

PART V

CONCLUSIONS AND RECOMMENDATIONS

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CONCLUSIONS AND RECOMMENDATIONS

The subjects discussed below require particular attention. For some, specific information is lacking and research is needed, but for others sufficient knowledge is available and extension work is needed to make it more readily accepted and applied.

Many of the subjects discussed are inter-related but they are considered separately to simplify their presentation.

Water Conservation

Sources of Sediment. The country in the Omeo land system is the most severely eroded in the catchment. It seems likely that a good deal of the finer sediment entering the Mitta Mitta arm of Lake Hume comes from this source. This area should take high priority in any soil conservation programme for the catchment.

Improvement of the condition of the Omeo land system involves problems of pasture improvement and management which are discussed later. Considerable mechanical works would also be necessary to arrest active gully-heads.

Erosion on steep country in the vicinity of the reservoir also results in discharge of sediment-loaded waters directly into Lake Hume. The main areas involved are the Bethanga land system, particularly the northern end, and the dry northerly slopes of the Murray valley. Pasture improvement and grazing management problems are involved.

Stream-bank erosion, of both major and minor streams, is resulting in undesirable sedimentation, particularly on the Mitta Mitta arm of the reservoir. Although mechanical works designed to protect the stream banks do achieve some control, the problem involves the behaviour of the stream-flow which in turn is a consequence of the general condition of the catchment. This influences surface run-off and infiltration and is discussed later.

To minimise sedimentation, all land-use practices should be designed and carried out in such a way that the overland movement of water is minimised.

Stream-flow Regime. As mentioned above, stream-bank erosion is a result of undesirable stream-flow conditions, resulting from rapid run-off. The maintenance of stream flows during dry periods is important for stock and domestic water supply within the catchment, and the extension of substantial flows well into the irrigation season is also desirable. Flood flows entering an already full reservoir before the start of irrigation are of little use.

The areas producing the greatest quantity of useful water are those with the highest precipitation. In general, these are well forested and in a suitable condition to achieve rapid infiltration. The condition of the snow country above the *E. delegatensis* forests is not as satisfactory. Soil compaction, opening up of inter-tussock spaces and the destruction of substantial areas of bog, with resultant stream entrenchment, have all been attributed directly or indirectly to the grazing of cattle. There seems to be no doubt that these conditions are detrimental to sustained stream-flows, but to what extent is not certain. Improvement of the condition of the snow country will require the close control of grazing and conservative management. Re-establishment of the extensively damaged bogs will possibly require small check dams on the entrenched streams to raise the water-table. Where extensive sheet erosion has occurred, such as on Mt. Hotham, Mt. Loch, Mt. Bogong and Mt. Nets, expensive hand mulching may be necessary to assist the revegetation.

Fire in the *E. pauciflora* woodlands, mostly in the Bogong land system, has resulted in destruction of the open, sub-alpine woodland formation, and its replacement by dense thickets of coppice growth. Snow, which formed drifts in gaps in the old woodland, is now blown across the landscape, and perhaps onto lower elevations where it rapidly melts and contributes only to peak flows. Opening of gaps in the coppice regrowth, to encourage snow drifts, would help keep water on the high country for longer periods. The presence of dense foliage, such as provided by low shrubs and coppice regrowth, within the snow mass or within a few feet of its surface, may cause more rapid melting due to re-radiation of infra-red wave lengths. The influence of both of these effects of vegetation on snow

accumulation and melting should be further investigated. Confirmation of these points could indicate the way to improvement of catchment conditions in this area.

The unimproved and often over-grazed condition of much of the Omeo land system and parts of other land systems in the south, results in rapid run-off, and has produced the severe gully and stream-bank erosion mentioned earlier. Pasture improvement and improved management techniques are needed.

The Enano land system has much dry country with poor ground cover. Conservative management, including control of Crown-land grazing and complete fire protection are needed.

Much of the Beloke land system is undeveloped. Landholders in this area should keep a close watch on grazing intensities to prevent over-grazing. However, this area is not as critical as others, because the swampy Morass Creek tends to smooth out high peak flows.

