APPENDIX 1 - CONSERVATION MANAGEMENT PRACTICES

A list of general recommended soil conservation management practices is given below. The Soil Conservation Authority, an its head office in Melbourne, or at any of its district offices, welcomes any enquires or requests for further advice on such matters. The nearest district SCA office to the Tanjil River Catchment is located at the State Public Office in Warragul.

A. <u>General Recommendations for engineering activities</u>

Engineering activities will be cheaper, more efficient and less harmful to the environment if attention is given to erosion and sediment control in the planning and design phases of a project rather than only during construction. Basic considerations in erosion and sediment control are:

(i) Bare soils will erode more rapidly than vegetated, mulched or paved areas.

(ii) Erosion rates are significantly influenced by the amount of overland flow which in turn affected by surface infiltration rates.

(iii) Sand and silt sized material is removed easily from drainage waters, however it is usually impractical to remove the finer particles that contribute to turbidity of drainage waters.

An erosion and sediment control program is based on the following principles"

(i) Keep the area of soil exposed to a minimum.

(ii) Minimise the time the soil is exposed and as far as possible avoid having the soil exposed during periods when high intensity or prolonged rain is prevalent.

(iii) Carry out earthworks in a manner that allows for the different erodibility and fertility of topsoils and subsoils.

(iv) Control surface drainage.

(v) Trap eroded soil before it damages downslope land, structures or waterways.

The most suitable program for a specific development depends on local circumstances and will usually involve a combination of the practices outlined below. More detailed information about conservation practices applicable to construction sites are given in the "Guidelines for Minimising Soil Erosion and Sedimentation from Construction Sites in Victoria", (obtainable from the Soil Conservation Authority).

Further advice can be provided by the SCA.

Some general conservation management objectives are listed below.

(i) Development should be programmed to minimise the area disturbed at any one time and to allow rapid protection (by vegetation, mulching or paving) of bared areas. This is particularly important on steep slopes, in areas where highly erodible soil horizons will be exposed, and if the area will be bare during high intensity rains. It may be necessary to establish temporary vegetative or other protection on areas that would otherwise be bare but remain unworked for long periods during construction.

(ii) When planning roads and general levelling operations for building sites, etc., steep slopes should be avoided as much as possible to reduce the amount of cut and fill needed. Aligning roads just off the contour in steep areas assists with surface drainage of the roads.

(iii) Topsoil and subsoil should be handled separately and placed in separate stockpiles (if stockpiling is necessary). Stockpiles should not be established within flood zones or in drainage lines, and if they are to remain unworked for long periods they should be protected by establishing a vegetative or other cover.

(iv) Adequate compaction of soil used for backfilling trenches, for fill batters and for general fill operations is necessary for short and long term stability. Allowance should be made for settlement of fill material where settlement could damage structures or interfere with surface drainage.

(v) When revegetation of bared areas is to be undertaken, the following measures should be followed as appropriate:

(a) The surface of the subsoil should be loosened and/or roughened (eg. by scarifying on broad areas, or by saw-tooth finish of cut batters) prior to topsoil spreading.

(b) Topsoil should be moist when spread, (i.e. neither too wet nor dry) and depths of about 5 to 10 cm are probably sufficient in most cases; deeper layers of topsoil may slump on steep slopes.

(c) The area should be shown with grasses and legumes. Specific recommendations for see and fertiliser mixtures can be provided by SCA district officers. Autumn sowings are generally most successful for establishing vegetation with minimum management inputs such as the follow-up watering or re-seeding.

(d) In critical areas (eg. batters, steep areas, drainage lines) early stability can be assisted by chemical and/or organic mulches.

(e) Follow-up waterings, fertilising and moving may be necessary to establish and maintain a persistent and dense vegetative cover.

(vi) Construction traffic should be confined where possible, to existing or proposed road alignments. Drainage line crossings which are to remain when construction activities have concluded should be established as soon as possible. If it is necessary to cross drainage lines at places other than sites were permanent crossings are to be established, temporary culverts or causeways should be established.

(vii) Measures should be undertaken to prevent construction traffic depositing soil onto roads outside the construction site or retarding basins.

(viii) Road parking areas, footpaths and driveways should be paved as early as practical.

(ix) Control of drainage by either temporary, or preferably permanent works is necessary from the start of construction. Interception banks and/or channels should be used to divert upslope drainage away from bared areas. This is particularly important for cut or fill batters. Cut-off drains to intercept ground-water flow may be required above cut batters. Berm drains should be installed on high batters. Cross drains and/or channels and/or pipes should be established as necessary within the construction area should be established as necessary within the construction area to prevent the uncontrolled concentration of surface drainage.

(x) Drains should be designed and should discharge in a manner that will not cause scouring and erosion. Pipes or paved or grassed channels may be needed to convey water down steep slopes and batters. Prevention of erosion from drain outlets may require level-spreaders, and concrete or rip rap aprons.

(xi) The increased slows that usually accompany development of an area and the possible need to stabilise natural waterways should be allowed for in planning and construction. The increased flows may be modified by using grassed waterways, sediment/retardation basins and overland flow rather than concrete pipes and channels.

(xii) The settleable fraction or eroded material in water draining bared areas should be removed by passing the water through settlement basins or, over grass filter-strips, or by other means before it enters natural waterways or underground drains or damages land or structures. Sediment removal is generally easier if only small volumes of water involved. Reducing the time between installing pipes and completing drainage pits and inlets, and providing temporary inlet protection and during construction will significantly reduce the sediment load leaving a construction site.

(xiii) Construction tracks, borrow pits and other temporary works that involve land disturbance should have similar drainage control, surface stabilisation and sediment control measures to those used for permanent structures and works. Once they are no longer required for construction, the areas should be re-instated and stabilised. Careful planning and design may enable temporary works to become a permanent feature – for example a sediment basin could become a water trap in a golf course or a lake in an urban park.

B. General recommendations for agricultural activities

(i) As far as practicable areas of different capability should be treated as separate management sites. This may involve fencing to facilitate control grazing.

(ii) Natural waterways should be carefully managed. In grazing areas, waterways which receive substantial flows should be excluded from grazing; in cropping areas such waterways should not be cultivated.

APPENDIX 2 - DESCRIPTION OF SOIL TYPES (as identified in section4)

GRADATIONAL NON GALCAREOUS SOILS

1. Gradational Grey or Grey-Brown Earths

Classification

Aas*	Grey Massive Earths	Structured Grey-Brown Earths
Factual Key:	Gn2.81, Gn 2.84, Gn2.91 Gn2.94	Gn4.51, Gn4.52, Gn3.91
Great Soil Group[1]:	Yellow Earths Wiesenboden (poorer drained variants) Yellow Podzolics	

Unified Soils Grouping (subsoil) CL

General Features: These soils have dark greyish brown sandy to silt loam surface horizons with gradational boundaries to yellowish brown sandy or silty clay loam to clay subsoils which show evidence or periodic saturation. The subsoils are either massive or moderately structured, the latter usually showing more mottling.

Occurrence: These soils occur throughout the hilly country on either Devonian or Tertiary sediments, and to a limited extent are associated with the Tertiary volcanics and the Quaternary alluvial deposits. Within the Devonian sediments, the massive soil variants usually occur on areas with silty parent material (DLO).

Land Use Limitations: These soils, particularly the structured variants, are commonly seasonally waterlogged, and the subsoils are moderately dispersive making then prone to gully or tunnel erosion.

