California State Water Resources Control Board
Office of Water Recycling

WATER RECLAMATION LOAN PROGRAM

BACKGROUND INFORMATION ON ECONOMIC ANALYSES OF RECLAMATION PROJECTS

April 1992

As part of the cost-effectiveness analysis of water reclamation projects, it is necessary to perform an economic analysis to determine whether a project is economically justified. It is common for a project proponent to consider a project monetarily justified if the proponent's revenues from a project exceed its expenses. While this approach may be prudent from the standpoint of ensuring that an agency remain financially whole, it may not lead to support of the most cost-effective project to meet an objective. The purpose of this paper is to explain what is intended by an economic analysis and to relate the analysis to projects proposed in the Water Reclamation Loan Program.

There are two general categories of monetary analyses: economic analysis and financial analysis. The purpose of the economic analysis is to determine all monetary costs and benefits regardless of who pays the costs or receives the benefits with the intent of determining the alternative of least cost and whether a project is justified in monetary terms. The economic analysis does not have the viewpoint of any particular public agency or private entity. On the other hand, a financial analysis is intended to determine who pays the costs and receives the benefits and to determine financial feasibility. Economic justification and financial feasibility do not always follow hand-in-hand, especially when subsidies are present or when water pricing structures represent average costs of existing facilities rather than marginal costs of new water developments, common situations in the California water industry.

The objective of the Water Reclamation Loan Program is to improve the financial feasibility of projects that are economically justified by providing capital funds at a subsidized interest rate. The basis of the economic criterion is found in the bond laws establishing the loan program. "Eligible water reclamation project" is defined as the "water reclamation project which is cost-effective when compared to the development of other new sources of water ..." in the Clean Water Bond Law of 1984 and "eligible reclamation project" means "a water reclamation project which is cost-effective when compared with the cost of alternative new freshwater supplies ..." in the Clean Water and Water Reclamation Bond Law of 1988. By policy of the State Water Resources Control Board (State Water Board) a cost-effectiveness analysis includes an economic analysis, which considers all monetary costs associated with each alternative and which will be given primary consideration unless other factors are overriding. Within this program, projects are justified in monetary terms by performing economic analyses comparing reclamation project alternatives with each other as well as with freshwater alternatives, which are the bench mark specified in the law.

In an economic analysis, project alternatives are usually compared on the basis of total net present worth of costs or net equivalent annual costs.

Such a basis presumes that all alternatives meet the same objectives or provide the same output. To provide a common basis in which to compare costs of water reclamation projects of various sizes and to compare costs of water reclamation with alternative freshwater projects, economic costs are to be reduced to unit costs of dollars per acre-foot. The data base and many of the procedures of economic analyses are common with financial analyses, which are usually performed by local agencies.

While the basic procedures of performing an economic analysis are common, certain rules apply to economic analyses that do not apply to financial feasibility analyses usually performed by local agencies. The most important rules are explained on our "Water Reclamation Loan Program Guidelines" and the "Loan Application Instructions". Additional information is found in the State Water Board's Interim Guidelines for Economic and Financial Analyses of Water Reclamation Projects and in a paper by Mills and Asano, "The Economic Benefits of Using Reclaimed Water" (Journal of Freshwater, 1986/87).

The data needed to determine the economic cost of water reclamation alternatives consist of the capital costs, operation and maintenance costs, and reclaimed water deliveries of the projects. A model table for this analysis, which is applicable to many conventional water reclamation projects, is shown in the attachment. One aspect of this analysis that can be confusing is that reclaimed water deliveries do not always translate into freshwater savings. In some cases, such as cooling towers, potable water must be replaced with a greater quantity of reclaimed water because of the poorer quality of the reclaimed water. Also, the replacement of fresh water in one location may merely shift the demand for fresh water to another location. The objective of the bond laws is to replace fresh water and augment water supplies. Therefore, in addition to determining the amount of reclaimed water deliveries for a proposed water reclamation project, it is necessary to estimate the amount of potential freshwater deliveries displaced. To provide a common basis of cost comparison with freshwater projects, the economic analysis is used to determine the cost per unit of fresh water replaced by the reclamation project.

Some water reclamation projects are proposed to serve water users that are not and would not be served with fresh water due to the minimal benefit of the use of the water, the general inaccessibility of fresh water, or the extremely high cost of fresh water. The advisory committee to the State Water Board that helped draft the 1984 bond law had a clear consensus that the loan program should not be used to subsidize projects that 1) create new uses of water or 2) are not cost-effective. The definition of "eligible water reclamation project" was worded to meet these two concerns by using alternative sources of fresh water as a benchmark.

