National Round Table on Sustainable Infrastructure

AN Innovative Approach TO Sustainable Infrastructure IN Canada

NRTSI

January 2007

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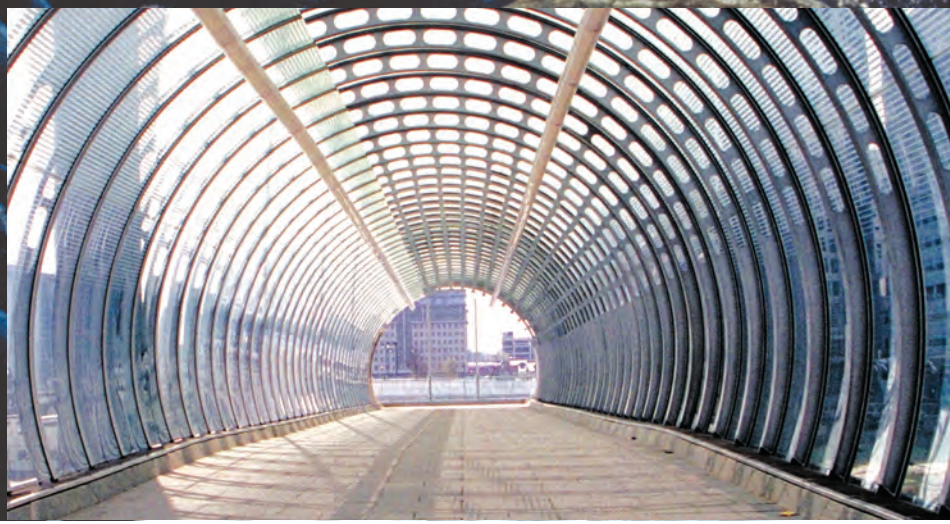
National Round Table on Sustainable Infrastructure



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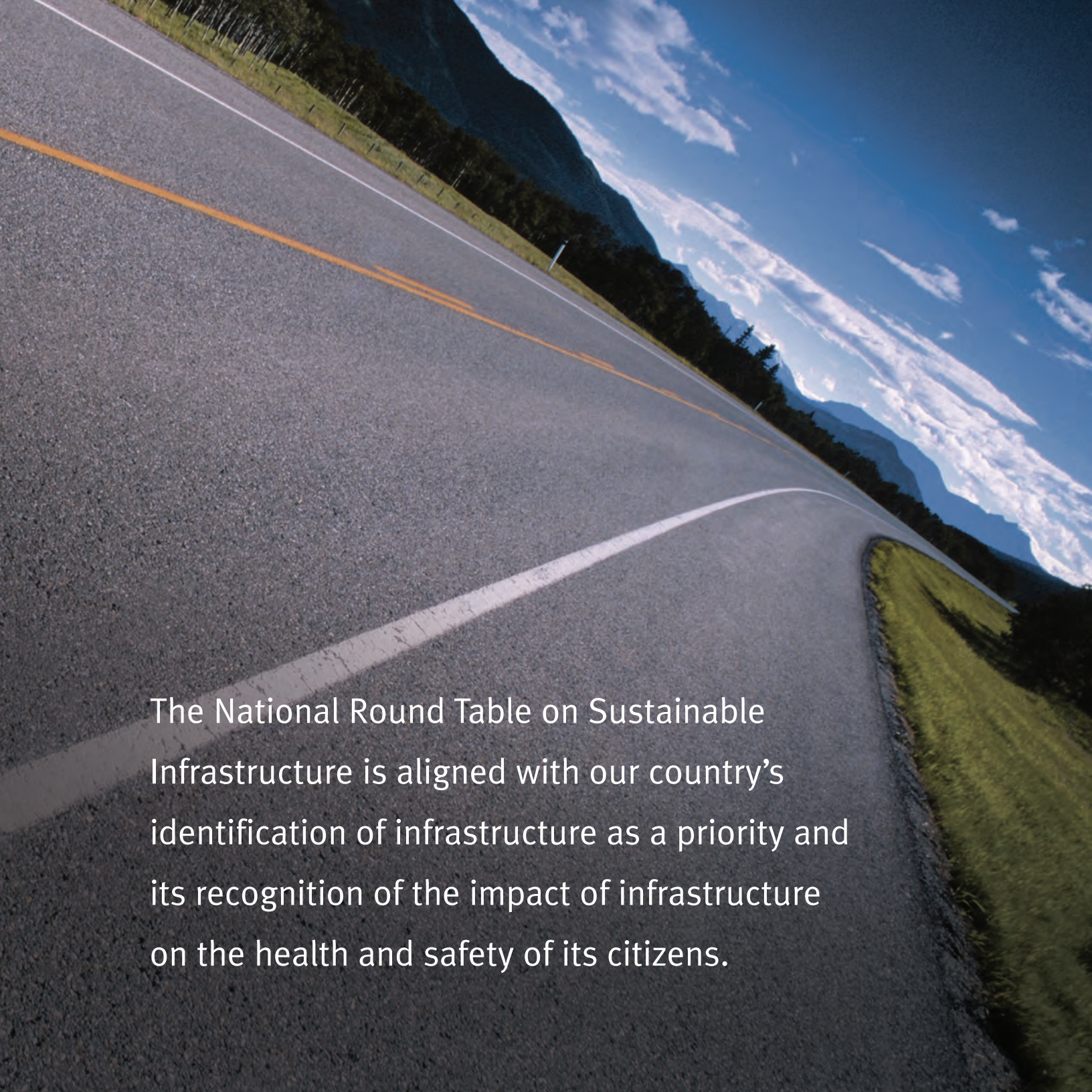

The National Round Table on Sustainable Infrastructure is aligned with our country's identification of infrastructure as a priority and its recognition of the impact of infrastructure on the health and safety of its citizens.

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Message from the Chair of the Transition Team of the National Round Table on Sustainable Infrastructure

In 2002, leaders and experts of Canada's infrastructure community pooled their resources to create the Technology Road Map (TRM). The TRM represented a national consensus on the current state of infrastructure systems; a vision for the industry and a strategy for meeting the long-term needs of Canada's civil infrastructure systems (CIS) through technology innovation. The initiative was led by four national bodies: the *Canadian Society for Civil Engineering*, the *Canadian Council of Professional Engineers*, the *Canadian Public Works Association* and the *National Research Council of Canada*.

In December 2005, these associations, in collaboration with close to 40 organizations from *all* parts of Canada, representing *all* orders of government, First Nations, non-governmental organizations and academia met to begin work on the creation of the *National Round Table on Sustainable Infrastructure* (NRTSI), the first recommendation of the TRM.

In November 2006, participants from close to 50 groups met in Toronto for a third meeting to share the results of one-year's work and to unanimously renew the call for the creation of the NRTSI.

The working group reports presented at the meeting demonstrate the potential value that a well-funded and supported round table can bring to infrastructure stakeholders.

The NRTSI is unique because:

- It is an initiative of the infrastructure community, one of a kind in North America.
- It brings to the table provincial, federal and municipal governments, non-governmental organizations, private sector, industry associations, industry, academia and First Nations experts from all regions of Canada.
- Stakeholders have committed time and resources, both human and financial, to continue to build the NRTSI.
- It is committed to a shared funding formula as outlined in the request for funding to the federal government.
- The initiative adds value to the infrastructure debate; optimizing interventions, and maximizing investments.

The National Round Table on Sustainable Infrastructure *does not aim* to be an advocacy body, duplicate government initiatives or functions of other organizations. It *does not lay claim* to be a decision-making or policy-making body.

The National Round Table on Sustainable Infrastructure DOES AIM TO:

- Be a "go to" resource on infrastructure.
- Become an important advisor to stakeholders to enable decision-makers to optimize their investment strategies.
- Be a catalyst for new innovative technologies and management tools.
- Advance capacity building within the sector and make greater use of new technologies and management practices.
- Help raise awareness and understanding of infrastructure issues among its stakeholders.
- Contribute to changing the "infrastructure culture" in Canada: fostering a long-term and holistic approach.
- Reduce duplication of efforts.
- Fill the information gap and help decision-makers make good, sound decisions about infrastructure.
- Provide advice to our stakeholders involved with the education system to assist with improving training related to infrastructure.
- Cluster small community issues and create a forum on small community needs.
- Work towards national standards in asset management.
- Building a united, forward looking industry.

For the NRTSI to succeed, it will require resources and investment from all participants.

NRTSI participants have identified and agreed upon the following deliverables:

- The creation of a forum to exchange views amongst infrastructure experts.
- A dynamic, on-line infrastructure information system.
- A suite of tools and guidelines addressing issues such as small versus large communities, life-cycle costing, and return-on-investment calculations.
  - Provide guidance on the appropriate use of the tool box; aligning tools to application.
- A clearinghouse of infrastructure case studies and issues that could be categorized, evaluated and searchable.
  - Case studies from Canada and abroad that would address innovation in and financing of infrastructure, as well as best practices.
  - Elaboration on the benefit for each case study.
- Portals and websites with regular updates.
- Municipal infrastructure investment planning products that meet the basic standards outlined in the National Asset Management framework.
- Metrics that measure the environmental effects of infrastructure.
- A framework to assess the cost-benefit of infrastructure.
- Assistance to infrastructure professionals.
- Play an educational support role and provide enlightenment and objectivity.

The National Round Table on Sustainable Infrastructure is aligned with our country's identification of infrastructure as a priority and its recognition of the impact of infrastructure on the health and safety of its citizens.

For the NRTSI to succeed, it will require resources and investment from all participants. Initial support from the federal government is crucial to get it launched. Let's seize the opportunity to harness the knowledge available and build on the commitment of the many experts that believe in the added value of the NRSTI. It will yield a great return on investment!

Marie Lemay, P.Eng., ing.

Let's seize the opportunity to harness the knowledge available and build on the commitment of the many experts that believe in the added value of the NRSTI.

The National Round Table on Sustainable Infrastructure—An Innovative Approach to Sustainable Infrastructure in Canada

Canada's prosperity has always been dependent upon innovative solutions to infrastructure needs. In fact, Confederation was based on the promise of providing a continuous means of communication between Prince Edward Island and the mainland. Canada's expansion to the West and to the North is the result of the work and foresight of national leaders who strived for a strong nation.

Much of Canada's infrastructure, which dates back to the post-war economic boom of the 1950s and 1960s, now requires special attention for renewal, dealing with the demands of urban expansion and the specific needs of small communities.

The opportunity exists to provide Canadian decision-makers and investors with the ability to examine, discuss and shape the infrastructure that Canadians need to deal with the multiple challenges of a highly competitive global economy that will characterize the 21st Century. The *National Round Table on Sustainable Infrastructure* is a unique initiative of the infrastructure community led by the Canadian Council of Professional Engineers (CCPE) with the active involvement of other stakeholders in the public and private sectors that aims to coalesce all orders of government together with the infrastructure community.

The National Round Table on Sustainable Infrastructure

As Infrastructure Canada was being created in 2002, infrastructure community leaders and experts pooled their resources to create the Technology Road Map (TRM). The TRM represented a national consensus on the current state of infrastructure systems; a vision for the industry and a strategy for meeting the long-term needs of Canada's civil infrastructure systems (CIS) through technology innovation. The initiative was led by four national bodies: the Canadian Society for Civil Engineering, the Canadian Council of Professional Engineers, the Canadian Public Works Association and the National Research Council of Canada.

In December 2005, these associations, in collaboration with close to 40 organizations, built on one of the ten TRM recommendations and met to discuss the creation of the *National Round Table on Sustainable Infrastructure* (NRTSI).

The NRTSI proposes to become an expert resource on infrastructure; a non-partisan body that facilitates the understanding of infrastructure needs and helps to define issues of national priority as well as identify and/or develop and disseminate tools to address these issues. It does this through deliberations and communications with expert decision-makers in all relevant sectors. The impact of the NRTSI is expected to be far reaching and cross beyond jurisdictional boundaries as it will provide opportunities to access and share information on issues such as innovation in technology, best practices and asset management.

The NRTSI will contribute to the decision-making process as communities grow by developing appropriate tools as well as helping educate the public. While research will be an important component of the NRTSI, the research initiated by the NRTSI will not duplicate research already undertaken or proposed, but rather will aim to fill the gaps in research and will be in support of the work of the NRTSI.

Much of Canada's infrastructure, which dates back to the post-war economic boom of the 1950s and 1960s, now requires special attention for renewal.

At this initial stage, five working groups have spearheaded activities to develop the template of what will become the NRTSI:

- **Infrastructure financing** to highlight findings on financing infrastructure with examples of best practices, list of practitioners and reference links.

- **Innovation as a solution** with one of the objectives to develop a web-based message forum to discuss innovative practices.
- **Smaller community infrastructure** to examine ways for smaller communities to develop their capacity for self-reliance and to develop a round table focused on issues that impact small communities.
- **National asset management** to provide a consistent structure and approach for use by the various professions and jurisdictions that are responsible for aspects of asset management directly or indirectly including planners, governments, accountants, auditors, engineers, etc.

In addition, the **Governance and Finance Working Group** was assigned the task of developing governance and financing models for the NRTSI that would garner support from the diverse group of stakeholders.

In May 2006, a communications framework was established to facilitate the sharing of information between meeting participants, but also with other organizations. In the past few months, NRTSI representatives have been asked to make presentations to several groups including the Government Finance Officers Association, the *Association des ingénieurs municipaux du Québec* (AIMQ), the Third Annual Future of Canada's Infrastructure Summit and to the Council of Ministers of Local Government Meeting. During this summer's federal consultations on infrastructure, organizers drew upon the knowledge of non-governmental members of the NRTSI.

Following two successful national meetings in Calgary (December 2005) and Montréal (May 2006), participants met in Toronto on November 28 to:

- Share accomplishments and lessons learned amongst leaders across Canada.

- Officially receive the working groups reports and provide feedback.
- Discuss the overall status and future of the NRTSI.
- Identify priority concerns.

The NRTSI is aligned with the Federal government's "long-term plan designed to make Canada a true world economic leader", as well as the provincial and territorial governments' quest, together with local and federal governments, to renew and strengthen our country's infrastructure, which is critical to our national economy and well-being.

The NRTSI is a natural complement to the efforts of all levels of government in investing for sustainable growth as they continue to invest in infrastructure and seek partnerships among themselves and the private sector in strategic areas that contribute to strong economies, including primary scientific research, a clean environment and modern infrastructure. It also provides the tools to reduce duplication.

Conclusion

A year ago, 39 groups joined resources to address national concerns on infrastructure. A year later, close to 50 groups, including all orders of government, First Nations, industry and academia, continue efforts towards creating the NRTSI and facilitating the development of sustainable infrastructure across the country.

Meeting participants agreed that the governance model would consist of an independent non-partisan body providing advice to stakeholders comprised of an advisory group of 31 members including from government 13 provincial and territorial representatives, one federal, six municipal and one First Nations, as well as 10 non-governmental organizations' representatives.

With the vast amount of work completed in such a short time-frame and little human and financial resources, the NRTSI stakeholders agree that their work over the past year has allowed them to get a glimpse of the great value a well resourced round table would bring.

The NRTSI will bring us closer to sustainable infrastructure by enabling decision-makers to optimize their investment strategies and maximize returns on our investments.

Our working groups' research has found that communities, large and small, would benefit from the work of the NRTSI as it would be a continuous source of information on infrastructure. Participants see value in the NRTSI and want to continue contributing both financial and human resources as they have been by supporting their representatives to contribute to the work of the NRTSI. Initial support from the federal government is crucial to get the NRTSI launched. For it to continue in the longer term (after the first five years), continued contributions from the private and public sector will be required.

Let's build on the tremendous infrastructure expertise the NRTSI brings together!

Future Directions

This chapter outlines future directions and deliverables and reinforces the NRTSI's value proposition, once it is launched, to demonstrate the impact that it can have for funding partners and stakeholders across Canada.

This chapter suggests various plans, activities and outputs in six broad areas: information and outreach, education and skills, national asset management, small communities, sustainable development and an institutional structure. It attests to both the engagement and considered thought that has gone into the initiative to date and articulates deliverables or "value propositions" in each case.

Purpose and Scope

Following is an initial statement of purpose and scope suggested for the NRTSI:

National Round Table on Sustainable Infrastructure Mandate:

"The NRTSI is a non-partisan multi-stakeholder body that facilitates the understanding of sustainable infrastructure capacities and needs, and helps to define issues of national priority. It does this through deliberations and communications with leaders in all relevant sectors."

Overall Value Proposition

The NRTSI will be successful if:

- It becomes ***accepted*** in its role and mandate, and becomes a true forum for sustainable infrastructure issues
- It becomes independent politically, socially and economically
- Canada becomes a ***world leader*** in dealing with sustainable infrastructure issues

Key Issues and Priorities

Participants have identified several priority issues for the NRTSI. The higher-priority issues are grouped in six areas:

A. Information, outreach and knowledge management—particularly around the issues of innovation and financing;

B. Education and skills;

C. National asset management;

D. Small communities;

E. Sustainable development opportunities;

F. NRTSI institutional structure.

Specific plans around each of these six areas are summarized below:

A. Information, Outreach and Knowledge Management

Activities and Outputs:

This initiative is intended to define stakeholder information needs, utilizing the breadth of current information to create a comprehensive ***information system***, and actively fill information gaps. The information would be communicated through various types of media (printed publications, CDs, portals, websites). Websites would be "live" and continuously refreshed.

The NRTSI would expand on the current roster of ***case studies***[1], tool kits and "how to" guidelines, and providing access to them online (through websites). Case studies specifically addressing innovation and financing would be included as well as international and domestic examples.

[1] The cases would cover a breadth of economic, environmental and social applications. A template could be developed for the cases that would address specific measures and the breadth of applications, and available in a searchable database.

Value Proposition for Information, Outreach and Knowledge Management:

The **information system**, as proposed, would help to maximize awareness of infrastructure issues and options amongst the target audience. The NRTSI would validate and maintain the objectivity of the information supplied to safeguard the integrity of information provided by experts and stakeholders. The information system would also reduce duplication of efforts in the documentation of infrastructure cases and guidelines. It would facilitate a greater distribution of innovative ideas and financing approaches in infrastructure projects.

A suite of ***tool kits*** and ***guidelines*** would address such issues as innovation, financing of infrastructure, life-cycle costing, and return-on-investment calculations.

While research will be an important component of the NRTSI, it will not duplicate that which is already undertaken or proposed, but rather will aim to fill the gaps in research and support the work of the NRTSI.

With regard to infrastructure ***financing*** specifically – the information system would provide tools and a user's guide to align tools with applications. It would provide case-study examples of various financing approaches including the use of alternative financing vehicles. The system would assist funding partners and stakeholders in defining appropriate levels of controls and financing and educating the public.

Innovation can play a significant role in improving our approach to infrastructure projects. The information system would provide both cases and tools to be more innovative. It would offer guidance on such issues as benefits, life-cycle costing (LCC), risk assessment and risk management. The system could also address ***where*** innovation takes place: in boardrooms, municipalities, and research and development institutions. Explicit recognition for innovators would help to showcase.

An "***information clearinghouse***" would comprise an inventory of infrastructure cases, tools, guidelines and issues that could be categorized, evaluated and be searchable. The proposed information system would not only disseminate information but also "report in", allowing for the submission of new cases and examples.

Audiences for the information system would include funding partners and stakeholders, specifically targeting decision-makers, owners, technical experts and practitioners. It would recognize, and in some cases differentiate between, various audiences in the relevant activities and outputs.

The support of associations and NRTSI members would be critical to the success of the information system.

B. Education and Skills Development

Needs and Challenges:

There are two general needs with respect to the education and training of practitioners in infrastructure development and delivery:

1. Proactively influencing the mainstream education system, and
2. Assisting existing professionals through life-long learning, continuous improvement and training opportunities.

The lack of skilled people in the infrastructure sector across Canada represents a major liability. This is a skill gap that needs to be addressed—to find more skilled people, as well as to better use existing resources. This acutely affects small municipalities as they often lack practitioners educated in the infrastructure field.

Value Proposition Education and Skills Development:

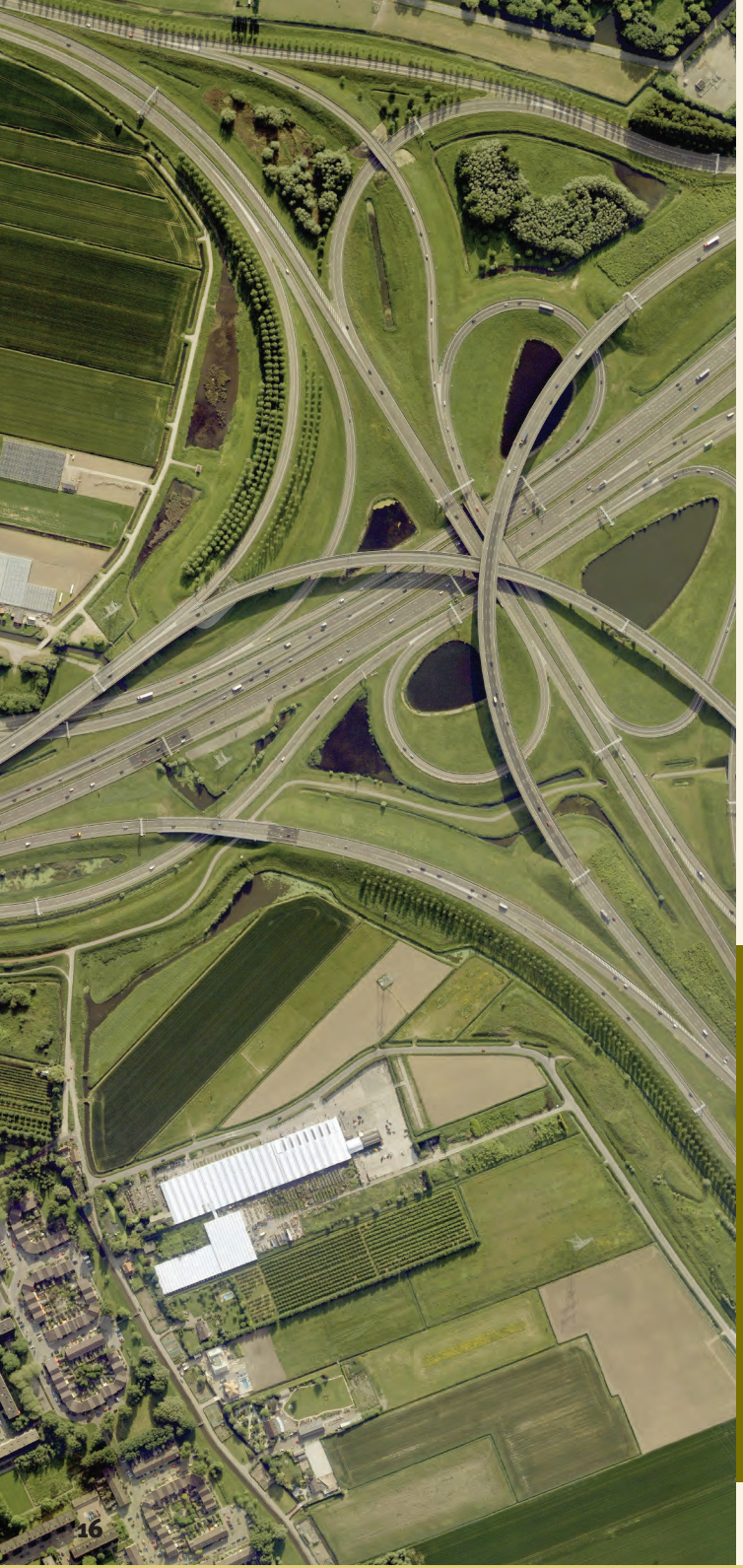
The NRTSI would develop an "infrastructure education road map", from university to continuing professional development.

A working group would be established to engage with funding partners and stakeholders to identify and assess gaps in infrastructure knowledge and to how best disseminate the information.

Furthermore, the education system must shift from a ***build*** to a ***build and maintain*** focus. Educational curricula should balance the issues of building ***new*** infrastructure, versus operating, maintaining and optimizing ***existing*** infrastructure.

Activities and Outputs:

The NRTSI would provide educational institutions and other training forums with information to assist them in expanding on continuing professional development curricula, allowing professionals to keep up to date with new technology and best practices.



