An introduction to the soils of the Lake Grace advisory district

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AN INTRODUCTION TO THE

SOILS

OF THE

LAKE GRACE

ADVISORY DISTRICT

- descriptions, illustrations and notes on eight common soils

COMPILED BY T.C. STONEMAN
Foreword

Descriptions, illustrations and notes on eight common soils

This publication is one of a series dealing with soils commonly occurring, or of particular significance, in the wheatbelt advisory districts of the Department of Agriculture. The districts regarded as "wheatbelt" are Geraldton, Three Springs, Moora, Northam, Merredin, Narrogin, Katanning, Lake Grace, Jerramungup, Albany and Esperance (see map). Most of the publications will be in this format, but those for Merredin and Northam will be rather more comprehensive in coverage of the soils, landscapes and agriculture of their respective districts.

The publications have the objective of encouraging and aiding recognition by advisory staff and farmers of different wheatbelt soils and the development of a greater appreciation of the influence that soil characteristics have on land capability.

Particular points to note with respect to the terminology and descriptions used in this publication follow.

Australian Great Soil Groups - The names used follow the identifications discussed by Stace et al. (1968) in "A handbook of Australian soils".

Northcote Soil Classification - as described in Northcote, K.H. (1979) "A factual key for the recognition of Australian soils".

Soil profile sketches - these line drawings interpret the profiles presented in the matching colour photographs.

Colour photographs - many of the colour photographs show a darker coloured vertical band of soil on either side of the depth tape. The strip has been moistened and is intended to indicate moist and dry soil colours.

Soil colours - the common names used in soil descriptions are standard names derived from Munsell soil colour codes.

pH values - all pH values recorded in the text are in 1:5 soil water. Values in 0.01 M CaCl₂ are also given with some soil profile descriptions.

Soil maps - the maps indicating where each soil most commonly occurs are derived from interpretations of Sheet 5 of the Atlas of Australian Soils (Northcote et al. 1967).

Particular acknowledgement is made for funds provided by the National Soil Conservation Program to assist the Department of Agriculture undertake this project.
The Lake Grace office of the Department of Agriculture serves an advisory district embracing the shires of Lake Grace, Kulin and Kondinin and adjacent parts of the shires of Kent and Dumbleyung. The District has an area of about 2.37 million hectares and has about 800 farms. The District has a mature landscape with little relief between the valleys and hilltops. External drainage consists of a system of very low gradient salt lake channels falling to the north and north-west. Geologically, the district is situated on the Yilgarn Block, which is composed of granitic gneiss and migmatic of Archaean age (i.e. older than 2,500 million years). More recent valley-fill alluviums of Cainozoic age are deposited in the two major salt lake drainage systems.

The undulating country between the major drainage lines is a mixture of yellow earths and siliceous sands (Soils 5 and 6) and lateritic podzolic soils (Soils 1 and 2) vegetated by low heath and small mallee eucalypts. The very gentle slopes of the upper tributary valleys have extensive areas of solidised solonetz, commonly with domed surfaces at the top of the clay layer (Soil 3), with mallee eucalyptus vegetation, and, particularly in the southern parts of the District, are extensive areas of solodic "moort" soils (Soil 7) typically vegetated by thickets of moort (Eucalyptus platypus). Closer to and fringing the major drainage lines are broad valley floors with a woodland of salmon gum (E. salmonophloia) and gimlet (E. salubris) on typically hard red surfaced "heavy land". Subsoils range in colour from yellow to red (Soil 8). Other woodlands of morrel (E. oleosa var. longicornis) and Kondinin blackbutt (E. kondininensis) occur, usually on rising country to the east and southeast of salt lakes; these are the solonised brown "morrel" soils with powdery grey (sometimes brown) surfaces and very high lime content through the soil profile (Soil 4).

The sketch opposite provides a diagrammatic representation of the topographic positions in which the various soils discussed in this publication are found.

Agricultural land use is almost entirely wheat and sheep farming, with lupin cropping becoming significant.

