



Rural Land

CAPABILITY MAPPING

SCALE 1:100 000

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As part of a basic inventory of the rural lands of New South Wales, land capability maps of the Eastern and Central Divisions are being prepared by the Soil Conservation Service. These maps will form an integral part of the natural resources information required for land use planning within the State.

THE CLASSIFICATION SYSTEM

The land capability classification used in this series of 1:100 000 scale maps is the standard eight-class system used by the Soil Conservation Service of New South Wales for evaluating rural land. It is based on an assessment of the biophysical characteristics of the land, the extent to which these will limit a particular type of land use, and the current technology that is available for the management of land. The classification also incorporates an assessment of the soil erosion hazards, with emphasis on a 'safe' level of land use, thus avoiding environmental problems caused by soil erosion and sedimentation. The capability classes categorise the land in terms of its general limitations. Specific numerical values for individual

limitations such as climate, slope gradient, landform types, adverse soil conditions, rock outcrop, drainage and inundation and productivity of crops etc. are not given. Instead, the classification outlines the types of land uses appropriate for a particular area of land and the types of land management practices needed to prevent soil erosion and maintain the productivity of the land. Definitions of the eight classes, together with the interpretations and implications appearing on the map legend are shown in Table 1. A complete description of each land capability class and the criteria used appears in Appendix 1.

Map Scale

Map scale is 1:100 000, i.e. 1 cm length is equivalent to 1000 m or 1 km distance. 1 cm² is equivalent in area to 100 ha.

Map Sheet

Each map sheet corresponds to the standard 1:100 000 topographic series of maps produced by the Division of National Mapping or the Royal Australian Survey Corps and available from the Division of National Mapping.

Table 1 Land Capability Map Legend

LAND CLASSIFICATION AND SOIL CONSERVATION PRACTICES		INTERPRETATIONS AND IMPLICATIONS		
SUITABLE FOR REGULAR CULTIVATION	I	No special soil conservation works or practices.	Land suitable for a wide variety of uses. Where soils are fertile, this is land with the highest potential for agriculture, and may be cultivated for vegetable and fruit production, cereal and other grain crops, energy crops, fodder and forage crops, and sugar cane in specific areas. Includes "prime agricultural land".	
	II	Soil conservation practices such as strip cropping, conservation tillage and adequate crop rotation.	Usually gently sloping land suitable for a wide variety of agricultural uses. Has a high potential for production of crops on fertile soils similar to Class I, but increasing limitations to production due to site conditions. Includes "prime agricultural land".	
	III	Structural soil conservation works such as graded banks, waterways and diversion banks, together with soil conservation practices such as conservation tillage and adequate crop rotation.	Sloping land suitable for cropping on a rotational basis. Generally used for the production of the same type of crops as listed for Class I, although productivity will vary depending upon soil fertility. Individual yields may be the same as for Classes I and II, but increasing restrictions due to the erosion hazard will reduce the total yield over time. Soil erosion problems are often severe. Generally fair to good agricultural land.	
SUITABLE FOR GRAZING	Occasional Cultivation	IV	Land not suitable for cultivation on a regular basis owing to limitations of slope gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Comprises the better classes of grazing land of the State and can be cultivated for an occasional crop, particularly a fodder crop, or for pasture renewal. Not suited to the range of agricultural uses listed for Classes I to III. If used for "hobby farms", adequate provision should be made for water supply, effluent disposal and selection of safe building sites and access roads.	
		V	Land not suitable for cultivation on a regular basis owing to considerable limitations of slope gradient, soil erosion, shallowness or rockiness, climate, or a combination of these factors. Soil erosion problems are often severe. Production is generally lower than for grazing lands in Class IV. Can be cultivated for an occasional crop, particularly a fodder crop or for pasture renewal. Not suited to the range of agricultural uses listed for Classes I to III. If used for "hobby farms" adequate provision should be made for water supply, effluent disposal, and selection of safe building sites and access roads.	
	No Cultivation	VI	Productivity will vary due to the soil depth and the soil fertility. Comprises the less productive grazing lands. If used for "hobby farms", adequate provision should be made for water supply, effluent disposal, and selection of safe building sites and access roads.	
OTHER	VII	Land best protected by green timber.	Generally comprises areas of steep slopes, shallow soils and/or rock outcrop. Adequate ground protection must be maintained by limiting grazing and minimising damage by fire. Destruction of trees is not generally recommended, but partial clearing for grazing purposes under strict management controls can be practised on small areas of low erosion hazard. Where clearing of these lands has occurred in the past, unstable soil and terrain sites should be returned to timber cover.	
	VIII	Cliffs, lakes or swamps and other lands unsuitable for agricultural and pastoral production.	Land unusable for agricultural or pastoral uses. Recommended uses are those compatible with the preservation of the natural vegetation, namely: water supply catchments, wildlife refuges, national and state parks, and scenic areas.	
	U	Urban areas	CLASS SUBSCRIPTS	SPECIAL USES
	M	Mining and quarrying areas.	c	Terrain developed for a specific crop (capability class range IV to VII) as a result of the combination of particular soil, terrain, climatic and economic conditions. The class includes such crops as grapes, bananas, avocados and pineapples.
		d	Terrain developed for intensive agricultural production and associated with flood irrigation. The class includes land developed for cotton and rice production.	

Map Exclusions

National and State parks, State forests, restricted water supply catchments, land set aside for soil conservation management and urban zonings have been excluded from the land capability assessment. This capability classification does not take into account land use restrictions which may apply under Section 21 of the Soil Conservation Act, 1938 (Protected Lands) and Section 26D of the Water Act, 1912 (Prescribed Streams or Lakes). For details of these restrictions, contact the nearest Soil Conservation Service office.

Map Reliability

A minimum mapping unit of 100 ha has been set as the standard of reliability. In many cases a smaller unit is mapped if the class unit can be easily delineated, if it is an area of critical hazard (e.g. alluvial mining site, land affected by severe soil erosion or salinity) or if it is an extension of a unit from the adjoining map sheet.

Area Measurements

Area measurements are undertaken for each map sheet and tables of various class groupings are prepared from the results. They list the area of each land capability class and the proportion of each class within the sheet. The area measurements for the Wagga Wagga sheet are included in Table 2 to illustrate the type of data available.

PREPARATION OF THE LAND CAPABILITY MAPS

The base maps for land capability are the standard 1:100 000 topographic series.

Standard aerial photography available from the N.S.W Central Mapping Authority is the principal information base for the mapping.

The mapping is carried out directly onto the relevant topographic sheets rather than drawn onto the aerial photographs and transferred at a later date. Where 1:100 000 topographic maps were not available, 1:25 000 or 1:50 000 topographic maps have been used and the information reduced to 1:100 000.

Climate, soils, geology, geomorphology, soil erosion, site and soil drainage characteristics, and current land use data are all considered in determining land capability.

Climatic data consider the likelihood of the season being long enough, with the availability of sufficient moisture and absence of temperature extremes, to grow a crop.

Soil types are assessed on their erodibility, the occurrence of any adverse soil physical or chemical characteristics, their recommended optimum use, and the land management practices needed to maintain the productivity of the soils and to prevent soil erosion. Where there is an absence of soils data, or where available information is sketchy, geological data are used to infer the soil types that are likely to occur and their limitations.

