APPENDIX E
Raucher Workshop Slides and Notes

An Economic Framework for Evaluating Water Reuse Projects

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Initial Workshop Meeting
Reclaimed Water Technical Committee
King County, WA
August 25, 2006

WateReuse Foundation: Project 03-006

Economic Analysis of Sustainable Water Use -- Benefits and Costs of Reuse

- Stratus Consulting Inc.
- Bahman Sheikh
- Kristin Darr
- National Water Research Institute
- Numerous water agencies participating (details to follow)

Acknowledgements

- WateReuse Foundation: *Economic Analysis of Sustainable Water Use -- Benefits and Costs of Reuse* (WRF Project 03-006) – in print very soon
- Awwa Research Foundation: *The Value of Water…* (AwwaRF Project 2855) – report in print, June 2005
- Bureau of Reclamation: *Net New Water Supply Study* (NEWAS) – manuscript forthcoming
- Cal DWR and UC Santa Cruz: *Tool to Guide State and Local Desal Planning* (just underway)

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Expectations and Realities for Today's Workshop

- The WRF "Economic Framework" is not a "Black Box" or miracle cure-all
  - Simply a systematic approach to examining benefits & costs, and informing decision-making
- Today as a "get acquainted" session
  - We introduce you to what we can offer through WRF materials and other experiences and tools
  - You introduce us to the regional context and issues of concern to you
  - Set the stage for continued dialogue & joint efforts to assess recycling in King Co. context

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Overview

- Objectives of our WRF project & “framework”
- Financial versus Economic perspectives
  - Financial: revenues and costs (cash flows)
  - Economics: benefits (social value) v. costs
- Key types of benefits (values) to consider
- Evidence of the size of some benefits values
- Overview of the “Economic Framework” and related WRF-sponsored materials

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Objectives of the WRF Project

- Develop an economic framework that includes and describes all the relevant benefits and costs of reuse
  - Ensure broader recognition of all the applicable benefits (and costs) of water reuse
- 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

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Core Issue: Are New Water Supplies Worth the Relatively High Cost?

- From a financial cash flow perspective, reuse projects may not seem fiscally sound
  - High costs mean high cash outflow
  - Revenue stream limited (net revenues < 0?)
- From economic perspective, are there benefits that might outweigh the costs?
  - Economic benefits are not the same as revenues
  - Embracing a broader, “social cost” perspective
  - Reflects full “value” of reuse or other options

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Why the Financials May Look Unfavorable

Revenues from reuse projects often limited

- Pricing strategies and other constraints
  - Reuse often priced to sell water at below cost of potable supplies
  - Potable supplies often under-priced (e.g., average vs. marginal costs, infrastructure)
- Volume of sales may be limited to targeted uses and by proximity to delivery infrastructure

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Why Look at the Economic Perspective?

- For many reuse projects, the benefits (i.e., value) to society may outweigh the costs
  - Broad range of benefits (some obscure)
  - Large and diverse set of beneficiaries
- Where benefits shown to outweigh costs:
  - Identify benefits and beneficiaries who might not be ratepayers (outside of service area)
  - Positive externalities become a valid basis for seeking cost sharing and subsidies

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The Challenge

Water reuse can generate many important types of benefits, but often the full range of benefits are not well recognized

- Some benefits are dispersed across political or district jurisdictional boundaries
  - Not all beneficiaries engaged in the deliberations
  - Disconnect between who benefits and who pays
- Important benefits may be obscure and/or hard to quantify & value ("full social cost accounting")