In the north of the catchment, the hilly country of the Murray land system should be managed carefully to maintain ground cover. Soil compaction, resulting from heavy grazing, is a serious problem on steeper slopes because cultivation is not generally possible. More subdivisional fencing is required to facilitate better control of grazing on the steep slopes.

Water Yield. There is little that can be done at present to increase total yield of water. The most substantial losses of water are by evaporation and transpiration. Insufficient is known of the rates of water usage by different forms of vegetation.

Some reduction of evapo-transpiration from pastures may be achieved by wind breaks. However, this would probably result in a longer growing season and not necessarily in increased water yield.

Forestry

Utilization of Mixed-Species Forest. Major utilization projects are at present aimed at the pure stands of *E. delegatensis*. These produce large volumes per acre of high-quality timber, and are thus an attractive economic proposition. The area of such timber are not great in proportion to the areas of better-quality mixed-eucalypt forest. Whilst foresters are claiming that there is insufficient unrealistic forest in Australia to meet future demands, (Turnball 1959) it seems unrealistic to allow the extensive mixed-species forests to stagnate. A programme of stand improvement in these forests, whilst not perhaps producing very attractive yields at present, would set the course for greater volume production in future years, and help to satisfy the demands which have been predicated.

Plantations. The Forest Commission of Victoria has embarked on an extensive programme of plantation establishment, in which 40,000 acre of plateau country in the Koetong land system is being cleared of native forest and planted to pines, mainly *Pinus radiata*. There are several other extensive areas of land in the catchment where climate, soils and topography are suitable for pine plantations and these areas are at present carrying only low-productivity eucalypt forest. There are numerous small areas in the upper reaches of the Lucyvale and Log Bridge Creeks, and much of the plateau country in the Bunjil land system which would be suitable.

Forest Roads. An extensive network of forest roads is necessary for quick access for fire suppression and is an essential part of any management scheme. In a study of logging practices in relation to sedimentation in pine forests in Idaho (USA), Haupt and Kidd (1965) concluded: "Sediment that reached the stream channels originated primarily on haul roads. Proximity of a road to a stream affected the frequency with which sediment flows reached the stream. Sediment reached channel bottoms through undisturbed buffer strips average 8 feet wide, but did not reach them if the strips were more than 30 feet wide." Road design and construction should be such that water concentrated by the road surface and rains does not cause erosion. Regular maintenance is essential to ensure that drains and culverts are free of debris and are operating satisfactorily. Where water discharges through culverts onto country not suited to cope with such concentrated flows, the flow should be spread to minimise the damage.

Logging. A certain amount of soil disturbance is inevitable during logging and in *E. delegatensis* forests exposure of bare soil is necessary to facilitate regeneration (Grose 1961). Logs are often hauled by winch or tractor up well-defined snig tracks. These tracks become drains for surface water, and

before being abandoned should be blocked at frequent intervals to divert and spread the water onto less-disturbed areas. Logs should never be hauled through perennial streams, and damage of the vegetation and ground cover within at least one chain of the banks of stream should be avoided. Maintenance of cleared tracks through logged areas simplifies access and is an aid to fire control.

Forest Fire Protection. Fire in forested country affects both the water supply and the timber crop.

A complete burn destroys the protective soil cover and exposes the soil to surface sealing by raindrop splash, and to sheet erosion. The resulting surface run-off may wash away some of the plant nutrients which were concentrated in the litter and organic material at the surface.

The effect on the timber crop varies with the intensity of the fire. A very hot fire will kill *E. delegatensis* forest; a mild fire may only cause damage to the lower part of the trunk. The heat may cause a breakdown of cells at the cambium and produce gum veins. A more severe scorch, such as produced by the burning of a small limb adjacent to the butt, may destroy the cambium at some point and cause the typical "fire scar" of dead wood so common in virtually all eucalypt forests. These fire scars provide access for wood-rotting fungi and termites to the inner parts of the tree, and lead to a considerable loss of timber.

Fire damage causes a check in growth and a loss of volume increment, particularly when the crowns of trees are affected.

