4	5	4	1.1

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability					Area (ha)
					sugar cane	maize	capsicums	rice	mango	
IMC	567	N	6Ufa	6Gna2	3	3	3	5	4	2.5
IMC	568	N	6Dyg		3	3	4	5	4	6.6
IMC	569	N	1Uga	1Dyc3	3	3	4	5	4	4.3
IMC	570	N	1UgaE		5	5	5	5	5	9.5
IMC	571	N	1Uga		3	3	4	5	4	7.6
IMC	572	N	6Dda		3	3	4	5	4	1.3
IMC	573	N	6Dda		3	3	4	5	4	1.5
IMC	574	N	6Dyf		3	3	4	5	3	2.9
IMC	575	N	6 P		5	5	5	5	5	8.7
IMC	576	N	6Ufa	6Gna2	3	3	3	4	4	21.5
IMC	577	N	6Dda		3	3	4	5	4	5.3
IMC	578	N	6Dbf2		3	3	3	5	4	3.8
IMC	579	N	6Gna2		3	3	3	5	4	19.3
IMC	580	N	6Dba2		3	3	4	5	4	3.3
IMC	581	N	1UgaE		5	5	5	5	5	3.0
IMC	582	N	1Uga		3	3	4	5	4	10.0
IMC	583	N	1UgaE		5	5	5	5	5	3.9
IMC	584	N	6 E		5	5	5	5	5	69.9
IMC	585	N	6Dyg	6Dyg3	3	4	4	5	4	3.5
IMC	586	N	6Dda3		3	4	4	5	4	3.2
IMC	587	N	6Dyg		4	4	4	5	4	3.5
IMC	588	N	6Ufe		3	3	4	5	4	1.0
IMC	589	Y	6Dyg	6Gna	3	3	4	5	4	6.2
IMC	590	N	1Ugc		4	4	4	4	4	1.5
IMC	591	Y	4Dyl	4Dbb	4	4	4	5	2	6.4
IMC	592	N	1Ugc2		3	3	3	5	4	3.8
IMC	593	N	3Uga8	3Uga9	2	3	4	3	4	141.1
IMC	594	N	3UgaE		5	5	5	5	5	8.8
IMC	595	N	3Uga8	3Uga2	2	3	4	3	4	23.3
IMC	596	N	1Dyc		4	4	4	5	4	13.2
IMC	598	N	4Dyf	4Dyg	3	4	4	5	4	27.9
IMC	599	N	4Dyl	4Dyf	4	4	4	5	2	9.0
IMC	600	N	4Dyf		3	4	4	5	4	3.2
IMC	601	N	5 R	5Dra	5	5	5	5	5	10.6
IMC	602	N	5Dra	5Dra5	4	4	4	5	2	23.7
IMC	603	N	5 R		5	5	5	5	5	4.7
IMC	604	N	4Dyl		4	4	4	5	2	16.9
IMC	605	N	1Dyc	1Dyc3	4	4	4	5	4	13.2
IMC	606	N	5Uga		4	4	4	5	4	2.6
IMC	607	N	5Dra	5Dra5	4	4	4	5	2	5.0
IMC	608	N	4Dyg3	4Dyh	3	3	3	5	4	8.5
IMC	609	N	5Dra	5Dra1	4	4	4	5	2	6.7
IMC	610	N	5 R		5	5	5	5	5	6.0
IMC	611	N	4Dyl		4	4	4	5	2	7.8
IMC	612	N	4Dyg	4Dyj	3	3	4	5	4	13.5
IMC	613	N	1Dyc		4	4	4	5	4	17.9
IMC	614	N	1Ugd		4	4	4	4	4	4.9
IMC	615	N	1DydS		4	4	4	4	5	4.6
IMC	616	N	4Dyf	4Dyf3	3	3	3	5	4	9.0
IMC	617	N	4Dyl	4Dyl3	4	4	4	5	2	35.6
IMC	618	Y	5Uga	4Dyl	4	4	4	4	4	0.9
IMC	619	N	5Dra		4	4	4	5	3	6.9
