

A Proposed Plan for the Rehabilitation of the Snowy River in Victoria

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SUMMARY

An environmentally degraded river can be best improved by a combination of restored environmental flows and management intervention targeted at reinstating desirable riverine features. This is demonstrated by the development of a river rehabilitation concept for the Snowy River in Victoria.

Concerns about the environmental condition of the Snowy River have been expressed for many years and have recently been reflected in submissions to the Snowy Water Inquiry. The causes of environmental degradation are complex. The primary factors are the significant reduction in flows resulting from the operation of the Snowy Mountains Hydro-Electric Scheme (SMS), and the demise of large stretches of riparian vegetation resulting from extensive agricultural development in parts of the catchment.

The degraded features of the Snowy River environment are identified, and a range of rehabilitation strategies are proposed. To achieve the greatest benefit a combination of increased flows and intervention is required. The intervention measures consist of the installation of structures in the River itself, as well as vegetation and environmental management.

When considering rehabilitation strategies for a river degraded through flow intervention:

- Identify the desirable riverine features
- Consider environmental flow reinstatement as a first strategy
- Supplement with management and structural intervention strategies

1 INTRODUCTION

This paper is based on a report prepared for the East Gippsland Catchment Management Authority / Dept of Natural Resources & Environment by a team of consultants led by ID&A Pty Ltd. (ID&A, 1998). The contribution of specialist inputs by Dr Chris Gippel, Doug Hall, Mike Stewardson, and Neil Sturgess as part of this team is acknowledged and much of the material in this paper is attributable to their inputs.

2 THE SNOWY RIVER IN VICTORIA

The natural flow regime of the Snowy River has been changed by the implementation of the Snowy Mountains Hydro-Electric Scheme (Erskine & Tilleard 1997, Stewardson et al 1997, SGCMC 1996). The diversion of water by this scheme, from the upper catchment of the Snowy, has caused a significant reduction in stream flow in the Lower Snowy River. The altered flow regime has impacted on the Snowy River downstream of the diversion in a number of ways, generally to the degradation of stream health. Agricultural activities in the catchment, and especially adjacent to the waterways, have also adversely impacted stream health over the last hundred years or more.

Figure 1 identifies the Reaches of the Snowy River in Victoria.

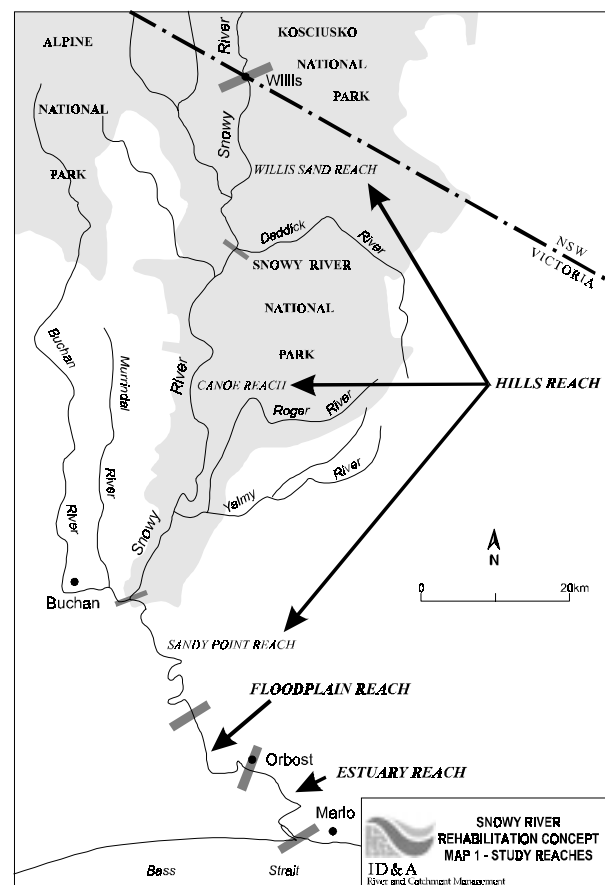


Figure 1 Snowy River in Victoria

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Stream health problems in the Snowy River in Victoria include:

- exotic weed invasion through reaches of high conservation value;
- loss of pools in the lower Snowy River
- reduction in fish habitat;
- deteriorating wetland values; and
- upstream migration of the saline wedge in the lower Snowy River.

