

5 Land conservation and susceptibility

5.1 Land susceptibility

The terms hazard and susceptibility are often used interchangeably, causing much confusion. Susceptibility of land to a specific deterioration process is defined here as a constant inherent feature, but the hazard changes depending upon the level of management and the type of land use.

Soil erosion and sedimentation is considered to be a major problem and can reduce the productivity of agricultural land. Sediment is the greatest pollutant of the world's surface waters as it degrades water quality and may carry adsorbed polluting chemicals (Robinson 1971). Furthermore most soils have very slow rates of formation and should be considered as a non-renewable resource thus the management of these soils is a very important consideration. It is therefore prudent to assess the risk, or susceptibility, of land to various forms of degradation.

Factors and processes

In this report six land degradation susceptibility processes were identified and studied. These are listed as follows:

- sheet and rill erosion
- gully and tunnel erosion
- mass movement (landslides)
- wind erosion
- waterlogging
- soil-structure decline

These processes have been investigated in previous studies. Previous land studies have used a suite of methods and approaches to define criteria and outputs representative of land degradation susceptibility across study areas. After evaluating existing methodologies with questionable output qualities, it was recommended to undertake an expert decision making approach for these processes. Experts with knowledge on catchment processes and limitations, collaborated in a suite of conferences and major meeting to identify limitations and inherent susceptibility of the land to further degradation.

The main soil-landform characteristics influencing the susceptibility of land to decline included soil chemical and physical properties, topographic indicators (slope, aspect, etc), geology, geomorphological processes and climate. Vegetation, land use and historic land management practices weren't considered in this approach and will be dealt with further as part of the LUIM project for the CCMA region. The inherent susceptibility to land degradation (ha and %) for land in the CCMA region is presented in Table 7.

Table 7 Inherent susceptibility to land degradation (ha and %) for land in the CCMA region

Hazard	High and Very High		Moderate		Low and Very Low	
	(ha)	(%)	(ha)	(%)	(ha)	(%)
Sheet and rill erosion	366 000	27.4	609 600	45.7	300 800	22.5
Gully and tunnel erosion	425 000	31.8	403 200	30.2	448 200	33.6
Mass movement (landslides)	353 300	26.5	87 900	6.6	835 200	62.6
Wind erosion	163 900	12.3	576 300	43.1	536 100	40.2
Waterlogging	697 300	52.2	431 600	32.3	147 400	11.0
Soil-structure decline	798 600	59.8	407 100	30.5	70 700	5.3

Sheet and rill erosion

The susceptibility of land to sheet and rill erosion is governed largely by the topsoil texture, slope of the land and length of slope. Other factors include hydrophobicity, percentage stone cover, tendency for aggregates to slake and disperse, size and weight of surface particles or aggregates, and the probability of intense summer rainfalls.

Soil loss from sheet and rill erosion is difficult to assess because of variability in soil loss within an area and the problem of measuring something that is not there. Sheet and rill erosion greatly reduces productivity, particularly in the case of texture contrast soils. The topsoil or A horizon is where most nutrients, organic matter, seed and macroporosity so desirable for a seedbed exists. If this is stripped away through soil loss the fertility of the soil is lost and productivity reduced.

Over 27% of the region have an inherent susceptibility to degradation by sheet and rill erosion. Landscapes most prone to degradation include the Otway Range, sediments of the Western Uplands and granitic slopes within the Western Plains and Western Uplands.

Gully and tunnel erosion

The susceptibility of land to tunnelling and gully erosion depends on a number of interrelated factors. These are principally rainfall intensity, vegetation cover, rooting depth, microrelief, slope, position in landscape, contributing upslope area, soil permeability, soil depth, soil cohesion and dispersibility. As the volume of overland flow increases and becomes channelised, the erosive power increases and resistance of the soil aggregates and particles to detachment becomes critical. The size and weight of the soil particles and their cohesion, or the tendency to slake or disperse will determine the resistance.

Gully and tunnel erosion is potentially a major degradation threat to water quality and biodiversity. Nearly 32% of the catchment has a high inherent susceptibility to gully and tunnel erosion. These areas of highest potential include the Ordovician sediments in the Western Uplands, but is also common on granitic parent material across the plains and uplands. The Otway Range also are extremely prone to tunnel and gully erosion. When gradational soils and stony loams on crests and upper slopes are cleared of the native deep-rooted vegetation, some rain percolates through the soil profile to the watertable, but some becomes overland flow with the potential to sheet erode the sloping land and scour out drainage depressions.

The presence of gullies and tunnels adversely affects productivity in a number of ways. As well as the land directly lost from production, the soil adjacent to the gully or tunnel is excessively drained thus reducing the vigour and number of plant species able to survive.