IMC	620	N	4Dyf		4	4	4	5	4	1.5
IMC	621	N	3UgaW	3Uga8	4	4	4	4	4	42.8
IMC	622	N	1Dyc	1Dyc1	4	4	4	4	4	7.8
IMC	623	N	4Dyg	4Dyg3	4	4	4	5	4	16.7
IMC	624	Y	4Dyl1	4Dyh1	4	4	4	5	4	8.4

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability					Area (ha)
					sugar cane	maize	capsicums	rice	mango	
IMC	625	N	4Dyf	4Dyg	4	4	4	5	4	3.3
IMC	626	N	4Dyh	4Dyg	4	4	4	5	4	14.4
IMC	627	N	4Dyl	4Dyc	4	4	4	5	3	20.9
IMC	628	N	4Dyf		3	3	3	5	4	15.7
IMC	629	N	4Dye		4	4	4	5	4	5.9
IMC	630	N	2Ugg		4	4	4	4	4	2.3
IMC	631	N	1DycS		4	4	4	4	4	4.9
IMC	632	N	1Dyc		4	4	4	5	4	18.6
IMC	633	N	4Dyf		3	3	3	5	4	33.7
IMC	634	N	2Ugel	2Ugc	4	4	4	4	4	5.2
IMC	635	N	6Gna2		3	3	3	5	3	3.7
IMC	636	N	6Ufd		2	3	3	5	4	1.3
IMC	637	N	6Dyg3		3	3	4	4	4	4.4
IMC	638	N	6Dyj		4	4	4	4	4	5.3
IMC	639	N	2Uge	2Ugd	2	3	4	2	4	50.4
IMC	640	N	6Dyj		4	4	4	4	4	7.4
IMC	641	N	6Gna		2	3	3	5	3	3.4
IMC	642	N	6 SP		4	4	4	4	4	4.3
IMC	643	N	6Dda		3	3	4	4	4	4.2
IMC	644	N	2Ugfl		2	3	4	5	4	3.3
IMC	645	N	4Dyl1	4Dyl	4	4	4	5	2	9.2
IMC	646	N	5Dra5		4	4	4	5	2	2.8
IMC	647	N	4Dyh	4Dyg	4	4	4	4	4	6.1
IMC	648	N	6Dyj		4	4	4	4	4	4.2
IMC	649	Y	2Uge	6Dyg	3	3	4	3	4	3.3
IMC	650	N	6Dyj		4	4	4	4	4	2.3
IMC	651	N	6Dyj		4	4	4	4	4	6.4
IMC	652	N	6 SP		4	4	4	4	4	1.1
IMC	653	N	2Ugc	2Uge	2	3	4	2	4	12.3
IMC	654	N	6Dyg		4	4	4	4	4	5.0
IMC	655	Y	6Dda	6Dyg	4	4	4	4	4	13.7
IMC	656	N	6Dyj		4	4	4	4	4	1.0
IMC	657	N	2Ugc		2	3	4	2	4	3.8
IMC	658	N	6Dyg		4	4	4	4	4	10.1
IMC	659	N	6Dyg		4	4	4	4	4	1.1
IMC	660	N	6 SP		4	4	4	4	4	0.8
IMC	661	Y	6Dyg	6Dda	4	4	4	4	4	16.7
IMC	662	N	6Dyj		4	4	4	4	4	3.8
IMC	663	N	6Dyg	6Dyj	4	4	4	4	4	46.5
IMC	664	N	6Dda	6Dyg	4	4	4	4	4	4.8
IMC	665	N	6Gna		4	4	3	5	3	11.1
IMC	666	N	6Dda	2Ugc	4	4	4	4	4	5.6
IMC	667	N	6Dyg		4	4	4	4	4	5.2
IMC	668	N	6Dyg		4	4	4	5	4	15.4
IMC	669	N	6Dda	2Ugc	4	4	4	4	4	2.5
IMC	670	N	6Dyg	6Dda	4	4	4	4	4	13.1
IMC	671	N	6 SP		4	4	4	4	4	1.9
IMC	672	N	2UghE	2Ugh2	5	5	5	5	5	43.3
