

Harvey Water Bulk Water Pricing: Recreational value of the dams

Paper 4 of 4 relating to aspects of dam safety and
cost allocation, provided as input to the Inquiry
into Harvey Water bulk Water

Prepared for the Economic Regulation Authority

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ACIL Tasman

Economics Policy Strategy

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Contents

Executive summary	iv
1 Purpose	1
2 Estimating recreational values	2
2.1 Concept of consumer surplus	2
2.2 Methods of non-market valuation	3
2.2.1 Revealed preference methods	3
2.2.2 Stated preference methods	4
2.3 Travel cost method	4
3 Recreation on the South West dams	6
3.1 Recreational activities	6
3.2 Infrastructure	7
4 Previous studies of the recreational value of the South West dams	8
4.1 Lucas (1991)	8
4.2 ACIL Tasman (2006)	9
5 Recreation's share of the cost of headworks	9
5.1 Value of water in irrigation	10
5.2 Cost sharing formula	10
6 Conclusion	11

Figures and tables

Figure 1 Measuring consumer surplus	3
Table 1 Present value of the total recreation benefits (1991 dollars)	8

Executive summary

This is the fourth paper in a series of four papers prepared by ACIL Tasman and commissioned by the Economic Regulation Authority of Western Australia – in relation to the current Inquiry into Harvey Water Bulk Water Pricing.

This paper focuses on the value of benefits recreational users derive from the South West dams supplying water for irrigation, as possible input into the cost sharing arrangements that will apply in formulating the bulk water price.

Harvey Water is supplied bulk water by the Water Corporation from the following dams in the South West: Stirling Dam, Harvey Dam, Logue Brook Dam, Wokalup Dam, Waroona Dam, Drakesbrook Dam, Samson Brook Dam and Wellington Dam. With the exception of Stirling and Samson Brook Dams, which supply water to the Integrated Water Supply Scheme (IWSS), these dams are open to recreational use.

The two most popular recreational dams are Logue Brook Dam and Waroona Dam. These dams and the surrounding forest attract large numbers of day trippers and overnight visitors and offer a range of recreation activities, including boating, canoeing, water skiing, swimming, hiking and fishing. Both dams offer a range of services, including boat ramps, toilets, picnicking facilities and walk trails. At Logue Brook Dam there are also several privately owned businesses that are used by many recreational users at the dam.

A key consideration in determining the level and structure of the bulk water price is the question of what proportion of the headworks costs (including the efficient level of dam safety costs) for these dams should be apportioned to recreational and other non-irrigation beneficiaries of maintaining and operating the dam infrastructure. As a guide, the ‘beneficiary pays principle’, states that a share of the costs of upgrading, maintaining and operating the dams be allocated to recreational users broadly in proportion to the benefits they receive from the recreational activities that make use of the dams.

In the original Bulk Water Supply Agreement the bulk water price was calculated on the basis that 15 per cent of the projected operating and renewals costs for the headworks infrastructure for the dams were attributed to non-irrigation beneficiaries, primarily recreational users. The remaining 85 per cent of projected costs were charged to Harvey Water.

The only reported study of the value of recreation on the South West dams is the Lucas (1991) study of the economic benefits of recreation activities at Waroona and Logue Brook Dams. Lucas applied the travel cost method to construct demand curves for recreation at both dams.

Visitors' willingness to pay for recreational opportunities at each dam (i.e. the recreational value of the dam) was estimated as the area under the respective demand curves (the consumer surplus) for each dam.

The recreational value for each dam was expressed as the present value of the estimated recreational benefits, calculated over a number of time periods ranging from 5 to 50 years, three discount rates (4 per cent, 6 per cent and 8 per cent) and different assumptions about the opportunity cost of travel time (0.1, 0.3, 0.6 and 1.0 times the after tax hourly wage).

