“Assessing the Economic Value of Protecting the Great Lakes” – 10 years later

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Assessing the Economic Value of Protecting the Great Lakes

Large project for Ontario Ministry of the Environment

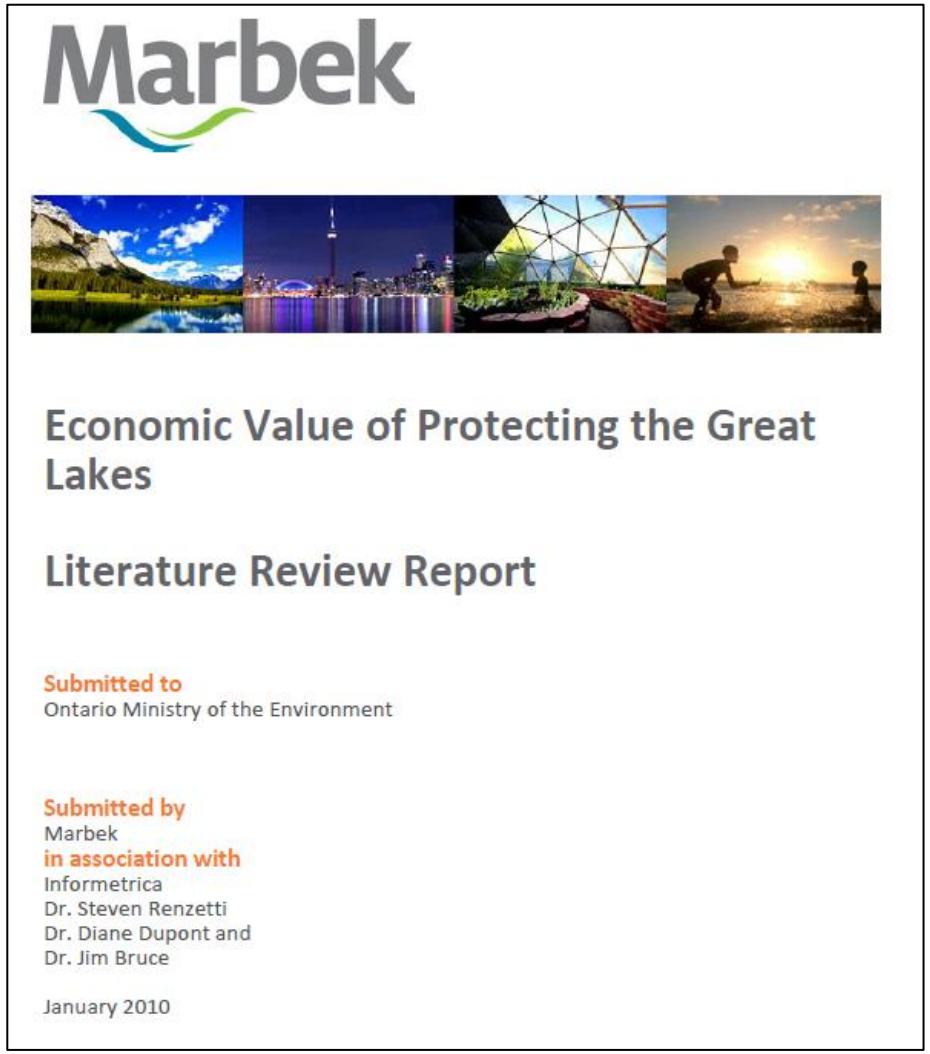
3 phases

Phase 1: Conduct a literature review

Phase 2: Prepare proposals for key priority areas

Phase 3: Conduct economic analyses for chosen studies

…all in 6 months (plus 6 months)



3 benefit cost analyses + 1 economic impact analysis

Marbek

Assessing the Economic Value of Protecting the Great Lakes: Rouge River Case Study for Nutrient Reduction and Nearshore Health Protection

Final Report

Submitted to

Ontario Ministry of Environment

Submitted by

Marbek

November 2010

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Marbek

Assessing the Economic Value of Protecting the Great Lakes Ecosystems:

A Cost-benefit Analysis of Habitat Protection and Restoration

Final Report

Submitted to

Ontario Ministry of Environment

Marbek

Assessing the Economic Value of Protecting the Great Lakes: Invasive Species Prevention and Mitigation

Final Report

Submitted to

Ontario Ministry of Environment

Assessing the Economic Value of Protecting the Great Lakes: Macroeconomic Impacts

Final Report

Prepared for

Marbek Resources Consultants Ltd.

