Understanding the Value of Marine Water Quality

Emilie Franke & Trina Wellman

Puget Sound Nutrient Forum

August 7, 2019

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Marine Water Quality from an Economic Perspective

1. Defining economic value
2. Benefits and costs
3. Valuing benefits
4. Cost considerations

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Question of Value

In the context of Puget Sound restoration and protection, there is often a broad value question:

What is the environmental value of what we are trying to protect or restore?

What is the value of Puget Sound?

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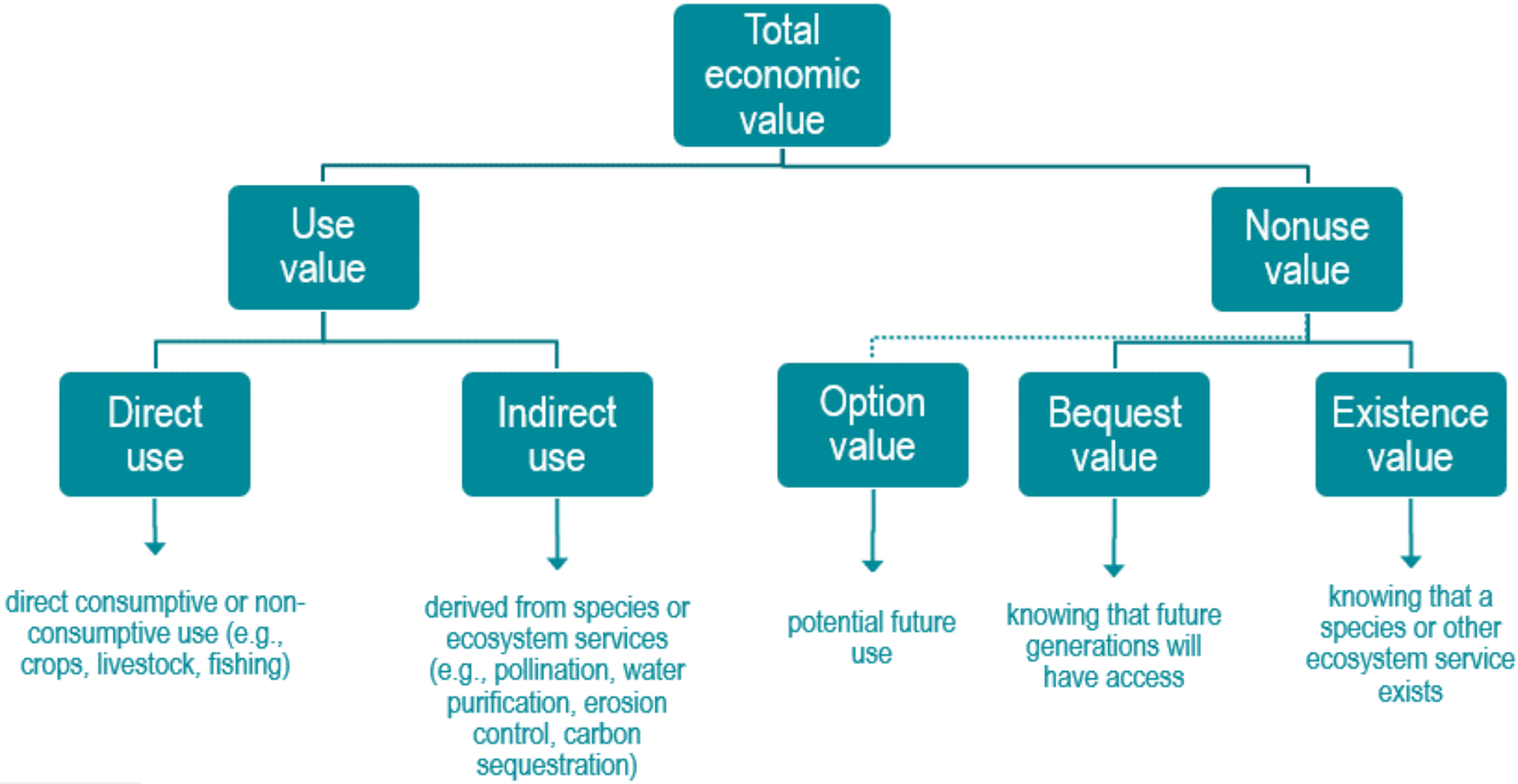

Source: Leif Anderson (NOAA)

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Value Estimate of Puget Sound Ecosystem Services

Partial valuation of ecosystem service benefits provided by Puget Sound (study by Batker et al. 2008):

- Identified 23 ecosystem service categories include flood protection, habitat, climate regulation, recreation, etc.
- Valuation for 12 out of 23 services based on available data from existing studies (benefits transfer).
- Summed ecosystem service estimates for 19 land cover types across the Puget Sound region.
- Estimated total $7.4 to $61.7 billion of ecosystem service benefits provided each year.