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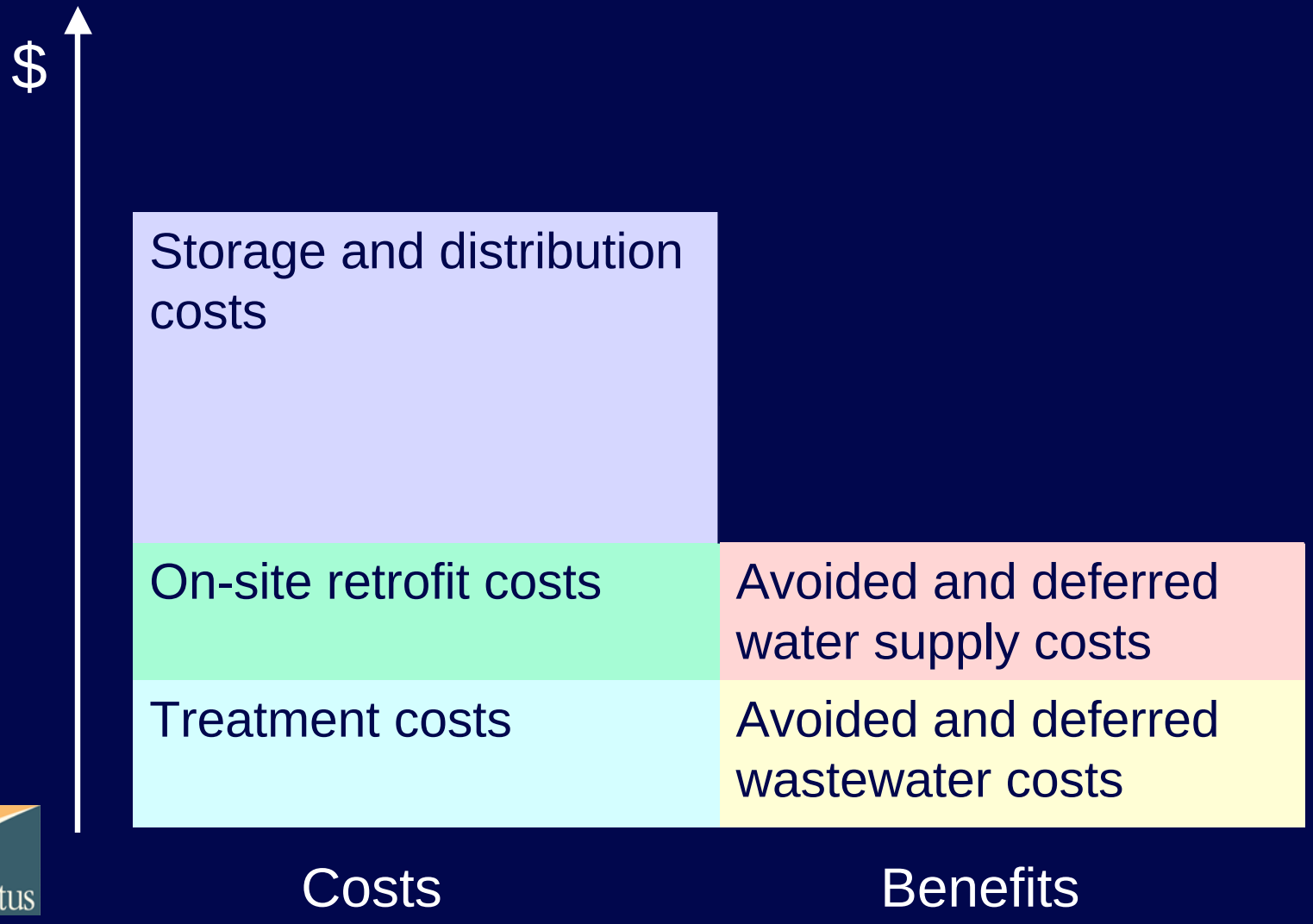
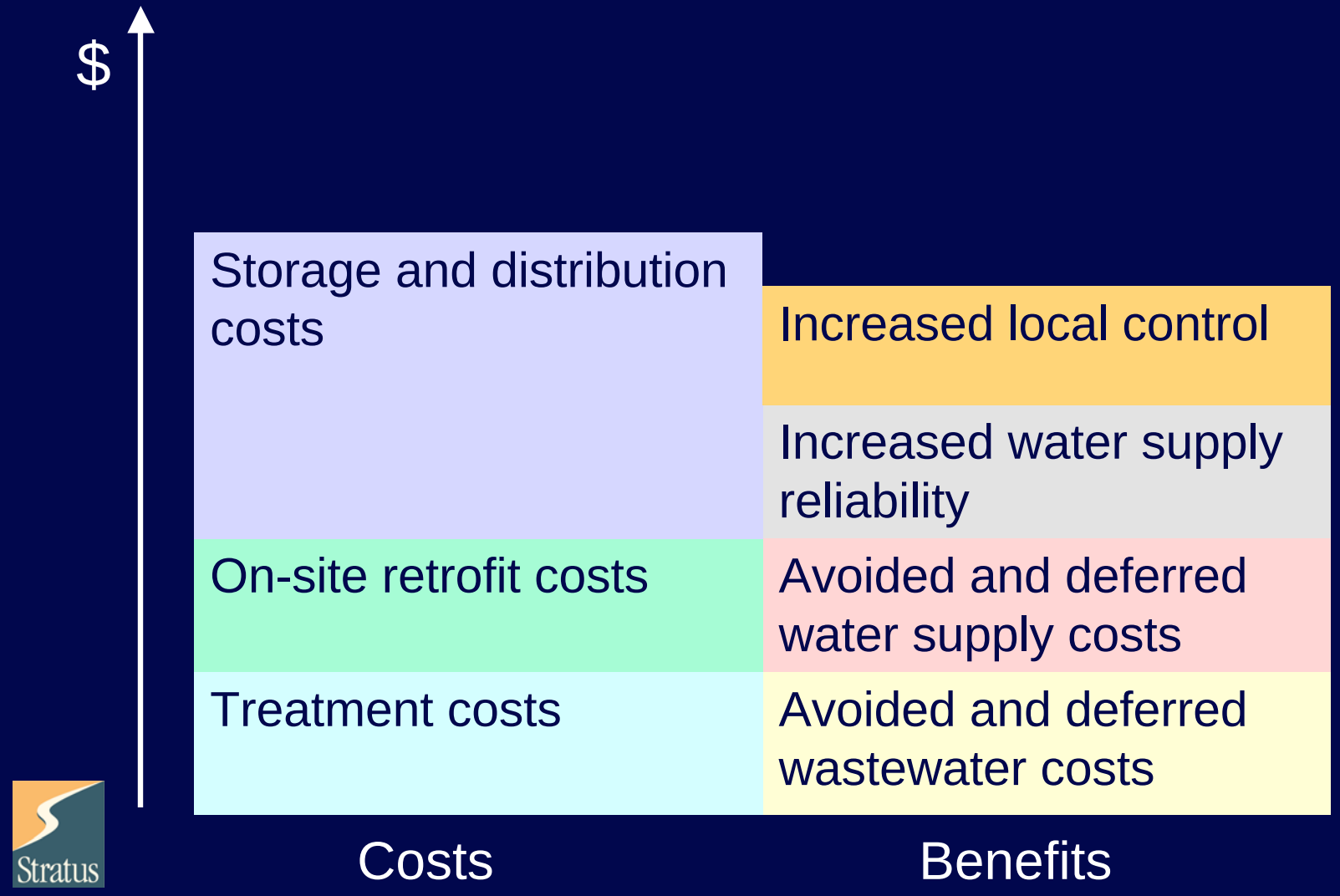
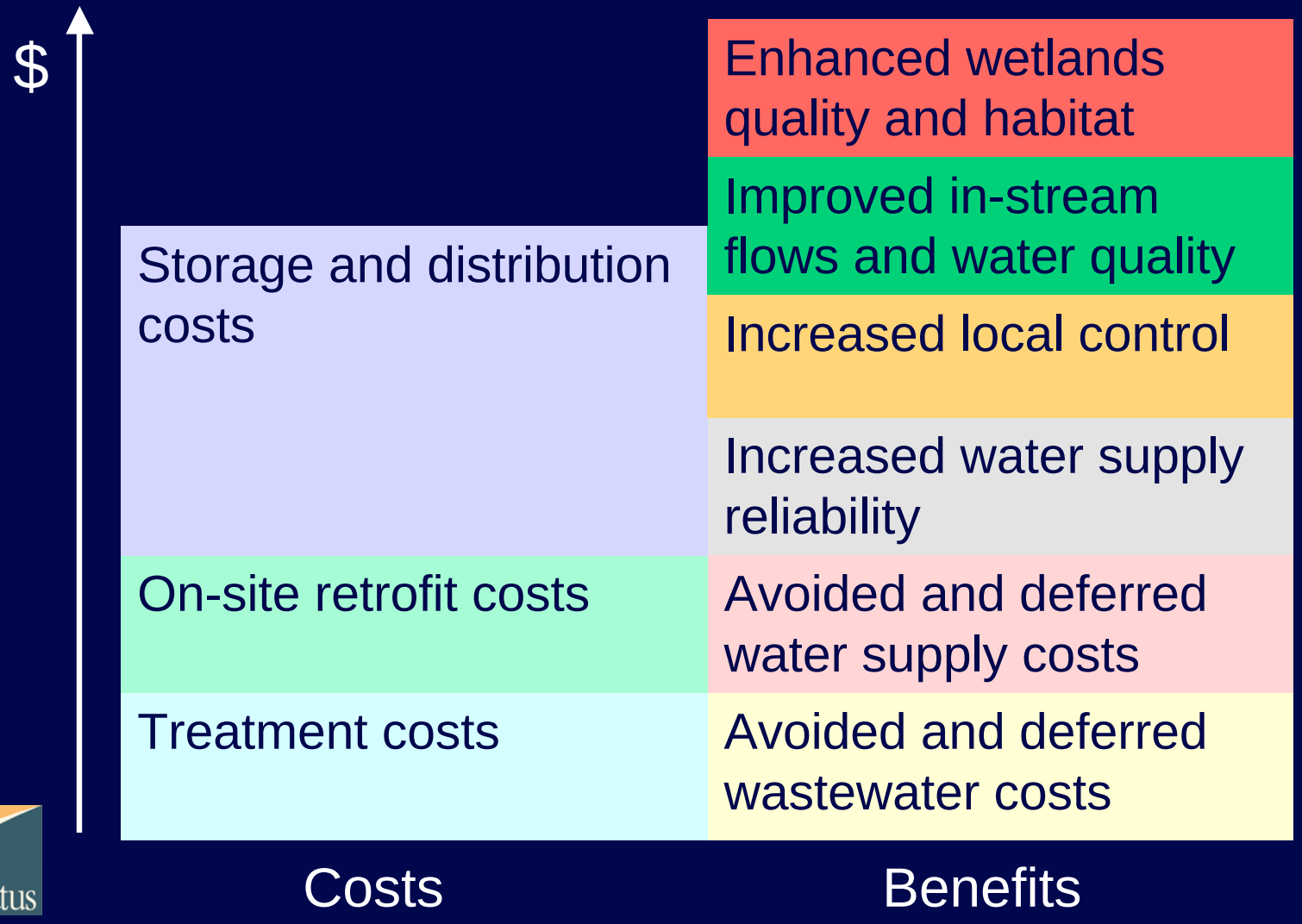
Counting All the Benefits



Counting All the Benefits



Counting All the Benefits



The Challenge (cont.)