Geomorphology data consider the slope gradient, slope length and shape, and the terrain type. The terrain type and the shape of the slope, combined with a knowledge of the geology can be used to infer particular soils types, or when combined with soils information, can be used to define the boundaries of different soil types. The delineation of a geomorphic floodplain is the obvious example of using a terrain unit to define a soils unit. In this case, the boundary of the floodplain can be taken to be the boundary of the alluvial soils unit.

Table 2 Area Measurements Wagga Wagga Land Capability Map

LAND CLASS	CODE	AREA (Sq. km)	AREA (%)
I	1	600	23.7
II	2	762	30.1
III	3	565	22.3
IV	4	93	3.7
V	5	280	11.1
VI	6	113	4.5
VII	7	31	1.2
VIII	8	8	0.3
ID	A	0	0.0
IID	B	0	0.0
IIID	C	0	0.0
IVD	D	0	0.0
State Forest	F	38	1.5
IVC	H	0	0.0
VC	I	0	0.0
VIC	J	0	0.0
VII C	K	0	0.0
Mining	M	0	0.0
National Park	P	3	0.1
Nature Reserve	R	0	0.0
Foreshores	S	0	0.0
Urban	U	37	1.5
Water	W	0	0.0
M.S.W.D.B. Restricted	X	0	0.0
State recreation area	Y	0	0.0
Military	Z	0	0.0
Total For Map		2530	

LAND CLASSES	AREA (SQ. KM)	(%)
I & II	1362	53.8
III	565	22.3
IV & V	373	14.7
VI	113	4.5
VII & VIII	39	1.5
OTHERS	78	3.1
I to III	1927	76.2
IV & V	373	14.7
VI	113	4.5
VII & VIII	39	1.5

Slope gradient, slope length and existing soil erosion data are combined to provide recommendations on the types of soil conservation practices necessary to prevent or to control soil erosion under differing land uses.

Site drainage limitations include the likelihood of flooding or prolonged inundation, whilst soil drainage limitations include low soil permeability, the presence of impermeable soil layers, seasonally or permanently high water tables and spring activity.

Site characteristics, such as the presence of various forms of soil erosion, rock outcrops and saline patches are also mapped from aerial photographs as they may directly determine the land capability class.

Geomorphology, soil erosion and current land use data are interpreted directly from the aerial photographs. Geology information is taken from the 1:250 000 geology sheets published by the Geological Survey of New South Wales. Some geological boundary refinement is possible from the aerial photographs.

Soils information is taken from published maps or unpublished Soil Conservation Service maps, where available, but owing to the scarcity of information, most

land capability classification depends upon local knowledge of soils. Aerial photograph interpretation is often used to refine soils information using colour and texture patterns and geomorphic, soil erosion and land use patterns.

On completion of the land capability classification, maps are field checked. To verify the interpretation of boundaries and land classes, detailed observations are made along most access roads and tracks. After making any necessary corrections, the maps are examined by a second person, using aerial photograph interpretation. This further check ensures standardization and co-ordination of the entire mapping programme (since there can be up to twelve people directly engaged in the preparation of these maps at one time). The maps are then drafted, printed and distributed.

HOW TO USE THE MAPS

The maps are used in conjunction with the appropriate 1:100 000 series of topographic maps. A series of coordinates and grid reference points on the maps allows direct referencing of the capability maps to the topographic maps to ensure an accurate fit in each sector. Some stretching of the paper on the land capability maps will occur during printing and this will need to be taken into account when using land capability maps with topographic maps.

It is important that the maps are not enlarged to scales of 1:50 000 or larger. The information is reliable only at the scale at which it is mapped and published. Enlarging the maps to scales of 1:50 000, or 1:25 000 or larger, will cause serious distortions in the reliability of the information as the boundaries will not correspond to the natural boundaries (soil type, slope, terrain) on the ground (that have been the basis of the separation of classes).

USE OF THE LAND CAPABILITY INFORMATION

For planning authorities such as city, municipal and shire councils, regional administrations and Government and semi-Government organisations, the primary use of the land capability maps is the identification of the various classes of rural land. The classification has an hierarchical sequence, ranging from land with the greatest potential for agricultural or pastoral use, to that which is entirely unsuitable for either. Class 1 lands are the best. They have few or no physical constraints to production, are fertile and can be regularly cultivated without incurring soil erosion problems. At the opposite end of the classification, lands in Class VIII are unsuitable for agricultural or pastoral use and should remain undisturbed. Between the two extremes is a range of classes recognising an increasing limitation to use and a decreasing versatility of use.

The maps have a variety of uses. For rural lands, they can be used to identify:

1. potential land capability
2. potential land use - broad categories only
3. soil erosion hazards and soil conservation requirements
4. catchment management requirements.

For rural land zoning purposes, they can identify:

1. the area and distribution of land of differing potential

2. land best retained in its natural state and therefore used for catchment protection, recreation areas, national parks, flora and fauna reserves.

Lands within Classes VII and VIII will generally have a high conservation value for recreation and wildlife reserves, because they often contain the least disturbed ecosystems. The selection of these areas for recreational or wildlife preservation purposes would not cause any significant conflict in terms of competing rural uses as they have low potential for agricultural use. Other relevant information would need to be assessed in conjunction with the land capability criteria before a decision could be made on their ultimate use.

For rural planning, the land capability classes can be combined into three categories of potential land use

- land suitable for cultivation (Classes I, II and III)
- land suitable for grazing (Classes IV, V and VI)
- land not suitable for agricultural use (Classes VII and VIII).

It will be noted that these classes do not indicate a particular type of crop or enterprise. Rather, they group these enterprises according to the similarity of land use and land management practices necessary to achieve production.

Thus, lands suitable for cultivation will incorporate all types of cropping enterprises which involve tillage operations to prepare a seedbed prior to planting. Grazing will incorporate all types of grazing enterprises such as beef, dairy cattle, sheep or goats and involve all types of pastures, ranging from native to semi-improved and fully improved pastures.

For urban and rural small lot zoning purposes, the maps can be used to identify:

1. areas preferred for retention for agricultural use.
2. areas potentially suited for urban and rural small lot uses.
3. areas with likely problems for urban and rural small lot uses.

For urban and rural small lot purposes, the interpretation of the maps can be expanded to provide some of these answers. The areas preferred for retention for agricultural purposes are based upon the existing farming enterprises in the area. If the area is to be used mainly for cropping, preference may be given to preserving Classes I, II and III. For mixed cropping and grazing purposes, or for grazing only, Classes I, II, III and IV - and possibly Class V - might be used.

Class V lands may or may not be retained for agricultural purposes, depending on the size, location, and existing or potential soil erosion hazard.

Land with likely problems for urban and rural small lot uses will be some Class III lands, Class V and Class VI lands.

Class III and V lands are based on soil erosion hazard estimates and the extent of their limitations can be interpreted with additional soils information. The types of limitations on Class VI lands can be determined by overlaying the capability maps with the topographic maps. The criteria for Class VI land are not based solely upon slope, but also on salinity potential, ground water seepage, waterlogging potential, rockiness or soil erosion hazard. If the topographic maps show low sloping lands, the limitation is not slope gradient. One or more of the other features therefore will be the principal limitation(s) and

may be more restrictive to the potential use of the land. For urban purposes, the conclusion would be that the land is unsuitable for urban uses. For rural residential purposes, a more detailed examination of the land, at a larger scale would be needed to identify the various land units and their distribution.