ACIL Tasman (2006) updated Lucas' (1991) present value estimates of recreation benefits for the Logue Brook Dam by inflating them to 2005 dollars. Using an estimate of the water taken from Logue Brook Dam of 5.3 gigalitres, ACIL Tasman showed the total dollar value of the recreation benefits for Logue Brook to be around 0.91 cents per kilolitre per annum.

The equivalent calculation for Waroona Dam assuming 7.7 gigalitres of water being taken yielded a value of the recreation benefits of 0.98 cents per kilolitre.

To test the veracity of the 85:15 cost sharing arrangement in the original Bulk Water Supply Agreement, we used the recreational values derived above and compared these with values of water use in irrigation derived from published water trading statistics for the Harvey Water Irrigation Area. The weighted average value of water in irrigation is estimated to around \$13/ML or 1.30 cents per kilolitre where the weights reflected the amount of water going to various enterprises (e.g. pasture, horticulture and vegetables). This figure is reasonably consistent with water trade data from around Australia.

Given the estimates of recreation benefits for Logue Brook and Waroona Dams were approximately 1.0 cent per kilolitre, the ratio of value of recreation to the value of irrigation is was estimated to be 1.00:1.30, or 43.5:56.5.

As the cost of service of Logue Brook and Waroona Dams is around 12 per cent of the total cost of service of the dams the share of the total cost that can be attributed to recreation is $0.435 \times 0.12 = 0.052$ or 5.2 per cent.

An estimate of the share of the dam safety costs that can be apportioned to Logue Brook and Waroona Dams is around 27 per cent (using Water Corporation data for dam safety costs in 2006 dollars). Therefore, the proportion of dam safety costs alone for these two dams that can be attributed to recreation is $0.435 \times 0.27 = 0.117$ or 11.7 per cent.

On the basis of these calculations, the 85:15 split would appear a little generous towards bulk water users in apportioning costs of dams on which recreation is allowed. A split of 90:10 might be more appropriate for dam safety costs and 95:5 for overall dam costs.



ACIL Tasman
Economics Policy Strategy

Harvey Water Bulk Water Pricing: Recreational value of the dams

1 Purpose

This paper is the fourth in a series of four short and inter-related papers prepared by ACIL Tasman for the Economic Regulation Authority's Inquiry on Harvey Water Bulk Water Pricing. The papers are concerned with different, but interrelated aspects of the level and structure of bulk water prices to Harvey Water.

More specifically, the four papers cover:

- Issues that arise in considering:
 - Whether it is appropriate for the full costs of meeting the Australian National Committee on Large Dams (ANCOLD) dam safety guidelines to be included in the price determination
 - If alternative approaches to the ANCOLD dam safety guidelines exist, what form might these take (Paper No. 1)
- The basis upon which costs of meeting dam safety requirements should be shared across stakeholders (Paper No. 2)
- Whether the current arrangements, including the approach taken in determining the terms and conditions in the current Bulk Water Supply Agreement (BWSA), entail a subsidy to Harvey Water and the possible relevance of this for cost allocation (Paper No. 3)
- A review of the value of benefits recreational users derive from the South West dams, as possible input into the cost sharing arrangements (Paper No. 4).

Harvey Water is supplied bulk water by the Water Corporation from the following dams in the South West: Stirling Dam, Harvey Dam, Logue Brook Dam, Wokalup Dam, Waroona Dam, Drakesbrook Dam, Samson Brook Dam and Wellington Dam. With the exception of Stirling and Samson Brook Dams, which supply water to the Integrated Water Supply Scheme (IWSS), these dams are open to recreational use.¹

A key consideration in determining the level and structure of the bulk water charge is the question of what proportion of the headworks costs (including the efficient level of dam safety costs) for these dams should be apportioned to recreational and other non-irrigation beneficiaries of maintaining and operating the dam infrastructure. As a guide, the 'beneficiary pays principle', states that a share of the costs of upgrading, maintaining and operating the dams be

¹ Closure of Logue Brook Dam to recreation is under consideration in view of the proposed water trade between Harvey Water and the Water Corporation, which will mean that this dam will be linked to the IWSS.

allocated to recreational users broadly in proportion to the benefits they receive from the recreational activities that make use of the dams.²

In the original BWSA the bulk water price was calculated on the basis that 15 per cent of the projected operating and renewals costs for the headworks infrastructure for the dams were attributed to non-irrigation beneficiaries, primarily recreational users. The remaining 85 per cent of projected costs were charged to Harvey Water.

