

ON THE ESTIMATION OF BENEFITS OF STREAM MANAGEMENT

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ABSTRACT

State funding of stream management in Victoria is shrinking in real terms. One possible explanation for this is the lack of hard data supporting claims for increased funding.

This paper reviews and makes comment on techniques for estimating the benefits of stream management, with particular reference to the management of erosion and sedimentation. Reference is made to benefit analyses that have been undertaken in Victoria for reducing the risk of an erosion head progression upstream in Bruthen Creek, and reducing the risk of a breakaway occurring in the Ovens River.

1. CONTEXT

The Victorian State government has been the primary source of funding to stream management since River Improvement Trusts started to form in the 1950's.

State funding to stream management is steadily decreasing in real terms per unit area despite increased expectations of functions and performance. In 1984, the functions of stream management authorities were confined to working towards the stability of bed and banks. In 1995, stream management authorities are expected to adopt far broader functions including management of sand and gravel extraction, community education and monitoring of water quality. Yet, although the percentage of Victoria in stream management districts increased over threefold between 1984 and 1995 (from 9 % to 32%), State Government funding has decreased in real terms (from \$3.6m in 1984 to \$3.0m in 1995). Why? One of the main reasons of the reduction of funding is believed to be that river managers are not selling the benefits of stream management well enough and that there is a lack of hard data supporting claims for increased funding.

This paper will satisfy its purpose if it provides river managers with:

- an awareness or reminder that methods for estimating benefits of stream management exist;

- an overview of the methods currently available for estimating benefits from stream management; and
- some detail on the estimation of benefits from management of erosion and sedimentation, illustrated by examples.

2. WHY ESTIMATE BENEFITS FROM STREAM MANAGEMENT?

Reasons to estimate benefits of stream management follow.

1. **Justification of expenditure of public moneys.** Rivers are public goods, and stream management is an investment for the future of streams for the whole community. As with all investments, it is important to be confident that the project will yield a net benefit.
2. **Ranking of projects.** As funding is limited, it is useful for funding agencies to be able to compare the return for an investment in a number of possible projects.
3. **Professionalism.** Illustrates that the organisation seeking funding has a professional approach.
4. **Identifies key issues.** As Sinden (1994) states:

... analyses help to define issues, focus debates, formulate problems, provide orientation, provide a framework for thought, expose fallacious arguments, and raise the general level of debate over particular issues.

As a note of caution, benefit-cost analysis of stream management is difficult because of the many difficult-to-value benefits that are involved. For this reason, great care is needed both in applying techniques and interpreting results. Furthermore, benefit-cost must never be allowed to monopolise the analytics used in the decision-making process. Stream management itself, and the economic analysis of it, are highly uncertain matters and there will always be a role for wise judgement in assessing all the intangible issues. However,

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unless some considered attempt is made to quantify these benefits in monetary or other terms, these benefits could be easily ignored or trivialised and stream management may not be funded to the extent that the issues demand.

3. GENERAL COMMENTS ON BENEFITS FROM STREAM MANAGEMENT

The essence of stream management is to change the river from what it would be without management to some better state. The economic benefit of management, that which we wish to identify in a benefit-cost analysis, is the difference in total economic value between these two states - with and without management.

The economic value of a river and its environs is made up of a number of different types of components. First, we can point to those values of the river which stem from the use which is made of the river. Use values include both consumptive and non-consumptive considerations and may be differentiated into values such as:

- direct productive uses such as use of the land surrounding the river for agriculture;
- direct consumptive uses, such as recreational fishing; and
- non-consumptive uses, such as sightseeing and camping.

Second, we note that use values can be distinguished from those values which people may associate with the river even though they do not use it, the latter are referred to as non-use values. The assessment of non-use values is more controversial than use values and is associated, amongst other things, with the value people might derive from knowing that the river or some attribute associated with it exists.

The goods and services provided by a natural asset can be classified into those which are traded in markets and those which are not. The former are called priced, or market values, while the latter are referred to as unpriced, or non-market values.

As a general rule, those goods and services produced by a natural asset which are traded in markets are associated with the use of the asset but, of course, not all use values are priced. For example, streamside agricultural land can be traded in a market but there is no market for the

sight-seeing opportunities provided by the river. Non-use values do not have prices.

In broad terms, then, the total economic value of the asset (measured in present value terms) can be considered as the sum of these types of values, that is:

total economic value =

use values (priced + unpriced) + non-use values
(unpriced).

3.1. USE VALUES

The basic approach to valuing the priced goods and services (eg. protection of agricultural land, bridges, roads) is the simple one of multiplying the quantity by the price, and capitalising by converting to a present value using an appropriate discount rate. The valuation problems associated with priced attributes are usually less severe than those associated with unpriced attributes. Apart from the ever-present problem of measuring the quantities of such goods and services, most such problems arise when the prices are administered in such a way that they do not reflect the true willingness to pay for that good or service, for example, if the government subsidises or taxes the good or service.

