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Department of Water Resources
State Water Resources Control Board
Department of Health Services

2002 RECYCLED WATER TASK FORCE

Economics Work Group
Draft White Paper

18 November 2002

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Introduction

The 2002 Recycled Water Task Force was established by Assembly Bill 331 (Goldberg, 2001). The Task Force is chaired by Richard Katz, a board member of the State Water Resources Control Board (SWRCB), and composed of leaders in water recycling from industry, academia, the public, environmental groups, and local, state, and federal government. The charge of the Task Force is to identify opportunities and impediments to increasing recycled water use in California. The California Department of Water Resources (DWR) is the lead agency in a collaborative effort with the SWRCB, and the Department of Health Services (DHS) to coordinate the efforts of the Task Force. A report of its findings will be made by the Task Force to the Legislature by July 1, 2003.

The Economics Work Group is one of six groups examining specific recycled water issues. The charge of the Economics Workgroup is to identify economic impediments to enhancing water recycling statewide and to make recommendations for mitigating these impediments**.** Some of the issues addressed by the Economics Workgroup are related to those being examined by the Funding/CALFED Coordination Work Group but are distinct. The Funding/CALFED Coordination Work Group is focusing on the process of providing funding for recycled water projects. The Economics Work Group is focusing on a systems approach to identifying a consistent economic feasibility framework for recycled water projects that addresses the true benefits and costs of projects, equitable sharing of costs proportionate to realized benefits, and opportunities for collaborative planning and partnering by project beneficiaries.

Background and Foundational Information

Insert Rich Mills' writeup here.

Review of Previous Work in the Economics of Recycled Water

A large body of work exists on the economics of water recycling from economic primers to practical guidebooks. An annotated bibliography of some of these works is provided in Appendix A and provides the reader with a starting point in finding additional information of interest. Common themes found in the works and identified as important by the Work Group to developing an economic feasibility framework will be highlighted.

At some point in the text or in an appendix, we still need a list of water recycling benefits and costs. I'll work on that next, but if anyone wants to brainstorm and send me his or her list—my email box is wide open.

Common Themes

There are some recurrent themes in the existing literature on the economics of recycled water and also in the discussions within the Economics Work Group. These themes point to what is important in economic feasibility analysis and what have the potential to be economic impediments to increasing the safe use of recycled water in California.

Theme #1: Difference between economic analysis and financial analysis

The difference between economic and financial analysis is an important distinction. Economic analysis answers the question of should a recycled water project be built based on the true benefits and costs to society. This entails the examination of the benefits and costs one would expect to be associated with a recycled water project. Examples on the benefits side are savings in the form of avoided costs of developing new fresh water sources and lower water rates for the recycled water user; and on the costs side, capital costs and operations and maintenance (O&M). These are also known as market benefits and costs since there is an observable market price.

Though more difficult to quantify, one must also consider non-market benefits and costs like environmental impacts in an economic analysis. Non-market benefits and costs are named such because markets do not exist where one can buy and sell them for a price. However, these impacts often represent key local, regional, or societal benefits and costs that if ignored would omit a major portion of any systems based economic feasibility analysis. To that end, analyzing non-market benefits and costs help cast a wider net in identifying stakeholders and developing collaborative partnerships early in the project planning process. Identifying the true benefits and costs of projects to a practical level of detail can also help identify the proportion of the total benefits a project beneficiary is expected to enjoy and is a starting point to identifying an equitable share of funding responsibility.

Financial analysis answers the question of can a recycled water project be financed and will it be able to generate sufficient cash flow to service its debt and cover O&M and other recurring costs. Creative funding partnerships and widely available information on funding sources are often cited as being needed for recycled water projects. The reader is referred to the Funding/CALFED Coordination section of this report for more information on the role of funding agencies, funding sources, and recommendations on improving the overall recycled water funding process.

Our work group has identified the lack of a consistent economic feasibility framework as an impediment. We don't address financial analysis and the Funding/CALFED Coordination Group does not mention it explicitly. In their White Paper they summarize DWR's competitive funding process, which is based in part on costs and benefits, but financial feasibility is not explicitly mentioned. The Funding/CALFED paper also talks about technical support for funding solicitation and selection criteria, but again, no direct mention of financial feasibility. It seems to me that financial feasibility analysis needs to take place after the economic feasibility analysis and prior to funding applications because any perennially limited funding should go to those projects that are economically and financial feasible. My question is: Should we (1) include financial feasibility analysis as a part of our White Paper; (2) mention it needs to be addressed, but don't claim it; (3) mention it and suggest the Funding/CALFED group include it, but their paper is complete, so this might not be the most useful option; (4) any other ideas?

