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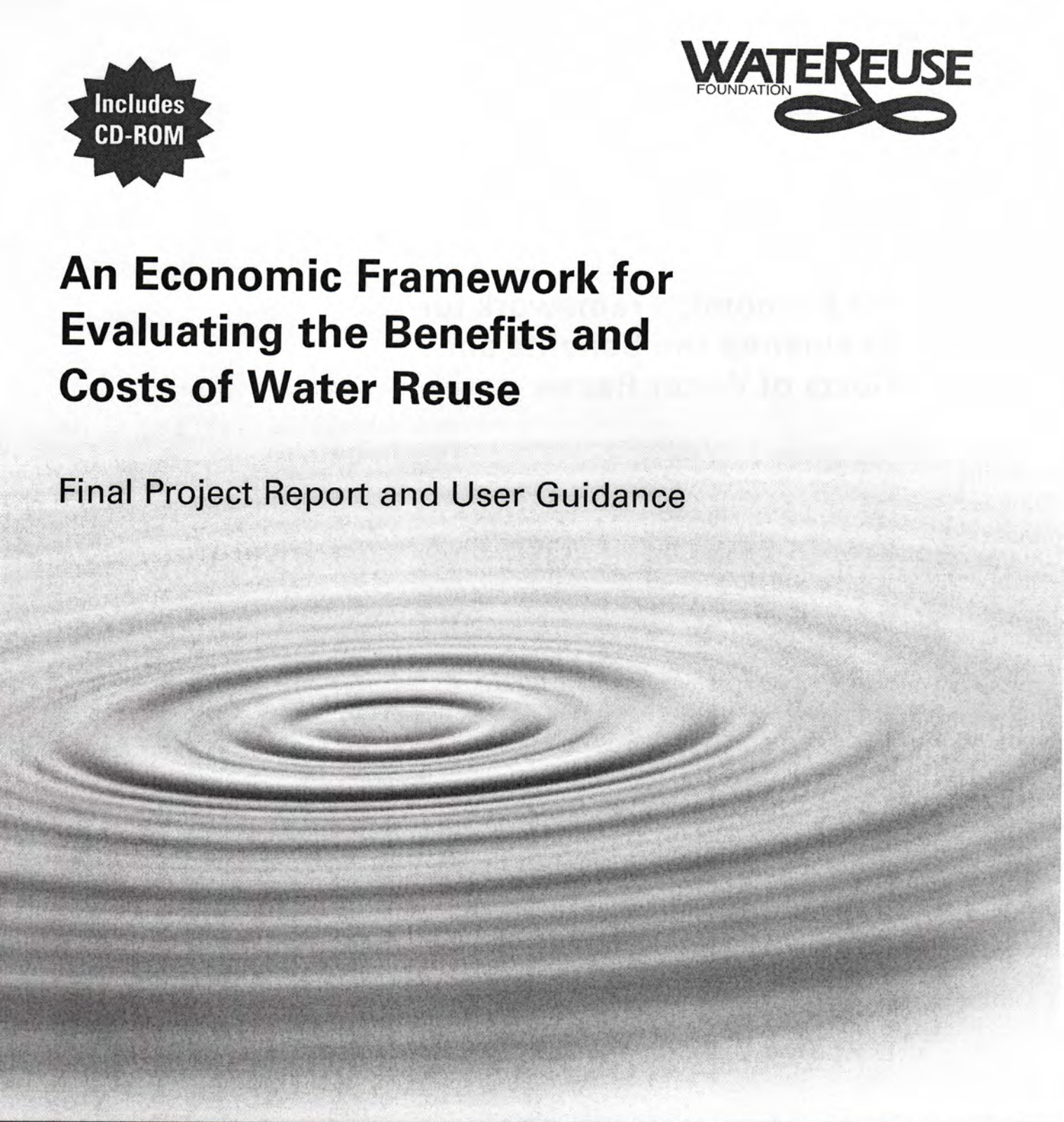
WATEREUSE FOUNDATION

An Economic Framework for Evaluating the Benefits and Costs of Water Reuse

Final Project Report and User Guidance



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An Economic Framework for Evaluating the Benefits and Costs of Water Reuse