Typical Profiles

a. Massive (non or weakly structured) variant. Factual Key GN2.81

Horizon	Depth (cm)	Description
A11	5	Very dark grey (10YR3/1) sandy loam; dry slightly hard consistence; weak crumb structure; pH 5.0, gradual boundary to,
A12	30	Very dark greyish brown (10YR3/2) light sandy clay loam; dry slightly hard consistence; weak rough ped structure, pH 5.5, gradual boundary to,
A3	60	Dark greyish brown (10YR4/2) sandy clay loam, dry slightly hard consistence, weak rough ped structure; pH 6.0, gradual boundary to,
B1	90	Brown (10YR5/3) silty clay loam; dry slightly hard consistence; weak rough ped structure, pH 6.0; gradual boundary to,
B3	150+	Yellowish brown (10YR5/4) light clay; moist hard consistence; weak rough ped structure, pH 5.5, common light grey mottles present

* Nearest suitable nomenclature often used.
1 AAS. Atlas of Australian Soils

b. Structured variant. Factual Key GN4.51

Horizon	Depth (cm)	Description
A1	5	Very dark grey (10YR3/1) loam; moist friable consistence; moderate subangular blocky structure, rough ped fabric; pH 6.0; gradational boundary to,
A3	35	Dark grey (10YR4/1) sandy clay loam, moist friable consistence; moderate subangular blocky structure, rough ped fabric; pH 6.0; gradual boundary to,
B1	50	Dark greyish brown (10YR4/2) silty clay loam moist hard consistence; moderate subangular blocky structure, rough ped fabric; pH 6.0, with few red-yellow brown mottles and common light grey mottles; gradual boundary to,
B2	120+	Yellowish brown (10YR5/4) light clay, moist hard consistence; moderate subangular blocky structure, rough ped fabric; pH 6.5; with common light grey and red brown mottles.

2. <u>Gradational Yellow or Yellow-Brown Earths</u>

Classification

AAS*:	Yellow Massive Earths	Structured Yellow-Brown Earths
Factual Key:	Gn2.21, Gn2.41, Gn2.61	Gn4.81, Gn4.84

Great Soil Group[2]: Yellow Earths Yellow Podzolics

Unified Soil Grouping (subsoil): ML-CL

General features: These soils have very dark grey to dark greyish brown loamy sand to loam surface horizons with gradual boundaries grading into yellowish brown or brownish yellow clays. The lower subsoils are sometimes faintly mottled and are either massive or moderately structured. Small amounts of gravel and stone are common.

Occurrence: These soils occur throughout the hilly country on either Devonian or Tertiary sediments and are found in association with type 1 soils (gradational grey or grey brown earths). They also occur to a limited extent on the drainage flats formed on recent Quaternary alluvium. The massive or weakly structured variants occur most commonly on the Tertiary sediments lower in the catchment. Within the Devonian sediments, both the massive and structured variants occur on the coarser parent materials (DLN, DLT) rather than on the silty sediment (DLO).

Land Use Limitations: Although being somewhat better drained than the associated type 1 soils, the gradational yellow or yellow brown earths, particularly the structured variants, may become waterlogged for short periods during the winter months. In addition the subsoils are slightly to moderately dispersive, though again this limitation is not as severe as it is with the type 1 soils.

* AAS. Atlas of Australian Soils
2 Nearest suitable nomenclature often used

Typical Profiles

a. Massive (weakly structured) variant. Factual Key GN2.61

Horizon	Depth (cm)	Description
A11	5	Very dark grey (10YR3/1) loamy sand; dry slightly hard consistence; weak structure with earthy fabric; pH 6.0; gradational boundary to,
A12	15	Very dark greyish brown (10YR3/2) loamy sand; dry hard consistence; weak structure with earthy fabric; pH 6.0; 2% small stones; gradual boundary to,
B11	35	Yellowish brown (10YR5/4) light sandy clay loam; dry hard consistence; weak structure with earthy fabric; pH 6.5; 5% small stones' gradual boundary to,
B12	45	Yellowish brown (10YR5/6) gravelly sandy clay loam, dry hard consistence; weak structure with earthy fabric; pH 6.5; 10% stones and gravel; gradual boundary to,
B2	120+	Brownish yellow (10YR6/6) sandy clay, moist hard consistence; weak structure with earthy fabric; pH 6.5; common light grey and few yellow brown mottles.

b. Structured variant. Factual Key Gn4.81

Horizon	Depth (cm)	Description
A1	10	Very dark greyish brown (10YR3/2) loam, fine sandy; dry hard consistence; moderate platy structure; rough ped fabric; pH 6.0; gradual boundary to,
A3	30	Brown (10YR5/3) silty loam, dry very hard consistence; moderate subangular blocky structure; rough ped fabric; pH 6.0, general boundary to,
B11	55	Yellowish brown (10YR5/4) silty clay loam; dry very hard consistence; moderate subangular blocky structure; rough ped fabric; pH 5.0; gradual boundary to,
B12	70	Yellowish brown (10YR5/4) silty clay; dry very hard consistence; moderate subangular blocky structure; rough ped fabric; pH 5.5; few faint light grey mottles; gradual boundary to,
B2	120+	Yellowish brown (10YR5/6) light clay, moist hard consistence; moderate angular blocky structure, rough ped fabric; pH 5.5; common distinct light grey mottles.

3. **Gradational Red Earths**

Classification

AAS*: Structured Red Earths

Factual Key: Gn4.11

Great Soil Group[3]: Krasnozems, Red Earths

Unified Soil Grouping (subsoil): CL, MH, CH

General features: These soils have dark reddish brown to dark brown light sandy clay loam to loam surface horizons with gradual boundaries to dark reddish brown sandy clay loam to clay loam subsoils which then grade to dark red or reddish brown light clays. The soils are characteristically moderately to strongly structured and well drained. Small amounts of ferruginous gravel occur in subsoils in some areas.

Occurrence: The gradational red earths occur predominantly on the areas of basic Tertiary volcanics which are scattered throughout the study area, but most commonly on undulating hill crests to the north of Willow Grove. These soils, formed from basalt are called Krasnozems. In addition there are some gradational red earths that have formed from metamorphosed Devonian sediments (m) in the Icy Creek region.

Land Use Limitation: These soils are widely recognised as having drainage and fertility properties which are favourable to agricultural activities; and in particular potato growing. However there are some limitations with respect to rural residential development. Subsoils exhibit a moderate shrink swell behaviour in some areas which would make the use of concrete slabs rather strip footings for building foundations a prudent move. In addition, the strong structure and low dispersibility of the subsoil clay often makes it difficult to effectively seal small farm dams from leaking.

Typical Profile

Factual Key Gn4.11

Horizon	Depth (cm)	Description
A1	15	Dark reddish brown (5YR3/2) loam; dry slightly hard consistence; moderate crumb structure; rough ped fabric; pH 6.0; gradual boundary to,
A3	35	Dark reddish brown (5YR3/3) sandy clay loam; dry hard consistence; strong subangular blocky structure; rough ped fabric; pH 5.5; gradual boundary to;
B1	75	Dark reddish brown (5YR3/4) clay loam; moist friable consistence; strong subangular blocky structure; rough ped fabric; pH 5.5; gradual boundary to,
B2	120+	Dark red (2.5YR3/6) light clay; moist friable consistence; moderate subangular blocky structure; rough ped fabric; pH 5.5.

* AAS. Atlas of Australian Soils
[3] Nearest suitable nomenclature often used.

4. Gradational Brown Earths

Classification

AAS*: Structured Brown Earths

Factual Key: Gn4.31, Gn3.24

Great Soil Group[4]: Brown Earths, Red Earths

Unified Soil Grouping (subsoil): CL, MH, CH

General features: These soils have dark grey brown to dark brown, sandy loam to loam surface horizons with gradual boundaries to dark brown sandy clay loam to clay loams which in turn grade to strong brown or dark yellowish brown light clays. The subsoils are moderately structured, sometimes mottled, and may contain small amounts of ferruginous or quartz gravels. They are moderately well to well drained.

Occurrence: These soils occur in conjunction with the gradational red earths and are frequently found in 'boundary area' where basalt parent material lies close to either Tertiary or Devonian sedimentary host rocks. They are therefore found scattered throughout the study area but most commonly on crest to the north of Willow Grove. The gradational brown earths are also found on metamorphosed Devonian sediments in the Icy Creek/Simpson's Farm areas and to a very limited extent on the drainage flats on Recent alluvium.

