Second Australian Stream Management Conference
8-11 February 1999, Adelaide, South Australia

On The Cost Of Stream Management And Rehabilitation In Australia

Lindsay J. White[1], Ian D. Rutherfurd[2] and Ross E. Hardie[3]

SUMMARY

This paper provides some preliminary information on:
1. the amount of money being spent on stream management (a subset of catchment management) at present in Australia;
2. the cost of doing typical stream management projects; and
3. the extra cost associated with stream rehabilitation work in streams.

Tens of millions of dollars are spent on stream related work in Australia per year at present. This amount is highly variable from year to year as programs such as the National Landcare Program, National Heritage Trust (NHT) and Natural Disaster Funding (NDF) come and go. Most money spent on river management in Australia is in the eastern mainland States. Traditional stream management of degraded streams (including stabilisation of the bed and banks) can be very expensive per stream kilometre (often in the order of tens to hundreds of thousands of dollars), but rehabilitation of degraded streams is likely to be even more. In part, this is because of the extra assessment and evaluation costs that are often associated with rehabilitation work.

MAIN POINTS OF THIS PAPER

- In the late 1990s, at least $50 million dollars is being spent on stream management in Australia each year, with most money being directed toward severely damaged streams.
- In many cases, ecologically oriented rehabilitation will cost even more than traditional erosion and flood control work
- The huge cost of this work is a strong incentive to preserve the streams that remain in good condition.

1. INTRODUCTION

It would be useful to know how much money is being spent on stream management in Australia at present. Such numbers are useful, for example, in defining the importance of stream management in relation to other publicly funded. In addition, a more detailed breakdown of the costs of stream management activities (on a project or resource scale) would be helpful for managers contemplating work in streams.

In this paper we provide a partial snapshot of national expenditure on stream management, as well as some indicative costs of elements of stream management projects. Finally, we touch on the *additional* costs that may be associated with modifying stream management works to enhance environmental values.

The problem one faces in gathering these numbers, of course, is to define stream management. For example, wastewater treatment plants contribute to stream health, but would they be defined as stream management? In this paper we define stream management narrowly as activities that improve the condition and health of stream-channels and their riparian zones – excluding the substantial costs of sewage treatment plants and broad-acre catchment management. Typical activities include construction of erosion control structures, riparian revegetation, weed and willow management, construction of fishways, negotiation of environmental flows etc. Thus, stream management can be seen as a subset of catchment management.

The data used in this paper was obtained from published reports, agency staff, consultants, or the Internet. All values are in 1997/98 Australian Dollars. These values can be corrected in the future for inflation by using the Consumer Price Index.

2. COSTS ON A NATIONAL, STATE AND REGIONAL SCALE

Table 1 lists some of the recent stream management funding from the Federal Government. These tables include funding for both works, monitoring, assessment and research. Some of these numbers may be double counted in the State figures in Table 2. Note that this table does not include the very large opportunity cost of water allocated to environmental flows, following the Council of Australian Governments (COAG) reform process that has been taking place in the States. For example, providing environmental flows to the Mersey

[1] Research scholar, Co-operative Research Centre for Catchment Hydrology, Monash University, Victoria
[2] Senior Research Fellow, Co-operative Research Centre for Catchment Hydrology, Monash University ,Victoria. Ph. (03) 9905 2940 fax (03) 9905 4944, email: rutherfurd@eng.monash.edu.au
[3] Senior Waterway Engineer, I.D. & A. Pty. Ltd., Wangaratta, Victoria

River in Tasmania will cost the Hydro Electric Corporation around $700,000 per year in lost power generation (Anderson, this volume).

The split of funding between regions within a State can be highly variable. For example, as shown on Figure 1, the split of NHT funding within Victoria between the ten Catchment Management Authorities and the State Government is inequitable. For example, the Goulburn Broken CMA received an equal amount of NHT funding to the total received by 7 other CMAs (Glenelg-Hopkins, North East, Wimmera, North Central, East Gippsland, Port Phillip and Mallee). This could in part be due to that the Goulburn-Broken is in the Murray-Darling Basin, which receives at least ten times the NHT funding per unit area than the rest of the country (based on the figures in Table 1).