University of Saskatchewan

Study Area: Rouge River Watershed (near Toronto)

Marbek

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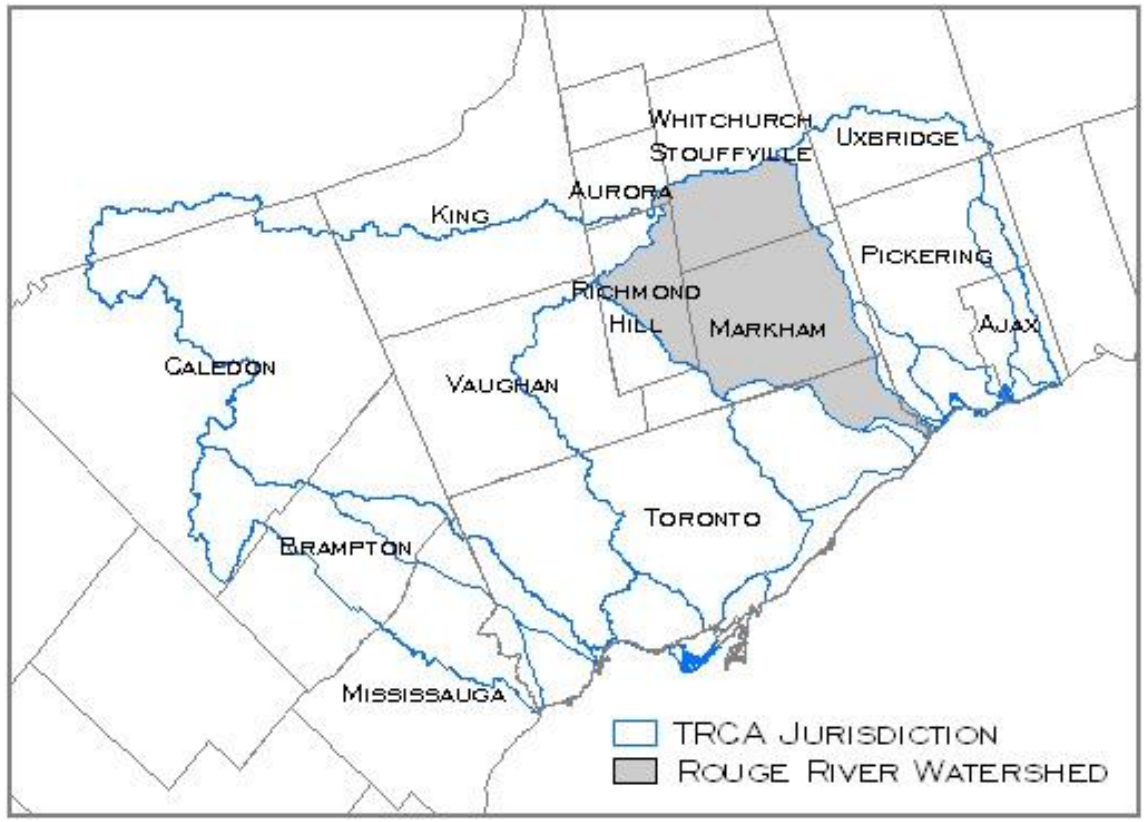
What are the costs and benefits of more sustainable urban development in a watershed?



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Economic analysis based on two future watershed plans

