2. LAND CAPABILITY ASSESSMENT

2.1 Philosophy and principles

Land capability assessment is a method of determining if a land area can sustain a specific use and level of management without causing any long-term degradation.

The objectives of land capability assessments are:

1. to assist land managers and land use planners to identify areas of land with physical constraints for a range of nominated land uses;

2. to identify management requirements that will ensure a particular land use can be sustained without causing on-site or off-site degradation to land or water quality.

To achieve these objectives it is necessary to know the natural characteristics of the land and understand the effects, both on-site and off-site, that the proposed land use may have on the land itself and the water derived from it.

Land capability assessments provide the means of analysing basic land information and identifying the effect of natural land characteristics on the ability of the land to maintain the desired level of production. The strength and usefulness of the methodology lies in its association with land systems since the results can be extrapolated, with care, to similar land components and land systems in other areas of the State.

'A land system is an area of land, distinct from the surrounding terrain, that has a specific climatic range, parent material and landform pattern. These features are expressed as a recurring sequence of land components.' Land system mapping is generally at a scale of 1:100 000 or 1:250 000 and is appropriate for large scale planning exercises, such as regional planning.

'A land component is an area of land, distinct from adjacent components because of specific slope, soil, aspect and/or vegetation characteristics'. A land capability mapping unit may be the same as a land component, however, a larger mapping scale may allow land components to be divided into distinct areas based on more specific soil and topographical characteristics.

The ratings provided by a land capability assessment are not intended to restrict development of land, but rather to identify the principle constraints of that land for a specified land use. It is a matter for the land manager or land-use planner to decide if the cost of overcoming the constraints is justified. Where particularly severe physical constraints exist, it may be necessary to ensure that proposed developments are only permitted subject to compliance with conditions relating to the management of that land. It should be stressed that the imposing of such conditions on development permits is quite a proper exercise of planning responsibility.

2.2 Land resource mapping - methodology and constraints

Mapping an area of land can be a complex task as many differences arise due to interactions between climate, geology and topography. While it is possible to measure and determine some of the land characteristics such as slope, rock outcrop, and soil type, other characteristics such as site drainage, and permeability are less easily determined.

The main objective of land resource mapping is to identify areas of land that are uniform with respect to the land characteristics which affect land use. These areas of land have a similar land use capability and are likely to respond in a similar way to management. By mapping areas of land with a limited range of variability the resultant map provides the basis for land capability assessment.

The following procedure has been adopted by the Land and Catchment Protection Branch as standard practice in land capability studies.

1. The geological boundaries are obtained from existing maps and verified in the field at the appropriate mapping scale.

2. The broad landform pattern and then the landform elements, which usually correspond to the final mapping units, are identified from air-photos using a binocular stereoscope. This forms the basis of the land system/land component concept.

3. Extensive field work ensures that the map units are consistent with respect to parent material, slope, position in the landscape, soil type, drainage and native vegetation.

4. A representative site for each map unit is selected, preferably one that has original native vegetation and/or an undisturbed soil profile. The incidence of any land degradation in each map unit is recorded.

5. From a soil pit or large exposure of the soil profile at each selected site, a detailed soil profile description is recorded. Colour photographs are taken and soil samples collected for the purpose of physical and chemical analyses (see Appendix 2 and the corresponding tables for each Map Unit in Section 4.2 for details).

6. The permeability of the soil profiles is measured during the winter-spring months when the soils are near field capacity, using the double ring infiltration method (see Appendix 3).

7. The map unit boundaries are carefully drawn onto a clear sheet and scanned into a Geographic Information System where the data is combined with base-map information on roads, contours and streams to produce a final map of the Shire with appropriate headings and legend.

8. Land capability ratings for those land uses relevant to the Shire are then derived from the climatic, land and soil data available for each map unit. Separate land capability assessment maps are prepared for up to 5 different land uses.

9. The accompanying report includes a 2-page data summary for each map unit as well as a description of the physical features of the Shire and some guidelines on land management.

2.3 Assessment

A land capability rating table lists land characteristics such as slope, site drainage or soil depth which may affect the ability of the land to support a specified activity. These land characteristics are then quantified and graded into five classes for the land use being assessed and each map unit within the study area is given a capability rating according to the tables shown in Section 2.4.

It is the most limiting factor that determines the "Capability Class", which can then be related to the degree of limitation for that land use and the general level of management that will be required to minimise degradation (Table 1.1).

