FORMS OF DEGRADATION

Salinity

Salinity develops when stored salts derived from the atmosphere and from roc weathering become concentrated in the root zone.

Susceptibility and incidence

Two main types of salinity occur in the general region around the study area.

The first, and potentially the most difficult to control, is caused by deep lead discharge. This results when salty water contained in deep leads (buried sands and gravels of ancestral river channels) is forced to the surface. The amount of water in the deep leads is influenced by seasonal rainfall, and some evidence suggests that years of excessive rainfall lead to an increase in the discharge of the deep lead system.

A susceptibility to salinity therefore exists in any part of the plain that overlies deep lead systems. Recharge to the deep leads takes place over vast areas and is extremely difficult to control.

This type of salinity was not found within the study area: however, it is likely that there are recharges sites within the study area which contribute water to the deep leads causing salinity to occur outside the study area.

The second main type is due to loam or regional groundwater systems not related to deep lead systems. Recharge is often very close to the incidence of salting. The Department of Conservation and Environment currently believe that recharge typically occurs through sedimentary terrain on crests and slopes where permeable fractured rock strata lie near or at the surface. Stored salts in the soil and weathered rock are mobilised by infiltrating water, and salting usually results on lower slopes and in depressions where the salty water-table nears or reaches the surface.

Clearing the native vegetation from recharge sites allows increased water infiltration to the groundwater systems, and is largely responsible for the increase in salting since European settlement.

It is this second type of salinisation that causes saline discharge sites within the study area.

Notable occurrences of salting in the study area are on lower slopes and in depression in the Burnbank Plains Unit and to a lesser extent in the Burnbank Slopes and Trawalla-Pinepark Units. Other minor instances of salinity occur throughout the study area.

Effect and management

When salt-bearing water tables reach within approximately 2 m of the soil surface, water rising by capillarity evaporates and concentrates the salts at the surface, resulting in the eventual death of crops, pastures and trees. Farm water supplies may also be contaminated, and in severe conditions where surface discharge occurs, stream flows become saline which adversely affects the stream ecology. Vegetation growing at the salting site may actually concentrate the salts in the soil by continually removing the soil water by transpiration. Ironically their growth can result in salts concentrating to toxic levels.

To reverse the dramatic increase in salted areas, land use must incorporate species with higher water use, especially in areas of maximum groundwater recharge, such as on the shallow permeable soils on sedimentary hills. Replanting with trees and deep-rooted perennial pastures and the use of deep-rooted species on flat recharge areas such as lucerne will encourage a balanced land use.

Unlike other forms of degradation, the cause and effects of salinity may operate on areas that are widely separated. Problems in extension and reclamation occur when the cause is inappropriate management further up the catchment. Effective treatment requires co-operative programmes within the region (e.g. LandCare group activities) to optimise and integrate land use and management practices.

Sheet Erosion

Sheet erosion takes place when the forces due to rainfall, flowing water and gravity overcome the cohesion and weight of the soil particles or aggregates. Sheet erosion only occurs in appreciable amounts when the land is devoid of a protective vegetative cover: for example, after overgrazing or cultivation, or when the growth of vegetation is affected by an adverse condition such as salinity, waterlogging or soil acidity.

Susceptibility

The potential for sheet erosion exists on any sloping land.

Potentially erosive overland flow results when rainfall or run-on exceeds the infiltration capacity of the soil. Erosion susceptibility is greatest in the steeper areas that have soils of low infiltration capacity.

In the study the areas with duplex soils and/or those with sealing or hard-setting surfaces are most likely to cause overland flow and have the potential to be sheet or rill-eroded. These areas include the steeper slopes on sedimentary rocks, especially the metamorphic aureole ridges (e.g. the Ben More Hills Unit), and less commonly the granitic slopes.

Incidence
Sheet erosion is widespread on the sharp, and generally cleared, metamorphic aureole peaks and ridges. Other notable instances occur on cleared sedimentary hills. In most cases land disturbance, such as clearing, overgrazing and cropping, vegetation harvesting or soil extraction, has increased overland water flow and exposed the soil to erosion. Erosion on granitic slopes is less common due to the high infiltration capacity of the topsoils. However, many of the granitic soils have relatively impermeable clay subsoils, and when rainfall exceeds the storage capacity of the surface soils, overland flow and sheet erosion occur. Rill and track erosion are specialised forms of sheet erosion, and frequently occur in conjunction with sheet erosion.

