Valuing Ecosystems Services of Surface Waters Improved by Reducing Over Enrichment

Presented at the ACES and Ecosystem Markets

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by
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CH2M HILL
Roadmap

- How does valuing ecosystems services fit into watershed management?

- Case Study: Valuing water quality improvements from reducing nutrients in Utah’s surface waters
  - Water Quality and how it affects Recreational Use and Enjoyment of Utah’s Waters
  - Willingness to Pay for Improving and Sustaining Water Quality for future generations

- Conclusions
Valuing Water Resources to Support Watershed Management

Value is derived from ecological services - “The functions a natural resource provides for other resources and for humans.”

Water & Water Resources

Direct Human Uses

Indirect

Passive Use

Existence value
Aesthetic value
Preservation of diversity
T&E species

Nesting Area for Birds
Breeding Area for Fish
Sediment Stabilization
Water Quality Enhancement

Many Others

Drinking Water
Wastewater Discharge
Cooling & Processing
Irrigation
Recreation
Sources & Effects of Nutrient Enrichment

Wastewater  Stormwater  Excess Nitrogen and Phosphorus  Agriculture

Increased Algal Growth and Decomposition

Algal Toxins, Low Dissolved Oxygen, High pH

Aquatic life impacts: fish kills, reduced diversity, ecosystem function
Human health impacts: algal toxins
Aesthetic impacts: recreation and property value
Water treatment impacts: clogged intakes, taste and odor, disinfectant byproducts

Farmington Bay  Matt Warner Reservoir  San Pitch River
Benefit Cost Analysis (BCA) Framework for Valuing Ecosystem Services

Benefit Categories

1) Recreational Value (*CH2M Hill Team*)

2) Quality of Life/Passive Value (*CH2M Hill Team*)

3) Property Value (*CH2M Hill Team*)

4) Water Treatment Cost Savings (*DWQ*)
   - a) Drinking Water
   - b) Industrial/Agricultural Users

Cost Categories

1) Wastewater Treatment Upgrades
   - a) POTW - previously completed (*CH2M Hill*)
   - b) Industrial/CAFO Dischargers (*DWQ*)

2) Stormwater (*DWQ*)

3) Nonpoint Source Pollution (*DWQ*)

4) TMDL/Site Specific Criteria Administration (*DWQ*)

BCA compares the economic value with the Utah Nutrient Reduction Plan to the economic value without plan implementation.
RECREATION SURVEY
Recreation Survey

- Survey Objective: Collect data on how people use Utah’s surface waters
- Survey Purpose: Support analysis of how water quality improvements affect the value of the recreation experience
- Surveys completed with 1405 households
  - Weighted to assure sample is representative of all Utah households who engage in outdoor recreation
  - Relative to general Utah population, the recreation sample is:
    - more male, younger, and higher educated
Recreation Demand Modeling: Where Do People Go, and How Often?

284 total sites capturing over 67% of all water-based recreation trips.
Recreation Demand Modeling: Site Characteristics

- **Proximity:** Travel Cost
- **Lakes**
  - **Water Clarity:** TSI (Secchi Depth)
  - **Algae vs. Sediment:** TSI (Chl-a) – TSI (Secchi Depth)
- **Rivers**
  - **Algae:** Avg summer Dissolved Oxygen Saturation
  - **Nutrients:**
    - Avg summer Total Inorganic Nitrogen (mg/l)
    - Avg summer Total Phosphorous (mg/l)
## Future Scenarios

### 131 Lakes and 153 Rivers

<table>
<thead>
<tr>
<th></th>
<th># Degrade</th>
<th># Constant</th>
<th># Improve</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Status Quo</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lakes</td>
<td>46</td>
<td>62</td>
<td>23</td>
</tr>
<tr>
<td>Rivers</td>
<td>73</td>
<td>64</td>
<td>16</td>
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<tr>
<td><strong>Maintain WQ</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Lakes</td>
<td>0</td>
<td>108</td>
<td>23</td>
</tr>
<tr>
<td>Rivers</td>
<td>0</td>
<td>137</td>
<td>16</td>
</tr>
<tr>
<td><strong>Improve WQ</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lakes</td>
<td>0</td>
<td>85</td>
<td>46</td>
</tr>
<tr>
<td>Rivers</td>
<td>0</td>
<td>80</td>
<td>73</td>
</tr>
</tbody>
</table>
## Aggregate Benefits of Alternative Water Quality Policies

<table>
<thead>
<tr>
<th></th>
<th>Status Quo</th>
<th>Maintain WQ</th>
<th>Improve WQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggregate*, discounted over 20 years</td>
<td>($50.8 million)</td>
<td>$142 million</td>
<td>$365.7 million</td>
</tr>
<tr>
<td>Average Annual Benefit (discounted)</td>
<td>($2.5 million)</td>
<td>$7.1 million</td>
<td>$18.3 million</td>
</tr>
</tbody>
</table>

*Assumes linear change in water quality to 20 years. Discount rate: 2.7%
TOTAL ECONOMIC VALUE SURVEY (IMPROVE AND SUSTAIN WATER QUALITY FOR FUTURE GENERATIONS)
Total Economic Value Survey

- Sample taken from all Utah households
  - Conducted August 2011
  - 2,700 surveys mailed
  - 25% response rate
- Intended to gauge the general population’s perception of trophic status and total willingness to pay to protect rivers and reservoirs from excess nutrients
We define a “User” as someone who spends some recreation time on or near Utah’s waters.