Table 1 – Some national costs of stream management

Item	Cost ($m)	Source
NHT: National Rivercare Program. This program includes: National River Health Program, Waterwatch Australia and elements of Fisheries Action Plan. (over 5 years)	$97 m	www.nht.gov.au
NHT: Murray-Darling 2001 (over 5 years)	$163 m	www.nht.gov.au
Land and Water Resources Research and Development Corporation – Stream Restoration Program	$0.5 per/yr	Nick Schofield, pers comm.
Environment Australia – National River Health Program	$4.4 m	Chris Gippel, pers. comm.
Co-operative Research Centre for Catchment Hydrology (cost of Waterway Management Program) (96/97)	$1.2 m	I. Rutherfurd, pers. comm.
Co-operative Research Centre for Freshwater Ecology (over 7 years)	$52 m	I. Rutherfurd, pers. comm.
Murray-Darling Basin Commission – river channel management (98/99)	$0.54 m	B. Campbell, pers. comm.
Murray-Darling Basin Commission – water quality monitoring (98/99)	$0.72 m	B. Campbell, pers. comm.
Snowy River Water Inquiry (1998)	$1 - $2 m	S. Hargraves, pers. comm.
National Land and Water Audit (for water volumes, environmental flows, and environmental condition).	$1m/yr	Colin Creighton, LWRRDC, pers comm.

Table 2 – Some costs of stream management: on a state by state basis

State	Item	Cost	Source
Qld	North region 1996/97 (Mackay to Mossman), including NDF/NHT, local precept rating, and State contribution	$2.0 m	L. Hinrichsen, pers. comm.
	South region 1996/97 (south of Mackay) including NDF/NHT, local precept rating, and State contribution	$0.53 m	L. Hinrichsen, pers. comm.
NSW	Funding from the State Rivercare Program (98/99)	$3.9 m	Land and Water News, 2(5) p.10
	Estimate of Sydney Water River Management Program 1997/98 (Catchment Management Trusts would also have significant budgets)	$6 m	G. Peters, pers. comm.
	Cost of the NSW Rivers Survey (a survey of fish at 80 sites throughout NSW)	$0.34	Harris, J.H. and P.C. Gehrke, 1997.
Vic	Waterway management projects funded by National Heritage Trust (1997/98 actual) – including matching State funding, excluding local funding	$5.8 m	P. Heaphy, pers. comm.
	Natural Heritage Trust (1998/99 bid) – including matching State funding, excluding local funding	$11.4 m	P. Heaphy, pers. comm
	Melbourne Water (1996/97) (including operations labour, project management, planning, monitoring). (Estimated cost to rehabilitate Melbourne streams = $163 m)	$11 m	K. Wood *et al*., this volume.
	NDF following October 1993 floods (Northeast Victoria)	$4.5 m	R. Hardie, pers. comm
	NDF following June 1998 floods (East Gippsland)	$15.9 m	R. Candy, pers. comm
	Estimated cost to apply the Index of Stream Condition at about 1 000 reaches across Victoria in 1999. (Excludes the cost to generate some data that is produced as part of other State government programs).	$0.5 m	L. White, pers. comm.
Tas	Rivercare program since 1996/97 (including approximately $0.7 m contribution from local Landcare groups)	$2.0 m	M. Giblin, pers. comm.
	Hydro Electric Corporation spending on stream management 1997/98 (catchment studies and issues investigation, environmental flow research and studies, erosion studies, fish migration / threatened species studies, water quality monitoring and related studies – a significant proportion of which is spent on lakes)	$0.55 m	H. Locher, pers. comm.
SA	Torrens Catchment Board, Onkaparinga Catchment Board, North Adelaide Barossa Valley Catchment Board, Catchment Subsidy Scheme, Mt. Lofty Ranges Catchment Program	$0.72 m	J. Burston, pers. comm.
	Mt Lofty Ranges stream management program	$0.75 m	J. Burston, pers. comm.

Figure 1 – Proportion of NHT funding for waterway management projects over $25 000 in 1997/98 for areas of Victoria (based on data provided by P.Heaphy)