C. National Asset Management

Activities and Outputs:

The National Asset Management Group is currently finishing the development of a common ***framework***. The draft framework will be issued for comment early in 2007, with the objective of completing it by March 2007. The contents include:

- Overall objectives, including sustainable development (SD);
- Definition of accountability;
- Baseline strategy;
- Characterization of activities re: scope and scale (national ‡ local);
- Discussions of vertical integration (i.e. linkages).

In addition, the National Asset Management Group plans to build an interactive ***inventory of assets***. It also plans to develop ***guidelines re: asset valuation***.

Value Proposition National Asset Management:

In the future, the framework could assist in identifying funds for infrastructure projects. The group has been in discussion with the Canadian Institute of Chartered Accountants (CICA) to have infrastructure identified as an asset in municipal budgets.

The NRTSI would deliver on the following three new initiatives:

- A clearinghouse of software & tools;
- The integration of asset management stakeholders; and
- The development of appropriate asset valuation and risk assessment tools.

Clearinghouse of software and tools: The group will develop an inventory of appropriate software tools, and expert systems that meet the basic standards outlined in the National Asset Management (NAM) framework.

Integration of Asset Management Stakeholders: The group will establish a permanent body to ensure engineers, finance professionals, planners, and policy makers work together within the NRTSI.

Asset Valuation and Risk Assessment: The group will develop different approaches for various assets. More convergence will be attained (through the stakeholder integration activity above)—by establishing appropriate valuation tools for each type of asset. We will work towards national standards.

D. Small Communities

Needs and Challenges

Small communities compete with big cities for money and attention. The ***cost per capita*** for community infrastructure is higher. Small communities have scale problems. They have a limited capacity to absorb information as they also suffer from strained resources and a limited number of suppliers who are willing to work with them.

Small communities in Canada require substantial support to be viable and attract private investments. This support includes both technical and financial aspects. Capacity building will be necessary, with skilled practitioners, predictable committed funding arrangements and revenue generating opportunities. There is little opportunity for full cost recovery, most notably for remote First Nations.

Value Proposition Small Communities:

Funding partners and stakeholders and end-users would find these resources valuable in planning communal projects and in determining appropriate levels of service. Better decisions would be made, based on the quality of data and sharing services with neighbouring municipalities or Tribal Councils—forming "Hub" models designed to optimize economies of scale. Accountability and transparency would be facilitated.

A better understanding of the capacity issues is required: How broad are the infrastructure needs and who can help? More information on populations and getting more information out to the appropriate people is needed. The viability of small communities depends on capacity, population base, the condition and nature of existing infrastructure, geographical location, budgets, level of services, etc. A "***one size solution***" will ***not*** do. Solutions must be locally-driven and built.

Activities and Deliverables:

The NRTSI would create a forum or working group dedicated to small community needs. It would develop specialized templates for inventory tools to gather data such as: population, capacity, condition and nature of existing infrastructure, model practices, budgets, etc. These tools would be site-specific and community-based in order to get buy-in from communities. The NRTSI would encourage organizations and communities to describe on their websites local projects that are currently up-and-running (e.g. projects in British Columbia and the InfraGuide).

E. Sustainable Development Opportunities

Needs and Challenges:

Sustainable development (SD) is a "horizontal" issue. It includes the consideration of economic, environmental and social opportunities in all other infrastructure issues and considerations.

A key issue is the lack of Canadians' awareness of consumption patterns and the meaning of sustainable development.

Activities and Deliverables:

This initiative would work within the variety of activities that have been cited elsewhere, but contribute through the cross-cutting "lens" of SD. Activities would include:

- Performing background research, including studies of sustainable capital assets and sustainable buildings;
- Building a file of best-practice case studies;

- Accounting for full and true costs of infrastructure and developing a framework for assessing the long term cost-benefits of infrastructure;
- Identifying metrics that measure the environmental effects of infrastructure (positive and negative); preparing a "template"; researching elements of a sustainability audit;
- Engaging SD experts; building an SD infrastructure network;
- Linking to other domestic and international outreach activities (e.g., the *National Round Table on the Economy and the Environment*; the *Integrated Sustainable Community Planning* initiative).

Value Proposition Sustainable Development Opportunities:

This initiative would become an integral part of decision-making in all infrastructure investments. In particular, the NRTSI would:

- Raise awareness of the consumption implications of infrastructure.
- Reinforce the role of infrastructure in achieving a sustainable Canada.

F. NRTSI Institutional Structure

Actions and Deliverables:

If the NRTSI is in a go-forward position, the following are the proposed action steps towards an effective institutional structure:

1. Formalize agreements with Infrastructure Canada and provincial/territorial stakeholders.
2. Maintain liaison with currently-engaged stakeholders.
3. Select Advisory Council representatives, including non-governmental organization representatives and municipal representatives.
4. Staff up. Build a secretariat.
5. Develop a more detailed multi-year action plan (e.g. working groups).
6. Expand the current communications strategy. Maintain ongoing communications activities.
7. At year three, develop a new cost-sharing formula.
8. At year five incorporate and move to the new cost sharing formula.

Infrastructure Financing

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Some participants were taking part in the working group in their capacities as individual experts in the field, rather than as official representatives of their respective organizations. In several cases, approval by the respective boards of directors or senior management of these organizations will be required to name official representatives, following a decision to formally establish the National Round Table on Sustainable Infrastructure.

Purpose

This working paper explores opportunities for the National Round Table on Sustainable Infrastructure to help build Canadian capacities for scanning, assessing, choosing, and implementing new methods of financing infrastructure. It draws upon a substantial body of work by Infrastructure Canada, the InfraGuide initiative, the Canadian Council on Public-Private Partnerships, TD Economics, Canada Mortgage and Housing Corporation, and other organizations.

The aim here is to "lift the lid" on a host of issues and potential solutions, without endorsing any specific point of view or direction. There appears to be a major niche for a forum that, without "reinventing the wheel" brings together the best available evidence on innovative financing methods, sorts it into manageable categories, and makes it widely accessible. Rightly or wrongly, there is an impression that Canada is lagging other Western countries in applying new financing techniques to infrastructure. Once fully established, the NRTSI could both assess the validity of this concern and take actions necessary to help remedy the situation.

As noted at the May 2006 NRTSI discussion in Montréal, there are many links between infrastructure financing methods and governance. This working paper does not address these links in a major way, nor is there a desire or intention to engage the NRTSI in what would potentially be regarded as political or policy debate. However, such links can form part of a matrix of considerations in collecting information about and sorting through financing methods in the future.

This working paper first presents a general overview of the infrastructure funding challenge, followed by a brief review of alternative funding mechanisms, including advantages,

disadvantages and examples. Three appendices serve to provide a breakdown of public and private infrastructure investment, a total of the gross capital stock for selected public infrastructure, as well as a series of ten case studies. These case studies attempt to illustrate the breadth of application, both in Canada and overseas, with a general description of the project, its approach financing, as well as some of the issues encountered and comments on results achieved.

The Infrastructure Financing Challenge

There is an increasing awareness among governments and private sector bodies of an ongoing general need for investment in local infrastructure across Canada, focusing on the basics, such as urban transportation, water supply, sewage treatment and solid waste disposal.

Governments invested heavily in local infrastructure during the 1950s to 1970s, in expectation of continued rapid growth in the economy. In recent decades, demands for competing government expenditures (particularly related to social and health programs) have been coupled with the inevitable impacts of an aging infrastructure stock. These have resulted in additional requirements to fund and finance infrastructure expansion and renewal.

While net improvements to key infrastructure systems have been made in recent years, a significant proportion of the older infrastructure is at or close to the end of its useful life. Governments are now faced with choices about how best to replace or renew older infrastructure, how to deal with the legacy of relatively less infrastructure investment in the 1980s and early 1990s, and how to respond to current growth pressures, particularly in newly developing suburbs and in downtown areas.

Municipal governments, responsible for just over 50 percent of local infrastructure, are still largely financed through the property tax base, and face local pressures to limit tax increases. They also continue to fund social programs and activities that involve income redistribution, which are not well-suited to this form of revenue, given geographic and other limitations of the tax base. Some municipal governments also find it challenging to retain adequate levels of technical and management personnel. Moreover, municipal programs that respond to immediate and visible needs of the electorate may take priority over those–like the renewal of infrastructure–that are mostly hidden and have a longer-term payback.

Within the above context, there is an emerging intergovernmental consensus on linkages between responsible infrastructure stewardship and the health, environmental and economic well-being of the country as a whole.

With respect to the review and assessment of infrastructure financing, there are a number of factors that need to be considered, which include—but are not necessarily limited to—the following:

- **The types of public and private infrastructure to be included**–should elements be included that are not critical to the economic, environmental, and health needs of the nation but on the other hand are important to the development of communities?
- **The scope of infrastructure financing applications**–should this involve the provision of new infrastructure, the renewal of existing infrastructure, the operation and maintenance of existing and new infrastructure?
- **The scope and diversity of financing measures for examination**–for example, by virtue of history and/or function, certain infrastructure elements are compatible with user fee funding whereas others are not.

- **The influence of proactive infrastructure management**–for example, whether life-cycle costing is included as the basis for decision-making or the extent of innovation that is applied to the design, construction, operation and maintenance of infrastructure.
- **The policy context of government**–legislation and regulations that apply to both government and the private sector.
- **The need for close cooperation between land-use planning and infrastructure engineering**–a recent major InfraGuide report identified this as a major source of potential reductions in infrastructure costs and of increased environmental and other benefits.
- **The willingness of the three orders of government to embrace methods that differ from conventional approaches to infrastructure financing**–related organizational capabilities of the three orders of government to apply new financing techniques, and risk management methods associated with those techniques.
- **The underlying causes of the so-called "infrastructure deficit"**–the extent of any deficit and how it is measured and interpreted (for example, how much of the deficit is related to somewhat visionary long-term growth plans as opposed to shorter term needs? How much of the deficit is due to different governments not having their own house in order?)
- **The timing of infrastructure investment**–for example, whether public transit is installed prior to the arrival of large populations, or after they are already in place, and patterns of commuting have been established.

With regard to the above, working group participants identified several key issues and challenges in building additional capacities across Canada.

Performance Measurement

In the context of infrastructure, a performance measure assesses the condition and service quality of infrastructure relative to its intended goals or objectives. It can also assess the effectiveness of a related decision-making process.

A performance indicator is a qualitative or quantitative measure of a service or activity used to compare actual performance against a standard or other target. For infrastructure, performance indicators commonly relate to statutory limits, safety responsiveness, cost, comfort, asset performance, reliability, efficiency, durability, capacity for future expansion, environmental protection, and customer satisfaction.

To illustrate, municipal public works departments can better support recommendations through the application of basic indicators, benchmarks and performance measures that clearly show the effect of each funding or planning decision. Properly implemented, indicators give decision-makers the ability to foresee more clearly the consequences of their decisions.

Level-of-Service Expectations

In the context of infrastructure, level of service can be defined as service quality for a particular activity or service area against which performance can be measured. Service levels usually relate to quality, quantity, reliability, responsiveness, environmental acceptability and recognized social and economic goals of the community. Consideration of these factors usually involves trade-offs, particularly as they relate to costs. As an example, municipalities typically set standards for levels of service for their water, storm and sanitary systems, roads and public transit.

Setting levels of service depends on five interrelated elements:

- An inventory of existing assets—their condition and performance.
- Consultation with users to determine acceptance levels of existing service, willingness to pay for higher service levels, and willingness to facilitate savings from lower levels of service.
- Strategic alignment with community goals through consultation or direction from elected and appointed officials.
- Assessment of risk.
- Financial considerations, including cost, resources available, user willingness to pay, and life-cycle cost implications.

"Infrastructure Deficit"

This is generally defined as the difference between needed infrastructure investment and the actual investment. Since both typically consist of a time series of monetary values, the calculation for a single value of the deficit should involve a present value financial analysis. Needed infrastructure investment is comprised of replacement, renewal, expansion of existing infrastructure as well as construction of new infrastructure in response to current and expected growth needs.

One of the current problems related to the value of an infrastructure deficit is that there is no common understanding of what should be included in the "needed" infrastructure investment*, particularly with respect to growth-related infrastructure needs. For example, in some cases, the infrastructure deficit has been referenced only as the value of the backlog of renewal work. Also, there is no clear definition of the standards by which values are measured. For example, the adequacy and condition of existing assets can be assessed and rated differently by different jurisdictions.

Capital Cost and Operation/ Maintenance Cost

Capital cost is generally regarded as the expenditure used to create new assets, rehabilitate existing assets or increase the capacity of existing assets beyond their original design capacity or service potential. Operating costs are the day-to-day expenses incurred in running a facility or maintaining infrastructure assets such as staff, administration, energy, chemicals and materials.

One of the issues related to the collection and assessment of expenditure data among governments is the lack of consistent designation of these different costs. Some governments designate certain infrastructure costs as capital whereas other governments designate the same type of expenditure as an operating cost. Regardless, a common decision-making issue among all government levels involves the trade off between increased capital costs and lower ongoing operating and maintenance costs. In many cases, governments have opted for lower capital costs because of budgetary pressures at the time of project initiation only to realize higher ongoing operating and maintenance costs. There is more interest and more discussion about employing a life-cycle approach to infrastructure planning and investment but much work has to be done to embed this approach.

Alternative Funding Mechanisms

Even small percentage shortfalls in funding for infrastructure can translate into larger financial impacts. Under-funding

* "Needed investment" implies a link to an expected or pre-determined "service level" – e.g. that Canadian Guidelines for Drinking Water Quality will be met, or that every building in the community shall be connected to a centralized wastewater service, or that the response time for a fire service shall be less than six minutes.

infrastructure impairs the ability of governments to provide essential services, support economic development, protect health and safety, improve environmental performance, support innovative community developments, increase housing affordability, and contribute to the quality of life. In a municipal context, a number of alternatives to the conventional property tax model have been suggested, as follows:

- Special levies to fund public transit, to protect watersheds, or to fund infrastructure repairs and replacement.
- Development fees or development cost charges associated with extending existing systems to new growth areas.
- Utility models which allow for user (consumption) fees to be charged for and dedicated to the service (such as user pay models for potable water services and sewage treatment).
- Government service partnerships among neighbouring communities to share infrastructure.
- Inter-jurisdictional partnerships, including public-private partnerships and those between public or private sectors and non-governmental organizations.

Some alternative funding techniques may better allocate costs to people benefiting from the service. Some may increase accountability by clear allocation of funds while others may increase flexibility or service levels through contractual arrangements or partnerships. Other benefits include the obvious supplement to property tax revenues and reliable, predictable funding for multi-year infrastructure investments.

Public-private partnerships (P3s) have the potential to reduce costs and expedite project delivery through limiting processes as well as the assignment of risks to the partner that is in the best position to manage the risk effectively.

The applicability of P3s depends on the jurisdiction responsible for the infrastructure project and the associated legislative framework. In a municipal context these have been applied to provide new bridges, recreational complexes, organic waste collection, water treatment plants and civic centres. In a provincial context, they have been applied to the provision of schools, public buildings and highways.

There is currently a closer examination of the potential for these partnerships by many government organizations in view of projected needs for new and expanded public infrastructure, coupled with the anticipation of potential efficiency and other benefits from engaging in P3s or in new forms of public-private cooperation. In addition, a growing number of pension funds and other organizations are looking for sound investments of the type that infrastructure projects can offer.

Brief Review of Alternative Infrastructure Funding Mechanisms

There are a myriad of financing tools that exist to finance core municipal infrastructure (defined as such core structures or systems as roads, water and sewer systems, public transit, bridges, etc.). The following list provides some financing tools that have been used by jurisdictions in the past. However, it is by no means exhaustive–innovative financing solutions are continually being devised and applied by jurisdictions.

A key issue encountered by the working group, and remaining to be resolved in the future is how to characterize the different techniques and the varying experience with them in a way that captures conflicting points of view about their fairness, efficacy, and long-term results for infrastructure quality and service levels.

User Pay and the Utility Model of Financing

Legislation governing municipalities sets out the principles of taxation and user fees and in some instance specifically establishes requirements for "user pay schemes" for municipal services (access to public libraries, swimming pools, etc.) Cities are looking also at user fees to manage demand for infrastructure and to provide more sustainable alternatives.

Many provinces expect or require municipalities to establish utilities for the provision of some municipal services (e.g. water and wastewater, hydro-electric or other power services). In most of these provinces, there is a Utilities Review Board established by the province to examine the activities of the utilities and ensure that where there is a proposal to change user fees, that the change is justified by changes in operating cost or investment needs. These utilities seek to apply a general principle of economics: that the price of a product should reflect the costs of producing it in order for a rational allocation of resources to be achieved in the market place. The view of the utility model of infrastructure financing is that, unless clearly known and undertaken to meet specific social or other objectives, subsidized services are to be discouraged.

Advantages

- Provides rigour in analysis of capital and operating costs and in management of assets.
- Separates most management and operational decisions from the political forum.
- Reflects efficiencies of the market place allocation of resources.
- Provides the opportunity for accessing private sector capital markets.

Disadvantages

- Equity issues–does not ensure equal access to service regardless of income.
- Complexity for decision-makers wishing to meet social objectives or needs.
- May require a third-party review agency.

Examples in Canada

- EPCOR – a multi-purpose utility company owned by the City of Edmonton, but operating in other localities in Alberta and British Columbia.
- Ontario Clean Water Agency.

Transfer Payments

Transfer payments from one order of government to another can include unconditional block transfers, grants, contributions, alternative funding arrangements, and flexible transfer payments. They can also include permanent dedicated revenue flows, such as a portion of excise tax on motor fuel (e.g. the federal gas tax agreements from the 2005 federal budget).

Advantages

- Widely used, the traditional form of financing infrastructure in Canada.
- Leveraging potential with other orders of government and private sector.
- No future costs.

Disadvantages

- There may be no or very limited long-term social equity in this type of financing, since taxpayers contributing to costs of infrastructure works are not necessarily those who will use it and benefit directly from them.

- No certainty or predictability in longer-term funding.
- May skew local decision-making in favour of capital-intensive types of projects, as compared with those requiring higher operating engagement.
- Opportunity costs are often not assessed quantitatively but qualitatively (in a political forum).

Examples in Canada

- Canada Strategic Infrastructure Fund and Municipal Rural Infrastructure Fund.

Loans / Capital Access Programs (CAPs)

The federal government also uses loan agreements, loan guarantees and capital access programs (CAPs). CAPs are similar to a loan guarantee: the lender is a private sector company and the borrower is a province and/or municipality. In the case of CAPs, both the borrower and the lender make a payment into a loss reserve fund, and the federal government matches the payment. In this way the lender risk is reduced, and private sector institutions will make loans that otherwise would be too risky.

Advantages

- Available immediately.
- Paid off over a longer period of time, allowing for intergenerational equity.

Disadvantages

- Provincial regulations sometimes restrict the amount of debt that a municipality can take on, restricting the ability of the municipality to take out loans.
- Smaller jurisdictions may not be able to access loans.
- The federal government in Canada cannot directly provide loans to municipalities.

Examples

- *Transportation Infrastructure Finance and Innovation Act* (TIFIA) program in the United States, a federal program that uses secured loans, loan guarantees and standby lines of credit to provide up to 33 percent of eligible project costs in credit assistance to transportation project proponents.

Bonds

A bond is a form of loan where the borrower promises to repay the capital value of the bond along with interest at a specific date. All three levels of government in Canada can issue and sell bonds for infrastructure. Municipal bonds are uncommon in Canada, however, because bonds issued by Municipal Finance Authorities are usually fully guaranteed by the provinces, consequently they are considered provincial rather than municipal bonds.

Advantages

- Ensure intergenerational equity, and provide immediate financing.
- In jurisdictions where several municipalities do not have a good bond rating, centralized agencies can be set up to distribute bond revenues (e.g. the Ontario Opportunity Bonds established by the Ontario Municipal Economic Infrastructure Financing Authority—interest earned on these bonds is provincial tax exempt).

Disadvantages

- More expensive than outright grants.
- Smaller jurisdictions may not have a good enough bond rating to issue bonds.
- May result in projects that cannot be sustained over time because local revenues do not cover the operating and maintenance costs of the infrastructure.

Examples in Canada

- Ontario Opportunity Bonds, and bonds issued through the Municipal Finance Authority of British Columbia.

Trust Funds

Earmarked taxation—when a percentage of tax revenues are dedicated to a specific investment area—provides revenue for trust funds. This means that expenditures for a specific type of infrastructure can be tracked, as long as the trust fund is only used for its intended purpose. In the United States, trust funds provide most federal funding for highway and transit projects.

Advantages

- May be equitable, if the source of funding comes from the ultimate user of the infrastructure.
- An easier sell politically, since taxes paid into the fund are considered a "user fee".

Disadvantages

- Long-term viability of the fund may be called into question if its funding source is not sustainable.
- May involve charges to newly arriving residents, e.g. first-time home-buyers, to cover investments of much wider community benefit.
- May create accountability and transparency challenges as taxpayers are not sure what the fund is about and what it is being used for.

Example

- The Highway Trust Fund (HTF) and Mass Transit Account (MTA) in the United States. Tax revenues directed to the HTF are derived from excise taxes on highway motor fuel and truck-related taxes on truck tires, sales of trucks and trailers, and heavy vehicle use. The MTA receives a portion of the motor fuel taxes, usually 2.86 cents per gallon, as does the Leaking Underground Storage Tank Trust Fund, usually 0.1 cent per gallon. The General Fund receives 2.5 cents per gallon of the tax on gasohol and some other alcohol fuels plus an additional 0.6 cent per gallon for fuels that are at least 10 percent ethanol. The Highway Account receives the remaining portion of the fuel tax proceeds.

Revolving Loan Funds / State Infrastructure Banks

A revolving fund is a method by which a higher order of government provides a renewable source of capital for loans at or below market interest rates for specific types of infrastructure. A higher or central order of government provides an initial grant, and lower jurisdictions provide a percent match and oversee administration of the fund. The lower jurisdiction is then able to lend and re-lend funds. The central government provides a yearly grant that declines over time. The administration of the fund is paid using interest income.

Advantages:

- Provides a source of sustainable, longer-term funding.
- Allows for the possibility of having operating funding since the infrastructure projects have been put in place.

Disadvantages

- The initial loan will need to be large enough to ensure that the annual outlay of funds will be sufficiently large–otherwise the annual outlay will have little noticeable effect.

Examples in Canada

- Green Municipal Investment Fund, administered by the Federation of Canadian Municipalities.

Tax Increment Financing

Through tax increment financing, municipalities can reinvest property tax revenues to meet community economic development objectives such as housing development, creating employment opportunities, revitalizing inner cities and redeveloping former industrial sites. As applied in Ontario, tax increment financing is based on municipal grants and loans that can be given under Planning Act community-improvement provisions. By calculating a grant or loan on the higher property tax that is generated from development (the tax increment), municipalities can offer eligible developers financing incentives that will put lands and buildings that might not otherwise be developed, back into productive use. Typically this involves making improvements to local infrastructure in order to stimulate private investment in the affected area. Tax increment financing is typically used in combination with special district financing.

Advantages

- Can help promote comprehensive approaches to infrastructure investment geared to community revitalization.
- Can support concentrated infrastructure investment in defined areas, gaining synergies from multiple improvements.
- Recognizes the reality that in many cases, future tax revenues may be far higher than they are at present, provided proactive investments are made.

Disadvantages

- Very limited practical experience with this financing tool in Canada.
- Not suitable for larger-scale infrastructure projects, as revenue impacts become diffuse.
- Can create major liability for a municipality in the future, if anticipated revenue increases do not materialize.

Examples in Canada

- Historic Galt City Centre in Cambridge, Ontario.
- Brandon, Manitoba has announced its intention to establish a "Downtown Renaissance District", using tax increment financing authority granted by the Government of Manitoba.

Development Charges

Municipalities often use development charges (also called "Development Cost Charges") to fund new infrastructure projects such as trunk sewer and water systems leading to new subdivision developments. Services within a subdivision are typically installed by the developer and then turned over to the municipality under what is known as a "development agreement". With these charges, the intention is that new residents incur the capital costs of constructing new infrastructure.

In a number of provinces, there is very limited oversight of municipal practices in applying development charges, and very limited public reporting of these revenues. In British Columbia and Ontario, however, there is comprehensive legislation in place. In British Columbia, municipalities are asked to consider housing affordability to future residents as a factor in setting development charges. Development charges are not applied in Manitoba or Quebec.