Land Use and Limitations: These soils have similar properties, and hence similar limitations to the gradational red earths. They do however exhibit a lower degree of subsoil shrink swell behaviour than the red soils. Like the red soils they are not dispersive but are still erodible to some extent due to their easy slaking tendency.

Typical Profile

Factual Key Gn4.31

Horizon	Depth (cm)	Description
A1	10	Dark brown (7.5YR3/2) loam; dry hard consistence; moderate crumb structure; rough ped fabric; pH 6.5; gradual boundary to,
A3	30	Very dark greyish brown (10YR3/2) clay loam; dry hard consistence' moderate subangular blocky structure' rough ped fabric; pH 6.5; gradual boundary to,
B1	50	Dark brown (10YR3/3) light clay; moist hard consistence; moderate subangular blocky structure; rough ped fabric; pH 6.5.
B2	120+	Dark yellowish brown (10YR4/4) light to medium clay; moist hard consistence; moderate subangular blocky structure; rough ped fabric; pH 6.5.

* AAS. Atlas of Australian Soils
[4] Nearest suitable nomenclature often used.

DUPLEX (TEXTURE CONTRAST) SOILS

5. Mottled Yellow duplex Soils

Classification

AAS[*]	Hard pedal mottled yellow duplex soils	Sandy apedal mottled yellow duplex soils
Factual Key:	Dy3.11, Dy3.21, Dy3.41	Dy5.51, Dy5.6, Dy5.81

Great Soil Group[5]: Yellow Podzolics, Soloths

Unified soil Grouping (subsoils): CL

General features; Generally these soils have a distinct texture contrast between hard setting surface horizons and moderately to strongly structured mottled clay subsoils. The surface horizons are very dark greyish brown to greyish brown loamy sand to loams, and are commonly differentiated into an A1 and an A2 horizon, where the latter may or may not be bleached. A2 or A3 horizons are commonly spwey and tacky when wet and very hardset when dry. There is generally a clear to abrupt boundary between these horizons and the mottled clay loam to light medium clay subsoil. The subsoil is usually moderately to strongly structured but may be apedal in better drained sandy areas. Subsoil colours vary from light brownish grey though to yellowish brown with most soils having value chroma ratings of 2 and hence fall into the category of 'yellow-grey duplex soils'. The dominant soils are somewhat poorly drained and all soils may contain small amounts of quartz gravel and stone.

Occurrence: soils if this type occur most commonly throughout the hilly country on Tertiary sediments to the south of Willow Grove. Less commonly they are found within the hilly country on Devonian sediments near Hill End. The sandy, better drained and generally apedal soils, are most commonly found within crest areas of map unit CR4 and to a limited extent on the steeper slopes SS1c and SS2c.

Land Use Limitations: These soils, particularly the hardsetting variants with silty textures, are moderately dispersive and hence prone to gully or tunnel erosion. In addition, relatively impermeable clay B horizons often restrict infiltration of rainfall giving rise to a perched water table in some areas.

Typical Profile

a. Hardsetting variants. Factual Key Dy3.41

Horizon	Depth (cm)	Description
A11	5	Very dark greyish brown (10YR3/1) sandy loam; dry slightly hard consistence; weakly structured with earthy fabric; pH 5.0; gradual boundary to,
A12	20	Dark greyish brown (10YR4/3) light sandy clay loam; dry slightly hard consistence; weakly structured with earthy fabric; pH 5.0; clear boundary to,
A2	50	Light brownish grey (10YR6/2) silty loam; dry hard consistence; weakly structured with earthy fabric; pH 5.5; few faint yellow brown mottles; clear boundary to,
B	120+	Yellowish brown (10YR5/4) light to medium clay; moist hard consistence; strong subangular blocky structure, rough ped fabric; pH 5.5; many distinct light grey and some few red brown mottles.

[*] AAS. Atlas of Australian Soils
[5] Nearest suitable nomenclature often used.

b. Sandy variant. Factual Key Dy5.81

Horizon	Depth (cm)	Description
A1	5	Very dark greyish brown (10YR3/2) loamy sand; dry slightly hard consistence; massive with earthy fabric; pH 5.0; gradual boundary to,
A3	30	Brown (10YR5/3) sandy loam; dry to slightly hard consistence; massive with earthy fabric; pH 5.0; clear boundary to,
B1	80	Light grey (10YR7/2) sandy loam, wet non sticky consistence; massive with earthy fabric; pH 5.5; small amounts of quartz gravels, clear boundary to,
B2	120+	Yellowish brown (10YR5/8) sandy clay; moist hard consistence; weakly structured with rough ped fabric; pH 5.5; many light grey mottles.

UNIFORM MEDIUM TEXTURED SOILS

3. Uniform Loamy soils

Classification

AAS*: Friable loams with rough-ped B horizon

Factual Key: Um6.12, Um6.14

Great Soil Group[6]: Brown Earth? Weisenboden

General features: These soils have distinctly structured profiles of uniform medium texture. The soils have dark brown to dark yellowish brown loam fine sandy to silty clay loam surface horizons overlying structured brown or strong brown sandy clay loam to fine sandy clay loam subsoils. Less commonly the subsoils may be greyish grown in colour and mottled. Soils may or may not be stony.

Occurrence: These soils occur in limited areas throughout the study area. They occur on Devonian metamorphics in the Icy Creek area where they are associated with gradational brown earths. South of Willow Grove they occur on drainage flats on Recent alluvium and to a lesser extent are found within the hilly terrain on either Devonian or Tertiary sediments.

Land Use Limitations: There are a few inherent limitations perceived with these soils due to their structure, and hence good drainage, and their non-dispersive and non expansive behaviour.

Typical Profile:

Factual key UM6.12

Horizon	Depth (cm)	Description
A1	15	Dark brown 910YR3/3) silty clay loam; dry hard consistence; weak crumb structure, rough ped fabric; diffuse boundary to,
A3	40	Dark yellowish brown (10YR3/4) clay loam; dry hard consistence; moderate subangualr blocky structure; rough ped fabric; pH 5.5; gradual boundary to,
B1	70	Dark yellowish brown (10YR3/6) heavy clay loam; dry hard consistence; strong subangular blocky structure; rough ped fabric; pH 6.0; few faint red brown mottles' gradual boundary to,

* AAS. Atlas of Australian Soils
[6] Nearest suitable nomenclature often used.

Horizon	Depth (cm)	Description
B2	120+	Strong brown (7.5YR4/6) fine sandy clay loam; dry very hard consistence; strong subangular blocky structure; rough ped fabric; pH 6.0; few distinct red brown mottles.

UNIFORMED COARSE TEXTURED SOILS

4. <u>Uniform Bleached Sands</u>

Classification

AAS[*]: Bleached sands with pan, Bleached sands with a colour B Horizon

Factual Key: Uc2.31, Uc2.32, Uc2.21

Great Soil Group[7]: Podzols

Unified Soils Grouping (subsoil): SP

General features: These soils have uniform coarse-textured profiles with bleached A2 horizons and coloured B horizons which may or may not contain a compacted, cemented or indurated layer (pan) with accumulation of humus, sesquioxide and/or silica. The soils have black to dark grey, and to loamy sand surfaces which grade into bleached grey or light brownish grey sandy A2 horizons. These are underlain by an abrupt boundary to a strong brown or yellowish brown sand to clayey sand subsoil which is commonly indurated and may contain a dark humus accumulation at the top. In soils where a hardpen is not present the coloured subsoils commonly contain up to 10% small stone and gravel accumulations.

Occurrence: These soils occur in sandier better drained areas on the Tertiary sediments to the south of Willow Grove and to a limited extent on the higher level terraces on Quaternary alluvium on the eastern side of the lower reaches of the Tanjil River. Within the Tertiary sediments they are found most commonly on the sandy undulating crest of map unit CR4.