IMC	673	N	6Dyj		4	4	4	5	4	4.3
IMC	674	N	2UghS		4	4	4	4	4	29.9
IMC	675	N	3UgeE		5	5	5	5	5	3.8
IMC	676	N	3UgeE		5	5	5	5	5	5.3
IMC	677	N	2UghW		4	4	4	4	4	3.0
IMC	678	N	3UgeS	3Uga9	4	4	4	4	4	13.4
IMC	679	N	6DyjS		4	4	4	4	5	18.3
IMC	680	N	6UgaW		4	4	4	4	4	2.5
IMC	681	N	6UgaW		4	4	4	4	4	0.6

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability					Area (ha)
					sugar cane	maize	capsicums	rice	mango	
IMC	682	N	6UgaW		4	4	4	4	4	0.9
IMC	683	N	6 E		5	5	5	5	5	49.1
IMC	684	N	6UgaS	6Ufa	4	4	4	4	4	12.1
IMC	685	N	3UgeS		4	4	4	4	4	19.3
IMC	686	Y	6Ufc	6Ucc	4	4	4	5	4	7.0
IMC	687	N	6Gna	6Uga	2	3	3	5	4	1.5
IMC	688	N	6Uga	6Gna	2	3	3	5	4	21.2
IMC	689	N	6Ufd	6Uga	2	3	3	5	4	2.3
IMC	690	N	6Dyj		4	4	4	4	4	0.8
IMC	691	N	3Uge8	3Uga9	2	3	4	3	4	333.2
IMC	692	N	3Uga8	3Uge8	2	3	4	3	4	136.0
IMC	693	N	3Uge8	3Uga8	2	3	4	3	4	75.5
IMC	694	N	6UgaW		4	4	4	4	4	6.3
IMC	695	N	6Uga	6Uga2	3	3	3	5	4	18.6
IMC	696	N	6Uga	6Ufa	3	3	3	5	4	11.9
IMC	697	N	6Gna2		3	3	3	5	4	1.8
IMC	698	N	6Uga	6Gna	3	3	4	5	4	1.4
IMC	699	N	6Gna2	6Dda	3	3	3	5	4	3.4
IMC	700	N	6Uga	6Gna	3	3	4	5	4	2.0
IMC	701	N	3Uga8	3Uge	3	3	4	5	4	95.9
IMC	702	N	3UgaE		5	5	5	5	5	3.9
IMC	703	N	3Uga8		4	4	4	5	4	2.1
IMC	704	N	5Dyb	5Dyc	3	3	3	5	4	9.9
IMC	705	N	5Dra	5Dya	4	4	4	5	2	81.9
IMC	706	N	5Dyc	5Dyb	4	4	4	5	4	1.7
IMC	707	N	5Ugb	5Dyc	4	4	4	5	4	6.8
IMC	708	N	5Dyc	5Uga	4	4	4	5	4	0.9
IMC	709	N	5Uga		3	3	4	5	4	1.5
IMC	710	N	5Ugb	5Dyc	3	3	4	5	4	5.9
IMC	711	N	6Gna2	6Uga	3	3	3	5	4	4.8
IMC	712	N	6Gna5	6Gna	3	3	3	5	4	5.4
IMC	713	N	6Dbb	6Uga	3	3	4	5	4	2.2
IMC	714	N	6Gna	6Uga	3	3	3	5	4	2.4
IMC	715	N	6Uga	6Gna	3	3	4	4	4	11.6
IMC	716	N	6Uga5		3	3	3	5	4	5.6
IMC	717	N	6Uga5	6Uga	3	3	3	5	4	27.0
IMC	718	Y	6Uga5	6Gna2	3	3	3	5	4	3.6
IMC	719	N	1Uga		3	3	4	5	4	1.5
IMC	720	N	6Dbb		3	3	4	5	4	1.3
IMC	721	N	6Dbh	6Uga5	4	4	4	5	4	3.8
IMC	722	N	1Uga	6Uga5	3	3	4	5	4	7.1
IMC	723	N	6Drc2	6Uga5	3	3	4	5	4	4.3