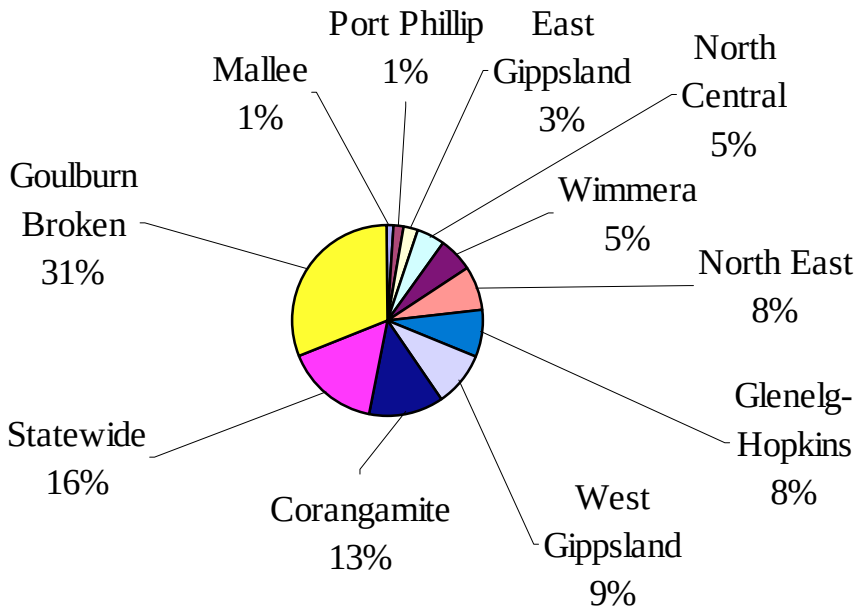

Table 3 –The costs of other items for comparison

Item	Cost ($m)	Source
Victorian Government Contribution to the Melbourne Festival (minimum)	$2.5 m	S. Bogle, pers. comm
Australian Sports Commission	$84 m	G. Blood, pers. comm.
Contingency fund for Sydney 2000 Olympics (1998)	$121 m	www.sydney.olympic.org
Sydney 2000 Olympics	$2,300 m	www.sydney.olympic.org
1995-96 Australian Defence Budget	$9,600 m	www.australia.org.tw/ introduction/english/ defence.html
Salmon 2000 (implementation of a plan to allow migratory fish to return to the Rhine)	$12 bn	Schulte-Wulwer-Leidig, A., 1995
Rehabilitation of the Kissemmee River, Florida, USA (to restore 35 km of channel)	$650 m	http://www.irn.org/pubs/wrr/ 9612/restore.html

3. THE COSTS OF PROJECTS, AND COMPONENTS OF PROJECTS

Indicative unit rates for some stream rehabilitation projects and techniques are provided in tables 4 and 5 below. Costs have been categorised into the cost of an entire project unit (such as realigning bends), and into the cost of resources used in a project (such as tree-planting). It should be noted that the rates will be highly variable and will depend on factors including: establishment costs of equipment, distance from work centres to work sites, and climatic and other environmental conditions.

Table 4 – Project scale costs

Item	Indicative unit rate	Source
Full revegetation (from tube-stock), and fencing, of a riparian strip on both banks.	$12,000	R. Hardie, pers. comm
Typical rock chute in a small creek (say streams up to 15 m wide, 1 m drop, length 10 m, apron length 4 m, abutment protection)	$5 000 - $20 000 per chute	R. Hardie, pers. comm.
Fishways: ▪ rock ramp (up to 2m vertical) ▪ vertical slot (3 – 6m vertical)	 $10 000 - $30 000 per vertical metre $60 000 - $100,000 per vertical metre	 T. O'Brien, pers. comm.
Stabilisation and revegetation of degraded urban streams (eg. Melbourne streams)	$0.5 - $0.8 m per kilometre	Melbourne Water
Flow alignment works:	$20 000 - $50 000 per bend on medium sized rivers	R. Hardie pers. comm
Twentymile Creek, Mississippi, USA. Stream rehabilitation involving grade control, alignment training, revegetation of an incised stream	$0.5 m per km	Danley, 1995

Table 5 – Resource scale costs (most numbers come from ID&A Pty Ltd)

Item	Indicative unit rate
Seed of native species (from Burston and Brown, 1996)	$170 / kg
Tree seedlings: ▪ 10 cm to 20 cm ▪ Speedlings (which are small)	 $0.50 to $1.00 each $0.20 to $0.40 each
Tree planting (including preparation, planting, excluding maintenance)	$3.00 / tree
Willow control: lopping (including safeguards to stop willow spread) followed up by herbicide treatment: ▪ Moderate infestation ▪ Severe infestation ▪ Intensive infestation	 $3 500 / km of bank $6 000 / km of bank $12 000 / km of bank
Fencing materials	$2.50 per metre of fence
Excavator hire ▪ 12 tonne ▪ 20 tonne ▪ 30 tonne	 $65 per hour $85 to $100 per hour $100 to $130 per hour
Broken rock (delivered)	$15 to $25 per cubic metre delivered ($9.40 - $15.60 per tonne)
Railway line (which can be used as piles)	$20 per metre
Timber that can be used in rails of flow retards ▪ Timber (red box), 150 to 300 mm diameter, 4 m length ▪ Timber (red box), 150 to 300 mm diameter, 6 m length	 $10 - $15 each $12 to $20 each
Labour ▪ project works supervisor ▪ works crew member	 $15 - $25 / hour $15 / hour
Survey team (surveyor, assistant, basic equipment)	$100 / hour
Engineering design and supervision	10 – 15 % of project cost
Administration	5 – 10% of project cost

4. ADDITIONAL COSTS OF STREAM REHABILITATION WORKS

Stream rehabilitation often involves works that enhance stream health, or modifications to works that would otherwise damage the health of the stream. Stream rehabilitation involves some new costs to stream managers (such as the cost of adding large woody debris to streams), as well as the extra costs of doing works so that they do not damage stream health. An example of the latter is rock chutes. The structure may survive, and protect the bed, at a slope of 10:1, but in many streams it has to be designed at a slope of around 20:1 to allow fish passage. Thus, provision of fish passage can virtually double the cost of the structure. There is also the substantial cost of pre-project assessment and post-project evaluation required for stream rehabilitation. Such assessment is essential for stream rehabilitation because we are, as yet, so uncertain about the effectiveness of stream rehabilitation works.