Minor examples of sheet erosion occur on the colluvial slopes surrounding the metamorphosed ridges.

Effect and management
Sheet erosion reduces on-site productivity – large through loss of the topsoil and its nutrients, and the exposure of hard-setting or inhospitable subsoil horizons. Off-site effects include: increased flash flooding, sedimentation and stream degradation, damage to roads.

Management practices which reduce sheet erosion include – in steeper areas fencing to preclude grazing and allow natural revegetation, and the control of rabbits – and in gentler areas pasture renovation and the construction of contour banks.

Gully Erosion

Gully erosion ensues when the forces due to rainfall, flowing water or gravity overcome the cohesion and weight of the soil particles/aggregates.

Susceptibility
Gullies develop where run-off and seepage waters accumulate, most commonly in valley colluvium and alluvium. The areas at greatest risk are the mid and lower slopes and valleys on or adjacent to the steeper hills and ridges. The retention of native vegetation usually prevents erosion, with the roots of plants providing mechanical resistance to soil detachment as well as keeping the soils relatively dry. Duplex soils with hardsetting surfaces are especially prone to gully erosion. These topsoils readily shed water increasing overland flow and leading to erosion. The clayey subsoils, as well as providing a choke to rainfall infiltration which in turn increases overland flow, tend to be unstable (with high slaking and dispersion characteristics), encouraging soil detachment.

Incidence
Gully erosion, often initiated by salting is common throughout the study area, especially on sedimentary terrain. Notable sites include: the undulating to hilly sedimentary terrain; and the lower colluvial slopes off the metamorphic aureole ridges. These areas include the Burnbank Slopes, the Burnbank Plains, the Ben More Foothills and the Trawalla-Pinepark Units.

Effect and management

Although the amount of land lost to production is small, gullies restrict the movement of livestock and machinery, and reduce the vigour of the adjacent vegetation. Gully head development may threaten roads and other services, while the general off-site effects include increased sedimentation and stream degradation, and frequency of flooding.

Reducing the overland flow into the gullies is an essential first step in preventing gully erosion or controlling an existing problem. In general, land management should be directed towards increasing water use by planting deep-rooted species such as trees or perennial pastures. Contour banking or deep ripping may be appropriate in some situations.

When gully erosion is advanced, common control measures include the construction of fences to keep out stock, of gully head structures and of diversion banks. Other measure include gully rebattering, planting trees, shrubs and grasses, eradicating rabbits.

Streambank Erosion

Streambank erosion results when forces due to water movement along a stream channel are sufficient to detach and remove soil material from the banks.

Susceptibility and incidence
The potential for this form of erosion exists along the banks of all streams in the catchment. The presence of native vegetation, mostly *Eucalyptus camaldulensis*, usually prevents significant erosion.

Effect and management
Significant streambank erosion can lead to sedimentation of stream channels and may damage structures such as roads and bridges. Along the stream itself, bank erosion can be reduced by establishing a dense cover of vegetation and by excluding stock, or at least by providing stock with stabilised access to the water. In severe cases, physical protection of the banks, for example by logs or rocks, may be necessary.

Gully erosion is not only unsightly; it lowers agricultural production, restricts access to properties, threatens roads and other structures and provides a source of sediment to clog streams and dams.

Wind Erosion

Wind erosion occurs when the forces due to wind are sufficient to overcome the cohesion and weight of the soil particles and allow their movement.

Susceptibility
The susceptibility of soils to wind erosion depends on a number of factors, including surface texture, position in landscape and the probability of strong winds when the soil is in a dry and exposed condition. Surface soils high in organic matter, or with sandy loam, silty or sandy textures, are most susceptible. In the study area the granitic soils on exposed crests and upper slopes are at greatest risk.

Incidence
In most years the area suffers only minor wind erosion.