ACIL Tasman was engaged to review the recreational benefits of the South West dams and conclude if the 85:15 cost sharing arrangement is still appropriate. Our analysis focused on reviewing the results of earlier studies in order to derive a value for the recreational use of the dams. This paper (Paper No. 4) reports on the findings of the study.

2 Estimating recreational values

2.1 Concept of consumer surplus

The South West dams provide amenity services to the public in the form of recreational and passive uses (not related to direct use), with benefits accruing directly to the people involved. These amenity services do however have strong public good characteristics and generally do not command a price in the market (i.e. they are non-market goods and services). Consequently, the value that the community places on these services cannot simply be observed from market information such as price and consumption levels and there is likely to be market failure. Therefore, there is a need to find an alternative means of estimating their value in order to inform public policy.

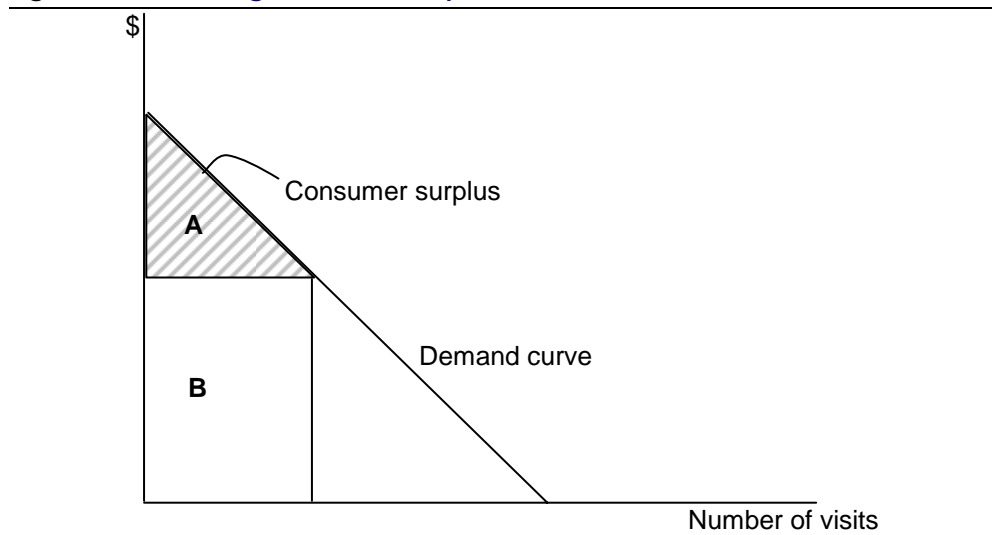
A range of techniques have been developed to estimate the values of non-market goods and services. These non-market valuation techniques are based on the fundamental concepts of welfare economics.

The monetary value an individual places on a recreation site can be measured by the consumer surplus. In the context of recreational benefits consumer surplus is the difference between the amount an individual pays to visit the site (the market price) and the maximum amount that individual would be willing to pay rather than forgo visiting the site. In other words, it is the difference between the willingness to pay for a trip to the site (area A+B) and total trip cost (area B) in Figure 1. This is the area below the demand curve (the willingness to pay for a trip) and above the price line (the price actually paid),

² A description of the two broad approaches to the allocation of costs, namely the 'beneficiary pays principle' and the 'impactor pays principle' is given in Paper No. 2.

that is, the shaded area A in Figure 1. Area A is also called the individual's access value for the site. Total welfare change can be measured by aggregating individual consumer surpluses.³

Figure 1 **Measuring consumer surplus**



2.2 Methods of non-market valuation

Non-market valuation techniques fall into two broad categories:

- Revealed preference methods – based on observed behaviour in real-world settings
- Stated preference methods – based on statements individuals make in response to questions about hypothetical situations. Preferences are stated rather than observed.