The leguminous scrub species which abound in most of the forested areas appear to be encouraged by fire. Repeated fires at intervals of not less than a few years may result in a gradual increase in scrub density. This would increase the fire hazard, reduce accessibility and also reduce the value of the forest floor for grazing.

The use of fire to clear ridge-top or strategically-located firebreaks may be justifiable, but the indiscriminate burning of large areas to reduce the fire hazard appears to be undesirable.

Investigations should be initiated to test the validity of these hypotheses and to provide estimates of any losses incurred.

Grazing and Agriculture

Pasture Improvement. Whilst considerable pasture improvement has been carried out in the north, the southern part of the catchment is poorly developed. Topdressing of native pastures has not been a common practice because of the high delivered cost of superphosphate. Most of the less-steep cleared country in the south could be sown to subterranean clover and Wimmera rye grass, and with regular dressings of superphosphate should allow a considerable increase in carrying capacity, as well as improve the condition of this part of the catchment.

Although pasture improvement is widely practised in the northern valleys, greater use could be made of perennial species in the upper valleys.

In both the north and the south, and particularly in the south, there is a great need for experimental work to demonstrate the suitabilities of various pasture species, fertilizer requirements and desirable management practices. This should be accompanied by a vigorous extension campaign to encourage adoption of improved farming practices.

Subdivisional Fencing. Proper management of pastures is dependent on adequate subdivisional fencing. Areas with different capabilities should be separated and large paddocks reduced in size so that more effective use is made of available forage. Adequate control of grazing on the steeper northerly slopes is most important, as stock prefer the warmer aspects, even if less feed is available. The advice of the District Conservation Officer should be sought whenever new subdivisional fencing is being planned.

Economics of Improvements. Farming is a business, and so, in all cases of improved farming techniques, the farmer must be sure that he will not lose financially by adopting new methods. In some cases, simple arithmetic can supply a convincing argument, but often a number of factors have to be

weighed and the calculations become so involved that an experienced economist is required to reach an answer.

The widespread adoption of improved farming techniques in the south has been hampered by economic arguments.- A study of the economics of pasture improvement in the southern agricultural areas should be made at an early date. Also, the economics of development of remote areas of the Beloke, Livingstone, Mowamba and Cobungra land systems should be studied.

Climatic Data. More climatic data would enable a better assessment of agricultural potential to be made. Temperature, humidity, evaporation and rainfall records are needed for areas around Benambra, Corryong, Walwa, Talgarno, Koetong-Shelley and for some of the upper-valley agricultural areas such as Mitta Mitta, Cravensville and Nariel.

Soils Data. More detailed soil surveys for restricted areas, such as Group Project areas or individual farm-plan areas, would allow a better assessment of land-use potential to be made.

Levels of Soil Phosphate. Research is needed to ascertain how much superphosphate is necessary to reach optimum levels in the soil, and to determine minimum applications necessary to maintain that level. Many farmers in the north have been applying superphosphate at a rate of one cwt, or one bag per acre annually for many years, and now find the pastures are not responding to these applications. It seems likely that the optimum phosphate level has been reached on some such areas, and a much reduced rate of application would be adequate to maintain it. Lack of other elements, such as potassium or trace elements may be limiting plant growth.

Steep Farm-land. The application of heavy dressings of superphosphate to steep hill country can lead to the encouragement of annuals at the expense of the native perennials. The lack of vegetative cover on these hills in late summer and early autumn may result in extensive soil erosion and fertility loss by both wind and water. Research into this problem is necessary.

Where tractor-working is possible, but there is danger of erosion from the cultivation of steep slopes, contour ripping or chisel ploughing has proved a satisfactory method of loosening compacted soils and reducing run-off. Sowing of pasture species may be accomplished in the same operation with a chisel seeder.

Irrigation. Many farms, particularly those in the upper reaches of valleys, have small perennial streams running through them. There is scope for the development of small privately-operated irrigation projects on these. Advice on the suitability of the area, the water supply, the soils, the type of equipment and the best pasture species should be sought from irrigation experts.