References to Soils of the Lake Grace advisory district

Further reading

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Soil 1. Lake Grace advisory district

**Classification**
Australian Great Soil Group: Lateritic podzolic
Northcote: Dy 5.41
Local name: Sandy gravel

**Soil profile description**
(see Fig. 1, colour photograph inside back cover)

- 0-7 cm brown loamy sand, with few ferruginous nodules, pH 7.2 (5.6 CaCl₂)
- 7-15 cm yellowish brown (conspicuously bleached) loamy sand, with ferruginous nodules common
- 15-110 cm yellow with many distinct red mottles, clayey sand, with many ferruginous nodules, pH 7.5 (6.2 CaCl₂)
- 110-140+ cm brownish yellow, with many prominent red, white and grey mottles, light clay, pH 6.1 (4.8 CaCl₂) (“mottled zone”)

**Distinguishing features**
- The native vegetation is low heath and small mallee.
- Map 1 provides an indication of the area within which this soil most frequently occurs in the Lake Grace advisory district.
- The upper metre of soil is slightly alkaline in reaction (pH 7.2-7.5) while the subsoil below 1 m is slightly acidic (pH 6.1).
- The soil usually occurs high in the landscape, on upper slopes and ridges with very gentle to gentle slopes. It commonly occurs in association with the gravelly Soil 2, sometimes with areas of exposed massive ironstone, and also within extensive areas of the deep sands, Soil 5 (yellow earth) and Soil 6 (siliceous sand).
Agricultural use and management

Soil characteristics

Favourable attributes
Water entry and drainage - good.
Soil workability - good, except where areas of massive ironstone are exposed at, or near, the soil surface.

Limitations
Nutrient status - low, particularly for phosphorus which becomes unavailable due to adsorption onto the ironstone gravels.
Water availability - low, due to sandy textures and presence of ironstone gravels, particularly when present as an indurated layer.

Agronomic considerations
Crops - given appropriate fertilizer and rotation practices, wheat is the most suitable crop for this soil. Other cereals can be grown, but are not as profitable at current prices. Lupins grow satisfactorily provided a shallow indurated layer does not restrict root growth.

Pastures - because of the almost neutral soil reaction, either subterranean clover or burr medic can be grown. Cropping frequency will determine which is the most suitable.

Soil conservation
Water erosion - sheet and rill erosion are possibilities particularly where massive ironstone areas or breakaways are a source of runoff water. Contour banks are sometimes required but contour working frequently provides adequate protection.

If surface sand is stripped by wind or water erosion, a hard and intractable surface is produced.

Water conservation
Dams excavated in this soil generally hold water satisfactorily. Natural catchments perform reasonably, particularly when in pasture. It is not usually possible to construct roadden catchments on these soils because of the depth of overburden over suitable clay material.
**Classification**
Australian Great Soil Group: Lateritic podzolic

| Northcote: Dy 5.42 | Local name: Sandy gravel |

**Soil profile description**
(see Fig. 2, colour photograph inside back cover)

- **0-7 cm** dark greyish brown loamy sand, pH 6.2 (5.1 CaCl₂)
- **7-20 cm** light yellowish brown sand, (conspicuously bleached) with very few ferruginous nodules, pH 7.5 (6.2 CaCl₂)
- **20-70 cm** very pale brown clayey sand with very many ferruginous nodules, pH 7.7 (7.1 CaCl₂)
- **70-120+ cm** yellow sandy clay with many prominent red mottles, pH 6.9 (6.1 CaCl₂) (mottled zone)

**Distinguishing features**
- The soil profile is approximately 0.5 m of pale sand to clayey sand overlying a yellow and red mottled sandy clay. The subsurface contains more than 70 per cent ironstone gravel nodules.
- The surface of the profile is slightly acidic in reaction (pH 6.2) but the subsurface and subsoil is alkaline to neutral (pH 7.7 - 6.9).
- The soil usually occurs relatively high in the landscape, on upper slopes and ridges, with very gentle to gentle slopes. It commonly occurs in association with Soil 1 (also known locally as a sandy gravel) and within extensive areas of the deep sandy soils, Soil 5 (yellow earth) and Soil 6 (siliceous sand).
- The native vegetation is low heath and small to medium height mallee.

- Map 2 provides an indication of the area within which this soil most frequently occurs in the Lake Grace advisory district.
Agricultural use and management

Soil characteristics

Favourable attributes
Water entry and drainage - good.
Soil workability - good.

Limitations
Nutrient status - low, especially for phosphorus which becomes unavailable due to adsorption onto the ironstone gravels.
Water availability - low, due to sandy textures and presence of ironstone gravels.