Land Use Limitations: These soils generally lack cohesion and hence are likely to erode from sloping areas when surface vegetative cover is disturbed. They have low water holding capacities and inherently low fertility. In some flatter areas hardpens may restrict downward movement of water giving rise to a temporarily perched watertable, but usually this is compensated by lateral drainage even on gentler slopes.

Typical Profile:

Factual Key Uc2.32

Horizon	Depth (cm)	Description
A1	15	Black (10YR2/1) coarse loamy sand; dry to slightly hard consistence; apedal with grainy fabric; pH 4.5; clear boundary to,
A2	45	Grey (10YR6/1) coarse sand; dry loose consistence; apedal with grainy fabric; pH 4.0; abrupt to,
B1	60	Strong brown (7.5YR4/6) coarse cemented sand; dry extremely hard consistence; apedal with grainy fabric; pH 4.5; 10% cemented soil material accumulations; gradual boundary to,

[*] AAS. Atlas of Australian Soils
[7] Nearest suitable nomenclature often used

Horizon	Depth (cm)	Description
B2	120+	Strong brown (75YR4/6) coarse sand; dry loose consistence; apedal with grainy fabric; pH 5.5.

5. Uniform Brownish Sands

Classification

AAS[*]: Brownish sands

Factual Key: Uc5.11

Great Soils Group[8]: Siliceous Sands

Unified Soils Grouping (subsoil): SP

General features: These soils have uniform coarse textured profiles that show weak pedological organisation or slight changes in colour and texture. They are loose to weakly coherent and lack structure development except in the immediate surface. The soils have very dark greyish brown sand to loamy sand surfaces which grade into brown or dark brown sand to loamy sand surfaces which grade into brown or dark brown sandy subsoils.

Occurrence: This soil type is rare within the study area. It was found to occur in small areas on drainage flats and terraces on Quaternary alluvium in the lower reaches of the Tanjil River.

Land Use Limitations: These soils have similar limitations with respect to erodibility and water holding capacity as the Bleached Sands, however as they occur in very flat areas the erosion risk is minimal.

Typical Profile

Factual Key Uc5.11

Horizon	Depth (cm)	Description
A1	5	Very dark greyish brown 910YR3/2) loamy sand; dry soft consistence; weakly structured with earthy fabric; pH 6.5; clear boundary to,
B1	55	Brown to dark brown (10YR4/3) sand; dry loose consistence; apedal with grainy fabric; pH 6.0; gradual to,
B2	150+	Dark brown (10YR3/3) sand’ moist loose consistence; apedal with grainy fabric; pH 6.0.

[*] AAS. Atlas of Australian Soils
[8] Nearest suitable nomenclature often used.

APPENDIX 3 - LAND FEATURES WHICH DETERMINE LAND CAPABILITY

The land features used in capability ratings can impose limitations to the use of land through their effects on the efforts and cost involved in land development and management. This section explains why these land features are important in determining capability.

1. <u>Slope</u>

As slope increases, erosion hazard increases because the erosivity of the runoff water increases. Lack of adequate ground cover, such as occurs during construction activities, on tracks and intensive use areas, under cropping uses where cultivation is required, or as a result of overgrazing, accentuates the erosion hazard.

A main influence of slope on rating for capability for residential uses is related to the increasing cost of providing engineering services as slope increases. The slope categories used in the ratings have been chosen as a basis of per block costs of building and providing services as described by Neil, R.C. and Scales, P.J. (1976)

For agricultural activities, steeper slopes are more difficult and costly to work, and may impose limitations on the type of machinery which can be used.

Seepage problems increase slope on certain soil types, and may increase the risk of mass movement such as slumping of the batters of excavations and road cuts. Problems with absorption and retention of septic effluent below the soil surface increase as the slopes become steeper.

In general the cost of developing and managing land increases as slope increases.

2. <u>Landslip Hazard</u>

Landslips are an important factor to consider with respect to human safety, damage to property and access. High landslip hazard can be permanent limitation to some land uses because even where it may be technically possible to prevent landslips, the cost would generally be prohibitive.

3. <u>Availability of Dam sites</u>

For broad scale rural residetnial or hobby farm development , dams may be required for irrigation or for stock water. In areas where reticulated water is not available dams may also be needed for domestic use.

Factors which affect the location and construction of farm dams are;

(a) slope (between 2 – 10% at the site).

(b) availability of natural depressions or drainage lines

(c) adequate catchment for required size of the dam.

(d) Sufficient clay material of a suitable type for the embankment.

(e) Depth of bed-rock.

(f) Soil percolation rate (also gravel and sand seams).

4. <u>Site Drainage</u>

Site drainage is influenced by rainfall, soil permeability, the steepness of the slope, slope shape and the position on the slope. It is important for most land uses that water floes freely from the site. Poor site drainage may result in the land becoming waterlogged and boggy. In addition plant growth may be inhibited, roads and buildings may be damaged through subsidence, and efficient disposal will not be possible.

Special practices or management to overcome poor site drainage will add to the cost of development and management.

5. Soil Profile Permeability

Soils of low permeability do not readily drain vertically through the profile, although when on sloping land lateral flow above a horizon of low permeability may occur. Areas with such soils may become waterlogged and plant growth could be inhibited. Soils with poor permeability may become too boggy for the use of agricultural machinery at certain times of the year.

Poor soil permeability may result in loss of production (reduced plant growth) and increased management restrictions, and increased costs in overcoming the problem of effluent disposal. Conversely, and extremely permeable soil may suffer from excessive leaching of plant nutrients or an inability to retain moisture for plant growth. Such a soil may also drain too rapidly to perform the purification function required for septic effluent disposal.

6. Infiltration

The ability to soil to absorb applied water (rain or irrigation water) has an important effect on the production of surface runoff and may also affect the ability of soil to provide moisture for plant growth because of limitations to the amount of water entering the soil. Raindrop splash and, in some instances, wash of surface soil may cause "surface sealing" which results in the blocking of surface pores and a reduction in the amount of water penetrating the soil. Soils differ in their resistence to surface sealing. Maintenance of an effective ground cover which prevents raindrop splash or surface wash is the best way to retain soil infiltration capacity.

7. Depth to Rock

If bedrock is close to the surface, excavation will be costly and cultivation may be difficult or impossible. Plant growth and water penetration are adversely affected by shallow soils.

These limitations to engineering activities may be overcome by blasting. In low intensity uses bedrock at shallow depth is regarded as a permanent limitation and will result in increased costs of agricultural production through the difficulty of constructing farm dams and reduced plant yield.

8. Depth to Winter Water Table

This factor is dependent on the soil profile permeability and site drainage. If the water table is too close to the surface the topsoil will become boggy and problems similar to those described for site drainage and profile permeability may occur. Special management requirements, such as drainage may be required to enable efficient effluent disposal and to prevent damage to roads and buildings, both during and after construction.

9. Moist Consistence and Dry Consistence

Consistence determination provides an indication of the coherence of soil. If soil becomes boggy when moist, or hard and powdery when dry, then fine cultivation, and thus management for intensive cropping, will be restricted.

10. A Horizon pH

The pH of the soil is a measure of the acidity of alkalinity. Most plants have a limited pH range for optimum growth. A pH differing from the optimum for high plant yield will result in a reduced crop production or may require costly treatment to bring the pH closer to the optimum.

11. A Horizon Soil Texture

A horizon or topsoil texture provides an indication of the likely physical performance of the soil or whether the topsoil will become sticky when wet (clay) or unstable when wet (sand) which are important considerations for some recreation pursuits.

The texture of the A horizon is one of the soil features which influences whether water can easily penetrate the topsoil. It also affects the ability of the soil to retain moisture available for plant use and the nutrient supplying ability of the soil. This facto may limit the growth of lawns supplying ability of lawns and gardens in urban use, and plant yield in agricultural use.

Some limitations imposed by soil texture can be reduced or overcome by special treatments such as addition of stabilising chemicals or organic matter, or simply by importing better quality topsoil.

