EROSION CONTROL IN THE HIGH ALPS

by P. A. Keane*

ABSTRACT

The Summit Area Works Programme (S.A.W.P.) of the N.S.W. Soil Conservation Service has achieved its aim after 21 years: to control erosion in the alpine area of the New South Wales Snowy Mountains. A maintenance programme is continuing, but primary stabilization of eroded areas has been achieved. This article reviews the work of over two decades.

INTRODUCTION

The mismanagement of the environment by man often leads to disastrous effects - one of the most serious being erosion, the accelerated loss of soil. One such area where extensive erosion damage occurred was the alpine area of the Snowy Mountains. Deterioration and destruction of the vegetation by fire and grazing lead inevitably to serious erosion. The extent of the damage was outlined in surveys carried out by Costin (1954), Durham (1956-59), Taylor (1957-58) and Morland (1958-59). As well, Greenup (1964) carried out a detailed erosion survey.

The Snowy Mountains Scheme was developed to make use of the high mountains as catchment areas for several rivers. Water yield for electricity generation and eventually irrigation became the prime concern. The attainment of high water quality lead to

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the exclusion of grazing and attendant management techniques. The repair and mitigation of erosion in the alpine areas was then necessary to maintain water quality and yield.

The Soil Conservation Service of New South Wales undertook the task of controlling erosion in the alpine areas. Work commenced spasmodically from 1956/57 and then with concentrated attempts in 1961. The Summit Area Works Programme (S.A.W.P.), as it has become known, has continued each year to the present time.

Clothier and Condon (1968) have previously outlined stabilization works undertaken between 1956/57 to 1967/68. The details of work in this period will be briefly summarised and followed by a summary of work in the subsequent years.

ALPINE ENVIRONMENT

The difficult environmental conditions encountered in the alpine area have been outlined in the references already cited, and also by Bryant (1971) and Keane (1977).

The most severely limiting factor is climate. This has restricted the works programme, since its inception, to the warmest months of the year, usually December to March. Even during this period, climate can cause severe disruptions: sudden snowfalls, heavy rain and hail, ~~and~~ thick fogs ~~often occur accompanied by~~ and high winds can all cause temporary or complete abandonment of work.

Access is a problem in the alpine area. That it is a problem is partly due to the climate, but also due to the often difficult topography and the prescence of impassable wet areas.

The works programme has always been tempered by the desire to cause minimal further damage to this easily damaged environment. If some further disturbance was ever necessary, all care was taken to ensure repair.

The 1956/57 to 1967/68 Period

Access

The main area of serious erosion was the Carruthers Mountain to Mount Twynam area. Work commenced in this area, and was largely concentrated in it over both the initial and later years. Access to these areas was by the Blue Lake walking and bridle track from Charlotte's Pass.

Work commenced at Carruthers Peak in mid-summer, 1957. Trials were established, but very little other work was achieved, as the camp was demolished by a storm. There was no further work in the area until 1961, following the construction of the Soil Conservation hut, flown in piece by piece by helicopter.

During the intervening period, works were undertaken at other places in the alpine area which were more accessible. Small areas were treated at Rawson's Pass, Lake Albina, Granite Peaks, Consett Stephen Pass, North Ramshead, and on the Albina track.

From 1961 onwards, work was concentrated in the Carruthers Peak areas with some preliminary work around Mount Twynam.

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Small areas were treated each year. This was largely because of the problem of access. Helicopters were used each year from 1960/61 to 1964/65. Only relatively small amounts of materials could be transported in this way. Access for personnel and for food was by horse or on foot.

In 1965/66 it was decided to upgrade the Blue Lake walking and bridle track. This was badly eroded, with deep gullies channelising and diverting water. A small four-wheel drive vehicle was used for the first time, providing a more economical method of transporting supplies.

During the 1967/68 season a track was constructed between the Soil Conservation hut and Mt. Twynam. Most of the erosion in the Carruthers area had been treated by this time, and it was necessary to have access to the very badly eroded areas around Twynam.

Stabilization

The techniques used in the earlier years were dependent firstly on achieving run-off control. Small banks or ditches were built, using a small bulldozer or by hand, to control run-off. Paved drains were also constructed. These early works can be seen mainly in the Carruthers Peak area, but there were some sites treated around Mount Twynam.

It became evident that structural measures were not necessary, as good regrowth of vegetation reduced run-off. It was still necessary to provide drains to carry water downslope, but special lining materials such as fibre-glass matting or jute mesh were being tried, rather than rock pavement.

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Site preparation was considered important, and areas were smoothed, filled and lightly cultivated, depending on access and severity of erosion. This work was either by hand or by bulldozer.

Seeding and fertilizing was then carried out. A wide variety of clovers and grasses were sown and fertilization was with a high analysis fertilizer - containing nitrogen, phosphorous and potassium. Detailed investigations were underway to determine the most suitable seed, fertilizer and mixtures.