Table 6: Some costs of activities related to stream rehabilitation

Item	Indicative unit rate	Source
Reintroduction of coarse woody debris (large logs)	$500 - $700 per piece	Various projects
Additional cost of designing rock-chutes to provide fish passage (ie. halving design slope)	Doubles the cost	L. White, pers. comm.
Cost of assessment of condition of streams in a catchment using the Anderson 'State of the Rivers' method (From NSW Department of Land and Water Conservation projects)	Average cost per site $250	Allan Raine, DLWC
Cost of assessment of a single reach using the Index of Stream Condition	$500	L.White, pers. comm.
Average cost of sampling fish population and diversity per site using a combination of techniques	$600 per site	T. Raadik, pers. comm. J. Harris, pers. comm.
Average cost per site for an AUSRIVAS macroinvertebrate survey (sampling, laboratory work & analysis)	Professional assessment $1500	EPA, Victoria
Additional cost of monitoring for biological change post-project	On the Broken River the scientific evaluation cost more than twice the structural works.	Mike Stewardson, Pers. comm.
Adding *phragmites austalis* or broken concrete pipes (obtained at no cost) to a bank stabilisation project to enhance habitat	5 – 10% of project cost	R. Morrison, pers. comm., L.White pers. com.

5. DISCUSSION

The figures presented here are not exhaustive, but we can make a few generalisations from them.

1. In Australia, several tens of millions of dollars are currently being spent on stream management each year. This amount has been boosted to at least $50 m with the injection of NHT funding. This amount remains small relative to total expenditure in other countries.
2. Most money spent on river management in Australia is spent in the eastern mainland States.
3. Per unit length of stream, funding of stream management in urban areas is typically greater than that in rural areas.
4. Some areas (eg. the Murray-Darling Basin) receive considerably more NHT funding per unit area than the rest of the country.
5. In an average year, flood damage leads to perhaps $4 – 5m of stream management works, somewhere in Australia, funded directly through Natural Disaster Funding.
6. Research into stream rehabilitation is receiving several million dollars of support in Australia. This, at least in part, reflects the new ecological issues surrounding this area of work. Similarly, stream rehabilitation projects with an ecological goal require more complex assessment of the initial problems and strategies, than do the traditional stream stabilisation projects. They also require more sophisticated and expensive evaluation.

7. It is expensive to rehabilitate degraded streams – typically costing several hundreds of thousands of dollars per kilometre of stream. If the primary objective of a stream management program is to enhance environmental values, then it is probably more cost effective to maintain streams in excellent or good condition than to attempt to rehabilitate streams in degraded condition. If the primary objective of a stream management program is to protect streamside public assets, then it may be appropriate to invest more money in degraded streams.
8. Designing stream management works so that they do not further degrade stream ecosystem can add considerably to their cost. Fishways are a good example of the additional cost.
9. On the other hand, rehabilitation enhancements can sometimes cost very little in a stream stabilisation project. For example, adding *phragmites australis* reeds, to a bank stabilisation project will cost less than 10% of the total cost of the works (Table 5). This is because the main cost is in establishing the equipment on site (eg. roads for access) which means that the incremental cost of the enhancement can small.
10. Almost all stream management projects today involve revegetation. This invariably involves fencing of some type, and this can cost $4 /m. The revegetation will cost up to $8,000/km for tube stock, decreasing with direct seeding and with the proportion of natural regeneration. Ongoing vegetation management and fence maintenance is often required

6. ACKNOWLEDGMENTS

The assistance of the many providers of information is acknowledged.

7. REFERENCES

Burston, J. and W. Brown, 1996, Watercourse revegetation - just a walk in the park, I.D. Rutherfurd and M. Walker (eds.), Proceedings of First National Conference on Stream Management in Australia, Merrijig.

Danley, H.D., M.J. Eubanks, and C.L. Jernigan, Jnr., 1995, Twentymile Creek Habitat Restoration Project, Mobile, US Army Corps of Engineers.

Schulte-Wulwer-Leidig, A., 1995, *Ecological Master Plan for the Rhine Catchment*, in Harper, D.M. and Ferguson, A.J.D. (eds.), *The Ecological Basis for River Management*, John Wiley & Sons Ltd, 505 pp.