12. B Horizon – Dispersion and Slaking

Dispersion and slaking are important for their influence on the erodibility of a soil. This is particularly important in construction activities where the B horizons, or sub-soil, is exposed in cut batters, or where the material is used in earth embankments. It can also be important in other uses, such as “paths and tracks”, where the area has been denuded of vegetation and possibly some topsoil. A high degree of slaking or dispersibility of soils will lead to soil erosion in these land uses.

In a high dispersible soil, soil pores become blocked thus reducing water infiltration and adversely affecting land uses requiring good drainage such as effluent disposal.

The problem of a dispersible B horizon may be overcome by careful management such as ensuring batters are well vegetated.

13. B Horizon Unified soil Group

The Unified Soil Classification is used by engineers to group soils with similar engineering properties. Such properties include, bearing capacity, drainage characteristics and the amount of shrinking and swelling a soil undergoes as the moisture content changes.

The soils of an area have been grouped according to these engineering properties. Soils having inherent engineering problems increase construction costs.

14. B Horizon Shrink-Swell

Shrink-swell is a percentage measurement of how much a soil increases and decreases in volume when set and dry respectively. These measurements were made on soil from the B horizon.

Shrink-swell influences the capability for land uses which require a stable foundation such as roads or buildings. Buildings and roads may shift or crack if constructed on soils which undergo large changes in volume when wetting or drying.

A high shrink-swell value requires special construction techniques such as laying a deeper than usual road paving or using a concrete slab rather than strip footings for dwelling construction.

15. Slumping of batters

Batters are man made earthern slopes. A knowledge of the stable angle (angle of repose) for the material involved is necessary for good management.

Slumping problems will increase in some areas because of low soil strength when wet and/or greater seepage. The increased mass of saturated soil increases the risk of slumping.

As with erosion hazard these problems can be overcome with careful management.

16. Erosion Hazard

Erosion can cause serious damage during building construction and on areas denuded of vegetation, such as picnic grounds, unsealed roads, cropland and overgrazed areas. Sedimentation of water courses and pollution of the water are also undesirable consequences of erosion. Most erosion can be prevented by correct management. However, the greater the potential erosion hazard, the greater will be the level of management.

17. Flood Hazard

Flood hazard is an important factor in terms of human safety, damage to property and general inconvenience. Thus flood prone land should not be used for capital intensive uses, but may be capable of supporting extensive land uses such as grazing.

In some areas the problem may be overcome by building levee banks or retarding basins. Some change in flooding characteristics may be possible by special management aimed at delaying surface runoff. However, when dealing with large catchments, the problem can be regarded as a long term hazard and a permanent limitation.

APPENDIX 4 - LAND CAPABILITY RATAIN TABLES

The soil Conservation has developed Capability Ratings systems for a variety of uses. The following tables have been used to assist the land assessment or evaluation process.

LAND CAPABILITY RATING FOR GENERAL CONSTRUCTION ACTIVITIES (* building foundations, secondary roads, shallow excavations)

Land features affecting use	Capability Class				
	1	2	3	4	5
Slope	Less than 5 %	5 % - 8 %	8 % - 15 %	15 % - 25 %	Greater than 25 %
Site Drainage	Excessively well drained. Well drained.	Moderately well drained	Imperfectly drained	Poorly drained	Very poorly drained
Flooding	Nil			Less than 1 per 100 years	Greater than 1 per 100 years
Depth to hard rock	Greater than 120 cm	120 cm to 80 cm	80 cm to 40 cm	40 cm to 15 cm	Less than 15 cm
Stones	Less than 10 %	10 % to 15 %	15 % to 35%	Greater than 35 %	
Boulders, rock outcrop	Less than 0.1%	0.1 % to 0.5 %	0.5 % to 5 %	5 % to 30 %	Greater than 30%
Unified soil Group	GW GC GM GP SW SC	SP SM CL	MH CH	OH OL ML	Pt
Shrink-swell potential	Less than 4 %	4 % to 12 %	12 % to 20 %	Greater than 12 %	
Depth to i) seasonal ii) permanent watertable	 Greater than 150 cm Greater than 200 cm	 90 cm to 150 cm 150 cm to 200 cm	 60 cm to 90 cm 120 cm to 150 cm	 30 cm to 60 cm 90 cm to 150 cm	 Less than 30 cm Less than 90 cm

*building foundations – for structures of no more than two stories.
Secondary roads – sealed for light vehicles, provision for drainage and kerbing.
Shallow excavations – levelling of construction sites, trenches for provision of services.
Depth to watertable – these depths correspond to site drainage assessment terms as used in site drainage classes.

LAND CAPABILITY RATING FOR ON-SITE DISPOSAL – areas capable of being used for on – site soil absorption of all-waste septic tank effluent from a single family dwelling.

Land features affecting use	Capability Class				
	1	2	3	4	5
Slope	0 % to 5 %	5% to 8 %	8 % to 15 %	15% to 30 %	More than 30 %
Site Drainage	Excessively well drained. Well drained	Moderately drained	Imperfectly drained	Poorly drained	Very poorly drained
Flooding return period	None			Less than 1 in 25 years	More than 1 in 25 years
Depth to seasonal watertable	More than 150 cm	150 cm to 120 cm	120 cm to 100 cm	90 cm to 60 cm	Less than 60 cm
Permeability k value	Rapid More than 1.0m/day	Moderately rapid 1.0 – 0.3 m/day	Moderately slow 0.3 – 0.1 m/day	Slow 0.1 – 0.05 m/day	Very slow Less than 0.05 m/day
Depth to rock or impervious layer	More than 200 cm	150 cm to 150 cm	150 cm to 100 cm	100 cm to 75 cm	Less than 75 cm
Gravel and stones	Less than 5 %	5 to 20 %	20 % to 40 %	40 % to 75 %	More than 75 %
Boulders, rock outcrop	Less than 0.02 %	0.02 % to 0.2 %	0.2 % to 2 %	2 % to 10 %	More than 10 %
Shrink-swell potential	Less than 4 %	4 % to 12 %	12 % to 20 %	More than 20 %	

Permeability: Where this is based on determination of hydraulic conductivity “K”. Where K exceeds 6.0 m/day, risk of polluting water bodies must be considered.

Depth of watertable: These depths correspond to site drainage assessment terms as used in site drainage classes.

LAND CAPABILITY RATING FOR EARTHEN DAMS – Areas capable of being used for the construction os small water storages with earthen embankments.

Land features affecting use	Capability Class				
	1	2	3	4	5
Slope: gully dam : hillside dam	2 % to 4 % 2 % to 5 %	4 % to 8 % 5 % to 10 %	0 – 2 %; 8 % to 12 % 0 - %; 10 % to 15 %	12 % to 15 % 15 % to 20 %	More than 15 % More than 20 %
Flooding return period	None			Less than 1 in 25 years	More than I in 25 years
Unified soil Group	GC, GM, SC	SM, CL (PL < 15)	ML, CH, CL (PL > 15)	OL, MH, OH	Pt
Thickness of construction material	More than 200 cm	200 cm to 75 cm	100 cm to 75 cm	75 cm to 30 cm	Less than 30 cm
Stones	Less than 5 %	5 % to 20 %	20 % to 50 %	50 % to 75 %	More than 75 %
Boulders and rock outcrop	Less than 0.05 %	0.5 % to 0.1 %	0.1 % to 1 %	1 % to 5 %	More than 5 %
Permeability	Very slow	Slow	Moderately slow	Moderate to very rapid	
Shrink – swell potential	Less than 4 %	4 % to 12 %	12 % to 20 %	More than 20 %	
Depth to hard rock	More than 300 cm	300 cm to 200 cm	200 cm to 150 cm	150 cm to 80 cm	Less than 80 cm
Dispersible clay	2 % to 6 %	6 % to 10 %	10 % to 16 %	More than 16 % Less than 2 %	
Depth to topsoil	10 cm to 25 cm	25 cm to 50 cm	50 cm to 100 cm 0 to 10 cm	100 cm to 200 cm	More than 200 cm

APPENDIX 5 - COMPUTERISED DATA HANDLING SYSTEM

A computerised data storage and manipulation system was developed to assist recording and evaluating information collected during the land resource survey. The system was developed for a HP9845B desk top computer.

