CREDIT VALLEY CONSERVATION

LAKE ONTARIO INTEGRATED SHORELINE STRATEGY BACKGROUND REVIEW AND DATA GAP ANALYSIS

APPENDIX H
Ecological Goods and Services Final Report

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1 INTRODUCTION

Shoreline and nearshore environments are where most people interact with the Great Lakes. These interactions include direct uses such as recreation (e.g. boating, fishing, and swimming) or municipal drinking water supply and indirect uses such as role the shoreline can play in mitigating property damages by buffering the effects of storms. While the nearshore is used directly and indirectly providing a wide array of benefits, it is simultaneously used as a repository for our wastewater discharge and storm water.

From an economic perspective these uses translate into (a) benefits (uses that improve peoples' well-being); or (b) costs (uses that reduce peoples' well-being). In economics well-being provided by environmental resources can be expressed using the total economic value (TEV) framework. This framework (shown in figure 1) suggests that economic values can be subdivided into direct use, indirect use, option, and non-use values.

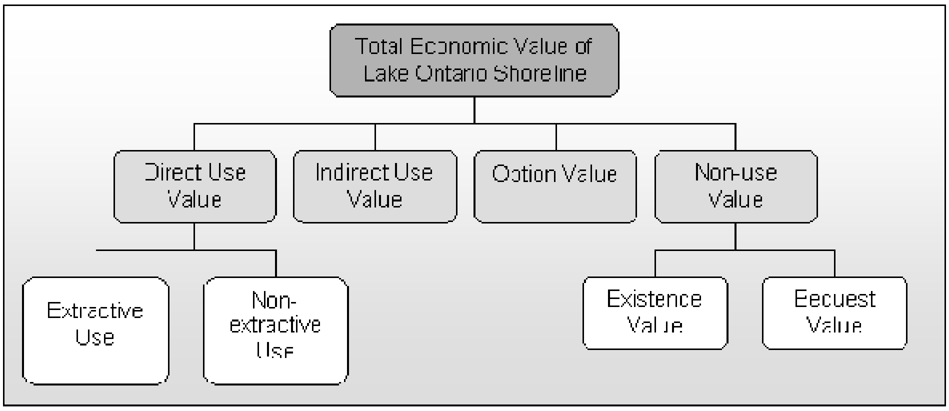

Figure 1 Total Economic Value

Direct Use Value **–** the values resulting from the direct use of a resource (i.e. output is directly consumed), which can be extractive (e.g. fish or timber harvest) or non-extractive (e.g. recreation).

Indirect Use Value **–** the values of a resource that support and protect economic activity and well-being (e.g. ecosystem services)

Option Value **–** when there is uncertainly over future demand and availability of a resource maintaining the option for future use may be considered valuable.

Non-use Values **–** the values of knowing a resource exists (existence value) and it will be available for future generations to enjoy (bequest value).

If the objective of land use policy is to improve the well-being of those who use the resource, than proposed changes to Lake Ontario Shoreline should examine all the values associated with the shoreline. Table 1 provides a list of potential values that should be examined when considering policy changes that influence the Lake Ontario shoreline and near shore environment.

Table 1: Some of the Potential Ecosystem Goods and Services Provided by Lake Ontario Shoreline

<table>
<tr><th colspan="3">Use Values</th><th>Non-use Values</th></tr>
<tr><th colspan="2">Direct</th><th rowspan="2">Indirect</th><th rowspan="2">Existence / Bequest</th></tr>
<tr><th>Extractive</th><th>Non-extractive</th></tr>
<tr><td>Drinking water
Industrial water use
Water for heating and cooling
Commercial harvest
- Fishing
Recreation
Fishing</td><td>Recreation
- Sailing
- Canoeing
- Rowing
- Waterskiing
- Wakeboarding
- Wildlife watching
- Walking
- Beach and lakefront
- Swimming
Transportation
- Commercial
- Tourism operators
Amenity</td><td>Gas regulation
Local climate regulation
Water filtration
Water supply
Nutrient cycling
Shoreline protection
Groundwater recharge
Flood control
Erosion control
Waste treatment</td><td>Biodiversity
Cultural heritage
Habitat</td></tr>
</table>

A key objective of the Lake Ontario Integrated Shoreline Strategy (LOISS) should be to ***maximize*** human well-being from use of the lakeshore ***subject to*** maintaining and improving ecosystem health. Incorporating an economic perspective in this way integrates the socio-economics and ecology to allow for identifying efficient, cost effective solutions. Therefore, this report will serve as a launching point for generating economic tools to assist in shoreline decision making by:

1. Identifying and documenting economic benefits and importance of the Great Lakes shoreline environment.
2. Identifying gaps in the existing literature
3. Identifying data necessary to facilitate the incorporation of human well-being into the decision making process.