Mass movement (landslides)

Mass movement encompasses erosion processes in which gravity is the primary force acting to dislodge and transport land surface materials. It is a function of the gravitational stress acting on the land surface

and the resistance of the surface soils and/or rock materials to dislodgement. When the gravitational stress exceeds this resistance, mass movement occurs. The occurrence of mass movement depends on the interaction of various factors including landform, lithology, soil type, rainfall intensity and duration, drainage characteristics and vegetation cover.

Landslip is seldom the result of a single factor as failure is the end result of activities and processes that have taken place over many years prior to the actual movement. In general, failures occur when the weight of the slope exceeds its restraining capacity. The most common triggering agent is the infiltration of water into the sloping land surface, which has the effect of both reducing the shear strength of the soil material and increasing the mass loading on the slope.

Within the study area there are a number of steeply sloping areas which may be susceptible to landslip if not managed correctly.

The analysis has determined that over 26% or 353 300 ha of the CCMA region has a high inherent susceptibility to land degradation (mass movement). The areas most prone include the slopes of the Otway Range, Heytesbury, Barrabool Hills and Bellarine Peninsula.

Wind erosion

Wind erosion is the loss of soil particles by wind. It occurs when the lift forces of the wind exceed the gravity and cohesion of the soil grains at the surface.

Susceptibility of land to wind erosion is determined by taking into account the inherent features of the soil, the climate and position in landscape. The erodibility of the topsoil is a major factor, but structure, texture, stoniness and organic matter are all significant. Land use and management may have a major influence on the degree of deterioration, particularly if dry soils are exposed when erosive winds are likely to occur.

Wind erosion is likely to reduce the organic matter and nutrients available in the topsoil, while the reduction in topsoil depth also leads to reduced water infiltration causing increased runoff and a fall in productivity.

Over 163 900 ha (12.3%) of the region is considered to have a high inherent susceptibility to wind erosion. The loose sandy topsoils on coastal dunes, sedimentary parent material on the Western Plains, granitic parent materials of the You Yangs and granites of the Midlands, are highly susceptible to wind erosion. The western basalt plains with fine sandy loam topsoils, and the lower hills and plateaux of the Otway Ranges have moderate to low susceptibilities.

Waterlogging

Waterlogging is the retention of excess water in the soil profile to the extent that soil is weakened and aeration is insufficient for healthy plant growth. This reduced soil aeration is controlled mainly by inherent soil factors including structure, texture, porosity, organic matter as well as climate and topography.

Waterlogging is favoured by low topographic positions that receive runoff, land with naturally high watertables, gentle slopes that are unable to shed excess water efficiently and soils with low permeabilities. High rainfall areas are also prone to waterlogging where soils are unable to shed excessive quantities. The Heytesbury region is an example of where excessive rainfall on heavy clay soils leads to seasonal waterlogging.

Waterlogging across the catchment is, spatially, the second highest in order of importance or affect. Nearly 700 000 ha is thought to have a high inherent susceptibility to waterlogging. Areas included are the Heytesbury region, basalt plains and rises throughout the Western Uplands and Western Plains. Natural swamps and wetlands are the most obvious areas prone to waterlogging.

Besides resulting in yield losses, waterlogging also presents a serious management constraint by limiting opportunities for farm operations in cropping and grazing systems. Traffic by wheels or hooves on waterlogged soil results in soil structure decline and can aggravate water erosion.

Soil-structure decline

Soil structure decline is the terminology used to refer to changes in the stability of soil aggregates and changes in arrangement of spaces (porosity) within soil material that result in conditions that are less favourable to plant growth. Changes in aggregate stability occur through excess tillage (pulverising when dry, dispersing when wet) and through prolonged (over years) cropping or grazing with resulting reduction of soil organic matter. Changes in porosity may result from compressing and churning moist or wet soil by wheels or hooves causing compaction and pugging. The primary affects are on soil hydrology, aeration, soil strength and root development. Soil structure decline can also increase the incidence of waterlogging and makes the soil more susceptible to erosion by wind or water.

Soil texture, organic matter, mineralogy, climate, topography, and vegetation all affect the degree to which soil structure is susceptible to decline.

Potentially the greatest land degradation issue across the Corangamite region, soil-structure decline has rated highest in terms of area highly likely to be inherently susceptible to degradation. Nearly 800 000 ha or 60% has a high rating. Landscapes thought most vulnerable include the Western Plains (sediment derived soils, basalt plains, slopes of the Heytesbury region) and the Southern Uplands (hills and low hills of the Otway Range, Bellarine Peninsula and coastal sediments).