- Many economic benefits hard to describe in ways that resonate with stakeholders & public officials
- Economics not always user friendly or communicative
  - Arcane terminology for benefit categories (fosters impression some benefits not included)
  - Measurement methods seen as smoke & mirrors
- Need to convey that BCA is a “tool,” not a “rule”

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The Challenge (cont.)

- Distribution of benefits rarely the same as the distribution of costs
  - Real or perceived equity issues
  - Externalities (beneficiaries outside rate base)
- Mistrust of benefit-cost analysis: some view as:
  - Incomplete (missing benefits or costs)
  - Biased (generating predetermined outcomes)

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Link to Triple Bottom Line

- TBL can be a useful approach for trying to reflect broad array of all benefits (and costs)
- Three bottom lines, to reflect:
  - Financial results (cash flow, revenues & costs)
  - Social outcomes (e.g., employment, equity)
  - Environmental (e.g., instream flows, fisheries)
- In essence, TBL = an initial step of a social benefit-cost analysis
  - Identifying *all* benefits & costs; both internal and external

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WRF Work Products

- User-friendly toolkit
  - Guidance (a “why” and “how to” user’s guide)
  - Case studies as practical examples
  - Templates and spreadsheet “model”
- Intent is to be generic, but focused & practical
  - Each reuse project has unique properties
  - Not a plug and play, or one size fits all “model”
- A “Framework” or “tool” to organize, develop, and communicate credible analyses of benefits & costs

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Overview of the Framework

1. Define the baseline (work w/ stakeholders)
2. Define relevant water agency options
3. Identify full range of benefits and costs
4. Screen benefits and costs
5. Quantify benefits and costs (to extent feasible)
6. Value benefits and costs (to extent feasible)
7. Qualitatively describe nonquantifiable Bs & Cs
8. Summarize and compare benefits and costs

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Overview of Framework (cont.)

9. List and assess all omissions, biases, and uncertainties (OBUs)
10. Conduct sensitivity analyses
11. Compare results to stakeholder perceptions
12. Use as communication tool throughout
    - Document key inputs and assumptions
    - Promote transparency
    - Embrace stakeholder input

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Defining the Baseline

- A critical key to a good economic analysis is to ensure proper definition of the baseline
  - Intent is "*without* project" versus "*with* project"
- Defining the baseline can be real challenge
  - Complex issue of where alternative water supply would come from, and what it would really cost
  - Or, baseline = what happens if more water is not added to the community supply portfolio
- Stakeholder baselines may reveal disagreement over core assumptions or goals (e.g., growth)

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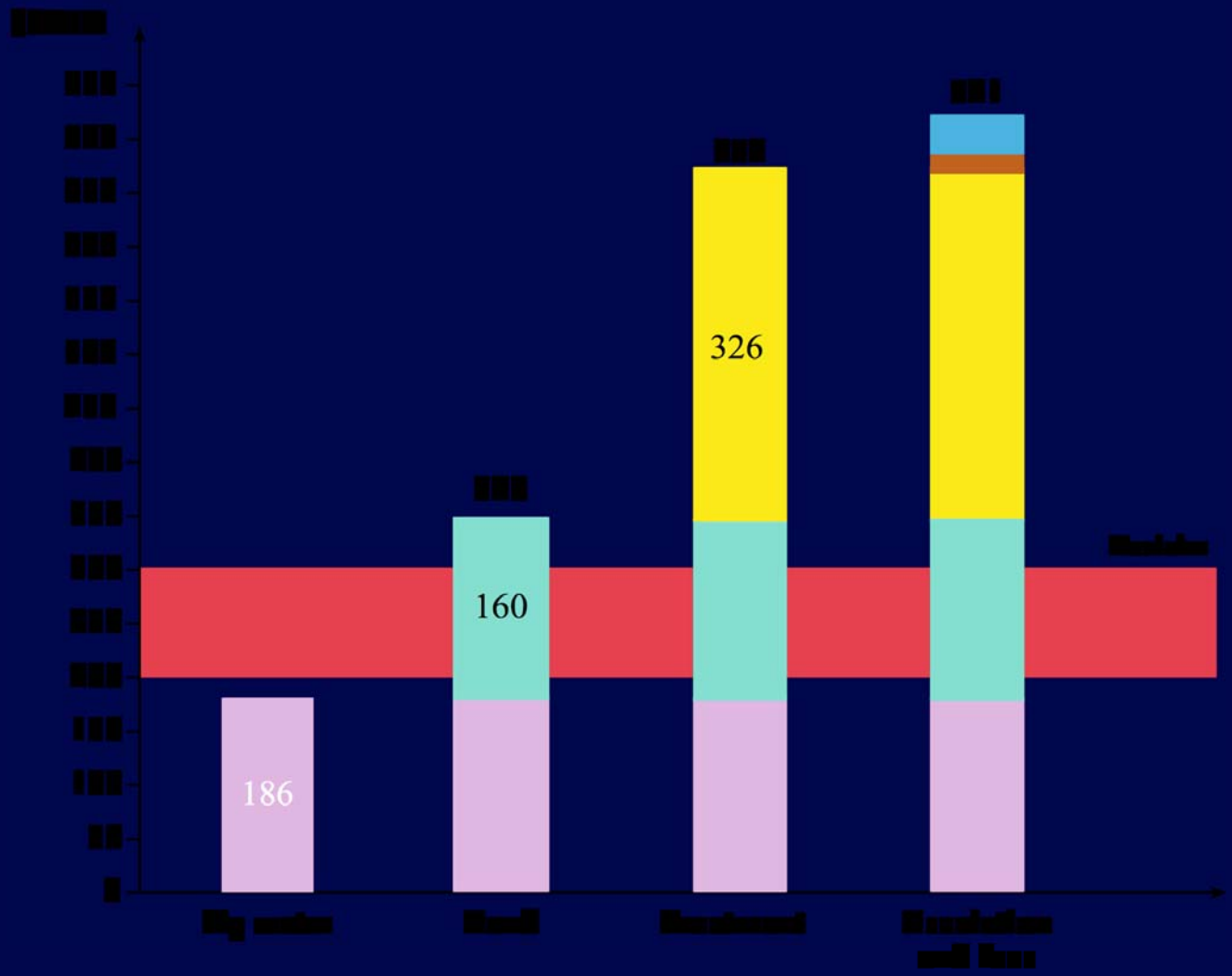
Apples-to-Apples Baseline: Reclaim vs. Ag Water



Some Key Sources of Value (Benefits) of Reuse, Desal, etc

- Postponed or avoided costs (cost offsets)
  - Compared to baseline water supply options
- Portfolio management and supply reliability
  - Diversifying risk across water supply options
- Positive externalities (enviro & social benefits)
  - Preserve & enhance freshwater stream flows
  - Wetland restoration or creation
  - Recreation use, habitat, wildlife, other values

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Other Key Benefits or Values of Reuse and Desal

- Improved quality of source water bodies
  - Higher instream flows & related benefits
  - Groundwater improvements (e.g., avoided subsidence, pumping costs, salt water intrusion)
- More local control
  - Reuse or desal as “local” water source
  - Not subject to whims of imported water
- Increased availability of traditional source waters for other users and uses

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Key Benefits of Reuse or Desal (cont.)