Mulching was then carried out, using meadow hay, at the rate of 4 to 5 tonnes per hectare. The hay was held in place by wire netting, or in some small areas by bitumen emulsion. Seeding, fertilizing, mulching and tacking down were all done by hand.

Drainage lines were reshaped and stabilized as necessary, and rock weirs constructed to trap bed load material.

The general locality, extent of area treated each year and costs are included in the Appendix.

The 1968/69 to 1976/77 Period

Access

Access was still a problem, especially regarding provision of materials. As well as the small four-wheel drive vehicles, other slightly larger vehicles were used. Increased amounts of materials were placed on site resulting in a gradual acceleration of work. At the same time, a great deal more work was put into maintaining access tracks in good condition

and repairing any ~~little~~ damage which may have occurred.

During the 1975/76 programme the track was extended from Mount Twynam to Mount Anderson. This was necessary so that the remaining large areas of erosion could be reached and treated. In the following year, this track which largely traversed erosion pavement, was stabilized and retired. Any retreatment necessary, including refertilization in the Mount Anderson area, will be carried out using a helicopter for materials, trail bikes for the workmen.

Tracks, no longer required in work area, are stabilized.

Tracks in the works area are stabilized when no longer required. There is rapid growth of the exotics used for initial vegetative cover followed by a relatively quick invasion of natives. In this way tracks no longer required ~~become quickly indiscernible~~ from the surrounding vegetation. quickly assume the ~~characteristics~~ characteristics of surrounding veget.

It is planned to close the track from Twynam to Carruthers hut in the ~~1977/78~~ 78/79 season, but the track from Charlotte's Pass to Carruther's Hut will be kept open for a number of years to enable maintenance work to be carried out.

STABILIZATION

The experience and expertise gained during the initial period and the results of trials commenced, resulted in increased efficiency in the rate and amount of work achieved. The locality, extent of area treated each year, including costs, are listed in the Appendix.

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Structural Techniques

Some structural soil conservation works were still used, but these were kept to a minimum. Several contour banks were constructed in the Twynam area and also at Bull's Peaks. Deep ripping of some areas was also used at these two locations. Flow lines and water disposal drains were shaped if necessary, and stabilized using jute mesh and bitumen emulsion. The technique of mulching eroded areas in strips across the slope, and the relatively rapid growth of vegetation meant that run-off control in the form of diversion banks or ditches was generally not required.

Site Preparation

Site preparation was kept to a minimum during this later period. There was little ground preparation, apart from deep ripping during the 1969/70 and 1970/71 works seasons. All areas treated at Bull's Peaks were ripped. Actively eroding edges between the erosion pavement and the uneroded or slightly eroded areas were shaped before further stabilization.

Seeding and Fertilizing

Glasshouse and field trials made possible specific recommendations regarding the use of exotic species and fertilizers. (Bryant, 1971/72)

In previous years, up to nine species of grasses, three cover crop species, and four legumes had been used. The recommendations resulted in a reduced number of species being used, usually two or three grasses, and one or two legumes (Table 1).

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Table 1. Recommended Species and Seeding Rate for Alpine Revegetation (After Bryant, 1971)

Species	Seeding Rate (in mixture kg/ha)
Agrostis tenuis (colonial bent)	
cv. Highland	1- 4
Agrostis stolonifera (creeping bent)	
cv. Seaside	1- 3
cv. Toronto	1- 3
Festuca rubra	
ssp. rubra (red fescue)	1- 3
ssp. commutata (Chewings Fescue)	1- 3
Lolium perenne (perennial ryegrass)	
cv. Tasmanian	5-10
cv. Ruanui	3- 8
Trifolium repens (white clover)	
cv. Ladino	2- 5
cv. Tasmanian	3- 5
cv. Idaho	2- 5
Trifolium ambiguum (Caucasian clover)	
cv. Summit	-
cv. Treeline	-
Avena sativa (oats)	
cv. Avon	10-20
Secale cereale (ryecorn)	10-50
Secale montanum (black winter ryecorn)	10-50

Note: Not all recommended species are commercially available. The species currently used are Highland bent, N.Z. perennial rye, and N.Z. white clover.

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From the 1971/72 season, seed of white clover was obtained from high altitude areas in New Zealand. The results from this seed proved superior, with better establishment and ground cover than Australian grown seed. In later years, all seed was obtained from high altitude areas in New Zealand, resulting in improved growth and persistence.

Trials in Association with C.S.I.R.O. established that the standard Rhizobium trifolii inoculum strain TA1, used for white clover was ineffective for high altitude conditions (Brockwell, et. al. 1972). Another inoculum, strain CC275e, proved superior and has been used since the 1971/72 season. Another result of this work was that legume seed was lime pelleted and inoculated by the single-step technique (Brockwell, 1962) rather than the three-step procedure (Hely, 1963). The single-step technique proved slightly but consistently superior to the three-step technique.

Fertilizer recommendations detailed the rates of the major elements, nitrogen, phosphorus and potassium required, the need for and rates of lime, and the requirement for boron and magnesium (Table 2).