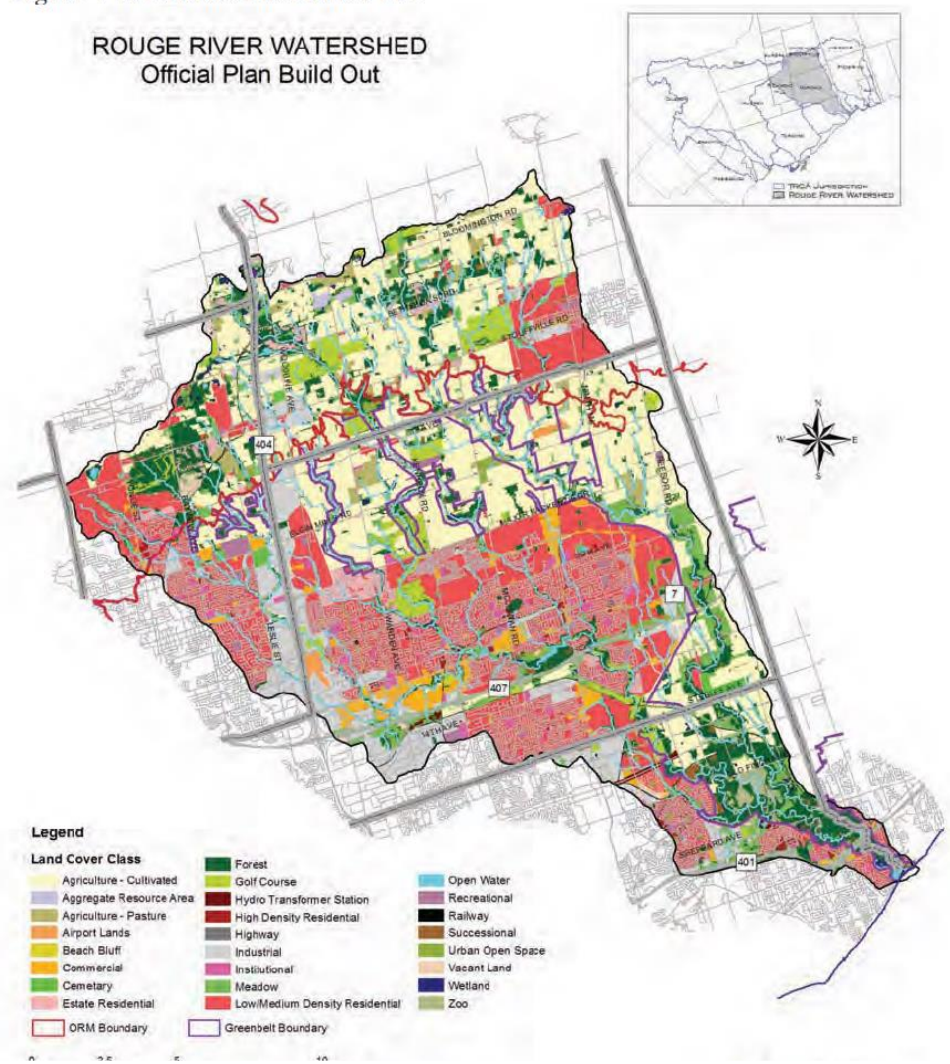
1. Full Build-Out (FBO)
2. Sustainable Communities (SC)

ROUGE RIVER WATERSHED PLAN

TOWARDS A HEALTHY AND SUSTAINABLE FUTURE

REPORT OF THE ROUGE WATERSHED TASK FORCE
2007

Figure 4-1: Official Plan Build-out



Economic analysis based on two future watershed plans

Two main differences between scenarios

1. **Land cover types**
   - Sustainable Communities has
     - 43% less agriculture (-3,398 hectares)
     - 5% less urban area (-991 hectares)
     - 65% more natural cover (+4,571 hectares)
2. **21 intervention strategies in Sustainable Communities**
   - Building retrofits, green roofs, stormwater ponds, etc

Background report on quantified environmental benefits between scenarios

Exhibit 2 Main Quantified Impacts from SC Scenario Relative to FBO Scenario

		Effects of SC, relative to FBO
Surface Water Quantity	Variability of Stream Flow	Significant decrease in 5% and 10% exceedence flows (20% to 40% decrease)
	Flooding and Flood Risk	Decrease in flood risk
	Erosion and Erosion Control	Decrease in erosion by an average of 26%. Sites downstream of new developments have the greatest reductions, compared to sites downstream of existing retrofitted developments
	Baseflow and Surface Water Withdrawals*	Modeling results not applicable or not available for our analysis
Surface Water Quality	TSS	Median TSS concentrations at the mouth of the watershed decrease by 28% and at some sites decrease by 48% and 62%. TSS loads decrease by 58% at the mouth of the Rouge and by an average of 38% over the whole watershed.
	Nutrients	P loads decrease for all sites by an average of 60%; N loads decrease for all sites by an average of 35%
	Lead and Heavy Metals	Lead is greatly reduced at all sites by an average of 63%; Copper and Zinc increase by an average of 20% at the headwaters but decrease by an average of 40% at sites near the mouth of the river (reasons for the increase in the headwaters were not investigated for our report)
	Bacteria	At 8 of the 20 sites, E.Coli increases by an average of 0.012 counts/100ml; near the mouth of the watershed, E.Coli decreases more significantly (27% for site 1 and 54% for site 4)
	Chloride	CL increases in all sites, by an average of 31%

Benefit cost analysis focus on changes between scenarios

Assessments of costs and benefits of sustainable community **relative to** full build-out scenario

1. **Value the incremental costs**
    - Costs of land cover changes
    - Costs of the intervention strategies

