2. LAND CAPABILITY ASSESSMENT

2.1 Philosophy and principles

Land capability assessment is a rational and systematic examination of the ability of land to sustain a specific use and the level of management required to prevent significant long-term degradation.

The objectives of land capability assessments are:

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

ii) to identify management requirements that will ensure a particular land use can be sustained without causing significant 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 that the proposed land use may have on the land itself and the water derived from it.

Land capability assessments provide a means of analysing basic land information and identifying the effect of natural land characteristics on the ability of the land to sustain a desired land use. A strength 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.

2.2 Land resource mapping - methodology and constraints

The main objective of land resource mapping is to identify and describe areas of land that are uniform with respect to the characteristics that affect land use. These areas will have a similar capability for a nominated use and are likely to respond in a similar way to management. By identifying areas of land with a limited range of variability, the resultant map provides the basis for land capability assessment (for specific methodologies, refer Appendix C).

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 following procedure was adopted for this study:

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

ii) The broad landform pattern and the landform elements are identified from air-photos using a binocular stereoscope. The map units are derived from this information.

iii) Extensive field verification of map units to ensure that map units are consistent with respect to parent material, slope, position in the landscape, soil type, drainage and native vegetation.

iv) A representative site for each map unit was 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.

v) A detailed soil profile description was recorded from a soil pit or large exposure of the soil profile at each selected site. Colour photographs are taken and soil samples collected for physical and chemical analyses (see Appendix D and the corresponding tables for each Map Unit in Section 4.2 for details).

vi) The permeability of the soil profile was measured when the soils were near field capacity (see Appendix C).

vii) The map unit boundaries are entered into the Department's Geographic Information System where the data is combined with base-map information on roads, contours and streams to produce a final base map of the study area with appropriate headings and legend.

viii) 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 based on standardised rating tables. Separate land capability assessment maps are prepared for a specified number of different land uses.

ix) The report includes a data summary for each map unit as well as a description of the physical features of the study area and some guidelines on land management.

2.3 Assessment Procedure

A land capability rating table lists key 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 quantified and graded into classes from Class 1 to Class 5, for the land use being assessed. 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 for the map unit. This is related to the degree of limitation for that land use and the general level of management that will be required to minimise degradation.

A Capability Class of One represents essentially no physical limitations to the proposed land use whilst a Class of Five indicates essentially prohibitive limitations to sustain the land use. Limitations in Class Five generally exceed the current level of management skills and technology available, and severe deterioration of the environment is likely to occur if development is attempted. Classes Two, Three or Four will require increasing levels of management to sustain the particular land use, otherwise the desired level of land performance will not be achieved and/or the environment will deteriorate (Tables 2.1 and 2.2).

2.4 Land Capability Rating Tables

Each land capability rating table (refer Tables 2.3, 2.4, 2.5, 2.6) contains criteria that will strongly influence the ability of the land to sustain the desired land use. The limitations distinguishing each Land Capability Class are also presented for comparison.

There has been no attempt to rank the criteria in order of importance. The objective of having class ratings is to identify the kind of limitation and its severity. It is recognised that criteria may interact, but an underlying objective of this study is to provide the information in a usable form, rather than have a convoluted series of alternative pathways that may 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.

Theoretically, a single diagnostic 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 form 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 effect of land degradation that would result if the land use was continued.

Table 2.1 Land Capability Classes for Effluent Disposal, Farm Dams and Building Foundations.

CLASS	CAPABILITY	DEGREE OF LIMITATION TO DEVELOPMENT	GENERAL DESCRIPTIONS AND MANAGEMENT GUIDELINES
Class 1	Very good	The limitation of long term instability, engineering difficulties, or erosion hazards does not occur, or they are very slight.	Areas with a very high capability for the proposed use. Standard designs and installation techniques, and normal site preparation and management, should be satisfactory to minimise the impact on the environment.
Class 2	Good	Slight limitations are present in the form of engineering difficulties and/or erosion hazard.	Areas with a high capability for the proposed use. Careful planning and the use of standard specifications for site preparation, construction and follow up management are necessary to minimise the impact of the development on the environment.
Class 3	Fair	Moderate engineering difficulties and/or moderately high erosion hazard exist during construction.	Areas with a fair capability for the proposed use. Specialised designs and techniques are required to minimise the impact of the development on the environment.
Class 4	Poor	Considerable engineering difficulties during development and/or a high erosion hazard exists, during and after construction.	Areas with a poor capability for the proposed use. Extensively modified design and installation techniques and exceptionally careful site preparation and management, are necessary to minimise the impact of the development on the environment.
Class 5	Very Poor	Long term severe instability, erosion hazards, or engineering difficulties exist which cannot be practically overcome with current technology.	Performance of the land for the proposed use is likely to be unsatisfactory. Severe deterioration of the environment will occur if development is attempted in these areas.

Table 2.2 Land Capability Classes for Agriculture

Land is assessed for agricultural production on the basis of climate, topography, and the inherent characteristics of the soil. Climate differs from topography and soil features in that it is a regional parameter rather than site specific. The assessment identifies the versatility and potential productivity of an area for a range of agricultural uses, and its ability to support disturbance such as various levels of cultivation.