Advantages

- They offer a basis for "user pay" principles to be applied, since extensions of infrastructure are financed by those who will use it, and where there is a demand for it.
- They can provide municipal revenues to match investments or grants received from federal and provincial governments.
- Where a consistent provincial legislative framework and appropriate reporting arrangements are in place, they can offer an accountable method of financing infrastructure.

Disadvantages

- As applied in many municipalities, they bear no relationship to "user pay" principles, e.g., being a flat rate regardless of infrastructure requirements, undermining the rationale for applying them, and distorting development decisions.
- They have negative impacts on housing affordability, reducing the numbers who can buy or rent within their means.
- They do not account for operational costs associated with new infrastructure.
- They do not recognize that new growth has economic benefits to the community far beyond those accruing to occupants of new developments.
- Some stakeholders believe that transparency and accountability issues associated with the application of development charges remain to be resolved.

Examples in Canada

- There are numerous examples in urban centres across Canada, with the exceptions noted above. See a study conducted for CMHC by IBI Group in 2005 for detailed case studies and analysis of this tool as a whole.

Special District Financing

Special district financing, which is very common in the United States, is another method used to finance new infrastructure that will benefit the homeowners who live in the area serviced by the new infrastructure. It is often used in combination with development charges. A designated urban district, usually referred to as a local improvement area, is created as an entity with the sole purpose of financing new infrastructure.

Advantages

- May be more equitable, in that those who benefit from the infrastructure pay for the infrastructure.
- Special districts may be able to finance infrastructure at better rates, and be better able to finance infrastructure over its life-cycle.

Disadvantages

- Not been widely used in Canada.
- May involve implicit subsidy and other costs to government.
- Oftentimes there can be a significant time lag between the establishment of a special district and the time it takes for the district to grow to a sufficient size.
- Can create market distortions, as nearby areas do not qualify, and developments side by side may be treated differently.

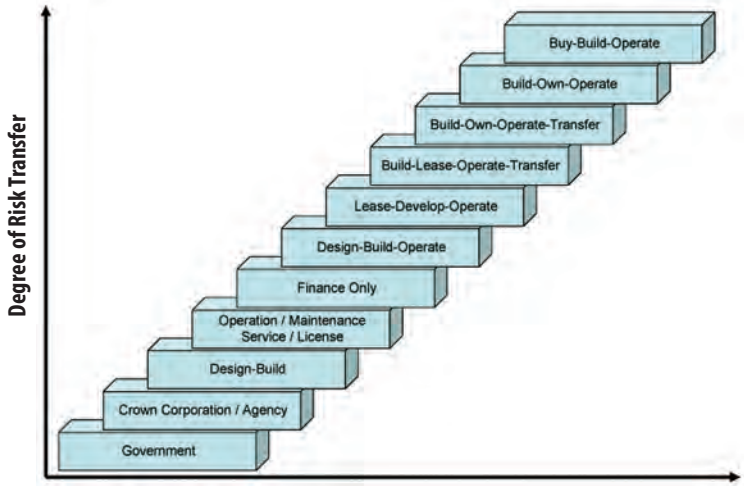
Examples

- The Rivers district, Calgary, Alberta.
- Historic Galt City Centre, Cambridge, Ontario.

Public-Private Partnerships

Public-private partnerships (P3s) are financing arrangements that increase involvement of the private sector in public service delivery and transfer some risk and reward to the private sector. P3s for infrastructure financing range from minimal private sector involvement, such as providing garbage collection services, to comprehensive private involvement in the designing, building, owning, operating and financing of a facility. There is no one specific model of a P3—the chart below outlines the range of P3 options that exist for project proponents.

The Scale of Public-Private Partnerships: Risk Transfer & Private Sector Involvement



Source: Canadian Council on Public-Private Partnerships

Advantages

- They may be able to provide more value for money–the benefits of a P3 can outweigh risk-adjusted costs, and efficiencies may be achieved.
- Appropriate risks can be more readily transferred to the private partner.

Disadvantages

- There is strong public and political opposition to public-private partnerships in a number of regions across Canada.
- Each specific model of P3 transfers various levels of risk and reward. Depending on the complexity of that distribution, in-house staff capabilities may need to be supplemented by outside expertise to ensure proper valuations.
- They may be regarded, unrealistically, as a "silver bullet" that can resolve intractable infrastructure problems in a single step.

Examples

There are numerous examples of P3s in use in Canada and around the world, involving models on the range of the spectrum of the chart shown above. Some issues and examples of P3s at work can be obtained from the Canadian Council of Public-Private Partnerships–information on projects in the transportation, water/wastewater and health care fields can be obtained at http://www.pppcouncil.ca/sectors.asp and through publications of the organization.

APPENDIX A – Public and Private Infrastructure Investment in Canada

(Distribution for Selected Major Types of Public Infrastructure Investment - $ millions)

YEAR:	2002			2003		
Utilities	Public: Private: Total:	70.8% 29.2% 100.0%	7,514.2 3,098.4 10,612.6	Public: Private: Total:	70.3% 29.7% 100.0%	8,657.1 3,651.2 12,308.4
Water, sewage and other systems*	Public: Private: Total:	92.6% 7.4% 100.0%	1,094.1 87.8 1,181.9	Public: Private: Total:	94.5% 5.5% 100.0%	1,698.8 99.1 1,797.8
Electric power	Public: Private: Total:	73.3% 26.7% 100.0%	6,356.2 2,318.8 8,675.0	Public: Private: Total:	71.2% 28.8% 100.0%	6,878.8 2,787.4 9,666.2
Gas distribution	Public: Private: Total:	8.1% 91.9% 100.0%	61.6 694.2 755.7	Public: Private: Total:	9.4% 90.6% 100.0%	79.6 764.7 844.3
Transportation	Public: Private: Total:	88.8% 11.2% 100.0%	7,208.9 910.5 8,119.4	Public: Private: Total:	91.0% 9.0% 100.0%	7,647.0 752.6 8,399.6
Roads, highways and bridges**	Public: Private: Total:	93.0% 7.0% 100.0%	6,149.6 460.0 6,609.6	Public: Private: Total:	96.3% 5.7% 100.0%	6,568.9 248.9 6,817.8
Transit and ground passenger	Public: Private: Total:	70.2% 29.8% 100.0%	1,059.3P 450.5 1,509.8	ublic: Private: Total:	68.2% 31.8% 100.0%	1,078.1 503.7 1,581.8
Grand Totals	**Public: Private: Total:**	**78.6% 21.4% 100.0%**	**14,723.1 4,008.9 18,732.0**	**Public: Private: Total:**	**78.7% 21.3% 100.0%**	**16,304.1 4,403.8 20,708.0**

Source: Statistics Canada, Investment and Capital Stock Division. Notes prepared by the Canadian Home Builders' Association in cooperation with Statistics Canada.

NOTES:

* Data for water, sewers and roads do not reflect the fact that subdivision services plus the vast majority of new off-site infrastructure services are currently funded in most provinces by private developers and then turned over to municipal governments following completion. Infrastructure investments in residential developments are estimated by Statistics Canada to amount to over $1 billion annually for elements funded by municipal levies. This may omit infrastructure funded and installed directly by developers via "development agreements". Discussions are underway with Statistics Canada experts to determine more precisely the sources and applications of funding.

** Roads, highways and bridges for public use are expenditures by Public Administration (NAICS 91) only, and do not include those expenditures by government-owned businesses.

APPENDIX B – Year-end Gross Capital Stock for Selected Infrastructure by Order of Government for Selected Infrastructure

(Thousands of Current Dollars)

Type of Infrastructure:	Federal Public Administration* (NAICS 911)	Provincial Public Administration (NAICS 912)	Municipal Public Administration (NAICS 913) and Water, Sewage and Other Systems (NAICS 2213)**	TOTAL
Waterworks Engineering***	3,857,468.0 (7.6 %)	4,340,109.3 (8.6 %)	42,497,880.6 (83.8 %)	50,695,457.9 (100.0 % of row) (16.3 % of column)
Sewage Engineering***	5,164,071.9 (7.8 %)	13,522,534.2 (20.4 %)	47,511,647.8 (71.8 %)	66,198,253.9 (100.0 % of row) (21.3 % of column)
Roads	4,516,993.0 (2.6 %)	98,434,268.2**** (56.5 %)	71,120,690.9 (40.9 %)	174,071,952.1 (100.0 % of row) (56.0 % of column)
Bridges	734,114.8 (3.7 %)	2,325,818.6 (62.0 %)	6,820,296.5 (34.3 %)	19,880,229.9 (100.0 % of row) (6.4 % of column)
TOTAL	14,272,647.0 (4.6 %)	128,622,730.3 (41.4 %)	167,950,515.8 (54.0 %)	310,845,893.8 (100.0 %)

Source: Statistics Canada, Investment and Capital Stock Division. Formatting and calculations by the Canadian Home Builders' Association.

NOTES:

* This figure does not include assets of federally-owned businesses

** These figures include a substantial amount of private sector-financed infrastructure that ends up in municipal ownership; private sector funding is estimated by Statistics Canada at about $1 billion annually relating to municipal levies. The main techniques in use, in all provinces except Quebec, are development cost charges, lot levies, and development agreements. According to a CMHC study published in 2005, the residential development industry is paying for 100 percent of subdivision services and also a large portion of off-site infrastructure. These costs are then passed on to new home buyers.

*** "Waterworks engineering" includes: reservoirs (plus dams); trunk and distribution mains for both water and sewage; water pumping stations and filtration plants; Water storage tanks; other waterworks construction. "Sewage engineering" includes: Sewage treatment and disposal plants (include pumping stations); sanitary and storm sewers, trunk and collection lines, open storm ditches; lagoons; other sewage system construction.

**** There has been a substantial move in recent years to transfer ownership of roads from provincial to municipal jurisdiction. Discussions are underway with Statistics Canada experts to determine if these are fully reflected in the roads data.

APPENDIX C – Infrastructure Financing Case Studies

Project Case Study 1 – Canada Line

Overview

The Canada Line, formerly known as the Richmond-Airport-Vancouver Line ("RAV Line"), is a new rapid transit line of the Greater Vancouver Transportation Authority (TransLink) currently under construction. The line will be the third in Greater Vancouver, and will be added to the existing SkyTrain rapid transit system but will not use linear induction motor technology. The line will connect downtown Vancouver to the Vancouver International Airport and Richmond City Centre in time for the 2010 Winter Olympics. Governance of the project is through Canada Line Rapid Transit Inc. (CLCO), a subsidiary of TransLink formerly known as RAV Project Management (RAVCO).

Financing

CLCO was set up by the agencies funding the transit line to oversee project design, procurement, construction and implementation. The total cost of the project is $1.9-billion (2003) and the funding agency contributions are as follows:

- Government of Canada: $420-million
- Government of British Columbia: $235-million
- Vancouver Airport Authority: $245-million
- TransLink: $320-million
- City of Vancouver: $25-million

The line will be built as a private-public partnership where the private contractors will contribute a portion of the construction costs and will be responsible for operating and maintenance costs. This investment is set at $657 million

(2003), as part of its obligation under a 35-year performance-based contract to design, build, operate, maintain and partially finance the line, with requirements to meet or exceed safety, speed, reliability, customer satisfaction and other specifications set by the agencies. During the operating period (2009-2040), the Concessionaire will receive payments for its costs. It is the largest urban public-private partnership yet to be implemented in Canada.

This approach to financing was designed to ensure that funding agencies and the public benefit from private sector

capital, innovation and efficiencies as well as from the private partner's interest in a successful transit system over the long-term. It also ensures that ownership of the Canada Line will be maintained in public hands, with TransLink controlling fares and safety and requiring that the private sector partner comply with service standards such as frequency, hours of operation, reliability and comfort.

Issues

Opponents of the Canada Line's public-private partnership believe it was politically motivated and that it will cost more money because of the private involvement. The private involvement has, however, allowed for the costs to be known and largely fixed up-front. Although the contract is meant to ensure that no cost over-runs are passed on to TransLink and thus the public, there is a concern that it may somehow cost the public more in the future. The primary risk to TransLink is for ridership targets, as it will have to make up the shortfall in revenue if they are not achieved. The other potential risk would be if TransLink were to cause delays in the project by not meeting their responsibilities, they might be required to pay the costs for these delays and to ensure that the project is completed on time.

Comments on Results Achieved

A highly-charged political debate about the merits of the public-private partnership and the risks being assumed by the parties resulted in considerable conflict among TransLink's Board of Directors. It illustrates the difficulties associated with employing non-traditional approaches to infrastructure financing, especially in regards to high-cost, high-visibility projects. In addition, the absence of a revenue stream that will clearly exceed construction and operating costs makes this type of financing approach a challenge for public transit projects.

Project Case Study 2 – Confederation Bridge

Overview

The Confederation Bridge is a 12.9 km two-lane bridge structure linking Prince Edward Island and New Brunswick. Construction started in the fall of 1993 and was completed in the spring of 1997 at a cost of approximately $1 billion. It is the longest bridge over ice-covered waters in the world. The bridge replaced a ferry service between the two provinces across the Northumberland Strait operated by a federal government Crown Corporation. There are no one-way tolls on the Confederation Bridge–tolls (currently $40.50 for a car) are collected upon departure from Prince Edward Island. The bridge opened on May 31,1997, and carries two lanes of traffic 24 hours a day, seven days a week. At normal speeds (80 km/hour), the crossing time is approximately 10 minutes.

Financing

The federal government pays SCDI an annual amount over 35 years that is equivalent to the ferry subsidy, adjusted for inflation. SCDI designed and built the bridge and toll plaza, financed the project, collects tolls, maintains the bridge in accordance with stipulated standards and makes payments to the bond holders. Annual toll increases must be approved by the federal government and cannot exceed 75 percent of the percentage increase in the Consumer Price Increase. In 1993, SCDI issued bonds to fund construction and capitalized interest ($660 million in 1993), backed by the federal government's commitment to pay the annual subsidy. In 1998, SCDI issued $328 million in toll revenue

bonds to finance ongoing operations. SCDI also generates revenue by leasing a utility corridor attached to the bridge. Shareholders of SCDI consist of: VINCI Concessions Canada Inc, Montreal; BPC Maritime Corporation, Toronto; Straight Crossing Inc. Calgary; and Ballast Nedam Canada Ltd., Edmonton.

Issues

The challenge of crossing the Strait had long been an issue. In fact, the Canadian government was able to persuade Prince Edward Island to join Confederation by promising to provide "a continuous means of communication between Prince Edward Island and the mainland." For over 100 years ferry services provided the link which the federal government partially funded through federal subsidies. Ultimately the federal government began the process in the 1980s that led to the construction of the Confederation Bridge. In 1987, the Government of Canada issued a proposal call challenging the private sector to devise an environmentally, technically and financially sound alternative to the ferry system. After an extensive process, Strait Crossing Development Inc. (SCDI) was named as the developer charged with designing, building, financing and operating the Confederation Bridge. Its subsidiary company, Strait Crossing Bridge Limited (SCBL), privately manages, maintains and operates the bridge until 2032, after which time the bridge becomes the property of the Canadian government.

Comments on Results Achieved

- Private sector interest in pursuing this design-build-finance-operate-transfer project resulted from clarity of financial terms of engagement set by Transport Canada.
- Financing through bond issues was feasible in view of stability of federal government annual payment equivalent to the subsidy (inflated) of the former ferry service.

Project Case Study 3 – Sea-to-Sky Highway Improvement Project

Overview

The Sea-to-Sky Highway (part of Highway 99) links communities from West Vancouver to Whistler. The British Columbia Ministry of Transportation (MoT) initiated the Sea-to-Sky Highway Improvement Project to increase the road's safety, reliability and capacity. In addition to meeting the area's future traffic needs, the upgrades will also enhance economic development opportunities for communities along the highway. The project is scheduled for completion in 2009, in time for the 2010 Olympic Games to be held in Vancouver and Whistler. The entire project includes the design and construction of improvements plus operations, maintenance and rehabilitation over 25 years.

Financing

Most of the project has been procured through a design-build-finance-operate (DBFO) model of public private partnership (P3). To accelerate the timetable, MoT undertook improvements on about one third of the highway using separate design-build contracts while the P3 process was underway. Hence, the P3 project itself represents about two thirds of the entire project. In order to be able to assess value

for expenditure and to establish parameters fort he DBFO model, the MoT developed a risk-adjusted public sector comparator (PSC), which was an estimate of a public sector cost of the project. The PSC amounted to a $744 million net present value. The province then set a budget of $600 million for the DBFO approach, and MoT calculated what baseline improvements it could make for this amount based on its cost of financing and conventional procurement. On this basis and incorporating its operations and maintenance costs, the government set an Annual Affordability Ceiling (AAC) which was the annual amount that the government was willing to pay to a contractor over the 25 year period. The government therefore established a price ceiling and baseline improvement requirements. Proponents competed on the basis of the scope of additional improvements they could offer within the fixed price; they did not compete on the basis of lowest price but on the value of work between the price ceiling and baseline requirements. MoT provided the short-list of bidders with the evaluation framework to be applied for the selection of the winning bid, which consisted of four major categories: safety, mobility, environment, and traffic management. The public sector costs of the selection process amounted to $22 million. This included partial compensation to the two unsuccessful bidders of $1.5 million each. S2S Transportation Group is the selected consortium.

Issues

In this regard, MoT estimated that the value of proposed S2S Transportation Group improvements associated with reduced travel times and improved safety for road users amounted to $131 million (NPV), which is 30 percent more than that provided through the baseline requirements. The performance-based contract with S2S Transportation Group is structured to ensure that the contractor has the appropriate incentives to meet or exceed the long-term objectives of safety, reliability and capacity. The Ministry of Transportation continues to own the road, rights-of-way, bridges and all other assets connected to the highway. MoT will ensure that specifications such as highway width, number of lanes, safety requirements, sightline requirements and signage are appropriately met. Apart from the deadline for the 2010 Olympic Games, a key issue with respect to this DBFO project was how to attain maximum value for expenditure associated with the four major categories noted above."

Comments on Results Achieved

The procurement method of using a price ceiling and evaluating proposals on the basis of added value improvements within this ceiling provided the mechanism for the government to achieve maximum value for expenditure. For the selected contractor, this resulted in additional passing lanes, additional median barrier, additional wide shoulders and improved lighting and reflective pavement markings.

Project Case Study 4 – Strathcona Water Recycling

Overview

About a decade ago, the City of Edmonton began looking for ways to cope with an ever-increasing demand for the North Saskatchewan River's water. Working as a team, the City and Petro-Canada found a way to treat wastewater in a specialized plant and then pipe it as far as Strathcona County. The water is not potable, so it will be used primarily for industry. The treatment occurs at the Gold Bar Wastewater Treatment Plant, which was outfitted with the necessary membrane treatment capabilities in 2005. It took about $13 million to upgrade the existing plant for the new technology. In addition, a 5.5-kilometre pipeline was constructed to deliver the water to Strathcona County.

Financing

The public-private partnership between the City of Edmonton, Petro-Canada and Strathcona County was funded by Petro-Canada for approximately $25 million.

Issues

Key issues that had to be resolved to carry out the project included: selection of a combination of treatment technologies that would provide an adequate quality of water to users; determination and management of key ongoing risks associated with the project, e.g., in the vent of interruption

in delivery; negotiating arrangements between the City of Edmonton and Strathcona County for a pipeline right of way; linking industrial requirements of and costs to Petro-Canada with municipal standards and expectations.

Comments on Results Achieved

By doing this project, Petro-Canada will reuse five million litres of recycled water per day, avoiding the need to draw as much fresh water from the North Saskatche-wan River. This project is the first of its kind in Canada and is claimed to set a new standard for environmental "best practices." The project meets Petro-Canada water needs for new industrial processes and provides surplus water for other users along the river valley.

Project Case Study 5 – London Congestion Charging

Overview

February 17, 2003, saw the introduction of the world's most ambitious urban road charging scheme in London, England. Motorists entering the central area between 7:00 a.m. and 6:30 p.m. paid a £5 fee ($12 CDN). The scheme applies only on weekdays (except public holidays). Exemptions and discounts apply to a number of vehicles, including those that perform critical public services and those that are environmentally friendly.

Compared to the previous year, traffic within the zone declined by 16 percent; the number of cars entering the zone was down by 38 percent; overall, the time taken for journeys to central London decreased by 14 percent; public transport was accommodating up to 130,000 more passengers every day; 11,000 additional spaces are available on buses each morning rush hour; and bus delays inside the charging zone due to traffic congestion fell by 50 percent in the first ten weeks.

Financing

The Congestion Charge is essentially a road pricing mechanism intended to reduce demand (and thereby congestion) while generating revenue to invest in public transport and other alternatives to driving.

Issues

Congestion was down but so were net revenue forecasts. In 2003, the congestion charge was expected to raise £63 to £66 million, only half anticipated revenue. The primary reason for the shortfall was higher-than-expected reduction in vehicles entering the central zone. Net revenues must be re-invested in improving transportation within Greater London. To date, some problems have arisen with enforcement. In the first three months, 250,000 penalty charge notices were issued. One in four notices was appealed; of these, two thirds were accepted. Transport for London have acknowledged ongoing concerns and have renegotiated terms with their main contractor, Capita [a private sector company], to ensure further improvements in the quality of service.

Comments on Results Achieved

Twelve important comments can be made about the London system based on early results:

- The primary aim is to reduce congestion. Such a charge should not be introduced if the primary objective is to raise revenue for funding infrastructure. Other types of road pricing schemes or taxes should be considered instead.

- Local governments must link a congestion charge to an overall transportation and development strategy for the area.
- Local traffic patterns must be thoroughly reviewed and levels of congestion assessed over time.
- A good public transport system needs to be in place before a congestion charge is introduced.
- It is important to know the levels of congestion in a city and its impact on the local economy.
- The nature and level of retail activity in downtown, compared with suburban or other regional shopping, must be assessed.
- Political leadership at the local level is critical. Resources would be needed to develop a comprehensive public consultation and information program.
- Proponents must be realistic and manage expectations about future revenues and funding streams for transport infrastructure.
- Financial resources need to be found up-front before the rewards (even if modest) of congestion charge revenue can be realized.
- A cautious approach to public-private partnerships is warranted, in light of London's experience.
- Effective hours of congestion charging must be appropriate to capture the peak congestion period.
- The system must be user-friendly. In Canadian cities, where alternatives to downtown shopping and entertainment already prevail, it would be important not to establish systemic barriers to going downtown.

Project Case Study 6 – Private Sector Financing of Brownfield Redevelopment Coupled with Major Infrastructure in Montréal

Overview

Redevelopment of a former GM car plant outside Montréal involves a large-scale site with an attractive location at the corner of two major highways. The plan includes complete demolition and remediation of the property, rezoning the property into mixed-use (residential and retail/other commercial), and redevelopment on a phased basis.

The project as a whole is being financed by a private sector investment fund that specializes in redevelopment of brownfields. The first phase of the project is being developed on approximately 86 acres of land located in the northwest quadrant of highways 640 and 15. The project will comprise approximately 1,200,000 square feet of gross leasable area, in addition to a new 147,000 square foot retail store on adjacent lands, which are integrated as part of the shopping centre. Subsequent phases of the project will include additional large format retailers, complementary retail and service uses, a potential food store, and a

fashion/lifestyle component that will be developed in a town centre format and which is projected to include ancillary office and retail components.

Financing

The investment company acquired the brownfield properties situated in the north-west quadrant of highways 15 and 640 (covering a surface close to 10,000,000 square feet), for the sum of $53 million. Development of the site is to be done in accordance with zoning as stipulated by the MRC de Thérèse-de-Blainville, for a mix of industrial, commercial and residential uses. The company has a flexible approach to pursuing brownfield investment opportunities, often partnering with owners, builders and other stakeholders to successfully redevelop brownfield properties. It can offer owners of brownfield properties protection through risk management and transfer mechanisms related to environmental liabilities associated with environmentally contaminated properties.

Issues

Issues to be addressed in the development include: costs of remediation in relation to the return on investment for the site as a whole; impacts on transport infrastructure arising from a change in use from a single industrial plan to a mix of industrial, commercial and residential uses; managing risks of the development for investors as it proceeds, given the potential for changes in the Montréal retail situation; environmental impacts of the new land uses.