Unpriced values involving past or present use are often fairly easily delineated and can be associated with those recreational activities which people undertake on or near the river, walking by the river, picnicking, camping, fishing and swimming. Use values can also be associated with the act of merely experiencing the environment of the river, that is, sightseeing.

3.2. NON-USE VALUES

The umbrella term for non-use values is the concept of existence value. This is the value obtained from knowledge that some attribute of the environment exists. Such a value is independent of any present or future use; indeed, people can value the existence of the attribute even though the idea of actually visiting the river may be repugnant to them. The evidence for the notion of existence values is the fact that people will contribute to funds to protect environmental assets in remote areas which they would never expect to visit. While these assets could be used vicariously through film or television (eg. The Man from Snowy River), such use is unlikely to explain the substantial support given to preservation activities.

Existence values are difficult to define and some economists have suggested that various altruistic motives may account for existence value, namely: bequest motives, philanthropic motives and sympathy motives.

4. GENERAL TECHNIQUES FOR ESTIMATING UNPRICED BENEFITS OF STREAM MANAGEMENT

Three broad classes of methods have become accepted by environmental economists and others for the evaluation of unpriced values:

- contingent valuation methods (see Wilks 1990);
- related market methods (see Sinden and Worrell 1979); and
- value transfer (see Read Sturgess and Associates *et al* 1992).

These classes of methods are described in the sections below.

There is also a set of methods by which values may be approximated (that is, methods of "partial" valuation) for a comparison with the costs of a management program. These methods, such as assessing the opportunity cost or the replacement cost of an environmental asset, or evaluating cost savings or interpreting past decisions have been discussed in Read Sturgess and Associates *et al.* (1992) and Sinden (1994).

4.1. CONTINGENT VALUATION METHODS

The contingent valuation methods are implemented through surveys or experiments and rely on what people say they would be willing to pay (or the compensation they would be willing to accept) for the items in question, that is, the methods measure their behavioural intentions. The term "contingent" is used because the subjects' responses are contingent upon the hypothetical choice situations that are described. Contingent valuation methods can be employed to measure any type of unpriced value, whether it be a use value, existence value or total economic value. With the present state of knowledge, existence values can only be estimated using contingent valuation methods. Most of the controversy surrounding the methods arises from the fact that the accuracy cannot readily be verified empirically. However, Sinden (1988) found that biases due to the

hypothetical nature of the procedure are not inevitable.

It is not proposed to reproduce here a detailed description of the methods and a discussion of the problems and biases which can arise in their use. These are readily available elsewhere (Sinden 1994). We note, however, that the controversy surrounding the methods stems from the fact that they deal with intended behaviour in hypothetical situations rather than observations of actual behaviour.

4.2. RELATED MARKET METHODS

The related market methods include the travel cost method and the hedonic price method. The related market approaches deal with actual behavioural responses.

The hedonic price method relies on investigating differences in the price of some marketable good which may result from differing exposures to some natural asset. For example, real estate value can be examined to detect any premium paid for locations with superior views. This may be difficult to apply to most stream management issues because of the small, localised markets involved.

The travel cost method uses observations on the expenses that people incur in visiting a location, and derives economic values by simulating how visitor numbers would respond to different entrance fees. It assumes that consumers of recreation would react to changes in the admission price in the same way that they do to the observed changes in travel or trip cost.

The problems with these methods centre around the fact that the markets which are used are only "related" and are not the market for the asset in question, which, by definition, does not exist. Thus, the "prices" may be real but they are only an indirect measure of the value in question. Nevertheless, because they provide values that are based on people "putting their money up", the related markets approaches, particularly the travel cost method, have appeal.

4.3. VALUE TRANSFER

The main difficulty with contingent valuation and the related market approaches is that they are expensive to apply. If these methods have been applied for one stream management issue, there is potential for the result to be transferred to other similar issues.

The process of transferring unpriced use values has been discussed extensively elsewhere and need not be repeated here (see Read Sturgess and Associates *et al.* 1992, I.D. & A. Pty. Ltd, 1995). We need only mention that it is the process of transferring values determined at one site (by one or other of the above methods) to the site of interest for the evaluation of a particular management program.

Desvouges, Naughton and Parsons (1992) suggest four criteria that must be satisfied before values are transferred from an original study to the site of interest.

1. The original study must be based on adequate data.
2. The original and new locations must offer similar recreation opportunities to a similar spectrum of households.
3. The benefits to be valued at the new site must be similar to those valued at the original site.
4. The original study must contain regression analysis of value (measured by willingness to pay), as a function of socio-economic and environmental variables.

The essence of these criteria is that the sites satisfy the common-sense requirement of being "comparable" and that there be sufficient information to allow systematic adjustment for differences between the sites. Applications of these criteria are discussed by, Loomis (1992) and Read Sturgess and Associates *et al* (1992).