2.2.1 Revealed preference methods

Revealed preference methods make use of observable market behaviour to infer either the marginal value of non-market goods or the value for a discrete change in non-market goods. All of these methods require an identifiable link between the non-market goods and some subset of the market goods. Furthermore, there also must be sufficient variation in the process of the market goods and the quantities of the non-market goods accompanying the observed transactions to be able to statistically identify these relationships.

Examples of revealed preference methods include the travel cost method and hedonic pricing.

³ See Chapter 9 in Boadway, R.W. and N Bruce (1984). *Welfare Economics*. Basil Blackwell: Oxford, for a discussion on the aggregation of individual consumer surpluses.

Revealed preference techniques rely on an identifiable link between observed market behaviour and the use of the non-market good by an individual. Where an identifiable link does not exist, the value that the individual places on a good or service is referred to as a non-use value. Option value, preservation value, bequest value, and intrinsic value are all terms which describe various non-use values.

Non-use values are those portions of total economic value that are unobtainable using revealed preference methods, which rely on observed market behaviour. If non-use values are likely to represent a significant part of total estimated economic value, then stated preference methods are a more appropriate tool.

Both use value and non-use value can incorporate the social benefits of recreation. What they do not include is the intrinsic value of a recreation site. Intrinsic value is the value residing in the site that is unrelated to human preferences or even human observation.⁴

2.2.2 Stated preference methods

Stated preference techniques utilise survey methodologies, which either directly ask respondents their willingness to pay, or offer them choices between bundles of attributes and then based on these choices infer the willingness to pay.

The key difference between revealed preference methods and stated preference methods is the type of data used to estimate values. Stated preference methods rely on data from carefully worded survey questions, while revealed preference methods rely on data that record people's actual choices (revealed behaviour).

Estimation of non-use values is in the domain of stated preference methods.

Examples of stated preference methods include contingent valuation and choice modelling.

2.3 Travel cost method

The only study of the value of recreation on the South West dams (Lucas 1991) used the travel cost method (TCM) and a rudimentary version of contingent valuation. TCM (a revealed preference method) uses the cost of travel incurred by individuals visiting a recreation site as a measure of how much they are willing to pay (WTP) to visit the site. Travel costs typically include fuel, entry fees, meals and accommodation and the opportunity cost of

⁴ Pearce, D., Atkinson, G. and S Mourato (2006). Cost-Benefit Analysis and the Environment: Recent Developments. OECD: Paris.

travel time. Aggregation of values across individuals then provides a total valuation of the recreation site in question.

As mentioned previously, the economic value measured by TCM is the ‘use value’, which relates to actual use of the recreation site (e.g. a visit to the site), planned use (e.g. a visit planned in the future) or possible use (the option value). In contrast the ‘non-use’ value refers to the willingness to pay to maintain a recreation site in existence even though there is no actual, planned or possible use.

TCM exploits the basic demand relationship where the quantity demanded varies negatively with price. People living closer to the site face a lower cost of travelling to the site and, all else constant, therefore probably take more trips.

Two alternative methods are commonly used in the travel cost model to measure WTP:

- The *individual travel cost method* uses the annual number of visits per person to the recreation site
- The *zonal travel cost method* measures the annual number of visits per capita from specified zones of visitor origin, typically constructed as concentric circles radiating from the recreation site.

The zonal model has fallen out of favour because of its lack of consistency with basic theory. However, it has less stringent data requirements than the individual travel cost method and adjusts automatically for frequency of visits by individuals. That is, zones that are farther away from the site of interest will produce fewer trips for given individuals and smaller frequencies of households taking trips. Nevertheless, when data are limited, the zonal model can provide a useful approximation⁵.

