Environmental Protocols

Accounting for Environmental and Social Outcomes in Decision Making

This document is the second in a series of best practices that focus on the interaction of natural systems and their effects on human quality of life in relation to municipal infrastructure delivery. For titles of other best practices in this and other series, please refer to *www.infraguide.ca*.

National Guide to Sustainable Municipal Infrastructure

NRC·CNRC Federation of Canadian Municipalities Canadä

Accounting for Environmental and Social Outcomes in Decision Making

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InfraGuide – Innovations and Best Practices

Why Canada Needs InfraGuide

Canadian municipalities spend $12 to $15 billion annually on infrastructure but it never seems to be enough. Existing infrastructure is ageing while demand grows for more and better roads, and improved water and sewer systems responding both to higher standards of safety, health and environmental protection as well as population growth. The solution is to change the way we plan, design and manage infrastructure. Only by doing so can municipalities meet new demands within a fiscally responsible and environmentally sustainable framework, while preserving our quality of life.

This is what the National Guide to Sustainable Municipal Infrastructure (InfraGuide) seeks to accomplish.

In 2001, the federal government, through its Infrastructure Canada Program (IC) and the National Research Council (NRC), joined forces with the Federation of Canadian Municipalities (FCM) to create the National Guide to Sustainable Municipal Infrastructure (InfraGuide). InfraGuide is both a new, national network of people and a growing collection of published best practice documents for use by decision makers and technical personnel in the public and private sectors. Based on Canadian experience and research, the reports set out the best practices to support sustainable municipal infrastructure decisions and actions in six key areas: 1) municipal roads and sidewalks 2) potable water 3) storm and wastewater 4) decision making and investment planning 5) environmental protocols and 6) transit. The best practices are available on-line and in hard copy.

A Knowledge Network of Excellence

InfraGuide's creation is made possible through $12.5 million from Infrastructure Canada, in-kind contributions from various facets of the industry, technical resources, the collaborative effort of municipal practitioners, researchers and other experts, and a host of volunteers throughout the country. By gathering and synthesizing the best Canadian experience and knowledge, InfraGuide helps municipalities get the maximum return on every dollar they spend on infrastructure—while being mindful of the social and environmental implications of their decisions.

Volunteer technical committees and working groups—with the assistance of consultants and other stakeholders—are responsible for the research and publication of the best practices. This is a system of shared knowledge, shared responsibility and shared benefits. We urge you to become a part of the InfraGuide Network of Excellence. Whether you are a municipal plant operator, a planner or a municipal councillor, your input is critical to the quality of our work.

Please join us.

Contact InfraGuide toll-free at **1-866-330-3350** or visit our Web site at ***www.infraguide.ca*** for more information. We look forward to working with you.

The InfraGuide Best Practices Focus

Environmental Protocols

Municipal infrastructure decisions, particularly those related to potable water, municipal roads, and storm and wastewater can have a significant impact on the natural environment. Environmental protocols focus on the interaction of natural systems and their effects on human quality of life in relation to municipal infrastructure delivery. Environmental elements and systems include land (including flora), water, air (including noise and light) and soil. Example practices include how to factor in environmental considerations in establishing the desired level of municipal infrastructure service; and definition of local environmental conditions, challenges and opportunities with respect to municipal infrastructure.

Decision Making and Investment Planning

Elected officials and senior municipal administrators need a framework for articulating the value of infrastructure planning and maintenance, while balancing social, environmental and economic factors. Decision-making and investment planning best practices transform complex and technical material into non-technical principles and guidelines for decision making, and facilitate the realization of adequate funding over the life cycle of the infrastructure. Examples include protocols for determining costs and benefits associated with desired levels of service; and strategic benchmarks, indicators or reference points for investment policy and planning decisions.

Potable Water

Potable water best practices address various approaches to enhance a municipality's or water utility's ability to manage drinking water delivery in a way that ensures public health and safety at best value and on a sustainable basis. Issues such as water accountability, water use and loss, deterioration and inspection of distribution systems, renewal planning and technologies for rehabilitation of potable water systems and water quality in the distribution systems are examined.

Municipal Roads and Sidewalks

Sound decision making and preventive maintenance are essential to managing municipal pavement infrastructure cost effectively. Municipal roads and sidewalks best practices address two priorities: front-end planning and decision making to identify and manage pavement infrastructures as a component of the infrastructure system; and a preventive approach to slow the deterioration of existing roadways. Example topics include timely preventative maintenance of municipal roads; construction and rehabilitation of utility boxes; and progressive improvement of asphalt and concrete pavement repair practices.

Transit

Urbanization places pressure on an eroding, ageing infrastructure, and raises concerns about declining air and water quality. Transit systems contribute to reducing traffic gridlock and improving road safety. Transit best practices address the need to improve supply, influence demand and make operational improvements with the least environmental impact, while meeting social and business needs.

Storm and Wastewater

Ageing buried infrastructure, diminishing financial resources, stricter legislation for effluents, increasing public awareness of environmental impacts due to wastewater and contaminated stormwater are challenges that municipalities have to deal with. Storm and wastewater best practices deal with buried linear infrastructure as well as end of pipe treatment and management issues. Examples include ways to control and reduce inflow and infiltration; how to secure relevant and consistent data sets; how to inspect and assess condition and performance of collections systems; treatment plant optimization; and management of biosolids.

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ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

Most Canadians live in municipalities. Municipal decision makers generate direct and profound implications on the quality of life of these municipal residents through the investment decisions they make regarding the provision of municipal infrastructure. Most Canadians also want infrastructure decisions consistent with sustainable development, which seeks to balance social, economic, and environmental outcomes over the long term. This guide lays out a simple approach to best practices for assessing the broad implications of infrastructure projects. There are two major benefits from this approach.

- Well-planned investments in infrastructure that properly safeguard valued environmental and social assets are a better strategy, because they eliminate or sharply reduce future costs.
- The integrated approach has the distinct advantage of demonstrating clearly a municipality's concern for taking care of its environment and social assets through, among other things, wise choices about infrastructure investment.

The integrated approach to decision making calls for identifying, quantifying, and monetizing the economic, environmental, and social costs and benefits associated with infrastructure investment. A cost-benefit analysis (CBA) framework can be used that displays all the relevant decision-making information in a convenient format: infrastructure costs, infrastructure need, value of environmental implications, and other regional and social impacts. Using consistent methods and placing alternative infrastructure investments side by side in the consistent framework helps facilitate comparison. The CBA approach stresses the importance of identifying the linkages between infrastructure design, infrastructure construction, human usage, implications on the environment, and environmental quality.

The suggested approach to the monetary valuation of a broad suite of project implications is based on the well-established economic principle of willingness to pay. Specific techniques for estimating monetary values are identified and described. Where monetary values cannot be estimated, project implications should be fully described in qualitative terms using a narrative approach that identifies the nature of the implications and their likely importance. The infrastructure costs, benefits from the infrastructure services, and project implications that have been measured in monetary terms become part of a formal systematic analysis using cost-benefit analysis.

The three main techniques for reporting information to decision makers include a valuation matrix that summarizes all the monetized values, the narrative description that assesses all the qualitative implications and, the benefit-cost analysis report.

Linking environmental and social stewardship, and the use of valuation methods can be facilitated through the introduction of new policies and municipal goals. It is imperative to design and implement an evaluation process to report on the implementation experience of municipalities that integrate CBA and valuation into their decision-making process.

The three main techniques for reporting information to decision makers include a valuation matrix that summarizes all the monetized values, the narrative description that assesses all the qualitative implications and, the benefit-cost analysis report.

1. General

1.1 Introduction

Most Canadians live in municipalities. Municipal decision makers generate direct and profound impacts on the quality of life of these municipal residents through the investment decisions they make regarding the provision of municipal infrastructure. While infrastructure investments are made to improve the overall quality of life of residents, it is increasingly recognized that infrastructure decisions can generate a broad set of outcomes, some of which may not be desirable.

Indeed, investments in infrastructure services, such as water, sewer, and transportation, can stimulate the local economy, improve environmental quality, and enhance the health and welfare of citizens. However, the installation of physical facilities, such as roads and sewer and water pipes, can also disturb natural environments such as fields, bogs, or forests. When ecosystem services and functions are impaired, adverse social and economic outcomes can be expected. For example, reduced green space may constrain important recreational and viewscape opportunities, which impacts the value placed by citizens on these opportunities. With constrained recreational opportunities, there may also be losses associated with decreased spending and revenue at the local level. Thus, it is often the case that investments in physical facilities, while beneficial to society, may also trigger some related or linked costs.