IMC	724	N	6Uga2	6Uga5	3	3	4	5	4	7.4
IMC	725	N	6Ufc5	6Dbb	3	3	3	5	4	1.5
IMC	726	Y	6Uga2	6Gna2	3	3	4	5	4	10.1
IMC	727	N	6Uga		3	3	4	5	4	1.3
IMC	728	N	6Uga		3	3	4	5	4	13.1
IMC	729	N	5Dra		4	4	4	5	2	1.3
IMC	730	N	5Dye		4	4	4	5	4	1.9
IMC	731	N	6Dba	6Dba	3	3	4	5	4	13.2
IMC	732	N	6 E		5	5	5	5	5	5.3
IMC	733	N	6Drc3	6Dba5	3	4	4	5	4	1.4
IMC	734	N	6Dba		4	4	4	5	4	21.9
IMC	735	N	1Uge		3	3	4	5	4	1.9
IMC	736	N	6Ddb		4	4	4	5	4	3.1
IMC	737	Y	1Dyd	1Uge	3	3	4	5	4	3.9
IMC	738	N	1Dyc		3	4	4	5	4	0.8

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability					Area (ha)
					sugar cane	maize	capsicums	rice	mango	
IMC	739	N	6Dba		3	4	4	5	4	5.7
IMC	740	N	6Dba2		3	3	4	5	4	0.5
IMC	741	N	5Ugb		4	4	4	5	4	0.3
IMC	742	N	5 R		5	5	5	5	5	3.9
IMC	743	N	6Dba		3	4	4	5	4	0.3
IMC	744	N	6Uga		4	4	4	5	4	3.6
IMC	746	N	6Dbf		3	3	3	5	2	2.5
IMC	747	N	6Drc2		3	3	4	5	3	4.3
IMC	748	N	6Gna	6Drb	3	3	3	5	4	1.7
IMC	749	Y	1Uge	1Dyd	3	3	4	5	4	4.0
IMC	750	N	1Uge	1Dyd	3	3	4	5	4	6.7
IMC	751	N	6Drc2		3	3	3	5	3	2.0
IMC	752	Y	1Uge	1Dyd	3	3	4	5	4	7.0
IMC	753	N	6Dbb		3	3	4	5	4	0.7
IMC	754	N	1UgeE		5	5	5	5	4	0.7
IMC	755	Y	6Ufa	6Gna	3	3	3	5	4	21.4
IMC	756	N	6Ddb		3	3	4	5	4	2.3
IMC	757	N	6Gna2	6Gne	3	3	3	5	4	13.2
IMC	758	N	6Dda		3	3	4	4	4	2.3
IMC	759	N	6Dba	6Dba5	3	3	4	4	4	9.8
IMC	760	N	6Dba		3	3	4	5	4	2.9
IMC	761	Y	6Dyg	6Drc	3	3	4	4	4	7.0
IMC	762	N	6Dda		3	3	4	4	4	3.2
IMC	763	N	6Dda2		3	3	4	5	4	1.0
IMC	764	N	1Uga		3	3	4	4	4	6.5
IMC	765	N	6Gna2		3	3	3	5	3	1.9
IMC	766	N	6Dda2		3	3	3	4	4	3.7
IMC	767	N	6Dbf2	6Dda	3	3	3	5	2	4.5
IMC	768	N	6Gna2	6Dda	3	3	3	5	4	2.3
IMC	769	Y	6Gna2	6Dda	3	3	3	5	4	31.3
IMC	770	N	6Dbf		2	3	3	5	3	1.4
IMC	771	N	6Dda		3	3	4	4	4	2.1
IMC	772	Y	6Gna2	6Dra2	3	3	3	5	4	14.6
IMC	773	N	6Dda		3	4	4	4	4	1.3
IMC	774	Y	6Dra2	6Gna2	3	3	3	5	4	2.5
IMC	775	N	6Dba		4	4	4	4	4	1.8
IMC	776	N	3UgaW		4	4	4	4	4	0.8