While the individual TCM is preferable for statistical precision, the choice of method is often dictated by the degree of variability in the number of trips taken. The zonal method is used where it is necessary to incorporate enough variation into the number of trips taken to be able to estimate a demand relationship.

The number of visits to a site is assumed to be influenced by:

- The cost and time of travel to the site
- The quality of the recreational site
- The amount of discretionary time available to the individual
- Income

⁵ Parsons, G.R. (2003). ‘The Travel Cost Model’. Chapter 9 in Champ, P.A., Boyle, K.J. and T.C. Brown, (Eds), A Primer on Nonmarket Valuation, Dordrecht, Kluwer Academic Publishers: The Netherlands.

- Opportunity cost of time (as reflected in the wage rate or some fraction thereof)
- Availability of substitute sites.

In its simplest form TCM is a single-site model of the number of trips to a recreation site a person makes over a year (or any other time period). The price of the trip is the cost of reaching the site, which includes a person's travel expenses and the time cost of making the trip.

However, travel costs alone will not explain an individual's demand for a recreation site. Other factors, including demographic variables, tastes and preferences, substitute and complementary goods, site quality and congestion, also determine demand.

The basic TCM makes the following assumptions:

- Individual behaviour related to increasing costs of travel corresponds to the changes in demand that would occur if prices changed
- Individuals derive no utility or disutility from the time spent travelling to the site
- The purpose of the trip is to visit the site and there are no alternative recreation sites available
- All visits are assumed to involve the same amount of time at the site
- Part of the cost of travel is the opportunity cost of the individual's time.

Data on costs and time of travel to the site and other relevant variables are collected from individual visitors in surveys. These data are used to estimate an empirical demand function for recreation at the site.

3 Recreation on the South West dams⁶

3.1 Recreational activities

The two most popular dams for recreation in the South West are Logue Brook Dam and Waroona Dam. These dams and the surrounding forest attract large numbers of day trippers and overnight visitors and offer a number of recreation activities including:

- Land based activities
 - Cycling – Munda Biddi trail
 - Bushwalking – unmarked and marked trails

⁶ This section of the report draws on earlier work by ACIL Tasman on the value of recreation at Logue Brook Dam undertaken for the Department of Water (See ACIL Tasman 2006).

- Sightseeing by vehicle along the many tracks around the dam
- Horse riding
- Picnics and barbeques
- Camping and caravanning
- Off road motorcycle and four wheel driving
- Water based activities
 - Water skiing – there is a gazetted water skiing area preventing skiers from going too close to the dam wall and outlet tower. There is also a recommended skiing route.
 - Canoeing
 - Sailing and windsurfing
 - Swimming
 - Marroning and fishing – the marron season is regulated by the Department of Fisheries. There are bag limits and regulations for trout fishing which are managed by the Department of Fisheries.

Activities further afield include the towns along the South West Highway and the growing number of tourist related activities along this route including wineries, historic sights, cheese factory, and nature-based activities (including the nearby Harvey, Waroona and Drakesbook dams).

3.2 Infrastructure

There is substantial public infrastructure supporting recreation at Logue Brook and Waroona Dams in particular. This infrastructure includes:

- Tracks to allow vehicles access to the dam and forest
- Boat ramps
- Picnicking facilities including tables and barbeques
- Marked walking trails including supporting information boards
- Lookouts
- Munda Bididi bicycle trail
- Public toilets.

At Logue Brook Dam there are also several privately owned businesses that are used by many recreational users at the dam. These include the Lake Brockman Tourist Park (caravan, park home chalet and camping sites) and Camp Logue Brook which is a 7th Day Adventist holiday camp. The Tourist Park is the only formal area where camping is allowed, however wild/bush camping outside the Tourist Park is allowed and occurs particularly during peak accommodation periods. The Tourist Park collects camping fees and maintains these sites on behalf of CALM.