The National Round Table on Environment and Economy, an independent advisory body that provides decisions makers, opinion leaders and the Canadian public with advice and recommendations for promoting sustainable development[1], explores a framework that is illustrative of how infrastructure investments are best considered. Under the Round Table's "capital framework," a stock of "capital" is considered to comprise Canada's national base of assets that enable us to create the set of economic and social outcomes that support continued development. Under this view, decisions are most productive by accounting for changes in *produced capital*, which consists of machinery, buildings, transportation networks, etc.; *natural capital,* which provides us with space to live, raw materials to utilize, and a clean environment within which to function; *human capital*, which enables us to make the most of our knowledge and abilities; and *social capital*, which facilitates the countless human interactions necessary for a healthy society.

Although we do not explore this "capital" decision-making framework explicitly in this best practice, it nevertheless provides a useful concept: infrastructure decisions are most productive for society when project outcomes are balanced to maintain social, economic, and environmental assets. In other words, it is not a best practice to treat infrastructure decisions independently from environmental, economic, and social considerations; they must be considered simultaneously. It is the recognition that infrastructure investment decision making should explicitly consider and balance a broad spectrum of social, economic, and environmental outcomes that is the impetus of this best practice.

When ecosystem services and functions are impaired, adverse social and economic outcomes can be expected.

1. *http://www.nrtee-trnee.ca/eng/overview/overview_e.htm* (Last accessed September 24, 2003)

The specific focus is to use cost-benefit analysis as an organizing framework to identify, quantify and, where possible, monetize a broad set of possible social, environmental, and economic outcomes associated with infrastructure investments and project options.

1.2 Purpose and Scope

The purpose of this best practice is to provide a framework, or concept, that aids with understanding the range of possible outcomes that can be triggered by infrastructure investments. The specific focus is to use cost-benefit analysis as an organizing framework to identify, quantify and, where possible, monetize a broad set of possible social, environmental, and economic outcomes associated with infrastructure investments and project options.[2]

Cost-benefit analysis (CBA) is a framework that is useful for organizing the life-cycle costs and benefits of investment decisions within one integrated framework. Within the CBA framework, environmental and social outcomes can be translated into monetary indicators, which are directly comparable with common project or economic metrics, such as infrastructure costs. As well, the CBA framework is sufficiently flexible to incorporate information that is not monetized, but nevertheless is important for assessing project outcomes.

The translation of infrastructure investment outcomes into monetized values is called valuation. Valuation is useful for incorporating indirect project outcomes, such as reduced environmental quality, into project costs or benefits. The use of a common metric provides decision makers with a consistent basis to compare the spectrum of possible project outcomes and to assess the trade-offs associated with project implementation. In effect, the CBA framework provides decision makers with a complete "snapshot" from which to compare and assess wide-ranging economic, social, and environmental project outcomes.

More specifically, this best practice:

- provides guidance on identifying, quantifying, and monetizing the outcomes of infrastructure investments; and
- investigates the tools that can be used by municipalities to trace the linkages between infrastructure investments and environmental, social, and economic outcomes.

This best practice describes methods to estimate monetary values for environmental, economic, and social outcomes that would be affected by infrastructure installation. It also provides advice on how to deal with situations where it is not possible to develop monetary values, and where qualitative descriptions are the best that can be developed. These methods are applicable to all types of municipal infrastructure projects, including new and replacement projects. Given that applying the methods within the CBA framework has cost in itself, municipalities may find budgetary considerations limit formal application of the methods to large projects (recognizing, of course, that "large" is a relative term which will have to be defined within the context of any municipality using the tools). Where budgetary or time constraints exist, the informal application of the methods presented in this best practice can strengthen the understanding of the possible implications of investment options under consideration. To the extent that municipal master plans include analysis of investment options and recommended investment choices, the best practices framework and tools would also be applicable.

2. The terms implications and outcomes are used interchangeably in this best practice.

Overall, the CBA framework is flexible in the sense that it can accommodate variations among municipalities in resources and analytical capabilities, and in the nature of projects. The methodology builds on the capabilities of all municipalities, and provides tools and implementation strategies for integrating a wider scope of societal values into infrastructure decision making. We note that the CBA framework is oriented toward using existing project information that may be obtained through the application of standard project assessment tools, such as engineering studies, and environmental impact assessments, and incorporating this information into the CBA framework.

We use the term implications to imply a suite of environmental quality changes that may include environmental impacts, which are identified by an environmental impact assessment (EIA), as well as other environmental implications that may not be deemed "significant" under an EIA. These other environmental implications may not be significant from an EIA perspective, but may have other socio-economic implications that are captured within the CBA. Thus, the CBA framework is really a complement to existing decision-making tools, such as environmental assessments but may also require information that may not be available from these tools.

Furthermore, although the framework and analytical methods presented in this best practice are primarily intended to address questions of infrastructure investment, they have broader applicability and could be applied to other decision-making situations that involve public investments.

1.3 How to Use This Document

This best practice is written as part of a series of guides that deal with integrating the environment into design and decision making as a means to develop more sustainable infrastructure. The best practices chosen for the guide are based on the priorities identified by municipal representatives and practitioners from across Canada. It is important to note that this guide is one of three environmental protocols that develop complementary concepts. These three documents are summarized below.

Strategic Commitment to the Environment by Municipal Corporations explores the long-term health and economic benefits of protecting the environment. It identifies high-level municipal officials as the most appropriate audience to receive and implement its message.

Environmental Assessment discusses the approach to assessing infrastructure projects to isolate any unwanted impacts on, or implications for, the environment and indicates how to develop mitigation procedures.

The above two best practices provide the groundwork for the application of environmental valuation tools in infrastructure investment decision making.

Accounting for Environmental and Social Outcomes in Decision Making outlines how to estimate the economic value of environmental implications stemming from infrastructure decisions and how to integrate those values into municipal decision making.

Restructuring decision making to include valuation tools necessarily requires impetus, or leadership, and the ability to link infrastructure projects with environmental implications. Hence, to get the maximum benefit from the use of the three guides, they are best implemented collectively.

Restructuring decision making to include valuation tools necessarily requires impetus, or leadership, and the ability to link infrastructure projects with environmental implications.

1.4 Glossary

Some key terms and concepts needed for the adoption of this best practice are listed below. The tools developed in this guide associate value with environmental, social, and economic changes, either positive or negative. To enforce how these tools are distinctive from processes used in environmental assessments, costs and benefits are referred to as implications.

Cost–benefit analysis (CBA) — A quantitative evaluation of the costs that would have been incurred by implementing an infrastructure project versus the overall benefits to society of the proposed project.

Environmental valuation — A process of transforming environmental implications into economic values, usually expressed in monetary terms (i.e., dollars).

Market — (Lipsey-Steiner-Purvis) From the point of view of a household, the market consists of those firms from which it can buy a well-defined product; from the point of view of a firm, the market consists of those buyers to whom it can sell a well-defined product.

Monetary valuation — A method to transform observed information from a market (i.e., the price at which people buy and sell an item) into economic values that are comparable.

Non-monetary valuation — Valuations that does not use monetary values.

Risk assessment — 1. The process of systematic assessment of environmental impacts, taking into account the possible danger as well as the likelihood of occurrence. 2. The identification and quantification of the risk resulting from a specific use or occurrence of a chemical compound, including the determination of dose–response relationships and the identification of target populations. The process entails hazard identification, effects assessment, exposure assessment, and risk characterization (cf. Nath et al., 1998).

Valued environmental attributes/components — Those aspects (components/processes/functions) of ecosystems, human health, and environmental welfare considered to be important and potentially at risk from human activity or natural hazards. The term is similar to "valued environmental components" used in environmental impact assessment.

2. Rationale

2.1 Background

Infrastructure projects pose direct and indirect implications for municipalities. These implications may vary in magnitude, and may be positive or negative. The nature of these implications is strongly interrelated with the natural environment in which the facilities are placed and how the project impacts environmental functions and services. Environmental functions and services are broadly defined as:

- resource provision (e.g., water, food, wood, fuels, soil);
- waste storage and assimilation (e.g., taking up contaminants to clean the air, water and soil, through plants, atmospheric reactions, etc.);
- aesthetic amenities (e.g., space and natural beauty); and
- life support systems (air, water, genetic diversity for resilience).