2.1 Hills Reach

Willow and other exotic plants have colonised sections of the Willis Sands and Canoe reaches of the river. This can be substantially attributed to creation of a niche associated with channel contraction under the lower flow regime. This reach of the Snowy River has been identified as being of high conservation value that is under threat from willow and blackberry colonisation.

2.2 Floodplain Reach

The change in the flow regime has resulted in a reduction in flow and a change in the bedform, which is now dominated by longitudinal bars. Deep pools and alternating bars, which existed prior to the Snowy Mountains Scheme, and which provided favourable aquatic habitat, are no longer characteristics of the Snowy River Floodplain Reach.

The loss of riparian and verge vegetation as a result of development of the floodplain, and its replacement in places with exotic species such as willows, has also degraded the river to some extent.

2.3 Estuarine Reach

The dominance of lower flows in the Snowy River has allowed the saline wedge to penetrate upstream more frequently. This has resulted in the conversion of wetlands that were only brackish at times of low flow, to wetlands that are essentially saline all year round. It has also imposed increasing limitations on water extraction for agriculture. Work done by Jon Hinwood and interpreted by Chris Gippel shows that the probability of saline migration up to, or passing, Orbost (km 18) has more than doubled. (Figure 2)

Loss of stream bank vegetation on the lower Snowy River associated with agrarian activities has increased the susceptibility of the stream bank to erosion. The upstream saline migration may also contribute to this erosion, if it affects the residual vegetation.

2.4 Wetlands

Wetlands in the Lower Snowy can be classified in a number of categories:

- floodplain wetlands fed by surface water (not by Snowy River)

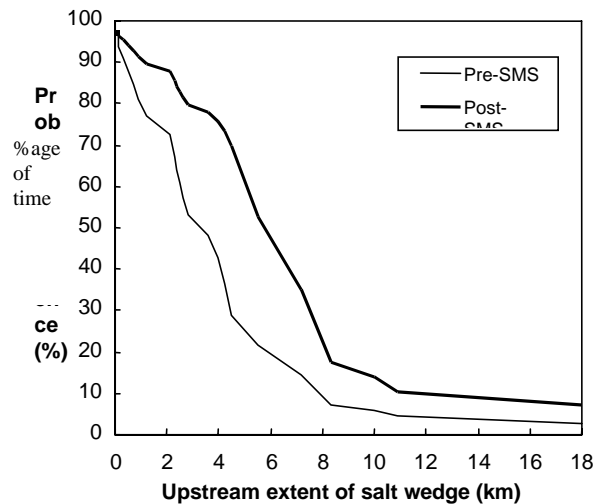


Figure 2 Probable Extent of Salt Wedge Location in the Lower Snowy River - pre and post SMS

- floodplain wetlands fed by overflow from the Snowy River
- estuarine wetlands fed by a combination of tidal flows and river flows.

Wetlands of the lower Snowy River are affected by:

- Direct disturbance of floodplain wetlands (conversion to farmland)
- Regulation of floodplain inundation by levee bank construction
- Regulation of flows by headwater dams

Despite suffering varying degrees of degradation, all wetlands of the lower Snowy below Orbost (except Cabbage Tree Lagoon) are listed on the Register of the National Estate, in which they are recognised as areas of zoological, botanical, geological and geomorphological significance (DCE, 1992).

3 RIVERINE FEATURES

To achieve rehabilitation of the Snowy River it is necessary to reinstate, fully or partially, some of the features/characteristics that are important to its environmental well-being.

3.1 Habitat

Doug Hall provided the expertise for the assessment of environmentally suitable conditions for aquatic species.

An important feature of the Snowy River is the amount and quality of habitat provided for aquatic fauna species (fish and macroinvertebrates). Riverine features that contribute to a good quality of habitat in the Snowy River are:

- suitable water temperature
- woody debris
- vegetation - instream and riparian
- deep pools

These features are currently absent or degraded in many parts of the Snowy River, particularly in the floodplain reach.

