Soil information sheets for the Mount Beaumont, Mallee and Esperance agricultural areas

Department of Agriculture and Food
Landcare Western Australia
Esperance Land Conservation District Committee
Mount Beaumont / Howick Catchment Group (W.A.)

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SOIL INFORMATION SHEETS
FOR THE MOUNT BEAUMONT, MALLEE AND ESPERANCE AGRICULTURAL AREAS
1996

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Introduction

These Soil Information Sheets are produced for the Esperance Land Conservation District and Mount Beaumont/Howick Catchment Group to provide an easy reference guide to the soils, land use and soil management recommendations for the Esperance, Condingup, Mount Beaumont and Salmon Gums agricultural areas.

The use of this information by the farming community, land use planners, research officers and extension personnel providing technical advice to land users, should assist in the development of sustainable agricultural systems for rural production in the area. The information should be used as a guide, and encourage the user to seek further information through relevant people and organisations.

The sheets have been prepared by the Natural Resources Assessment Group, Agriculture Western Australia. Contributors were Paula Needham (Perth) and Tim Overheu (Albany) in consultation with Brendan Nicholas and Jeremy Lemon (Esperance District Office), and Gottfried Scholz (Perth).

Information on the soil sheets

Each sheet summarises information on the soil's characteristic properties, and associated land use suitability and management. A photograph of a representative profile is provided for each soil. Technical terms are defined in the Soil Sheet Glossary.

Information is presented under the following headings:

Soil series and groups: The use of soil series is being adopted over Western Australia as a means of identifying particular soils. Each series is identified by a unique name, usually from the locality where it was first described. A series links a range of soils with similar profile characteristics and management requirements which have common agricultural uses. Soils have also been placed in groups based on simple, descriptive factors e.g. pale deep sand. A local name (in brackets) is supplied and followed by a brief description to aid identification.

Occurrence: This describes the distribution of the soil over the agricultural areas, followed by a description of the landscape positions in which it may occur. Where the soil has been identified in a soil-landscape mapping project in the area, the relevant map units in which the soil occurs are listed at the bottom of the page.

Native vegetation: A brief description of either indicator vegetation for the soil or common natural vegetation is presented. Where possible, both the common name and corresponding botanical name are given.

Soil profile description: Identification, classification and description of the main soil features. It is simplified from profile descriptions collected during land resource surveys, but should be sufficient for identification. Soil colour, structure, and other terms are defined in the glossary.

Characteristic soil properties: Summarises the main features, including some chemical and physical attributes which may be relevant to land use. Comment is made on the drainage, water repellence, pH (acidity or alkalinity), hardsetting or loose surface, stones, sodicity of the subsoil, dispersive nature, possible subsoil salinity and perched watertable.
An effective rooting depth is estimated. This is an approximation, usually to the depth of an impediment to plant roots, such as a dense clay layer, dense ferruginous (ironstone) gravel or bedrock.

**Soil classification**: This is an extra for the scientist who may be using this information to understand and evaluate the soils. Two soil classification systems are used: the Australian Soil Classification and the Northcote Principal Profile Form (PPF). Both are defined in the glossary.

A map unit is also included in the soil classification box. This is a number or a label which appears on a set of soil-landscape maps for the Esperance Land Resource Survey, Condingup and Mount Beaumont surveys.

**Agricultural land use and management**

This briefly describes the agricultural system that may best suit the soil based on soil properties and limitations for sustainable production and minimal land degradation.

Crops, trees, annual and perennial pastures for the area are described and discussed. Each land use may be specific for particular crops, rotations or species. This information is based on the soil properties and limitations only and should be taken as a guide. It should also act as a catalyst to encourage land managers to seek further information.

**Favourable qualities**: Lists the positive features of the soil.

**Soil characteristics and land conservation**: Lists factors that might limit production and affect management. Headings such as acidity, salinity, waterlogging or wind erosion are preceded by a ranking of high, moderate, low or very low, or may just include a statement on suitability or unsuitability.

**Mallee agricultural areas**

The Mount Beaumont and Esperance agricultural areas fall within the Mallee and Esperance Sandplain areas of the Southern Sustainable Rural Development program. The agricultural development and landcare extension activities are overseen by the Esperance District Office of Agriculture Western Australia. This area comprises approximately 1.2 million hectares and about 700 farms. These soil information sheets cover part of this area, as illustrated below.

The annual rainfall is highest on the coast, particularly near Esperance, where it averages 670 mm per year. It decreases slightly to the east and west, and declines rapidly with increasing distance inland. The average annual rainfall for the Mount Beaumont area, 70 km inland, ranges between 300 and 400 mm.

The landscape and geology of the Esperance sandplain is relatively simple compared with the Mount Beaumont area. The Esperance sandplain is a result of the reworking (or masking) of aeolian (wind-borne) sands and sand sheets over gravels and clay. The clays are developing on sedimentary material deposited over granite bedrock. The soils remain remarkably uniform across a variety of landscapes, often differing only in depth of sand or gravel over the clay. The vegetation also remains relatively consistent. Drainage is restricted by the lack of southerly flowing rivers. Most drainage channels terminate at large salt lake estuaries, barred to the sea by large calcareous sand dunes (Overheu et al. 1993).
The Mount Beaumont area, although somewhat similar in the level to gently undulating landscape, comprises a few gravelly rises and granite outcrops with a veneer of wind-borne sand deposited on the surface. Not only are most soils strongly calcareous in nature, dense, hardsetting, easily degraded, and often subtly salt-affected, but they also tend to occur in intense patterns or isolated groups, mixed (by natural or man-assisted means) with other soils.

The Mount Beaumont soils may have evolved through a number of distinct developmental phases (e.g. light fluffy, calcareous, saline material being blown from nearby salt lakes, and settling as a thin mantle over the soils; the shrinking and swelling of particular types of clays; the deposition of wind blown sand), which has caused great variability across a small range of soils. It is not unusual for some soils to be mistaken for better soils in the Salmon Gums area. (In many ways the northern portion of the Mount Beaumont area is very similar to the nearby lower Nullarbor Plain and it is possible that material contributed to or from the Nullarbor, may be similar to the material contributed to the soils of Mount Beaumont.)

All of this makes the Mount Beaumont area agriculturally significant, bearing in mind that the countryside may be difficult to manage. Drainage is slow, with water either ponding on a large plateau or slowly meandering over the landscape, eventually finding its way into the internally drained salt lake systems to the north.

The dominant land uses for the Esperance area are cereal cropping, sheep and cattle grazing, with a growing interest in blue gum agroforestry.

Land use around Mount Beaumont is limited by rainfall and is mainly wheat and sheep production.

Location of areas covered by these soil information sheets.
## Soil type summary

<table>
<thead>
<tr>
<th>Soil series</th>
<th>Soil group</th>
<th>Common name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beete</td>
<td>Calcareous loamy earth</td>
<td>Kopi, fluff</td>
<td>A loose and powdery (fluffy) surface over an alkaline, highly calcareous loam subsoil. Alkaline throughout and the subsoil is often high in salt.</td>
</tr>
<tr>
<td>Corinup</td>
<td>Pale deep sand</td>
<td>Deep sand</td>
<td>A deep fine sand, grey at the surface and grading to white then yellow.</td>
</tr>
<tr>
<td>Dowak</td>
<td>Hard cracking clay</td>
<td>Dowak clay loam</td>
<td>A grey-brown clay loam grading to clay, always associated with gilgai (crabhole) country.</td>
</tr>
<tr>
<td>Fleming (moderately deep gravel phase)</td>
<td>Grey deep sandy duplex</td>
<td>Fleming sand</td>
<td>A deep duplex with more than 30 cm of sand over a gravel layer over a slightly dispersive, yellowish brown to grey mottled clay layer by 80 cm.</td>
</tr>
<tr>
<td>Fleming (shallow gravel phase)</td>
<td>Grey deep sandy duplex</td>
<td>Fleming gravelly sand</td>
<td>A deep duplex with less than 30 cm of sand over a gravel layer over a clay subsoil within 30-80 cm.</td>
</tr>
<tr>
<td>Heart Echo</td>
<td>Pale deep sand</td>
<td>Deep mallee sand</td>
<td>A deep sand, grey at the surface, grading to white, and overlying yellowish sand.</td>
</tr>
<tr>
<td>Karlsberg</td>
<td>Alkaline grey shallow loamy duplex</td>
<td>Sandy loam over clay</td>
<td>A shallow sand over loam over clay. Similar to the kopi soil (Beete Series), but lacks a powdery surface and is heavier in texture.</td>
</tr>
<tr>
<td>Scaddan</td>
<td>Alkaline grey shallow sandy duplex</td>
<td>Scaddan sand</td>
<td>A light-surfaced duplex soil with alkaline, sodic and columnar subsoils. Often confused with the Circle Valley soil but the clay subsoil has a strongly domed, very hard surface.</td>
</tr>
<tr>
<td>Scaddan (degraded)</td>
<td>Alkaline grey shallow sandy duplex</td>
<td>Scaddan sandy loam</td>
<td>A hardsetting variant of Scaddan Series whose topsoil has been lost through wind erosion or mixed with subsoil material by cultivation.</td>
</tr>
</tbody>
</table>
Soil sheet glossary

**Acidic:** The soil has an acidic reaction or pH. The pH measured in a dilute solution of calcium chloride is less than 6.0. When a soil is strongly acidic (pH less than 4.5) there is a large increase in the solubility of aluminium in the soil, which can be toxic to plants.