There is a limit to which the interpretation of the maps can be expanded. However, if users are aware of the criteria upon which the land has been classified, a fair degree of ancillary interpretations can be made from the maps.

LEVEL OF INTERPRETATION

The maps are best used as a source of general information in relation to rural land use potential over large areas. However, they will also provide reliable interpretation of land down to individual parcels of 200-300 ha. While minimum mapping units have been set as 100 ha, and smaller units are often defined, it is best to under-utilize the maps, rather than over-utilize them. Comments on land capability, land use potential and soil erosion hazards can be made on these 200-300 ha parcels. Over larger areas, the maps become more reliable because overall errors are minimized.

The maps cannot be used to provide information about a specific site, this requires detailed site investigations.

In mapping a natural resource, a fixed boundary is unrealistic as land often grades from one group to another. Hence, the boundaries on the land capability maps must be accepted with some degree of flexibility, particularly when they are transposed to a field situation.

As stated previously, the Soil Conservation Service does ~ not recommend the enlargement of land capability maps as this will not provide greater detail. Most enlarging is done to allow the information to be fitted over base maps of another scale.

For planning on a shire or regional basis, the 1:100 000 maps are ideal. They cover the same area as 8 x 1:25 000 maps or 2 x 1:50 000 maps and therefore reduce the number of maps involved. They contain most of the topographical information of the 1:25 000 maps, but do not have cadastral information.

THE SERVICE AND LAND USE PLANNING

The Soil Conservation service acknowledges that local demands require appropriate local responses inland use planning issues. It has adopted general principles regarding land use and land use planning and encourages other land use planning authorities to adopt these. They are:

1. Land should be used according to its capability for a particular use.
2. In rural land use planning, the better classes of agricultural land should be retained for permanent agricultural production. Pressures for subdivision into lot sizes generally considered too small to be economic units should be directed at lands with a lower potential for agricultural use. Thus preference is given to retaining Classes I, II, III and possibly Class IV for agricultural use. Classes VII and VIII are best left undeveloped. Development for urban or rural small lot purposes is preferred on Classes V and VI, or possibly Class N if these lands have the capability for such uses.

3. All land developments should incorporate programmes for the prevention and/or control of soil erosion, on-site and off-site, during the development and maintenance phases.
4. When land is developed, the impact of that development on the TOTAL catchment must be considered in addition to the immediate site effects.

APPENDIX 1:

DESCRIPTIONS OF THE RURAL LAND CAPABILITY CLASSIFICATION

The classification system used by the Soil Conservation Service of N.S.W does not always reflect the existing land uses. Instead, it indicates the maximum potential safe use of the land for crop production, pasture improvement and grazing.

An important criterion in the rural capability classification is the increase in soil erosion susceptibility and/or deterioration in soil structure caused by land management practices and the relationship of these practices to the potential use of land. Other criteria used include the occurrence of physical and chemical limitations at the site which are unrelated to soil erosion but which may place over-riding restrictions on the potential use of the land. The system thus recognises four broad categories of land as they relate to:

- (i) the capacity of land for particular types of use; and
- (ii) the presence of physical and/or chemical limitations.

□ The first category represents land capable of frequent growing of crops which use tillage practices involving a series of soil workings. It includes land where the soils are sufficiently deep and which have a structure and texture which will not break down under tillage within the limits defined; are free of excessive salts; relatively free of large stones or in-situ rock so as not to restrict the use of farm machinery; and which have good profile drainage, but a sufficient water-holding capacity to meet the requirements of the crop. This category comprises Classes I, II and III.

A parcel of land in this grouping must be able to sustain two consecutive crops in two years without incurring a significant breakdown in soil structure or a substantial increase in soil erosion susceptibility. If the soil structure is so degraded under the first or second crop that a third cannot be planted, the land is placed in a grazing class. If it can safely sustain two annual cultivations and be ready for a third crop, it is placed in a cultivation class.

The term 'crop' applies to grain, fodder or forage species. The potential for cultivation applies to the ability of the soil to withstand the effects of cultivation, not the type of crop produced.

□ The second category includes land capable only of infrequent growing of crops when using tillage practices involving a series of soil workings. This land is best used for grazing but it can occasionally be tilled for different types of crops or for pasture establishment or renewal. However, because of site factors such as climate, soil type, slope, topographic location or drainage, it is unsuitable for repeated cultivation. Comprises Classes IV and V of the capability classification.

- Grazing land which is unsuited to tillage operations makes up a third category. It includes lands having a series of physical or chemical constraints which limit productivity. Physical constraints may include soil properties such as depth, stoniness, and erodibility or drainage, or site features such as slope, landform elements, rock outcrops and erosion hazards. Chemical limitations include both deficiencies and toxic levels of all nutrients. This category comprises Class VI, of the capability classification.
- A final category includes land considered unsuited for any type of cropping or grazing because of its physical limitations. These may physically restrict production and may result in an extreme soil erosion hazard if general land clearing takes place. This category is represented by Classes VII and VIII. Depending on the measures required to control soil erosion and to sustain permanent production, these four broad categories which define a potential intensity of use are further sub-divided. Definitions for each of the classes are:

LAND SUITABLE FOR REGULAR CULTIVATION CLASSES I, II AND III

Soils must be able to sustain at least two successive seasonal or annual tillage phases for crop production which the tilled layer is inverted or shattered, without producing either a significant increase in soil erosion susceptibility, or a significant deterioration in soil structure

The proportion of time under tillage and crops shall not be less than one-half the time under other land

General Criteria

1. Climatic and environmental conditions are favourable for growing any commercially produced crops.
2. Soils are deep to moderately deep, well-drained with adequate water available.
3. Soils can be maintained in good structure and productivity, although they may require a ley phase to allow soil structure to re-establish. This ley phase can be longer than the cultivation phase.
4. Productivity is variable, ranging from moderate to high and may comprise some of the most productive lands of the State.
5. Lands are not likely to accumulate excessive salt or develop prolonged high water tables.
6. Inundation of the land will not be of a frequency or duration to restrict the growing of any crop.
7. Any adverse physical or chemical constraints to the soil (e.g. rock outcrops, nutrient deficiencies or toxic levels) can be overcome economically. The proportion of in-situ rock outcrop may range from 0 to 30 percent of the land surface area, depending on the type and distribution of rock. Where the proportion of rock outcrop is greater than 30 per cent, the capability is Classes IV, VI or VIII, depending upon the amount of rock, its type and bedding patterns.'
8. Rock or stone content will not restrict cultivation practices.

Class I

Land of low soil erosion hazard, which is subject to water erosion only during flood events and wind erosion during prolonged droughts. No special soil conservation works or practices are necessary, except those management factors needed to preserve soil structure or productivity.

In addition to the general criteria for cultivation lands, the following conditions are to be satisfied:

- lands are either level or very gently sloping, not exceeding 1½ per cent slope gradient
- terrain unit: alluvial plain, flood plain, coastal plain or plateau
- erosion damage is nil to low and potential for future erosion is low.



Class I land on alluvial soil (Taree, NSW) used for vegetable production



Class I land: Irrigated lucerne on alluvial terraces, Scone N.S.W.