Agronomic considerations
Crops - given appropriate fertilizer and rotation practices, wheat is the most suitable crop. Other cereals can be grown but are not as profitable. Lupins do not do well.

Pastures - the slightly acidic soil conditions in the surface soil horizons make subterranean clover the appropriate pasture legume although burr medics can also be grown.

Soil conservation
Water erosion - sheet and rill erosion are possibilities, particularly where run-on of water can occur from upslope. Contour banks are sometimes required, but contour working frequently provides adequate protection.

Water conservation
Dams excavated in this soil generally hold water satisfactorily.
Natural catchments perform reasonably, particularly when in pasture. It is not usually possible to construct roaded catchments on these soils because of the depth of overburden over suitable clay material.

Map 2.
Soil profile description

(see Fig. 3, colour photograph inside back cover)

- 0-10 cm greyish brown sand, pH 7.9 (6.4 CaCl₂)
- 10-20 cm very pale brown sand, conspicuously bleached with very few ferruginous nodules and quartz grit, pH 7.4 (6.4 CaCl₂)
- 20-45 cm reddish brown sandy clay, with many distinct red and grey mottles, domed columnar structure, pH 7.1 (5.6 CaCl₂)
- 45-120 cm yellow sandy clay with distinct orange mottles common, pH 9.4 (7.9 CaCl₂)
- 120-130 cm dark yellowish brown sandy clay with ferruginous nodules common
- 130-165 cm pinkish grey medium clay, with few distinct yellow mottles
- 165-180+ cm very pale brown clayey sand with few distinct orange mottles, pH 8.8 (7.1 CaCl₂)

Distinguishing features

- The soil profile is a shallow surface sand horizon over a dense dark coloured sandy clay subsoil which has a distinctly domed surface. The deeper subsoil is mainly yellow sandy clay with orange mottles.
- The soil profile is alkaline to strongly alkaline throughout. More typically, the surface sands of this soil type have a pH between 6.0 and 6.5.
- The soil occurs on level valley floors within the same topographic areas as Soil 7 (solodic soil).
- The native vegetation is typically medium to tall mallee.

- Map 3 provides an indication of the area within which this soil most frequently occurs in the Lake Grace advisory district.
Agricultural use and management

Soil characteristics

Favourable attributes
Water entry - good.
Soil workability - good except if clay subsoil is shallow and is within depth of cultivation.

Limitations
Nutrient status - poor, due to sand surface and highly alkaline and sodic subsoil.
Water availability - limited due to restricted root penetration of dense clay subsoil.
Soil workability - if the surface sand is very shallow, cultivation can incorporate some of the subsoil clay and will produce a very hardsetting and undesirable soil surface.

Agronomic considerations
Crops - given appropriate fertilizer and rotation practices, wheat is the most suitable crop for this soil. Other cereals can be grown, but are not as profitable. Lupins do not do well because of restricted root penetration and highly alkaline subsoils.
Pastures - medics are the most suitable species on these alkaline soils. Disc medic (M. tornata) and strand medic (M. littoralis) are the preferred species of medic although burr medic will also grow.

Soil conservation
Wind erosion of the sandy surface soil occurs unless surface cover is protected.
Waterlogging of the surface sands can occur in wet seasons because of slow drainage into the subsoil.
Salinity due to shallow groundwater can occur, particularly in areas close to the major regional drainage systems.

Water conservation
Dams excavated in this soil hold water satisfactorily but test boring is required to make sure salty groundwater is not encountered in dam excavations.
Natural catchments are fair to poor, depending on depth of surface sand, and slope of the catchment. Roaded catchments perform well.
**Classification**  
Australian Great Soil Group: Solonized brown soil  
Northcote: Gc 1.12  
Local name: Morrel

### Soil profile description
(see Fig. 4, colour photograph inside back cover)

- **0-5 cm** dark greyish brown silty clay loam with very few calcareous nodules, highly calcareous, pH 8.6 (7.2 CaCl₂)
- **5-15 cm** greyish brown silty clay loam, with very few calcareous nodules, highly calcareous
- **15-45 cm** very pale brown light clay, highly calcareous, pH 9.9 (9.0 CaCl₂) 0.37% chloride
- **45-120 cm** very pale brown medium clay, with very few distinct brown mottles, slightly calcareous, pH 10.1 (9.0 CaCl₂) 0.27% chloride
- **120-180+ cm** light brown medium clay with few distinct white mottles, pH 9.9 (8.6 CaCl₂) 0.30% chloride