2 LITERATURE REVIEW: THE ECONOMIC CONTRIBUTION OF THE LAKE ONTARIO SHORELINE

The valuation literature on goods and services provided by shoreline environments is dominantly focused on coastal shorelines (e.g. Silberman et al., 1992; Gren, 1993; Le Goffe, 1995; Pompe and Rinehart, 1995; Brystrom, 2000; Taylor and Smith, 2000; Leggett and Bockstael, 2000; Parsons and Powell, 2001; Hanley et al., 2003). Studies examining values in Great Lakes region tend to focus on commercial and trade implications (Krantzberg and de Boer, 2006) and if non-market values are considered at all, coastal shoreline values are relied on to infer freshwater shoreline values (Troy and Bagstad, 2009). Despite the vast number of studies exploring the economic contribution and value of the Great Lakes, particularly the commercial and recreational values, only a handful have focused specifically on the nearshore environment (Kreutzwiser, 1982; Bishop et al., 2000; Institute for Research and Innovation in Sustainability, 2006; Branden et al. 2008a; Braden et al. 2008b).

2.1 Market Values

Most of the direct use resources, such as commercial fishing or water use, have a market value that can be conventionally measured, e.g. total landed value of fish. Table 2 provides an example of such market values for some direct uses of ecological goods and services.

Table 2: Summary of Select Market Values Provided by Great Lakes Resources to Ontario (Adapted from Krantzberg and de Boer, 2006)

Economic Sector	Value (per year)	Notes
Commercial Fishing	$35 million	Landed value of fish only (before processing)
Aquaculture	$23-24 million	Landed value of fish
	$65 million	Total value added to the economy
Transportation	$2.2 to 3 billion	Value added to provincial GDP through activities generated by transport activity
Sport Fishing	$500 million	Direct spending on trips only

In the process of generating market values, humans use near shore resources and land as raw materials as well as waste repositories. This use of land and resources lead to external costs, namely environmental degradation. Heal et al. (2002) summarised that human uses of the Great Lakes shoreline has led to a build up of pollutants including toxic chemicals, nutrients, pathogens, sedimentation and siltation, oxygen-depleting substances, taste and odour, and PCBs. These pollutants are being the result of contaminated sediments, urban runoff and storm sewers, agriculture, atmospheric deposition, habitat modification, land disposal, and septic tanks.

In order to fully understand the role shoreline environments play in influencing human well-being, we must be aware of and account for these external costs. Krantzberg and de Boer (2006), identify key threats to the value of the Great Lakes as a whole. Some of the threats that are relevant to the Credit Valley Conservation's portion of the Shoreline are summarised in table 3 below.

Table 3: Summary of Economic Threats to the Market Value of Great Lakes Resources (Adapted from Krantzberg and de Boer, 2006)

Threat	Potential Loss	Notes	Geographic Area
Sprawl	$700 million to $1 billion	Excess costs for infrastructure, operating, maintenance, emissions, health care, traffic policing, etc.	Greater Toronto Area
	$18 billion	Infrastructure needed over next 15 years to provide drinking water to Great Lakes population due to inefficient pricing of water use in the past	Ontario, Canada
Invasive Species	$500 million	Control costs spent by Canada every year on current invasive species	Ontario, Canada
	$4 million	Monitoring, reporting, and public dissemination of all ballasting activities	Canada and U.S.
Toxic Chemicals	$93-$250 million	Reduced productivity and increased social costs due to mercury exposure	Ontario, Canada
	$5 billion +	Increased mortality rates due to pollution carried in the Great Lakes	Ontario, Canada

2.2 Non-market Values

The idea of incorporating non-market values into policy making is one that has been slowly gaining increasing support over the last few decades. As a result analysts have been increasingly reliant on existing literature. A recent government report attempted to incorporate the role of shorelines and near shore environments in the process of examining the ecosystem services provided by the southern Ontario landscape (Troy and Bagstad, 2009). Specifically, they produced estimates for the near shore, embayments and coves, coastal wetlands, and beach (summarized in Table 4).