The following land is not Class I:

1. Level or gently sloping land, whose soils are excessively drained, have a low water holding capacity and require constant irrigation to support cropping. Land capability is Class IV or Class VI depending on the requirements to maintain ground cover.
2. Land with excessive accumulation of salt, with electrical conductivity exceeding 4 mS cm⁻¹. Such land is classified as Class VI.
3. Land adjacent to areas of excessive salt accumulation. These require careful management to prevent the expansion of saline areas. They should not be used to their full potential but to a level of use to prevent an increase in surface salt concentrations. Accordingly, they may be classed as VI or VII, depending on the circumstances of a particular site.

Class II

Land of moderate soil erosion hazard subject to sheet, rill, gully and wind erosion but where the erosion can be controlled by cultural techniques such as strip cropping, conservation tillage, adequate crop rotation and, in areas subject to wind erosion, by the retention of windbreaks. Land in this class is generally subject to sheet, rill and wind erosion, although in some cases it may be affected by gully erosion where the gullies have been formed by runoff across the slope from adjacent terrain units. Although soil loss by sheet, rill and wind erosion may equal or exceed soil lost by gully erosion, its impact on the ground surface is less obvious. Soil erosion can be controlled by land management practices generally included under the term cultural practices, e.g. strip cropping, conservation tillage (stubble retention, tyne rather than disc or mouldboard cultivations, minimum tillage, direct drill) and by adequate crop rotation, specifically with a pasture phase. In the western limits of the cultivation lands, some form of timber retention to serve as windbreaks is recommended to reduce wind erosion hazard.

Land which requires some form of mechanical protection, such as structural banks or waterways, to prevent and/or to control soil erosion is generally rated Class III. However, if an isolated structure is required, such as a diversion bank, a gully control structure or a waterway to carry water from adjacent lands, but the major form of protection is by cultural practices, the unit is Class II.

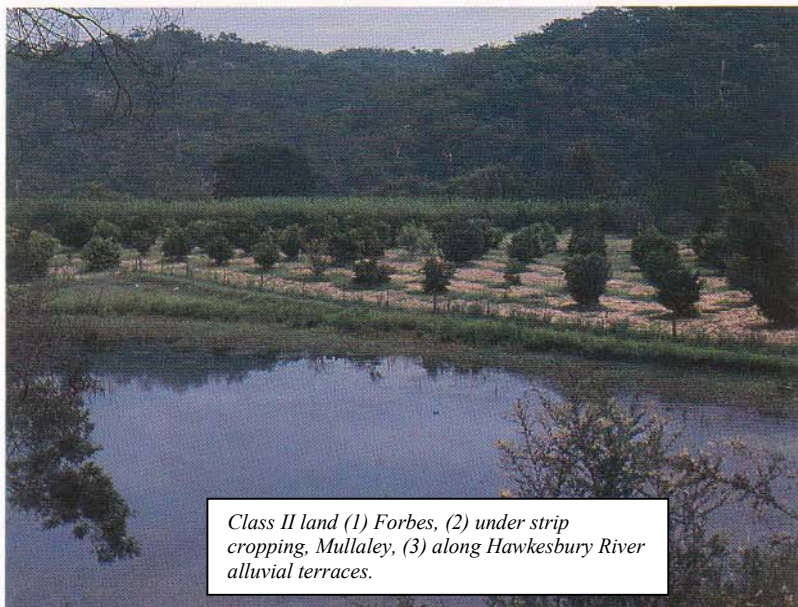
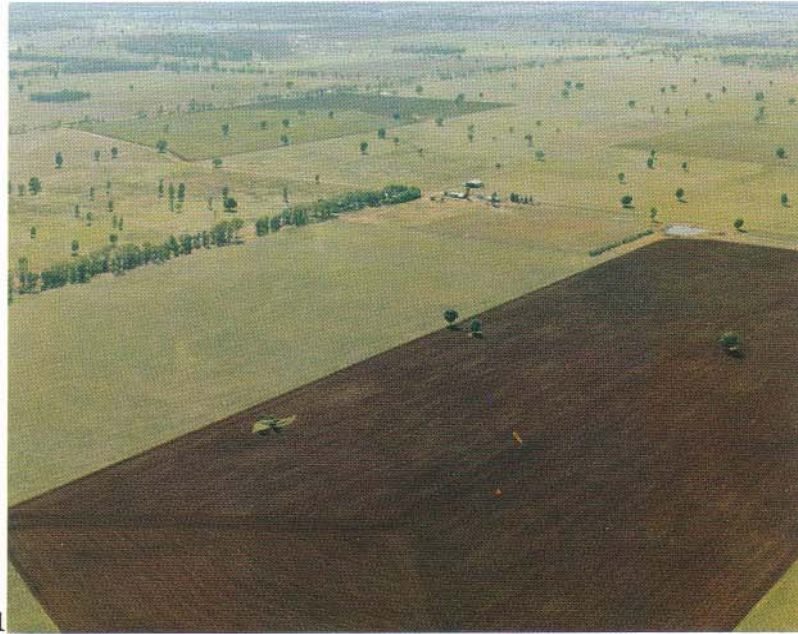
Land requiring protection in the form of structural works from run-on from adjacent lands may be included in this class if the structural works are not required to control soil erosion within the land unit itself.

In addition to the general criteria for cultivation lands, the following conditions are to be satisfied:

- Lands are very gently sloping to undulating. Upper slopes may range from approximately 2 per cent gradient in the northern part of the State, to 5 per cent in the southern part of the State and in isolated areas up to 10 per cent where the soils are deep, well structured and of low erosion hazard (e.g. krasnozems). However the upper slope limit may be modified by the length of the slope. With long slope lengths, the upper slope limit is reduced.
- Terrain unit: all plain units (floodplain, coastal plain, drainage depressions) where horizontal or transverse gradients exceed 1½ per cent but are less than 5 per cent.
 - footslopes, where soils are of low to moderate erodibility and run-on from adjacent topographic units can be controlled
 - hillslopes where gradients are less than 5 per cent, except in isolated situations.
- Erosion damage is nil to moderate and potential future soil erosion is low to moderate.

The following land is not Class II:

1. Level or gently sloping land, where the soils are excessively drained, have a low water holding capacity and require constant irrigation to support cropping. Land capability is Class IV or Class VI depending upon the requirements to maintain ground cover.



Class II land (1) Forbes, (2) under strip cropping, Mullaley, (3) along Hawkesbury River alluvial terraces.

2. Land with excessive accumulation of salt, with electrical conductivity exceeding 4 mS cm^{-1} . The land is classified as Class VI.
3. Land adjacent to areas of excessive salt accumulation. These areas require careful management to prevent the expansion of saline areas. Their use may not be to, their full potential, but a use to stop the increase in salt concentrations at the surface. They may accordingly be classified as Classes VI or VII, depending upon the circumstances of the particular site.
4. Areas of level or gently sloping land, with deep to moderately deep heavy-textured soils, poorly drained and suitable only for a crop which has a high water requirement or which has the ability to withstand waterlogging or flooding for prolonged periods. If the land is suitable for only one specific crop, and the site conditions are unsuitable for all other crops that can be commercially grown in the same area but with different soil conditions, the land cannot be placed in a cultivation class.

A specific example of this situation is the sugar cane lands of the North Coast. Sugar cane has been grown on poorly drained, deep, heavy-textured soils. With current technology, no other crop has been grown on these areas. The cane has a growth period of 2 to 2½ years before harvest. Tillage practices are less than those defined to satisfy the conditions for cultivation land. The land classification is Class IV or Class VI, depending upon the suitability of the site for pasture production.