Linked to these functions and services are direct and indirect human uses by different segments of society. Table 2–1 traces the relationship between functions and services, human uses and benefiting segments of society. When infrastructure investments degrade environmental functions and services, a number of outcomes associated with human uses can be expected. Further, these outcomes may fall disproportionably on different segments of society. For example, a new urban development could decrease surface water quality, and impact human uses that require clean water. Impacted segments of society could include manufacturing processes, which may need to upgrade their treatment facility, and municipalities, which may have to find an alternative water supply source or upgrade their treatment facility.

Given the wide spectrum of possible outcomes that can be attributed to infrastructure investments, the challenge facing decision makers is to identify and assess the spectrum of possible outcomes. Ensuring consideration of the wide-ranging outcomes in municipal infrastructure investments requires an organizing framework to identify the relevant outcomes, and the appropriate methods to assess the significance of these possible outcomes.

Cost-benefit analysis is a widely used decision-making framework to assess projects in terms of their potential change in societal well-being. Cost-benefit analysis evolved based on the need for governments to assess and prioritize projects, and to allocate limited budgets and resources. Projects are recommended that maximize social well-being or welfare at minimum cost. CBA is a tool to compare the aggregate costs and benefits for each investment alternative to reach a recommended choice and makes clear the advantages and disadvantages of decisions with respect to impacts on society. CBA also aims to guide decision making and project selection so scarce resources are used, or allocated efficiently, where they provide the highest increase in social welfare.

Cost-benefit analysis is a widely used decision-making framework to assess projects in terms of their potential change in societal well-being.

Investments in sewage treatment limit the discharge of sewage into receiving waters, and thus impacts on ecosystems and humans are avoided or mitigated.

Table 2–1: Linking Environmental Functions and Services to Human Uses

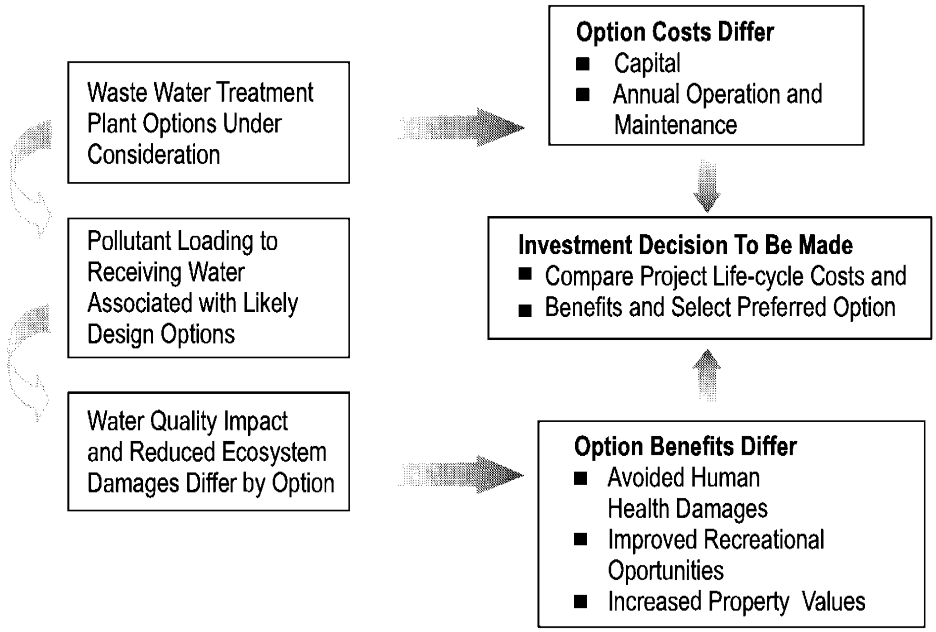
Environmental Function or Service	Linked Human Use of Function or Service	Linked Direct or Indirect Human Use	Segment Benefiting
Waste storage and assimilation and life support system ➤	Clean water for irrigation and stock watering	Direct use	Agriculture
Waste storage and assimilation and life support system ➤	Clean water for municipal and rural domestic use	Direct use	Domestic/municipal
Resource provision and waste storage and assimilation ➤	Clean water for manufacturing	Direct use	Industrial
Aesthetic amenities and resource provision ➤	Clean water and habitat for recreational fishing	Indirect uses	Recreation
Waste storage and assimilation, aesthetic amenity and life support system ➤	Clean water for swimming and boating	Indirect uses	Recreation
All services and functions ➤	Spiritual, cultural and aesthetic values of a healthy environment	Indirect uses	Households

The CBA framework draws together considerations of the cost of infrastructure, and the services or benefit it is intended to produce, and then balances these with a careful analysis of the other environmental and socio-economic outcomes (i.e., costs and benefits) that may result. A CBA of a municipal infrastructure investment requires a formal assessment of the full range of associated costs and benefits. Further, the CBA framework assumes a long-term view, and therefore accounts for changes attributable to investments over a very long time horizon. This long time horizon allows for long-lived costs and benefits to be captured in the framework. This is particularly useful to comprehend the overall significance of small but reoccurring future benefits and costs.

The line of reasoning to assess these costs and benefits must start with a linking of the investment to changes in environmental quality, impacts on human and ecosystem receptors and, ultimately, changes in monetary value. Below we explore this reasoning using a sewage treatment plant investment as an example.

Investments in sewage treatment limit the discharge of sewage into receiving waters, and thus impacts on ecosystems and humans are avoided or mitigated. The avoided damages to ecosystems and humans attributable to the sewage treatment plant can then be said to be the benefits of the plant. The quantified and monetized benefits can be compared to the costs of the investment, and an assessment made on the desirability of the investment. In other words, are the benefits greater than the costs? Implicitly, the sewage treatment investment alters a set of biophysical and socio-economic relationships that ultimately link the discharge of sewage with impacts on ecosystem and humans, as shown in Figure 2–1.

Figure 2–1: A conceptual overview of a CBA of a sewage treatment plant



Infrastructure investments can be expected to trigger a variety of beneficial effects. There can be benefits due to the avoidance of remedial expenditures (e.g., fish habitat enhancement) that might have been required without the investment; health benefits due to avoided impacts on humans as a result of decreased contamination; benefits to users of natural resources whose quality is maintained or improved due to the investment; benefits of a more intrinsic nature related to the value people place on a cleaner environment for its own sake, for its potential future use, and for the benefit of future generations.

Costs stem from the expenditure of real resources required to construct, operate, and maintain the infrastructure, as well as other indirect effects that might occur. These could include lost business opportunities from the land on which a new sewage treatment plant is constructed, or a decrease in property values in areas adjacent to the new plant. Other "costs" may include greenhouse gas emission increases, and loss of habitat at the facility location or for solids disposal locations.

In principle, the value of these different types of costs and benefits can be estimated in monetary terms and aggregated into one overall measure of the desirability of the investment. The value of the positive implications or "outcomes" of the investment can be estimated on the basis of what people and businesses are willing to pay for them. Ultimately, the benefits of the investment should be greater than the costs to ensure citizens are better off with the investment. If the benefits are not greater than the cost, then alternatives can be considered which reduce costs or increase benefits.

The most pressing challenge with CBA is to determine all the environmental and social implications of investment options, and assess the extent to which they can be expressed in monetary terms. Usually, valuation means expressing environmental values in monetary terms to make them comparable with the conventional measures, such as construction costs. Where monetary valuation is not possible, it will be the decision makers' responsibility to weigh the remaining qualitative factors relative to the monetary values. For many municipalities, building quantitative environmental values into an integrated decision-making framework presents an interesting challenge. Specifically, the challenge is to develop appropriate monetary measures of environmental and social values, and to deal with those outcomes for which monetary measures are not available.

Figure 2–1
A conceptual overview of a CBA of a sewage treatment plant

The value of the positive implications or "outcomes" of the investment can be estimated on the basis of what people and businesses are willing to pay for them.

Development plans and projects that create healthy, natural, social, and economic environments help to emphasize a municipality's competitiveness.

By using common metrics, such as dollars, to compare different project outcomes, the CBA framework complements environmental and social information by transforming possible outcomes into comparable values. This gives decision makers a common frame of reference to aid in understanding the trade-offs associated with different investments or project decisions. The CBA framework and method presented later in this guide are meant to help in the process of gathering information on community and environmental values so a greater range of variables can be considered in infrastructure decision making.