**Alkaline:** The soil has an alkaline reaction or pH. The pH measured in dilute solution of calcium chloride is more than 7.0. An alkaline soil alters the availability of some nutrients for plant growth and will affect the growth of certain crops (e.g. narrow-leafed lupins). If a soil is strongly alkaline (pH more than 8.5) it can indicate unfavourable conditions for most plants.

**Australian Soil Classification:** A system developed by Ray Isbell (CSIRO Division of Soils) to classify Australian soils. This system is being adopted as a national standard.

**Bleached layer:** Subsurface soil that is white, near white or much paler than adjacent soil layers, caused by the leaching of soil minerals.

**Cracking clay:** Clay soils that develop vertical cracks when dry.

**Dispersion or clay dispersion:** The complete breakdown of aggregates into sand, silt and clay-sized particles when wet and usually occurs slowly, often taking hours to complete. The dispersed clay can block pores, reducing rainfall infiltration and gas exchange. A characteristic sign of dispersion is muddy or cloudy water, the cloudiness being dispersed clay in suspension.

Dispersion is a mainly chemical process that can occur in soils with low stability. Some soils disperse immediately on wetting, while others need an input of energy through raindrop impact, cultivation or stock trampling. Dispersive behaviour is largely governed by the exchangeable sodium percentage (ESP) and the electrolyte (salt) concentration. A straightforward test for dispersion is described in Farmnote No. 57/90.

**Duplex soil:** A soil that has an abrupt texture change between the topsoil and subsoil. The typical example is a sand over clay.

**EC or Electrical Conductivity:** A measure of soluble salts present in soil or water. For soils it is commonly the electrical conductivity of a soil-water suspension (1 part soil to 5 parts water). The unit of measurement is milliSiemens per metre (mS/m) and is rated as follows:

<table>
<thead>
<tr>
<th>EC (mS/m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20</td>
<td>very low salinity</td>
</tr>
<tr>
<td>21-40</td>
<td>low salinity</td>
</tr>
<tr>
<td>41-80</td>
<td>moderate salinity</td>
</tr>
<tr>
<td>81-160</td>
<td>high salinity</td>
</tr>
<tr>
<td>More than 161</td>
<td>very high salinity</td>
</tr>
</tbody>
</table>

MilliSiemens per metre can be converted to grains per gallon (gr/g) by multiplying the figure in mS/m by 0.385.

**Effective rooting depth:** Refers to the rooting depth of the soil in which plants may have an unimpeded path until an obstruction such as a dense layer of clay or rock is encountered. It is only approximate, as good subsoil structure may allow more root penetration.

**Erosion:** The wearing away of the land surface and removal of soil by running water, rain, wind, frost or other geological agents.
ESP: Abbreviation for Exchangeable Sodium Percentage. If a soil has an ESP between 6 and 14 it can be considered to be sodic, and above 15 strongly sodic. Soils that are sodic could suffer problems such as sealing and dispersion which affect plant growth and/or land use.

**Further information (Southern Region, Agriculture Western Australia)**

Soil Resource Officers:
- Esperance District Office (090) 831-111
- Albany Regional Office (098) 928-444

Land Conservation Officers:
- Esperance District Office (090) 831-111

Revegetation Officer:
- Katanning District Office (098) 213-333

Farming Systems Development Officers: All of the above

**Gilgai surface relief** (or crabhole country): Gilgais are irregular small depressions (20-60 cm deep) and mounds separated by level or gently sloping land. They are caused by soils with shrink-swell properties.

**Granite:** A coarse grained igneous rock, that underlies most of the landscape.

**Gravel:** Any coarse mineral material or fragments from 2 to 60 mm in diameter. These could be ironstone, quartz, other rock fragment or any concretions or nodules.

**Horizon:** A soil layer more or less parallel to the land surface which differs from the layers below and/or above it in properties such as colour, texture and structure.

**Landscape:** Part of an area of land that is characterised by processes of erosion, weathering, sedimentation, and movements in the earth’s crust. It includes all identifiable and measurable features such as climate, geology, soils and land use.

**Lime** (or calcium carbonate): Usually found in heavier soils that are alkaline. Lime can be present as soft segregations or nodules, or be finely mixed through the soil. The presence of lime can be detected with a simple test using dilute acid (1M hydrochloric). Drops of acid are placed on a clod of soil and if lime is present the soil effervesces immediately (i.e. bubbles of gas are released), due to the release of carbon dioxide.

**Map unit:** A representation of a soil or group of soils, that occurs within an area. A soil-landscape area is a topographic unit (e.g. low hills and rises or a level to gently undulating plain) that contains a series of common soil units. These units can be found on the corresponding soil-landscape map produced for the area.

**Mottles:** Patches of different colours, often red, brown, orange or blue-grey spots in a soil horizon. Mottles form when there are fluctuating watertables, therefore they often indicate periodic or seasonal waterlogging. However, some mottling in our soils is a carryover from when south-western Australia had a tropical climate. This is the same geological period as when most of the gravel and cemented ironstone also formed.

**Northcote PPF:** Stands for Principal Profile Form. It is a coded description of the soil derived by working through a diagnostic key developed by K. Northcote. An example may be Dy5.43 where D stands for Duplex; y stands for yellow and the numbers are further descriptions of soil characteristics. It is being replaced by the Australian Soil Classification.
Peds: Distinct structural features within the soil. Sand, silt, clay and iron minerals within a soil bind together to form aggregates having shapes such as columnar (described in the sheets as domed), prismatic, blocky or horizontally layered (platy). The spaces between the peds act as pathways for air, water and roots. The opposite to a structured soil is apedal or structureless.

**pH:** Measures the concentration of hydrogen ions in the soil. The pH is measured on a logarithmic scale (i.e. pH = negative logarithm of concentration of hydrogen ions). A soil with a pH of 5 contains 10 times as many hydrogen ions as a soil with a pH of 6.

Two systems are commonly used to measure pH, one in calcium chloride solution and the other in a soil:water suspension. As a general rule, to convert from pH\(_w\) to pH\(_{Ca}\), subtract 0.8, although the difference can range between 0.6 and 1.2, and in extreme cases from 0 to 2. In general, pH is of most concern when the soils are either strongly acid or strongly alkaline. Most of our soils are becoming more acid over time due to removal of agricultural produce (i.e. grain, hay, wool) and through the use of nitrogen fertilisers.

<table>
<thead>
<tr>
<th>Soil reaction</th>
<th>pH(_{Ca})</th>
<th>pH(_w)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly acid</td>
<td>Less than 4.5</td>
<td>Less than 5.5</td>
</tr>
<tr>
<td>Acid</td>
<td>4.5-6.0</td>
<td>5.5-6.5</td>
</tr>
<tr>
<td>Near neutral</td>
<td>6.0-6.5</td>
<td>6.5-7.5</td>
</tr>
<tr>
<td>Alkaline</td>
<td>6.5-7.5</td>
<td>7.5-8.5</td>
</tr>
<tr>
<td>Strongly alkaline</td>
<td>More than 7.5</td>
<td>More than 8.5</td>
</tr>
</tbody>
</table>

**Profile:** A soil profile is a vertical exposure of soil extending from the surface to the decomposing rock or other underlying consolidated material. It could be in a soil pit or an existing vertical exposure such as the side of a road cutting. The illustrations on the soil information sheets are examples of soil profiles.

**Relief:** The difference in elevation between the high and low points of a land surface.

**Salinity:** The presence of high concentrations of soluble salts in the soil. The dominant salt in WA soils is sodium chloride, but other salts such as sodium carbonate are sometimes present. High salinity adversely affects plant root growth and the ability of roots to extract water from the soil. It is estimated from the electrical conductivity of a mixture of soil and water.

**Segregations:** Gravels or other accumulations of material which occur in the soil. They are formed by the concentration of some constituent by chemical or biological action. ‘Ferruginous’ describes concentrations of iron.