Table 4: Summary of Great Lake Shoreline and Nearshore Ecosystem Services from Troy and Bagstad (2009)

Cover type	Description	Services Considered	Estimated Value (per ha per year)
Open water - great lakes near shore margin	Nearshore zones where defined as surface waters where depth is less than 10 meters for Lake Eire, 20 meters for Huron, and 30 Meters for Ontario.	- Recreation - Aesthetic and amenity	$795
Open water – embayments and coves	Areas of the Great Lakes forming significant embayment, estuaries or coves	- Nutrient regulation - Water supply - Recreation - Aesthetic and amenity - Habitat refugium	$1,852
Wetlands - Great Lakes coastal	Wetlands, bogs, marshes, and fens designated as coastal but not located in urban / suburban areas	- Gas regulation - Nutrient regulation - Recreation - Aesthetic and amenity - Other Cultural	$14,761
Beach	Open and treed sand barrens / dunes	- Disturbance regulation	$89,608

	located within 1 km of the coast	- Recreation - Aesthetic and amenity	

While Troy and Bagstad (2009) were able to put approximate estimates on these shoreline and near shore resources, further investigation revealed they relied significantly on studies focused on coastal environments. Despite having to rely on coastal values, Troy and Bagstad (2009) were only able to attribute values for a small selection ecosystem services. In fact, Pendletona et al. (2007) examined the peer-reviewed literature on coastal non-market valuation studies and concluded the literature is insufficient to support effective policy, with the possible exception of beach and recreational fishing.

Drinking Water

One remarkable gap in the literature is related to drinking water. While nearly every document and publication highlighting the importance of protecting the Great Lakes makes reference to the provision of drinking water, only one study was found that attempted to estimate welfare implications of drinking water consumption (Renzetti, 1999). Simply recognizing the importance of a resource for something as essential as drinking water is not enough. Everyday decisions impact the quantity and quality of drinking water and until we understand its value relative to others we will continue to make poor trade off decisions.

Aesthetic and Amenity Values

Aesthetic and amenity values are relatively well documented and can be divided into two broad categories of literature: those that focus on valuing an environmental amenity (Earnhart, 2001; Johnston et al., 2002; Pompe, 2008) and those that focus on the dis-amenity of living near a polluted site (Zegarac and Muir, 1998; Patunru et al., 2007; Austin et al., 2008; Braden et al., 2008a; Braden et al., 2008b). Table 5 provides benefit estimates of environmental amenities for some of the above studies.

Table 5: Summary of Studies Valuing Amenities of Shoreline Environments

Study	Method	Geographic Area	Amenity	Benefit Estimate
Earnhart (2001)	Combined hedonic pricing and conjoint analysis	Fairfield, Connecticut	Property adjacent to coastal marsh	2.7% increase in property price
Johnston et al. (2002)	Hedonic pricing	Peconic Estuary, Long Island	Property adjacent to open space	12.8% price premium
Pompe (2008)	Hedonic pricing	South Carolina	Waterfront property	53.5% price premium
			Property with water vista	36.6% price premium

For example, it is intuitive that properties in proximity to environmental amenities and scenic vista command a price premium. However, quantifying the dis-amenity of properties in proximity to polluted sites is much more useful since it is ultimately tied to human actions that can invoke change. In other words, the value of a dis-amenity highlights the cost of environmental damages and represents a benefit of restoration (highlighted in Table 6). It should be noted that restoring degraded shoreline area not only recovers the property values losses, it has also been shown to produce increased property tax revenues for local municipalities (Zegarac and Muir, 1998; Braden et al. 2008a; Braden et al. 2008b).

Table 6: Summary of Studies Valuing Dis-amenities of Shoreline Environments

Study	Description	Geographic Area	Benefit Estimate	Units
Zegarac and Muir (1998)	Increase in property value after restoration of Hamilton Harbour	Hamilton, Ontario	$12,065 per waterfront property	1996 CAD
Leggett and Bockstael (2000)	Increase in property value from improving fecal coliform counts from 240/100mL to 100/100mL	Chesapeake Bay, Anne Arundel County, Maryland	$230,000 or 2% of assessed value	
Austin et al. (2008)	Projected increase in property value from restoration of water quality in Great Lakes	Buffalo, New York	$0.6 to $1.1 billion	2006 USD
		Chicago, Illinois	$7.4 to $13.3 billion	
		Cleveland, Ohio	$2.1 to $3.7 billion	
		Detroit, Michigan	$3.7 to $7 billion	
		Duluth, Minnesota	$0.2 to $0.3 billion	
		Erie, Pennsylvania	$0.4 to $0.5 billion	
		Gary, Indiana	$0.2 to $0.3 billion	
		Milwaukee, Wisconsin	$1.5 to 2.3 billion	
Braden et al. (2008a)	Depressed property value from proximity to Area of Concern	Buffalo River, New York	$118 million	
Braden et al. (2008b)	Depressed property value from proximity to Area of Concern	Sheboygan River, Wisconsin	$158 million	