Can we think more specifically about how people value water quality?

Batker, D., P. Swedeen, R. Costanza, I. de la Torre, R. Boumans, & K. Bagstad. 2008. A New View of the Puget Sound Economy: The Economic Value of Nature's Services in the Puget Sound Basin. Earth Economics. Tacoma, WA. 90p.

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Economic Value of Water Quality

Consider this question from two perspectives:

<u>Cost of doing nothing</u>:

What are people losing by not making water quality improvements?

<u>Benefit of taking action</u>:

How much better off would people be if water quality were improved?

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Costs and Benefits

What are the costs of WQ improvements and who incurs those costs?

-Taxpayers, municipalities, landowners, etc.

What are the benefits of WQ improvements and who are the beneficiaries?

-General public, recreational users, property owners, etc.

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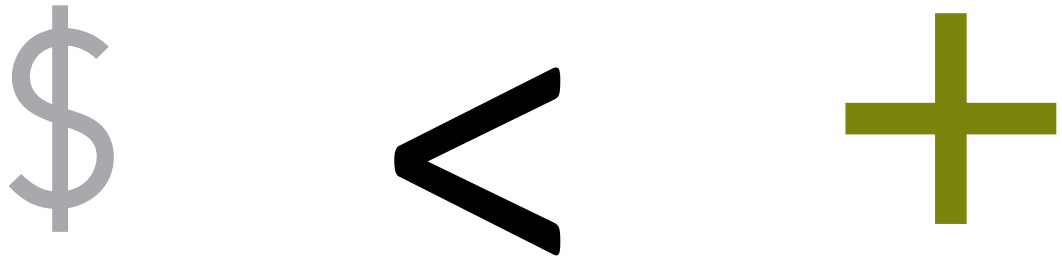
Costs and Benefits



Ideally the benefits outweigh the costs. How can we value the benefits?

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Valuing Improved Water Quality

Benefit to People	Valuation Method
Recreation (swimming, boating, fishing etc.)	Travel Cost Models: How does WQ impact recreational site selection/characteristics and associated recreational use value?
Aesthetic value	Hedonic Pricing: How does WQ impact property and home prices?
Non-use values (bequest, existence, option values)	Contingent valuation*: Ask people directly "How much are you willing to pay for WQ improvements?"
Others	

**Contingent valuation can also capture other benefits including recreational value and aesthetic value.*

Dumas, C.F., P.W. Schuhmann, & J.C. Whitehead. 2005. Measuring the Economic Benefits of Water Quality Improvement with Benefit Transfer: An Introduction for Noneconomists. *American Fisheries Society Symposium*.

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Note on Value Estimates for WQ

Tend to be more studies available for:

- rivers & lakes (vs. estuaries & coastal areas)
- regions outside Puget Sound

Differences across studies:

- water quality parameter of focus (e.g. nitrogen, bacteria, etc.)
- baseline and the level of change (e.g. % change in nutrient loads or bacteria levels)

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Value of WQ for Recreation

Travel cost model example: North Carolina study (Phaneuf 2002)

- For the Cape Fear River Basin, the willingness to pay for a reduction in pollution loadings (such that less than 10% of water quality readings exceed WQ standards) was $1.00-$6.29 per trip.
- Based on total angler recreational days, total annual benefit of improvements is $14.1-$88.9 million for the Cape Fear River Basin.

Phaneuf, D. J. 2002. A random utility model for total maximum daily loads: Estimating the benefits of watershed-based ambient water quality improvements, *Water Resour. Res.*, 38(11), 1254.

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Value of WQ for Recreation

Impact of WQ on Puget Sound park visitation (study by Kreitler et al. 2013)

- At state parks with access to Puget Sound, a 10% increase in bacteria levels associated with a 2.5% decrease in park visits.
- Could apply recreational value estimates relevant to Puget Sound recreation trips to determine the $ value of the change in park visits.

Kreitler J, Papenfus M, Byrd K, Labiosa W (2013) Interacting Coastal Based Ecosystem Services: Recreation and Water Quality in Puget Sound, WA. *PLoS ONE* 8(2): e56670.

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Value of WQ for Property Owners

Review of existing studies on WQ and property values (study by Nicholls & Crompton 2018)

- Out of 43 distinct studies, 41 studies showed a statistically significant relationship between WQ and property price.
- Studies show that better water quality has positive effect on property values.

Nicholls, S. & J. Crompton. 2018. A Comprehensive Review of the Evidence of the Impact of Surface Water Quality on Property Values. *Sustainability* 10(2): 500.

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Value of WQ for Property Owners

Study	Study Area	WQ & Property Variable	Results
Poor, Pessagno, Paul 2007	St. Mary's River, MD	TSS & DIN; single family homes	Price decrease of $1,086 for 1 mg/L increase of TSS Price decrease of $17,642 for 1 mg/L increase of DIN
Netusil, Kincaid, Chang 2014	Johnson Creek (Portland, OR) & Burnt Bridge Creek (Vancouver, WA)	DO; single family homes	Price increase of 2.81-13.71% within ¼ mi of water; 1.19-8.18% within 1 mi of water for 1 mg/L increase in DO during the dry season.