**Slaking:** Slaking is the disintegration of aggregates (clods) into minute pieces when wet rapidly, because they cannot tolerate the stresses imposed by rapid water intake. Slaking causes the soil to slump and then it either sets hard on drying into a compact mass (hardset surface) or forms a surface crust. Slaking is a physical rather than a chemical process, compared with dispersion which is mainly chemical. It occurs in soils with weak structural development, particularly when the soil contains low organic matter.

**Slope:** An incline either upward or downward from the horizontal. Its angle is measured as a percentage. Observations span an area of about 20 m, so as to not be influenced too much by features of microrelief.
Sodicity: A measure of exchangeable sodium in the soil. Soils that are sodic have a high percentage of cation exchange sites occupied by sodium ions. Sodicity adversely affects the stability of the soil and increases the likelihood of the soil dispersing. Problems with sodic soils include difficult seedbed preparation, reduced rainfall infiltration, reduced seedling emergence and poor root growth in sodic subsoils.

Soil colour: A soil's colour can be determined by comparing the actual colour in the field with a small booklet called a Munsell Soil Colour Chart. This contains a set of standard (international) colour chips, not much different to an interior house paint guide. The use of the Munsell book means that the colour description will be exact so that "Scientist John in Sydney" can read a soil description, refer to his Munsell book and appreciate that exact colour. It also avoids approximate naming of the soil colour (e.g. a pinkish grey-brown).

Soil strength: Resistance to breaking or deformation. It is determined by the force just sufficient to break a 20 mm aggregate (or fragment of soil), when pressed between the thumb and forefinger. Strength is classed according to the force required:

- **Loose**: No force required e.g. sands.
- **Very weak**: Very slight force required.
- **Weak**: Small but significant force.
- **Firm**: Moderate to firm force.
- **Very firm**: Strong force but within the power of thumb and forefinger.
- **Strong**: Beyond the power of thumb and forefinger. Can be crushed underfoot on a hard flat surface with small force.
- **Very strong**: Crushed underfoot on hard flat surface with full body weight applied slowly.
- **Rigid**: Cannot be crushed underfoot by full body weight.

Structure: Describes the distinctness, size and shape of the soil aggregates or peds. The surface structure in many agricultural soils reflects recent management practices, especially the amount and frequency of cultivation. The soil aggregates are largely created by cultivation rather than being an inherent soil property. The soil structure described in these sheets therefore concentrates on subsoil structure which is an intrinsic soil property. Four soil structural forms or shapes are mentioned:

- **Columnar**: The soil aggregates or particles are arranged in a large column shape, with a well defined dome on the top. Often the dome has been cut off through cultivation. Sand seams are usually found extending down the soil profile between the columns. Columns can be composed of smaller peds.
- **Prismatic**: The soil particles are arranged in a large prism or triangular-like shape with well defined flat surfaces. Small sand seams often occur between the ped faces.
- **Blocky**: Soil particles are arranged in a near cubic or rectangular shape. Blocky structure can also be expressed as either angular blocky (adjoining faces are mostly angular) or subangular blocky (adjoining faces can be subrounded).
- **Polyhedral**: The soil aggregates are arranged in an approximately interlocking cubic shape, but the adjoining soil aggregates often have many sides and angles. The name is derived from Latin where poly means many and hedral means faces or sides. A soil layer with a polyhedral structure often appears to crumble when manipulated.

A moderate or strongly structured soil allows roots to grow through the soil even if the soil contains a large amount of clay. The exception is with 'domed' or columnar structured subsoils where the top of the clay layer is rounded into a distinct dome shape (more common in mallee soils). There is limited root growth into the domes and crop roots are essentially restricted to the sand seams between the clay columns.
**Subsoil:** Refers to a soil layer with certain properties, usually higher clay content and/or brighter colours, rather than a given depth. For instance, in ‘duplex’ soils the subsoil corresponds to the clay layer and the depth to this layer can vary from 10 to 80 cm.

**Surface condition:** Usually assessed when dry and separated into several groups:

- **Cracking**
  Deep cracks at least 5 mm wide in summer due to shrink-swell clay minerals.

- **Firm**
  Hard but can be indented by pressure of the forefinger.

- **Hardsetting**
  Soil is hard when dry. A pencil cannot easily be pushed into the surface. The artificial aggregates formed after tilling, slake when wetted rapidly and the soil mass slumps and sets very hard on drying. Hardsetting soils often become slippery and boggy when wet.

- **Loose to soft**
  Easily disturbed by pressure of the forefinger and does not hold together (e.g. loose sand).

- **Surface crust**
  Distinct layer ranging from a few millimetres to a few centimetres thick, which is hard when dry and can be easily separated from and lifted off the soil below. If the soil dries out during winter the crust becomes hard and obstructs seedling emergence, but underneath the crust the soil is usually moist and not hard.

**Texture:** A measure of the proportion of sand, silt and clay-sized particles in a soil. The coarsest soils are sands which contain less than 5% clay. Medium textures such as loam contain about 25% clay, and heavy clays have more than 50% clay. The ‘field’ (or hand) texture is a measure of the behaviour of a small handful of soil when moistened and kneaded into a ball and then pressed out between thumb and forefinger to form a ribbon. The behaviour of the soil during bolus formation and the ribbon length determine the field texture (also refer to TopCrop Soil field texture card). Soil texture is important because it affects water storage and erodibility, two very important soil properties in our Australian environment. It is also important in relation to other properties including water repellence, nutrient deficiencies, nutrient leaching, subsoil compaction and soil structure decline.

**Waterlogging:** Excess water in the root zone either present as a perched watertable or water ponded on the soil surface. The excess water inhibits gas exchange with the atmosphere, and as microbes use the available oxygen the soil becomes anaerobic (i.e. deficient in oxygen). The tolerance of crops and pastures to waterlogging varies considerably and also depends on the stage of crop growth. Prolonged waterlogging can reduce crop yields by more than 25%.

**Water repellence:** A condition which affects the wetting pattern of soils, especially sandy soils, and results in an uneven wetting pattern in autumn. In the paddock, patches of wet soil alternate with patches of dry soil which results in poor germination of crops and pasture. It is caused by the build-up of organic coatings on the sand grains. Water repellence can be demonstrated by a water droplet placed on the surface of a soil. If a soil is water repellent the water droplet will form a bead and not penetrate quickly.

**Weathering:** Weathering is the physical and chemical disintegration, alteration, and decomposition of rocks and minerals at or near the earth's surface by atmospheric and biological agents.

**Water availability:** Describes the amount of moisture in the soil that is available to be absorbed by plant roots.
Acknowledgments

The authors gratefully acknowledge all who assisted with the compilation of these soil sheets. In particular, we thank members and associates of the Mount Beaumont/West Howick Catchment Committee who allowed soil pits on their properties; the back hoe operator, Mr John Platt (Esperance Land Conservation District Committee Project Officer); staff of Agriculture Western Australia at Esperance and Perth, for reviewing the information; Western Australian Herbarium for plant identification; and the National Landcare Program for funding.

Further reading


Best way to use the sheets

1. Compare the field site with the landscape description on the soil information sheet.
   
   ✔ Go to step 2.

2. Dig a hole! Use the soil description and the representative photograph to determine whether the soil in the field matches the soil type illustrated on the sheet.
   
   If the soil matches the description and colour photograph, go to step 4.

   If the soil does *not* roughly resemble the soil description or the photograph, go to step 3.

   ✔

3. Record the site location and details and contact the nearest Agriculture Western Australia office with either a Soil Resource Officer or a Land Conservation Officer.

4. If the soil matches the description and colour photograph, refer to the reverse of the sheet for all land use information and management considerations for the soil.
   
   ✔

It is important to understand that:

- Because the scale of mapping for the Esperance and Mount Beaumont surveys is 1:50,000, it is possible that any one of the described soils could occur in a different landscape from that indicated and on the farm being planned without being delineated on the final soil-landscape map.

- Matching the soil information sheet to the actual field site does *not imply that they must be identical*, rather that they should be similar in most aspects.
Soil information sheet for Mallee area, Mount Beaumont

**Beete Soil Series**  
**Calcareous loamy earth**  
*(Kopi or fluff)*

This soil has a loose and powdery (fluffy) surface over an alkaline, highly calcareous loam subsoil. The profile is alkaline throughout and the subsoil is often high in salt.

**Occurrence:** Level to gently undulating landscapes of the mallee country around Mount Beaumont, Salmon Gums and Cascades. This soil is dominant, but commonly found in small patches mixed with other 'mallee-type' soils. Near salt lakes it is highly saline, and is the predominant component in crabhole country. The soil may cover the landscape as a mantle.