### Distinguishing features
- The soil commonly occurs on level to gently sloping land surfaces, frequently to the east and south-east of salt lakes.
- The native vegetation is usually dominated by *Eucalyptus oleosa* var. *longicornis* (morrel) and *E. kondininensis* (Kodinin blackbutt). *Atriplex* species (saltbush) and *Maireana brevifolia* (bluebush) are also commonplace.
- Map 4 provides an indication of the area within which this soil most frequently occurs in the Lake Grace advisory district.
Agricultural use and management

**Soil characteristics**

*Favourable attributes*

Nutrient status - reasonably good, particularly for potassium.

Soil workability - good under favourable moisture conditions.

*Limitations*

Salinity - subsoils are always saline, and removal of surface soil by erosion results in serious salinity problems.

Wind erosion - the fine textured surface soils are very vulnerable to wind erosion when exposed by cultivation or overgrazing.

Water availability - limited by the osmotic effects of high concentrations of soluble salts in the soil solution.

**Agronomic considerations**

Crops - soil salinity and alkalinity limit productivity of cereals. Cereal rye is the most adapted to these conditions. Barley and oats are usually more tolerant than wheat. Lupins cannot be grown satisfactorily on this soil.

Pastures - medics are the pasture legume of choice for this soil, because of the alkaline conditions. In many areas, particularly those where salinity problems have been aggravated by wind erosion, salt tolerant shrubs (saltbush and bluebush) can provide a viable alternative.

**Soil conservation**

Wind erosion and salinity problems are closely associated on this soil. Adoption of farming practices to minimize wind erosion of the fine and loose surface soil is essential if serious loss of production resulting from soil salinity in the exposed subsoil is to be avoided. Soil salinity due to shallow groundwater does not usually occur on this soil.

**Water conservation**

Dams excavated in this soil usually do not hold water satisfactorily.

Natural catchments do not shed water well and improved catchments are also unsatisfactory.

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Map 4.
**Classification**

Australian Great Soil Group: Yellow earth

Northcote: Gn 2.22

Local name: Yellow sandplain

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**Soil profile description**

(see Fig. 5, colour photograph inside back cover)

0-10 cm brown sand,
  pH 6.8 (5.4 CaCl₂)

10-40 cm yellow clayey sand,
  pH 6.8 (5.9 CaCl₂)

40-120 cm yellow sandy loam,
  pH 7.0 (6.2 CaCl₂)

120-180+ cm yellow light sandy clay loam with
  ferruginous nodules common
  pH 5.8 (4.8 CaCl₂)

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**Distinguishing features**

- The soil profile is yellow throughout apart from surface darkening by organic matter, with texture increasing gradually from sand at the surface to light sandy clay loam at depth.

- The profile is neutral to slightly acidic throughout (pH 7.0-5.8).

- The soil occurs on level to gently sloping land surfaces, frequently over extensive areas, in association with Soil 6 (siliceous sand) and with the gravelly soils, Soils 1 and 2 (lateritic podzolics).

- The native vegetation is low to medium heath.

- Map 5 provides an indication of the area within which this soil most frequently occurs in the Lake Grace advisory district.
Agricultural use and management

Soil characteristics

Favourable attributes
Water entry and drainage - good.
Soil workability - good.
Water availability - fairly good.

Limitations
Nutrient status - fairly low.
Compaction - the subsurface is susceptible to compaction by tractors and machinery, but is responsive to deep ripping.

Agronomic considerations
Crops - given appropriate fertilizer and rotation practices, all cereals and lupins are suited to this soil. Wheat and lupins are the most profitable.

Pastures - the slightly acidic soil conditions make subterranean clover or burr medics the appropriate pasture legumes.

Soil conservation
Water erosion, in the form of sheet and rill erosion, can occur in cultivated paddocks unless contour practices are adopted.
Wind erosion can occur if the sandy surface is left exposed by cultivation or overgrazing.

Water conservation
Dams excavated in this soil usually do not hold water.
Natural catchments are poor, but roaded catchments if carefully constructed and maintained can be successful.