Development of the Stream Flats. The development of the stream flats involves a number of problems. In many areas annual flooding is common, and they are usually the coldest and wettest part of the valley landscape in winter. Although nothing can be done to alleviate the coldness, drainage could reduce the wetness and assist in the rapid removal of flood-waters. As stream levels fall in summer, the stream flats become quite dry, although a water-table will usually be encountered within five to ten feet of the surface. Deep-rooted perennial species which can tolerate short periods of water-logging or complete submergence are required as the basis for high-productivity pastures. Flats which are regularly flooded in spring are difficult to keep clear of debris and weeds, such as *Polygonum hydropiper* and *Rumex crispus*.

Great care should be exercised in the removal of any stream-bank vegetation. In general, clearing and cultivation of stream flats should extend no closer to stream banks than about one chain.

Much greater use could be made of most stream flats.

Engineering

Road Construction. Road works by organizations other than the Forests Commission are largely confined to repairs, maintenance and reconstruction of sub-standard sections. The Forests Commission usually constructs some new road each year, as well as maintaining their existing roads. Forests Commission policy requires that in proclaimed urban water-supply catchments, all earth works,

including road works, must be referred to the Soil Conservation Authority for consideration of conservation aspects before construction begins. The extension of this principle to all road construction organizations in all proclaimed catchments is desirable.

Roads in winter snowfall areas present a particular problem because of the great volume of water which is held in the areas as snow. Roads cross drainage lines and the direction of sub-surface water movement more-or-less at right-angles, and must therefore intercept substantial quantities of both surface and sub-surface water, particularly during the thaw. Allowance must be made for this in the design of roads and road drainage in snow areas. Culvert out-falls should receive particular attention to ensure that erosion is not caused by the channeling of water.

The use of deposits of shaley or gravelly colluvial material from gullies near the base of slopes, for road-making material, should be carefully controlled. Mismanagement, or failure to adequately rehabilitate the area when finished with, could result in serious erosion.

Transmission lines. The clearing of transmission lines and ground hauling of heavy equipment up steep slopes has caused some erosion problems in the catchment in the past. Organizations engaged in such operations should work in close liaison with District Conservation Officers so that damage is kept to a minimum and is promptly repaired.

Farm Dams. Water conservation for stock and domestic purposes is an essential part of good farming, and helps to make it possible for land to be used to its best advantage. The failure of a farm dam, which may result from poor design or poor construction, involves loss, and the sudden release of dammed water when a wall fails can cause considerable damage to property. Well-placed dams can eliminate a considerable amount of stock trafficking and enable more efficient use of pastures.

Officers of the Soil Conservation Authority are trained in surveying dam sites and can give advice on construction methods. They also have available to them a soil testing laboratory which advises on the suitability of the soil material for dam construction.

General Assessment of the Area

The condition of the catchment for its function as a water-supply area is generally satisfactory. Erosion, the worst of which is in the southern tablelands, is producing some sedimentation of Lake Hume. Over the period 1932-59, approximately 13,500 acre feet of sediment has been deposited in the reservoir (S. R. and W. S. C. priv. comm.) but this is not regarded as serious by the controlling authorities. Sediment from Koetong Creek and the Mitta Mitta River has been higher than average in recent years. The former is probably the result of extensive fires in the Koetong Creek catchment in 1952.

A comparison of the inferred virgin condition of the vegetation of the snow country and its present condition, in relation to the collection and release of precipitation water, and particularly snow, indicates that deterioration of its effectiveness has occurred.

In general, agricultural production could be increased greatly by the more widespread application of the results of research. This applies particularly to the southern areas and the less accessible of the northern valleys, where the economics of improved techniques are often questioned. Research is still needed on many aspects of farm management and particularly in relation to steep land.

Although timber production from *E. delegatensis* forests is high, too little emphasis is placed on the mixed-species forests, much of which could be managed to produce large quantities of useful timber. There are large areas of forested Crown land in the northern half of the catchment which appear to be suitable for conversion to plantations of softwoods.

Effective fire protection is essential for stable land-use. In recent years, fires have caused little damage, despite several hazardous summers. Emphasis has been placed on the early discovery and suppression of fire, and this has included the development of a network of good forest roads to provide rapid access. Much progress has been made, but many areas still remain inaccessible.