**Native vegetation:** Combines mallee and scrub. Common species are giant mallee (*Eucalyptus oleosa*), ironbark (*E. indurata*) and broombush (*Melaleuca uncinata*).

**Soil profile description**

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>Light brown to grey-brown sandy loam; powdery surface, some carbonate fragments; alkaline (pHw 8.0); clear boundary.</td>
</tr>
<tr>
<td>10-20</td>
<td>Dark yellowish brown loam to clay loam; 20-50% carbonate concretions; strongly alkaline (pHw 9.0).</td>
</tr>
<tr>
<td>20-100</td>
<td>Pink gravelly clay loam; large amounts of carbonate cemented in places; strongly alkaline (pHw 9.5); abrupt boundary.</td>
</tr>
<tr>
<td>100-145</td>
<td>Light yellowish brown with olive coloured mottles; light to light-medium clay; prismatic structure; alkaline (pHw 7.0-8.5).</td>
</tr>
</tbody>
</table>

**Characteristic soil properties**
- Alkaline and calcareous throughout
- Highly saline below 20 cm (EC more than 200 mS/m)
- Effective rooting depth about 20 cm
- Sodic below 20 cm
- Fluffy, puffy soil material throughout
- Water repellent topsoil

**Soil classification**

Australian Soil Classification: **Ephipsodic Regolithic Supracalcic Calcarosol**

Northcote PPF: **Gc1.12**

Map unit: Soil 3 on Mount Beaumont map, S3 on Esperance map sheets, Sc3 on Condingup soil-landscape sheets and Bg on Salmon Gums survey

Compiled by Tim Overheu, Brendan Nicholas and Paula Needham  
Natural Resources Assessment Group, Agriculture Western Australia, 1996
## Agricultural land use and management

**Beete Soil Series**

**Calcareous loamy earth**

*(Kopi or fluff)*

Generally, this soil yields poorly as it is highly alkaline, inhibiting nutrient availability. It should be maintained under natural vegetation, or if cleared, planted to salt-tolerant fodder shrubs and grazed in rotation.

### Crops

This soil is marginal (sometimes unsuitable) for cereals. Boron toxicity, subsoil salinity and high alkalinity are limiting factors. Boron toxicity is more significant in dry years. Barley is more suitable than wheat as it tolerates higher alkalinity and poor drainage. The recommended variety is Skiff. It is unsuitable for grain legumes such as lupins or peas because of the alkalinity and risk of wind erosion.

### Trees

Suitable trees are limited by low rainfall, alkalinity and salinity, and the dense carbonate nodular, calcareous subsoil. When cleared, natural revegetation is very slow, exposing the soil to degradation. Volunteer native saltbushes are often the first coloniser plants.

### Annual pastures

Barrel medics are marginally suitable. Sub. clovers or other medics are unlikely to perform well.

### Perennial pastures

Bluebush and salt-tolerant shrubs grow well and may provide autumn grazing for sheep, but the soil is unsuitable for traditional pastures. Bluebush is preferred because it regenerates freely.

### Favourable qualities

Well drained, good workability, no risk of soil acidification.

### Soil characteristics and land conservation

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dams &amp; catchments</strong></td>
<td>Unsuitable for roaded catchments.</td>
</tr>
<tr>
<td><strong>pH</strong></td>
<td>Alkaline; prone to nutrient unavailability.</td>
</tr>
<tr>
<td><strong>Salinity</strong></td>
<td>High risk. Contains considerable salt at shallow depth. Land quality at any site varies depending on salt concentration and alkalinity.</td>
</tr>
<tr>
<td><strong>Structural decline</strong></td>
<td>Trampling by sheep results in severe breakdown.</td>
</tr>
<tr>
<td><strong>Water availability</strong></td>
<td>Moderate.</td>
</tr>
<tr>
<td><strong>Water erosion</strong></td>
<td>Low risk, although the surface can become slippery after rain.</td>
</tr>
<tr>
<td><strong>Water repellence</strong></td>
<td>Moderate; topsoil often contributes to water repellence.</td>
</tr>
<tr>
<td><strong>Waterlogging</strong></td>
<td>Usually low, but can be severe in some areas.</td>
</tr>
<tr>
<td><strong>Wind erosion</strong></td>
<td>High risk; exposed areas blow easily. Some concern that fluffy, salt-laden material is being deposited across the landscape. May affect surrounding soils.</td>
</tr>
<tr>
<td><strong>Workability</strong></td>
<td>Good, although dense carbonate nodules and calcareous material may cause problems.</td>
</tr>
</tbody>
</table>
Soil information sheet for the Esperance Sandplain

**Corinup Soil Series**

This is a deep fine sand, grey at the surface and grading to white then yellow.

**Occurrence:** The Corinup soil is very common over the Esperance and adjacent south coastal areas. It occurs as dunes and deep sand sheets on the sandplain, often associated with Fleming sand (moderately deep sand over ironstone gravel).

**Native vegetation:** Typical vegetation includes showy banksia (*Banksia speciosa*), Christmas tree (*Nuytsia floribunda*) and coastal jugflower (*Adenanthes cuneatus*).

**Soil profile description**

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12</td>
<td>Dark grey fine sand; water repellent; acidic (pHw 6.0); very low salinity; clear boundary.</td>
</tr>
<tr>
<td>12-65</td>
<td>Pale brown (bleached) fine sand; acidic (pHw 6.5); very low salinity; gradual boundary.</td>
</tr>
<tr>
<td>65-120</td>
<td>Brownish yellow fine sand; near neutral (pHw 7.0); very low salinity; gradual boundary.</td>
</tr>
<tr>
<td>120-150</td>
<td>Yellow clayey fine sand, with white mottles; near neutral (pHw 7.0); very low salinity.</td>
</tr>
</tbody>
</table>

**Characteristic soil properties**

- Fine sand throughout
- Slightly acidic topsoil over neutral subsoil
- Well drained
- Nutrient leaching
- Effective rooting depth exceeds 2 m

**Soil classification**

- **Australian Soil Classification:** Basic Arenic Bleached-Orthic Tenosol
- **Northcote PPF:** Uc2.21
- **Map unit:** G3a-d, Y2, E3a-h on Esperance region soil-landscape, Es3 and Co3 on Condingup

Compiled by Tim Overheu, Brendan Nicholas and Paula Needham
Natural Resources Assessment Group, Agriculture Western Australia, 1996
**Agricultural land use and management**

**Corinup Soil Series**

**Pale deep sand**

*(Deep sand)*

Nutrient status is low. Suitable for cereal/lupin rotations using minimum till and stubble retention, or revegetated with trees for shelter belts or agroforestry.

**Crops:** This is a very versatile soil and with reasonable annual rainfall, high yields can be obtained using high fertiliser input. The most appropriate crops are cereals rotated with lupins. Other options include barley, canola and oats. Stubble retention systems are essential to maintain ground cover. Minimum tillage and/or direct drilling are recommended with occasional deep ripping to alleviate subsoil compaction. If water repellence develops, it may be necessary to seed with press wheels.

**Trees:** Blue gums *(Eucalyptus globulus)* or *Pinus radiata* can be grown commercially in areas receiving 500 mm of rainfall. Rooting depth is good but saline groundwater at 200 cm will affect growth in some places.

**Annual pastures:** Sub. clover grows with difficulty. Serradella is an alternative.

**Perennial pastures:** A mix of serradella and veldt grass provides the best long-term option. Lucerne is suitable but insects are a problem. Other options include phalaris, fescue or brumby perennial ryegrass. Console lovegrass, tagasaste and Rhodes grass have potential.

**Favourable qualities**

Well drained, unlikely to waterlog, easy to cultivate, and good volume of subsoil for root development.

**Soil characteristics and land conservation**

<table>
<thead>
<tr>
<th>Dams &amp; Catchments</th>
<th>Flat batter dams are a viable option but only when clay is within 90 cm of the surface. Not suitable for roaded catchments.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH</strong></td>
<td>The slightly acidic pH is within the tolerable range for most recommended cereals. This is not affecting plant growth, but will increase after longer agricultural production.</td>
</tr>
<tr>
<td><strong>Salinity</strong></td>
<td>Very low, except in areas with shallow saline groundwater.</td>
</tr>
<tr>
<td><strong>Structural Decline</strong></td>
<td>Low risk.</td>
</tr>
<tr>
<td><strong>Water Availability</strong></td>
<td>Low. Water draining through this soil can add significantly to groundwater recharge.</td>
</tr>
<tr>
<td><strong>Water Erosion</strong></td>
<td>Generally unlikely, however will occur if saturated and experiencing surface flow (e.g. along drainage lines in wet year).</td>
</tr>
<tr>
<td><strong>Water Repellence</strong></td>
<td>Moderate risk. May become a problem, especially if legumes are grown.</td>
</tr>
<tr>
<td><strong>Waterlogging</strong></td>
<td>Low risk. This is a free-draining soil in which waterlogging is unusual.</td>
</tr>
<tr>
<td><strong>Wind Erosion</strong></td>
<td>High risk. Surface cover must be maintained as wind erosion can be extreme due to the loose, fine sandy topsoil.</td>
</tr>
<tr>
<td><strong>Workability</strong></td>
<td>Good. Compacted layers may form between 15 and 30 cm because of cultivation. Deep ripping may be an option (not generally recommended).</td>
</tr>
</tbody>
</table>
Soil information sheet for Mallee area, Mount Beaumont

Dowak Soil Series

This is a grey-brown clay loam grading to clay, always associated with gilgai (crabhole) country.