3.2 Aesthetic Appeal

The features that contribute to the aesthetic appeal of the river are:

- Continuity of indigenous riparian vegetation
- Clear, clean water
- Presence of fish

The Snowy River, especially in the floodplain reach, is deficient in the first of these features.

3.3 Fish Passage

The river serves as a channel for migration for a large proportion of the fish species that are known to occur in the Snowy River. To perform this function adequately the river must have the following features:

- adequate depth as required by any and all of the species
- availability of resting places. These are usually well-shaded, deep pools with plenty of shelter
- shade and cover
- velocity diversity
- no barriers (rock bars, etc) to fish migration

Generally there have not been any fish barriers identified in the Snowy under the present flow regime (Hall, 1989). However the other features are deficient, especially in the floodplain reach.

3.4 Substrate Mobility (sediment transport)

An inherent function of any river is the transport of sediment. A desirable feature related to this function is that it occurs in such a way that extremes of erosion or sedimentation are avoided throughout the river's course. Generally the Snowy River appears to perform this function satisfactorily, with a flow regime that punctuates long periods of low flows with regular floods.

3.5 Riparian Ecosystem

A healthy riparian zone contributes to maintaining water quality, terrestrial and aquatic ecosystems, and bank stabilisation. Among other things it:

- Reduces fine sediment levels
- Reduces contaminant loads
- Reduces nuisance plant growths
- Maintains lower summer maximum temperatures by shading

- Increases in-stream habitat features and food supplies.
- Reduces floodflow effects
- Protects banks from erosion
- Provides in-stream food supplies and habitat
- Provides habitat for terrestrial species

The riparian vegetation along a number of stretches of the Snowy River is severely degraded as a result of agricultural development, and the opportunistic invasion by exotic species of river margins under a reduced flow regime.

3.6 Floodplain Inundation

Historically, during flood events the overbank flow of the Snowy River recharges a number of wetland areas on the floodplain. This process has now been circumvented to some extent by the construction of levees. However there are still some wetlands that are serviced through strategic breaks in the levee banks, such as at Lynn's Gulch. These wetlands are of considerable ecological importance, especially in regard to habitat for birdlife.

3.7 Estuarine Processes

The flow in the Snowy River is the principal form of control over the upstream migration of the saline wedge. The other control is the size of the opening to the sea at the mouth. However this is also a function of flows in the Snowy, since it is the high flood flows that scour out the opening. Upstream migration of the saline wedge affects not only the Snowy River itself, but also the estuarine lakes system of Lake Corringale, Lake Curlip and Lake Wat Wat.

4 REHABILITATION STRATEGIES

Potential strategies for the rehabilitation of the Lower Snowy River can essentially be categorised principally within twin concepts for river rehabilitation:

- (i) Reinstatement of environmental flows
- (ii) Physical intervention in the River or its environs to address environmental issues and compensate for intercepted flows. These strategies are designed to manipulate the physical or biological state of the bed, banks, or verge of the River.

4.1 Increase in Environmental Flows

It should be emphasised that the most appropriate measure for the long term rehabilitation of the Snowy River would be the reinstatement of the pre-SMS flow regime. An increase in environmental flows has been identified as the only feasible rehabilitation measure to address the frequency of saline wedge migration upstream. While strategies have been identified to address other rehabilitation measures on the River, they tend to be singular measures focused on a particular river characteristic. While there is considerable effort devoted to the integration of the individual measures,

their interaction can be complex, since they are designed to manipulate environmental conditions in different ways. By contrast the reinstatement of environmental flows addresses most of the issues in a single strategy.

It is acknowledged that reinstatement of flows alone would not completely rehabilitate the River. There would still be land use and riparian vegetation issues to be addressed. It may not even, of its own, bring about the reinstatement of pools and alternating bars in the floodplain reach. This is due to the riverbed characteristics, which have been changing even before the SMS was implemented, showing an apparent increase in mean river bed particle size. However flow reinstatement would certainly provide conditions under which rehabilitation could be achieved with relatively little input or intervention.