Table 1.1 Land Capability classes

Capability Class		Degree of Limitation to Development	General Description and Management Guidelines
1	(Very good)	The limitations of long term instability, engineering difficulties or erosion hazards do not occur or they are very slight.	Areas with high capability for the proposed use. Standard designs and installation techniques, normal site preparation and management should be satisfactory to minimise the impact of the environment.
2	(Good)	Slight limitations are present in the form of engineering difficulties and/or erosion hazard.	Areas capable of being used for the proposed use. Careful planning and the use of standard specifications for site preparation, construction and follow-up management should minimise development impact of the environment.
3	(Fair)	Moderate engineering difficulties and/or moderately high erosion hazard exist during construction.	Areas with fair capability for the proposed use. Specialised designs and techniques are required to minimise development impact of the environment.
4	(Poor)	Considerable engineering difficulties during development and/or a high erosion hazard exists during and after construction.	Areas with poor capability for proposed use. Extensively modified design and installation techniques, exceptionally careful site preparation and management are necessary to minimise the impact on the environment.
5	(Very poor)	Long-term, severe instability, erosion hazards or engineering difficulties which cannot be practically overcome with current technology.	Areas with very poor capability for the proposed use. Severe deterioration of the environment will probably occur if development is attempted in these areas.

A capability class of one represents no restraints to the proposed land use whilst class five indicates a very low capability to sustain the land use, that is, limitations exceed the current level of management skills and technology available and severe deterioration of the environment is likely to occur if development is attempted.

2.4 Land Capability Rating Tables

In this report a simplistic approach to land capability assessment has been adopted, for example, each rating table has the following structure:

I. the criteria which directly influence land use are identified,

II. the level of management required to sustain the land use without degradation of the soil or environment, is specified, and

III. class limits are assigned to each criterion ranging from no limitation (Class 1) to extreme limitations (Class 5).

There has been no attempt to rank the criteria in order of importance since the objective of having class ratings is to identify the kind of limitation and its severity. It is fully recognised that there will be reinforcing and counteracting influences, complete independence and "shades of grey", but an unwritten objective of this study is to provide the information in a usable form rather than have a convoluted series of alternative pathways that would be too complex for the intended user to follow.

Where there are known interactions between different criteria, they are discussed and the possible results outlined, however it is the responsibility of the planner or land manager to assess the importance of the limiting factor(s) and whether improved management or additional financial input can reduce or overcome the limitation. For example, a plough-pan at 20 cm depth may cause an area to be rated as Class 4 for cereal production, but the landholder may be prepared to deep-rip and incorporate lime and organic matter because the increased level of production will continue for many years, making the higher level of management economical. Alternatively, a lateritic hardpan at 40 cm depth would be a more difficult limitation to overcome and an alternative land use to cropping might need to be considered.

A single land quality could be found and used to rate land performance, but there is the risk of such a feature masking the true parameters that affect the land use, thus preventing a change to a more appropriate land use or level of management. Land use and land management practices will continue to change and if the community is concerned about long-term sustainability of specific land uses, then the limitations of the soil, the various processes of land degradation and the possibility of off-site effects, must be recognised. Once a limitation to land use is identified, steps can be taken to overcome or minimise the long-term degradation effects that would result if the land use was continued.

Table 2.1 Land Capability Assessment for Agriculture

Land is assessed for agricultural production on the basis of climate, topography and the inherent characteristics of the soil. It is a general assessment that identifies, above all, the versatility and potential productivity of an area for a wide range of crops and pastures. It is assumed that commonly-used management practices will occur, particularly in relation to cultivation and fertiliser application. Supplementary water applications are not anticipated.

January 1993

Parameters influencing agricultural production	Land capability ratings				
	Class 1	Class 2	Class 3	Class 4	Class 5
CLIMATE: Length of growing season* (months)	12 - 11	10-8	7 - 5	4 - 2	< 2
TOPOGRAPHY: Slope (%)	< 1	1 - 3	4 - 10	11 - 32	> 32
SOIL: Topsoil condition *	25 - 21	20 - 16	15 - 11	10-6	5 - 1
Depth of topsoil (cm)	> 30	30 - 16	15 - 11	10 - 5	< 5
Depth to rock/hardpan (m)	> 2.0	2.0 - 1.5	1.5 - 1.0	1.0 - 0.5	< 0.5
Depth to seasonal watertable (m)	> 5.0	5.0 - 2.0	2.0 - 1.5	1.5 - 1.0	< 1.0
Total amount of water (mm) available to plants	> 200	200 - 151	150 - 101	100 - 51	< 50
Index of permeability/rainfall*	Very high	High	Moderate	Low	Very low
Dispersibility of topsoil (Emerson)*	E6	E5, E4	E3.4, E3.3	E3.2, E3.1,E2	El
Linear Shrinkage	0 - 6	7 - 12	13 - 17	18 - 22	> 22
Gravel/stone/boulder content (% v/v)	0	1 - 10	11 - 25	26 - 50	> 50
Electrical conductivity (us cm-1) *	< 300	300 - 600	600 - 1400	1400 - 3500	> 3500
Susceptibility to sheet/rill/erosion *	Very low	Low	Moderate	High	Very high
Susceptibility to gully erosion*	Very low	Low	Moderate	High	Very high
Susceptibility to erosion by wind *	Very low	Low	Moderate	High	Very high

* See Appendix **1**

NB: The potential agricultural productivity of an area can thus be classified by the CTS criteria (Climate, Topography and Soil) e.g. the 'ideal' prime agricultural areas would be denoted by $C_1T_1S_1$ compared with another area that had, for example, a 5-7 month growing season, slopes of 3% and a depth to rock/hardpan of only 0.7 m, denoted by $C_3T_2S_4$.