Map 5.
Soil 6. Lake Grace advisory district

**Classification**
Australian Great Soil Group: Siliceous sand

Northcote: Uc 2.12
Local name: Deep sands

**Soil profile description**
(see Fig. 6, colour photograph inside back cover)

- 0-10 cm dark grey sand, pH 6.7 (5.4 CaCl₂)
- 10-60 cm very pale brown (conspicuously bleached) sand, pH 6.8 (5.6 CaCl₂)
- 60-80 cm yellow with orange mottles common, clayey sand with hard and soft ferruginous nodules common, pH 7.3
- 80-100 cm yellow with orange mottles common, clayey sand with hard and soft ferruginous nodules common, pH 7.3 (6.4 CaCl₂)
- 100-150+ cm brownish yellow clayey sand with many prominent red mottles, with very many hard and soft ferruginous nodules, pH 7.0

**Distinguishing features**
- The soil profile is very pale sand in the top 0.5 m or so, passing to a yellow mottled clayey sand beneath. Soft and hard ironstone gravel nodules are present in appreciable quantities below 80 cm.
- The profile is neutral in reaction throughout (pH 6.8-7.3).
- Similar soils are recognized by the very pale surface colour, which frequently extends to well below 1 m depth. Ironstone gravels are sometimes present in the subsoil.
- The soil commonly occurs on gently sloping land surfaces, often as relatively minor areas associated with more extensive areas of yellow earths (Soil 5), and with the gravelly soils, Soils 1 and 2 (lateritic podzolics).
- The native vegetation is low to medium height heath.
- Map 6 provides an indication of the area within which this soil most frequently occurs in the Lake Grace advisory district.
Agricultural use and management

Soil characteristics
Favourable attributes
Water entry - good.
Soil workability - good.

Limitations
Nutrient status - very low, particularly potassium.
Soil compaction - some subsurface soil compaction has been demonstrated, deeper than in Soil 5, but not usually considered necessary to deep rip.
Water availability - very low due to sand texture and excessive drainage.

Agronomic considerations
Crops - wheat-lupin rotations are successful, provided good grass control is achieved (to minimize take-all). Rates of simazine must be kept lower than Soil 5.
Pastures - subterranean clover is the appropriate pasture legume, but productivity is limited by poor water and nutrient availability. Serradella will grow well providing early maturing varieties are used.

Other plants - tagasaste should be considered as an alternative plant to use as a fodder crop and as a water-using crop (see salinity below).

Soil conservation
Wind erosion of the sandy surface occurs readily unless surface cover is maintained.
Water erosion, as sheet or rill erosion, can occur in cultivated paddocks unless contour practices are adopted.
Salinity is not usually a problem on these soils. However, because of the sandy nature and the limited use of soil water by the relatively poor crop and pasture growth, these soils are sources of excess water which moves downslope in the soil and can cause either seepage salinity problems or contribute to groundwater beneath the valley floors.

Water conservation
Dam excavation in this soil is usually impracticable due to the depth of sand overlying clay subsoil.
Natural catchments are very poor and improved catchments are not possible because of the excessive depth of surface sand.
Soaks for stock water can often be developed on the lower parts of areas of these soils.

Map 6.
Soil 7. Lake Grace advisory district

<table>
<thead>
<tr>
<th>Classification</th>
<th>Northcote: Dg 2.33</th>
<th>Local name: Moort</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australian Great Soil Group: Solodic</td>
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</table>

**Soil profile description**
(see Fig. 7, colour photograph inside back cover)

Surface: few quartz gravels
0-10 cm dark grey sandy loam, pH 7.5 (6.3 CaCl₂).
At 10 cm sporadic bleach on surface of clay horizon
10-20 cm very pale brown sandy clay with many distinct orange and brown mottles, with columnar to prismatic structure, pH 8.8 (7.1 CaCl₂)
20-50 cm light grey sandy clay with faint orange mottles common, pH 9.5 (7.4 CaCl₂)
50-90 cm light grey medium clay, with few faint orange mottles, pH 8.8 (7.1 CaCl₂)
90-130 cm light grey medium clay, with distinct orange mottles common, pH 9.0
130-190+ cm light grey light clay, pH 9.5