Occurrence: One of the dominant soils in gilgai (crabhole) depressions on level to gently undulating plains. Usually associated with other soils especially Beete (kopi or fluff) which covers 50% of the crabhole area. Other clay soils with a self-mulching surface (Clyde Hill Series) may replace Dowak at the bottom of crabholes.

Native vegetation: In virgin or remnant bush, most plants (especially Melaleuca species) grow in the crabhole depressions. Dowak soil carries mallees and open shrubs including cap-fruited mallee (Eucalyptus dielsii), Port Lincoln mallee (E. conglobata) and tea-tree (Melaleuca preissiana).

Soil profile description

Depth (cm)

<table>
<thead>
<tr>
<th>Depth</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Dark grey sandy clay loam; crumb structure; cracking surface; acidic (pH, 6.5).</td>
</tr>
<tr>
<td>5-10</td>
<td>Light brownish grey clay loam with brown mottles; strongly prismatic structure; acidic (pH, 6.5).</td>
</tr>
<tr>
<td>10-65</td>
<td>Grey and brown sandy light medium clay; light brownish grey mottles; deep cracks 1-2 cm wide, strong columnar structure parting into coarse blocky structure, becoming structureless with depth; acidic (pH, 6.5).</td>
</tr>
</tbody>
</table>

Characteristic soil properties

- High shrink and swell characteristics
- Always associated with crabholes
- Waterlogging can occur at any time
- Surface often deeply cracked
- Effective rooting depth depends on salinity

Soil classification

Australian Soil Classification: Episodic Massive Grey Vertosol
Northcote PPF: Gm4.52
Map unit: Soil 4 on the Mount Beaumont soil map, Do4 at Salmon Gums

Compiled by Tim Overheu, Brendan Nicholas and Paula Needham
Natural Resources Assessment Group, Agriculture Western Australia, 1996
Agricultural land use and management

**Dowak Soil Series**

**Hard cracking clay**

**(Dowak clay loam)**

This is a difficult soil whose best use is for pasture that tolerates heavy soil and waterlogging.

**Crops:** Although it is unwise to cultivate crabhole country, various crops can be grown. The more saline phases may not perform at all. It is important to check pH before selecting crops as it varies through mixing with nearby alkaline soils. Wheat, barley, peas, canola and faba beans are suitable, but do not perform well in wet conditions. Direct drilling when the soil is moist is necessary to maintain soil structure and associated benefits.

**Trees:** Waterlogging, heavy texture and shallow rooting depth limit the choice of suitable trees. This soil is suited to a large variety of *Melaleuca* species.

**Annual pastures:** Acid-tolerant medics such as burr medics, and sub. clover can be grown on the slightly acidic phases. Barrel medics are better suited to alkaline soils.

**Perennial pastures:** Low rainfall and the heavy texture reduce the number of suitable pasture varieties. Tall wheat grass may succeed and puccinellia and saltwater couch suit salt-affected areas. Palaris may grow in crabhole areas unsuitable for cropping.

**Favourable qualities**

Good workability, low risk of soil acidification, good production potential in average rainfall years.

**Soil characteristics and land conservation**

<table>
<thead>
<tr>
<th>Dams &amp; catchments</th>
<th>Marginal for dam construction. Building suitable catchments is difficult in crabhole country.</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>Low risk.</td>
</tr>
<tr>
<td>Salinity</td>
<td>Moderate to high risk. Frequently associated with waterlogging.</td>
</tr>
<tr>
<td>Structural decline</td>
<td>Sometimes called a ‘Sunday soil’. Excessive or inappropriate cultivation at the wrong moisture state will damage surface structure reducing infiltration. The surface is self-mulching and as such will be prone to temporary crusting but may eventually regenerate when worked under optimal conditions. Becomes slippery when wet.</td>
</tr>
<tr>
<td>Water availability</td>
<td>Moderate, as the clay holds water tightly.</td>
</tr>
<tr>
<td>Water erosion</td>
<td>Moderate risk. Possible on sloping land, especially if the surface is hard or sealed.</td>
</tr>
<tr>
<td>Water repellence</td>
<td>Low.</td>
</tr>
<tr>
<td>Waterlogging</td>
<td>Tends to become waterlogged after every rain storm.</td>
</tr>
<tr>
<td>Wind erosion</td>
<td>Low risk, except on the fluffy-surfaced crabhole soils.</td>
</tr>
<tr>
<td>Workability</td>
<td>Fair. Cultivating over crabholes is generally not recommended because of the degradation of structure, especially if the crabholes are deep or the surface sets hard. Soils may respond to gypsum.</td>
</tr>
</tbody>
</table>


Soil information sheet for the Esperance Sandplain area

**Fleming Soil Series**
*(moderately deep gravel phase)*

**Grey deep sandy duplex**
*(Fleming sand)*

This is a deeper gravelly duplex with the depth of sand overlying the gravel layer between 30 and 80 cm. A slightly dispersive, yellowish brown to grey mottled clay layer underlies the gravel.

**Occurrence:** Occupies about 30% of the lower Esperance area and many landforms across the Esperance and south coastal sandplain, in association with either Fleming shallow gravelly phase or Corinup deep sand. Usually found on level to gently undulating areas, where the relief is extremely low (less than 9 m) and slope to 5%.

**Native vegetation:** Dominant vegetation is blue mallee *(Eucalyptus tetragona)*, chittick *(Lambertia inermis)* and Christmas tree *(Nuytsia floribunda)* with dense low heath.

**Soil profile description**

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>Greyish brown fine sand; acidic <em>(pH₆ 6.5)</em>.</td>
</tr>
<tr>
<td>10-55</td>
<td>Light grey (bleached) fine sand; near neutral <em>(pH₆ 7.0)</em>.</td>
</tr>
<tr>
<td>55-65</td>
<td>Light yellowish brown (bleached) sand with more than 50% ironstone gravel; alkaline <em>(pH₆ 7.5)</em>.</td>
</tr>
<tr>
<td>65-140</td>
<td>Light yellowish brown sandy clay; slightly dispersive; prominent medium grey mottles and a few small soft ironstone gravels; alkaline <em>(pH₆ 7.5)</em>.</td>
</tr>
</tbody>
</table>

**Characteristic soil properties**

- Gravel can often occur as a thin layer less than 20 cm over the clay
- Topsoil may become acidic with time
- Effective rooting depth is 30 to 80 cm
- Slightly acidic topsoil grading to neutral in the subsoil
- Topsoil can become water repellent

**Soil classification**

**Australian Soil Classification:** *Ferric Mottled-Subnatric Yellow Sodosol*

**Northcote PPF:** *Dy5.82*

**Map unit:** E2a-f on the soil-landscape map of the Esperance Region

Compiled by Tim Overheu, Brendan Nicholas and Paula Needham

Natural Resources Assessment Group, Agriculture Western Australia, 1996
Agricultural land use and management

**Fleming Soil Series**

*(moderately deep gravel phase)*

This is a versatile and productive soil with a moderately deep layer of sand over clay. However, all nutrients leach from these deep sands, especially potash. A cropping rotation using minimum tillage and stubble retention would be suitable.

**Crops:** The best options are lupin/wheat or wheat/pasture rotations. Barley, oats and canola can also be grown on these soils. Peas are not suitable because of the high risk of wind erosion. It is necessary to maintain stubble in multiple cropping operations and advisable to use direct drilling or minimum tillage.

**Trees:** Blue gums (*Eucalyptus globulus*) may be planted for shelter but not for high production because of the limited depth of sand over clay and possible high watertables.

**Annual pastures:** Subterranean clover is the best choice.

**Perennial pastures:** A mix of serradella and veldt grass provides the best long-term option. Lucerne dislikes waterlogging and may not be suitable in some of these soils. Other options include phalaris, fescue, brumby and perennial rye grass. Console lovegrass and Rhodes grass have potential.