2.2 Benefits

What are the benefits of an integrated decision-making process for infrastructure investment? First, it is evident a well-planned investment in infrastructure that safeguards valued environmental functions and services over the long term is a better strategy, because it eliminates or reduces future social and economic costs. In this sense, it is economically efficient, because it allows municipalities to allocate fewer resources to infrastructure-related activities than otherwise would be the case and to avoid future expenditures that could be avoided through careful planning. So infrastructure projects based on comprehensive decision frameworks limit the costs of environmental, social, and economic risk, respect codes of due diligence, and are less expensive in the long term.

Second, the integrated approach has the distinct advantage of demonstrating clearly a municipality's concern for taking care of its environment and society through, among other things, wise choices about infrastructure investment. It is becoming more and more recognized that the "quality of life in cities is a prime determinant of investment decisions and, hence, the attraction of knowledge workers."[3] A healthy environment is a key contributor to the quality of life.

Development plans and projects that create healthy, natural, social, and economic environments help to emphasize a municipality's competitiveness. As a result, leading municipalities have taken initiatives toward holistic decision making by assigning value up front to the environment to capture a full range of benefits from planned projects. In effect, incorporating valuation (through the use of CBA) into the decision-making process helps expand economic opportunities and enhance societal well-being over the long term.

In support of this evolving approach to decision making, this best practice is meant to make the methods of CBA more accessible, increase the appreciation of its applicability, and improve the understanding of its strengths and weaknesses. This is being done to provide decision makers and municipal leaders with the benefit of a framework that can coherently assemble divergent information within one unifying framework.

3. National Round Table on the Environment and the Economy, *http://www.nrtee-trnee.ca/eng/programs/Current_Programs/Urban_Sustainability/urban_sustainability_e.htm*

2.3 Risks

Valuing environmental and social outcomes can be a complex task and is not without risks. The methods required can be demanding in terms of time, expertise, and resources. Consequently, municipalities need to be aware that there will be costs to identifying, quantifying, and monetizing the type of benefits described in the previous section. However, rather than regard this as a threat, this challenge should be seen as an opportunity to enhance staff skills and expertise, much of which could probably be accomplished by fine-tuning existing staff training programs.

Other risks include possible incremental effects of infrastructure on larger ecosystems that cannot be adequately captured in the analysis. For example, an increase in surface water volume from road widening or increases in carbon releases from a pumping station upgrade. Cumulative effects on watersheds can be significant over time and must be addressed through other techniques.

Similarly, there is a risk that significant costs and benefits will be missed in the evaluation, and therefore care must be taken to identify a full range. To mitigate these risks, the project-based CBA approach should be nestled within a large decision-making process so broader implications and outcomes can be captured. As well, input from stakeholders can assist with defining a fulsome range of costs and benefits.

Employing a two-phase approach to the implementation of an integrated CBA decision-making framework can moderate the risks associated with processes requiring greater technical know-how and increased staff time.

In the **first phase**, the emphasis can be placed on the identification of environmental, social, and economic outcomes and on generating a full qualitative description of the implications and their likely value. This gives staff the opportunity to develop their grasp of the technical aspects of the CBA and valuation process. At the same time, decision makers will be able to familiarize themselves with the type of information they will be receiving and to assess its strengths and weaknesses. This process is discussed in more detail in Section 3 of this best practice.

In the **second phase**, the process would be extended to include the quantification and the monetary valuation of the environmental, social, and economic outcomes where possible. In cases where monetization may not be possible, a qualitative assessment of the implications (as in phase 1) would provide a means to investigate the possible range of outcomes associated with the investment. Moving from phase 1 to phase 2 will be a judgment call on the part of staff and decision makers, although one could expect that a set schedule would be adopted. Phase 2 could also be designed with several steps over which the complexity of the analysis undertaken would be gradually increased. A municipality could decide in the first step to adopt the methods and approaches identified in this guide, but to limit the monetary valuation to only a few key costs and benefits. As familiarity with the CBA framework and valuation process grows and the information produced is better appreciated, the range of variables included in the monetization process would be gradually extended.

Finally, CBA implementation should be iterative and adaptive and, therefore, should be expected to change as municipalities gain experience in the use of CBA.

To mitigate these risks, the project-based CBA approach should be nestled within a large decision-making process so broader implications and outcomes can be captured.

3. Methodology

This section lays out the elements of the overall framework for integrating environmental and social values into the process used to make decisions about infrastructure investment. In many ways, it describes a technical methodology for identifying, quantifying, and monetizing the range of outcomes associated with a proposed infrastructure facility, and then taking those values into account when a decision is made whether or not to proceed, or if adjustments to the project are required to mitigate adverse effects. This type of decision could be limited to examining a single project option or could include a comparison of several options to select the best one.

The section begins with a description of the decision-making process as a way of demonstrating how information from a CBA would be incorporated. The concept of a decision or value matrix is introduced as an organizing device that assembles the relevant information about a proposed investment into a systematic format that will facilitate comparative analysis in situations where several options are being considered. Next, the tools required to estimate the monetary value of infrastructure investments are introduced and described, as are some qualitative indicators that could be used to characterize those outcomes for which a monetary value cannot be estimated. The section concludes with a brief discussion of some issues related to reporting the results of the analysis conducted in support of the decision-making process.

3.1 Decision-Making Process

Municipal decision making can be described as the analysis of different investment strategies balanced against the public acceptance of solutions from the environmental, economic, and social standpoints. Examining a full range of implications, both positive and negative, aligns project expectations and priorities, and captures the greatest array of benefits. Evaluating environmental and socio-economic implications alongside infrastructure considerations is accomplished by integrating monetary and non-monetary valuation methods in a standard decision-making process (i.e., CBA). Various alternatives are examined for their related costs and benefits to determine what set of trade-offs is most suitable. Analysis of decision-making processes is intended to show how and where environmental and socio-economic valuation is relevant in infrastructure project planning.

Municipal decision making can be described as the analysis of different investment strategies balanced against the public acceptance of solutions from the environmental, economic, and social standpoints.

Decision making, in any context, follows a standard process beginning with an outline of the project at hand and an identification of the decision to be made. Goals for the project outcome are set, alternative actions or strategies are identified, followed by an analysis of all potential costs and benefits. Following analysis, the results are summarized and presented to the appropriate authority to elicit a decision.