The freshwater analysis for comparison with the reclamation alternatives can be more difficult for an applicant. The freshwater alternative must be a realistic, feasible alternative that is seriously being considered to accommodate increasing water demands in the project area. The reclaimed water produced by the project must offset the same water demands as the freshwater alternative being used for comparison. Water supply studies are available for many areas of the state where reclamation projects are being proposed. If such studies are available, the economic analysis of the freshwater alternative is greatly facilitated. In a few areas, recent studies may not be

available or water planning may be in a state of flux and an appropriate alternative is unclear. Nevertheless, the applicant must demonstrate that there is a future unmet water demand and that water projects are seriously being proposed to meet this demand and to provide the costs of such projects. In an attempt to justify some expensive water reclamation projects, seawater desalination has been proposed as the alternative water supply for cost comparison, because desalination is very expensive. It must be shown, however, that desalination is being pursued seriously and on more than an experimental basis, as evidenced by water supply planning reports.

Assistance is available from the Office of Water Recycling of the State Water Board is developing economic analyses for water reclamation projects and their appropriate freshwater alternatives. With the assistance of the California Department of Water Resources and regional water wholesale agencies, data have been developed for much of the service area of the State Water Project for use in the freshwater cost analyses.

Attachment

EXAMPLE ECONOMIC ANALYSIS

Water Reclamation Project

To illustrate a typical economic analysis, a hypothetical water reclamation project, called the Mountain Valley Water Reclamation Project, will be used. The project, proposed to be constructed by the Mountain Valley Water District, is designed to deliver ultimately 2,354 acre-feet/year of reclaimed water for landscape irrigation purposes. The economic cost of the project is derived in Table 1. The analysis covers the period of design through 20 years of operation. The economic cost of a project is determined by dividing the total net present worth of costs of the project by the present worth of fresh water replaced, in this case yielding a unit cost in units of dollars per acre-foot. Determining the present worth of a commodity seems peculiar, but makes sense when it is understood that the purpose of an economic analysis is to determine the value of resources invested in a project and the benefits or other products resulting from the project. The use of dollars is simply a common measure of the value of the resources. In this case, the value of the product is measured in acre-feet rather than dollars. Resources have a time value, the same as dollars do.

In this example, it is assumed that the project delivers only reclaimed water, that is, no supplemental fresh water is added to the system to meet peak flows or other situations. In addition, all reclaimed water deliveries are assumed to replace fresh water on a one-for-one basis, for example, it does not take more reclaimed water to irrigate a golf course than potable water. Thus, reclaimed water sales do not need any adjustment. Because reclaimed water generally has nitrogen and phosphorus content which can allow the reduced application of fertilizer in irrigation uses, an estimate of the value of this benefit is made, as shown in column F. Facilities having a useful life longer than the planning period of 20 years will have a salvage value at the end of the planning period, as shown in column G. It is derived assuming straight-line depreciation, thus:

Item	Capital cost, $	Useful life, yr	Salvage value, $
Treatment facilities	1,913,000	20	0
Storage facilities	2,166,000	75	1,588,400
Pump stations	1,160,000	20	0
Pipelines	922,000	50	553,200
Engineering, legal, admin	924,000	0	0
Total	7,085,000		2,141,600

The present worth is determined using a discount rate of 6 percent in this case. The discount rate is the time value of resources, established by economists in the Department of Water Resources or the U. S. Environmental

Protection Agency. This rate is not the cost of borrowing money by local agencies. Inflation is excluded in an economic analysis, since it does not represent a change in the real value of resources. The net present worth of the project is determined by adding columns I, J, and K and subtracting columns L and M. The unit economic cost, shown at the bottom of the table, is $505/acre-foot.

Alternative Freshwater Cost

In this example, it is assumed that the project is located in San Diego County. The water displaced by the water reclamation project is potable water obtained from several sources, including local reservoirs and the Metropolitan Water District of Southern California (MWD), which obtains the bulk of its supply from the State Water Project and the Colorado River. There are plans to accommodate new demands for water in the service area of this project by additional purchases of MWD water. To meet growing demands for water, the State Water Project, MWD and the San Diego County Water Authority are planning capital expansions of their systems. The costs of these new facilities plus the operation and maintenance costs to deliver the additional water are summarized below, adjusted to July 1991 dollars. In this example, there is no added line item in the table below for the retail potable water agency, the Mountain Valley Water District. It is assumed that the potable water is received by the Mountain Valley Water District from the San Diego County Water Authority at adequate pressure for final distribution in Mountain Valley's system to the water customers without any significant variable costs.