Recreation Values

Another well document benefit of shoreline environments is that of recreational values, particularly those related to beach recreation. Again, most of the research has been done for coastal environments (Whitehead et al., 1997; Kline and Swallow, 1998; Johnston et al., 2002; Hanley et al., 2003; Whitehead et al., 2009). However, there has been some work on the Great Lakes shoreline examining the benefits of cleaning up the Hamilton Harbour area of concern (Dupont, 2003) as well as some beach recreation values estimated for some regional conservation areas (Ecologistics, 1990). Table 7 summarizes selected studies estimating the recreational value of shoreline and coastal environments.

In 2008 CVC commissioned a study to examine the economics of fishing in the CVC jurisdiction (DSS Management Consultants Inc., 2008). The study estimated the total annual value of the fishery to be in the order of $1.2 million. This converts to a cumulative net present value of around $48 million.

Table 7: Summary of Studies Valuing Recreation Benefits from Shoreline Environments

Study	Recreation	Value Estimate	Notes
Ecologistics (1990)	Beach Recreation	$44 per household per year	WTP to prevent water quality decline at Kelso Conservation Area (1988 CAD)
		$60 per household per year	WTP to prevent water quality decline at Guelph Lake Conservation Area (1988 CAD)
		$80 per household per year	WTP to prevent water quality decline at Rockwood Conservation Area (1988 CAD)
Whitehead et al. (1997)	General Recreation	$23 to $80 per trip	An active users WTP for estuarine quality improvements in North Carolina (1990 USD)
Kline and Swallow (1998)	General Recreation	$3.06 to $4.18 per trip	Average value of coastal recreation in Southern New England (1995 USD)
Johnston et al. (2002)	Swimming	$8.59 per trip	Value of a recreation trip to the Peconic Estuary System, Long Island (1995 USD)
	Boating	$19.23 per trip	
	Fishing	$40.25 per trip	
	Wildlife Viewing	$49.83 per trip	
Dupont (2003)	Swimming	$57.57 per household per year	An active users WTP for improvements to Hamilton Harbour (1995 CAD)
	Boating	$33.13 per household per year	
	Fishing	$15.40 per household per year	
Hanely et al. (2003)	Beach Recreation	£0.48 per trip	Increase in value resulting from coastal water quality improvements in Scotland (1999 GBP)
Whitehead et al. (2009)	Hunting and Fishing	$1870 per acre	Average recreational value of coastal marsh in Saginaw Bay

Other Non-market Values

There are a number of other non-market values aside from amenity and recreation values, as highlighted in Table 1. However, the literature examining those services within the context of shoreline or even coastal environments is rather scarce.

The benefit of nutrient regulation in coastal regions has been done using a couple different economic valuation methods: replacement cost (Gren, 1993; Brystrom, 2000), and contingent valuation (Le Goffe, 1995). Both studies demonstrate the important economic role of coastal ecosystems in terms of nutrient regulation. Grenn (1993) demonstrates that coastal wetland restoration reduces nitrogen loading at a significantly lower cost then requiring nitrogen emission reductions at the source. Similarly, Bystrom (2000) showed that use of coastal wetlands as nitrogen sinks could reduce total abatement costs to Swedish agricultural sources by 30%. In France, Le Goffe (1995) examined the benefits of improving water quality issues from urban and agricultural pollution to residents of Brest harbour, finding their willingness to pay averaged 215 French Francs per household per year.

Disturbance regulation is another essential service provided by coastal and shoreline environments. However, literature relevant to great lakes shoreline environment is in short supply. Pomope and Rinehart (1995) estimate the enhancement of property values adjacent to beaches with varying beach width, showing that property values are greater for properties with larger beach width. This increase in value was postulated to result from the greater storm protection and recreation values provided by larger beaches. However, the proportion of value attributable solely to storm protection could not be estimated. In another study, Parsons and Powell (2001) examined the cost of Delaware's eroding ocean beaches, finding that if erosion rates remain at historical levels the cost of coastline retreat over the next 50 years is about $291 million (2000 USD).