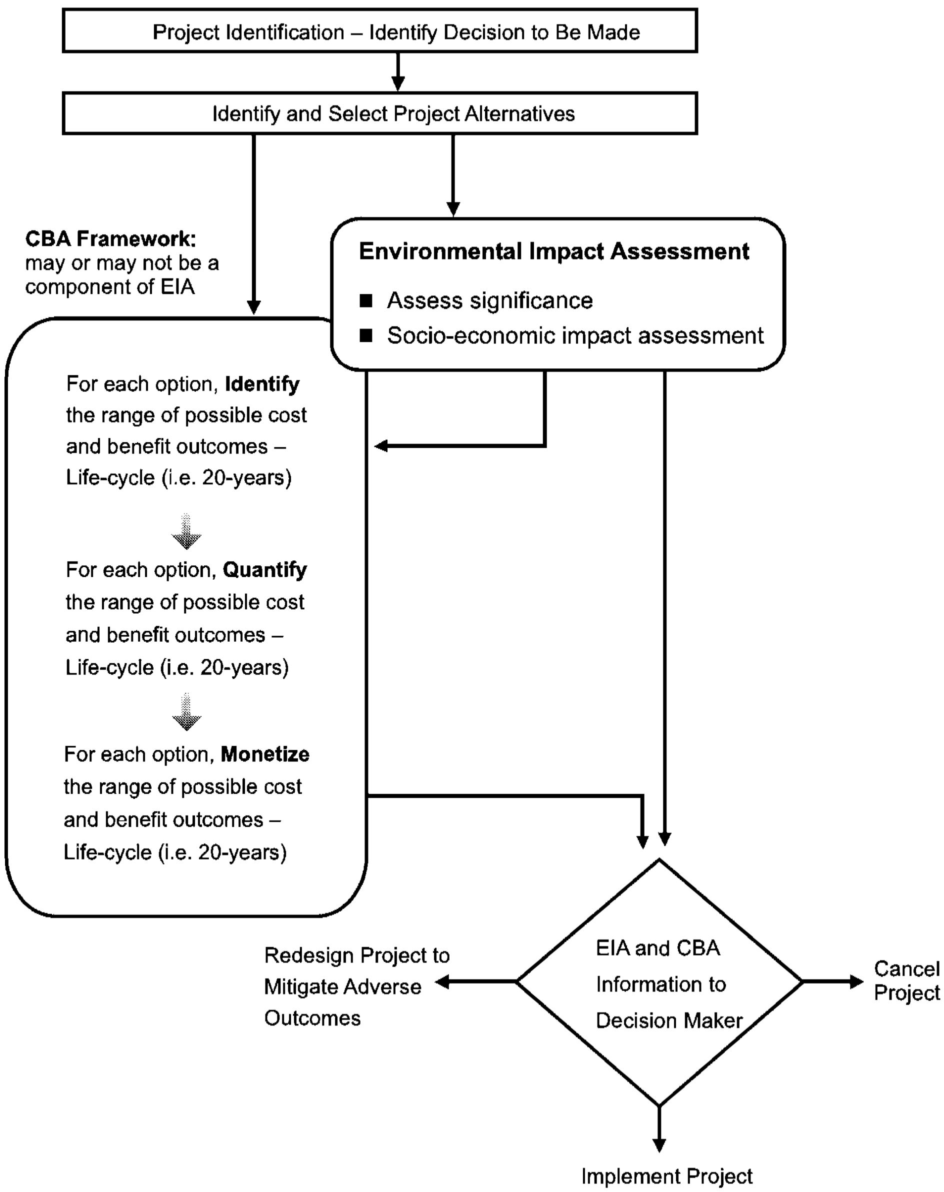
3. Methodology

3.1 Decision-Making Process

Figure 3–1
Decision-making process

A general overview of the decision-making process with respect to CBA input is illustrated in Figure 3–1. The Figure identifies where the CBA framework (valuation) enters into the established decision-making process. It is important to note that the CBA is a complement to best practices such as environmental impact assessment. Indeed, the CBA ideally would use information developed by the EIA as the basis for identifying and quantifying project impacts on humans and ecosystems. This is the case in Ontario, for example, where a CBA is a component of the EIA process.

Figure 3–1: Decision-making process



For the most part, the technical analysis of environmental impacts performed as part of environmental impact assessments focuses on physical measures of impact. The monetary and non-monetary valuation methods discussed below in this best practice extend the analysis to capture a broader context of market and non-market community behaviour and beliefs. In this sense, applying the CBA framework provides a complementary analysis of the significance of the environmental and social impacts by making explicit the broader implications an infrastructure decision will have on the community as a whole. Additional information on the components and framework assumptions of a CBA is provided in Appendix A.

3.2 Identifying Linkages, Costs, and Benefits

Infrastructure design and construction, human usage, impacts on the environment, and environmental quality implications are inescapably linked. In the short term, a causal chain links design to construction to human usage. Links to environmental impacts could run from both construction and human usage, with subsequent implications for environmental quality. In the long term, there could be feedback linkages running from environmental quality to human usage, and future design and construction considerations. Determining the specific linkages and implications for a given project is vital to developing a full understanding and appreciation for the range of outcomes. So, identifying the linkages between aspects of a project and implications over the full life of a project is an important first step in identifying and communicating the broad project implications to decision makers for consideration.

To begin a CBA of the municipal infrastructure investments, we need to identify the types of costs and benefits that flow from the investments. We must also identify the bio-physical and socio-economic linkages that trigger the costs and the benefits. In tables 3–1 and 3–2, we trace some of the environmental and economic benefits triggered by the sewage treatment plant example introduced above. Some of these benefits can be identified, some quantified, and a few monetized. Thus, it can be expected that a mix of qualitative and quantitative information can be assembled in a consistent format that provides an indication of the scope of beneficial outcomes as well as costs the investment can be expected to trigger.

Infrastructure design and construction, human usage, impacts on the environment, and environmental quality implications are inescapably linked.

Table 3–1: Benefits of Investments in Sewage Treatment

Investment ➤	Environmental Function and Service Impact ➤	Human Use Benefit
An investment in municipal sewage treatment results in:	■ Higher dissolved oxygen ■ Control of phosphorous levels ■ Lower turbidity ■ Lower sediments ■ Decreased pathogens ■ Increased fauna and flora diversity and abundance ■ Reduced fish mortality ■ Reduced invertebrate mortality	1. Increased recreational use 2. Higher property values adjacent to improved water quality 3. Reduced health risk from recreational contact and consumption of fish and shellfish 4. Increased value placed on ecosystem and water quality by individuals/households 5. Increased commercial and recreational fisheries use 6. Households are willing-to-pay to maintain or improve water services

Table 3–2: Costs of Investment

Investment ➤	Costs ➤	Type of Economic costs
The investment triggers cost:	■ Real resource expenditures to build, operate and maintain ■ Lost production from land ■ Decrease in property values ■ Increase in greenhous gases (GHGs)	1. Capital costs 2. Yearly costs 3. Lost profit 4. Lost property value adjacent to plant 5. Investment to sequester carbon or reduce GHGs from other sources

3.3 Quantifying the Costs and Benefits

Quantifying the costs and benefits are useful in a number of ways.

- First, it is the quantified bio-physical information that forms the basis for tracing and estimating the monetized changes in human uses and values placed on environmental quality. Thus, a quantification of the environmental impacts is a necessary step in the CBA. In this step in the process, the environmental impact information is either generated or adopted from an EIA. The aim here is to develop a quantified relationship between the project and changes in environmental quality. A quantitative relationship is then made to human uses and values.
- For example, for a sewage treatment plant, the investment may reduce fecal coliform counts by a certain level. The improved water quality reduces the number of beach closure days and therefore increases the number of swimming days for citizens. As well, adverse health impacts associated with contaminated water may be avoided. Since citizens place value on beach days and on the avoidance of bacterial contamination, monetized value can be assigned to a project that improves water quality. Specific valuation methods are discussed in more detail in Table 3–5.
- Second, it may be useful to present to decision makers the biophysical information about the project, such as the percentage improvement in water quality, along with the monetized information the CBA produces. Presenting both the bio-physical (generated from an EIA or other approach) and CBA outcome information together affords decision makers with the ability to assess and weigh different types of information, including monetized and non-monetized project outcome indicators. These indicators really form the basis on which decisions about project design or implementation are made.

Finally, in cases where it is not possible, for whatever reason — lack of data, lack of resources, lack of time — to estimate monetary values for environmental implications, these implications should be dealt with in qualitative terms. Two methods can be used: a narrative description, and a supplementary qualitative ranking scale. Using a supplementary scale may help but, on its own, it would likely be insufficient to satisfy the decision makers' information needs and may engender controversy over the subjective rankings and weighting schemes employed.

3.3.1 Narrative Description

The most direct way to deal with environmental and social outcomes in qualitative terms is to write a narrative that clearly identifies the nature of the impact(s), the cause of the impact(s), the expected magnitude of the impact(s), an assessment of the likely importance of the impact(s) to residents, and the steps that could be taken to mitigate or eliminate the impact(s). Much of the information required for this narrative could be extracted from an environmental assessment if one has been conducted, or from other less formal assessments. Otherwise the analyst(s) preparing the information will have to prepare the narrative as an accompanying document. The primary objective of the narrative must be to convey to decision makers the extent and significance of implications so they can assign the weight to be given to them in the decision-making process.

3.3.2 Qualitative Scale

For the analysis of outcomes, a qualitative scale could be used to rank or rate the severity of an impact. Table 3–3 gives an example of the type of scale that could be used. Different scales could be developed for different types of implications, recognizing that the ranking on one scale would not be comparable with that on another scale. For example, a ranking of three on a scale for the loss of wooded areas would not be comparable to the same ranking on a scale assigned to increases in soil salinity, since the two implications may be very different in terms of their environmental importance and the importance attached to them by stakeholders.

Table 3–3 Sample Qualitative Scale

Environmental Impact	Scale Value
Extremely high	6
Very high	5
High	4
Moderate	3
Low	2
Extremely low	1
Unknown/unable to classify	U

So, care must be taken with the use of scales, because the number of the scale may not properly reflect the importance of an impact for the environment or the importance attached to the impact by stakeholders, which can lead to inconsistent outcomes. Scales may not differentiate properly between environmental and social implications, particularly when either the consequences or the likelihood of an impact are extreme. Thus, in deciding whether or not to use scales, an important consideration will be the extent to which the scale conveys information to decision makers more effectively than the narrative description.

The primary objective of the narrative must be to convey to decision makers the extent and significance of implications so they can assign the weight to be given to them in the decision-making process.