The aim behind developing such a system was to make it easier for the land resource surveyor to evaluate the mass of information that is derived from the many field site observations that are made throughout a survey. From the onset, the aim was to develop not just a storage system or 'glorified filing cabinet', but rather a manipulative system which would allow the surveyor rapid access to selected items of information from either the whole, or from any particular subset of the total site information stored. The system was designed by a computer programmer in close liaison with land resource surveyor in order to derive a product which would be beneficial both during the survey, when the resource surveyor needs to correlate and assess his results, and after the survey, when others may wish to gain information from the field records which may not need to be covered in sufficient detail in the survey report. The system sets up a data base for the field survey results which will allow a rapid reassessment of any of the 'raw data' in the light of future requirements.

THE INFORMATION RECORDED IN THE FIELD

Figure 7 is a copy of the field record card development for this study. The card allows the field surveyor to record a number of items of information which have been numbered here to facilitate description in the adjacent table.

The card has been primarily designed to record only those items of information which are actually collected in the field. Basically it consists of three parts as follows:

Upper Portion, Items No. 1 – 35.

Information about the site , its location, its surface appearance, the soil classification and important parameters relating to the soil which have been inferred from the profile description.

Central Portion

Soil Profile description.

Lower Potion, Items 41 – 45.

Information on the vegetation and any additional notes about the site which it is considered necessary to record.

In addition to the above information (Items 1 – 35, 41 – 45) which should be recorded in the field, there are several items which may be recorded at a later stage. These include the location in terms of the appropriate topographic map sheet number and grid references, the evaluation (also obtained from the topographic map sheet), rainfall, and the final map unit (items 36 – 40, 2). The latter is usually determined only after all the data has been assessed. Items of information such as survey name, shire etc., which are usually constant for a significant number of observations need not be laboriously recorded at every site but rather recorded only as the data is being typed into the computer. Thus items 47 – 79 do not appear on the field record card but will appear on the computer records.

The terminology used for describing the land and its soils is basically consistent with that outlined in the 1979 draft edition of the SCA "Manual for description of sites and soil profiles", and should be understandable to land resource survey workers in this country.

The information recorded is either alpha-numeric in nature and for many of the items a checklist of 'acceptable values' has been fed into the computer to guard against errors in entering data which could later produce nonsensical results. All information is recorded as a logical abbreviation of normal longhand records, and as such the card and any subsequent computer output are easy to understand.

Items of information shown on the card here have been selected by the surveyor, before the onset of the survey, and have been designed to provide sufficient data for an assessment of land capability to be made subsequent to the land inventory, or land resource survey. However, should others with interests in different types of information wish to use the storage and manipulation system, the 'tags' for each item of information can be easily changed and likewise the list of 'acceptable values' corresponding to each item can be altered.

USING THE PROGRAM

The data storage and manipulation system is relatively simple and currently relies on cassette tapes as permanent records for the program itself and the recorded site data. To use the system the program tape is inserted where upon the operator receives a series of basic operating instructions on a video screen. The operator is then given the choice of using either the EDIT or PRINT functions of the program. The former enables either new site information to be added to the system or for existing information to be edited. The latter enables the operator to retrieve and sort either the whole, or any desired subset of the existing site data in the system before obtaining a print-out on either the video screen or paper.

Once a decision to either EDIT or PRINT is made, the computer ' reads' the relevant instructions from the program tape which can then be replaced with the cassette tapes on which the site information is recorded.

1. The Data Entry Process

Entry of data directly from the field record cards onto the cassette tapes is by means of a keyboard beneath the video screen. The operator receives visual prompts from the computer to type in each item of information in order as it appears on the field record card following the numbering sequence in figure 7. As it is not always necessary or possible to complete the field record card a response to an item prompt from the computer can be omitted if necessary. For a number of key items on the card a checklist of acceptable values has been inserted into the program to prevent any inadvertent errors entering the system.

In the lower part of the card no checklist of values has been programmed and vegetation and any other notes can be recorded in longhand within the limits of space available. The operator is now able to record any items of information which may not appear on the site cards but which still need to be recorded. The might include the study area name and the relevant shire for example.

For ease of data entry the soil profile descriptions is recorded last. Here again the computer prompts for the relevant items of information reading from left to right across the field card and repeats the process for a maximum of several lines or 'soil horizons'. At the end of this entry the operator may stop the computer or repeat the process for another site. On average it requires about 4 – 5 minutes to enter a full description for any one site.

2. The Data Editing Process

On the completion of each full site entry the operator can view all the information just inserted. Any alterations can be made by identifying the incorrect item by number (see figure 7) and then deleting the previous entry when it is identifies on the screen, and retyping the correct response for that item. This correction process can be continued until the operator is satisfied the full site entry is correct before moving on to the next site.

Should the operator wish to edit portions of a number of site records some time after the data entry stage, the EDIT program allows this for either a number of individual sites or for blocks of sites. In the latter case only the first and last site numbers need to be entered into the computer rather than a list of every site. The computer will display the information recorded for each site in turn allowing any corrections to be made as described above.

3. The Data Manipulation and Print Out Process

The PRINT program allows the operator to retrieve and sort any of the items of information recorded on the field card with the exception of the soil profile description. The profile description in itself is t rarely of importance in characterising a site or map unit, but rather the properties of the soil which are derived from the description are significant. These properties, such as soil drainage and permeability, are summarised in the upper portion of the record card and also within the factual key notation classifying the soil (item 34).

The programmer has attempted to break down the data collection and assessment process that the resource surveyor undertakes into a series of simple steps to enable the computer to repeat the process but at an infinitely faster rate and in a more consistent manner. In order to follow these steps it is helpful if the reader pictures the computer as containing a sea of items of information.

When the operator wishes to know something about either all or part of the site information that is recorded, he must retrieve those site numbers which will provide the necessary information and sort then in a logical manner which will clearly show what is required.

(a) Retrieval of information

In the simplest case, the operator may wish to fine information relating to a particular site or group of sites which has been recorded on the field record cards. All items are tied to individual sites identified by their site numbers. In this example, the sites are readily identified and easily 'plucked from the sea'. However, more commonly the operator requires information relating to sites or groups of sites which are related by some common factor of interest, and where the identifying site numbers are not apparent.

For example, information may be required about:

(a) those sites with a particular geology eg. TVO

or (b) those sites with a particular red soils (Gn4)

or (c) those sites occurring above a particular range of evaluation eg. 400 m

or (d) those sites within a particular geographic area (identified by sub area name)

or (e) those sites within a particular geographic area (identified by a range of grid references)

or (f) those sites occurring over a particular slope range eg. (5 – 10 % average slope)In each of these cases particular sites need to be retrieved form the sea of information using a common tag other than the site number. Following the above example, the sites would be retrieved on the following basis.

(a) retrieved on geology – tem 3 – value TVO

(b) retrieved on soil classification; factual key – item – Value Gn 4

(c) retrieved on elevation – item 39 – value 400*

(d) retrieved on study sub area – item 47 – value LT,

(e) retrieved on grid reference 1 – item 37 – minimum value x,
maximum value y.

(f) retrieved on Slope average – item 6 – minimum value 5,
maximum value 10.

Note that there are two types of retrieval criteria, those which are alphanumeric and those which are numeric. When using the program the operator must identify what the retrieval criteria are, and enter first the item number followed by the desired value for each. Alphanumeric and numeric criteria are asked for separately by the computer.

* For purely numeric items a minimum and maximum must be given to the computer. For this case, a minimum of 400 and a suitably high arbitary maximum of 500 could be given. If we wished to retrieve just those sites at 400 m then 400 would be inserted for both the minimum and maximum value.