Comments on Results Achieved

It is too soon to draw specific lessons from this redevelopment project or about its success in financing infrastructure on and off-site. In general, redeveloping brownfields requires solutions designed to attract new business, retain jobs, build a stronger tax base, and make communities attractive places to live and work. This can yield net benefits for increased infrastructure efficiency. In the case of this project, no public sector investment has been necessary to stimulate a major redevelopment effort and increased use of existing transportation infrastructure.

Project Case Study 7 – Moncton Water Treatment Plant Renewal

Overview

For many years the Greater Moncton Area suffered through periods of poor water quality, which culminated in community-wide "boil water orders" in 1997 and again in 1999. The need for a water filtration plant was identified in Moncton's 1989 Water System Master Plan, but lack of funding delayed the project for 10 years. Faced with boil orders and outrage from its citizens and the business community, Moncton had to act quickly to get the situation under control and ensure that current and future water quality objectives were met consistently.

A 102,300 m3/day water treatment plant was built in a period of 18 months through a partnership with the US Filter Corporation. This plant serves an approximate

combined population for Moncton, Dieppe and Riverview of 100,000 persons. There are six employees in the highly automated plant which utilizes a multi-media, high rate adsorption / clarification process designed to remove turbidity, colour, iron and manganese, as well as microbial contaminants including viruses, bacteria, giardia and cryptosporidium from the water. The plant also manages corrosion control in the distribution systems and has a 30 percent expansion capability to 136,400 m3/day.

Financing

Initial estimates were that this would cost approximately $32.8 million if the conventional municipal engineering contract route were followed. Invitations were sent out for a public-private partnership to finance, build and operate a water treatment plant for the next 20 years. The cost of the new plant was $23 million, a saving of approximately $10 million over the initial estimates by the City. The City has a twenty-year contract with the private sector partner (now Veolia Water Services which purchased the US Filter operations), at a largely-fixed cost, with confidence that the partner has in-depth access to resources with appropriate skills and experience and a plant that is capable of meeting the community's needs for many years to come.

Issues

In order to take advantage of municipal HST exemptions, the contract was converted from a "finance, build, own and operate" contract to a "finance, build and operate" contract–thus relieving the contractor of having to pay HST on all construction costs. The City of Moncton purchased the plant for $1 and is now re-paying the partner for the initial investment over a 20-year period, at the end of which the City will fully own the plant.

Comments on Results Achieved

Provisions of provincial and federal legislation need to be examined to ensure that there is a level playing field between conventional project management and project management under a public private partnership.

Project Case Study 8 – City of Regina Storm Drainage

Overview

In 1983, a catastrophic rainstorm caused sewer backup or flooding damage to approximately 10,000 (1 in 5) of the City's homes. A program of storm drainage master-planning study was initiated. Findings of the early studies indicated that an $88 million, 25-year investment program and operational costs of $1 million per year were required to upgrade the City's storm drainage system capacity to provide modern standards of service [1].

Prior to 1992, storm drainage operating costs and capital investments were funded from general operating funds, competing with all other non-utility services. Regina's tax base did not have the capacity to support the added cost or to address the urgency with which a comprehensive storm drainage upgrading program was required.

Financing

For 2006, the budgeted annual drainage levy revenue is approximately $6.04 million. Revenues are used to fund operating, capital and administrative expenditures. Annual capital investment in the storm drainage system (average of current five-year capital program expenditures), is $3.96 million. This funding is invested in storm drainage capacity upgrades and storm sewer renewal work. The balance,

[1] Note: cost figures are not adjusted to current values.

approximately $2.08 is required for operating, engineering, public education and administrative costs. A prioritisation process is used to allocate capital funding to achieve the greatest benefit in terms of service improvement and cost effectiveness. To date, $40 million has been invested in system upgrades resulting in significant improvements in service levels in the highest priority drainage areas. As analysis, planning and investment continue to refine and define the extent and cost of the capital program, it is anticipated that, to achieve desired service standards throughout the City, a further $100 million (based on 2005 costs) will be required.

Issues

Advantages gained by implementing the storm drainage utility go far beyond the generation of funds. A secure, predictable level of funding has allowed programs to be developed and priorities addressed in a systematic, objective manner. The approach facilitates long-term decision-making and secures public confidence and trust in the program. Residents and business owners view the City's storm drainage upgrading program, its financing through the drainage levy, and its results very positively. Without the utility, such results would not have been possible.

Comments on Results Achieved

By placing the construction and maintenance of storm sewers within the context of a full-cost pricing utility model, the system could be managed without having to compete with other municipal projects for funds derived from property taxes.

Project Case Study 9 – Brisbane Airport Rail Link

Overview

Brisbane Airport Rail Link is an 8.5 km elevated spur line linking new stations at Brisbane Airport's domestic and international terminals with the City and the Gold Coast. Airtrain, a consortium including Transfield and Macquarie Corporate Finance, was awarded an exclusive mandate by the Queensland government in May 1996 to develop a detailed proposal for the rail link. An agreement was concluded in April 1998. The infrastructure is owned by the private sector, but operated under contract by the public Queensland Rail.

Financing

The unique nature of the project was that it was a BOOT (build, own, operate and transfer) infrastructure project and as such was underpinned by over 100 deeds and agreements - each one of which yielding differing stakeholder expectations. Airtrain's contract involves no cost to the state government or Queensland Rail (QR), which operates the service until the end of the 35-year concession. Construction and operation of the $A 220 million ($US 114.2 million) line is funded by 33-year bonds. Track for almost the entire line was constructed on a concrete pier viaduct, something never before undertaken in Australia on such a scale.

Issues

Similar to the Sydney Airport Rail Link, the primary issue has been the relatively high fares required to recover the construction cost, which compare unfavourably to the zone-based fares on the rest of the Brisbane Citytrain system, with which the service is integrated. To use the service from stations between South Bank and Eagle Junction on journeys expressly to and from Brisbane Airport, costs $11 each way. Concession fares are not offered for the AirTrain's Airport travel. Travel on the AirTrain between ordinary CityTrain stations, which do not include Airport travel, is charged at the usual (lower) CityTrain rate, including concession rates (i.e. it is only when the AirTrain service includes actual travel to and from the Brisbane Airport that the charge is higher than the CityTrain fare).

As of April 2005, Brisbane Airport Corporation announced that the AirTrain service would be running at a profit for the first time, due to passenger growth and managerial restructuring of the operator. This has not stopped calls for the service to be brought within the Translink price structure, which would mean a service nearly four times cheaper.

Comments on Results Achieved

Clearly, combining public and private sector infrastructure investment, construction and operations presents public communications and integration challenges. Nonetheless, the willingness of the public to pay higher fares for travel to an airport (compared to the cost of taxis and limos) can make projects of this nature feasible, provided the size of the facility and resultant point-to-point demand is sufficient to warrant the investment.

It is interesting to note that similar projects have been proposed for Toronto and Montreal, whereas the Canada Line in Vancouver (see Project Case Study 1) is committed to offering travel to and from the Vancouver International Airport at a flat fare consistent with the remainder of the TransLink system.

Project Case Study 10 – Innovative Demand Side Management Financing, City of Toronto

Overview

The "Element" residential project in Toronto's entertainment district combines high standards of building construction and relatively new technologies with innovative financing and an innovative energy technology, supplied by a joint-venture of the City of Toronto called "Enwave". Enwave is one of the largest district energy systems in North America, serving 51 percent of the potential heating market and providing heating and/or cooling services to over 140 institutional and commercial buildings in downtown Toronto. Enwave was reconstituted in December 1999 as a private corporation with OMERS (the Borealis Penco Fund) and the City of Toronto as shareholders.

Deep lake water cooling (DLWC) eliminates 500,000 kWh of electricity per year and no maintenance for air conditioning equipment is required. The Enwave DLWC is the largest system of its kind in the world, capable of servicing a large area of downtown Toronto. Three massive pipes extend 83 metres below the surface of Lake Ontario and extract water from its depths, where the temperature is a consistent 4 ^{0}C. By way of an energy-transfer station, cold-air energy is extracted and distributed to Enwave customers for air conditioning, while the clean, drinkable water continues on its way into the municipal supply.

The Element building envelope helps insulate residents from escalating energy prices. It includes low-emission, Argon-fill windows, high efficiency boilers (87 percent), low flow showerheads that save on gas consumption, Energy Star™ appliances, dual flush toilets, and water saving fixtures that save over 20 percent on water consumption.

Financing

Green, high-performance buildings add cost to development. But this added investment results directly in operating cost savings that accrue to the homeowner. Rather than raise the price of a home, the developer is partnering with the Toronto Atmospheric Fund (TAF) on an innovative financing approach that leverages operating cost savings to pay for incremental capital costs of energy efficient upgrades, like better heating and cooling equipment, ventilation systems, and building envelope (e.g., windows and walls).

Issues

Key issues to be resolved in developing this project included: bridging the gap between higher costs to the developer and impending savings to the condominium corporation; finding

a willing source of financing to bridge this gap; selecting viable building standards and technologies that would assure repayment of the TAF "green loan" through savings in energy and water consumption; and developing an adequate building load for the Enwave DLWC system.

Comments on Results Achieved

It is rather early to be drawing firm conclusions from the Toronto experience with green loans to reduce infrastructure demand. However, it would appear that there has been sufficient success to extend the technique to additional projects, and an announcement on this was anticipated prior to the end of 2006.

Innovation as a Solution

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1. Background/Introduction

1.1 National Round Table on Sustainable Infrastructure

Canadians enjoy an enviable quality of life. A significant factor to Canada's high-standard of living, productivity and global competitiveness is our capital stock of public infrastructure—buildings, bridges, highways and energy infrastructure. All levels of government share responsibility for funding and maintaining Canada's public infrastructure.

Despite its importance, our infrastructure is aging and stressed. A substantial portion of the country's public infrastructure was built more than 40 years ago.

Add to this, the fact that infrastructure-related technologies and innovations are not being developed and/or adopted quickly enough. Part of the reason for this is the lack of the appropriate data, forecasting and management tools required to assist in investment decision-making.

The "Civil Infrastructure Systems Technology Road Map", developed in consultation with many members of Canada's infrastructure community in 2003, suggested that there is a need and an appetite for a multi-stakeholder forum to address these issues. As a result, the National Round Table on Sustainable Infrastructure (NRTSI) has been established to be an independent, multi-stakeholder, non-partisan advisory body. It is a forum to bring together diverse and diffused communities—to generate greater understanding and synergies—in order to define issues of national priority, and to support the sustainable allocation of resources for the nation's infrastructure.

One of the outputs of the inaugural meeting of the NRTSI in December 2005 was the establishment of a working group (see Appendix A) to investigate innovation as a solution in infrastructure. This report documents the output of that working group.

1.2 Terms of Reference

The increased adoption of innovation (both technologies and practices) is crucial to the improved infrastructure performance in Canada. Clearly, decisions with a focus on the long-term, which take into account the full life-cycle, need to take the place of decisions currently based on immediate return or political gain.

This working group has conducted a review of relevant work and prepared this report to help decision-makers in understanding the benefits of adopting innovation and to assist technical staff in making the necessary case for innovative solutions to these decision-makers.

The working group reviewed over 30 definitions of innovation from sources throughout the world. A synthesis is presented in Section 2. It also reviewed seven reports (Appendix B) that had evaluated innovation in construction to assess the barriers to the adoption of innovation and the methods to overcome those barriers. Section 3 provides a summary of the barriers. The working group also reviewed twelve case studies highlighting a combination of both technical and management innovations. All the case studies are provided in Appendix C. These cases were analyzed in order to identify the issues surrounding the barriers to the adoption of innovation and the methods used to overcome those barriers. This analysis is presented in Section 3. Finally, Section 4 stresses the benefits of innovation and the recipients of the benefits identified in these case studies.

This report ends by providing some recommendations to assist in building the case for innovative solutions.

2. Definition of Innovation

Definitions were evaluated for appropriateness in dealing with a product or process:

- Newness
- Significant difference
  — Market introduction (post R&D)
- Ability to improve a situation

The working group determined that selecting one definition would be too restrictive and proposes that the following two definitions provide adequate description to innovation in the context of this work:

1. Innovation is the creation, development and implementation of a new product, process or service, with the aim of improving efficiency, effectiveness or competitive advantage. Innovation should apply to products, services, manufacturing processes, managerial processes or the design of an organization.

   It is most often viewed at a product or process level, where product innovation satisfies a customer's needs and process innovation improves efficiency and effectiveness.

2. Innovation is the process of converting knowledge and ideas into new or improved products and services that are valued by the community (i.e. construction industry) or into better ways of doing business (sustainable infrastructure). The innovation process incorporates research and development, commercialization and technology diffusion.

In addition, for the record, the Conference Board of Canada offers this broader definition which also appealed to the working group. This definition is:

"A process through which economic or social value is extracted from knowledge—through the creation, diffusion, and transformation of ideas—to produce new or significantly improved products or processes".

3. Issues Regarding the Adoption of Innovation

The working group reviewed seven reports that had investigated and or evaluated at the aspect of innovation in construction or infrastructure with the intent to identify: the issues surrounding the barriers to the adoption of innovation; the methods used to overcome those barriers; the benefits of innovation; and the recipients of the benefits.

The barriers to innovation are well documented and the methods to overcome those barriers are both diverse and less well documented. The barriers can be grouped into the following categories:

Industry structure, governance and fiscal issues
Industry fragmentation; very tradition based; distrust between owner and contactor; lowest initial cost procurement as opposed to quality and life-cycle value; low and unpredictable profit margins; low investment in new equipment.

R&D – Expenditure, focus and transfer
Insufficient R&D investment by government and/or industry; inappropriate tax incentives; informal or proprietary innovation; lack of focus in R&D spending; overly slow and poor dissemination of new ideas.

Regulations – codes and standards
Codes and standards that are overly-prescriptive or are otherwise out of date, so as to not facilitate implementation and acceptance of the technology; inappropriately enforced and onerous regulations.

Skilled workers
Lack of skilled workers and in-house expertise; low investment in training.

Relevance to the owner
High cost to acquire innovative product or process; low perceived benefit to owners from innovation; unwillingness of building owners/financiers to pay for development of innovations; low interest by clients.

Risk allocation
Allocation of risk and reward between the owner/client and the designer/contractor does not support innovation; fear of risk-taking and litigation; resistance to change; onerous liabilities.

Overcoming barriers
With respect to overcoming the barriers to innovation, the most stated method reflected a user's ability to justify the innovation by showing that the benefit outweighed the cost / effort (i.e. they made the business case).

Also, experience has shown that when feasible, proactive discussions with regulators as well as codes, standards and training bodies can accelerate the early adoption and acceptance of new technologies and methods.

Having the necessary enabling standards and regulatory acceptance in place up-front can also help to mitigate perceived risk of implementation.

Having reviewed the issues surrounding the adoption of innovation, the working group then decided to look for examples (case studies) where innovation was adopted and to document the benefits / compelling reason(s) why clients, owners and the industry should be more innovative in its work.

4. Benefits of Innovation

4.1 Results from Case Studies

The working group identified case studies where innovative processes or technologies had occurred through a review of research reports, publications, Infraguide and industry contacts. The case studies reviewed are not an exhaustive list of innovations but were the ones that could be reviewed with the time and resources available. In total, 12 case studies were reviewed and all the case studies are included in Appendix C.

The benefits arising from the adoption of innovation varied significantly within the case studies with some benefits easily quantifiable while others were not so easily quantifiable. The following briefly summarizes the identified benefits from each case study:

Case Study 1: **Across Canada – Facilitating more durable, resilient concrete structures via diagnosis, remediation and prevention of Alkali-Aggregate Reaction.**	
Monetary benefit	• Premature failures avoided thereby increasing the service life of structures and reducing repair and remediation costs • Scarce financial resources re-distributed elsewhere
Non-monetary benefits	• Service levels to users maintained
Other public benefits	• Service life of a broad array of concrete infrastructure assets extended
Case Study 2: **Calgary - Biological nutrient removal from municipal wastewater**	
Monetary benefit	• Annual savings in chemical costs estimated to be in excess of $2 million per year, (over $50 million saved since conversion)
Non-monetary benefits	• Reduced environmental impact on Bow River by reduction of leaching nutrients and chemicals
Other public benefits	• Economic: Knowledge-based economy strengthened as Calgary's consulting community exported knowledge gained from Bonnybrook experience to worldwide market. • Recognition-Bonnybrook plant receives international visitors to view the process and is known for being the first, full scale tertiary treatment wastewater facility. Calgary receives high marks from environmental assessors. BBC recently produced a program examining why Calgary's plan is so highly regarded.

Case Study 3: **Cambridge – Application of asset management**	
Monetary benefit	Not determined.
Non-monetary benefits	• Management of city's infrastructure. • Budget for asset management obtained. • Condition rating and prioritization of replacement or rehabilitation of assets will be possible.
Other public benefits	• Not determined.
Case Study 4: **Confederation Bridge - A P3 with innovative structural design and construction materials.**	
Monetary benefit	• High durability structure, lower maintenance costs (i.e. life-cycle considered), improved safety (lowering claims).
Non-monetary benefits	• Added flexibility in mobility of people, goods and services between Prince Edward Island and the mainland.
Other public benefits	• Not determined.
Case Study 5: **Edmonton - Asset Accounting Implementation for Drainage Services**	
Monetary benefit	• Provides more accurate information for setting depreciation and utility rates.
Non-monetary benefits	• Drainage Services is ready for impending accounting changes. • Provides more public transparency through more detailed cost of service information.
Other public benefits	• Not determined.
Case study 6: **Halifax Regional Water Commission—Reduction of leakage**	
Monetary benefit	• Savings of half-a-million dollars per year. • Deferral of capital investment.
Non-monetary benefits	• Reduced leakage by 30 million litres per day. • Less wear and tear on system extends life-cycle.
Other public benefits	• Less disruption of service to customers. • Drastically reduced liability due to reduced risk of streets and adjacent property being damaged from aggravated leakage.

Case Study 7: **London – Best practices in coordinating infrastructure works**	
Monetary benefit	Not determined.
Non-monetary benefits	• London has gained considerable legitimacy for infrastructure management and municipal administrators are now aware of how to further improve future infrastructure works. • Moved the city towards more effective coordination of infrastructure projects. • Important tool for council—providing a base understanding of issues and resulting in positive proactive steps.
Other public benefits	Not determined.
Case Study 8: **Alberta—Municipal Infrastructure Management System, an asset management software for small to medium municipalities**	
Monetary benefit	• The initiative has provided a Tool Set valued at $40,000 that small to medium municipalities could otherwise not afford. Additionally, the Municipal Infrastructure Management System (MIMS) support team provides consultative services (spatial data reviews, training, installations and on-going support) valued at over $20,000 per site. • The major monetary benefits are in risk reduction and improved information handling that are conservatively estimated at $40,000 annually per site based on having a consistent, accurate and available data set. This contributes to reduced costs for new engineering projects, earlier repairs and maintenance and more. • The returns will continue to accrue in years to come as additional sites join the program and the information is leveraged for better decision-making.
Non-monetary benefits / Other public benefits	• Improved and sustainable infrastructure information ensures future generations will have sound, consistent information to make better decisions supporting the health and safety of their communities. • Engineering firms have joined onto the program as they see the logical benefits of working with existing, consistent and standardized information.

Case Study 9: **Advancing Canadian Wastewater Assets at the Pine Creek Centre - Enable full-scale research in wastewater treatment**	
Monetary benefits	• A thorough understanding of new options for wastewater treatment, storm water treatment, and pollution impacts on surface and groundwater receiving bodies will allow designers to reduce artificially high safety factors in new designs and allow operators to increase effluent throughput in existing treatment plants with resulting reduction in capital and operating costs. • An estimated $27 billion (CWWA, 2003) in economic benefits for all Canadian municipalities could be realized just by making better use of existing treatment plant capacity. • The ACWA facility will also yield other real tangible benefits to Canadians beyond savings in deferred capital expenditures and operational costs. Health is a top priority to Canadians.
Non-monetary benefits	• Less environmental impact
Other public benefits	• ACWA will push the technological boundaries of wastewater treatment to safeguard the public against threats to their health. • New and emerging pollutants and pathogens pose a serious risk to public health. Research to be undertaken at the ACWA facility will be a crucial element to the development of effective and cost efficient treatment technologies to address these pollutants and pathogens. • These advancements in basic and applied knowledge will keep the knowledge-based consulting industry competitive in the significant world water economy, and create an opportunity to grow Canada's manufacturing and service industry.
Case Study 10: **Calgary Shawnessy LRT Station - use of innovative concrete material to provide durability and aesthetically-pleasing structure**	
Monetary benefit	• Reduced likelihood of future maintenance problems due to reduction of steel reinforcing and hence improved life-cycle costs.
Non-monetary benefits	• Not determined.
Other public benefits	• Aesthetically pleasing, functional and durable roof structure for the LRT station.

Case Study 11: **Edmonton - Use of granular materials to reduce sidewalk cracking**	
Monetary benefit	• Expectations are that sidewalk life-cycles have been at least doubled as a result of using an updated / innovative construction process. Adoption of this new technique has resulted in the continuation of sidewalk construction spending.
Non-monetary benefits	• Sidewalks stay in good condition longer, providing better service to the public and reducing complaints.
Other public benefits	• Not determined.
Case Study 12: **Ottawa - Cost-Benefit Analysis to Determine Water Requirements for Fire Protection**	
Monetary benefit	Annual savings of between $1.0 and $1.25 million were determined to be possible for Ottawa by using reduced water main sizes – this based on water flow for fire R&D. Anticipated savings are: • 15 % for new developments • 6 to 10 % for pipe replacement • 9 to 12 % for structural rehabilitation
Non-monetary benefits	Improved quality of potable water through reduced aging of water in pipes.
Other public benefits	Increased potential for the use of trenchless technologies for rehabilitation reducing disruption to the community.

4.2 Benefits of Innovation

One of the initial intents of the working group was to document the benefits of innovation to assist the proponent in making the compelling case for innovation in projects. Unfortunately the benefits of innovation are not well documented and concrete information is not readily available.

The benefits that had been identified in the case studies were analysed to determine the nature of the benefits that had been identified and to group them according to monetary, non-monetary and societal benefits. In addition, the working group supplemented the listed benefits with additional ones based on their own experience and background. Some of the benefits of innovation are summarized in the following groupings:

Monetary Benefits

The monetary benefits of an innovation are the ones that many decision-makers are looking for. Many of these innovations have higher initial costs with savings coming from longer-term benefits that may not be easily quantified and can only be determined based on assumptions. The benefits tend to occur in the following areas:

- Initial cost savings through a newer technology, enhanced process, reduced capacity requirements, etc.
- Operational cost savings through reduced chemicals, reduced usage, reduced losses, etc.
- Maintenance cost savings
- Deferral of capital investments through longer life spans, improved operations
- Improved accuracy in setting depreciation and rates
- Reduced risk

Non-monetary

The non-monetary benefits are often improved environment, increased economic parameters, operational improvements, etc. Some specific benefits observed in these case studies are:

- Reduced environmental impact on local watercourses through the reduction of nutrients and chemicals
- Increased service levels
- Improved asset management
- Improved information management

Societal

The societal benefits of innovation are often broader in scope than the monetary or non-monetary benefits and can often be mixed with the overall societal benefit of the new infrastructure project. Some specific benefits observed in the case studies are:

- Improved economic climate through increased flexibility and mobility of goods and people
- Improved processes for the management of infrastructure
- A more sustainable infrastructure
- An infrastructure that can more easily adapt to the demands of the changing climate
- Transfer of technology to local firms improving their potential for international activity
- Improved aesthetics

Societal benefits should fit with the community's values and priorities and the proponent should show how the project enhances the value to the community.

4.3 Determining the Benefits

The following cost / benefit statements are intended to give some direction to the proponent (champion) of an innovation in determining the benefits of that innovation so that the decision makers can be more easily shown the benefits. It is not intended to be an all-inclusive approach but a set of examples that will help the proponent in preparing the compelling case for the innovation.

1. Time and effort saved by reducing the decision-making process can be translated into salaries.

2. The saving on maintenance and operation costs can be estimated through assuming the reduction and calculating the savings.

3. The economic benefit of an improvement such as reduced disruption during the construction of the infrastructure can be determined by estimating the impact of the improvement. For instance impact on car flows using an old roadway repair method can be quantified and then the estimated improvement with the new method can be determined to give the improvement.

4. Life-cycle cost / benefit analysis looks at the total cost and benefits of construction, operation and maintenance, rehabilitation and replacement over the life of the project and can allow for an estimation of money saved by extending the service life of a project or structure; for example, investing $10 million for 10 years vs investing $12 million for 20 years represents a minimum (without accounting for inflation) of $0.4 million saving per year for 20 years or $8 million total.