Final Project Report and User Guidance

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Cosponsors
Southwest Florida Water Management District
California State Water Resources Control Board
United States Bureau of Reclamation
Inland Empire Utilities Agency (CA)
Las Vegas Valley Water District (NV)
Santa Clara Valley Water District (CA)

Participating Agencies
Dublin San Ramon Services District (CA)
El Paso Water Utilities (TX)
Inland Empire Utilities Agency (CA)
Las Vegas Valley Water District (NV)
Orange County Water District (CA)
Phoenix Water Services Department (AZ)
Pinellas County Utilities (FL)
San Diego County Water Authority (CA)
Santa Clara Valley Water District (CA)
West and Central Basin Municipal Water Districts (CA)

Published by the WateReuse Foundation
Alexandria, VA

About the WateReuse Foundation

The mission of the WateReuse Foundation is to conduct and promote applied research on the reclamation, recycling, reuse, and desalination of water. The Foundation's research advances the science of water reuse and supports communities across the United States and abroad in their efforts to create new sources of high quality water through reclamation, recycling, reuse, and desalination while protecting public health and the environment.

The Foundation sponsors research on all aspects of water reuse, including emerging chemical contaminants, microbiological agents, treatment technologies, salinity management and desalination, public perception and acceptance, economics, and marketing. The Foundation's research informs the public of the safety of reclaimed water and provides water professionals with the tools and knowledge to meet their commitment of increasing reliability and quality.

The Foundation's funding partners include the U.S. Bureau of Reclamation, the California State Water Resources Control Board, the Southwest Florida Water Management District, and the California Department of Water Resources. Funding is also provided by the Foundation's Subscribers, water and wastewater agencies, and other interested organizations. The Foundation also conducts research in cooperation with two water research coalitions – the Global Water Research Coalition and the Joint Water Reuse & Desalination Task Force.

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WateReuse Foundation Project Number: WRF-03-006
WateReuse Foundation Product Number: 03-006-02

ISBN: 0-9747586-9-8
Library of Congress Control Number: 2006931650

Printed in the United States of America

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FOREWORD

The WateReuse Foundation, a nonprofit corporation, sponsors research that advances the science of water reclamation, recycling, reuse, and desalination. The Foundation funds projects that meet the water reuse and desalination research needs of water and wastewater agencies and the public. The goal of the Foundation's research is to ensure that water reuse and desalination projects provide high-quality water, protect public health, and improve the environment.

A Research Plan guides the Foundation's research program. Under the plan, a research agenda of high-priority topics is maintained. The agenda is developed in cooperation with the water reuse and desalination communities, including water professionals, academics, and Foundation Subscribers. The Foundation's research focuses on a broad range of water reuse research topics including the following:

- Defining and addressing emerging contaminants;
- Public perceptions of the benefits and risks of water reuse;
- Management practices related to indirect potable reuse;
- Groundwater recharge and aquifer storage and recovery;
- Evaluating methods for managing salinity and desalination; and
- Economics and marketing of water reuse.

The Research Plan outlines the role of the Foundation's Research Advisory Committee (RAC), Project Advisory Committees (PACs), and Foundation staff. The RAC sets priorities, recommends projects for funding, and provides advice and recommendations on the Foundation's research agenda and other related efforts. PACs are convened for each project and provide technical review and oversight. The Foundation's RAC and PACs consists of experts in their fields and provide the Foundation with an independent review, which ensures the credibility of the Foundation's research results. The Foundation's Project Managers facilitate the efforts of the RAC and PACs and provide overall management of projects.

The Foundation's funding partners are the U.S. Bureau of Reclamation, the California State Water Resources Control Board, the Southwest Florida Water Management District, the California Department of Water Resources, Foundation Subscribers, water and wastewater agencies, and other interested organizations. The Foundation leverages its financial and intellectual capital through these partnerships and funding relationships. The Foundation is also a member of two water research coalitions: the Global Water Research Coalition and the Joint Water Reuse & Desalination Task Force.