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CLASS	CAPABILITY	DEGREE OF LIMITATION
Class 1	Very good	Can sustain a wide range of uses including an intensive cropping regime. Very high levels of production possible with standard management levels.
Class 2	Good	Moderate limitations to agricultural productivity, overcome by readily available management practices.
Class 3	Fair	Can sustain agricultural uses with low to moderate levels of land disturbance such as broadacre cultivation in rotation with improved pastures. Moderate to high levels of production possible with specialist management practices such as minimum tillage.
Class 4	Poor	Low capacity to resist land disturbance such as cultivation. Recommended for low disturbance agriculture such as grazing or perennial horticulture. Moderate production levels possible with specialist management such as improved pasture establishment with minimum tillage techniques.
Class 5	Very poor	Very low capability to resist disturbance. Minimal grazing levels or non-agricultural uses recommended. Areas of low productive capacity.

Note: These agricultural ratings are for comparative purposes only and should not be used as a basis for detailed property planning.

Table 2.3 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).

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PARAMETERS INFLUENCING EFFLUENT DISPOSAL	LAND CAPABILITY RATINGS				
	Class 1	**Class 2**	**Class 3**	**Class 4**	**Class 5**
Slope (%)*	< 3	3 - 10	11 - 20	21 - 32	> 32
Flooding risk*	Nil	Low	Moderate	High	Very High
Drainage*	Rapidly drained	Well drained	Moderately drained	Imperfectly drained	Poorly/Very poorly drained
Depth to seasonal watertable (m)	> 2.0	2.0 - 1.5	1.5 - 1.0	1.0 - 0.5	< 0.5
Depth to hard rock/impermeable layer (m)	> 1.5	1.0 - 1.5	1.0 - 0.75	0.75 - 0.5	< 0.5
No. of months/year when average daily rainfall > K_{sat}*	0	1	2	3	> 3
Permeability (K_{sat} mm/d)*	> 500**	500 - 100	100 - 50	50 - 10	< 10

Note: 10 mm/day is equivalent to disposing of 1000 l/d along a 0.5 x 200 m trench

* See Appendix A

** Permeabilities > 1000 mm/d could pollute groundwaters

Table 2.4 Land capability assessment for earthen dams

This table should only be considered for small farm dams to 1000 m^3 in capacity, that have a top water level less than 3 m above the original ground surface at the upstream side of the wall.

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PARAMETERS INFLUENCING THE CONSTRUCTION OF EARTHEN DAMS	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
Suitability of subsoil*	Very high	High	Moderate	Low	Very low
Depth to seasonal watertable (m)	> 5		5 - 2		< 2
Depth to hard rock (m)	> 5	5 - 3	3 - 2	2 - 1	< 1
Permeability (Ksat mm/d) *,***	< 1	1 - 10	11 - 100	101 - 1000	> 1000
Susceptibility to slope failure	Very low	Low	Moderate	High	Very high

Note: Rock outcrop, depth of top soil and flooding risk were also considered but have not been included for reasons given in Appendix A. Dispersibility of subsoil has not been included as it is only limiting when associated with other parameters such as linear shrinkage and permeability.

* See Appendix A

** If there is a high linear shrinkage but a low dispersion, increase rating by one class

*** As the subsoil is compacted during the construction of a dam, the permeability is affected by the dispersion characteristics of the soil. Therefore, when there is an Emerson class of 1, 2 or 3, the permeability rating is upgraded 1 class. When the Emerson class is a 5 or 6 it remains the same.

Table 2.5 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 mm thick and reinforced

ii) Stumps or strip footings

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PARAMETERS INFLUENCING BUILDING FOUNDATIONS	LAND CAPABILITY RATINGS				
	Class 1	**Class 2**	**Class 3**	**Class 4**	**Class 5**
Slope (%) i) Slab ii) Stumps/footings	 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 drained
Depth to 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 hardrock (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) Slab ii) Stumps/footings	 <12 <6	 13 - 17 7 - 12	 18 - 22 13 - 17	 22 - 30 18 - 22	 >30 >22
Flood risk	Nil	Low	Moderate	Moderate/high	High

* See Appendix A

Table 2.6 Land capability assessment for agriculture

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PARAMETERS INFLUENCING AGRICULTURAL PRODUCTION		LAND CAPABILITY RATINGS				
		Class 1	**Class 2**	**Class 3**	**Class 4**	**Class 5**
C : Climate	Length of growing season (months)	12 - 9	8 - 7	6 - 5	4 - 2	< 2
T : Topography	Slope (%)	1 - 3	4 - 1 0	11 - 20	21 - 32	> 32
S : Soil	Topsoil condition*	25 - 21	20 - 16	15 - 11	10 - 6	5 - 1
	Depth of topsoil (mm)**	> 300	300 - 151	150 - 101	100 - 50	< 50
	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 - 0
	Index of permeability/rainfall*	Very high	High	Moderate	Low	Very low
	Dispersibility of topsoil (Emerson)*	E6	E3.1, E3.2, E4, E5	E3.3 E3.4	E2	E1
	Gravel/stone/boulder content (v/v %) ***	0	1 - 10	11 - 25	26 - 50	> 50
	Electrical conductivity (µS 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 wind erosion*	Very low	Low	Moderate	High	Very high

* See Appendix A

** If it is a gradational or uniform soil, use depth to subsoil

*** If the gravel content in the subsoil is the limiting feature, and the topsoil is greater than 300 mm and has less than 15% gravel, upgrade by one grade

Note: The potential agricultural productivity of land is generally classified by the CTS criteria (Climate, Topography and Soil); e.g. the 'ideal' agricultural areas would be denoted by C_1 T_1 S_1 compared with another area that had, for example, a 5-6 month growing season, slopes of 3% and a depth to rock/hardpan of only 0.7 m, denoted by C_3 T_1 S_4. The overall Land Capability Class would be 4; with soil factors being the major limiting features.