5. For projects that can be repeated elsewhere determine the potential savings from each project to determine the economic or non-monetary benefit of the innovation when it is proven.

6. Estimate the saving from reducing damage, urgent repairs and failures cost per year (failures including saving from less claims) from using the improved technology or procedure.

5. Summary and Recommendations

There is not one simple definition for 'innovation' but a multiple of terms that are often developed for a specific industry or situation. In all considerations it is obvious that for infrastructure any definition of innovation must consider both technical and non-technical aspects. In fact, many of the more successful examples of innovation have involved management or process changes.

A significant amount of research has been conducted into the barriers to innovation and the methods to overcome those barriers. Less research has been done on the benefits of innovation and how to quantify those benefits. This said, it is clear that organizations that regularly adopt innovation focus on the benefits.

Developing a case to proceed with an innovative technology, application or management process is not an easy task. Decision-makers are reluctant to invest in an untried approach that contains both known and unknown risks. In preparing the rationale, successful proponents have been able to mitigate the risk through prototypes, case studies and phased approaches. When the perceived benefits of

the innovation are clearly greater than the perceived risks or costs, obtaining approval from the decision-maker is easier.

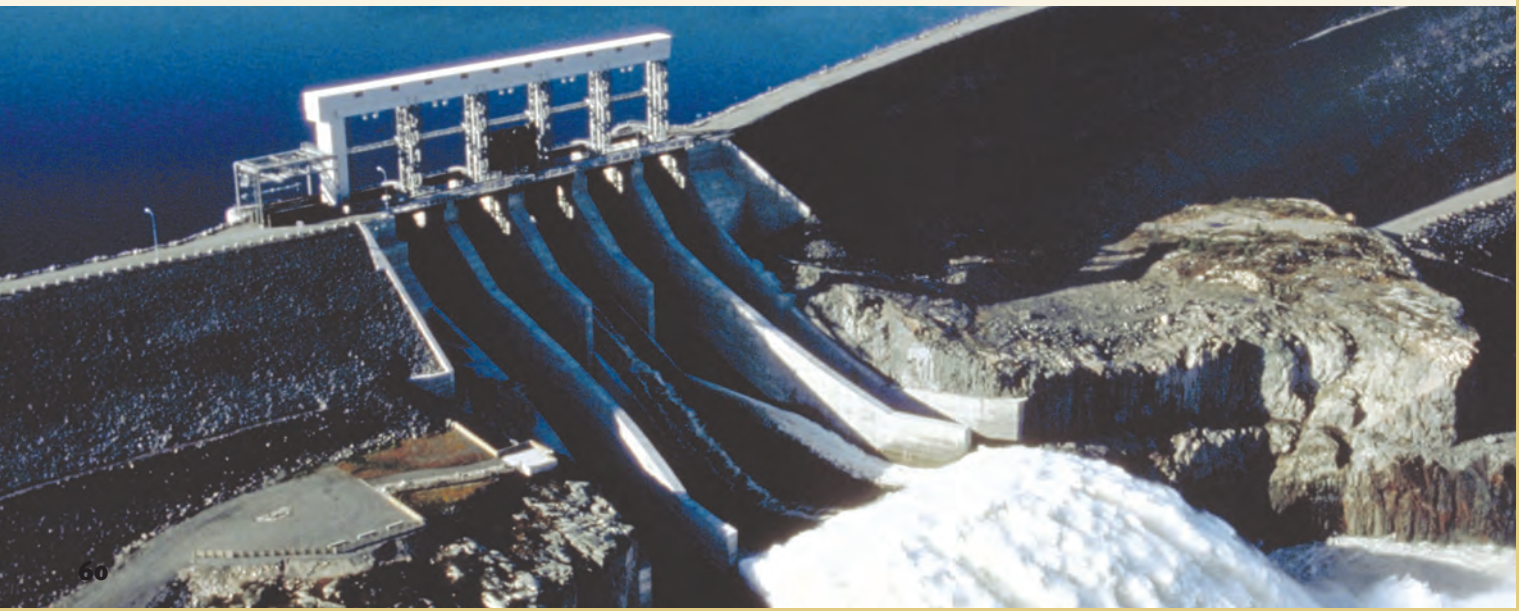
It is therefore more important to concentrate on the benefits not the barriers. Unfortunately the benefits of innovation are not well documented and more work is required to provide adequate examples for proponents. However in the case studies that were reviewed the benefits of the innovation were always considered worth the effort.

Many benefits come from a longer-term perspective requiring life-cycle analysis. The proponent should look for savings in all areas: initial capital cost, labour, maintenance, operations, deferred capital expenditure, the environment, speed and ease of construction, minimized disruption to the community, etc.

While the decision-makers will be looking for monetary benefits it is important not to ignore or diminish the sometimes greater non-monetary benefits. Societal benefits might be the most significant benefits but are also the most difficult to quantify. It is important to show how the project enhances the community's values and priorities. In addition always consider the economic spin-offs from nurturing local firms with new ideas that may go onto compete nationally or globally.

In moving forward the working group recommends that the following be considered by the National Round Table on Sustainable Infrastructure:

- Develop methods, based on best practices, that will facilitate proponents in quantifying the benefits of innovation while the project is being planned and to measure the benefits once a project is completed.
- Document the benefits of innovation through enhancing the case studies reviewed and developing additional case studies.
- Communicate the benefits of these innovations to all involved in infrastructure.



Appendix A – Reports Reviewed

Submission to Innovation Strategy (2002)—The National Steering Committee for Innovation in Construction - http://www.innovation.gc.ca/gol/innovation/site.nsf/en/in02370.html

Submission to Innovation Strategy (2002) —Achieving Excellence in Construction. Prepared by: Pieter Van Vliet, P. Eng., FEIC, FCSME - Chair, Canadian Construction Research Board. http://www.innovation.gc.ca/gol/innovation/site.nsf/en/in02302.html

The Canadian Construction, Architecture and Engineering Industry-2002. Industry Innovation Profile. http://www.innovation.gc.ca/gol/innovation/site.nsf/en/in02571.html

FCM Submission on Canada's Innovation Strategy submitted by the Federation of Canadian Municipalities to the Honourable Allan Rock, P.C., M.P., and the Honourable Jane Stewart, P.C., M.P. http://www.innovation.gc.ca/gol/innovation/site.nsf/en/in02321.html

Submission to Innovation Strategy—The Housing Industry submitted by The Canadian Home Builders' Association http://www.innovation.gc.ca/gol/innovation/site.nsf/en/in02277.html

Survey of Improvement and Innovation in Construction Investments http://www.statcan.ca/cgi-bin/imdb/p2SV.pl?Function=getSurvey&SDDS=5010&lang=en&db=IMDB&dbg=f&adm=8&dis=2

From Vertical to Horizontal: Learning from the Innovations of the Building Construction Industry (Federal Highway Administration) http://www.tfhrc.gov/focus/aug05/02.htm

Appendix B – Case Studies

The following twelve case studies were reviewed:

Case study 1	Across Canada—Facilitating more durable, resilient concrete structures via diagnosis, remediation and prevention of Alkali-Aggregate Reaction
Case study 2	Calgary—Biological Nutrient Removal from Municipal Wastewater
Case study 3	Cambridge—Application of Asset Management
Case study 4	Confederation Bridge—A P3 with innovative structural design and construction materials
Case study 5	Edmonton—Asset Accounting implementation for Drainage Services
Case study 6	Halifax Regional Water Commission—Reduction of Leakage
Case study 7	London—Best Practices in Coordinating Infrastructure Works
Case study 8	Alberta—Municipal Infrastructure Management System, an Asset Management Software for Medium to Small Municipalities
Case study 9	Advancing Canadian Wastewater Assets at the Pine Creek Centre—Enable Full-scale Research in Wastewater Treatment
Case study 10	Calgary Shawnessy LRT Station—use of Innovative Concrete Material to Provide Durability and Aesthetically Pleasing Structure
Case study 11	Edmonton—Use of Granular Materials to Reduce Sidewalk Cracking
Case study 12	Ottawa—Cost Benefit Analysis to Determine Water Requirements for Fire Protection

Case Study 1:

Facilitating more durable, resilient concrete structures via diagnosis, remediation and prevention of Alkali-Aggregate Reaction

Community	**Across Canada**	Province	Ontario, Quebec, Atlantic Canada
		Date	

Context of the innovation:
The problem of alkali-aggregate reaction (AAR) in concrete infrastructure was recognized more than 60 years ago. It has affected a range of infrastructure assets and sub-systems including: bridges, piers, walkways, stairs, barriers, and dams to name a few. In Canada, potentially reactive aggregates occur in all regions, with the most severe cases of deleterious expansion of concrete being found in Ontario, Quebec and Atlantic Canada.

Nature of the innovation: Canadian engineers and scientists are well recognized for their work in the identification of AAR aggregates, as well as for the development of methods to mitigate the impacts of AAR and to treat structures that have been damaged by AAR.

Perceived challenges to be overcome:
Ongoing need for applied R & D in response to new materials, construction processes and environmental constraints related to sourcing, utilization and recycling of Canada's construction aggregate resources emerge.

Dissemination and updating of mainstream practitioners on how to remediate existing affected structures.

Dissemination and updating of mainstream practitioners on how to prevent the impacts of AAR in new structures.

How were the challenges overcome:

Research in this field is ongoing and standards and guidelines dealing with AAR issues are updated frequently.

Dissemination of this knowledge to mainstream practitioners is done via the inclusion of this knowledge in relevant CSA standards such as: A23.1 "Concrete Materials and Methods of Construction" which is broadly referenced in all parts of the country within building codes, infrastructure codes, the National Master Specification, local by-laws and related contracts. Another CSA publication, A864, "Guide to the Evaluation and Management of Concrete Structures Affected by Alkali-Aggregate Reaction" provides a summary of current practice in this area.

The CSA publications are augmented via training courses and professional seminars that are offered by a broad array of providers including: colleges, universities, industry associations and professional societies.

Perceived or real results

	Monetary benefit	Premature failures avoided increasing the service life of structures and reducing repair and remediation costs. Scarce financial resources can be re-deployed elsewhere.
	Non-monetary benefits	Service levels to users maintained.
	Other public benefits Was the innovation worth the effort	Service life of a broad array of concrete infrastructure assets extended. Yes

Transfer of innovation

	Who else has used it	Canadian expertise is recognized as world-class, and Canadian working groups have attracted corresponding members from the United States and Europe. Furthermore, CSA publications in this area are widely referenced and/or adapted for use in other countries.
	How were they informed	

Lessons learned or observations:

n/a

Case Study 2:

Calgary-Biological Nutrient Removal from Municipal Wastewater

Community	**City of Calgary**	Province	Alberta
		Date	1980s/ongoing
Context of the innovation			
Replacing the chemical process for nutrient reduction in wastewater with a natural process			
Nature of the innovation			
Creating an environment in the wastewater process stream that encourages the growth of specific organisms that reduce/consume nitrogen and phosphorous from the wastewater.			
Perceived challenges to be overcome			
Proving the innovation was "market ready" by implementing the concept at full scale without upsetting the existing processes and hence impacting discharge quality of the effluent released to the receiving water body. Retrofitting the process module into existing secondary treatment plants.			
How were the challenges overcome			
City of Calgary was prepared to test this process at full scale by phasing it into the Bonnybrook Plant on a module by module basis. Engineering designs were prepared for retrofit of existing chambers to create the necessary environmental conditions.			

Perceived or real results		
	Monetary benefit	Annual savings in chemical costs estimated to be in excess of $2 million per year (over $50 million saved since conversion)
	Non-monetary benefits	Reduced environmental impact on Bow River by reduction of nutrients and chemicals
	Other public benefits	Economic: Knowledge-based economy strengthened as Calgary's consulting community exported knowledge gained from Bonnybrook experience to worldwide market. Recognition: Bonnybrook plant receives international visitors to view the process and is known for being first full scale tertiary treatment wastewater facility. Calgary receives high marks from environmental assessors. BBC recently produced a program examining why Calgary's plant is so highly regarded.
	Was the innovation worth the effort	The final results have exceeded the original expectations, and this process has become the model/standard for the industry.
Transfer of innovation		
	Who else has used it	It is used worldwide with the Bochton plant in the U.K. as an example of an existing facility that was converted to tertiary treatment.
	How were they informed	Marketing conducted by Calgary's design engineering community, technical papers presented at technical conferences in Canada and abroad.
Lessons learned or observations		
Cooperation between regulators, operators, engineers and scientists and the water industry can lead to innovations which can be made market ready by testing at full scale, when risks and consequences are understood and mitigated.		

Case Study 3:

Cambridge-Application of Asset Management

Community	**City of Cambridge**	Province	Ontario
		Date	2005

Context of the innovation

The City of Cambridge has developed an aggressive approach towards managing its infrastructure assets more effectively by introducing new technical skill sets and associated technology highlighted by InfraGuide best practices. Cambridge has dedicated $1.5 million towards a new asset management division based on InfraGuide best practices.

Nature of the innovation

Perceived challenges to be overcome

"Cambridge has a very capital-intensive public works operation with thousands of records and pieces of information that could not be managed without the assistance of computer technology. Studies conducted by the city have found that it is not managing infrastructure in a cohesive way and various divisions and individuals approach asset management in a disjointed way. There exists no cohesive approach to asset management, making it very difficult to manage.

How were the challenges overcome

- Used several InfraGuide best practices including *Planning and Defining Municipal Infrastructure Needs* and *Managing Infrastructure Assets*.
- Developed a clear vision and presented logical and defensible case for the development of a comprehensive system to manage municipal asset statistics.
- Created Asset Management Division to consolidate the fragmented work of managing infrastructure assets.

Perceived or real results		
	Monetary benefit	
	Non-monetary benefits	• Management of city's infrastructure • Budget for asset management obtained • Condition rating and prioritization of replacement or rehabilitation of assets will be possible
	Other public benefits	
	Was the innovation worth the effort	Yes
Transfer of innovation		
	Who else has used it	n/a
	How were they informed	n/a
Lessons learned or observations		
n/a		

Case Study 4:

Confederation Bridge - A P3 with innovative structural design and construction materials

Community	**Cape Jourimain, New Brunswick, and Borden-Carleton, Prince Edward Island**	Province	Prince Edward Island and New Brunswick
		Date	1997

Context of the innovation:
At the time that Prince Edward Island joined Confederation in 1873, the federal government promised the Islanders continuous transport between Prince Edward Island and the mainland.

The crossing was quite dangerous, particularly in winter, for the small boats that had to travel through the ice and harsh sea conditions of the Northumberland Strait. Although a permanent ferry service was implemented across the Northumberland Strait in 1917, lobbying for a bridge crossing for motor vehicles went on for many years. Technological innovations in the late 1980s and early 1990s made the construction of the 13 kilometer Confederation Bridge possible.

In June of 1997, the Confederation Bridge, linking Cape Jourimain, New Brunswick, and Borden-Carleton, Prince Edward Island opened, providing a fixed link between the two provinces.

Nature of the innovation
There were a series of innovations in both structural engineering and construction materials technology that made construction of the Confederation Bridge possible. These included:

- One of the first structures in Canada to employ the 'companion-action' structural analysis and design.
- First structure in Canada to utilize high-performance, high-strength concrete formulations.
- One of the first structures that took into consideration, future climatic conditions and 'climate change' impacts during the design phase and well before 'climate change impacts' were generally accepted as a serious issue for Canada's infrastructure.

Perceived challenges to be overcome
- A structure with a specified 100 year service life in a severe Atlantic environment.
- Uncertainties in future weather patterns and climatic shifts including: hurricanes, wind loads and sea-ice.
- Highly corrosive, high-chloride environment.
- Wide temperature extremes.
- Access to navigation channel for sea vessels had to remain.

How were the challenges overcome
- High-performance, high-strength concrete materials were developed via research and development.
- Innovative structural design approach was employed (companion-action approach to design).

• The design team worked closely with climatologists to interpret weather uncertainties and to model possible future weather loads, and extreme weather scenarios. • The bridge height near the centre of the channel is sufficient to accommodate sea vessels – while other portions are lower so as to mitigate vulnerabilities due to high wind loads.		
Perceived or real results		
	Monetary benefit	High-durability structure; lowers maintenance costs, improves safety (lowering claims).
	Non-monetary benefits	Added flexibility in mobility of people, goods and services between Prince Edward Island and the mainland.
	Other public benefits	
	Was the innovation worth the effort	Yes.
Transfer of innovation		
	Who else has used it	Many of the technological innovations that were developed for the Confederation Bridge have become part of mainstream practice within the Canadian civil engineering community.
	How were they informed	CSA standards as well as the National Building Code of Canada, along with various handbooks from industry sector associations are facilitating the transfer of this knowledge into mainstream practice. For example: • High-performance concrete is now a basic reference within CSA concrete material standards. • The Companion Action structural design approach is now employed within all CSA structural design standards (concrete, masonry, steel and wood) and as well, is part of the National Building Code of Canada, 2005. • This technology is making its way into university and college curricula, as well as numerous continuing education seminars for practitioners, available through a variety of sources.
Lessons learned or observations		
n/a		

Case Study 5:

Edmonton-Asset Accounting Implementation for Drainage Services

Community	**Edmonton**	Province	Alberta
		Date	January 1, 2004
Context of the innovation			
In preparation of impending accounting standards requiring municipalities to better account for their assets through capitalization and depreciation, the City of Edmonton's Drainage Services Branch proactively implemented an asset accounting system on January 1, 2004. This system allows users to extract more detailed information for better decision-making and for satisfying increasing pressures for transparency by the public sector.			
Nature of the innovation			
Prior to the implementation of the Asset Accounting (AA) system, all assets were put into one broad category and depreciated. The process of developing the AA system involved first defining all assets through the development of a Property Unit Catalog, classifying the assets into manageable classes and then depreciating each class separately. The system also takes into account asset retirements. The development of the AA system took approximately 2 years and involved organizational and process changes.			
Perceived challenges to be overcome			
• Significant process redesign • Education and training • Alignment with existing systems • Allocation of resources for project			
How were the challenges overcome			
Challenges were overcome through upper management support and hiring of an external consultant to work through the issues.			

Perceived challenges to be overcome

- Significant process redesign
- Education and training
- Alignment with existing systems
- Allocation of resources for project

How were the challenges overcome

Challenges were overcome through upper management support and hiring of an external consultant to work through the issues.

Perceived or real results

Monetary benefits	The asset accounting system provides more accurate information for setting depreciation and utility rates, and it supports future rate structure and cost allocation reviews. In addition, the asset accounting system is proposed to be a platform for the development of asset management tools.
Non-monetary benefits	Public transparency is provided by the asset accounting system through the tracking of more detailed cost of services information. In addition, drainage services will be ready for impending accounting changes.
Other public benefits	
Was the innovation worth the effort	Yes

Transfer of innovation

Who else has used it	Mobile Equipment Services (MES) Branch of Corporate Services Department
How were they informed	Personnel from drainage met and worked with MES staff.

Lessons learned or observations

- It is very important to have the appropriate people on the project steering committee to champion the project.
- Communication throughout the project is critical. It is important to have periodic updates, and technology can be used to your advantage (e.g. intranet postings).
- The basic IT framework for the asset accounting system is based on SAP, one of Edmonton's corporate systems. They tried not to over-customize, as it would create additional upfront and maintenance work later. In addition, over-customization would make it more difficult for other departments to fit into the system.

Case Study 6:

Halifax Regional Water Commission—Reduction of Leakage

Community	**Halifax**	Province	Ontario
		Date	2005

Context of the innovation

The Halifax Regional Water Commission uses a holistic approach to reduce its leakage within the water distribution system. This approach centers around leak detection, metering, speed and quality of repairs, and asset management. This holistic approach initially developed by the International Water Association can be found in various InfraGuide best practices. Implementing these InfraGuide methodologies has helped Halifax save millions of dollars to date.

Nature of the innovation

Perceived challenges to be overcome

"Leakage is a serious problem across Canada where between 10% and 50% of potable water is lost due to leaking pipes in the distribution system. In older cities deteriorating municipal infrastructure causes potable water leakage to be as high as 30% to 50%. This is not only a waste of a precious resource but also valuable tax dollars.

How were the challenges overcome

"... adopt an international best practice on water loss control in the distribution system and revolutionize their leakage prevention."

- Used InfraGuide – *Water Use and Loss in the Distribution System*.
- Implemented a fully metered system for 100% accountability and effective control of water.

Perceived or real results

Monetary benefit	• Savings of half a million dollars per year • Deferral of capital investment
Non-monetary benefits	• Reduced leakage by 30 million litres per day • Less wear and tear on system extends life-cycle
Other public benefits	• Less disruption of service to customers • Drastically reduced liability due to reduced risk of streets and adjacent property being damaged from aggravated leakage
Was the innovation worth the effort	Yes

Transfer of innovation		
	Who else has used it	
	How were they informed	
Lessons learned or observations		
n/a		

Case Study 7:

London—Best Practices in Coordinating Infrastructure Works

Community	**City of London**	Province	Ontario
		Date	2005

Context of the innovation

The City of London has successfully applied the InfraGuide best practice *Coordinating Infrastructure Works*, resulting in significant efficiency gains in the areas of pavement degradation fees and local improvement charges. London has witnessed several positive steps towards a widely coordinated infrastructure program, bringing significant credibility to the practices the City of London implements while minimizing disruption and maximizing the value of their infrastructure works.

Nature of the innovation

Perceived challenges to be overcome

Public works managers are often exposed to public complaints when poor coordination between infrastructure projects exists. Disruption and social costs to the community along with the perception of waste and inefficiency is an unfortunate, if inevitable outcome of a lack of effective coordination. This, along with fairly dramatic growth in new developments in cities such as London can negatively influence the coordination of infrastructure works.

How were the challenges overcome

- Used InfraGuide's *Coordinating Infrastructure Works*
- Adopted pavement degradation fees and local improvement charges.
- Other practices being implemented

Perceived or real results		
	Monetary benefit	
	Non-monetary benefits	• London has gained considerable legitimacy and municipal administrators are now aware of how to further improve future infrastructure works • Moved the city towards more effective coordination of infrastructure projects • Important took for council, providing a base understanding of the issues and resulting in positive proactive steps.
	Other public benefits	
	Was the innovation worth the effort	Yes
Transfer of innovation		
	Who else has used it	
	How were they informed	
Lessons learned or observations		
n/a		

Case Study 8:

Alberta - Municipal Infrastructure Management System, an Asset Management Software for Small to Medium Municipalities

Community	**Alberta Province Wide - >100 municipalities**	Province	Alberta
Prepared by	Barry Huyberts, MIMS Program Director, MIMS	Date	2003

Context of the innovation

We are in a period of significant concern regarding the state of municipal infrastructure. Financial constraints during the 1990s caused a lack of investment in new infrastructure to meet the demands of Alberta's growing economy, and to insufficient investment in the maintenance of existing roads, water and sewer systems, and other municipal infrastructure assets.

Some of the most pressing financial issues were addressed through the work of the Premier's Task Force on Infrastructure, whose recommendations in late 1999 led to a significant infusion of new provincial funds into municipal infrastructure. However, all parties recognized that a clearer understanding of infrastructure issues was necessary in order to address these challenges in a sustainable manner.

Alberta Municipal Affairs initiated discussions with the Alberta Urban Municipalities Association (AUMA) and the Alberta Association of Municipal Districts & Counties (AAMD&C) in early 2000 to explore the possibility of a joint effort to assist Alberta municipalities in understanding and better managing their infrastructure. It was immediately recognized that a broader approach to stakeholder involvement was required for such an undertaking, and as a result the Local Government Administration Association, the Alberta Rural Municipal Administrators Association, Alberta Environment and Alberta Infrastructure (later Alberta Transportation) were invited to join the initiative. These diverse entities, in conjunction with a consortium led by Sierra Systems and selected through a public RFP process to provide technical expertise, became the key partners in the Municipal Infrastructure Management System (MIMS) initiative.

The MIMS initiative was conceived by Alberta Municipal Affairs, AUMA and AAMD&C as a means of developing tools to help small- to medium-sized municipalities gather information about their infrastructure assets in standardized format, and then use that information to more effectively manage those assets. These municipalities were targeted out of recognition that unlike larger centres, few small to medium sized municipalities had sufficient local resources to develop their own infrastructure management solutions.