Class III

Land of moderate to high soil erosion hazard, subject to sheet, rill and gully erosion where the soil erosion can be controlled by the use of structural soil conservation measures, or by very strict land management practices where tillage of soil is avoided during periods of high soil erosion hazard. In the latter circumstance, this will involve manipulating the cropping or rotation phases to avoid times of high soil erosion hazard.

Class III land is land which can be regularly cultivated but needs structural works to control soil erosion. Broad-based banks and grassed waterways on Class III land at Eugowra, N.S.W



Class III land on krasnozem soils, Robertson, N.S.W.

In most parts of New South Wales, land in Class III will require a rotation phase to maintain soil structure and productivity, reduce disease and weed infestations and decrease the soil erosion hazard.

In addition to the general criteria for cultivation lands, the following conditions are to be satisfied:

- Lands are gently sloping to undulating. Slopes may range from 2 to 8 per cent in the north of the State, from 3 to 10 per cent in the central areas and from 5 to 12 per cent in the southern part of the State. Where soils are deep, well structured, relatively fertile, of low erodibility and quickly revegetated, the upper slope limits for Class III may be extended to 15 to 18 per cent, depending upon the land management practices implemented to control soil erosion.

In all cases, the upper slope is the maximum slope limit for cultivation recommended by the Soil Conservation Service. Above these slope limits, adequate protection from soil erosion cannot be economically implemented, without seriously impairing commercial farming operations.

- Terrain unit: hillslopes where gradients are those defined above; footslopes where soils are of low to high erodibility; drainage depressions where overland flows can be controlled or diverted by structural measures or crop management practices.
- Erosion damage is nil to severe, but the land can quickly be restored and returned for cropping. The potential for future erosion is moderate to severe.

The following land is not Class III:

1. Level or gently sloping land, where the soils are excessively drained, have a low water holding capacity and require constant irrigation to support cropping. Land capability is Class IV or Class VI depending upon the requirements to maintain ground cover.

2. Land with excessive accumulation of salt, with electrical conductivity exceeding 4 mS cm^{-1} . The land is classified as Class VI.
3. Land adjacent to areas of excessive salt accumulation. These areas require careful management to prevent the expansion of saline areas. Their use may not be to their full potential, but a use to stop the increase in salt concentrations at the surface. They may accordingly be classified as Classes VI or VII, depending upon the circumstances of the particular site.

LAND SUITABLE FOR GRAZING WITH OR WITHOUT OCCASIONAL CULTIVATION CLASSES IV AND V

Land with a high potential for grazing over the long term.

Generally comprises two major land types:

- a. Land capable of cultivation on an irregular basis owing to the severe soil erosion problems likely to develop if cultivated continuously. Land that cannot produce two consecutive annual crops without a significant breakdown in soil structure under the conditions specified for cultivation land, but which may be cultivated for one crop without a breakdown in soil structure, followed by a period under pasture, is included in these classes. Crops may include grain, fodder or forage species.
- b. Land not capable of cultivation for annual crops owing to climatic, physical or chemical limitations of the site. However, the land is capable of cultivation for the establishment of a permanent pasture. Physical limitations may include such soil characteristics as shallowness, heavy texture, lack of structure or a weak structure, low water holding capacity, high erodibility and impeded drainage and site characteristics such as slope gradient, periodic inundation, seepage flows, and exposure to climatic extremes (frosts, cold air drainage, hail). Chemical limitations mainly comprise toxic nutrient levels (including excess salts) but may also comprise soils which exhibit nutrient fixation even with the application of high rates of the specific nutrient.

The basic criterion separating these two essentially grazing classes from Class VI is that they can be cultivated for an occasional crop, or cultivated for pasture establishment. Slope gradients and site characteristics restrict the suitability of cultivation on Class VI land.

General Criteria

1. Environmental conditions are not restrictive to native pastures or commercially available improved pasture species for more than six months in any twelve months continuous period, although they may be restrictive to the growth of cash crops.
2. Slope gradients may range from flat to rolling. The upper slope to Classes IV and V is set by the safe working limits of machinery used for installing soil erosion control works.
3. Soil limitations are more restrictive than for Classes I, II and III but not as restrictive as for Classes VI, VII and VIII. Soil characteristics *limiting to Classes I, II and III* but not limiting for Classes IV and V may include one, or more than one, of the following:
 - (i) Shallow depth, insufficient for the growth of cash crops, but capable of growing pastures
 - (ii) heavy soil texture

- (iii) moderate to high soil erodibility
- (iv) moderate to low water holding capacity
- (v) occasional high water table
- (vi) impeded soil profile drainage
- (vii) low nutrient status.
4. Soil erosion damage and/or soil erosion hazard is nil to moderately severe but use of soil conservation works and/or land management practices is feasible.
5. Lands are not likely to accumulate excessive salt or develop prolonged high water tables.
6. Low-lying level land may be subject to a frequency of flooding likely to cause excessive soil erosion if the land is cultivated for crops.
7. Rock or stone content will not restrict cultivation for pasture establishment. The proportion of in-situ rock generally does not exceed 50% of the surface area of the land and, in specific instances, may be lower. If the proportion of rock outcrop exceeds 50% of the surface area, the land capability is Class VI or Class VIII.

Class IV

Land of low to moderate soil erosion hazard, subject to minor to moderate sheet, rill and gully erosion, where the existing and potential soil erosion can be controlled by land management practices. These land management practices will include establishment of improved pastures, stock control, application of fertilizer and where annual crops are grown, the establishment of a rotation system which will minimize soil erosion losses and maintain soil structure and fertility.



Class IV land: Grazing land at Ebor N.S.W: Erosion hazards are low.

In addition to the general criteria for Classes IV and V the following conditions are to be satisfied:

- Maximum slope gradient is 25 per cent, the safe upper limit for operation on the contour of soil conservation earth-moving machinery. However, where the soils are deep and well structured, fertile, of low erodibility and quickly revegetated, the upper slope limit may increase to 33 per cent.
- Terrain units: hillslopes, where gradients are within the range previously defined;
 - all footslopes, where soils are of low to moderate erodibility;

- drainage depressions, which are subject to periodic overland flow, seasonal waterlogging or impeded soil profile drainage.

Erosion damage is nil to moderate and potential for future erosion is low to moderate.

The following land is not Class IV:

1. Land with excessive accumulation of salt, with electrical conductivity exceeding 4 mS cm^{-1} . The land is classified as Class VI.
2. Land adjacent to areas of excessive salt accumulation. These areas require careful management to prevent the expansion of saline areas. Their use may not be to their full potential, but a use to stop the increase in salt concentrations at the surface. They may accordingly be classified as Classes VI or VII, depending upon the circumstances of the particular site.
3. Where the proportion of rock outcrop is sufficiently large to restrict cultivation. In this situation, the appropriate classification is Class VI.
4. Land where the soils are sufficiently shallow to be classified as skeletal soils. The appropriate classification is Class VI.
5. All land affected by or subject to, mass movement. On slopes of less than 33 per cent, the land is Class VI and for slopes greater than 33 per cent, the appropriate land classification is Class VII.

These lands require special management practices to reduce the potential for further mass movement to occur. Such management practices include fencing off of areas affected by movements and reducing stocking rates to maintain ground cover and to encourage tree regeneration.