The method is cheap and easy to use. It is the basis of a rapid appraisal method (RAM) of the benefits of stream management (Read Sturgess and Associates *et. al.* 1992). The validity of values obtained in this way has been scrutinised by Smith (1992) and Desvouges, Naughton and Parsons (1992), amongst others.

As an aside, the authors are surprised and somewhat disappointed that the RAM has not found more use since it was developed nearly four years ago. There may be many reasons for this situation but we do not believe lack of relevance is one of them. Is it possible that the funding situation is not as tight as we imagine? Or, has it just been forgotten as the personnel of relevant Government Departments change and the departments themselves undergo massive change? In the interests of decision making which uses all relevant information, we hope there may be a revival of interest in the approach.

The problem for the evaluation of stream management programs in Victoria is that there is

only one study from which values might be legitimately transferred, namely Sinden's evaluation of recreational activities in the Ovens and King River catchments (Sinden 1988). That study is now getting "long in the tooth" and there is a need for more studies of that type. In fact, just one well-designed study to suit the requirements of value transfer will go a long way to assisting the next generation of economic evaluations of management programs.

5. ESTIMATION OF THE BENEFITS OF MANAGING EROSION AND SEDIMENTATION

As the focus of the conference is the estimation of the benefits associated with the management of stream erosion and sedimentation, examples of two past analyses are included in this section. It is important to note that management of erosion and sedimentation is but one of the spectrum of roles of stream management authorities in Victoria.

The benefit of managing erosion and sedimentation is often measured as the value of avoiding the various types of damage that might result without management.

In broad terms the benefits of stream management in terms of avoidance of damage can be classified into the following categories:

- avoiding a reduction in the flow of services (eg. progressive build-up of silt reducing pasture production or progressive degradation of scenery);
- avoiding a shortened life of assets (eg. fences or bridges may require replacement before normal time due to siltation or erosion); and
- avoiding the loss of assets (eg. agricultural land or fish habitat).

In some cases, of course, management of sedimentation and erosion will produce additional benefits because it enhances the flow of services from the river and its environs (eg. stream-side revegetation for stabilisation also can provide increased scenic amenity). Two examples of the estimation of benefits in Victoria follow.

5.1. EXAMPLE 1: MANAGEMENT TO PREVENT THE UPSTREAM PROGRESSION OF AN EROSION HEAD: BRUTHEN CREEK

Bruthen Creek is located in South Gippsland.

A rock chute in Bruthen Creek was severely damaged by a flood in September 1993. A subsequent investigation revealed that the average recurrence interval of the flood was approximately 100 years, considerably higher than the design average recurrence interval of 30 years.

A cost benefit analysis was undertaken to assist Treasury to decide whether it was worthwhile to allocate Natural Disaster Funding to repair the rock chute and surrounding channel. A comparison was made of stabilising Bruthen Creek now, in the future when a bridge was threatened, or not at all. The main source of benefits from stabilising Bruthen Creek would derive from extending the life of assets (particularly a reasonably new bridge worth \$400,000) based on an average rate of progression of the primary erosion head. The rate of erosion head progression was estimated using 90 years of data.

The cost of the works was estimated to be \$377,000. The marketable benefit to cost ratio of the project was calculated to be 0.8, with public marketable benefits providing 3/4 of these benefits. The unpriced benefits were described in the funding application.

Funding to stabilise Bruthen Creek has been approved by Treasury.

5.2. EXAMPLE 2: MANAGEMENT TO PREVENT RISK OF A BREAKAWAY: OVENS RIVER

The Ovens River is in North Eastern Victoria. There is a threat of an avulsion into Happy Valley Creek, near Myrtleford.

The benefits of reducing the risk of an avulsion into Happy Valley Creek were estimated. It was judged that:

- without works, the occurrence of two twenty year floods and a 100 year flood, irrespective of order, would cause the breakaway during the next 30 years (the planning horizon chosen) in the absence of management; and

- even if the works were undertaken the breakaway would occur in a flood with a 500-year return period.

Benefits were derived by deferring the replacement of public and private assets. The benefits of reducing the risk of the breakaway were discounted by both a discount rate and the probability of the floods judged to cause the breakaway. A sensitivity analysis was also undertaken.

The conclusions of the analysis were:

- the present value of the quantifiable benefits of the works to prevent the breakaway is \$0.1 million; and
- the present value of the cost of the works program is \$0.57m.

For the program to break even the quantifiable benefits would need to be valued at \$0.47m (based on discounted probability).

6. CONCLUDING COMMENTS

Techniques are available estimate the benefits of stream management works, some of which have been reviewed in this paper. The detail and cost of the analysis should be commensurate with the required accuracy of the results.

A considered but yet imperfect estimation of benefits is likely to result in better decisions by river managers and funding agencies than no estimation of benefits at all.

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