In light of the autonomy of municipal governments and their sensitivity to any perception that the province might impose new responsibilities or costs upon them, the MIMS partners recognized that municipal use of any infrastructure management solution would have to be voluntary. In addition, targeting small- to medium-sized municipalities meant that the MIMS initiative would need to not only address the range of technical infrastructure management requirements, but would also have to be suitable for use by smaller and less technically sophisticated municipal operations.

The MIMS partners responded by adopting an inclusive "grassroots"-driven approach, not only involving key stakeholders on the MIMS Management Committee, but also

ensuring direct participation of municipal clients during every phase of the project: via working groups, advisory groups, workshops, municipal pilot sites, and other means. From January 2000 to June 2003, the MIMS team developed a project blueprint, examined existing infrastructure management systems, gathered detailed information directly from municipal clients regarding their needs, and ultimately used that information to design and develop a new Municipal Infrastructure Management System (MIMS).

Canadian municipalities are becoming increasingly aware of the importance of a sound infrastructure to support the sustainability of their communities. Mayors and municipal officials spend significant effort dealing directly with infrastructure-related issues.

Knowing what you own (inventory) and what condition the assets are (condition assessment) are a basis for making sound decisions for operational maintenance and long-term capital replacement. The business drivers include sustainable community plans, accountability (understanding tangible assets), risk management, and health and social well-being.

Managing these large assets often requires key decisions and investments. Many small- to medium-sized municipalities have been unable to afford comprehensive infrastructure management systems while others have found these systems to be complex. Additionally, the recognition that asset management processes, resources, skills, and data standards vary greatly between municipalities required an innovative approach to ensuring data is consistent, reliable and accessible.

MIMS is an application that will allow municipal employees (Managers, Operations and Public Works) and engineering consultants to collect the right information, in the right way. This information can be located easily through a map viewer, which shows a graphical representation of your infrastructure. This enables municipalities to address their infrastructure data needs while having a tool to support information management and reporting.

The heart to the MIMS Tool Set is an integrated set of tools to view spatial data (CAD and GIS) and database information. The MIMS Tool Set and Six-Step getting started program are provided to Alberta municipalities at no direct cost, it is free! While this program is voluntary, over 100 communities have started with MIMS and another 60 are considering use of the MIMS.

MIMS
Municipal Infrastructure Management System

Nature of the innovation

The collaboration of municipal public works, municipal administrators, finance officers and engineers resulted in the development of this important tool set. These tools include asset inventory, condition, and work request modules supporting infrastructure networks for roads, water, sewer, storm, gas, and buildings. MIMS effectively tracks the inventory, condition assessment, and events about the assets which assists municipalities in the management of their infrastructure.

The backbone or heart to the MIMS Tool Set is an integrated set of geographic

information system (GIS) and infrastructure specific database tools including a map viewer for spatial, CAD, GIS data. For example, the location of a curb cock valve and all of its details such as depth of bury and type can be identified in seconds. MIMS enables public works employees to record what they know or need to know about the infrastructure. Data is stored in a centralized system and located through a map viewer showing a graphical representation of each infrastructure. Employees and partners can gain a broad picture of their infrastructure systems and stay on top of their condition assessments.

The MIMS application, tools and the program are the result of public/private cooperation and directly attributable to multi-levels of government and industry working toward a common interest – improvement of infrastructure management to support sustainability of communities.

The involvement of key stakeholders and municipal clients in each step within the MIMS development process, and the adoption of a thorough and deliberate approach to needs identification, has resulted in the release of MIMS 4.2, a fully functional, user-friendly infrastructure management system that is uniquely suited to the needs of small- to medium-sized municipalities including several First Nations communities.

Perceived challenges to be overcome

How to get municipal decision-makers to internalize the use of MIMS on a regular basis and as part of their long-term infrastructure planning and capital/operating budget setting? How to get municipal stakeholders to invest in good information management practices that will support the community?

A basic premise is that sound data forms a foundation for better planning and decision-making, in other words doing the right work at the right time should save money. Municipal representatives including council, chief administration officers, public works, and finance, worked with industry to identify the importance of asset information.

This means helping them change their current practice of paper-based, manual information management to easy-to-use technology supporting a sustainable and automated information approach.

Key issues were identified through open discussion and "brainstorming" at the Management Committee level, and through the direct input of municipal clients on the working groups. The active involvement of key stakeholders and clients ensured that critical issues affecting team performance were identified early in the process. Significant challenges identified early on include:

- Establishing a common vision for the MIMS initiative that encompassed the priorities and perspectives of a very diverse group of stakeholders.
- Ensuring the necessary expertise to address the complexity and functionality of the solution required.
- Variance and diversity of technology, experience and knowledge among team participants, stakeholders and clients.
- Municipal sensitivities regarding ownership of data, security of data, and potential costs associated with developing and using MIMS.
- Balancing the desire for quick results with the importance of fully understanding and responding to the needs identified by municipal users.

Each issue was addressed in a collaborative and proactive fashion, through open discussion at the Management Committee, and through direct participation of municipal clients on the working groups. Specific "problem-solving tools" utilized in this phase include:

- A special workshop to discuss and develop a common project vision.
- Regular review of the vision and guiding principles at each Management Committee meeting to reinforce a common project philosophy.
- Selection of a qualified consultant, through a public RFP process, to provide the Management Committee with needed technical expertise.
- Informal training provided by the consultant to Management Committee members, both individually and as a group.
- Open and ongoing dialogue at Management Committee meetings, and between team members outside of meetings.
- Both formal and informal project status reporting structures.
- Collaborative development of the tool set as a means to further investigate and ultimately address various stakeholder concerns.

How were the challenges overcome

The first step was to help communities understand the problem and challenges through presentations and workshops. Next, an application was developed to assist communities in gathering information about what they own and what condition these assets are in. Then a map viewer was integrated to allow municipalities to see their infrastructure information in context to their municipal property and other data sets (e.g., orthophotos). Finally, a work request module was developed to support day to day efforts (tactical) with the strategic management of the infrastructure.

Over the last three years the effort has focused on creating understanding and use of the tool through training and installation programs. This in turn has resulted in the significant uptake of the tools and greater awareness and interest in the program.

The intended benefits of the initiative have been realized:

- Municipal employees can easily locate important infrastructure within the community.
- Inventory of infrastructure networks and the related assets can be queried and reported.
- Condition and related events, testing, maintenance of the assets can be tracked.
- Information can be effectively shared with engineering and other partners.
- Users use common/standardized terminology through an easy to use interface.
- Data can be leveraged for other advanced engineering, spatial or finance applications.
- Information is available to support complex analysis and decision-making.

Client satisfaction with the project processes was measured through the structured (survey) and unstructured feedback from clients that came through the municipal association members on the Management Committee, feedback from municipal user sites, and through more formal vehicles such as the website, stakeholder conferences and meetings, and through letters, memos and e-mails. In addition, the Management Committee (which included direct representation from municipal clients) constantly evaluated project processes during their regular meetings through the review of status reports provided by the project manager.

Client satisfaction with project deliverables (the MIMS Tool Set and client training) was measured through a variety of formal and informal tools. Specific examples include: • Formal client satisfaction survey instruments. • Feedback solicited from pilot sites, prototype sites and end-users. • Feedback from presentations and workshops held for stakeholders groups. • Both solicited and unsolicited letters, e-mails or comments from clients/users. • The number and content of entries on the MIMS Problem Reporting Database and the maintenance of an "Issues log". • On-going feedback through the stakeholder representatives on the Management Committee. • On-going input from the User Advisory Committee.		
Perceived or real results		
	Monetary benefit	• Cost of system development/maintenance over 5 years is ~ $3M. • Cost of implementation and other data support over 5 years is ~ $2M. • Benefit based on Tool Set market value uptake by 100 sites at is ~ $5M, savings directly to municipalities based on market value cost of $40,000 for 4 asset modules and GIS tools. • Benefit based on leveraged implementation support (spatial data reviews, training, installations and on-going support) to 100 sites is ~ $3M, savings to municipalities based on $30,000 per site over ~ average 2-3 year period. • Improved efficiency based on 1 improved decision for 100 sites is ~$1M, assumed savings based on a single $1,000 improvement to asset repair or dig location identification. • Improved effectiveness based on 1 less risk situation for 100 sites is ~ $1M, assumed savings based on a single error or quality decision that took $1,000 in previous manual effort. The major monetary benefits are in risk reduction and improved information handling annually per site based on having a consistent, accurate and available data set. This contributes to reduced costs for new engineering projects, earlier repairs and maintenance and more. The returns will continue to accrue in years to come as additional sites join the program and the information is leveraged for better decision-making.

	Non-monetary benefits / Other public benefits	• Exceeded initial target audience of 50 sites • Voluntary uptake and interest by > 50% of all Alberta municipalities • >80% satisfaction level expressed in annual end program completion surveys • >80% satisfaction level expressed in training programs
		• >300 personnel trained in use of MIMS and infrastructure management • Recognition of program as recipient of the 2004 Premiers Award of Excellence • Recognition of program as recipient of Alberta Venture Performance Excellence 2004 • Voluntary commitment by Consulting Engineers of Alberta to program Improved and sustainable infrastructure information ensures future generations will have sound, consistent information to make better decisions supporting the health and safety of their communities. Engineering firms have joined onto the program as the see the logical benefits of working with existing, consistent and standardized information. Further indications of client satisfaction with project processes include: • Feedback from clients who participated at various stages of the project (for example, Brad Watson, manager of the Town of Swan Hills, wrote to Deputy Minister Brad Pickering in August 2002 saying "The MIMS Project is ... most worthwhile and it has been exciting for me to be involved"). • Numerous other direct testimonials have been received.
	Was the innovation worth the effort?	Absolutely! Numerous municipal stakeholders have provided positive testimonials and references for the difference MIMS makes within their communities. The journey is underway with the end outcome of better decision-making and ultimately more sustainable communities.
	What risks were identified and how were those risks managed?	The major risk identified at the beginning of the project was uptake and use by stakeholders. This risk was mitigated by: ensuring stakeholder input and design of the tool set; developing a standardized tool that would be modified once for everyone; ensuring the tool set was usable; and continually asking for feedback by users on the tool set. Another risk was the perceived concern by municipalities that 'big brother' was building a single repository to gather all their data. This risk was mitigated by ensuring municipalities could continue working

		with and leveraging their own data sets and maintaining those data sets in their own environment and with those of their engineering partners. This strategy also helped address a significant bandwidth issue whereby many communities lacked the infrastructure for a complex web-based tool that required large data set transfers.
		Finally, the risk of municipalities being unable to ensure effective data gathering was identified. This risk was mitigated by: leveraging numerous existing data sets; involving engineering firms in the use and support of the tool set; Alberta Municipal Affairs providing specific grant funding for infrastructure data gathering; providing multiple asset networks based on core data that allowed municipalities to begin the journey incrementally rather than in a big bang; and resource constraining expectation.
Transfer of innovation		
	Who else has used it	The tool set has been evaluated by non-municipal entities including the Centre for Sustainable Infrastructure Research in Regina, the National Research Council, and the Municipal Infrastructure Investment Program, all with a positive response. Further, several interested non-municipal users are currently assessing the tool set for potential use. Most importantly, a large number of the consulting engineers of Alberta have supported the program and are actively using MIMS to support their work and relationships with the municipalities–in other words the program standard has been adopted!
	How were they informed	Planned workshops, joint collaboration sessions, MIMS News, by word-of-mouth, formal conference presentations, and through the MIMS website.
Lessons learned or observations		
The focus of the initiative has been on developing a tool set that is user friendly, thereby allowing non-technical users and others to gain confidence in using MIMS and supporting their communities. This approach has resulted in a very positive response and uptake of the tools. The continuing approach to engage users with enhancements is also proving to be invaluable toward continuing innovation and user satisfaction. Additional information on the initiative and contacts for the program are available through www.abmims.org **Barry Huybens, CMC** **Sierra Systems** 10104-103rd Avenue Suite 1300 Bell Tower Edmonton, AB T5J 0H8 Dir | 780.412.2219 Cell | 780.718.7626 Tel | 780.424.0852 Fax | 780.426.0281 www.SierraSystems.com		

Case Study 9:

Advancing Canadian Wastewater Assets at the Pine Creek Centre - Enable Full-scale Research in Wastewater Treatment

Community	**Pine Creek Centre**	Province	Alberta
		Date	2006

Context of the innovation

There is no research facility in the world that enables full-scale research in wastewater treatment coupled with experimental facilities to assess the full impact of discharges on the receiving waters. ACWA fills this void and provides an unparalleled opportunity to undertake research never before possible.

Nature of the innovation

ACWA (Advancing Canadian Wastewater Assets) will be a unique, world-class facility for full-scale testing of new options for wastewater treatment, storm water treatment, and pollution impacts on surface and groundwater receiving bodies.

Perceived challenges to be overcome

Treatment plants operated by municipalities cannot be pushed to failure, nor is it possible to use them to study the fate and mass balance of emerging pathogens. Such research can only be conducted under the controlled environment of a dedicated research facility. This facility must also include the necessary infrastructure to quantify the complete ecological and toxicological impacts of plant effluent discharges to receiving waters, without placing the environment at risk. Experimental riverine channels close the loop between society, the natural environment and the technological solutions to our wastewater problems. New discoveries and the development of novel technologies will allow the knowledge-based component of the water industry to expand, and the supply and manufacturing related industries to test their innovative products at full scale allowing them to be deemed market-ready. The optimization of existing treatment facilities is essential to achieving cost-effective solutions.

How were the challenges overcome

To achieve the full potential of existing and future wastewater treatment infrastructure, full-scale facilities are required where wastewater technologies can be systematically pushed to their limits without placing the environment at risk.

Perceived or real results

Monetary benefits	A thorough understanding of these mechanisms will allow designers to reduce artificially high factors of safety in new designs and operators increase throughput on existing plants with the resultant reduction in capital and operating costs. An estimated $27 billion (CWWA, 2003) in economic benefits will be realized just by making better use of existing plant capacity. The ACWA facility will also yield other real tangible benefits to Canadians beyond savings in deferred capital expenditures and operational costs. Health is a top priority to Canadians.

	Non-monetary benefits	
	Other public benefits	ACWA will push the technological boundaries of wastewater treatment to safeguard the public against threats to their health. New and emerging pollutants and pathogens pose a serious risk to public health. Research to be undertaken at the ACWA facility will be a crucial element to the development of effective and cost-efficient treatment technologies to address these pollutants and pathogens. These advancements in basic and applied knowledge will keep the knowledge-based consulting industry competitive in the significant world water economy, and create an opportunity to grow Canada's manufacturing and service industry.
	Was the innovation worth the effort	
Transfer of innovation		
	Who else has used it	
	How were they informed	
Lessons learned or observations		
n/a		

Case Study 10:

Calgary Shawnessy LRT Station - use of Innovative Concrete Material to Provide Durability and Aesthetically Pleasing Structure

Community	**Calgary**	Province	Alberta
		Date	2004

Context of the innovation

Calgary is experiencing rapid growth in population and concurrent demand on urban infrastructure, particularly related to mobility. One response to this has been expansion of the city's existing light rail transit lines by extending them further into the suburbs. Recent expansion of the south line entailed construction of two new stations. The City of Calgary is committed to the use of innovative and durable solutions to help meet these growing demands.

Nature of the innovation

The use of a new, ultra-high strength, concrete, "Ductal®", in the construction of a thin, unreinforced shell roof/canopy system for the Shawnessy Light Rail Transit Station in Calgary. Use of this material would provide an aesthetically pleasing structure, which, because of the absence of reinforcement, would avoid durability issues typically associated with normal reinforced concrete or the use of other materials, such as structural steel.

Perceived challenges to be overcome

The primary challenge was the use of a new material in a new application, in a highly visible context. Analysis of the roof structure, using the measured properties of the material, suggested that the design was quite capable of resisting the design loads, however, the client, the City of Calgary, believed there was sufficient uncertainty in the behaviour, such that it required further confirmation of the performance. With concerns about the environment, safety and aesthetics, community input and acceptance of the design was also integral.

How were the challenges overcome

In a joint owner/contractor/university/consultant collaboration, a full-scale prototype of one of the roof elements was tested using the factored design loads for snow and wind. The testing addressed the issues of performance and the levels of stresses and deformations that resulted for the application of the factored design loads. The testing also addressed the potential problem of vibrations of the roof assembly. In all cases, the prototype performed better than expected, hence providing the confidence in design and the performance of the new material, Ductal®.

Perceived or real results

Monetary benefit	Not known
Non-monetary benefits	Reduced likelihood of future maintenance problems due to reduction of steel reinforcing and hence improved life-cycle costs.
Other public benefits	Aesthetically pleasing, functional and durable roof structure for the LRT station.

	Was the innovation worth the effort	Most definitely! To date, the project has received six prestigious awards.
Transfer of innovation		
	Who else has used it	The material technology has also been used in bridges, high-security applications, cladding and building structures.
	How were they informed	The development of the roof has been featured in several magazines, the subject of one journal paper and has received six provincial, national and international awards. It was also highlighted in the 2007 CCPE Commemorative Calendar.
Lessons learned or observations		
The project required commitment from all stakeholders/collaborators and a common level of trust to enable utilization of a new material technology in a new application that had never before been attempted anywhere in the world. The use of a new material demonstrated its successful performance in the world's first film-shelled canopy system and demonstrated the advancement in precast concrete technology and the enormous potential of this innovation for future generations of concrete construction. The ability to use a "moldable" material to create newly conceived shapes and designs previously restricted by the characteristics of other construction materials is now possible. The challenge ahead is to find the optimized shapes for each use. When this is determined, precasters, manufacturers and contractors can invest in the formworks to produce these pieces. The true economics of these systems will eventually bring value to the users in the standard mass production of optimized shapes.		

Case Study 11:

Edmonton - Use of Granular Materials to Reduce Sidewalk Cracking

Community	**City of Edmonton**	Province	Alberta
		Date	May 2006

Context of the innovation

The City of Edmonton has over 4,000 km of sidewalk, however a significant portion displays a longitudinal crack which greatly reduces expected service life. These cracks widen over the years and occasionally show differential displacement between the edges. It was necessary to find the root cause of this problem and develop an appropriate solution.

Nature of the innovation

Placement of a 150mm thick layer of granular material immediately below the concrete. This acts as a stress-absorbing membrane to reduce the horizontal tensile stresses imparted by the shrinkage of the clay subgrade as well as to mitigate winter frost heave.

Perceived challenges to be overcome

Acceptance by the development industry

How were the challenges overcome

The need for achieving longer sidewalk service life was obvious when presented with the large amount of relatively young inventory (20 to 25 years) that had failed.

Perceived or real results

Monetary benefits	Expectations are that sidewalk life-cycles have been at least doubled, resulting in a much delayed need for reinvestment.
Non-monetary benefits	Sidewalks stay in good condition longer, providing better service to the public and reducing complaints
Other public benefits	
Was the innovation worth the effort	Yes

Transfer of innovation

Who else has used it	City of Regina. Possibly also Winnipeg, Saskatoon, and Calgary
How were they informed	These cities were part of a consortium funding the research carried out by the National Research Council

Lessons learned or observations

Research projects can have enormous returns on investment.

Case Study 12:

Ottawa - Cost-Benefit Analysis to Determine Water Requirements for Fire Protection

Community	**Ottawa**	Province	Ontario
		Date	2006

Context of the innovation

Firefighting capabilities depend primarily on the total quantity of water available and the flow rate supplied at the fire site. The sizing of most watermains in a typical water distribution system is governed by flow rates needed for firefighting. Hence the estimation of fire flow demand is of particular importance in the design of watermains.

Nature of the innovation

A new method (herein called the Ottawa Method) was developed based on fundamental fire engineering concepts and is practical for watermain designers. The Ottawa Method considers both fire flows required for firefighting (offensive operations) and for exposure protection (defensive operations). The method assumes that both offensive and defensive firefighting operations will be undertaken by the fire service simultaneously, although this is often not the case. Offensive operations typically involve suppression of the source fire either by interior fire attack or by exterior fire streams. This water removes the energy produced by the fire (i.e. the heat release rate). Water required for protecting adjacent buildings during a fire is referred to as fire flow for defensive operations. Defensive operations typically involve directing water at the exposed structures to prevent their ignition from the source fire.

Perceived challenges to be overcome

Most Ontario municipalities currently use the Fire Underwriters Survey (FUS) guide to calculate fire flow demands. This is only one method of computing water requirements for firefighting. Various existing methods produce diverse results and lead to the question of what is an acceptable flow rate for fire protection. Over-estimation of needs leads to over-sizing of watermains.

The unnecessary over-sizing of mains is not cost-effective, and can lead to excessive water age in outlying areas of a distribution system. Water age is a key determining factor of disinfectant residual in a distribution system, and is an increasingly important consideration in planning for system growth and rehabilitation. In order to minimize risks to public health and avoid costly new treatment or maintenance practices, watermains must be sized appropriately, so that actual fire demands can be met while avoiding excessive water age.

How were the challenges overcome

A new method for calculating fire flows and evaluates the costs and benefits of applying this new method to watermain sizing. The cost benefit evaluation includes: selection and characterization of four pilot areas in the urbanized part of the City of Ottawa; fire flow demand calculations for typical buildings in these areas based on the FUS and new methods; hydraulic modeling for pipe sizing purposes; analysis of the benefits of the smaller diameter pipe set determined for each area based on the new method; and extrapolation to estimate potential benefits city-wide.

Perceived or real results		
	Monetary benefit	Overall savings between $725,000 and $830,000 were determined for Ottawa in using the new approach. Anticipated savings are: • 15 % for new developments. • 6 to 10 % for pipe replacement. • 9 to 12 % for structural rehabilitation.
	Non-monetary benefits	Improved quality of water through reduced aging.
	Other public benefits	Increased potential for the use of trenchless technologies for rehabilitation reducing disruption to the community.
	Was the innovation worth the effort	TBD.
Transfer of innovation		
	Who else has used it	No one. New concept.
	How were they informed	
Lessons learned or observations		
Increased insurance rates are not anticipated through the use of this new design method.		

Smaller Community Infrastructure

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Chair:
Dale Wall, British Columbia Ministry of Community Services

At the December 8, 2005, National Round Table on Sustainable Infrastructure (NRTSI) meeting, the Smaller Community Infrastructure Working Group (SCIWG) was created to address the unique issues faced by smaller communities throughout Canada. The original group was small, chaired by the British Columbia representative, with membership from Alberta, Manitoba and Ontario.

From the onset, it was clear that smaller communities are also impacted by our national infrastructure deficit, often lacking in capacity, resources and not benefiting from the 'economies of scale' realized by the larger communities. While smaller communities are challenged by a number of issues, the December 2005 working session identified some key infrastructure-related issues that were thought to be universal across the country.

These include:

- Financing
- Capacity for planning (skills training)
- Need industry at table
- Sharing best practices (bulletin board)
- Contraction—attraction to bidders
- Attracting industry—different approach to attracting bidders
- Regional solutions to local problems
- Shared professional resources
- Lack of uniform standards
- Skilled operators—shared resources
- Ownership of and liability for water systems
- Strategic investment in infrastructure

From this, the SCIWG developed an "action plan" which captured those activities seen as critical to improving the small communities' ability to effectively and efficiently develop, implement and maintain sustainable infrastructure. The action plan included the following activities:

- Develop community capacity—skills assessment and training, gap analysis
- Investment from federal, provincial and territorial governments' infrastructure programs
- Create best practices bulletin board
- Encourage coordinated and planned infrastructure investment
- Develop a round table focused on small communities—local/regional conducted across Canada and
- Engage the Federation of Canadian Municipalities (FCM) and municipal organizations

At the second NRTSI meeting on May 4, 2006, the SCIWG presented the concept of a "pilot project" to the NRTSI group as a whole. The pilot project involved the development of a small community infrastructure website—a website that would act as an information portal, a bulletin board and a location for the sharing of information pertinent to small communities. Activities prior to the May 4, 2006, meeting were summarized as follows:

- Activities were limited to those performed within the British Columbia Ministry of Community Services

- Activities were based on the selection of action item(s) that would provide:
  - — Desired outcome from action plan/high priority items
  - — Appropriate scale
  - — Result in effective/efficient development/ implementation
  - — Acknowledge resourcing limitations

Further to the above noted activities, the following outputs, deliverables and accomplishments were presented to the NRTSI at the May 4, 2006, meeting:

- Research options and opportunities to establish a "smaller community infrastructure" network/ clearinghouse/bulletin board. This was seen as one of the priority action items that would have strong links to many items listed under the action plan. The work included:
  - — Review of existing web pages/portals/networks
  - — Identification of successes
  - — Identification of synergies/applicability
  - — Ensuring "interoperability" (sharing ability) and
    - • XML—eXtensible Markup Language
    - • RSS—Real Simple Syndication
- Development of framework for pilot project (in British Columbia):
  - — Selection of appropriate delivery mechanism
  - — Identification of partners
  - — Creation of project charter

The Pilot Project—Overview

There were a number of reasons why proceeding with a pilot project in British Columbia was a logical first step. The following information supported a British Columbia pilot project approach:

- Existing and suitable web-based infrastructure is available in British Columbia.
- This infrastructure follows current federal thinking regarding sustainable web/data infrastructure, interoperability, and data consolidation.
- Cost-effective and very little outside resourcing needed.
- Can provide a quick 'win', where at the very least, it will be a useful tool and resource for British Columbia/discussion piece for the NRTSI.
- Implementation/deliverables achieved in a short period.
- It is anticipated that the pilot project will provide a proven and established framework for other provinces/jurisdictions to implement without the financial burden of starting from scratch.