Once a slope failure is initiated, practical methods to prevent further movement are extremely limited, except on sites where structural methods can be justified economically. Land management practices offer the main practical method to minimize future damage.

Class V

Land of moderate to high soil erosion hazard and/or subject to severe sheet, rill and gully erosion, where soil erosion is controlled by the use of structural soil conservation measures, or by strict land management practices, in excess of the requirements listed for Class IV

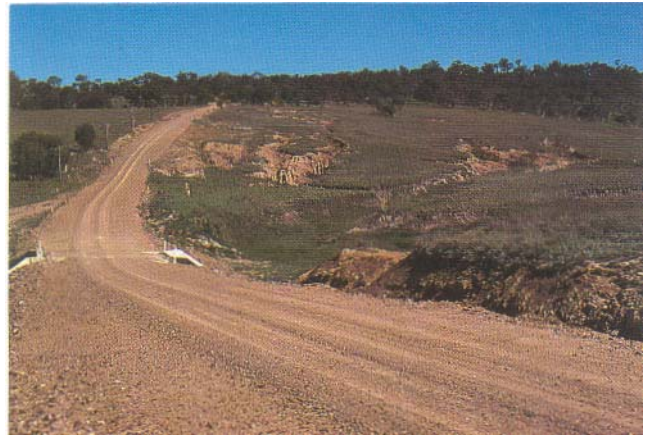
Where structural soil conservation measures are considered to be unsuitable, the following land management practices may be implemented:

1. Fencing out of eroded areas.
2. Revegetation, including reforestation of eroded areas. Alternatively, in some situations, reduction of timber cover to improve grass cover is recommended.
3. Log or pole structures within eroding gullies.
4. Restriction or exclusion of stock.
5. De-watering systems.
6. Contour or deep ripping.

In addition to the general criteria for these lands, the following conditions are to be satisfied:

Maximum slope gradient is 25 per cent, the safe upper limit for the operation of soil conservation earth-moving equipment on the contour.

Class V land: Grazing land affected by soil erosion which can be treated by structural works.



1. On yellow podzolic soils Ebor, N.S.W



1. On red duplex soils Tamworth, N.S.W.

- Terrain units: hillslopes where gradients are within the range previously defined;
 - footslopes where soils are of moderate to severe erodibility;
 - drainage depressions subject to gully erosion.

Erosion damage is nil to severe and potential for further damage is moderate to severe. However, the erosion damage can quickly be restored and returned for grazing and occasional cultivation.

The following land is not Class V:

1. Land with excessive accumulation of salt, with electrical conductivity exceeding 4 mS cm^{-1} . The land is classified as Class VI.
2. Land adjacent to areas of excessive salt accumulation. These areas require careful management to prevent the expansion of saline areas. Their use may not be to their full potential, but a use to stop the increase in salt concentrations at the surface. They may accordingly be classified as Classes VI and VII, depending upon the circumstances of the particular site.
3. Where the proportion of rock outcrop is sufficiently large to restrict cultivation. In this situation, the appropriate classification is Class VI.
4. Land where the soils are sufficiently shallow to be classified as skeletal soils. The appropriate classification is Class VI.

5. Where the soil erosion damage, or the potential for erosion damage, is of such severity as to permit only limited, controlled grazing (Class VI) or the total exclusion of stock and the reforestation of the land (Classes VII and VIII). Some areas of low sloping land in the Shoalhaven Valley subject to very severe gully erosion when cleared and with soils of very high to extreme erodibilities, have been classified as Class VII. Cleared land should be allowed to revert to timber and timbered lands should remain uncleared.
6. Land defined as not being suitable for cultivation but because of farmer demands, the slopes are banked to permit cultivation. If the land is used to its potential and regular cultivation is not to be practised, the land would be classified as Class IV. However, the inclusion of banks does not make the land Class V. Its true classification still remains Class IV but the land is being used beyond its capability and thus the need for soil conservation banks.
7. Grasslands where the cultural practices used for pasture improvement may be the same techniques recommended for the control of sheet, rill and gully erosion. In the Bombala District of N.S.W, chisel ploughing is recommended as one method of treating lands affected by sheet and gully erosion. It has proved to be very effective in achieving this aim. Chisel ploughing is also a recommended technique as part of a pasture improvement programme on these same lands. Care is required to distinguish the purpose for which chisel ploughing is required as the purpose may be the criterion upon which the land is classified. Assuming that the land in question falls into either Class IV or Class V and that chisel ploughing is a recommended land management technique, the determining criterion will be the purpose for which chisel ploughing is required. If chisel ploughing is recommended as part of a programme to control sheet and gully erosion, the appropriate land class is Class V. If chisel ploughing is recommended solely as part of a pasture management programme, the capability of the land will be Class IV.
8. Land subject to any type of mass movement. The appropriate classes are Classes VI or VII.

LAND SUITABLE FOR GRAZING

Class VI

Land not suited for any type of cultivation, but best used for grazing. Soil erosion hazard varies from nil to high and the land is subject to varying degrees of soil erosion.

The class generally comprises land with a range of physical or climatic limitations which prevent cultivation for crops or pastures and restrict the use of soil conservation structural works as a means of soil erosion control.

These physical limitations may include one or more of the following:

1. shallow soils
2. high rock content (greater than 50 per cent of the surface area)
3. very high soil erodibility ratings
4. excess salt concentration
5. impeded drainage, high water tables or seepage flows

6. areas regularly inundated
7. steep or awkward slope gradients, limiting the ability to install soil conservation structural works.

General Criteria

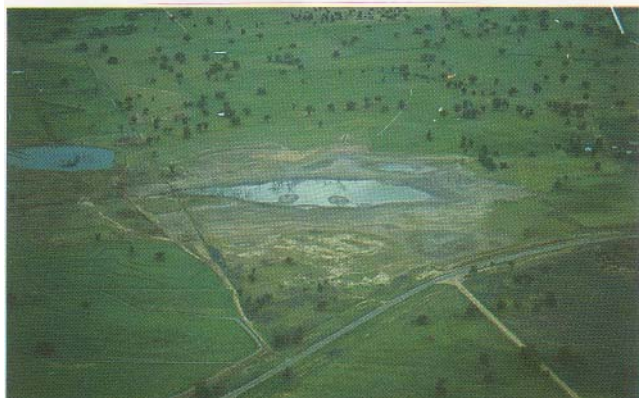
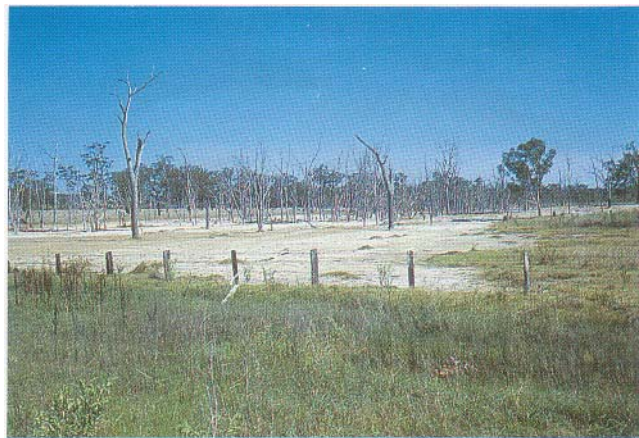
All, or nearly all, of the following conditions are to be satisfied:

1. Slopes do not exceed 33 per cent (18 degrees). Where the soils are deep and well structured, fertile, of low erodibility and quickly revegetated, the upper slope limit can be extended to 50 per cent.
2. The degree of rockiness or stoniness is slight to high but not extreme.
3. Soil erosion damage or hazard is slight to severe, but earthworks are not practical except in isolated locations. Severely eroded areas can best be restored by land management practices including the restriction of grazing intensities, establishment or re-establishment of pastures, prevention of fire and eradication of rabbits.