- Wastewater-receiving waters improved
  - e.g., salinity impacts
- Energy savings & related air pollution, climate impacts
  - Reduced long-distance pumping of source waters
- Community stability or economic development
  - A tool to accommodate or manage growth

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How large might some values be?

Increased reliability of water supply: Reuse is drought-insensitive

- Part of "portfolio management" approach
  - Minimizing covariance between supply options
  - Perhaps 50% "premium" for reclaim v. river source (better w/ reuse even if pay more $/AF)
- Households willing to pay considerable amounts to avoid drought-related water use restrictions
  - Perhaps $100 per year or more per household
  - Translates to perhaps $4000 / AF (or higher)

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How large are some of these values? (cont.)

Instream flows and/or wetland preservation

- Recreational uses may account for $ millions per year
  - Instream whitewater boating and fishing
  - Wetland area and near-stream visitation
- Ecological services, critical habitat, special status species preservation ("nonuse values")
  - Can be worth $ millions per year
  - Raises the question: who writes the check?

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WRF Guidance: Examples of Values for Aquatic T&E Species

Value (June 2004 USD)	Description
$7.25 per household per year Boyle and Bishop (1987)	This study found an average state-wide bid of $6.88 (2002 USD) per household to preserve the striped shiner, a state-listed endangered minnow with no direct use value in Wisconsin (the striped shiner is state listed as an endangered species, but not listed federally).
$10.79 annually per taxpayer[a] Cummings et al. (1994)	This study found that taxpayers would be willing to pay an average of $10.24 (2002 USD) annually to preserve the federally listed endangered Colorado squawfish in New Mexico.
$40-$112 (average of $80) annually per household	This meta-analysis examined WTP values for the protection of Pacific salmon/steelhead.
$9-$10 (average of $10) annually per household Loomis and White (1996)	This meta-analysis examined WTP values for protection of Atlantic salmon.
$9.77 annually per household Berrens et al. (1996)	This study estimated WTP for protecting instream flows specifically for the silvery minnow on the middle Rio Grande and to protect minimum instream flows on all major New Mexico rivers to protect 11 total listed fish species.

a. More than one taxpayer may reside per household.

Example of Application to T&E Species Habitat

Detail on benefit value derivation for water recycling project

Benefit category	Annual quantity	Unit value used	Comments
Habitat creation/ T&E species	1.1 million households in the Phoenix Metro area	$8-$16 per year/household, scaled to $0.20-$0.40 per household to reflect the level of impact that this project might have on the total species survival (a possible 2.5% increase in habitat for the Yuma clapper rail population)	WTP values for protection of T&E species range from ten to hundreds of dollars per household per year. However, these estimates are based on scenarios that result in a significant change in the probability of survival of a species. This is not appropriate for the Tres Rios Project example. We use WTP values from Reaves et al. (1999) because of the types of species evaluated in the study (birds) were generally consistent with those found in the region of Tres Rios.

Acknowledging Uncertainties and Omissions

Omissions, biases, and uncertainties and their effect on the project

Benefit or cost category	Likely impact on net benefits	Comment
Habitat creation/ T&E species	U (+ or -)	The WTP value used in our calculation may be an overestimate or underestimate of the WTP households possess for habitat creation for T&E species. The Reaves et al. (1999) study calculates WTP values for habitat creation that results in a significant probability increase of a species survival. A project of the Tres Rios scale would most likely not result in significant changes in species survival probability. We have attempted to correct this overestimate. It is unclear if our 0.025 scaling factor is too high or too conservative, resulting in a WTP range that might overstate or understate benefits.
Habitat creation/ T&E species	++	We conservatively assume that only those residents in the immediate Phoenix metropolitan area have a positive WTP for T&E habitat creation in the river corridor. This assumption most likely results in an underestimate because it is highly probable that people outside the Phoenix metropolitan area do have a positive WTP for the protection of T&E species living along the Salt River corridor within which habitat will be improved.
WWTP: O&M costs saved	+	The costs avoided from not having to expand and upgrade the WWTP reflect only capital outlays. O&M savings are also likely, but are not included in the cost savings estimate used here (data not available).

Conclusions

- Reuse often is relatively expensive, but …
- It typically provides some relatively unique yet important types of values
  - These benefits can provide very high values
- When speaking of the “value” of reuse, desal, or similar assets
  - Financial analysis perspective is too limited
  - Need to adopt a broad economic perspective

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An Economic Framework for Evaluating Water Reuse Projects: ***Analysis Steps***

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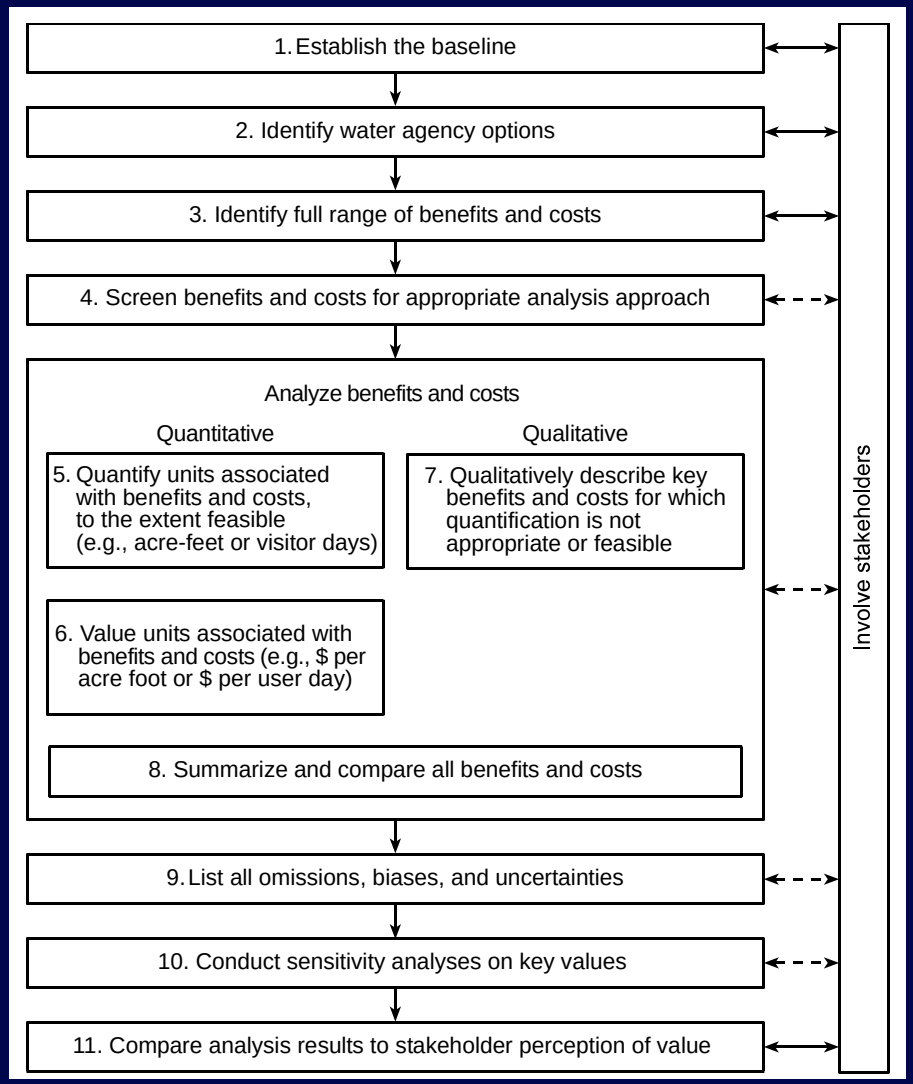
Steps in the Economic Analysis Framework