The Pilot Project—Existing Web-Based Infrastructure

A succinct review of existing web/data/information sources revealed the waterbucket.ca as a successful model to work from. This was further collaborated through discussions with British Columbia Water & Waste Association (BCWWA) and Lanarc Consulting (Web engineers) who participated in Water Connections: Feasibility Review and Next Steps Meeting in Ottawa. The focus of this meeting was to identify information requirements of Canada's water community, looking at leveraging geospatial information sharing standards to connect the water community through existing portals and networks.

The proposed pilot project would draw from experiences and strengths gained in the development process of the waterbucket.ca site. It is a stand-alone site, yet it is hosted by, and integrated with the BC Stewardship Centre (BCSC) website. The BCSC is part of a national coalition that functions under the Stewardship Canada umbrella. The BCSC became the prototype for the national Stewardship Canada Portal a number of years ago.

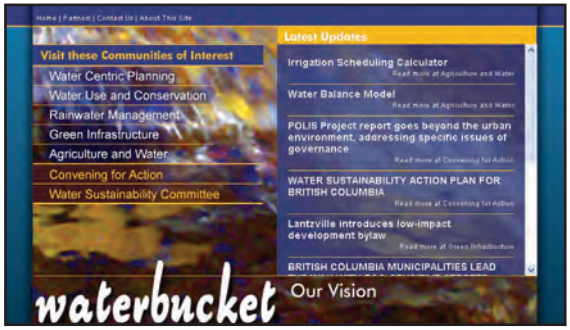
Both the hardware and software are located in British Columbia, and have been made available by the BC Stewardship Technical Committee for use on the Stewardship Canada Portal. This arrangement allows all provinces and territories to create their own independently managed provincial or territorial stewardship centres, to share operating costs and to share product development costs.

The BCSC is hosting a one-screen entry to the WaterBucket.ca, thereby providing a virtual community of information, knowledge and resources. It should be noted that too many websites begin as ad hoc efforts created by small interest groups working in isolation from their peers. By joining with the BCSC, this will enable Waterbucket.ca to avoid the phenomena of becoming an "orphan site".

The Partnership envisions a dynamic database driven website—simple but effective in enabling information exchange, learning and interaction. The development of a highly interactive site is a priority and close attention is being paid to creating a design that is clear, compelling and effective for the user.

The website is hosted on the BC Stewardship Centre's provincial website and has a dedicated front page with the domain name of WaterBucket.ca. The website is envisioned to;

- fulfil the over-riding intention to create and grow a community in terms of both place and people;
- focus on content requirements, ease of navigation and user interactivity;
- function as;
  - — Content provider (onsite content, e-newsletters)
  - — Navigator (within the site and to selected off-site resources)
  - — Dialogue facilitator (list servers, discussion boards, chat-rooms, and on-line call response centre)
  - — Promoter of case studies, success stories and lessons learned from initiatives



- present information in various ways to different audiences (e.g. government, officials and staff, industry representatives practitioners and community groups);
- provide for both synchronous and asynchronous communication among partners, members, visitors and other interested parties; and
- create a web of relationships across initiatives, scales (i.e. regional watersheds, neighbourhoods, and site/building), regions of British Columbia, disciplines (e.g. engineering, planning, and architecture) topics, and audiences.

Pilot Project— Proposed Deliverables

- Develop a "community of interest" (COI) on WaterBucket.ca entitled "Small Community Infrastructure". This will be done by;
  - — Establishing partners and steering committee
    - BC ministries (Community Services, Health, Environment, Transportation, Energy, Mines and Petroleum Resources), local government, NGOs, First Nations, federal agencies, industry, as well as others
  - — Establish funding partners
    - BC Ministry of Community Services, Ministry of Health and others
  - — Develop simple project charter
    - What information/format is desired?
    - Best practices, bulletin board, industry corner, etc.
- Assess applicability for using WaterBucket.ca as a Canada-wide portal
  - — Identify options for Canada-wide applications
  - — Identify costs and resources required
- Present COI and develop feasibility report for presentation to the NRTSI

Pilot Project— Project Implementation

Project implementation was initiated with the creation of a "focus group". The initial Focus Group Working Session took place in Victoria, British Columbia, on August 17, 2006. This initial meeting was designed to be for a small group of invited individuals based on their experience, connection and integration with various aspects of small community infrastructure. Ultimately, focus group members had to either be; a funding partner, considered an "end-user", or be strongly linked to what was considered the "target audience" of the website. Representation included:

- Federal government
- Provincial government
- Local government (small communities)
- Non-government organizations
- Small, private infrastructure (service) providers
- Private sector

The invitation and agenda for the first meeting clearly described the intent of the pilot project and is captured below:

> *Stemming from the need and desire to assist small communities manage and operate their environmental infrastructure, the provincial government has committed to the development of a Small Community Infrastructure (SCI) Community of Interest (COI) webpage. This COI webpage will be aimed at smaller communities and will be focused on their needs as users of the site. As such, it is essential that the site be user friendly, simple, and become recognized as a valuable tool by small system operators/managers etc. This COI webpage does not aim to re-invent what others have*

done, nor to step on their toes. Other sites are already up and running and a valuable resource in their own right. The COI will be hosted by the www.waterbucket.ca webpage and will be the "portal" to these other sites and resources. It is the hope of the project sponsors that eventually the COI will be launched as a national portal which will be tailored for each province and territory.

The initial focus group meeting was considered a success, with 100 percent support from all participants. Discussions and outcomes from this meeting allowed the web design consultants to develop a web framework that would capture and manage the information that was determined to be critical and essential for the project to become a valuable tool. The other critical outcome from the initial focus group meeting was the accepted understanding that the focus group would act as "champions" for the website, working towards building sufficient content and appropriate promotion for the website.

On November 6, 2006, a second Focus Group Working Session took place, which involved a much broader level of participation. The focus of the second working session included the following outcomes:

- Final approval of webpage layout
- Approval in principle of content layout
- Acknowledgement from participants as being subject area experts and contributors (champions)
- Fully training participants on how to contribute articles/content to webpage
- Identify information gaps
- Recognition and agreement from participants on next steps

In addition, it was predetermined that the focus group participants must:

- Recognize the limitations of the website—i.e. it cannot be all things to all people from the beginning; and
- Time will be needed to further develop content and add subject areas as needed.

Pilot Project—Outcomes/ Deliverables (December 2006)

As of December 2006, the website is fully functional, but not ready to formally launch. The rational behind this delay is to first; ensure that there is sufficient content available on the website so potential end-users find value; secondly, develop additional web tools (i.e. within the web architecture) that will further enhance the interoperability of the site, and thirdly, to fully promote the site before a formal, hard launch.

At this point, integration and participation provincially has been strong with considerable positive feedback from most of the targeted end-users. Early in 2007, the British Columbia Ministry of Community Services will be promoting the website via various venues such as the BC On-site Wastewater Association AGM, the British Columbia Water & Waste Association AGM, through the Union of British Columbia Municipalities, as well as other smaller seminars and workshops.

The site will provide overview information and provide links to websites and tools that already exist and are considered valuable to smaller communities. In addressing the NRTSI Small Community Infrastructure Working Group Action Plan, the site also provides the creation of a Best Practices Bulletin Board, helps build small community capacity through the dissemination of information, and engages small communities in networking opportunities.

A very limited number of examples of existing websites and/or resources/tools linked to the website include:

- British Columbia Water & Waste Association
  - — Small Water Systems Information
  - — Decentralized Wastewater
  - — Water Sustainability
  - — Cross-connection control
  - — Small System Management courses
  - — Operator education and training
- Sustainable Infrastructure Society
  - — Water rate calculator
  - — SCADA Pilot Program
- British Columbia On-site Sewage Association
  - — WOTEC Training Centre
- The Government of British Columbia
  - — Ministry of Community Services
    - • Funding Programs
    - • Water Conservation Calculator
    - • Benchmarking Tool
- Universities
  - — University of Victoria
    - • Polis Research on Water Governance
- Federal Government
  - — Infraguide
- Local Governments
  - — Smart Bylaws
    - • Low Impact Development Bylaws
    - • Demand Management Bylaws

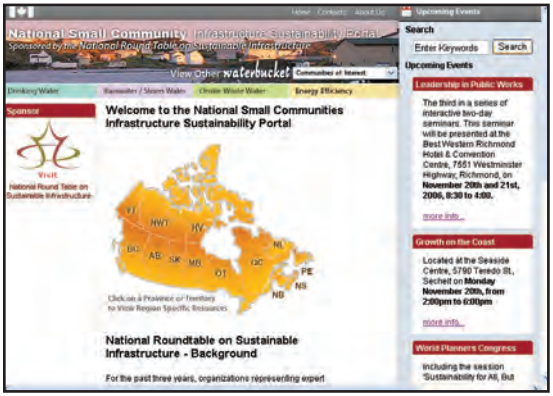
Pilot Project—Summary

It was extremely unfortunate that this pilot project was not presented to the NRTSI group during the last meeting on November 28, 2006. As the project continues to move forward and get closer to the formal launch, it is hopeful that there will be another opportunity to present the information to the NRTSI group and further discuss the value of the project to British Columbia, to other Canadian jurisdictions, and to the NRTSI.

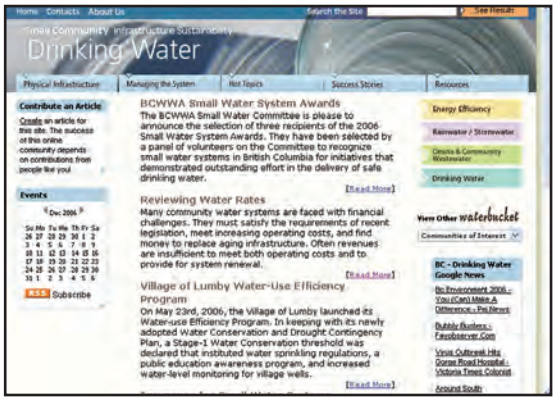
Please refer to Appendix A for some example screen shots from the Small Community Infrastructure webpage pilot project.

Appendix A

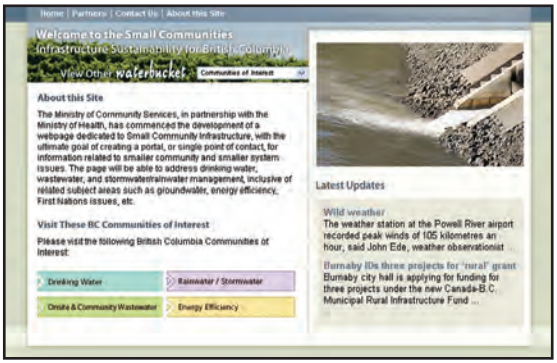
A 'mock' NRTSI/Canada sponsor home page



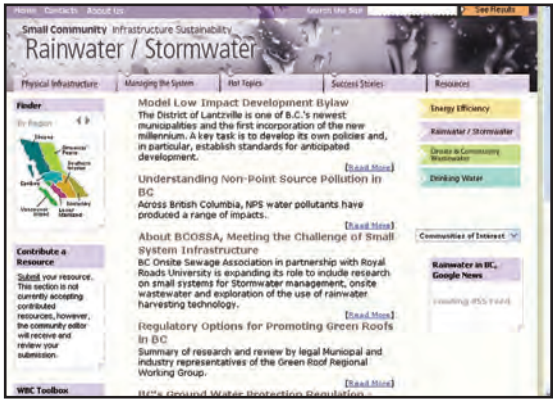
British Columbia Drinking Water sub-page



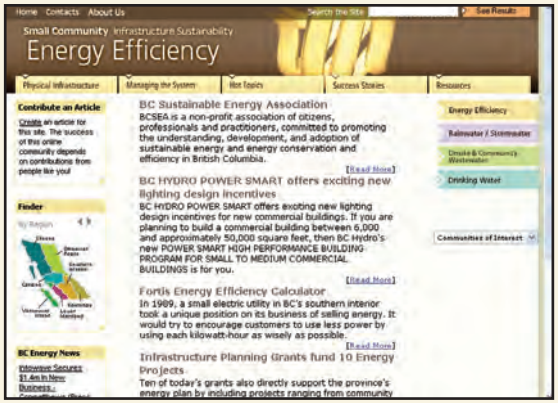
British Columbia Small Communities Infrastructure home page



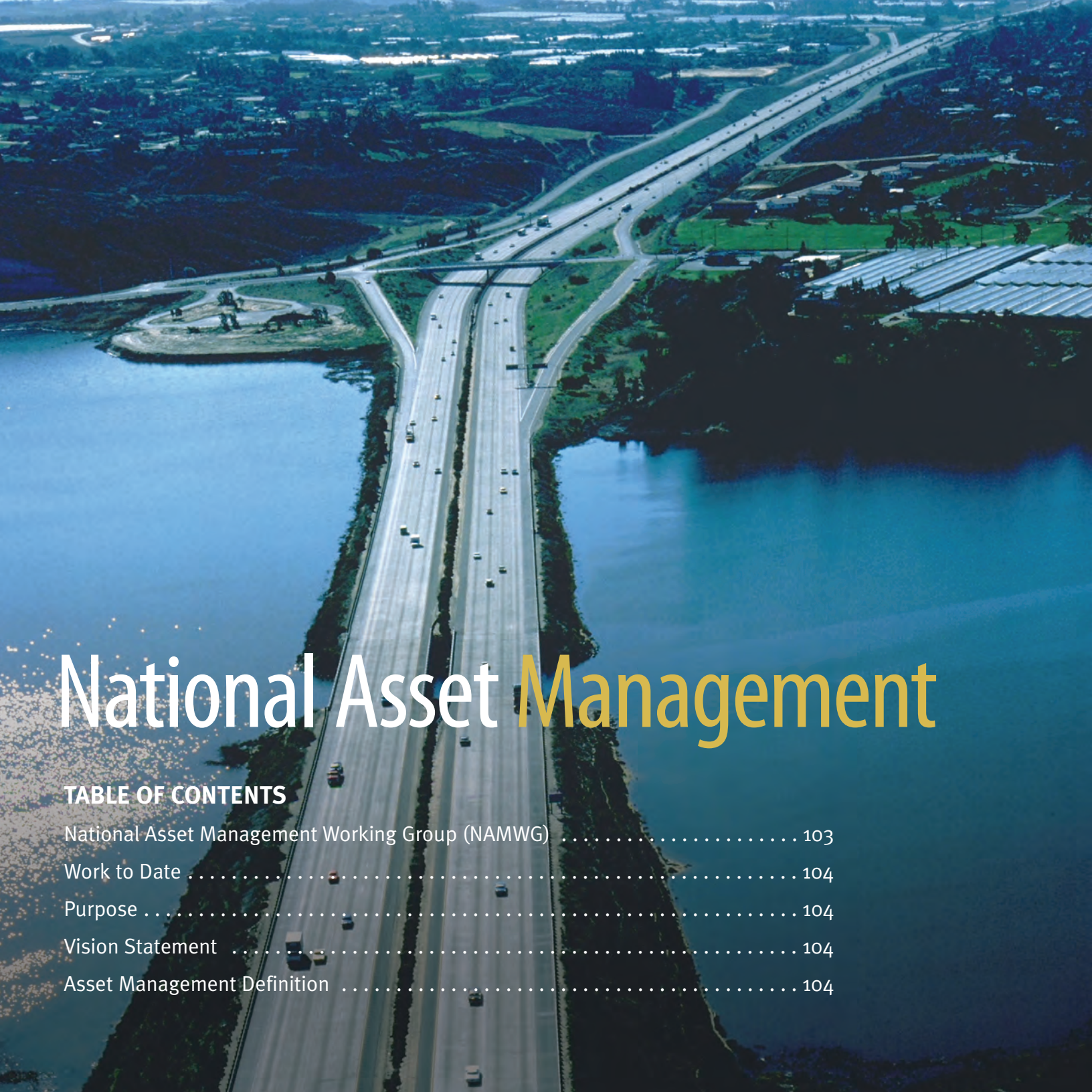
British Columbia Rainwater/Stormwater sub-page



British Columbia Energy Efficiency sub-page



British Columbia Onsite & Wastewater sub-page



National Asset Management

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National Asset Management Working Group (NAMWG)[1]

Working Group

The Canadian Public Works Association (CPWA) was asked to form this group to develop a strategy and program for implementing the asset management recommendations of the report Technology Road Map: Civil Infrastructure Systems. Infrastructure Canada is co-chair of the working group with CPWA. Mr. Tony Varriano, Director General, Issues Management, Infrastructure Canada and Mr. Peter Enslen from the City of Calgary representing CPWA are the co-chairs.

The National Asset Management Working Group (NAMWG) was established at the same time as the initial National Round Table Working Group, which investigated the establishment of the National Round Table for Sustainable Infrastructure. At the time, NAMWG was independent of the Round Table group. As work of both groups progressed, the NAMWG aligned itself with the National Round table process to ensure that the work carried out by the NAMWG was consistent with, yet did not duplicate, the work of the other groups associated with the NRTSI.

In forming the working group and having reviewed the experience of others, especially the very good asset management work carried out by Australia and New Zealand, we recognized the need for a multi-discipline approach. In fact stressing the breakdown of "silos" in the workplace and the multi-discipline nature of asset management has been and is one of the key messages of the working group. The invitations to become part of the group focused initially on the technical, financial and political nature of the asset management process. In that vein, with Infrastructure Canada and the Canadian Public Works Association as co-chairs, the Group was formed with representation from the Government Financial Officers Association and the Federation of Canadian Municipalities. Provincial input was sought through the Ontario Ministry of Public Infrastructure Renewal. This choice was made as the provinces of Ontario and Alberta were the only provinces to date in Canada that had a cabinet position with a Minister having "Infrastructure" inclusive in their title. Other partners participants include CERIU from Quebec, the Canadian Society for Civil Engineering, (one of the founding partners for the TRM report) and InfraGuide / NRC. When the magnitude of "standards" for infrastructure was explored, The Canadian Standards Association was a logical addition to the Group. It was soon evident that the infrastructure planning and sustainability component was missing and the Canadian Institute of Planners agreed to join the group.

The makeup of the group is extremely important. The Technology Road Map Report identified a very diverse fractured community dealing with infrastructure with little or no dialogue among the sectors of the community. The NAMWG set a objective in its makeup to address that very specific issue. The objective in the longer term, including stakeholder input, is to ensure the various "communities" involved in the implementation of asset management strategies and programs are equally involved in developing the framework for asset management and are all comfortable with our vision, asset management definition and, ultimately the Framework for Asset Management for

[1] Disclaimer: The National Asset Management Work Group pre-dates the National Round Table on Sustainable Infrastructure (NRTSI) and was created following a recommendation from the Technology Road Map (TRM). It draws on its own resources but is aligned and affiliated with the NRTSI since February 2006.

Canada. This is integration of our asset management community across diverse discipline is a very important part of our work and message of the working group, besides the physical output Described below is the output to date with the approved "Vision Statement" and "Definition" and an update of the on-going work on the National Asset Management Framework.

Work to Date

The NAMWG has defined and agreed to its purpose. A vision statement has been approved by the group as has a multi-discipline definition of "asset management". These have not yet had peer review and will be part of the stakeholder package sent out for review shortly.

Purpose

The purpose of the NAMWG is to develop a model national framework for the integrated management of linear municipal infrastructure assets. This includes development of a variety of complementary initiatives that will support the implementation of the framework in Canada. It builds on earlier initiatives of the NRC, CPWA, CCPE, and others.

Vision Statement

"In 2020, through collaboration of all orders of government, communities in Canada will have sustainable municipal infrastructure with the levels of service that support the community's health, safety, economic prosperity and quality of life."

Specifically, Canadian communities will:

- Make sound municipal infrastructure decisions based on full lifecycle analysis that are socially, environmentally and economically sustainable;
- Have eliminated the current infrastructure and deferred maintenance deficits and have access to sustainable funding mechanisms;
- Have improved overall resilience and adaptability of municipal infrastructure to the impacts of climate change; and
- Are recognized as leaders in innovative infrastructure technology and practice.

Asset Management Definition

Asset Management can be defined as an integrated approach involving planning, engineering and finance to effectively manage existing and new municipal infrastructure in a sustainable manner to maximize benefits, reduce risk and provide satisfactory levels of service to the community user in an environmentally and ecologically responsible manner.

A key output of the group is the "National Framework for Asset Management". In preparing such a framework the group has considered:

- Why do the framework?
- What is asset management?
- How do you do asset management?

The focus is on the "Why" and "What" as opposed to the "How". The rationale for this is there are many techniques for carrying out asset management programs, no one of which meets the needs of all circumstances. Tremendous effort to date in both the public and private sectors has focused on this area with excellent results available in the marketplace. The working group therefore chose not to duplicate efforts already available nor make decisions on the quality of any particular approach, methodology or software package.

"Why" do an asset management program is a core question that needs to be answered for the public, the politicians and all the technical and professional staff potentially involved in a program. With multi-level government programs funding infrastructure and governments requesting an "accountability" framework, the National Asset Management Framework will assist the users in providing at least the base condition needed for such accountability.

The "What" question addresses the fundamental elements of an asset management program and their interrelationship as a minimum. Again, it does not explain how a program should be developed or implemented but rather identifies just what should be defined to ensure the program is complete.