By its definition of stipulating more stringent land management techniques, Class VI accommodates any land with one, or more than one, of a wide range of physical limitations. It includes land with:

- (i) shallow soils
- (ii) excess salt concentrations
- (iii) high rock content, usually exceeding 50 per cent of the surface area of the land, but not exceeding 70 per cent of the surface area. In some cases, the proportion of rock outcrop can be less than 50 per cent of the surface area

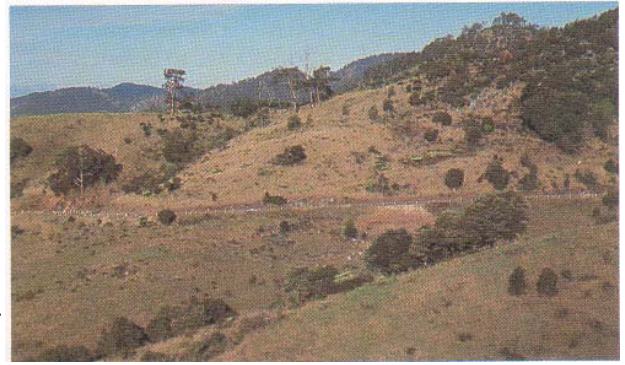
Class VI land: Lands affected by dryland salinity (Hunter Valley) and irrigation induced salinity (Wakool N.S.W)



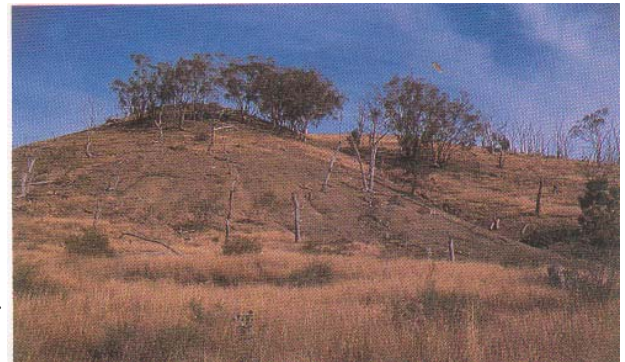
- (iv) impeded drainage, high water tables or perched water tables for prolonged periods
- (v) areas frequently or regularly inundated
- (vi) seepage flows - all permanent springs and the areas below them permanently or seasonally waterlogged are classified as Class VI - they appear as distinctly darker tones in aerial photographs
- (vii) all drainage lines, arbitrarily defined as being fourth stream order and lower, where the stream may be either stable or actively eroding. Strict management techniques are required to ensure that these areas do not become unstable because of land use practices. Where the drainage line is actively eroding and major structural works are considered to be unsuitable or too costly, stabilization is usually achieved over the long term using land management techniques
- (viii) slope gradients are greater than 25 per cent, but less than 33 per cent, except in specific situations defined previously, in which cases the upper slope limit is extended to 50 per cent
- (ix) mass movement on slopes of less than 33 per cent
- (x) excessively free-draining, with low water holding capacity
- (xi) severe soil erosion where it is not economic to treat the erosion by soil conservation structural works
- (xii) high soil erosion hazard, and can be cleared without causing severe soil erosion, provided specific land management practices are incorporated during clearing. These may include specific techniques for clearing timber, retention of timber in strategic areas, controlled stocking in susceptible terrain positions (e.g. footslopes, drainage lines), and maintenance of a good ground cover at all times.

The following land is not Class VI:

1. Low sloping land with soils of very high to extreme erodibility ratings. When cleared, the soil erosion developing on these lands is of such an extreme intensity that it is uneconomic to repair. Such land should not be cleared and cleared land is best withdrawn from use and allowed to revert to native timber. The appropriate classification is Class VII.
2. All well-defined, incised drainage channels of fifth stream order and greater, where grazing of the beds and banks of the channel is likely to cause or likely to increase their instability. These areas are best left unused for any grazing or agricultural purposes. They are best fenced out and the appropriate classification is Class VIII. At many scales of mapping, these areas are too narrow to delineate with any suitable precision. Because of their critical nature in the disposal of drainage from agricultural lands, it is preferable to exaggerate the size of the units to ensure that they are considered in the management plan. *Class VI lands may also be defined on the basis of (1) slope, (2) shallow soils, (3) rock outcrop, (4) landslide hazard, (5) scalds, (6) waterlogging, (7) erosion beyond the scope of structural treatment, or a combination of these factors.*



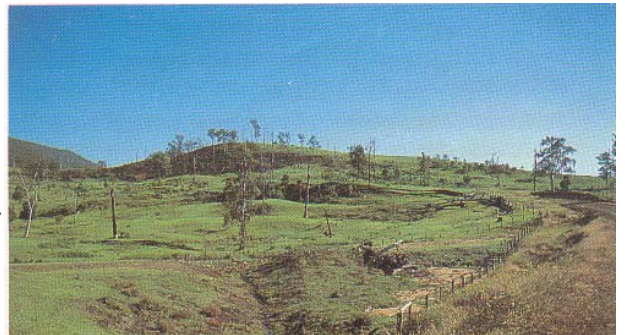
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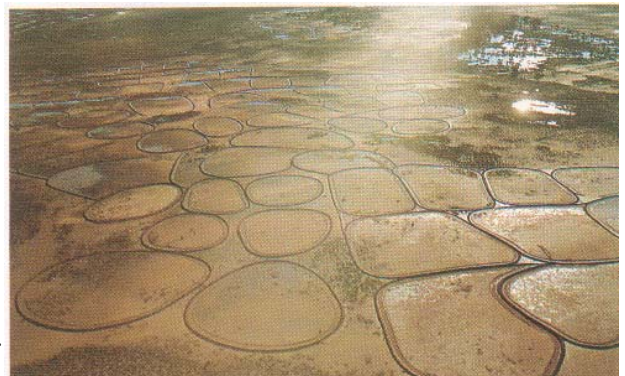
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LAND BEST PROTECTED BY GREEN TIMBER Class VII

Land which, owing to its high soil erosion hazard and severe site limitations, should best remain under green timber.

The distinctions between Classes VII and VIII are rather fine. Essentially, the difference is that Class VII land, can support some limited clearing and maintain a moderate level of production. The erosion hazard still remains high.

Production from Class VIII land is negligible and environmental problems much greater.

In notified catchment areas, where Class VII and Class VIII lands are classified primarily on the basis of slope, they correspond to areas defined as protected lands under Section 21 of the Soil Conservation Act.

General Criteria

Land is included in Class VII for one or more than one of the following limitations:

1. Slope: slopes *usually* exceed 33 per cent, but are often not steeper than 50 per cent. Exceptions occur to these ranges, depending upon the other limitations. Lower sloping lands, with skeletal soils and high stone content are classified as Class VII. Lands in high rainfall areas with slopes greater than 50 per cent, and with moderate soil depth, may be classified as Class VII.
2. Extreme soil erodibility: land which will develop an extensive and complex pattern of gully and sheet erosion when cleared. The gully erosion always appears active and very little vegetation establishes within the gullied areas. Gully patterns may comprise fluted columns, collapses of sides and headwalls, tunnel characteristics, etc.
3. Severe salinity problems: comprises subcatchments where clearing has led or may lead to excessive movement of salt into the groundwater.