The only perceived measure to control the saline migration is the provision of increased flows. A flow of 1000 ML/d would prevent the saline wedge from penetrating higher than 7-8 km from the mouth of the Snowy River.

A constant minimum flow is not recommended, since in the pre-SMS flow regime saline migration past Orbost also occurred, though less frequently. Rather, a flow pattern approaching that of the pre-SMS flow regime would be desirable. Improvement in the containment of the saline wedge will be seen to the extent that additional releases from Lake Jindabyne approach the pre-SMS flow regime.

4.2 Reinstatement of Pools in Lower Snowy

An assessment of fluvial processes related to pool formation, and options for creating appropriate conditions, was undertaken by Mike Stewardson. (See Stewardson, this volume for more details)

Historical evidence indicates that the floodplain reach of the Snowy River exhibited a favourable pool riffle morphology in the first half of this century. This was associated with regular alternating side-attached bars. However, since the late 1960's the bars have deteriorated and the pools have infilled, to the point where they are practically non-existent today. In their place is a more uniform river bed characterised by longitudinal bars.

In this latter condition hydraulic diversity and riverbed variations are much reduced. This is environmentally less favourable because:

- Habitat for aquatic fauna (fish and macroinvertebrates) is limited
- Water temperatures are likely to increase and dissolved oxygen levels are likely to decrease.

The Rehabilitation Concept Plan proposes a strategy of structural intervention to reinstate the alternating side-attached bars and thus the associated pool / riffle morphology. This will be achieved by the installation of timber pile fields in the form of retards at the historical locations of the bank-attached side bars. These retards will increase the flow resistance, resulting in deposition of sediment around the pile fields. Eventually they will effectively increase the velocity in the part of the channel opposite the toe of the bar, creating suitable conditions to scour a pool near the river bank.

The extent and cost of these works is dependent on the prevailing flow regime in the River. With increased flows, due to releases from Lake Jindabyne, the extent of the pile field can be reduced from that required for the present flow regime (since the channel constriction requirement is reduced for increased flows).

The alternating bars can be introduced into most of the floodplain reach from Jarrahmond Gauge down to Orbost.

4.3 Wetlands Rehabilitation

Appropriate wetlands rehabilitation strategies were developed by Dr Chris Gippel. The limitations of wetland rehabilitation are that:

- Much of the suitable land is privately owned, and landholders may be unwilling to convert agriculturally productive land to wetlands
- Much of the suitable land is protected from flooding by levees
- Landholders may be unenthusiastic about fencing Crown riparian land because of reduced access for stock watering, creating areas where pests may proliferate, and maintenance costs.
- Between Jarrahmond and Orbost, the most suitable land for rehabilitation of ephemeral wetlands is distant from the river channel and is alienated from it by levees. These wetlands would not be connected to the river during flood events, and so would not be useful as fish breeding habitat.

The Rehabilitation Plan recommends the following strategy be adopted for wetland rehabilitation, in order of priority:

- (i) Rehabilitate high value wetlands below Orbost
- (ii) Alternative management of some areas of Crown frontage - principally fencing and revegetation of low-lying areas to create ephemeral wetlands (meadows and marshes)
- (iii) Increased releases from Lake Jindabyne to limit the saline intrusion along the river

- (iv) Exclude stock from remaining and functional (but degraded and threatened) wetlands, such as those in the vicinity of the highway bridge at Orbost
- (v) Management of low-lying floodplain land distant from the river channel (historical ephemeral and/or deep wetlands) in cooperation with landowners. This would principally involve fencing and revegetation of low-lying areas to create ephemeral and/or deep wetlands. Areas that are less affected by levees and are, therefore, receiving regular flood flows from the river are the highest priority. Areas with local water replenishment are also suitable for rehabilitation.

4.4 Riparian Vegetation Rehabilitation

The following important components of a riparian vegetation rehabilitation program on the lower Snowy River were identified by Doug Hall.

Stock Access

A fencing program to exclude stock from all river frontage is a necessary pre-requisite and priority for riparian rehabilitation.