4 Previous studies of the recreational value of the South West dams

4.1 Lucas (1991)

The first reported study of the value of recreation on the South West dams is the Lucas (1991) study of the economic benefits of recreation activities at Waroona and Logue Brook Dams. This study, which compared TCM (the zonal model) and contingent valuation as techniques for valuing the recreational benefits of the two dams, found TCM to be the most appropriate technique.

Using survey information collected from visitors to Logue Brook and Waroona Dams, Lucas constructed demand curves for recreation at both dams⁷. The visitors' willingness to pay for recreational opportunities at each dam (i.e. the individual's recreational value for the dam) was estimated as the area under the respective demand curve (the consumer surplus) for each dam.

The recreational value for each dam was expressed as the present value of the estimated recreation benefits, calculated over a number of time periods ranging from 5 to 50 years, three discount rates (4 per cent, 6 per cent and 8 per cent) and different assumptions about the opportunity cost of travel time (0.1, 0.3, 0.6 and 1.0 times the after tax hourly wage). Table 1 presents the present value of the total recreation benefits for 20, 30 and 50 year periods using a discount rate of 6 per cent and an opportunity cost of travel time equal to 0.3 times the after tax hourly wage.

Table 1 **Present value of the total recreation benefits (1991 dollars)**

	20 years	30 years	50 years
Logue Brook Dam	\$955,239	\$1,028, 575	\$1,177,808
Waroona Dam	\$1,353,953	\$1,624,852	\$1,860,000

Note: Present value estimated at a discount rate of 6 per cent and an opportunity cost of travel time of 0.3 times the after tax hourly wage

Data source: Lucas (1991).

The contingent valuation part of the study consisted of a single willingness to pay question administered to a sub-sample of respondents. Although the estimates of consumer surplus using contingent valuation were of the same order of magnitude as the TCM estimates, the rudimentary nature of the approach exposed the results to a range of biases known to trouble contingent valuation studies.

⁷ Lucas derived four demand curves based on the assumption made about the opportunity cost of travel time.

4.2 ACIL Tasman (2006)

In a study of the value of recreation at the Logue Brook Dam, ACIL Tasman updated Lucas' (1991) present value estimates of recreation benefits for the Logue Brook Dam by inflating them to 2005 dollars. The updated estimates were found to be of the same order of magnitude of estimates derived in a number of overseas studies.

Using an estimate of the water taken from Logue Brook Dam of 5.3 gigalitres, ACIL Tasman estimated the value of the recreation benefits for Logue Brook to be 0.91 cents per kilolitre per annum.⁸ The equivalent calculation for Waroona Dam assuming 7.7 gigalitres of water being taken yielded a value of the recreation benefits of 0.98 cents per kilolitre.

The recreational benefits were converted to a per kilolitre basis to facilitate comparison with water values in other uses. However, this is somewhat problematic as recreational benefits are unlikely to change incrementally with changes in volumes of water in a dam. The change in recreation value is more likely to be a step function at the point where the water level in the dam is too low to allow active recreation pursuits such as sailing and water skiing.

There is also the related issue of substitutes for Logue Brook and Waroona Dams in terms of recreational use. For example, if either of these dams were closed to recreation, recreational users could potentially move to the other dam or any other of the dams open to recreation. However, this could result in congestion at one or another of the dams and a consequent loss in the value of recreation at that dam, despite the volume of water in the dam not changing.⁹

Care therefore needs to be taken in extrapolating the cents per kilolitre estimates of recreation benefits to other dams in the South West. Truer measures of the value of recreation are the present values calculations of recreation benefits shown in Table 1.

5 Recreation's share of the cost of headworks

As discussed earlier, the 'beneficiary pays principle', states that a share of the costs of upgrading, maintaining and operating the South West dams be

⁸ This figure is calculated by dividing the present value of the recreation benefits over 30 years by 5.3 GL times 30 years.