**Favourable qualities**

Good nutrient availability within the rooting zone (except for potash), good workability, good production potential.

**Soil characteristics and land conservation**

<table>
<thead>
<tr>
<th>Dams &amp; catchments</th>
<th>Suitable for dam construction. Flat batter dams are a viable option. Catchments are expensive due to depth of overburden.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH</strong></td>
<td>Not limiting to plant growth at present, but could become a concern in time.</td>
</tr>
<tr>
<td><strong>Salinity</strong></td>
<td>Low risk, although can be a problem in low lying areas.</td>
</tr>
<tr>
<td><strong>Structural decline</strong></td>
<td>Low, because of the sandy surface. The subsoil clay is slightly dispersive, and could cause problems if brought to the surface.</td>
</tr>
<tr>
<td><strong>Water availability</strong></td>
<td>Low water-holding capacity because of the light textured sandy topsoil, but availability can be higher on level ground, where run-on water is received.</td>
</tr>
<tr>
<td><strong>Water erosion</strong></td>
<td>Low risk. Increases where soils are saturated and receive large volumes of water from upslope.</td>
</tr>
<tr>
<td><strong>Water repellence</strong></td>
<td>Moderate risk, especially if legumes are used in the rotation.</td>
</tr>
<tr>
<td><strong>Waterlogging</strong></td>
<td>Generally well drained but depends on the depth of sand and gravel over the clay. If sand and gravel layers are shallow, waterlogging may occur (see Fleming gravelly sand).</td>
</tr>
<tr>
<td><strong>Wind erosion</strong></td>
<td>High risk, so the surface must be protected at all times.</td>
</tr>
<tr>
<td><strong>Workability</strong></td>
<td>Good.</td>
</tr>
</tbody>
</table>

(Fleming sand)
Soil information sheet for the Esperance Sandplain area

Fleming Soil Series
(shallow gravel phase)

Grey deep sandy duplex
(Fleming gravelly sand)

This is a deep duplex soil with less than 30 cm of sand over a gravel layer over a clay subsoil.

Occurrence: On a wide range of landforms across the Esperance and south coastal sandplain. It occupies about 50% of the lower Esperance area usually on level to gently undulating sandplain where the relief is extremely low (less than 9 m) and the slope is less than 5%.

Native vegetation: Dominant vegetation comprises blue mallee (Eucalyptus tetragona) and ridge-fruited mallee (E. incrassata) with dense low heath including Dryandra and Melaleuca species. Where the soil is associated with shallow rock outcrops, vegetation will include square-fruited mallee (E. tetraptera) and one-sided bottlebrush (Calothamnus quadrifidus).

Soil profile description

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-10</td>
<td>Dark greyish brown, water repellent loamy fine sand; acidic (pHw 6.5).</td>
</tr>
<tr>
<td>10-20</td>
<td>Light grey fine sandy gravel (over 50% ironstone gravel); near neutral (pHw 7.0).</td>
</tr>
<tr>
<td>20-60</td>
<td>Light yellowish brown sandy gravel (over 50% ironstone gravel); near neutral (pHw 7.0).</td>
</tr>
<tr>
<td>60-140+</td>
<td>Light yellowish brown slightly cemented sandy clay; grey mottles and a few soft gravels; structureless; near neutral (pHw 7.0).</td>
</tr>
</tbody>
</table>

Characteristic soil properties

- Fine surface sand
- 'Shallow' means the depth of sand over gravel, not the depth over clay
- Effective rooting depth is 60 cm
- pH is neutral throughout but often slightly acidic at the surface

Soil classification

Australian Soil Classification: Ferric Mottled-Submatric Yellow Sodosol
Northcote PPF: Dy5.82
Map units: E1a-f on Esperance region soil-landscape, E51 on the Condingup soil-landscape map

Compiled by Tim Overheu, Brendan Nicholas and Paula Needham
Natural Resources Assessment Group, Agriculture Western Australia, 1996
Agricultural land use and management

**Fleming Soil Series**
*(shallow gravel phase)*

**Grey deep sandy duplex**
*(Fleming gravelly sand)*

The most suitable land use is determined by the depth of sand to the clay. If the sand is deep, the soil will behave more like a Fleming moderately deep gravel or a Corinup sand. If the sand is shallow, waterlogging may limit options.

**Crops:** Cereals grow well on sites free of waterlogging. Cereal/pasture rotations using minimum tillage, or continuous pasture may be suitable. Lupins, wheat and canola are suitable on well drained soil. If prone to waterlogging, avoid wheat and lupins, and crop barley or oats infrequently. Stubble retention is necessary in multiple cropping, and direct drilling or minimum tillage should be adopted.

**Trees:** May not grow well because of restricted rooting depth and risk of waterlogging.

**Annual pastures:** If poorly drained, it is necessary to plant Balansa or sub. clovers such as Trikkala which tolerate waterlogging. Serradella is an option if the soil is well drained.

**Perennial pastures:** Serradella and veldt grass are options for well drained sites. On poorly drained areas, pastures such as phalaris, fescue, brumby, perennial rye or tall wheat grass will tolerate the waterlogging.

**Favourable qualities**
Reasonably good nutrient availability, good soil workability.

**Soil characteristics and land conservation**

<table>
<thead>
<tr>
<th>Dams &amp; catchments</th>
<th>Suitable for dam construction. Flat batter dams are a viable option.</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>Could become a problem, but not yet affecting plant growth. High risk of surface or topsoil acidification so monitoring is required.</td>
</tr>
<tr>
<td>Salinity</td>
<td>Low to moderate risk, although risk can increase over low lying areas associated with waterlogging.</td>
</tr>
<tr>
<td>Structural decline</td>
<td>Low risk.</td>
</tr>
<tr>
<td>Water availability</td>
<td>Low to moderate water-holding capacity.</td>
</tr>
<tr>
<td>Water erosion</td>
<td>Moderate risk; may occur on sloping sites if the sand layer is shallow and becomes saturated.</td>
</tr>
<tr>
<td>Water repellence</td>
<td>High; topsoil can become strongly water repellent.</td>
</tr>
<tr>
<td>Waterlogging</td>
<td>Moderate to high risk. Unless on a sloping site, drainage may be a problem because of the depth to clay.</td>
</tr>
<tr>
<td>Wind erosion</td>
<td>High risk, unless there is more than 50% gravel on the surface.</td>
</tr>
<tr>
<td>Workability</td>
<td>Good.</td>
</tr>
</tbody>
</table>


Soil information sheet for Mallee area, Mount Beaumont

**Heart Echo Soil Series**

*Pale deep sand*  
*(Deep mallee sand)*

This is a deep sand, grey at the surface, grading to white, and overlying yellowish brown sand.

**Occurrence:** Not very widespread but occurs in association with other moderately deep duplex soils, dunes or lunettes. In the Mount Beaumont area it occurs only on low sand dunes in the east.

**Native vegetation:** Open shrub and mallee including ridge-fruited mallee (*Eucalyptus incrassata*), blue mallee (*E. tetragona*), narrow-leaf mallee (*E. angulosa*) and southern plains banksia (*Banksia media*).

**Soil profile description**

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-10</td>
<td>Light yellowish brown water repellent sand; near neutral (pH$_w$ 7.0).</td>
</tr>
<tr>
<td>10-60</td>
<td>Light grey sand; near neutral (pH$_w$ 7.0).</td>
</tr>
<tr>
<td>60-150</td>
<td>Yellowish brown fine sand; near neutral (pH$_w$ 7.0).</td>
</tr>
</tbody>
</table>

**Characteristic soil properties**

- Fine sand throughout
- Effective rooting depth over 2 m
- Neutral to slightly acidic pH
- Topsoil can become water repellent

**Soil classification**

- **Australian Soil Classification:** Basic Arenic Bleached-Orthic Tenosol
- **Northcote PPF:** Uc2.21
- **Map unit:** Soil 1 on Mount Beaumont map, S5 on Esperance Region, Hess on Salmon Gums survey

Compiled by Tim Overheu, Brendan Nicholas and Paula Needham  
Natural Resources Assessment Group, Agriculture Western Australia, 1996
Agricultural land use and management

Heart Echo Soil Series

Pale deep sand
(Deep mallee sand)

The soil is very low in nutrients, particularly potash.

Crops: Wheat, barley and lupins are suitable using minimum tillage and stubble retention. It is necessary to direct drill in order to maintain surface stability and reduce wind erosion during establishment. Stubble retention is essential.

Forage crops: Tagasaste and lucerne may provide alternatives.

Annual pastures: Sub. clover is suitable, provided surface potash levels are above 65 ppm. On land that is marginal for potash, early maturing serradella is an alternative.