Finally, non-use values have been shown to comprise a considerable portion of the total economic value of resources. Silberman et al. (1992) estimated the value of restoring New Jersey beaches to both users and non-users, finding non-use value to be $9.26 (a one time contribution in 1985 USD) compared to $6.40 for recreational use. Examining the restoration of coastal wetlands, Whitehead et al. (1997) found that non-users of the Albemarle-Pamlico estuarine system were willing to pay between $19.83 to $41.31 per household per year (1991 USD). When compared to values estimated for users, Whitehead et al. (1997) suggested that the non-use portion of value held by users comprised a large portion of their overall willingness to pay for estuarine quality improvement.

2.3 Restoration of Shoreline Environments and Damages Caused by Human Activity

Most studies that examine the economic benefits of ecosystems are less interested in estimating the total value and more concerned with the change in economic value resulting from (i) restoring the shoreline environment (Ecologistics, 1990; Zegarac and Muir, 1998; Whitehead et al., 1997; Leggett and Bockstael, 2000; Dupont, 2003; Hanely et al., 2003), or (ii) damages caused by human activity (Bishop et al., 2000; Braden et al., 2008a; Braden et al., 2008b).

One notable example is a study exploring the implications of invasive marine species (Nunes and Van Den Bergh, 2004). The study provided examples of the various types of economic damages (Table 8) resulting from transporting marine species in the ballasts of cargo ships. The benefits (in terms of reduced damages) of a policy designed to limit the introduction of invasive species in North Holland waters was estimated to range from 225 to 326 million euros.

Table 8: Classification of Damages Caused by Invasive Species (Adapted from Nunes and Van Den Bergh, 2004)

Value Component		Example of Damages	Most Suitable Valuation Technique
Use Values	Direct Use	Loss of tourism and recreational benefits (e.g., visits to the beach, swimming and sailing)	Travel cost method
		Effects on marine resources with commercial value (e.g., destruction fish populations	Market price valuation
		Effects on human health (e.g., skin allergies and gastrointestinal disorders)	Contingent valuation Dose-Response
	Indirect Use	Effects on ecological services	Contingent valuation
Non-use Values	Bequest	Risk of loss of legacy benefits	Contingent valuation
	Existence	Risk of loss of existence benefits	Contingent valuation

Changes to shoreline environments, whether restoring natural conditions or further development, have significant implications for the well-being of local and regional citizens. Understanding the implication to well-being requires economic tools, of which three are most relevant:

- Economic Impact Analysis
    - Method for determining how a change in policy or other action affects regional income, revenues, expenditures, and jobs.
- Cost-effectiveness Analysis
    - Method used when it is unnecessary or impractical to consider the dollar value of the benefits.
    - Identifies which option has the lowest cost of achieving a given benefit.
- Benefit-cost analysis
    - Method comparing the present value of all socio-economic benefits with the opportunity cost of a change in policy or action.
    - Requires the quantification of benefits

Economic Impact Analysis

Economic impact assessments track the impact that economic activity (e.g. spending on recreation) in a particular location has on the rest of the local economy. In the US, Austin et al. (2007a) used such an impact analysis to measure the multiplier effects from a $26 billion investment in Great Lakes restoration. The study estimated that this investment would increase short-term economic activity between $30 and $50 billion. It should be noted that these estimates do not represent economic value; rather it is a measure of economic activity generated by spending in the local economy. While studies such as these do not measure value, they do have an important place in policy development.

Another example of particular relevance to the Lake Ontario shoreline demonstrated economic significance of recreational spending generated by public marshes at Long Point and Point Pelee (Kreutzwiser, 1981). In purist of nature viewing, photography, fishing, waterfowl hunting and canoeing, users had a direct impact on the economy by spending more than $250,000, of which approximately $120,000 was spent in the local community. Considering the impact on the local economy only, Kreutzwiser (1981) suggests that this spending generated additional (or indirect) economic activity of $105,000 for a total economic impact of $225,000.