3.4 Monetizing the Costs and Benefits

3.4.1 Valuation Matrix

In selecting infrastructure investments, municipal decision makers will be seeking to achieve the best use of their resources on behalf of the community they represent. The technical term often applied to this process is "maximizing the net benefit produced by the invested resources."[4] From the public perspective, this requires integration of the project outcomes on the community at large into a comprehensive range of costs and benefits. Capturing all these implications leads to sustainable solutions that protect the environment, society, and the economy in the long term. This means including both the market and non-market implications of the investment. The monetary and non-monetary valuation methods described below are required to estimate quantitative and qualitative values for the non-market environmental and socio-economic implications. Equally important is a means of communicating these values to decision makers.

4. This is also referred to as maximizing the benefits for a given level of cost, or minimizing the cost of achieving a given level of benefits. Whatever the term used, it refers to the objective of trying to achieve the most economically efficient use of resources.

Figure 3–2
Possible layers in a valuation matrix

To be successful, the methods also require stakeholder involvement in developing a set of quantitative and monetized indicators which reflect the identified costs and benefits implications of the project.

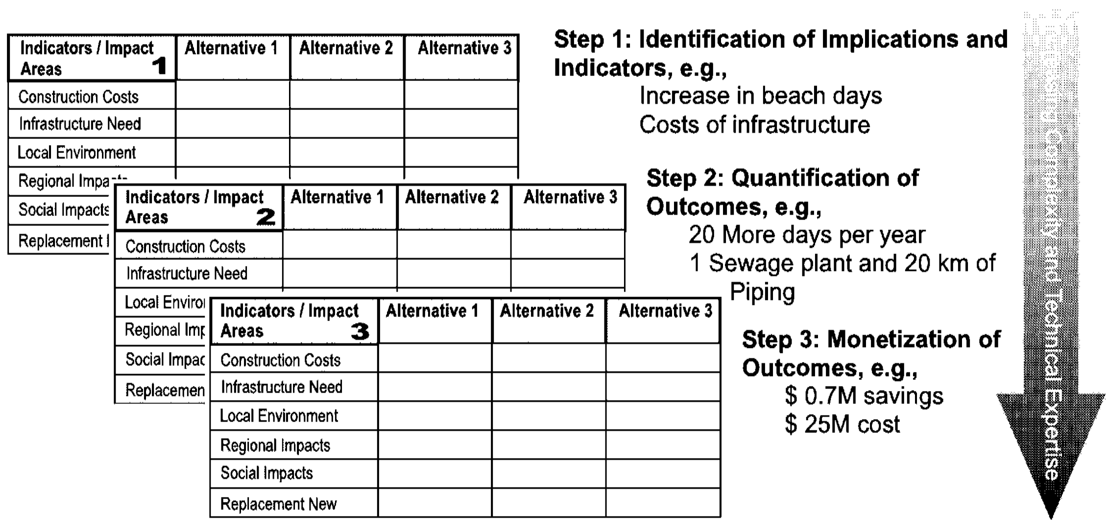
One way to organize and present valuations to decision makers is by using a valuation matrix. These matrices act as a communication link between the project analysis and decision makers, and also between the three main steps of evaluation.

The format of the valuation matrix provides a logical framework that can help structure the analytical steps in valuing environmental and other implications. The project alternatives are identified and placed in the top row of the matrix. Potential implications are determined, based on the nature of the project, the experience and judgment of municipal staff and other experts, and input from the public. These implications along with other factors, such as project cost, determine which indicators will be used as the decision criteria listed in the first column in the valuation matrix. Following this step, technical analyses are completed to evaluate each alternative with respect to each indicator. Results are summarized in the valuation matrix. When the matrix is completed, it gives qualitative, quantitative, and monetized measures of how each alternative performs with respect to each indicator. The advantage of the valuation matrix is that this information is provided for all the alternatives in one place, making comparisons much easier.

Figure 3–2 shows the steps in developing a valuation matrix where implications are first identified, then some are quantified, and a few monetized. The information relating to the identified implications are gathered and assembled in a way that is informative for decision makers in a qualitative sense. Increasing in complexity is the quantification of outcomes, which could include indicators such as changes in pollutant loading, improvements in ambient water quality, or improved recreational days. Finally, the quantified information is translated into monetary values which can be compared with, for example, standard engineering costs. Section 3.3 provides guidance on the technical task of valuing the outcomes.

The type of valuation matrix presented here is a simple example of how information can be presented on a consistent basis for decision-making purposes. All successful analysis and reporting approaches will point toward analyzing those implications that are deemed relevant to the municipality. To be successful, the methods also require stakeholder involvement in developing a set of quantitative and monetized indicators which reflect the identified costs and benefits implications of the project.

Figure 3–2: Possible layers in a valuation matrix



3.4.2 Valuation Methods

Two main approaches can be used to lead a community toward reaching a consensus on achieving municipal goals. These approaches can be viewed as two ends of a spectrum. One could be called the analytical information approach that fully implements a CBA. Under this approach, the emphasis is placed on identifying and valuing all the costs and benefit outcomes of a proposed infrastructure investment, and communicating this information to decision makers and stakeholders to foster rapid consensus around a preferred solution. The second approach emphasizes providing leadership as to the direction of municipal activities. It relies on effective communication by municipal leaders rather than the widespread dissemination of analytical information. Portraying them as opposite ends of a spectrum is a useful device to emphasize their differences. However, since the path to good decisions generally requires contributions from both approaches, in reality the two approaches are best used together.

This section outlines the technical aspects of valuation since it underlies successful execution of the CBA. Section 4 discusses the leadership approach and its role in formulating municipal policies to stimulate coordination and stewardship of community assets.

The purpose of valuation is to express or measure outcomes or changes associated with infrastructure investments in units that are comparable with the costs incurred by, and the value of the services (benefits) generated by, infrastructure. Since infrastructure costs are measured in monetary terms, this means valuing the outcomes in monetary terms as well. Once the impacts have been valued, they can be entered into a valuation matrix as discussed above.

There will be situations where there is no feasible method by which to reach a monetary value for all outcomes. This could be for technical reasons (an accepted method has not been developed yet); financial reasons (a method exists but it is too costly to apply relative to the small size of the project under consideration); and time (a method exists but it could not be applied within the time frame assigned for making a decision). In such cases, it will be necessary to deal with the environmental implications in question in qualitative (non-monetary) terms. Section 3.2 outlined some methods for treating project outcomes qualitatively. It is important to note that implications treated in qualitative terms will not be directly comparable with the monetized values in a valuation matrix. It will be the job of the decision makers to decide on the importance of the qualitative items and the weight they will be given in the decision-making process.

3.4.3 Monetary Values

Municipal infrastructure projects are usually developed to satisfy the perceived needs and wants of residents, or possibly future residents in the case of new housing, commercial, or industrial developments. The conventional practice has been to design infrastructure projects in response to the perceived needs and wants, estimate their cost in terms of labour, materials, and land required, and assess the costs relative to the estimated benefits or services provided, and the ability of the municipality to pay. The consistent theme of this guide has been to argue that the conventional practice needs to be extended to include the value of environmental and social implications attributable to infrastructure projects.

The consistent theme of this guide has been to argue that the conventional practice needs to be extended to include the value of environmental and social implications attributable to infrastructure projects.

Expressing those values in monetary terms frequently requires the application of specific valuation methods. Typically, the environmental goods and services that must be valued are supplied by non-market mechanisms. That is, they are provided free by nature or "free of charge" by government organizations, or for a nominal charge that doesn't reflect their actual value. The alternative would be private sector businesses charging a market price, although value can't be observed in cases when there are no substitutes, such as clean air or water. To deal with these types of situations, economists have devised a variety of ways to value non-market goods and services.

Table 3–4
Willingness to Pay Approaches

The choice of method to use will depend on a variety of factors, such as the particular type of environmental impact that needs to be valued, the data requirements of the method, the availability of data, and the cost and time required to acquire data if none are available.

The basic concept underlying economic value is willingness to pay (WTP). Market prices capture consumers' willingness to pay for goods and services provided through markets. The valuation tools described below are based on methodologies designed to estimate the monetary value of non-market goods and services, such as clean water, air, or park space, based on expressions of willingness to pay. Table 3–4 summarizes the approaches to willingness to pay valuation.

Table 3–4: Willingness to Pay Approaches

Approach	Example
Direct market transactions	Decreased fish populations due to polluted water. Valuation based on lost commercial fishing income.
Surrogate markets for services not directly consumed	Water-based recreation activities dependent on access to water and water quality. Valuation is based on measures of purchased goods and services required to participate in the activity and time spent travelling to the location of the activity.
Creation of artificial markets	Bird watching activities at a local lake are threatened by degraded water quality leading to a decline in bird populations. The value attached to water quality can be estimated using surveys to determine what individuals would be willing to pay to protect water quality.