Willows

A staged willow removal program is recommended for the lower Snowy River. Willow removal would always be followed by replanting of indigenous species and, in areas with high erosion potential, may require additional short-term bank stabilisation measures.

Willow removal is also a vital strategy for the Hill Reaches of the Snowy in Victoria, and the upstream areas in NSW. Failure to deal with the problems upstream may limit the benefit that can be gained through any willow removal/replacement program downstream.

Weed Control

Weed infestation of lower Snowy riparian habitats is widespread and in heavily infested areas severely restricts establishment and growth of desirable indigenous plants. Weed eradication is unlikely and an appropriate weed control program is recommended as part of the riparian rehabilitation program. Weed control measures can include physical or chemical intervention and should be applied on an on-going, as needs basis. It is anticipated that weed control requirements will diminish with the progressive establishment of indigenous riparian communities.

Revegetation

Revegetation of riparian habitats with appropriate indigenous species will improve the stability and ecology of the riverine environment and should be implemented in conjunction with or following other rehabilitation strategies. Severely degraded sites or areas with high erosion potential may require works to stabilise revegetated areas in the short-term.

4.5 Large Woody Debris

Strategies for the reinstatement of large woody debris were developed by Dr Chris Gippel and Doug Hall.

Instream debris, most notably large woody debris such as logs and large branches, provide hard surfaces for attachment and growth of aquatic plants and invertebrates and also habitat conditions of fundamental importance for maintenance of fish populations. The Lower Snowy is notably lacking in woody debris. This could be due to a combination of loss of riparian vegetation and historical desnagging activities.

Re-creation of alternating bars and associated pools provides an ideal opportunity for reinstating woody debris leading to further improvement to the ecology of the lower Snowy River. Woody debris introduced at appropriate orientation and loadings (about 0.01 m³/m²) in the reformed pools will improve available habitat, leading to increases in abundance of most organisms. This will also help improve the stability of adjacent river banks. It is proposed that woody debris be installed in pools following their reformation and that introduced debris be appropriately anchored to help maintain their positions, particularly during high flow events. The woody debris may be arranged in the form of log jams to increase their stability, and overcome logistical problems associated with sourcing and transporting trees rather than logs.

5 CONCLUSION

Rehabilitation is best achieved by a combination of reinstatement of environmental flows and management intervention. For the Snowy River in Victoria the rehabilitation strategy incorporates proposals for increased flows to control upstream saline migration events, and improve riverine habitat. Supporting this are structural interventionist strategies; to re-establish pools in the floodplain reach; to introduce large woody debris to enhance the pool habitat; to improve the riparian vegetation; and to rehabilitate degrading wetlands.

6 REFERENCES

- Department of Conservation and Environment (1992) "Lower Snowy River Wetlands Proposed Management Plan". Orbost Region and National Parks and Public Land Division, DCE, East Melbourne, Victoria, Australia, 103 pp.
- Erskine W.D., Tilleard J.W. (May 1997), "Formative Processes of Alternating Bank-Attached Side Bars and Associated Pool-Riffle Sequences on Sand Bed Streams Similar to the Snowy River at Jarrahmond, Victoria", Dept Natural Resources and Environment Victoria.
- Hall, D.N. (1989) "Preliminary assessment of daily flows required to maintain habitat for fish assemblages in the LaTrobe, Thomson, Mitchell and Snowy Rivers", Gippsland. Technical Report No. 85, Arthur Rylah Institute for Environmental Research, Department of Conservation, Forests and Lands, Victoria.
- ID&A (1998), "Snowy River Rehabilitation Concept Plan", East Gippsland Catchment Management Authority.
- SGCMC (1996), "Expert Panel Environmental Flow Assessment of the Snowy River below Jindabyne Dam", Snowy Genoa Catchment Management Committee.
- Stewardson M.J., White L., Gippel C.J., Finlayson B.L., Tilleard J.W., (August 1997) "A Review of Concepts for Habitat Enhancement and Rehabilitation of Alternate Bars in the Lower Snowy River Above Orbost", Report by The Centre for Environmental Applied Hydrology and ID&A to Department of Natural Resources and Environment and Snowy River Improvement Trust.