Cost Effectiveness Analysis

One study in Sweden demonstrated the cost effectiveness of using natural coastline and wetlands to reduce nitrogen pollution (Gren,1993) by comparing the costs of two policies (i) total costs for reducing nitrogen emission at each source by 50%, and (ii) total cost for reducing the load of nitrogen to the Stockholm archipelago by 50%. The latter policy was significantly more cost effective because it accounted for the ecosystem as a nitrogen sink and the included the restoration of coastal wetlands – a low cost alternative to reducing nitrogen loading – all of which reduced the need for man-made reductions at the emission source.

Benefit-cost Analysis

There are a few examples of benefit-cost analysis conducted within the context of the Great Lakes, the most impressive being the work by Austin et al. (2007a). This analysis examined the United States' Great Lakes Regional Collaboration Strategy which articulates a restoration plan designed to enhance coastal health, treat areas of concern, reduce non-point contamination sources, eliminate toxic pollutants, preserve habitats, address invasive species, and develop a system of indicators. The collaboration strategy is a massive undertaking proposed by US federal, state, and local governments. Taking into account initial capital costs and continuing operating costs, the strategy is estimated to cost $26 billion in present value terms. A detailed analysis of restoration benefits resulted in their estimation in excess of $50 billion (summarized in Table 9), for a benefit-cost ration of 2:1.

Table 9: Economic Benefits from Great Lakes Restoration in the United States (from Austin et al., 2007)

Benefit Description	Benefit Estimate
Direct use economic benefits from tourism, fishing and other recreation	$6.5 to $11.8 billion
Rise in coastal property values by areas of concern remediation	$12 to $ 19 billion
Reduction in costs to municipalities from reduced water treatment costs	$50 to $125 million
Total quantifiable benefits	$18 to $31 billion
Expected total benefits (including unquantifiable benefits)	> $50 billion

While Austin et al. (2007a) provide a comprehensive assessment of the benefits and costs of Great Lakes restoration south of the boarder, the scope of such an analysis provides little guidance for Credit Valley's assessment of the Lake Ontario shoreline. However, two other studies focused on coastal areas provide some insight to conducting a benefit-cost analysis to a small portion of a shoreline using an ecosystem services approach (Whitehead et al., 1997; Luisetti et al., 2008).

Recognizing the increasing threats and vulnerability to shoreline environments from climate change, the UK government is reorienting its coastal strategy to increase flexibility and adaptability (Luisetti et al., 2008). This policy switch has led to managed realignment projects resulting in the restoration of salt marshes, which under the new policy are considered a more sustainable form of flood defense. In addition to flood defense benefits, the restored salt marshes have resulted in a number of other benefits including increased biodiversity and carbon storage. Luisetti et al. (2008) used an ecosystem services approach to assess the costs and benefits of various managed realignments of the shoreline finding that restoring the natural shoreline had significant net benefits.

Having developed a comprehensive conservation and management plan for the Albemorle-pamlico estuarine system, resource managers wanted to understand human dimensions of the estuarine system, specifically the benefits and costs to current and future generations (Whitehead et al., 1997). Using two valuation methods (contingent valuation and travel cost) to estimate the benefits of maintaining and improving water quality and wildlife habitat, Whitehead et al. (1997) also estimated significant net benefits ranging from $75.6 to $321.6 million (1995 USD). However, only administrative costs were considered, which included stewardship, management actions, enforcement, monitoring, increased cost-share programs, land acquisition, restoration, and education programming.

3 INFORMATION GAPS AND DATA NEEDS

Addressing the question of human values from the Lake Ontario shoreline and nearshore environment will require a variety of information and data ranging from psychological and behavioural to biological and physical. Ultimately, this analysis will be concerned with how people use the shoreline and nearshore environment and how changes to biological and physical components result in perceived and experienced changes in human well-being.

3.1 Existing Shoreline and Near Shore Use

The first step to understanding the human dimensions of shoreline management will be characterizing the existing shoreline and near shore use. The characterization should include (but not limited to) the following information:

- Areas used for recreation
  - Beach – area, access, and usage
  - Open and green space – area, access, and usage
  - Wetlands – area, access, and usage
  - Community gardens – area and usage
- Residential
  - Area of residential land use in the study area
  - Number of waterfront properties
- Industrial
  - Area and location
  - What types of industry? What is being manufactured?
- Agricultural production – what types and how much?
- Natural shoreline
- Hard shoreline
  - What are the hard shoreline features?