4. Soil physical limitations including shallow soils, stoniness.

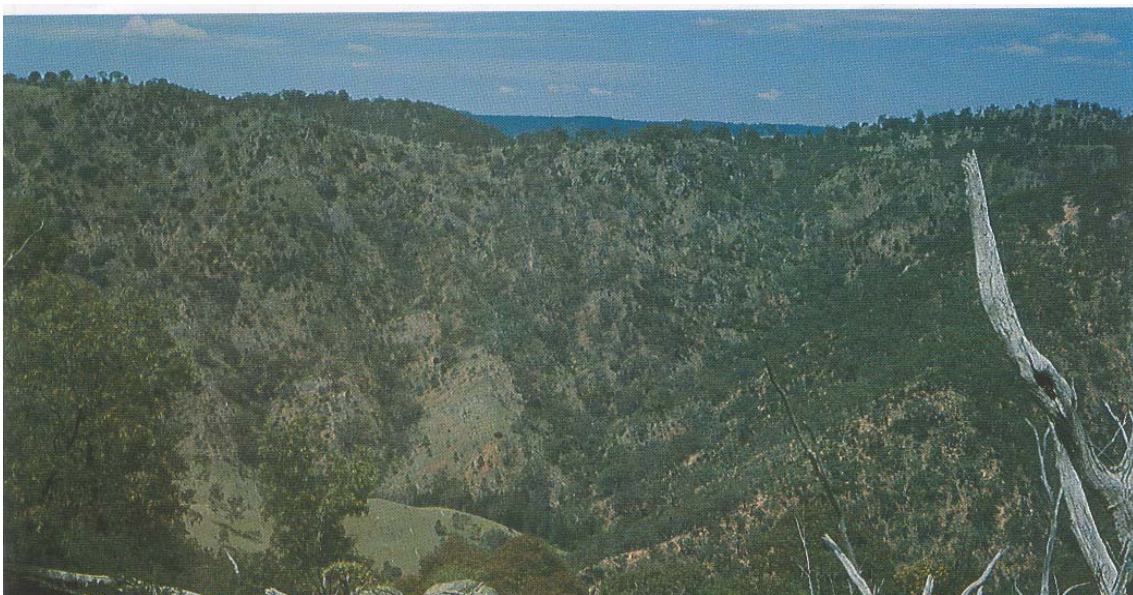
Class VII is used for all eroded lands where it is considered that the best method to control soil erosion is by the re-establishment of native vegetation and the exclusion of stock, on a long term basis. Some structural works may be incorporated but the *essential* requirement is the re-establishment of native forest vegetation. One anomaly is the alpine areas of New South Wales. It supports mainly low shrub or herb communities. These areas should still be classified as Class VII even though there is a natural absence of trees.

The following land is *not* Class VII:

1. Steep, vertical escarpments typical of Hawkesbury Sandstone terrain. The correct classification is Class VIII.
2. Areas of almost continuous rock outcrop (greater than 70 per cent of surface area), typical of areas of sandstone and granite terrain. Class VIII is the correct classification.
3. Where slopes are greater than 33 per cent, where the soils are deep and well aggregated, and although subject to sheet erosion when cleared, they will stabilize relatively quickly. These slopes are Class VI even though they may be mapped as protected land.

Class VII is not used in any way to infer that such lands are suitable or best suited for forest production. Often the best timber-producing lands are the low sloping lands within Classes I to IV. Because of their preferred use for cropping and grazing, these lower sloping lands have been extensively cleared. It is the steeper lands that have been retained as forests. Although a large proportion of these forest lands are Class VII, it is not correct to apply the corollary that Class VII lands are those lands best suited for forestry operations.

Class VII land: Steep slopes have been partly cleared and overgrazed. Erosion control is best achieved by removing livestock and allowing native timber to regenerate. ✓





OTHER LAND

Class VIII

Land not suitable for agricultural or pastoral production because of severe physical limitations to the land. These may include:

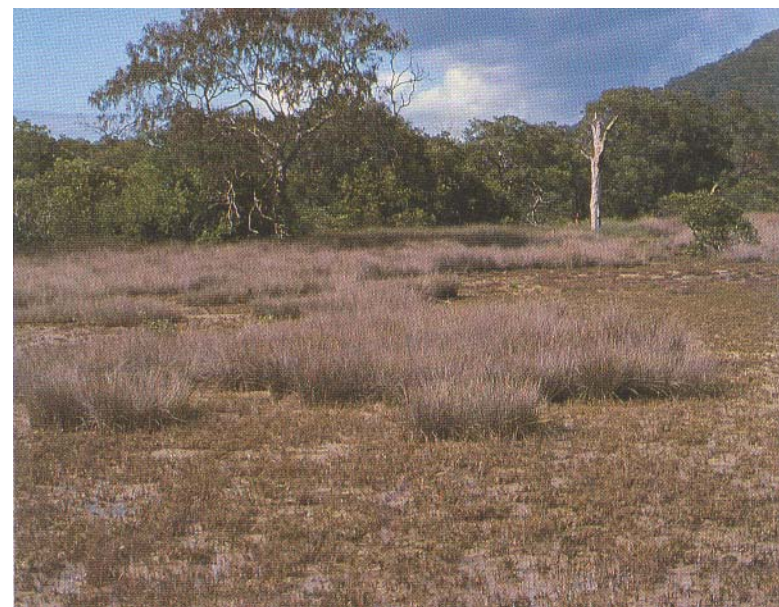
1. Steep to precipitous slopes (in most situations, slopes greater than 50 per cent).
2. High proportion of rock outcrop at or close to the surface (greater than 70 per cent of surface area).
3. Subject to permanent inundation. Includes beds and banks of streams of fifth order or greater, swamps, lagoons, lakes, tidal flats, estuaries.
4. Areas of sand accumulation (coastal dunes, beaches, etc.) with low fertility, low water holding capacity and subject to severe wind erosion when depleted of ground cover.

Expanding upon these general limitations, the following are specific examples of Class VIII land:

- Beach foredunes and some secondary dunes depending upon their relative relief and exposure to on-shore winds.
- Swamps, lakes, lagoons, etc., which may become dry after prolonged drought conditions. When dry, the bed of the landform unit may be suitable for cropping or grazing. However, the most appropriate classification is the most limiting classification as the areas are inundated for a majority of the seasons.
- Steeply sloping terrain along river channels. Such terrain may vary from the high relief gorge terrain of the Shoalhaven River to short, but steep, slopes lining small streams. The erosion hazard of these slopes is often high. Ground cover is low and grass growth sparse. These areas are best excluded from all agricultural and pastoral activities and retained for river protection purposes.

Existing and derelict mining areas are classified as mining lands. They are generally not included within the land capability classification because of the special characteristics associated with these uses and often the special requirements necessary for rehabilitation.

Urban lands and irrigated lands with permanent bays and channels are separately identified and excluded from the rural land capability classification.



Class VIII land: These lands are classified on the basis of excessive slope, greater than 70 per cent surface rock outcrop, or permanent inundation.