Table 3–5 provides a brief description of six monetary valuation methods that could be used to estimate the value of outcomes to be incorporated into the decision-making process.[5] The methods discussed have been widely used, and there is an extensive literature detailing their strengths and weaknesses. As well, the large literature provides many examples to guide municipal valuation work. The choice of method to use will depend on a variety of factors, such as the particular type of environmental impact that needs to be valued, the data requirements of the method, the availability of data, and the cost and time required to acquire data if none are available.

5. For a more extensive and detailed analysis of these and other valuation methods, see Monitoring the Value of Natural Capital: Water, prepared for Environment Canada and Statistics Canada by Gardner Pinfold Consulting Economists Limited, September 2002.

Table 3–5: Valuation Methods (in alphabetical order)

Description	Observations	Application	References
Averting Behaviour/Defensive Expenditures			
The Willingness to Pay (WTP) to avoid or reduce the risk of an adverse environmental impact can be inferred from voluntary expenditures to prevent or offset the impact (e.g., purchases of water filters or bottled water to avoid illness caused by contaminated drinking water). This approach measures actual expenditure rather than maximum WTP.	Models actual expenditures, thus actual behaviour. However, it does not reflect what people would pay over and above market prices.	Health risks or other damages due to environmental contamination or other causes	http://www.arcbc.org/arcbcweb/pdf/vol2no2/sr_an%20overview_valuation_techniques.pdf
Benefits Transfer			
Environmental values estimated in one area are adopted and applied to another area in lieu of developing new estimates. For example, one form of benefits transfer involves the transfer of unit values, for instance the value per user day of recreation, from one area to another. It is imperative that the similarities and differences of the two areas are well understood so the values can be adjusted to account for local conditions.	Often recommended because it is inexpensive. Accuracy depends on the quality of the initial study and the ability to adjust the value to reflect local conditions, which may require rigorous analysis.	Potentially applicable to a wide range of values, such as recreation, ecosystem values, aesthetic amenities, environmental quality, utility services, assuming suitable base studies can be found.	http://www.epa.gov/unix0008/water/wastewater/cafohome/cafodownload/cafodocs/Benefits_Attach_B.pdf
Contingent Value			
Contingent value surveys are used to determine the value of unpriced environmental goods and services. Statements about value are elicited from survey respondents by asking questions that reveal their willingness to pay for the amenity. Both use and non-use values can be determined with this method.	Method is very flexible, but requires great care in designing survey questions, and there is considerable controversy over the accuracy of its value estimates.	Widely applicable to many situations, such as recreation activities, ecosystem values, aesthetic amenities, environmental quality, utility services.	http://www.ecosystemvaluation.org/contingent_valuation.htm
Hedonic Property Value Model			
The hedonic model infers the value of real estate amenities from real estate price differentials associated with those amenities. Regression analysis is used to determine how price varies in response to the amenities.	Preferred by some analysts, because it uses actual market data. Requires extensive data and analytical abilities.	Aesthetic amenities, environmental quality, utility services.	http://www.ecosystemvaluation.org/hedonic_pricing.htm
Restoration or Replacement Cost			
This technique entails calculating the cost to restore or replace environmental assets or facilities that provided amenity and that are damaged. It assumes that the actual loss of amenity is at least as large as the cost of restoration and that restoration will be undertaken. This method does not provide a direct measure of actual damages.	It is often easier to measure the cost of producing the benefits than the benefits themselves. However, the amenities studied may be only a fraction of actual benefits so there is danger of under-estimating the true values.	Damage to property causing loss of amenity (e.g., flooding, loss of habitat).	http://www.ecosystemvaluation.org/cost_avoided.htm
Travel Cost			
The travel cost method is used primarily to value recreational facilities. Travel cost is the cost incurred to visit the facility. The value of the facility or of its attributes is inferred from the cost incurred to visit the facility. For instance, people may be willing to travel further (i.e., incur greater cost) to get to a beach with better water quality. The increase in travel cost implicitly measures the value assigned to the superior water quality.	Advantages are that the method is based on actual behaviour. However, the method does not reflect the value non-users may hold, and there are issues regarding the comparability of value estimates with market price values.	Recreation activities.	http://www.ecosystemvaluation.org/travel_costs.htm

This guide suggests three main techniques for reporting information to decision makers: the valuation matrix that summarizes all the monetized values, the narrative description that assesses all the qualitative implications and, if used, the benefit-cost analysis report.

3.4.4 Integrating Valuations into Decision Making

The monetary values estimated for the range of outcomes for a proposed infrastructure investment can be inserted into the valuation matrix. This provides a relatively complete information package for decision makers. The narrative description assessing qualitative implications completes the information package. Finally, the CBA would identify all the infrastructure costs and benefits from the infrastructure services, and environmental and social implications that have been measured in monetary terms to a formal systematic analysis.[6] Of course, not all the implications can be understood, and special challenges arise in the case of cumulative impacts or future climate changes. Thus, a precautionary approach can be adopted. That is, in the case of uncertain but potentially significant outcomes, a qualitative description can be used to provide guidance in decision making about uncertain outcomes.

For the benefit–cost analysis, it is necessary to specify a time frame for the analysis (e.g., 5, 10, 20 years). The time frame should be long enough to capture all the relevant costs and benefits attributable to an infrastructure project. This is especially true for analyses that consider the environment, since many of the benefits of, for example, improved water or air quality, are often not captured in the short term, when most of the construction and maintenance costs occur. Since costs and benefits are being measured over some period into the future, it is necessary to use discounted cash flow analysis. The choice of discount rate can be an issue. See Appendix A for more detail.

3.5 Reporting and Matrix Tools

This guide suggests three main techniques for reporting information to decision makers: the valuation matrix that summarizes all the monetized values, the narrative description that assesses all the qualitative implications and, if used, the benefit-cost analysis report. The valuation matrix suggested is a reporting tool for presenting the cost and monetary impact values succinctly. However, it should be remembered the information contained in tables of numbers is not readily apparent to many people. The same caution is likely to apply to the benefit–cost analysis, since such reports tend to be dense with data and analysis. Even the narrative, depending on its length and the implications and issues that it covers, may be a test of the reader's tenacity.

Hence, it is strongly suggested that a fourth reporting approach be used in the form of a graphics (e.g., PowerPoint) electronic slide presentation[7] that summarizes the main findings of all the analysis in about 10 to 12 slides that can be printed and made available electronically via an e-mail attachment or on a Web site, as could any of the other three documents. The documents distributed to stakeholders beyond the decision makers are, of course, a matter of municipal policy.

Reporting can also provide opportunities to include the results from public and stakeholder participation. The implications in the valuation matrix can be ranked according to what priorities are identified. It is also possible to weight certain categories (like safety or the environment) by using an explicit point system to indicate the implications of the highest relevance.

6. The following three references provide detailed information on benefit–cost analysis. The first reference provides an overview discussion of the methodology and the experience of its application. The next two references are to technical guides for the application of benefit-cost analysis produced by Transport Canada and the Treasury Board of Canada, respectively.
   http://www.federalreserve.gov/boarddocs/speeches/2002/200210163/default.htm
   http://www.tc.gc.ca/finance/BCA/en/TOC_e.htm
   http://www.tbs-sct.gc.ca/fin/sigs/Revolving_Funds/bcag/BCA2_E.asp
7. PowerPoint is used as an example since many people are familiar with it. Any presentation package could be used.

4. Implementation

Decision making in a municipality affects the projects and plans that shape the quality of life of its citizens. Expanding the decision-making perspective to include full consideration of the environmental, social, and economic outcomes of decisions requires assigning value to those implications. Monetary values should be estimated for outcomes using appropriate methods whenever possible, and qualitative assessment should be applied to any other implications for which monetary values cannot be developed. In this way, all the outcomes of a proposed infrastructure investment are analyzed and can be integrated into the decision-making process.

Where valuation methods and qualitative assessments are not currently used, guidelines and a policy framework are needed to assure that they are used. Changing what is involved in decision making is a challenging process. There have been two major factors identified to effect changes in municipal decision making: natural resource depletion and leadership (NRTEE, p. 9). As valuation methods translate the importance of environmental and socio-economic resources, leadership is responsible for affecting policies and projects accordingly.

Linking environmental and social stewardship and the use of valuation methods can be facilitated through the introduction of new policies and municipal goals. Table 4–1 summarizes some of the tools available to leaders to strengthen municipal decision making.