Component	Unit cost, $/AF
State Water Project Los Banos Grandes Reservoir, capital cost	271
State Water Project transportation, O&M cost	111
MWD treatment and distribution system expansion, capital and O&M cost	293
San Diego County Water Authority distribution system expansion, capital cost	223
Total	898

The cost of new alternative freshwater supplies is estimated to be $898/AF, which is greater than the water reclamation project cost of $505/AF. Therefore, the reclamation project is economically justified.

File name: C:\OWR\ECONINFO 4/17/92
Conversion to Word: EconomicsBackgroundInfo.doc 1/8/2002

Table 1. MOUNTAIN VALLEY WATER RECLAMATION PROJECT, ECONOMIC ANALYSIS /a/

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Fiscal year ending	Reclaimed water sales (fresh water displaced) AF	Design & Construction costs, $	O&M costs, $ Fixed	O&M costs, $ Variable	Ferti-lizer credit $ /b/	Salvage value, $ /c/	Present worth factor at 6%	Present worth of costs, $ Design & Construction cost	Present worth of costs, $ Fixed O&M costs	Present worth of costs, $ Variable O&M costs	Present worth of costs, $ Ferti-lizer credit	Present worth of costs, $ Salvage value	Present worth of costs, $ Total	Present worth of sales, AF
1990		357,040	0	0	0		1.123600	401,170	0	0	0	0	401,170	0
1991		3,464,770	0	0	0		1.060000	3,672,656	0	0	0	0	3,672,656	0
1992	1,086	3,263,190	190,000	233,490	43,440		1.000000	3,263,190	190,000	423,490	43,440	0	3,643,240	1,086
1993	2,172		190,000	466,980	86,880		0.943396	0	179,245	619,792	81,962	0	537,830	2,049
1994	2,263		190,000	486,545	90,520		0.889996	0	169,099	602,123	80,562	0	521,560	2,014
1995	2,354		190,000	506,110	94,160		0.839619	0	159,528	584,467	79,059	0	505,409	1,976
1996	2,354		190,000	506,110	94,160		0.792094	0	150,498	551,384	74,584	0	476,801	1,865
1997	2,354		190,000	506,110	94,160		0.747258	0	141,979	520,174	70,362	0	449,812	1,759
1998	2,354		190,000	506,110	94,160		0.704961	0	133,943	490,730	66,379	0	424,351	1,659
1999	2,354		190,000	506,110	94,160		0.665057	0	126,361	462,953	62,622	0	400,331	1,566
2000	2,354		190,000	506,110	94,160		0.627412	0	119,208	436,748	59,077	0	377,671	1,477
2001	2,354		190,000	506,110	94,160		0.591898	0	112,461	412,026	55,733	0	356,293	1,393
2002	2,354		190,000	506,110	94,160		0.558395	0	106,095	388,704	52,578	0	336,126	1,314
2003	2,354		190,000	506,110	94,160		0.526788	0	100,090	366,702	49,602	0	317,100	1,240
2004	2,354		190,000	506,110	94,160		0.496969	0	94,424	345,945	46,795	0	299,151	1,170
2005	2,354		190,000	506,110	94,160		0.468839	0	89,079	326,364	44,146	0	282,218	1,104
2006	2,354		190,000	506,110	94,160		0.442301	0	84,037	307,890	41,647	0	266,243	1,041
2007	2,354		190,000	506,110	94,160		0.417265	0	79,280	290,462	39,290	0	251,173	982
2008	2,354		190,000	506,110	94,160		0.393646	0	74,793	274,021	37,066	0	236,955	927
2009	2,354		190,000	506,110	94,160		0.371364	0	70,559	258,510	34,968	0	223,543	874
2010	2,354		190,000	506,110	94,160		0.350344	0	66,565	243,878	32,988	0	210,889	825
2011	2,354		190,000	506,110	94,160	2,141,600	0.330513	0	62,797	230,073	31,121	707,827	(508,874)	778
Total		3,821,810						7,337,016	2,310,042	8,136,439	1,083,981	707,827	13,681,648	27,100

Unit Cost ($/AF) = (Total present worth of costs)/(Total present worth of sales) = 505

/a/ All costs adjusted to midpoint of construction, July 1991. Unless other wise noted, all costs and water sales obtained for Project Report, January 1990
/b/ A credit for fertilizer value in reclaimed water is assumed to be $40/AF
/c/ Useful lives: Pipelines, 50 yr; treatment facilities, pump station mechanical/electrical, 20 yrs; storage reservoir, 75 yrs. No salvage value for engineering, legal and adminstration costs.