**Distinguishing features**
- In summary, the soil profile is a very shallow surface sandy loam over a dense, somewhat domed, structured clay. The clay has dark mottles in its upper 10 cm but beneath is light coloured sandy clay to medium clay.
- The soil surface is typically very hard setting and quartz gravels are usually common on the soil surface.
- The profile is alkaline to highly alkaline throughout (pH 7.5-9.5).
- The soil usually occurs on level to gently sloping valley floors and lower slopes within the same topographic areas as Soil 3 (solodized solonetz).
- The native vegetation is usually dominated by moort (*Eucalyptus platypus*) and mallee (*Eucalyptus* spp.).
- Map 7 provides an indication of the area within which this soil most frequently occurs in the Lake Grace advisory district.
Agricultural use and management

Soil characteristics

Favourable attributes
Water availability - good.

Limitations
Nutrient status - poor due to high alkalinity and sodicity in the subsoil.

Soil workability - difficult, usually due to incorporation of shallow subsoil material into the soil surface by clearing operations and cultivation. The resultant topsoil is usually very hardsetting and has a narrow range of soil moisture content within which it is workable.

Agronomic considerations
Crops - given appropriate fertilizer and rotation practices, wheat is the best crop for this soil. Other cereals can be grown but are not as profitable. Lupins cannot be grown satisfactorily on this soil.

Pastures - medics are the appropriate legume pastures, but difficulties frequently arise in maintaining improved pasture because of adverse effects of the hardsetting soil surface on seedling establishment. Applications of gypsum can improve surface soil structure, and lead to improved crop and pasture performance. Burr medics are more persistent than other medics and perform well in a year-in-year-out rotation.

Soil conservation
Waterlogging and shallow inundation can occur on flat areas in wet periods owing to slow drainage of water into the subsoil.

Sheet water erosion on sloping sites can remove topsoil exposing an intractable subsoil clay.

Water conservation
Dams and natural catchments perform well.
Soil profile description
(see Fig. 8, colour photograph inside back cover)

0-8 cm very dark greyish brown clay loam, pH 7.4 (6.1 CaCl₂)
8-15 cm dark brown light clay, slightly calcareous, pH 9.1 (7.2 CaCl₂)
15-30 cm reddish brown medium clay with few faint brown mottles, calcareous pH 9.4 (8.1 CaCl₂)
30-160+ cm yellowish red medium clay with pockets of soft calcium carbonate and few calcium carbonate nodules pH 9.7 (8.4 CaCl₂)

Distinguishing features
- The profile is a brown clay loam over a brown to red, light to medium clay, containing soft and hard accumulations of calcium carbonate.
- The soil is slightly alkaline in reaction at the surface and highly alkaline in the subsoil.
- The soil occurs on broad flat valleys or plains flanking saline valleys.
- The native vegetation is a salmon gum (Eucalyptus salmonophloia) and gimlet (E. salubris) woodland.

• Map 8 provides an indication of the area within which this soil most frequently occurs in the Lake Grace advisory district.
Agricultural use and management

Soil characteristics

Favourable attributes
Water entry and drainage - reasonably good.
Water availability - good.
Soil workability - good.
Nutrient status - reasonable, apart from phosphorus.

Limitations
Surface soil structure is often degraded as a result of excessive cultivation.

Agronomic considerations
Crops - given appropriate fertilizer and rotation practices, all cereal crops can be grown successfully.
Wheat is the most profitable. The soil is not suitable for lupins, but is suitable for field peas.
Pastures - medics are the appropriate pasture legumes. Barrel medics are particularly well suited.

Soil conservation
Water erosion, in the form of sheet erosion, occurs on cultivated soils on gentle slopes.
Poor soil structure can be a problem requiring minimum cultivation techniques and sometimes application of gypsum.

Water conservation
Excavated dams and natural catchments perform satisfactorily. Test boring is required to make sure salty groundwater will not be encountered in dam excavations.

Map 8.
FIGURE 1. Lateric podzolic (Sandy gravel)

FIGURE 2. Lateric podzolic (Sandy gravel)

FIGURE 3. Solonized solonetz (Sand over clay)

FIGURE 4. Solonized brown soil (Morrel)

FIGURE 5. Yellow earth (Yellow sandplain)

FIGURE 6. Siliceous sand (Deep sands)

FIGURE 7. Solodic (Moort)

FIGURE 8. Solonized brown soil (Red heavy soil)