Step 1 – Define the Baseline

- Intent is "*without* project" versus "*with* project"
  - What alternative would have been undertaken to accomplish the same goal as the project
  - "No action" is a possibility if it is the most likely approach without the project

Step 2 – Define Project Options

- Define what projects are considered feasible for adding to the water supply portfolio
- Can include alternative alignments of the same project
- Provides a place to record relevant information for each project to be considered

Step 3 – Identify Benefits and Costs

- Identify the full range of relevant benefits and costs for the selected option
- Include costs and benefits beyond those normally considered by the utility alone or by customers alone – no matter who benefits or pays, or where they happen
- Listed within a simple benefit/cost taxonomy
  - Direct – directly affects utility (or customers)
    - Internal financial costs, avoided water supply and wastewater costs, water reliability and quality
  - Indirect – societal or other benefits/costs that indirectly affect the utility
    - Environment, recreation, public health, economic, social and equity

Benefit and Cost Identification

Template for step 3
Checklist overview of benefits and cost categories across water supply options

Category	Option 1	Option 2	Option 3	Option 4	Option 5
Costs to water agency (internal financial costs)					
Capital					
Water					
Land					
Treatment					
Distribution					
Administrative fees					
Administrative costs					
Avoided water supply and wastewater costs (relative to baseline)					
Supply costs					
Treatment capacity					
Wastewater capacity					
Treatment variable costs					
Water reliability and quality					
Water quality (aesthetics)					
Water quality (regulatory compliance)					
Quality reliability					
Supply reliability					

Benefit and Cost Identification (cont.)

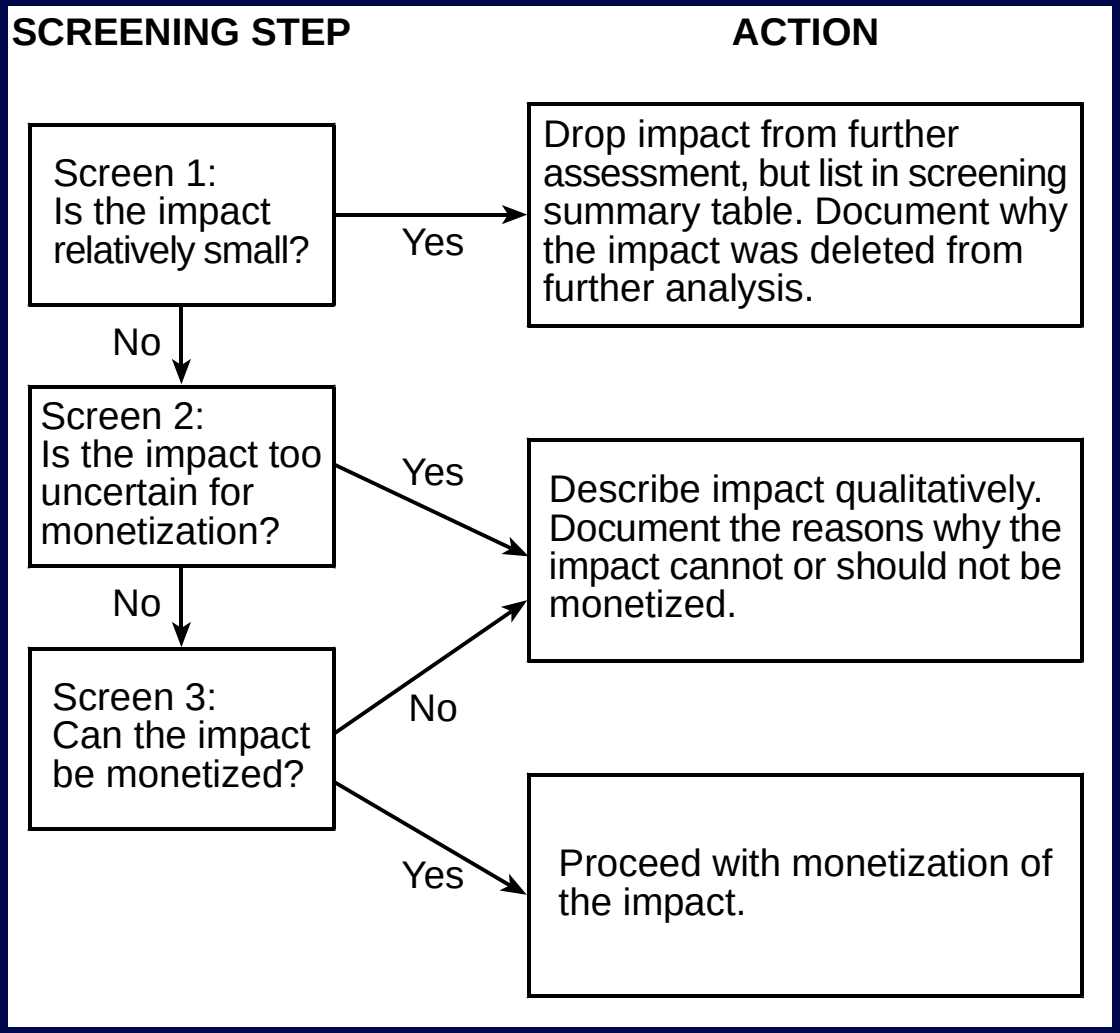
Template for step 3
Checklist overview of benefits and cost categories across water supply options

Category	Option 1	Option 2	Option 3	Option 4	Option 5
Environmental and recreational impacts					
Sourcewater protection					
Downstream habitats					
Environmental restoration					
Groundwater					
Coastal ecosystems					
T&E species					
Terrestrial ecosystems					
Recreation					
Public health and safety					
Change in risk of illness (morbidity)					
Change in risk of premature fatality (mortality)					
Economic, social, and equity impacts					
Economic development/growth					
Resource access					
Resource location					
Aesthetics					
Cultural values					

Step 4 – Screen Benefits and Costs

- Screen benefits and costs for the appropriate analysis approach
  - Those that can be monetized
  - Those that should be assessed qualitatively
  - Any that are insignificantly small and can be eliminated from further analysis

Screening Analysis Flow Chart



Example for Step 4

Summary screening analysis

Benefits and costs receiving full or partial economic valuation

- Habitat creation (T&E species) (+)
- Recreation (+)
- Avoided expansion of treatment capacity (+)
- Capital costs of Tres Rios Project (-)
- Operation and maintenance costs (-)

*Benefits and costs requiring qualitative assessment**

(+) Water quality (regulatory compliance)

(+) Aesthetic improvements

Impacts deleted from further analysis: Impacts that are relatively small or mitigated

- None

* Place “+” or “-” in parenthesis for positive benefits or costs (negative benefits), respectively.