The objective of this report is to provide a practical, user-friendly, yet robust tool that wastewater agencies can use to identify and assess the benefits and costs of their water reuse options. The key is to provide an objective and comprehensive basis for considering all the benefits and costs so that utility managers, governing officials, customers, and other stakeholders can better understand the implications of applicable reuse options.

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ACKNOWLEDGMENTS

This project was funded by the WateReuse Foundation in cooperation with the Southwest Florida Water Management District, the California State Water Resources Control Board, the United States Bureau of Reclamation, Inland Empire Utilities Agency (CA), Las Vegas Valley Water District (NV), and Santa Clara Valley Water District (CA).

This study would not have been possible without the insights, efforts, and dedication of many individuals and organizations. These include the members of the research team and PAC members (as identified blow); the WateReuse Foundation's project manager, Josh Dickinson; many key individuals at the participating utilities and related organizations; and the outstanding editorial and production staff at Stratus Consulting (including Diane Callow, Laura Cross, and Erin Miles).

The research team would like to thank the WateReuse Foundation for funding this applied research project, as well as the following organizations for their in-kind contributions: Dublin San Ramon Services District (CA), El Paso Water Utilities (TX), Inland Empire Utilities Agency (CA), Las Vegas Valley Water District (NV), Orange County Water District (CA), Phoenix Water Services Department (AZ), Pinellas County Utilities (FL), San Diego County Water Authority (CA), Santa Clara Valley Water District (CA), and West and Central Basin Municipal Water Districts (CA).

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EXECUTIVE SUMMARY

PROJECT BACKGROUND AND OBJECTIVES

This research report develops an economic framework that is a tool to help water agencies and other water sector professionals conduct a benefit–cost analysis (BCA) of reuse or desalination investments. The economic framework is designed to help water managers (1) identify, (2) estimate (to the degree feasible and meaningful), and (3) effectively communicate the full range of benefits associated with water reuse projects or related activities.

Having a reasonably complete recognition and accounting of the full range of benefits of a reuse or desalination project is extremely important. This is because the financial costs of building and operating a reuse or desalination facility are often relatively high (compared to the cost of using more traditional sources of water). Given the high relative costs, water agencies and water resource planning bodies may wonder whether the expense is justified—i.e., whether the benefits may outweigh the costs. They may also face difficulties obtaining support from local governing officials or customers, or need economic justification for seeking funding support (e.g., cost sharing with neighboring entities in the region, or state and federal grants or loans).

One of the key challenges in assessing whether or where the benefits of reuse outweigh the costs is that the benefits are often hard to estimate in full. Among the key reasons that benefits are hard to identify or estimate are:

1. Benefits often are very diverse in type (i.e., many types of benefits may be generated, and several may not be immediately obvious to some parties);
2. Many of the benefit types are hard to explain, and/or difficult to estimate in monetary terms (e.g., many benefits involve "nonmarket" values for ecological or recreational services); and
3. Those who receive or enjoy the benefits (i.e., the beneficiaries) often are dispersed across water agency and political jurisdictional boundaries (meaning that there often are large externalities, and these are often positive externalities rather than negative ones).

These factors can make it very difficult to justify or build public/political support for reuse or desalination projects that, in reality, often have many important net social benefits to offer. This report is intended to help agencies overcome these challenges.

DIFFERENCES BETWEEN FINANCIAL AND ECONOMIC ANALYSIS

While technological advances and increased demands for water have combined to make water reuse increasingly feasible and more cost-effective, there are still several economic roadblocks to broader implementation of water reuse. One of the key challenges for reuse applications is that the financial assessment of such projects may often appear unfavorable,

even though there may be total project benefits that outweigh the project's costs. Therefore, at the outset, it is important to make a clear distinction between:

1. A financial analysis of reuse (which is based solely on the cash flows of expenses and revenues in and out of the utility); and
2. An economic analysis that provides a broader perspective of the value of the reuse-generated waters (i.e., provides a suitable benefit–cost perspective for considering if a reuse investment is worth the expense to the broader region and community as a whole).

In brief, water reuse often is considered relatively expensive in terms of the direct financial cost of installing and operating the required treatment processes and related infrastructure. At the same time, the anticipated revenue stream may appear relative low. Thus, on a cash flow basis, reuse may appear to be a financial loser.