An economic analysis should be conducted for all alternative projects to identify cost effectiveness and the results may be inputted into a financial analysis framework or funding process. Maintaining the distinction between economic and financial analysis is important, especially since it is easy to fall into the trap of using the terms financial and economic interchangeably. Confusion of the two will cause an impediment to developing recycled water projects because a project may be economically feasible, but not financially and vice versa. As long as one is careful in referring to the two types of analyses appropriately, the distinction does not appear to be a major impediment to recycled water use in California.

Theme #2: Quantifying Benefits and Costs

When market information (i.e., prices) exists for benefits and costs, then quantifying is straightforward. However, market information is not readily available for many benefits and costs such as environmental impacts, socio-economic impacts, and reduced risk as with improved water reliability. Economic techniques exist to quantify non-market benefits and costs. Examples of more widely used techniques are:

> **Contingent Valuation Method** usually presents a hypothetical situation through a survey instrument and survey respondents are asked how much they are willing to pay in increased prices, rates, taxes, etc., to receive a benefit. For instance, how much would residential rate payers be willing to pay for upgrading a wastewater treatment facility so that it may produce recycled water that will decrease their community's drought impacts by a given percentage. The range of rate increases identified by the respondents represents an estimated value of the benefit of decreased drought impacts attributed to the proposed recycled water project.
>
> **Travel Cost Method** where the costs of traveling to and cost of activities at the resource are used as a proxy of what the resource is worth. For instance, a person travels to the Bay-Delta for recreational sport fishing. The costs that could be considered are travel (e.g., car rental, airfare), time (opportunity cost of what else the time could be used for), lodging, activity (boat rental, bait and tackle), cost of substitute activities. If a benefit of a recycled water project is increased recreational sport fishing, then the estimated benefits form a travel cost analysis maybe attributed to the project.
>
> **Hedonic Price Method** uses the attributes of a resource to value it through other transactions such as real estate. Real estate values are affected by a parcel's attributes such as size, quality of public services, proximity to transportation, etc. A parcel's value could also be affected by proximity to desirable environmental resources, incidence of drought conditions, drinking water quality, availability of recycled water, and other factors. It would be logical expect that a parcel with a low risk of drought restrictions and high drinking water quality would garnish a higher selling price, while a parcel with frequent drought restrictions and poor drinking water quality would be worth less. A statistical hedonic model of a market transaction, such as real estate sales, as a function of attributes may be used to determine the magnitude of how each attribute affects sale price.

Damage Assessment Methods consider the replacement costs for a resource. If a drinking water aquifer is made non-potable due to saltwater intrusion, the cost of that damage is the cost of replacing the drinking water that would have come from the aquifer. That cost would be saved and be realized as a benefit of a recycled water project that produces indirect potable water that is used to stem saltwater intrusion.

Transfer of Benefits Method takes existing estimated values for a similar resource from another study and applies it to a case where there is no time or funding to conduct a primary study. For instance, the estimated drought protection benefits in an urban community are estimated in a previous study. Those estimates may be applied to a similar urban community with similar water supply conditions as a proxy of the drought protection benefits.

The above techniques are sometimes criticized for being too costly, time consuming, or nebulous. These criticisms are sometimes valid, but the tradeoffs for not identifying non-market benefits include missing:

- Important benefits and costs that will initially bias the economic and financial analyses
- Important benefits and costs that will be occur later in the project time horizon
- Potential beneficiaries and other stakeholders of a recycled water project
- Key opportunities for casting a wide net to identifying important economic concerns and developing collaborative partnerships

In the extreme case that quantifying certain non-market benefits and cost is not possible, those that can be quantified should be to the extent practical and the remaining impacts should be described qualitatively in detail. Increasingly recycled water decision makers must consider non-market impacts for a systematic and holistic analysis of projects. But by not doing so, the lack of estimates for non-market benefits and costs is an impediment to increasing recycled water use in California or any place else.