IMC	777	N	3Uge8	3Uga	3	3	4	4	4	238.3
IMC	778	N	5Dra	5Ugb	4	4	4	5	3	2.5
IMC	779	N	5Ugb	5Dra	3	3	4	5	4	4.5
IMC	780	N	3Uge1	3Uga	3	3	4	4	4	159.4
IMC	781	N	3Uge8	3Uga	3	3	4	4	4	40.2
IMC	782	N	3UgeE		5	5	5	5	5	2.0
IMC	783	N	3UgeE		5	5	5	5	5	7.8
IMC	784	N	6UfeE		5	5	5	5	5	1.1
IMC	785	N	3UgeE		5	5	5	5	5	23.7
IMC	786	N	3Uge8	3Uga	3	3	4	3	4	70.3
IMC	787	N	3Uga8	3Uge	3	3	4	3	4	92.9
IMC	788	N	3Uga9		4	4	4	4	4	92.7
IMC	789	N	3Uga9		4	4	4	4	4	53.0
IMC	790	N	3UgaR		5	5	5	5	5	0.7
IMC	791	N	6Gna2		3	3	3	5	4	2.9
IMC	792	Y	6Gna2	6Uga	3	3	3	5	4	4.1
IMC	793	Y	6Gna2	6Dyb2	3	3	3	5	4	4.9
IMC	794	N	6Gna2	6Uga	3	3	3	5	4	5.3
IMC	795	N	3Uga8		3	3	4	3	4	10.8
IMC	796	N	6UgaW		4	4	4	4	4	3.9

Appendix III (continued)

Survey	UMA no.	Complex	Dominant soil type	Soil type 2	Land suitability					Area (ha)
					sugar cane	maize	capsicums	rice	mango	
IMC	797	N	6Ufd		3	3	3	4	4	1.0
IMC	798	Y	6Uga	6Gna2	3	3	4	4	4	4.0
IMC	799	N	6Uga	6Gna	3	3	4	4	4	6.8
IMC	800	N	6Gna2		3	3	3	5	4	1.2
IMC	801	N	6Ufd		3	3	3	5	4	1.5
IMC	802	Y	6Uga	6Ufe	3	3	3	4	4	4.9
IMC	803	N	6UgaS		4	4	4	5	4	0.8
IMC	804	N	3UgaE		5	5	5	5	5	5.2
IMC	805	N	6UgaE		5	5	5	5	5	4.2
IMC	806	N	6Uga	6Gna	3	3	3	5	4	34.0
IMC	807	N	6Gna2		3	3	3	5	4	1.5
IMC	808	N	6Ufe		3	3	3	5	4	3.6
IMC	809	N	6Uga	6Gna	3	3	3	4	4	11.1
IMC	810	N	3UgaS		4	4	4	4	4	92.0
IMC	811	N	3Uga9		4	4	4	4	4	69.1
IMC	812	N	6Uga	6Gna2	2	3	4	4	4	2.6
IMC	813	N	6UgaS		4	4	4	5	4	4.4
IMC	814	N	3Uga3	3Uga8	3	3	4	3	4	12.7
IMC	815	N	3Uge8	3Uge2	3	3	4	4	4	20.6
IMC	816	N	4Dyj		3	4	4	5	4	10.9
IMC	817	N	4Dyl		4	4	4	5	2	4.4
IMC	818	N	3UgaR		5	5	5	5	5	0.4
IMC	819	N	4Dyd		3	3	3	5	4	1.6
IMC	820	N	3Uga8		3	3	4	4	4	18.2
IMC	821	N	6UfeE		5	5	5	5	5	4.9
IMC	822	N	4Dya		3	4	4	5	4	6.4
IMC	823	Y	6Dyj	6Dda	4	4	4	4	4	12.5
IMC	824	N	6Ddb	6Ufe	4	4	4	4	4	1.6
IMC	825	N	1Ugc2	1Dyc	3	3	4	5	4	3.7
IMC	826	N	4Dyh		4	4	4	4	4	1.6
IMC	827	N	3Uga		3	3	4	4	4	6.0