Example for Step 4 (2)

Summary screening analysis

Benefits and costs receiving full or partial economic valuation

- Avoided O&M costs of water supply treatment (+)
- Avoided capital costs of wastewater treatment and disposal (main plant) (+)
- Avoided O&M costs for wastewater treatment and disposal (+)
- Reduced pumping costs (supplemental summer groundwater pumping substituted for year-round potable water pumping from Lake Mead) (+)
- Avoided capital cost of wastewater collection system expansion (+)
- Avoided O&M cost of wastewater collection system expansion (+)
- Creation of green belts for recreational use (new golf course) (+)
- Increased property values from location near golf development (+)
- Capital costs for reclamation treatment (-)
- O&M costs for reclamation treatment (-)
- Capital costs for recycled water distribution (-)
- O&M costs for recycled water distribution (-)
- Summer supplement potable water purchase costs (-)
- Financing costs (-)

* Place “+” or “-” in parenthesis for positive benefits or costs (negative benefits), respectively.

Example for Step 4 (2) (cont.)

Summary screening analysis
*Benefits and costs requiring qualitative assessment**
(+) Source water protection (phosphorous content TMDL)
(+) Reduced erosion in the Las Vegas wash
(+) Reduced chemical runoff
(+) Reduced public health risk due to less contact with polluted water
(-) Increased administrative costs (e.g., backflow prevention program)
(-) Public information campaign costs (initial + continuing education of users)
Impacts deleted from further analysis: Impacts that are relatively small or mitigated
❁ None identified
* Place “+” or “-” in parenthesis for positive benefits or costs (negative benefits), respectively.

Step 5 – Quantify Units

- Quantify the units associated with the benefit or cost – for example:
  - Volume of water delivered (e.g., acre-feet)
  - Number of recreational user outings (e.g., user days)
  - Area of habitat created (e.g., acres)
- Match units with metric available for valuation of the benefit or cost ($/unit value)

Step 6 – Monetize Benefits

- Value units associated with benefits and costs in monetary terms
- Dollars per unit (e.g., dollars per acre-foot, or dollars per user day)
- Ranges of values may be better to represent the uncertainty associated with some dollar per unit values
- Annual benefit or cost values should be projected over the useful project life

Example for Steps 5 and 6

Detail on benefit value derivation for water recycling project			
Benefit category	Annual quantity	Unit value used	Comments
Water reliability (Approach 1)	A total of 4,300 AF provided to 356,000 households (based on 926,000 residents/ 2.6 residents per household)	$80 per household, scaled down to reflect that the reuse project only provides a small increase in overall reliability. Scaled WTP used in this analysis is estimated to be $3.20 per household (4% of $80).	The WTP values are derived from a number of stated preference studies with values per year per household ranging from $80 (Howe and Smith, 1994) to $421 (Carson and Mitchell, 1987) for ensuring 100% water reliability (see Appendix D).
Water reliability (Approach 2)	4,300 AF/year (based on 3.8 mgd)	Estimated value of $250 per AF is applied for our calculations.	The WTP values are based on a number of reveled preference studies with values ranging from $51 (Fisher et al., 1995) to $353 (Thomas and Rodrigo, 1996) per AF (see Appendix D).

Example for Steps 5 and 6 (cont.)

Detail on benefit value derivation for water recycling project			
Benefit category	Annual quantity	Unit value used	Comments
Water quality improvement of Tampa Bay	2 million households	$30-$130 per household/ year, scaled to $0.12-0.52 per household/year to reflect impact of the reuse project in reducing the overall contaminant load to Tampa Bay (perhaps about 0.4% of overall contaminant load to the Bay per year is prevented from entering the water body due to the reuse project).	Studies have shown that the public places value on improvements or protection of coastal ecosystems. Annual values range from ten to hundreds of dollars per household for noticeable improvements in coastal ecosystem health (Croke et al., 1987; Kaoru, 1993; and Whitehead et al., 1995) (see Appendix B.5).

Example for Steps 5 and 6 (2)

Detail on benefit value derivation for water recycling project

Benefit category	Annual quantity	Unit value used	Comments
Habitat creation/ T&E species	1.1 million households in the Phoenix Metro area	$8-$16 per year/household, scaled to $0.20-$0.40 per household to reflect the level of impact that this project might have on the total species survival (a possible 2.5% increase in habitat for the Yuma clapper rail population)	WTP values for protection of T&E species range from ten to hundreds of dollars per household per year. However, these estimates are based on scenarios that result in a significant change in the probability of survival of a species. This is not appropriate for the Tres Rios Project example. We use WTP values from Reaves et al. (1999) because of the types of species evaluated in the study (birds) were generally consistent with those found in the region of Tres Rios.

Example for Steps 5 and 6 (2) (cont.)

Detail on benefit value derivation for water recycling project

Benefit category	Annual quantity	Unit value used	Comments
Recreation	Estimated that the 800-acre site might receive 15,000 user days per year, based on visitation rates to the Las Vegas Wash Wetland Nature Preserve	$32-$44 per user day	A 1996 meta analysis (Rosenberger and Loomis, 2001) found that average WTP values per user day for near-water recreational activities ranged from $32 to $44 per day (see Appendix A.2).

Step 7 – Qualitative Assessment

- Qualitatively describe key benefits and costs for which quantification is not appropriate or desirable
- Impacts assessed on 5-point scale, ranging from –2 (very negative impact) to +2 (very positive impact)
- Rankings should be accompanied by explanation of the benefit or cost, and should be carried throughout the analysis

Example Qualitative Assessment

Qualitative benefits summary – Water supply and water quality

Benefit	Qualitative indicator
Improved Water Supply Reliability	++
Additional Hydrologic Data for Improved Management	+
Reduced TDS Concentration in Groundwater	+
Reduced Nitrate Concentration in Groundwater	+

Step 8 – Summarize Outcomes

- Summarize all present values for costs and benefits, and compare benefits to costs
- Qualitative benefits and costs should be included in this summary
- Distributional aspects should also be presented – stakeholders affected by each benefit or cost should be identified

Example for Step 8

Costs and benefits of water reuse project (2003 USD per year)

	Dollar amount	Stakeholder accruing cost or benefit
Cost components		
Capital cost (annualized)	$320,0,00/year	Pinellas County
Water purchase costs	$120,000/year	Pinellas County
Total costs	*$440,000*	
Benefit components		
Water supply reliability	$1.1 million	Public
Improved coastal water quality in Tampa Bay	$250,000 to $1 million	Public
Total monetized benefits	*$1.4 to $2.2 million*	
*Benefits requiring qualitative assessment**		
Downstream habitat improvement due to water quality improvement	+	Public
Protection of endangered manatee in Tampa Bay Estuary	+	Public
Potential downstream habitat degradation due to loss of water discharge flows	-	Public
Monetized net benefits (monetized benefits minus costs)	*$960,000 to $1.8 million*	

Example for Step 8 (2)

Costs and benefits of water reuse project (2003 USD per year)