<table>
<thead>
<tr>
<th>Distribution of Utah Households by Water-based Recreation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonuser</td>
<td>26.8%</td>
</tr>
<tr>
<td>User</td>
<td>73.2%</td>
</tr>
<tr>
<td>Both River and Lake</td>
<td>53.2%</td>
</tr>
<tr>
<td>River only</td>
<td>7.5%</td>
</tr>
<tr>
<td>Lake Only</td>
<td>12.5%</td>
</tr>
<tr>
<td>Public Opinions About the Importance of Water Quality Related Issues in Utah (%)</td>
<td>High importance</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Maintaining water quality for future generations</td>
<td>84</td>
</tr>
<tr>
<td>Improving water quality for fish and wildlife</td>
<td>63</td>
</tr>
<tr>
<td>Imposing water cleanup costs on industry</td>
<td>63</td>
</tr>
<tr>
<td>Maintaining good water quality in lakes and rivers so I can visit in the future</td>
<td>60</td>
</tr>
<tr>
<td>Keeping monthly water bills as low as possible</td>
<td>56</td>
</tr>
<tr>
<td>Improving water quality in all lakes and rivers even those not frequently used by...</td>
<td>52</td>
</tr>
<tr>
<td>Improving water quality in lakes and rivers used primarily for recreation</td>
<td>47</td>
</tr>
</tbody>
</table>
Net Benefits Under Future Scenarios

The Stated Preference Valuation Method Presents Choices to People.

- Scenario #1: Maintain Water Quality
- Scenario #2: Improve Water Quality
## Bid Response

### All Respondents

<table>
<thead>
<tr>
<th>Bid</th>
<th>Maintain (% Yes)</th>
<th>Improve (% Yes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2</td>
<td>76%</td>
<td>75%</td>
</tr>
<tr>
<td>$5</td>
<td>77%</td>
<td>68%</td>
</tr>
<tr>
<td>$7</td>
<td>42%</td>
<td>62%</td>
</tr>
<tr>
<td>$10</td>
<td>44%</td>
<td>54%</td>
</tr>
<tr>
<td>$12</td>
<td>63%</td>
<td>50%</td>
</tr>
<tr>
<td>$15</td>
<td>41%</td>
<td>47%</td>
</tr>
<tr>
<td>$20</td>
<td>40%</td>
<td>62%</td>
</tr>
<tr>
<td>$30</td>
<td>31%</td>
<td>51%</td>
</tr>
<tr>
<td>$40</td>
<td>29%</td>
<td>32%</td>
</tr>
<tr>
<td>$50</td>
<td>26%</td>
<td>31%</td>
</tr>
</tbody>
</table>

### Nonusers

![Graph showing bid response for nonusers]

### Users

![Graph showing bid response for users]
## Annual Total Economic Value (lower bound)

<table>
<thead>
<tr>
<th></th>
<th>Maintain WQ</th>
<th></th>
<th>Improve WQ</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WTP/HH</td>
<td>Aggregate</td>
<td>WTP/HH</td>
<td>Aggregate</td>
</tr>
<tr>
<td>Users (73%)</td>
<td>$38</td>
<td>$24 million</td>
<td>$97</td>
<td>$63 million</td>
</tr>
<tr>
<td>Nonusers (27%)</td>
<td>$26</td>
<td>$6 million</td>
<td>$26</td>
<td>$6 million</td>
</tr>
<tr>
<td>Total</td>
<td>$30 million</td>
<td>$30 million</td>
<td>$69 million</td>
<td>$69 million</td>
</tr>
<tr>
<td>Net Present Value (2.7%)</td>
<td>$463 million</td>
<td></td>
<td>$1,051 million</td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

- People’s recreation behavior is consistent with their statements.
- Recreation benefits are a fraction of total economic value, consistent with people’s statements that what they value is protecting water quality for future generations.
- Households are willing to pay for improving and protecting water quality – So we have some dollars to work with.
- Use $ wisely and will have public support.
  - Spend the $ where can deliver results
  - Dollars will go farther if prioritize by maximizing net benefits.
Additional Information

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