While financial analyses are very important and useful in many ways, they typically provide too limited a context with which to evaluate the real social worth of a reuse project. This is because a financial analysis focuses strictly on revenue and cost streams internal to the water agency, and these cash flows are not the same as the true worth or value of most water reuse projects to the community and society as a whole. For example, a financial analysis does not include benefits such as the environmental and social costs avoided when reuse enables a community to forgo developing alternative water supply options (e.g., when reuse avoids the need to extract more raw water from flow-limited streams). This WateReuse Foundation economic framework report and associated tools provide a suitable economic framework within which the benefits ("value") of water reuse projects can be more fully identified and evaluated, and then properly compared to the full costs of reuse.

KEY ISSUES AND APPROACHES FOR BENEFIT–COST ANALYSIS

How does an agency demonstrate that a reuse project is "economically and environmentally appropriate," or that a project provides "the greatest public benefits?" To address these questions, this report provides an analytical tool for conducting a "full social cost accounting" of the benefits and costs of reuse projects. Benefit–cost analysis is a technique that enables program evaluators to undertake structured comparative analyses of alternative approaches to achieve the same general outcome. It is widely used, and in some cases federally mandated, in evaluating complex projects that have substantial environmental and social impacts.

The term "full social cost accounting" refers to the economics perspective of trying to identify and account for *all* the benefits and costs of a potential action or policy, regardless of who bears the impact, or whether the impact can be valued using observed market prices. In other words, our framework is intended to help utilities include benefits, costs, and risks borne "internally" by the wastewater (and/or water supply) agency *as well as* those impacts borne "externally" by other parties (e.g., households, businesses, special interest groups). The approach is also intended to help utilities include, to the greatest degree feasible, "nonmarket" goods and services—meaning impacts that are not typically traded in markets and therefore do not have market-observable values (instead, these values need to be estimated using nonmarket valuation techniques—revealed or stated preference methods such as hedonic pricing or conjoint survey analysis, respectively, and/or using results of studies applied elsewhere, an approach referred to as "benefits transfer").

ENGAGING CUSTOMERS, GOVERNING OFFICIALS, AND OTHER STAKEHOLDERS

In addition to developing a tool to encompass the environmental and economic implications of reuse projects, another key function of the economic framework project is to provide a basis that agencies can use to help communicate their key assumptions, inputs, and findings with impacted communities and stakeholders. The tool developed can (and should) be used to facilitate a process wherein input is invited from relevant individuals and organizations, and through which utilities systematically reveal the key assumptions, input values, sensitivities, and other factors embodied in the analysis.

The framework tools are *not* intended to be used as a "black box" that develops fixed empirical outputs (e.g., dollar values) for all benefits and costs. Instead, the materials provided here are intended as a tool to help organize, document, and communicate benefit–cost information in a transparent manner, so that it can help guide public discourse and policy making.

There are several important reasons for engaging stakeholders throughout the application and interpretation of the economic framework. First, it is important to ensure that the key benefits of a potential reuse project are well recognized. Water reuse can generate many important types of benefits, but often the full range of benefits are not well recognized.

In addition, it is important that analysts applying the framework avoid technical jargon, and instead try to find and apply lay terms (especially to describe the types of benefits to be derived) that communicate with (i.e., can be understood by) the key stakeholders. This can be a challenge, because many reuse benefits are hard to describe in ways that resonate with stakeholders and public officials.

Also, it is important to consider stakeholders within the context of equity—what is often referred to as environmental justice. The economic framework encourages utility analysts to identify the key beneficiaries of reuse projects. This is intended to help all parties recognize (and consider the implications of) who will realize benefits, and who will bear the costs of a reuse project.

There are several additional important advantages from applying the broad BCA of the water reuse economic framework. Identifying and describing the full range of benefits, including those that accrue beyond the utility and its customers, will help the water agency:

- Recognize the full range of benefits of each reuse option, and portray all these benefits to governing/oversight bodies;
- Facilitate buy-in and support from utility customers, and help diffuse or offset possible opposition (e.g., by describing green values attributable to reuse, such as instream flow enhancement, and highlighting the local control benefits of reliance on a local water source);
- Identify beneficiaries beyond the agency's customer base, thereby providing a basis for pursuing broader cost-recovery (i.e., by showing who benefits and how they benefit, there is a more logical and equitable basis for cost allocations that better reflect the distribution of benefits); and
- Provide a basis for seeking external funding support, by recognizing and systematically characterizing the external benefits (e.g., for seeking state or federal

grants to recognize how the water district reuse choices generate benefits to downstream users and/or for the environment in general).