2. **Value the incremental benefits**
    - Avoided costs
    - Benefits based on indicators

3. **Compare costs and benefits**

Tallying up the present value of costs

Exhibit 26 Summary of the Present Value of Costs

($millions)		Low*	Mean*	High*
Urban Greenfield Development	Medium Density Residential	$58.13	$80.33	$102.66
	Commercial and Industrial	$131.86	$175.91	$219.89
	Managed open space	$0.16	$0.20	$0.23
	Educational, institutional	$0.02	$0.03	$0.03
Urban Retrofit	Medium Density Residential	$668.60	$757.11	$845.16
	Educational and Institutional	$7.30	$8.31	$9.29
	Commercial	$29.28	$34.15	$38.96
	Industrial	$90.43	$105.94	$121.18
	Managed open space	$0.08	$0.09	$0.11
	Roadways	$76.30	$91.42	$106.06
Rural Agricultural Areas		$1.34	$1.34	$1.63
Transportation Corridors		$0.19	$0.19	$0.22
Natural Cover	Educational Costs	$3.52	$4.28	$5.03
	Restoration Costs Wetlands	$37.46	$44.88	$52.43
	Restoration Costs Forests	$3.12	$3.74	$4.35
Lost Urban Land		$79.01	$94.76	$110.63
Lost Agricultural Land		$71.07	$85.65	$99.69
Total		$1,380.31	$1,484.22	$1,587.97

Valuing benefits based on indicators required non-market valuation

1. **Identify***:* Link specific benefits to relative change in human and environmental indicators

2. **Quantify***:* Need a quantified human and/or environmental impact (e.g. tonnes of carbon, # visitors to park)
   - Ideally a benefit relevant indicator

3. **Monetize***:* Use benefit transfer method

1) Linking environmental indicators with ecosystem services

Exhibit 13 Summary of the links between the indicators and benefits that were monetized

Indicators	Ecosystem Services							
	Surface Water Quality*	Aesthetic and Amenity	Recreation	Beaches	Local Climate Regulation	Air Quality	Carbon	Disturbance Prevention
Surface Water Quantity								
Surface Water Quality	High correlation and good data available			High correlation and good data available				
Aquatic System	Helpful in informing assumptions regarding benefits from surface water quality improvements							
Quantity of Natural Cover		High correlation and good data available	High correlation and good data available			High correlation and good data available	High correlation and good data available	High correlation and good data available
Nature-Based Recreation			Helpful in informing assumptions					

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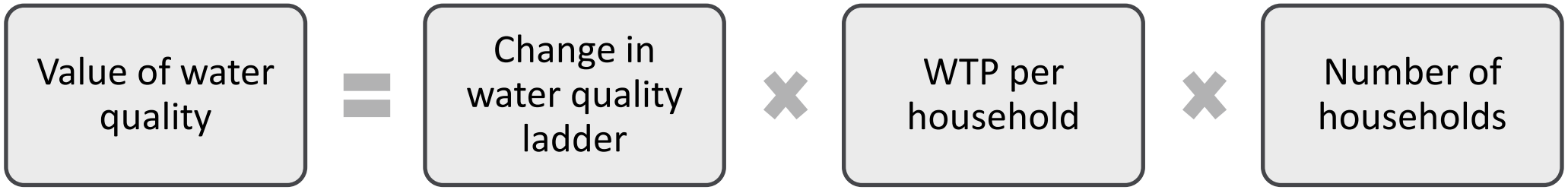
Valuing surface water quality improvements

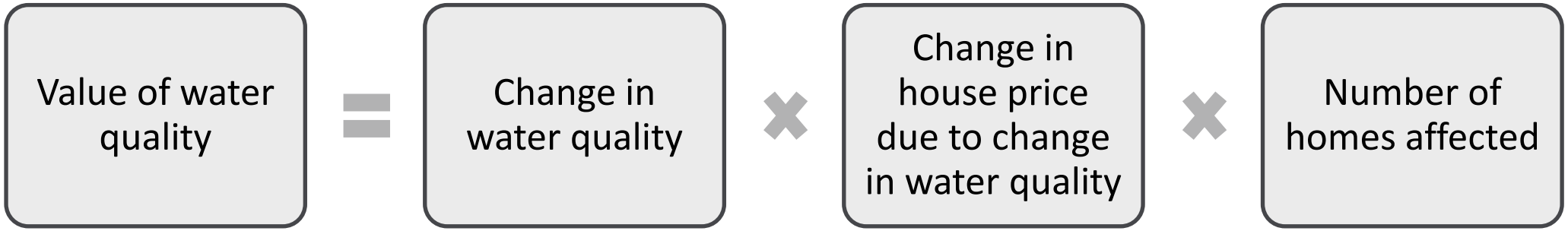
Difficult to disentangle all the separate benefits from water quality improvements