Seed and fertilizer were broadcast by hand.

Mulching

Hay mulching remained the method used for protection during plant germination and establishment phase. The mulch protected the seedlings against the vagaries of alpine climate and also provided a more favourable conditions for early growth.

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Table 2. Recommended Fertilizer Mixture for Alpine Revegetation (After Bryant, 1972)

Fertilizer				Rate (kg/ha)
Nitrogen	Phosphorus	Potassium	Other	
12	23	0		125.5
11	15	9		251
			Lime	627.6
			borax (B)	5.7
			epsom salt (Mg)	16.8

From the 1969/70 season mulch rates were varied. Heavy rates of hay in mid-season were found to be hindering growth by depressing optimum germination temperatures. The rates at this time were therefore reduced. However the mulching rates were not varied at the beginning and towards the end of the season, as the chance of frost is highest at these times.

From this same season bitumen emulsion alone was used to tack down the hay mulch. This immediately resulted in larger areas being treated.

Native Species

The use of native species was initiated during the 1968/69 works season, but results were not encouraging. Both sowing of harvested native seed and vegetative methods have been tried with varying success, the vegetative methods proving better.

The extent of work undertaken, coupled with the short season has meant that the most important consideration has been primary stabilization by exotic species, with only relatively minor amounts of native species being sown.

MAINTENANCE

An important aspect of the works programme each year has been the maintenance of areas previously treated. This has usually involved refertilization of areas treated in the preceding years.

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However, if establishment failure from the previous year's sowing was evident, full re-treatment was given.

All areas which had been stabilized by mulching and pinning with galvanized wire netting have been re-stabilized using mulch tacked with bitumen emulsion after removal of the netting. This netting appeared to work well in early years, but it was noticed that all species, particularly natives were adversely affected by its prescence. It is thought that the netting slowly released zinc into the soil underneath it, causing toxicity problems. It was noted that some of the exotic species, notably bent, were more tolerant of the conditions created. Since the wire has been removed there has been good establishment of exotic and native species.

Black wire netting, also used in earlier years, rusted and disintegrated after four to five years, without having any adverse affects.

Continued maintenance of the more recently treated areas will be necessary for some years to come. Maintenance fertilizations will become unnecessary as natives become established.

EVALUATION OF THE WORKS

The results obtained during the past twenty years have generally been excellent. While complete ground cover has not been achieved on the previously seriously eroded sites, even these are stable, with no evidence of soil movement.

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Where less soil had been removed there is good establishment of natives as competition from the exotic species gradually diminishes.

The relatively new silt fans in many drainage lines are stable, becoming bog or fen communities once again.

While the alpine soil and vegetation may only very slowly return to its former stable situation, it can be said with confidence that the alpine environment is regenerating.

SUMMARY

The Summit Area Works Progamme has successfully completed its task. The many problems encountered were solved with gained experience and experimentation, in what can be described as one of the most difficult environments on the Australian continent.

The alpine area is now a safe catchment, delivering clean water to the Snowy Mountains Scheme. As a wilderness area in the Kosciusko National Park it will remain little disturbed, preserving this fragile environment from further damage.

ACKNOWLEDGEMENTS

Thanks must go to the many officers of the Soil Conservation Service who worked in many ways towards the completion of the works programme.

The assistance of the Snowy Mountains Hydro-Electric Authority, Kosciusko National Park, C.S.I.R.O., and Department of Main Roads is acknowledged.

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APPENDIX

Summit Area Works Programme 1956/57 to 1976/77

Year (season)	Area Treated (location)	Extent of Area (ha)	Expenditure ($)
1956/57	Carruthers	0.8	$ 3,300
1957/58	Rawson Pass Albina Lake	1.0	$ 7,957
1958/59	Granite Peaks		Nil
1959/60	Granite Peaks Consett Stephen Pass	3.6	$ 9,008
1960/61	North Ramshead Albina Track Carruthers	3.6	$33,400
1961/62	Carruthers Twynam	3.2	$18,952
1962/63	Rawsons Pass Carruthers Twynam	3.0	$19,283
1963/64	Carruthers	4.3	$23,025
1964/65	Carruthers	2.8	$18,690
1965/66	Carruthers	2.2	$19,058
1966/67	Carruthers	2.8	$26,592
1967/68	Blue Lake Track Carruthers Twynam Track	5.0	$27,600
1968/69	Twynam	4.8	$27,877
1969/70	Carruthers Twynam	14.8	$29,190
1970/71	Bulls Peaks Twynam	30.0	$27,792
1971/72	Twynam Bulls Peaks	38.0	$29,485
1972/73	Carruthers Twynam	14.0	$35,823
1973/74	Carruthers Twynam	27.0	$44,600
1974/75	Twynam	12.0	$44,600
1975/76	Twynam Anderson (Anderson Track)	4.0	$55,552
	Anderson son	15.0	$49,290