In addition to the simple retrieval examples given above, an operator may wish to retrieve those sites with more than one item in common. For example he may be interested in those sites;

(a) with slopes between 10 and 25 % and occurring on TPH geology

or (b) with poorly drained soils in La Trobe land system

or (c) occurring in map unit CR2 above 200 m elevation and having a factual key classification Gn4.

In each of these examples the retrieval criteria is identified and entered in turn into the computer when prompted.

ie. (a) Computer displays – "alphabetic retrieval criteria" –
Operator enters –
item 3 (geology), value, TPH
Computer Displays – "numeric retrieval criteria" –
Operator enters –
item 6 (slope average) minimum value of 10, maximum value 25.

(b) Computer displays – "alphabetic retrieval criteria" –
Operator enters –
item 9 (soil drainage) value P.
Operator enters –
item 4 (land system) value Le.
Computer displays – "numeric retrieval criteria" –
Operator enters –
'continue'

(c) Computer displays – "alphabetic retrieval criteria" –
Operator enters –
item 2 (final map unit) value CR2.

Operator enters –
item 34 (soil factual key) value Gn4.
Computer displays – "numeric retrieval criteria" –
Operator enters –
item 39 (elevation) value minimum 200, value maximum 5000.

For either alphanumeric criteria up to three retrieval items can be nominated. These are 'added' together so that in the last example the sites which occur in CR2, and above 200 m elevation, and have Gn4.11 soils are retrieved from the sea of information.

(b) Sorting of information

Once a particular subset of the total number of sites has been plucked from the sea by the retrieval criteria and gathered into the computer's memory, the operator needs to decide how those sites should be sorted before they appear on screen. The operator many use any combination of items to sort the sites that were retrieved, bearing in mind that they will be sorted initially by the first factor nominated, then the second, then the third etc. for example, if map units and land systems were sought which occurred in a group of sites retrieved on the basis of one or more factors, the computer would prompt to have the retrieval sites sorted on item 2 (final map unit), then item 4 (land system) and then possibly item 1 (site number). The information retrieved and sorted in the computer memory would then be displayed or printed out.

(c) ***Printing the information***

Before displaying or printing any information pertaining to the retrieved and sorted sites, the operator must decide which items of information from each site are wanted. Up to 20 items of information can be printed for each site in any order across the page.

For example, if the operator was interested in general soil conditions occurring in retrieved sites the following items might be chosen for each site: factual key (34), soil drainage (9), bottom (soil depth, and nature of lowest horizon) (50), permeability 20 – 50 (17) and estimated USG (26). If these sites were sorted in order of their final map units, geology, and site numbers, it might also be desirable to have those items (nos. 2, 3, 1) displayed as well. Each item number is typed in the order required for display.

Before the output is displayed the operator is able to type an explanatory or identifying heading which would appear in addition tot he retrieval criteria, the sorting criteria and the list of items printed, on top of the print-out.

(d) ***Other Capabilities***

Statistics. Once the desired information is displayed, either on screen or as a print-out, some simple statistical analyses can be done on any of the numeric items retrieved.

Up to five numeric items can be studied, the ones of most likely interest being slope and elevation parameters. For each variable the computer will list the number of observations, the number of blank records, the mean, variance, standard deviation, minimum value, maximum value, range, mid-range, co-efficient of variation, standard error of the mean, upper and lower limits of the 95 % confidence interval on the mean, and the correlation matrix between it and other items identified.

Maps. The program has a mapping facility which enables retrieved sites to be plotted at a variety of scales according to the grid sheet references (items 36 – 38) entered for each site.

The operator must identify the area of interest by specifying the desired grid reference for the lower left hand corner of the map, whose size is then limited only by the size of the screen relative to the scale chosen.

For each site 'captured' within the plot, any particular item of information can be displayed on the screen or paper print-out. For example, the map could be used only to show simply the site numbers, or else it could display the geology or soil drainage encountered at each of those sites. This facility therefore allows a limited spacial representation of certain site parameters to be shown at a variety of mapping scales.

(e) ***Conclusion***

Although the program has only been used at this stage for relatively simple manipulative and sorting work, its usefulness should increase with greater operator handling. To date, this rather elemental system has been successfully used to establish a physical data base for land capability information in Central Gippsland, and to assist the author correlate and assess parameters for a large number of sites for this study.

Figure 7

SOIL CONSERVATION AUTHORITY					FILE RECORD CARD				LAND CAPABILITY ASSESSMENT			
Map Unit	3	4	5	**Slope Av**	6	**Boulders**	7	8	**Soil Drainage**	9	**Site No.**	1
Landform	10	11	12	**Slope Rge**	13-14	**Stone**	15	16	**Perm 20-50**	17	**Date**	18
Sketch				**Slope Lth**	19	**Gravel**	20	21	**Perm Deep**	22	**Air Ph Yr**	23
				Aspect	24	**Microrelief**		25	**Est Usg**	26	**Air Run No**	27
				Relief	28	**Surface Condit**		29	**Erosion**	30	**Site Photo**	31
Site Drainage		32		**Site Cond**	33	**Soil Classification**			34		35	

Depth	BDY	Horizon	Colour Mottles	Texture	Consist	Structure	Fabric	pH	Disp	Miscellaneous
Veg/Extra Notes		**41-45**								
						Location		36	37	38

Elevation 39 Rainfall 40

Table 10 ITEMS LISTED ON FIELD RECORD CARD

Item no.	Item Name*	Meaning or example of terms used
1	Site number	Self explanatory; numeric eg. 1-999
2	Final Map Unit	Nomenclature identifying the final division of the land classification or inventory system into which the site has been classified; alphanumeric eg. CR2.
3	Map unit – geology	Classification of the area according to relevant Dept. of Mines and Energy map; eg. TVO
4	Map unit – land system	Classification of the area according to relevant SCA land systems map; eg. NM
5	Map unit – component	Classification of the area according to relevant SCA land system, numeric eg. 1.
6	Slope Average	Value in %, numeric
7	Boulders - %	Estimated % cover (note, boulders are larger than 25 cm diameter)
8	Boulders – type	Rock type, alphabetic abbreviation eg. BAS – basalt, GRN – granite
9	Soil Drainage	Refers to freedom with which excess water can move through the soil profile; eg. MW – Moderately well
10	Landform - adjacent	Descriptive terminology (alphabetic) abbreviated; eg. U – undulating
11	- type	e.g. HI – hill
12	- element	e.g. MS – mid slope
13	Slope range - lower	Value in %, numeric
14	- upper	Value in %, numeric
15	Stone - %	Estimated % cover (stones are 75 mm – 25 cm dia.)
16	Stone – type	Rock type as for boulders
17	Permeability 20 – 50	Refers to the ability of the soil to transmit water in the 20 – 50 cm depth area (approximate depth of soil absorption trenches for effluent disposal) alphabetic eg. SP – some – what poor.
18	Date	Self explanatory – of observation numeric eg. 9/9/80

Item no.	Item Name*	Meaning or example of terms used
19	Slope length	Average length of slope/slopes in metres; numeric
20	Gravel %	Estimated % cover (gravels are 2 mm – 75 mm)
21	Gravel type	Abbreviated terms; alphabetic eg. Q – Quartz, IS – Ironstone
22	Permeability – Deep	As for 17, but at depth to approximate conditions at base of excavation
23	Air photo, year	Reference to aerial photograph used to delineate map unit and locate site; shows area and year of flight; eg. MOE 72.
24	Aspect	Direction of slope faces if any; alphabetic eg. NNW
25	Microrelief	Refers to local differences in topography of surface; alphabetic eg. SM – smooth
26	Estimated USG	Estimated Unified soils Group classification of subsoil for engineering purposes, alphabetic eg. CH.
27	Air photo, Run, No.	As for 23, shows identifying run numbers and photo number; numeric eg. 5, 32
28	Relief	Refers to general differences in elevation within map unit, numeric in metres.
29	Surface condition:	Refers to nature of soil surface; alphabetic eg. H – hardset
30	Erosion:	Refers to an assessment of current land deterioration at site; alphanumeric, type/severity abbreviation eg. GL3 – gully, severe where severity ranges from 1 – 4 (minor – very severe)
31	Site photo:	Record of any photographs taken in field
32	Site drainage:	Refers to the ability or susceptibility of the area to shed or receive runoff water, terms as for soil drainage
33	Site condition:	Is roughly equivalent to land use; numeric and relating to severity of land disturbance; eg. 0 – natural undisturbed; 3 – cultivated pasture, 7 – built up urban – highly disturbed.
34	Soil Classification – Factual Key	Northcote soil classification system; alphanumeric eg. Gn4.11
35	Soil classification – GSG	Classification according to Great Soil Group classification system; alphabetic eg. Krasnozem