Perennial pastures: Lack of rainfall over the upper Mount Beaumont area and the light soil reduce the number of suitable perennial pasture varieties. Couch, perennial veldt grass and sheep’s burnet may be appropriate on uncropped areas. Tagasaste may persist where the deep sands are moist.

Favourable qualities
Moderately well to well drained; good aeration and volume of soil for root development.

Soil characteristics and land conservation

<table>
<thead>
<tr>
<th>Dams &amp; catchments</th>
<th>Suited for dams and catchments but limited due to expense of removing overburden. In salt lake areas limited by shallow depth to groundwater.</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>Surface acidification could become a problem.</td>
</tr>
<tr>
<td>Salinity</td>
<td>Very low, except on dunes surrounding salt lakes.</td>
</tr>
<tr>
<td>Structural decline</td>
<td>Low risk.</td>
</tr>
<tr>
<td>Water availability</td>
<td>Limited by sandy nature. Recharge to the groundwater is high.</td>
</tr>
<tr>
<td>Water erosion</td>
<td>Low risk, but will erode if saturated.</td>
</tr>
<tr>
<td>Water repellence</td>
<td>Moderate risk, especially if legumes are included in the rotation.</td>
</tr>
<tr>
<td>Waterlogging</td>
<td>Very low risk, as soil drains rapidly.</td>
</tr>
<tr>
<td>Wind erosion</td>
<td>High risk. Susceptible where surface vegetation has been removed.</td>
</tr>
<tr>
<td>Workability</td>
<td>Good. Compacted layers can be a problem at 15 to 30 cm depth. Can be alleviated by deep ripping.</td>
</tr>
</tbody>
</table>
Karlsberg Soil Series  Alkaline grey shallow loamy duplex (Sandy loam over clay)

This is a shallow sand over loam over clay. It is similar to the kopii soil (Beete Series), but lacks a powdery surface and is heavier in texture. The sandy topsoil is shallow and sometimes absent. The subsoil contains high percentages of carbonate, and in some areas loose limestone rubble litters the surface.

Occurrence: Widespread, but does not cover large areas on its own. Most common in isolated patches in close association with two other mallee soils - Beete and Scaddan. Intergrades between these soils are common.

Native vegetation: Open scrub and mallee including hook-leaved mallee (Eucalyptus uncinata), Hopetoun mallee (E. leptocalyx), redwood (E. transcontinentalis) and shrubs of Melaleuca pentagona, tangling melaleuca (M. cardiophylla) and broombush (M. uncinata).

Soil profile description

Depth (cm) | Description
---|---
0-10 | Dark greyish brown sandy loam; blocky structure often with surface crust; alkaline (pHw 8.5).
10-30 | Brown sandy clay; columnar structure; strongly alkaline (pHw 9.0).
30-145 | Brownish yellow gravelly light clay; large amounts of carbonate concretions and powdered carbonate; strongly alkaline (pHw 10.0).
145-160 | Yellow and brown mottled clay; prismatic structure; alkaline (pHw 8.0).

Characteristic soil properties

- Alkaline throughout
- Highly saline below 30 cm (EC more than 200 mS/m)
- Rooting depth of crops is about 10 cm
- Moderate salinity to 30 cm
- Sodic and dispersive below 30 cm
- Surface can become hardsetting after cultivation

Soil classification

Australian Soil Classification: Epihypersodic Pedal Supracalcic Calcarosol
Northcote PPF: Dy4.13
Map unit: Soil 5 on the Mount Beaumont soil map

Compiled by Tim Overheu, Brendan Nicholas and Paula Needham
Natural Resources Assessment Group, Agriculture Western Australia, 1996
Agricultural land use and management

**Karlsberg Soil Series**  
*Alkaline grey shallow loamy duplex*  
*(Sandy loam over clay)*

The soil is prone to severe surface crusting and sealing, hindering infiltration and aeration. If handled in the right way it responds with relatively high yields.

Crops: High carbonate, high subsoil alkalinity, boron toxicity and surface salinity limit yields. Possible crops include wheat, barley and peas. Care must be taken to avoid wind erosion on pea stubbles. Lupins are unsuitable because of soil alkalinity and shallow rooting depth. Direct drilling is advisable in order to maintain soil structure. Suited to cereal/alternative legume or cereal/pasture rotations.

**Annual pastures:** Barrel medic is most suited because of high soil pH.

**Perennial pastures:** Lack of rainfall over the upper Mount Beaumont area and heavy soil reduce suitable perennial pastures. Tall wheat grass may be possible. Where the soil is damp or moist through summer and seasonally waterlogged in winter, tall wheat grass, perennial veldt grass, phalaris and possibly lucerne may be appropriate. In salt-affected areas, puccinellia and saltwater couch are suitable.

**Favourable qualities**
Moderately well drained, no risk of soil acidification.

**Soil characteristics and land conservation**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dams &amp; catchments</td>
<td>Dams and catchments are constructed with difficulty. This soil is unsuitable for roaded catchments because of its high carbonate content.</td>
</tr>
<tr>
<td>pH</td>
<td>Not prone to acidification.</td>
</tr>
<tr>
<td>Salinity</td>
<td>High risk. Contains more surface salt than Beete soils to the north. Salinity is a risk in degraded areas.</td>
</tr>
<tr>
<td>Structural decline</td>
<td>Moderate to high risk. Dispersive clays often come to the surface during clearing and cultivation causing structural decline once the sandy layer is incorporated into the subsoil. Minimum tillage is necessary and the soil must not be worked when wet.</td>
</tr>
<tr>
<td>Water availability</td>
<td>Moderate depending on the condition.</td>
</tr>
<tr>
<td>Water erosion</td>
<td>Low to moderate risk. If the dispersive subsoils are exposed at the surface reducing water infiltration, erosion may be a hazard on sloping land.</td>
</tr>
<tr>
<td>Water repellence</td>
<td>Low risk. Not prone to water repellence.</td>
</tr>
<tr>
<td>Waterlogging</td>
<td>Where cultivation has not brought clay to the surface, the soil can be moderately well drained. Waterlogging and boggy conditions occur frequently where dispersive clay has surfaced, clogging soil and reducing infiltration.</td>
</tr>
<tr>
<td>Wind erosion</td>
<td>Low risk. The thin sandy surface is erodible but frequently has been mixed with the subsoil reducing risks.</td>
</tr>
<tr>
<td>Workability</td>
<td>Fair to poor. If cultivated when wet, a hardsetting topsoil will develop.</td>
</tr>
</tbody>
</table>
Soil information sheet for Mallee area, Mount Beaumont

**Scaddan Soil Series**

**Alkaline grey shallow sandy duplex**

*(Scaddan sand)*

This is a light-surfaced duplex soil with alkaline, sodic and domed subsoils. It is often confused with the Circle Valley soil in the Salmon Gums area but the clay subsoil has a strongly domed, very hard surface.

**Occurrence:** Widely distributed over the mallee areas of the South Coast. In the Mount Beaumont area it is common in drainage lines and often associated with Beete and Karlsberg soils.

**Native vegetation:** Changes with depth of fine sand over the domed clay layer. The deeper the fine sand, the sparser the vegetation. Mallee and open shrubs such as Alexander River mallee (*Eucalyptus micranthera*), Hopetoun mallee (*E. leptocalyx*), hook-leaved mallee (*E. uncinata*), tangling melaleuca (*Melaleuca cardiophylla*) and *M. pentagona* are typical.

**Soil profile description**

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Grey fine sand, slightly crusted; near neutral (pHw 7.0); abrupt boundary.</td>
</tr>
<tr>
<td>5-10</td>
<td>Light brownish grey (fine) sand; near neutral (pHw 7.0); wavy boundary.</td>
</tr>
<tr>
<td>10-20</td>
<td>Yellowish brown sandy clay loam; columnar structure; strongly alkaline (pHw 9.0); tongues of sand from upper layer between domes of clay; clear boundary.</td>
</tr>
<tr>
<td>20-50</td>
<td>Pale olive light clay; blocky structure; calcareous nodules; alkaline (pHw 8.5); gradual boundary.</td>
</tr>
<tr>
<td>50-150</td>
<td>Brown and olive mottled clay; prismatic structure; many small calcareous nodules; alkaline (pHw 8.0).</td>
</tr>
</tbody>
</table>

**Characteristic soil properties**

- Low salinity above 20 cm
- Sodic subsoil below 20 cm (ESP 10 to 30)
- Moderately saline below 20 cm (EC 75 mS/m)

- Effective rooting depth is 10 to 30 cm depending on sand thickness. Roots can exploit sand-filled cracks between domes of clay

**Soil classification**

**Australian Soil Classification:** *Supracalcic Hyperamorphic Yellow Sodosol*

**Northcote PPF:** Dy4.43

**Map unit:** Soil 6 on Mount Beaumont soil map, S1 on Esperance sheets, Sc1 on Condingup, ScS on Salmon Gums survey

Compiled by Tim Overheu, Brendan Nicholas and Paula Needham
Natural Resources Assessment Group, Agriculture Western Australia, 1996
Agricultural land use and management

**Scaddan Soil Series**  
**Alkaline grey shallow sandy duplex**  
*(Scaddan sand)*

This soil has high production potential in a good year with adequate rainfall. Nutrient availability is low because of soil alkalinity.