To integrate environmental and social stewardship, and consideration of environmental implications into municipal decision making requires acceptance by both the decision makers and municipal staff. Table 4–2 presents four methods to encourage staff to adopt CBA and valuation practices.

4. Implementation

Table 4–1
Integration Tools for Environmental and Sustainable Development at the Municipal Level

Linking environmental and social stewardship and the use of valuation methods can be facilitated through the introduction of new policies and municipal goals.

Table 4–1: Integration Tools for Environmental and Sustainable Development at the Municipal Level

- **Clear policies:** enable goals to be visualized, directions set, and progress gauged.
- **State-of-the-environment reporting:** track trends and ensure timely identification of issues.
- **Environmental committee:** reviews municipal actions and issues from an environmental perspective.
- **Citizens' environmental advisory council:** draws on the knowledge and expertise of citizens and assists in ongoing communication with constituencies.
- **Environmental code of practice:** needs to be in place for municipal bodies.
- **Performance appraisals:** monitor staff and departmental adherence to codes of practice, and encourage initiative.
- **Inter-municipal coordinating bodies:** share experience and clout, capital, annual operation and maintenance policies, legislative constraints, etc.

Table 4–2
Employee Adoption

Table 4–2: Employee Adoption

Adopt decision tools in conjunction with ***training programs***	Provide the necessary resources (importance of the environment and improved data systems) to be applied.
Keep the process ***flexible***	Build on the capabilities of staff. Be cautious not to overburden employees.
Showcase analyses	Use awards programs and other incentives to promote adoption.
Introduce in ***priority areas***	Allocate funds and focus efforts (e.g., transportation, energy use, economic development and education and awareness).

5. Evaluation

The rate at which municipalities will adopt CBA and valuation into their decision-making processes will vary. Some may have already started the process; others will adopt a more measured approach consistent with their available resources. They may also be interested in observing feedback on the experience of the early adopters. This makes it imperative that an evaluation process is designed and implemented to report on the implementation experience of municipalities that have set about integrating CBA and valuation into their decision-making process.

It is evident that CBA processes will vary considerably and will need to be customized for each municipality. The evaluation mechanism should collect feedback from both decision makers and municipal officials to determine whether useful information was collected, whether use of the valuation matrix expanded throughout municipal departments and consultant proposals, and the resource cost to the municipality of implementing the integrated process. It will also be important for the evaluation to report on what worked well, what didn't work and the major barriers that had to be overcome. Sharing this evaluation information with other municipalities through the Federation of Canadian Municipalities and national industry/ professional associations will be an important step in spreading the successful implementation of environmental valuation throughout Canada in pursuit of the goals of sustainable infrastructure and maintaining and improving environmental, economic, and social outcomes.

It will also be important for the evaluation to report on what worked well, what didn't work and the major barriers that had to be overcome.

Appendix A

CBA Framework Overview

In this appendix, we outline the key CBA framework assumptions necessary to estimate the net benefit of the infrastructure investments. These are common components of the CBA framework that must be addressed at the start of each CBA, and decisions made on how the components will be treated within the CBA framework.

Efficiency, Distribution, and Equity

The analysis must distinguish between *efficiency* benefits and costs, and those of a *distribution* or *equity* nature. *Efficiency* benefits and costs refer to a benefit/cost that occurs with an option but not without it. So, in the case of the infrastructure investments, municipal citizens would get some service or value that would not be available without the investment. *Distributional* or *equity* issues concern who enjoys the benefits and who bears the costs of investments.

It should be a priority to distinguish between efficiency and distributional benefits and costs since the benefits of an option may accrue to one group while the costs are borne by a different group. So, it is important to note that measurement of efficiency benefits/costs in a conventional CBA frequently ignores distribution considerations and only looks at the aggregate benefits and aggregate costs. For the CBA of infrastructure investments, it would be appropriate to measure the efficiency benefits and costs in the first instance, and also to identify the incidence of the benefits and costs so the equity or distributional impact of the investment can be understood.

Time Frame

The CBA assumes a life-cycle perspective, meaning costs and benefits will be identified and accounted for in the long term. For example, a 20-year period is a common time frame selected for CBA analysis and can be related to the productive life of the investment.

Accounting Stance

The accounting stance of a CBA used can vary, and should be based on project outcomes that affect either directly or indirectly municipal citizens. The analysis therefore assumes a local perspective for identifying the benefits and costs that accrue to municipalities as a result of the investment.

Baseline

Within the CBA framework, the costs and benefits must be identified and monetized on an incremental basis relative to an established baseline. The approach is to assume a "with and without" basis, where the benefits with the proposed investment are compared to a baseline without the investment. Clearly delineating the baseline so an incremental analysis of the costs and benefits can be conducted is absolutely critical to a sound analysis of the benefits within the CBA framework.

The baseline will be the stream of benefits and costs that will prevail if the status quo (i.e., without the proposed designation) is maintained in the future. The baseline benefit and cost values (net benefit) are then compared to the investment scenario, and the difference is the net benefit (or cost) of the proposed investment.

Clearly delineating the baseline so an incremental analysis of the costs and benefits can be conducted is absolutely critical to a sound analysis of the benefits within the CBA framework.

Discount Rate

A discount rate must be specified for the analysis to bring future dollars into a current base year. Usually this rate is given in real terms, that is, net of any inflation. The Treasury Board Secretariat of the Government of Canada recommends a real discount rate of 10 percent.[8] However, in projects with environmental outcomes and long-term benefits, a much lower rate is usually used (say five percent). It is good practice to conduct a discount rate sensitivity analysis using a range of plus/minus possibilities. This will be particularly important if the net benefits for the base discount rate are close to zero. In any case, it would be wise to know if the analysis results are sensitive to changes in the discount rate. If they are sensitive, then the results are less certain and there is a greater chance that the regulatory measure will not produce a socially beneficial (efficient) outcome.

The analysis must also specify a base year for the estimation of benefits and costs. All benefits and costs should be expressed in terms of base year prices before discounting, that is constant dollar values to be consistent with the real discount rate. Benefits and costs should be reported in present value terms (discounted at the specified discount rate) and expressed as the net present value of benefits less costs, often referred to as the NPV.

We now move on to discuss the methods used to develop the CBA.

CBA Methodology

A number of steps are followed to estimate the costs and benefits of the investments. These steps include the following.

Step 1: Identification of Infrastructure Investment Options – The first step is to identify the options that will be implemented under the investment. To define and value benefits and costs, a fully defined set of viable options associated with the investment must be specified. Benefits and costs cannot be properly defined in the abstract. They only have validity in respect to a specific set of assumptions regarding the proposed options. For this reason, the analysis should investigate options that may include different sets of options and different methods for implementing them.

Step 2: Identify, Quantify, and Value Costs and Benefits – Estimate the costs and benefits for the options under consideration. Specific types of costs and benefits anticipated to flow from the proposed regulations include:

Costs for the investments, which are expenditures (capital and operating/ maintenance) associated with constructing and operating the infrastructure. The sum of the individual costs to businesses and individuals who are also impacted by the infrastructure, net of taxes, is also required.

Costs to government may include linked activates to the infrastructure that are not reflected in the capital and operation costs. For example, an education program may be implemented in conjunction with the capital spending for the project. The estimated government outlays are a measure of the government costs of the proposed investment.

Benefits of the proposed investment are really avoided or reduced costs, due to a reduction in the release into the environment of pollutants or avoided damages to ecosystem functions and services. These benefits can then be traced to human uses and changes in value.

8. Treasury Board Secretariat, Benefit-Cost Analysis Guide, March 1998, p. 48

The **net benefit analysis** attempts to monetize the identified costs and benefits to estimate the monetized value of the net benefit of the proposed designations.

Step 3: Estimate of Net Benefit – The CBA should report the findings in terms of net benefit (discounted benefits minus discounted costs) and uncertainty. Estimates of the costs and benefits as well as the distributional implications should be given to decision makers.

Step 4: Risk and Uncertainty Testing – Ranges of uncertainty around key input variables should be identified to bound the uncertainty in the estimates of net present value (net benefit defined as benefits minus costs). Ranges of discount rates should also be tested to identify the sensitivity of the net benefit estimate to changes in the discount rate. The risk and uncertainty testing is aimed at identifying the confidence in the estimate of net benefit and if the proposed investment has inherent risks that may significantly impact the value of the net benefit estimate. This risk and uncertainty should be conveyed to decision makers.

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Notes