Theme #3: Identifying Beneficiaries and Equitable Shares of Funding Proportionate to Benefits

Identifying those benefiting from a recycled water project would be in large part accomplished by going through the process of identifying the true benefits and costs of a project. In the economic analysis process, the stakeholders would be identified along with the magnitude of their expected gain or loss. This is important because sometimes a project is economically feasible, but financially infeasible, especially from a local funding perspective. Costs can be overwhelming for a local municipality to fund alone. However, if a local project would produce significant benefits to in-stream uses in say the Bay-Delta or the Colorado River Basin then significant regional and federal funding is justified. Regional planning, communication, and collaboration play a large role in such an effort.

Without an equitable distribution of the funding burden, opportunities are lost to develop recycled water projects and that is a clear impediment to increasing the use of recycled water.

Theme #4: Comparison to Fresh Water Alternatives

I don't recall if the work group feels we needed to include this in the white paper? If so, should we include desalination as a becoming increasingly viable along with traditional freshwater sources like reservoirs?

(Just some notes if we decide to include this section: Decision makers need a benchmark for comparing the incremental costs of developing recycled water with the cost of producing the same amount of water through a fresh water development project (e.g., new reservoir or desalination facility). Without an appropriate benchmark, a proper comparison cannot be made between recycled water and other freshwater sources resulting in decisions being made with incomplete information. This constitutes an impediment to recycled water use.)

Theme #5: Need for Consistent Economic Feasibility Framework

The primary government funding agencies for recycled water projects in California are local agencies, the DWR, the SWRCB, CALFED, US Environmental Protection Agency (USEPA) and the US Bureau of Reclamation (USBR). Each agency has it's own economic analysis process and criteria for projects. Entities such as the California Urban Water Agencies and the WateReuse Association of California also have feasibility assessment frameworks that address economic analysis. While there is overlap in the basic economic analysis, specific requirements may cause the analysis to be incompatible across agencies, so that "apples are being compared to oranges." Similarly, many funding agencies require some economic analysis or data reporting in their applications, but these requirements are sometimes not consistent, causing the applicant to do additional work to tailor each application. A consistent economic feasibility framework across funding agencies would greatly decrease duplicative work, allow projects to be compared by the same criteria—"apples to apples, " and increase the opportunity for communication and collaboration for planning and identifying equitable funding partnerships.

The framework would include the obvious components of quantifiable benefits and costs, non-market benefits and costs to a practical level of detail, collaborative regional planning, opportunity for equitable financing partnerships, a mechanism to funnel relevant economic feasibility findings into financial analysis and funding decisions. Without such a framework, the lack of comparability between frameworks, information on costs and benefits, information inputs into financial and funding decisions, collaboration, communication, and funding partnerships all represent impediments to increasing water recycling in California.

Case Studies

Case Studies will be used to illustrate the importance of economic feasibility analysis.

Case Study #1: Ground Water Replenishment System

The Ground Water Replenishment System (GWRS) is a joint project of the Orange County Water District (OCWD) and the Orange County Sanitation District (OCSD) that began development in 1995. The aim of the project is to recycle/reuse 70,000 AF/yr of secondary effluent through a treatment train of microfiltration, reverse osmosis filtration and ultra violet disinfection. The high quality product waters will be transported for injection into the Orange

County aquifer system to ensure sustainable supplies for future generations, assist California to reach its future water allocation from the Colorado River of 4.4 million AF/yr, reduce dependence on Bay Delta supplies, and draught proofing.

Year-Round Availability of Water for Recycling/Reuse

One benefit of using wastewater for source water is its availability on a year-round basis, thus making it an uninterruptible supply. The difference at present between an interruptible supply and an uninterruptible supply if purchased from the Metropolitan Water District of Southern California (MWD) is $138/AF. This project will reduce if not eliminate this cost from future calculations. In terms of the GWRS project the annual benefit could be well over $10 million.

Improved Water Quality

The GWR System is projected to produce a water with a quality of 65 mg/L TDS which is much lower than the present supplies imported into the basin for recharge or from existing groundwater sources. State Project water has an average TDS of 250 mg/L, while the Colorado River water averages 700 mg/L and the Santa Ana River averages 625 mg/L. At present, the average TDS level in the basin is about 600 mg/L (about the same as the average flow of the Santa Ana River) and has been increasing at a rate of about 14 mg/L a year based on an average replenishment of 350,000/AF/yr of water from various sources. Management of salinity has been a major regional water quality issue and the focus of many capital projects and management strategies including groundwater-desalting facilities, management of high salinity waste streams and changes in water importation strategies.