  - What were designed to do? Are they effective?
  - Will hard shoreline infrastructure need replacing? If so, when and at what cost?
- Transportation routes
  - Areas of high recreational water traffic
  - Commercial shipping lanes and usage
- Given the shorelines' existing uses, what ecosystem services are currently being provided? Can these services be verified with biological and physical data or analysis?

3.2 Future Shoreline and Near Shore Use

Since economic analysis is based on understanding changes, examining the human dimensions of shoreline management with economic tools will require at least an approximate understanding of how things are going to change. Therefore, in addition to characterizing existing uses of the shoreline resource we will also need to explore / forecast / model the impacts from potential future land, shoreline, and near shore use scenarios.

3.3 Existing Environmental Issues

Environmental damages are directly or indirectly linked in some way to the human use of a resource. The characterization phase should also detail existing environmental issues along the shoreline and near shore environment. Specific question of relevance for economic analysis include (but not limited to):

- What are the key pollution sources?
  - Residential and industrial wastewater
  - Polluted storm water from urban areas
  - Excess nutrients from upstream agricultural practices
  - Other?
- What damage has been caused by pollution?
  - Impact on environmental quality
  - Impact on human uses (e.g. number of beach closures due to poor water quality)
- Are there issues resulting from development (e.g. lost wetlands, riparian area or other natural shoreline cover)?
  - Impacts on environmental quality
  - Impacts on human uses
- What type of resource extraction occurs in the study area and quantify how much?
  - Water demand (residential / industrial / agricultural)
  - Fish (recreational and commercial extraction)
  - Aggregate extraction
  - Other?

3.4 Existing and Missing Economic Values

In terms of placing a monetary value on benefits from the provision of ecosystem services or on environmental damages, there are a number of techniques that could be used. The method that involves the smallest investment in time and resource is value transfer, which relies on the results from previous valuation studies. Given the significant gaps in the peer-reviewed literature it is unclear whether there is enough relevant information on shoreline services and related environmental issues to effectively rely on value transfer. As mentioned, Pendletona et al. (2007) concluded that existing literature on coastal non-market valuation studies is insufficient to support effective policy. Furthermore, the lack of literature devoted to the Great Lakes context means many value transfers would have to be based on values from coastal literature. In some cases there are sufficient similarities between the human use of Great Lakes shoreline and coastal environments to justify the transfer of coastal non-market values (e.g. beach recreation and amenity values from open water vistas). Consequently, it is recommended that where suitable estimate exist valuation of shoreline management should be done using value transfer. For the areas where significant gaps in the literature make value transfer difficult primary analysis should be considered. Specific methods will depend on the specific environmental problems identified and proposed management strategies.

3.5 The Integration of Ecological and Economic Perspectives

It is clear from the review of literature that natural coastal and shoreline environments provide significant economic benefits which must be considered in order to properly inform policy and management decisions. However, it would be prudent to offer a cautionary note when interpreting non-market benefits. For example, when considering the benefits of water quality Steinnes (1992) demonstrates that economic value is often attached to a perceived measure of water quality as opposed to an objective scientific measure, which raises questions on how economists and natural scientists collaborate when developing public policy based on water quality. For example, in Hanley et al. (2003) the value a water quality improvement described to study participants simply as a “guarantee that bathing water quality would meet EU standards at all sites.” In some case, it is possible to integrate economic and ecological models to directly tie the valuation to objective water quality measures. For example, Leggett and Bockstael (2000) were able to estimate increased property value of reducing fecal coliform counts from 240/100mL to 100/100mL. However, this is only possible using revealed preference valuation methods. Use of stated preference methods inevitably relies on the perception of the individual respondent. Consequently, as the LOISS moves forward there will need to be continued communication between the ecologic and economic components in order to achieve the desired integration.

4 MOVING FORWARD

Most problems facing the Lake Ontario shoreline and near shore environment within Credit Valley Conservation's jurisdiction arise directly or indirectly from human activity. Many of these activities, including agriculture, commercial fishing, waste disposal, and urban development, adversely affect water quality and the shoreline resources, while other activates, such as recreation and tourism, are adversely affected by degraded shoreline environments.

The LOISS is a multi-year project designed to develop a compressive conservation and management plan for shoreline within Credit Valley Conservation's jurisdiction. Such a plan should strive to maintain ecological integrity of the shoreline through long-term planning. However, such long-term plan will not be successful without considering the human dimensions of the shoreline. Consequently, future economic contributions to this project should include economic efficiency analysis of proposed long-term plans which considers all aspects of well-being whether generated from market or non-market sources.

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