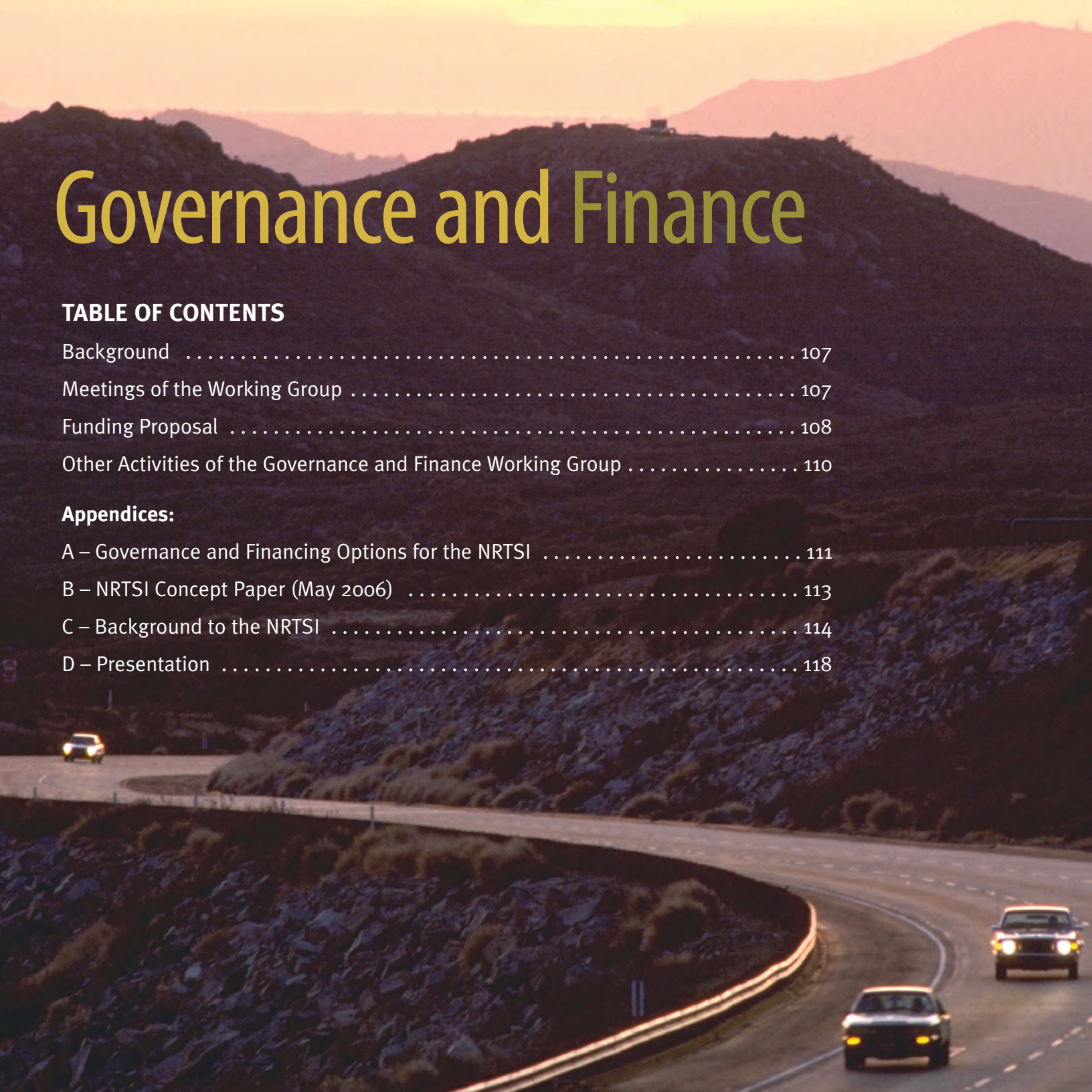
One of the key purposes of addressing the "What" is to ensure that when a municipality or owner of infrastructure carries out an asset management plan and strategy that the accountability issues respecting federal and provincial / territorial programs are taken into consideration as well as local needs. The intent is to set a 'baseline' for the strategy upon which any user can build to meet their own specific needs.

The concepts of "How" are included but, as explained above are not presented in any detail in the framework.

The NAMWG will be discussing the draft "framework" at their meeting on November 27. It is expected the 'draft' framework will reach a conclusion sufficient to permit stakeholder input. At the same time the NAMWG will be considering a communications program and strategy integrating our program needs with the messaging and communications vehicles of the NRTSI.

Stakeholder input will be a key task over the next several months. The NAMWG will be going out to the infrastructure community for comment and discussion of the deliverables above. This input will be reflected in future a future version of the documents.

The NAMWG intends also to review its mandate, terms of reference and deliverables in light of changing times. The Group will determine on November 27 the 'path forward' beyond the deliverables referenced above as well as the program to complete publish and get commitment to the deliverables achieved to date.



Governance and Finance

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David McKay, Alberta Infrastructure and Transportation
Gerry Maffre, Infrastructure Canada
Ian Neville, Canadian Public Works Association
Chris Wade, City of Calgary
Gary Webster, Infrastructure Canada

Following the inaugural meeting of the NRTSI on December 8, 2005, in Calgary, the Governance and Finance Working Group started its work. The governance and financing model developed by the working group was endorsed at the stakeholder meeting on May 4, 2006. In June 2006, a request for funding was sent to the federal government. To date no response has been received.

It is hoped that a response will be received in the near future in order to build on the momentum gained and the good work already done.

It was clear at the May meeting that funding is needed to produce valuable research, recommendations and tools for stakeholders.

Background

At the inaugural meeting of the National Round Table on Sustainable Infrastructure held in Calgary, Alberta on December 8, 2005, a Governance and Finance Working Group was created. The action plan identified at that time was as follows:

- The working group was assigned the task of reviewing the mandate and developing a model that would garner support from the diverse group of stakeholders.
- The first meeting would be held by teleconference in January.
- The working group would report back to participants by mid-year on general governance principles and the definition of the Round Table, with a more detailed report on governance structure within one year.

Meetings of the Working Group

The Governance and Finance Working Group held teleconferences on February 3, March 24 and June 14, 2006.

At the February 3 teleconference and the one on March 24, the group reviewed background documents previously created for the NRTSI. It was agreed that the concept paper (Appendix B) should be revised, funding options (Appendix A) and a background paper (Appendix C) be developed to be presented at the May 4, 2006, meeting for adoption.

At the May 4, 2006, meeting in Montréal, Quebec, the stakeholders endorsed the working group's approach in principle with the goal of having full funding in place by the fall. Thus, the following action plan was put in place for the working group whereby they would finalize a business model that would:

- Elaborate on membership in an advisory council and an executive board.

- Consider the criteria for a host organization for the NRTSI—a legal entity.
- Add "transit" to the overall scope included in "infrastructure".
- Submit a request for funding to the federal government.

During the June 14 teleconference, the working group reviewed the draft funding proposal prepared by the Canadian Council of Professional Engineers (CCPE) and endorsed CCPE being the host organization for the NRTSI.

Funding Proposal

Following is a synopsis of the funding proposal that was submitted to Infrastructure Canada.

Introduction, Need and Background

On June 23, 2006, CCPE, on behalf of the group of infrastructure-related organizations, requested core funding of one million dollars per year for five years from Infrastructure Canada to establish the NRTSI stating that creating the Round Table is a crucial step toward ensuring that the backbone of our country—its infrastructure—is able to support our economy and quality of life well into the new century.

The proposal clearly states the need for the creation of the NRTSI and provides background information on for example *Civil Infrastructure Systems Technology Road Map 2003-2013* (TRM), the inaugural meeting of the NRTSI in December 2005 and the May 4, 2006, meeting. It affirms that the goal is to launch the NRTSI in fall, 2006, and its initial focus will be municipal public works, i.e. water systems, sewers, roads and bridges. The NRTSI will be an independent, multi-stakeholder, non-partisan, not-for-profit advisory body providing counsel to the infrastructure community as requested by that community. It will not duplicate other initiatives, functions or roles. It will not be a decision-making body or a policymaking body. It will not be an advocacy group.

It will be a national forum…

- within which a diverse and complex community can meet to build capacity, management best practices and innovation.
- promoting networking, collaboration and greater understanding across and within the infrastructure community.
- focussed on the collection, analysis and dissemination of infrastructure knowledge, innovation, indicators, models and commission research.
- advising policy-makers on a broad strategic framework over both the short- and long-term. Alternate planning scenarios for sustainable infrastructure will respect short-term frameworks often required by government while a long-term (30 years) planning framework would provide a strategic basis for shorter-term investment decisions.

Governance

The NRTSI will be governed by an advisory council comprised of, and appointed by, its stakeholders. Specifically, there will be up to 31 senior/executive representatives: one from the federal government; one from each of 13 provinces/territories; six municipal; one from First Nations; and 10 from industry.

The Advisory Council will conduct its business with the help of issue and/or project committees or working groups as determined by the Council. Decisions will be reached by a consensus of the Council and if none is reached, the issue will be returned to the working groups for further work. No single stakeholder will have a disproportionate interest or influence over the work of the NRTSI. At the very least, the NRTSI will allow stakeholders to contribute, learn, adopt,

adapt and/or be guided by NRTSI outputs in their own jurisdictions.

The NRTSI will be managed by a small secretariat and will be located within the offices of CCPE for the first five years.

Participation

Invitations to join the NRTSI will be extended to the infrastructure community's major players including all three orders of government; First Nations organizations; public works operations; urban planners; banking and insurance industries; engineering, architectural and professional services industries; construction and environmental service industries; research and the education community; others as may be approved by the Advisory Council.

Programming

The NRTSI will deliver programming through its working groups. Specifically, the Round Table will:

- build a more cohesive, collaborative sustainable infrastructure community;
- help decision-makers to:
  - build a shared vision between stakeholders (public and private);
  - develop a long-term (i.e. 30-year) strategic framework for sustainable infrastructure supported by five-year plans.
- develop and/or share knowledge, technology and best practices across the community;
- assess and establish life-cycle management guidelines of total capital stock;
- provide a catalyst for the development and use of innovative management, technology and financing tools; and
- help maximize the use of each dollar invested in sustainable infrastructure.

Secretariat

The Secretariat will be responsible for:

- organizing meetings of the Advisory Council and committees;
- carrying out the administration;
- carrying out or contracting out all of the activities such as the research, meeting logistics, report dissemination, etc. such that the needs of stakeholders are met; and
- reporting to the Advisory Council on the status of the activities and financial results.

Communications Support

The NRTSI recognizes the importance of ensuring that its information and program results are disseminated to all interested audiences. An initial communications framework has been developed, and several communications tools (logo, website, newsletter) have been created. Effective communications and knowledge transfer will be ongoing.

Addressing Stakeholder Concerns

The fact that the NRTSI is structured as an independent advisory body with a balanced representation recognizes the constitutional responsibility of provinces/territories (P/T) for local government (and municipal infrastructure) and does not allow any single organization to have undue weight in terms of voting on issues. The proposed financing model also reinforces the independent nature of the NRTSI and encourages partner investment. In addition, we have addressed the concern of the Provincial/Territorial Council of Deputy Ministers for local government not to be formally involved with the NRTSI while continuing to observe its growth. The concept incorporates the Council's decision leaving it to each P/T jurisdiction to be independently involved at its discretion, by making a seat on the governing body available for each province and territory.

Addressing the federal government's focus and Infrastructure Canada's priorities

Creating the NRTSI will result in better infrastructure planning and more effective development and dissemination of innovation and best practices, all leading to efficient investment of taxpayers' dollars in sustainable infrastructure.

The NRTSI will manage government investment in an open and transparent fashion, will require in-kind investments from other partners and will be accountable for meeting clear and objective measures.

This approach is in line with the federal government's objective of "maximizing value for taxpayers' money by supporting infrastructure projects that adhere to best practices, by not funding cost overruns and by requiring fund recipients to be accountable to Canadian taxpayers."

Financing

The NRTSI is requesting federal funding of $1 million per year for five years so as to establish the secretariat and base programming. Stakeholders will provide "in kind" support at a value of approximately $1 million per year for the five years including financing the travel and participation of their representatives.

The NRTSI will develop a transition plan in Year Three to move to a shared funding formula with the federal government. The shared funding mechanism will be in place by Year Five so that NRTSI can become a separately incorporated organization. If there is no demonstrated stakeholder support for the shared funding formula at that point, the NRTSI will be phased out.

Partner Commitment

The more than 45 founding organizations of the NRTSI have demonstrated their commitment to the Round Table by absorbing the costs of the time and expense to travel to two stakeholder meetings, and by participating in the four working groups and on the transition team. This commitment will only grow stronger once a formal partnership with the federal government is established.

Other Activities of the Governance and Finance Working Group

Several meetings took place as follows:

- Provincial/Territorial Council of Deputy Ministers Responsible for Local Government Teleconference on January 27
- Minister Cannon on May 11
- Deputy Minister Louis Ranger on September 28
- Consultation session with Minister Cannon and other key stakeholders on September 28

Several presentations were also delivered to build support and awareness of the NRTSI concept. These include:

- Government Finance Officers Association on May 6
- Provincial/Territorial Deputy Ministers on June 18
- The *Association des Ingénieurs municipaux du Québec* (AIMQ) on September 19
- Council of Ministers of Local Government on September 20
- Third Annual Future of Canada's Infrastructure Summit on September 27

See Appendix D for a copy of the presentation.

Appendix A

Governance and Financing Options for the NRTSI

Presented by the Working Group on Governance and Financing of the NRTSI

May 2006

The governance and financing options for the National Round Table on Sustainable Infrastructure depend on its mandate and goals.

"The National Round Table on Sustainable Infrastructure (NRTSI) is to be an independent, multi-stakeholder, non-partisan, not-for-profit advisory body that:

- provides decision-makers, and stakeholders with advice on sustainable infrastructure;
- develops, commissions, collects, analyzes and shares data, trends, forecasts, technical and management innovation and tools;
- provides high-level coordination of infrastructure initiatives;
- creates a forum to bring together an important yet highly diverse, diffused and complex community to generate greater understanding, synergies so as to support the community's optimal use of available resources.

The NRTSI will address broader infrastructure areas with an integrated, holistic approach. The initial focus of the NRTSI is to be public works, i.e., water systems, sewers, roads and bridges. With a focus on "sustainable" infrastructure, the NRTSI will be able to anticipate the social, economic and other community environmental factors that impact on, and are impacted by, infrastructure decision-making."

Governance

Reporting

Based on the mandate, and in light of the feedback received from the provincial and territorial government representatives the option of the NRTSI reporting to a federal minister is not recommended. The NRTSI mandate is not solely to provide advice to the federal government but to all stakeholders. This initiative is one of the infrastructure community not of the federal government and reporting to a federal minister, even in a symbolic way, may lead to a perception that the NRTSI is a political entity serving primarily the federal government.

The recommendation for the reporting is: *that the NRTSI reports to its Advisory Council composed of representatives of all stakeholders* (see Table 1 for more details).

Advisory Council Composition

It is agreed that the NRTSI will be governed by an Advisory Council. This group will lead the NRTSI and will guide its evolution.

Several options were considered for the Council's composition. Table 1 describes the options as well as the pros and cons of each.

The recommendation for the Advisory Council composition (option 2 in attached table): *That the Advisory Council representing the stakeholders be composed as follows*:

31 senior level representatives from:

- Government (20)
  - — 1 federal
  - — All provinces/territories invited to sit on Advisory Council (possibility of 13)
  - — 6 municipal

- First Nations (1)
- Industry (10)
  - — two engineering groups
  - — one urban planner group
  - — one banking—insurance industry
  - — four industry association
  - — two research and education community

When the focus of the NRTSI shifts, the composition for government could shift as well. For the time being, the term of the representatives should be left to each stakeholder to determine. Flexibility will be built in allowing for observers and replacement representatives to reflect the diversity of issues. The different organizations will be responsible for identifying the appropriate representative within their "jurisdiction".

Co-Chairs

The Advisory Council will be co-chaired; one co-chair representing government and the other representing industry. The chairs should have two-year renewable terms. The terms will end on alternate years.

Secretariat

The Secretariat will be responsible for:

- Organizing meetings of the Advisory Council and committees;
- Carrying out the administration;
- Carrying out or contracting out all of the activities such as the research, meeting logistics, report dissemination, etc. such that the needs of stakeholders are met;
- Reporting to the Advisory Council on the status of the activities and financial results.

Appropriate but minimal staff and overhead will be required. An effort to use existing available resources will be made.

Committees

Committees will be created as needed to address specific issues. The existing working groups could become committees of the NRTSI.

Membership

There is no such thing as a member of the NRTSI. The NRTSI has stakeholders.

Financing

There are many options for financing including a single source (i.e., the federal government), a combination of co-financing from federal and provincial and territorial governments, or a combination of co-financing between private and public sectors. These options are also presented in Table 1.

Recommendation for funding (option 2 in attached table): *That the federal government funds the 'secretariat' of the NRTSI plus some base research for the NRTSI (total $1,000,000) and the stakeholders share the costs of additional research/projects and be responsible for financing the travel and participation of their representatives.*

The stakeholders will be providing significant contribution including "in kind" contribution (estimated in the order of $1,000,000). The initial funding should be for a period of five years. After year three, the NRTSI will develop a transition plan to move to a shared funding approach amongst the stakeholders.

It is recommended that the option of delivering the secretariat through an existing non-government organization be seriously considered.

Appendix B
NRTSI Concept Paper (May 2006)

The Concept

The National Round Table on Sustainable Infrastructure (NRTSI) is to be an independent, multi-stakeholder, non-partisan, not-for-profit advisory body that:

- provides decision-makers, and stakeholders with advice on sustainable infrastructure;
- develops, commissions, collects, analyzes and shares data, trends, forecasts, technical and management innovation and tools;
- provides high level coordination of Infrastructure initiatives;
- creates a forum to bring together an important yet highly diverse, diffused and complex community to generate greater understanding, synergies so as to support the community's optimal use of available resources.

The NRTSI will address broader infrastructure areas with an integrated, holistic approach. The initial focus of the NRTSI is to be public works, i.e. water systems, sewers, roads and bridges. With a focus on "sustainable" infrastructure, the NRTSI will be able to anticipate the social, economic and other community environmental factors that impact on, and are impacted by, infrastructure decision making.

Invitations to join the NRTSI would be extended to the infrastructure community's major players which would include:

- all three orders of government
- urban planners
- banking and insurance industries
- engineering and professional services industries
- construction and environmental service industries
- research and the education community
- others, as may be approved by the advisory council

The NRTSI would be governed by an Advisory Council comprised of, and appointed by, its stakeholders. It would conduct its business with the help of issue and/or project committees or working groups as determined by the Advisory Council. Decision would be reached by a consensus of the Advisory Council and if none is reached, the issue would be returned to the working groups for further work. No one stakeholder will have a disproportionate interest or influence over the work of the NRTSI. At the very least, the NRTSI would allow stakeholders to contribute, learn, adopt, adapt and/or be guided by NRTSI outputs in their own jurisdictions.

The NRTSI would be managed by a small secretariat and would be located at a place to be determined by the stakeholders.

Specific Deliverables of the NRTSI

The NRTSI would:

- build a more cohesive, collaborative sustainable infrastructure community;
- help decision makers to :
  i. build a shared vision between stakeholders (public and private);
  ii. develop a long-term (i.e., 30 years) strategic framework for sustainable infrastructure supported by five years plans.
- develop and/or share knowledge, technology and best practices across the community;
- assess and establish life-cycle management guidelines of total capital stock;

- provide a catalyst to the development and utilization of new and innovative management, technology and financing tools;
- help to maximize the use of each dollar invested in sustainable infrastructure.

Appendix C

Background to the NRTSI

Support for an NRTSI emanated from a series of town hall meetings held in 2002 by the Canadian Council of Professional Engineers, the Canadian Public Works Association, the National Research Council and the Canadian Society of Civil Engineers which culminated in a consensus report produced in June, 2003. The report is called the "Civil Infrastructure Systems Technology Road Map 2003-2013 (TRM).

The TRM made 10 specific recommendations including the creation of an NRTSI.

In reaching its recommendations the TRM concluded that:

- Infrastructure is central to our quality of life, public health and economic prosperity;
- Canada's infrastructure is deteriorating;
- There are growing needs for the repair and rehabilitation of existing infrastructure and a significant gap in the building of new infrastructure;
- Technology innovation and management tools are not being developed or harnessed effectively;
- There is a need and an appetite to develop a long-term vision and strategic priorities based on that vision;
- The inconsistent quality of data, forecasting and management tools made the development of investment priorities difficult;
- There is an excellent opportunity to bring a diverse community together to address an important domestic challenge and to advance Canadian expertise internationally.

In short, the recommendation for a National Round Table on Sustainable Infrastructure comes from experts within the professional, construction and research industries of the infrastructure community itself.

Public Sector Awareness and Commitment to Sustainable Infrastructure

While the idea originated within the infrastructure community, it is clear that provincial and territorial leaders have been concerned with the state of infrastructure for a number of years as evidenced by their inclusion of the subject on provincial and territorial premiers meeting agendas and recently the formation of a Task Force on Advocacy and Municipal Infrastructure (TFAMI) by the Council of the P/T Ministers Responsible for Local Government.

Municipal governments across the country have been equally aware of the need to address Canada's failing infrastructure and the efforts of cities to broker a new deal with the federal government is recognition of the seriousness with which they wish to address infrastructure gap.

As for the federal government, in 2000 it created the Infrastructure Canada Program. In 2002, it created the Department of Infrastructure Canada, providing a focal point for the Government of Canada on infrastructure issues. In 2003, Transport Canada's "Straight Ahead – A Vision for Transportation in Canada" included a focus on competitive communities.

In 2004, the federal Speech from the Throne called for "a new deal for Canada's municipalities…a new deal that targets infrastructure needed to support quality of life and sustainable growth."

Development of the NRTSI and Core Mandate

To consider how an NRTSI might work, its mandate and governance structure, a working group was formed in 2004 under the leadership of the Canadian Council of Professional Engineers and included senior representatives from the Federation of Canadian Municipalities, the Conference Board of Canada, the Canadian Construction Association, the Canadian Public Works Association and Infrastructure Canada.

Members were attracted to the round table model because of its non-partisan, multi-stakeholder focus comprising senior leadership and reporting to a very senior and committed member of the governing party. The working group further concluded that NRTSI's advice, recommendations and output would be produced for and shared with all stakeholders, both within the public and private sectors.

Members discussed the scope of the NRTSI's business and concluded that in the early years it should focus on public works at the municipal level i.e. water and sewer systems, roads and bridges evolving over time to include other sustainable infrastructure interests.

In designing the NRTSI's mandate, members were conscious of the immediate needs within the sustainable infrastructure community that are not being met:

- a national forum for a diverse and complex community to meet on sustainable infrastructure – a "go-to place" promoting networking, collaboration and greater understanding across and within the community;
- a forum of stakeholders with expertise to collect, analyze and disseminate infrastructure knowledge, innovation, indicators, models and commission research—an engine for capacity building, management best practices and innovation;
- a forum to develop and inform policy-makers on a broad strategic framework for sustainable infrastructure with alternate planning scenarios respecting a short-term framework applicable to municipal, provincial and national governments;
- a forum that would develop and inform policy-makers on a long-term (30 years) planning framework within which shorter-term investment decisions at all levels would find their strategic rationale.

The working group was conscious that a lot of work is being committed to infrastructure both within the public and the private sectors. It strongly believed that the creation of an NRTSI will provide a strong impetus to help better planning, better development and dissemination of innovation and best practices ultimately leading to a better use of investment dollars targeted at sustainable infrastructure in the years to come. The NRTSI will become a valuable, informed and trusted resource to decision-makers at all levels of government and within the private sector in Canada.

Meeting of the NRTSI on December 8, 2005, in Calgary, Alberta

At the inaugural meeting of the NRTSI in Calgary, a working group was formed to develop a governance and financing model for the NRTSI to be presented to the stakeholders at a meeting in May 2006 for their input with the goal of implementation in the fall of 2006.

List of Participants

The creation of the National Round Table on Sustainable Infrastructure is an initiative of the infrastructure community led by the Canadian Council of Professional Engineers (CCPE).

The work completed to date would not have been made possible without the on-going support of the following organizations and their representatives.

Alberta Infrastructure and Transportation
Association of Consulting Engineers of Canada
British Columbia Institute of Technology
Canadian Automobile Association
Canadian Construction Association
Canadian Construction Innovation Council
Canadian Council for Public-Private Partnerships
Canadian Council of Professional Engineers
Canadian Home Builders' Association
Canadian Institute of Planners
Canadian Public Works Association
Canadian Society for Civil Engineering
Canadian Standards Association
Canadian Urban Transit Association
Canadian Water and Wastewater Association
Canadian Water Resources Association
Canada West Foundation
Can/Am Border Trade Alliance
Cement Association of Canada
Centre d'expertise et de recherche en infrastructures urbaines
City of Calgary
City of Edmonton, Infrastructure Services
City of Hamilton
City of Powell River
Conference Board of Canada
Federation of Canadian Municipalities
Geomatics Industry Association of Canada
Government Finance Officers Association
Government of Alberta, Ministry of Municipal Affairs
Government of British Columbia, Infrastructure and Engineering
Government of British Columbia, Ministry of Community Services
Government of Manitoba, Canada-Manitoba Infrastructure Secretariat
Government of New Brunswick, Department of Environment and Local Government
Government of Newfoundland and Labrador, Department of Municipal and Provincial Affairs
Government of Northwest Territories, Municipal and Community Affairs
Government of Nova Scotia, Service Nova Scotia and Municipal Relations
Government of Nunavut, Capital Projects
Government of Ontario, Ministry of Public Infrastructure Renewal
Government of Yukon
Infrastructure Canada
National Guide to Sustainable Municipal Infrastructure
National Research Council Canada
Ontario First Nations Technical Services Corporation
PCL Construction Management Inc.
Pollution Probe
Public Infrastructure Engineering Vulnerability Committee
Royal Architecture Institute of Canada
TD Economics
The Road & Infrastructure Program of Canada
Town of Vulcan
Transportation Association of Canada
Université du Québec en Outaouais
University of Calgary
University of Regina
Ville de Gatineau
Ville de Terrebonne
Western Economic Diversification Canada

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