The OCWD 1999 Master Plan Report included a chapter on Basin Water Quality Management that identified the impact of salinity on consumer costs. It cited a 1998 USBR/MWD Salinity management Report that looked at the impacts of importing higher TDS water supplies on the consumers in Southern California. It reported that a 100-mg/L reduction in TDS would reduce consumer costs in the MWD service area (17 million population) by $95 million or about $12 million for the OCWD service area.

It is also critical for long-term planning purposes to note that the rate at which groundwater TDS has been increasing is accelerating in recent years. Average long-term increases are averaging 8.5 mg/L between 1965 and 1995 and during 1996-97 the deterioration increased at a rate of nearly 14 mg/L. The trend is steadily upward at a rate of about 85 mg/L per decade adding in excess of $10 million a year in consumer costs within the OCWD service area per 100-mg/L increases in TDS.

Costs for providing wellhead treatment for poor quality groundwater are illustrated by the costs of operating the Tustin Desalter, which began operation in 1996 to treat three wells in the area, which had high nitrate levels and high TDS. Costs for construction of the 3,271-afy facilities were $6.63 million with annual O&M costs of $1.5 million. This works out to an approximate average amortized cost of $445/af as compared to a projected average replenishment assessment cost to the producers of $175/AF for the GWRS project water.

The GWRS project water will be of very high quality (65 mg/L) and when compared to some of the higher TDS groundwater sources, e.g. City of Anaheim with a groundwater TDS of 623 mg/L, it will dilute the existing more saline waters by ten fold. Thus the value of lower salts to Anaheim could amount to millions of dollars in consumer costs.

Nitrate Nitrogen

Another water quality benefit is the lowering of nitrate levels in groundwater. Nitrate levels in the Santa Ana River, the major source of water, now average 7-8 mg/L. The present Basin Plan water quality objective is 10 mg/L. This objective may be lowered to 3 mg/L in the future (Grebbien and Atwater, 1999). The GWRS is expected to produce water with a nitrate level of 0.9 mg/L. Alternative means of nitrate removal include wellhead treatment at a cost, which has cost $433/AF/y for the Tustin Desalter.

Total Organic Carbon (TOC)

Another water quality benefit is the lowering of total organic carbon levels in the groundwater basin. Present Santa Ana River water has an average TOC level of 5.46 mg/L. The target level for the GWRS is 0.25 mg/L. Long-term benefits are based on health effects improvements, which are difficult to quantify.

What is important to note is the large difference in quality between the GWRS product water and the existing groundwater and blended supplies. Water produced by the GWRS will be an order of magnitude better in terms of TDS and nitrate quality compared to the poorest quality groundwater in the OCWD service area.

Additional benefits of the project
(within the Orange County Water District boundaries)

The Value of Averting Sea Water Intrusion

The economic effects from groundwater contamination by seawater are huge. These effects can include impairment of the basin as a storage reservoir, the degradation and loss of the potable water supply stored in the basin, and the lost of the basin's value as a fresh water distribution system (NRC, 1997).

Value of Drought-proofing

Assigning a value to a ground water basin that can be used for an emergency water supply and distribution system during periods of extended drought, disruption of imported supplies due to shortages, natural disasters or other events has not been estimated and it is hard to calculate within the time constraints of this brief report. Needless to say, there is a high value placed on assurances of having a supply in place which could last as long as 3 years given present demands and estimated storage capacity and sustained yield.

The estimated cost savings for improved reliability and drought proofing have been estimated based on avoided drought penalties and water rate increases for imported supplies. The possible benefits of the GWRS project have been estimated to be in the range of $175-250/AF/y or between $7.6 and $13 million a year over a 40-year period with a total present value of $227 million based on present value with a 5.5% discount factor for 40 years (PRAG, 2001).

The new source waters, secondary treated effluent, have a monetized value based on the treatment investment of $229/AF. This generally unrecognized value would be over $17 million annually.