	Dollar amount	Stakeholder accruing cost or benefit
Cost components		
Total capital and operating cost (annualized) for full-scale wetlands construction (Magdal, 2005)	$10,000,000/year	Phoenix, Tempe, Mesa, Scottsdale, Glendale, and the Bureau of Reclamation
Total costs	*$10 million*	
Benefit components		
Habitat creation/T&E species protection	$220,000-$440,000	Public
Recreation at the Tres Rios site	$480,000 to $660,000	Public
Avoided expansion of WWTP treatment capacity (annualized capital cost avoided)	$50,000,000	WWTP (cities) and customers
Total monetized benefits	*$50.7 to $51.1 million*	
Benefits requiring qualitative assessment		
Aesthetic improvement due to wetland areas	+	*General public*
Monetized net benefits (monetized benefits minus costs)	*~$41 million per year*	

Example for Step 8 (3)

Benefit-cost analysis overview

	Present value
Costs – Total Capital and O&M	$3,243,681
Monetizable Benefits	
Water Supply Benefits	$12,082,722
Qualitative Benefits	Qualitative indicator*
Improved Water Supply Reliability	++
Additional Hydrologic Data for Improved Basin Management	+
Reduced TDS Concentration in Groundwater	+
Reduced Nitrate Concentration in G roundwater	+
Improved Habitat for Threatened and Endangered Species	+
Improved Fisheries Management	+
Improved Downstream Riparian Habitat	+
Improved Flood Protection	+
Agricultural Benefits	+
Reduced Conflict between Agricultural and M&I Users	++

* Magnitude of effect on net benefits.

+ = Likely to increase net benefits relative to quantified estimates.
++ = Likely to increase net benefits significantly.

Step 9 – List OBUs

- List and assess all omissions, biases and uncertainties
  - Omissions – possibly important benefits or costs not included in the analysis
  - Biases – quantified outcomes the analyst knows are likely to be skewed to upper or lower bound
  - Uncertainties – results for which it is not clear whether the result is too high or too low
- Impact that OBUs may have on final outcome of the analysis should be described

Example for Step 9

Omissions, biases, and uncertainties and their effect on the project		
Benefit or cost category	Likely impact on net benefits	Comment
Reliability (industrial users)	++	The WTP values used to calculate the benefit of reliability are based on surveys of residential customers. If the WTP values held by industrial water users were also taken into account, then the total benefit of reliability would likely increase, perhaps significantly.
Reliability (residential users)	U (+ or -)	The WTP values taken from the literature are scaled to 10% to reflect an assumed apportionment of how large a share of the value of absolute water supply reliability can be attributed to the fractional gain in overall reliability provided by the current reuse program. The 10% assumed here could be an overestimate or an underestimate. Further analysis would be needed to refine this scaling factor.

Example for Step 9 (cont.)

Omissions, biases, and uncertainties and their effect on the project

Benefit or cost category	Likely impact on net benefits	Comment
Habitat creation/ T&E species	U (+ or -)	The WTP value used in our calculation may be an overestimate or underestimate of the WTP households possess for habitat creation for T&E species. The Reaves et al. (1999) study calculates WTP values for habitat creation that results in a significant probability increase of a species survival. A project of the Tres Rios scale would most likely not result in significant changes in species survival probability. We have attempted to correct this overestimate. It is unclear if our 0.025 scaling factor is too high or too conservative, resulting in a WTP range that might overstate or understate benefits.
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WWTP: O&M costs saved	+	The costs avoided from not having to expand and upgrade the WWTP reflect only capital outlays. O&M savings are also likely, but are not included in the cost savings estimate used here (data not available).

Step 10 – Sensitivity Analysis

- Conduct sensitivity analyses on key values
- Key variables and benefit or cost values should be explored to determine the impact of assumptions, uncertainty, or natural variability on the outcome of the analysis

Sensitivity Analysis Applied to Discount Rate for the Water Recycling Project
(thousands of dollars)

Discount rate	Monetized benefit	Cost	Monetized net benefit (NPV)
0%	49,000-51,500	30,000	19,000-21,500
3%	39,500-41,700	26,000	13,500-15,700
6%	29,500-34,000	22,000	7,500-12,000
9%	15,950-21,300	16,000	(50)-5,300
12%	8,500-14,000	11,000	(3,500)-3,000
15%	2,500-8,000	8,000	(5,500)-0

Step 11 – Stakeholder Perspectives

- Compare analysis results with values from stakeholder perspective
- Part of an on-going process of ensuring stakeholder involvement
- Compare stakeholder expected values (or perception of value) to the results of the analysis
  - Good check on the reasonableness of the results
  - Can provide basis for cost-sharing arrangements

Project Beneficiaries Example

Project beneficiaries summary		
Local	Regional	Statewide
Cities of Simi Valley, Camarillo, and Thousand Oaks	Calleguas MWD	
Camarosa Water District	Metropolitan Water District of Southern California	Bay-Delta users
Ventura County Waterworks District No. 8		
Ventura County Waterworks District No. 1	Users in the Calleguas Creek Watershed	
Camarillo Sanitation District		

Conclusions

- Economic framework is designed to help organize information and facilitate presentation to others
- Alternative forms for conducting the framework – paper templates or MS Excel tool
- Scope and detail of analysis determined by project needs

An Economic Framework for Evaluating Water Reuse Projects: ***Equity Perspectives***

Bob Raucher
Jim Henderson
Stratus Consulting Inc.
Boulder, CO

Initial Workshop Meeting
Reclaimed Water Technical Committee
King County, WA
August 25, 2006

Stratus

Equity or Perspectives Analysis: What Might it Mean?

3 Fundamental questions (at least):

- Who is being considered
  - Individuals, organizations, entities, sub-populations?
- Is it intended to be a “process” or an “analysis”?
  - Perhaps some of both?
- Why do an equity or perspectives analysis?
  - What are motives and intended uses?

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How are the groups (stakeholders) defined?

Who are you including in the analysis?

- Utilities, political jurisdiction entities only?
  - Cities/townships,Tribes, Agencies, Districts, …
- Formal organizations beyond utilities & towns
  - e.g., Sierra Club, similar NGOs
  - Regional businesses or commercial sectors
- Individuals,households defined by ethnicity, socio-economic status, risk-sensitivity, etc.
  - e.g., ethnic minorities, low income households
  - Sensitive subpopulations (elderly, children, …)

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Process, Analysis, or Both?