Therefore, the economic framework provided here is designed to help utility analysts think about the distribution of all lifecycle benefits and costs, and also to provide a forum around which stakeholder interactions can be structured.

KEY ENVIRONMENTAL AND ECONOMIC BENEFITS AND COSTS TO INCLUDE IN THE ASSESSMENT

For some, a major concern regarding the development of reuse projects is the potential for adverse environmental or public health impacts, or both. These issues and concerns need to be given due consideration.

At the same time, comparatively little attention has focused on reuse as a mechanism for reducing adverse environmental impacts. The environmental and other benefits of reuse may include:

1. Increased ability to meet critical instream flow conditions for fish and other aquatic species and ecosystem services of concern, by reducing demands on existing freshwater surface and/or groundwater supplies.
2. Reduced energy consumption and air pollution where imported waters would be the alternative to reuse, by reducing the need for pumping large volumes of source water across great distances and gradients.
3. Increased protection of groundwater systems—from subsidence, reduced storage capacity, and salt water intrusion, by reducing pumping demands on aquifers.
4. Increased reliability and drought relief (i.e., reducing the variability and uncertainty about the volume of water available to the community, in the event of droughts or other source water-impacting events).
5. Increased local control (i.e., reuse water can be viewed as a local resource, in contrast to waters imported to a community from regions and/or by agencies beyond the jurisdiction and control of the local community).
6. Sustained agricultural communities, by reducing municipal demands on waters currently applied to irrigation.
7. Any cost savings associated with using reuse relative to other water supply and wastewater management options (e.g., costs avoided because new waters and/or related infrastructure expansion will not need to be incurred by the community or because wastewater treatment and discharges may be reduced or postponed).

A COMPARATIVE CONTEXT, WITH CAREFUL ATTENTION TO DEFINING THE BASELINE

One important key to conducting a proper economic evaluation is to place reuse in a comparative context, evaluating these options in terms of both a default scenario of no new water supplies, as well as comparing reuse to other water supply alternatives (e.g., additional surface water extractions, agricultural-urban water transfers, water conservation) specific to given regions. The key is to set up the economic analysis in a "with versus without" reuse context.

A challenge to defining the baseline is that the "with" and "without" context can become a place where stakeholder and utility hidden agendas or disagreement over core assumptions often arise. For example, setting the baseline may set off a debate between the utility and stakeholders over future demand projections (e.g., where some members of the community hold alternative views about the size and pace of future population growth, or about the effectiveness of additional conservation opportunities). Therefore, it is important to carefully define the baseline, be transparent about underlying assumptions, and engage relevant stakeholders at this critical stage of the economic analysis.

WHAT THE ECONOMIC FRAMEWORK TOOL AND GUIDANCE OFFER

The framework and its associated tools have been developed with the objective of providing water agency professions with a way to:

- Provide a technically sound, objective basis for identifying, quantifying, and monetizing benefits and costs (and net benefits)
    - Include and describe all the relevant benefits and costs of reuse
    - Adhere to principles of economics for professional integrity and rigor
    - Reveal how to address benefits that cannot be readily quantified or valued
- Work with stakeholders and public officials—and water agency professionals—to develop a "common parlance" for benefits (and costs)
    - Ensure that technicians (economists and engineers) do not talk past public officials, customers, constituencies, and stakeholders
    - Embrace and integrate stakeholder perceptions and value systems
    - Ensure broader recognition of all applicable benefits (and costs) of reuse.

The economic framework is intended to be generic, since each water reuse project and location has its unique properties. Thus, the framework tool should not be seen as a "plug and play" or "one size fits all" model. Rather, it is a practical framework or tool to organize, develop, and communicate credible analyses of benefits and costs.