Table 2.2 Land Capability Assessment for On-site Effluent Disposal

Areas capable of absorbing effluent from a standard, anaerobic, all waste, septic tank connected to a single family dwelling (approximate output of 1000 litres per day) by means of

I. absorption trenches
II. transpiration beds

November 1992

Parameters influencing agricultural production	Land capability ratings				
	Class 1	**Class 2**	**Class 3**	**Class 4**	**Class 5**
1. Slope (%)*	< 3	3 - 10	11 - 20	21 - 32	> 32
2. Flooding risk*	Nil	Low	Moderate		High
3. Drainage	Rapidly drained	Well drained	Moderately well drained	Imperfectly drained	Poorly – very poorly drained
4. Depth to seasonal watertable (m)	> 2.0	2.0 - 1.5	1.5 - 1.0	1.0 - 0.5	< 0.5
5. Depth to hard rock/impermeable layer (m)	> 1.5	1.0 - 1.5	1.0 - 0.75	0.75 - 0.5	< 0.5
6. No. of months/year when Av. Daily rainfall > K_{sat}	0	1	2	3	> 3
7. Permeability (K_{sat}. mm/d)	> 500**	500 - 100	100 - 50	50 - 10	< 10+

+ 10 mm/day - to disposing of 1000 l/d along a 0.5 x 200 m trench
* See Appendix 1
** Permeabilities > 1000 mm/d could pollute groundwaters

Table 2.3 Land Capability Assessment for Building Foundations

Areas capable of being used for the construction of buildings of one or two stories. It is assumed that any excavation will be less than 1.5 m and can be completed by a tractor-backhoe or equipment of similar capacity. Two methods of construction are considered:

I. Concrete slab - 100 m thick and reinforced
II. Stumps or strip footings

November 1992

Parameters influencing agricultural production	Land capability ratings				
	Class 1	Class 2	Class 3	Class 4	Class 5
Slope (%) i) ii)	0-1 0-5	2-5 6-10	6-10 11 -30	11 -30 30-45	> 30 > 45
Drainage*	Rapidly drained	Well drained	Moderately well drained	Imperfectly drained	Poorly – very poorly drained
Depth of seasonal watertable (m)	> 5	5 - 2	2 - 1	1 - 0.5	< 0.5
Proportion of stones & boulders v/v%	0	1 - 10	11 - 20	21 - 50	> 50
Depth to hard rock (m)	> 1.5	1.5 - 0.75	0.75 - 0.51	0.5 - 0.25	< 0.25
Susceptibility to slope failure *	Very low	Low	Moderate	High	Very high
Linear shrinkage (%) i) ii)	< 12 <6	13 -17 7-12	18 – 22 13-17	22 – 30 18-22	> 30 >22
Bearing capacity (kpa)	> 50		< 50		

Table 2.4 Land Capability Assessment for Earthen Dams

This table should only be considered for small farm dams 5 3000 m3 in capacity which have a top water level < 3 m above the original ground surface at the upstream side of the wall.

November 1992

Parameters influencing agricultural production	Land capability ratings				
	Class 1	Class 2	Class 3	Class 4	Class 5
Slope (%)*	3-7	0-3	7-10	10-20	>20
Linear shrinkage (%)	0 - 5	6 - 12	13 - 17	18 - 22	> 22
Depth of clay layer*	> 2.0	2.0 - 1.5	1.5 - 1.0	1.0 - 0.5	< 0.5
Depth to seasonal watertable (m)	> 5	5 - 4	4 - 3	3 - 2	< 2
Depth to hard rock (m)	> 5	5 - 4	3-2	2 - 1	< 1
Permeability (K_{sat} mm/d)	< 1	1 - 10	11 - 100	101 - 1000	>1000
Dispersibility of subsoil Emerson (1977)	E3	E4	E5	E2	El, E6
Susceptibility to slope failure*	Very low	Low	Moderate	High	Very high

* See Appendix 1

The following criteria were considered but have not been included for reasons given in Appendix 1.

Criteria not included:

Rock outcrop*

Depth of topsoil* Flooding risk*

Unified Soil Group*