Use two different methods:

1. Meta-analysis based on stated preference studies ($35 million per year)



2. Unit transfer based on hedonic price method ($101 million per year)

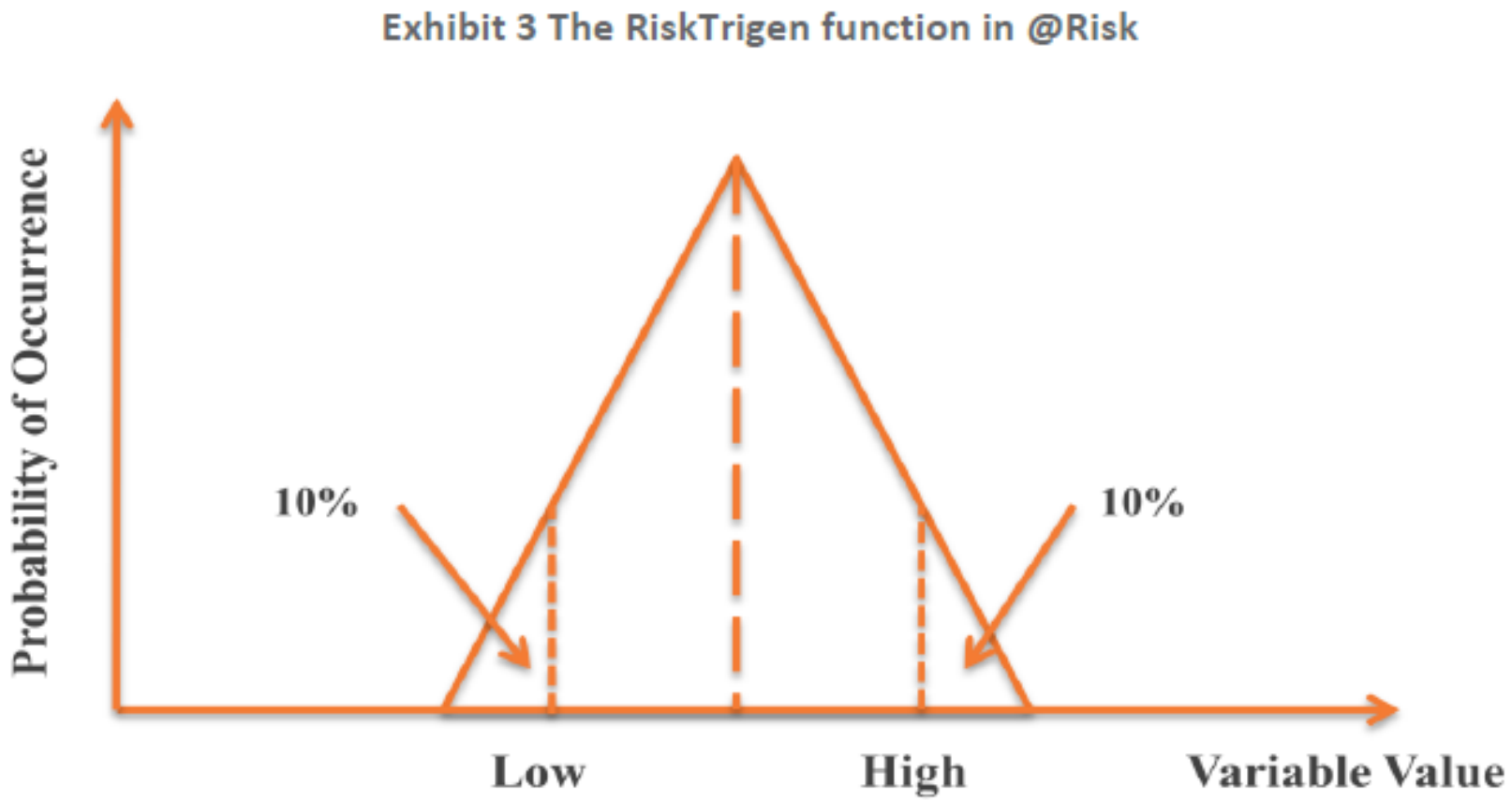


Similar valuation approaches used for other benefit categories

Exhibit 21 Methodologies for Calculating Benefit Values

Benefit	Methodology
Aesthetic and Amenity - Natural Cover	WTP to live in neighbourhoods closer to natural cover
Wildlife Viewing	WTP for wildlife viewing trips
Beaches	WTP for avoided beach closure days
Air Quality	Avoided cost of damages to human health and the environment
Local Climate Regulation	Avoided cost of building energy use
Carbon	Avoided cost of damages to human health and the environment
Disturbance Prevention	Avoided cost of sedimentation damages