Effect and management
The main effects of wind erosion are loss of productivity through loss of vegetation cover, surface nutrients and topsoil. To reduce the hazard the topsoil must be protected, especially during dry and windy periods. In cropping rotations stubble should be retained as long as possible and the length of fallow periods minimised, and when cultivated the ground left in a ridged cloddy condition. In grazed areas a good pasture cover should be maintained. Fertilizer application, resowing, rabbit control and conservative stocking rates may be necessary.

Soil Compaction

Compaction is the increase in soil bulk density and the related decrease in porosity that develops when the physical pressure on the soil exceeds its ability to resist deformation.

Susceptibility
Susceptibility to compaction depends largely on soil organic matter and moisture content, texture and structure. When moist, soils are at their weakest state and hence are most vulnerable. Soil texture influences the maximum amount of packing that can occur and medium textures, such as loams and clay loams, are most susceptible. Organic matter promotes the formation of aggregates that resist deformation and compaction.

Incidence
Some degree of compaction occurs throughout most soils. It is most noticeable in soils that are regularly cultivated, or are subjected to continuous trafficking such as may occur near farm gates.

Effect and management
Soil compaction, since it affects most soil types, is a significant but often unnoticed form of soil degradation. It can hinder seed germination, decrease seedling emergence and reduce plant vigour. Other effects include increased run-off, leading to sheet erosion on-site and increased flash flooding and sedimentation off-site. Management practices such as minimum tillage, spray seeding or long pasture phases in a cropping rotation tend to reduce compaction by maintaining organic matter and by reducing mechanical disturbance. Susceptible soils should be grazed as little as possible whenever the soils are wet.

Slope Failure

Slope failure occurs when the shear forces exceed soil strength. This generally occurs when soil strength is reduced by an increase in water content and after clearing when the tree roots – which increased the strength in the soil by physical binding – being to rot. A slope failure may range from minor slumping on hillsides to a major landslide where large volumes of soil and/or rock slide down a hillslope.

Susceptibility
The susceptibility is greatest on the steeper slopes of the basaltic scarps, the metamorphic aureole ridges and the granitic and sedimentary hills. Soils with high infiltration rates allow the soil and weathered rock to become rapidly wetted, and therefore have a higher weight and lower strength. Similarly if an impermeable layer underlies the soil or weathered rock, the overlying zones become saturated and unstable. Clearing the perennial native vegetation extends the period when the soil is wet, and removes the anchoring effect of tree roots. Undercutting of slopes by road construction may

contributed to slopes failure. Risk of slope failure is highest when periods of prolonged soil saturation on steeper terrain coincide with any seismic activity.

Incidence

In the study area the actual incidence of slope failures is low. Minor movement occurs on the basaltic cones and scarps, especially where the basaltic soils overlie weathered sedimentary parent materials, and on the steeper granitic and sedimentary slopes of the Ben More Foothills and Ben More Hills Units.

Effect and management

Slope failures limit productivity by exposing inhospitable subsoils, and may cause damage to structures such as fences, buildings and roads. Stabilisation of hazardous areas may sometimes be achieved by replanting deep rooted plants, especially trees, which help to anchor the soil and decrease the soil moisture content: of course it takes many years for the trees to grow large enough to be effective.

Soil Acidification

Soil acidification is associated with improved pastures. The addition of nitrogen from either fertilisers or legumes results in acidification of the soil as the nitrogen is converted to nitrates. When nitrates are taken up by plants or leached from the system soil acidity increases. The build up of organic matter associated with improved pasture results in increased soil acidification. Removal of product (e.g. grain, hay or animal product) also serves to increase soil acidification.

Susceptibility

The susceptibility of soils to acidification is influenced by climatic factors, such as annual rainfall, and soil parameters such as organic matter content, clay content and mineralogy, texture, permeability and water-holding capacity. Light textured soils (i.e. sandy or loamy textured soils) of low initial organic matter content are most susceptible.

Incidence

Soil acidification is a potential, and probably widespread, problem in all cleared areas sown to improved pastures – especially legumes.

Effect and management

Soil acidification can result in aluminium and manganese toxicity, decreased availability of phosphorus, molybdenum, magnesium and calcium or decreased activity of soil microbes, including nodule bacteria. Regular dressings of lime may be required if toxicity problems severely limit plant production. The reduced growth of plants on soils affected by soil acidification undoubtably contributes to water recharge and hence in increasing soil salting.