Equity of Recycled Water Funding and Sharing of Realized Benefits

Most, if not all, successful water recycling projects in California have been realized as a result of cooperative funding alliances. Typically, these involve Federal funds (i.e. BUREC Title XVI), State Funds (i.e. SWRCB Prop. 13), Regional Funds (i.e. MWD's Local Resources Program), and local water and sewer agency funding sources. Provision of these funds is justified because water recycling provides benefits on a number of levels. Demands for fresh water placed on Federal and State water projects are reduced by recycled water use offsets. State water bodies also benefit by the reduced flow of treated sewage. Finally, local agencies benefit through the increased water reliability resulting from this diversification of water supply sources. Currently, these funding alliances are simply a result of circumstances. For instance, State funds are dependent on availability of funds from voter approved bonds, Federal funds are subject to annual budget approval, and a substantial local share must be secured from rate payers as well. Therefore, it is important that the Taskforce examine ways that the economics of recycled water project funding be considered as an important element in securing the funds to realize a greater potential for water recycling in California.

The current funding alliances noted above have resulted in a number of successful water recycling projects that have produced, and beneficially used, thousands of acre-feet of recycled water. However, there are ways to improve the current evaluation and funding frameworks and remove impediments that restrict the funding of recycled water projects. One step would be to move toward more long term and consistent commitments of Federal and State funds for recycling projects. Another would be to explore more pay for performance funding programs, like the MWD LRP. Through these programs project operators are paid a set fee per acre-foot beneficially used. Finally, a comparison of the multiple benefits from projects should be analyzed to assure an equitable process for allocating funding responsibility is in place.

A key reason for funding alliances being developed is the reality that most, if not all, water recycling projects are not cost effective based solely on local funding and benefits. The interest in developing water recycling projects is often driven at the local level by the need for water supply reliability, or sewage treatment or disposal issues. Regional and State-wide interests in funding for the recycling, meanwhile, tends to encourage economies of scale and larger regional and state-wide benefits that result from supplementing that local funding.

If California is to increase the level of beneficial use of recycled water, more funding partnerships will need to be encouraged and implemented. The partnerships need to have funding commitments proportional to benefits. To accomplish this goal, current partnering incentives may need to be enhanced, while additional incentives may need to be developed. Additionally, it may be necessary to find ways to provide incentives and mechanisms that entice potential partners to engage in discussions that could result in the formation of effective partnerships.

One additional benefit of funding partnering is the risk reduction it can mean for the agencies involved. A local agency embarking alone on a water recycling project assumes significant individual financial risk. That same project funded with a number of risk sharing partners spreads the risk so that it is much more manageable. This is especially true of smaller public agencies with a limited revenue base and costly bond funding options.

Recommendations

Development of a Consistent Economic Feasibility Analysis Framework

The need for a consistent economic feasibility analysis framework is clear and a team should be convened to develop such a framework. A team of economists representing local, state, and federal recycled water funding agencies, recycled water experts, and stakeholders should be established. Their tasks would include:

A. Identifying a set of desirable characteristics for an economic feasibility analysis framework based on true benefits and costs for recycled water projects in California.
B. Reviewing the existing frameworks to find the commonalities and gaps based on the characteristics from A; add components to the framework that fill in the gaps.
C. Developing a practical and implementable process to identify and include non-market benefits and costs into the framework. This is large task and perhaps a second team can be established for this purpose.
D. Developing a mechanism to increase the opportunity for identifying equitable funding schemes based on the benefits and costs analysis.
E. Developing guidance to conduct an economic feasibility analysis
F. Developing a mechanism for information from the economic feasibility analysis to feed into the financial feasibility analysis and funding decision making.
G. Other tasks the team finds necessary.

The team and their representative agencies must be given the authority and resources to pursue this endeavor. A lead agency must be identified.

Improvement in Non-market Value Estimates

Not accounting for non-market impacts of recycled water projects can be an impediment to analyzing the feasibility of the projects. Studies need to be designed to identify and quantify non-market benefits and costs of projects. Perhaps these studies can be designed to address regional benefits and costs (e.g. Northern/Southern California, urban/rural) or by use of recycled water (e.g. ground water injection, industrial applications) so that each project will not need a new study. A team or a sub-set of the framework team should be convened to develop the capacity to estimate non-market benefits and costs. Their tasks would include:

A. Reviewing the non-market value estimation literature to find applications to or methodologies amenable to recycle water projects.
B. Identify gaps in the literature and suggest ways to fill them with new work.
C. Work collaboratively with industry and academic experts to identify the needs and extent of new work.
D. Conduct or manage the project to contract out the new work.
E. Integrate new results into the economic feasibility framework.
F. Other tasks the team finds necessary.

The team and their representative agencies must be given the authority and resources to pursue this endeavor. A lead agency must be identified.

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