Incorporating uncertainty into the analysis is important



…but can be challenging to do well

Surface water quality benefits were over 50% of all benefits

Exhibit 27 Summary of the Present Value of Benefits

($millions)	Low*	Mean*	High*
Avoided Costs	$120.09	$133.53	$147.13
Surface Water Quality	$1,059.05	$1,253.12	$1,442.10
Aesthetic and Amenity – Natural Cover	$250.86	$381.00	$508.98
Recreation	$109.76	$203.02	$296.10
Beaches	$11.30	$29.74	$47.50
Air Quality	$20.06	$24.48	$28.83
Carbon	$16.55	$20.11	$23.52
Local Climate Regulation	$15.53	$22.85	$30.09
Disturbance Prevention	$0.20	$0.33	$0.45
Total	$1,909.04	$2,171.47	$2,430.63

Beneficial for society to pursue sustainable communities

Exhibit 28 Summary of the Present Value Net of Benefits

($millions)	Low*	Mean*	High*
Total Costs	$1,380.31	$1,484.22	$1,587.97
Total Benefits	$1,909.04	$2,171.47	$2,430.63
Net Benefits	$415.82	$687.25	$959.61
Benefit Cost Ratio	1.27	1.47	1.67

Lots of impacts that could not be quantified/monetized

Impact Categories	Possible Impact from SC	Reason not Quantified/Monetized	Possible Significance
Industrial Water	Improved SWQ; improved water supply	Lack of data on value of marginal improvements in water quality/quantity for industrial use	Avoided cost of industrial water treatment and water consumption
Agricultural Water	Improved SWQ; improved water supply	Lack of data on value of marginal improvements in water quality/quantity for agricultural use	Avoided economic losses to agricultural production due to poor irrigation water quality
Recreational Boating	Improved SWQ; improved water supply	Part of the benefit is incorporated in the value of SWQ quantified in section 3.3.3; lack of data on value associated with incremental water level changes	Value of improvements in recreational boating
Commercial Fishing	Increased abundance and diversity of fish species populations	Lack of information on impact to commercial fishing industry	Increased value of commercial fishing industry
Other Recreation	Increased magnitude and value of other recreational activities	Lack of data on impact to other recreational activities	Increased value of other recreational activities (i.e.: hiking, camping, picnicking, mountain biking, etc.)
Water Purification / Waste Treatment	Improved SWQ	Part of the benefit is incorporated in the value of improved SWQ, quantified in section 3.3.3; cannot value costs to wastewater treatment plants because there are none in the watershed	Avoided cost of drinking water treatment for sediments and nutrients
Soil Retention	Reduced soil erosion, increased soil formation	Part of the benefit is incorporated in the value of improved SWQ, quantified in section 3.3.3; lack of data on impact on and value of infrastructure	Avoided cost of damage to infrastructure caused by soil erosion; avoided costs to water treatment plants, Loss of shoreline/lakefront property; loss of recreational fishing vlue due to increased turbidity
Nutrient Cycling	Reduced nutrient loading; improved nutrient cycling due to increase in tree cover and soil formation	Lack of information on impact to nutrient cycling	Value of fertile soil for plant growth; avoided cost of nutrient control measures
Biodiversity	Increased abundance and diversity of threatened and endangered fish and wildlife	Lack of clear indicator on biodiversity effects from SC scenario	Value of improved biodiversity to Rouge River Watershed residents

Some concluding thoughts

- Benefit cost analysis may not require monetizing all impacts
- Costs and market benefits also have uncertainty and can be challenging to estimate
- Need for valuation models/tools not just numbers with dollar signs

Benefit transfer in practice

- Lots and lots of assumptions…so transparency is crucial
- Beware the benefit transfer 'Russian Doll' chain
- Really need to be careful with per/ha transfers
- Benefit transfer requires benefits to transfer…
- Not just errors to worry about, but also loss of contextual information (e.g. distribution)
- Benefit transfer often seems like the only choice, when valuation is tacked on after
    - Need integration of valuation methods early on