- Process (inclusiveness, outreach, etc.)
  - ID and include stakeholders in meetings and deliberations
- Analysis (qualitative or quantitative)
  - Link numeric outcomes to different groups (e.g., who pays how much, who benefits how much)?
  - Any “weighting” would be subjective
- Hybrid: (include some elements of both above)

Stratus

Motives and Uses of Equity Analysis

- Secure external funding support
  - E.g., state or federal grant (e.g., US BOR)
  - Need evidence of broader regional or state-wide benefits (beyond rate base, service area)
- Negotiate cost sharing arrangements
  - Rates, and/or differentials, *within* service area
  - Cost share from *out-of-service-area* beneficiaries
- Concern over potential inequitable treatment of vulnerable or disadvantaged subpopulations
  - "Environmental Justice"

Stratus

Some options

- Suitable options for an equity analysis depend on how prior 3 questions are answered
- Options for “analysis” we have seen or used
  - Listing of who benefits (and who pays)
  - Quantitative estimates of how much each group benefits and/or pays
  - Weighting schemes across objectives, based on input from involved entities (San Jose)
  - Ex post survey of target groups

Stratus

Project Beneficiaries Example

Project beneficiaries summary

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Guide for Linking Types of Potential Benefits to Impacts that May Be Generated by Reuse Projects

Water reuse project impact	Types of benefits potentially generated	Likely beneficiaries
A. Improve or preserve surface water flows and/or quality (e.g., by reducing surface water extractions, and/or by improving quality of discharged effluent)	+ Recreational benefits to downstream users of instream and near-stream services (e.g., anglers, boaters, hikers, wildlife viewers), plus related organizations (e.g., Trout Unlimited). See Appendix A.	All downstream recreational users, including many people from outside the utility service area/customer base.
	+ Environmental benefits via improved downstream flows and aquatic and riparian habitat (e.g., protect or enhance populations of fish and wildlife, some of which may be special status species such as endangered salmon). See Appendix B.	All people with nonuse (passive use) motives (e.g., stewardship, existence, bequest values) for preserving ecosystems. Includes mostly people and organizations from outside the service area (e.g., Sierra Club, Audubon Society).

Incidence reflected alongside Benefit-Cost Summary

Costs and benefits of water reuse project (2003 USD per year)

	Dollar amount	Stakeholder accruing cost or benefit
Cost components		
Total capital and operating cost (annualized) for full-scale wetlands construction (Magdal, 2005)	$10,000,000/year	Phoenix, Tempe, Mesa, Scottsdale, Glendale, and the Bureau of Reclamation
Total costs	*$10 million*	
Benefit components		
Habitat creation/T&E species protection	$220,000-$440,000	Public
Recreation at the Tres Rios site	$480,000 to $660,000	Public
Avoided expansion of WWTP treatment capacity (annualized capital cost avoided)	$50,000,000	WWTP (cities) and customers
Total monetized benefits	*$50.7 to $51.1 million*	
Benefits requiring qualitative assessment		
Aesthetic improvement due to wetland areas	+	*General public*
Monetized net benefits (monetized benefits minus costs)	*~$41 million per year*	

South Bay Analysis

- South Bay Water Recycling (SBWR) multi-agency program
- Utilized two tools for analysis
  - Computer-assisted decision support – used Criterium Decision Plus ™ multi-objective decision support software
  - Benefit-cost analysis model

Computer-Assisted Decision Support

Criteria and weights for SBWR long-term projects

Criteria (subcriteria)	Rating (% of rating)	
Water Supply		*0.23*
Sustainability	60%	
Maximize Yield/Offset Potable Supply	40%	
Public Perception		*0.16*
Costs		*0.17*
Capital Costs	39%	
Unit Costs ($/AF)	38%	
Unit Costs ($/mgd)	23%	
WWTP Discharge		*0.10*
Local Environmental Benefits		*0.10*
Improve Quality of Life		*0.09*
Cost Recovery		*0.07*
Community Economic Benefits	51%	
Potential Cost Recovery	32%	
Revenue Potential	18%	
Impact to Plant		*0.05*
System Factors		*0.04*
Institutional Obstacles	39%	
Certainty of Demand	31%	
Flexible to Changing Conditions	30%	

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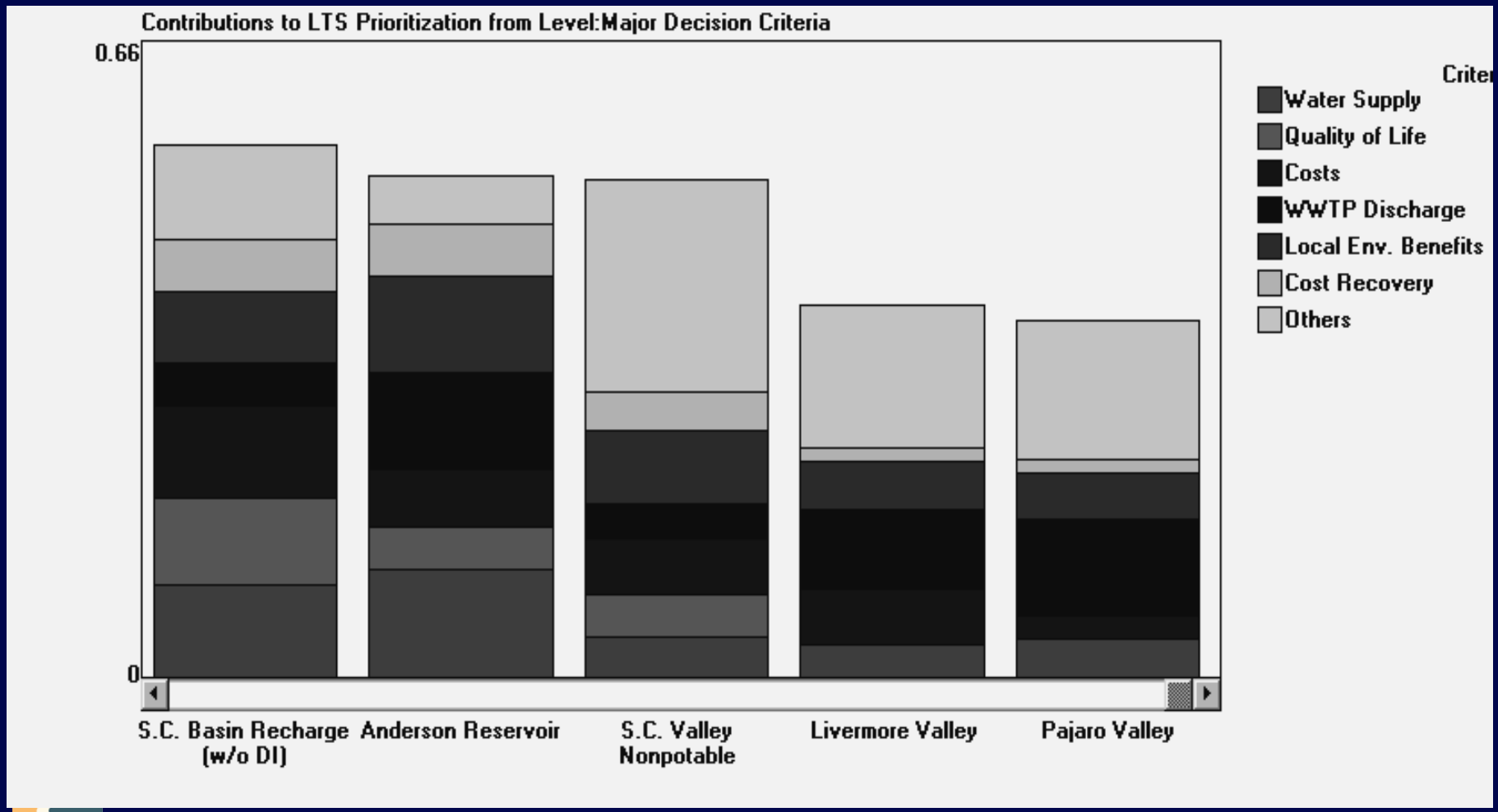
Rosenblum, Eric. 2004. The Water Reclamation Matrix: A Framework for Sustainable Urban Water Use

Project Ranking



Rosenblum, Eric. 2004. The Water Reclamation Matrix: A Framework for Sustainable Urban Water Use.

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