Adapted from Nicholls & Crompton 2018.

Nicholls, S. & J. Crompton. 2018. A Comprehensive Review of the Evidence of the Impact of Surface Water Quality on Property Values. *Sustainability* 10(2): 500.

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Value of Water Quality for General Public

Contingent valuation example: Utah study (Nelson et al. 2015)

- Asked UT households how much they would be willing to pay on their monthly water/sewer bill for nutrient reduction program.
- To prevent further WQ deterioration (maintain), recreational users are willing to pay up to $13.63 per month; nonusers are willing to pay up to $8.31 per month.
- To improve WQ beyond current levels, recreational users are willing to pay up to $32 per month.

Nelson, N.M., J.B. Loomis, P.M. Jakus, M.J. Kealy, N. von Stackelburg, & J. Ostermiller. 2015. Linking ecological data and economics to estimate the total economic value of improving water quality by reducing nutrients. *Ecological Economics* 118: 1-9.

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Costs and Benefits

What are the costs of WQ improvements and who incurs those costs?

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Cost-Effectiveness

- What is the greatest benefit achievable with a specified budget?
- What is the lowest cost means of achieving a specified level of benefit?
- Costs of nutrient reduction will vary.

  Point Sources: 2011 Economic Evaluation of nutrient removal for WA WWTPs includes estimates of per unit nutrient removal cost ($/lb) for different technologies and WWTP capacities (Tetra Tech 2011).

  Nonpoint Sources: BMP cost-effectiveness studies from other regions.

Tetra Tech. 2011. Technical And Economic Evaluation Of Nitrogen And Phosphorus Removal At Municipal Wastewater Treatment Facilities. Prepared for Washington State Department of Ecology. WA Dept. of Ecology Publication no. 11-10-060.

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Cost: Regional

Maximizing efficiency would focus on treatments, practices, and/or locations that have the greatest nutrient reduction potential per $.

- Water Quality Trading programs at the regional level (e.g. Long Island Sound Nitrogen Credit Exchange program)

Efficiency vs. equity

Connecticut Department of Environmental Protection. 2010. Connecticut's Nitrogen Credit Exchange –An Incentive-based Water Quality Trading Program. The Connecticut Department of Environmental Protection. Bureau of Water Protection and Land Reuse. Hartford, CT. 10p.

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Cost: Individuals

Affordability of water/sewer rates

Available resources and recent discussions include:

Ramseur, J.L. 2017. EPA Policies Concerning Integrated Planning and Affordability of Water Infrastructure. Congressional Research Service. CRS Report R44223. 14 March 2017. https://crsreports.congress.gov/product/pdf/R/R44223

Teodoro, M.P. 2018. Measuring Household Affordability for Water and Sewer Utilities. Journal AWWA 110(6): 13-24. https://doi.org/10.5942/jawwa.2018.110.0002

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References (links in earlier slides)

Batker, D., P. Swedeen, R. Costanza, I. de la Torre, R. Boumans, & K. Bagstad. 2008. A New View of the Puget Sound Economy: The Economic Value of Nature's Services in the Puget Sound Basin. Earth Economics. Tacoma, WA. 90p.

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Netusil, N.R.; Kincaid, M.; Chang, H. 2014. Valuing water quality in urban watersheds: A comparative analysis of Johnson Creek, Oregon, and Burnt Bridge Creek, Washington. *Water Resour. Res*. 50, 4254—4268

Nicholls, S. & J. Crompton. 2018. A Comprehensive Review of the Evidence of the Impact of Surface Water Quality on Property Values. *Sustainability* 10(2): 500.

Phaneuf, D. J. 2002. A random utility model for total maximum daily loads: Estimating the benefits of watershed-based ambient water quality improvements, *Water Resour. Res.*, 38(11), 1254.

Poor, P.J.; Pessagno, K.L.; Paul, R.W. 2007. Exploring the hedonic value of ambient water quality: A local watershed-based study. *Ecol. Econ*. 60(4), 797—806.

Ramseur, J.L. 2017. EPA Policies Concerning Integrated Planning and Affordability of Water Infrastructure. Congressional Research Service. CRS Report R44223. 14 March 2017. https://crsreports.congress.gov/product/pdf/R/R44223

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Wrap-Up

Thank you!

Emilie Franke emilie.franke@norecon.com

Katharine (Trina) Wellman katharine.wellman@norecon.com

Fall 2019 Northern Economics products

- Economics Guidance Document for Puget Sound Partnership
- Marine Water Quality Implementation Strategy Project (Costs and Values Synthesis)
- Land Cover & Development Implementation Strategy Project (Identifying Ecosystem Service Benefits of Critical Areas)

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