Item no.	Item Name*	Meaning or example of terms used
36	Location – map sheet	1:100 000 topographic sheet number eg. 8121
37	Location – grid reference 1	Grid reference for vertical lines on map sheet
38	Location – grid reference 2	Grid reference for horizontal lines on map sheet
39	Elevation	Elevation of site in metres as shown on topographic map
40	Rainfall	Approximated for site from whatever data available; numeric, in mm
41, 42	Vegetation	Longhand description of native vegetation (2 lines available)
43-45	Notes	Longhand description of any extra notes required (3 lines available)
46	Miscellaneous	Computer 'space' available for additional site classification required
47	Sub-area	Abbreviation for study area location eg. LT – Lower Tanjil
48	Shire	Abbreviation for relevant country shire eg. NAR – Narracan
49	Study area	Abbreviation for Study name eg. TAN – Tanjil catchment
50	Bottom	Refers to the depth of sampling and the nature of the last horizon encountered. The data is automatically extracted from the profile description. Eg. 120 + B2 – depth of sampling was 120 cm, however soil was deeper, and last horizon described was the B2.

*1. Items listed are those used for land capability surveys in Gippsland. For future use, any items could be delineated or redefined. The full range of items used for this survey is given in the program and this can either be expanded or reduced for future surveys.

2. Items of information contained in the central portions of the card relate to a description of the soil profile. The items are self explanatory to soil surveys and need not be described here. Soil profile descriptive information is stored by the computer but not available for manipulation under this program. However, the classification of the soil, and the most important parameters which have been deduced from the profile description, are itemised in the upper portion of the card and available for data manipulation.

APPENDIX 6 - AERIAL PHOTOGRAPHS USED IN THE STUDY

Two scales of black and white aerial photographs were used. For the broadscale land systems study, 1967 – 68 photographs with a minimal scale of 1: 80 000 were used.

For detailed freehold land study, 1970 and 1972 photographs with a nominal scale of 1: 25 000 were used. Aerial photograph centres have been marked on figure (8) with a cross identifying those used for the freehold study, and across within a circle for those used for the broadscle study.

Map Sheet 1:100, 000 series	Photo Name	Film No.	Date	Altitude Ft	Run	Photo Nos
Broadscale Study						
Matlock 8122	Warburton	CAD7010	12.12.68	25,000	8	26 – 31
		CAD7010	19.12.68	25,000	9	82 – 90
		CAD7010	22.12.68	25,000	10	142 – 148
Moe 8121	Warragul	CAD37	18.4.67	25,000	1	61 – 67
		CAD37	18.4.67	25,000	2	119 – 121
Detailed Study						
Matlock 8122	Walhalla	VIC.5653	10.3.72	16,000	2	82 – 86
		VIC.2662	10.3.72	16,000	3	10 – 17
		VIC.2662	13.3.72	16,000	4	35 – 42
		VIC.2661	17.3.72	14,280	5	34 – 40
		VIC.2662	13.3.72	15,000	6	67 – 72
		VIC.2662	17.3.72	14,000	7	86 – 91
Moe 8121	Moe	VIC.2456	1.12.70	13,400	1	99 – 104
		VIC.2456	1.12.70	13,400	2	118 – 123
		VIC.2456	1.12.70	13,400	3	74 – 79
		VIC.2456	1.12.70	13,400	4	9 – 12

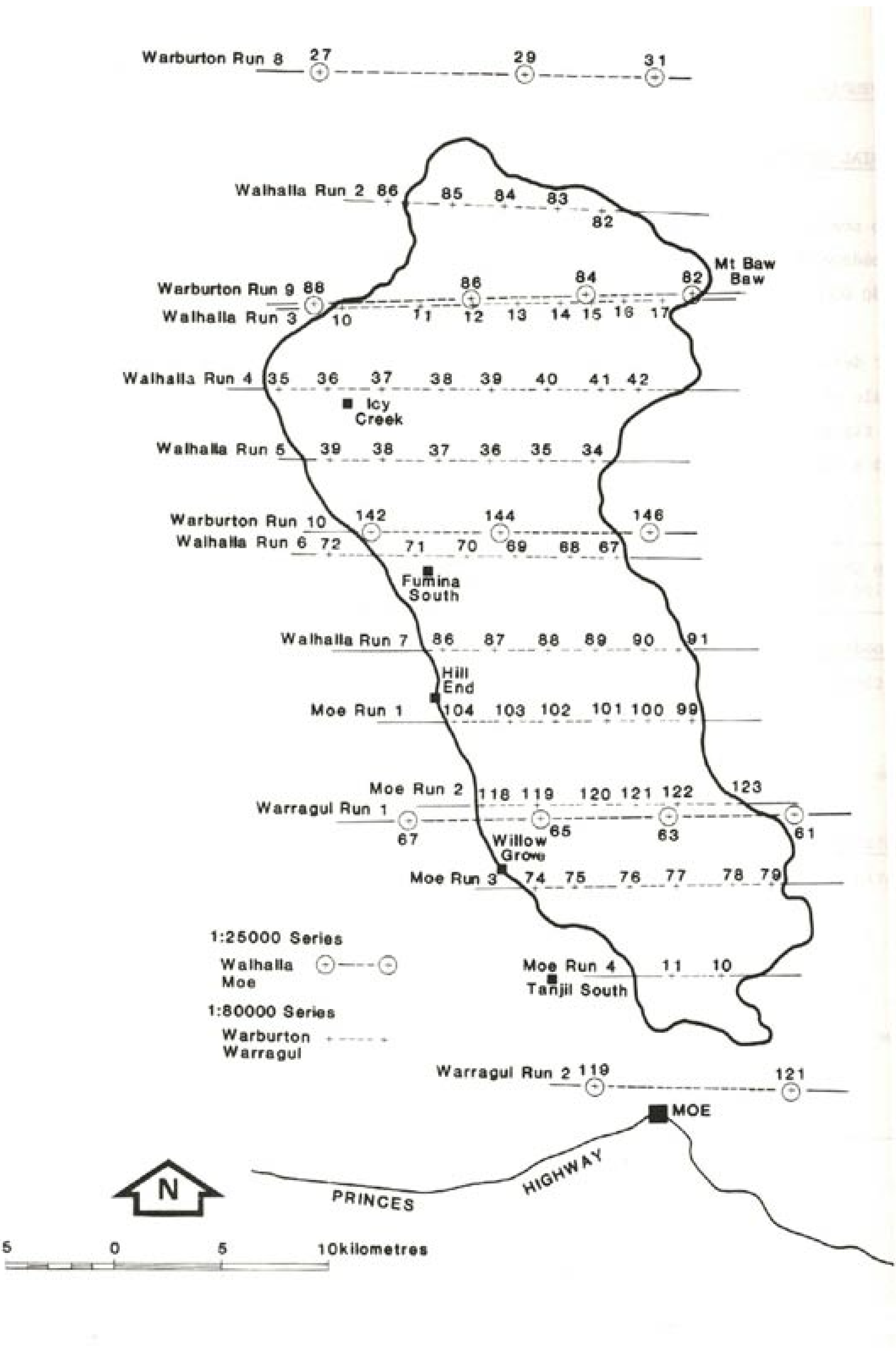

Fig 8 – Aerial photography of the Tanjil River catchment