**Crops:** Suitable for cereal/canola/pasture rotation using minimum tillage and stubble retention. Peas should be avoided because of the risk of wind erosion. It is possible to grow lupins on the deeper areas, but the sand must be at least 25 cm deep. Reduced tillage is recommended to reduce risk of wind erosion.

**Trees:** Various trees and shrubs suit this soil. Factors to consider are depth to clay, waterlogging and subsoil pH.

**Annual pastures:** Acid-tolerant medics such as burr medic are suitable, or sub. clover.

**Perennial pastures:** Low rainfall reduces the number of suitable varieties. Where the soil is moist in summer, tall wheat grass, perennial veldt grass, phalaris, Rhodes grass and possibly lucerne may be appropriate. In salt-affected areas, puccinellia and saltwater couch are suitable.

**Favourable qualities**
Moderately well drained, good workability, low risk of soil acidification, high production potential in a good year.

**Soil characteristics and land conservation**

<table>
<thead>
<tr>
<th><strong>Dams &amp; catchments</strong></th>
<th>Dams are effective and hold water well. Shallow country is ideal for roaded catchments. Shallow scraped catchments with minimal subsoil disturbance are best. Take care not to disturb deeper layers which contain carbonate, especially during catchment maintenance.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH</strong></td>
<td>Very low risk of acidification.</td>
</tr>
<tr>
<td><strong>Salinity</strong></td>
<td>Moderate to high. Subsoil salinity is a problem, and low-lying, waterlogged areas may show effects.</td>
</tr>
<tr>
<td><strong>Structural decline</strong></td>
<td>Prone to surface structural decline due to mixing topsoil and subsoil. When topsoil clay content is above 10%, hardsetting develops causing problems with water infiltration and workability.</td>
</tr>
<tr>
<td><strong>Water availability</strong></td>
<td>Moderate. Varies with the depth of sand over the clay.</td>
</tr>
<tr>
<td><strong>Water erosion</strong></td>
<td>High risk in sloping areas.</td>
</tr>
<tr>
<td><strong>Water repellence</strong></td>
<td>Moderate. The sandy topsoil can be water repellent.</td>
</tr>
<tr>
<td><strong>Waterlogging</strong></td>
<td>Widespread over all areas.</td>
</tr>
<tr>
<td><strong>Wind erosion</strong></td>
<td>High risk. The sandy surface is prone to erosion as it is generally too shallow to protect the highly dispersive clayey subsoil.</td>
</tr>
<tr>
<td><strong>Workability</strong></td>
<td>Good, due to the light sandy topsoil.</td>
</tr>
</tbody>
</table>
Soil information sheet for Mallee area, Mount Beaumont

**Scaddan Soil Series**  
*(degraded form)*  

**Alkaline grey shallow loamy duplex**  
*(Scaddan sandy loam)*

This is a hardsetting variant of Scaddan Series, known locally as dog shit clay. The topsoil has been lost through wind erosion or mixed with subsoil material by cultivation. This has changed the hazards and opportunities in managing this soil.

**Occurrence:** This soil is the result of past farming practices during the development of the mallee area. The history of wind erosion and cultivation determines the level of degradation of the original Scaddan sand. It occurs in the farmed area of the mallee, usually in association with Scaddan sand and Beete soils.

**Native vegetation:** Fuchsia mallee (*Eucalyptus forrestiana*) is common, also hook-leaved mallee (*E. uncinata*), with a characteristic understorey of melaleuca species. *Melaleuca cardiophylla* (tangling melaleuca) and *M. pentagona* are common.

**Soil profile description**

<table>
<thead>
<tr>
<th>Depth (cm)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15</td>
<td>Very dark greyish brown sandy loam; massive structure; firm consistence; neutral (pH<em>₇</em>5) modified by cultivation; non-saline, EC 14 mS/m; sharp boundary.</td>
</tr>
<tr>
<td>15-24</td>
<td>Light grey light medium clay; massive structure; very firm consistence; alkaline (pH<em>₉</em>0); slightly saline, EC 50 mS/m; gradual boundary.</td>
</tr>
<tr>
<td>24-40</td>
<td>Pale yellow light medium clay; non-calcareous; massive structure; very firm consistence; few fine calcareous segregations; alkaline (pH<em>₉</em>5); saline, EC 108 mS/m; gradual boundary.</td>
</tr>
<tr>
<td>40-100</td>
<td>Pale yellow light medium clay; highly calcareous; polyhedral structure; very firm consistence; common medium calcareous segregations; alkaline (pH<em>₉</em>5); saline, EC 170 mS/m.</td>
</tr>
</tbody>
</table>

**Characteristic soil properties**

- Low salinity above 20 cm  
- Moderately saline and increasing below 20 cm  
- Hardsetting topsoil  
- Clayey sand to sandy loam topsoil

**Soil classification**

- **Australian Soil Classification:** Supracalcic Hypernatric Yellow Sodosol  
- **Northcote PPF:** Dg 1.1  
- **Map unit:** Occurs across the Scaddan and Cascade Systems

Compiled by Brendan Nicholas, Tim Overheu and Paula Needham  
Natural Resources Assessment Group, Agriculture Western Australia, 1996
Agricultural land use and management

**Scaddan Soil Series**  
*Alkaline grey shallow loamy duplex*  
*(degraded form)*

(degraded form)

Scaddan sandy loam

Magnesium and zinc availability is low because of soil alkalinity. Crop establishment and emergence can be hindered by hardsetting topsoils.

**Crops:** Wheat, barley and canola are successful. Field peas and faba beans can also be grown due to low wind erosion risk. Reduced tillage is recommended to reduce risk of structural decline. Soil moisture available to plants is low which can affect grain-filling on a tight finish to the season.

**Trees:** Various trees and shrubs suit this soil.

**Annual pastures:** Medic varieties such as Caliph, Santiago, Orion and Circle Valley are suitable.

**Perennial pastures:** Low rainfall reduces the number of suitable varieties. Where the soil is moist in summer, tall wheat grass, perennial veldt grass, phalaris, Rhodes grass and possibly lucerne may be appropriate. In salt-affected areas, puccinellia and saltwater couch are suitable.

**Favourable qualities**
Moderately well drained (but prone to waterlogging); low wind erosion risk.

**Soil characteristics and land conservation**

<table>
<thead>
<tr>
<th>Dams &amp; catchments</th>
<th>Dams are effective and hold water well. Shallow country is ideal for roaded catchments. Take care not to disturb deeper layers which contain carbonate. Earthworks will erode on sloping ground.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>pH</strong></td>
<td>Alkaline throughout; very low acidification risk.</td>
</tr>
<tr>
<td><strong>Salinity</strong></td>
<td>Low in topsoil, high in subsoil.</td>
</tr>
<tr>
<td><strong>Structural decline</strong></td>
<td>Prone to surface structural decline due to mixing of topsoil and subsoil resulting in sodic topsoils. When topsoil clay content is above 10% a hardsetting surface develops causing problems with water infiltration and workability. Responds to gypsum. Stubble retention is important to maintain organic matter in topsoil.</td>
</tr>
<tr>
<td><strong>Water availability</strong></td>
<td>Moderate.</td>
</tr>
<tr>
<td><strong>Water erosion</strong></td>
<td>High risk in sloping areas.</td>
</tr>
<tr>
<td><strong>Water repellence</strong></td>
<td>Low. The clayey sand/sandy loam topsoil is not repellent.</td>
</tr>
<tr>
<td><strong>Waterlogging</strong></td>
<td>Likely in level areas after large rainfall events.</td>
</tr>
<tr>
<td><strong>Wind erosion</strong></td>
<td>Low risk.</td>
</tr>
<tr>
<td><strong>Workability</strong></td>
<td>Moderate to poor, depending on topsoil clay content and degree of hardsetting. The soil can only be worked over a narrow moisture range. This led to the term ‘Sunday country’ as the soil is too wet on Saturday and too dry by Monday.</td>
</tr>
</tbody>
</table>