⁹ There is little information in the literature on how recreational values change with changes in water levels in dams (see, for example, Ward, F. A., Roach, B. A. and J.E. Henderson (1996). 'The economic value of water in recreation: evidence from the California drought'. *Water Resources Research*, 32, pp. 1075-1081).

allocated to recreational users broadly in proportion to the benefits they receive from the recreational activities.¹⁰

In the original BWSA the sharing arrangement apportioned 15 per cent of the costs to recreation and other non-consumptive uses. To test the veracity of the cost sharing formula, we used the recreational values derived above and compared these with values of water use in irrigation derived from published water trading statistics for the Harvey water Irrigation Area.

5.1 Value of water in irrigation

The water trading statistics for the Harvey Water Irrigation Area were used to estimate the value of water to irrigation.

The average value of water trades across the three irrigation districts that make up the Harvey Water Irrigation Area from 1997/98 to 2005/06 are:

- Waroona \$12/ML
- Harvey \$15/ML
- Collie \$11/ML.¹¹

A weighted average value is around \$13/ML or 1.30 cents per kilolitre where the weights reflect the amount of water going to various enterprises (e.g. pasture, horticulture and vegetables). This figure is reasonably consistent with water trade data from around Australia.

5.2 Cost sharing formula

In order to test the veracity of the original 85:15 sharing arrangements, we assume that all the recreation activities occur at Logue Brook and Waroona Dams. The estimates of recreation benefits for Logue Brook and Waroona Dams were approximately 1.0 cent per kilolitre so the ratio of value of recreation to the value of irrigation is 1.00:1.30, or 43.5:56.5.

As the cost of service of Logue Brook and Waroona Dams is around 12 per cent of the total cost of service of the dams the share of the total cost that can be attributed to recreation is $0.435 \times 0.12 = 0.052$ or 5.2 per cent.

An estimate of the share of the dam safety costs that can be apportioned to Logue Brook and Waroona Dams is around 27 per cent (using Water Corporation data for dam safety costs in 2006 dollars).¹²

¹⁰ A more detailed discussion of the issues in cost sharing is provided in Paper No. 2 of this series.

¹¹ Data supplied by Harvey Water

Therefore, the proportion of dam safety costs alone for these two dams that can be attributed to recreation is $0.435 \times 0.27 = 0.117$ or 11.7 per cent.

On the basis of these calculations, the 85:15 split would appear a little generous towards bulk water users in apportioning costs of dams on which recreation is allowed. A split of 90:10 might be more appropriate for dam safety costs and 95:5 for overall dam costs.

If recreation on Logue Brook Dam was banned due to the dam supplying water to the IWSS, the share of costs previously apportioned to recreational users might best be allocated to urban water users. This would in fact involve a hybrid beneficiary pays/user pays principal – reflecting the assessment that the ‘impactor’ in creating the requirement to exclude recreational use would be the urban rather than irrigation usage.

The method we have used in deriving these figures is somewhat arbitrary and so they should be treated as broadly indicative rather than precise point estimates. Moreover, the numbers are likely to change through time, especially if dams like Logue Brook are diverted to urban use and other dams like Harvey are opened up for greater recreation activity.

6 Conclusion

ACIL Tasman was engaged to review the recreational benefits of the South West dams and conclude if the 85:15 cost sharing arrangement is still appropriate. Our analysis focused on reviewing the results of earlier studies in order to estimate the value of recreational use of the dams. A new study of recreational benefits was not considered due to time and resource constraints.

The value of the recreation benefits for Logue Brook Dam and Waroona Dam are estimated to be 0.91 cents per kilolitre per annum and 0.98 cents per kilolitre per annum respectively.

Taking the value of irrigation water to be 1.30 cents per kilolitre the share of total dam costs that can be apportioned to recreation on a beneficiary pays basis is around 5 per cent. In the case of dam safety costs alone, the figure is more like 12 per cent.

On the basis if these figures the 85:15 split would appear to be a little generous towards extractive users of the water. For total dam costs a split of 95:5 would seem more appropriate.

¹² The estimates of percentage shares of costs were supplied by Greg Watkinson of the ERA at the time of writing.